

2020-2022 GEO Work Programme

Copernicus Climate Change Service (C3S)

1. Executive Summary

The Copernicus Climate Change Service (C3S), one of the six core Services of the Copernicus Programme has become operational in 2018. During (2019 and 2020) C3S service elements will be consolidated to serve better needs from the users in demand of (past present and future) climate information. Users include policy makers, intermediaries and scientists. The work programme of C3S beyond 2021 will seek enhanced continuity and will depend upon the wider programmatic elements of the future Multi-Financial Framework of the European Commission and in particular the future Space regulation.

2. Purpose

Copernicus is the European Union (EU) flagship programme for monitoring the Earth's environment using space and in-situ observations. Copernicus delivers operational data and information services on a range of topical areas. Based upon these baseline services, many other value-added products can be tailored to more specific public, policy or commercial needs.

Copernicus includes six core thematic services: Atmosphere monitoring, Land Monitoring, Marine Environment Monitoring, Emergency Management, Security and **Climate Change**. The Atmosphere Monitoring Service includes monitoring for air quality and UV forecasts at global and European level, greenhouse gases, climate forcing and emissions. The Land Monitoring Service includes the monitoring for water management, agriculture and food security, land-use change, forest monitoring, soil quality, urban planning and natural protection services. The Marine Environment Monitoring Service includes the monitoring for marine safety and transport, oil-spill detection, water quality, ocean forecasting and the polar environment. The Emergency Management Service supports mitigating the effects of natural and manmade disasters such as floods, forest fires and earthquakes and contribute to humanitarian aid exercises. The Security supports peace-keeping efforts, maritime surveillance and border control. Last but not least, the **Climate Change Service (C3S)** cuts across all the above themes and is about providing authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide.

One key and probably unique feature of the Copernicus programme is that Copernicus products including the information services provided are freely and openly accessible to users.

The **Copernicus Climate Change Service (C3S)** routinely monitors and analyses more than 20 ECVs to build a global picture of our climate, from the past to the future, as well as developing customisable climate indicators for relevant economic sectors, such as energy, water management, agriculture, insurance, health....

C3S is developed and operated in a way that complements the established range of meteorological and environmental services that are operated nationally. The strong involvement of current service providers and relevant academic communities ensures that C3S fully benefits from existing infrastructure and knowledge. It also ensures that the Service is implemented consistently with the EU principles of complementarity and subsidiarity. The service elements for C3S are procured by means of competitive Invitations To Tender (ITT), and delivered by about 200 companies and organisations across Europe.

In a nutshell, the portfolio of C3S consists of:

- Observation collection and processing. This includes data rescue activities, access to reference networks, access to climate archive, and high resolution

- datasets over Europe. This also includes satellite reprocessing for climate reanalyses
- Observational gridded products. This includes climate data records providing information for 22 Essential Climate Variable products
 - Global Climate Reanalyses
 - Regional Climate Reanalyses
 - Multi-model seasonal forecasts (current providers: ECMWF, Meteo-France, UKMO, DWD, CMCC)
 - Access to global and regional (over Europe) climate projections
 - Sectoral Information System: A series of end-to-end demonstrators as well as operational production of climate impact indicators in the area of a number of economic sectors: Energy, Water management, Tourism, Insurance, Agriculture, Health, etc.

3. Background and Previous Achievements

2018 has been a critical year for C3S. The Delegation Agreement with the European Commission, which kick-started C3S, was signed in November 2014. After 3 years of development and pre-operational preparation, C3S migrated from a concept into an operational Service during 2018. In particular, Europe's Climate Data Store (CDS), has been launched in June 2018. The CDS is a one-stop-shop for past, present and future climate information. The CDS greatly improves access to climate data and tools, is open and free for all to use, and will change the ways in which society can benefit from Earth observations and climate science.

The CDS is a cloud-based tool that allows policy-makers, businesses and scientists to browse and combine online petabytes of raw data, build their own applications, maps and graphs online in real time, and access all relevant climate information at the push of a button.

The CDS includes a toolbox enabling users to build their own web-based apps, and to analyse, monitor and predict changes in climate drivers – such as surface temperature and soil moisture – and their impact on business sectors such as energy, water management or tourism. Transforming data into climate-related information is therefore key added value of the Climate Data Store.

At the time of writing, the CDS has already 8200 registered users having downloaded more than 3 Pbytes of data and products.

