

# KEPLER

## Improving the capacity of Copernicus for the Polar Regions

Key Environmental monitoring for Polar Latitudes and European Readiness

<https://kepler-polar.eu/>

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### Background

KEPLER is a multi-partner initiative, built around the operational European Ice Services and Copernicus information providers, to prepare a road map for Copernicus to deliver an improved European capacity for monitoring and forecasting the Polar Regions.

The marine environment in the Polar Regions is changing; with this comes both challenges and opportunities. Earth Observation (EO) has a key role to play in the sustainable development of the region, and the information services provided must be flexible to respond to the changing needs and conditions. Importantly they must provide much needed information for Arctic peoples and wider society, science, private sector and decision makers.

Our motivation is to put the public and stakeholders at the centre of Copernicus. This follows the recommendations of the 'Copernicus User Uptake' review, and its 4 themes of:

- Opening up of new Arctic sea routes
- Increased access to natural resources
- Development of new fisheries
- Easier access to tourism in the polar regions
- Specialised environmental monitoring



Copernicus, along with the KEPLER road map, are part of the solution to ensure increased European take-up of these opportunities.

### WP1 Stakeholder needs and network coordination

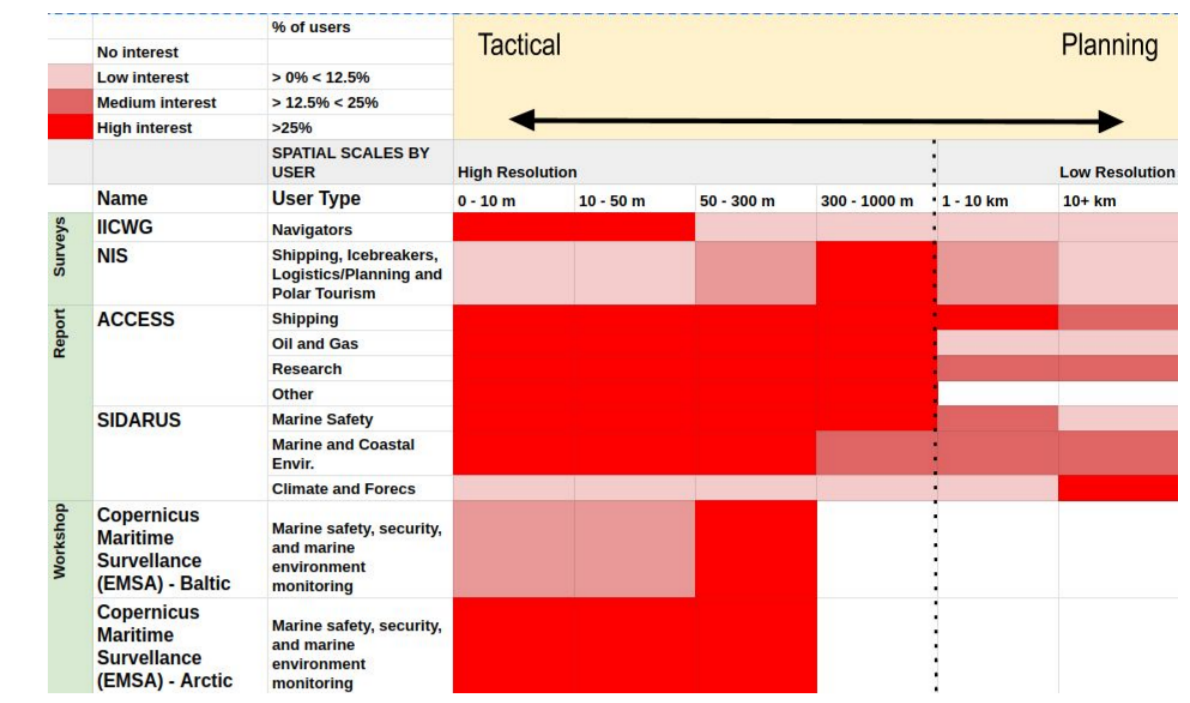
Central to KEPLER that the needs of users are taken into account

Covered a range of groups:

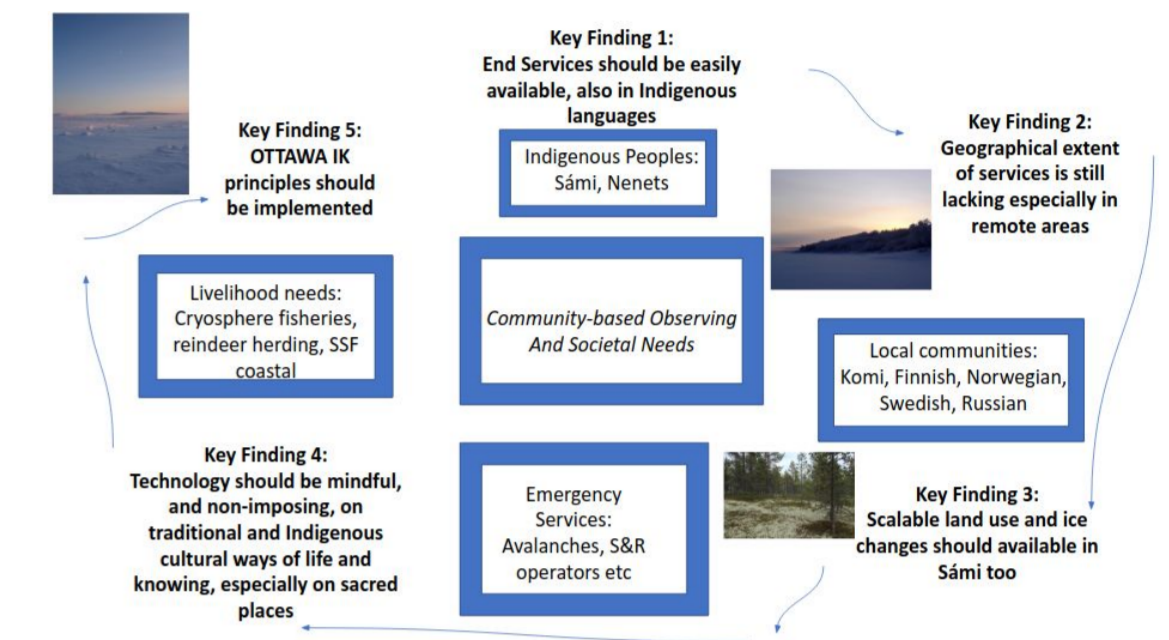
- Maritime and research sector needs
- Community-based observing and societal needs
- Climate and weather forecasting needs

#### Key findings

- Maritime sector needs are stable over past 10-15 years, repeated polling is not yielding the desired improvements to information products
  - There is a **clear gap** in definitions and terminology between the maritime end-users and data providers.
  - Many end-users were **unaware** of the range of metocean services available.
- Access to high-latitude communications remains an issue (both on land and at sea), particularly with increasing data volumes
- Overall need is for high spatial resolution information products, with timely delivery, and in familiar data formats (not NetCDF)

