



Copernicus In Situ Component

State of Play Reports Summary: Progress and Actions

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Introduction

The Reports on the State of Play of the provision of In Situ data for the Copernicus Services¹, are a key step in the current phase of the European Environment Agency's (EEA) work to improve the provision of In Situ data for Copernicus Services.² The analysis examines the position on a service by services basis, including a description of main achievements, cross-cutting gaps, challenges and risks, and the expected evolution of the In Situ Component. Strong messages emerge about the importance of further progress in understanding and documenting requirements, in exchanging information, in improving access to datasets, and in promoting awareness.

The Copernicus programme is very successful and many high quality Copernicus Data and Information products are being extensively used by the end users. In situ data constitute part of the foundation for Copernicus' success and an enormous amount of essential in situ data is already being made available by data providers and used by the Copernicus services and the Space Component. However, it is clear that the value to users of the existing product portfolios of the Copernicus Services can be significantly enhanced if issues critical to the provision of In Situ data are successfully addressed. **Above all there is a need to build stronger partnerships and to seek engagement across a wide community.**

Background

In Situ data are essential for an effective Service component, for product generation, calibration and validation. **The enormous potential of satellite imagery cannot be realised without ground truth and the complementary use of In Situ data**, which are required to develop and improve processing algorithms, to improve satellite and derived information with measurements of known accuracy, to provide corrections, and to provide final products that most closely match user needs. A lack of adequate In Situ data can result in products that are poorly characterised, suffer from inconsistencies and, thus are not eligible for validation. **Absent or insufficient In Situ data can result in delays to product delivery, more effort expended during production and lower quality.**

Framework and approach of the Reports

The EEA is mandated under its 2014 agreement with the European Commission to coordinate the Copernicus In Situ Component – maintaining an overview of the state of play, managing the provision of cross-cutting In Situ data and managing partnerships with data providers. A key element of this mandate is to report on the State of Play. The reports aim to provide a coherent overview of the status of the Copernicus In Situ component, future perspectives and challenges.

The reports focus respectively on Spatial **Reference Data** and **Observational data**

The enquiry is structured around the following steps:

1. **Building the baseline:** the baseline of In Situ data currently used or required by the Copernicus services, based on preliminary desk research and existing knowledge and experience.
2. **Validating the baseline:** through direct interaction with the Entrusted Entities of the Copernicus Services.

¹ Published in December 2017, at <https://insitu.copernicus.eu/library/reports/>

² Copernicus encompasses three components: Space, Services and In Situ. The Copernicus Regulation defines 'in situ data' as observation data from ground-, sea- or air-borne sensors, as well as reference and ancillary data licensed or provided for use in Copernicus, and specifies that the Member States' In Situ infrastructures are essential contributions to Copernicus.

3. **Assessing the gaps:** the validated baseline has been used to identify gaps in meeting In Situ data requirements, and to prioritise them.
4. **Proposing actionable recommendations.**
5. **Monitoring In Situ data evolution:** the availability of in situ datasets will be monitored, with a view to updating the gap analysis and the requirements database based on the latest releases of relevant datasets and progress in arrangements with data providers and other stakeholders.

The State of play is analysed in terms of the characteristics of the In Situ data sets used by the Copernicus Services, broadly:

- Level of detail (scale/resolution)
- Quality and data format (including INSPIRE compliance)
- Space and time coverage
- Timeliness and update frequency
- Accessibility – both data policy aspects and logistics
- Sustainability

The reports are built on very detailed discussion with the Service providers and entrusted entities and on the Factsheets compiled in 2017 relating to individual Service components.

Findings and proposed actions

The conclusions of the two reports were discussed with the Copernicus Services at the In Situ Data Coordination Workshop in November 2017. It is important to see the conclusions in the light of Copernicus' success. Copernicus is delivering excellent Data and Information products to the end users based on and validated by use of in situ data delivered by data providers at national, European, and global level. Notwithstanding this important fact, as indicated above, it is common ground that the value to users of the existing product portfolios of the Copernicus Services can be significantly enhanced if issues critical to the provision of In Situ data are successfully addressed. It has of course been evident from the start that many players need to be engaged in actions to improve the availability of in situ data required by the Copernicus Services, and the findings emphasise this.

