

WP4000 Status Quo Report


Water

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Acronyms


ACQWA	Assessing Climate impacts on the Quantity and quality of Water (FP7)
ADEOS-II	JAXA Advanced Earth Observing Satellite-II
AEGOS	African-European Georesources Observation System
AMESD	African Monitoring of the Environment for Sustainable Development
AMSR	Advanced Microwave Scanning Radiometer
AQUASTAT	FAO's Information System on Water and Agriculture
ASCAT	Advanced Scatterometer (on MetOp)
BALTEX	The Baltic Sea Experiment
BALWOIS	Water Observation and Information System for Balkan Countries
BfG	German Federal Institute of Hydrology
BIOFRESH	Biodiversity of freshwater ecosystems: Status, trends, pressures, and conservation priorities
BRAHMATWINN	Twinning European and South Asian River basins to enhance capacity and implement adaptive integrated water resources management approaches
CEOP-AEGIS	Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations (FP7)
CEOS	Committee on Earth Observation Satellites
CHy	WMO Commission for Hydrology
CLIMATEWATER	Bridging the gap between adaptation strategies of climate change impacts and European water policies
CLIMB	Climate Induced Changes on the Hydrology of Mediterranean Basins
COMENVIR	Communicating environmental impacts on water quality, availability and use
CoP	Community of Practice
CORDIS	Community Research and Development Information Service
CTRH	Center of Technological Research Hellas
DEM	Digital Elevation Model
DevCoCast	GEONETCast for and by Developing Countries
DLR-DFD	German Aerospace Centre - Remote Sensing Data Centre
DWD	Deutscher Wetterdienst
EARS	Environmental Agency of the Republic of Slovenia
EC	European Commission
ECMWF	European Centre for Medium Range Weather Forecasts
Ecohydrology	A scientific programme to understand the dynamic relationships between hydrological, social and ecological systems
ECV	Essential Climate Variable
EDO	European Drought Observatory
EEA	European Environment Agency
EFAS	European Flood Alert System
EMWIS	Euro-Mediterranean Information System on know-how in the Water sector

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EO	Earth Observation
ERA-NET	EUWI Research Area Network
ERCE	European Regional Centre for Ecohydrology
ESSP	Earth System Science Partnership
ETC/W	European Topic Centre on Water
ETN-R	European Terrestrial Network for River Discharge
EUMETCast	EUMETSAT's Broadcast System for Environmental Data
EUMETNET	Network of European Meteorological Services
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EurAqua	European Network of Freshwater Research Organisation
EURO-FRIEND	Flow Regimes from International Experimental and Network Data (Europe)
EuroGEOSS	European approach to the Global Earth Observation System of Systems (FP7)
EUROWET	Integration of European Wetland Research in sustainable management of the water cycle
EU-WATCH	Water and Global Change
EUWI	European Water Initiative
ESA	European Space Agency
EWA	European Water Archive
FAO	Food and Agriculture Organization
FRIEND	Flow Regimes from International Experimental and Network Data
G8	Group of Eight
GAW	WMO Global Atmospheric Watch
GCOS	Global Climate Observing System
GENESIS	Groundwater and dependent Ecosystems: NEw Scientific basIS on climate change and land-use impacts for the update of the EU Groundwater Directive
GEO	Group on Earth Observation
GEMS Water	Global Environment Monitoring System Water
GEOLAND	GMES integrated project on land cover and vegetation
GEOLAND-2	GMES preoperational Land Monitoring Service
GEOSS	Global Earth Observation System of Systems
GEWEX	Global Energy and Water Cycle Experiment
GKSS	GKSS Research Centre
GLAS	Geoscience Laser Altimeter System
GlobCorine	Corine-compatible land cover/use service
GMES	Global Monitoring for Environment and Security
GNU	GMES Network of Users
GOS	WMO Global Observing System
GOOS	IOC/WMO/UNEP/ICSU Global Ocean Observing System
GPCC	WMO Global Precipitation Climatology Centre
GRACE	Gravity Recovery and Climate Experiment

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GRAPHIC	Groundwater Resources Assessment under the Pressures of Humanity and Climate Change
GRDC	Global Runoff Data Centre
GSE Land	GMES Service Element Land
GT-NET	Global Terrestrial Observing Network
GTN-G	Global Terrestrial Network – Glaciers
GTN-H	Global Terrestrial Network – Hydrology
GTN-L	Global Terrestrial Network – Lakes
GTN-P	Global Terrestrial Network – Permafrost
GTN-R	Global Terrestrial Network for River Discharge
GTOS	Global Terrestrial Observing System
G-WADI	A global network for water development information in arid lands
HELP	Hydrology for Environment, Life and Policy
HEPEX	Hydrologic Ensemble Prediction Experiment
HLWG	European GEOSS High Level Working Group
H-SAF	Theme on support to Hydrology and Water Management
HWRP	Hydrology and Water Resources Programme
HYDROLARE	International Data Centre for the Hydrology of Lakes and Reservoirs
HYDROWEB	HYDROWEB hydrological database
HyMeX	Hydrological cycle in the Mediterranean Experiment
Hypox	In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies (FP7)
IAH	International Association of Hydrogeologists
IAHR	International Association of Hydraulic Engineering and Research
IAHS	International Association of Hydrological Sciences
ICES	International Council for the Exploration of the Sea
ICESat	Ice, Cloud, and land Elevation Satellite
ICID	International Commission on Irrigation and Drainage
ICOLD	International Commission on Large Dams
ICSU	International Council for Science
IFI	The International Flood Initiative, which is based on the International Centre for Water Hazard and Risk Management (ICHARM, Japan)
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IGOS-P	Integrated Global Observing Strategy Partnership
IGRAC	International Groundwater Resources Assessment Centre
IGWCO	Integrated Global Water Cycle Observations
IHA	International Hydropower Association
IHP	UNESCO International Hydrological Programme
INRB	Instituto Nacional de Recursos Biológicos
INSEA	Data Integration System for Eutrophication Assessment in Coastal Waters

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INSPIRE	Infrastructure for Spatial Information in the European Community
IOC	Intergovernmental Oceanographic Commission of UNESCO
IRSA-CNR	Water Research Institute of the Italian National Research Council
ISARM	Internationally Shared Aquifers Resources Management Programme
ISI	The International Sediment Initiative aims at assessing erosion and sediment transport to marine, lake or reservoir environments
IST	Instituto Superior Tecnico, Technical University of Lisbon
ITC	Geo-Information Science and Earth Observation
IPCC	Intergovernmental Panel on Climate Change
IRSA-CNR	Water Research Institute of the Italian National Research Council
IST	Instituto Superior Tecnico, Technical University of Lisbon
IWA	International Water Association
IWALC	International Water Associations Liaison Committee
IWRA	International Water Resources Association
JIIHP	The Joint International Isotopes in Hydrology Programme aims at an integration of isotopes in hydrological practices
JMP	Joint Monitoring Programme on Water Supply and Sanitation
JRC	European Commission, DG Joint Research Centre
MetOp	Meteorological Operational Satellite
MIRAGE	Mediterranean intermittent river management
NHS	National Hydrological Service
NMHS	National Meteorological and Hydrological Service
NVE	Norwegian Water Resources and Energy Directorate
PCCP	The programme From Potential Conflict to Cooperation Potential facilitates international dialogues to foster peace, cooperation and development related to the management of shared water resources
PUMA	Preparation for Use of MSG in Africa
RAMFLOOD	Decision Support System for Risk Assessment and Management of Floods
RAMWASS	Integrated Decision Support System for Risk Assessment and Management
RA VI	WMO Regional Association for Europe
REFRESH	Adaptive strategies to mitigate the impacts of climate change on European freshwater ecosystems
RISKBASE	Risk Based Management of River Basins
RIVERTWIN	Regional Model for Integrated Water Management in Twinned River Basins
ROSHYDROMET	Federal Service of Russia for Hydrometeorology and Environmental Monitoring
RRR	WMO Rolling Requirements Review
SBA	Societal Benefit Area
SCENE	Water Scenarios for Europe and for Neighbouring States
SEIS	Shared Environmental Information System
SEWING	System for European Water monitoring
SIL	Societas Internationalis Limnologiae

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SMOS	ESA Soil Moisture and Ocean Salinity Mission
SOG	WMO Statements of Guidance
SWIFT-WFD	Screening methods for Water data InFormation in support of the implementation of the Water Framework Directive
TERCUD	Territory, Culture and Development Research Center
TOPC	Terrestrial Observation Panel on Climate
TWIN2GO	Coordinating Twinning partnerships towards more adaptive Governance in river basins
TWINBAS	Twinning European and third countries river basins for development of integrated water resources management methods
TWINBASIN	Promoting Twinning of River Basins for Developing Integrated Water Resources Management Practices
TYIP	GEOSS 10-Year Implementation Plan
UIC	User Interface Committee
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
UNW-DPC	UN-Water Decade Programme on Capacity Development
UWWT	Urban Waste Water Treatment
VC	Virtual constellation
WACMOS	ESA initiative to produce global products for the whole water cycle
WASSERMED	Water Availability and Security in Southern Europe and the Mediterranean
WCCoP	Water Cycle Community of Practice
WCP	World Climate Programme of WMO
WCRP	World Climate Research Programme
WET	Theme on Water Education and Training through access to data and information
WETWIN	Enhancing the role of wetlands in integrated water resources management for twinned river basins in EU, Africa and South-America in support of EU water initiatives
WFD	Water Framework Directive
WHYCOS	World Hydrological Cycle Observing System
WHYMAP	The World-wide Hydrogeological Mapping and Assessment Programme establishes a global database and GIS of groundwater data to support sustainable management of groundwater resources
WISE	Water Information System for Europe
WISER	Water bodies in Europe: integrative systems to assess ecological status and recovery
WMO	World Meteorological Organization
WWAP	World Water Assessment Programme
WWDR-3	United Nations 3 rd World Water Development Report
WWW	WMO World Weather Watch
ZMAW	Centre for Marine and Atmospheric Sciences

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1 Introduction

1.1 Background

The inter-governmental Group on Earth Observation (GEO) initiated the establishment of a coordinated Global Earth Observation System of Systems (GEOSS).


GEO was launched in response to calls for action by the 2002 World Summit on Sustainable Development and by the G8 (Group of Eight) leading industrialised countries. These high-level meetings recognised that international collaboration is essential for exploiting the growing potential of earth observations to support decision making in an increasingly complex and environmentally stressed world. GEO is a voluntary partnership of governments and international organisations. As of November 2009, GEO's members include 81 governments and the European Commission. In addition, 58 intergovernmental, international, and regional organisations with a mandate in earth observation or related issues have been recognised as participating organisations.

The development of GEOSS is supposed to qualitatively improve our understanding of the Earth system, enhancing global policy- and decision-making abilities to promote the environment, human health, safety, and welfare. GEOSS is expected to generate societal benefits in the following nine areas, the so-called Societal Benefit Areas (SBA):

- **Disasters:** reducing loss of life and property from natural disasters
- **Human health:** increasing the understanding of environmental factors affecting human health and well-being
- **Energy:** improving the sustainable management of energy resources
- **Climate:** improving the understanding and the prediction of climate variability and change as well as the adaptation to altered environmental conditions
- **Water:** improving sustainable water resource management through better understanding of the water cycle
- **Weather:** improving the information base with respect to meteorological parameters, weather forecasting and warning
- **Ecosystems:** improving the management and protection of terrestrial, coastal and marine ecosystems
- **Agriculture:** supporting sustainable agriculture and combating desertification
- **Biodiversity:** improving the understanding, monitoring and conserving of biodiversity

A GEOSS 10-Year Implementation Plan (TYIP, 2005-2015) was adopted during the Third Earth Observation Summit 2005 in Brussels to develop GEOSS. The Plan defines a vision statement for GEOSS, its purpose and scope, expected benefits, and the nine SBAs. The implementation of GEOSS is realised through a number of dedicated tasks that are defined in the GEO Work Plan. This document (the current version being the 2009-2011 Work Plan) is updated annually.

GEO is governed by a plenary consisting of all member states and participating organisations. It meets at least once a year at the level of senior officials and periodically at the ministerial level. An Executive Committee oversees GEO activities when the plenary is not in session. Additionally, GEO established four permanent bodies to guide the implementation of the TYIP. These committees are organised around four transverse areas which cut across, and are relevant to each of the nine SBAs:

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- Architecture & Data Committee
- Science & Technology Committee
- User Interface Committee
- Capacity Building Committee

1.2 Scope and objectives of the EUGENE project

The EUGENE project is an FP-7 funded support action to foster collaboration between pan-European organisations in the field of earth observation and to strengthen the coordination of national and regional programmes and organisations in their work towards GEO by establishing an appropriate coordination process. The goal of EUGENE is to contribute to the establishment of a coordinated and sustained European earth observing system component as part of GEOSS.

The EUGENE project aims at further developing a comprehensive European GEO strategy by proposing a structured European approach for selected GEO Societal Benefit Areas (SBAs). This will also encompass intrinsic cross-cutting issues, such as data sharing, with special attention to the relationship between relevant European frameworks and GEOSS.

EUGENE addresses European activities and actors in three SBAs, which correspond to European political priorities:

- Climate
- Disasters
- Water

The project work plan is intentionally limited to these three areas as a subset to start with and to allow working at a sufficient level of detail. For each of the three SBAs, a consolidated status-quo report has been documented. These reports provide information on relevant European activities and contributions to GEO. They form the basis for further considerations on a European GEO approach with the ultimate goal to establish a coordinated and sustained European earth observing system component as part of the GEOSS, maximizing both the GEO added value and the European benefit from GEOSS.

1.3 Scope of the Status-quo Report Water


The scope of the Status-quo Report Water is defined by relevant GEO targets. According to the recent draft document (Document 12, Revision 1, accepted by GEO VI, 18th November 2009; GEO 2009, p. 19), the Strategic Targets for the Water SBA are defined as follows:

“Before 2015, GEO aims to:

Produce comprehensive sets of data and information products to support decision-making for efficient management of the world's water resources, based on coordinated, sustained observations of the water cycle on multiple scales.

This will be achieved through:

- Development of a sustained, operational monitoring system for the global water cycle, combining space-based, airborne, and *in-situ* observation networks which will:


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- address water resources in terms of quantitative availability and water quality; include integrated *in-situ* reference sites for monitoring essential variables for water cycle measurement;
 - promote the upgrading of *in-situ* networks in regions where current networks do not meet emerging standards for observations, network enhancements, data systems, planning frameworks and implementation programs;
 - allow for different types of measurements to be planned in a structured way across variables, sensors, platforms and nations and in some cases development of sensor technology;
 - deliver a broad range of integrated data products that cover many different spatial and temporal scales, combining detailed point *in-situ* measurements with coarser comprehensive coverage provided by satellites.
- Development of widely available, sustained water cycle data sets and related information products, at both global and basin scales, tailored to the near- and long-term needs of stakeholders and end-users, which will:
 - exploit past and current *in-situ* and satellite-based observations as well as fostering their integration into advanced models for integrated water resource management;
 - focus attention on developing local, regional and global hydrological risk (e.g., floods, droughts) assessment, prediction and management systems and expanded applications of integrated water resource management for sustained development;
 - promote the next generation of improved/enhanced products and innovative observations (with special emphasis on observational gaps: e.g., precipitation and run-off at high latitudes and water quality measurements from space), for water resources management.

This will be demonstrated by:

- An operationalized and sustained global network of in-situ observation sites.
- Increased availability of information products and services for monitoring changes in the water cycle, including clouds and precipitation, appropriate for both research and integrated water resource management.
- Increased availability of data and information, including quantity and quality of both surface and groundwater, to support a water cycle decision making system.
- Routine, reliable production of “watershed” and human health indicators from satellite data, surface and subsurface data, and data assimilation capabilities.”

On the GEO website the following text highlights the actual situation: “Freshwater is vital for households, agriculture, and industry, and ever larger quantities will be needed for burgeoning human populations over the coming decades. Unfortunately, current observation systems cannot adequately monitor long-term changes and transfers in the global water system and their implications for people, the climate, and biodiversity. The amount of freshwater available for human consumption and for ecosystem services is affected by many variables. GEOSS seeks to track these variables by filling in existing information gaps about water resources, integrating data sets from various monitoring systems, developing better forecasting models, and disseminating the results to a wider range of decision makers.”

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According to the Strategic Target for the Water SBA, the focus of this SBA lies on the terrestrial component of the water cycle and on water resource management applications. Due to the strong cross-cutting nature of ocean observations, GEO activities in this field and associated applications are addressed indirectly in many of the SBAs, including Water. Therefore, ocean observation systems and data products are considered in this Status-quo Report only in case they are relevant to applications within the Water SBA.

The Status-quo Report Water contains a chapter on current user requirements related to application areas within the GEO Water SBA, which have been gathered from recent requirement analyses conducted in the GEO framework (Chapter 2). Based on these user requirements and taking programmatic considerations related to the European institutional landscape into account, Chapter 3 summarises relevant European organisations, initiatives and programmes (associated Earth observation systems and data sets are contained in a detailed catalogue in Appendix-A). Chapter 4 highlights cooperation activities of pan-European organisations within the GEO framework and beyond GEO on international level. Based on the collected information, an assessment of pan-European and significant national European initiatives in the field of Earth observation has been conducted. The results are included in Chapter 5, which discusses major strengths and gaps in EO for the Water SBA (Chapter 5.1) as well as emerging challenges and opportunities for Europe (Chapter 5.2).


1.4 Objective of the Status–quo Report Water and methodology

The objective of the Status-quo Report Water is to build a basis to develop a strategic approach to a consolidated European contribution to the Water SBA. Draft versions of the Status-quo Report Water have been used to prepare an Expert Workshop on Water, which has been conducted in May 2010 at the German Federal Institute of Hydrology (BfG). The workshop has been the starting point for the establishment of the network processes the EUGENE project is aiming at. Based on the results of the status-quo analysis, relevant European actors in the Water SBA gathered at the workshop. The workshop is considered to be an important mechanism for the strategy development within EUGENE.

In the framework of a status-quo analysis, a review of existing user requirement studies has been conducted first. Different organisations have already determined user requirements with a focus on applications within the GEO Water SBA. The corresponding user requirements have been used in the status-quo analysis to assess the importance of an Earth observation initiative for the Water SBA and to limit the scope of the analysis to a reasonable number of initiatives. According to this approach, an overview of current Earth observation activities, with a focus on the pan-European organisations/programmes, but also encompassing significant activities at European Member States level, has been prepared. To take stock of strategies and future plans of the involved European organisations in Earth observation, this issue was discussed at the Expert Workshop on Water to supplement the Status-quo Report.

The assessment procedure of European and relevant national activities in the field of Earth observation is based on the information on user requirements (Chapter 2), existing and planned systems and programmes (Chapter 3) and major observational gaps related to the required EO parameters (Chapter 5.1). In addition, involvement of and advice by the organisations themselves has been aspired. The relevant organisations contributed to the assessment process through reviews of the Status-quo Report Water and participation in the Expert Workshops on Water (May 2010, BfG).

In the assessment procedure, European Earth observation activities are matched with user requirements, which have been documented in Chapter 2. These user requirements are a key criterion to determine the relevance of an Earth observation system, data product or programme for GEOSS.

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However, a number of additional technological, programmatic and strategic criteria have been taken into account in the assessment procedure. The following assessment criteria have been identified:

- ***Provision of Earth observations in accordance with user requirements and demand***

One of the primary objectives of GEO is to build GEOSS according to the needs and concerns of a broad range of user communities to provide the data and information required by user groups on national, regional and global scales. Thus, determining accordance of European Earth observation systems and data products with user requirements is an important step in this status-quo analysis (cf. Chapter 2).

- ***Active participation in / contribution to an existing GEO Task***

The agreed framework for the implementation of GEOSS is the GEO work plan, which is updated annually and which contains a number of so-called GEO Tasks. These Tasks involve participants from the GEO Member States and Participating Organisations. Involvement of a European organisation in a GEO Task is a clear sign that the GEO initiative is recognised by the organisation. It further shows, in which topic or application area the organisation is involved in and which Earth observation components it may potentially contribute to GEOSS.

- ***Application of GEOSS data sharing principles and data standards***


The application of GEOSS data sharing principles and data standards is clearly regarded as an important strength of an Earth observation system.

