EUROPEAN
COMMISSION

Brussels, 10.1.2014
SWD(2014) 2 final

PART 2/2

COMMISSION STAFF WORKING DOCUMENT

Part 2 EU 6th National Communication

Accompanying the document

Commission Communication

SIXTH NATIONAL COMMUNICATION AND FIRST BIENNIAL REPORT FROM THE EUROPEAN UNION UNDER THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

{C(2014) 3 final}
{SWD(2014) 1 final}

TABLE OF CONTENTS

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Key developments

- The EUs provision of bilateral financial support has increased during the reporting period, peaking in 2012 at the level of USD 943 million (€734 million)[1]
- Total financial support provided by the EU in the years 2008 to 2012 amounted to USD 4 032 million (€2 967 million)
- Support to adaptation action has seen increased importance during the reporting period: in 2012, support to adaptation and mitigation are at similar levels
- Most of the climate change support provided by the EU is channelled through projects in which climate change is not the principle policy objective, thus demonstrating the success of the climate change mainstreaming efforts
- The EU has increased its focus in supporting the poorest and most vulnerable countries, which can be seen by the implementation of initiatives such as the Global Climate Change Alliance (GCCA) and the increased financial support to adaptation.

7.1. Introduction

This chapter of the EU's 6th National Communication includes information on financial resources and transfer of technology by the EU. Information on financial resources and transfer of technology by the EU's Member States can be found in their respective National Communications. However, some of the qualitative information reported also includes the Member States. In such circumstances there is a clear reference to the EU and its Member States.

Where similar information is required in NC6 and in BR1, the EU has opted to include such information in BR1 alone (the respective NC6 chapter shall refer to the relevant BR1 chapter).

7.2. Provision of new and additional resources

With the Lisbon Treaty putting the fight against poverty at the core of the EU's external and development cooperation policies, the EU is attaching increasing importance to climate finance. In this respect the EU has increased the amount of finance dedicated to mitigation and adaptation and is climate proofing its aid that is not directly climate-related.

EU climate and development actions are largely intertwined, contributing to inclusive growth for sustainable human development which cannot be thought of without limiting climate change. The EU promotes a common and comprehensive approach to financing

1 The Exchange rates used in this report are those published by the OECD Statistics service. EUR to USD in 2007: 0.73; 2008: 0.684; 2009: 0.72; 2010: 0.755; 2011: 0.719; 2012: 0.778.

for development, including climate change actions as part of the "Agenda for Change". We emphasise mutually reinforcing climate and development co-benefits. One Euro or one Dollar spent on climate or climate-related objectives should serve multiple purposes, such as energy, development and poverty eradication, biodiversity or resilience to climate impacts to take a few examples. The EU emphasises the catalytic role that ODA has in facilitating increased financing from other sources. Thus, the EU has strengthened efforts to create instruments and platforms that support leveraging of financing from multiple sources, in particular from the private sector.

The implementation of climate action at national and regional level is supported by geographical instruments. These mechanisms include the European Development Fund (in the ACP countries), the Development Cooperation Instrument (in Asia, Latin America and South Africa), and the European Neighborhood & Partnership Instrument (in the EU's neighbor regions). These are complemented by a specific thematic programme on environment and sustainable management of natural resources, including energy that addresses global environmental challenges as well as issues of common interest to groups of countries that do not belong to a single region. Further, the EU has established a number of innovative initiatives and facilities such as the Global Climate Change Alliance (GCCA), the Forest Law Enforcement, Governance and Trade (FLEGT), the Global Energy Efficiency and Renewable Energy Fund (GEEREF) and the EU water facility.

The EU has increased the amount of financial support to mitigation and adaptation action in developing countries. Between 2008 and 2012, the EU commitments to support climate relevant activities in developing country amounted to USD 4 032 million (€2 967 million). The support has been increasing from USD 435 million (€318 million) in 2007 (as reported in the previous NC) to USD 943 million (€734 million) in 2012. These resources are considered to be "new and additional resources"; meaning that they were committed after and not included in the 5th National Communication report.

Further, during the reporting period the EU and its Member States delivered on its commitments to provide fast start finance: EU and its Member States committed €7 300 million for fast-start finance for tackling climate change over the period 2010-2012, thus exceeding the goal of €7 200 million, despite a difficult economic situation and budgetary constraints.

7.3. Assistance to developing country Parties that are particularly vulnerable to climate change

The adaptation challenge is very unevenly distributed among countries and regions depending on their specific exposure, vulnerability and capacity to adapt. Developing countries, and in particular the least developed countries as well as SIDS and African countries will face the biggest challenge because poverty and low levels of development are major factors determining vulnerability and capacity to adapt. This is why the EU has taken steps to strengthen its support to adaptation in the field. This has happened by integrating adaptation considerations into existing and new development assistance

programmes and through engagement in new areas of work such as combined adaptation and disaster risk reduction efforts. Further, the EU has increased its support to support those countries and regions that are most vulnerable to climate change by building the human and technical capacity needed to tackle it.

The assistance provided by the EU for the purpose of assisting developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting the costs of adaptation to those adverse effects has been increasing from USD 125 million (€86 million) in 2008 to USD 710 million (€553 million) in 2012, to reach a cumulative amount of USD 2 246 million (€1 670 million) in the period 2008-2012[2].

The Cancun Adaptation Framework adopted in 2010 under UNFCCC provides a framework for action on adaptation. The EU supports the work under UNFCC to accompany the Least Developed Countries to formulate and implement National Adaptation Planning processes that integrate adaptation into the countries national and sector development strategies and plans.

EU support to adaptation thus builds on available vulnerability assessments, and on the needs and priorities expressed by the developing countries in their national development and adaptation planning processes, including National Adaptation Programmes of Action (NAPAs).

The EU also strongly backs the UNFCCC Nairobi Work Programme (NWP) on adaptation, which aims to improve our knowledge of the impacts of climate change and of countries' vulnerabilities, adaptation needs and responses.

7.3.1. Focusing climate support on LDCs and SIDS: the Global Climate Change Alliance (GCCA)

In 2007, the EU pioneered the establishment of the Global Climate Change Alliance (GCCA). The GCCA is now a well-established mechanism and a reference for future actions. Back in 2008, the GCCA was working with four countries. By the end of 2012, over 45 GCCA programmes were either up and running or in preparation in more than 35 countries and 8 sub-regions within an envelope of € 290 million.

The GCCA works hard to support those poorer countries and regions which are the most vulnerable to climate change by building the human, technical and financial capacity needed to tackle it. This support particularly focuses on the Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

Examples of actions are multiple and range from mangrove restoration in Guyana, to increased land tenure security in Rwanda to improved early warning and monitoring in Vanuatu, with a common leitmotiv of securing livelihoods and protecting communities at risk.

2 These figures include support projects that have climate change as their principal objective (100% of budget included) and projects that have climate change as a significant objective (40% of budget included). See section 7.4 below and the relevant section in the Biennial Report for further details on the methodology used to calculate overall support.

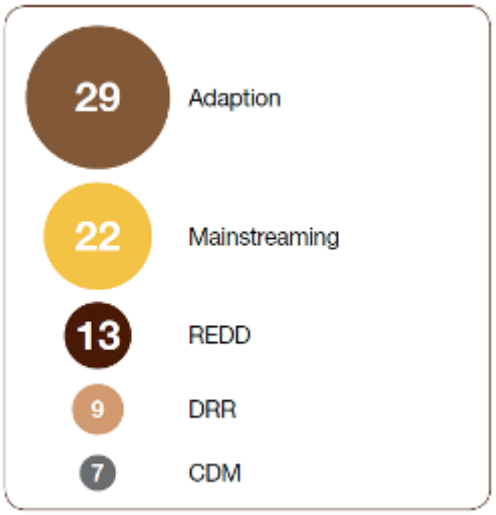
The GCCA's technical support focuses in five priority areas.

Figure **Error! No text of specified style in document.**-1 The five priority areas of the GCCA

Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

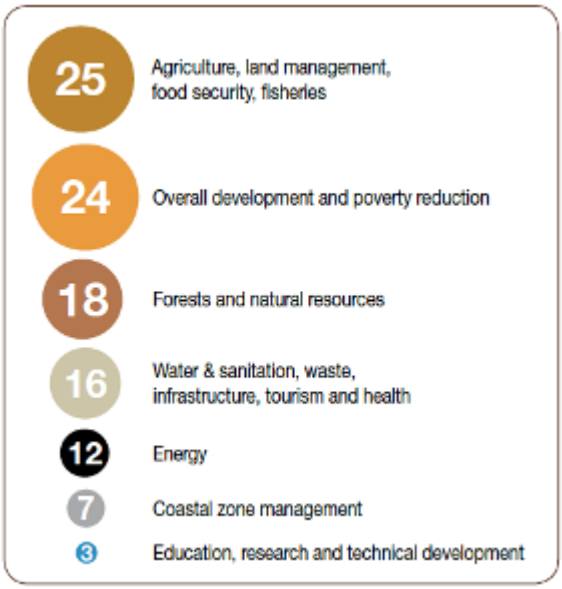
Although the scope of the GCCA is wider than solely adaptation, the figures below demonstrate a clear focus on adaptation and on those sectors of most relevance to LDCs and SIDS.

Figure **Error! No text of specified style in document.**-2 Distribution of priority areas supported by the GCCA to 2012 (number of interventions)



Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

Figure **Error! No text of specified style in document.**-3 Distribution of sectors supported by the GCCA to 2012 (number of interventions)



Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

7.4. Provision of financial resources through bilateral channels

For detailed information on the provision of support by the EU in 2011 and 2012, please refer to the relevant sections of the BR (chapter 6).

The approach used by the EU to track its bilateral provision of climate finance, technology and capacity building support is based on the OECD DAC system of Rio markers that has been integrated into the EUs own monitoring and reporting system.

According to the Rio marker methodology an activity is classified as climate change mitigation-related (either marked as 'Principal' or 'Significant') if it "contributes to the objective of stabilisation of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration."

As regards adaptation, an aid activity is marked as relevant if it "intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience. This encompasses a range of activities from information and knowledge generation, to capacity development, planning and the implementation of climate change adaptation actions."

The Rio markers are policy makers, and were originally not intended for accurate quantification of flows to support policy goals. Therefore, an activity can have more than one principal or significant policy objective (i.e. it can be marked for several Rio

markers; mitigation, adaptation and other Rio conventions such as Biodiversity and Desertification).

The EU has adopted the following approach to "translate" the Rio marked data into estimated climate finance flows:

- If an activity is marked as principal for mitigation or adaptation, 100% of the support is considered and reported as climate finance;
- If an aid activity is marked as significant for mitigation or adaptation, then only 40% of the support is considered and reported as climate finance.
- To avoid double counting, any activity can only count as 100%, 40% or 0%. If an activity is marked for both mitigation and adaptation, only the highest marking will count when calculating the total climate relevant financial contributing of the activity.

As can be seen in *Figure* Error! **No text of specified style in document.**-4 and *Figure Error!* ***No text of specified style in document.****-5*, the total support provided by the EU during the reporting period shows a clear increasing trend, peaking in 2009 and 2012 (at USD 1003 / € 722 million and USD 943 / €734 million respectively), with support provided more than doubling between the first and the last years of the reporting period (USD 460 / €315 million in 2009 and USD 943/ €734 million in 2012).

Figure **Error! No text of specified style in document.**-4 - *Total climate change relevant support provided by the EU between 2008 and 2012 (USD 1000)*

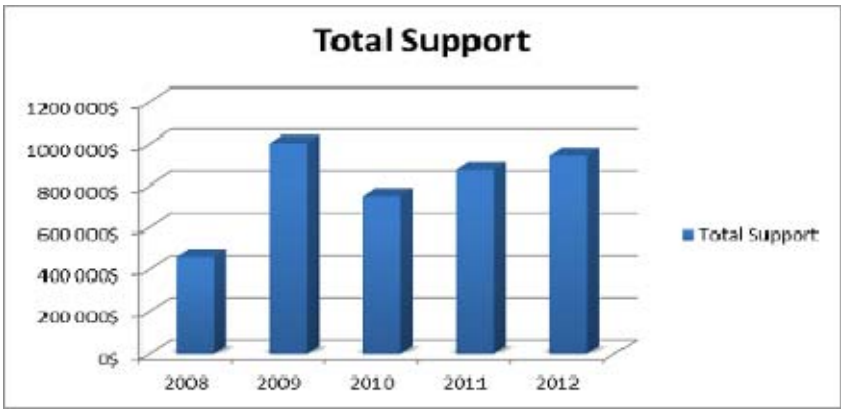


Figure ***Error! No text of specified style in document.****-5- Total climate change relevant support provided by the EU between 2008 and 2012 (EUR 1000)*

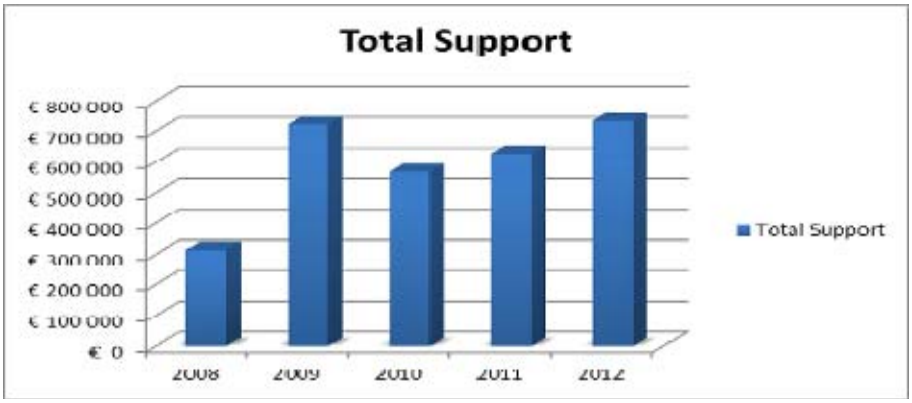


Figure Error! ***No text of specified style in document.****-6* and *Figure Error!* ***No text of specified style in document.****-7* provide a graphic overview of the support to mitigation and adaptation relevant activities respectively (using the allocation methodology described above). Please note that the figures for mitigation and adaptation should not be added as some activities may contribute to both mitigation and adaptation. The figures demonstrate that the EU has been successful in increasing the support to adaptation in both absolute and relative terms.

Support to adaptation and mitigation was in 2012,at a similar level (USD 713 / €554 million for mitigation and USD 711 / €553 million for adaptation), with the largest increase in the reporting period for adaptation (from USD 126 / €86 million in 2008 in relation to adaptation, and from USD 438 / €300 million for mitigation in the same year).

Figure ***Error! No text of specified style in document.****-6 - Support to mitigation and to adaptation (USD 1000)*

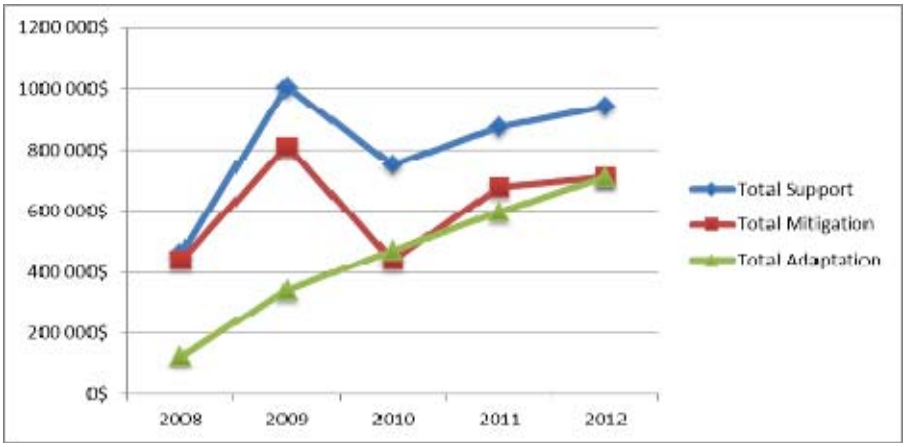


Figure ***Error! No text of specified style in document.****-7- Support to mitigation and to adaptation (EUR 1000*)

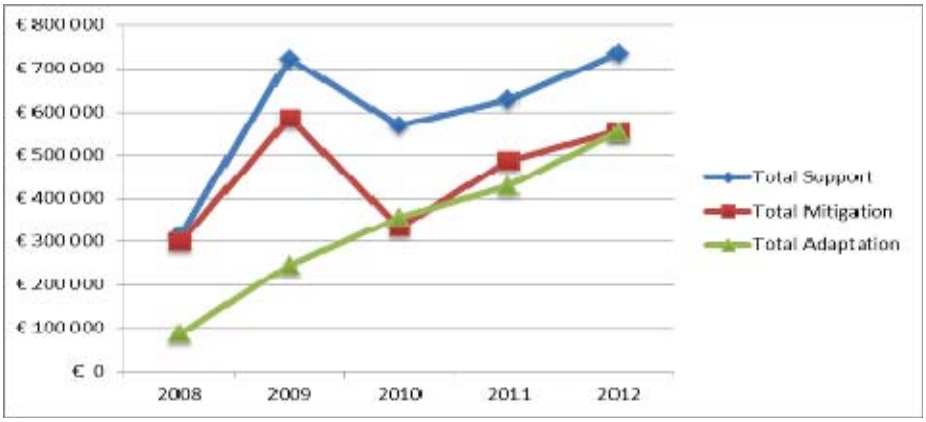


Figure Error! ***No text of specified style in document.****-8* and *Figure Error!* ***No text of specified style in document.****-9* show that both with regards to mitigation and to adaptation, the climate change relevant support provided by the EU in the period 2008-2012 is integrated in projects and programmes that serve multiple objectives, i.e. projects in which climate change in Rio marker terms is a significant, but not a principal policy objective. These results are a clear demonstration of the EU and partner countries' efforts in mainstreaming climate change into other sectoral cooperation projects (figures for Mitigation 1 and 2 and Adaptation 1 and 2 have been derived through the application of the methodology explained above).

Figure ***Error! No text of specified style in document.****-8 – Support provided through projects and initiatives where climate change is a principal (2) or significant (1) policy objective (2008-2012) (USD 1000).*

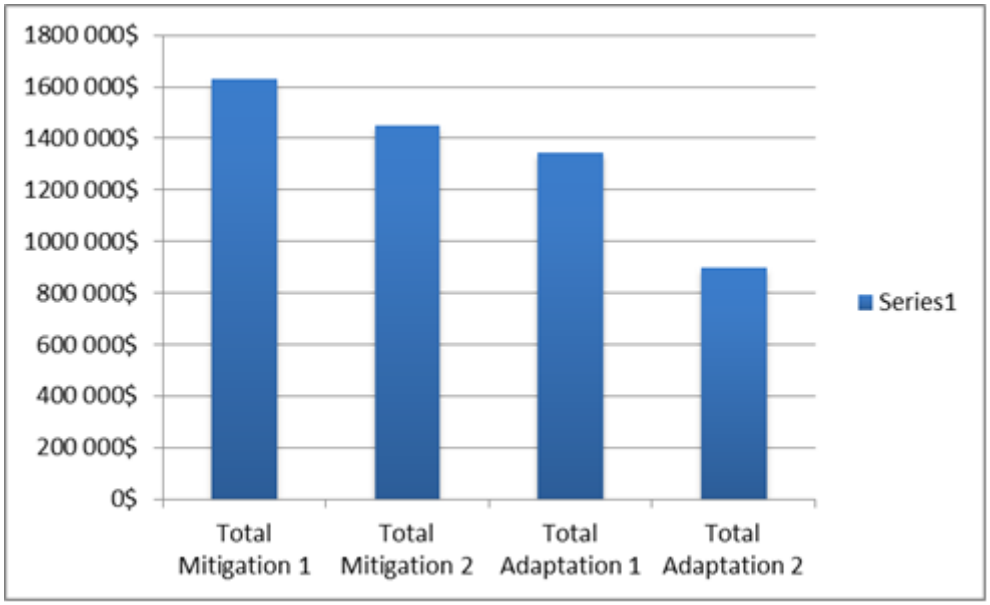
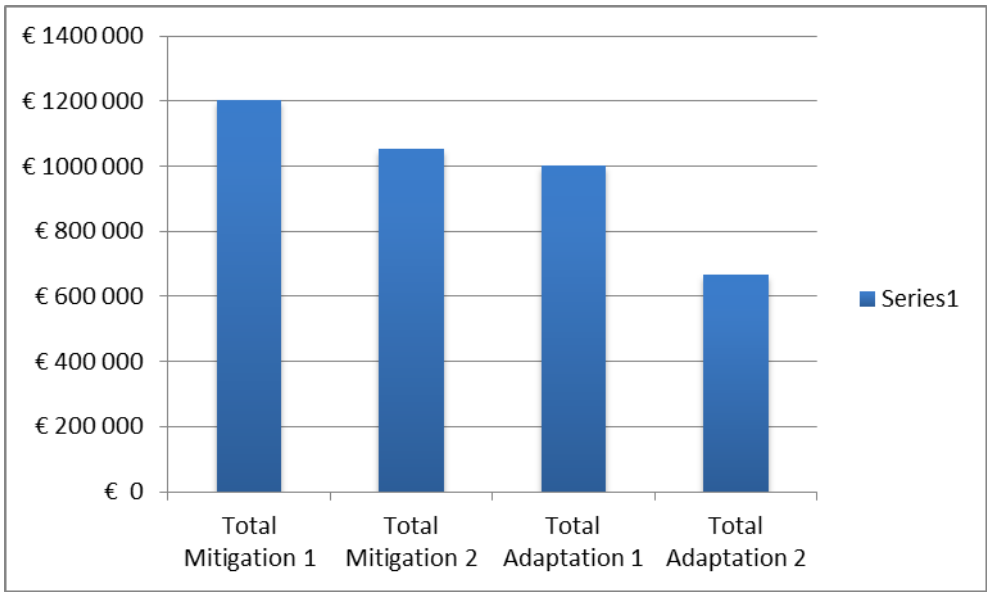


Figure ***Error! No text of specified style in document.****-9 - Support provided through projects and initiatives where climate change is a principal (2) or significant (1) policy objective (2008-2012) (EUR 1000).*



The EU has been making an important effort to ensure that its climate change mitigation and adaptation projects cover all the key sectors, namely those included in the reporting guidelines (Energy, Transport, Forestry, Agriculture, Waste Management/Water and Sanitation and Industry) and capacity building, coastal zone management and other vulnerability assessments specifically on what adaptation to climate change is concerned.

Table *Error!* ***No text of specified style in document.****-1*(for the years 2008 to 2010) and Table *Error!* ***No text of specified style in document.****-2* (for the years 2011 and 2012)[3] show, that the highest level of support goes for cross-cutting projects (those projects which impact more than one sector) and to the energy sector (in Table *Error!* ***No text of specified style in document.****-3*, the energy sector includes also cross-cutting projects). It may also be noted that while the forestry sector has maintained a relatively high level of support, the support provided to the agriculture sector has shown an increasing trend throughout the reporting period.

3 Data for 2008 to 2010 and for 2011 and 2012 are presented differently due to the different reporting formats used in the National Communication and in the Biennial Report – note that details in relation to support provided in 2011 and 2012 are reported in the Biennial Report alone.

Table ***Error! No text of specified style in document.****-1* - Provision of mitigation support by sectors for the years 2008-2010 (EUR and USD 1000)

	Mitigation											
	Energy		Transport		Forestry		Agriculture		Waste Management		Industry	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2008	€ 150 985	220 738$	€ 0	0$	€ 110 361	161 347$	€ 9 049	13 230$	€ 12 350	18 056$	€ 17 150	25 074$
2009	€ 508 558	706 331$	€ 0	0$	€ 64 066	88 981$	€ 8 994	12 492$	€ 0	0$	€ 2 000	2 778$
2010	€ 220 638	292 236$	€ 600	795$	€ 96 345	127 609$	€ 15 200	20 132$	€ 0	0$	€ 0	0$
TOTAL	€ 880 181		€ 600	795$	€ 270 772	377 937$	€ 33 243	45 854$	€ 12 350	18 056$	€ 19 150	27 851$

***** Energy includes cross cutting/multi-sector or other

Table ***Error! No text of specified style in document.****-2*- Provision of adaptation support by sectors for the years 2008-2010 (EUR and USD 1000)

	Adaptation					
	Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2008	€ 16 164	23 632$	€ 120	175$	€ 69 797	102 043$
2009	€ 35 806	49 731$	€ 36 821	51 140$	€ 172 990	240 263$
2010	€ 45 260	59 947$	€ 0	0$	€ 311 033	411 964$
TOTAL	€ 97 230	133 310$	€ 36 941	51 315$	€ 553 820	754 270$

Table ***Error! No text of specified style in document.***-*3* - Provision of support by sectors for the years 2011 and 2012

	Mitigation															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011	€ 40 709	56 620$							€ 9 280	12 907$			€ 35 861	49 876$		
2012	€ 148 138	190 409$	€ 13 600	17 481$			€ 2 702	3 472$			€ 12 200	15 681$			€ 8 000	10 283$
	Adaptation															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011			€ 8 990	12 503$			€ 64 079	89 123$			€ 7 800	10 848$	€ 4 600	6 398$	€ 3 200	4 451$
2012							€ 44 940	57 763$			€ 17 962	23 088$	€ 8 000	10 283$	€ 8 132	10 452$
	Cross-cutting															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011							€ 16 520	22 976$	€ 34 000	47 288$	€ 12 800	17 803$	€ 390 532	543 160$		
2012	€ 3 595	4 621$					€ 56 036	72 026$	€ 79 800	102 571$	€ 69 684	89 568$	€ 242 473	311 662$	€ 18 480	23 753$
TOTAL	€ 192 443	251 650$	€ 22 590	29 984$	€ 0	0$	€ 184 277	245 361$	€ 123 080	162 765$	€ 120 446	156 988$	€ 681 466	921 379$	€ 37 812	48 939$

Table *Error!* ***No text of specified style in document.****-4* shows the EU's climate finance by regions As can be seen, Africa attracts most of the support provided by the EU, summing a total of USD 1 698 / €1 252 million in the reporting period.

Table ***Error! No text of specified style in document.****-4-* Provision of support by region

	ACP		Africa		Asia		Caribbean		Eastern Europe and Central Asia		Latin America		Oceania		Unspecified LDCs		
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EU*
2008			€ 185 720	271 521$	€ 82 443	120 531$			€ 38 156	55 784$	€ 16 401	23 979$	€ 4 509	6 592$			€
2009	€ 348 800	484 444$	€ 185 191	257 209$	€ 50 784	70 533$	€ 16 867	23 426$	€ 34 438	47 830$	€ 64 218	89 192$	€ 40 770	56 625$			€
2010	€ 81 600	108 079$	€ 303 215	401 609$	€ 132 008	174 845$	€ 4 300	5 695$	€ 15 600	20 662$	€ 49 445	65 490$	€ 28 928	38 315$			€
2011			€ 231 639	322 168$	€ 100 880	140 306$	€ 28 034	38 990$	€ 80 600	112 100$	€ 27 755	38 602$	€ 5 090	7 079$	€ 154 374	214 707$	
2012	€ 27 706	35 611$	€ 346 730	445 668$	€ 88 900	114 267$	€ 42 112	54 129$	€ 42 680	54 859$	€ 82 840	106 478$	€ 26 908	34 586$	€ 14 825	19 055$	€
TOTAL	€ 458 106	628 135$	€ 1 252 495	1 698 176$	€ 455 015	620 482$	€ 91 313	122 240$	€ 211 474	291 235$	€ 240 659	323 741$	€ 106 205	143 197$	€ 169 199	233 762$	€

Table *Error!* ***No text of specified style in document.****-5* and Table *Error!* ***No text of specified style in document.****-6* below illustrate the key figures of the support provided by the EU during the reporting period. It should be noted that figures for "Total Mitigation" and "Total Adaptation" cannot be added, as they have been derived using the methodology explained above. Summing these two figures will result in a figure higher than the Total support provided (however, summing Mitigation 1 and Mitigation 2 shall be equal to Total Mitigation, likewise for Adaptation 1 and Adaptation 2).

Table ***Error! No text of specified style in document.***-5- Key figures of support provided (USD 1000)

	2008	2009	2010	*2011*	2012	TOTAL
Total Support	459 937$	1 002 904$	752 074$	*873 953$*	*943 114$*	4 031 982$
Total Mitigation	438 444$	810 581$	440 772$	*677 676$*	*712 725$*	3 080 198$
Total Adaptation	125 850$	341 134$	471 911$	*596 205$*	*710 682$*	2 245 783$
Total Mitigation 1	126 905$	349 582$	175 633$	*432 891$*	*543 413$*	1 628 423$
Total Mitigation 2	311 539$	461 000$	265 139$	*244 784$*	*169 312$*	1 451 775$
Total Adaptation 1	91 242$	159 398$	271 865$	*367 610$*	*455 763$*	1 345 878$
Total Adaptation 2	34 609$	181 735$	200 046$	*228 595$*	*254 920$*	899 905$

Table ***Error! No text of specified style in document.***-*6* - Key figures of support provided (EUR 1000)

	2008	2009	2010	*2011*	2012	TOTAL
Total Support	€ 314 597	€ 722 091	€ 567 816	*€ 628 372*	€ 733 743	€ 2 966 618
Total Mitigation	€ 299 896	€ 583 619	€ 332 783	*€ 487 249*	€ 554 500	€ 2 258 046
Total Adaptation	€ 86 082	€ 245 616	€ 356 293	*€ 428 672*	€ 552 911	€ 1 669 573
Total Mitigation 1	€ 86 803	€ 251 699	€ 132 603	*€ 311 249*	€ 422 775	€ 1 205 128
Total Mitigation 2	€ 213 093	€ 331 920	€ 200 180	*€ 176 000*	€ 131 725	€ 1 052 918
Total Adaptation 1	€ 62 409	€ 114 767	€ 205 258	*€ 264 312*	€ 354 583	€ 1 001 329
Total Adaptation 2	€ 23 672	€ 130 849	€ 151 035	*€ 164 360*	€ 198 328	€ 668 244

The tables below are a detailed description of the support provided to each of our developing country partners for the years 2008 to 2010. Such detailed reporting for the years 2011 and 2012 is included in the Biennial Report and the CTF Appendix

Table ***Error! No text of specified style in document.***-*7*- Bilateral and regional financial contributions related to the implementation of the convention, 2008 (EUR and USD 1000)

	Mitigation												Adaptation					
Recipient Country / Region	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Azerbaijan	€ 100	146$											€ 100	146$				
Bolivia					€ 920	1 345$	€ 206	301$									€ 368	538$
Brazil					€ 2 499	3 653$											€ 999	1 461$
Burkina Faso	€ 500	731$					€ 1 048	1 532$	€ 980	1 433$			€ 200	292$			€ 292	427$
Burma/Myanmar	€ 140	205$											€ 140	205$				
Cambodia	€ 1 082	1 581$											€ 2 205	3 224$				
Cameroon	€ 141	205$			€ 8 857	12 949$							€ 3 599	5 262$				
Chad					€ 4 500	6 579$											€ 1 800	2 632$
China	€ 27 590	40 337$			€ 2 169	3 171$												
Congo					€ 2 000	2 924$											€ 800	1 170$
Costa Rica					€ 1 800	2 632$												
Democratic Republic of Congo					€ 24 286	35 506$			€ 170								€ 7 100	10 380$
Ecuador	€ 78	114$																
Ethiopia					€ 12 688	18 550$	€ 1 994	2 915$									€ 5 873	8 586$

	Mitigation												Adaptation					
Recipient Country / Region	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Georgia	€ 62	90$					€ 890	1 302$					€ 62	90$			€ 356	521$
Ghana	€ 1 917	2 802$																
Guatemala					€ 946	1 383$											€ 378	553$
Guinea Bissau	€ 1 692	2 473$													€ 120	175$		
Guyana					€ 116	170$							€ 116	170$				
India	€ 337	492$																
Indonesia					€ 1 797	2 627$							€ 719	1 051$				
Kazakhstan	€ 199	291$											€ 199	291$				
Kenya					€ 611	893$											€ 244	357$
Kyrgyzstan	€ 604	883$																
Lebanon									€ 7 200								€ 7 200	10 526$
Lesotho	€ 90	132$															€ 90	132$
Madagascar					€ 2 280	3 333$											€ 912	1 333$
Maldives	€ 1 520	2 222$															€ 3 800	5 556$
Morocco	€ 30 664	44 830$																
Mozambique	€ 1 400	2 047$																
Nepal					€ 200	292$											€ 200	292$
Nicaragua					€ 614	898$											€ 246	359$
Nigeria	€ 2 298	3 360$			€ 1 119	1 637$											€ 448	655$

	Mitigation												Adaptation					
Recipient Country / Region	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Pakistan	€ 25 000	36 550$																
Palestine	€ 1 309	1 914$																
Paraguay	€ 19	28$			€ 48	70$											€ 67	98$
Samoa					€ 29	42$												
Sierra Leone					€ 2 400	3 509$											€ 960	1 404$
Sudan							€ 540	789$									€ 540	789$
Tajikistan	€ 644	942$																
Tanzania	€ 882	1 290$			€ 1 231	1 799$											€ 2 698	3 944$
Togo	€ 2 000	2 924$															€ 2 000	2 924$
Turks and Caicos Islands	€ 210	307$															€ 210	307$
Uganda					€ 10 000	14 620$											€ 4 000	5 848$
Uruguay	€ 163	238$			€ 545	797$					€ 150	219,77$					€ 218	319$
Vanuatu	€ 1 280	1 871$															€ 3 200	4 678$
Regional Africa	€ 3 710	5 423$			€ 8 447	12 350$			€ 400								€ 4 171	6 098$
Regional Asia	€ 6 305	9 217$			€ 1 000	1 462$					€ 10 000	14 619,88$					€ 3 561	5 207$
Regional Latin America	€ 500	731$			€ 3 784	5 532$											€ 1 200	1 754$
Unspecified LDCs																		