The reports, and follow up work, generated a wide range of findings and recommendations. The following paragraphs seek to bring together under 5 headings, the key findings and the actions taken, in relation to cross-cutting requirements and activities.

It is important to underline that the predominant part of Copernicus' in situ data activities are carried out by the Copernicus Services, ESA and EUMETSAT. These are not covered here, but information relating to the individual Services, ESA, and EUMETSAT can be found in Copernicus In Situ Evolution Workshop Document, available [here](#).

I. PARTNERSHIPS WITH DATA PROVIDERS

The delivery chain between data providers and users can be complex, with multiple frameworks and networks for collecting and publishing local, national and regional scale data, coupled with a wide variety of commercial and non-commercial access agreements. With a couple of exceptions these arrangements are not designed to meet Copernicus requirements and dealing with them can be complex. **The international nature of many networks also leads to the need for a coordinated common approach across Copernicus itself and where the EU represents Copernicus' interests.**

The main objectives in the light of this finding are to:

- **Reduce complexity** through better exploitation of agreements between Copernicus and European and international partners, promoting data sharing, standardisation/ harmonisation and common access agreements to improve access to in situ data for and across Copernicus;
- **Create efficient interfaces** to enable practical access to data, and cohesion with external data networks and depositories; and
- **Build trusting relationships** and highlight mutual benefits or 'quid pro quo' scenarios.

Key Action Areas identified, and their status, are:

(1) Analyse the potential benefits of, and identify suitable entry points for, effective engagement with international organisations, particularly WMO and GOOS/IOC; and with UN-GGIM and GEO/GEOSS.

WMO engagement analysis is in progress. The current top priority is dialogue with the WMO Integrated Global Observing System (WIGOS). Initial meetings were held March 2018. An analysis of engagement with UN-GGIM and UN-GGIM Europe, FAO, and GEO/GEOSS is foreseen for the second half of 2018.

(2) The International Cooperation Arrangements between Copernicus and non-EU countries should be explored to the maximum to ensure availability and delivery of essential in situ data to Copernicus

A Technical Operating Agreement (TOA) has been signed with GeoScience Australia under the umbrella of the Cooperating Arrangement between Australia and the European Commission. Similarly, on the basis of the recently signed Cooperating Arrangements, the EEA will prepare and implement TOAs with India, Colombia, Chile and Brazil with the purpose of establishing links with relevant data providers and owners, and making essential in situ data available to the Copernicus DIASs and Copernicus services, e.g. air quality observations requested by the Copernicus Atmosphere Monitoring Service.

(3) Build partnership with EuroGeographics and its members with a view to improving Copernicus' access to European geospatial data and services.

A new partnership agreement between EuroGeographics and the EEA was signed March 2017. Users of Copernicus services are set to benefit from a new partnership which improves access to pan-European maps and land information from official sources. The Agreement signals a commitment to make more national authoritative geospatial information available through Copernicus.

The partnership agreement has five main objectives:

- To improve Copernicus access to EuroGeographics data and services, produced using official geospatial data from its members.
- To enhance the dialogue between Copernicus and EuroGeographics members.
- To foster knowledge exchange between Copernicus and EuroGeographics members.
- To promote awareness raising activities.
- To support initiatives to provide pan-European harmonised data services.
- To facilitate coordination and communication between the two organisations,

EuroGeographics has established dedicated knowledge exchange network to share expertise and experiences.

The Agreement provides the framework for bilateral agreements between the EEA and individual Eurogeographics' members that are required to make specific data available to the Copernicus Emergency Management Service. Currently, bilateral agreements with 24 members have been signed and implemented.

(4) Build a partnership with EUMETNET and prepare a licensing agreement covering the Copernicus Services' use of meteorological, climatological, and hydrological data owned by EUMETNET members.

