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List of abbreviations

Abbreviation	*Explanation*
ACTRIS	Aerosols, Clouds, and race Gases Research Infrastructure Network
AERONET	Aerosol Robotic Network
Airbase	European Air Quality Information System Maintained by the European Environment Agency
BSRN	Baseline Surface Radiation Network
CPR	The Continuous Plankton Recorder
D	Delivery (by GISC Project)
DC	Date centre
DG ENT	Directorate-General for Enterprise and Industry
DG MARE	Directorate-General for Maritime Affairs and Fisheries
DG RTD	Directorate-General for Research and Innovation
DoW	Description of Work
EARLINET	European Aerosol Research Lidar Network
EBAS	Database hosting observation data of atmospheric chemical composition and physical properties at the Norwegian institute for air research
EC	European Commission
ECMWF	European Centre for Medium Weather Forecast
EEA	European Environment Agency
EIONET	European Environment Information and Observation Network
EMEP	European Monitoring and Evaluation Programme
EMODNET	European Marine Observation and Data Network
EMS	Emergency services
ERIC	European Research Infrastructure Consortium
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
ESRL	Earth System Research Laboratory
EU	European Union
EUMETNET	Network of European National Meteorological Services
EUR	Euro
EuroArgo	European contribution to broad-scale global array of temperature/salinity profiling floats
EuroGeographics	Association of mapping and cadastral agencies in Europe
EuroGOOS	European Global Ocean Observing System
EuroSITES	European Ocean Observatory Network
EUSAAR	European Supersites for Atmospheric Aerosol Research
FAO	The UN Food and Agriculture Organization
FixO3	The Fixed point Open Ocean Observatory network
FP7	7^{th} Framework programme
GAW	Global Atmosphere Watch
GEO	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GIO	GMES initial operations
GISC	GMES in situ coordination
GLOSS	Global Sea Level Observing System

GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
GROOM	Gliders for Research Ocean Observation and Management
IAGOS	In-service aircraft for a global observing system
ICOS	Integrated Carbon Observation System
IFREMER	French Research Institute for Exploration of the Sea
InGOS	Integrated non-CO_2 Greenhouse Gas Observing System
INSPIRE	Infrastructure for Spatial Information in Europe
IPR	Intellectual property rights
IOC	International Oceanographic Commission
ISDC	In situ data coordinator
JERICO	Joint European Research Infrastructure network for Coastal Observatories
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JRC	Joint Research Centre of the European Commission
MACC	Monitoring Atmospheric and Climate
MyOcean	GMES Marine Service, FP7 project.
NDACC	Network for the Detection of Atmospheric Composition Change
NILU	Norwegian Institute for Air Research
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Centre
NORS	Demonstration Network of Ground-based Remote Sensing Observations in Support of the GMES Atmospheric Service
NRT	Near real time
PDCA	Plan – develop – check – act
R&D	Research and development
PSI	Directive on the re-use of public sector information (Directive 2003/98/EC known as the 'PSI Directive')
QW	Quick win
ROOS	Regional Ocean Observation System
SeaDataNet	Pan-European Infrastructure for Ocean & Marine Data Management
SEIS	Shared Environmental Information System
SLA	Service Level Agreement
TAC	Thematic Assembly Centre
TCCON	Total Carbon Column Observing Network
UNEP	United Nations Environment Programme
UN-GGIM	The United Nations initiative on Global Geospatial Information Management
UV	Ultra violet
WFP	The World Food Programme
WIS	WMO Information System
WMO	World Meteorological Organisation
WP	Work Package

1 Executive Summary

This report synthesises the main content and conclusions of the analyses and deliverables provided by the GISC project. The result is the Initial Framework, which is a set of recommended approaches and solutions for the sustainable provision of in-situ data in support for an operational Copernicus in-situ system.

In other words, the Initial Framework serves as a logical framework that combines the GISC project activities and deliverables, and links these to the recommendations presented by this report.

First part of the report (Chapter 3) focuses on the main results of the GISC project. The chapter addresses the three central elements for the successful and sustainable in-situ provision, namely: providing decision basis, securing partnerships and ensuring data access. The three elements address a broad range of aspects, such as technical requirements, cost estimation, prioritisation and governance/coordination aspects.

At the same time, it is made clear that challenges remain in order to successfully secure in-situ data provision. Challenges concern mainly the complexity related to different stakeholders, policies and interests and also to the costs involved. Such complexity calls for in-situ coordination as part of in-situ governance. The report outlines four governance scenarios involving in-situ coordination.

Second part of the report (Chapter 4) presents the current situation, the GISC approach and the lessons learned for each of the services; emergency, land monitoring, atmosphere and marine. Referring to the needs and challenges, the chapter also provides an overview of proposed recommendations for each service.

Third part of the report (Chapter 5) consolidates common recommendations as challenges and needs often concern more or all of the services.

The main themes of recommendations concern:

- Data sharing and license policies – developing or aligning common Copernicus data policy framework.

- Minimising duplication of efforts – enhancing networking and establishing partnerships regionally and globally.

- Mobilising available resources – utilising crowd-sourcing and public private partnerships, and involving existing data centres.

- Sustaining in-situ observation and accessibility – securing efforts and results based on research (infrastructure) projects.

- Facilitating data flow by technical framework infrastructure - establishing data gateways and selected data nodes.

- Ensuring cross-cutting requirements – facilitating access to same data relevant for two or more Copernicus services (cross-service need).

- Securing in-situ data provision in an efficient and cost-effective manner – initiating in-situ cross-service coordination, possibly as a coordinating entity, in support of the in-situ activities of the individual Copernicus services.

2 Introduction

2.1 Background

The Copernicus programme, formerly known as the GMES (Global Monitoring for Environment and Security), is the European initiative for the establishment of a European capacity for Earth Observation. It aims at monitoring and forecasting the state of the environment on land, at sea and in the atmosphere. Moreover it supports emergency response activities in and outside of Europe. From its outset, GMES/Copernicus builds on the research activities carried out under several work programmes of the European Community and the Copernicus/GMES Space Component Programme of the European Space Agency (ESA).

2.1.1 GMES initial operations (GIO) – 2011-2013

In September 2010 the European Council adopted the regulation on the GMES programme and its initial operations from 2011–2013 (GIO) to allow an operational GMES system by 2014[1]. The regulation entered into force in November 2010.

The GMES programme comprises the following:

1. A service component ensuring access to information for the areas:
    - Atmosphere monitoring;
    - Climate change monitoring in support of adaptation and mitigation policies
    - Emergency management;
    - Land monitoring;
    - Marine environment monitoring;
    - Security
2. A space component ensuring sustainable space borne observations for the services;
3. An in-situ component ensuring observations through airborne, seaborne and ground-based installations for the services.

The objective of the GMES/Copernicus has from the beginning aimed at becoming a source of timely and up-to-date information about environment and security for the benefit of individual citizens and decision-makers (European, national, regional, local, corporations, etc.).

Whereas the space component of GMES is managed and developed by ESA, the GMES in-situ component is based on observation infrastructures owned and operated by a large number of national and European stakeholders. In some cases they are coordinated within the framework of existing European and international networks.

The in-situ component is facilitated by the European Environment Agency (EEA) through the FP7 funded Coordination Action “GMES In-situ Coordination – GISC”[2]. The GISC project is acting between data providers and GMES services to stimulate an open access to all relevant in-situ data in a cost effective and sustainable way. The project’s main objectives are to

[1] Regulation (EU) No 911/2010 of the European Parliament and of the Council on the European Earth Monitoring Programme (GMES) and its initial operations (2011 – 2013).
[2] http://gisc.ew.eea.europa.eu/

determine methods enabling networks to provide the required in-situ data for GMES. Moreover, the needs of GMES services for in-situ data are identified and prioritised in consultation with stakeholders. Finally, approaches for the integration of in-situ assets and networks into long-term sustainable frameworks for GMES services, including providing proofs of concept of operational in-situ architecture should be explored.

The GISC objectives are integrated in four interrelated work packages:

- WP1: Cooperating with the users, stakeholders, and service providers, as well as exploring and determining methods to enable networks to provide the required in-situ data for GMES;
- WP 2: Documenting the in-situ data needs and data requirements;
- WP 3: Exploring approaches to the integration of in-situ assets and networks into long-term sustainable frameworks for the GMES services;
- WP 4: Evaluation of in-situ data delivery in order to select ‘quick-wins’.

2.1.2 Copernicus – 2013 - 2020

In continuation of the GIO phase, in-situ data will remain an indispensable part in the operational phase for GMES 2014-2020, now renamed the Copernicus programme. This is underlined through the recent proposal for a regulation establishing the European Earth Observation Programme Copernicus[3]. The operationalisation of the Copernicus programme relies on the long term and continuous availability of data. In-situ data is indispensable to proof the accuracy of space products and is used to process, calibrate and validate satellite imagery. In-situ data is also crucial for robustness and affects the quality of the Copernicus services’ products, and is required during the production, evaluation and distribution processes. In-situ will remain an integrated part of Copernicus, as proposed by the Draft Regulation.

2.2 Objective of the report

The objective of the GISC project, according to its description of work (DoW)[4], is to act between data providers and networks with the aim to develop an adequate system for the provision of the required in-situ data to the Copernicus services, which also takes into account over time changing demands.

As part of the preparatory work, this report of the GISC project presents an Initial Framework – a set of approaches and solutions for the sustainable provision of in-situ data in support for building up an operational in-situ system. The Initial Framework serves as a logical framework that combines the project activities and deliverables, and link these to the recommendations presented.

The specific purpose of this report is to provide a set of recommendations enabling the sustainable interface between in-situ providers and other components of the Copernicus programme. This report complies with the DoW, and has been developed in consultation with the Commission in order to include current needs and related changes. Accordingly, the

[3] Proposal for a Regulation of the European Parliament and of the Council on establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010. Brussels, 29.5.2013, COM(2013) 312 final 2013/0164 (COD)

[4] Annex 1 to the grant agreement, GISC No.249327 from 20/11/2009, p.7

content of this report is based on the outcome of the meeting held 26 June 2013 with the Copernicus Unit of DG Enterprise, and subsequent consultations in August, September and October 2013. This means that this report provides the "big picture" on the status of in-situ data provision to the Copernicus services. Also, the report provides recommendations mainly where the sustainability of such data flow and organisation is at risk. However, this is not to undermine the many detailed observations and related recommendations provided by GISC and the stakeholders during the GISC project. These are made available during the project phase through the GISC deliverables[5].

Therefore, the purpose of this report is not to repeat the detailed analyses and conclusions. Instead, it is a final presentation that synthesises important elements and lessons of the GISC project, providing a status of the current provision of in-situ data for Copernicus services.

2.3 The outline of the report

Chapter 3 below presents the overall conclusions, drawn from acquired results of GISC. At the same time, the chapter also makes clear that some challenges remain in order to successfully secure in-situ data provision. The chapter focus on the three central elements for the successful and sustainable in-situ provision, namely: providing decision basis, securing partnerships and ensuring data access. The GISC activities and accumulated knowledge related to these three central elements form the Initial Framework, which is presented at the end of the chapter.

Chapter 4 presents briefly the current situation, the GISC approach and the lessons learned for each of the services. Referring to the needs and challenges, the chapter also provides an overview of proposed recommendations for each service.

As challenges and needs often concern more or all of the services, Chapter 5 addresses common recommendations.