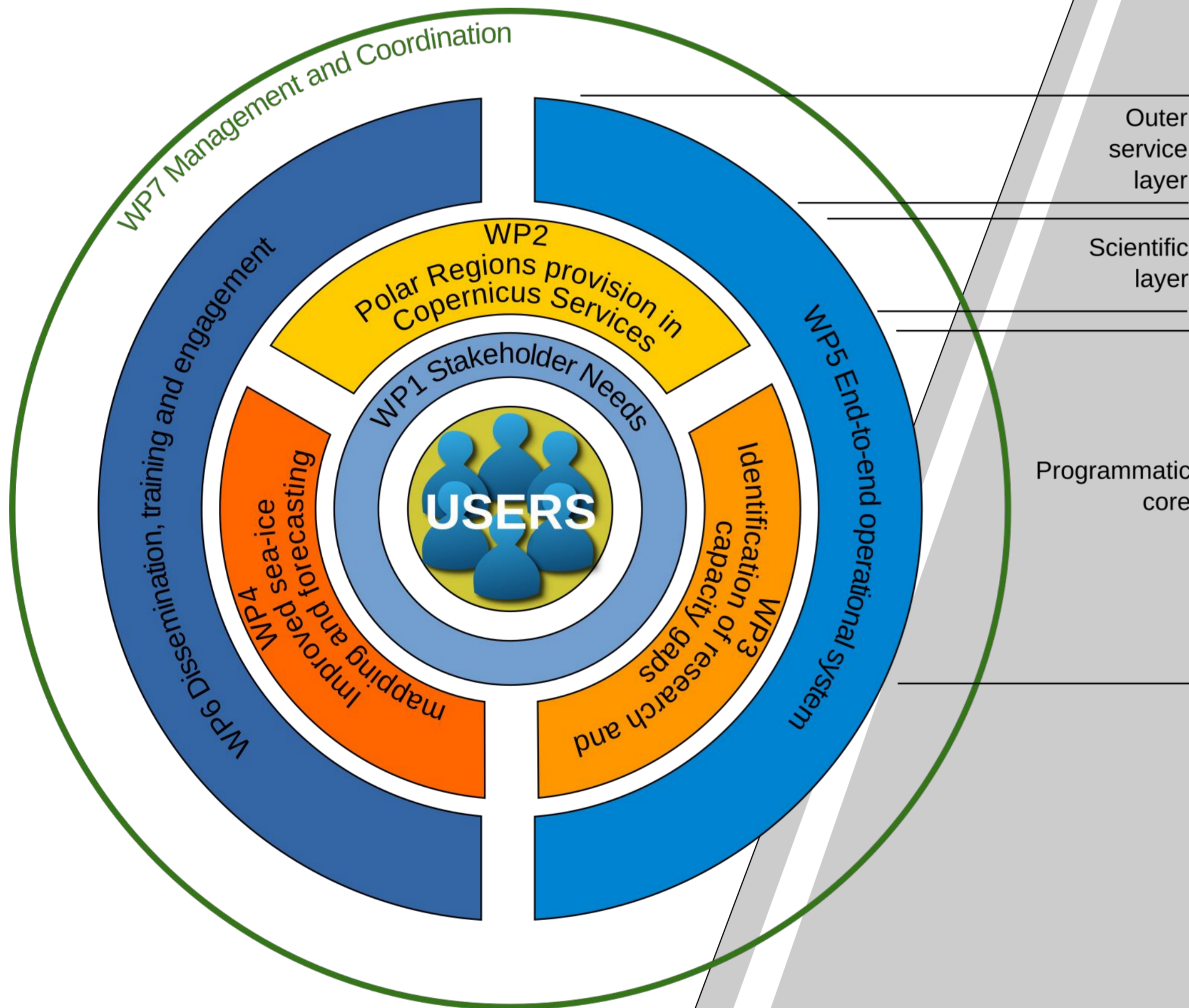


List of reports, Summary of user requirements surveys and reports, key parameters assessed, and their conclusions on spatial resolution according to tactical and planning timescales [\[Link to full spreadsheet\]](#)



### WP2 Polar Regions provision in Copernicus Services

- A **comprehensive and detailed description** of the Land and Marine Copernicus services is assessed in two distinct tasks
  - This description takes into account all the components of what is meant by "service"
- A **detailed list of parameters** is given in the CLMS and CMEMS catalogue
- A current state of CLMS and CMEMS polar product users has then been established