The license agreement between EUMETNET and EEA was signed in December 2017. The Agreement constitutes an important and significant contribution to the Copernicus programme. Stable and sustainable delivery of essential up-to-date and historical information on weather and climate from EUMETNET members are now available to all Copernicus services. The Agreement was made possible through the successful cooperation between EUMETNET and the EEA. It demonstrates EUMETNET's strong commitment to the Copernicus programme and is an excellent example of how crosscutting coordination can bring benefit to the Copernicus programme. Copernicus services can reuse all the data produced by EUMETNET members for their own purposes, free of charge. The only limitations are attribution of ownership and proper licensing with data owners in case of redistribution of such data. The EUMETNET data will benefit several Copernicus services, with the first, immediate users being the CS3 (Climate Service), the CAMS (Atmosphere Service) and the CEMS (Emergency Management Service). The agreement should be recognised as a best practice of efficiency because it establishes a single interface access for the Copernicus Service operators to use meteorological, hydrological and climatological data and products from EUMETNET in the routine production of the Copernicus Services.

(5) Update the partnership agreement with EuroGeoSurveys

An agreement was signed by the EEA and EuroGeoSurveys in October 2016. The general objective of this agreement is to secure a long-term cooperation in integrating environmental and geo-scientific data, information and knowledge. The specific objectives are to secure awareness and commitment to the provision and use of data released through EuroGeoSurveys and capacities by EEA, the wider Environmental expert community, Copernicus services and public. The objective is to promote appropriate use of geological data and knowledge in the whole spectrum of environmental issues. The Agreement emphasises that the parties shall join their expertise to improve access and use conditions of in situ data for the Copernicus services, in particular as regards landslides, subsidence, and minerals and mining monitoring which could support a future European Ground Motion Service.

II. ACCESS TO MORE, BETTER AND SUSTAINABLE IN SITU DATA

Real, open and free data exchange is far from a reality but should be a long-term aspiration. There is a need to address data policies and define agreements to implement data sharing measures and simplify or harmonise data access conditions. In the short-term and in certain cases, the focus will be on ensuring the quality of the in situ data and on making essential in situ data freely available for Copernicus internal use, i.e. for production and validation.

The Services, conscious of the potential of developments such as the new agreement with EUMETNET, wish to implement these as effectively as possible and may need further support to facilitate the flow of data that they need.

A lot of importance is attached to the implementation of the INSPIRE Directive and its promotion among institutional and commercial data providers. INSPIRE clearly contributes to the ease of managing EU28

National datasets because of standard implementing procedures, and Copernicus should benefit from this. Moreover, vice-versa, the MS (implementing INSPIRE) can also benefit from the use of EO data to improve/update their reference datasets – see the example by a National Road Authority.³

The needs of the Copernicus Services should be considered in the context of a broader data-gathering framework and reflected in EU and global information initiatives. Potential value also lies in exploiting synergies with instruments such as Horizon 2020, EMODnet, and with European Research Infrastructures which are important for the provision of key datasets and whose role needs to be consolidated.

The main objectives in the light of this finding are to:

- **Increase the number of open and free data sets** available to and sharable across Copernicus;
- **Ensure that the EEA-EUMETNET licensing agreement is effectively implemented** for the benefit of the Services and that potential benefits are realised;
- Promote the use and availability of **INSPIRE** compliant data sets;
- Secure benefits where possible from projects under **Horizon 2020 and European Open Science Cloud (EOSC)** relevant to the provision of cross-cutting in situ data to Copernicus;
- Improve understanding of in situ data issues surrounding Research Infrastructures relevant to Copernicus and how to deal with them;
- **Identify solutions to key sustainability issues** relating to in situ data networks or sensors important to Copernicus (services).

Key Action Areas identified, and their status, are:

(1) Undertake a study of in situ data delivery options, and develop targeted approach strategies and recommendations for ways forward

This work has been launched with a kick-off meeting in March 2018.

(2) Support the Services in the implementation and review of the EEA-EUMETNET licensing agreement

Being pursued in ongoing dialogue with the Services.