- ***Continuity of data provision***

The issue of data continuity is indirectly included in the considerations on user requirements. In general, coordinated and sustained observation systems are in accordance with the strategic targets of GEO. Therefore, projects which are funded for a limited time span are generally of minor relevance for the development and implementation of GEOSS. It is noted, however, that some short term projects, may have developed relevant data sets such as Digital Elevation Models (DEM) or soil maps, which are useful for a long time period and for a number of application areas. In general, projects that are funded in the framework of long-term programmes in strategic areas relevant to the Water SBA, potentially play a more important role for GEOSS and will primarily be considered here.

- ***Cooperation with developing countries / capacity building for Earth observation***

An important goal of GEO is to ensure development of the scientific skills and the technical capacity to make the best use of Earth Observation technology in developing countries. Activities of European organisations in the field of capacity building for Earth observation use in developing countries therefore contribute to this GEO goal. The activities may therefore be directly linked to the GEO work plan and Earth observation components developed in this framework may be directly relevant to GEOSS.

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2 User requirements

Hydrological data are needed by many different users ranging from local to global levels. Likewise the spatial coverage of the required data varies from a local to a global scale. In this report all different user groups and different applications are taken into account and the user needs are not limited to European users. The considered Earth observations refer to parameters that are sensed or measured and derived products from sensed or measured parameters, but not to model outputs. The range of parameters is not restricted by any technology but encompasses in-situ measurements as well as airborne and space-based data. In order to minimize overlap and redundancies and to stay in line with the GEO report on Earth observation priorities for the Water SBA this report focuses on terrestrial hydrology and water resources.

Many investigations have been carried out by well established international communities to identify and define the requirements of end-users. The following outline is based on existing documents on the subject of Earth observation demands for hydrological data. Each of these documents is a kind of consensus document, summarizing the needs of the corresponding user-community. The following reports have been used to put together priority parameters for hydrological Earth observation needs:

- **GEOSS 10-Year Implementation Plan Reference Document**

In the GEOSS 10-Year Implementation Plan¹ the GEO Water SBA is defined as follows: Water: Improving water resource management through better understanding of the water cycle: Water-related issues addressed by GEOSS will include: precipitation; soil moisture; stream flow; lake and reservoir levels; snow cover; glaciers and ice; evaporation and transpiration; groundwater; and water quality and water use. GEOSS implementation will improve integrated water resource management by bringing together observations, prediction, and decision support systems and by creating better linkages to climate and other data. *In situ* networks and the automation of data collection will be consolidated, and the capacity to collect and use hydrological observations will be built where it is lacking.


The GEOSS 10-Year Implementation Plan Reference Document² provides a table of observation requirements with 54 parameters encompassing not only the above mentioned core parameters of the hydrological cycle but also many forcing elements and additional state and flux variables. Many of them are highly relevant for hydrological modelling, water resources management or policy making. Furthermore it is presented for which application each parameter is needed and what the current status (2005) of observation is. The status is described qualitatively in five classes and is based on experts' ratings.

- **GEO Task US-09-01a report: Earth Observation Priorities for the Water SBA**

GEO has established four committees to guide the implementation of the 10-Year Implementation Plan. The committees are organised around four transverse areas of user engagement, architecture and data management, science and technology and capacity building, which cut across, and are relevant to, each of the issue-specific SBAs. The User Interface Committee (UIC), one of the four committees, engages users in the nine SBAs in the development, implementation, and use of a sustained GEOSS that provides the data and information required by user groups on national, regional and global scales. The UIC aims at enabling GEO to address the needs and concerns of a broad range of user communities. Thus, identification of user requirements and gaps related to current Earth observation systems in the context of GEOSS is an essential component of the activities of the committee and is addressed by GEO

¹ <http://www.earthobservations.org/documents/10-Year%20Implementation%20Plan.pdf>

² <http://www.earthobservations.org/documents/10-Year%20Plan%20Reference%20Document.pdf>


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Task US-09-01a, being lead by the UIC. The objective of GEO Task US-09-01a is to establish and conduct a process to identify critical Earth observation priorities within each SBA and those common to the nine SBAs. Many countries and organizations have written reports, held workshops, sponsored projects, conducted surveys, and produced documents that specify Earth observation needs. In addition, researchers and practitioners have also identified and recommended key Earth observation needs in publications and peer-reviewed literature. Task US-09-01a focuses on compiling information on observation parameters from a representative sampling of these existing materials and analyzing across the materials to determine the priority observations. This task considers all types of Earth observations, including ground, in situ, airborne, and space-based observations. The task includes direct measurements and derived parameters as well as model products. This task seeks to identify Earth observation needs across a full spectrum of user types and communities in each SBA, including observation needs from all geographic regions with significant representation from developing countries. The objective of the SBA specific reports is to identify Earth observation priorities within each of the SBAs. The primary audience for these reports is the UIC, which will perform a meta-analysis across all nine SBA reports to identify critical Earth observation priorities common to many of the SBAs. Based on the nine SBA reports, the UIC will produce an overall Task US-09-01a report, including the common observations and recommendations for GEO processes to determine Earth observation priorities in the future. The report on the Water SBA (GEO 2010) has been made available for the EUGENE Status-Quo-Analysis of the Water work package and represents an important information source for this chapter on user requirements. The report focuses on the Earth observations within the Water SBA, independent of any specific technology or collection method. Thus, the report addresses the “demand” side of observation needs and priorities. The report does not address the specific source of the observations or the sensor technology involved with producing the observations. Similarly, any discussions of visualization tools, decision support tools, added-value products or system processing characteristics (e.g., data format, data outlet) associated with the direct use of the observations are beyond the scope of this report. In this report, the term Earth observation refers to parameters and variables (e.g., physical, geophysical, chemical, biological) sensed or measured, derived parameters and products, and related parameters from model outputs. The term Earth observation priorities refers to the parameters deemed of higher significance than others for the given SBA, as determined through the methodologies described within. The report uses the terms “user needs” and “user requirements” interchangeably to refer to Earth observations that are articulated and desired by the groups and users in the cited documents. The term “requirements” is used generally in the report to reflect users’ wants and needs; the use in this report does not imply technical, engineering specifications. It is noted that the Task US-09-01a is focused on global level user requirements and European user requirements are only indirectly addressed in the Water SBA report.

- **WMO Statement of Guidance for Hydrology³**

The Rolling Requirements Review (RRR) of the World Meteorological Organization (WMO) gathers and analyzes requirements from a number of WMO programs representing different application areas. The RRR is a formalized mechanism with regular updates of requirements involving key user groups, stakeholders and organizations. These WMO requirements, together with requirements of other organizations, are recorded in a database maintained by WMO. Furthermore, capabilities of current space-based Earth observation systems are rec-

³ <http://www.wmo.int/pages/prog/sat/SOG/SOG-Hydrology.doc>

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orded in a database maintained by CEOS (Committee on Earth Observation Satellites) and assessed against user requirements. Suggestions for future developments of observation systems are made. The RRR process leads to a number of guidance documents, the so-called Statements of Guidance (SOG), which contain Earth observation priorities for a number of selected application areas. The SOG “Hydrology” (WMO 2008) documents 11 hydrometeorological variables, which have been identified by the Terrestrial Observation Panel on Climate (TOPC) as being of high observation priority (GCOS 1997 in WMO 2008). An expert meeting on the Establishment of a Global Terrestrial Network – Hydrology (GTN-H) confirmed these 11 variables (GCOS 2000) recognizing that several of these variables have both an *in-situ* as well as a satellite observation component. These eleven variables and additional parameters are briefly discussed, including their current state of observation. Examples for variable-derived products for hydrology are given.

- **IGWCO Assessment Report 2007⁴**


The IGOS Global Water Cycle Theme was initiated by the World Climate Research Programme (WCRP) at the IGOS-P meeting 2000 in Brazil. Within the framework of the IGOS objectives, the IGWCO contributes to critical social issues dealing with the hydrological cycle by addressing concerns about long-term sustainability of safe water globally. Simultaneously, it addresses environmental issues and the need to detect and understand climate change through the observation and analysis of trends in atmospheric water vapour, precipitation, stream flow and other water cycle variables. With respect to these various concerns, the primary objective of the IGWCO is to provide a framework for guiding decisions regarding priorities and strategies for the maintenance and enhancement of water cycle observations. The IGWCO has been active in the establishment of a GEO Water Cycle Community of Practice (WCCoP), which aims at providing a unique perspective on the information needs of the water community by bringing together representatives who have knowledge of the decision processes in the water sector with those who promote an effective use of Earth Observations to address those questions.

It is highlighted that the Earth observation parameters, which are documented in the SOG Hydrology (WMO 2008) and the IGWCO assessment report (IGOS 2007) have primarily been determined to fulfil the requirements of WMO observation programmes and the observations under the IGWCO framework. They thus represent programme-specific requirements, which may vary from the overall requirements for Earth observations within the GEO Water SBA.

Unfortunately there is no consistent or standardized terminology used in the reports. The term “parameter” is often used synonymously with the term “variable” (e.g. liquid precipitation at the surface, relative humidity at the surface) but also as an overall term for a field of variables (e.g. water quality, snow, groundwater). In addition, one and the same parameter can have different names in different studies. Thus, the described user requirements from the different reports are not fully comparable to each other. Table 1 presents all parameters and variables from the indicated reports except three parameters from the Ten-Year Implementation Plan that have been omitted as they are beyond the terrestrial focus of the Water SBA. Every parameter from the reports is listed separately unless it is already unambiguously covered by another expression. This may result in redundancy but provides a much more transparent overview.

⁴ http://www.earthobservations.org/documents/igwco/IGWCO_assessment_report_final.pdf

PARAMETER	GEO TYIP	GEO Water SBA Priorities	WMO SOG	IGWCO
Water Flux Information				
Atmospheric Precipitation	■			
Precipitation (liquid)*	■	■	■	■
Precipitation (snow)*	■	■	■	■
Stream flow*	■	■	■	■
Evaporation	■	■	■	■
Transpiration	■	■		■
Groundwater Fluxes*			■	
Water Storage Information				
Soil Moisture (surface) *	■	■	■	■
Soil Moisture (vadose zone) *	■	■	■	■
Groundwater Level	■	■		■
Groundwater Storage	■	■		■
Lake and River Extent	■	■	■	■
Lake and River Level*	■	■	■	■
Reservoir Extent	■	■	■	■
Reservoir level	■	■	■	■
Snow Cover*	■	■	■	■
Snow Water Equivalent	■	■	■	■
Ground Ice	■			
Permafrost / Frozen Soil*	■	■		■
Glaciers, Ice Caps, Ice Sheets (Extent, Depth) *	■	■	■	■
Clouds	■	■		■
Wind Direction*	■	■		
Wind Speed*	■	■		
Air Temperature*	■	■		
Water Vapour*	■			■
Atmospheric Pressure*	■	■		
Surface Air Humidity		■	■	
Wetlands and Floodplains Extent		■	■	
Wetlands and Floodplains Level		■	■	
Snow depth		■	■	■
Radiation and Energy Budget Information				
Downward Long wave Radiation*	■	■		
Downward Shortwave Radiation*	■	■		
Albedo*	■	■		
Emissivity	■	■		
Surface Temperature	■		■	
Fractional Vegetation Coverage	■			

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PARAMETER	GEO TYIP	GEO Water SBA Priorities	WMO SOG	IGWCO
Roughness	■	■		
Sensible Heat Flux	■			
Soil Heat Flux	■			
Latent Heat Flux	■			■
Soil Temperature		■		
Short-wave and Long-wave outgoing radiation at Top of Atmosphere			■	
Other Bio-geophysical Information				
Topography / Geography	■	■		
Vegetation Type*	■	■	■	
Vegetation Height	■			
Vegetation Rooting Depth	■			
Land Use and its Change*	■	■		
Soil Type	■	■		
Biomass*		■		
Leaf Area Index*		■		
NDVI		■	■	
Other Bio-geochemical Information				
Water Chemistry	■			
Nutrient Cycling	■			
Precipitation Isotope Signatures			■	
Water Quality		■		■
Biogeochemical Fluxes from land to ocean			■	
Anthropogenic & Socio-economic Information				
Irrigated Area	■			
Irrigation Amount	■			
Industrial Water Use	■			
Drinking Water	■			
Population Density	■			
Water Demand for nature Conservation	■			
Water Pollutant Area	■			
Ecosystem Water Demand	■			
Water Sources and Water Demand/Use*		■	■	


Table 1: Earth observation priorities in the GEO Water SBA according to four relevant documents. Parameters marked with (*) are Essential Climate Variables (ECV).

GEO TYIP = GEO Ten-Year Implementation Plan Reference Document

GEO Water SBA Priorities = Critical Earth Observation Priorities for the Water SBA

WMO SOG = WMO Statement of Guidance for Hydrology

IGWCO: The Integrated Global Water Cycle observation Theme, Assessment Report


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With regard to the identification of relevant hydrological parameters two different approaches can be distinguished in the considered reports. The GEO 10-Year Implementation Plan and the GEO report on Earth observation priorities for the Water SBA take all parameters into account that are needed for the considered applications. This includes parameters about water fluxes, water storages and water properties but also parameters that are not or only indirectly part of the hydrological cycle (like topography, soil temperature, LAI etc.) but nevertheless important for several applications, e.g. hydrological modelling. The WMO Statement of Guidance for Hydrology and the IGWCO Assessment Report are limited to a set of key parameters of the hydrological cycle. As mentioned above eleven hydrometeorological variables have been identified by the Terrestrial Observation Panel on Climate (TOPC) as being of high observation priority (GCOS 1997 in WMO 2008). They have been confirmed by an expert meeting on the Establishment of a Global Terrestrial Network – Hydrology (GTN-H) and they are an integral component of the Statement of Guidance for Hydrology. These eleven parameters correspond largely with the IGWCO Water Cycle Variables, as shown in Table 2. Thus the selected parameters represent a kind of consensus set of hydrological key parameters of these initiatives. A set of hydrological essential variables that is defined and accepted by the international community, like the Essential Climate Variables (ECV), does not yet exist (but some of the hydrological parameters are part of the ECVs, cf. Table 1).

GCOS Hydrometeorological Variables	IGWCO Water Cycle Variables
1. Surface water discharge	Stream flow and surface water storage (IGWCO Water Cycle Variable 4.3)
2. Surface water storage fluxes	
3. Groundwater fluxes	Groundwater (IGWCO Water Cycle Variable 4.8)
4. Water use	
5. Biogeochemical fluxes	Water quality (IGWCO Water Cycle Variable 4.9)
6. Isotopic signatures	
7. Precipitation	Precipitation (IGWCO Water Cycle Variable 4.1)
8. Evaporation	Evaporation and Evapotranspiration (IGWCO Water Cycle Variable 4.6)
9. Vapour pressure / relative humidity	Clouds and water vapour (IGWCO Water Cycle Variable 4.5)
10. Soil moisture	Soil moisture (IGWCO Water Cycle Variable 4.2)
11. Snow water equivalent	Cryospheric variables (IGWCO Water Cycle Variable 4.4)
	Energy-Water interactions and climate (IGWCO Water Cycle Variable 4.7)


Table 2: GCOS Hydrometeorological Variables (GCOS 1997) and IGWCO Water Cycle Variables (IGOS 2007)

Hydrological data is used for a broad range of different applications and consequently there are different requirements in terms of parameter specifications like spatial and temporal resolution, coverage, accuracy, time period, delivery time. To be able to analyse to which extent the stated requirements are met it is necessary to know the specifications for each parameter per application. The report “*Critical Earth Observation Priorities for the Water SBA*” provides a kind of lumped specifications for all parameters, encompassing the needs of all considered applications. Table 3 from the *Statement of Guidance for Hydrology* shows the requirements for selected parameters with different specifications for different applications. It is aspired that a comparable table with differentiated specifications for all considered parameters is generated within the GEO Task US-09-01a. Based on this a sound gap analysis, that has not yet been performed would be feasible.

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Product name	Content	Use (examples only)	Spatial resolution	Temporal resolution	Timelines
Discharge	Gridded runoff fields	Water balance computation	1° x 1°	Monthly	DT
Discharge	Point data	Weather and flow forecasting; model validation	N/A	Hourly to daily	NRT
Discharge	Point data	Global water cycle analysis	By station (river-basin)	Daily / Monthly	DT
Soil moisture	Gridded (preferably)	Weather and flow forecasting; assimilation in models	TBD	Daily to monthly	NRT
BGC flux into oceans	By major watershed	Global BGC cycles analysis	By watershed	Daily to monthly	DT
Isotope composition	D ¹⁸ O, ² H, ³ H	Various	By station	Weekly to monthly	DT
Precipitation	Solid and liquid separately; point data	Regional water cycle analysis; Hydrological forecasting	1° x 1° globally, 0.5° x 0.5° regionally; point data	Daily to monthly	DT
Precipitation, evapotranspiration	Point data	Real-time data for assimilation in models, water budget	Point	Hourly to daily	RT
Snow water equivalent	Gridded	Various	TBD	TBD	DT
Ground water fluxes	Aquifer withdrawal / recharge rates	Various	By aquifer	TBD	DT
Water use	Differentiated consumptive/non-consumptive use	Various	Point or polygon	Monthly, annual	DT
Water Use	Gridded consumptive / non-consumptive use	Various	0.5° x 0.5°	Monthly	DT
Surface storage Flux	Volume changes in lakes and reservoirs	Water cycle analysis	Polygon	Monthly to seasonal	DT

Table 3: Examples from the WMO Statement of Guidance for Hydrology for selected parameters and their required specifications for different applications.

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2.1 Pan-European policy framework and emerging requirements


Chapter 3.1 gives an overview of the current pan-European policy framework in the water area and emerging Earth observation requirements.

“Protecting the quality of Europe’s water resources has been a high priority for the European Union (EU) since it started adopting legislation in the area of environmental protection. The first directives, adopted in the mid-1970s, established a series of quality standards aimed at protecting human health and the living environment, including surface water used for drinking water, bathing water, fish waters, shellfish waters, groundwater and water for human consumption. In the same "generation" of legislation, a directive that set standards for the discharge of dangerous substances into the aquatic environment was for many years the main instrument to control emissions from industry” (European Commission 2008, p. 1). Since the 1980s, further directives have been developed, which were focused on different aspects of water quality protection and especially the sources of pollutants. This led to a number of rather specified policies and legislations addressing important issues related to water quality.

To improve coordination of environmental objectives set in earlier legislations in the field of water quality, the Water Framework Directive (WFD) entered into force in 2000 and now represents a global unified approach to deal with water related issues in Europe. The WFD “provides a new overall quality or good status objective for all water sources, thus providing the link between emission controls and the achievement of quality objectives, both chemical and ecological” (European Commission 2008, p.2). In a novel approach, the WFD takes into account both point and diffuse sources of pollution, the latter being mainly attributed to the use of chemicals in agriculture.

The objective of the Water Framework Directive is to create national management systems that cover the entire catchment area of rivers to facilitate high water quality in the waters of the EU. In addition to surface waters, it also regulates the management and monitoring of groundwater, which is why it also concerns aspects of drinking water and soil conservation. Following a detailed recording and assessment of the status of the surface and ground waters, national and international action programmes and integrated river basin management plans had to be developed by the end of 2009 in this respect to guarantee a high water quality. The WFD addresses a number of other (pre-existing) directives, which are listed in Annex VI of the WFD:

- Bathing Water Directive
- Birds Directive
- Drinking Water Directive
- Major Accidents Directive
- Environmental Impact Assessment Directive
- Sewage Sludge Directive
- Urban Wastewater Treatment Directive
- Plant Protection Products Directive
- Nitrates Directive
- Habitats Directive
- Integrated Pollution Prevention Control Directive

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According to the WFD, measures, which are required under these directives, have to be included in the programme of measures of the WFD and have to be integrated into river basin management planning. Thus, implementation of the directives listed in Annex VI represents a minimum requirement for WFD implementation.

“Proper implementation of WFD requires continued integration across sectoral activities (agriculture, rural development, economy, energy, transport, water infrastructure), and needs to be supported by intense information exchange between relevant actors [...]” (European Environment Agency 2009, p. 20). To comply with the requirements and objectives, which are defined in the WFD, comprehensive information, e.g. on the status of surface waters and groundwater, on pollution sources, on water use and potential consequences of improved water resource management is required.


Groundwater is one of the key components of the WFD, which includes a number of different steps for achieving good quantitative and chemical status of groundwater by 2015. “While the quantitative status objectives are clear in the WFD, aiming at ensuring a balance between abstraction and recharge of groundwater, chemical status criteria were more complex to be defined at the time of the adoption of the WFD, and it was therefore decided to request the Commission to come forward with a proposal for a “daughter” directive clarifying good chemical status criteria and specifications related to the identification and reversal of pollution trends. This new Groundwater Directive has been adopted in 2006” (European Commission 2010).

