

Norwegian Space Activities

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What is SIOS?

SIOS

- One of 44 proposals in the 2008 roadmap of the European Strategy Forum on Research Infrastructures (ESFRI)
- Establish an (Arctic) Earth System Observing Facility on and around Svalbard that covers meteorological, geophysical, hydrological, cryospheric and biological processes from a set of platforms matching Earth System models (ESM).
- Establish a first important node in the envisaged Sustained Arctic Observing Network (SAON).

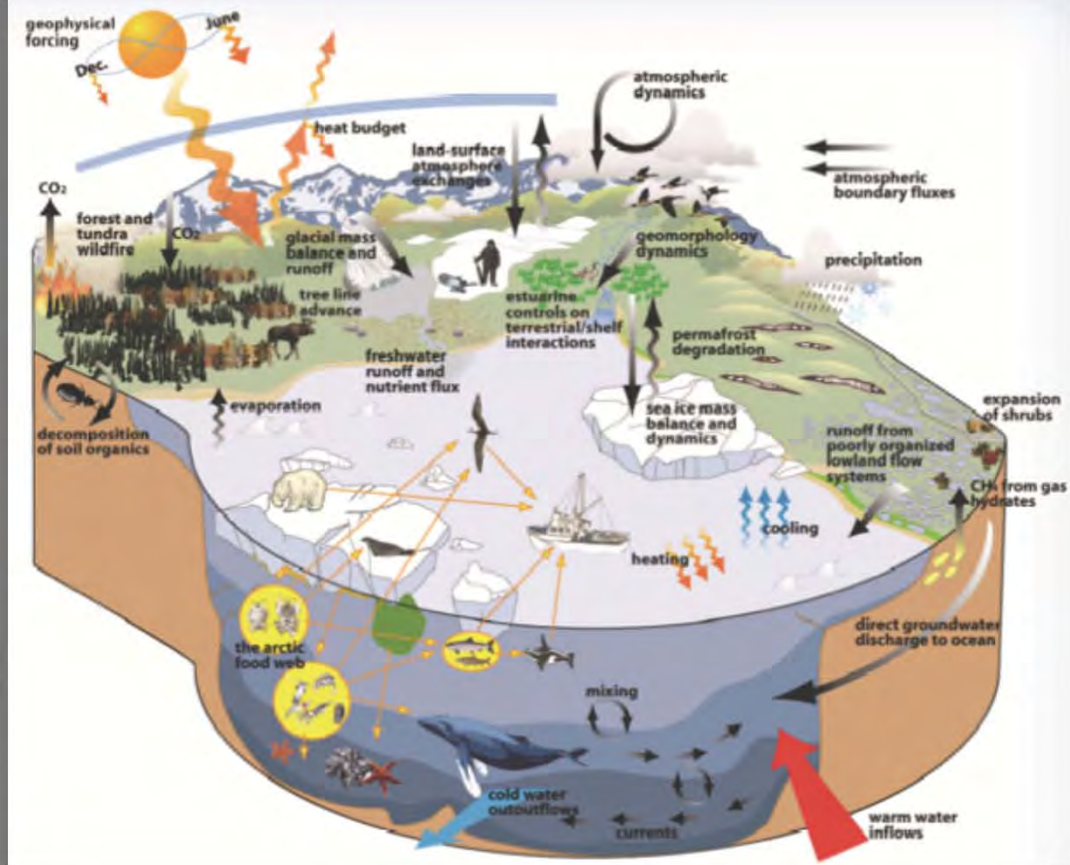


Figure from Karl, T.R. and Trenberth, K.E., 2003: Modern Global Climate Change, *Science*, 302: 1719 - 1723.

Why such a system on Svalbard?



Earth System Models have to be applied and tested in regions where changes are expected to be most pronounced and system coupling is assumed to be strongest, i.e. in the Arctic. Svalbard is a region with especially large changes/variability in the Arctic.



- In Svalbard many elements are already in place: No need to start from scratch!
- Scientific activities in Svalbard are characterized by extensive international cooperation with a strong European core (ARCFAC) and a growing global participation
- Svalbard was a major hub of IPY activities, and SIOS will contribute to secure the heritage of IPY
- SIOS will follow up the EU Arctic Communication (November 2008)

Why such a system on Svalbard?