(3) Explore the scope to promote greater use of INSPIRE compliant data by the Copernicus Services

The Copernicus Reference Data Access portal (CORDA) provides access to Spatial Reference Data from European data providers, including openly available Land Parcel Information System datasets, INSPIRE compliant datasets. The timely implementation of INSPIRE by Member States is of paramount importance to Copernicus. Harmonised INSPIRE Annex I datasets will gradually be made available via CORDA, starting with Administrative Units and Transport Networks. First analyses regarding Administrative Units suggest that some effort is needed before these data can be combined into a complete and harmonised EU dataset as required by the Copernicus services. Consequently, a closer dialogue with the INSPIRE community and fora will be pursued, e.g. during the 2018 INSPIRE conference. It is expected that the coming Copernicus programme level digital elevation model will be made available through CORDA.

(4) Explore the development of specific datasets meeting cross-cutting requirements, starting with the Settlements theme

³http://www.efgs.info/wp-content/uploads/conferences/efgs/2016/S6-4_presentationV3_OlaNordbeck_EFGS2016.pdf

A thematic study on the available information about settlements (overview of the existing datasets, identification of gaps, and proposed actions to fill them) is underway, with completion expected by end-May. This will include a survey of private sector datasets relevant to the study. Information about settlements is considered a key requirement by the Copernicus Emergency Management Service.

(5) Mapping and engagement with EU-level initiatives (e.g. H2020, Open Science Cloud) to identify where there may be value to Copernicus (e.g. to help close gaps or develop access to data) and recommendations for ways forward to realise benefits.

A project is underway, with dialogue currently taking place with a number of H2020/EOSC projects.

(6) Undertake an assessment of the issues around Research Infrastructures and how to deal with them, including possible responses to their heterogeneous approaches to delivery, Criticalities for Copernicus services, Data policy and attribution issues, and Potential improved funding mechanisms

An initial assessment report was produced in December 2017, available on insitu.copernicus.eu.

European Research Infrastructures (who are part of the ENVRI Community) provide critical data to Copernicus services, in particular CMEMS and CAMS, but C3S is also supposed to require data from RIs in the future. Likewise the Copernicus Space Component needs high quality in situ data to do CAL/VAL activities, and some of these are delivered through RIs as well.

Key findings:

- Sustainability and robustness of data provision schemes are key to the users. It is important to address these issues whenever implementing data provision contracts with Copernicus;
- While the general organization of RIs are not supported by Copernicus, it is clear that it is important to evaluate the feasibility of Copernicus Service funding contribution to the maintenance of specific services of European Research Infrastructures;
- The level of awareness of requirements from the Copernicus Services are low with respect to the Research Infrastructures consulted. A joint meeting of the Research Infrastructures and the Copernicus Services should be considered;
- Three RIs in the atmospheric domain have established strong links with CAMS but without strong interactions between the 3. Better share of knowledge and good practice is recommended.

Further work will build on this to identify ways forward.

(7) Undertake a survey of risks to the sustainability of important datasets (e.g. observation networks and crowd sourcing initiatives such as OpenStreetMap) and develop a report to underpin and inform further supportive actions

A survey has recently concluded, which has gathered information regarding the sustainability of in situ observation data sources. A report will be published following analysis of the responses.

(8) Analyse the potential of the European Location Services (ELS) to support Copernicus' in situ data requirements

Evaluation of the current ELS platform in terms of accessibility (i.e. timeliness and technical constraints) and data model (i.e. harmonized data model) is under way. The use cases investigated are provided by the Copernicus Emergency Management Service. This work should be completed by end-May.

III. EXCHANGE OF KNOWLEDGE AND DATA BETWEEN AND WITHIN COPERNICUS COMPONENTS

The different Copernicus Services face differing issues in accessing In Situ data; some for example have well-established arrangements with data providers, while others have a partial view of the cross-cutting potential of In Situ or have not fully explored yet the potential of the effective use of In Situ data and information. Where in situ data are utilised there may be scope for technical refinement to make better use of them; for example, in the Observations domain to improve prediction skills and reduce uncertainties in Copernicus forecast models; and for Spatial Data to develop improved data integration and flow mechanisms.