	Mitigation												Adaptation					
Recipient Country / Region	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Regional Eastern Europe and Central Asia	€ 10 801	15 791$			€ 1 828	2 672$	€ 1 571	2 296$	€ 3 600		€ 7 000	10 233,92$					€ 10 141	14 827$
Regional Oceania																		
Global	€ 27 750	40 571$			€ 13 648	19 953$	€ 2 800	4 094$					€ 8 825	12 902$			€ 5 724	8 368$

* Energy includes cross cutting/multi-sector or other

Table ***Error! No text of specified style in document.-8*** - Bilateral and regional financial contributions related to the implementation of the convention, 2009 (EUR and USD 1000)

	Mitigation														
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coasta
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1*
Bangladesh	€ 3 400	4 722$			€ 10 000	13 889$									
Bolivia															
Brazil					€ 4 910	6 819$									
Central African Republic					€ 1 600	2 222$									
Chad															
Cuba	€ 3 000	4 167$			€ 3 000	4 167$									
Ecuador					€ 960	1 333$									

	Mitigation														
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coasta
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1*
Ghana					€ 8 000	11 111$									
Guyana					€ 4 165	5 785$									€
India											€ 2 000	2 778$			
Jamaica	€ 1 652	2 294$													
Jordan	€ 10 000	13 889$													
Kiribati	€ 4 100	5 694$													
Malawi					€ 3 880	5 389$									
Maldives	€ 2 700	3 750$													
Mali					€ 5 650	7 847$									
Marshal Islands	€ 7 576	10 522$											€ 5 776	8 022$	
Mauritius	€ 50 025	69 479$													
Micronesia	€ 2 988	4 150$													
Nauru	€ 2 300	3 194$													
Niue	€ 1 020	1 417$													
Palau	€ 988	1 372$													
Rwanda	€ 1 822	2 531$													
Senegal	€ 1 600	2 222$													
Seychelles	€ 800	1 111$													
Tanzania	€ 3 200	4 444$													
Thailand	€ 1 800	2 500$													
Tuvalu	€ 1 760	2 444$													

	Mitigation														
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coasta
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1*
Uganda															
Vanuatu															
Venezuela															
ACP	€ 296 000	411 111$					€ 6 400	8 889$							
Africa	€ 35 505	49 313$													€
Asia	€ 1 600	2 222$													
Caribbean					€ 2 775	3 854$									
Eastern Europe and Central Asia	€ 20 175	28 021$			€ 4 400	6 111$							€ 2 053	2 851$	
Latin America	€ 25 940	36 028$													
Oceania															€
All Other	€ 28 607	39 732$			€ 14 726	20 453$	€ 2 594	3 603$					€ 27 977	38 857$	

* Energy includes cross cutting/multi-sector or other

Table ***Error! No text of specified style in document.***-9 - Bilateral and regional financial contributions related to the implementation of the convention, 2010 (EUR and USD 1000)

	Mitigation														
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coasta
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1*
Belize	€ 1 160	1 536 $											€ 2 900	3 841 $	
Bhutan	€ 2 240	2 967 $													
Bolivia															
Brazil					€ 6 985	9 252 $									
Burkina Faso															
Chad							€ 5 600	7 417 $							
China	€ 4 243	5 620 $													
Congo					€ 2 000	2 649 $									
Egypt	€ 20 000	26 490 $													
Ethiopia	€ 13 700	18 146 $											€ 13 700	18 146 $	
Guyana					€ 1 500	1 987 $									
Honduras					€ 8 400	11 126 $									
India	€ 23 400	30 993 $													
Indonesia	€ 5 125	6 788 $													
Jordan															
Kenya					€ 920	1 219 $									
Kiribati															
Laos															
Lebanon							€ 5 600	7 417 $							

	Mitigation														
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coasta
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1*
Lesotho															
Malawi															
Malaysia	€ 600	795 $			€ 1 600	2 119 $									
Morocco	€ 20 000	26 490 $													
Mozambique	€ 6 080	8 053 $													
Namibia															
Nepal	€ 3 200	4 238 $													
Papua New Guinea															
Philippines	€ 1 400	1 854 $													
Solomon Islands	€ 1 120	1 483 $											€ 2 800	3 709 $	
Thailand	€ 800	1 060 $													
Timor Leste															
Turkmenistan	€ 1 200	1 589 $													
Turks and Caicos Islands															
Vietnam	€ 4 400	5 828 $													
ACP					€ 13 600	18 013 $									
Africa	€ 12 200	16 159 $			€ 51 140	67 735 $	€ 4 000	5 298 $							
Asia	€ 45 700	60 530 $													
Eastern Europe and Central Asia	€ 7 600	10 066 $													
Latin America	€ 6 500	8 609 $											€ 5 000	6 623 $	
Oceania	€ 4 560	6 040 $													

	Mitigation														
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coasta
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1*
Global	€ 35 410	46 901 $	€ 600 000	794 702 $	€ 10 200	13 510 $							€ 20 860	27 629 $	

* Energy includes cross cutting/multi-sector or other

7.5. Provision of financial resources through multilateral channels

All the cooperation by the EU is considered to be bilateral, even when the EU partners with a multilateral organization as a delivery instruments (e.g. UNEP)[4]. In that regard, the only relevant figures to be reported are those referring to the EU contributions to the UNFCCC and Kyoto Protocol, which can be seen in Table *Error! **No text of specified style in document.**-10* (for ease of reference, data for the whole reporting period is included in this chapter).

Table ***Error! No text of specified style in document.**-10* - Contributions to multilateral organizations

Institution or programme	Contribution (US dollars)				
	2008	2009	2010	2011	2012
Multilateral institutions:					
1. World Bank					
2. International Finance Corporation					
3. African Development Bank					
4. Asian Development Bank					
5. European Bank for Reconstruction and Development					
6. Inter-American Development Bank					
7. United Nations Development Programme					
- specific programmes					
8. United Nations Environment Programme					
- specific programmes					
9. UNFCCC	617 775$	668 231$	690 756$	709 506$	730 144$
- Supplementary Fund	75 267$	128 509$	101 891$	106 993$	95 228$
10. Other					

7.6. Activities related to transfer of technology

7.6.1. Promotion of transfer of technology and support of endogenous capacities and technologies of developing countries

For a description of steps taken to promote, facilitate and finance transfer of technology, and to support development and enhancement of endogenous capacities and technologies of developing countries, please refer to section [BR1] 6.4. of Annex 1: EU 1st Biennial Report.

7.7. Information under Article 10 of the Kyoto Protocol

For information on steps taken to promote, facilitate and finance transfer of technology, and to support development and enhancement of endogenous capacities and technologies of developing countries, please refer to section [BR1] 6.5 in EU's 1st Biennial Report.

4 For additional information, please consult the relevant section of the Biennial Report.

8. RESEARCH AND SYSTEMIC OBSERVATION

Key developments

Research is a shared competence of the EU and its Member States. Only actions coordinated at EU level are reported in the EU National Communication.

The EU contributes to Research and Systematic Observation (RSO) through the involvement of multiple actors and through a suite of instruments, tools and programmes and across multiple sectorial policies including:

- Past EU Framework Programmes (FP) for Research and Technological Development and in the present EU Framework Programmes for Innovation (Horizon 2020)
- LIFE+ (EU's funding instrument for the environment)
- Competitiveness and Innovation Framework Programme
- International Development Cooperation
- Contribution to and/or financial support for major international institutions, research initiatives and programmes such as the UNFCCC, the Intergovernmental Panel on Climate Change (IPCC) and the Global Climate Observing System (GCOS), among others.

The new EU Framework Programme for Research and Innovation (Horizon 2020), set up for the period 2014-2020, contains the objective of reaching 35% climate relevant expenditures.

8.1. Introduction

Research on climate change processes and impacts on natural resources and humankind helps us to identify and assess key drivers and improves our understanding of their interactions. The EU contributes to Research and Systematic Observation (RSO) through the involvement of multiple actors (see section 8.2.1.1), through a suite of instruments, tools and programmes and across multiple sectorial policies (see section 8.2.1.2).

The research aims to better understand the climate evolution (past, present future), identify and quantify its impact on ecosystems and humans (from local to global scales) and facilitate the design and development of cost-efficient response strategies and measures. The EU is a world leader in research and innovation, responsible for 24 % of global expenditure on research, 32 % of high impact publications and 32 % of patent applications while representing only 7 % of the population[5].

Climate change research has been carried out during previous Framework Programmes and continued during the 7th Framework Programme for Research and Technological Development (FP7), which was the EU's main instrument for funding research in Europe for the period 2007-2013. Climate research will be central in Horizon 2020, new EU Framework Programme for Research and Innovation.

Climate change research in FP7 aimed to support projects that analyse the pressures on the environment (atmosphere, ocean, land, and cryosystems) to improve understanding of the complex climate system, also through Earth System modelling. Another key research area

5 http://ec.europa.eu/research/iscp/pdf/com_2012_497_communication_from_commission_to_inst_en.pdf

was assessing impacts, vulnerabilities and solutions for adapting to climate change, developing strategies for disaster risk reduction and to support a transition to a low-carbon society.

FP7's total budget exceeded €50 billion over 7 years, with an additional €2.75 billion directed to the European Atomic Energy Community (EURATOM[6]) (increased by 65% when compared to FP6 in average annual terms), distributed through grants to co-finance research activities in priority areas. In FP7 it is estimated that 15% to 20% of the whole budget (approximately € 7.5 billion to € 10 billion) was dedicated to actions supporting directly or indirectly climate change objectives.[7].

EU research programmes are open to participation from across the globe. FP7 was the multiannual regional programme for funding research in Europe and beyond – in principle all parts were open to international cooperation. It was managed by the European Commission and relied on contributions from 27 EU Member States and 14 Associated Countries[8]. All these countries could participate in the FP7, as could the countries that have an international agreement with the EU on Science & Technology[9] and those covered by the European Neighbourhood Policy[10]. Currently, 6% of participants in the FP7 come from third countries[11]. The Marie Skłodowska-Curie actions, that fund mobility and training for researchers, support participants from 80 different countries. The European Research Council (ERC), which funds researchers from anywhere in the world to do cutting-edge research in Europe, has begun a campaign to attract more participants from third countries. The Commission's in-house science service, the Joint Research Centre (JRC), also maintains close research links to organisations around the world.

In what regards the financing of RSO and while some calls are still open and a final figure cannot yet be given, a rough estimation indicates that from 2007 to 2013 in FP7 over € 800 million have been spent to support dedicated climate change research actions[12], through the Cooperation Programme[13] which provides support for research projects carried out by consortia with participants from different countries and through the funding of investigator-driven 'frontier' research awarded by the European Research Council[14] (ERC). These dedicated climate research activities are complemented by other activities funded by the Framework Programme, notably on energy and transport, which contribute to the identification and development of mitigation technologies and options through energy efficiency, renewable energy, carbon capture and storage and more environmentally friendly transport systems.

---

6 http://ec.europa.eu/energy/nuclear/euratom/euratom_en.htm

7 http://ec.europa.eu/dgs/jrc/downloads/events/20120306-copenhagen/andrea-tilche.pdf

8 Albania, Bosnia & Herzegovina, Croatia, Faroe Islands, Former Yugoslav Republic of Macedonia, Iceland, Israel, Liechtenstein, Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey

9 Argentina, Australia, Brazil, Canada, China, Egypt, India, Japan, Republic of Korea, Mexico, Morocco, New Zealand, Russia, South Africa, Tunisia, Ukraine and the United State of America

10 Algeria, Armenia, Azerbaijan, Belarus, Georgia, Jordan, Palestinian-administrated areas and Syrian Arab Republic

11 For the purpose of this document Third Country Participants are all those participants who are established in a non EU country, which is not associated to the Seventh Framework Programme of the European Community for Research, Technological Development and Demonstration Activities (FP7) ftp://ftp.cordis.europa.eu/pub/fp7/docs/guideline-third-country-participants_en.pdf

12 European Research on Climate Change Funded by the Seventh Framework Programme

http://bookshop.europa.eu/en/research-on-climate-change-pbKI0313365ISBN 978-92-79-31251-9

doi 10.2777/30474

13 http://cordis.europa.eu/fp7/cooperation/

14 http://erc.europa.eu/

In the scope of Horizon 2020 European researchers will be free to cooperate with their third country counterparts on topics of their own choice. This will be complemented by targeted activities in which cooperation will be sought on particular topics and with well-identified partners. The strategy will also promote common international principles in research and innovation, such as that on research integrity, gender awareness and open access, in order to provide the global research and innovation community with a level playing field in international cooperation. The strategy also aims at having research and innovation contribute more strongly to the Union's external policies. The Commission will report on progress every two years[15].

Considering the crucial role of research and innovation in tackling climate change[16], 'climate action, resource efficiency and raw materials' has been identified as one of the societal challenges that will drive the activities from research to market in Horizon 2020. Low-carbon solutions in the energy system, mobility and transport will be the focus of two other societal challenges. The programme marks a new emphasis on innovation-related solutions and it is expected that around 35% of the Horizon 2020 budget of around €70 billion will be climate related expenditure.

Research is a shared competence with the Member States. A strong partnership will be ensured by building on the work of the Strategic Forum for International Science and Technology Cooperation (SFIC)[17]. SFIC is a strategic forum and an advisory body to the Council and the Commission with a view to implementing a European Partnership in the field of international scientific and technological cooperation (S&T cooperation). Member States and the Commission are members of the Forum while countries associated to the FP7 have an observer's status. SFIC's objective is to facilitate the further development, implementation and monitoring of the international dimension of the European Research Area (ERA) by the sharing of information and consultation between the partners with a view to identifying common priorities which could lead to coordinated or joint initiatives, and coordinating activities and positions vis-à-vis third countries and within international fora[18].

There are two types of RSO actions that can be distinguished: those that are implemented by MS and others that are coordinated at EU level. The latter form the scope of this chapter which begins by describing in general terms the policy and funding of RSO, the EU's participation in GCOS's activities and finally presents some of most emblematic RSO projects.

8.2. General policy on and funding of research and systematic observation

8.2.1. General policy on RSO

Research on climate change has an illustrious European history. In the late 19th century, Swedish Svante Arrhenius proposed a theory to explain ice ages and developed the first arguments to describe what is now widely known as the greenhouse effect. Germany's Wladimir Köppen subsequently laid the foundations for climatology, while in the late 1930s it was the British scientist Guy Stewart Callendar who confirmed the link between rising carbon dioxide levels and global temperature. Climate change research has been present in

15 http://europa.eu/rapid/press-release_IP-12-967_en.htm

16 COMMISSION STAFF WORKING PAPER, IMPACT ASSESSMENT Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation'; COM(2011) 808 final

17 http://europa.eu/rapid/press-release_IP-12-967_en.htm?locale=en

18 http://ec.europa.eu/research/iscp/pdf/st01352.en13.pdf

the EU's FP since the 1980s – FP1 (1984–1988). In the 1990s, research concentrated on the carbon cycle and ecosystem functioning. Since then climate change research has proliferated in size and complexity. FP5 (1998-2002) supported projects in the action "Global Change, Climate and Biodiversity", while FP6 (2003-2006) backed many integrated projects on climate change, with research areas ranging from atmospheric pollutants to the prediction of climate change and its impacts. In FP7, climate relevant research is conducted with across various themes such as 'Environment (including Climate Change)', 'Energy' and 'Food, Agriculture, Fisheries and Biotechnology'. Targeted climate change research falls under the theme 'Environment (including climate change)', 'Activity 6.1 Climate Change, Pollution and Risks'.

Climate change research findings and IPCC's assessments have provided the scientific basis for global policy actions, such as the UNFCCC, the Kyoto Protocol and the international post-2012 process launched at the UNFCCC conference in Bali (December 2007). The EU – together with its international partners – now aims to forge at a new comprehensive global agreement tackling climate change which will set priorities, commitments and goals for the near- to long-term.

Research and innovation contribute to a package of external policies covering, for example, trade, enlargement, development and the Common Foreign and Security Policy (CFSP). In its 2012 Communication on 'Enhancing and focusing EU international co-operation in research and innovation'[19], the European Commission emphasised the importance of adequate "scale and scope" in international co-operation activities which will allow us to make a real difference.

Different countries are developing different scientific and research strengths. By combining research teams from all over the world, access to new data and scientific results and innovative solutions can be enhanced. For Europe, cooperation means accessing new sources of knowledge, attracting fresh scientific talent and investment, agreeing on common procedures for conducting research and developing common standards.

Article 189 of the TFEU, conferring on the Union a shared space competence which it pursues alongside that of the Member States, needs to be seen in this context. The Union thus has a specific mandate to draw up a European space policy, and, "to this end, it may promote joint initiatives, support research and technological development and coordinate the efforts needed for the exploration and exploitation of space". To this end, "...Parliament and the Council shall establish the necessary measures, which may take the form of a European space programme".

In this new framework, Europe's space policy is aimed at achieving the following objectives: promoting technological and scientific progress, stimulating industrial innovation and competitiveness, enabling European citizens to reap the benefits of space applications and raising Europe's profile on the international stage in the area of space. In order to achieve those goals, Europe needs to keep independent access to space.

The first priorities for this policy set out at the fourth Space Council meeting are the flagship Galileo and Copernicus projects. The 5th Space Council meeting approved those projects and identified further priorities. Climate change, security, competitiveness and space exploration

19 COM(2012) 497 final

have ever since been reaffirmed as priority areas where specific action continues to be required[20].

Finally, in what concerns the support for developing countries to establish and maintain observing systems, related data and monitoring systems some of the relevant activities are the African Monitoring of Environment for Sustainable Development (AMESD[21]) programme and its successor Monitoring of Environment and Security in Africa (MESA) and natural resources in Africa and a tripartite collaboration[22] between the JRC, NASA and the South African National Space Agency (SANSA) has been in place since 2011 around the exploitation of data generated by the Multi-angle Imaging Spectro Radiometer (MISR) instrument on-board the NASA Terra platform.

8.2.1.1. Institutional mapping, actors and roles and responsibilities

In the EU there two sets of RSO actions that can be distinguished: those that are implemented by MS and others that are coordinated at the EU level. The latter make up are the scope of this chapter and a complex myriad of institutions contributes to it. A brief description of the roles and responsibilities of the main RSO actors at the EU level is provided below.

Directorate-General for Research and Innovation[23]

The mission of the DG Research and Innovation is to develop and implement the European research and innovation policy with a view to achieving the goals of Europe 2020 and the Innovation Union.

As such, the DG contributes to making Europe a better place in which to live and work, improving Europe's competitiveness, growth and job creation while tackling the main current and future societal challenges. To do so, DG Research and Innovation supports relevant activities through European FPs, coordinates and supports national and regional R&D programmes, contributes to the ERA by developing the conditions for researchers and knowledge to circulate freely, and supports European organisations and researchers in their cooperation at international level.

Joint Research Centre (JRC)

As the Commission's in-house science service, the JRC's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. The JRC is a Directorate-General of the European Commission under the European Commissioner for Research, Innovation and Science. The Headquarters of the Directorate-General[24] are located in Brussels, while the seven JRC institutes are located on five separate sites in Belgium, Germany, Italy, the Netherlands and Spain.

Especially relevant to the issue of climate change is the *Institute for Environment and* Sustainability (IES) [25]. Its mission is to provide scientific and technical support to EU policies for the protection of the European and global environment, and to carryout research to understand the complex interactions between human activity and the physical environment, in

20 http://ec.europa.eu/enterprise/policies/space/files/policy/comm_pdf_com_2011_0152_f_communication_en.pdf

21 http://au.int/amesd/home/144-mesa-a-leap-forward-for-earth-observation-applications-in-africa-.html

22 http://www-misr.jpl.nasa.gov/index.cfm http://www.jpl.nasa.gov/news/news.php?release=2010-325

http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11780&dt_code=NWS&lang=en

http://earthdata.nasa.gov/featured-stories/featured-research/new-angles

23 http://ec.europa.eu/research/index.cfm?pg=dg

24 http://ec.europa.eu/dgs/jrc/index.cfm?id=1490&lang=en

25 http://ies.jrc.ec.europa.eu/

particular the climate system, and how to manage strategic resources (water, land, forests, food, minerals, etc.) in a more sustainable manner or evaluate risks. Together with other JRC institutes, the IES provides the scientific basis for the conception, development, implementation and evaluation of EU policies that promote the greening of Europe and the global sustainable management of natural resources. It also works in partnership with other Directorates General to support the strategic priorities of the Commission.

JRC has been actively involved in GCOS (see section 8.3) for many years, both through its participation in its governing body and panels, including:

- the Steering Committee
- the Atmospheric Observation Panel for Climate (AOPC)[26] and
- the Terrestrial Observation Panel for Climate (TOPC)[27].
- as well as its contributions to the drafting of key documents for the systematic observation of the Earth, such as the Adequacy Reports and the Implementation Plans.

Similarly, JRC staff members regularly contribute to the work of Committee on Earth Observation Satellites (CEOS)[28], in particular through its panels dedicated to climate, calibration and validation, as well as land surface processes. CEOS coordinates, in particular, the responses of all Space Agencies to the recommendations issued by GCOS as part of the Implementation Plans and associated documents.

JRC also contributes directly to the IPCC activities, both in terms of writing or reviewing the various chapters of the successive assessments. While GCOS deals with the observational component of the climate, IPCC provides modelling and prediction support to UNFCCC.

Directorate-General Enterprise and Industry[29]

The European Commission's Directorate-General for Enterprise and Industry has the mission to promote a growth-friendly framework for European enterprises. It has a key role in the Europe 2020 agenda of smart, sustainable and inclusive growth. It is responsible for the product legislation in a number of sectors to ensure a well-functioning internal market, manages large industrial programmes in space and satellite navigation (GALILEO and Copernicus), and is the voice of SMEs in European policy-making. In this context, the Copernicus's Climate Change Service will become relevant (see section 8.5.2).

Directorate-General for Climate Action [30]

DG Climate Action was established in February 2010, climate change being previously included in the remit of DG Environment of the European Commission. It leads international negotiations on climate, helps the EU to deal with the consequences of climate change and to meet its targets for 2020 and develops and implements the EU Emissions Trading Scheme (EU ETS). It also promotes the development and demonstration of low carbon[31] and adaptation technologies, especially through the development and implementation of cost

26 http://www.wmo.int/pages/prog/gcos/index.php?name=AOPC

27 http://www.wmo.int/pages/prog/gcos/index.php?name=TOPC

28 http://www.ceos.org/

29 http://ec.europa.eu/enterprise/dg/

30 http://ec.europa.eu/dgs/clima/mission/index_en.htm

31 http://ec.europa.eu/clima/policies/lowcarbon/index_en.htm

effective regulatory frameworks for their deployment (e.g., carbon capture and storage[32], fluorinated gases[33], the control of ozone depleting substances, vehicle efficiency standards[34], fuel quality standards) as well as through the development of appropriate financial support schemes.

European Research Council (ERC)[35]

The ERC is the European Union funding body that implements the Specific FP7 Programme 'Ideas'. This Programme supports "investigator-driven" research carried out across all fields by individual national or transnational teams in competition at the European level. The ERC consists of independent Scientific Council, responsible for scientific strategy, and an administrative arm, the European Research Council Executive Agency (ERCEA).

European Environment Agency (EEA)[36]*and* European Environment Information and Observation Network *(EIONET)*[37]

The EEA is an agency of the European Union. Its task is to provide sound, independent information on the environment as a major information source for those involved in developing, adopting, implementing and evaluating environmental policy, as well as the general public. The EEA does not fund research projects but produces European, pan-European and regional integrated environmental data and indicator sets, assessments and thematic analyses in order to provide a sound decision basis for environmental policies in the EU and Member countries and for cooperation with candidate and potential candidate countries.[38] Currently, the EEA has 32 member countries.

Relevant EEA products and services, which make use of results from a range of EU funded research projects on climate change and climate change impacts, include:

- assessment reports published in 2012 and 2013 on 'Urban adaptation to climate change in Europe[39]', 'Climate change, impacts and vulnerability in Europe 2012[40]' and on 'Adaptation in Europe - Addressing risks and opportunities from climate change in the context of socio-economic developments[41]'
- Climate-ADAPT, the European Climate Adaptation Platform[42] (see section **Error! Reference source not found.**)

EEA's mandate is to:

- help the Community and member countries[43] make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability

32 http://ec.europa.eu/clima/policies/lowcarbon/ccs/index_en.htm

33 http://ec.europa.eu/clima/policies/f-gas/index_en.htm

34 http://ec.europa.eu/clima/policies/transport/vehicles/index_en.htm

35 http://erc.europa.eu/about-erc/mission

36 http://www.eea.europa.eu/about-us/who

37 http://eionet.europa.eu/. Eionet was set up in 1994 in accordance with the Council Regulation (EEC) No 1210/90 of 7 May 1990 on the establishment of the EEA and has grown as the EEA has enlarged

38 http://www.eea.europa.eu/about-us/what

39 http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change

40 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

41 http://www.eea.europa.eu/publications/adaptation-in-europe

42 http://climate-adapt.eea.europa.eu/

43 http://www.eea.europa.eu/about-us/countries-and-eionet/intro

- coordinate the European environment information and observation network (Eionet)
- coordinate in-situ observations and contribute to the development of the services, in particular to the technical coordination of the Land Monitoring Service. Use of the Copernicus services is an integrated part of EEA's strategy to improve environmental information. Copernicus also plays an important role in the implementation of the principles of the Shared Environmental Information System (SEIS), and has the potential to make effective use of existing infrastructures in accordance with the INSPIRE directive. In the global context, Copernicus is an integral part of the Global Earth Observation System of Systems (GEOSS) (see section 8.3).

Eionet is a partnership network of the EEA and its member and cooperating countries. The EEA is responsible for developing the network and coordinating its activities. To do this, the EEA works closely together with the National Focal Points (NFPs), typically national environment agencies or environment ministries in the member countries. Eionet has become a model for the provision of high quality data, information and assessments on the state of the environment and the pressures and driving forces acting upon it.

The European topic Centres (ETCs)[44] are a consortium of organisations from EEA member countries with expertise in a specific environmental area and contracted by the EEA to support its work programme. These centres of thematic expertise carry out specific tasks identified in the EEA strategy (five-year work programme) and the annual work programmes. They are designated by the EEA Management Board following a Europe-wide competitive selection process and work as extensions of the EEA in specific topic areas.

Each ETC consists of a lead organisation and specialist partner organisations from the environmental research and information community, which combine their resources in their particular areas of expertise. The ETCs, working together with Eionet countries, facilitate the provision of data and information from the countries and deliver reports and other services to the EEA and Eionet. There are currently 6 ETCs, one of which concerns Air Pollution and Climate Change Mitigation (ETC/ACM[45]) and another Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA[46]) (see section **Error! Reference source not found.**).

European Space Agency (ESA)[47]

ESA is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. ESA is an international organisation with 20 Member States. By coordinating the financial and intellectual resources of its members, it can undertake programmes and activities far beyond the scope of any single European country. ESA's job is to draw up the European space programme and implement it. ESA's programmes are designed to find out more about Earth, its immediate space environment, our solar system and the Universe, as well as to develop satellite-based technologies and services, and to promote European industries. ESA also works closely with space organisations outside of Europe.

44 http://acm.eionet.europa.eu/

45 http://acm.eionet.europa.eu/

46 http://cca.eionet.europa.eu/

47 http://www.esa.int/About_Us/Welcome_to_ESA/What_is_ESA

ESA has 20 Member States[48]. In recent years the ties between the Commission and ESA have been reinforced by the increasing role that space plays in supporting Europe's social, political and economic policies, in line with Article 189 of the TFEU.

The legal basis for the EU/ESA cooperation is provided by a Framework Agreement which entered into force in May 2004. Under this agreement the European Commission and ESA coordinate their actions through the Joint Secretariat, a small team of the European Commission's administrators and the ESA executive. The Member States of the two organisations meet at ministerial level in the Space Council, which is a concomitant meeting of the EU and ESA Councils, prepared by Member States representatives in the High-level Space Policy Group (HSPG).

One of ESA's activities is observing the state and evolution of Planet Earth, which encompasses two programmes: the Living Planet and Copernicus, in addition to Earthnet, financed through ESA's General Budget, enabling access to EO data. .

Also, to respond to the need for climate-quality satellite data, ESA has set up a new programme, the ESA Climate Change Initiative. A € 75 million programme, it will run from 2009 to 2016 and consist of three stages: requirement analysis, algorithm development and prototype ECV building; ECV production and system development; and user analysis and feedback[49] (see also section 8.3).

In addition to ESA's CCI, ESA's Living Planet programme supports through dedicated scientific missions, the Earth Explorers, and its exploitation programme components, increasing the knowledge base of processes and their interactions underlining climate.

European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT[50])

The main purpose of EUMETSAT is to deliver weather and climate-related satellite data, images and products 24 hours a day, 365 days a year. This information is supplied to the National Meteorological Services of the organisation's Member, the European Centre for Medium range Weather Forecasting (ECMWF) and Cooperating States in Europe, as well as other users world-wide. EUMETSAT is an international organisation and was founded in 1986.

EUMETSAT contributes to the global effort to meet the climate challenge. Its Meteosat and Metop satellites, as well as data and products from the Jason satellites already provide a wealth of environmental and climate data. The latter are further analysed by its network of Satellite Application Facilities (SAFs) and distributed rapidly to the global user community. The organisation also possesses a unique archive of relevant long-term satellite data dating back to 1981.

EUMETSAT and its partners are contributing to the overall European-scale efforts to define a comprehensive, global, space-based climate monitoring system to address the challenges posed by global climate change.

48 Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom. Canada takes part in some projects under a Cooperation agreement. Poland exchanged Accession Agreements with ESA in September 2012 to become the 20th Member State. Hungary, Estonia and Slovenia are 'European Cooperating States'. Other countries have signed cooperation agreements with ESA.

49 http://www.esa-cci.org/

50 http://www.eumetsat.int/Home/Main/AboutEUMETSAT/index.htm?l=en

The Satellite Application Facility on Climate Monitoring (CM SAF) aims at the provision of satellite-derived geophysical parameter data sets suitable for climate monitoring. CM SAF provides climatologies for ECVs, as required by the GCOS implementation plan in support of the UNFCCC.

The CM SAF data products are categorized in monitoring data obtained in near real time and data sets based on carefully intersensor calibrated radiances. The products are derived from several instruments on-board meteorological operational satellites in geostationary and polar orbit as the Meteosat and EUMETSAT Polar System satellites, respectively[51].

European Institute of Innovation & Technology (EIT)[52]

The EIT is a body of the European Union that aims to promote sustainable growth and competitiveness by reinforcing the innovation capacity of the EU. To do so, EIT integrates higher education, research and business in areas of high societal need through the Knowledge and Innovation Communities (KICs). Climate-KIC[53] aims to significantly accelerate the innovation required for a transformation to a low-carbon economy, and to ensure Europe benefits from new technologies, company growth and jobs.

*Figure **Error! No text of specified style in document.**-10 EIT lines of action*

8.2.1.2. Main instruments, policies and programmes

7th Framework Programme (FP7)

FP7 (2007-2013) was the EU's main instrument for funding research in Europe and beyond from 2007 to 2013. This multi-annual regional programme relied on contributions from 27 EU Member States and 14 Associated Countries[54]. In principle, all parts of FP7 were open to international cooperation, while many third countries (especially developing ones and economies in transition) were eligible for EU funding.

51 http://www.cmsaf.eu/bvbw/appmanager/bvbw/cmsafInternet

52 http://eit.europa.eu/

53 www.climate-kic.org

54 Albania, Bosnia & Herzegovina, Croatia, Faroe Islands, Former Yugoslav Republic of Macedonia, Iceland, Israel, Liechtenstein, Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey

FP7was structured around five specific programmes:

- Cooperation – collaborative research: was the core of FP7, representing two thirds of the overall budget. It fostered collaborative research across Europe and other partner countries through projects by transnational consortia of industry and academia (for more details on RSO and International Cooperation see Section 8.3 below). Research was carried out in ten key thematic areas:
  - health
  - food, agriculture and fisheries, and biotechnology
  - information and communication technologies
  - nanosciences, nanotechnologies, materials and new production technologies
  - energy
  - environment (including climate change)
  - transport (including aeronautics)
  - socio-economic sciences and the humanities
  - space
  - security
- Capacities – capacity building for research (network, research infrastructure, and others) in order to strengthen the research capacities that Europe needs if it is to become a thriving knowledge-based economy. It covered the following activities:
  - research infrastructures
  - research for the benefit of SMEs
  - regions of knowledge
  - research potential
  - science in society
  - specific activities of international cooperation.
- People – provided support for researcher mobility and career development, both for researchers inside the EU and internationally. It was implemented via a set of Marie Curie actions, providing fellowships and other measures to help researchers build their skills and competences throughout their careers:
  - initial training of researchers – Marie Curie Networks
  - industry-academia partnerships
  - co-funding of regional, national and international mobility programmes
  - intra-European fellowships
  - international dimension-outgoing and incoming fellowships, international cooperation scheme, reintegration grants

    - Marie Curie Awards
- Ideas: supported "frontier research" solely on the basis of scientific excellence. Research could be carried out in any area of science or technology, including engineering, socio-economic sciences and the humanities. In contrast with the Cooperation programme, there was no obligation for cross-border partnerships. Projects were implemented by "individual teams" around a "principal investigator". The programme was implemented via the ERC.
- Euratom (nuclear research and training activities): comprises research, technological development, international cooperation, dissemination of technical information, and exploitation activities, as well as training. Two specific programmes are planned:
    - fusion energy research (in particular ITER), and nuclear fission and radiation protection;
    - activities of the JRC in the field of nuclear energy, including nuclear waste management and environmental impact, nuclear safety and nuclear security. In addition to direct actions in the nuclear field, the JRC carries out research in a number of other areas to provide scientific and technological support to EU policy making.