For remote sensing and Earth observation

- Almost all orbits of polar orbiting satellites pass over or at a short distance from Svalbard.
 - Svalbard is the largest downlink site for polar orbiting Earth observing satellites
 - The Svalbard region is therefore excellently covered by satellite measurements
- Research infrastructure on Svalbard offers a unique possibility for performing ground-based validation of satellite data for multidisciplinary polar research
- The use of satellite data has no negative impact on the environment
- Svalbard has the highest available data bandwidth in the High Arctic





- Norway has established an international university in Longyearbyen with students and staff from 25 countries.
- Research organizations from 15 countries are present on a regular basis, operating a wide variety of land and sea-based facilities.
- Svalbard is accessible all year round because of its advanced community infrastructure and its relatively mild climate.

- **Four main research sites:**
 - Ny-Ålesund
 - Barentsburg
 - Longyearbyen
 - Hornsund
- **Several smaller research sites:**
 - Torun Polar Station, Kaffiøyra
 - Isfjord radio, Kapp Linné
 - Petuniabukta
- **Research vessels**
 - Lance, Teisten, "Barentsburg", etc.
- **Marine observation platforms**
 - Hausgarten
- **Svalbard Rocket Range**
- **Svalbard Satellite Station**



- **Science balloons**
- **Unmanned Aerial Vehicle (UAV)**

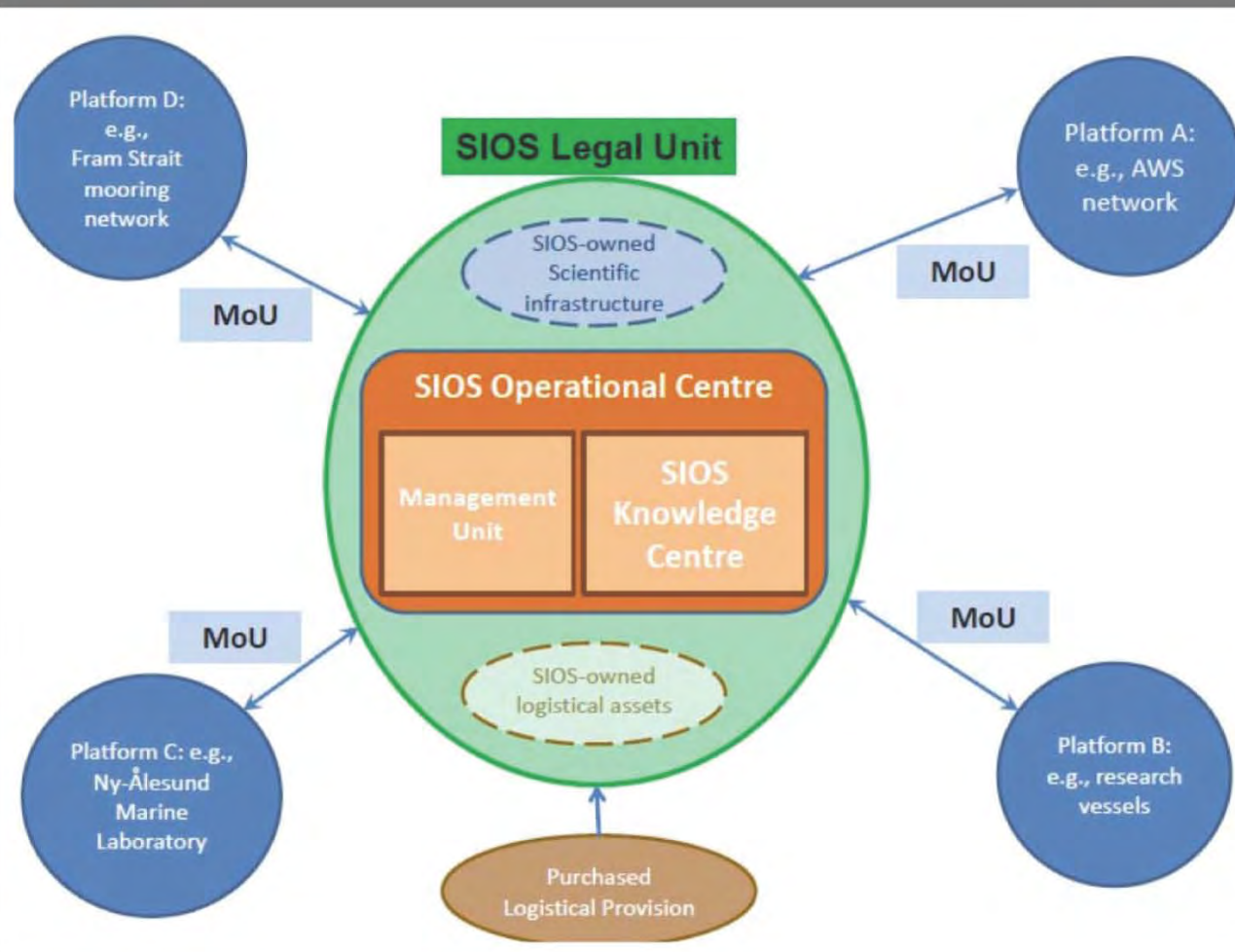
A fundamental objective for SIOS is to supply **added value** to all the investors beyond what their own investments would provide in solitude. The integration and structuring of **coordinated observations** with clear scientific goals is the means of SIOS to achieve an understanding of changes. The **enhancements of infrastructure** shall be made to achieve this.