In addition to water quality, issues of surface water quantity are addressed in the context of natural hazards in Europe. Flooding is a serious problem in Europe and is addressed by the EU Floods Directive since 2007. The directive aims at reducing and managing the risks that floods pose to human health, the environment, cultural heritage and economic activity and applies to inland waters as well as all coastal waters across the whole territory of the EU. The Floods Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015 (JRC, accessed 26.04.2010 at <http://floods.jrc.ec.europa.eu/eu-floods-directive>).


Issues of water scarcity and drought have been raised by the Communication of the European Commission to the European Parliament in 2007 “Addressing the challenge of water scarcity and droughts in the European Union” (COM(2007) 414 final). The follow-up process of the Communication comprises a work programme 2009-2012 that includes aspects such as putting the right price tag on water, allocating water and water-related funding more efficiently, financing water efficiency, improving drought risk management, considering additional water supply infrastructures, fostering water efficient technologies and practises, fostering the emergence of a water saving culture in Europe, and improving knowledge and data collection. The DESERT Action of JRC contributes to an improved drought risk management by the development of a prototype of a European Drought Observatory (EDO) by 2012. Furthermore, within the Common Implementation Strategy of the WFD an Expert Network on Water Scarcity and Droughts has been established.

Emerging requirements for EO systems can be summarised as follows:

- Availability of harmonized transboundary EO for whole catchments
- Development of EO systems and methods to determine current state of environment and to assess implications of planning measures (scenarios)
- Development of EO systems and methods and availability of suitable EO data, indicators, models and analyses to assess achievement of objectives of relevant EU directives

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- Time- and cost-efficient assessment of water quality and water quantity needs to be facilitated by the development of new (satellite-based and in-situ) systems and products

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3 Existing systems, initiatives and programmes

This chapter documents existing and planned European systems and programmes, which may be relevant for GEOSS.

Chapter 3.1 lists pan-European and national level **organisations**, which are major players in Europe in the field of Earth observations and pan-European **initiatives, programmes and systems** on Earth observation, such as GMES or INSPIRE. The organisations, programmes and initiatives listed in Chapters 3.1 may already contribute to the GEO-process by participating in various GEO Tasks or working groups or support the development of the GEOSS by the registration of Earth observation components. Annex A includes a catalogue with detailed information on the identified organisations, initiatives, programmes and systems.

In Chapter 3.2, European Earth observation projects are listed. The list includes projects, which have been/are currently linked to GMES or GEOSS or other Earth observation activities. Other projects may have contributed/are contributing to the development of Earth observation capabilities in general. Annex B provides further details, e.g. on topics/outputs, (funding) framework or duration of these projects.


3.1 European organisations, initiatives, programmes and systems

The following pan-European organisations have been identified as being major players in the field of Earth observation in relation to the Water SBA:

- European Centre for Medium Range Weather Forecasts (ECMWF)
- European Commission, DG Joint Research Centre (JRC)
- European Environmental Agency (EEA)
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
- European Space Agency (ESA)

The following 31 international and pan-European initiatives, programmes and systems have been identified:

- EEA data service
- EUMETSAT's Broadcast System for Environmental Data (EUMETCast)
- EUMETSAT Earth Observation Portal
- European Drought Observatory (EDO)
- European Flood Alert System (EFAS)
- European Regional Centre for Ecohydrology (ERCE)
- Euro-Mediterranean Information System on know-how in the Water sector (EMWIS)
- European Network of Freshwater Research Organisation (EurAqua)
- European Terrestrial Network for River Discharge (ETN-R)


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- European Topic Centre on Water (ETC-Water)
- European Water Archive (EWA)
- European Water Initiative (EUWI)
- Eye on Earth
- Flow Regimes from International Experimental and Network Data (EURO-FRIEND)
- Global Monitoring for Environment and Security (GMES)
- Global Precipitation Climatology Centre (GPCC)
- Global Runoff Data Centre (GRDC)
- Global Water System Project (GWSP)
- Hydrologic Ensemble Prediction Experiment (HEPEX)
- IHP-HELP Centre for Water Law, Policy and Science
- Infrastructure for Spatial Information in the European Community (INSPIRE)
- International Groundwater Resources Assessment Centre (IGRAC)
- International Soil Moisture Network
- Network of European Meteorological Services (EUMETNET)
- Shared Environmental Information System (SEIS)
- The Baltic Sea Experiment (BALTEX)
- The Geological Surveys of Europe (EuroGeoSurveys)
- TIGER Initiative
- UNESCO International Hydrological Programme (IHP), national secretariats in Europe
- Water Observation and Information System for Balkan Countries (BALWOIS)
- WMO Hydrology and Water Resources Programme (HWRP), national secretariats in Europe

A detailed description of the organisations, initiatives, programmes and systems is included in a catalogue in Appendix A. The catalogue contains the following information:

- Institutional framework
- Brief description of work
- Earth observation topics, outputs and activities
- GEOSS Common Infrastructure (GCI) components (analysed from GCI Registration holdings at <http://geossregistries.info/holdings.htm>)
- Participation in GEO Water SBA Tasks

3.2 European Earth observation projects


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Numerous European Earth observation projects have been/are conducted under the Research Framework programmes of the European Commission or through other funding mechanisms. Many of those projects contributed to the development of GMES over the last years. The **Community Research and Development Information Service (CORDIS)**⁵ of the European Commission provides information about the Research & Development activities of the European Commission and includes a database of projects under the different Framework Programmes (FP4, FP5, FP6, FP7). In addition, the European Commission maintains – through the FP7-project SWIFT – a database of GMES related projects⁶. These databases have been analysed to identify completed and ongoing projects, which are relevant for the GEO Water SBA. The following 44 projects have been identified:

- Adaptive strategies to mitigate the impacts of climate change on European freshwater ecosystems (REFRESH)
- African-European Georesources Observation System (AEGOS)
- African Monitoring of the Environment for Sustainable Development (AMESD)
- Assessing Climate impacts on the Quantity and quality of water (ACQWA)
- Available Water Resources in Mountain Environment (AWARE)
- Biodiversity of freshwater ecosystems: Status, trends, pressures, and conservation priorities (BIOFRESH)
- Bridging the gap between adaptation strategies of climate change impacts and European water policies (CLIMATEWATER)
- Climate Induced Changes on the Hydrology of Mediterranean Basins (CLIMB)
- Communicating environmental impacts on water quality, availability and use (COMENVIR)
- Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations (CEOP-AEGIS)
- Coordinating Twinning partnerships towards more adaptive Governance in river basins (TWIN2GO)
- Data Integration System for Eutrophication Assessment in Coastal Waters (INSEA)
- Decision Support System for Risk Assessment and Management of Floods (RAMFLOOD)
- Enhancing the role of wetlands in integrated water resources management for twinned river basins in EU, Africa and South-America in support of EU water initiatives (WETWIN)
- ESA initiative to produce global products for the whole water cycle (WACMOS)
- European Approach to GEOSS (EuroGEOSS)
- EUWI Research Area Network (ERA-NET) (SPLASH)
- GMES integrated project on land cover and vegetation (geoland)
- GMES preoperational Land Monitoring Service (geoland-2)
- GEONETCast for and by Developing Countries (DevCoCast)


⁵ http://cordis.europa.eu/home_en.html

⁶ <http://www.gmes.info/pages-principales/projects/project-database/>

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- Corine-compatible land cover/use service (GlobCorine)
- GMES Network of Users (GNU)
- GMES Service Element Land (GSE Land)
- Groundwater and dependent Ecosystems: NEw Scientific basIS on climate change and land-use impacts for the update of the EU Groundwater Directive (GENESIS)
- HYdrological cycle in the Mediterranean Experiment (HyMeX)
- Hypoxic (low oxygen) conditions in aquatic ecosystems (Hypox)
- Integrated Decision Support System for Risk Assessment and Management (RAMWASS)
- Integration of European Wetland Research in sustainable management of the water cycle (EUROWET)
- Mediterranean intermittent river management (MIRAGE)
- Multilingual cross-border access to ground water databases (eWater)
- Preparation for Use of MSG in Africa (PUMA)
- Promoting Twinning of River Basins for Developing Integrated Water Resources Management Practices (TWINBASIN)
- Regional Model for Integrated Water Management in Twinned River Basins (RIVERTWIN)
- Risk Based Management of River Basins (RISKBASE)
- Screening methods for Water data InFormation in support of the implementation of the Water Framework Directive (SWIFT-WFD)
- System for European Water monitoring (SEWING)
- HYDROWEB hydrological database (HYDROWEB)
- EUMETSAT Satellite Application Facility – Theme on support to Hydrology and Water Management (H-SAF)
- Twinning European and South Asian River basins to enhance capacity and implement adaptive integrated water resources management approaches (BRAHMATWINN)
- Twinning European and third countries river basins for development of integrated water resources management methods (TWINBAS)
- Water and Global Change (EU-WATCH)
- Water Availability and Security in Southern Europe and the Mediterranean (WASSERMED)
- Water bodies in Europe: integrative systems to assess ecological status and recovery (WISER)
- Water Scenarios for Europe and for Neighbouring States (SCENE)

Further details on these projects can be found in Appendix B. Where applicable, information on Earth observation data sets and products will be given.

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4 International cooperation

This chapter addresses major international cooperation frameworks and European cooperation under the GEO umbrella.

Many of the international frameworks, which are described in Chapter 4.1 are substantially supported by pan-European, national European and international organisations, which are located in Europe. These contributions are either realized directly (e.g. through financial or technical support or by providing EO data) or indirectly through associated or co-sponsoring programmes. It is, however, beyond the scope of this report to provide details on these contributions, since the cooperation processes and activities in the area of water cycle observations and water resource management are very complex and largely uncoordinated on international level. There is currently no international overarching coordination framework (besides the Water SBA of GEO), which is dedicated to all aspects related to water. The topic of water is rather addressed in the context of a huge number of programmes as described below.

Chapter 4.2 addresses involvement of European organisations in the Tasks of the current GEO Work Plan 2009-2011.

4.1 International cooperation frameworks

This chapter documents relevant international organisations and cooperation frameworks in the water area. European organisations are to a great extent involved in international programmes, which aim at coordinating Earth observations internationally and to build global Earth observation systems.

Chapter 4.1.1 addresses the overarching framework of the United Nations Framework Convention on Climate Change (UNFCCC) and the supporting frameworks IPCC, GCOS and GTOS, since current challenges in the water area are strongly coupled with global (climate) change and the described frameworks also address observations of the global water cycle.


Chapter 4.1.2 describes the most important organisations and frameworks under the umbrella of the United Nations, which are related to water.

In addition to the contributions of the United Nations, other relevant international organisations and frameworks related to water are documented in Chapter 4.1.3.

4.1.1 Overarching frameworks: UNFCCC, IPCC, GCOS and GTOS

United Nations Framework Convention on Climate Change

A major political driver for the coordination of Earth observations of the hydrological cycle is the **United Nations Framework Convention on Climate Change (UNFCCC)**. The UNFCCC is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED) 1992. The UNFCCC aims at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

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Based on this treaty, which has to be considered as legally not binding, the Kyoto Protocol has been developed in 2005 that formulate concrete and mandatory emission limits.

Intergovernmental Panel on Climate Change

The UNFCCC requires extensive research and systematic observation of the climate system. The **Intergovernmental Panel on Climate Change (IPCC)** conducts regular assessments of the state of the global climate system, its development and possible consequences for natural and socio-economic systems. The IPCC assessment reports are a major scientific input to inform the negotiations under the UNFCCC.

Global Climate Observation System

The **Global Climate Observation System (GCOS)** has been established in 1992 is an international coordinated system of climate observation systems. GCOS is seen as the climate observing component of GEOSS and is based on the following other global observing systems, and cooperates with those:

- WMO Global Observing System (GOS);
- WMO Global Atmospheric Watch (GAW);
- IOC/WMO/UNEP/ICSU Global Ocean Observing System (GOOS);
- FAO/UNEP/UNESCO/WMO/ICSU Global Terrestrial Observing System (GTOS, see below).


GCOS is co-sponsored by:

- World Meteorological Organization (WMO);
- Intergovernmental Oceanographic Commission (IOC) of UNESCO;
- United Nations Environment Programme (UNEP);
- International Council for Science (ICSU).

The goal of GCOS is “to provide comprehensive information on the total climate system, involving a multidisciplinary range of physical, chemical and biological properties, and atmospheric, oceanic, hydrological, cryospheric and terrestrial processes” (GCOS 2010). GCOS coordinates and provides relevant observations of the climate system and includes in-situ, airborne and space-based observational components. The most critical geophysical variables to be observed have been defined as the Essential Climate Variables (ECV) and are required to support UNFCCC and IPCC. The ECVs are grouped into atmospheric, oceanic and terrestrial variables, whereas the terrestrial ECVs contain a number of critical hydrological variables. Chapter 2 of this status-quo report addresses several ECVs in the context of user requirements of the GEO Water SBA (see Table 1). However, as mentioned in Chapter 2, no internationally agreed set of essential hydrological variables have been defined yet.

Global Terrestrial Observing System

The **Global Terrestrial Observing System (GTOS)** is a programme for observations, modelling, and analysis of terrestrial ecosystems to support sustainable development. GTOS facilitates access to information on terrestrial ecosystems so that researchers and policy makers can detect and manage global and regional environmental change. As part of GTOS, the Global Terrestrial Observing Network (GT-NET) is envisaged as a master network system. It has been in development since June 1997,

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when a meeting of experts on ecological networks established that GT-NET should generate complete and coherent data sets on global terrestrial ecosystems through international research collaboration. These networks provide support to gather the required global data on the terrestrial ECVs. The terrestrial ECVs relevant to hydrology are addressed by the following Global Terrestrial Networks (GTN), which are implemented by various international and national organisations:

- Global Terrestrial Network – River Discharge (GTN-R)
- Global Terrestrial Network – Lakes (GTN-L)
- Global Terrestrial Network – Glaciers (GTN-G)
- Global Terrestrial Network – Permafrost (GTN-P)
- Global Terrestrial Network – Hydrology (GTN-H)

Table 4 lists networks and international data centres that contribute to the observation of different ECVs related to hydrology in the framework of GCOS and GTOS and WMO programmes.

Networks contributing to GCOS	International Data Centres and Archives	Essential Climate Variables (ECVs)
GCOS Surface Network (GSN)	<ul style="list-style-type: none"> ▪ Global Precipitation Climatology Centre (GPCC) – see Chapter 4.1.2 ▪ Global Precipitation Climatology Project (GPCP) of GEWEX – see Chapter 4.1.2 	<ul style="list-style-type: none"> ▪ Precipitation ⁷
GCOS/GTOS Global Terrestrial Network – River Discharge (GTN-R)	<ul style="list-style-type: none"> ▪ Global Runoff Data Centre (GRDC) - see Chapter 4.1.2 	<ul style="list-style-type: none"> ▪ River Discharge
GCOS/GTOS Global Terrestrial Network – Lakes	<ul style="list-style-type: none"> ▪ International Data Centre on the Hydrology of Lakes and Reservoirs (HYDROLARE) - see Chapter 4.1.2 	<ul style="list-style-type: none"> ▪ Lake Level ▪ Lake Area ▪ Lake Temperature
WWW/GOS ⁸ synoptic network	<ul style="list-style-type: none"> ▪ National Snow and Ice Data Center (NSIDC) - Chapter 4.1.3 	<ul style="list-style-type: none"> ▪ Snow Cover
GCOS/GTOS Global Terrestrial Network - Glaciers (GTN-G)	<ul style="list-style-type: none"> ▪ World Glacier Monitoring Service (WGMS) ▪ National Snow and Ice Data Center (NSIDC) 	<ul style="list-style-type: none"> ▪ Glaciers mass balance and length ▪ Ice sheet mass balance
GCOS/GTOS Global Terrestrial Network - Permafrost (GTN-P)	<ul style="list-style-type: none"> ▪ National Climatic Data Center (NCDC) ▪ NSIDC 	<ul style="list-style-type: none"> ▪ Permafrost borehole-temperatures ▪ Active-layer thickness
Global Terrestrial Network Hydrology (GTN-H)	<ul style="list-style-type: none"> ▪ Distributed 	<ul style="list-style-type: none"> ▪ All hydrological ECVs

Table 4: Networks and international data centres contributing to GCOS.

⁷ Precipitation is regarded as an atmospheric ECV

⁸ WWW: WMO World Weather Watch
GOS: WMO Global Observing System

4.1.2 The United Nations system

UN-Water

The UN has established a coordination body in 2003, called **UN-Water**. It coordinates water related activities of 26 UN organisations and additional partners. United Nations organizations include those responsible for major funds and programs, specialised agencies, regional commissions, United Nations conventions and other entities within the UN system. Other organizations outside of the United Nations are partners in UN-Water. Figure 1 provides an overview of UN-Water members and Figure 2 shows partner organizations of UN-Water.



Figure 1 : UN member organizations of UN-Water.

Source (accessed 08.07.2010): <http://www.unwater.org/members.html>


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Figure 2 : Partner organizations of UN-Water.

Source (accessed 08.07.2010): <http://www.unwater.org/members.html>

The range of topics that are covered by UN-Water is huge. It covers issues related to surface waters, groundwater and efforts to achieve the Millennium Development Goals (MDGs). UN-Water organizes the World Water Day, the Water for Life Decade and has four specific programmes:

- The **World Water Assessment Programme (WWAP)** was founded in 2000 and is the flagship programme of UN-Water. WWAP monitors freshwater issues in order to provide recommendations, develop case studies, enhance assessment capacity at a national level and inform the decision-making process. Its primary product, the World Water Development Report (WWDR), is a periodic, comprehensive review providing a picture of the state of the world's freshwater resources.
- The WHO/ United Nations Children's Fund (UNICEF) **Joint Monitoring Programme on Water Supply and Sanitation (JMP)** is an official mechanism of the UN System mandated to monitor global progress towards the MDGs targets for drinking-water and sanitation. The JMP issues regular global reports on water and sanitation coverage.

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- The **UN-Water Decade Programme on Capacity Development (UNW-DPC)** strengthens the activities of other UN organizations under UN-Water and supports them in their efforts to achieve the MDGs related to water. UNW-DPC undertakes capacity development, education, training and institutional development related to water.
- The **UN-Water Decade Programme on Advocacy and Communication (UNW-DPAC)** develops communication campaigns illustrating the benefits of sound water management for poverty reduction and advocates for actions to implement effective water policies. UNW-DPAC is implemented by the United Nations Office to support the International Decade for Action Water for Life 2005-2015 (UNO-IDfA).

Two major programmes (IHP and HWRP) under the auspices of UN-Water members are detailed below.

International Hydrological Programme (IHP) and Hydrology and Water Resources Programme (HWRP)


Two programmes currently exist within the UN system, which are explicitly and comprehensively focused on water:

- The **International Hydrological Programme (IHP)** of the United Nations Educational, Scientific and Cultural Organization (UNESCO)
- **Hydrology and Water Resources Programme (HWRP)** of the World Meteorological Organization (WMO)

The **IHP** is a long-term scientific cooperative programme of UNESCO, which has been established in 1975. It is focused on water research, water resources management, education and capacity-building. UNESCO Regional Offices are responsible for the implementation of IHP at the regional level. Regional Hydrologists are posted in the field and serve as IHP focal points for all issues relating to the Programme, both at regional and national levels. The efforts of the IHP are supported by National Committees, which present reports on their activities in the framework of the Programme.

IHP operates two cross-cutting programmes:

- **Hydrology for Environment, Life and Policy (HELP)** aims – in close cooperation with WMO and the Global Energy and Water Cycle Experiment (GEWEX) – at developing a new approach on integrated basin management by addressing five key policy issues: (1) Water and climate, (2) Water and food, (3) Water quality and human health, (4) Water and the environment and (5) Water and conflict.
- The **Flow Regimes from International Experimental and Network Data (FRIEND)** programme is a scientific programme aiming at an improved understanding of river flow regimes (hydrological variability and similarity across time and space) in different parts of the world. A regional cooperation model for Northern Europe represented the starting point of the development of further regional sub-networks worldwide. Through international cooperation, FRIEND has achieved to build comprehensive hydrological databases, such as the **European Water Archive (EWA)**, which contains long-term daily flow data and catchment information for about 3800 river gauging stations in 29 European countries.