[5] Access all GISC deliverables at http://gisc.ew.eea.europa.eu/gisc-project/deliverables

3 *GISC Matters* – main results and remaining challenges

By the activities and analyses undertaken, the GISC project has contributed to the sustainable development of the in-situ component of the Copernicus programme by facilitating harmonisation of data access, re-use of the data for more than one service and possibly also for downstream services. The GISC activities and contributions have focused around the three central elements for the successful and sustainable in-situ provision, namely: providing decision basis (information basis), securing partnerships and approaches and ensuring data access, coordination and governance[6].

3.1 Providing decision basis - GISC developed methodology and cost estimation

The GISC project has not only provided input and evidence for sustained in-situ data access. Of equal value for the sustainability of the Copernicus in-situ component is the tools and methodologies that GISC has developed, which offer valuable support to the Copernicus services also in the operational phase.

Most essential is the methodologies developed for determining in-situ requirements (D2.1 *Report on In-situ Data Requirements*) and prioritisation of data (D2.2 and D2.4 *Analysis of in-Situ Requirements* and *Report on Criteria to Determine Priorities for Support*). These tools allow the Copernicus services to undertake a qualified evaluation and assessment of current needs for in-situ data and its prioritisation based on set criteria. By such means, the Copernicus services are able to produce better services and products taking needs, possibilities and limitations into account.

In-situ Data Requirements
Since its beginning in January 2010, the GISC project has collected the in-situ requirements of all existing Copernicus services (Land, Emergency management, Marine, Atmosphere) in consultation with stakeholders from the current service technical coordinators. Results were published in report D2.1. Alongside, a database was set up where requirements were stored. Due to the evolvement of the services, GISC has continuously maintained and updated this database[7]. It is **recommended** that the Copernicus services continue to update the requirements data base.

Based on such inventory of in-situ data requirements, it is possible to:

- deliver a comprehensive harmonised documentation and specification of the in-situ data requirements;
- establish and maintain a consistent overview of requirements, taking into account synergies, gaps, overlaps, constraints on priorities and other issues such as restriction to access or use, intellectual property rights (IPR), infrastructure and architecture ensuring sustainable data provision;

[6] Described in D3.1 *Report on outcome of exploration of approaches,* and also D3.2 *Recommended Solutions*, p. 83ss.
[7] See latest; *Note on in-situ data requirements Update of D2.1 – Report on In-situ data requirements,* September 2013.

- prioritise in-situ needs in the light of their urgency and contribution to Copernicus services;
- provide the basis for cost estimations;
- identify data provider organisations or networks with whom a dialogue is needed.

The requirements were classified in essential, desirable and useful data. The essential data is the most critical, meaning that a product cannot be delivered according to its specifications without such essential data. Desirable and useful data are merely included for redundancy and for product support respectively.

Criteria for determining priorities for support and costs
Addressing the above-mentioned database of in-situ requirements, GISC provides a methodology that defines criteria to determine priorities amongst in-situ data sources[8]. The criteria address data access based on limitations and gaps in availability and also on the importance to Copernicus. The prioritisation of in-situ data may be determined by assessing the following five characteristics of each data:

- Is the data essential?
- Does the data serve multiple uses?
- Does the data add to the sustainable development of Copernicus?
- Is the data fit for purpose?, and
- To which degree is the data accessible.

Furthermore, cost categories are added to the prioritisation[9]. Grouping the priorities into different classes and cost categories help identifying actions to ensure access to the essential in-situ data for the Copernicus services.

Cost estimation and value of in-situ component
The cost estimation involves a long-term cost assessment of the service requirements as communicated by Copernicus services/technical coordinators. One should, however, differentiate between the costs arising for Copernicus and the value which in situ component represents in Europe.

The requirements were basis for a cost valuation of the in-situ component which was conducted in 2010. The costs and methodology were determined by external consultancy using different models which were based among others on effective data license costs, labour costs and assumptions on efforts for coordination[10].

The requirements database has been updated frequently[11]. The costs were reassessed in 2011 and 2012. However, the estimations must be read with reservations:

- The cost valuation was not updated since 2012.

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[8] See joint Report D2.2 and D2.4 *Analysis of in situ requirements & Report on criteria to determine priorities for support*, p. 17ss

[9] See D2.3 *GMES In-situ Cost Assessment 2011 Update*, p. 8ss.

[10] See D2.3 *GMES In-situ Cost Assessment 2011 Update*, p. 12ss. as updated by December 2012, see GISC internal note: *Cost Note GMES in-situ 2013*, 7 December 2012 The methodology applied for the cost assessment is based on Ecorys (2010) *GMES in-situ cost assessment, Implementation of methodology to GMES services: Land and Marine*, Business deliverable 3.

[11] See note 7.

- Not all relevant in situ networks are yet included, the climate change service is only partially covered via the potential overlap with existing services, and the in situ data requirements of the security service are essentially unknown.
- The analysis does not reflect, which of the required datasets being actually used by the Copernicus services.
- The on-going implementation of the Quick-Wins may influence the future funding needs for in-situ data.
- Several countries have changed/may change their data access policies and offer free of charge access to their data (e.g. such as through Inspire or PSI).

The costs reflected below have to be seen as **the overall annual monetary value of the in situ component and are not related to the financial needs to be covered by Copernicus.** Also, it shall be noticed that coordination and data access costs are generally attributed to the services, whereas setup and operation costs are not. This means that the costs mentioned do not necessarily represent the actual need for additional funding. The in-situ component is already to a large extent financed by public funds and programmes primarily at Member State level[12]. These are supplemented by funds and programmes at EU level. Therefore, the actual need for additional in-situ funding depends on the future funding available at national and EU levels.

Thus, the overall annual costs of the in situ component may be estimated to approximately 410 Mio EUR (417,785,000 EUR), which for the period from 2014 to 2020 (7 years) amounts to 2.9 Billion Euro:

Cost type	**Annual amount (in 1000 EUR)**	**Share**
Setup costs	77,765	19%
Operation Costs	274,920	66%
Data access costs*	55,197	13%
Coordination costs*	9,903	2%
Total	417,785	100%

* Costs due to Copernicus core services (i.e. not the value of the in-situ data in place) are estimated by the Commission to be nowadays of the order of 10% of the indicated costs in the table.

Furthermore, these annual costs are shared by the four different Copernicus services:

Services[13]	**Annual amount (in 1000 EUR)**	**Share**
Land	81,086	19%
Emergency Response	9,424	2%
Atmosphere	179,053	43%
Marine	148,224	35%
Total	417,785	100%

[12] See Commission Communication on GMES: *We care for a safer planet*, 12.11.2008, COM(2008) 748 final.
[13] 350k EUR coordination costs for ESA were spread over the four services equally (87.500 EUR each).

3.2 Securing network and partnerships

The detailed GISC analyses and recommendations have been formulated as a result of an on-going involvement of a broad range of stakeholders, Copernicus services, data providers and EU and International organisations. It is also a result of a sustainable process of networking and establishing partnerships.

The success and sustainability of the Copernicus programme depend on the ability of creating networks and partnerships. This means that GISC during the GIO phase deliberately has paid attention to the basic elements typically associated with network management:

Basic elements of network management
Network incentives based on network synergies Data exchange takes place based on incentives for both data providers and data users – without incentives for participation, the process risks failing in attracting the participation of valuable partners. Typical, the network incentives are related to the expected outcome of each individual actor. Therefore, the process itself is important in order to gain incentives. Trust, credibility and confidence in the repeated interaction amongst participants are essential preconditions of any network based organisation. **Transparency** Network incentives are linked to clarity and transparent governance structures. Uncertainty creates confusion and lack of incentive. **Flexibility** Network coordination and governance call for flexibility in addressing the specific needs of each particular network relation. Flexibility is also needed to manage and facilitate the significant diversities amongst parties, and the many learning processes involved in the network synergies. Such learning is essential for the on-going development and improvement of the outcome of the networking itself (i.e better data access and better products), and the gained value for each network participant. **Legitimacy** Copernicus network governance is significantly based on the legitimacy of participation and involvement of both the European public and private sector. It is basically a matter of trust and credibility amongst the parties involved and of attracting potential new participants. The Copernicus service providers and coordinators are in need of such legitimacy in order to sustain network incentives and synergies. Legitimacy is closely related to the accountability of the governance structure and the coordinating institutions involved.

GISC has been instrumental in creating and employing partnerships between Copernicus and in-situ data owners/providers to make available the essential in-situ data requested by the Copernicus services. Based on such trust, GISC has in several cases sealed the partnership by written agreements. In addition, GISC has in some cases gone further to facilitate and/or to conclude detailed agreements on data access (such as Service Level Agreements).

GISC has been instrumental in[14]:

[14] See for details; D1.6 on the *Progress in negotiation and development of partnership* and also D3.4 on *Data exchange agreements, etc.*

- Creating or initiating partnerships with mandated organisations and networks working at the European level, e.g. EuroGOOS, EUMETNET, EuroGeographics, EuroGeoSurveys and Eionet;
- Initiating contacts with private sector in-situ data and service providers, such as the Princess Cruises;
- Initiating Letters of Intent/MoUs, drafting Country Framework Agreements on commitment to provide access to in-situ data;
- Improving licensing conditions and adapting existing data policies to augment availability and use of in-situ data, and formalising the relations between in-situ data networks / providers and the Copernicus services.

Many of the approaches are cross-cutting in nature and may range from inter alia awareness-raising, exchange of letters of intent to conclusion of bilateral or multilateral agreements.

***Monitoring Matters* Workshop – a stakeholder endorsement**

The GISC workshop *Monitoring Matters* held in Copenhagen in April 2013 gave the stakeholders – or partners - an opportunity to discuss and give their own views based on the GISC presentations, activities and deliveries. The results from the *Monitoring Matters* workshop are also incorporated in this final report.

Amongst the key messages of the workshop, the stakeholders emphasised that in-situ data and in-situ coordination also in the future are needed for sustaining Copernicus services[15]:

Monitoring Matters **Work Shop, Copenhagen April 2013** Key Messages on in-situ data and in-situ coordination
• The Copernicus services cannot deliver the expected outputs without in-situ data. The importance of in-situ data to the functioning and operations of Copernicus was repeatedly underlined by the Copernicus services and the space component. A significant percentage of the growth and pay-back from Copernicus is not realised if in-situ is not made available. • The in-situ data landscape is hugely diverse and needs coordination. The diverse nature of in-situ (various data providers, different standards, scales, quality, coverage, decentralisation/centralisation, legal constraints and data policies) is a factor that requires management and coordination. It is not an option to do nothing; the in-situ component cannot be left on its own. It needs European engagement. • In-situ coordination is appreciated by stakeholders in terms of enabling direct contact and improving access to in-situ data. • In-situ coordination for Copernicus is needed to work alongside existing coordination mechanisms. Copernicus in-situ data coordination has an important cross-cutting facilitation role between the Copernicus components and the data provider networks. It improves the re-use of capacities and processes which already exist and can improve data access and the technical solutions behind it. It can also ensure adaptable in-situ interfaces not directly integrated into the services production environment, but made available as reusable elements.

[15] Workshop Report *Monitoring Matters*, p. 3s, 13s and p. 19.

3.3 Ensuring data access, coordination and governance

Quick Wins – securing sustained data provision
The Quick Wins (case studies) provide important evidence of and contribution to the sustainability of in-situ data provision. These GISC case studies have not only addressed the sustainability of selected data flows, they have also in specific cases been a decisive factor in improving the current flows and access to in-situ data for the services.