The other highlights of the year 2018 have been the systematic production of monthly climate bulletins on the C3S website and in partnership with Euronews, as well as the publication of the first European State of the Climate 2017 (published in April 2018), compiled by the Copernicus Services at the European Centre for Medium-Range Weather Forecasts (ECMWF), C3S and the Atmosphere Monitoring Service (AMS), with some support from the Marine Environment Monitoring Service. This report is available at <https://climate.copernicus.eu/CopernicusESC> and covers two main themes: The Climate in 2017 and Headline Climate Indicators.

C3S is now contributing routinely to the WMO State of the Climate, as well as the GCOS climate indicators portal.

4. Key Activities

The current Delegation Agreement signed between ECMWF and the European Commission covers the period November 2014 until December 2020. Some provisions have been made to ensure operations of the Service until mid 2021 or so. This means that the current GEO work programme 2020-2022 goes beyond the current arrangement with the European

Commission and we will report here only what activities are envisaged until the end of 2020 (assuming continuity 6 months into 2021).

As C3S has just become “operational”, much effort during 2019 and 2020 will be dedicated to the consolidation of the Service, in many aspects:

- Inclusion of additional climate datasets into the Climate Data Store
- Continuation of production of climate data records for climate monitoring, including from global and regional reanalyses
- Development of an optimal environment for downstream applications and use cases on the Climate Data Store toolbox in a wide variety of economic sectors (energy, agriculture, water, tourism, shipping, insurance, health, biodiversity, disaster risk reduction, etc.)
- Ramp up of the Quality Assurance mechanisms and processes to ensure authoritativeness of the Service
- Full deployment of a training strategy, including an ambitious train-the-trainer programme, focused towards Europe but also supporting third countries and programmes in need of climate information for their own services.
- More generally, improvement of the quality of Service: User support, performance of the CDS, documentation.

New prototype service elements will be engaged in 2019 and consolidated in 2020, corresponding to an important demand by the user community: An Attribution Service element, as well as a decadal (5-10 year) prediction element.

5. Relationship to GEO Engagement Priorities and to other Work Programme Activities

By making this information freely available to users, the C3S supports the United Nations Sustainable Development Goals (SDGs), is an operational response to the Global Climate Observing System (GCOS) requirements, and an important resource to GEO and the Global Framework for Climate Services (GFCS). By providing a wealth of quality assured climate data and use cases, C3S is a resource for initiatives such as EUROGEOSS.

6. Governance

The governance of C3S follows the Delegation Agreement signed between ECMWF and the European Commission. C3S is an operational programme, scientifically audited by an Expert Panel, and scrutinised by the European Union Copernicus Committee and its User Forum.

7. Data Policy

C3S follows the Copernicus Programme Data Policy. Currently, The Regulation requires Copernicus data and information to be made available on a full, open and free of charge basis, subject to limitations concerning registration, dissemination formats, and access restrictions.

8. Annexes:

1. Brief CV of Project Leaders

Jean-Noël Thépaut: Head of the Copernicus Climate Change Service

Dr. Jean-Noël Thépaut is the Head of the Copernicus Climate Change Service (C3S) and Deputy Director of Copernicus Services at the European Centre for Medium-Range Weather Forecasts (ECMWF). C3S is a core Copernicus Service operated by ECMWF on behalf of the European Union. C3S combines observations of the climate system with the latest science to develop authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide.

Prior to this role he was the Head Data Division and Deputy Director of the Research Department at European Centre for Medium-Range Weather Forecasts (ECMWF) where his section developed world-class data assimilation algorithms for Numerical Weather Prediction, the exploitation of satellite observations from operational and research Earth Observation platforms, and the development and production of state-of-the-art climate re-analyses.

Jean-Noël Thépaut is “Ingénieur Général des Ponts, des Eaux et des Forêts” and graduated from the French National School of Meteorology. He received his PhD from PARIS-VI University in 1992 in the field of atmospheric data assimilation. He was also involved in the early development of the variational data assimilation systems at ECMWF and Météo-France.

Jean-Noël has served on a number of Committees, including the EUMETSAT Mission Expert Team for Meteosat Third Generation and EPS Second Generation, the NASA Global Modeling and Assimilation Office Advisory Board and the ESA Earth's Science Advisory Committee (ESAC). He is currently co-chair of the World Climate Research Programme Data Advisory Council.

Jean-Noël Thépaut is the GEO Point of Contact at ECMWF.