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In addition, IHP collaborates with ten associated programmes:

- **Ecohydrology:** A scientific programme to understand the dynamic relationships between hydrological, social and ecological systems (UNESCO)
- **GRAPHIC:** Groundwater Resources Assessment under the Pressures of Humanity and Climate Change (UNESCO)
- **G-WADI:** A global network for water development information in arid lands (UNESCO)
- **IFI:** The International Flood Initiative, which is based on the International Centre for Water Hazard and Risk Management (ICHARM, Japan) (UNESCO)
- **ISARM:** Internationally Shared Aquifers Resources Management Programme (UNESCO, IAH⁹, FAO, UNECE)
- **ISI:** The International Sediment Initiative aims at assessing erosion and sediment transport to marine, lake or reservoir environments (UNESCO)
- **JIIHP:** The Joint International Isotopes in Hydrology Programme aims at an integration of isotopes in hydrological practices (UNESCO, IAEA)
- **PCCP:** The programme From Potential Conflict to Cooperation Potential facilitates international dialogues to foster peace, cooperation and development related to the management of shared water resources (UNESCO, WWAP)
- **WET:** Theme on Water Education and Training through access to data and information (UNESCO)
- **WHYMAP:** The World-wide Hydrogeological Mapping and Assessment Programme compiles data on groundwater from national, regional and global sources, and visualises them in maps, web map applications and services (UNESCO, CGMW, IAH, IAEA, BGR)

The **HWRP** is a global programme of WMO to integrated water resources management at national, basin, regional and international levels. It aims at supporting the hydrological services of the member countries in their operational work and at building a worldwide hydrological information network. The contributions to HWRP are prepared by experts from the NHS, international working groups and rapporteurs. The WMO **Commission for Hydrology (CHy)** provides guidance and oversight for the implementation of the Programme. The six Regional Associations of WMO address regional aspects of HWRP and implement regional activities through their working groups on hydrology. HWRP is implemented through sub-programmes:

- Basic Systems in Hydrology
- Hydrological Forecasting in Water Resources Management
- Capacity-building in Hydrology and Water Resources Management
- Cooperation in Water-related Issues

⁹ IAH: International Association of Hydrogeologists

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Within HWRP, the **World Hydrological Cycle Observing System (WHYCOS)** has been launched to collect, analyse, exchange, disseminate and use water-related information. WHYCOS is implemented through different regional components.

Due to their cross-cutting nature, other international programmes are linked with HWRP, mainly:

- World Climate Programme (WCP) of WMO
- Global Energy and Water Cycle Experiment (GEWEX) of WMO, UNESCO, IOC and ICSU
- World Climate Research Programme (WCRP) of WMO, UNESCO, IOC and ICSU

National IHP/HWRP Committees have been established in many (European) countries and support the implementation of IHP and HWRP. National secretariats act as interfaces between IHP/HWRP on international level and national activities related to water resources management and research.

Other UN frameworks related to water

The **Food and Agriculture Organization (FAO)** of the United Nations addresses water issues in relation to agriculture and land use management. The **World Health Organization (WHO)** is elaborating on the consequences of water issues for human health. Water issues with environmental implications are covered by the **United Nations Environment Programme (UNEP)**.


The FAO operates **AQUASTAT**, a global information system on water and agriculture, which collects, analyzes and disseminates information on water resources, water uses, and agricultural water management with an emphasis on countries in Africa, Asia, Latin America and the Caribbean.

The **Global Environment Monitoring System Water (GEMS/Water)** runs under the auspices of WMO and UNEP and develops and maintains a global freshwater quality information system.

The hydrological counterpart of GEMS/Water for river discharge is the **Global Runoff Data Centre (GRDC)** of WMO, which is hosted at the Federal Institute of Hydrology (BfG) in Germany. The GRDC contributes to the World Climate Research Programme (WCRP), the Global Climate Observing System (GCOS), the World Water Assessment Programme (WWAP), and other international programmes and initiatives focused on Earth observation. The GRDC aims at facilitating exchange of hydrological data and information on the global scale and maintains the Global Runoff Data Base, which contains river discharge data of more than 7.500 gauging stations worldwide. In addition, the GRDC operates specialised databases such as the European Water Archive (EWA) of the Northern European FRIEND initiative of UNESCO-IHP and is linked to GEOSS through its contribution to the **Global Terrestrial Network of Hydrology (GTN-H)**.

The sister data centre of WMO is the **Global Precipitation Climatology Centre (GPCC)**, which is located at the Deutscher Wetterdienst (DWD) as a German contribution to the World Climate Research Programme (WCRP). The GPCC holds the largest monthly in-situ precipitation database in the World to analyse the spatial and temporal distribution of global precipitation on a monthly time-scale. The GPCC produces monthly gridded data sets of global land-surface precipitation, which are also used for validation purposes of satellite-derived data sets of the GEWEX¹⁰ Global Precipitation Climatology Project (GPCP).

¹⁰ GEWEX: Global Energy and Water Cycle Experiment

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The International Groundwater Resources Assessment Centre (**IGRAC**) is an initiative of WMO and UNESCO and is hosted by The Netherlands at Deltares. IGRAC facilitates and promotes global sharing of information and knowledge required for sustainable groundwater resources development and management. The main activities are the Development of a Global Groundwater Information System (GGIS), Transboundary Aquifers Assessment, Global Groundwater Monitoring (GGMN) and Global Groundwater Assessments.

In 2008, an agreement between WMO and the Federal Service of Russia for Hydrometeorology and Environmental Monitoring (ROSHYDROMET) was signed to establish the International Data Centre for the Hydrology of Lakes and Reservoirs (**HYDROLARE**), which will be hosted by the Russian Federation. HYDROLARE aims at developing a global monitoring system on lakes and reservoirs to facilitate sustainable use, preservation and management of their water resources.

Several other UN initiatives and programmes address issues related to water. These programmes are often of strong cross-cutting nature and their activities are therefore often interlinked. There is collaboration of UN programmes with other inter-disciplinary initiatives outside the UN system.

4.1.3 Cooperation frameworks outside the UN system


A considerable number of international non-governmental organizations in the water area exist in addition to the water programmes described above. Many of these organizations are of scientific nature.

A noteworthy example for scientific cooperation in the study of water related issues of global environmental change is the **Global Water Systems Project (GWSP)**. The GWSP is associated to the Earth System Science Partnership (ESSP), which consists of the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), DIVERSITAS and the World Climate Research Programme (WCRP). The international project office of GWSP is located in Bonn and is funded by the Federal Republic of Germany. The GWSP conducts research on global assessments of water, and the development of adaptation strategies with the appropriate scientific basis and international consensus. GWSP coordinates and supports research to understand this complex system with its interactions between natural and human components and their feedbacks. GWSP aims at providing strategies for policy-informing research on human dimensions underpinned by political discourse, global observing systems, model simulations, and by delivering tailored products for water managers.

The **Global Water Partnership (GWP)** is an international network to advance integrated water resources management (IWRM) by providing a platform for international exchange of knowledge and practices on IWRM. GWP consists of several Country Water Partnerships and Regional Water Partnerships and is financially supported by a number of European countries, the European Commission, Canada and the United States.

Several of the major non-governmental organizations operating in the water sector are informally linked together through the **International Water Associations Liaison Committee (IWALC)**. This Committee meets usually once a year in order to exchange information between the committee members and to coordinate efforts in the international arena. The following IWALC member associations appear to be relevant in the context of the GEO Water SBA:

- International Association of Hydrological Sciences (IAHS)
- International Association of Hydrogeologists (IAH)

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- International Association of Hydraulic Engineering and Research (IAHR)
- International Commission on Irrigation and Drainage (ICID)
- International Commission on Large Dams (ICOLD)
- International Water Resources Association (IWRA)
- International Water Association (IWA)
- Societas Internationalis Limnologiae (SIL)
- International Hydropower Association (IHA)

In addition to the above mentioned international frameworks and programmes, there is significant international collaboration of European NHS in transboundary river catchments. This has been especially induced by the establishment of the Water Framework Directive (WFD), which calls for the development of (transboundary) river basin management plans.


Finally, the **European Network of Freshwater Research Organisations (EurAqua)** should be mentioned in this context. Many European NHS are involved in this international network, which aims at contributing to the development of European freshwater science and its dissemination on a European scale. Amongst other activities, EurAqua provides expert advice to European institutions and other stakeholders.

4.2 Cooperation of European organisations in the GEO framework

Information on international cooperation activities of European organisations has been drawn from the GEO Work Plan 2009-2011 Information Management System & Task Sheets (accessible online at <http://www.grouponearthobservations.org/cdb/docshow.php?id=1>). In every Task Sheet, a section called "Contribution to Outputs and Activities Above" documents the involvement of individual organisations to the Task. The Task Sheets represent the most up-to-date information on cooperation in the framework of the GEO Work Plan. The latest update of the Water SBA Task Sheets has been made in February 2010.

GEO has undertaken efforts to harmonise the procedures to report and display the status of the individual Tasks, information is available on the GEO website under "GEO Work Plan 2009-2011 Information Management System & Task Sheets". For various reasons the information given in the Task Sheets does not necessarily correspond to the actual status of activities, outputs or involvement of organisations in the Tasks. Therefore, for this overview of European contributions in the GEO Water SBA Tasks, the concrete input to the Tasks had to be determined. Appendix-B includes a catalogue, which introduces each of the Water SBA Tasks briefly (the Task descriptions are taken from the Task Sheets). The catalogue further documents the participating organisation, project or programme and the identified inputs to the Task. The following Tasks are part of the GEO 2009-2011 Work Plan for the Water SBA and have been analysed for the Water Status-quo report:

- **WA-06-02: Droughts, Floods and Water Resource Management (overarching Task)**
 - WA-06-02a Forecasting for Droughts and Floods
 - WA-06-02b Impacts from Drought
 - WA-06-02c Mountain Water Resources

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- WA-06-02d Prototype Regional Drought Early Warning
- **WA-06-07: Capacity Building for Water Resource Management (overarching Task)**
 - WA-06-07a Capacity Building WRM Latin America
 - WA-06-07b Capacity Building WRM Africa
 - WA-06-07c Capacity Building WRM Asia
- **WA-08-01: Integrated Products for Water Resource Management (overarching Task)**
 - WA-08-01a Soil moisture
 - WA-08-01b Runoff
 - WA-08-01c Groundwater
 - WA-08-01d Precipitation
 - WA-08-01e Water Cycle Data Integration
 - WA-08-01f Improved Water Discovery and Quality Assessments
 - WA-08-01g Global Water Quality Monitoring

Figure 3 shows that Europe contributes to all Water SBA Tasks, except to Task WA-08-01f (Improved Water Discovery and Quality Assessments). The number of European entities involved varies between one (WA-06-02c) and eleven (WA-06-01a). Four Tasks can be identified, where European participation is strongest:

- WA-06-01a: Forecasting for Droughts and Floods – 11 participants
- WA-08-01e: Water Cycle Data Integration – 8 participants
- WA-08-01b: Runoff – 5 participants
- WA-08-01g: Global Water Quality Monitoring – 5 participants

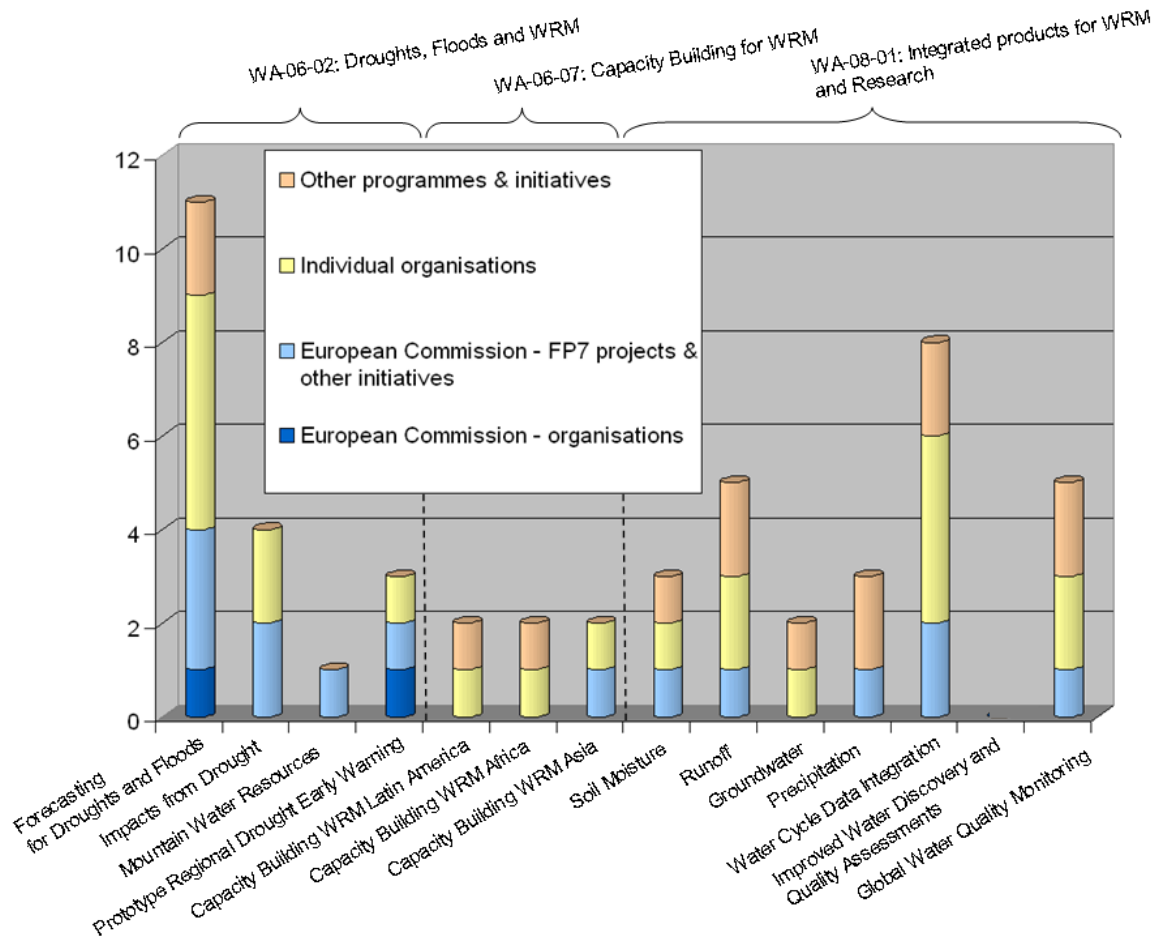



Figure 3 : European contributions to the GEO Work Plan 2009-2011 in the Water SBA – number of contributing organisations, programmes and initiatives per GEO Task. Source: GEO Task Sheets, 02/2010.

The European Commission (EC) is supporting the Tasks mainly through different FP7 projects. Four different projects have been identified that currently contribute to the GEO Water SBA Tasks:

- CEOP-AEGIS:** The project “Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations” (CEOP-AEGIS) is currently involved in six Tasks, contributing on different levels, e.g. by developing case studies on drought early warning or by reporting on methods and results from the ongoing project activities. CEOP-AEGIS is funded until 04/2012.
- ACQWA:** The project “Assessing Climate impacts on the Quantity and quality of Water” (ACQWA) is supporting the work of Task WA-06-02c. In fact, the Task description states that the Task activities are build on the results of the ACQWA project. ACQWA is funded until 09/2013.
- Hypox:** The project “In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies” (Hypox) contributes to Tasks WA-08-01e and WA-08-01g by providing GEOSS compliant data sets and monitoring capacities. Hypox is funded until 03/2012.

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- **EuroGEOSS:** The EuroGEOSS projects aims at developing European approaches to GEOSS by making existing systems and applications interoperable and used within the GEOSS and INSPIRE frameworks. The project focuses on the three strategic areas of Drought, Forestry and Biodiversity and contributes to Tasks WA-06-02b and WA-06-02d by developing of Task specific GEOSS component for Europe. EuroGEOSS is funded until 04/2012.


In addition, the EC contributes by giving general expertise to Task WA-06-02a by a representative of the Joint Research Centre (JRC) and through different programmes and initiatives, namely:

- **GMES:** In the framework of the land monitoring services of GMES (Global Monitoring for Environment and Security), the GEOLAND project participated in Task WA-06-01a. According to discussions at the European GEOSS Workshop on Water, contribution is continued under the GEOLAND-2 project (an FP7 funded research project). GEOLAND-2 is delivering services for land monitoring during the pre-operational phase of GMES and is one of the so-called “Fast-Track-Services” of GMES. The Water Quality Services of GEOLAND-2 address the Water Framework Directive (WFD), a main component of the European environmental legislation, and focus on identification and management of nutrient and pesticide inputs into the water cycle. It is anticipated that the GMES services will be developed to a fully operational mode until 2014 potentially building a basis for a sustainable contribution to GEO Tasks. GMES is being promoted as the major contribution of Europe to GEOSS.
- **EFAS:** The European Flood Alert System (EFAS) is currently being developed by the EC through a research project at the JRC and mainly aims at providing relevant information to the EC for the preparation and management of aid during a flood crisis. Following a pilot study of Eastern Africa, JRC has started the development of a pan-African flood early warning system, using the same principles as for EFAS. EFAS participates in Task WA-06-02a. However, a concrete contribution to the GEO Task has not been identified in the Task Sheet.
- **ETN-R:** The European Terrestrial Network for River Discharge (ETN-R) is an information infrastructure for the automated collection, quality control and redistribution of near real-time river discharge and water level data from 30 European national and trans-boundary river basins. The ETN-R is a contribution of the Global Runoff Data Centre (GRDC) to EFAS and will contribute to the GRDC project Global Terrestrial Network for River Discharge (GTN-R).

Furthermore, the EC contributes to Task WA-06-02d by a representative of the Joint Research Centre (JRC) through:

- **EDO:** The prototype of a European Drought Observatory (EDO) is currently under development at JRC. It is a contribution of the European Commission to an improved risk management as identified in the follow-up process to the Communication on Water Scarcity and Droughts (COM(2007) 414 final). The multi-scale approach of EDO allows for the inclusion of drought information at regional, national, and continental-scale from the respective competent authorities in Europe, thus serving as an important cornerstone in an international network towards a Global Drought Early Warning System. JRC participates in Task WA-06-02d with the EDO prototype through its participation in the RTD-FP7 project EuroGEOSS.


Besides the pan-European contributions of the EC, three pan-European organisations, namely the European Centre for Medium-Range Weather Forecasts (ECMWF), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the European Space Agency (ESA) participate in different Water SBA Tasks: ECMWF mainly participates in Task WA-06-02a by providing general expertise and indirectly by cooperating with EFAS. EUMETSAT is representing CEOS in Task WA-06-07a. ESA is directly involved in Task WA-08-01a by providing a soil moisture data base study and in Task WA-08-01b through projects on river and lake level monitoring.

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A considerable proportion (approximately 40 %) of European contributions to GEO Tasks is realised by European Member States, either through the involvement of national level organisations in different projects, initiatives or programmes or through direct participation of national level organisations. In Figure 2, these contributions are part of the category “Individual organisations” (42 %), which also includes contributions by international organisations (the remaining 2 %). A list of national level organisations, which are individually contributing to GEO Tasks, is given here:

- Center of Technological Research Hellas (CTRH), GR
- Centre for Marine and Atmospheric Sciences (ZMAW), DE
- Deutscher Wetterdienst (DWD), DE
- Environmental Agency of the Republic of Slovenia (EARS), SI
- Federal Institute of Hydrology (BfG), DE
- German Aerospace Centre - Remote Sensing Data Centre (DLR-DFD), DE
- GKSS Research Centre (GKSS), DE
- Instituto Nacional de Recursos Biológicos (INRB), PT
- Instituto Superior Tecnico, Technical University of Lisbon (IST), PT
- Norwegian Water Resources and Energy Directorate (NVE), N
- Territory, Culture and Development Research Center (TERCUD), PT
- University of Thessaloniki, GR
- VU University of Amsterdam, NL
- Water Research Institute of the Italian National Research Council (IRSA-CNR), IT

Finally, national level contributions are also realised through participation in or hosting of international organisations such as the International Groundwater Resources Assessment Centre (IGRAC, hosted by NL), the WMO Global Precipitation Climatology Centre (GPCC, hosted by DE) or the WMO Global Runoff Data Centre (GRDC, hosted by DE). The International Institute for Geo-Information Science and Earth Observation (ITC) is based in The Netherlands and contributes directly to Task WA-06-07b and indirectly to Task WA-06-07c via the ESA led CEOS-TIGER initiative.