In FP7, climate relevant research has been conducted across various themes such as 'Environment (including Climate Change)', 'Energy' and 'Food, Agriculture, Fisheries and Biotechnology'. Targeted climate change research falls under the theme 'Environment (including climate change)', 'Activity 6.1 Climate Change, Pollution and Risks', focusing in particular on the following issues:

- the earth system and climate, and related abrupt changes
- natural and anthropogenic emissions
- the global carbon cycle
- greenhouse gases
- future climate
- the natural, social and economic impacts of climate change
- mitigation and adaptation strategies, including novel responses to climate change
- natural climate-related hazards such as floods, droughts, storms or forest fires
- climate change impacts on health.

Progress has been – and continues to be – made in reducing fragmentation across the European Research Area and in strengthening coordination of national and regional research programmes. FP7 is supporting two main tools to achieve these goals – the ERA-NET scheme and actions under Article 185, as described below.

European research Area (ERA)

The European Commission's 2012 policy Communication on the European Research Area[55] led to a significant improvement in Europe's research performance to promote growth and job creation.

With the explicit objective of opening up and connecting EU research systems – important due to the increased cross-national nature – the ERA reform agenda focuses on five key priorities:

- more effective national research systems
- optimal transnational co-operation and competition on common research agendas, grand challenges and infrastructures
- an open labour market for researchers facilitating mobility, supporting training and ensuring attractive careers
- gender equality and gender mainstreaming in research encouraging gender diversity to foster science excellence and relevance
- optimal circulation and transfer of scientific knowledge to guarantee access to and uptake of knowledge by all .

The objective of the ERA-NET scheme is to step up the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States through:

- the networking of research activities conducted at national or regional level, and
- the mutual opening of national and regional research programmes.

The scheme will contribute to making a reality of the ERA by improving the coherence and coordination across Europe of such research programmes. The scheme will also enable national systems to take on tasks collectively that they would not have been able to tackle independently.

Both networking and mutual opening require a progressive approach. The ERA-NET scheme therefore has a long-term perspective that must also allow for the different way that research is organised in different Member States and Associated States[56].

The Joint Programming Initiatives (JPI) are also part of the ERA. Particularly relevant in this context are the JPI on Connecting Climate Knowledge for Europe (JPI-Climate) and on Agriculture, Food Security and Climate Change (FACCE-JPI). The concept of Joint Programming was introduced by the European Commission in July 2008. It is one of the five initiatives for implementing ERA.

JPI-Climate[57] is a fundamental European initiative on the coordination of climate research funding. 'Climate knowledge' is understood in a rather broad sense, including all kinds of scientific knowledge on causes and consequences, on cost, risks and benefits of climate change as well as possible responses. JPI Climate aims to contribute to a highly coordinated knowledge development by not only improving the scientific expertise on climate change

55 COM(2012) 392 final

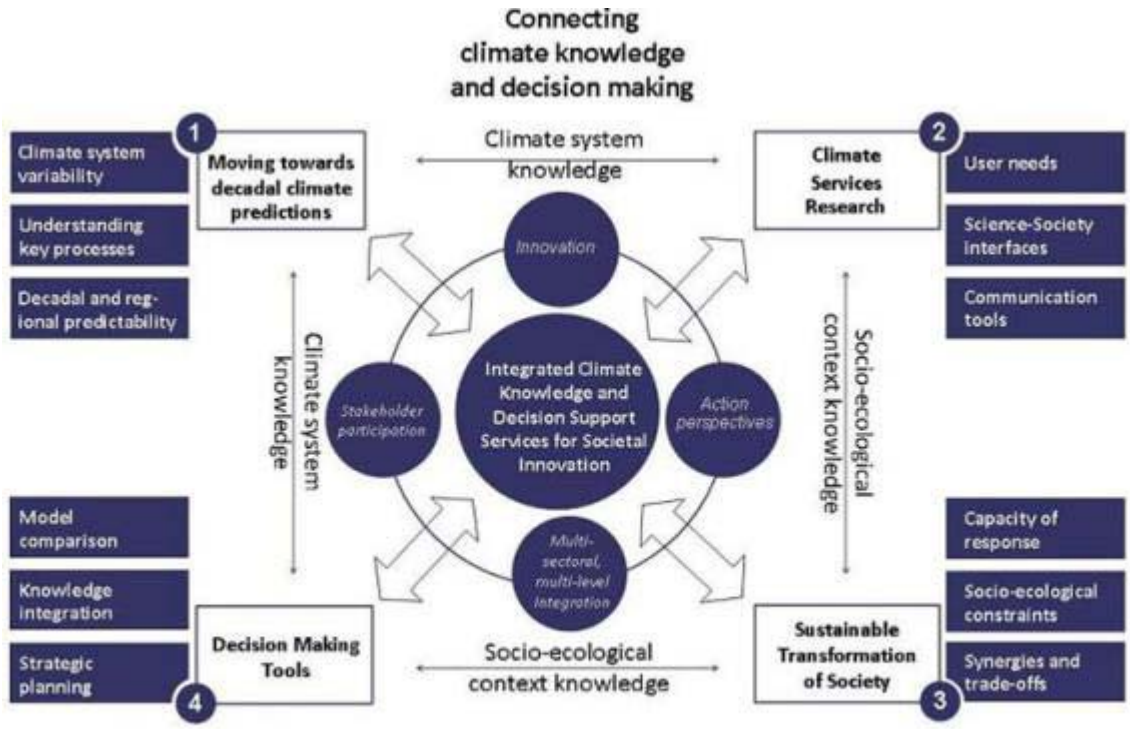
56 http://www.cordis.europa.eu/coordination/era-net.htm

57 http://www.jpi-climate.eu/

risks and adaptation options, but also by connecting that knowledge with decision-making on safety and major investments in climate-vulnerable sectors in Europe. The research agenda includes 4 modules:

- moving towards reliable Decadal Climate Predictions
- researching Climate Service Development and Deployment
- sustainable Transformations of Society in the face of Climate Change
- improving Tools for Decision Making under Climate Change.

*Figure **Error! No text of specified style in document.**-11 JPI Climate conceptual framework*



The FACCE-JPI brings together 21 countries that are committed to building an integrated European Research Area addressing the interconnected challenges of sustainable agriculture, food security and impacts of climate change.

The integrated FACCE-JPI strategic research agenda defines five core research themes:

- sustainable food security under climate change, based on an integrated food systems perspective: modelling, benchmarking and policy research perspective
- environmentally sustainable growth and intensification of agricultural systems under current and future climate and resource availability
- assessing and reducing trade-offs between food production, biodiversity and ecosystem services

- adaptation to climate change throughout the whole food chain, including market repercussions
- greenhouse gas mitigation: nitrous oxide and methane mitigation in the agriculture and forestry sector, carbon sequestration, fossil fuel substitution and mitigating GHG emissions induced by indirect land use change.

These core research themes are gradually taken into account by national research agendas with a view to aligning national programmes for which much research has already been undertaken, and inspire pilot joint actions[58] on topics for which research is lacking.

An implementation plan will be launched in the summer of 2013, which will set out short-term and mid-term priority actions to implement the FACCE-JPI strategic research agenda, in keeping with the first Work-Programme of Horizon 2020.

The JPI Urban Europe aims to respond to the grand challenge of urbanisation in Europe, and beyond. While doing so, it is sought at developing innovative R& D solutions, inter alia, in the area of environmental and ecosystem services to tackle the Climate Change challenge. The JPI is collaborating with cities, industry, and the European Commission in the context of the European Innovation Partnership on Smart Cities and Communities, which will set the pace for innovation path of European urban areas from 2014 to 2020, in partnership with countries and urbanised regions throughout the world, e.g. China, to share experiences and develop joint solutions[59].

Article 185[60]

Actions under Article 185 of the TFEU [ex Article 169 of the Treaty establishing the European Community (TEC)] aim to integrate parts of national and regional programmes for joint implementation, together with the Commission, of a real European research programme. The actions supported here may cover subjects not directly linked to the ten themes in as far as they have a sufficient EU added value. They will also be used to enhance the complementarity and synergy between FP7 and activities carried out under intergovernmental structures such as EUREKA[61] and COST[62].

Copernicus

The Copernicus Climate Change service capitalises on three main components: sustained network of in situ and satellite-based observations, re-analysis of the Earth climate with a variety of models driven by observations and modelling scenarios based on a variety of climate projections. These three components will allow a panoply of climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, ocean acidification, warming up of the ocean, among others) and climate indices (e.g., based on records of temperature, precipitation, drought events) for both the identified climate drivers and the expected climate impacts. The pre-operational phase of the Copernicus climate change (CC) service started in earnest with the 2013 FP7 Space Call that identified five major domains of activities directly related to climate modelling and observation analyses.

58 http://www.faccejpi.com/FACCE-MACSUR

59 http://www.jpi-urbaneurope.eu/.

60 http://cordis.europa.eu/fp7/art185/home_en.html

61 http://www.eurekanetwork.org/about

62 http://www.cost.eu/about_cost

The 6th FP7 space call for 2013 from DG Enterprise and Industry has prioritized developments relevant for a Climate Change service for a total budget of € 26 million : Global 20th century re-analysis and coupling methods, ensemble system of regional re-analyses, traceable quality assurance system for multi-decadal ECVs, provision of access to simulated & observed climate datasets and climate indicator toolbox and, attribution products. Proposals have been evaluated and are currently under negotiation.

The Climate Change service is designed to provide information to increase the knowledge base to support adaptation and mitigation policies. It will in particular contribute to the provision of ECVs, climate analyses and projections at temporal and spatial scales relevant to adaptation and mitigation strategies for the various Union's sectoral policies. As an example the Climate Change service will deliver series of climate data records to monitor major climate drivers, e.g. Greenhouse Gases, and climate impacts, e.g. surface temperature and precipitation; it will also deliver information of direct relevance to sectors such as Agriculture and Forestry, Health, Infrastructure, Energy and Tourism to name but a few.

LIFE+

The LIFE programme is the EU's funding instrument for the environment. The general objective of LIFE is to contribute to the implementation, update and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value. It comprises:

- LIFE+ Nature & Biodiversity
- LIFE+ Environment Policy & Governance
- LIFE+ Information & Communication.

LIFE began in 1992 and to date there have been three complete phases of the programme (LIFE I: 1992-1995, LIFE II: 1996-1999 and LIFE III: 2000-2006). LIFE+, running from 2007-2013 had a budget of €2 143 billion. Climate change is an important priority for the LIFE+ programme.

The Commission launched a discussion process on the future of LIFE+ from 2014 onwards; with a view to designing a future EU financial instrument (a continuation of LIFE+) that would best address the needs of the environment and climate protection. The resulting Regulation on the establishment of a programme for the Environment and Climate action (LIFE) for the period 2014-2020 was adopted in December 2013.

In particular, the new LIFE programme will support public authorities, NGOs and private actors, especially small and medium enterprises, in testing small-scale low carbon and adaptation technologies, new approaches and methodologies to address climate issues. Specific local and regional climate mitigation or adaptation strategies or action plans will also be financed. Moreover, the sub-programme will support capacity building as well as awareness-raising actions involving stakeholders, in order to improve the implementation of the existing climate legislation.

Competitiveness and Innovation Framework Programme[63]

With small and medium-sized enterprises (SMEs) as its main target, the Competitiveness and Innovation Framework Programme (CIP) supported innovation activities (including eco-innovation), provided better access to finance and delivered business support services in the regions. It encouraged a better take-up and use of information and communication technologies (ICT) and helped to develop the information society. It also promoted the increased use of renewable energies and energy efficiency.

The CIP ran from 2007 to 2013 with an overall budget of € 3 621 million and was divided into three operational programmes. Each programme had its specific objectives, aimed at contributing to the competitiveness of enterprises and their innovative capacity in their own areas, such as ICT or sustainable energy:

- the Entrepreneurship and Innovation Programme (EIP)
- the Information Communication Technologies Policy Support Programme (ICT-PSP)
- the Intelligent Energy Europe Programme (IEE).

The new Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME[64]) will run from 2014 to 2020, with a planned budget of € 2.5billion (current prices). COSME should start on 1 January 2014.

Its objectives are to:

- facilitate access to finance for Small and Medium-sized Enterprises (SMEs),
- create an environment favourable to business creation and growth
- encourage an entrepreneurial culture in Europe
- increase the sustainable competitiveness of EU companies and
- help small businesses operate outside their home countries and improving their access to markets.

COSME will:

- ensure continuity with initiatives and actions already undertaken under the Entrepreneurship and Innovation Programme (EIP), such as the Enterprise Europe Network, building on results and lessons learnt.
- continue the many successful features of the EIP, while simplifying management of the programme to make it easier for entrepreneurs and small businesses to benefit.
- support, complement and help coordinate actions by EU member countries. COSME will specifically tackle transnational issues that – thanks to economies of scale and the demonstration effect – can be more effectively addressed at European level.

COSME is expected to contribute to an annual increase of € 1.1 billion in the EU's GDP. The Enterprise Europe Network is expected to assist 40 000 companies with partnership agreements, resulting in:

- 1200 new business products, services or processes annually

63 http://ec.europa.eu/cip/index_en.htm

64 http://ec.europa.eu/cip/cosme/index_en.htm

- € 400 million annually in additional turnover for assisted companies.

Access to finance will be easier for entrepreneurs, in particular those willing to launch cross-border activities, resulting in an expected annual increase of € 3.5 billion in additional lending and/or investment for EU companies.

Organising co-operation at different levels, co-ordinating national or European policies, networking teams and increasing the mobility of individuals and ideas is therefore a requirement resulting from the development of modern research in a global environment. Without determined actions at European level the present fragmentation of Europe's efforts cannot be overcome.

8.2.1.3. International Cooperation

International cooperation in research and innovation is not an end in itself. It is a means for the Union to achieve its higher-level objectives, in particular by:

- strengthening the Union's excellence and attractiveness in research and innovation and its economic and industrial competitiveness
- tackling global societal challenges, such as food and energy security and climate change and
- supporting the Union's external policies.

The impact of climate change in one country may depend on what happens thousands of kilometres away. Global business draws on diminishing natural resources around the world, and water and air pollution are not confined within national nor even regional borders. Food and energy security as well as water supply also depend on cross-border co-operation.

The only way to handle these issues effectively is for countries and regions to work together, pooling resources for research and innovation, to respond to common global challenges and move towards more sustainable livelihoods.

Considering the global character of environmental problems, international cooperation activities have become a top priority worldwide. This continues good previous practices and opens all the research themes and projects to international collaboration

Most of the instruments, policies and programmes of the EU, as stated above, are in general open to all while International Cooperation Partner Countries (ICPC[65]). A new element is that the 'Environment' theme under FP7 comprises Specific International Cooperation Actions (SICA), which addresses research problems of mutual interest and benefit between the EU and ICPC.

International cooperation activities have the following overall objectives:

- supporting European scientific and economic development through strategic partnerships with third countries in selected fields of science and by engaging the best third country scientists to work in and with Europe
- facilitating contacts with partners in third countries with the aim of providing better access to research carried out elsewhere in the world and
- addressing specific problems that third countries face or that have a global character.

65 http://ec.europa.eu/research/environment/pdf/icpc-list.pdf#view=fit&pagemode=none

Besides this general policy, there are some topics in the work programme in which specific reference is made to the need for international cooperation with specific countries or regions. A partner search service has been set up to facilitate new collaborations with researchers worldwide[66].

Established in 1984, the Committee on Earth Observation Satellites (CEOS) coordinates civil space-borne observations of the Earth. Participating agencies strive to enhance international coordination and data exchange and to optimize societal benefit. Currently, 53 members and associate members made up of space agencies, national, and international organizations participate in CEOS planning and activities. The European Commission is a full member of CEOS and through the JRC is actively involved in the CEOS Working Groups and Virtual Constellations (including acting as the Current Chair for the Working Group on Climate)

In addition to bilateral and regional co-operation, which was also envisaged in the scope of FP7 (above), the EU research contributes to international initiatives such as the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention on Biological Diversity (UNCBD), United Nations Convention to Combat Desertification (UNCCD). The EU was also a leading player at the United Nations Rio+20 Sustainable Development Summit in June 2012, and is committed to implementing the measures agreed there.

The European Commission works closely with the Belmont Forum, which aims to improve coordination of research strategies and priorities in order to improve co-design, co-alignment, and co-funding of major research programmes.

In terms of Systematic Observation, the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, highlighted the urgent need for coordinated observations relating to the state of the Earth. The June 2003 summit of the heads of states of the Group of Eight industrialised countries in France reinforced the importance of earth observation as a priority activity. Europe is a global leading player in the advancement of earth observation technologies and related environmental applications. European remote-sensing satellites cover all of the Earth's climatic zones, while European ground-, air- and ocean-based monitoring devices serve users by providing high-quality observation data for subjects as diverse as urban planning, adaptation to climate change, disaster reduction, disease control and humanitarian relief. The Group on Earth Observations (GEO) is a voluntary partnership involving 90 governments, the European Commission and 67 international and regional bodies. It is developing a Global Earth Observation System of Systems (GEOSS), which provides data and information for examining natural and human-induced disasters, as well as managing natural resources (see section 8.5.1). The EU also contributes to the work of GCOS (see 8.3) and COSPAR. The European institutions are particularly active in GEO, GCOS and CEOS, among others.

The EU Environmental Technologies Action Plan (ETAP)[67], which was adopted in 2004, is intended to make eco-innovation an everyday reality throughout Europe. Covering a wide range of activities promoting eco-innovation and use of environmental technologies, its objective is to improve European competitiveness in this area and enable the EU to become the recognised world leader. The ETAP encompasses nine actions that the European

66 http://ec.europa.eu/research/environment/index_en.cfm?pg=coop

67 http://ec.europa.eu/environment/etap/index_en.htm

Commission and some that other stakeholders, such national and regional governments should undertake for the plan to be successful. An integral part of the ETAP is getting from research to markets – in other words, to increase and focus research. It thus puts forward actions to attract more private and public investment for the development and demonstration of environmental technologies in line with the EU objective to raise overall R&D investment to 3% of GDP. The actions aim to improve the innovation process and to take inventions out of laboratories and onto the market.[68]

The proposal for a new EU International Strategy for Research and Innovation will be mainly implemented through Horizon 2020, as well as through joint initiatives with EU Member States. In addition to Horizon 2020 being fully open to international participation, targeted actions with key partners and regions will focus on societal challenges and enabling and industrial technologies.

Multi-annual programmes for cooperating with key partner countries and regions will be developed in order to enhance and focus international cooperation. The strategy also calls for improving the policy dialogue with our partners and for improved information gathering as part of a proposed Research and Innovation Observatory. In addition, the European Union will aim to increase its leverage in relevant international organisations[69].

8.2.2. Funding of RSO

The EU is among the world leaders in research and innovation and is regarded as an attractive partner for international cooperation. Environmental research is a particularly good example of EU efforts to provide a common reference framework and tackle global societal challenges – whether they relate to climate, disasters, water or pollution – together with international partners. FP7 supported competitiveness and excellence in research and innovation through strategic scientific partnerships with non-EU countries and regions. This broadens access to knowledge outside the Union and access to markets worldwide.

The EU's commitment to effective multilateral processes in international fora is central to the EU's external policies. At the same time sustainable development is an overarching objective of the EU with a clear external dimension. Environmental and development challenges are inextricably linked. The scale and scope of these challenges requires increased global collaboration.

Participants from developing countries and emerging economies, Mediterranean partner countries, Western Balkan countries, as well as Russia and the new independent states can be funded in the field of environmental research. Other third country participants can also participate in EU projects; however, funding is not available unless it is explicitly mentioned in the relevant topic of the work programme or it is clearly demonstrated that it is essential for carrying out the research activity[70].

Considering the crucial role of research and innovation in tackling climate change[71], 'climate action, resource efficiency and raw materials' has been identified as one of the societal challenges that will drive the activities from research to market in Horizon 2020. Low-carbon solutions in the energy system, mobility and transport will be the focus of two other societal

68 http://ec.europa.eu/research/environment/index_en.cfm?pg=policy

69 http://europa.eu/rapid/press-release_IP-12-967_en.htm?locale=en

70 http://ec.europa.eu/research/environment/index_en.cfm?pg=coop)

71 COMMISSION STAFF WORKING PAPER, IMPACT ASSESSMENT Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation'; COM(2011) 808 final

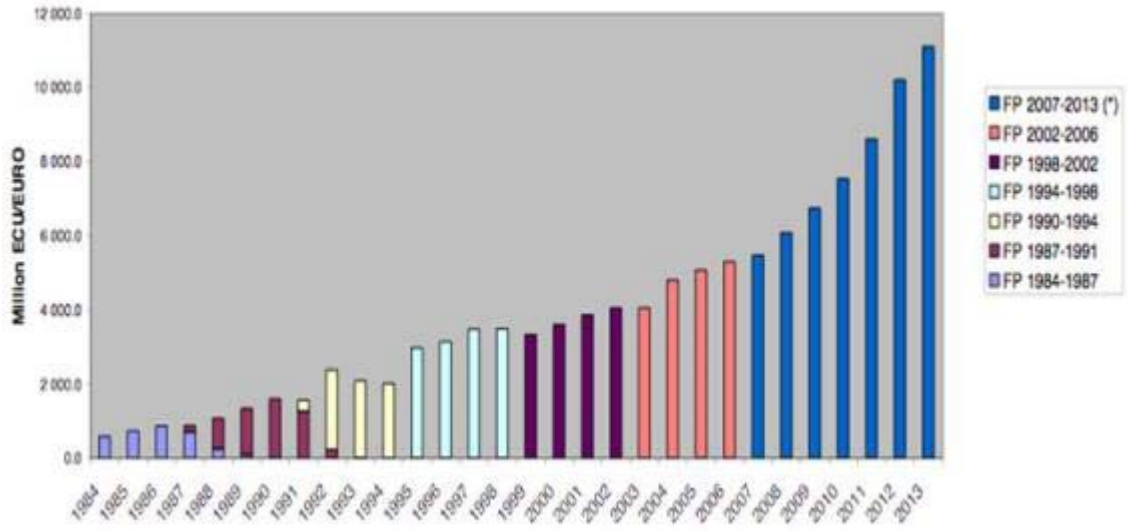
challenges. The programme marks a new emphasis on innovation-related solutions and it is expected that around 35% of the Horizon 2020 budget of around €70 billion will be climate related expenditure.

FP7

Climate research was one of the main research themes of the EU's FP7 (2007-2013) and will be central in Horizon 2020[72], the EU's new Framework Programme for Research and Innovation 2014-2020.

FP7's total budget exceeded € 50 billion over 7 years, with an additional of € 2.75 billion directed to EURATOM (increased by 65% when compared to FP6 in average annual terms), distributed through grants to co-finance research activities (in priority areas). The increase in the commitments towards the development of community research has been a trend since FP1 (1984) as shown in *Figure* ***Error! No text of specified style in document.****-12*.

Figure ***Error! No text of specified style in document.****-12 Development of Community Research – Commitments (current prices).*



Source: *http://ec.europa.eu/research/fp7/pdf/fp-1984-2013_en.pdf*

Note: the final numbers for 2012 and 2013 may change.

As part of a €10.8 billion budget for research and innovation agreed for 2013, the European Commission has announced an €8.1 billion euro package of calls for proposals under the FP7.

This was the final and largest ever package of FP7 calls, and is an important part of the Commission's commitment to work for growth and jobs in Europe:

- the budget and work programme were agreed in 2012 and funding awarded in 2013 – the closing dates for proposals were in September 2012. The calls address key concerns faced by Europeans for which action at EU level is essential. € 4.8 billion will be invested in thematic areas, with specific priorities to preserve oceans and water, better use of raw materials, efficient energy, promote efficiency in the processing of biological resources, develop smart cities and tackle issues such as public sector reform, brain research and anti-microbial resistance

72 http://ec.europa.eu/research/horizon2020/index_en.cfm

- making Europe a destination for world-class researchers is another key priority. The European Research Council will invest over € 1.7 billion in the best researchers and additional € 963 million will support mobility through "Marie Curie Actions".
- small and medium-sized enterprises, recognised as vital for innovation, are given special incentives to participate with a total package of € 1.2 billion.

Figure **Error! No text of specified style in document.**-13 shows the work programme comparison among 2012 and 2013 and Figure 8-10 the budget execution by theme between 2007 and 2013.

Figure **Error! No text of specified style in document.**-13 Work programme comparison (2012 and 2013)

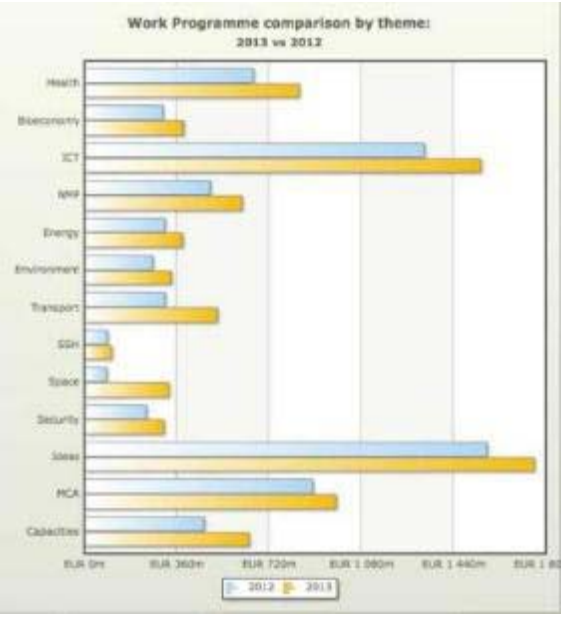
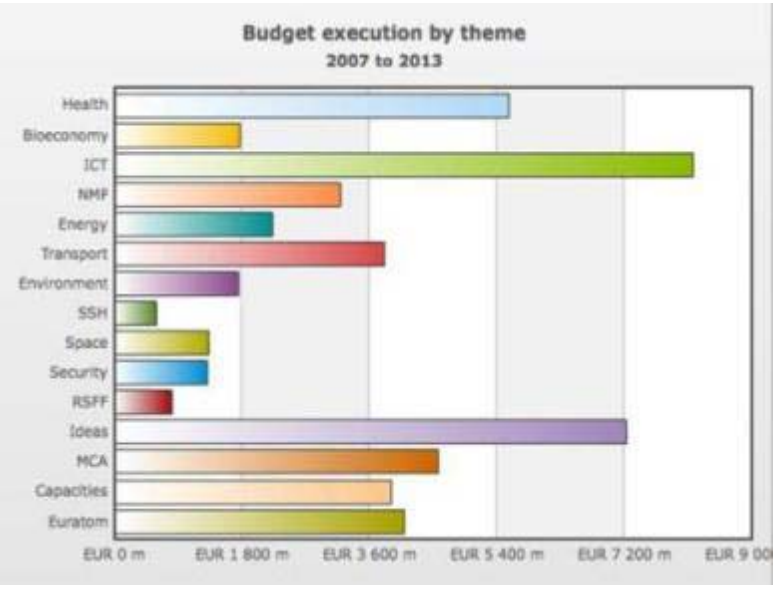


Figure **Error! No text of specified style in document.**-14 Budget execution by theme



Source: http://ec.europa.eu/research/fp7/index_en.cfm?pg=budget

Climate change research in FP7 aimed to support projects that analyse the pressures on the environment (oceans, land, atmosphere and ecosystems) and improved our understanding of the complex climate system, also through Earth System modelling. Another key research area is assessing impacts, vulnerabilities and solutions for adapting to climate change, developing strategies for disaster risk reduction and to stimulate a transition to a low-carbon climate-resilient society.

While some calls are still open and a final figure cannot yet be given, a rough estimation indicates that from 2007 to 2013 in FP7 over € 800 Million were spent on supporting climate change research[73]. The majority of the funding was provided for collaborative research projects within the 'Cooperation' programme, complemented by other funding for research infrastructures for climate observations and modelling and for investigator-driven 'frontier' research awarded by the European Research Council (ERC)[74]. These dedicated climate research activities are complemented by other activities funded by the Framework Programme, notably on energy and transport, which contribute to the identification and development of mitigation technologies and options through energy efficiency, renewable energy, carbon capture and storage and more environmentally friendly transport systems.

Horizon 2020, set up for the period 2014-2020, contains the objective of reaching 35% climate relevant expenditures.

LIFE+

The current phase of the programme, LIFE+, runs from 2007-2013 and has a budget of € 2.143 billion. LIFE+ covers both the operational expenditure of DG Environment and the co-financing of projects. According to Article 6 of the LIFE+ Regulation, at least 78% of the LIFE+ budgetary resources must be used for project action grants (i.e. LIFE+ projects). LIFE+ is open to public or private bodies, actors or institutions registered in the European Union. Project proposals can either be submitted by a single beneficiary or by a partnership, which includes a coordinating beneficiary and one or several associated beneficiaries. They can be either national or transnational, but the actions must exclusively take place within the territory of the 27 Member States of the European Union.

Under the next EU budget, the Commission wants to increase support for climate activities through all major EU funding programmes (e.g. European Agricultural Development Fund, European Regional Development Fund, Horizon 2020) to 20% of the overall EU budget. LIFE brings added value by addressing the specific needs of climate and environmental projects.

For the 2014-2020 period, the new LIFE Programme for Environment and Climate Action will have a budget of €3.46 billion, including a new €864 million sub-programme for climate action (LIFE Climate Action). This amounts to a tripling of the climate action budget compared to the LIFE+ programme, focussing on reducing greenhouse gas emissions; increasing resilience to climate change; and increasing awareness, communication, and exchange of information on climate actions.

Other

73 European Research on Climate Change Funded by the Seventh Framework Programme

ISBN 978-92-79-31251-9

doi 10.2777/30474

74 http://erc.europa.eu/

The EU is also largely supporting the Sentinel space programme, within the Copernicus programme through the funding of the procurement of a panoply of dedicated satellites and the associated operations.

8.3. Summary information on GCOS activities

GCOS is intended to be a long-term, user-driven operational system capable of providing the comprehensive observations required for:

- monitoring the climate system
- detecting and attributing climate change
- assessing impacts of, and supporting adaptation to, climate variability and change
- application to national economic development and
- research to improve understanding, modelling and prediction of the climate system.

As contributing to GCOS, the EU contributes to the collection of Atmospheric, Oceanic and Terrestrial Essential Climate Variables (ECVs) through Copernicus, the European system for monitoring the Earth.

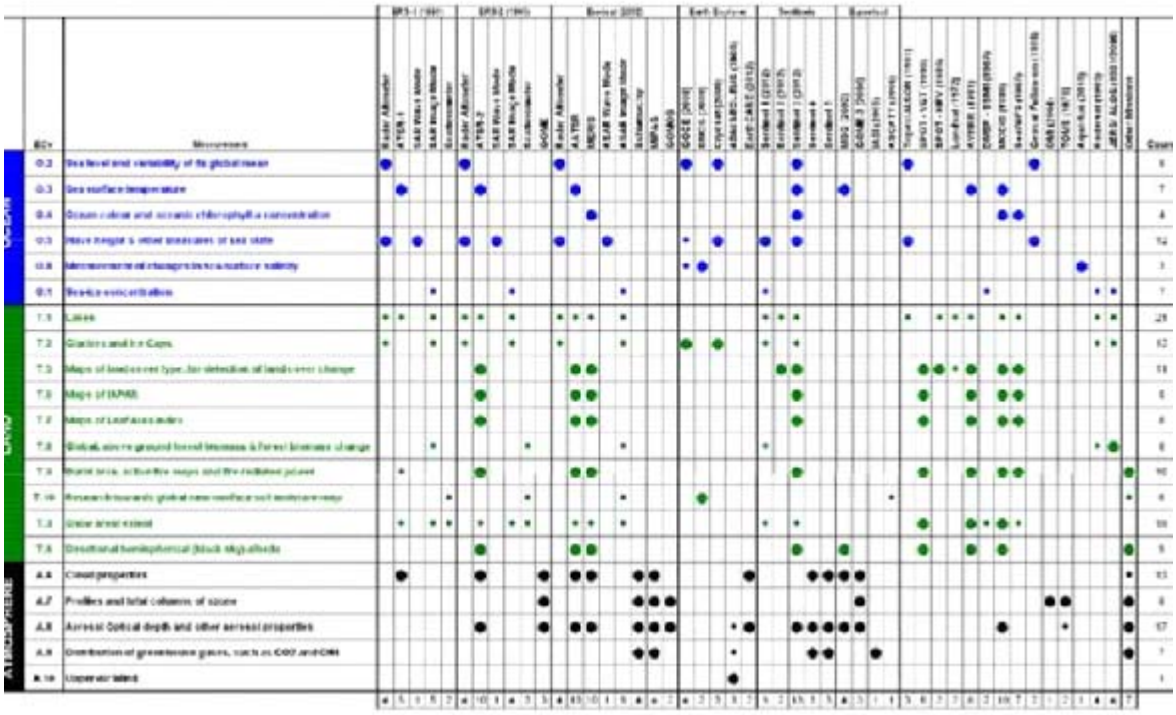
On 26 September 2008, the 5th Space Council welcomed the progress made with the implementation of the European Space Policy and highlighted new priority areas in a Resolution adopted both by the Council of the EU (Competitiveness) and by the Ministerial Council of the European Space Agency (ESA).

The Resolution also took stock of the progress made with the two European flagship programmes Galileo and Copernicus (formerly called GMES), and called for the scientific community, in conjunction with the European Commission, ESA and EUMETSAT, to define how the range of GMES (presently Copernicus) services and European space observation archives can contribute most effectively to the provision of data including ECVs for scientific research.