The important contribution of the Quick Wins was recognised as a key message from the *Monitoring Matters* workshop[16]:

Monitoring Matters **Work Shop, Copenhagen April 2013** Key Message on role of Quick Wins
The 'Quick Wins' implemented by GISC have enabled solutions. GISC Quick Wins (case studies) demonstrate the value of pooling existing capacities via interactions with countries and coordinating bodies. In-situ coordination needs time and effort, but not a big budget, to achieve results which benefit the Copernicus services. Commitment to support Copernicus depends, inter alia, on a suitable governance structure and clarity on operational continuity of the services.

The following table presents briefly the GISC Quick Wins, including their contribution to in-situ sustainability and the development/alignment with Inspire and SEIS principles:

Quick Win	Included in GIO scope	Adding to in-situ sustainability	Covered by Inspire directive and / or aligned with SEIS principles
Surface air quality (near real-time measurements) Quick win on provision of near-real time air quality information involving Eionet	No (MACC II)	Yes (Eionet Coordination structures, data access point, data providers, data for downstream services, e-Reporting.	Aligned with SEIS principles. Aligned with Inspire (Annex III: (Atmospheric Conditions, Environmental Monitoring Facilities, Area mgt/restrict./reg. zones and reporting units, Human health and safety). Also e-Reporting for Air Quality Directive.
Selected geospatial data for GIO EMS Quick win on the national reference data for the Emergency Management service together with EuroGeographics	Yes (EMS response products)	Yes, (EG Coordination structure and data providers)	Covered by Inspire (mainly Annex I) for content.
Argo float measurement data Quick win on the Euro-Argo as an example of the dependency of Copernicus on research infrastructures	No (MyOcean2)	Yes, re-useable[17] data, data providers, coordination structure and data access point	Aligned with SEIS principles (full and open access to the data)

[16] Workshop Report *Monitoring Matters*, p. 4.
[17] Reusable for Climate Change

Selected geospatial data for GIO Land Quick win on the national reference data for the Pan-European Land component based on results of the GIO land grant agreements, the GISC country visits and the Reference Data Access survey	Yes (EMS and GIO land)	Yes, re-useable coordination structure, data providers and data.	Covered by Inspire (Annex I: Admin. units, Transport networks, Hydrography, Geographical names; Annex II: Elevation, Ortho-imagery, Annex III: Land use)
European Meteorological Network - EUMETNET Quick win on provision of meteorological data involving EUMETNET	Yes and No (MACC II, EMS, MyOcean 2)	Yes, re-useable data, data providers, coordination structure and data access point	Covered by Inspire (Annex III: Meteorological geographical features)

As described in detail in GISC deliverables D4.1 – D4.3, the outcomes of the Quick Wins have demonstrated methods to sustainably provide and secure in-situ data to the Copernicus services and the beneficiaries they address. Furthermore, the Quick Wins have provided a number of lessons useful for the assessment of strengths and weaknesses of the proposed solutions. These lessons may help to shape the overall in-situ strategy for an operational phase of Copernicus from 2014 and beyond.

Therefore, the Quick Wins represent an important and very successful outcome of the GISC project. The case studies illustrate the functioning of services and also identify areas for improvement. However, as they are only case studies they cover only a part of the overall requirements.

The sustainability of the Quick Wins may be promising. However, as the GISC project is coming to a close, the sustainability requires a successful hand-over process.

Some challenges remain

The GISC project has successfully identified sustainable patterns for the in-situ component of the Copernicus Programme. The GISC project has even by its activities, especially through the Quick Wins, been able to improve the actual data provision for selected data.

Despite this predominantly positive message, GISC studies also reveal that challenges remain in order to secure sustainable in-situ data provision for the development of the Copernicus Programme. This report will present these challenges accompanied with our recommendations.

An important and overall observation, which underscores the recommendations presented in this report, is that one should not underestimate the complexity involved in in-situ data provision. This implies that the in-situ landscape is characterised by many different stakeholders, different policies and different interests. The close interrelationship with the global coverage represents a challenge in its own. Also, the cost involved is an important factor as in-situ data provision and management is not for free. Therefore, the complexity means that different scenarios for securing a sustainable evolution of the in-situ component of the Copernicus Programme are thinkable[18]. It emphasizes the need for in-situ coordination under which different governance scenarios are possible. And it suggests that the recommendations provided by the GISC project should be taken into account when managing such complexity.

[18] See for instance D3.2 on *Recommended Solutions* p. 80ss.

The need for In-situ Coordination
The GISC experiences emphasise the need for in-situ coordination. This is an important element in sustaining the successful implementation of Copernicus in the operational phase. The need for in-situ coordination is also reflected by the Draft Copernicus Regulation, Art. 6.

The need for in-situ coordination relates to three main functions:

First, the GISC Quick Wins highlight the important role of in-situ data coordination in the identification of in-situ requirements. The in-situ coordination function does not concern the actual collection, processing and validation of the data. This is done by the services themselves. Services also identify data providers which can fulfil their data needs, and the in-situ data coordinator role would then be to assist with the implementation of provisions needed to ensure the access to the data flows. In cases when coordination needs regarding data access are identified by the services, the in-situ data coordinator will assist the services in identifying solutions and promoting necessary actions to improve data access.

Second, for cross-service needs, the in-situ data coordinator(s) has/have an important role in identifying solutions that cater for more than one service's needs in order to avoid duplication. Such cross-services support is typically needed as the in-situ data landscape is characterised by vast and complex diversity in terms of character of data providers, applied standards, quality, technical abilities, legal constraints, data policies, etc.. Managing such complexity needs coordination. The role of the in-situ coordinator(s) will be to address common Copernicus aspects for more than one Copernicus service, as the individual and technical specialisation of the individual services do not allow for such an overview of cross-service needs.

Third, the central role of the cross-service in-situ coordinator(s) also makes a useful focal point to ensure the alignment with the overall Copernicus and EU policy goals.

The need for cross-service coordination has been emphasised by stakeholders, for instance at the GISC Workshop *Monitoring Matters*[19].

Governance scenarios
Based on the above findings, the GISC project has identified four governance scenarios involving in-situ coordination[20]:

Scenario A is the baseline scenario. Copernicus services (the technical coordinators and service providers) are carrying out the primary activities (*managing information* and *enabling data access*). Parts of the activity *establishing partnerships* are carried out by the Commission, but certain tasks may be shared with the technical coordinators and selected service providers.

This means that Copernicus will not be supported by a dedicated in-situ coordinator.

Scenario B introduces the Copernicus in-situ data coordinator (ISDC). In this scenario, the ISDC will focus primarily on *managing information*. The ISDC will work together with the Copernicus technical coordinators (for the services and the space component) to ensure that

[19] Workshop report *Monitoring Matters*, p. 3 and 13s. See also Meeting report between MACC and GISC at ECMWF 30 May 2013, Item 8.
[20] See D3.2 on *Recommended Solutions* p. 85ss.

in-situ data requirements are documented and analysed in a consistent and harmonised fashion to allow for an optimised implementation of data access arrangements, in particular as regards cross-service/cross-cutting requirements. The activity *enabling data access* is handled by the technical coordinators (services and space). The activity *establishing partnerships* is primarily carried out by the Commission, but certain tasks may be shared with the ISDC and the technical coordinators.

Scenario B suggests an ISDC, which is carrying out a limited number of the key aspects of the GISC functions of today.

Scenario C expands the role of the ISDC to focus on *managing information* and *establishing partnerships*. The ISDC will share the activity *enabling data access* with the technical coordinators (services and space). Concerning data access arrangements, the ISDC will primarily focus on cross-service in-situ data required by more than one service and by the space component.

Scenario C introduces an ISDC with more or less similar functions as fulfilled by the GISC project. In coordination with the services and the Commission, the ISDC will thus continue the enhancement of data flows from data providers to the services.

In **Scenario D,** the ISDC will not be limited to focussing on cross-cutting in-situ data requirement as in Scenario C. The ISDC will facilitate and lead all three primary activities, i.e. *managing information*, *establishing partnerships,* and *enabling data access* for all required data.

Scenario D aims at a truly horizontal and coordinated approach amongst the services. It is a scenario that emphasises both in-situ cross-cutting as well as service specific coordination as a major objective in itself. Scenario D allows for the ISDC to have a leading and facilitating role beyond the current GISC activities.

In-situ governance – sustaining the service evolution process[21]

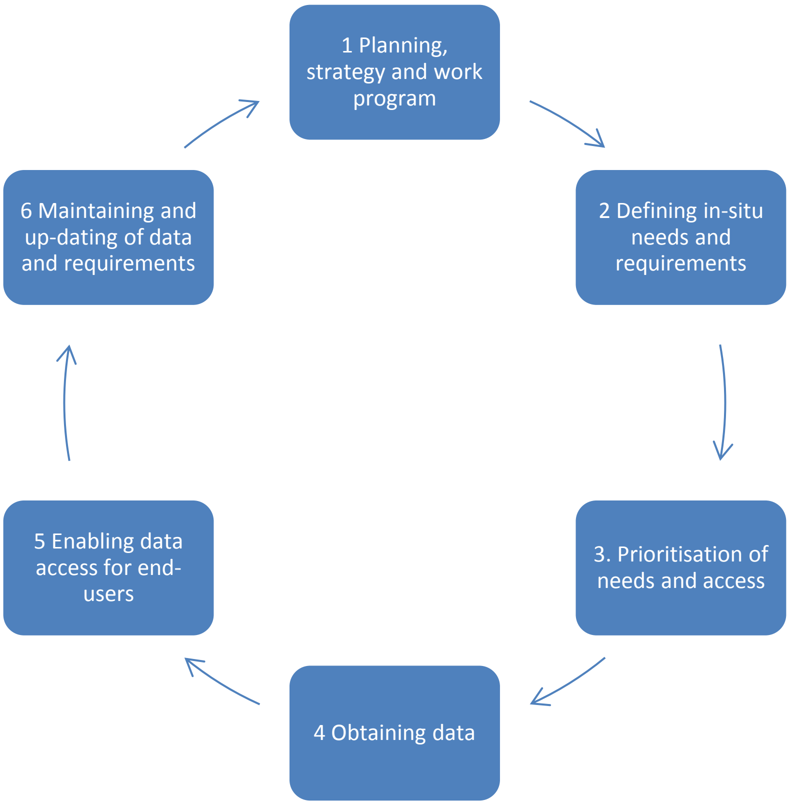
Each of the scenarios above represents an organised and coordinated management approach to enable relevant data access, and to ensure that data flows are effectively maintained in order to meet the demands and requirements of the end-users[22]. This means that the Copernicus in-situ management process provides the framework for a structured approach for the evolution of Copernicus. It allows for a flexible and on-going adjustment of planning, setting of objectives and measure and for revising the process accommodating new or changed requirements. The rationale and needs involved in this management approach have been taken into account by GISC in its analyses and formulation of recommendations.

Figure 3-1 illustrates the Copernicus in-situ management process/service evolution process:

[21] See D3.2 on *Recommended Solutions*, p. 23ss and Annex B.

[22] The processes involved apply the principles of generic public management, such as the classic Deming Circle also known as the PDCA (plan–do–check–act) iterative four-step management method. See for instance http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html

Figure 3-1: The Copernicus in-situ management process



3.4 The Initial Framework – the basic concept

The GISC activities presented above in sections 3.1-3.3 relate to the three central elements for the successful and sustainable in-situ provision (i.e. providing decision basis, securing partnerships and ensuring data access). These elements allow GISC to establish the Initial Framework.