The main integrating element and exhibition window of SIOS

- Data handling, storage and delivery (mostly as a portal, but with option of physical data centre), including access to Earth Observation segment (satellite data)
- Interface between scientific platforms and user/stakeholder community
- Facilitator for scientific integration (interdisciplinary activities, ESS)
- Education and training on graduate and under-graduate levels
- Public outreach activities
- Coordination and service functions



SIOS-PP Governance model



- To develop a dedicated remote sensing strategy for SIOS, covering both satellite observations and near-surface activities, such as air-borne, balloon- and rocket-borne observations
- The Remote Sensing strategy will feed into all the other platforms and the Knowledge Centre, and will be a major new asset made available through SIOS
- It will enable the SIOS infrastructure and, in a more general sense, Svalbard to gain a leading role in providing quality controlled remote sensing data for polar research
- With a coordinated and tailored data management facility for a wide range of remote sensing data, SIOS will be ideally suited to validate and promote use of satellite and other remote sensing products over land, sea, cryosphere and atmosphere/space for research and monitoring in the Arctic

WP7 subtasks:

- **Task 7.1:** Inventory and application of relevant satellite missions
- **Task 7.2:** Investigation of satellite validation needs in the Arctic
- **Task 7.3:** Development of long-term validation and cooperation agreements with satellite owners
- **Task 7.4:** Integration of SIOS in international remote sensing long-term strategies, e.g. GMES and GEOSS
- **Task 7.5:** UAV-, rocket and balloon-based observations

Deliverable 7.7



**Svalbard Integrated Arctic Earth Observing System –
Preparatory Phase Project
(SIOS-PP)**

PROJECT NUMBER: 261747
FP7-INFRASTRUCTURES-2010-1

Deliverable D7.7:
The overall remote sensing strategy for SIOS

The overall remote sensing strategy

The overall remote sensing strategy



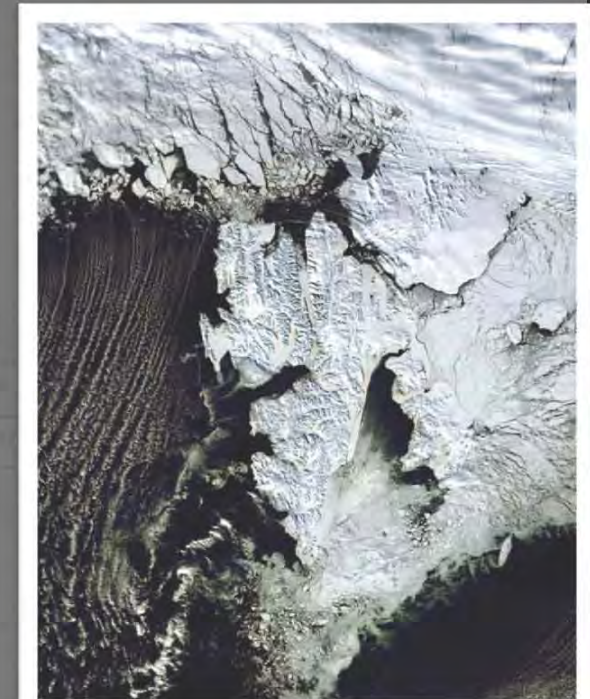
Overarching goals:

- All field work within SIOS covered with relevant satellite information
- Access to time series of defined satellite information at all coordinates in the SIOS area
- Common data ordering and access for all satellite information
- Satellite Earth Observation is an overarching methodology to develop Earth System science

Key products/services:



1. **General access to satellite data** - both optical and radar satellites
2. **Specific datasets and satellite images relevant for the SIOS area**
 - Including cloud free satellite images of Svalbard using Sentinel-2/Landsat-8
 - Including time series of satellite images from Svalbard – both radar and optical.
3. **Provide high-resolution orthorectified satellite images**
4. **Visualization:** Opportunities for combining/merging orthorectified satellite data with other data sets (f.ex. In-situ data)
5. **Support Cal/Val activities**
6. **Education/Outreach:** Basic training/introduction to remote sensing satellite data.