The European Commission has undertaken to evaluate the status quo and future plans for the provision of climate data and identify what actions are required to build on existing and planned capacities to secure a dependable and comprehensive information source for climate data. The Copernicus' Climate Change service will in particular contribute to the provision of Essential Climate Variables (ECVs), climate analyses and projections at temporal and spatial scales relevant to adaptation and mitigation strategies for the various Union's sectoral policies.

Figure Error! ***No text of specified style in document.****-15* shows how ESA and other European missions contribute to ECVs data collection.

Figure ***Error! No text of specified style in document.****-15 How ESA and other European missions contribute to ECVs.*



Source:
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/13553/1/cc_and_space_final_report_100310_jrc_report.pdf

8.4. Research

The following sections present the main research projects related to:

- the climate process and climate system studies, including re-analysis and paleoclimate studies
- research on the impacts of climate change
- socio-economic analysis, including analysis of both the impacts of climate change and response options and
- research and development on mitigation and adaptation technologies.

These projects presented below provide examples of research projects undertaken; a full list is available in the European research on climate change catalogue[75].

75 European Research on Climate Change Funded by the Seventh Framework Programme
http://bookshop.europa.eu/en/research-on-climate-change-pbKI0313365/downloads/KI-03-13-365-EN-C/KI0313365ENC_002.pdf?FileName=KI0313365ENC_002.pdf&SKU=KI0313365ENC_PDF&CatalogueNumber=KI-03-13-365-EN-C

8.4.1. Climate process and climate system studies, including paleoclimate studies

8.4.1.1. EU-WATCH[76]

Title	Water and Global Change
Instrument	Specific Targeted Research Project, FP6
Total Cost	€ 13 878 339
EU Contribution	€ 9 980 096
Duration	54 months
Start Date	1/2/2007
Consortium	25 partners, 14 countries
Project Coordinator	Centre for Ecology and Hydrology
Key Words	Water cycle, climate change, floods, droughts, feedbacks, water resources, landuse change, extremes, climate data

Main projects objectives include uniting the hydrological, water resources and climate communities to analyse, quantify and predict the components of the current and future global water cycles. To assess related water resources, evaluate their uncertainties and clarify the overall vulnerability of global water resources related to the main societal and economic sectors. WATCH has analysed and described the current global water cycle, especially changes in extremes (droughts and floods). It is also evaluating, in a consistent way, how the global water cycle and its extremes will respond to future drivers of global change (including increasing greenhouse gas concentrations and land cover change). An essential component of the analysis of the 20th and 21st century global water cycle will be a better understanding of feedbacks in the coupled system as they affect the global water cycle and the uncertainties in coupled climate-hydrological model predictions using a combination of model ensembles and observations. Finally WATCH will provide comprehensive quantitative and qualitative assessments and predictions of the vulnerability of the water resources and water-climate-related vulnerabilities and risks for the 21st century.

For the first time the global hydrological cycle has been assessed on a daily timeframe. The common methodologies developed between the climate and hydrology communities have enabled a coherent assessment of the global water cycle. These exemplar datasets and methodologies have led to substantial model development and greatly increased our understanding of the global water cycle.

A number of tools such as the drought and flood atlases have pushed forward our knowledge and provided useful mechanisms for assessing the frequency and severity of extremes. The location and extent of large scale droughts were satisfactorily reproduced by the model

76 www.eu-watch.org

ensembles. The dividends of the close working relationship between the climate and water scientist should not be underestimated. The new consolidated data sets developed by WATCH are a strong legacy from the project which underpin its achievements and will provide a resource for environmental scientists for many years to come. In particular the 20th Century climatological data has generated much interest in the wider research community. The comparison of 13 model outputs all following the same protocol and using the same dataset have enabled many model developments. The multi-model outcomes of WATCH have also benefited the assessment of feedbacks and extremes. The quantification of uncertainties in our models of the global water cycle is leading to new ways of assessing impact and adaptation studies. Climate change, demographic and land-use change, and changing patterns of consumption all drive changes in river flow and water resources. Overall WATCH has delivered a new appreciation of the interaction between the drivers of past and future changes in water resources.

8.4.1.2. PAGE21[77]

Title	Changing Permafrost in the Arctic and its Global Effects in the 21st Century
Instrument	Large-scale integrating collaborative project under the ENV call topic "Vulnerability of Arctic permafrost to climate change and implications for global GHG emissions and future climate" (ENV.2011.1.1.3-1)
Total Cost	€ 9 269 927
EU Contribution	€ 6 951 895
Duration	48 months
Start Date	1/11/2011
Consortium	18 partners from 11 countries
Project Coordinator	The Alfred Wegener Institute for Polar and Marine Research (Germany)
Key Words	Permafrost, arctic, climate change, carbon

The key objectives of PAGE21 are:

- to improve our understanding of the processes affecting the size of the arctic permafrost carbon and nitrogen pools through detailed field studies and monitoring, in order to quantify their size and their vulnerability to climate change,

77 http://page21.eu

- to produce, assemble and assess high-quality datasets in order to develop and evaluate representations of permafrost and related processes in global models,
- to improve these models accordingly,
- to use these models to reduce the uncertainties in feedbacks from arctic permafrost to global change, thereby providing the means to assess the feasibility of stabilization scenarios, and
- to ensure widespread dissemination of our results in order to provide direct input into the ongoing debate on climate-change mitigation.

The timing of this project is such that the main scientific results from PAGE21, and in particular the model-based assessments will build entirely on new outputs and results from the CMIP5 Climate Model Intercomparison Project designed to inform the IPCC Fifth Assessment Report.

However, PAGE21 is designed to leave a legacy that will endure beyond the lifetime of the projections that it produces. This legacy will comprise

- an improved understanding of the key processes and parameters that determine the vulnerability of arctic permafrost to climate change,
- the production of a suite of major European coupled climate models including detailed and validated representations of permafrost-related processes, that will reduce uncertainties in future climate projections produced well beyond the lifetime of PAGE21, and
- the training of a new generation of permafrost scientists who will bridge the long-standing gap between permafrost field science and global climate modelling, for the long-term benefit of science and society.

8.4.1.3. ATP[78]

Title	Arctic Tipping Points
Instrument	FP7, Collaborative project
Total Cost	€ 6 545 464
EU Contribution	€ 4 998 098
Duration	2009-2012
Start Date	01/02/2009
Consortium	13 partners from 11 countries
Project Coordinator	Paul Wassmann UoT, Norway
Key Words	Climate change, Arctic marine ecosystems, time-series, ecological thresholds, regime shifts, early warning indicators, socio-economic impacts, EU policy integrated management.

The objectives of the project included to investigate the existence of climate-driven tipping points for key species and ecosystem processes through analysis of available time-series data and coordinated experimental evaluations. These experimental evaluations will be used to validate the thresholds identified from time-series analysis, and to postulate new climate-driven tipping points. Ecosystem models will test these, and help to formulate future trajectories of Arctic marine ecosystems under climate change scenarios that consider the possibilities of tipping points.

Main results of the project include:

- identified climate thresholds and tipping points for key Arctic marine ecosystem components and processes
- modelled future trajectories, tipping points and regime shifts through coupled physical/biological and regional climate models
- development of early-warning indicators of climatic thresholds for major phytoplankton taxa
- evaluation of expected changes in relationships between a) climate forcing and biological responses and b) ecosystem components and their inter-relationships during regime shifts
- assessments of the implications of changes in the Arctic for socio-economic activities and governance of Arctic resources

78 www.eu-atp.org

- white paper evaluating different policy options in avoiding exceeding tipping points for Arctic ecosystems.

8.4.1.4. ICE2SEA[79]

Title	Ice2sea – estimating the future contribution of continental ice to sea-level rise
Instrument	Collaborative project – Large-scale integrating project, FP7
Total Cost	€ 13 632 213
EU Contribution	€ 9 994 842
Duration	51 months
Start Date	1/03/2009
Consortium	24 partners from 13 countries
Project Coordinator	British Antarctic Survey, Natural Environment Research Council (United Kingdom)
Key Words	Sea-level rise, glaciers, IPCC, climate change

Ice2sea is a collaborative research programme involving 24 institutional partners. Ice2sea is specifically focussed on the contribution to sea-level rise that will arise from loss of continental glaciers and ice sheets and which give rise to the largest part of the uncertainty in the projections.

The ice2sea programme receives funding from FP7 and from the many national agencies funding the institutional partners.

The programme ran for four years, (2009-2013) with a schedule designed to provide input to the next Intergovernmental Panel on Climate Change (IPCC) assessment of climate change and its impacts.

From its outset, ice2sea had twin goals of improving the science that underpins sea-level prediction, and of providing new sea-level projections based on the most up-to-date climate projections. These goals have been realised through:

- targeted studies of key processes in mountain glaciers, ice caps, and in the polar ice sheets (Greenland and Antarctica)
- improved satellite determinations of current changes in continental ice mass
- development of more reliable techniques for predicting the response of ice-sheets and glaciers to environmental change

79 http://www.ice2sea.eu

- delivery of comprehensive projections of the contribution of continental ice to sea-level rise over the next 200 years.

The ice2sea projections based on simulations of physical processes suggest lower overall contributions from melting ice to sea-level rise than many studies published since IPCC fourth assessment report (AR4) (2007).

For the "business as usual" mid-range emissions scenario (A1B), the ice2sea projections based on simulations of physical process suggest a range of contributions to sea-level rise slightly higher than the 'incomplete' projections presented in the IPCC AR4 (2007). However, they are considerably lower than several high-end projections published since AR4. To obtain a projection of total global sea-level rise, other contributions, not explicitly addressed by ice2sea, must be added (e.g. thermal expansion of the oceans, and changes in terrestrial water storage).

For the period after 2100, sea levels will continue to rise, initially at an accelerating rate, for many centuries.

8.4.2. Modelling and prediction, including general circulation models

Understanding climate variability is of prime importance for assessing climate change projections and designing adaptation strategies accordingly. The Arctic is the most vulnerable region to climate change. During the last 100 years, the Arctic atmosphere has warmed up almost twice as fast as the global average. Arctic sea ice cover has rapidly thinned and decreased during at least three decades. For example September 2008 and 2009 had the second and third lowest summer sea ice extents in the Arctic ever observed; Arctic sea ice might completely disappear in summer by the end of this century.

8.4.2.1. AMAZALERT[80]

Title	AMAZALERT – Raising the alert about critical feedbacks between climate and long-tern land use change in the Amazon
Instrument	SP1-Cooperation; Collaborative project FP7, Funding Scheme: SICA
Total Cost	€ 4 757 920
EU Contribution	€ 3 494 420
Duration	36 months
Start Date	1/09/2011
Consortium	14 partners from 9 countries
Project Coordinator	• Stichting Dienst Landbouwkundig Onderzoek – ALTERRA (Netherlands)
Key Words	Amazonia, deforestation, climate change, REDD, tipping points, early warning system, climate feedbacks, CO_2, policy earth model, DGVM

AMAZALERT will:

- identify the most important ecosystem services represented by Amazonia
- analyse and improve coupled models of global climate and Amazon land use, vegetation and socio-economic drivers to quantify anthropogenic and climate induced land-use and land cover change and non-linear, irreversible feedbacks among these components
- assess the potential role of regional and global policies and societal responses in the Amazon region for altering the trajectory of land-use change in the face of climate change and other anthropogenic factors
- propose an Early Warning System (EWS) for detecting any imminent irreversible loss of Amazon ecosystem services
- propose policy response strategies to avoid such loss.

Halfway the project, first important results have been achieved:

- the most important ecosystem services of the Amazon: maintaining water cycling and climate, carbon storage, regional production and biodiversity
- multi-model projections for the Amazon basin from the state-of-the-art in climate and earth system modelling were presented. The simulations were carried out

80 http://www.eu-amazalert.org

according to different IPCC scenarios of greenhouse gas concentrations including land use change consistent with development pathway and policy decisions

- first simulations with vegetation and climate models show a challenge to correctly represent biomass, temperature and CO2 sensitivity of forest growth
- field work has addressed temperature and drought sensitivities
- a set of detailed land use change scenarios have been simulated
- the boundary conditions for an early warning system have been defined
- policy research identified both national and international policies and initiatives affecting land use in the Amazon – directly and indirectly.

In 3 years' time, the project should provide a set of greatly improved tools to evaluate, and assist in political decisions on, the future management of the Amazon region, including ways to monitor the functioning of the Amazon to avoid immanent, irreversible changes to its environment. This means:

- sets of scenarios that include both the response of the natural system to climate and land-use change, as well as the likely effects of policies and the possible response of the agriculture and society to Amazon degradation. These scenarios will aid in evaluating possible courses of action.
- a blueprint for an early warning system of irreversible change, based upon a monitoring network, including land surface cover, climate, rivers, and socio-economic indicators.

8.4.2.2. CARBOCHANGE[81]

Title	Changes in carbon uptake and emissions by oceans in a changing climate
Instrument	Collaborative Project (large-scale integrating project) FP7
Total Cost	€ 9 556 960
EU Contribution	€ 6 989 906
Duration	48 months
Start Date	01/03/2011
Consortium	28 partners from 15 countries
Project Coordinator	University of Bergen (Norway)
Key Words	Climate, Environment

CARBOCHANGE provides the best possible process-based quantification of net ocean carbon uptake under changing climate conditions using past and present ocean carbon cycle changes for a better prediction of future ocean carbon uptake. The consortium improves the quantitative understanding of key biogeochemical and physical processes through a combination of observations and models. New process understanding is up-scaled to large-scale integrative feedbacks of the ocean carbon cycle to climate change and rising carbon dioxide concentrations. The vulnerability of the ocean carbon sources and sinks are quantified in a probabilistic sense.

Results will be optimal process descriptions and most realistic error margins for future ocean carbon uptake quantifications with models under the presently available observational evidence. The project will deliver calibrated future evolutions of ocean pH and carbonate saturation as required by the research community on ocean acidification. The time history of atmosphere-ocean carbon fluxes past, present and future are synthesised globally as well as regionally. Observations and model results will merge into GEOSS/GEO through links with the European Research Infrastructure ICOS. The project is a key contributor to annual worldwide carbon budget updates. The results will be communicated to policy makers.

81 http://www.carbochange.eu

8.4.2.3. GHG EUROPE[82]

Title	Greenhouse gas management in European land use systems
Instrument	FP7 Large-scale Integrating Project
Total Cost	€ 8 925 737
EU Contribution	€ 6 648 703
Duration	45 months
Start Date	01/01/2010
Consortium	41 partners from 15 countries
Project Coordinator	Johann Heinrich von Thünen-Institut (Germany)
Key Words	greenhouse gas, land use management, climate change, carbon balance

GHG-Europe aims to improve our understanding and capacity for predicting the European terrestrial carbon and greenhouse gas (GHG) budget by applying a systematic, comprehensive and integrative approach. GHG-Europe quantifies the annual to decadal variability of the carbon and GHG budgets of terrestrial ecosystems via data-model integration, diagnostic and predictive modelling. Ultimately, the scientific challenge is to determine how, and to what degree, the carbon cycle and GHG emissions in terrestrial ecosystems can be managed.

An important finding for forests was that the stimulatory effect of nitrogen deposition in most European forests does not stem from increased photosynthesis, but from increased carbon allocation to wood. This could increase forest vulnerability to extreme events.

Although afforestation is thought to sequester carbon it turned out that afforested grasslands accumulate labile soil organic carbon but the stable fractions are depleted. This makes the soil carbon pool more vulnerable to future disturbance and loss.

Croplands are the largest N_2O source in Europe. Sensitivity analyses with models showed that there is some scope for mitigation by changes in the timing and forms of fertilizer applications.

82 www.ghg-europe.eu

8.4.2.4. COMBINE[83]

Title	Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection
Instrument	Collaborative and large-scale Integrating Project
Total Cost	€ 11 423 157
EU Contribution	€ 7 922 679
Duration	48 months
Start Date	01/05/2009
Consortium	23 partners from 14 countries
Project Coordinator	Max Planck Institute for Meteorology, Max-Planck-Gesellschaft (Germany)
Key Words	Earth system model, processes, initialization, decadal climate prediction, climate projection, impacts, scenarios, climate policies

The overarching objectives of the COMBINE project are:

- to advance the prediction capabilities of ESMs by including critical physical and biogeochemical processes ("new components") into the models
- to represent more accurately the forcing mechanisms and the feedbacks determining the magnitude of climate change in the 21st century
- to assess, improve and implement new strategies of ocean and sea-ice initialization techniques for decadal climate prediction
- to combine ESMs and integrated assessment models to find revised CO2 emission scenarios, including those scenarios constructed on the basis of climate policy
- to assess climate change impacts on water availability and agriculture, globally and more specifically in three selected regions: The Arctic, the Eastern Mediterranean and the Amazon basin, where different feedbacks are important.

The COMBINE partners have advanced significantly on developing the scientific and technical foundations for incorporating new components in ESMs. The first phase of the COMBINE numerical experiments has been completed. The main results achieved so far are:

83 www.combine-project.eu

- implementation and testing of land use changes and wildfire impacts, processes for the terrestrial and oceanic nitrogen cycles, and processes related to methane emissions from permafrost and wetland changes

- evaluations of cloud-radiation and aerosol--cloud effects and land use impacts on tropospheric chemistry

- incorporation of tropical and polar stratospheric dynamical variability in ESMs

- improved understanding of processes regulating ice-sheet surface energy and mass balances; increased realism of the representation of surface snow processes in both ice-sheet and sea-ice models

- a new ocean re-analysis has been conducted using up-to-date quality-controlled ocean observation data sets and atmospheric forcing fluxes, with significant progress in sea-ice assimilation

- decadal prediction and centennial projection following the Coupled Model Inter-comparison Project phase 5 (CMIP5) protocols completed with the relevant COMBINE ESMs. The decadal experiments have been initialized using observation based ocean state estimates. The combined results of the new ESMs and integrated assessment models will provide new information to the policy makers on the necessary reduction in CO2 emissions for reaching defined targets in global warming, with implications for international climate negotiations. The results obtained will contribute not only to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, but also directly to European climate policies. Harmonisation and standardisation of climate simulations and model data will contribute to further strengthen the European climate modelling community and the European voice in international climate negotiations.

8.4.2.5. SPECS[84]

Title	Seasonal-to-decadal climate Prediction for the improvement of European Climate Services
Instrument	Collaborative Project large scale integrating project
Total Cost	€ 11 785 694
EU Contribution	€ 8 224 862
Duration	51 months
Start Date	1/11/2012
Consortium	20 partners, 9 countries
Project Coordinator	• Fundació Institut Català de Ciències del Clima (IC3), Spain
Key Words	Climate prediction, climate services, climate modelling, forecast reliability, forecast quality, initialisation, calibration, downscaling, impact assessment, operational prediction

The project's objectives include:

- evaluation of the forecast quality of current climate forecast systems
- test specific hypotheses for the improvement of s2d predictions
- integrate the best observational data of the climate system as initial conditions
- improve forecast quality by better initialization and by increasing the spatial resolution of the forecast systems
- achieve a best assessment of the uncertainties in climate prediction
- perform reliable and accurate local-to-regional predictions via the combination and calibration of the information from different sources and a range of state-of-the-art regionalisation tools
- illustrate the usefulness of the improvements for climate services and better communicate actionable climate information
- support the European contributions to WMO research initiatives on s2d climate prediction.

SPECS will be the origin of a new generation of European climate forecast systems, with improved forecast quality including better reliability, higher resolution, a simpler access to their data and an exhaustive documentation. This will result in more actionable operational

84 http://www.specs-fp7.eu/SPECS/Home.html

seasonal forecasts and the advancement towards a better understanding of the usefulness of decadal predictions.

The processes responsible for s2d climate predictability will be better understood, including those linked to the changes in both natural and anthropogenic forcings. This knowledge will be used to interpret an ambitious set of coordinated global forecast experiments that aim to assess the role of the appropriate initialization of different components of the climate system (sea ice, continental surfaces, atmospheric composition) and of the necessary model improvement (increased resolution, atmospheric chemistry, vegetation, ocean-atmosphere coupling).

A set of functions in the R language with standardized input-output will be created to perform statistical downscaling in a climate-prediction context. They will be merged with existing and new forecast verification functions to be publicly released as the first tool of its kind. This will provide a long-lasting response to the demand of local climate predictions for specific services.

SPECS will also provide a coordinated European response to and leadership in the different international initiatives in climate prediction, as well as a set of case studies illustrating the socio-economic benefits of climate prediction.

At the end of the SPECS project, climate predictions and climate-change projections will be brought closer together for the benefit of both climate services and the advancement of climate adaptation.

8.4.3. Research on the impacts of climate change

8.4.3.1. CLIMAFRICA[85]

Title	Climate change predictions in Sub-Saharan Africa: impacts and adaptations
Instrument	Collaborative Project
Total Cost	€ 4 662 503
EU Contribution	€ 3 496 232
Duration	48 months
Start Date	01/10/10
Consortium	The ClimAfrica consortium is formed by 18 institutions, 9 from Europe, 8 from Africa, and the Food and Agriculture Organization of the United Nations (FAO). African countries directly involved are: Burkina Faso, Congo, Ghana, Kenya, Malawi, South Africa, Sudan and Togo
Project Coordinator	Euro-Mediterranean Centre on Climate Change (CMCC), Italy
Key Words	Sub-Saharan Africa, Climate Predictions, Climate Impacts, Adaptation, Agriculture and Water Resources, Socio-economic Analysis

ClimAfrica aims at producing the most appropriate and up-to-date tools to better understand and predict climate change in Sub-Saharan Africa (SSA) for the next 10-20 years, analysing the expected impacts on water and agriculture and proposing adaptation strategies tailored to the African context. Specific objectives are:

Develop improved climate predictions for SSA on seasonal to decadal scale

Assess climate impacts in key sectors of SSA livelihood and economy, like water resources and agriculture

Evaluate the vulnerability of ecosystems and civil population to inter-annual variations and decadal trends in climate

Suggest and analyse new adaptation strategies suited to SSA

Develop a new concept of medium term monitoring and forecasting warning system for food security, risk management and civil protection

Analyse the economic impacts of climate change on agriculture and water resources in SSA and the cost-effectiveness of potential adaptation measures.

85 www. climafrica.net

The results include state of the art data streams of remotely sensed land surface properties, harmonized meteorological reanalysis, and synergistic land use products are already available; among them a 30+ year (1979-2010) record of global daily soil moisture database, with 0.25 degree spatial resolution. ClimAfrica is already delivering improved climate predictions, ranging from 50 km to 25 km resolution, from the dynamical downscaling, and to point resolution, from statistical downscaling, for the specific field studies carried out in Burkina Faso, Congo, Ethiopia, Ghana, Kenya, Malawi, Sudan, Tanzania, and Togo. The resolution will be even higher for the impact models on water balance and main crop types, i.e. Sorghum, Maize, Millet, Rice, and Cassava. Other expected results are: new adaptation strategies suited to local needs; the assessment of economic implications of climate change impacts and adaptation options; a prototype of a medium term monitoring and forecasting warning system for food security, risk management and civil protection.

8.4.3.2. CLICO[86]

Title	Climate Change. Hydro-conflicts and Human Security
Instrument	Collaborative Project – Theme 8, Socio – Economic Sciences and Humanities (SSH)
Total Cost	€ 3.766.269
EU Contribution	€ 2.991.352
Duration	36 months
Start Date	01/01/2010
Consortium	14 partners from 11 countries
Project Coordinator	Unversitat Autonoma de Barcelona (Spain)
Key Words	Water, droughts, floods, climate change, conflict, security, vulnerability, adaptation, transboundary management, institutions, Middle East, Sahel, socio-economic sciences and humanities

CLICO explored the social dimensions of climate change and in particular the conditions under which hydro-climatic hazards, such as drought or floods, may infringe upon the security of human populations. The project focused on the geographical areas of the Mediterranean, Middle East and the Sahel, and on water-related stresses such as droughts, floods and sea-level rise, expected to intensify with climate change. More concretely, the project pursued the following objectives:

86 www.clico-fp7.eu

To understand relationships between hydro-climatic hazards, climate change vulnerability, human security and conflict, through theoretically-informed, comparative, empirical, quantitative and qualitative social science research.

To map international and national policies for security and adaptation in water resources and hazard management, and develop policy priorities as regards hydro-climatic hazards ("hydro-security") in the region, applicable to the UN, EU and national states.

Key findings:

- climate change is one among many factors affecting human security
- climate change is less influential than political, economic and social factors in causing or exacerbating water-related conflicts (for majority of CLICO studies)
- states are important actors in adaptation, but not the only ones; civil society and self-adaptation are also relevant
- climate change adaptation can increase human insecurity and conflict, e.g. via divergent or mal-adaptations

Recommendations for policy-makers:

- address root causes of vulnerability, such as poverty, lack of knowledge and institutions plagued by corruption
- strengthen social security systems is an effective way for improving human security
- affected groups should be empowered to influence adaptation decisions
- integrating policies, e.g. link adaptation to policy agendas such as human development and poverty reduction
- implementing some existing policies could improve human security
- avoiding simplistic explanations on the impact of climate change on conflict.

8.4.3.3. CLIMB[87]

Title	Climate Induced Changes on the Hydrology of Mediterranean Basins: Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modelling System
Instrument	CP-SICA
Total Cost	€ 4 157 348
EU Contribution	€ 3 148 945
Duration	48 months
Start Date	1st January 2010
Consortium	21 beneficiaries from 9 countries
Project Coordinator	Ludwig-Maximilians-Universitaet Muenchen, Department of Geography (DE)
Key Words	Mediterranean, climate change impacts, uncertainty, environmental monitoring, hydrological modelling, socio-economic factor assessment, risk assessment

CLIMB improves modelling capabilities and develops appropriate tools to advance the capacity to assess climate effects on water resources and uses. The project consortium employs a combination of novel field monitoring concepts, remote sensing techniques, integrated hydrologic (and biophysical) modelling and socioeconomic factor analyses to reduce existing uncertainties in cli-mate change impact analysis and to create an integrated quantitative risk and vulnerability assessment tool.

This tool will serve as a platform for the dissemination of scientific project results and the communication with and planning for local and regional stakeholders.

The analysis of climate change impacts on available water resources is targeted to selected mesoscale river or aquifer catchments, representing water management units for regional water authorities. Study sites are located in Sardinia, Northern Italy, Southern France, Turkey, Tunisia, Egypt and the Palestinian-administered area Gaza.

In its effort to grant easy-access to data and results from the project, CLIMB will develop a WebGIS-Server and Client architecture open to the public. It will disseminate the impacts of cli-mate change on selected hydrological indicators, including a rigorous assessment of related uncertainties, as determined from the multi-model ensembles employed in the seven case studies. Further, it will comprise a risk modelling tool, assessing the risk of income loss and out-migration due to water shortages in agriculture, forestry and the tourism sector, based on the identification of key socio-economic indicators. Site-specific adaptive measures will be proposed and recommendations for future water resources management will be given,

87 www.climb-fp7.eu

taking into account a thorough diagnosis of climate change impacts on water uses and rivalries. Further, it is expected that CLIMB results can be regionalized in general for water-stressed areas, in which climate and socioeconomic conditions render water-related problems compelling and urgent. This can happen in various ways to:

- foster and intensify the dialogue between scientists, managers, water experts and stakeholders in addressing local impacts of climate changes and identifying means for their assessments
- raise awareness among stakeholders about climate change impacts on water resources and land uses, which will lead to adequate approaches and adaptation strategies for water resources management and for food security
- empower stakeholders and scientists by providing new tools of decisions making in assessing climate change impacts.

These science-management-policy links are indispensable to provide visibility of the research findings beyond the borders of the scientific community and will allow for an uptake of research results into policy and management practice. An important output of the research in the individual study sites will be the development of a set of recommendations for an improved monitoring and modelling strategy for climate change impact assessment, addressing in particular the minimum requirements towards data collection and model complexity to achieve sufficient predictive power for climate change impact assessment in the targeted regions and beyond.

8.4.3.4. WASSERMED[88]

Title	Water Availability and Security in Southern EuRope and the Mediterranean
Instrument	FP7 Collaborative Project
Total Cost	€ 3 669 943
EU Contribution	€ 2 933 973
Duration	39 months
Start Date	1 January 2010
Consortium	12 partners from 9 countries
Project Coordinator	Prof. Roberto Roson (CMCC, IT)
Key Words	Water scarcity, water security, climate change, Mediterranean region

WASSERMed is an interdisciplinary project, which overall aims at all three targets of the call through the integration of climate change scenarios, holistic water system modelling and interdisciplinary impact assessment.

The WASSERMed Project analyses, in a multi-disciplinary way, ongoing and future climate induced changes in hydrological budgets and extremes in southern Europe, North Africa and the Middle East under the frame of threats to national and human security. This includes the assessment of changes in mean flows, frequency and magnitude of extreme precipitation (intensity and duration), surface run-off, stream flows ground water balance, as well as social and economic factors.

Five case studies have been considered:

- Syros Island (Cyclades Complex, Greece), a region which is characterised by multiple water uses and experiences significant tourism development in recent years,
- Sardinia Island (Italy), with huge water demand and conflicting water uses between agricultural and tourism sectors,
- Merguellil watershed (Tunisia), a river basin which concentrates multiple and conflicting water uses,
- Jordan river basin, where the Case Study will focus mainly on trans-boundary water management and conflicting water demands, and

88 www.wassermed.eu

- the Nile River system, focusing mainly on Egypt and issues related to inter-regional water supply-demand balances and allocation.

The impact of climate change on the Mediterranean agricultural sector will likely be affected by water availability and could be prevalently:

- positive for the Northern Mediterranean countries and areas characterized by relatively cold and humid climate, and
- negative for the Southern Mediterranean countries and the areas already characterized by arid and semi-arid conditions.

The extension of the areas suitable for cultivation toward the Northern latitudes and higher altitudes and the overall expansion of the cultivation season could bring benefits especially to the Northern Mediterranean countries.

Results of the macroeconomic analysis of the consequences of climate change on agricultural productivity and tourism attractiveness indicate that several Mediterranean countries will likely face water shortages with significant implications in terms of agricultural productivity, income and welfare. The analysis of climate change impacts on tourism indicates that conditions will remain favourable for outdoor activities in the Mediterranean basin; however a change in seasonality is foreseen. Particularly, negative impacts for summer tourism are foreseen in Southern Mediterranean countries, whereas the situation is different for northern countries.

Different policy and adaptation options have emerged in the five case studies. However, similarities and recurrent issues have also been noticed: solutions for increased water productivity, recycling, desalination, water harvesting.

8.4.3.5. IMPACT2C[89]

Title	Quantifying projected impacts under 2°C warming
Instrument	Collaborative project (large-scale integrating project), FP7
Total Cost	€ 8 447 372
EU Contribution	€ 6 499 999
Duration	48 months
Start Date	1/10/2011
Consortium	29 partners from 17 countries
Project Coordinator	Coordinator: Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung
Key Words	Climate change, 2°C warming, impacts, vulnerability, risks, adaptation, decision making, sector, floods, droughts, water availability, water management, agriculture, forestry, health, air pollution

The project aims at:

- providing detailed information based on an ensemble of climate change scenarios, plus statistics and derived indices, tailored to the needs of various sectors, for the time slice in which the global temperature is simulated to be 2oC above pre industrial levels
- giving a detailed assessment of risks, vulnerabilities, impacts and associated costs for a broad range of sectors against the background of socio-economic scenarios consistent with the development paths aimed at global warming being limited to 2oC
- developing an optimal mix of response strategies (technological, governance, capacity building) accounting for the regional differences in adaptive capacities, which are distinguished between those that can be accommodated autonomously and those that require additional policy interventions.

Expected results comprise:

- estimating the key impacts of a 2 ºC (1.5 ºC) climate change signal for different regions and sectors, both in Europe and outside, and suggesting appropriate response strategies;
- tailoring the scenarios to the needs of the sectoral impact modellers by providing bias corrections, downscaled products and derived statistics and associated uncertainties;

89 http://www.impact2c.eu

- developing integrated (climate – impact – cost) assessments of uncertainty in support of the (cross) sectoral climate change impact and adaptation projections, developing policy guidelines to deal with these uncertainties.

IMPACT2C draws this information together in a synthesis report that highlights the risks, trade-offs, synergies and costs. This will be particularly useful for European authorities who participate in international negotiations on climate change.

The project also includes an ambitious awareness-raising programme that will disseminate the findings effectively and provide easily accessible climate-related information to policy-makers, the media, and users in general.

8.4.4. Socio-economic analysis, including analysis of both the impacts of climate change and response options

8.4.4.1. CLIMATE-ADAPT[90]

The European Climate Adaptation Platform (CLIMATE-ADAPT) is a partnership between the European Commission (DG Climate Action, Joint Research Centre and other DGs) and the European Environment Agency.

CLIMATE-ADAPT aims to support Europe in adapting to climate change. It is an initiative of the European Commission and helps users to access and share data and information on:

- expected climate change in Europe
- current and future vulnerability of regions and sectors
- EU, national and transnational adaptation strategies and actions
- adaptation case studies and potential adaptation options
- tools that support adaptation planning.

CLIMATE-ADAPT organises information under the following main entry points:

- adaptation information (observations and scenarios, vulnerabilities and risks, adaptation measures, national adaptation strategies, research projects)
- EU sector policies (agriculture and forestry, biodiversity, coastal areas, disaster risk reduction, financial, health, infrastructure, marine and fisheries, water management)
- transnational regions, countries and urban areas
- tools (adaptation support tool, case study search tool, map viewer).

The platform includes a database that contains quality-checked information that can be easily searched.