The Initial Framework provides both the information and the methodological basis and presents a logical chain approach linking data sources to the data users (i.e. the Copernicus services).

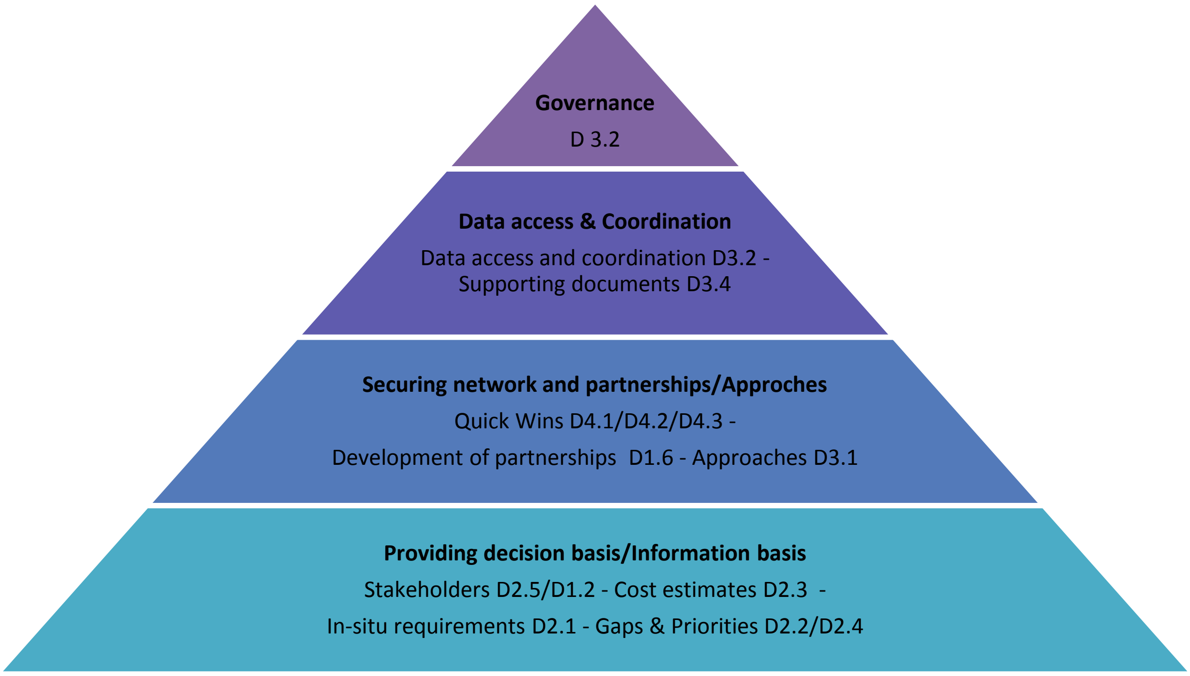
Therefore, the Initial Framework presents a set of components necessary to construct and manage an efficient and sustainable interface between the central elements for in-situ provision based on the project deliveries. Moreover, it is a presentation that combines the logic of the components of the Initial Framework with project activities and deliveries of the GISC Project. This serves as a “chain of evidence” sustaining the recommendations presented in this report.

The components of the Initial Framework are shown in Figure 1 below and are composed of the GISC deliverables:

- Providing decision basis (Information basis): information and processes necessary to provide an appropriate decision basis for Copernicus as regards in-situ data issues. Elements are inventories of services’ requirements for in-situ data, gap analyses, cost valuation, priorities, and catalogue of data providers (GISC D2.1, D2.3, D2.2/2.4, D2.5);

- Securing network and partnerships (Approaches): a set of different approaches aimed at, individually or in combination, providing solutions to in-situ data access challenges and problems. Approaches were developed in D3.1 and a limited number of quick wins (five) are implemented through D4.1/D4.2/D4.3 supported by development of partnership D1.6;
- Data access and coordination: focuses on (a) ensuring the availability of in-situ data nodes and the data flow from the nodes to Copernicus through agreements (D3.4), and (b) coordinating the data flow from the providers towards the data nodes through the proposed data access nodes and coordination (D3.2) for the atmosphere, emergency, land, and marine services;
- Governance: activities related to acquiring the information basis and data access and coordination managed within the Copernicus governance structure (D3.2).

Figure 3-2: The GISC Initial Framework – a "pyramid" presentation



Based on the work with each of the deliverables, which constitute the Initial Framework, the GISC project has been able to identify needs, challenges and related recommendations for sustainable in-situ data provision. These are presented in the next chapters.

4 Copernicus services – in-situ data provision

4.1 Emergency management service

4.1.1 Current situation

The GIO EMS provides mapping products to stakeholders in the field of disaster management and emergency response, in particular Civil Protection Authorities and Humanitarian Aid actors. The GIO EMS products offer timely and accurate geospatial information for all the phases of a crisis.

Required in-situ data is mainly geospatial, also known as reference data. In Europe, reference data is managed by institutions of the Member States. Data owners are usually mapping and cadaster agencies and/ or defense agencies. In the international context the overview of ownership and access conditions is more blurry.

The GIO EMS service providers have full responsibility for organizing access to reference data as part of their product development. Known issues, which the service providers face, are the variable quality of freely available data sources (e.g. OpenStreetMap), high license costs of commercial products and restrictive and very different data access policies in member state authorities. This causes difficulties in obtaining essential data for the production and delivery of the services' products.

To overcome the existing obstacles, GISC held a dialogue with Member States institutions to explain the benefits of data sharing with the GIO EMS and to identify concerns of stakeholders regarding the free use and integration of national data in Copernicus products. As a further solution the GISC project signed an agreement with EuroGeographics (EG). The agreement aims at facilitating and securing free access to national reference data from EG member countries and to provide their data to the GIO EMS. The provision of national data will improve the overall GIO EMS product quality as standards are guaranteed e.g. through the Inspire directive . For areas outside of Europe the GIO EMS will for the moment continue being dependent on freely available data.

4.1.2 The GISC approach

A framework agreement between the EEA acting as Copernicus in-situ coordinator and EuroGeographics, the association of national mapping and cadastre authorities in 44 countries across Europe, was signed on 16 November 2011. The agreement was carried out in consultation with the Joint Research Centre of the European Commission (JRC) acting as technical coordinator of the GIO EMS and member organisations of EuroGeographics. The purpose of the consultations was to design a solution for free of charge provision of geospatial reference data for the GIO EMS.

In November 2012 a joint letter from the EEA and EuroGeographics was sent to all 56 member organisations of EuroGeographics. The letter, when signed by the individual member, provides the legal ground for requesting free of charge access to available online authoritative geospatial reference data required by the GIO EMS until end of the GIO phase, i.e. end of 2014.

Moreover, it specifies the terms and conditions under which data is requested. In addition EEA prepared an operational procedure in consultation with the JRC providing guidance on the information to be made available to the JRC to allow an operational access to online geospatial reference data available in the EuroGeographics member organisations.

The data have been already successfully used by the service providers in creating mapping products in support to national emergency management activities in EU countries e.g. during the severe floods in May – June 2013, specifically in the Czech Republic and Germany. The availability of authoritative geospatial reference data allowed the service provider to timely respond to the call from the responsible authorities of these countries and to provide them with high quality products.

This successful case study demonstrates how the involvement of a network which is representing national authorities of its member countries, facilitates free of charge access to authoritative geospatial reference data for a Copernicus service[23]. It also exemplifies the role which European thematic networks can play in gaining countries' commitment to provide access to their data for the Copernicus programme.

4.1.3 Lessons learned and recommendations - for the sustainability of in-situ data provision

The case study demonstrated two key activities of in situ coordination: besides the sensitisation for the subject and negotiations to allow the free access to authoritative geospatial reference data for GIO EMS, a technical framework had to be established and managed. Key stakeholders were EEA in their role as in situ coordinator and JRC in their role as technical service coordinators.

The solution pointed out by the EuroGeographics case is a first step into a fully operational data flow. As a lesson, the solution indicates the important value in cooperating with international organisations for the coordination and access to in-situ data held at national levels. This is a lesson to be employed by other services as well. However, the EuroGeographics case also has its limitations. The diversity of implemented technical solutions in countries, the need for harmonisation of national data at European level as well as a single data access interface are still issues to be addressed in future coordination activities.

Also, the implemented solution is currently service specific and cannot be applied to other Copernicus services that require the same type of data. For emergency situations the affected area for which reference data is required is small compared to e.g. products of the land service covering local hotspots up to the whole European continent. Moreover, the GIO EMS supports national emergency management activities during and in the aftermath of a crisis. This specific incentive may have played a decisive role in opening up data access for the Copernicus EMS.

However, besides the successful provision of in-situ data through the EuroGeographics agreement there are remaining issues to be addressed in the future. The agreement lasts until the end of the GIO period in 2014. Therefore the dialogue with Member States has to be continued to ensure a long-term sustainable data provision to the Copernicus EMS. This is of course also dependent on the future (post-GIO) definition of the service.

Also, an important challenge the EMS is facing is its global coverage. Partnerships with individual countries won't be able to negotiate. Thus, a centralised provision of essential datasets for disaster hotspot areas could be considered. Moreover, global initiatives like the UN initiative on Global

[23] For more information on this Quick Win, see GISC deliverable D4.3.

Geospatial Information Management (UN-GGIM) or GEO might help making geospatial data available among and between Member States and international organizations.

Finally, essential data requirements exist, which are currently not available[24]. Those could be procured through service providers.

The following table provides suggestions for improved in-situ data provision for the emergency service:

Emergency: Recommendations for sustainable in-situ data provision

In-situ needs/requirements	Activities recommended	GISC ref
A. European data access		
Agreement on data exchange – The agreement between EEA and EuroGeographics and the letter provides a solution until the end of 2014. As Copernicus EMS activities will continue also beyond 2014 there will be a further need for geospatial reference data.	Negotiations with EuroGeographics or directly with national data providers should be addressed to secure the operational access to national geospatial reference data for Copernicus EMS beyond 2014.	D4.3, p. 24 Note QW June, p. 3 D3.2, p. 69ss
Critical infrastructures – EU coverage public services + critical infrastructures – utilities. The required data might be available from individual Member States underlying different access conditions.	Setup of a spatial data set for risk prone areas should be considered.	D2.2/2.4 p. 32ss
Large scale population information (100 m x 100 m)The required data might be available in the individual Member States with different specifications and quality. Available global datasets have lower resolution (e.g. 1km x 1km). Access conditions vary from free and open access to restricted access and license costs.	1) Data access has to be negotiated with relevant data owners. 2) Validation of existing datasets is necessary.	D2.2/2.4 p. 32ss
Data access - harmonise access to national reference data	Invest in further technical harmonisation steps to achieve an easy access to the national reference data through standardised web services. Currently different technical solutions exist in the Member States.	D4.3 p.23s
Data access – non-availability of data	For the Emergency Response service several datasets are required which are currently not available. In discussion with the technical service coordinator, it should be discussed which of the data is of highest importance and how the data could best be procured (e.g. large scale transport networks, critical infrastructure (e.g. hospitals and schools), post-disaster aerial imagery).	D.2.2/2.4, p. 32ss
B. Global data access		
To date the emergency response service's area of activity has mainly been outside of Europe. In some cases in-situ data might not be available at all or it might be difficult to access for certain areas. For areas outside of Europe the EMS depends mainly only on free and open data for which quality and coverage is uncertain.	1) Utilise/partnership with: GEO and International organisations (UN GGIM, WFP, UNEP, FAO). 2) Set up a data base of reference data for global disaster hotpots. Consistent 1:50K reference layers should be generated including a layer of "asset-at-risk" (referring to the economic value of the assets at risk). This database could also be useful for disaster preparedness and mitigation activities of DG ECHO. 3) Consider improved access to: Post-disaster aerial imagery for assessing damages. 4) Evaluate together with DG EuropeAid possibilities to support the set-up of in-situ observation infrastructures, their operation and	D2.1. p.55; D2.2/2.4, p. 51 and 56ss. D3.2, p. 69ss

[24] For more details, see GISC deliverable D2.4 p. 32ss.

	their maintenance in less developed countries. This solution/recommendation is in line with the GISC Euro-Argo QW (see further D4.3 on Euro-Argo). 5) An alternatively recommendation: Utilise global datasets for the service. However, their limitations in relation to scale and detail of information have to be kept in mind.	
Built-up areas/settlements, 1:25 000, global coverage Currently no global dataset exists at the required scale. On global scale products derived from satellite imagery are available but at coarse resolution.	Setup of a spatial data set at least for high risk areas should be considered	D2.2/2.4 p. 32ss
C. Utilise Resources – R&D		
Apply **social media** - R & D activity	There is a growing importance of social media in emergencies. It is recommended to explore the use of geo-tagged media information to contribute to a better understanding of what has happened, the potential impact and to support the situational assessment.	Monitoring matters report p.12s.
Engage **volunteers and crowd mapping** - R & D activity	1) Further explore the engagement of volunteers and crowd mapping in general as important source of spatial data. 2) There is a need to better understand the mechanism, quality, speed of data delivery, etc. This should be done through research activities.	Monitoring matters report p.12s.