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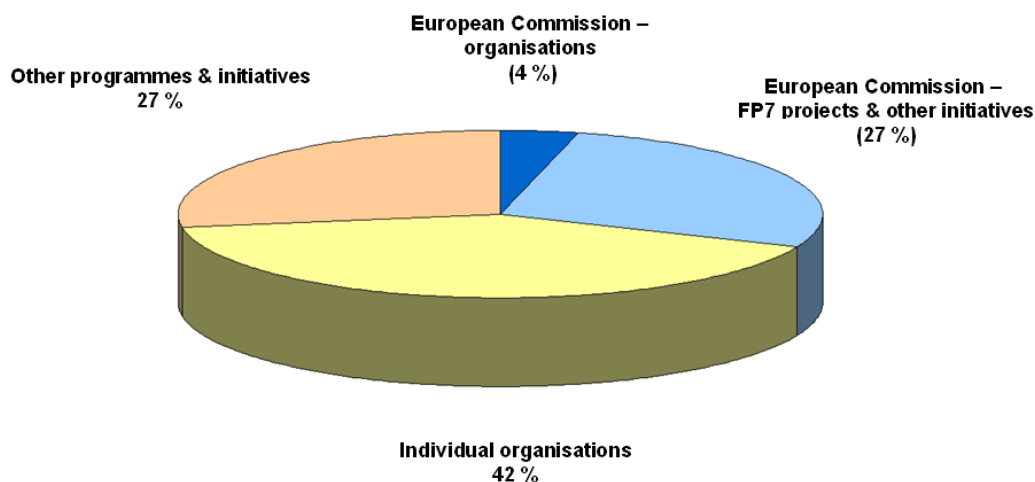



Figure 4 : European contributions to the GEO Work Plan 2009-2011 in the Water SBA – percentage of contributions according to type of organisation, programme and initiative. Source: GEO Task Sheets, 02/2010.

In addition the European involvement in different GEO Tasks, pan-European and national European organisations are participating in different Communities of Practice (CoP), which are established under GEO to facilitate cooperation and exchange among GEO Member States and Participating Organisations. The CoPs are focused on different aspects under the nine Societal Benefit Areas of GEOSS – one CoP is addressing the Water Cycle and builds on the legacy of the Integrated Global Water Cycle Observations (IGWCO) theme under the umbrella of the Integrated Global Observing Strategy Partnership (IGOS-P). According to the “Guidelines for Generating Community of Practice Proposals”, which are currently drafted by the GEO User Interface Committee (UIC), CoPs are “self-organising, informal groups”. Therefore, information on the membership of CoPs, which are relevant for the Water SBA, is still being collected¹¹.

The GEO Plenary established Committees and Working Groups to address aspects of GEOSS implementation and provide a mechanism for GEO Members and Participating Organizations to engage in the work of GEO. Thus, the GEO committees represent an additional opportunity of pan-European and national European organisations to contribute to the implementation of GEO. European Member States and the EC are well represented in these committees.

¹¹ An informal cooperation with the GEO Water Cycle CoP (WCCOP) has been established on the occasion of the EUGENE project. It is anticipated that information about European participation in the WCCOP is retrieved through an informal reporting mechanism, which has also been established to identify concrete possibilities for cooperation of European organisations and the WCCOP.

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5 Gaps, challenges, strengths and opportunities


5.1 Gaps and challenges

This chapter gives an outline of the current major gaps of hydrological Earth observations on international level. In chapter 5.1.1, specific European issues related to general observational gaps are highlighted, where applicable. Observational gaps may arise from a lack of observation, inadequate data specifications (e.g. coverage, frequency, data quality etc.) or restrictive data policies.

As no analysis of user requirements that contains Earth observation specifications (cf. Chapter 2) could be indentified, the stated requirements cannot simply be compared to the currently provided hydrological data sets to identify observational gaps. Detailed Earth observation requirements are available in the WMO database for different users, but it must be noted that this database contains programme-specific requirements and requirements from hydrology are poorly represented and very generic. Furthermore, there are large regional differences in density and quality of monitoring networks and data sharing principles can vary from country to country and may change in the short term due to changing national investment policies.

The following reports assess unmet hydrological data requirements:

- **GTOS (2000): Establishment of a Global Hydrological Observation Network for Climate**
www.fao.org/gtos/doc/pub26.pdf
 This report of the GCOS/GTOS/HWRP Expert Meeting in June 2000 gives an overview of the Status quo of terrestrial Earth observations of hydrological parameters at that time. For each of the eleven hydrometeorological Variables (defined by GCOS, cp. Chapter 2) the available data is described and it is discussed whether it meets requirements or not.
- **WMO (2008): Statement of Guidance Hydrology**
<http://www.wmo.ch/pages/prog/sat/SOG/SOG-Hydrology.doc>
 The Statement of Guidance is prepared as a result of a comparison of user requirements with observing system capabilities for a given application based on the WMO database. The main aim of it is to draw attention to the most important gaps between user requirements and observing system capabilities in the context of the application.
- **GEOSS 10-Year Implementation Plan Reference Document (2005):**
<http://www.earthobservations.org/documents/10-Year%20Implementation%20Plan.pdf>
 The 10-Year Implementation Plan Reference Document gives a qualitative evaluation of the status of observation for each required parameter at that time (2005). The evaluation is based on experts' ratings and is performed using five classes ranging from "0" (monitored with acceptable accuracy, spatial and temporal resolution; timeliness and in all countries worldwide) to "5" (still in research phase; could be available in ten years). It is aimed to get an actual evaluation of the observational status of the required parameters within the GEO Task US-09-01a, which is not yet integrated into the GEO report on Earth Observation Priorities for the Water Societal Benefit Area.
- **World Water Development Report (2009): Chapter 13 - Bridging the observational gap**
http://www.unesco.org/water/wwap/wwdr/wwdr3/pdf/25_WWDR3_ch_13.pdf
 Chapter 13 "bridging the observational gap" of the third edition of the United Nations World Water Development Report (WWDP 2009) provides an evaluation of the current sta-

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tus of water observations. Terrestrial hydrologic networks and space based observations are taken into account. Recent developments and trends are described and opportunities and challenges are outlined. The evaluation takes place on a certain degree of abstraction and does not include a gap analysis for specific parameters.

- **GCOS (2009): Progress Report on the Implementation of the Global Observing System for climate in Support of the UNFCCC 2004-2008**
www.wmo.int/pages/prog/gcos/Publications/gcos-129.pdf

The GCOS progress report addresses the progress since late 2004 in implementation of the 131 Actions called for in the Implementation Plan from 2004 (www.wmo.ch/pages/prog/gcos/Publications/gcos-92.pdf). The presented progress evaluations are related to the progress within the defined actions and do not characterize the status of observations, but information on the status of observed parameters and networks are also given.

- **JRC Scientific and Technical Reports (2010): European capacity for monitoring and assimilating space based climate change observations – Status and prospects**
<http://publications.jrc.ec.europa.eu/repository/handle/111111111/765>

The report reviews the current capabilities of a European space-based ECV monitoring system. The current European contributions are analyzed and a gap analysis of European space contributions to Essential Climate Variables is given in table format.


- **Dossier on the Space-based Component of the Global Observing System (GOS-2010)**
<ftp://ftp.wmo.int/Documents/PublicWeb/sat/DossierGOS/>

The Dossier on the Space-based Component of the Global Observing System (GOS) is compiled in the framework of the WMO Space Programme. The dossier reviews the status of existing satellite programs and provides information on available instruments. Long-term evolution of the programs is analyzed to discover possible gaps of service. Finally, a major achievement of the dossier is an analysis of the compliance of current Earth observation systems with user requirements, which is not yet integrated in the 2010 edition.

5.1.1 Observational gaps

In-situ networks

Many required parameters of the terrestrial component of the water cycle (including many terrestrial ECV's, cf. Table 1) cannot be monitored from space at present. In 2001 the Global Terrestrial Network – Hydrology (GTN-H) was established as a “network of networks” for global and regional climate and water applications. It links existing networks and systems for integrated observations of the global water cycle. Figure 5 shows the GTN-H configuration (GCOS 2009).

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The adequacy of any hydrologic observation network is related to the accuracy of measurement systems, the density and representativeness of the network, and monitoring, data retrieval, storage and dissemination practices. The adequacy varies widely by region, but observations for many water cycle variables have inadequate spatial and temporal coverage. Notwithstanding existing positive examples there are generally inadequate hydrologic monitoring networks in developing countries and especially in least developed countries. Many systems lack adequate quality assurance and control standards for calibrating instruments, they are often rudimentary, irregularly updated and without sufficient quality control to make observations truly useful. Reasons can be found in the low quality and quantity of basic equipment, poor technology, few laboratories for recalibrating equipment, inadequately trained human resources at both professional and technician levels and insufficient financial resources to sustain current operations or address new technologies.

According to the GCOS progress report (2009) terrestrial networks are still poorly coordinated and harmonized and the progress in establishing institutional support for them has been slow. The objective of creating a comprehensive and well coordinated reference network for in-situ observations of the terrestrial ECVs is still a largely unmet challenge.

Satellite-based Earth observations


Although the majority of observations required for hydrologic applications are collected by in-situ observation networks, a number of hydrologic applications can be identified, which make use of satellite-based EO data at different level of maturity:

- Observation of key parameters of the hydrologic cycle such as surface water levels, snow, glaciers and (sea) ice cover extent;
- Observations of ancillary parameters used in hydrologic models such as land cover and land use (change), surface roughness, vegetation indices, topography (DEM) or lake and reservoir extent;
- “Synoptic, multi-sensor satellite data products and imagery have become increasingly valuable tools for the assessment of water quality in inland and near shore coastal waters” (GEO 2007, p. 7). The use of satellite-based observations to determine the content of particulates (sediment and other matter) and pollutants in coastal waters and large rivers is a further promising application area.
- New technological developments enable observations of soil moisture (e.g. by SMOS or ASCAT on MetOp) and groundwater storage changes (e.g. by GRACE) from space; radar altimetry (onboard TOPEX/Poseidon, Jason-1, Envisat) allows for supplementing terrestrial water level observations with “sufficient accuracy” (cf. WWDP 2009).

In general, satellite-based EO can be predominantly applied for large-scale processes and structures and cover large regions (continental-scale) and the globe. In remote areas, in-situ infrastructure is often only sparse or not existent and satellite EO can provide valuable additional data to close spatial and temporal observation gaps.

Despite apparent progress in the development and utilisation of satellite observations in hydrology, some important limitations have to be highlighted:

- In general, **spatial and temporal resolution** of observations is not sufficient with respect to many hydrologic parameters, especially precipitation (including phase), soil moisture, water level, vegetation properties, water quality and fluvial sediment transport (D-GEO 2009).

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- Observations for many water cycle variables have inadequate **spatial and temporal coverage** (WWAP 2009). There is a need to develop integrative approaches, which use both in-situ and remotely-sensed observations that make best use of the complementary nature of in-situ and satellite observations (cf. DLR 2008). **Integrated observation systems** can be used to close spatial and temporal observation gaps and facilitate continuous and consistent quantification of hydrologic variables at the global, regional and basin levels. These systems will need data assimilation products, including models calibrated from the integrated networks and multiplatform observations (WWDP 2009).
- For several hydrologic applications, a high potential of the use of satellite-based observations is visible (e.g. use of altimeter measurements to derive water levels and discharge series). However, application of these satellite-based observations is often only (or merely) realised in the framework of R&D projects and concrete plans to transfer these methods to an operational stage have not been developed.
- Due to the limited lifetime of satellites, data continuity and consistency in terms of observation technology is often at risk.

Further observation gaps can be directly linked to specific EO parameters and are discussed in detail below.


Parameter specific observation gaps

In the following section the status of in-situ and satellite-based observations and major observation gaps are briefly outlined for hydrological key parameters. The following information has been mainly extracted from GCOS (2004), WMO (2008) and WWAP (2009) unless noted otherwise:

- *Precipitation*
 - Global coverage from *in-situ* precipitation observations exhibits with large regional differences. Exchange of data is achieved in real-time and near real-time mode and subsets of the precipitation measurements made are accessible through global networks and data centres.
 - Several precipitation estimation methods based on microwave and infrared instruments on numerous satellites and associated different data retrieval and interpretation algorithms have reached a semi-operational and, in a few cases, an operational level. For the use in flash flood forecasting, methods to derive real-time precipitation information from satellites need to be improved. In general, satellite-based precipitation measurements still have only marginal spatial and temporal resolution and accuracy despite high coverage. A large deficit exists with respect to precipitation information (phase, intensity/quantity) (D-GEO 2009).
- *Isotope Signatures*
 - For isotope signatures only a small global network of terrestrial stations exists where all data are accessible.
- *Stream flow*
 - On a global scale, terrestrial measurements of stream flow are marginal and generally of unacceptable quality and coverage in remote and mountain areas.
 - Terrestrial water level observations of large rivers, lakes and reservoirs can be supplemented by radar altimetry instruments with sufficient accuracy. The use of altimetry observations is not appropriate for smaller tributaries.
- *Evaporation*


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- Direct observations of evaporation are sparse and most evaporation values are derived estimates. Terrestrial measurements on a global scale are declining in terms of spatial coverage at a time when traditional in-situ observations like evaporation pans and lysimeters are largely discontinued. Replacing traditional observation methods by using flux towers, evaporation estimates are made using eddy correlation and Bowen Ratio techniques. The number of these towers is very limited and data are not readily available on a global scale.
- Evaporation is inferred from surface temperatures, radiation fluxes (and their diurnal variations) and vegetation indexes, as systematically observed in VIS/IR imagery from geostationary and low orbiting meteorological satellites.
- *Surface Water Storage Fluxes*
 - While terrestrial observations are being made for lakes and reservoirs (levels of lakes and reservoirs, volumetric observations), observations are not yet available for wetlands, large floodplains and estuaries.
 - Space-based observations such as those derived from altimetry observations are also becoming available. Presently, the ability of the ICESat / GLAS (radar altimeter) instrument to provide accurate measurements of lake level is being tested (WMO 2008).
- *Soil moisture*
 - The establishment of an operational global in-situ network on soil moisture has not been fully achieved yet (cf. Figure 3). However, the International Soil Moisture Network, an international initiative to establish and maintain a global in-situ soil moisture database, is currently coordinated by the Global Energy and Water Cycle Experiment (GEWEX) in cooperation with the Group of Earth Observation (GEO) and the Committee on Earth Observation Satellites (CEOS). The data hosting facility will be developed and maintained by the Vienna University of Technology and funded by ESA.
 - The use of microwave remote sensing (either active or passive) allows derivation of soil wetness of the first few centimetres. However, this information is only partially useful for hydrological studies and forecasting and need to be augmented for example by infiltration models. Most of the active and passive microwave instruments provide some soil moisture information for regions of limited vegetation cover. However, under many conditions remote-sensing data are inadequate, and information regarding moisture depth remains elusive. However, simple exponential filtering techniques have been used to handle soil depth issues (e.g. Albergel et al. 2008), and surface soil moisture estimates have been used in land data assimilation systems (Albergel et al. 2010). Other approaches to determine soil water content are based on physical models, which utilize remote sensing information (e.g. Mauser & Bach (2009)).
- *Relative humidity*
 - Relative humidity is observed from in-situ networks with generally sufficient global coverage and is a basic variable for estimation of evapotranspiration as well as in use for water cycle studies and modelling.
 - Sounding instruments using both infrared and microwave are used on satellites.
- *Groundwater*
 - There is no systematic monitoring of groundwater. Only a few countries have up-to-date groundwater databases from which the current quality and quantity of groundwater resources

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can be elaborated. Overall global access to groundwater data (groundwater levels, rates of recharge and abstraction in particular) is highly limited.

- There is promising evidence that gravimetric remote sensing methods allow aquifer monitoring on global to sub-regional levels, especially in sparsely gauged areas, but separating water masses (soil moisture, vegetation and groundwater) is still difficult. Nevertheless, at large scales gravimetric observations of large aquifers from GRACE (NASA/DLR mission) and missions like the Gravity Field and Steady-State Ocean Circulation Explorer (GOCE, ESA mission) satellite have delivered useful results.
- *Snow cover, depth, and snow water equivalent*
 - Conventional terrestrial snow observation methods include snow-pillow networks and regularly worked snow depth measurement courses as well as networks of snow gauges. Derived from measured snow densities, snow water equivalent is calculated. On the northern hemisphere, snow observations are generally adequate but a real representativeness of snow cover thickness can often not be assessed with a high reliability.
 - Satellite-based systems include AVHRR sensors. On a regional basis, passive microwave sensors such as SSM / I can be used to map extent and depth of moderate to thick snow covers. The overall important snow-water equivalent of snow packs should be derived on the basis of improved algorithms from microwave brightness temperature.
 - Extension of measurement networks and development of suitable satellite systems and remote sensing methods to determine snow water equivalents are therefore required (D-GEO 2009).
- *Water use*
 - Global data on water use exist primarily for the agricultural sector (for example, the AQUASTAT database by the Food and Agriculture Organization of the United Nations). Data on consumptive and non-consumptive use of water resources are not a regular part of many national statistics, although where abstractions are licensed, information on the maximum use of water may be available. This situation is unsatisfactory because it prevents effective management of water demand relative to availability and supply of freshwater.
- *Water quality, biogeochemical fluxes, fluvial sediment transport*
 - Terrestrial water quality observation networks are sparse and frequently use spot rather than continuous observations. Terrestrial observations of biogeochemical fluxes are being made but temporal and spatial coverage as well as global access to such observations is insufficient at present.
 - Space-based observations are so far very limited and not available in an operational mode. Through the IGWCO, a project: "Multi-sensor Space borne Monitoring of Global Large Lakes: Towards an Operational Assessment of Trends in Water Quantity and Quality" is being supported.
 - "The content of particulates (sediment and other matter) and pollutants is determined using in-situ methods and also remote sensing in the case of particulates. Whilst in-situ methods permit only a random data capture, the frequently marginal spatial resolution and the great extinction in cloudy waters primarily restrict the satellite-based information gained to areas near to the surface of large water bodies. Frequent cloud cover in central latitudes also restricts the availability of suitable data and therefore the temporal resolution" (D-GEO 2009, pp. 26-27).
- *Land cover/ land use*

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- One deficit is to be found in the low spatial and inadequate spectral resolution of the optical satellite sensors predominantly used (e.g. Landsat 5 TM, Landsat 7 ETM+, Spot) which impair accuracy in differentiating plant properties (D-GEO 2009). The frequent occurrence of clouds particularly in central latitudes also limits the availability of useful optical data and therefore temporal resolution. Although the European land use classification CORINE LC derived from satellite data provides detailed information on land use, the German Federal Environmental Agency (UBA) specifies a requirement for a higher depth of differentiation (e.g. with respect to the degree of sealing and agricultural areas) and a higher spatial and temporal resolution to implement the Water Framework Directive (UBA 2004, in D-GEO 2009).

5.1.2 Data sharing issues in hydrology

For various reasons there is little sharing of existing hydrological data, which hampers many hydrological applications (forecasting, disaster warning and prevention, integrated water resources management in transboundary basins). Internationally, existing reasons can be grouped as follows:


- Reluctance to share Data due to
 - Security concerns
 - National data policies
 - Poor data quality and lacking quality management
 - Lack of involvement in regional and global studies
 - Commercial considerations
 - Political sensitivities about transboundary resources
- Technical limitations due to
 - Limited physical access to data due to insufficient communication infrastructure
 - Lack of agreed protocols for data sharing (including metadata standards)
- Loss of data as a result of disasters, social unrest or technological evolution

The situation is especially critical for forecasting purposes when data need to be shared in real or near real-time.

5.1.3 Gaps and challenges in Europe

Recently, the WMO Regional Association for Europe (RA VI) has drafted a strategic plan for the enhancement of meteorological and hydrological services in Europe (WMO 2007). This document includes an analysis of the current situation of NMHS, their observation infrastructure and capabilities in Europe. Many of the gaps mentioned above also apply to Europe – a few of the identified gaps in WMO (2007) are summarized here, since they are also relevant in the context of the EUGENE project:

- General decrease of government funding to support the requirements of the meteorological and hydrological infrastructure
- In the light of decreasing funds for NMHSs, a requirement to deliver more (data, services, products) for the same or less resources is visible

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- Lack of reactivity and competitiveness of some NMHS in complying with supra-national regulations
- Technological gap between NMHSs of developed and developing countries within RA VI; need for improvements to the infrastructure, especially in eastern European countries

Although abundant activities and interagency collaboration mechanisms in the area of water cycle observation and water resource management can be identified in Europe, no overarching coordinating body or programme is dedicated solely to water issues. In fact, water cycle observations and water resource management tasks are implicitly covered by programmes and projects of different pan-European and national European organizations. A pan-European coordination process or systematic framework in the water area, which could lead to the identification and closure of observation gaps and to a harmonization of the activities of different players, especially with a view to the GEO initiative, is currently not visible.