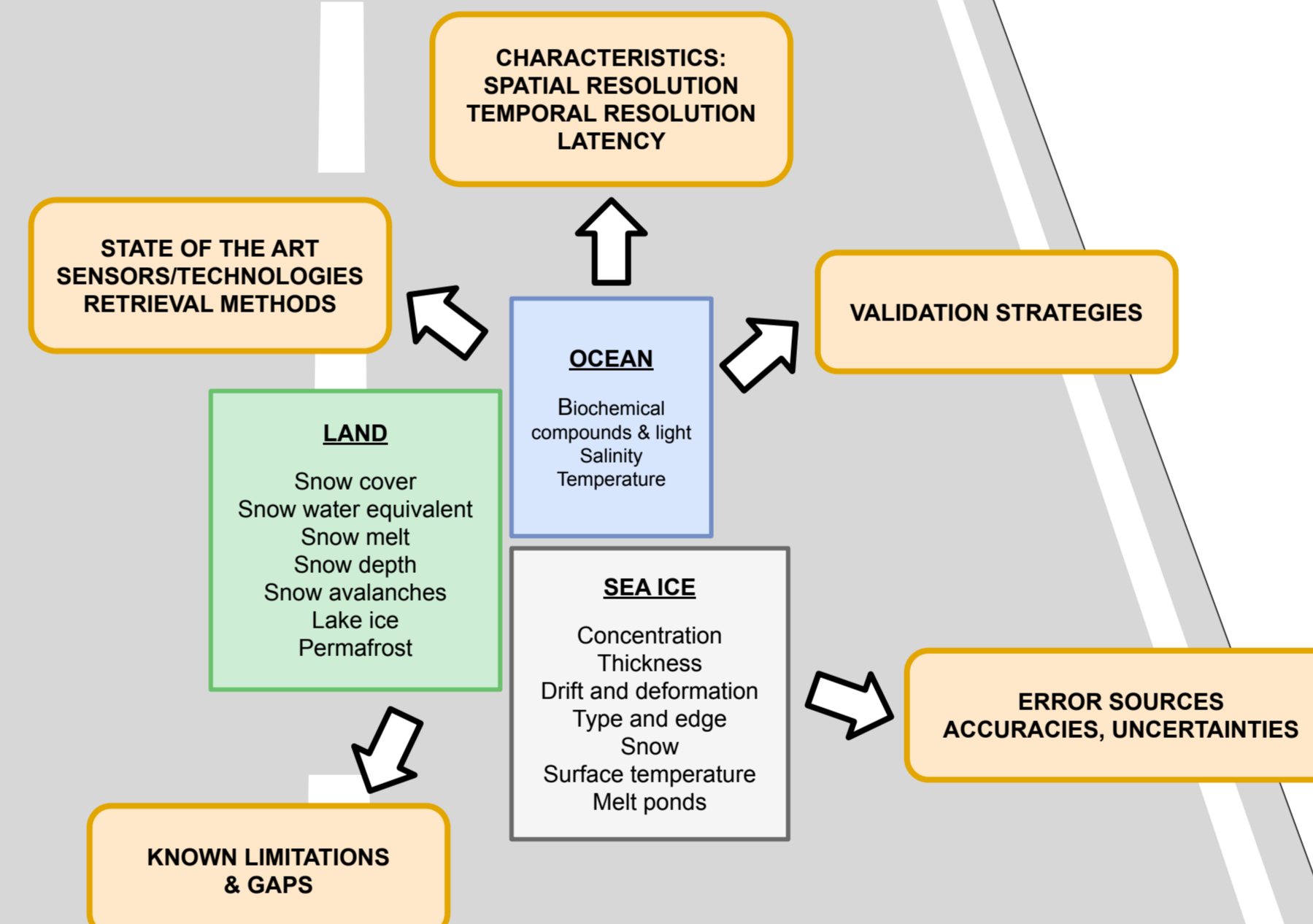
KEPLER Work Packages

### WP3 Identification of research and capacity gaps

- In situ observing systems including Citizen Science
- New and novel in-situ and airborne observation sensors and techniques
- Space-based capability
- Integration and assimilation through Quantitative Network Design (QND)

Space-based capability task is key to assessing Earth Observation (EO) capacity and what is needed based on the input from users in WP1. Culminated in [a 184-page report, D3.3](#)

Other tasks in WP3 identify the requirements for ground-truth and determining the effect of implementing different options