4.2 Land monitoring service (GIO Land)

4.2.1 Current situation

The land monitoring service is implementing a portfolio of products at global level (JRC) and at European continental and local level (EEA). The latter focus on both generic land cover datasets covering the full EEA39, such as CLC (CORINE Land Cover) and the thematic High Resolution Layers (HRL), as well as on tailored land cover datasets over dedicated hotspots, such as urban areas (Urban Atlas) or riparian zones. In-situ data for the pan-European and local components of the land monitoring service are mainly needed for 3 steps in the overall production process, i.e.: selection of training areas for classifiers; verification and enhancement of intermediate products, and an independent statistical validation at the end of the production. Reference data is the main type of data required.

The HRL are produced by several consortia from the private industry, which have full responsibility for arranging access to in situ data as part of their production process. In contrary the CLC update is in the hands of the EEA member countries. EEA prepared grants to all its members for a decentralised common production of the GIO land service (the Pan-European component). As part of the grant agreements, countries agreed to provide access to national reference data for the production of the national CLC inventories and HRL when they participate in their verification and/or enhancement. However, national reference data is also required for other Copernicus services. Hence a cross-cutting solution whereby this data can be used for other purposes would benefit the Copernicus programme. The challenge is therefore to gain access to national reference data for at least the service providers involved in the HRL production. At best the data would be offered free of charge to all Copernicus services. This would follow the current Copernicus in-situ approach, according to which in-situ data access is mainly under the responsibility of the Member States.

4.2.2 The GISC approach

GISC investigated to what degree in-situ data provided by the Member States can be used for other Copernicus services by entailing a number of activities for the sustainable development of Copernicus:

- An analysis of the information regarding the access conditions around the GIO land in-situ data sets. This has provided an initial knowledge of what in-situ data is available for GIO Land only and what is available for other Copernicus services or wider use.
- In a second step, GISC analysed the information provided by countries on the availability of data through the GISC country visits.
- A third information input came through the work carried out in relation to the Reference Data Access (RDA) activity. The GMES User Forum had decided in 2011 to investigate the availability of reference data in Member States. This activity includes verifying the status of the data nodes, which are provided by the countries as part of the survey.
- INSPIRE reporting is used as ancillary information when no information is available from the country visits and/or RDA survey.

At the moment of this report, the GISC project has finalised analysing responses from 33 countries and verifying whether it is possible to secure some of the in-situ data relevant for the European component of the GIO Land service as in-kind contribution for other Copernicus services. This work, which was conducted for two data themes, has been done in close co-operation with the technical coordinator of the GIO Land service. As a next step it has to be decided how this analysis can be expanded to more data themes. The final results should allow an evaluation of a decentralised data provision through the countries. The aim hereof is to enable the Copernicus services to access all required data in a satisfying way. When the decentralised approach is continued it is important to explore the experiences of the service providing industry which is until now fully responsible for arranging access to in situ data as part of the service contracts. A decentralised data access should enable all GIO Land stakeholders to benefit from the in situ data provided by the Member States.

4.2.3 Lessons learned and recommendations - for the sustainability of in-situ data provision

The use of grant agreements in getting access to Member State reference data have some advantages for the production of CLC and HRL. Several datasets, which might be owned by different institutions in the countries, are addressed in one single annex. Also, as part of the grant agreements the countries are able to offer their data to other Copernicus services as well.

The analysis conducted within the GISC project applying the approach described above shows that access to in-situ data of countries is increasing. It is assumed that the publication of the results of the analysis will enable the service providers to identify possible data nodes and to use the offered data in the production process.

The conducted work in this QW underlines that a central in-situ coordination unit would be helpful to do such in-depth and complex analysis facilitating the work that for now is done by the technical service coordinators or a service provider in a time consuming way.

Currently, data policies still differ greatly amongst countries. While several countries follow a full, free and open approach, others have restricted license policies including license costs. The various procedures for accessing data within the pan-European land monitoring service are problematic. For example, the voluntary provision of data through Member States leads to only partial coverage of the EEA39 countries, as well as to differences in quality and no clarity on how to access the data. Therefore, the best in-situ solution would be through the INSPIRE directive. This will simplify the identification and sharing of data among public institutions. Until the full implementation of the directive, a two-string approach is the most feasible for some of the required reference datasets. This means that essential data, which is currently unavailable from the majority of Member States, could be centrally developed or acquired for a transition period. When countries have fully implemented the Inspire directive the datasets can be obtained from national institutions.

Land cover changes and their effects on ecosystems are a serious concern in European environmental policy making. A remaining challenge is therefore to streamline all related European activities, e.g. to synchronise LUCAS and GIO Land mapping campaigns to achieve the greatest benefit. Moreover, it should be considered to harmonise European and global activities, e.g. by setting up a common validation site sampling design (i.e. a common stratification schema) providing reference information which could be used on all mapping scales (local to global). The involvement of citizens for land cover validation could be considered as well.

The following table provides suggestions for improved in-situ data provision for the GIO land service:

Land: Recommendations for sustainable in-situ data provision

In-situ needs/requirements	Activities recommended	GISC ref
A. European data access		
Access and availability to geospatial data differ amongst countries.	In the current situation a two-string approach is the most feasible for some of the required reference datasets: Essential data, which is not easily available, could be centrally developed or acquired elsewhere for a transition period. When countries have fully implemented the Inspire directive the datasets can be obtained from national institutions.	D4.3, p. 30 D2.2/2.4, p. 25ss and 55s D3.2, p. 59ss
Land use - cover area frame survey (**LUCAS**)	1) Extend the scope of the EC steering group on land cover information from LUCAS to Copernicus land services. 2) Synchronise activities between LUCAS, which is coordinated by Eurostat, and the Copernicus pan-EU Land service.	Monitoring matters report, p. 12 D3.2, p. 60ss
Ortho-photos/ Very high resolution (VHR) satellite imagery	1) Even if VHR imagery is not considered as in-situ data, it can be used to replace ortho-photos. Such data is often used for the verification of classification results. It is thus recommended to include sub-meter resolution VHR data in the next version of ESA DWH. 2) Such data should be up-to-date. The imagery should at least cover hotspot areas and "ground truth" sites (chipsets) as agreed in the common stratification schema mentioned above.	Monitoring Matters report, p.12
LPIS	Initiate a discussion between DG-AGRI, JRC and Member States in order to facilitate coordinated access to LPIS data.	D2.4, p.30 D3.2, p. 60ss
National wetlands	Coordinate the regular and systematic collection of national wetlands data from European member states. This could be done e.g. through the EIONET.	D2.4, p.30
National grassland	Coordinate the regular and systematic collection of National grassland data from European member states. This could be done e.g. through the EIONET.	D2.4, p.30

National forest inventories	1) Coordinate the regular and systematic collection of forest inventory data from European member states. This could be done e.g. through the EIONET. 2) Publish the inventory results spatially, i.e. aggregate forest plots which serve as source for the inventories.	D2.4, p.29
B. Global data access		
Lack of global data outside Europe (certain data: for radiation, fire data, land surface temperature validation): Some of the data is provided through WMO. However, current data policies allow the data to be used for research only. There is a limited geographic coverage of in-situ observations outside of Europe. Moreover, the sustainability of some observation networks is not guaranteed.	1) An agreement with ECMWF could support the provision of required data for the Global Land component. 2) To increase observation networks in the developing countries a dialogue could be considered with other DGs of the European Commission.	D2.2/2.4, p. 25ss, p. 51 and p. 55s. Monitoring Matters report, p.14
Global, pan-European and local components	A harmonised sampling and monitoring strategy for ground truth sites should be developed according to a schema fitting from global to local scale (see comment about on the common stratification schema)	Monitoring matters report, p.12 D3.2, p. 60ss
C. Utilise Resources – R&D		
Crowdsourcing - R & D activity	Voluntary geographic information has large potential for collecting in-situ information. The Geo-Wiki[25] project is one successful example. It is recommended to explore this potential.	D4.3, p.36, Monitoring Matters report, p.12s.

4.3 Atmosphere service

4.3.1 Current situation

The Monitoring Atmospheric Composition and Climate-service (MACC-II) is the current pre-operational Copernicus atmosphere service. MACC-II monitors the global distributions and long-range transport of greenhouse gases, provides data records on atmospheric composition for recent years and data for monitoring present conditions and forecasts of the distribution of key constituents for a few days ahead.

The challenges faced by the atmosphere service concerning availability and accessibility of in-situ data are linked to the diversity of observing systems providing data at the national, European and global levels as well as the fact that a large number of essential observing infrastructures are set in a research regime. Moreover, certain data are not available at all or in a scattered way (e.g. pollen data, validated UV observations).

MACC II is currently using in-situ observations from three categories of data providers: operational observing systems (e.g. meteorological observations), networks reporting according to European legislation and international conventions (e.g. air quality observations), and global and regional networks primarily built and managed as research infrastructures and thus subject to irregular funding (e.g. aerosol and greenhouse gas observations, which obviously have a much wider use than for the atmosphere service).

[25] http://www.geo-wiki.org/

4.3.2 The GISC approach

Through the 'Air Quality Quick Win', GISC focused on securing better coverage and sustainable provision of near real time air quality observations which are used to produce and validate air quality analyses and forecasts for Europe.

The Air Quality Quick Win set up a single point of access to near real time air quality observations for MACC-II through the EEA/Eionet Airbase. This solution enables MACC-II to focus on the use of the observations rather than acquiring data and managing the data flow. It means that all bilateral arrangements and technical interfaces will eventually be replaced by the single interface to near real time air quality observations collected and managed by Eionet and the EEA.

In addition to the solution for near real time air quality observations for Europe, GISC has also acted to facilitate access to global atmosphere data for Copernicus services from the Norwegian Institute for Air Research (NILU). NILU functions as data centre for data from EMEP, ACTRIS (follow up of EUSAAR and EARLINET) and NDACC.