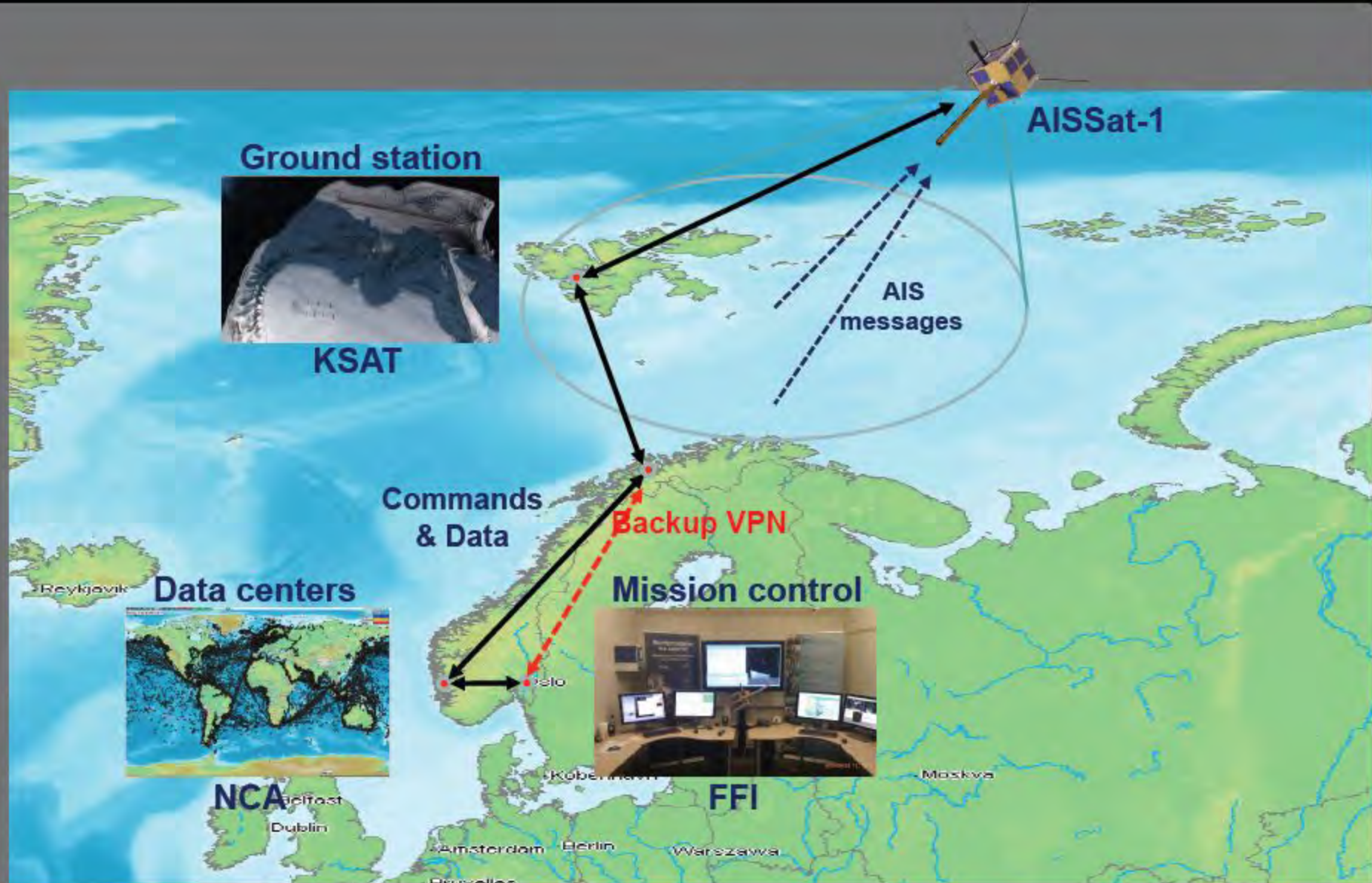


A Norwegian satellite

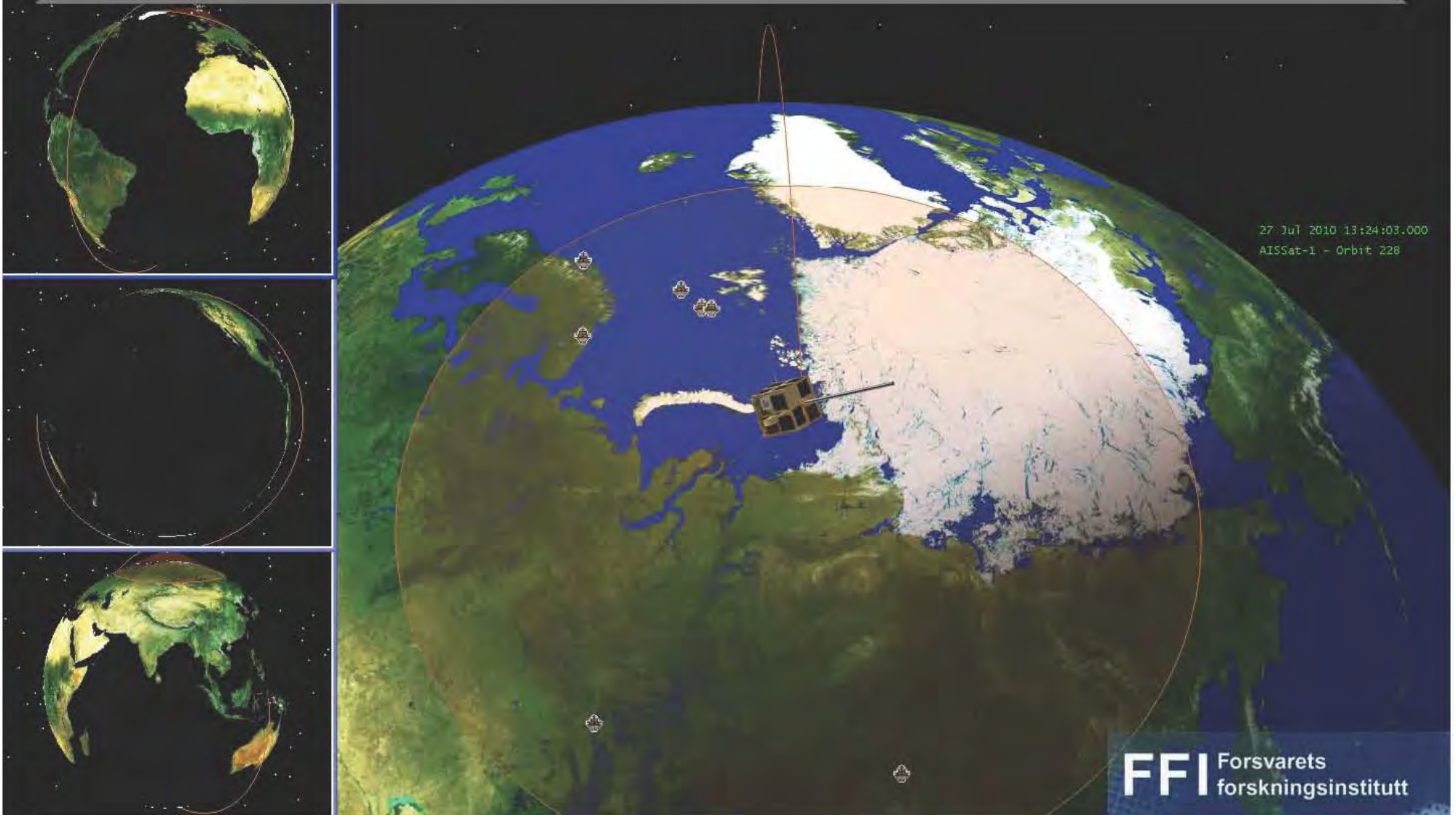
- AISSat-1
- UTIAS GNB
- KSeatex AIS Rx
- 6 kg, 20x20x20 cm
- ISRO PSLV, 12 July 2010
- Polar orbit, 630 km
- KSAT Svalsat, Svalbard
- Cost approx. 4 M€