#### Key Findings for EO Capacity

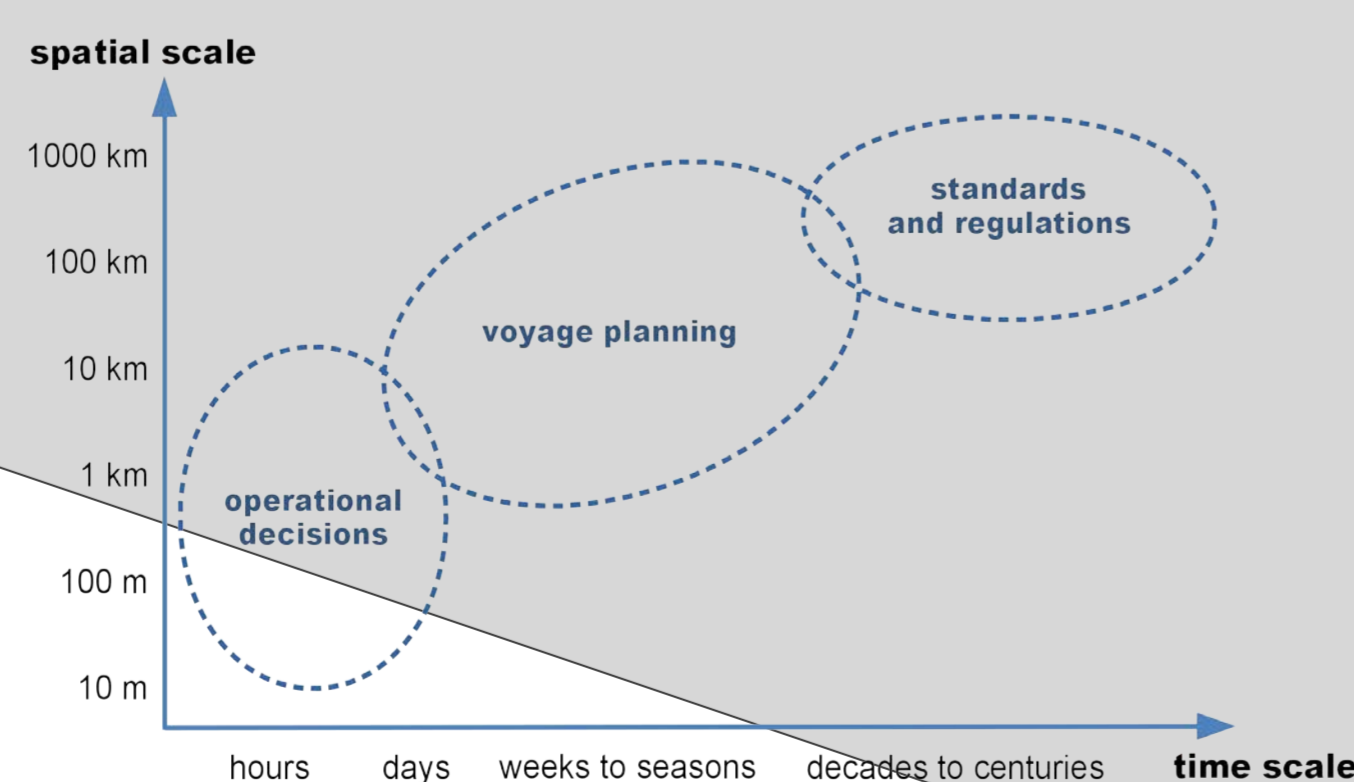
- Analysis of current satellite acquired variables
- Identified 14 remotely sensed parameters which are not currently being served in Copernicus
  - Recommendation for the future evolution of Copernicus Services.
- List of parameters which can be acquired with future missions
  - Special focus on the High Priority Candidate Missions (HPCMs) missions: CIMR, CRISTAL, ROSE-L
  - These have great potential for monitoring of the Polar Regions

#### Key Findings for Supporting EO

- **Need more dialogue** between the broader European polar research and monitoring community, and the Copernicus Services (and associated TACs)
  - This in turn **impacts the quality of Copernicus polar products and services**
  - 7 recommendations with a focus on **quality control** and **utilization of the wider community** to provide cal/val and **independent assessment** of Copernicus Services output
- Copernicus should make a greater effort to **highlight and grow the number of Citizen Science projects** using or validating their products
  - One Copernicus Service, or most likely Copernicus In Situ Component, is encouraged to take ownership/stewardship of CS needs and interaction