NILU also operates the World Data Centre for Aerosols under the WMO-GAW programme. In this regard, GISC held two meetings with WMO to discuss access to meteorological data beyond EU-27 coverage and data on atmospheric chemistry (aerosol and ozone data) ensured by Global Atmosphere Watch (GAW) data centres. WMO's general position is that Copernicus, considered as an EU contribution to GEOSS, can have access to data contributed to the WMO.

For what concerns meteorological observations and products, which is needed by all Copernicus services, GISC has worked with EUMETNET to draft a partnership agreement establishing the principles for access to data held by EUMETNET members. The partnership agreement has not been finalised due to uncertainties about the overall governance of the Copernicus programme, but is nevertheless a valid example of a sustainable approach to operational access to in-situ data.

4.3.3 Lessons learned and recommendations for the sustainability of in-situ data provision

The Air Quality Quick Win has demonstrated the strength of establishing partnerships in order to agree on data access conditions and operating procedures for operational service provision. The EEA/Eionet solution comprised in the Air Quality Quick Win is already used by Copernicus downstream services such as obsAIRve, and is expected to be used by other end-users; including other Copernicus services for instance a future Climate Change Service. A general recommendation is therefore to pursue partnership agreements with all essential data providers for the atmosphere service.

The Quick Win has also shown that existing data flows in most cases need some degree of development and re-configuration to take Copernicus requirements into account. Moreover, the technical solutions behind actual data access are not developed swiftly. These processes require time and effort.

In the case of the Air Quality Quick Win, the existing data flow in question (the EEA/Eionet air quality data flow) links up with EU regulatory reporting obligations, which ensures its sustainability. A pointer for future solutions could be to make broader use of existing EU legal reporting frameworks as a basis for requesting additional in-situ data needed by Copernicus.

Many of the data providers delivering information about the composition of the atmosphere rely heavily on research infrastructures or individual research projects and are primarily serving research needs. And in this field, the Copernicus services represent only a few of the overall number of users. Therefore, there are challenges related to the continuity of a wide range of essential data flows for the atmosphere service in an operational constitution, in particular surface CO2 fluxes and profiles of greenhouse gases and other atmospheric chemical species. Moving towards the next phase of Copernicus, it is recommended to take steps to mitigate potential risks of using research infrastructures for operational purposes.

There are also areas where improvements in the underlying observing system and its characteristics (such as timeliness) are required in order to fulfil the atmosphere service product portfolio, for instance as regards validated UV observations. Long term planning and efficient coordination of operational and R&D activities is important in order to make the best use of available funding sources across Europe with the view to closing gaps.

It is considered a priority to optimise the collaboration with the WMO GAW programme which coordinates a large number of relevant observing networks. Partnership agreements with WMO GAW contributing networks such as TCCON, AERONET, BSRN, NOAA ESRL and NDACC should be considered in order to formalise data access arrangements and to support the European components of these networks.

Another lesson learned is that data policies are in many cases targeted towards scientific use. Data policies for priority data flows should therefore be adapted to include use for operational purposes.

Finally, it should be noted that a number of data centres are undertaking important tasks vis-à-vis gathering, coordinating and quality checking atmospheric chemistry observations from multiple networks and individual data providers. Such data centres (e.g. EIONET Airbase, EMEP, EBAS, ACTRIS, ICOS and others) are providing essential in-situ data related activities for the atmosphere service. However, coordination may be needed in order to take full advantage of the data provision.

The following table provides specific suggestions for improved in-situ data provision for the atmosphere service:

Atmosphere: Recommendations for sustainable in-situ data provision

In-situ needs/requirements	Activities recommended	GISC ref
A. Surface air quality (NRT) observations		
Data covering EEA39 are primarily made available via the Eionet and EMEP networks and related NRT activities data distribution systems. It is important to ensure that these distribution systems reach and maintain a service level necessary to meet the requirements of a future operational atmosphere service (including improved timeliness of EMEP validated data)	1) Maintain a well-functioning technical interface between the atmosphere service and EEA/Eionet including operating procedures/SLA (GISC Quick-Win activity). 2) Maintain a strong cooperation with EMEP. No acquisition of data yet, but should be available from NILU as access node for EMEP data. 3) Pursue data access outside Europe. There is a significant scope for better coordination with China, Japan, South-East Asia, USA etc.	D2.2/2.4, p. 37ss D3.2, p. 31ss

B. Greenhouse gas observations		
Sustainability of monitoring of greenhouse gases is limited due to the fact that greenhouse gas measurements are primarily provided via research infrastructures and institutions. At European level current monitoring infrastructures include ICOS, InGOS and NORS (NDACC). Concerning columns and profile observations of greenhouse gases there are issues regarding the coverage and representativeness of some networks at European and global level. Although greenhouse gas modelling is primarily performed in delayed mode, timeliness may be a problem where validated data are concerned.	4) The European funded research infrastructures targeting greenhouse gas observations serve a multitude of purposes. Hence, it is recommended to evaluate the possibility of continuity, or even operational status, and better coverage (e.g. in remote marine areas) from other European funding mechanisms, or as a subject for further dedicated R&D projects (See also Euro-Argo Quick Win in section 4.4.) 5) Ensure that data policies can accommodate operational use of data.	D2.2/2.4, p. 37ss D3.2, p. 31ss
C. Vertical atmosphere profiles (ground based and aircraft measurements)		
Sustainability of vertical profile measurements is limited due to the fact that ozone, aerosol, CO, NOx, CO2 measurements are primarily provided via national research infrastructures and institutions. Existing current monitoring infrastructures include IAGOS, ACTRIS/EARLINET, NILU, NORS and NDACC. The major issue related to ozone sondes in Europe is the lack of sufficient ozone soundings for model validation/assimilation purposes.	1) Evaluate the possibility of continuity, or even operational status, better coverage and timeliness of observations from other European funding mechanisms, or as a subject for further dedicated R&D projects. 2) Ensure that data policies can accommodate operational use of data.	D2.2/2.4, p. 37ss D3.2, p. 31ss
D. Aerosols		
Important initiatives towards implementing NRT services for data on atmospheric aerosol properties have been taken (INSPIRE, EMEP, WIS). Continued support of NRT delivery of observations from current stations is important. Current data providers at European and global level include ACTRIS, EUSAAR/EMEP, AERONET, NDACC, SKYNET, WMO GAW.	1) Evaluate the possibility of pursuing continuity – or event operational status - of observations of the European projects from other European funding mechanisms or as a subject for further dedicated R&D projects. 2) Ensure that data policies can accommodate operational use of data.	D2.2/2.4, p. 37ss D3.2, p. 31ss
E. Pollen data		
EAN does not allow access for the atmosphere service (no one outside the network has access). No observations/data available to meet requirements.	Explore ways of generate data and data delivery to close gaps.	D2.2/2.4, p. 37ss D3.2, p. 31ss and follow-up talks (atmosphere service).
F. Validated UV observations		
Observations of sufficient quantity and quality are not available in a timely manner. The atmosphere service is therefore not able to perform NRT validation of UV products.	Explore ways of generate data and data delivery to close gaps.	D2.2/2.4, p. 37ss D3.2, p. 31ss
G. Global atmosphere columns and profiles from WMO GAW		
The world data centres cover observations of ozone, solar radiation, aerosols, greenhouse gases and reactive gases. Access to NRT to observations (ozone and carbon monoxide) is currently provided by 12 WMO GAW stations. The sustainability of profile and column observations is a major issue due to the fact that the measurements are primarily provided via research infrastructures and institutions. Formal agreements with WMO GAW contributing networks (e.g. TCCON, AERONET, BSRN, NOAA ESRL and NDACC) could be considered to formalise data access arrangements and to support the European components of these networks.	1) Develop a common approach and data policy model that will ensure access to observations from WMO GAW world data centres for operational services. 2) Support the on-going work of WMO GAW regarding improving access to near real time observations, including the work of the WMO GAW expert team on near real time chemical data transfer.	D2.2/2.4, p. 37ss D3.2, p. 31ss

4.4 Marine service

4.4.1 Current situation

The Marine Service, implemented through the MyOcean2 project, has set up services for ocean monitoring and forecasting over the global ocean and European seas. In-situ and satellite observations are routinely assimilated in ocean models to provide in real time or in delayed mode (re-analyses) integrated descriptions and short-term forecasts of the ocean physical and biogeochemical state. A key European added value offered by the marine service is to model off-shore and international waters comprehensively, for which in-situ monitoring of the water column (temperature and salinity) is required. Three key in-situ platforms provide these kinds of variables, each suited to different marine areas and complementing satellite and modelling capacities; namely Argo floats, Gliders, moored and drifting buoys. Argo and buoy data are operationally assimilated in to the marine service.

In addition, global and regional oceanographic observation systems play a significant role in obtaining, distributing and facilitating access to oceanographic data. Such data access is provided extensively by the Global Ocean Observing System (GOOS), and especially the GOOS regional alliances, such as EuroGOOS and the Regional Ocean Observation Systems (ROOSs).

Data is provided to MyOcean2 via different types of observing systems. Some observing systems are designed to provide measurements in a reliable and continuous manner, however others are more directed toward oceanographic research and are relying on the dedication of university scientists and irregular funding. Likewise, data policies may in some cases cover a wide range of user types including the 'operational user', while others are predominantly designed to meet the needs of scientific users. Marine data, especially such which has been collected and archived offline (not real time), is frequently difficult to access.

Today MyOcean2 is handling all aspects of in situ data access and coordination. This is primarily accomplished through the in situ TAC. The distributed in situ TAC is building on key infrastructure elements like the Coriolis data centre, the ROOS's regional portals and SeaDataNet2 i.e. the same data nodes which also constitute the EMODnet physics portal. The in situ TAC has been very successful in the course of the MyOcean project.

4.4.1 The GISC approach

Extensive consultations with core marine stakeholders were carried out via two workshops convened by GISC. The workshops (June 2010 and November 2011) were organised to analyse marine in-situ data requirements, identify corresponding observing systems, exploring existing gaps and to provide recommendations on the sustainability and evolution of the marine in-situ observing system.

The workshop confirmed that data delivered by Euro-Argo is essential for the marine service's capability to deliver services related to forecasts of the global ocean and regional seas. Argo data is also used for validation of satellite data. However, challenges relate to the long-term sustainability of Euro-Argo and its capacity. The same may be concluded for most of the other data sources for the marine service.

As a Quick Win, GISC undertook to demonstrate the steps necessary to prepare for the operational use of European research infrastructures in support of Copernicus using Euro-

Argo as an example. Further, the GISC has focused on sustaining Euro-Argo in the Copernicus data delivery chain also involving the EU Commission level across different DGs. This was addressed via bilateral contacts with DG ENTR, DG RTD and DG MARE as well as via active participation in Copernicus User Forum meetings and in the Expert Group on Marine Research Infrastructures set up by DG RTD in 2010. The main objective of these activities was to highlight the multi-purpose functioning of Euro-Argo in meeting various EU objectives. In this process, DG MARE may come through as a potential long-term (2014-2020) EU funding source for Euro-Argo.

The workshop also stated that the regional implementation of Euro-Argo should be achieved within a Euro-Argo/EuroGOOS coordination framework as ROOS's are significantly involved in the processing of data for Euro-Argo. In order to facilitate the access to data for the Copernicus marine service, GISC held several sessions with EuroGOOS and the chairs of the ROOS's in order to prepare for a partnership agreement with EuroGOOS and specific service level agreements (SLAs) with the ROOS's. The partnership agreement was signed in April 2013. Also, drafts and principles of possible SLAs were discussed.