90 http://climate-adapt.eea.europa.eu/about

8.4.4.2. ADAM[91]

Title	Adaptation and Mitigation Strategies: Supporting European climate policy
Instrument	FP6
Total Cost	€ 18 216 125
EU Contribution	€ 12 905 000
Duration	41 months
Start Date	01/03/2006
Consortium	27 partners from 15 countries
Project Coordinator	University of East Anglia, UK
Key Words	Mitigation and adaptation scenarios, climate governance, regional policy appraisal, energy technologies

The project objectives can be summarized as:

- to assess the extent to which existing and evolving EU (and world) mitigation and adaptation policies can achieve a tolerable transition to a world with a global climate no warmer than 2°C above pre-industrial levels, and to identify their associated costs and effectiveness, including assessment of the damages avoided compared to a scenario where climate change continues unchecked to 5°C
- to develop and appraise a portfolio of longer term strategic policy options addressing identified shortfalls between existing mitigation policies and the achievement of the EU's 2°C target, also between existing adaptation policy development and implied EU goals for adaptation.
- to develop a novel Policy-options Appraisal Framework, apply to existing and evolving policies, and new, long-term strategic policy options, so as to inform: European and international climate protection strategy in post-2012 Kyoto negotiations, a re-structuring of International Development Assistance, the EU electricity sector and regional spatial planning.

The emerging results include:

- effective climate policy involves portfolios of adaptation and mitigation activities;

91 www.adamproject.eu

- three conditions for 'achieving' 2^0C: technology innovation, global participation, 'Europeanisation';
- adaptation is about establishing process more than about delivering outcomes;
- substantial fragmentation of the global regime will reduce efficiency, effectiveness and equity;
- climate policy appraisal processes in Europe are weak and unreflexive.

The target audience for ADAM was policy-makers; the following project outputs were made available:

- policy briefings and dialogues
- a Cambridge University Press book series
- special journal issues
- journal papers.

8.4.4.3. REDD-ALERT[92]

Title	Reducing Emissions from Deforestation and Degradation through Alternative Landuses in Rainforests of the Tropics (REDD-ALERT)
Instrument	Collaborative Project (CP), FP7
Total Cost	€ 4 520 466
EU Contribution	€ 3 488 760
Duration	42 months
Start Date	1 May 2009
Consortium	12 partners from 11 countries
Project Coordinator	Dr Robin Matthews
Key Words	Climate change, REDD+, land use change, deforestation, carbon

92 www.redd-alert.eu

The project's objectives are:

- documenting the diversity in social, cultural, economic and ecological drivers of forest transition and conservation in selected case study areas in Indonesia, Vietnam, Cameroon, and Peru
- quantifying rates of forest conversion and change in forest carbon stocks using improved methods
- improving accounting of the consequences of land use change for GHG emissions in tropical forest margins including peatlands
- identifying and assessing viable policy options addressing the drivers of deforestation and their consistency with other policy approaches
- analysing scenarios of the local impacts of potential international REDD+ policies on GHG emission reductions, land use and livelihoods
- developing new negotiation support tools for stakeholders at international, national and local scales to explore options for incorporating REDD+ into post-2012 climate agreements.

Results showed that some developing tropical countries have recently been through a forest transition, thus shifting from declining to expanding forests at a national scale. However, in many of these (e.g. Vietnam), a significant part of the recent increase in national forest cover is associated with an increase in importation of food and timber products from aboard, representing leakage of carbon stocks across international borders. Avoiding deforestation and restoring forests will require a mixture of state-level command-and-control (regulatory) approaches, emerging market-based instruments (e.g. eco-certification of products, corporate environmental responsibility, stewardship agreements, and other demand-driven interventions), options, and management measures. Most of the available policy instruments tend to focus on local and proximate drivers with very few instruments that address global underlying (e.g. world demand) and national underlying drivers (e.g. population growth, the perceived need for economic growth).

Significant progress was made in the quantification of carbon and GHG fluxes following land use change in the tropics, contributing to narrower confidence intervals on peat-based emissions and their reporting standards. Specifically, it was found that net CO_2 emissions and removals contributed more than 90% to the soil net balance of all GHGs across all land-use categories on peat soils, that the overall decrease in CH_4 emissions from conversion of peat swamp forests does not offset the simultaneous increase in soil CO_2 emissions due to accelerated peat decomposition, and that forest conversion to agriculture and agroforestry significantly and highly increased soil N_2O emissions. For mineral soils, it was found that there was a strong geographic bias in the published literature, with most studies being skewed toward regions with higher precipitation and allophanic clay mineralogy, while areas with low precipitation and high activity clays were clearly underrepresented. It was also found that measurement of soil carbon stocks down to one metre was sufficient to capture changes following land use change.

Policy analysis and modelling work showed the high degree of complexity at local levels and highlighted the need to take this heterogeneity into account – it is unlikely that there will be a 'one size fits all' approach to make REDD+ work. It is important to see REDD+ as part of larger systems which also include arable agriculture, grasslands, wetlands, and human

settlements, as these can often be a driver of deforestation (e.g. agriculture) or may represent leakage (alternative income opportunities. Dealing with any one land use component (such as forests) in isolation is likely to result in partial solutions at best as the Law of Unintended Consequences starts to operate.

There are indications that there is only a short and relatively small window of opportunity of making REDD+ work – these included the fact that forest-related emissions as a fraction of total global greenhouse gas emissions have been decreasing over time due to the increase in fossil fuel emissions, and that the cost efficiency of REDD+ may be much less than originally thought due to the need to factor in safeguard costs, transaction costs and monitoring costs.

8.4.4.4. RESPONSES[93]

Title	European responses to climate change: deep emissions reductions and mainstreaming of mitigation and adaptation (RESPONSES)
Instrument	Small or medium-scale focused research project
Total Cost	€ 4 117 787
EU Contribution	€ 3 149 659
Duration	40 months
Start Date	1 January 2010
Consortium	10 partners from 9 countries (7 EU Member States)
Project Coordinator	Institute for Environmental Studies, VU University, Amsterdam, The Netherlands
Key Words	Climate change, adaptation, EU sectoral policy, mainstreaming, low emissions scenarios

The RESPONSES project addressed policy challenges. Its overall objective was to assess integrated EU climate-change policy responses to achieve ambitious mitigation and environmental targets while at the same time reducing the Union's vulnerability to inevitable climate-change impacts. The empirical focus of the project was on five EU policy sectors: water and agriculture, biodiversity, regional and cohesion policy, health, and energy. Specifically, the project:

- developed a new set of low emission scenarios;
- developed and assessed strategies for integrating mitigation and adaptation to climate impacts into existing EU policies; and
- identified synergies, trade-offs and conflicts between mitigation and adaptation, and identify opportunities for future EU strategies and policy measures.

93 www.responsesproject.eu

Key results include:

- synergies can be achieved between greenhouse gas emissions reductions (mitigation) and increasing climate resilience (adaptation) in some areas of EU policy, such as land use management in agriculture. But for much EU policy mitigation and adaptation are likely to remain separate
- the electricity sector is critical to achieving deep emissions reductions in the EU. Under a new RESPONSES low emissions scenario for the EU, we find that a reduction of 34-43% in total EU emissions by 2050 could be achieved in the power generation sector alone, with wind generation playing a major role
- a key governance dilemma for climate adaptation mainstreaming exists between the need for central direction and the benefits of local discretion. The European Commission can play an important role in providing guidance, information and supporting capabilities on the ground. Especially for long-term investments, there will be growing benefits in opting for robust solutions that are resilient under different scenarios
- mainstreaming adaptation often involves linkages between different sectoral policies (for instance, between water and agriculture, or between cohesion and health policies). The RESPONSES project developed a way of mapping these interactions and linking them to climate vulnerabilities and adaptation strategies. There are many opportunities for cross-sectoral support for adaptation
- EU nature and biodiversity policy is implemented by providing protected areas for valuable and endangered species and ecosystem types. With changing climates, the suitability of localities for species and ecosystems will shift over time. The current policy of protecting particular species and habitats at particular places is untenable given climate change. Key adaptive responses, such as habitat restoration and ensuring coherence of reserve networks, are left to the discretion of EU Member States
- the distribution of climate vulnerabilities across the EU varies greatly by impact category (RESPONSES looked at fire, heat stress and river flooding). A new analysis, combining climate impacts with adaptive capacity, shows that climate risks, which currently exist mainly in southern Europe, will grow significantly in many parts of continental Europe by the 2040s. In contrast, for Ireland, Scandinavia, much of Poland, the Baltic countries, and most UK regions, overall impacts will remain relatively lower
- many new and emerging vector-borne diseases could potentially become endemic in Europe over the coming decades under climate change. However, based on modelling dengue fever risk in Europe, the scale of disease burden appears to be modest, even when looking at projections to the end of the century. Effective public health interventions exist for some diseases, as well as for reducing heat stress risk among vulnerable groups.
- appraising the eventual effect of policy interventions made today on mitigation and adaptation goals is fraught with problems. For adaptation, it often makes sense to focus efforts on correcting existing mal-adaptations, rather than trying to prepare for highly uncertain conditions in the far-future.

8.4.4.5. CLIMSAVE[94]

Title	Climate change integrated assessment methodology for cross-sectoral adaptation and vulnerability in Europe
Instrument	FP7 Collaborative Project FP7 Collaborative Project
Total Cost	€ 4 157 842
EU Contribution	€ 3 149 644
Duration	46 months
Start Date	01/01/2010
Consortium	18 partners from 13 countries
Project Coordinator	Chancellor, Master and Scholars of the University of Oxford (United Kingdom)
Key Words	Climate change, impacts, adaptation, vulnerability, cross-sectoral

The overall aim of the CLIMSAVE project is to deliver an integrated methodology to assess cross-sectoral climate change impacts, adaptation and vulnerability. It will put science in the service of stakeholders and policy-makers by providing a common platform for an improved integrated assessment of climate change impacts, vulnerability and related cost-effective adaptation measures covering key sectors in Europe. There are six specific objectives:

- to analyse the policy and governance context for adaptation
- to develop an Integrated Assessment Platform which includes linkages and feedbacks between key landscape sectors
- to apply the Integrated Assessment Platform to assess climate change impacts on, and adaptation options for, ecosystem services
- to integrate stakeholder input into climate change impacts and adaptation research through the development of participatory scenarios
- to identify vulnerability hotspots through metrics of impacts and adaptive capacity and
- to analyse the cost-effectiveness of adaptation strategies and investigate sources of uncertainty to inform appropriate policy options.

CLIMSAVE's integrated assessment approach will enable stakeholders to explore and understand the interactions between different sectors, rather than viewing their own area in isolation. This contributes to the development of a well adapted Europe by building the

94 www.climsave.eu

capacity of decision-makers to understand cross-sectoral vulnerability to climate change and how it might be reduced by various adaptation options.

A number of CLIMSAVE outputs are already available from the project website (www.climsave.eu). These include reports on the stakeholder workshops, scenario development, adaptive capacity, vulnerability, adaptation policy and governance, and the specification of the Integrated Assessment Platform and the sectoral meta-models within it. The final output from CLIMSAVE will be the Integrated Assessment Platform which will allow stakeholders or interested citizens to analyse climate change impacts, vulnerability and adaptation options themselves. The Platform will be available from October 2013 from the CLIMSAVE website (www.climsave.eu) and the Climate-Adapt website (www.climate-adapt.eea.europa.eu).

8.4.4.6. CLIMATECOST[95]

Title	ClimateCost: The Full Costs of Climate Change
Instrument	FP7, Collaborative Project
Total Cost	€ 4 600 000
EU Contribution	€ 3 500 000
Duration	32 months
Start Date	December 2008
Consortium	22 partners from 14 countries
Project Coordinator	Stockholm Environment Institute Oxford, UK
Key Words	Climate change economics, cost of inaction, mitigation costs, social cost of carbon

The objectives were to advance knowledge across the areas outlined above, by:

- identifying and developing consistent climate and socio-economic scenarios, including for mitigation
- quantifying the effects of climate change in Europe, in physical terms and economic costs (for coastal zones, health, energy, agriculture and infrastructure), and identifying the costs and benefits of adaptation
- assessing the impacts and economic costs of major catastrophic and socially contingent events

95 www.climatecost.cc

- updating the costs of mitigation, including (induced) technological change, non-CO2 GHG and sinks, and recent abatement technologies
- quantifying and monetising the ancillary air-quality co-benefits of mitigation in Europe, China and India
- developing a number of existing global level economic Integrated Assessment Models (IAMs)
- providing policy relevant output, including analysis of policy scenarios

The project advanced multi-disciplinary research, developing integrated bottom-up and top-down analysis, and directly engaging policy makers to provide policy relevant outputs.

In what regards main results, the project provided a more complete, updated assessment of cost of mitigation, impacts and economic costs of climate change, and the costs and benefits of adaptation. The potential impact of the project has been primarily through the outputs and results (including a set of policy briefs), which are highly relevant for European Commission climate policy, as well as for Member States. Indeed, the results have already been included in policy discussion and deliberations.

The project has provided results on the future potential economic costs of climate change that are of high relevance to Commission Services and have been cited in the 2013 EU Strategy on adaptation to climate change (COM(2013) 216 final). This information, and analysis of the costs and benefits of adaptation, has been included in the European Climate Adaptation Platform (CLIMATE-ADAPT).

In addition, in relation to long-term targets and justification for mitigation, the study has provided final results and available models that are of high relevance for the Commission and others, in relation to the short- and long-term GHG emission reduction targets and stabilisation. This includes information on the cost of inaction for Europe under future scenarios – and the economic co-benefits of mitigation for Europe – which were both included in the European Commission's impact assessment for the Roadmap for moving to a competitive low carbon economy in 2050.

An updated suite of models that are used in European Commission mitigation cost and economic analyses (POLES, GEM-E3) has been produced, with new runs with these models. An updated suite of CGM and IAM models has been produced, for potential use in policy analysis, including the new PAGE09 model.

The results of the project also provide valuable research inputs, as measured through the publication of many academic papers. The project has produced a set of policy briefing notes that summarise sector results.

8.4.4.7. MEDIATION[96]

Title	Methodology for Effective Decision-making on Impacts and AdaptaTION
Instrument	Collaborative Project, FP7
Total Cost	€ 4 050 579
EU Contribution	€ 3 142 744
Duration	42 months
Start Date	1 January 2010
Consortium	11 partners from 8 countries
Project Coordinator	Alterra (The Netherlands)
Key Words	Climate change, adaptation strategies, methods and tools, decision-support

MEDIATION aims to provide a coherent framework for systematically identifying available methods and tools that can be meaningfully applied to address specific adaptation and vulnerability questions and support adaptation action. This is required to address the currently fragmented knowledge base supporting climate change adaptation decision-making in Europe, in particular in the area of methods and tools. To achieve this, firstly the knowledge requirements associated with the ongoing impact assessment and adaptation policy developments in Europe had to be mapped for various decision domains, in consultation with the appropriate decision- makers and stakeholders. Secondly, existing methods, tools and metrics had to be reviewed, linked and - where needed and feasible - improved or developed. A final objective was to make the framework and associated toolbox available, and disseminate the project results.

Rather than suggesting a one-size-fits-all solution, MEDIATION acknowledges that adaptation questions are diverse as they are determined by their regional and sectoral context. A diagnostic framework for problem-oriented adaptation research was developed that organizes adaptation questions into a logical structure, linking them to suitable methods and tools. The framework was used for UNEP PROVIA's Guidance for the Assessment of Impacts, Vulnerability and Adaptation and is made available via an interactive platform, which includes:

- the Adaptation Pathfinder that enables users to find the most appropriate methods and tools for their adaptation questions
- the MEDIATION Toolbox that provides detailed information about some 40 methods and tools with conditions for their applicability; and

96 http://mediation-project.eu

- the Case study search tool. The platform is intended to be used by experts with basic technical or scientific knowledge and skills, who engage in policy advice, policy analysis, or other research aiming at supporting climate change adaptation decision making.

8.4.5. Research and development on mitigation and adaptation technologies

As referred in the Section 7.6 addressing EU funded technology transfer initiatives and programmes, a number of other climate change activities involving technology transfer funded by the EU, most notably in the area of research are referred in the Biennial Report. Examples include FP7, the Strategic Energy Technology Plan (SET), the Near-zero Emissions Power Generation technology through Carbon Dioxide Capture and Storage, European Energy Technology Platforms and NER, among others. Below, some examples of projects are referred. Here only those that are not considered as Technology Transfer are referred.

8.4.5.1. PLANETS[97]

Title	Probabilistic Long-Term Assessment Of New Energy Technology Scenarios – PLANETS
Instrument	FP7, Integrated Project
Total Cost	€ 1 927 049
EU Contribution	€ 1 541 673
Duration	30 Months
Start Date	January 2008
Consortium	8 partners from 8 European countries
Project Coordinator	Mariaester CASSINELLI/FONDAZIONE ENI ENRICO MATTEI/ITALY
Key Words	Energy, Energy Technologies, Economy, Climate, Models, Modelling

The objective of the PLANETS project was to devise robust scenarios for the evolution of energy technologies in the next 50 years. It was foreseen to assess the impact of technology development and deployment at world and European levels, by means of an ensemble of analytical tools designed to foresee the best technological hedging policy in response to future environmental and energy policies.

A shift towards climate stabilisation can occur along different pathways. The PLANETS project analysed ten possible climate control scenarios with six different integrated

97 http://www.feem-project.net/planets/

assessment models. These scenarios combined long-term climate stabilisation targets of 500 and 530 ppm equivalent (ppm-e) – consistent with long-term equilibrium temperature increases of 2.3ºC and 2.5°C respectively, under a central value for the climate sensitivity – with different strategies regarding how to achieve these targets. Immediate and fully cooperative action starting from 2012 was compared with "second-best" scenarios characterised by different regional emission quotas.

Results indicate that emission reduction targets for 2050 are relevant for the economics of long-term climate stabilisation. Models find that several scenarios with a 500 ppm-e climate target are unreachable, in particular those in which some regions aim at initially mild reductions followed by more drastic reductions after 2050. Postponing abatement makes it impossible, or at least considerably more costly, to achieve climate stabilisation.

8.4.5.2. NER 300[98]

NER300 is one of the world's largest funding programmes for innovative low-carbon energy demonstration projects. The programme is conceived as a catalyst for the demonstration of environmentally safe carbon capture and storage (CCS) and innovative renewable energy (RES) technologies on a commercial scale within the European Union. The European Commission is responsible for the overall management and implementation of NER300. In this, the Commission draws on the unique expertise of the European Investment Bank (EIB) to evaluate proposals submitted by Member States, to sell NER allowances on its behalf, and to manage the revenues and the disbursement of funds to Member States during project implementation.

The aim of NER300 is to establish a demonstration programme comprising the best possible CCS and RES projects and involving all Member States. The programme intends to support a wide range of CCS technologies (pre-combustion, post-combustion, oxyfuel, and industrial applications) and RES technologies (bioenergy, concentrated solar power, photovoltaics, geothermal, wind, ocean, hydropower, and smart grids).

NER300 also seeks to leverage a considerable amount of private investment and/or national co-funding across the EU, boost the deployment of innovative low-carbon technologies and stimulate the creation of jobs in those technologies within the EU.

NER300 is so called because it is funded from the sale of 300 million emission allowances from the new entrants' reserve (NER) set up for the third phase of the EU emissions trading system (EU ETS). The funds from the sales are to be distributed to projects selected through two rounds of calls for proposals, covering 200 and 100 million allowances respectively.

Under the first call for proposals the European Commission in December 2012 made funding awards for a total value of €1.2 billion to 23 renewable energy projects. This amount is estimated to have leveraged additional funding of over €2 billion from private sources. The projects awarded funding are now moving towards implementation. They must reach their final investment decisions by December 2014, and enter into operation by December 2016.

The second call for proposals was launched on 3 April 2013. Thirty-three projects were submitted by the 3 July deadline. Awards will be funded from the sale of the remaining 100 million allowances and unused funds from the first call.

98 http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

8.5. Systematic observation

The EU contributes to Systematic Observation through various channels and various programmes and projects as, for example, GCOS, (see 8.3), GEOSS (see 8.5.1), Copernicus (see 8.5.2), IES' activities (see 8.5.3).

The following topics include the description of the most emblematic projects and programmes on systematic observation covering:

- atmospheric climate observing systems, including those measuring atmospheric constituents
- ocean climate observing systems
- terrestrial climate observing systems
- cryosphere
- paleoclimate
- support for developing countries to establish and maintain observing systems, related data and monitoring systems.

8.5.1. GEOSS[99]

Europe is a global leading player in the advancement of earth observation technologies and related environmental applications. European remote-sensing satellites cover all of the Earth's climatic zones, while European ground-, air- and ocean-based monitoring devices serve users by providing high-quality observation data for subjects as diverse as urban planning, adaptation to climate change, disaster reduction, disease control and humanitarian relief. Earth observation projects are increasingly being integrated into the GEOSS which brings together 89 partner countries from around the world, as well as the European Commission and 67 participating organisations.

Before 2015, GEO Climate Social Benefit Area (SBA) aims to:

- Achieve effective and sustained operation of the global climate observing system and reliable delivery of climate information of a quality needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle

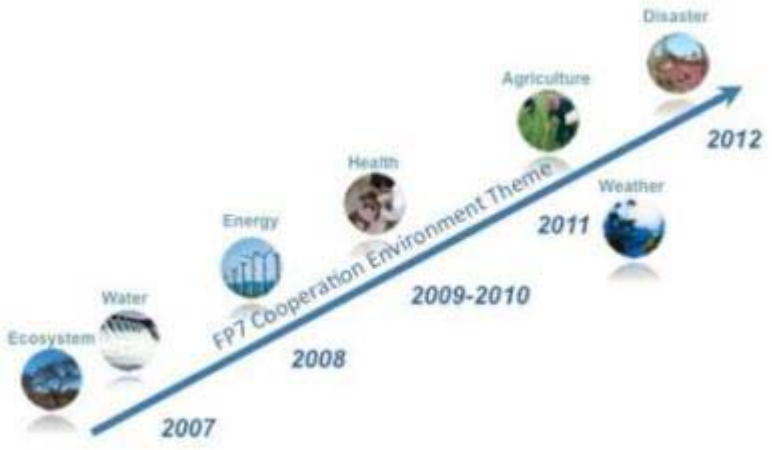
This will be demonstrated by:

- Improved scientific understanding, modelling & prediction of climate.
- Accessibility of all the observational data needed for climate monitoring and services in support of adaptation to climate variability and change.
- Development and facilitation of a comprehensive (atmosphere, ocean, land) global carbon observation and analysis system in support of monitoring based decision-making and related environmental treaty obligations

99 http://ec.europa.eu/research/environment/index_en.cfm?pg=earth

- Availability of all Essential Climate Variables defined by GCOS and needed by the WCRP, the IPCC and the UNFCCC.

*Figure **Error! No text of specified style in document.**-16 Annual call addressing GEO[100] Societal benefit Areas specifically*



In FP7, four blocks toward the establishment of GEOSS are emphasised:

- integration of European activities within the Group on Earth Observations (GEO), supporting European activities at global level
- cross-cutting research activities relevant to GEO understanding, modelling and predicting environmental phenomena
- emerging earth observation activities, supporting the development of European earth observation systems and activities in areas of environmental research needed for GEOSS
- developing capacity-building activities in the domain of earth observation, providing support to international research initiatives in which Europe would contribute to the development of observing systems.

Long term funding/resourcing in order to achieve sustained operation of the necessary Earth Observing (EO) infra-structure (space-based and in-situ) and improved access to and exchange of data and information is of paramount importance for all SBAs under consideration. Based on the work that has been conducted within the EUGENE[101] project, the European GEO approach should strive to achieve the following goals:

- implement Copernicus data and services and secure its further development and other European GEO systems, such as the European Meteorological Infrastructure (EMI), in close cooperation with GEOSS, where appropriate
- intensify contributions to GEO standardisation activities to promote INSPIRE and other European standards and specifications

100 http://earthobservations.org/about_geo.shtml

101 http://www.eugene-fp7.eu/docs/EUGENE_Report_web.pdf

- further invest in European scientific expertise and innovative capabilities and offer expertise within international collaboration frameworks, such as GEOSS
- offer cooperation to the developing world, with a focus in Africa
- participate more actively in GEOSS to better address European requirements
- take advantage of GEOSS and its political profile, especially as to the
    - sustainability and interoperability of systems
    - promotion and implementation of the Data Sharing Principles
    - strengthened in-situ systems
    - documented data quality and
    - user-driven recognition of information requirements for the benefit of decision-making
- improve coordination of European GEO actors on all levels[102].

8.5.2. Copernicus[103]

Copernicus is a European system for monitoring the Earth. Copernicus consists of a complex set of systems which collect data from multiple sources: earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors. It processes these data and provides users with reliable and up-to-date information through a set of services related to environmental and security issues.

The services address six thematic areas: land, marine, atmosphere, climate change, emergency management and security. They support a wide range of applications, including environment protection, management of urban areas, regional and local planning, agriculture, forestry, fisheries, health, transport, climate change, sustainable development, civil protection and tourism.

The main users of Copernicus services are policymakers and public authorities who need the information to develop environmental legislation and policies or to take critical decisions in the event of an emergency, such as a natural disaster or a humanitarian crisis.

Based on the Copernicus services, many other value-added services can be tailored to more specific public or commercial needs. This will create new business opportunities. In fact, several economic studies conducted to date have demonstrated a huge potential for job creation, innovation and growth.

The Copernicus programme is coordinated and managed by the European Commission. The development of the observation infrastructure is performed under the aegis of the ESA for the space component and of the EEA and the MS for the in situ component.

The services have reached different degrees of maturity. Some are already operational (land monitoring and emergency management) while others are still in a pre-operational mode (atmosphere monitoring and marine monitoring) or in a development phase (climate change monitoring and services for security applications).

102 http://www.eugene-fp7.eu/docs/EUGENE_Report_web.pdf

103 http://copernicus.eu/pages-principales/overview/copernicus-in-brief/

The Copernicus Climate Change service will capitalise on three main components: sustained network of in situ and satellite-based observations, re-analysis of the Earth climate with a variety of models driven by observations, modelling scenarios based on a variety of climate projections. These three components will allow a panoply of climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, ocean acidification, warming up of the ocean, among others) and climate indices (e.g. based on records of temperature, precipitation, drought events) for both the identified climate drivers and the expected climate impacts to be derived. The pre-operational phase of the Copernicus CC service started in earnest with the 2013 FP7 Space call that identified five major domains of activities directly related to climate modelling and observation analyses. The proposed strategy is to build upon the proposals resulting from this and other efforts (e.g., ESA Climate Change Initiative, EUMETSAT Climate Satellite Application Facility (SAF), EEA, WMO through the Global Framework for Climate Services (GFCS) initiative, among others). The enormous level of available information will then have to be harmonised, coordinated, and tailored to the users' needs and quality checked. All are provided free of charge to users. The provision of Copernicus services is based on the processing of environmental data collected from two main sources:

- A space component[104], which consists of several Earth observation satellites;
- An in situ component[105], which consist of a multitude of sensors on the ground, at sea or in the air.

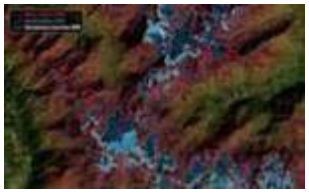
Examples of on-going projects[106] related to Climate Change include:

CORE-CLIMAX[107]

COordinating Earth observation data validation for RE-analysis for CLIMAte ServiceS

(FP7 / 2013 – 2015)

CORE-CLIMAX aims to coordinate the identification of essential climate change variables and the creation of long term climate data records. The project will help to substantiate how Copernicus observations and products can contribute to climate change analyses.



CryoLand[108]

(2011 - 2015 / EU FP7)

Copernicus Service Snow and Land Ice

CryoLand services assist European public authorities and affected industries in dealing more effectively with the climate change challenge by means of fast and cost effective remote sensing techniques for snow and ice monitoring. It

104 http://copernicus.eu/pages-principales/infrastructure/space-component/

105 http://copernicus.eu/pages-principales/infrastructure/in-situ-component/

106 http://copernicus.eu/pages-principales/projects/other-fp7-projects/climate-change/

107 http://coreclimax.itc.nl/

108 http://www.cryoland.eu/

	provides a set of tools for spatially detailed observations of snow cover and glaciers based on satellite data, integrated with ground based measurements.
	MAIRES[109] (EU FP7) Monitoring Arctic Land and Sea Ice using Russian and European Satellites MAIRES will develop new methods for mapping of sea ice, icebergs and glaciers in the Arctic. By joint analysis of high-resolution images from European and Russian satellites obtained in the last decades, the project expects to obtain significant new knowledge about ice in the Arctic.
	OPERR[110] (2011 - 2013 / EU FP7) Operational Pan-European River Runoff OPERR will develop an operational real-time river discharge model covering all of Europe. The project will provide data for monitoring and warning of flooding events, as well as data on predicted high concentrations of nutrients in flood water and will validate and apply data for shelf sea models, supporting the performance of regional ocean models.
	CARBONES[111] (2010 - 2013 / EUEU FP7) 30-year re-analysis of CARBON fluxes and pools over Europe and the Globe CARBONES aims at establishing a first reanalysis of the carbon cycle in a long-term perspective (20-30 years). By integrating essential climate variables such as atmospheric carbon dioxide, leaf area and biomass data, CARBONES will improve the ability to predict how the carbon cycle of ecosystems respond to greenhouse gas emissions and climate change.

109 http://%20http//www.nersc.no/project/maires

110 http://www.smhi.se/en/Research/Research-departments/Oceanography/operr-operational-pan-eurhttp://www.carbones.eu/opean-river-runoff-1.16820

111 http://www.carbones.eu/

EURO4M[112]

(2010 - 2014 / EUEU FP7)

European Reanalysis and Observations for Monitoring

EURO4M strengthens the Europe's capacity to monitor climate change over extended time periods. Thanks to the collection of regional observation datasets of Essential Climate Variables (ECV) and to the performance a comprehensive model-based regional reanalysis, EURO4M will help better understand and predict climate change.

MONARCH-A[113]

(2010 - 2013 / EUEU FP7)

Monitoring and Assessing Regional Climate change in High latitudes and the Arctic

MONARCH-A aims to generate a dedicated and comprehensive information package showcasing Arctic climate change in a 30-50 years perspective. This information package will consider a set of multidisciplinary Essential Climate Variables, their mutual forcing and feedback mechanisms associated with changes in terrestrial carbon and water fluxes, sea level and ocean circulation, and the marine carbon cycle.

ReCover[114]

(2010 - 2013 / EU FP7)

Science-based remote sensing services to support REDD and sustainable forest management in tropical region

ReCover supports the fight against deforestation and forest degradation in the tropical region by developing a state-of-the-art service capabilities for enhanced forest monitoring. Its main focus is to develop a sound statistical concept and accuracy assessment procedure that enables the generation of more reliable estimates for forest degradation and change.

REDDAF[115]

(2011 - 2014 / EU FP7)

Reducing Emissions from Deforestation and Degradation in Africa

112 http://www.euro4m.eu/

113 http://monarch-a.nersc.no/

114 http://www.vtt.fi/sites/recover/

115 http://www.reddaf.info/

	REDDAF supports countries in the African Congo Basin in monitoring deforestation and forest degradation more effectively. REDDAF will establish innovative services based on EO and in-situ measurements which respond to the needs of the users in the Congo Basin Region. The services are related to the Monitoring, Reporting and Verification (MRV) requirements within the new REDD policy process.
	REDD-FLAME[116] (2011 - 2013 / EU FP7) REDD Fast Logging Assessment & Monitoring Environment REDD-FLAME will design and implement a satellite system for monitoring tropical and subtropical forests. This system will be able to identify quickly the first signs of illegal logging and thus allow earlier intervention by the authorities and better management of these fragile and valuable environments to prevent lasting damage.
	REDDINESS (2011 - 2013 / EU FP7) Support EO-driven forest and carbon monitoring in Central Africa for REDD The REDDINESS project aims to enhance the existing capabilities within national forest monitoring centres in Gabon and the Republic of Congo in undertaking forest assessments, forest mappings and carbon trend estimations. It will also undertake knowledge transfers and work to increase the readiness of the countries to join the carbon trade market.
	SIDARUS[117] (2011 - 2014 / EU FP7) Sea Ice Downstream Services for Arctic and Antarctic Users and Stakeholders Polar regions are strongly affected by climate change: temperature is increasing, sea ice is retreating during the summer and land ice decreases. SIDARUS seeks to establish a set of sea ice services for climate research, marine safety and environmental monitoring in the Arctic and Antarctic regions.

116 http://redd-flame.info/

117 http://sidarus.nersc.no/

8.5.3. JRC-IES activities

The activities of the JRC-IES are outlined in the Multiannual Work Programme[118], which is funded through the specific programme of the JRC within the FP7 of the European Union. The research activities of the Institute for Environment and Sustainability are presently divided into 20 Research Actions distributed amongst the Scientific Units. The most relevant for climate change are as follows:

- Water Resources Unit
  - Action 22001 - Monitoring across Policies and Environmental Media (MAPLE)
  - Action 22010 - European and Global Freshwaters (FRESHWATERS)
  - Action 22011 - Coastal and Marine Waters (SEACOAST)
- Air and Climate Unit
  - Action 24007 - Air and Climate Analysis (ACA)
  - Action 24009 - Air and Climate Foresight (ACF)
- Forest Resources and Climate Unit
  - Action 22003 - Forest Modelling and Information Systems (FORESTMOD)
  - Action 42003 - Global Forest Assessment and Monitoring (GLOBE-TREES)
- Climate Risk Management Unit
  - Action 24008 - Climate Risk - LESS Developed Countries (CR-LESS-DC)
  - Action 32004 - Climate Risk - MORE Developed Countries (CR-MORE-DC) .