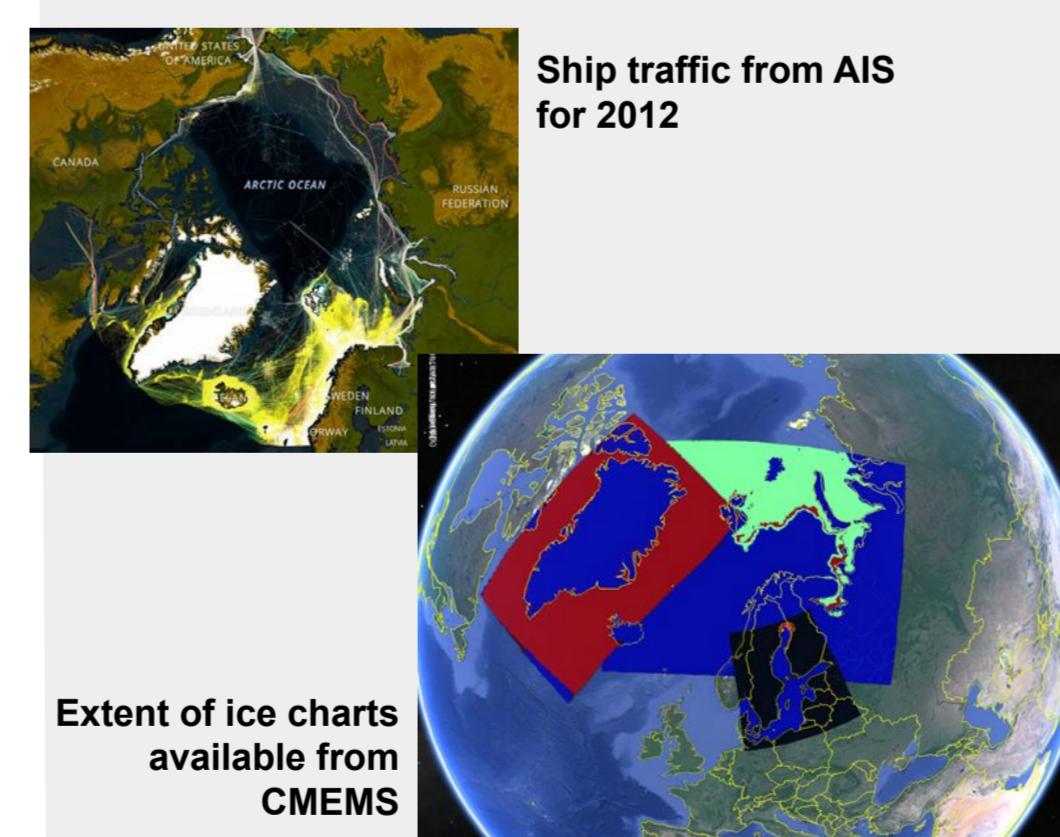
### WP4 Improved sea-ice mapping and forecasting

- Covers requirements at different spatial/temporal scales
- Need for further harmonization of sea ice mapping products
- Improved coordination of a complex landscape of Essential Climate Variable (ECV) suppliers
- Increased forecast spatial resolution and more study of forecast quality



#### Snapshot from Task 1

Contrasting ship routes with ice chart availability



Illustrates the need for harmonization of ice mapping products to have a pan-Arctic service for ships traversing different regions

#### Snapshot from Task 2

The landscape of sea-ice ECV producers/providers



Illustrates the complex workflow from raw observations to user-relevant products, and potential to optimize coordination between space agencies, Copernicus providers and other institutes

### WP5 End-to-end operational system roadmap

- Synthesise the requirements collected in WP1 and the analyses provided by WPs 2-4 into a roadmap for the implementation of an end-to-end operational system
- Will cover all components of that system
  - the observing system (both in situ and spaceborne addressing requirements and gaps in data frequency and latency, and data handling capabilities)
  - designed to support needs such as monitoring of climate change, waste/pollution management, safe and efficient navigation in ice infested waters and facilitate the shift towards a low carbon economy.
  - suggest strategies to close gaps in our current modelling capabilities and ways to develop and sustain the observing system.