4.4.2 Lessons learned and recommendations for the sustainability of in-situ data provision

The overall lesson concerns the sustainability of the marine service, which relates to establishing and maintaining partnerships involving Euro-Argo, EuroGOOS and other important infrastructures providing essential data and resources. This is a matter of securing reliable marine data, to align data requirements and to utilise and coordinate existing resources.

A second lesson concerns the number of research infrastructures, incl. ERICs, ESFRI and non-ESFRI projects. These are essential data providers to the marine service (as well as the atmosphere service). As Copernicus moves into full operations, the issue of sustaining these research infrastructures becomes important. Experience shows that research funds are often used to set up infrastructures, however securing financial resources to maintain and operate them is more difficult. While the ERIC mechanism will address various issues regarding governance and technical coordination, sustainable funding mechanisms are not easily secured, as is shown by the case study of the Euro-Argo Quick Win.

The third lesson concerns the global potential. A large number of networks and organisations worldwide are putting significant efforts into consolidating, integrating, and stabilising the observation systems and data management infrastructures. Although these initiatives are not only a response to requirements generated by Copernicus, it is clear that Copernicus will greatly benefit from these initiatives. In some cases they may even be fundamental to the success of the marine service. In this respect, data centres (such as EMODNET, MyOcean In-situ TAC, CORIOLIS, SeaDataNet) are undertaking an important role in gathering, coordinating, and quality controlling observations from multiple networks and individual data providers[26].

The following table provides specific suggestions for improved in-situ data provision for the marine service:

[26] See common recommendations, Chapter 5.

Marine: Recommendations for sustainable in-situ data provision

In-situ needs/requirements	Activities recommended	GISC ref
A. Partnership		
Partnerships between Copernicus and in-situ data providers at the **national** (e.g. NODCs), European (e.g. EuroGOOS), and **global** level (e.g. GOOS, IOC, and JCOMM). There is a need for better coordination for the design and implementation of the global and regional observing systems both by geographical area (global and regional seas) and by component (instrumentation type or more likely measurement types).	1) A European link with international co-ordination bodies (JCOMM, GOOS) should be established especially regarding the European contribution to international observation capacities as well as the access by marine services to datasets collected by non-European operators. It should also include a European participation and contribution to the international JCOMM structure. 2) Enhancing co-ordination of the regional network should be a priority. This means for instance: a) A continuation of the implementation of the partnership agreement of April 2013 between EuroGOOS and the EEA, and the efforts in arranging for a SLA on the access to oceanographic information, if possible by the Copernicus Marine service and/or the future in-situ coordinator. b) A further strengthening of the coordination at European level in co-operation with Member States and ROOSes, as facilitated by EuroGOOS. This could for instance involve the network of Tide gauges and coastal and regional moorings operated by EuroGOOS ROOSs. c) A further focus on collaboration with other projects in order to consolidate data exchange system for EuroGOOS and fill gaps, such as to handle Coastal Real Time data for JERICO, and to work with GROOM to be able to integrate in a sustained manner European Glider data in the Global component of the in-situ TAC.	D2.2/2.4 p. 42ss and 59s. D3.2, p. 46ss
B. Marine data requirements		
Sea surface temperature and salinity Euro-Argo, EuroSITES/FixO3, Ferrybox, Buoys	1) Euro-Argo needs to be consolidated and sustained in its core mission (global array, temperature and salinity) 2) More Argo floats are needed in the Mediterranean, Black Sea, the Nordic Sea and the Arctic to fully cover services' needs and ensure full geographical coverage 3) FerryBox: Currently, there is no formal European coordination for the FerryBox network. Also, further opportunities for partnership with the shipping industry concerning FerryBox should be investigated. 4) Drifting Buoys: additional data could be gathered by adding subsurface sensors and reporting these data (in real-time) 5) FixO3, now integrating EuroSITES, improves access to open ocean fixed point observatories also for the Copernicus marine service.	D2.2/2.4, p. 42ss D3.2, p. 46ss
Sea level Tide gauges	The data contribution trough GLOSS should be further explored as a promising data source.	D2.3. p 59
Sea ice and wind Argo	In the Arctic ice covered seas, where Argo floats cannot ascend to the surface and transmit data, it is necessary to use other techniques such as ice-deployed buoys and under ice floats with acoustic data transmission. Such solutions should be further exploited in order to obtain relevant data from the Arctic.	D2.2/2.4, p. 55
Currents Drifters, Smart Buoys, Argo, EuroSITES/FixO3	Improvements are required for better sampling (e.g. increase European contribution to Argo, EuroSITES/FixO3.	D 2.3, p. 34 and gap analysis from EEA

		workshop June 2010.
Ocean colour (derived chlorophyll) Data from IFREMER water quality observing network.	Improvements are required for better sampling (e.g. increase European contribution to Argo)	Gap analysis from EEA workshop June 2010
Biogeochemical measurements CPR, FerryBox, Gliders, Buoys Ecosystem models are developing in general. However, it is a general observation that biogeochemical data is missing for most sea areas. Also, there is a challenge to quality control data sets in real-time.	1) Data management activities should be improved for core bio-geochemical observations (as a general recommendation). 2) For gliders: develop agreements that will facilitate open and free access to glider data. 3) Drifting Buoys: In order to enhance the flow of data, it is recommended to add subsurface sensors allowing for real-time reporting. 4) Involvement of the Continuous Plankton Recorder (CPR) should be continued. 5) FerryBox could be further developed to meet the requirements of the Copernicus marine service through implementation of new sensors to provide more biogeochemical data. 6) More Argo floats are needed in the Mediterranean, Black Sea, the Nordic Sea and the Arctic to fully cover requirements for data, including biogeochemical variables.	D2.2/2.4, p. 42ss
C. Sustainability		
Lacking sustainability of observations together with coordination and operating costs are the two major issues for the Marine service.	Sustainable solutions are needed. In this respects, DG MARE may come through as a potential long-term (2014-2020) EU funding source for Euro-Argo	D2.2/2.4 p. 53 and 59s D 2.3, p. 34 D3.2, p. 46ss
The relationship between the **research infrastructures** and an operational Copernicus programme is not automatically established. Research infrastructures serve multiple purposes and respond to different EU strategic priorities including Copernicus.	1) Processes and coordination must be put in place to ensure that research infrastructures are recognised as important multipurpose partners and embedded in European/international networks and funding instruments. 2) Create partnership agreements ensuring access to data for Copernicus service products.	D4.3, p. 35. D2.2/2.4, p. 59s.
Climate change research and operational oceanography requirements.	Copernicus services need to evolve to better respond to the needs of climate change research and operational oceanography requirements.	D2.2/2.4, p. 43.
D. Utilise Resources and in-situ coordination		
Data **exchange EMODnet** portal	Connect to the EMODnet portal for near real time data access for some data sets; should be envisaged in the future that both Copernicus marine service and EMODnet can access the same in-situ data within a common platform	D2.2/2.4 p. 42ss D3.2, p. 46ss
The **in-situ TAC** is an essential distributed data management infrastructure for the marine service, and is building on existing infrastructures and initiatives including Coriolis, ROOSes, SeaDataNet, in harmonisation with EMODnet.	1) Ensure the functions of the in-situ TAC for the operational phase of Copernicus post 2014. 2) Sustain the in-situ TAC distributed system to fulfil the needs of both Copernicus marine and downstream services for ROOSs and European countries.	D2.2/2.4 p. 42ss D3.2, p. 46ss

5 Cross-cutting aspects for services – in-situ data provision

In addition to the individual Copernicus services presented in the previous chapter, the GISC experiences also allow for presenting some cross-cutting recommendation with regard to securing data access. This also calls for cross-cutting coordination.

The table below provides cross-service recommendations related to the following categories:

- Different data sharing and license policies.
- Risk of duplication of efforts.
- Sustainability of in-situ observations
- Research projects
- Utilise additional available resources
- ESA collaboration, and
- The need for cross-cutting in-situ coordination and governance

Cross-cutting: Recommendations for sustainable in-situ data provision

In-situ needs/requirements	Activities recommended	GISC ref
A. Different data sharing and license policies		
Different data sharing and license policies exist in the countries ranging from full, free and open access to restricted licenses and license fees. Moreover, different technical solutions are implemented, which make a standard access through web services impossible. Some Member States are reluctant to share data with Copernicus due to lack of clarity on how their data will be used in the framework of the Copernicus data policy. The lack of data is also related to license models which range from a free and open up to restricted commercial access of data with many specific conditions and restrictions in between both. There is no straight forward mechanism to access national data despite existing legal frameworks and initiatives like SEIS and the Inspire.	Different solutions should be discussed: 1) The Inspire process may help establishing the necessary infrastructure to make spatial information from Member States accessible and interoperable. Furthermore, Inspire provides the legal framework enabling the access to national reference data. 2) The development and agreement on a Copernicus data policy framework would be a cross-cutting priority for all services to allow long-term planning. This should include that countries provide full access to their national data. 3) A common technical interface should be provided which allows an easy access to all data from the different countries. Open standards should be followed to allow an easy retrieval of data through the internet.	D4.3, p. 30ss D2.2/2.4, p. 14 and 55. Monitoring Matters report, p. 3s and 19.
Scientific use only Often data policies allow 'scientific use' only – especially in atmosphere and marine services.	Ensure that data policies can accommodate use of data by an operational user, i.e. that the shift from R&D to full operations can be supported.	D2.2/2.4, p. 37ss
B. Risks of duplication of efforts		
Risks of duplication of efforts. Without harmonisation and coordination there is a risk of duplicated efforts. The different services might try to get access to the same type of data from data providers. A common approach and single access point would facilitate the access to data. This issue was also raised by countries during the Monitoring Matters event. Moreover, Member State institutions deliver already many data to networks and due to reporting obligations. It is preferred by the data providers to use these existing data flows instead of creating new ones.	1) Ensure an effective utilisation of resources and data flows based on cross-cutting coordination amongst the data providers and the different Copernicus services. 2) Put in place harmonised agreements improving coordination, data access costs and harmonise data access. 3) Investigate existing legal frameworks for future long term data provision (e.g. Inspire, PSI). 4) Investigate ways and sources to allow data procurement from countries not ready to share data under a free and open licensing model.	D2.2/2.4, p. 52s and 59s. Note 22 March 2013 prepared for GMES Bureau. Monitoring Matters Report, p. 13 and 19s

