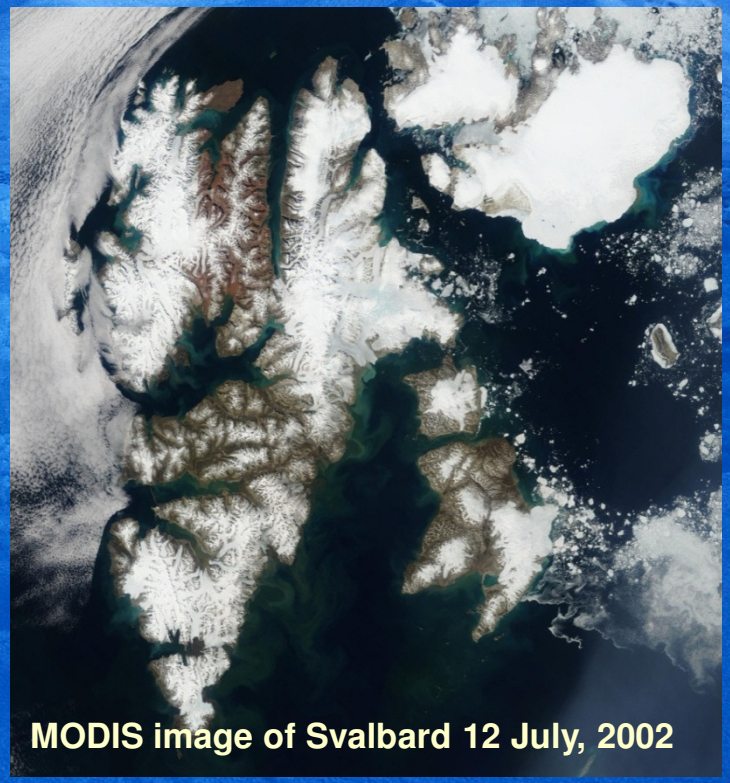
The Svalbard Integrated Arctic Earth Observing System (SIOS) – An Initiative for a Large-Scale International Arctic Infrastructure

Georg Hansen, Karin Refsnes and Ingrid Berthinussen

Research Council of Norway

Vision and main goal of SIOS

- **Vision:** The Svalbard Integrated Arctic Earth Observing System (SIOS) shall be a regional observational system for long-term observations of global environmental change (GEC) within an Earth System Science perspective in and around Svalbard. SIOS will develop and implement methods for how observational networks in the Arctic are to be construed.
- **Main goal:** Establish a network of observation platforms (including use of satellite data) for meteorological, hydro-logical, cryospheric, oceanic, other geophysical as well as marine and terrestrial biological processes with a common coordination centre.

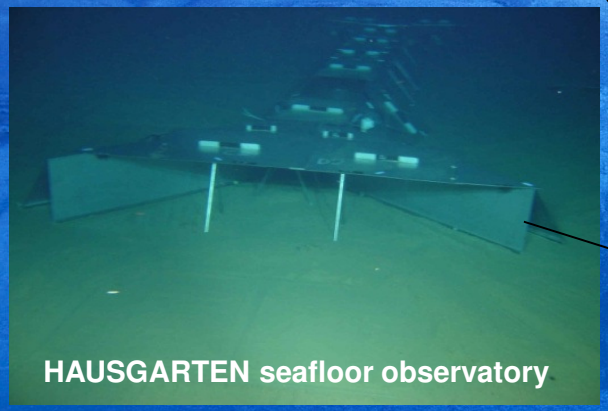


MODIS image of Svalbard 12 July, 2002

Geographical target area of SIOS

- the main archipelago of Svalbard
- Small islands: Hopen, Bear Island
- NW Barents Sea,
- NE Norwegian Sea
- Flexible border towards Greenland, Franz Josef Land, Northern Fenno-scandia