JRC Actions are grouped under five Policy Themes, according to the European Union's Seventh Framework Programme (FP7) and the Seventh Framework Programme of the European Atomic Energy Community (EURATOM). Starting from 2011 Work Programme, Actions are developed around seven Thematic Areas:

- Towards an open and competitive economy
- Development of a low carbon society
- Sustainable management of natural resources
- Safety of food and consumer products
- Nuclear safety and security
- Security and crisis management
  - Reference materials and measurements[119].

IES's projects per year, covering the period 2010 to 2013, related to the development of a low carbon society thematic area can be accessed through JRC project browser[120].

118 http://ec.europa.eu/dgs/jrc/downloads/mawp2007_2013.pdf

119 http://projects.jrc.ec.europa.eu/jpb_public/mainMenu.html;jsessionid=kTLQR7VH2bGS5ysFRxv6xyXFdsrvzLNjQLJLRTKdLY0fxMBXBwrn!-1647626627

120 http://projects.jrc.ec.europa.eu/jpb_public/act/publicexportworkprogramme.html

8.5.4. Atmospheric climate observing systems, including those measuring atmospheric constituents

8.5.4.1. Copernicus Atmosphere Monitoring Service[121]

Copernicus Atmosphere monitoring service provides continuous data and information on atmospheric composition. The service describes the current situation, forecasts the situation a few days ahead, and analyses consistently retrospective data records for recent years.

The Copernicus atmosphere monitoring service supports many applications in a variety of domains including health, environmental monitoring, renewables energies, meteorology, and climatology.

It provides daily information on the global atmospheric composition by monitoring and forecasting constituents such as greenhouse gases (carbon dioxide and methane), reactive gases (e.g. carbon monoxide, oxidised nitrogen compounds, sulphur dioxide), ozone and aerosols.

It provides near-real-time analysis and 3-day forecasts, as well as reanalysis, of the European air quality, thus enabling a permanent assessment of the air we breathe.

The monitoring and reanalysis of greenhouse gases and aerosols contribute to climate change studies by describing climate forcing.

Thanks to daily analysis and forecasts of ultra violet (UV) radiation, solar energy and stratospheric ozone, the service supports public health policies (e.g. skin cancer prevention) and solar energy users.

The service is delivered in a pre-operational mode. The products delivered by the Copernicus atmosphere monitoring service are provided free of charge through the atmosphere.copernicus.eu webportal, which is operated by the EU-funded project MACC-II.

121 http://www.copernicus.eu/pages-principales/services/atmosphere-monitoring/

8.5.4.2. RECONCILE[122]

Title	Reconciliation of essential process parameters for an enhanced predictability of arctic stratospheric ozone loss and its climate interactions
Instrument	FP7, Collaborative Project
Total Cost	€ 4 656 564
EU Contribution	€ 3 499 782
Duration	48 months
Start Date	1/03/2009
Consortium	16 partners from 8 countries
Project Coordinator	Forschungszentrum Jülich (Germany)
Key Words	Ozone Layer, Climate Change, Long Term Predictions

The issues where the lack of understanding is most palpable are the catalytic ClOx/BrOx chemistry, chlorine activation on cold stratospheric aerosol, NAT nucleation mechanisms, and mixing and transport of processed air to lower latitudes. A catalogue of open questions in all these areas has been defined including:

- Are there unknown additional mechanisms for O_3 destruction in polar winter?
- Does the cold binary aerosol suffice to activate chlorine or are plar stratospheric clouds (PSCs) required?
    - How does nitric acid trihydrate (NAT) nucleation leading to large denitrifying particles work?
    - How intense is the transport through the vortex edge in both directions and how does it influence estimates of ozone depletion?

These and other important questions will be addressed in RECONCILE with the aim to develop parameterisations that can be used in computer models simulating stratospheric chemistry and transport.

Key results from laboratory experiments and the field activities in the Arctic winter 2009/10 include:

- consistent quantification of the ClOOCl photolysis rate

122 https://www.fp7-reconcile.eu

- unambiguous demonstration of heterogeneous NAT nucleation in the absence of ice and detection of various possible „nuclei“, with implications for PSC formation and denitrification
- strong evidence for significant chlorine activation not only on PSCs but also on cold binary aerosol
- identification and quantification of discrepancies between observations and models with respect to transport and mixing (with ongoing work to refine the models).

Sophisticated process parameters and parameterisations have been implemented in the chemistry climate model (CCM) LMDZrepro. Improved CCM simulations better reproduce observed past Antarctic ozone losses, while in the Arctic, external processes determining the stability of the polar vortex drive the interannual variability. In both hemispheres, the new and more robust CCM simulations confirm our current estimates of 21st century ozone depletion and recovery date.

8.5.4.3. EUCLIPSE[123]

Title	EU Cloud Intercomparison, Process Study & Evaluation Project
Instrument	FP7 Collaborative Project
Total Cost	€ 4 985 600
EU Contribution	€ 3 500 000
Duration	48 months
Start Date	01/02/2010
Consortium	12 partners from 9 countries
Project Coordinator	KNMI (The Netherlands)
Key Words	Clouds, climate change

EUCLIPSE represents a focused multi-disciplinary effort to respond to this challenge by fostering coordinated research in the area of cloud feedbacks on climate change. The specific objectives of EUCLIPSE are:

- evaluation of cloud processes in Earth System Models.
- development of physical understanding of how cloud processes respond and feedback to climate change.
- development of a metric to measure the relative credibility of the cloud feedbacks by different Earth System Models.

123 www.euclipse.eu

- improvement the parameterization of cloud related processes in current Earth System Models.

Expected Results include:

- improvement of the representation of cloud related processes
- a metrics to quantify the ability of Earth System Models to represent clouds, radiation and precipitation
- reduction of the uncertainty of model-based estimates of climate change due to cloud related processes
- dissemination of new tools, analysis methods, simulations and observations that will provide a useful data base for the model development community at large.

8.5.4.4. COCOS[124]

Title	Coordination action Carbon Observing System
Instrument	Coordination action
Total Cost	€ 1 876 367
EU Contribution	€ 1 747 683
Duration	36 months
Start Date	1/05/2008
Consortium	11 partners from 6 countries
Project Coordinator	VU University Amsterdam, the Netherlands
Key Words	Carbon, observations, ocean, land, international coordination, GEO, environment, climate change

Project objectives include:

- assess the status, and update where required, the essential carbon cycle variables of the Integrated Global Carbon Observations (IGCO) list of core variables
- improve the interoperability of a priori data sets that are used in global scale inversion studies through joint activities between ecosystem and ocean bottom-up observation communities
- perform integrated regional-scale multiple constraint assessments of the land and ocean carbon balance through the use of harmonized data sets

124 http://www.cocos-carbon.org/

- identify, narrow down uncertainties and decrease differences in emerging global data sets that are aimed at providing constraints on the vulnerability of the global carbon cycle
- contribute to the implementation and improvement of the global observing systems by organizing a large international conference in light of monitoring requirements for the Group on Earth Observations (GEO)
- through executing these objectives, demonstrate and strengthen European leadership in designing and operating systematic long-term carbon observations in critical regions of the globe.

Scientists have been brought together to pool their expertise, and design and implement common procedures for data collection, quality control and storage. To achieve this objective, COCOS organised the series of workshops shown in the table. COCOS also organised a major international conference: “Carbon in a Changing World”.

The COCOS Data Portal provides access to the Carbon Cycle data. On the interpretation, particularly using so called inverse models, COCOS made significant progress. It has also evaluated the usefulness of a series of observations, including total column CO_2 retrievals from space and from the surface. COCOS has collaborated with the Global Carbon Project in a project to create regional-scale resolution maps of the world’s carbon budget over both land and ocean. The project is known as RECCAP (REgional Carbon Cycle Assessment and Processes). More than 150 scientists from all over the world are working on RECCAP. COCOS identified a number of emerging gaps in our knowledge of the carbon cycle, and provided new access for instance to ocean carbon data. Through collaborating with international scientist COCOS produced the GEO Carbon strategy report that is widely regarded as providing the blueprint for a Global Carbon Observing system, both in situ and from space. COCOS has put the European Carbon Cycle Community at the forefront of global carbon monitoring science.

8.5.4.5. GEOCARBON[125]

Title	Operational Global Carbon Observing System
Instrument	Collaborative project FP7
Total Cost	€ 8 672 736
EU Contribution	€ 6 648 530
Duration	36 months
Start Date	01/10/2011
Consortium	25 partners from 11 countries
Project Coordinator	CMCC – Euro-Mediterranean Centre on Climate Change (Italy)
Key Words	Climate change, carbon cycle, GHG budget, carbon observations, data assimilation, tropical forests, economic analysis

GEOCARBON aims at designing a coordinated and integrated Global Carbon Observation and Analysis System, addressing the climate targets of the Group on Earth Observations (GEO) toward building an operational Global Earth Observation System of Systems (GEOSS) for carbon. Specific objectives are:

- Provide an aggregated set of harmonized global carbon (CO2 and CH4) data and information (integrating the land, ocean, atmosphere and anthropogenic component)
- Develop improved Carbon Cycle Data Assimilation Systems (CCDAS)
- Provide global annual budgets of CO2 and CH4 with reduced uncertainty
- Provide improved regional carbon budgets, with a focus on tropics (Amazon and Central Africa)
- Define the specifications for an operational Global Carbon Observing System
- Provide an economic assessment of the value of an enhanced global carbon observing system
- Strengthen the effectiveness of the global carbon contribution to the GEO system.

GEOCARBON is conceived to support the implementation of the GEO 2012-2015 Work Plan and the achievements of the GEOSS 2015 Strategic Targets on climate, and it is already contributing to these results. The ultimate expected outcome of the project is the provision of an aggregated and harmonized set of data and information on carbon pools, sources and sinks, ranging from regional to the global scale and with an increased resolution and accuracy, and a reduced uncertainty. This will improve the global understanding of carbon

125 http://www.geocarbon.net/

cycle, and its role in the climate change system, both from a scientific and policy perspective, and help scientists and policy makers better define the future targets on greenhouse gases reduction and the actions needed to mitigate and adapt to climate change. Finally, a strategy for a continued and sustained Global Carbon Observing and Analysis System will be delivered.

8.5.5. Ocean climate observing systems

8.5.5.1. MyCopernicus Marine Monitoring Service[126]

The Copernicus marine monitoring service provides regular and systematic reference information on the state of the physical oceans and regional seas. The observations and forecasts produced by the service support all marine applications.

For instance, the provision of data on currents, winds and sea ice help to improve ship routing services, offshore operations or search and rescue operations, thus contributing to marine safety.

The service also contributes to the protection and the sustainable management of living marine resources in particular for aquaculture, fishery research or regional fishery organisations.

Physical and marine biogeochemical components are useful for water quality monitoring and pollution control. Sea level rise helps to assess coastal erosion. Sea surface temperature is one of the primary physical impacts of climate change and has direct consequences on marine ecosystems. As a result of this, the service supports a wide range of coastal and marine environment applications.

Many of the data delivered by the service (e.g. temperature, salinity, sea level, currents, wind and sea ice) also play a crucial role in the domain of weather, climate and seasonal forecasting.

The service is currently delivered in a pre-operational mode.

The products delivered by the Copernicus marine environment monitoring service today are provided free of charge to registered users through an Interactive Catalogue available on the marine.copernicus.eu web portal. The pre-operational marine service of Copernicus is currently provided through the EU-funded project MyOcean2 (see below).

8.5.5.2. myOcean[127]

The main objective of the MyOcean2 project is to deliver and operate a rigorous, robust and sustainable Ocean Monitoring and Forecasting system of the GMES Marine Service (OMF/GMS) to users for all marine applications: maritime safety, marine resources, marine and coastal environment and climate, seasonal and weather forecasting.

In the period from April 2012 to September 2014, MyOcean2 is ensuring a controlled continuation and extension of the services and systems already implemented in MyOcean, a previous FP7-funded project (April 2009- March 2012) that has advanced the pre-operational marine service capabilities by conducting the necessary research and development.

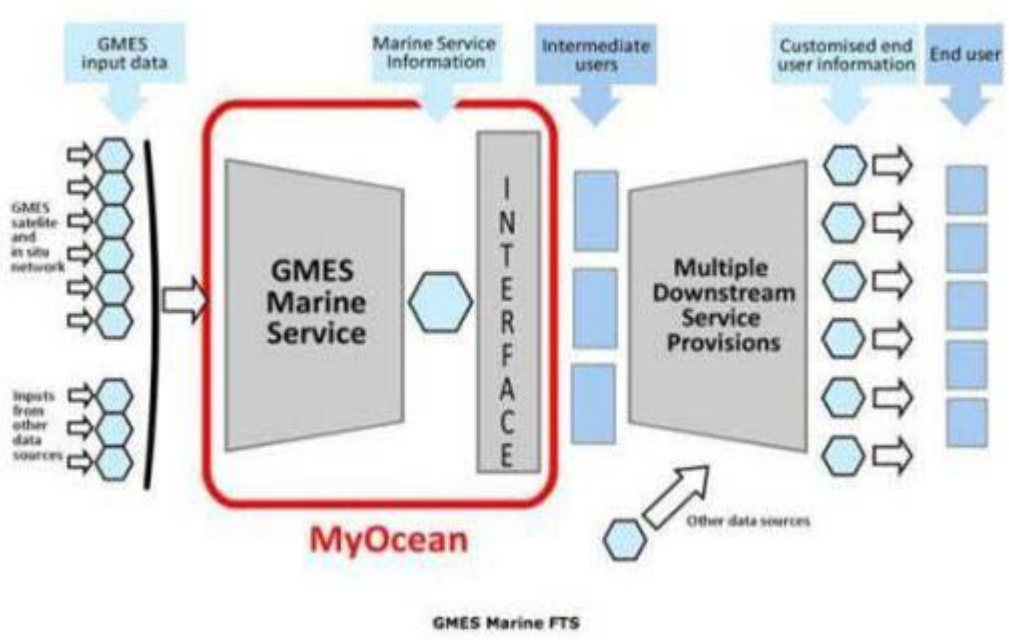
126 http://www.copernicus.eu/pages-principales/services/marine-monitoring/

127 http://www.myocean.eu/web/3-objective.php

The MyOcean2 marine service consists of the following activities:

- data acquisition from the ground segment of the space-based observation systems and in situ networks
- acquisition of atmospheric forcing data (winds, temperatures, fluxes) from National Meteorological Services and ECMWF
- compilation of these data into quality-controlled datasets at Thematic Data Assembly Centres (sea surface temperature, ocean colour, sea level, sea ice, surface winds and fluxes, and in-situ data) suitable for the generation of more extensive data sets for subsequent use, analytical products and assimilation by ocean models
- running numerical ocean models in near real time to assimilate thematic data and generate analyses and forecasts to an agreed and generally perpetually repeating cycle. The monitoring and Forecasting Centres operate regional (Arctic, Baltic, North West shelf, Irish-Bay of Biscay and Iberian Coast, Mediterranean Sea and Black Sea) and global models. The centres will also operate offline to produce reanalysis /hindcasts
- preparation and delivery of products suitable for external service provision and
- preparation phase for a fully operational service by the end of 2014.

*Figure **Error! No text of specified style in document.**-17 The COPERNICUS Marine Fast-Track Service chain and its Ocean Monitoring & Forecasting (OMF) component.*



8.5.5.3. NACLIM[128]

Title	North Atlantic Climate – Predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability and change
Instrument	FP7, Funding Scheme SP1-Cooperation
Total Cost	€ 11 046 614
EU Contribution	€ 8 598 407
Duration	48 months
Start Date	01/11/2012
Consortium	18 partners from 10 countries
Project Coordinator	University of Hamburg
Key Words	Climate change, Environment and Health, Marine Environment

The project aims at investigating and quantifying the predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability on seasonal to decadal time scales. SST and sea-ice forcing have a crucial impact on weather and climate in Europe. It will analyse the multi-model decadal prediction experiments currently performed as part of the CMIP5 Project and assess the quality of predictions of the near-future state of key oceanic and atmospheric quantities relevant to the SST and sea-ice distribution and the related climate. Long-term observations of relevant ocean parameters will be carried out, for assessing the forecast skill of the model-based prediction results. We will identify observations that are key to the quality of the prediction and optimize the present observing system. The project will quantify the impact of North Atlantic/European climate change on oceanic ecosystems and urban societies.

The project's results include:

- quantify the uncertainty of state-of-the-art climate forecasts by evaluating the ability to model the most important oceanic and atmospheric processes in the North Atlantic and Arctic Oceans, and by comparing key quantities with observations
- optimize the present North Atlantic observation system by evaluating the impact of its components on the quality and quality control of model forecasts, and their value in determining the present ocean state and its past variability
- quantify the impact on oceanic ecosystems and on European urban societies of predicted North Atlantic/Arctic Ocean variability

128 www.naclim.eu

- critically assess the use of climate forecast parameters for use by stakeholders in society, politics and industry.

8.5.5.4. THOR[129]

Title	Thermohaline Overturning – at Risk? – THOR
Instrument	FP7 Environment (Climate Change, Policy and Risks)
Total Cost	€ 12 948 295
EU Contribution	€ 9 274 427
Duration	48 months
Start Date	December 2008
Consortium	20 higher educational and research institutions of 9 European countries
Project Coordinator	Hamburg University

THOR will establish an operational system that monitors and forecasts development of the North Atlantic thermohaline circulation (THC) on decadal time scales and assess its stability and risk of a breakdown in a changing climate. Together with pre-existing data sets, ongoing observations within the project will -for the first time - allow precise quantitative monitoring of the THC and its sources.

By identifying key processes manifested in paleo observations, THOR' models will be able to provide early identification of any systematic changes occurring.

The combined effect of various global warming scenarios and melting of the Greenland ice sheet will be thoroughly assessed in a coupled climate model. Through these studies and the assimilation of systematic observations at key locations into ocean models, THOR will be able to forecast the development of the Atlantic THC with emphasis on the European/North Atlantic region and its variability until 2025.

Expected Results

- quantifying THC variability on time scales up to centennial and identification of the key processes and feed-back mechanisms responsible for this variability
- quantifying ocean state uncertainties derived from combined model and data analysis
- quantifying Atlantic THC flux variability on time scales up to decadal, providing benchmarks for model tests

129 www.eu-thor.eu, http://vimeo.com/54353956, http://cordis.europa.eu/projects/rcn/88858_en.html

- quantifying the strength of the Nordic sources to the deep limb of the THC
- quantifying the skill of coupled forecast models on decadal time scales
- forecasting the THC variability on decadal time scales
- near real time data transfer from deep sea moorings
- assimilation techniques for coupled ocean-atmosphere general circulation models.

Parties outside the consortium that will benefit from the dissemination of the results of THOR, and that will be able to exploit them, fall into a number of categories: other scientists, instrument manufacturers, meteorological organizations, policy makers, end users in general, and the general public.

8.5.5.5. ACOBAR[130]

Title	Acoustic Technology for Observing the interior of the Arctic Ocean
Instrument	Small – medium scale focussed research project
Total Cost	€ 4 090 000
EU Contribution	€ 3 000 000
Duration	48 months
Start Date	01/10/2008
Consortium	9 partners from 5 countries
Project Coordinator	Nansen Environmental and Remote Sensing Centre – NERSC (Norway)
Key Words	ocean observing system, Arctic, underwater acoustics, climate change, oceanography, climate, acoustic tomography, gliders, data assimilation, acoustic navigation

The main objective of ACOBAR is to develop an acoustic system for monitoring of the interior of the Arctic Ocean. The project will collect 3-D observations of properties and transport of water masses in the Fram Strait using an acoustic tomography array, consisting of source and receivers, in combination with acoustic ice-tethered profilers (AITPs), oceanographic moorings and profiling gliders. Navigation of gliders under the ice by use of acoustic signals from the tomography sources will be developed and tested. Data transmission by acoustic modems from underwater platforms to the surface for downloading to ships will be demonstrated. The AITPs are deployed on ice floes with underwater sound source, hydrophones, modems and satellite communication, allowing near real time data transmission via satellite. ACOBAR will contribute to establish a future Arctic Ocean Observing System.

130 http://acobar.nersc.no/

The expected results of ACOBAR will consist of new acoustic technology for observing the interior of the ocean, new observational data of the deep ocean from tomography as well as from gliders, use of acoustics for underwater communication and navigation, and data transmission from underwater platforms and vehicles that can operate under ice. Results of ACOBAR will be used to improve the ocean observing capability in the polar oceans, and will thus contribute to build the Arctic Regional Ocean Observing System (Arctic ROOS), a component of the Global Ocean Observing System (GOOS).

The project will strengthen European expertise in underwater acoustic navigation, communication, data transmission and tomography. The project will promote the use of underwater acoustic technology for monitoring the ocean. The technology will be used to build a long-term ocean monitoring system for the polar oceans.

8.5.5.6. EuroSITES[131]

Title	European Network of Deep Ocean Observatories
Instrument	Collaborative Project FP7
Total Cost	€ 4 700 000
EU Contribution	**€** 3 500 000
Duration	36 months
Start Date	1/04/2008
Consortium	13 partners from 8 countries (1 ICPC)
Project Coordinator	National Oceanography Centre, Southampton – NOCS (UK)
Key Words	EuroSITES, Deep sea, open ocean, Ocean Observatories, Eulerian, time-series, ocean interior, seafloor, subseafloor, COPERNICUS, GEO, GEOSS

EuroSITES will integrate and enhance the existing in situ infrastructure of 9 European deep ocean observatories. Integration will be carried out regionally across Europe and vertically through the ocean environment to include monitoring of the ocean interior, seafloor and subseafloor. Specific science missions will be conducted to develop the sustained monitoring capabilities of key environmental features e.g. pH, dissolved oxygen.

EuroSITES will focus on scientific excellence, best practice, common data management and effective communication to industry, policy makers and the general public. This will be achieved through close interaction with relevant European initiatives including ESONET (FP6 NoE), and EMSO PP (FP7). EuroSITES will contribute to the sub-sea component of COPERNICUS and to the GEOSS.

131 http://www.eurosites.info/

EuroSITES is expected to have the following results: the establishment of an integrated European network of 9 existing deep ocean observatories; a major advance in the way the European community monitors the ocean interior, seafloor and sub-seafloor; improvement of ocean data management and sensor/data accuracy; increase in effective communication of ocean science, ocean observation and outputs.

EuroSITES will also form an essential component of European and International Ocean Observation programmes including GOOS and GEOSS.

8.5.5.7. HYPOX[132]

Title	In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies
Instrument	FP7 collaborative project / small or medium-scale focused research project (Grant #226213)
Total Cost	€ 4 665 281
EU Contribution	€ 3 499 711
Duration	36 months
Start Date	1/04/2009
Consortium	16 partners plus 4 affiliated partners from 13 countries
Project Coordinator	Prof. Antje Boetius, Dr. Felix Janssen, Dr. Christoph Waldmann
Key Words	Oxygen depletion, climate change, in situ water cycle monitoring, GEOSS, aquatic ecosystems, marine, freshwater, global ocean observation, eutrophication, biodiversity

A better understanding of global changes in oxy-gen depletion requires a global observation sys-tem. Oxygen and associated parameters need to be monitored at high resolution, including the assessment of physical mixing and of the role of the seafloor in controlling ecosystem sensitivity and recovery. Within HYPOX, oxygen depletion and associated processes were monitored in a broad range of aquatic systems that differ in oxygen status and sensitivity towards change: oxygen-rich open ocean with high sensitivity to global warming (Arctic), semi-enclosed basins with permanent anoxia (Black Sea, Baltic Sea) and land-locked systems with seasonal or local oxygen depletion (fjords, lagoons, lakes). The results were combined with information on past hypoxia and state-of-the-art numerical modelling to predict future hypoxia and its effect on aquatic ecosystems and to decide on appropriate oxygen monitoring efforts in the future.

HYPOX carried out pioneering work to build capacities for state-of-the-art oxygen monitoring. An increased demand for oxygen observations is foreseen in the context of the

132 http://www.hypox.net/

Marine Strategy Framework Directive and in response to the expected increase in the use of marine resources. HYPOX knowledge contributes to a conclusive oxygen observation strategy to monitor global change effects and to ensure sustainability of the envisaged maritime activities. This represents a major impact generated by the project that will extend into the future. HYPOX deployed stand-alone or cabled observatories that are able to perform long-term continuous measurements of oxygen and associated parameters. The adopted monitoring strategies account for temporal and spatial scales of oxygen depletion that are inadequately addressed by previous oxygen observation approaches. Ecosystem responses with a special focus on biogeochemical processes and element cycling were included as well as the investigation of past hypoxic conditions based on faunal patterns and organic as well as inorganic proxies from the sediment record. Based on generalized findings achieved by careful analysis of the data from observatories and field campaigns as well as application of data assimilation and modelling techniques, hypoxia ecosystems were classified and recommendations for future oxygen monitoring defined.

The results obtained in HYPOX are highly relevant to GEOSS objectives from ecosystem, water management, and climate points of view. Four HYPOX services compliant with GEOSS accepted standards have been registered at the GEOSS registry. A standardized and GEOSS compliant da-ta flow from the observatories to the end users was established. Through these activities HYPOX substantially improved the interoperability of observation systems for oxygen depletion in different systems. All observations and measurements obtained by observatories and during targeted field campaigns are disseminated through the HYPOX data portal. The project web site (www.hypox.net) provides access to the data portal as well as to reports, presentations and public outreach material including brochures, policy briefs, posters, images, and video footage.

8.5.5.8. GEOWOW[133]

Title	GEOSS interoperability for Weather, Ocean and Water
Instrument	FP7, Collaborative Project
Total Cost	€ 9 168 704
EUEU Contribution	€ 6 399 098
Duration	36 months
Start Date	01/09/2011
Consortium	15 partners from 7 countries
Project Coordinator	ESA (FR)
Key Words	GEO, GEOSS, GCI, Multidisciplinary Interoperability

GEOWOW will propose and validate an architectural model federating Earth Observation and other Earth Science data holdings at global, regional and local scale; allow easy and harmonized access to heterogeneous data; contribute to the GCI interoperability, standardisation and operability; develop services for data dissemination, access and use for the selected SBAs; establish and promote data sharing and usage procedures consistent with the GEOSS Data Sharing Implementation Guidelines and contribute to the development of the GEOSS Data CORE (Collection of Open Resources for Everyone).

Moreover, the project will support users of the SBAs by: providing harmonized and fast data access for meteorological hazard application development (Weather SBA); deploying an e-infrastructure giving access to in-situ and satellite data for hydrological application and Run-off process (Water SBA); enhancing the access to in-situ and satellite ocean observations, to information on threats to ocean ecosystems, and to key ocean forecasts and projections (Ecosystem SBA).

GEOWOW will facilitate discovery, access and use of resources (data, products, models) for different communities by revising the GEOSS architecture and evolving the GCI.

Moreover, the project will contribute to support Earth Science Research, to develop new Earth Science applications and to promote GEOSS, by putting in practice the Data Sharing Action Plan, and to the development of the GEOSS Data CORE.

Besides the impacts related to increased interoperability, significant benefits are expected from the GEOWOW achievements in the targeted thematic areas, a specific aim of the project being to respond to the needs in terms of data, tools and services in the Weather, Water and Ocean Ecosystem research and management.

133 http://www.geowow.eu/

GEOWOW will also support innovation and foster the creation of research-led jobs in SMEs (Small Medium Enterprises), with a specific activity aimed at identifying opportunities and needs of SMEs in Europe in the Earth Observation and Geographic Information-related sector.

8.5.6. Terrestrial climate observing systems

8.5.6.1. Copernicus Land Monitoring Service [134]

The Copernicus land monitoring service provides geographical information on land cover and on variables related, for instance, to the vegetation state or the water cycle. It supports applications in a variety of domains such as spatial planning, forest management, water management, agriculture and food security, etc.

The service became operational in 2012. It consists of three main components: a Pan-European component, a global component and a local component.

The Pan-European component is coordinated by the European Environment Agency and will produce 5 high resolution data sets describing the main land cover types: artificial surfaces (e.g. roads and paved areas), forest areas, agricultural areas (grasslands), wetlands, and small water bodies. The pan-European component is also updating the Corine Land Cover dataset to the reference year 2012.

The global component is coordinated by the European Commission JRC. It will produce data across a wide range of biophysical variables at a global scale (i.e. worldwide), which will describe the state of vegetation (e.g. leaf area index), the energy budget (e.g. albedo) and the water cycle (e.g. soil moisture index).

The local component is coordinated by the European Environment Agency and aims to provide specific and more detailed information that is complementary to the information obtained through the Pan-European component. Besides an update of the Urban Atlas, the next local component will address biodiversity in areas around rivers.

8.5.6.2. CARBOEUROPE[135]

Title	Assessment of the European Terrestrial Carbon Balance
Instrument	FP6, Integrated Project
Total Cost	€ 23 656 645
EU Contribution	€ 16 310 000
Duration	60 months
Start Date	1/1/2004
Consortium	61 partners from 17 countries

134 http://www.copernicus.eu/pages-principales/services/land-monitoring/

135 www.carboeurope.org

Title	Assessment of the European Terrestrial Carbon Balance
Project Coordinator	• Max Planck Gesellschaft zur Förderung der Wissenschaften E.V. (Germany)
Key Words	European Carbon Balance, mechanism controlling carbon cycle in European terrestrial ecosystems, atmospheric CO_2 concentration

CarboEurope-IP aimed to understand and quantify the terrestrial carbon balance of Europe and the associated uncertainty at local, regional and continental scale. In order to achieve this strategic objective, the project addresses the following topics and associated questions:

"The European Carbon Balance" What is the carbon balance of the European continent and its geographical pattern, and how does it change over time?

"Processes and Modelling" What are the controlling mechanisms of carbon cycling in European ecosystems? How do external parameters such as climate change and variability, and changing land management affect the European carbon balance?

"Detection of Kyoto" Can the effective CO_2 reduction in the atmosphere in response to fossil fuel emission reduction and enhanced carbon sequestration on land be detected in the context of the Kyoto commitments of Europe?

The key innovation of the CARBOEUROPE-IP was solving the scientific challenge of quantifying the terrestrial carbon balance at different scales and with known, acceptable uncertainties. The increase in spatial and temporal resolution of the observational and modelling program will allow for the first time a consistent application of a multiple constraint approach of bottom-up and top-down estimates to determine the terrestrial carbon balance of Europe with the geographical patterns and variability of sources and sinks. CARBOEUROPE-IP aims at providing a system for carbon accounting for the European continent, and it will further investigate the main controlling mechanisms of carbon cycling in European ecosystems. CARBOEUROPE-IP integrates and expands the research efforts of 95 European institutes. Finally, it addresses basic scientific questions of high political relevance.

8.5.6.3. NITROEUROPE[136]

Title	The nitrogen cycle and its influence on the European greenhouse gas balance
Instrument	FP6, Integrated Project
Total Cost	€ 26 943 227
EU Contribution	€ 16 600 000
Duration	63 months
Start Date	01/02/2006
Consortium	62 partners from 24 countries
Project Coordinator	Natural Environment Research Council (NERC, UK)
Key Words	• Nitrogen, agriculture, climate change, air quality

NitroEurope addresses the major question: What is the effect of reactive nitrogen (N) supply on net greenhouse gas budgets for Europe?

Objectives:

- establish robust datasets of N fluxes and net greenhouse-gas exchange (NGE) in relation to C-N cycling of European ecosystems,
- quantify the effects of past and present global changes on C-N cycling and NGE,
- simulate observed fluxes of N and NGE, their interactions and responses to global change/land-management decisions, applying refined plot-scale models,
- quantify multiple N and C fluxes for European landscapes, including interactions between farm-scale management, atmospheric and water dispersion,
- up-scaling Nr and NGE fluxes for terrestrial ecosystems to regional/European levels, considering spatial variability, allowing assessment of past, present and future changes,
- assess uncertainties in European model results and use these together with independent measurement/inverse modelling approaches for verification of European Nitrous Oxide (N2O) and Methane (CH4) inventories and refinement of IPCC approaches.

NitroEurope delivers results to a wide range of users and stakeholders. The substantial amount of new measurements of Nr fluxes and NGE on a large network of sites create a unique dataset, which is compiled and stored in a sophisticated database. Researchers within

136 http://www.nitroeurope.eu/

NitroEurope and a wider research community can access these datasets for in-depth analyses. In addition to that, a network of manipulation sites provides insight into the effects of future climate conditions on agricultural land and semi-natural and natural ecosystems. These are of vital importance for gaining a better understanding of the contribution of Nr to biogeochemical cycles. Modelling activities on different spatial scales – from plot to landscape to European – generate results for the assessment of management options for a better management of the nitrogen cycle. Supported by verification activities and uncertainty assessments, these results provide a direct evidence base for the design of agricultural and environmental policies.

8.5.6.4. Carbo-Extreme[137]

Title	The terrestrial Carbon cycle under Climate Variability and Extremes – a Pan-European Synthesis
Instrument	FP7-ENV-2008-1; Collaborative project
Total Cost	€ 4 677 523
EU Contribution	€ 3 312 754
Duration	48 months
Start Date	01/06/2009
Consortium	25 partners from 12 countries
Project Coordinator	Dr.Markus Reichstein, Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. (Germany)
Key Words	Climate change, extreme events, climate variability, terrestrial carbon cycle, carbon sink, carbon pools and fluxes, ecosystem manipulation experiments, long-term observations, process studies, carbon cycle modelling, model-data integration, model scenarios, carbon vulnerability analysis, policy interaction, drought, heat wave, heavy precipitation, forest ecosystems, agriculture, grasslands, soil process studies, tree-ring analysis, tree mortality, primary production, respiration, climate model, eddy covariance measurements, flux measurements, remote sensing, database, spatio-temporal patterns, uncertainty analysis.

The overall objective is to obtain a better and more predictive understanding of European terrestrial carbon cycle responses to climate variability and extreme weather events. In particular the aim is to identify the most sensitive and vulnerable carbon pools and processes under different scenarios and to map the most likely trajectory of carbon pools in Europe over the 21st century, including uncertainties.