The main objectives in the light of this finding are to:

- **Support information exchange** between the Services on efficient approaches and instruments, and on the potential value that can be added to products through effective utilisation of In Situ data;
- Understand the technical benefits and scope for Copernicus to contribute to an **integrated observing system**; and
- Understand synergies between **Space and In Situ** components, to promote dialogue and supportive future alignment; and consider possible synergies with work on User Uptake.

Key Action Areas identified, and their status, are:

(1) With the Copernicus Services and the Copernicus Space Component, assess the potential, appetite for and value of facilitating meetings, workshops and analysis delivered through mapping and the development of the Copernicus In Situ Information System (CIS²).

This work will primarily build upon the development of CIS² and the outcome of the continued dialogue between the EEA and the Copernicus Services, ESA and EUMETSAT.

(2) In dialogue with the Copernicus Space Component, explore synergies between the future needs of the Copernicus space component and the In Situ component, promoting dialogue between space providers and the Services; and explore the scope to integrate and align the requirements of Future Sentinels with In Situ requirements; in particular, analyse the contribution of Copernicus In Situ to an integrated carbon monitoring system.

An initial report has been published December 2017, available on insitu.copernicus.eu, and due for update in April 2018.

The report provides an initial overview of the in situ data usage for the Copernicus Space Component, the Sentinel missions and covers the thematic domains of meteorology, oceanography, atmospheric chemistry and air Quality and climate and consequently Sentinel -3, -4, -5p, -5, -6, -7.

The usage of in situ data for the Copernicus Space Component (CSC) is split in four parts: Calibration verification; indirect verification of on-board calibration through assimilation of in-situ observations; product validation (level-2 and higher-level products); and indirect usage through assimilation.

Key findings:

- A key requirement of the CSC is that in-situ data used directly for calibration verification and product validation can be considered of Fiducial Reference Measurement (FRM) quality. FRM is a suite of independent, fully characterized, and traceable ground measurements that follow the guidelines initially outlined by the GEO/CEOS Quality Assurance framework for Earth Observation (QA4EO);

- Due to the lack of global coordinating mechanisms for most in situ observations, a variety of data access agreements and mechanisms have to be used by the CSC to address all of the above categories, leading to system complexity and potentially decreased efficiency and quality;
- Several observing systems relevant to the CSC are provided by non-sustained funding mechanisms, and this remains a significant concern.

IV. DOCUMENTATION OF THE COPERNICUS IN SITU COMPONENT

More work is required to clearly define the issues described in the State of Play Reports and link these to relevant Copernicus data and information products through detailed requirement mapping. This should be delivered through the development and implementation of the Copernicus In Situ Information System (CIS²), a core EEA led In Situ Component activity.

The objective in the light of this finding is to **continue to improve the detail and accuracy of statements of requirement in a transparent and standardised manner.**

The Key Action Area identified, and its status is:

Action needs to focus on close interaction between the Services, the EEA and its contractors on mapping and defining clear requirements for in situ data to develop exemplary repository of in situ requirements.

CIS² has been designed and implemented. Work is underway to populate CIS²; a first version will be made available to the Services for review in April 2018.

V. STAKEHOLDER AWARENESS

The importance of improved and structured communication is widely recognised, both between the Services and between Services and data providers, including through workshops and conferences. The services have a key role in developing a strong narrative in support of an improved In Situ component.

The key objective is to **improve data providers' understanding of Copernicus' in situ data requirements and their willingness to contribute through awareness raising.**

The Key Action Area identified, and its status is:

Alongside ongoing communication efforts (website, newsletters, factsheets...) EEA and its contractors to facilitate and support high-profile events.

The Evolution of the Copernicus In Situ Component is the core of discussion at the 25 April Workshop; support to occasional meetings (e.g. the EOOS forum) is continuing, and further discussions are planned with key European and International data provider networks such as EUMETNET, Eurogeographics, WMO, FAO, UN-GGIM/UN-GGIM Europe, and GEO.