AISSat-1: Norway's own satellite

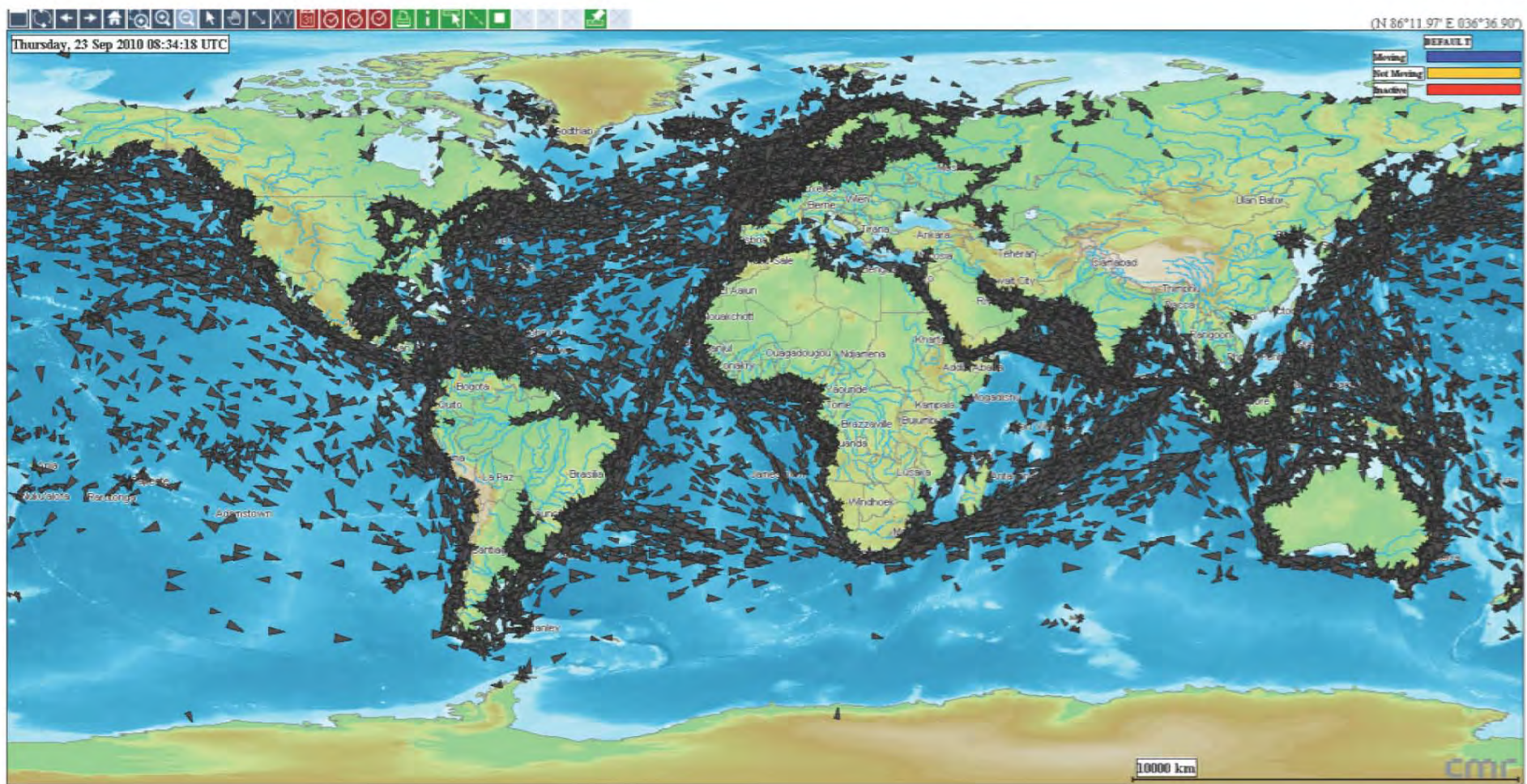


AISSat's first orbits

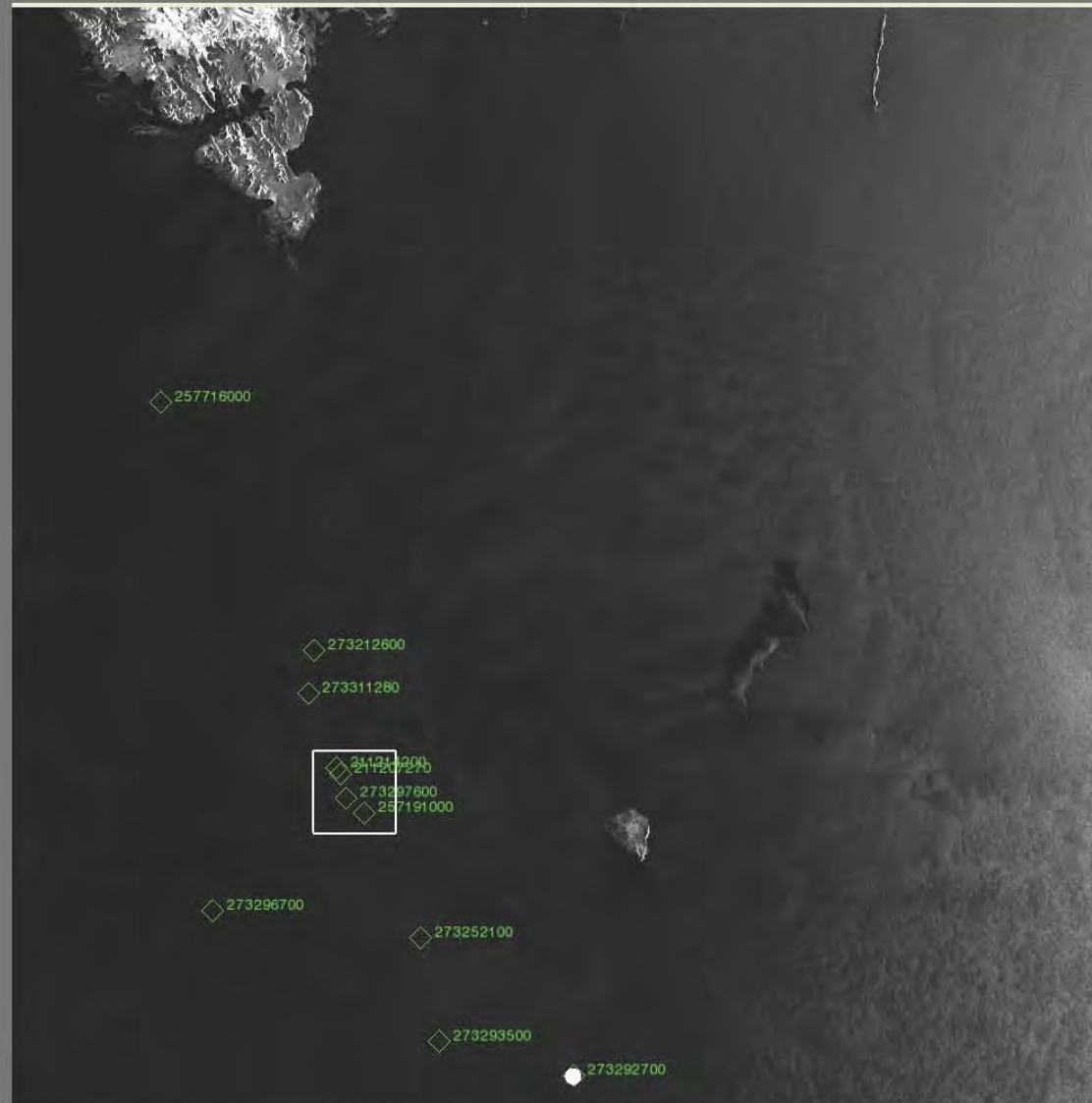


AISSat-1 in operation

7 orbits (half a day)



The classic – SAR and AIS



Radarsat 2 + AISat-1
14.2.2012

NORSAT-1 mission

- Carry three scientific payloads:
 - TSI, Total Solar Irradiation instrument (CLARA)
 - Langmuir Probe (LP1-LP4)
 - AIS receiver (new HW, new algorithms, two orthogonal antennas AIS1/AIS2 and new SW)
- Any polar orbit including a dusk/dawn orbit
- Orbit height: $550 \text{ km} \leq \text{orbit height} \leq 650 \text{ km}$
- Sun vector, pointing towards the sun and accuracy within a 1 degree cone
- Continuous operation of all payloads
- Priority of operation:
 1. TSI instrument (pointing towards the sun)
 2. Langmuir Probe (pointing of probes)
 3. AIS receiver
- Satellite lifetime ≥ 3 years (best effort)