137 www.carbo-extreme.eu

By building a consistent harmonized multi-source database on the European carbon cycle components for studying climate variability and extreme events and, performing a Bayesian model calibration and comparison, we aim to improve terrestrial carbon cycle predictions and their uncertainties in scenario analyses, giving advice to the European Commission and other stakeholders.

Climate extremes strongly influence terrestrial ecosystems and their carbon cycle. Multiple evidence indicates that water-cycle extremes, in particular droughts, are a dominant threat to carbon cycle related ecosystem services. All land use types in Europe are vulnerable to climate extremes to some degree. Taken together, with both their large carbon stocks and long generation time, forests are expected to experience the largest, most diverse, and longest lasting consequences for carbon cycling from climate extremes compared to other land-cover types.

8.5.6.5. GHGEUROPE[138]

Title	Greenhouse gas management in European land use systems
Instrument	FP7 Large-scale Integrating Project
Total Cost	€ 8 925 737
EUEU Contribution	€ 6 648 704
Duration	45 months
Start Date	01/01/2010
Consortium	41 partners from 15 countries
Project Coordinator	Johann Heinrich von Thünen-Institut (Germany)
Key Words	Greenhouse gas, land use management, climate change, carbon balance

GHG-Europe aims to improve our understanding and capacity for predicting the European terrestrial carbon and greenhouse gas (GHG) budget by applying a systematic, comprehensive and integrative approach. GHG-Europe quantifies the annual to decadal variability of the carbon and GHG budgets of terrestrial ecosystems via data-model integration, diagnostic and predictive modelling. Ultimately, the scientific challenge is to determine how, and to what degree, the carbon cycle and GHG emissions in terrestrial ecosystems can be managed.

An important finding for forests was that the stimulatory effect of nitrogen deposition in most European forests does not stem from increased photosynthesis, but from increased carbon allocation to wood. This could increase forest vulnerability to extreme events.

138 www.ghg-europe.eu

Although afforestation is thought to sequester carbon it turned out that afforested grasslands accumulate labile soil organic carbon but the stable fractions are depleted. This makes the soil carbon pool more vulnerable to future disturbance and loss.

Croplands are the largest N_2O source in Europe. Sensitivity analyses with models showed that there is some scope for mitigation by changes in the timing and forms of fertilizer applications.

8.5.7. Paleoclimate

8.5.7.1. PAST4FUTURE[139]

Title	Climate change – Learning from the past climate
Instrument	FP7. SP1-Cooperation. Collaborative project. Large-scale integrating project. FP7-ENV-2009-1
Total Cost	€ 9 233 878
EU Contribution	€ 6 647 909
Duration	60 months
Start Date	1/1/2010
Consortium	22 partners from 12 countries
Project Coordinator	University of Copenhagen
Key Words	Climate change, abrupt change, interglacial, sea level, sea ice, ocean circulation, thresholds, greenhouse gases, solar insolation, volcanic forcing, ice sheets

The key objective for Past4Future is to provide the answers to the following key questions:

- what are the dynamics of the climate over interglacial periods?
- what causes climate changes and abrupt changes over the course of interglacial periods?
- what causes climate changes and abrupt changes over the course of interglacial periods?
- can we understand the greenhouse gas records of the interglacial periods?
- what can the past tell us about risks for climate changes/threats in the future?

The programme results will strengthen our understanding the responses of the Earth system in warmer climate, and will improve predictions of climate change risks and possible abrupt changes in the coming centuries. Past4Future will deliver knowledge that is of particular

139 www.past4future.eu

relevance from a European perspective. The need to predict future climate change strongly influences the prospects of both citizens and policy makers of the European Union. The program will inform the international debate on climate system stability and the dissemination of results will be targeted to both citizens and governmental and non-governmental stakeholders. Past4Future will leave a legacy of improved understanding of past drivers of sea level and sea ice changes as well as of greenhouse gas concentrations.

8.5.8. Support for developing countries to establish and maintain observing systems, related data and monitoring systems

The following activities are relevant in this context:

- as mentioned above, the African Monitoring of Environment for Sustainable Development (AMESD[140]) programme and its successor Monitoring of Environment and Security in Africa (MESA) are activities jointly supported and managed by the European Commission and EUMETSAT, which aim at monitoring the state and evolution of the environment and natural resources in Africa, encouraging the use of remote sensing data (in particular from the MSG instruments of EUMETSAT) in a wide range of applications, from policy making to resource management, and widely distributing products and services to current and prospective users and
- a tripartite collaboration[141] between the JRC, NASA and the South African National Space Agency (SANSA) has been in place since 2011 around the exploitation of data generated by the Multi-angle Imaging Spectro Radiometer (MISR) instrument on-board the NASA Terra platform.

8.6. Research Infrastructures

Research Infrastructures (RI) are facilities, resources, organisational systems and services that are used by the research communities to conduct research and innovation in their fields. This includes:

- major scientific equipment (or sets of instruments)
- knowledge-based resources such as collections, archives or scientific data
- e-infrastructures, such as data, computing and software systems
- any other infrastructure of a unique nature essential to achieve excellence in research and innovation

The objectives of the RI projects are:

- to open access to the research infrastructures existing in the individual Member State to all European researchers
- to avoid duplication of effort and to coordinate and rationalise the use of these research infrastructures

140 http://au.int/amesd/home/144-mesa-a-leap-forward-for-earth-observation-applications-in-africa-.html

141 http://www-misr.jpl.nasa.gov/index.cfm http://www.jpl.nasa.gov/news/news.php?release=2010-325

http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11780&dt_code=NWS&lang=en

http://earthdata.nasa.gov/featured-stories/featured-research/new-angles

- to trigger the exchange of best practice, develop interoperability of facilities and resources, develop the training of the next generation of researchers
- to connect national research communities and increase the overall quality of the research and innovation.

8.6.1. Atmospheric research

8.6.1.1. ICOS[142]

Title	Integrated Carbon Observing System
Instrument	Collaborative project and coordination and support action
Total Cost	€ 5 742 042
EU Contribution	€ 4299 996
Duration	60 months
Start Date	1/04/2008
Consortium	20 partners from 15 countries
Project Coordinator	Alternative Energies and Atomic Energy Commission, FR
Key Words	Carbon, climate change, greenhouse gases

ICOS is designed to provide the long-term observations required to understand the present state and predict future behavior of the carbon cycle and greenhouse gas emissions over Europe.

The huge uncertainty associated with the behavior of future natural CO_2 sources and sinks, future anthropogenic emissions and the mitigation efforts creates the need to monitor CO_2 with a substantially improved observing, analysis and forecast system.

The first objective of ICOS is to monitor greenhouse gases and provide effective access to these data to enable multi-scale research on GHG emissions, sinks and their drivers.

The second objective is to provide information on regional budgets of greenhouse gas sources and sinks, their human and natural drivers, and the controlling mechanisms. ICOS will permit to detect changes in region- al greenhouse gas fluxes, early warning of negative developments and the response of natural fluxes to extreme climate events, to reduce uncertainties in Earth System models.

Europe is the third largest emitter of fossil CO_2, after China and the USA. Europe has committed itself to reduce its emissions by 20% in 2020. In this context establishing the current baseline of the carbon balance and monitoring its changes independently is crucial and timely. ICOS will provide key data and information in this respect.

142 http://www.icos-infrastructure.eu/

ICOS is part of the global carbon strategy of the Group on Earth Observation (GEO), where well-calibrated surface networks are strengthened by complementary observations of CO_2 and CH_4 from space.

ICOS also strengthens the European leader- ship for GHG research, and several FP7 programs ensure a wide usage for ICOS data.

Beyond scientists and international programmes (Global Carbon Project, WMO-GAW), users of ICOS include:

- pre-operational service providers in GMES/Copernicus (MACC-II, land services),
- regional authorities and protocol verification bodies,
- the private sector
- educational organizations, the media and the general public.

8.6.1.2. IAGOS[143]

Title	In-service Aircraft for a Global Observing System – European Research Infrastructure
Instrument	Collaborative project and coordination and support action
Total Cost	€ 4 389 127
EU Contribution	€ 3 300 000
Duration	60 months
Start Date	01/09/2008
Consortium	15 Partners from 3 countries
Project Coordinator	Forschungszentrum Jülich GmbH, DE
Key Words	Climate change, air quality, aviation, weather prediction

IAGOS aims at establishing a cost efficient, world class Research Infrastructure for high-quality observations of atmospheric composition on a global scale. This will be achieved by merging scientific measurement technology with the global infrastructure of commercial aviation. The specific objectives are to:

- collect global data sets of atmospheric chemical composition in the upper troposphere and lower stratosphere and vertical profiles of trace species by a set of autonomous instruments deployed aboard a fleet of passenger aircraft of internationally operating airlines

143 http://www.iagos.org/

- provide long-term, frequent, regular, accurate, and spatially resolved in-situ data on atmospheric chemical composition, aerosol particles and clouds to the global scientific community.

IAGOS will eliminate major deficiencies in current atmospheric observation capabilities by filling the gap between satellite observations and ground based data.

IAGOS will provide long term, high-quality in-situ data for the upper troposphere and lower stratosphere where information is very sparse compared to the surface, although this region is paramount for understanding the causes of climate change. These data will serve as a basis for analyses of trends and budgets of atmospheric trace species as well as for investigating atmospheric trans- port processes

IAGOS will also provide vertical profile in- formation at many locations over the globe from thousands of take-offs and landings. These profiles are essential for the validation of numerical models and satellite data products, including those used for IPCC and for the Copernicus Atmospheric Service.

Real-time transmission of IAGOS multi-component datasets will enable weather services and airlines to exploit the data for improving air quality forecasts and numerical weather prediction, and potentially for improved crisis management during volcanic eruptions.

8.6.1.3. ACTRIS[144]

Title	Aerosols, Clouds, and Trace gases Research InfraStructure Network
Instrument	Collaborative project and coordination and support action
Total Cost	€ 11 496 772
EU Contribution	€ 7 800 000
Duration	48 months
Start Date	01/04/2011
Consortium	29 partners from 19 countries
Project Coordinator	Gelsomina Pappalardo
Key Words	Climate change, air quality, long-range transport of pollutants, aerosols, clouds, trace gases

ACTRIS aims at integrating European ground- based stations equipped with advanced atmospheric probing instrumentation for aerosols, clouds and short-lived gas-phase species. ACTRIS has the essential role to sup- port building of new knowledge as well as policy issues on climate change, air quality and long-range transport of pollutants. The main objectives are:

144 www.actris.net/

- to provide long-term observational and high-quality data relevant to climate and air quality research on the regional scale produced with standardized or comparable procedures and access to high-quality information and services for the user communities
- to provide a coordinated framework to support transnational access to European advanced infra- structures and enhance training of new scientists in the field of atmospheric observation
- to develop new technologies and the use of multiple techniques at ground-based stations, particularly for the calibration/ validation/ integration of satellite sensors and improvement of parameterisations used in global and regional scale climate and air quality models.

The scientific community and many national, EU and international programmes and projects heavily rely on the high-quality atmospheric data as currently provided by ACTRIS.

The data products facilitate and enhance scientific exchange with user communities working on models, satellite retrievals, and forecast systems. The access opportunities to the high quality infrastructures strength- en and reinforce European collaboration, and training of the young research community are of great benefit to the research infra- structures through sharing of experience, knowledge, and human capital, and will pro- mote atmospheric research and develop future research activities using best practices and innovative investments in atmospheric instrumentation. For the future, the development of new synergetic algorithms for advanced higher-level products will further improve the knowledge of atmospheric processes. It is expected that ACTRIS outcomes will be used to support decisions in a wide range of policy areas, including air quality, but also health, international protocols, and research requirements.

8.6.1.4. EUFAR[145]

Title	European Facility for Airborne Research in environmental and geoscience
Instrument	Collaborative project and coordination and support action
Total Cost	€ 9 657 391
EU Contribution	€ 8 000 000
Duration	60 months
Start Date	1/10/2008
Consortium	32 partners (14 operators of airborne facilities, and 18 experts in airborne research)
Project Coordinator	Jean-Louis Brenguier, Météo-France, FR
Key Words	Airborne research, Measurement campaign, Environmental and Geo-sciences, Instrumental research, Climate Change, Air Quality, Land Use, Air Pollutant Emissions, Atmosphere-Biosphere Interactions, Model Parameterisations

The main goal of the project is to provide scientists with access to the most complete range of research infrastructures, EUFAR:

- develops transnational access to national infra- structures
- reduces redundancy and fills the gaps
- improves the service by strengthening expertise through exchange of knowledge, development of standards and protocols, constitution of databases, and joint instrumental research activities
- promotes the use of research infrastructures, especially for young scientists from countries where such facilities are lacking.

EUFAR will provide:

- improved access to – and use of – the pool of research infrastructures through (i) the unique portal to all airborne research activities in environmental and geosciences in Europe; (ii) the coordinated implementation of access activities amongst the operators; (iii) the exchange of knowledge via the expert working groups; (iv) the education and training activities; (v) the improvement and harmonization of standards and proto- cols; (vi) the archive of data generated and easy access to users.
- optimum development of research infrastructures through (i) the independent overview of EUFAR progress by experienced and eminent re- searchers; (ii) the

145 www.eufar.net

collect of scientific demand and the exploration of solutions; (iii) the three joint research activities.

- collaborative arrangements and perspectives for the long-term sustainability of EUFAR.

8.6.1.5. INGOS[146]

Title	Integrated Non-CO_2 Greenhouse gas Observing System
Instrument	Collaborative project and coordination and support action
Total Cost	€ 10 000 000
EU Contribution	€8 000 000
Duration	48 months
Start Date	01/10/2011
Consortium	34 partners from 14 countries
Project Coordinator	Alex Vermeulen
Key Words	Climate change, non-CO_2 greenhouse gases, monitoring, inverse modelling, emissions.

The objective of InGOS is to integrate existing European facilities for monitoring of atmospheric non-CO_2 greenhouse gases (NCGHGs), at ecosystem flux measurement sites and over the ocean, by developing common quality control and quality assurance procedures. New measurement techniques and instrumentation will be explored for preparing the integration of NCGHG measurements into ICOS, thus giving these observations an operational, long-term monitoring perspective.

Sub objectives are:

- harmonize and standardize the measurements of NCGHGs
- provide capacity building in new member states and countries with inadequate existing infrastructure
- support existing observation sites and transfer of selected sites into supersites
- integrate and further integrate marine observations of the NCGHGs with land-based observations
- improve measurement methods by testing new innovative techniques and strategies
- test advanced isotope techniques for application in the network to enable attribution of the atmospheric fractions to source categories

146 http://www.ingos-infrastructure.eu/

- integrate data for network evaluation by using inverse modelling and data-assimilation methods and developments in bottom up inventories
- link the network to remote sensing data of column abundances from in-situ and satellite observations
- prepare for the integration of the NCGHG network with the Integrated Carbon Observation System.

InGOS will lead to major advances in the following areas:

- integrate European facilities for monitoring of NCGHGs
- improve the quality of historical, current and future NCGHG measurements
- prepare expansion of the current network with new stations in under sampled regions
- provide Near-Real Time access to atmospheric NCGHG data
- improve analysis methods using innovative techniques and strategies
- improve halocarbon measurements
- link remote sensing data to the in situ network
- attribute source categories by advanced isotope techniques
- inverse Modelling of European NCGHG measurements
- link to European flux towers
- ocean observations
- InGOS Data Centre.

8.6.1.6. IS-ENES

Title	Infrastructure for the European Network for Earth System Modelling – Phase 2
Instrument	Collaborative project and coordination and support action
Total Cost	€ 11 175 385
EU Contribution	€ 7 999 941
Duration	48 months
Start Date	01/04/2013
Consortium	23 partners from 11 countries
Project Coordinator	Sylvie Joussaume
Key Words	Earth system modelling, climate change, model data archives, high-

Title	Infrastructure for the European Network for Earth System Modelling – Phase 2
	performance computing

IS-ENES2 has four main objectives:

- to foster the integration of the European Climate and Earth system modelling community
- to enhance the development of Earth System Models,
- to support high-end simulations enabling to better understand and predict climate variations and change
- to facilitate the application of Earth system model simulations to better predict and understand climate change impacts on society by enhancing the dissemination of model results from both global and regional model experiments.

IS-ENES2, builds on the outputs of IS-ENES and the FP7 METAFOR project. It encompasses both global and regional models and supports the data and metadata infrastructure as well as international standards for the WCRP CMIP5 and CORDEX experiments. It further supports developments to ease the use of climate model data by the climate impact research community. It strengthens the ENES community capacity to provide more reliable decadal predictions at regional scale for society.

Networking activities will increase the cohesion of the European ESM community and advance a coordinated European Network for Earth System modeling.

Joint research activities will improve the efficient use of ESMs, high-performance computers, access to model results in terms of data and metadata and will contribute to the development of international databases and standards.

Finally, IS-ENES2 will provide services on models and model data and metadata both to climate modeling groups and to the users of model results, including the impacts community.

IS-ENES2 will mainly benefit to the climate modeling and climate impact communities. It will also enhance innovation through collaboration with ICT technologies and through use of model results for emerging European Climate Services and corporations.

8.6.2. Ocean and Marine research

8.6.2.1. EURO-ARGO[147]

Title	Global Ocean Observing Infrastructure
Instrument	Collaborative project and coordination and support action
Total Cost	01/01/2008
EU Contribution	30 months
Duration	€ 4 210 105
Start Date	€ 2 995 859
Consortium	Institut Français de Recherche pour l'Exploitation de la MER (IFREMER) Brest, FR
Project Coordinator	Pierre-Yves LE TRAON

The main objective of the Euro-Argo preparatory phase is to undertake the work needed to ensure that by 2010 Europe will be able to:

- deploy, maintain and operate an array of 800 floats. This will require Europe to deploy 250 floats per annum worldwide.
- provide a world-class service to the research (cli- mate) and environment monitoring (e.g. GMES) communities.

The main expected outcome of the preparatory phase proposal is an agreement between member states and other funding agencies for long term (> 10 years) operation of Euro-Argo (financial, governance, organization, technical). To reach such an agreement, it will be necessary to work on several key technical (float technology, data management and delivery system) and organizational (logistics for deployment, coordination of national contributions) issues, to consolidate and broaden the user community and to demonstrate further the impact and utility of the infrastructure for Europe.

The preparatory phase proposal work packages will inter alia focus on:

- the consolidation and strengthening of existing national contributions to the infrastructure.
- the development of a direct EC-wide contribution through Copernicus
- the development of legal and governance arrangements for the Euro-Argo infrastructure
- evaluation and improvement of the European contribution to the Argo data management and de livery system

147 www.ifremer.fr/euro-argo/

- enhancing European float technological capabilities (performances, sensors, communication systems) and working towards using Argo to study aspects of ocean biogeochemistry
- the development of a vigorous European Argo user community
- exploiting the open access to Argo data as an educational "window" on the oceans and their role in climate
- developing new partnerships between European Argo nations, new European countries and nations outside Europe
- integrating the European observing array into the international system
- developing a ten year implementation plan.

8.6.2.2. GROOM[148]

Title	Gliders for Research, Ocean Observation and Management
Instrument	Collaborative project
Total Cost	€ 4 938 338
EU Contribution	€ 3 500 000
Duration	36 months
Start Date	01/10/2011
Consortium	19 partners from 9 countries
Project Coordinator	Laurent Mortier, UNIVERSITE PIERRE-ET- MARIE CURIE, FR
Key Words	Underwater gliders, Marine Research Infrastructure, Ocean Observing System

The objective of the GROOM project is to design a new European Research Infrastructure (RI) that uses underwater gliders for collecting oceanographic data for research applications and oceanic monitoring. This infrastructure will be based on a distributed architecture of gliderports around the European seas and overseas, working in close coordination. This architecture is the required and cost-effective way to operate fleets gliders in combination with other existing observing systems. This infrastructure must be suitable to deploy, maintain and operate individual as well as fleets of gliders continuously for operational monitoring to the benefit of the regional and global ocean observing systems and for a wide range of marine research fields. As an overall objective, the GROOM project will propose a roadmap for a ten year implementation plan of a global glider program.

The expected results of GROOM will comprise:

148 www.groom-fp7.eu

- consolidation of the fragmented infrastructure into one coherent system, but keeping the individual Member States identity and responsibility,
- increase of the scientific benefit for users of the infrastructure by, for example, defining protocols and standards, ensuring interoperability, opening the infrastructure for outside users, establishing an adequate data distribution system,
- provision of the basis for establishing the detailed plans for a new glider legal infrastructure by evaluating the existing legal and financial models against the requirements of a glider infrastructure
- communication to European stakeholders and international bodies active with marine research infrastructure and observing systems via publications in respective journals and via international oversight committees
- tests and operations at sea of tools and methods, as well of new research strategies (new sensors, fleet deployments). The existing national RIs will manage these tests in European seas and overseas, resulting in an early stage of a future European RI.

8.6.2.3. MESOAQUA[149]

Title	Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean
Instrument	Collaborative project and coordination and support action
Total Cost	€ 4 559 470
EU Contribution	€ 3 500 000
Duration	48 months
Start Date	01/01/2009
Consortium	5 partners from 5 countries
Project Coordinator	University of Bergen, NO
Key Words	Marine ecosystems, pelagic food web

Mesocosm science requires a relatively costly and complex infrastructure that has only been developed in a limited number of almost exclusively land-based and in-shore locations around the world. Transfer of know-how, data and training between these facilities has been limited and mainly dependent on personal contacts. To meet this shortfall, MESOAQUA worked in synergy to strengthen experimental ecology as a discipline within European and international marine science. The overall objectives of MESOAQUA are to: offer researchers access to a range of leading mesocosm facilities in contrasting environments from the Arctic to the Mediterranean; develop and test new technologies that allow access to off-shore environments; improve the services of the facilities through the exchange of technology and

149 http://www.mesoaqua.eu/

experience; facilitate cross-disciplinary fertilisation, transnational network building and a better coordination of mesocosm research; train young scientists in the use of experimental ecosystem research.

During four years, MESOAQUA offered to more than 150 European and not-European marine scientists, access to its mesocosm facilities where they were leading or contributing to 23 different mesocosm experiments. MESOAQUA advanced the state-of-the-art of mesocosm technology and expanded the range of environments in which they can be used, collaborating to the development and test of two state-of-the art mesocosm platforms that can be used for open ocean research. MESAQUA has tremendously increased the research standard of the European mesocosm facilities through an inter-facility transfer of technology and dissemination of knowledge. MESOAQUA has successfully optimized the effectiveness and enhanced the exchange of information and dissemination of knowledge about mesocosm research, by creating a mailing list (≈ 500 contacts) and a web portal (http://mesoaqua.eu) that function as an international information hub for establishing new contacts and for coordination of research activities.

8.6.3. Arctic research

8.6.3.1. SIOS[150]

Title	Svalbard Integrated Earth Observing System - Preparatory Phase
Instrument	Construction of New Research Infrastructures - Preparatory Phase
Total Cost	€ 6 675 481
EU Contribution	€ 3 999 965
Duration	48 months
Start Date	01/10/2010
Consortium	26 partners from 14 countries, plus 23 associated partners from additional 5 countries
Project Coordinator	Jon Børre Ørbæk
Key Words	Arctic, Research Infrastructure, Earth System Science, Climate Change, Environmental Change, ESFRI Roadmap

SIOS shall be a regional observational sys- tem for long term acquisition and proliferation of fundamental knowledge on global environmental change within an Earth System Science (ESS) perspective in and around Svalbard. SIOS aims to be the world's leading large-scale research infrastructure in the Arctic, and will provide state-of-the-art research services and observations to the international polar research community.

SIOS will:

150 www.sios-svalbard.org

- improve collaboration and formalise scientific and observational integration between the extensive existing research infrastructures already in place in Svalbard.
- provide a regional, world class, integrated observing system for long-term acquisition of fundamental data about global environmental change in an Earth System Science perspective.
- provide better coordinated services for the international research community with respect to access to infrastructure, data and knowledge, sharing of data, logistics, training and education.
- establish close coordination with other ESFRI projects with Arctic nodes, regional research networks in the European Arctic and contribute to the realisation of a pan-Arctic Observing Network (SAON), as endorsed by the Arctic Council.

The fact that Svalbard is hosting a unique set of international research stations in all fields of natural science, contributes to better understand the multitude of environmental arctic change. The integration and structuring of coordinated observations with clear scientific goals, is the means of SIOS to achieve an understanding of the coupled and underlying processes in global change. SIOS thus supply added value to all the investors beyond what their own investments would provide in solitude, and the enhancements of the research infrastructure shall be made to achieve this.

SIOS will set an example for how to systematically construct observational networks in the Arctic. The joint services offered by SIOS will generate added value for all partners and benefit the international polar research community as a whole. SIOS will establish an experimental environment where it will be attractive to perform shorter term basic and applied research against the combined back- drop of both the core measurement program and the services provided by the Knowledge Center. The nature of such basic and applied research will not be restricted by SIOS but can potentially inform subsequent evolution of SIOS monitoring activities.

SIOS thus contributes to further develop the research infrastructure in and around Svalbard into the leading polar research infra- structure in the Arctic.

8.6.3.2. INTERACT[151]

Title	International Network for Terrestrial Research and Monitoring in the Arctic
Instrument	Research Infrastructures for Polar research
Total Cost	€ 9 362 620
EU Contribution	€ 7 300 000
Duration	48 Months
Start Date	01/01/2011

151 http://www.eu-interact.org/

Title	International Network for Terrestrial Research and Monitoring in the Arctic
Consortium	32 partners from 12 countries and 20 Observer Stations
Project Coordinator	Terry Callaghan
Key Words	Climate change, changes in the cryosphere, biosphere, feedback mechanisms, trans-national access to the whole Arctic, research station's managers forum, improving monitoring technology, improving data access and outreach

INTERACT has a main objective to build capacity for identifying, understanding, predicting and responding to diverse environmental changes throughout the wide environmental and land-use envelopes of the Arctic. Implicit is the aim to build capacity for monitoring, research, education and outreach.

Detailed objectives include sustaining the current observing capacity of existing infrastructures and their networking activities throughout the Arctic, expanding this observing capacity by responding to new needs from the research, assessment and wider stakeholder communities, improving the efficiency of observing by developing and deploying new observing technologies implemented with standard protocols, and making archived and new observations more accessible to a wide range of users. Further- more, INTERACT aims to generate increased research activity by increasing access to the Arctic for researchers and to provide legacy by engaging the next generation of researchers in collaborative educational activities. INTERACT aims to provide outreach to relevant local, regional and global stakeholders.

INTERACT has already increased the capacity for monitoring, research, education and out-reach in the Arctic. INTERACT has grown from 33 to over 50 research infrastructures (and is still growing) in all arctic countries. Almost all the major northern terrestrial infrastructures in the North will be collaborating within INTERACT. The INTERACT Stations are strategically sampling the environmental space of the Arctic. The one-stop-shop provides immediate and simple access to terrestrial facilities, activities and information from the whole environmental envelope, as well as a rapid response system to record extreme events with potentially large impacts. Within the first two years 360 researchers have received access to 20 research stations.

INTERACT has become a major initiative recognised at local, regional and global levels. It is a task within SAON and is contributing to GEO. It has been endorsed by all major Arctic initiatives.

8.6.4. Biodiversity

8.6.4.1. ANAEE

Title	Infrastructure for Analysis and Experimentation on Ecosystems
Instrument	Collaborative project and coordination and support action
Total Cost	€ 4 787 692
EU Contribution	€ 3 400 000
Duration	42 months
Start Date	01/11/2012
Consortium	13 partners from 10 countries
Project Coordinator	Abad Chabbi
Key Words	Research infrastructure, ecosystem, experimental, distributed infrastructure, in natura platform, in vitro platform, ecotron, modelling platform, analytical platform, roadmap, governance, legal framework, business plan, innovation

AnaEE will provide Europe with a distributed and coordinated set of in natura and in vitro experimental sites covering the full range of Europe's ecosystems and climate zones. These highly-equipped sites will be linked to centralised state-of-the-art analytical and modelling platforms that will analyse and predict in a precise manner the response of the main continental ecosystems to environ- mental and land use changes.

AnaEE is on the ESFRI (European Strategy Forum on Research Infrastructures) roadmap and will be rolled out in three phases:

- preparatory Phase (2012 to 2016)
- construction Phase (2014 to 2018)
- implementation Phase (2018 onwards).

AnaEE will provide scientists with a unique platform to conduct experimental research into climate, land use and global changes. The integrated experimental, modelling and analytical facilities within AnaEE will allow scientists to manipulate drivers using state-of-the-art techniques in a highly inter- disciplinary research environment and generate high quality data and projections on continental ecosystems responses to global changes.

AnaEE will provide industry actors with opportunities to develop new technologies as part of this state-of-art experimental plat- form enabling them to develop new products, expand markets and consequently create jobs and socio-economic benefits for society at wide.

AnaEE will provide policy makers with the capacity to acclimate and mitigate the effects of climate change by providing them with the quality data, analyses and forecasts needed to make informed decisions on environmental and land-use regulation and policies.

8.6.4.2. TREES4FUTURE[152]

Title	Designing Trees for the Future
Instrument	Research Infra-structures Integrating Activity
Total Cost	€ 9 059 348
EU Contribution	3 7 000 000
Duration	48 months
Start Date	01/11/2011
Consortium	28 partners from 13 countries
Project Coordinator	Dr. Luc E. Pâques, INRA, FR
Key Words	Forest, Infrastructure, Breeding, Wood Quality, Climate Change, Adaptation, Innovation, Genetics, Biological Resources, Wood Technology, GIS, Modelling, Databases, Economy, Environment

The project partners of Trees4Future represent a wide range of expertise from the tree/population scale to the forestry land- scape scale. Trees4Future will develop new integrated facilities and research tools, in addition to providing trans-national access (TNA) to their research infrastructures. The results of their joint research effort will help the European forestry sector respond in a sustainable manner to increasing demands for wood products and services (including the preservation of forest biodiversity) in the context of changing climatic conditions.

Trees4Future will develop:

- a user-friendly analytical platform for statistical and genetic data analysis. This will be a novel and unique platform in Europe that will enable forest researchers to have free access to a wider, better performing and integrated way of analysing their datasets, coupled with a data-mining tool
- a platform for molecular analysis. The platform will collect and provide a set of genetic markers and standardised laboratory protocols for genetic identification and fingerprinting of forest resources from several species. It will support the development of a pan-European traceability system for example for forest reproductive material

152 www.trees4future.eu

- a GIS-based decision making tool for better matching forest tree species and varieties to environmental conditions across Europe, in particular in the context of climate change. This tool will also enable breeders to delineate pan-European breeding zones and deployment zones in the frame of collaborative tree improvement programmes
- a clearinghouse with GIS functionality. The research data from national and EU environmental and genetic databases, plots and resources will help improve existing data sources and provide a common reference point to access the data via geo-enabled web services
- integrated compatible modelling tools for prediction of forest wood resources and services. These tools will be interconnected and enriched by integrating genetic information as well as wood quality models in order to better assess forest goods and services and their sustainability in relation to management practices and changes in environment. They will help with evaluating adaptation and mitigation strategies for European forests
- high-throughput phenotyping methodologies. For some key-traits linked to tree adaptation and wood properties, improved or innovative assessment methods or tools will be developed to increase phenotyping capacity, compatible with new needs in genetic studies and genomic selection for example. Several of these outcomes together with TNA infrastructures should further support the creation of a European Tree Breeding Centre envisioned in the preceding project TREEBREEDEX.

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

Key Developments

The EU has been investing a significant amount of effort and resources to increase the awareness of the Europeans to the challenges posed by the impacts of climate change and to the opportunities arising from, in particular, reducing greenhouse gas emissions. Actions in the field of education and training, in addition to awareness raising campaigns, have played a major role.

The key developments and highlights since NC5 are:

- The EU-wide awareness-raising campaigns
    - You Control Climate Change (2005 to 2009) and
    - A world you like with a climate you like
- Lifelong Learning Programme – Education and training components
- Intelligent Energy Europe Programme - Education and training components
- Sustainable Energy Europe Campaign
- Covenant of Mayors
- European Mobility Week
- Green Week
- The involvement of stakeholders in the decision making process (namely on the EU strategy on adaptation to climate change and the Roadmap for moving to a competitive low-carbon economy in 2050)

9.1. Introduction and general policy toward education, training and public awareness

This chapter on education, training and public awareness has been structured in order to be as consistent as possible with the structure proposed by the UNFCCC reporting guidelines, thus enhancing comparability with reports by other Parties and facilitating the task of the expert review team.

The chapter focuses on key aspects related to education, training public awareness and support to developing country partners on matters related to Article 6 of the Convention. In order to keep the chapter concise, only a brief description of the most relevant activities is included. In most cases the internet address of the activities is provided, thus facilitating access to additional information.

In the European Union, responsibility for education and training policy lies with Member States. The EU's role is to support the improvement of national systems through complementary EU level tools, mutual learning, exchange of good practices and financial support.

The Member States' 6th National Communications report on details of education and training activities at the national level. Nevertheless, the EU supports the Member States' activities under different programmes and actions. Therefore, the EU 6th National Communication

reports not only on public awareness activities, but also on education and training activities at the EU level.

9.2. Primary, secondary and higher education

Activities on primary, secondary and higher education comprise

- The Lifelong Learning Programme
- The Intelligent Energy Europe Programme

9.2.1. Lifelong Learning Programme - Education[153]

http://ec.europa.eu/education/lifelong-learning-programme/doc78_en.htm

The European Commission's Lifelong Learning Programme enables people at all stages of their lives to take part in stimulating learning experiences, as well as helping to develop the education and training sector across Europe.

