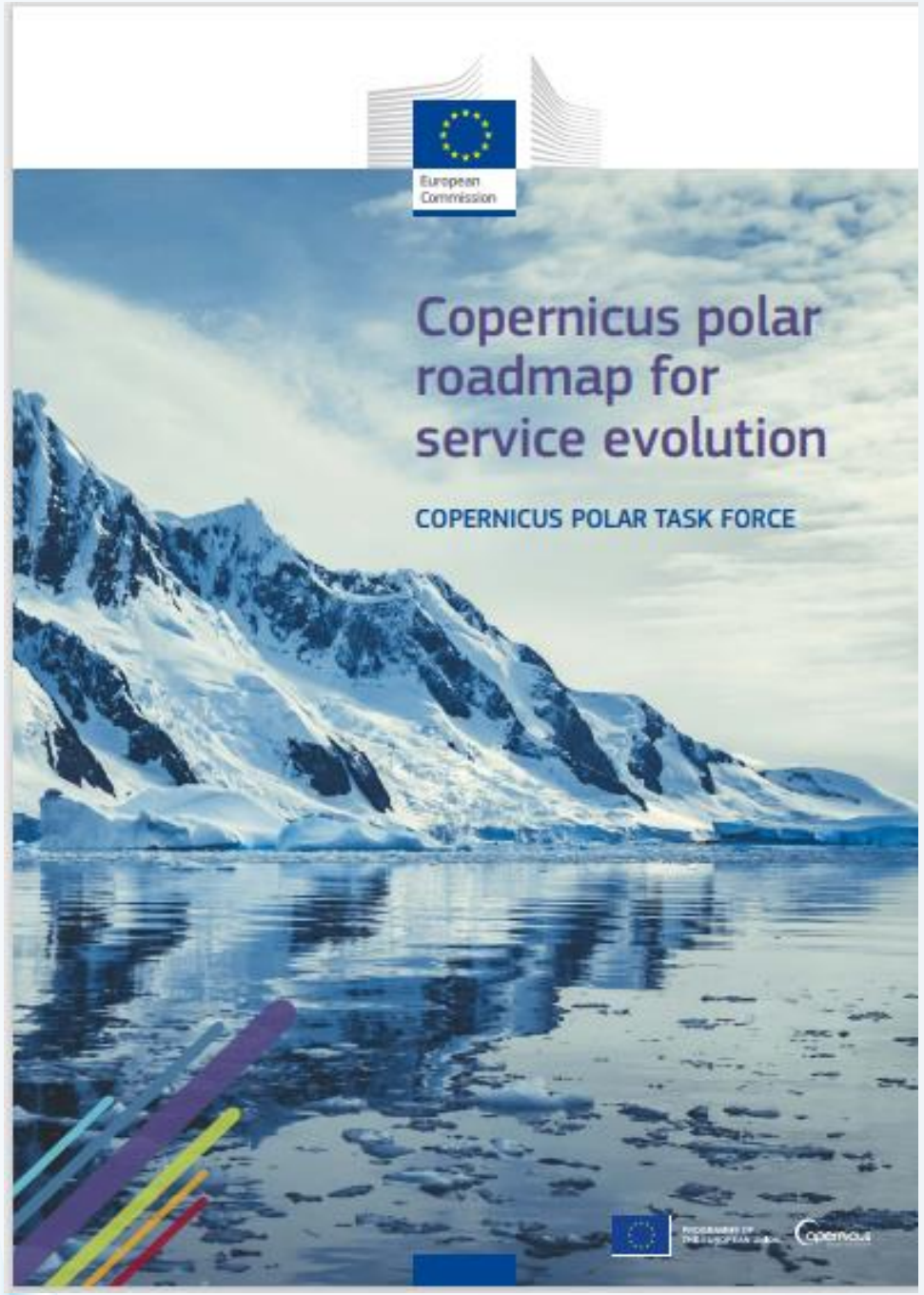

Copernicus Polar Roadmap for Service Evolution

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European Commission | Copernicus Europe's eyes on Earth

Background

The updated EU Arctic Strategy from 2021 highlights Earth observation as a suitable tool for policy implementation

Take the Polar Expert Group (I, II and III) recommendations into the Copernicus Services

Harmonise Copernicus Service (and product) development in the polar domain, supported by sufficient in-situ data

Copernicus Polar Roadmap for Service Evolution

- Product of the Copernicus Polar Task Force
- Published as a joint DEFIS-JRC policy document August 2024
- Input from user survey issued fall 2023, PEG III report, bilateral meetings, conferences, documentation from Copernicus Services, KEPLER recommendations, ++

The roadmap serves three main purposes:

- Make recommendations to Copernicus Services and management
- Inform our users on strategic development
- Define Copernicus Services' role in the polar domain

High-level recommendations and remarks for the next 5-10 years

- Continuity and contingency (avoid observation gaps)
- Enhanced in-situ capabilities
- Uptake of suitable third-party missions
- Cross-cutting activities, e.g. iceberg forecasting (CSS – CMEMS – C3S)
- Improve harmonisation across the Copernicus Services and thematic hubs
- Provide labelled data for machine learning & establish a Task Force on AI/ML
- Strengthen international collaboration, and connection to relevant entities
- Improve the connection to ESA CCI and Horizon projects
- **Extending the Copernicus Arctic Hub into a Polar Hub**
- **Copernicus data to remain free and open**