	5) Follow-up on the dual approach for reducing duplication of efforts[27]. Sustain the in-situ delivery by arranging commitment from national authorities.	
Marine and atmosphere data Both Copernicus Marine and Atmosphere services (and in the future also the Climate service) share to some extent common requirement and thus, need for access to same data.	Data obtained/made available for the marine and/or the atmosphere services need to be made available for other services. The services should made common efforts to identify the specific common requirements, and obtain data access in coordinated manners.	D3.2, p. 31ss, 46ss and 76ss
Meteorological observations – for all services Meteorological observation data are essential for most of the Copernicus services, i.e. Atmosphere, Marine and Global Land (and in the future also the Climate service). Meteorological data such as air pressure, humidity , longwave and shortwave radiation, precipitation, temperature, wind direction and wind speed information are requested and used by all Copernicus services	Conclude partnership agreement with EUMETNET to secure access to meteorological data for all operational services. Through the GISC Quick Win on provision of meteorological data involving EUMETNET, a draft partnership agreement has been prepared in consultation with EUMETNET. It is recommended to formalise the partnership between the meteorological community via dialogue with WMO and EUMETNET and Copernicus to ensure continuous and reliable access to global meteorological observations and products by a data access agreement.	D4.3 p. 16ss D3.4 (overall) D2.2/2.4, p. 25ss, 36 and 57ss. Note 22 March 2013 prepared for GMES Bureau D3.2, p. 76ss
Land and Emergency data - for all services Overlapping requirements exist. Require to some extent same kind of reference data. Currently, different mechanisms are in place to access the data.	1) Align these procedures for Copernicus. This will avoid a duplication of efforts and resources. 2) It should be achieved that essentially required data is provided by all Member States for all Copernicus services.	D2.2/2.4, p. 51 and 55s. D4.3, p. 36ss
Land and Emergency National geospatial reference data. Access to national reference data for the land and emergency services is handled differently, via the GIO land grant and the EEA-EuroGeographics agreement.	1) Sustain the GISC QW implementation by seeking on-going commitment from national authorities. 2) Continue the efforts in concluding and sustaining agreements for access to data sets for Land service. 3) Establish one single agreement with Member State authorities about access to this data for all Copernicus services 4) Evaluate ways to access data at global scale, e.g. through partnerships with international organisations such as WFP, FAO and initiatives like the UN GGIM; 5) Data made accessible for emergency management purposes at JRC also being made available for the land service, if countries agreed. 6) Expand list of shared data to lower priority data, which is not included in the current agreements. 7) Ensure an effective utilisation of resources and data flows based on cross-cutting coordination amongst the data providers and the different Copernicus services. 8) Undertake updating of in-situ requirements according to service evolution processes – regular check and clarification with Land and Emergency services; 9) Initiate access arrangements with countries –	Note of 22 March 2013 prepared for GMES Bureau Monitoring Matters Report, p. 13s

[27] The GISC project developed so called dual approach, which is to engage the countries through the interface of the international commitments that they have already made to existing European or international networks and coordinating bodies. From one side (in dialogue with countries), the GISC project aimed to identify the availability of observational assets, stressing the re-use of existing capacities, making them more multi-purpose, and not to creating new infrastructures, as well as to confirm or where needed to extend the mandate from countries given to the coordinating bodies and to promote the solutions proposed by GISC to the networks. From another side (in dialogue with the coordinating bodies) the objective was to use their coordination mechanisms and expertise in different thematic areas for accessing in-situ data in a sustainable way with the overall goal at concluding partnerships agreements.

	harmonisation of access and use conditions; 10) Define solutions to complement the missing EU datasets.	
Land, climate and marine Observations primarily provided by ICOS and IAGOS (ESFRI research infrastructures) are of relevance for GIO Land (global component), and are also expected to be required by the up-coming Copernicus climate change service (according to expert rapport) and by the Copernicus marine service in support of new products. The observations in question are primarily surface carbon dioxide fluxes (ICOS) and profiles of greenhouse gases and other atmospheric chemical species measured from en route aircrafts (IAGOS).	Ensure long-term availability of observations from the ESFRI research infrastructures ICOS and IAGOS. Euro-Argo QW could be advised here as the solution forward.	D2.2/2.4, p. 57ss. D3.2, p. 76ss
C. Sustainability of in-situ observations		
Sustainability of in-situ observations for Copernicus is crucial. Just because in-situ infrastructures exist does not mean that they are fit for purpose and can provide data in a continuous way. This concerns both national infrastructures and European research infrastructures.	Long term strategies to secure sustainability must be developed and put in place. Such strategies should be based on the recommendations provided by this report.	Monitoring Matters report, p. 3s D3.2 (overall points)
D. Research projects		
Research projects Research infrastructures are vital to Copernicus. In-situ data sources based on research projects and European Research Infrastructures are unsustainable. Research projects have a limited duration. This means that such data is rather unreliable for an operational Copernicus service. The atmosphere and marine services, as well as the coming climate change service, will to a fairly large extend be dependent on in-situ observations provided via research infrastructures.	There is a need to: 1) explore possibilities for cross-institutional funding not only for research projects but in-situ observations in general. 2) develop mechanisms to leverage the outcomes of research infrastructures in order to meet the new and existing requirements of operational Copernicus services, and taking into account the multipurpose nature of research infrastructures. 3) look into data policy issues, especially the ones dealing with “scientific use only” only; 4)streamline the EU initiatives for multi-purpose and multi-use of data; 5) ensure an effective utilization of resources and data flows based on cross-cutting coordination amongst the RIs and the different Copernicus services.	Monitoring Matters report, p. 3s and 19. D2.2/2.4, p. 57ss. D4.3, p. 35. Note 22 March 2013 prepared for GMES Bureau D3.2, p. 12 and 22.
E. Utilise additional available resources		
Data centres are undertaking an important role in gathering, coordinating, and quality controlling atmospheric chemistry observations from multiple networks and individual data providers. The sustainability of these data centres is essential to the Copernicus atmosphere service. Examples of data centres NILU, EMODNET, MyOcean In-situ TAC, CORIOLIS, WMO GAW World Data Centres, SeaDataNet.	1) Ensure and maintain effective links between Copernicus and relevant data centres, as the centres are providing essential observations. The operational phase of Copernicus may take advantage of the GISC efforts undertaken in ensuring partnership and good relationships to such data centres. 2) The sustainability requires a successful hand-over process from the GISC project to the Copernicus operational phase 2014 and beyond.	D2.2/2.4, p. 57ss D3.2, p. 76ss
Volunteered geographic information (crowdsourcing) is a potential in-situ data source in geospatial data collection.	1) It should be explored how reliable such data is in terms of availability, timeliness and fitness for purpose as input to Copernicus services. 2) It should be explored how far the use of citizens as sensors and the combination of crowd sourced and citizen science data with definitive mapping and cadastre information can be used for Copernicus. 3) To ensure quality products, harmonisation efforts are needed as Copernicus moves into the full operations phase.	Monitoring Matters report, p. 3s and 12. D4.3, p. 36
Public private partnerships have a significant potential to set-up monitoring networks, to operate and to maintain them.	Opportunities for public private partnerships should be explored. Already today the private industry is active in in-situ observations and related services, such as private meteorological services and ferry boxes. Besides, private	D4.3, p. 36

	stakeholders could be involved in the deployment, operations and maintenance of in-situ observing systems.	
F. ESA collaboration		
ESA collaboration In-situ data is essential for Calibration/Validation activities of ESA	Collaborate with ESA to ensure that ESA and Copernicus services have harmonised and coordinated access to in-situ data.	Monitoring Matters report, p. 3s and 13s.
Cross-cutting in-situ coordination is needed. Space agencies are addressing in-situ issues such as data availability and best practice/protocols through bodies such as the Ground-Segment Coordination Body, the Cal/Val Infrastructure Working Group and the Cal/Val working group of the Committee on Earth Observation Satellites.	Closer coordination for ESA and Copernicus is needed when it comes to in-situ needs, also as activities increases as part of the Sentinel era	Monitoring Matters report, p. 14.
G. In-situ coordination and governance		
In-situ governance – sustaining the service evolution process.	Copernicus services and in-situ coordinators may apply the following steps based on generic management principles involving plan-do-act-revise: Step 1: Planning, strategy and work program Step 2: Defining in-situ needs and requirements Step 3: Prioritisation of needs and access Step 4: Obtaining data Step 5: Enabling data access for end-users Step 6: Maintaining and up-dating of data access and data requirements	D3.2 p. 80ss and Annex B
Current solutions do not cover cross-cutting requirements. The GISC Quick Win activities show that the coordination of in-situ data access is beneficial to the services and data providers. Such coordination can improve access to in-situ data largely. As it is a long-lasting effort, in-situ coordination does not happen automatically – and it takes time!	Cross-coordination, possibly as a coordinating entity, could support the in-situ activities of all Copernicus services. It could also support the space component for which the availability of in-situ data for Cal/Val activities is essential. Besides, the cross-coordinator could support: a) Align with EU policy objectives and overall Copernicus strategy and work plan. b) Anchor to EU process and development in general, such as the overall implementation of SEIS and Inspire, development of Copernicus, and to provide overall support to the services and to the Commission. c) Introduce common best practises, standards and policies, facilitating data policies to better meet Copernicus requirements, and issuing guidelines and recommendations concerning data access standards d) Coordinate common in situ data gateways and data nodes being data centre or portal that makes data e) Assist in maintaining common inventories of in situ data requirements, solutions, and providers. This will allow for efficient information and risk management across all Copernicus services, e.g. what will be the effect of changes (coverage, quality, timeliness, etc.) how many services and products will be affected? f) Support in preparing for long-term plans and proposals targeting both national and EU level funding options in collaboration with the technical coordinators, in particular as concerns general cross-cutting issues. This shall also involve R&D activities and research infrastructure projects; g) Facilitate Copernicus input regarding in situ data to relevant EU level initiatives such as INSPIRE, SEIS, EMODnet, and re-use of public information;	Monitoring Matters report, p. 19. D4.3, p. 36. D3.2 p. 80ss and Annex A and Annex B.

Ensure data flow by framework infrastructures based on **data gateways and selected data nodes,**	Copernicus services and in-situ coordinators may: a. Facilitate data-access gateway(s) based on data nodes. b. Design, propose and implement technical and institutional frameworks. This also involves the technical requirements regarding the interoperability of systems. c. Care-take the in situ data gateways providing continuous and reliable access to in situ data for GMES from in situ data providers via the selected data nodes being data centre or portal that makes data. d. By doing so, also support the SEIS development.	D3.2, p. 26ss, p. 32ss (atmosphere), p. 48ss (marine), p. 61ss (land) and p. 70ss (emergency). See also Annexes A and D
Networks and intergovernmental organisations Organisations and networks are making important contributions to the in-situ observation infrastructure. Coordination activities are needed in order to take advantage of the many on-going initiatives and approaches concerning developing and implementing standards, best practices and strategies. The examples of accessing air quality data through the Eionet, reference data through support of EuroGeographics and meteorological data through EUMETNET underline the importance of involving existing networks and intergovernmental organisations in the in-situ data provision. Such interaction is likely to create a win-win situation and ensure benefit for Copernicus and also for the data providing networks.	<u>Copernicus should:</u> 1) Become an active partner in these networks and intergovernmental organisations. These networks have the relevant links to national member organisations and data nodes are often in place to access the data of their members centrally. 2) Assure that these organisations and networks e.g. WMO (and contributing networks), EUMETNET, Eionet, and EMEP are regularly informed about the Copernicus service's requirements for in-situ data and the expected evolution of these requirements. 3) Builds on and supports activities which are proposed by the organisations and networks and which enable the Copernicus services to meet end user requirements	D2.2/2.4, p. 57ss D3.2, p. 76ss D4.3, p. 36ss
There is a **potential among European coordinating bodies and networks** to facilitate access to in-situ data. They are able to take up significant coordination responsibilities targeting Copernicus needs for in-situ data.	Such potential could be taken into account in the operational phase of Copernicus, and would require in-situ coordination.	Monitoring Matters report, p. 3s and 19. D3.2, p. 76ss and 80ss.
Global data Copernicus services need **access to global data**. Global data is necessary to underpin the world-wide reach of the services' product portfolio.	As recommended above, improve international cooperation such as with the GEO and other organisations to encourage their members to share in situ data.	D4.3, p. 36. Monitoring Matters report, p. 3s. D3.2, Chapter 4 and 5.