With a budget of nearly € 7 billion for 2007 to 2013, the programme funds a range of actions including exchanges, study visits and networking activities. Projects are intended not only for individual students and learners, but also for teachers, trainers and all others involved in education and training.

There are several sub-programmes with environment, sustainability and climate change related activities:

- Comenius: Environmental sustainability training for children through online simulation, exploration and collaboration;
- Erasmus: The lived experience of climate change: interdisciplinary e-module development and virtual mobility;
- Erasmus: Development of MSc programme in environmental security and management (available in several languages).

9.2.2. Intelligent Energy Europe Programme - Education[154]

http://ec.europa.eu/energy/intelligent/

Intelligent Energy – Europe (IEE) offers a helping hand to organisations willing to improve energy sustainability. Launched by the European Commission in 2003, the programme is part of a broad push to create an energy-intelligent future. It supports EU energy efficiency and renewable energy policies, with a view to reaching the EU 2020 targets (20 % cut in greenhouse gas emissions, 20 % improvement in energy efficiency and 20% of renewable energy sources in EU energy consumption).

In an effort to help young children understand many of the issues behind climate change, the programme has supported a number of decentralised, practical, grassroots schemes which promote energy education in primary schools all over Europe. The projects bring together local experts on energy efficiency and the children's teachers to run entertaining and informative classes on energy-saving issues.

153 The Lifelong Learning Programme also has a focus on training, which is dealt with in the relevant section of this chapter.

154 The Intelligent Energy Europe Programme also has a focus on training, which is dealt with in the relevant section of this chapter.

9.2.3. European Environment Agency (EEA) initiatives on education and training on climate change

The EEA, an agency of the European Union, addresses many audiences through its communication activities, including children and young people. Various products and events are used to communicate about climate change and other environmental topics in a creative and educational manner.

Between 2008 and 2012 the main actions of the EEA in terms of education on climate change were:

- Eco Agents, the EEA educational 'flagship' targeting children, is a website in the form of a comic strip. It included downloadable quizzes on climate change and a library of related links, among other things. The intended target audience is 9-12 year old children across Europe. Eco Agents is available in 24 languages.
- EEA and Eco Schools collaboration. In October 2007, the EEA and the Eco Schools network held a workshop to develop educational environmental material on climate change, biodiversity and sustainable lifestyle. The target audience is teachers of 9-14 year-old children across Europe. The process continued over the 2008-2012 period.

9.3. Public information campaigns

The European Commission has carried out several EU-wide public information and awareness-raising campaigns that are of direct or indirect relevance to climate change.

Many of the campaigns make considerable use of the internet and social media tools, but all also include opportunities for personal live interaction. The campaigns employ websites, Facebook pages, Twitter feeds, video productions, seminars, workshops and other types of live events.

The main campaigns undertaken during the reporting period were:

- You Control Climate Change
- A world you like with a climate you like
- Sustainable Energy Europe Campaign
- Resource Efficiency Campaign
- Biodiversity Campaign
- Covenant of Mayors
- European Mobility Week
- Green Week
- European Business Awards for the Environment
- European Green Capital Award

9.3.1. You Control Climate Change

http://ec.europa.eu/clima/sites/campaign/index.htm

The European Commission launched this public awareness raising campaign in May 2006. The campaign aimed to give people a sense of responsibility, among other things by providing practical tips on how small changes to daily habits can achieve collectively significant reductions in GHG emissions.

The campaign used a wide variety of supports to reach a broad public, especially young people. The campaign website, available in 21 language versions, was the cornerstone of the campaign and the place where all the resources and information were available.[155] Other supports included videos, publications, advertising (TV, cinema, newspaper, online, outdoor), posters, applications (screen saver, carbon calculator), game (Living together!), news articles, and video podcasts.

The campaign was carried out in 3 phases from 2006 to 2009, with a budget of approximately €7.2 million.

9.3.2. A world you like, with a climate you like

http://world-you-like.europa.eu/en/

A world you like, with a climate you like is the European Commission's latest pan-European public communication campaign on climate change. Focused on practical solutions to climate change, it ran from October 2011 to December 2012.

The campaign's central message was that making the transition to low-carbon society is not only urgent but also feasible, affordable and will enhance our quality of life. The campaign showcases and promotes dialogue on existing solutions and best practices applied by citizens, businesses and authorities across the European Union. It covered five areas: travel and transport; production and innovation; building and living; shopping and eating; and re-use and recycling.

The campaign was centred on an interactive, user friendly website in 23 languages which featured background information on the low-carbon society, videos of success stories for each Member State and information on the campaign events. The website also had a dedicated section about the more than 250 partner organisations which support the campaign by promoting it through their own networks and events.

Through the campaign the Commission wanted to hear from Europeans about their expectations and success stories. For this purpose, the World You Like Challenge was set up to find and reward the most creative, efficient, inspiring and practical solutions to reduce greenhouse gas emissions. Some 269 projects took part. Following a public vote from which a shortlist of best projects was compiled, one European winner as well as one national winner for Bulgaria, Italy, Lithuania, Poland and Portugal and three European level winners were chosen.

In addition, through the campaign website and a range of social media channels (Facebook, Twitter, YouTube, Flickr and Pinterest), people were able to discuss Europe's low-carbon future with other Europeans including Connie Hedegaard, European Commissioner for Climate Action. Commissioner Hedegaard also participated personally in more than 10 events in different EU Member States.

9.3.3. Sustainable Energy Europe Campaign

http://www.eusew.eu/index.php

155 http://ec.europa.eu/environment/climat/campaign/index_en.htm

The Sustainable Energy Europe Campaign (2005-2011 and 2012-2015) is a European Commission initiative to raise public awareness and promote sustainable energy production and use across Europe. The campaign showcases activities dedicated to energy efficiency and renewable energy solutions. The focus is on spreading best practice in sustainable energy technology, building alliances and inspiring new energy ideas and actions.

The annual highlight of the campaign is Sustainable Energy Week, which consists of a high level policy conference held in Brussels and a series of local Energy Days for the general public throughout Europe, organised by municipalities, regions and other stakeholders.

9.3.4. Resource Efficiency Campaign

www.generationawake.eu

https://www.facebook.com/GenerationAwake

"Generation Awake. Your choices make a world of difference!" is an EU campaign to encourage consumers to be more efficient in their use of resources. It is raising awareness of the need to use scarce natural resources wisely and encouraging citizens to think about their impact on the planet when making purchasing decisions.

The key message is 'consume differently, and think before you choose'. By making the right choices we can all help preserve natural resources, save money, reduce our impact on the environment and make our future more sustainable.

The main tools are a dedicated multi-lingual website and a Facebook page where visitors are encouraged to join "Generation awake" and accept challenges, like using only public transport for a month or reducing showering time to save water.

9.3.5. Biodiversity Campaign

www.weareallinthistogether.eu

This EU-wide campaign (completed in 2012), raised public awareness of the need to halt the loss of biodiversity, among other things to help combat climate change.

9.3.6. Covenant of Mayors

http://www.covenantofmayors.eu/index_en.html

The Covenant of Mayors initiative encourages local and regional authorities to commit to meet or exceed the EU's target of reducing greenhouse gas emissions by 20 % by 2020. They do so by voluntarily developing Sustainable Energy Action Plans. The Covenant was launched by the European Commission in 2008, and by late November 2013 had been signed by 5 395 local and regional authorities with a combined population of over 176 million people.

For more information, see the Policies and Measures section.

9.3.7. European Mobility Week

http://www.mobilityweek.eu/home/

European Mobility Week is an annual campaign on sustainable urban mobility organised with the political and financial support of the Directorates-General for the Environment and Transport of the European Commission. The campaign, which runs from 16 to 22 September every year, encourages local authorities to introduce and promote sustainable transport measures and to invite their citizens to try out alternatives to car use. As part of the week's

activities many local authorities organise a car-free day where designated areas are reserved solely for pedestrians, cyclists and public transport for the entire day.

Since its introduction in 2002, the impact of European Mobility Week has steadily grown, both across Europe and around the world. In recent years, the campaign has spread to countries outside the EU, including Japan, Taiwan, Brazil, Colombia and Ecuador.

In 2013, 1 930 cities from a record 47 countries in the EU and beyond took part in European Mobility Week. Since 2002 a total of 7 700 permanent measures to improve sustainability have been implemented by participating cities, mainly focussing on infrastructure for cycling and walking, traffic calming, improving transport accessibility and raising awareness about sustainable travel behaviour.

9.3.8. Green Week

http://ec.europa.eu/environment/greenweek/

The European Commission's Green Week is the biggest annual conference on European environment policy. It is open to the public and participation is free of charge.

Green Week offers a unique opportunity for debate and exchanges of experiences and best practice. Over the past decade, the conference has established itself as an unmissable event for anyone involved with protecting the environment. The 2012 edition attracted some 3 100 participants from government, business and industry, non-governmental organisations, academia and the media.

The themes of Green Week over recent years have been:

- 2008 - Sustainable Consumption and Production
- 2009 - Climate Change: act and adapt
- 2010 - Biodiversity – our lifeline
- 2011 - Resource efficiency: using less, living better
- 2012 - Every drop counts: the water challenge
- 2013 – Cleaner air for all

More than 16 000 people and 860 speakers participated in the Green Week events over these five years. The busiest year was 2009 (dedicated to climate change), with more than 4 000 people attending.

9.3.9. European Business Awards for the Environment

http://ec.europa.eu/environment/awards

The European Business Awards for the Environment, presented by the European Commission every two years since 1987, recognise European companies that have made an outstanding contribution to sustainable development.

The competition has four award categories: management, product, process and international co-operation. The scheme rewards companies that set an example in each category through a combination of innovation, economic viability, environmental concern and social responsibility.

To be eligible, companies must first succeed in their national award schemes, which are organised throughout Europe every year. This means that the companies awarded the European prize are 'the best of the best'; the most far-sighted, responsible and innovative across Europe.

9.3.10. European Green Capital Award

http://ec.europa.eu/environment/europeangreencapital/index_en.htm

Europe is an urban society that faces many environmental challenges. The European Commission has long recognised the important role that local authorities play in improving the environment.

The European Green Capital Award has been conceived as an initiative to promote and reward these efforts.

The award aims to provide an incentive for cities to inspire each other and share best practices, while at the same time engaging in friendly competition. In other words, the cities become role models for each other.

Starting in 2010, one European city has been awarded the title of European Green Capital each year. The award is given to a city that:

- has a consistent record of achieving high environmental standards;
- is committed to ongoing and ambitious goals for further environmental improvement and sustainable development; and
- can act as a role model to inspire other cities and promote best practices to all other European cities.

The winners to date are Stockholm (Sweden) 2010, Hamburg (Germany) 2011, Vitoria-Gasteiz (Spain) 2012, Nantes (France) 2013. Copenhagen (Denmark) will be European Green Capital in 2014 and Bristol (United Kingdom) in 2015.

9.3.11. Eurobarometer results on climate change (for 2009 and 2011)

http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1162&format=HTML&aged=1&language=EN&guiLanguage=fr

http://ec.europa.eu/public_opinion/archives/ebs/ebs_322_en.pdf

http://ec.europa.eu/public_opinion/archives/ebs/ebs_372_en.pdf

Two surveys on European's attitudes towards climate change have been published in November 2009 and October 2011 respectively:

Both in 2009 and 2011, Europeans considered climate change to be the second most serious problem the world faced (after poverty, lack of food and drinking water). In 2013, for the first time, the availability of energy was added to the list of issues presented to the respondents. It was cited as a serious issue by 28 % of EU citizens. The perceived seriousness of climate change has increased between the two surveys: while in 2009 the average rating out of 10 for the perceived seriousness of the problem was 7.1; in 2011, the average rating was 7.4.

In 2009, 64 % of respondents believed that citizens themselves were not doing enough to combat climate change. In 2011, however, 53 % reported that they had personally taken some form of action while 41 % stated that they had not. In 2011, almost 80 % (up from the near two-thirds in 2009) consider that taking action to combat climate change can boost the

economy and jobs and over two-thirds support basing taxation to a greater extent on energy use, with a majority in favour of this in every Member State.

There is a widespread expectation that Europe will become a climate-friendly, low-carbon economy by 2050:

- 88% believe Europe will be using more renewable energy;
- 87% expect we will be more energy-efficient; and
- 73% believe cars will be powered more efficiently.

9.3.12. Websites, media and social media

The table below lists the key climate change websites and social media, in addition to those identified in this chapter.

*Table **Error! No text of specified style in document.**-11 Websites, and social media*

Title	**Address**
DG Climate Action	http://ec.europa.eu/dgs/clima/mission/index_en.htm
Connie Hedegaard, Commissioner for Climate Action	http://ec.europa.eu/commission_2010-2014/hedegaard/index_en.htm
Commissioner Hedegaard on Facebook	https://www.facebook.com/ConnieHedegaardEU
Commissioner Hedegaard on Twitter	@CHedegaardEU
Active media outreach through press releases media articles and interviews	http://tinyurl.com/cwms82z (e.g.)
European Climate Adaptation Platform	http://climate-adapt.eea.europa.eu/
Energy strategy 2020	http://ec.europa.eu/energy/energy2020/energy2020_en.htm
Energy efficiency	http://ec.europa.eu/energy/energy2020/efficiency/index_en.htm
Energy-saving light-bulbs	http://ec.europa.eu/energy/lumen/index_en.htm
Emissions trading 'mindstretcher'	http://www.eea.europa.eu/themes/climate/multimedia/emissions-trading-mindstretcher

9.3.13. Publications

The table below lists key climate change publications and their internet address.

*Table **Error! No text of specified style in document.**-12 List of publications*

Title	**Address**
Environment for Europeans magazine (quarterly, circulation 60 000)	http://ec.europa.eu/environment/news/efe/archives.html
Intelligent Energy Europe magazine (bi-annual, 50 000 copies)	http://ec.europa.eu/energy/intelligent/promotional-tools/iee-magazine/index_en.htm
Climate change: fact sheet	http://ec.europa.eu/clima/publications/docs/factsheet-climate-change_en.pdf
The EU Emissions Trading System (EU ETS): fact sheet	http://ec.europa.eu/clima/publications/docs/factsheet_ets_2013_en.pdf
Ensuring safe use of Carbon Capture and Storage in Europe	http://ec.europa.eu/clima/publications/docs/factsheet_ccs_en.pdf
Resource efficiency	http://ec.europa.eu/environment/pubs/pdf/factsheets/resource_efficiency/en.pdf
Sustainable production and consumption	http://ec.europa.eu/environment/pubs/pdf/factsheets/sustainable_consumption.pdf
Eco-innovation	http://ec.europa.eu/environment/pubs/pdf/factsheets/eco_innovation.pdf
Nature's role in climate change	http://ec.europa.eu/environment/pubs/pdf/factsheets/Nature%20and%20Climate%20Change/Nature%20and%20Climate%20Change_EN.pdf
EU Biodiversity strategy	http://ec.europa.eu/environment/nature/info/pubs/docs/factsheets/Biod%20Strategy%20FS.pdf
Ecosystem goods and services	http://ec.europa.eu/environment/pubs/pdf/factsheets/Ecosystems%20goods%20and%20Services/Ecosystem_EN.pdf
Soil: the hidden part of the climate cycle	http://ec.europa.eu/environment/soil/pdf/soil_and_climate.pdf
Ensuring safe use of carbon capture and storage in Europe	http://ec.europa.eu/clima/publications/docs/factsheet_ccs_en.pdf
Renewables make the difference	http://tinyurl.com/cv2q388
Better light with less energy	http://tinyurl.com/d94sy6t
EU fast start funding report 2011	http://ec.europa.eu/clima/policies/finance/international/faststart/docs/fast_start_2011_en.pdf
The EU and developing countries working together	http://ec.europa.eu/europeaid/infopoint/publications/europeaid/244a_en.htm
Global Climate Change Alliance	http://www.gcca.eu/usr/GCCA_English_lo-res-rev.pdf

9.3.13.1.EEA publications

The tables below list the key climate change publications by the European Environment Agency and their internet address.

The general EEA publications page is http://www.eea.europa.eu/publications.

*Table **Error! No text of specified style in document.**-13 EEA regular reports*

Title	Address
EEA Signals (annual)	http://www.eea.europa.eu//publications/eea-signals-2013
2010 state of environment and outlook report	http://www.eea.europa.eu/soer/synthesis/synthesis
Transport and environment (annual)	http://www.eea.europa.eu/publications/foundations-for-greener-transport
EU GHG inventory (annual)	http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2013
GHG trends and projections (annual)	http://www.eea.europa.eu/publications/ghg-trends-and-projections-2013

*Table **Error! No text of specified style in document.**-14 Examples of EEA ad-hoc reports*

Title	Address
Forests, health and climate change	http://www.eea.europa.eu/publications/forests-health-and-climate-change
Regional climate adaptation – the Alps	http://www.eea.europa.eu/publications/alps-climate-change-and-adaptation-2009

9.3.14. Video productions

The table below lists video productions and their internet address.

Title	Address
Feature video on Roadmap for a low-carbon economy	http://tinyurl.com/cq3zxr4
Commissioner Hedegaard video clip ahead of Durban conference	http://tinyurl.com/c5x79vq
Videos on energy efficiency, security and renewables	http://ec.europa.eu/energy/efficiency/publications/index_en.htm http://ec.europa.eu/energy/intelligent/promotional-tools/videos/index_en.htm http://ec.europa.eu/avservices/video/player.cfm?ref=I058287
One Degree Matters (EEA documentary)	http://www.eea.europa.eu/multimedia/films/one-degreematters/view
Environmental Atlas of Europe (EEA)	http://www.eea.europa.eu/atlas/eea
Information videos and green tips (EEA)	http://www.eea.europa.eu/multimedia/climate-change-2014-time-to-act/view http://www.eea.europa.eu/multimedia/green-tipg-tyres/view

9.4. Training programmes

As with education, the EU programmes that are most relevant to training on climate change are

- The Lifelong Learning programme, and
- The Intelligent Energy - Europe Programme.

9.4.1. Lifelong Learning Programme – Training

As stated in section 9.2.1, the European Commission's Lifelong Learning Programme enables people at all stages of life to take part in stimulating learning experiences, as well as helping to develop the education and training sector across Europe.

Two of its two sub-programmes have climate change relevant training activities:

- **Leonardo da Vinci**: Training Mediterranean local authorities and civil organisations on integrated coastal zone management and reaction to the impacts of climate change
- **Leonardo da Vinci**: Training municipal climate protection managers in Central Europe http://www.clipma.eu/

9.4.2. Intelligent Energy Europe Programme - Training

http://ec.europa.eu/energy/intelligent/

As mentioned in section 9.2.2, the Intelligent Energy – Europe (IEE) Programme offers a helping hand to organisations willing to improve energy sustainability.

Intelligent Energy Europe supports a number of training programmes across Europe with a contribution of up to 75 % of the budget. The main training areas are energy saving, building certification, renewable energy technologies, biofuels and sustainable transport. Training or capacity building programmes typically target a variety of actors including local authorities, energy agencies, energy businesses, building professionals, and building owners.

The following are some of the programme's key training initiatives:

- **ManagEnergy Vocational Training corner** on energy efficiency and renewables. ManagEnergy offers a wide range of tools and facilities which aim at enabling best practice sharing, ensuring capacity building and improving networking among energy actors across Europe. http://learn-energy.net/training/#2
- **BUILD UP portal** for energy efficiency in buildings aims at training the construction work force at national level in all Member States. The actions aim at establishing national qualification platforms and roadmaps as well as setting up or upgrading qualification schemes. http://www.buildup.eu/home
- **Training on Sustainable Urban Mobility Plans** for public authorities. Training materials have been developed and training workshops took place in 2012 in many EU Member States. http://mobilityplans.eu/index.php?ID1=9&id=9
- **EDUCATE**: Promoting and disseminating sustainable practices in architecture.
- **UP-RES** (Urban planners with renewable energy skills): Workshops and professional development programmes on energy issues to train urban and regional planners in five countries (Hungary, Finland, Spain, United Kingdom and Germany).

- **ECOWILL**: Roll-out of eco-driving training courses.
- **TRANSPORT LEARNING**: Training to help transport professionals achieve energy savings in urban transport.

9.4.3. ManagEnergy

http://www.managenergy.net/

ManagEnergy is a technical support initiative financed under the Intelligent Energy - Europe programme and managed by the European Commission's Executive Agency for Competitiveness and Innovation (EACI). It supports local and regional energy actions in the fields of energy efficiency and renewable energy. Its main target groups include local and regional public authorities, energy agencies and other organisations. It was launched in 2002 following requests for improved communication and information on locally relevant sustainable energy issues.

ManagEnergy offers a wide range of tools and facilities, which aim at enabling best practice sharing, ensuring capacity building and improving networking among energy actors across Europe.

They include training resources, technical workshops tailored to local and regional needs, an annual award competition for case studies, high-quality publications, networking events at the European and local scale as well as an interactive website with policy and funding information, cutting-edge partner search tools, interactive maps, project databases, audiovisual libraries and capacity building resources.

9.5. Resource or information centres

It is the EU's policy to make all relevant information publicly available. For a list of publications and websites, please refer to the respective sections above.

9.6. Involvement of the public and non-governmental organisations

EU law requires extensive engagement and consultation of stakeholders during the policy-making process. The following two examples illustrate stakeholder engagement and consultation in the process of formulating EU mitigation and adaptation policies. Both policy initiatives were preceded by wide-ranging consultation and benefited from a broad spectrum of scientific and policy expertise.

9.6.1. EU strategy on adaptation to climate change

http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_en.pdf

The preparation of the Adaptation Strategy, adopted by the European Commission in April 2013, included the following steps:

- Consultation with the Adaptation Steering Group: This group was created in September 2010 to support the Commission in developing its approach to adaptation. The ASG consists of representatives from EU Member States and a wide range of stakeholders, including business organisations and NGOs. The Group met seven times between September 2010 and January 2013.
- Ad hoc online public consultation: This ran for 13 weeks between May and August 2012. The Commission received a total of 175 replies from a broad range of

stakeholders, including Member States, business organisations, environmental NGOs and citizens.

- Thematic seminars: Various events were held in 2012 to consult Member States and key stakeholder groups on specific dimensions of the Adaptation Strategy (e.g. standards, forestry).

9.6.2. A Roadmap for moving to a competitive low-carbon economy in 2050

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0288:FIN:EN:PDF

Prior to adopting the Roadmap in March 2011, the European Commission consulted stakeholders through an online questionnaire on their vision and views regarding an EU low-carbon economy by 2050. To prepare its impact assessment of the Roadmap, a review was undertaken of reports published by the end of 2010 on how to decarbonise the economy and society.

9.7. International Cooperation on Education, Training and Public Awareness

9.7.1. Amended New Delhi Work Programme on Article 6 of the Convention

The European Union contributed actively to the intermediate and final reviews of the Amended New Delhi Work Programme on Article 6 of the Convention (education, training and public awareness) and to the elaboration in 2012 of its successor, the Doha Work Programme on Article 6. This was carried out through written submissions and active EU participation in Article 6 negotiations.

The EU also provided funding to the UNFCCC Secretariat for Article 6 activities. The main activities supported in 2012 were the workshop on the implementation of Article 6 in least developed countries, held in Bonn on 19-21 June 2012, in which the EU's Focal Point on Article 6 took part, and youth participation at COP 18/CMP 8 in Doha.

The European regional workshop on Article 6 was held in Stockholm, Sweden – an EU Member State – on 18-20 May 2009.

9.7.2. Article 6-related international cooperation activities

The EU has been actively supporting a number of activities to implement Article 6 in developing countries and other third countries. More specific details about the EU's international cooperation on climate change are provided in the respective section. Below is a list of examples of EU-supported activities relating to education, training and public awareness in third countries.

9.7.2.1. Global Climate Change Alliance (GCCA)

http://www.gcca.eu/pages/1_2-Home.html

The GCCA was launched by the European Commission in 2007 to strengthen dialogue and cooperation on climate change between the EU and the most vulnerable developing countries, particularly least developed countries and small island developing states (for more information on the GCCA see the chapter on international cooperation on adaptation).

Mainstreaming climate action into development and poverty reduction is a key focus of GCCA training activities. In 2011 and 2012 the GCCA held training workshops on mainstreaming climate change into national development planning and budgeting in all its regions. Around 200 senior officials from finance, planning and environment ministries participated.

9.7.2.2. Climate Change Media Partnership

http://www.climatemediapartnership.org/about/

The Climate Media Partnership, set up by Internews, Panos and the International Institute for Environment and Development (IIED), aims to improve media coverage of climate change issues in developing countries. The EU provided funding of € 768 000 for the 2009 to 2011 period.

9.7.2.3. World Bank Partnership for Market Readiness (WBPMR)

The EU's contribution to the WBMPR, for the 2011-2016 period, amounts to € 5 million for capacity building in developing countries, including the organisation of training workshops to help countries build expertise in market mechanisms.

9.7.2.4. Supporting access to information and justice on environmental matters in Kyrgyz Republic

The EU has provided support amounting to € 270 000 for civil society capacity-building on environment, including training of NGOs, regional environment protection departments, local governments and judiciary. The funding took place between 2008 and 2011.

9.7.2.5. Programme for environmental awareness raising in Central Asia (AWARE)

The AWARE programme aims at supporting environmental awareness in Central Asia and enhancing regional cooperation and partnership with Europe regarding environmental awareness on the most problematic environmental areas, including climate change. The EU's contribution amounted to € 800 000 for the 2011-2013 period.

9.7.2.6. Strengthening Capacity in Developing Countries for Training Purposes on Climate Change project

http://www.c3d-unitar.org

The project Capacity Development for Adaptation to Climate Change & GHG Mitigation in Non-Annex I Countries (C3D) seeks to improve the capacity of research and training institutions in developing countries to support climate change adaptation and mitigation action. The project is run by the UN Institute for Training and Research (UNITAR).

The EU provided funding of € 1.4 million over the period 2006-2009.

9.7.2.7. The CLARIS LPB Project

http://www.claris-eu.org

The CLARIS LPB Project aims at predicting the regional climate change impacts on La Plata Basin (LPB) in South America, and at designing adaptation strategies for land-use, agriculture, rural development, hydropower production, river transportation, water resources and ecological systems in wetlands.

One of the CLARIS LPB project objectives has been to train young South American students and scientists in European institutes through grants allocated each year.

9.7.2.8. Group on Earth Observations (GEO)[156]

The Group on Earth Observations is coordinating efforts to build a Global Earth Observation System of Systems, or GEOSS and aims at, among other objectives, developing capacity-building activities in the domain of earth observation, providing support to international research initiatives in which Europe would contribute to the development of observing systems.

Within it, specifically, the purpose of the GEO Network for Capacity Building (GEONetCab) project is to create the conditions for the improvement and increase of the GEO (Group on Earth Observations) capacity building activities and framework, with special emphasis on developing countries, new EU member states (and EU neighbouring states). This applies particularly to climate monitoring and increasing the effectiveness and efficiency of GEO capacity building for application in the GEO societal benefit areas.

156 For more information on GEO, please see section 8.5.1

10. LIST OF ABBREVIATIONS

AAU	Assigned Amount Unit
AEA	Annual Emission Allowances
AMESD	African Monitoring of Environment for Sustainable Development
Art	Article
BAM	baseline scenario of EUCLIMIT
BR	Biennial report
BR1	1st Biennial report
BRICS	Brazil, Russia, India, China and South Africa
CAP	Common Agricultural Policy
CB	Capacity building
CCC	Climate Change Committee (under the Monitoring Mechanism Decision)
CCCA	Cambodia Climate Change Alliance
CCPMs	Common and Coordinated Policies and Measures
CCS	Carbon Capture and storage
CDM	Clean Development Mechanism
CEOS	Committee on Earth Observation Satellites
CER	Certified Emission Reduction
CIF	Climate Investment Funds
CION	European Commission
CITL	Community Independent Transaction Log
CM	Cropland Management
CM SAF	Satellite Application Facility on Climate Monitoring
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalents
COP	Conference of Parties
COSME	Programme for the Competitiveness of enterprises and SMEs
COSPAR	Committee on Space Research
CP	Commitment Period
CPA	Classification of products by activity in the European Union
CRF	Common Reporting Format
CTF	Common Tabular Format
DCs	Developing countries
DDC	District Development Committee
DG	Directorate-General
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EAP	Environment Action Programme
ECMWF	European Centre for Medium range Weather Forecasting
ECU	European Currency Unit
ECV	Essential Climate Variable

EDCTP	European and Developing Countries Clinical Trials Partnership
EEA	European Environment Agency
EEAS	European External Action Service
Eionet	European Environment Information and Observation Network
EIT	Economy in transition
EMU	Economic and Monetary Union
EO	Earth Observation
EP	European Parliament
ERA	European Research Area
ERA-NET	European Research Area Net
ERC	European Research Council
ERDF	European Regional Development Fund
ERT	Expert Review Team
ERU	Emission Reduction Unit
ESA	European Space Agency
ESD	Effort Sharing Decision
ESF	European Social Fund
ESSP	Earth System Science Partnership
ETAP	EU Environmental Technologies Action Plan
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation
ETS	Emission trading scheme
EU ETS	The European Union's emission trading scheme
EU	European Union
EUCLIMIT	Development and application of EU economy-wide climate mitigation modelling capacity (project)
EU-13	The new EU Member States: Estonia, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Czech Republic, Hungary, Cyprus (joined 2004); Bulgaria, Romania (joined 2007), Croatia (joined 2013)
EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom
EU-27	EU-15 plus Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia,
EU-28	EU-27 plus Croatia
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUR	Euro
EURATOM	European Atomic Energy Community
FACCE-JPI	Joint Programming Initiative Agriculture, Food Security and Climate Change
FCDR	Fundamental Climate Data Records
FlexMechs	Flexible Mechanisms under the Kyoto Protocol
FM	Forest Management
FP	Framework Programme
FP6	6th Framework Programme
FP7	7th Framework Programme

FSF	Fast Start Financing
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GHG	Greenhouse Gases
GIS	Geographical Information Systems
GM	Grazing Land Management
GVA	Gross Value Added
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IA	Impact Assessment
IAB	Impact Assessment Board
ICPC	International Cooperation Partner Countries
ICSU	International Council for Science
IDR	In Depth Review
IET	International Emissions Trading
IOCCG	International Ocean Colour Coordinating Group
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental panel on climate change
JI	Joint Implementation
JPI	Joint Programming Initiative
JRC	Joint Research Centre
koe	Kilograms of Oil Equivalents
KP	Kyoto Protocol
LBA	Legally-Binding Agreement
lCER	Long-term Certified Emission Reduction
LDCF	Least Developed Countries Fund
LDCs	Least developed countries
LECB	Low Emission Capacity-Building Programme
LEDS	Low-Emission Development Strategies
LULUCF	Land use, land use Change and Forestry
MESA	Monitoring of Environment and Security in Africa
MISR	Multi-angle Imaging SpectroRadiometer
MMD	Monitoring Mechanism Decision
MMR	Monitoring Mechanism Regulation
MRV	Monitoring, Reporting and Verification
MS	EU Member State
MSG	Meteosat Second Generation
Mt	Megatonnes

Mtoe	Megatonnes of oil equivalent
N_2O	Nitrous Oxide
NACE	Statistical classification of economic activities in the European Union
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NAS	National Adaptation Strategy
NASA	National Aeronautics and Space Administration
NC	National Communication
NC4	4th National Communication
NC5	5th National Communication
NC6	6th National Communication
NCCC	National Climate Change Committee
NCCSP	Nepal Climate Change Support Programme
NCGHG	non-CO_2 greenhouse gas
NEC	National Emissions Ceiling
NER	New Entrant Reserve
NF_3	Nitrogen Trifluoride
NIR	National Inventory Report
NMVOC	Non-methane volatile organic compounds
NREAP	National Renewable Energy Action Plan
NOx	Nitrogen oxides
ODA	Official Development Assistance
PaMs	Policies and measures
PASAP	Peri-urban water and sanitation programme
PFCs	Perfluorocarbons
QELRC	quantified emission limitation and reduction commitment
RMU	Removal Unit
RSO	Research and Systematic Observation
RV	Revegetation
SAF	Satellite Application Facility
SANSA	South African National Space Agency
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SDS	Sustainable Development Strategy
SEF	Standard Electronic Format for reporting Kyoto Protocol units
SF_6	Sulphur Hexafluoride
SICA	Specific International Cooperation Actions
SME	Small and Medium-sized Enterprises
SO_2	Sulphur Dioxide
SPP	Strategic Planning and Programming

tCER	Temporary Certified Emission Reduction
TFEU	Treaty on the Functioning of the European Union
toe	Tonnes of Oil Equivalents
TT	Technology transfer
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations framework convention on climate change
USD	United States of America Dollars
VDC	Village Development Committee
VE	Verified emissions
WAM	With additional measures scenario
WCRP	World Climate Research Programme
WEM	With existing measures scenario
WG I	Working Group I under the CCC
WG II	Working Group II under the CCC
WOM	Without measures scenario

11. APPENDIX: SUMMARY OF REPORTING OF SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2 OF THE KYOTO PROTOCOL.

Information reported under Article 7 paragraph 2	National Communication section(s)
National systems in accordance with Article 5, paragraph 1	3.3
National registry	3.4
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	4.3.2, 4.3.3, 5.5
Policies and measures in accordance with Article 2	4.3.4
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	4.2.5
Information under Article 10	
Art 10, para a (efforts to improve emissions inventories)	3.3
Art 10, para b (policy action on mitigation AND adaptation measures)	4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 6.4
Art 10, para c (Activities related to transfer of technology)	7.6, 7.7
Art 10, para d (Activities related to systematic observation)	8.2, 8.3
Art 10e (Activities related to international education and training, and national level public awareness)	9.3, 9.7
Financial Resources	7.2, 7.3, 7.4