Building on existing infrastructure



The SIOS Operational Centre

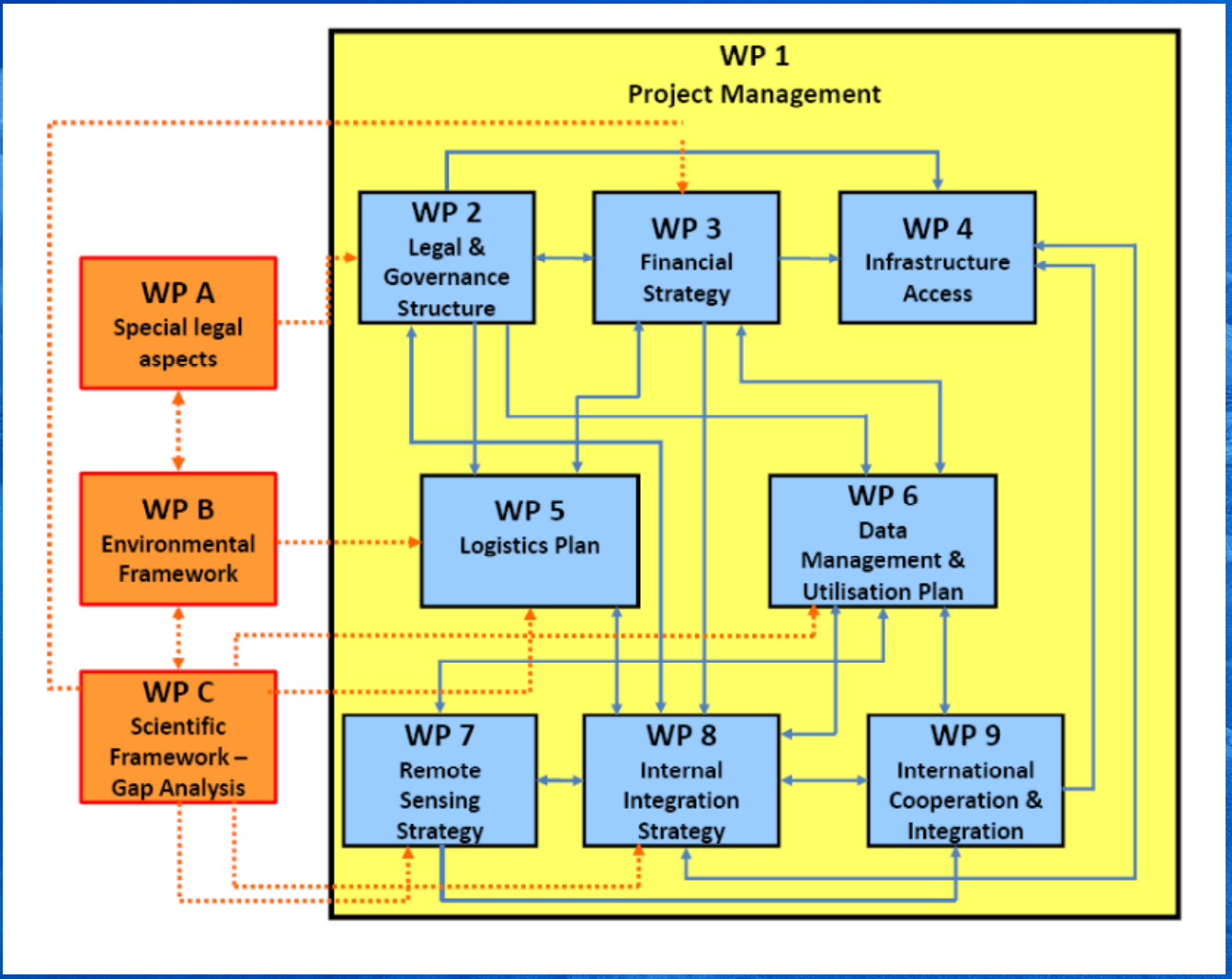
The main integrating element and exhibition window of SIOS

- 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 of graduate and (possibly) under-graduate students
- Public outreach activities
- General service functions for visiting scientists
- Management of the SIOS legal entity

SIOS – Time Schedule

- 9 December, 2008: SIOS on revised ESFRI Roadmap
- 3 December, 2009: submission of **SIOS Preparatory Phase** proposal
- March 2010: proposal accepted, contract negotiations with EC
- October 2010 – September 2013: SIOS Preparatory Phase project: clarification of legal status, governance structure and financial strategy and business plan, plus other strategic processes
- Mid-term of SIOS-PP reached 1 April, 2012
- From 2013 (at latest): SIOS implementation phase
- From end of 2013: SIOS operational phase (since much infrastructure already in place)

The SIOS Preparatory Phase Project



EU-funded project:

- 4 mill. Euro over a 3-yr period (01/10/2010 – 30/09/2013)
- Establishment of formal and financial framework of a possible future research infrastructure
- National Norwegian funding of WPs A-C

Participating countries

- Norway (11)
- Germany (1)
- Poland (2)
- Italy (1)
- UK (1)
- Russia (2)
- France (1)
- Finland (1)
- Netherlands (1)
- Sweden (1)
- Denmark (1)
- Korea (1)
- China (1)
- Japan (1)

Associated:

- India
- Czech Republic
- USA
- Spain
- Canada

What has been achieved so far (1)?

