Arctic Observing Systems – Challenges, New opportunities and Integration

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By

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Building an integrated Arctic Observing System

Need to collect, process and disseminate data from
• Ocean,
• Atmosphere,
• Cryosphere and
• Terrestrial themes

Involve a wide range of data-providing institutions
A variety of instruments and platforms should be used
Links to socio-economic and other types of data
Main challenges in building Arctic observing systems

• Define the scope of different systems (sensors, platforms, thematic area, operational usage, etc)
• Connect existing systems, which are usually discipline-oriented (or regionally defined or user defined)
• How to best identify and fill major gaps in the observing systems
• Establish Pan-Arctic agreements and collaboration between countries and transnational organisations
• Engage industry and stakeholders
• Resolve legal issues, ownership and rights of usage
• Cost and funding plan
Copernicus consists of a complex set of systems which collect data from multiple sources: earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors. It processes these data and provides users with reliable and up-to-date information through a set of services related to environmental and security issues.
The services support a wide range of applications, including:

- environment protection,
- management of urban areas,
- regional and local planning,
- agriculture,
- forestry,
- fisheries,
- health,
- transport,
- climate change,
- sustainable development,
- civil protection and
- tourism

### Copernicus dedicated satellite missions

(3-line free and open data policy)

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Mission</th>
<th>Details</th>
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<tbody>
<tr>
<td>Sentinel-1 (A/B)</td>
<td>SAR imaging</td>
<td>All weather, day/night applications, interferometry</td>
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<tr>
<td>Sentinel-2 (A/B)</td>
<td>Multi-spectral imaging</td>
<td>Land applications: urban, forest, agriculture,… Continuity of Landsat, SPOT</td>
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<tr>
<td>Sentinel-3 (A/B)</td>
<td>Ocean and global land monitoring</td>
<td>Wide-swath ocean color, vegetation, sea/land surface temperature, altimetry</td>
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<td>Sentinel-4 (A/B)</td>
<td>Geostationary atmospheric monitoring</td>
<td>Atmospheric composition monitoring, trans-boundary pollution</td>
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<td>Sentinel-5 precursor/ Sentinel-5 (A/B)</td>
<td>Low-orbit atmospheric monitoring</td>
<td>Atmospheric composition monitoring</td>
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<tr>
<td>Jason-CS (A/B)</td>
<td>Low inclination Altimetry</td>
<td>Sea-level, wave height and marine wind speed</td>
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Polar orbiting satellites: key to observe the Arctic

CryoSat-2: 2010 - present
Instruments and platforms for ocean observations
Arctic ROOS data portal for in situ data
(NRT in situ data: under development by IMR)

Data from last 30 days,
Updated 30 May 2016

3 ITPs transmit CTD
data on 30.05 2016

http://arctic-roos.org
Airborne observing systems

Electromagnetic induction instrument for ice thickness measurements

Ref. C. Haas, AWI
Sea ice freeboard and draft from airborne EM surveys

Ref. C. Haas, AWI
Detailed mapping of sea ice underside with 2D sonar

The GAIVA autosub equipped with Geoacoustics Geoswath Plus 500 MHz multibeam echosounder has been used to map the underside of the ice (ref. Peter Wadhams et al.)
Multipurpose Acoustic Networks in the Arctic
- coupled with oceanographic moorings and drifting ITPs

The Fram Strait acoustic system: developed since 2008

A future underwater acoustic network – GPS for floats and gliders, listening system, and to measure averaged temperature and current (Mikhalevsky, et al. 2015)
Ocean temperature in Fram Strait from acoustic travel time data

Blue: Temperature from acoustics
Red: Temperature from ocean model
Future: international collaboration to build an Arctic – cabled system

Develop an implementation plan – first two nodes.

For example, the first nodes could be in the Beaufort Sea off the North Slope of Alaska or coordinated with the Svalbard Integrated Earth Observing System in Fram Strait.
Collaboration Japan-Norway

- Earth Observation data: develop products and services from Sentinel and JAXA data
- In situ observing platforms and sensors: technology development, testing and deployment during field expeditions (Session TECH)
- Data dissemination, archiving and sharing of data from EO and in situ instruments
- Training and education of young scientists (Session EDU)