For example, in the context of the GMES Land Monitoring Service (geoland-2), a number of relevant Earth observations and products are delivered under the Water Quality Service, which has been set up to address the Water Framework Directive. Other relevant aspects of water resource management such as floods and droughts are currently only covered partially by GMES (under the aspect of emergency response) and are mainly addressed elsewhere (by JRC's Actions on Flood and on Desertification, Land Degradation and Drought).


5.2 Strengths and opportunities in Europe

Based on the status-quo assessment, the following chapters analyse the strengths and opportunities for Europe in the GEO context.

5.2.1 Strengths

International cooperation

- Europe has developed extensive capabilities in Earth observation that are contributing to the implementation of key international frameworks such as GCOS/GTOS, IHP and HWRP. These international cooperation efforts are for example supported by European countries through hosting of international data centres such as GRDC, GPCC and IGRAC and/or by providing scientific expertise.
- In Europe, the EU Water Framework Directive (WFD) represents an important basis for international cooperation in water protection and management. The WFD, which entered into force in 2000, represents an integrated approach to water resource management, which addresses various sectoral activities (agriculture, rural development, economy, energy, transport, water infrastructure) and needs to be supported by intense information exchange between relevant actors (European Environment Agency 2009). The WFD requires international cooperation in transboundary catchments to develop river basin management plans.
- Operational hydrological networks have been established by European NHS and the WFD provides a legal basis to increase international cooperation and data exchange, especially for transboundary river basins.

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- The EU supports international cooperation in the water area by funding projects on twinned river basins in European and non-European countries. These projects aim at making research results related to IWRM and water governance transferable to other regions of the world. Many twinning projects thereby contribute to build capacity to use Earth observations in developing countries.
- Europe is strongly engaged in capacity building for Earth observations through dedicated programmes such as PUMA, EUMETCast, TIGER and AMESD (for further information, see Appendix) and various national European projects. In the framework of the GMES programme, the extension of Earth observation services to other regions outside Europe is currently pursued for Africa. The GMES Africa Action Plan (consultation phase until July 2010), a joint effort of the African Union (AU) and the EU under the auspices of the EU-Africa partnership on Science, Information Society and Space will aim at jointly developing a strategy to provide sustainable, reliable and timely Earth observation information services and products related to environmental and security issues.

European programmatic frameworks

- In the field of Earth observation and spatial information, two flagship programmes have been developed in Europe: GMES (Global Monitoring for Environment and Security) and the INSPIRE Directive (Infrastructure for Spatial Information in Europe). Both initiatives aim at establishing long-term, sustainable frameworks in their specific fields and are thus a major contribution of Europe to the GEOSS.
- Europe delivers Earth observation services and products through a considerable number of short- and medium-termed projects. Since these projects are embedded in long-term frameworks such as GMES or the EU Framework Programmes, they represent important contributions to international Earth observation activities. It can be recognized that links of European (and national) projects to the GEOSS initiative are increasingly made explicit.
- In June 2010, a legal basis for the phase of ‘initial operations’ of GMES has been reached by the adoption of the European Commission’s proposal for a regulation on GMES through the European Parliament. Entry of GMES into the initial operations phase (2011-13) is an important milestone to establish a sustainable and long-term Earth observation programme in Europe. Free and open availability (for local, regional and national users) of the data produced under GMES is a key element of the GMES programme.
- Another recent milestone in reaching the goal of free and open access to European Earth observation data was the revision of ESA’s data policies for ERS, ENVISAT and Earth Explorer missions and the new Joint Principles for a Sentinel Data Policy, which will basically provide most of ESA’s satellite data openly and free of charge.

Various other strengths


- Through the operational hydrological networks of European NHS, systematic observations of hydrological parameters are made. Corresponding operational and scientific archives are maintained on European level (e.g. EIONET, WISE, EWA, etc.) and Europe contributes with this experience – and to some extent also with hydrologic data – to international frameworks in the water sector.

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- Strong investments have been made in Research and Development (R&D) projects and initiatives, e.g. under the EU Framework Programmes or by ESA, which can be considered as the forerunners of European operational programmes in Earth observation. In the framework of GMES, pre-operational services have now been developed to prepare transfer of R&D developments into operational services.
- Europe has developed various Earth observation systems and databases for different purposes such as flood forecasting, drought observation and water quality monitoring. Europe is undertaking efforts to transfer suitable systems to other regions of the world, especially to developing countries and is therefore supporting the efforts of developing countries to build capacity in the sustainable management of natural resources through the use of Earth observation. This involves close cooperation with local/regional stakeholders and users regarding techniques and methodologies and an exchange of knowledge and experiences.

5.2.2 Opportunities


- Many processes at different stages of maturity are underway in Europe to develop Earth observation capabilities and systems. Europe should take the chance to **develop its programmes in consideration of international developments**, especially as regards the GEOSS initiative. Due to various reasons, it is sensible to assure compatibility of systems and programmes with GEOSS at early planning stages. For example, the EEA is currently tasked with coordinating the in-situ observation component of GMES – an important pillar and milestone of the GMES programme – and needs to interact with GEO regarding issues such as data sharing principles and data sharing infrastructure.
- Under **GMES**, more and more Earth observation **services and products with global coverage** or for others regions of the world outside Europe are developed. The GEOSS initiative provides an opportunity for Europe to plan global and non-European components of GMES under consideration of international (i.e. external) data sources and to maximize benefit from GEOSS for GMES.
- Despite abundant funding possibilities for Earth observation, future definition of **European funding mechanisms** (especially the EU Framework Programme) could exhibit a **stronger strategic orientation of topics**, especially with a view to existing gaps in the GEO Work Plan and addressing long-term Earth observation needs in key areas of the Water SBA.
- On a pan-European level, **interagency collaboration** mechanisms in the water sector are abundant. However, collaboration amongst pan-European organizations might be improved by **stronger national involvement** of European countries. The GEOSS initiative can be seen as an opportunity to achieve this, since it is an intergovernmental initiative with considerable participation of European countries, the European Commission and several European organizations. The European GEO High Level Working Group (HLWG) might serve as a potential nucleus to establish such an increased collaboration. Especially due to its cross-cutting nature, GEO might serve as an appropriate umbrella to evoke increased coordination in the water sector and in the field of Earth observation in Europe.
- A major issue in the water sector is **access to hydrological data and sharing of data** amongst different countries. GEO follows the vision for free and open data access and has already influenced discussions and decisions related to data sharing in Europe. A good example for the effect GEO has on national/regional discussion processes is ESA's new data policy for the Sentinel missions and the revision of the data policies of other ESA satellite missions. GEO's

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political momentum should be used to further **free and open data sharing in Europe**, e.g. in shaping national implementation of the INSPIRE Directive, and in other regions of the world.

- Although the majority of observations required for hydrologic applications are collected by in-situ observation networks, various **hydrological applications of remote sensing technology** exist. Europe is contributing successfully to the development of such technologies and should even intensify international cooperation and contribution to international systems and programmes. GEO could assist Europe in establishing **strategic involvements in the different international frameworks**, which are related to GEO. For example, CEOS¹² has established different virtual constellations (VC), which address certain Earth observation requirements through combined, overlapping use of different satellite systems (as a contribution to GEO Task AR-09-02a). Europe may consider contributing to the VCs through suitable technology (e.g. SMOS) and support the development of a VC dedicated to the water sector.
- The status-quo-analysis has shown that relevant European activities in the field of Earth observation exist and that Europe is involved in many GEO Tasks of the Water SBA. However, many efforts of Europe remain to be hidden in the complex GEOSS initiative. In order to **increase Europe's visibility** in GEO, a stronger strategic and coordinated involvement of European organizations and a **better 'marketing' of abundant European contributions** seem to be appropriate next steps.


¹² CEOS: Committee on Earth observation satellites

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6 Conclusion

Based on the status-quo analysis and discussions with experts at the European GEOSS Workshop on Water (May 2010) and at other occasions (project meetings, bilateral meetings), the following conclusions are drawn:

- (1) Europe has developed extensive capabilities and expertise in the water sector, e.g.
 - Operational **hydrological networks**;
 - European and international **satellite missions and programmes** that deliver hydrological parameters or ancillary information;
 - **Data archives, monitoring and early warning systems and maps** that contain information on different hydrological parameters;
 - The **European Water Framework Directive (WFD)** as a legal framework for Integrated Water Resources Management (IWRM), international cooperation and data exchange.
- (2) These capabilities have been developed through **efforts of national and European organisations**, by strong **investments in Research and Development (R&D)** projects and initiatives (e.g. under the EU Framework Programmes or by ESA) or in the framework of **GMES and INSPIRE**. The **continuity/sustainability of European space activities in Earth observation**, e.g. through meteorological satellites and recently through the Sentinel programme can be seen as a major European achievement.
- (3) Europe's achievements contribute substantially to the **implementation of key international frameworks** such as GCOS/GTOS, IHP and HWRP.
- (4) Involvement of pan-European and national European organisations in GEO is abundant, and in some cases extensive. **Visibility of European contributions to the GEO Tasks** should, however, be increased by improved coordination and targeted actions.
- (5) Specific areas where **European contributions to GEOSS could be strengthened**:
 - Groundwater maps are a clear European highlight (due to the historical background and because Europe has set standards); Europe could therefore contribute (even further) to **foster groundwater issues and related activities within GEO**;
 - Observations and activities related to **water quality** are not very well established within GEO; Europe has abundant capabilities and activities related to water quality and could promote this topic within GEO; the GMES Land Service (geoland-2) could be a potential starting point;
 - The importance of **in-situ observations of hydrological and hydrogeological parameters** has been stressed many times during the workshop; Europe's current efforts to coordinate the GMES in-situ component (via an FP7 funded project) also open possibilities to develop relevant contributions to the GEOSS Water SBA;
 - Important **developments in the framework of GMES** are currently ongoing (e.g. "GMES and Africa" process; coordination of GMES in-situ component; transition from R&D to operations). Thus, the opportunity arises to even **further dovetail GMES developments with GEO** in order to assure that Europe effectively contributes to GEOSS and benefits as much as possible from GEOSS;
 - Promote **full and open access to hydrological data within GEOSS**, since restrictive and complex data policies pose a major obstacle in hydrology so far;

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- Many of the GEOSS components already undergo extensive **quality controls** by the organisations/countries, which provide the data; appropriate documentation of metadata is one way of documenting these control mechanisms; Europe should assure **proper documentation of quality assurance procedures** when registering components in GEOSS, e.g. by appropriate metadata descriptions;
- The issue of **fragmentation of the water sector** was repeatedly mentioned during the workshop. Organisations/countries, which are well organised and structured, are able to take a steering role within GEO. Therefore, an **improved coordination of existing initiatives and actors at national level** seems to be appropriate.

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Appendix A Existing organisations, initiatives, programmes and systems

Organisations

ECMWF	
Name	European Centre for Medium Range Weather Forecasts
Homepage	http://www.ecmwf.int
Institutional framework	International organisation
Brief description	The ECMWF is an intergovernmental organisation supported by 32 States. It operates a state-of-the-art super-computing facility and provides operational medium- and extended-range forecasts. It pursues scientific and technical collaboration with several international organisations, particularly satellite agencies and the European Commission.
Earth observation topics, outputs and activities	
Topics	Medium- and extended-range weather forecasts
Outputs	Deterministic and ensemble weather prediction products up to 15 days; monthly and seasonal weather forecasts; re-analyses; training and expertise
Own programmes, initiatives and projects	n/s
GEO involvement	
Participation in GEO Task (Water SBA)	WA-06-02a


EEA	
Name	European Environmental Agency
Homepage	http://www.eea.europa.eu/
Institutional framework	European organisation
Brief description	“The core objective of the EEA is to produce 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 and those covered by the European Neighbourhood Policy.” [self-presentation EEA website]
Earth observation topics, outputs and activities	
Topics	Various environmental topics with European focus e.g. Biodiversity, Climate Change, Natural Resources and Water

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	Quality
Outputs	Data Sets, EO products and services
Own programmes, initiatives and projects	WISE, Eye on Earth, GMES, ETC-Water, WWA-Dataservice, SEIS
GEO involvement	
Participation in GEO Task (Water SBA)	n/s


ESA	
Name	European Space Agency
Homepage	http://www.esa.int
Institutional framework	European organisation
Brief description	"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." [self-presentation ESA website]
Earth observation topics, outputs and activities	
Topics	Various satellite observations related to Earth System Science
Outputs	Satellite data
Own programmes, initiatives and projects	The Living Planet; GMES; TIGER-1; TIGER-2; Support to Science Element (STSE); Data User Element (DUE)
GEO involvement	
Participation in GEO Task (Water SBA)	WA-08-01g; WA-08-01-a

EUMETSAT	
Name	European Organisation for the Exploitation of Meteorological Satellites
Homepage	http://www.eumetsat.int
Institutional framework	European organisation
Brief description	"The main purpose of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) is to deliver weather and climate-related satellite data, images and products." [self-presentation EUMETSAT website]
Earth observation topics, outputs and activities	
Topics	Meteorology; hydrometeorology; climate
Outputs	Satellite (raw) data; Earth observation products; training and expertise

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Own programmes, initiatives and projects	Satellite missions; EUMETSAT Network of Satellite Application Facilities (SAF); EUMETCast Broadcast System for Environmental Data
GEO involvement	
Participation in GEO Task (Water SBA)	WA-08-01d; WA-06-07a

JRC	
Name	European Commission, DG Joint Research Centre
Homepage	http://ec.europa.eu/dgs/jrc/index.cfm
Institutional framework	European Commission
Brief description	"The Joint Research Centre is a research based policy support organisation and an integral part of the European Commission. The JRC is providing the scientific advice and technical know-how to support a wide range of EU policies." [self-presentation JRC website]
Earth observation topics, outputs and activities	
Topics	Environment and Health; Climate Change; Global Environment Monitoring; Transport and Air Quality; Rural, Water and Ecosystem Resources; Spatial Data Infrastructures; Land Management and Natural Hazards
Outputs	Policy support based on Earth observation data and services; research relevant to different EU environmental policies; training and expertise
Own programmes, initiatives and projects	Research actions focussing on above mentioned topics, e.g. JRC Flood Action or JRC Action on Desertification, Land Degradation and Drought
GEO involvement	
Participation in GEO Task (Water SBA)	WA-06-02a

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Initiatives, programmes and systems

AMMA International

Name	AMMA International
Homepage	http://www.amma-international.org/spip.php?article88
Institutional framework	a. o. European Commission
Brief description	<p>Improving the understanding of the West African Monsoon (WAM) and its influence on the physical, chemical and biological environment, regionally and globally. Providing the underpinning science that relates variability of the WAM to issues of health, water resources, food security and demography for West African nations and defining and implementing relevant monitoring and prediction strategies. Ensuring that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision making activity. [taken from AMMA international website]</p>
Earth observation topics, outputs and activities	
Topics	Monsoon mechanisms and its components: Atmospheric dynamics, Continental water cycle, Atmospheric chemistry and Surface conditions
Outputs	Situ observations, satellite products and models on different spatial scales to characterize the WAM and its variability.
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	n/a

BALTEX

Name	The Baltic Sea Experiment
Homepage	http://www.baltex-research.eu/

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Institutional framework	WCRP; GEWEX
Brief description	"The research focus of BALTEX has primarily been on the hydrological cycle and the exchange of energy between the atmosphere and the surface of the Earth, because they control and regulate the climate in a fundamental manner. BALTEX Phase II extends the scope of research to regional climate change, water management and air and water quality." [taken from BALTEX website]
Earth observation topics, outputs and activities	
Topics	Hydrological cycle; exchange of energy between atmosphere and Earth surface; Baltic Sea region
Outputs	Hydrological models; hydrological database
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	n/a


BALWOIS

Name	Water Observation and Information System for Balkan Countries
Homepage	http://www.balwois.com/cms/index.php?option=com_frontpage&Itemid=1
Institutional framework	n/s
Brief description	"The general is concern to create in Balkan a community of the main stakeholders in the field of water protection and water management ranging from scientists, private sector, experts, NGO's, to decision makers and large public." [taken from BALWOIS website]
Earth observation topics, outputs and activities	
Topics	Water scarcity, floods, droughts, environmental degradation
Outputs	n/s
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	n/a


EDO

Name	European Drought Observatory
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Homepage	http://edo.jrc.ec.europa.eu/php/index.php?action=view&id=36
Institutional framework	JRC
Brief description	<p>JRC is developing and implementing the prototype of a European Drought Observatory (EDO) to provide timely and authorized information on the occurrence and evolution of drought situations in Europe as well as predictions for their likely development. EDO will consist of a web-based information system, integrating information from various sources and disciplines relevant to monitoring and detecting droughts throughout Europe. JRC will provide consistent information on the European level to the Commission, Member States, and the public. Following the subsidiarity principle, the envisaged multi-scale approach will allow for the seamless integration of national and regional information of higher spatial resolution, such as that provided by National Drought Observatories, regional authorities, or local River Basin Authorities.</p> <p>The European Drought Observatory will contribute to preparedness and public awareness within an integral approach to risk management of natural hazards.</p>
Earth observation topics, outputs and activities	
Topics	Drought Monitoring, Detection, Forecasting, and Assessment; information on droughts on European, national, and regional scale
Outputs	Drought index maps, drought index timeseries
GEO involvement	
GCI component	
Participation in GEO Task (Water SBA)	WA-06-02d

EEA Dataservice	
Name	European Environment Agency Dataservice
Homepage	http://dataservice.eea.europa.eu/clc/eeaclc.asp
Institutional framework	EEA
Brief description	"The European Environment Agency data service provides view and download services of European data sets related to different environmental themes." [taken from GEOSS Registry]
Earth observation topics, outputs and activities	
Topics	Different environmental themes including water

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Outputs	DatSERVICE providing access to datasets, maps, graphs and indicators; organisation and data centre database
GEO involvement	
GCI component	
Participation in GEO Task (Water SBA)	n/a

EFAS

Name	European Flood Alert System
Homepage	http://floods.jrc.ec.europa.eu/
Institutional framework	JRC
Brief description	EFAS is a flood forecasting system currently under development and testing at the European Commission DG Joint Research Centre in close collaboration with National Hydrological and Meteorological Services. It aims at providing the European Commission with information for the preparation and management of aid during a flood crisis; NMHS should benefit from additional medium-range flood information that might contribute to increased preparedness in an upcoming flood event.
Earth observation topics, outputs and activities	
Topics	Flood forecasting
Outputs	Flood simulation and alert model for major European river basins; maps
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-06-02a

EMWIS


Name	Euro-Mediterranean Information System on know-how in the Water sector
Homepage	http://www.semide.net
Institutional framework	Union for the Mediterranean (EUROMED); MEDA-Water
Brief description	"EMWIS is an initiative of the Euro-Mediterranean Partnership. It provides a strategic tool for exchanging information and knowledge in the water sector between and within the Euro Mediterranean partnership countries." [taken from EMWIS

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	website]
Earth observation topics, outputs and activities	
Topics	Water sector; Euro-Mediterranean countries
Outputs	Articles (country water profiles), water glossary, communication platform
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	n/a

ERCE	
Name	European Regional Centre for Ecohydrology
Homepage	http://www.erce.unesco.lodz.pl/
Institutional framework	UNESCO; hosted by Poland at the Polish Academy of Science
Brief description	"The Centre carries out transdisciplinary ecohydrological research on sustainable management, protection, and restoration of aquatic resources at the catchment scale. Research areas include: hydrology, hydrobiology, hydroacoustics, environmental chemistry, landscape processes, soil ecology, phytotechnology, environmental toxicology and genetics, population studies, and mathematical modeling." [taken from ERCE website]
Earth observation topics, outputs and activities	
Topics	Ecological aspects of the hydrological cycle
Outputs	Research results; tools for implementation of WFD
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a


ETC-Water	
Name	European Topic Centre on Water
Homepage	http://water.eionet.europa.eu
Institutional framework	EEA; EIONET
Brief description	"The European Topic Centre on Water (ETC/W) is an international consortium brought together to support the European Environment Agency (EEA) in its mission to deliver timely, targeted, relevant and reliable information to policy-


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	<p>makers and the public for the development and implementation of sound environmental policies in the European Union and other EEA member countries. The intention is to establish a seamless environmental information system to assist the Commission and EEA member countries in their attempts to improve the environment, move towards sustainability and integrate environmental policies with other sectors such as economic, social, transport, industry, energy and agriculture." [taken from ETC-Water website]</p>
Earth observation topics, outputs and activities	
Topics	Water related issues of EEA
Outputs	Databases; (interactive) maps; graphs; geospatial data; policy recommendations
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a