Copernicus Service evolution

- Recommendations for improved products, e.g:
  - Improved sea-ice models (Marine Service)
    - Examples of products: sea ice age, melt ponds, albedo, snow thickness, detection of leads
  - Include burned area in wildfire monitoring (CAMS)
- Recommendations for new products, e.g:
  - Iceberg forecasting (CMEMS/CEMS), avalanche monitoring (CLM)
  - Provide regional reanalysis for Antarctica (C3S)
- Recommendations for Service management, e.g:
  - Provide polar projection maps
  - Consider an OceanPredict initiative/task team for Polar Oceans (CMEMS)
  - Cloud-based tools to avoid need to download in remote areas (CLMS)

Copernicus Marine Service

Recommendations build mainly on Kepler, which are largely supported by user survey, divided in three categories:

1) Improved observational products

- propose a roadmap at European level to put in place a permanent and well-maintained in-situ sea ice repository designed for operational applications.

2) Model and assimilation enhancements (identified by CMEMS and endorsed by the PTF)

- Provide uncertainties in polar remote sensing data and model output products

3) Enhanced product lines from forecasting and reanalysis

- Moving towards an ensemble/probabilistic forecasting capacity with extended (monthly) range forecasts

Copernicus Climate Change Service

Overall user demand for continuity and long time-series

- provide additional cryospheric parameters related to sea ice, ice sheets and glaciers; Address gaps in observing and modelling sea ice thickness
- improve consistency between different reanalysis products and provide closed energy and water budgets for the polar regions
- provide seasonal forecasts of biogeochemical variables
- Develop a regional reanalysis for Antarctica
- dedicated efforts to improve consistency of climate datasets and products across land, ocean and atmosphere;

Copernicus Atmosphere Monitoring Service

Improvement of most current products (except Ozone layer), no requests for additional products. Specific recommendations on the wildfire, black carbon and methane products include:

- Regular updates of vegetation, peat, and permafrost maps.
- Include Black Carbon deposition on the ground in reanalysis
- Recommendations to the GHG emissions monitoring service currently under development in CAMS, e.g. improving polar coverage
- Inclusion of MethaneSat and MERLIN data (when available)

Copernicus Emergency Management Service

Recommendations include:

- Timely availability of ortho-imagery accessible through direct download
- Pre-event imagery not older than 2y
- Expanding the availability of DEMs on a pan-arctic scale
- Make DEMs accessible through direct dowload

Copernicus Land Monitoring Service

CLMS in general does not cover Polar regions very well (above 66N), and many global products have poorer resolution or insufficient layers in boreal/arctic regions

Specific recommendations include:

- Uptake of mature ESA CCI products into the service (e.g. permafrost)
- Include coastal zones and protected areas in the Arctic regions
- Evaluate and harmonise existing datasets
- Develop landslide/slope failure and avalanche monitoring
- Make cloud computing processing tools available for users
- **Extend the EGMS to all Arctic regions and to cryosphere (incl. Antarctica)**

Cross-cutting topics

Antarctica: list of products to be extended to include Antarctica, or to be developed

Permafrost: CLMS (and later C3S) to take up data from ESA CCI_Permafrost phase 1 now, and from phase 2 after validation

Outreach: specific suggestions to increase user uptake in and for polar regions, e.g. Use Cases with local needs, and cloud-based tools

User requirements on key products/physical variables over Antarctica to be provided by Copernicus (order does not indicate priority):

1. Ice sheet velocity
2. Grounding line location
3. Inland ice discharge/mass flux
4. Mass balance products (e.g. input output method (IOM) and elevation change)
5. Crevasse fields
6. Calving front position/inland ice extent
7. Front retreat rates
8. Iceberg size (volume) and drift
9. Surface melt extent
10. Supraglacial lake location and size
11. Sea ice thickness
12. Snow thickness on sea ice
13. Sea ice concentration
14. Sea ice extent
15. Sea ice drift
16. Flooded sea ice datasets (time series)
17. Altimeter-based tides
18. Snow cover over ice-free land
19. Snow thickness over ice-free land
20. Albedo
21. Spectral reflectance
22. Surface temperature (for all surface types, including sea, permafrost)
23. Vegetation datasets (time series with highest spatial resolution)
24. Terrain deformation datasets (extension of EGMS)

Observations

The roadmap focuses mainly on the Copernicus Services and In Situ Component, but to reflect the responses from the user survey, some general recommendations on Sentinel development are included:

- Continuity and contingency (especially a concern on SAR acquisition)
- Complete geographical coverage of Polar Regions

The roadmap identifies three general issues for polar observations: 1) lack of data; 2) information bottlenecks; 3) interoperability, and gives general recommendations for measures to take. These put emphasis on strengthening collaboration, both politic and scientific, national and international, and between public and private entities.

Further, some specific recommendations include:

- Use the international Polar Year in 2032 for coordinated in-situ data collection
- Link in-situ mapping service to the Polar Hub
- Encourage use of citizen science
- Make use of highly elliptical orbit (HEO) missions (e.g. collaboration with Canada)
- Detailed recommendations on the topics of Sea ice and terrestrial ice, Atmosphere and ocean, and Land systems

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Thank you

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