ETN-R	
Name	European Terrestrial Network for River Discharge
Homepage	http://www.bafg.de/GRDC/EN/02__Services/05__Special__DBs/ETNR/etnr.html
Institutional framework	GRDC; EFAS
Brief description	<p>"ETN-R aims at delivering the service of providing near real-time river discharge and water level data from 30 national and trans-boundary European river basins (involving totally 35 countries) to the European Flood Alert System (EFAS) research project." [taken from GRDC website]</p>
Earth observation topics, outputs and activities	
Topics	River discharge; water level; floods
Outputs	Near Real-Time river discharge and water level data from 30 European rivers
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-06-02a

EUMETCast


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Name	EUMETSAT's Broadcast System for Environmental Data
Homepage	http://www.eumetsat.int/Home/Main/What_We_Do/EUMETCast/index.htm?l=en
Institutional framework	EUMETSAT; GEONETCast
Brief description	"EUMETSAT's Broadcast System for Environmental Data, is a multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology" [taken from EUMETSAT website] EUMETCast is a EUMETSAT contribution to GEONETCast.
Earth observation topics, outputs and activities	
Topics	n/a
Outputs	Broadcast System for Environmental Data
GEO involvement	
GCI component	
Participation in GEO Task (Water SBA)	n/a

EUMETNET	
Name	Network of European Meteorological Services
Homepage	http://www.eumetnet.eu/
Institutional framework	Collaboration of European NMS
Brief description	"EUMETNET is a network grouping 26 European National Meteorological Services. EUMETNET provides a framework to organise co-operative programmes between the Members in the various fields of basic meteorological activities such as observing systems, data processing, basic forecasting products, research and development, training. Through EUMETNET Programmes, the Members intend to develop their collective capability to serve environment management and climate monitoring and to bring to all European users the best available quality of meteorological information." [taken from EUMETNET website]
Earth observation topics, outputs and activities	
Topics	Various meteorological topics
Outputs	EUMETNET Earth observation programmes
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a


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EUMETSAT Earth Observation Portal

Name	EUMETSAT Earth Observation Portal
Homepage	http://navigator.eumetsat.int
Institutional framework	EUMETSAT
Brief description	<p>"The EUMETSAT Earth Observation portal provides EUMETSAT users a single point of online access to all EUMETSAT data and dissemination services. This allows users to discover, search and order data or/and subscribe to dissemination services (in particular to EUMETCast/GEONETCast). It will also, at a later stage, allow users to discover, search, order and subscribe Earth observation data from other partner agencies via interoperability arrangements and using a Clearinghouse engine." [taken from GEOSS Registry]</p>
Earth observation topics, outputs and activities	
Topics	n/a
Outputs	Portal for EUMETSAT data and dissemination services
GEO involvement	
GCI component	
Participation in GEO Task (Water SBA)	n/a

EurAqua

Name	European Network of Freshwater Research Organisation
Homepage	http://www.euraqua.org/
Institutional framework	Collaboration of European freshwater research organisations
Brief description	<p>"The aim of EurAqua is to contribute substantially to the development of European freshwater science and its dissemination on a European scale, thus having a significant input on the development of the scientific basis of European water management." [taken from EurAqua website]. Amongst other activities, EurAqua provides expert advice to European institutions and other stakeholders.</p>
Earth observation topics, outputs and activities	
Topics	Freshwater science
Outputs	Collaboration platform; research projects; position papers; network of hydrological observatories in Europe
GEO involvement	

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GCI component	n/a
Participation in GEO Task (Water SBA)	n/a

EURO-FRIEND

Name	Flow Regimes from International Experimental and Network Data
Homepage	http://ne-friend.bafg.de/servlet/is/7398/
Institutional framework	UNESCO-IHP
Brief description	"The FRIEND programme is an international collaborative study intended to develop, through the mutual exchange of data, knowledge and techniques at a regional level and a better understanding of hydrological variability and similarity across time and space." [taken from EURO-FRIEND website]
Earth observation topics, outputs and activities	
Topics	River flow regimes
Outputs	Hydrological database (European Water Archive (EWA, see below)); regional sub-networks
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a

EuroGeoSurveys


Name	The Geological Surveys of Europe
Homepage	http://www.eurogeosurveys.org/home.html
Institutional framework	Collaboration of European Geological Surveys
Brief description	"EuroGeoSurveys is an organisation of 32 European Geological Surveys and aims at providing the European Institutions with expert, neutral, balanced and practical pan-European advice and information as an aid to problem-solving, policy, regulatory and programme formulation in different areas." [taken from EuroGeoSurveys website]
Earth observation topics, outputs and activities	
Topics	Various geoscientific topics including groundwater
Outputs	n/s
GEO involvement	

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GCI component	n/a
Participation in GEO Task (Water SBA)	n/a


EUWI	
Name	European Water Initiative
Homepage	http://www.euwi.net
Institutional framework	EuropeAid; JRC
Brief description	<p>"EUWI is an international political initiative promoting partnership on water issues between governments, aid donors, industry, NGOs and other bodies. The goal is to create the conditions for mobilising all available EU resources (human & financial), and to coordinate them to achieve the water-related Millennium Development Goals (MDGs) in partner countries." [taken from EUWI website]</p>
Earth observation topics, outputs and activities	
Topics	Integrated Water Resource Management (IWRM)
Outputs	n/a
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a

EWA	
Name	European Water Archive
Homepage	http://www.bafg.de/nn_267044/GRDC/EN/02_Services/05_Special_DBs/EWA/ewa_node.html?__nnn=true
Institutional framework	UNESCO EURO-FRIEND; GRDC
Brief description	<p>The EWA has been developed in support of UNESCO-IHP, UNESCO-HWRP and the FRIEND programme. It contains long-term daily flow data and catchment information to study river flow regimes.</p>
Earth observation topics, outputs and activities	
Topics	River flow regimes in Europe
Outputs	<p>Archive of long-term daily flow data and catchment information for more than 3800 river gauging stations in 29 countries in Europe</p>
GEO involvement	

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GCI component	No
Participation in GEO Task (Water SBA)	n/a

Eye on Earth

Name	Eye on Earth
Homepage	http://www.eea.europa.eu/data-and-maps/explore-interactive-maps/eye-on-earth
Institutional framework	EEA
Brief description	"Eye on Earth is a two-way communication platform on the environment which brings together scientific information with feedback and observations of millions of ordinary people." [taken from Eye on Earth website]
Earth observation topics, outputs and activities	
Topics	Observation of water quality and air quality in Europe
Outputs	Interactive map
GEO involvement	
GCI component	
Participation in GEO Task (Water SBA)	n/a

GMES


Name	Global Monitoring for Environment and Security
Homepage	http://www.gmes.info/pages-principales/projects/
Institutional framework	European Commission; ESA; EEA; EU-FP7
Brief description	GMES is an initiative of the EU to establish a European capacity for Earth observation. The European Commission coordinates the overall GMES programme, while ESA is responsible for developing the space component and EEA is coordinating the in-situ component of GMES. The programme is a major European contribution to the GEOSS.
Earth observation topics, outputs and activities	
Topics	Earth observations for environmental topics and issues related to the security of the citizens; land, ocean, atmosphere monitoring; emergency response; civil security
Outputs	ESA satellite missions; broad variety of Earth observation data

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	and services
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-08-01g / WA-08-01g

GPCC	
Name	Global Precipitation Climatology Centre
Homepage	http://gpcc.dwd.de
Institutional framework	WMO; hosted by Germany at the Deutscher Wetterdienst (DWD)
Brief description	"The Global Precipitation Climatology Centre (GPCC) provides global precipitation analyses for monitoring and research of the earth's climate. The centre is a German contribution to the World Climate Research Programme (WCRP) and to the Global Climate Observing System (GCOS)." [taken from GPCC website]
Earth observation topics, outputs and activities	
Topics	Global precipitation climatology
Outputs	Monthly in-situ precipitation database; raster maps
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-08-01d / WA-08-01e


GRDC	
Name	Global Runoff Data Center
Homepage	http://grdc.bafg.de
Institutional framework	WMO; hosted by Germany at the Federal Institute of Hydrology (BfG)
Brief description	The GRDC contributes to the World Climate Research Programme (WCRP), the Global Climate Observing System (GCOS), the World Water Assessment Programme (WWAP), and other international programmes and initiatives focused on Earth observation. The GRDC aims at facilitating exchange of hydrological data and information on the global scale and maintains the Global Runoff Data Base, which contains river discharge data of more than 7.500 gauging stations worldwide. The GRDC is linked to GEOSS through its contribution to the Global Terrestrial Network of Hydrology (GTN-H).

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Earth observation topics, outputs and activities	
Topics	River discharge
Outputs	Global Runoff Database; various special databases; GIS products
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-06-02a / WA-08-01b / WA-08-01d / WA-08-01e

HEPEX	
Name	Hydrologic Ensemble Prediction Experiment
Homepage	http://www.hepex.org
Institutional framework	JRC
Brief description	"HEPEX is an international effort that brings together hydrological and meteorological communities from around the globe to build a research project focused on advancing probabilistic hydrologic forecast techniques." [taken from HEPEX website]
Earth observation topics, outputs and activities	
Topics	Probabilistic hydrologic forecasting
Outputs	HEPEX Wiki; Testbeds; THORPEX/HEPEX Hydrologic Prediction System (THEPS)
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-06-02a


HWRP	
Name	WMO Hydrology and Water Resources Programme, national secretariats in Europe
Homepage	http://www.wmo.int
Institutional framework	WMO
Brief description	"It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources." [taken from HWRP website] National secretariats act as interfaces between HWRP on international level and national activities related to water resources management and research.

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Earth observation topics, outputs and activities	
Topics	Hydrology and Water Resources; IWRM
Outputs	Support to NHS to build a worldwide hydrological information network
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a


IGRAC	
Name	International Groundwater Resources Assessment Centre
Homepage	http://www.igrac.net/
Institutional framework	UNESCO; WMO
Brief description	The International Groundwater Resources Assessment Centre (IGRAC) is an initiative of WMO and UNESCO and is hosted by The Netherlands at Deltares. IGRAC facilitates and promotes global sharing of information and knowledge required for sustainable groundwater resources development and management. The main activities are the Development of a Global Groundwater Information System (GGIS), Transboundary Aquifers Assessment, Global Groundwater Monitoring (GGMN) and Global Groundwater Assessments.
Topics	Groundwater resources information, knowledge and assessment
Outputs	Global Groundwater Information System (GGIS); ; Global Groundwater Monitoring Network (under development); guidelines and protocols for the assessment of groundwater resources and other reports
GCI component	
Participation in GEO Task (Water SBA)	WA-08-01c (Task Lead)

IHP	
Name	UNESCO International Hydrological Programme, national secretariats in Europe
Homepage	www.unesco.org/water/ihp/
Institutional framework	UNESCO


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Brief description	<p>The IHP is a long-term scientific cooperative programme of UNESCO, which has been established in 1975. It is focused on water research, water resources management, education and capacity-building. UNESCO Regional Offices are responsible for the implementation of IHP at the regional level. Regional Hydrologists are posted in the field and serve as IHP focal points for all issues relating to the Programme, both at regional and national levels. The efforts of the IHP are supported by National Committees, which present reports on their activities in the framework of the Programme. National secretariats act as interfaces between IHP on international level and national activities related to water resources management and research.</p>
Earth observation topics, outputs and activities	
Topics	Water research, water resources management, education and capacity-building
Outputs	Dedicated cross-cutting programmes (HELP; FIREND) in support of the above mentioned topics
GEO involvement	
GCI component	n/a
Participation in GEO Task (Water SBA)	n/a


IHP-HELP Centre for Water Law, Policy and Science	
Name	IHP-HELP Centre for Water Law, Policy and Science
Homepage	http://www.dundee.ac.uk/water/about-us/
Institutional framework	
Brief description	<p>"The IHP-HELP Centre for Water Law, Policy and Science is a multidisciplinary department of the University of Dundee specializing in international water law, national water law and hydrological science. The Centre aims to assist national governments and international agencies in meeting the UN's Millennium Development Goals, and to develop innovative models and practices for integrated water resources management." [taken from the IHP-HELP Centre's website]</p>
Earth observation topics, outputs and activities	
Topics	Water Law, Policy and Science
Outputs	Research results; participation in several research projects; university education
GEO involvement	

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GCI component	n/a
Participation in GEO Task (Water SBA)	n/a

INSPIRE	
Name	Infrastructure for Spatial Information in the European Community
Homepage	http://inspire.jrc.ec.europa.eu/
Institutional framework	EU Directive
Brief description	INSIPRE is a European Directive, which aims at establishing "an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment."
Earth observation topics, outputs and activities	
Topics	Spatial data infrastructure; data standards
Outputs	European spatial data infrastructure; INSPIRE Geoportal; spatial data standards
GEO involvement	
GCI component	
Participation in GEO Task (Water SBA)	n/a


ISMN	
Name	International Soil Moisture Network
Homepage	http://www.ipf.tuwien.ac.at/insitu/
Institutional framework	GEWEX; CEOS; GEO
Brief description	"The International Soil Moisture Network is an international cooperation to establish and maintain a global in-situ soil moisture database. This database is an essential means of the geoscientific community for validating and improving global satellite observations and land surface models." [taken from International Soil Moisture Network website]
Topics	Soil moisture
Outputs	Global in-situ soil moisture database
GCI component	No

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Participation in GEO Task (Water SBA)	WA-08-01a
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SEIS	
Name	Shared Environmental Information System
Homepage	http://ec.europa.eu/environment/seis/index.htm
Institutional framework	European Commission; EEA
Brief description	"The Shared Environmental Information System (SEIS) is a collaborative initiative of the European Commission and the European Environment Agency (EEA) to establish together with the Member States an integrated and shared EU-wide environmental information system." [taken from SEIS (EC) website]
Earth observation topics, outputs and activities	
Topics	Broad variety of environmental information
Outputs	n/s
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	n/a


TIGER	
Name	TIGER
Homepage	http://www.tiger.esa.int
Institutional framework	Committee of Earth Observation Satellites (CEOS); ESA
Brief description	"The initiative has been launched by the European Space Agency (ESA), within the context of the Committee of Earth Observation Satellites (CEOS). The overall objective of the initiative is to assist African countries to overcome problems faced in the collection, analysis and use of water related geo-information by exploiting the advantages of Earth Observation (EO) technology. TIGER is focusing on the use of space technology for water resource management in Africa." [taken from TIGER website] TIGER is implemented by various ESA funded projects (see Chapter 3.2 and Appendix B)
Earth observation topics, outputs and activities	
Topics	Collection, analysis and use of water related geo-information


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	based on EO
Outputs	Satellite data (EO Portal); software; training courses
GEO involvement	
GCI component	No
Participation in GEO Task (Water SBA)	WA-06-07b / WA-08-01a

WISE	
Name	Water Information System for Europe
Homepage	http://water.europa.eu/
Institutional framework	European Commission; EEA
Brief description	The main roles and responsibilities are to host the Water Data Centre, to conduct environmental monitoring and water resources modelling including nowcasting and forecasting services and to collect and disseminate water statistics and to release this information to a broad range of stakeholders.
Earth observation topics, outputs and activities	
Topics	Data and information on European water issues
Outputs	WISE-RTD Web Portal
GEO involvement	

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GCI component	
Participation in GEO Task (Water SBA)	n/a


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Appendix B Catalogue of European Earth observation projects


EU funded projects

Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
ACQWA	Assessing Climate impacts on the Quantity and quality of water	http://www.acqwa.ch/	EU-FP7	2008 (2008-2011)	Influence of climatic change on the major determinants of river discharge at various time and space scales; analyse their impact on society and economy	WA-06-02c
AEGOS	African-European Georesources Observation System	http://www.aegos.org/	EU-FP7	2008 (2008-2011)	Spatial data information and service infrastructure on georesources in Africa; capacity building and training	n/a
AMESD	African Monitoring of the Environment for Sustainable Development	http://www.amesd.org	EDF ¹³	2007	Information Services for agricultural and environmental management	n/a


¹³ EDF: European Development Fund

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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
AWARE	A tool for monitoring and forecasting Available Water REsource in mountain environment	http://www.aware-eu.info	EU-FP6	2005 (2005-2008)	Research project to provide tools for monitoring and predicting water availability in catchments influenced by snowmelt	n/a
BIOFRESH	Biodiversity of freshwater ecosystems: Status, trends, pressures, and conservation priorities	http://www.freshwaterbiodiversity.it	EU-FP7	2009 (2009-2014)	Information platform on freshwater biodiversity	n/a
BRAHMATWINN	Twinning European and South Asian River basins to enhance capacity and implement adaptive integrated water resources management approaches	http://www.brahmatwinn.uni-jena.de	EU-FP6	2006 (2006-2009)	See project name	n/a
CEOP-AEGIS	Coordinated Asia-European long-term Observing system of Qinghai-Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	http://www.ceop-aegis.org/modx/	EU-FP7	2008 (2008-2012)	See project title	WA-08-01e / WA-08-01d / WA-08-01-a / WA-06-07c / WA-06-02b
CLIMATEWATER	Bridging the gap between adaptation strategies of climate change impacts and European water policies	http://www.climatewater.org/	EU-FP7	2008 (2008-2011)	Research on European and international adaptation measures and strategies related to climate change impacts; water policies	n/a
CLIMB	Climate Induced Changes on the Hydrology of Mediterranean Basins	http://www.climb-fp7.eu	EU-FP7	2010 (2010-2014)	Development and dissemination of research and technology for hydrology and water resources management	n/a

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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
COMENVIR	Communicating environmental impacts on water quality, availability and use	http://www.ecoserve.ie	EU-FP7	2009 (2009-2013)	Communication platform	n/a
DevCoCast	GEONETCast for and by Developing Countries	http://www.vgt4africa.org	EU-FP7	2010	Broadcast System for environmental data focused on user needs in developing countries	n/a
EANNet	Europe-Africa Marine EO Network	http://www.eamnet.eu/cms/?q=node/1	EU-FP7	2010 (2010-2013)	EAMNet aims to construct a network linking Earth Observation (EO) information providers, user networks and centres of excellence in Europe and Africa in the area of coastal and marine observations towards sustainable development in Africa.	n/a
EuroGEOSS	A European Approach to GEOSS	http://www.eurogeoss.eu/	EU-FP7, GEOSS; INSPIRE	2008 (2008-2011)	The EuroGEOSS project aims at developing European approaches to GEOSS by making existing systems and applications interoperable and used within the GEOSS and INSPIRE frameworks. The project focuses on the three strategic areas of Drought, Forestry and Biodiversity.	WA-06-02b / WA-06-02d
EUROWET	Integration of European Wetland Research in sustainable management of the water cycle	http://eurowet.brgm.fr/	EU-FP6	2002 (2002-2004)	Coordination platform for wetland research	n/a
EU-WATCH	Water and Global Change	http://www.eu-watch.org	EU-FP6	2007 (2007-2011)	Analysis, quantification and prediction of components of the current and future global water cycles and related water resources states; uncertainties and vulnerability of global water resources related to main societal and economic sectors	n/a

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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
eWater	Multilingual cross-border access to ground water databases	http://217.19.225.45/geonetwark4ewater/srv/en/main.home	EU-FP6		multilingual Internet system, providing access to hydrogeological measurement data as well as ground water maps in EU countries	
GENESIS	Groundwater and dependent Ecosystems: New Scientific basis on climate change and land-use impacts for the update of the EU Groundwater Directive	www.thegenesisproject.eu	EU-FP7	2009 (2009-2014)	Development of methods, concepts and tools for the revision of the Ground Water Directive	n/a
geoland	GMES integrated project on land cover and vegetation	http://www.gmes-geoland.info/	EU-FP6; GMES	2004 (39 months)	Products and services, utilizing available Earth Observation resources in combination with in-situ measurements, and integrating them with existing models into pre-operational geo-information services	WA-06-02a
geoland-2	GMES Preoperational Land Monitoring Service	http://www.land.eu/	EU-FP7; GMES	2009 (2009-2013)	Core Mapping Service: land cover/land use (changes), biophysical parameters; Core Information Service: applications (e.g. water quality)	WA-06-02a
GlobCorine	Corine-compatible land cover/use service	http://dup.esrin.esa.it/projects/summary114.asp	ESA; EEA	2004 (long term)	Global land cover / land use map and a land change indicator based on Corine Land Cover (CLC) legend	n/a
GNU	GMES Network of Users	http://www.gmes-network-of-users.eu/	EU-FP6, GMES	2007 (2007-2010)	Coordination Platform	n/a

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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
GSE Land	GMES Service Element Land	http://www.gmes-gseland.info/	ESA; GMES	n/s (completed)	Geo-information services over large areas and for a wide spectrum of land applications focusing on land cover change and environmental stress in Europe	n/a
H-SAF	EUMETSAT Satellite Application Facility . Theme on support to Hydrology and Water Management	http://www.meteoam.it/modules.php?name=hsaf	Satellite Application Facility (SAF)	2005 (2005-2010)	Satellite-derived products for operational hydrology, focusing on precipitation, soil moisture and snow parameters	n/a
HYDROWEB	HYDROWEB hydrological database	http://www.legos.obs-mip.fr/en/equipes/gohs/resultats/i_hydroweb	n/s	2002 2002 (2002-2014)	Water levels of rivers, lakes and wetlands; based on satellite altimetry	n/a
HyMeX	Hydrological cycle in the Mediterranean Experiment	http://www.hymex.org	WWRP-THORPEX ¹⁴ ; WCRP-GEWEX ¹⁵	2006 (2006-2020)	Quantification of the hydrological cycle and related processes in the Mediterranean, with emphasis on high-impact weather events, inter-annual to decadal variability of the Mediterranean coupled system, and associated trends in the context of global change. NOTE: HyMeX is not an EU funded project, but there is considerable participation of national European organizations.	n/a
Hypox	Hypoxic (low oxygen) conditions in aquatic ecosystems	http://www.hypox.net/	EU-FP7	2009 (2009-2012)	Global monitoring of oxygen depletion; implementation of reliable long-term sensors to different platforms for in situ monitoring; local training and implementing competence around the Black Sea	WA-08-01g / WA-08-01e / WA-08-01g

¹⁴ WWRP-THORPEX: World Weather Research Programme-The Observing System Research and Predictability Experiment

¹⁵ WCRP-GEWEX: World Climate Research Programme-Global Energy and Water Cycle Experiment

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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
INSEA	Data Integration System for Eutrophication Assessment in Coastal Waters	http://www.insea.info/	EU-FP6	2006 (2006-2008)	Modelling tools, database applications, viewing services, catalogue services and communication devices for eutrophication assessment in coastal waters	n/a
MIRAGE	Mediterranean intermittent river management	http://www.mirage-project.eu/	EU-FP7	2009 (2009-2011)	Management framework for intermittent rivers	n/a
PUMA	Preparation for Use of MSG in Africa	http://www.eumetsat.int/Home/Main/AboutEUMETSAT/InternationalRelations/Africa/SP_1226315293835	EDF	2001 (2001-2005)	Infrastructure, training and support required for receiving space-based meteorological and environmental data in Africa	n/a
RAMFLOOD	Decision Support System for Risk Assessment and Management of Floods	http://www.cimne.upc.es/ramflood	EU-FP5; IST	2003 (2003-2006)	DSS for hazard assessment and management of emergency scenarios due to severe floods	n/a
RAMWASS	Integrated Decision Support System for Risk Assessment and Management	http://www.ramwass.net/	EU-FP6	2005	Emergency assessment tool for European rivers	n/a
RISKBASE	Risk Based Management of River Basins	http://www.riskbase.info	EU-FP6	2007	Integrated risk assessment-based management approaches in river basins	n/a



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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
RIVERTWIN	Regional Model for Integrated Water Management in Twinned River Basins	http://www.rivertwin.de/	EU-FP7; EUWI	2003 (2003-2007)	GIS development for testing and implementing an integrated regional model for strategic planning of water resources management in twinned river basins	n/a
REFRESH	Adaptive strategies to mitigate the impacts of climate change on European freshwater ecosystems	n/a	EU-FP7	2010 (2010-2014)	See project name	n/a
SCENES	Water Scenarios for Europe and for Neighbouring States	http://www.environment.fi/scene/scenes	EU-FP6	2006 (2006-2010)	See project name	n/a
SEWING	System for European Water Monitoring	http://www.sewing.mixdes.org/	EU-FP5	2001 (2001-2004)	Monitoring system for water quality	n/a
SPLASH	EUWI Research Area Network (ERA-NET)	http://www.splash-era.net	EU-FP6; ERA-NET; EUWI	2007 (2007-2010)	Coordination of European research on water in developing countries	n/a
SWIFT-WFD	Screening methods for Water data Information in support of the implementation of the Water Framework Directive	http://www.swift-wfd.com	EU-FP6	2003 (2003-2006)	Production of quality control tools for validation purposes of screening methods for water monitoring	n/a
TWIN2GO	Coordinating Twinning partnerships towards more adaptive Governance in river basins	http://www.twin2go.eu	EU-FP7	2009 (2009-2011)	Review and synthesis of research on IWRM in basins around the world. The consolidated outcomes will feed into best practice guidelines for the implementation of adaptive water governance.	n/a



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Acronym	Name	Homepage	Framework	Start date (duration)	Topics / Outputs	Participation in GEO Task (Water SBA)
TWINBAS	Twinning European and third countries river basins for development of integrated water resources management methods	http://ivl.dataphone.se/twinbas/	EU-FP6	2003 (2003-2006)	See project name	n/a
TWINBASIN	Promoting Twinning of River Basins for Developing Integrated Water Resources Management Practices	http://www.twinbasin.org/	EU-FP6	2003 (2003-2007)	Communication platform; see project name	n/a
WACMOS	ESA initiative to produce global products for the whole water cycle	http://wacmos.itc.nl/	ESA	2008	Data of Evapotranspiration, Soil Moisture, Clouds, Water Vapour	n/a
WASSERMED	Water Availability and Security in Southern Europe and the Mediterranean	http://www.wassermed.eu/	EU-FP7	2010 (2010-2013)	High resolution gridded climate database, climatic/hydrologic scenarios	n/a
WETWIN	Enhancing the role of wetlands in integrated water resources management for twinned river basins in EU, Africa and South-America in support of EU water initiatives	http://www.wetwin.net	EU-FP7	2008 (2007-2013)	See project name	n/a
WISER	Water bodies in Europe: integrative systems to assess ecological status and recovery	http://www.wiser.eu/	EU-FP7	2009 (2009-2012)	Data on the biota and environmental conditions in European surface waters	n/a

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Appendix C European contributions to GEO Work Plan 2009-2011 Tasks in the Water SBA

The following information is based on the Task Sheets taken from the GEO website (<http://www.grouponearthobservations.org/cdb/docshow.php?id=1>) and represents the status of early 2010. For more information on the Task Sheets see Chapter 4.1.


Task number:	WA-06-02a		
Task:	Forecasting for Droughts and Floods		
Overarching Task:	Droughts, Floods and Water Resource Management		
Task definition:	Improve forecasting methods for extreme events (floods, droughts) used by hydrological services throughout the world to help bridge the gap between research and user communities. Expand upon initiatives such as (i) HEPEX (Hydrological Ensemble Prediction Experiment) (ii) the European Flood Alert System EFAS to produce twice-daily 10-day early flood warnings for Europe, and (iii) GMES projects related to land management (GEOLAND).		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	DG Joint Research Centre	JRC	JRC Flood action; general expertise
European Commission – FP7-projects & initiatives	European Flood Alert System	EFAS	n/a
	European Terrestrial Network for River Discharge	ETN-R	Special database of GRDC; contribution to EFAS
	GMES – GEOLAND	GEOLAND	Water quality products: GEOLAND-2
Pan-European and national European organisations	Center of Technological Research Hellas [GR]	CTRH	Research on tsunami, flood and drought prediction
	European Centre for Medium Range Weather Forecasts	ECMWF	General expertise
	Federal Institute of Hydrology [DE]	BfG	General expertise
	Norwegian Water Resources and Energy Directorate [N]	NVE	Research on snow reservoir detection from satellites
	Territory, Culture and Development Research Center [PT]	TERCUD	Research on flood risk, impact and response measures
Indirect European contribution through international programmes & initiatives	WMO Global Runoff Data Centre	GRDC	River discharge data; GRDC is hosted by BfG
	HEPEX (Hydrologic Ensemble Prediction Experiment) initiative	HEPEX	Probabilistic hydrologic forecast techniques; JRC co-chairs HEPEX

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Task number:	WA-06-02b		
Task:	Impacts from Drought		
Overarching Task:	Droughts, Floods and Water Resource Management		
Task definition:	Track and analyze impacts from drought (including feedbacks such as soil drying) to provide a tangible and practical demonstration of the value of integrated water cycle observations. Develop a full and operational data cycle of environmental information from “producer-to-consumer”/“source to sink”, and explore the application of data products to Water and Agriculture.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Coordinated Asia-European long-term Observing system of Qinghai-Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	CEOP-AEGIS	Case studies on drought early warning in SE Asia and India; promotion of systems in other regions
	FP7-project: A European approach to GEOSS	EuroGEOSS	Development of Task specific GEOSS component for Europe
Pan-European and national European organisations	Center of Technological Research Hellas [GR]	CTRH	Research on drought prediction
	Instituto Nacional de Recursos Biológicos [PT]	INRB	Research on degraded soils and agricultural practices under drought stress
Indirect European contribution through international programmes & initiatives	n/a	n/a	n/a

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Task number:	WA-06-02c		
Task:	Mountain Water Resources		
Overarching Task:	Droughts, Floods and Water Resource Management		
Task definition:	Analyze the future of water resources in vulnerable mountain regions in the context of climate change and increasing extreme events. Build upon the European project ACQWA (Assessing Climatic change and impacts on the Quantity and quality of WAter) to deliver among others, technical papers on downscaling techniques for hydrological modelling and water policy recommendations for decision-makers.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Assessing Climate Impacts on the Quantity and quality of Water	ACQWA	The GEO progress report 2009 highlights the establishment of a database infrastructure by the UNEP Global Resource Information Database (GRID) as a major ACQWA deliverable.
Pan-European and national European organisations	n/a	n/a	n/a
Indirect European contribution through international programmes & initiatives	n/a	n/a	n/a

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Task number:	WA-06-02d		
Task:	Prototype Regional Drought Early Warning Test Beds		
Overarching Task:	Droughts, Floods and Water Resource Management		
Task definition:	Explore expanding the concept of the North American Drought Monitor and drought portal through prototype drought early warning test bed activities in specific international river basins, such as on the US-Canada border, basins in Central America and the Caribbean, the Mediterranean, and other drought-sensitive regions.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	DG Joint Research Centre	JRC	Prototype European Drought Observatory (EDO)
European Commission – FP7-projects & initiatives	FP7-project: A European approach to GEOSS	EuroGEOSS	Development of Task specific GEOSS component for Europe
Pan-European and national European organisations	Environmental Agency of the Republic of Slovenia [SI]	EARS	Hosting a regional drought early warning prototype system for SE Europe; EARS is hosting Drought management centre for SE Europe (UNCCD, WMO)
Indirect European contribution through international programmes & initiatives	n/a	n/a	n/a

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Task number:	WA-06-07a		
Task:	Capacity Building WRM Latin America		
Overarching Task:	Capacity Building for Water Resource Management (WRM)		
Task definition:	<p>Develop a proposal along the lines of the ESA/UNESCO TIGER programme focused on the use of Earth observation data for water resources management (surface waters, groundwater). This to help: (i) Identify data and general support from space agencies; (ii) Identify a coordinating agency to organise calls for proposals and securing reviews and monitoring of the proposals; (iii) Identify further funding sources; and (iv) Issue a call for proposals to the research and development community. The program will be initiated in Latin America and then be extended to Asia and Africa. Linkages with existing GEO efforts will be made.</p>		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	n/a	n/a	n/a
Pan-European and national European organisations	International Institute for Geo-Information Science and Earth Observation [NL]	ITC	n/s
Indirect European contribution through international programmes & initiatives	Committee on Earth Observation Satellites	CEOS	n/s; participation of EU-METSAT

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Task number:	WA-06-07b		
Task:	Capacity Building WRM Africa		
Overarching Task:	Capacity Building for Water Resource Management (WRM)		
Task definition:	<p>In the scope of Phase 2 of the TIGER initiative (focusing on the use of space technology for water resource management in Africa), assist African countries to overcome problems faced in the collection, analysis and dissemination of water-related geo-information. Exploit the advantages of Earth Observation (EO) technology to build the basis for an independent African capacity and set up sustainable water observation systems. In addition, build and extend the Central American "SERVIR" (visualization and monitoring using Earth science data) for hydrologic applications (e.g. flood warning) to East Africa and possibly other parts of the world. Other important projects include the hydrologic data integration and assimilation systems of the 'Land Information System' (LIS).</p>		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	n/a	n/a	n/a
Pan-European and national European organisations	GKSS Research Centre [DE]	GKSS	n/s
Indirect European contribution through international programmes & initiatives	TIGER initiative [CEOS; ESA]	TIGER	Capacity building for EO use in Africa; contribution via ESA and ITC [NL] ; ESA also contributes to the African Water Cycle Coordination Initiative (AWCCI)

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Task number:	WA-06-07c		
Task:	Capacity Building WRM Asia		
Overarching Task:	Capacity Building for Water Resource Management (WRM)		
Task definition:	Build upon the Asian Water Cycle Initiative (AWCI) to develop competencies among water management practitioners, researchers, and administrators (AWCI addresses climate change monitoring in Asia through the integration of in-situ and satellite/remote sensing). In addition, build upon Sentinel Asia to develop disaster management-support systems in the Asia-Pacific region and building capacity for utilization of satellite images.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Coordinated Asia-European long-term Observing system of Qinghai-Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	CEOP-AEGIS	Contributes to establishing capabilities for an integrated water resources observing system, including training (China, India)
Pan-European and national European organisations	German Aerospace Centre – Remote Sensing Data Centre	DLR-DFD	Integrated Water Management in the Mekong Delta Vietnam
Indirect European contribution through international programmes & initiatives	n/a	n/a	n/a

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Task number:	WA-08-01a		
Task:	Soil Moisture		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Establish a global soil moisture network suitable for the development of multi-purpose soil moisture products. Apply in-situ based products to the calibration and validation of remotely-sensed observations. Such a global network is still to be established and is as such a high priority. Make relevant synergies with Task US-09-03 (Cross-cutting Products and Services).		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Coordinated Asia-European long-term Observing system of Qinghai-Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	CEOP-AEGIS	Reporting on methods and results on soil moisture monitoring activities within CEOP-AEGIS
Pan-European and national European organisations	European Space Agency	ESA	Soil moisture data base study
Indirect European contribution through international programmes & initiatives	TIGER initiative	TIGER	The University of Vienna [AT] routinely produced monthly soil moisture maps and started to produce an operational soil moisture monitoring service in Africa through the SHARE project.

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Task number:	WA-08-01b		
Task:	Runoff		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Integrate, in a phased approach, dedicated river gauging networks of existing hydrological stations into a global runoff observation network. The main output of the HARON project (Hydrological Applications and Run-Off Network) will be strengthened in-situ and satellite monitoring networks of estuaries, rivers, lakes, reservoirs, and groundwater levels.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Coordinated Asia-European long-term Observing system of Qinghai-Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	CEOP-AEGIS	Reporting on methods and results on a grid-based water balance and runoff model to e developed by CEOP-AEGIS
Pan-European and national European organisations	European Space Agency	ESA	Contributes via projects on river and lake level monitoring (SOLS, HYSOPE)
	Deutscher Wetterdienst [DE]	DWD	n/s
Indirect European contribution through international programmes & initiatives	Committee on Earth Observation Satellites	CEOS	Participation of CNES [FR], which contributes via projects on river and lake level monitoring (SOLS, HYSOPE)
	WMO Global Runoff Data Centre	GRDC	River discharge data; GRDC is hosted by BfG [DE]

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Task number:	WA-08-01c		
Task:	Groundwater		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Establish a Global Groundwater Monitoring Network (GGMN) for a periodic assessment of global groundwater resources, using information from existing national, regional and global networks – in order to represent changes in groundwater resources at scales relevant to regional and global groundwater resource assessment.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	n/a	n/a	n/a
Pan-European and national European organisations	University of Thessaloniki [GR]	n/a	Groundwater data collection and evaluation; currently inactive
Indirect European contribution through international programmes & initiatives	International Groundwater Resources Assessment Centre [WMO, UNESCO]	IGRAC	Task Lead; IGRAC is hosted by NL at Deltares

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Task number:	WA-08-01d		
Task:	Precipitation		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Under the guidance of CGMS/International Precipitation Working Group (IPWG), promote and advance the development and validation of multi-sensor satellite-based precipitation estimates, including snowfall. Inputs from the Precipitation Virtual Constellation (AR-09-02a) will supplement these efforts.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	CEOP-AEGIS	Reporting of methods and results of estimation and monitoring of precipitation on Qinghai–Tibet Plateau
Pan-European and national European organisations	n/a	n/a	n/a
Indirect European contribution through international programmes & initiatives	CGMS International Precipitation Working Group [CGMS; WMO]	CGMS-IPWG	Task Leads; contribution through NASA [USA] and ZAMW [DE]
	WMO Global Precipitation Climatology Centre	GPCC	Global Precipitation data; GPCC is hosted by DWD [DE]
	WMO Global Runoff Data Centre	GRDC	River discharge data; precipitation products such as runoff coefficients; GRDC is hosted by BfG [DE]

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Task number:	WA-08-01e		
Task:	Water Cycle Data Integration		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Upcoming satellite launches and plans for new missions provide new global data sets that will supplement the in-situ networks for many water cycle variables. The Coordinated Energy and water cycle Observations Project (CEOP) under the WCRP Global Energy and Water-cycle Experiment (GEWEX) is tailoring and developing tools to access the various data collections and undertake data integration work over the Internet.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon system with Ground satellite Image data and numerical Simulations	CEOP-AEGIS	Reporting on methods and results of work on integration of very diverse data into a coherent set of hydrological data products
	FP7-project: In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies	HYPOX	Providing GEOSS compliant data sets on aquatic hypoxia
Pan-European and national European organisations	Centre for Marine and Atmospheric Sciences	ZMAW	n/s
	GKSS Research Centre [DE]	GKSS	n/s
	VU University Amsterdam	n/a	n/s
	Water Research Institute of the Italian National Research Council	IRSA-CNR	n/s
Indirect European contribution through international programmes & initiatives	WMO Global Precipitation Climatology Centre	GPCC	Global Precipitation data; GPCC is hosted by DWD [DE]
	WMO Global Runoff Data Centre	GRDC	River discharge data; GRDC is hosted by BfG [DE]

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Task number:	WA-08-01f		
Task:	Improved Water Discovery and Quality Assessments		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Conduct pilot projects in cooperation with local, regional, and national groups, and other organizations to provide water quantity and quality assistance where it is needed, but not now available. These projects over twelve in number are focused on developing countries and realizable in the field within one year, and/or slightly more in time. They will be sustainable, reusable, repeatable, and scalable. Currently, the sub-task has submitted more than four of the Pilot Projects for potential funding by sponsor groups.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	n/a	n/a	n/a
Pan-European and national European organisations	n/a	n/a	n/a
Indirect European contribution through international programmes & initiatives	n/a	n/a	n/a

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Task number:	WA-08-01g		
Task:	Global Water Quality Monitoring		
Overarching Task:	Integrated Products for Water Resource Management and Research		
Task definition:	Initiate projects to develop operational observation and monitoring systems of water quality, integrating in-situ water quality monitoring methods for terrestrial sources & the coastal ocean with remote-sensed operational systems of global-scale freshwater quality. Ensure that resulting information systems are compatible and interoperable as part of the system of systems. Make relevant synergies with HE-07-02 and develop models that relate water quality databases to exposure and health effects data; and identify mechanisms for alerting public health professionals on hazardous conditions identified by the monitoring of these parameters.		
Participation from Europe			
	Name	Acronym	Nature of involvement & comments
European Commission – organisations	n/a	n/a	n/a
European Commission – FP7-projects & initiatives	FP7-project: In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies	HYPOX	Contributes oxygen monitoring capacities in compliance with GEOSS standards
Pan-European and national European organisations	GKSS Research Centre [DE]	GKSS	n/s
	Instituto Superior Tecnico, Technical University of Lisbon [PT]	IST	Bacteriological and Viral Water Quality monitoring
Indirect European contribution through international programmes & initiatives	Committee on Earth Observation Satellites	CEOS	Demonstrator project for combined use of space observations and modeling for land hydrology; contribution through CNES [FR]

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