- The gap analysis has been completed resulting in:
  - An overview over scientific key topics to be addressed by SIOS (SIOS Science Plan vs. 0)
  - A list of existing scientific infrastructure addressing these key topics (approximately 470 single entries from 91 institutes)
  - A list of proposals for additional instrumentation to be established through SIOS (~160 single entries)
  - Total cost estimate so far: 75 mill. Euro (not complete), nearly half of these investments proposed to be made by Norway (not realistic)
- Challenge: bottom-up process so far; no mechanism in place to perform a prioritzation process and to balance between the wide range of disciplines under the SIOS umbrella

SIOS Gap Analysis: Scientific Key Topics

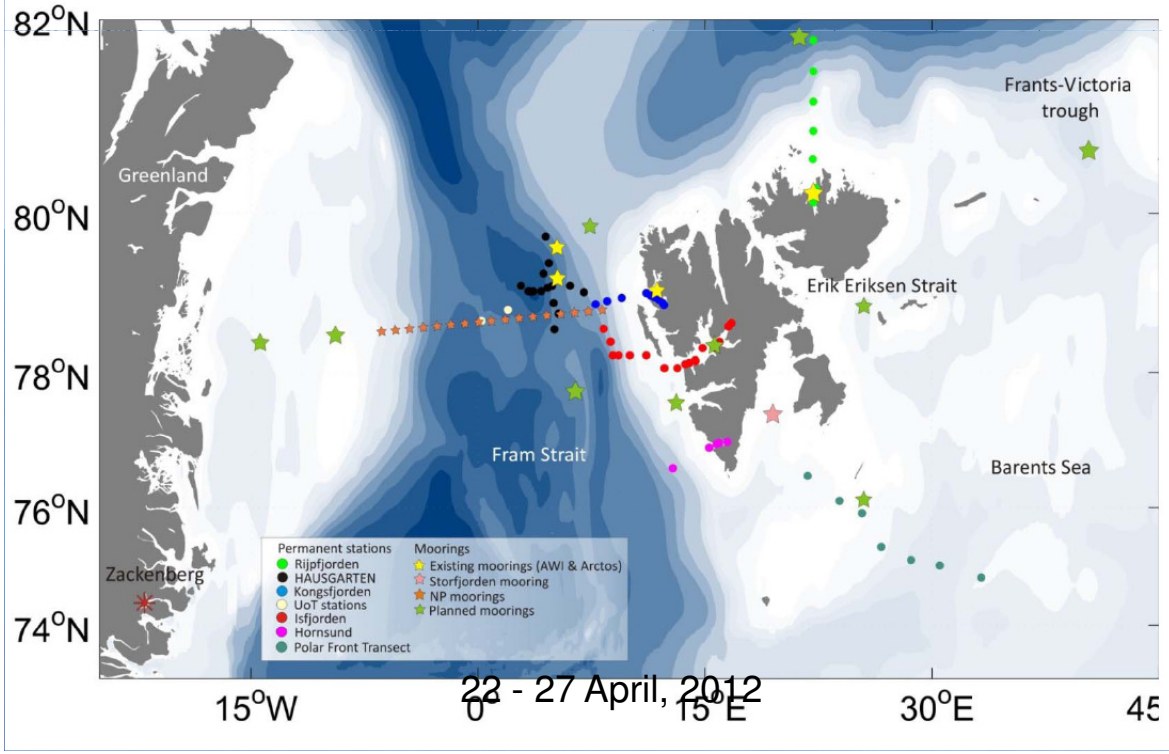
- **KT 1.** Vertical coupling in the arctic atmosphere downward from space
- **KT 2.** The Arctic lower atmosphere – boundary layer system: dynamical and radiation feedback processes
- **KT 3.** Oceanic and sea ice processes
- **KT 4.** Marine transport of energy, nutrients and pollution (horizontally, vertically and through the food chain)
- **KT 5.** Glacier and ice cap mass balance and dynamics
- **KT 6.** Greenhouse gas processes and feedbacks in the Arctic climate system
- **KT 7.** Arctic permafrost, periglacial geomorphological processes including geohazards related to periglacial landscape development
- **KT 8.** Isostasy and changes in Solid Earth's local and regional stress field
- **KT 9.** Direct human impact of the Arctic System
- **KT 10.** Inter-compartmental transition processes related to pollutants and impact of climate change
- **KT 11.** Arctic (terrestial) ecosystem resilience to climate variability and change

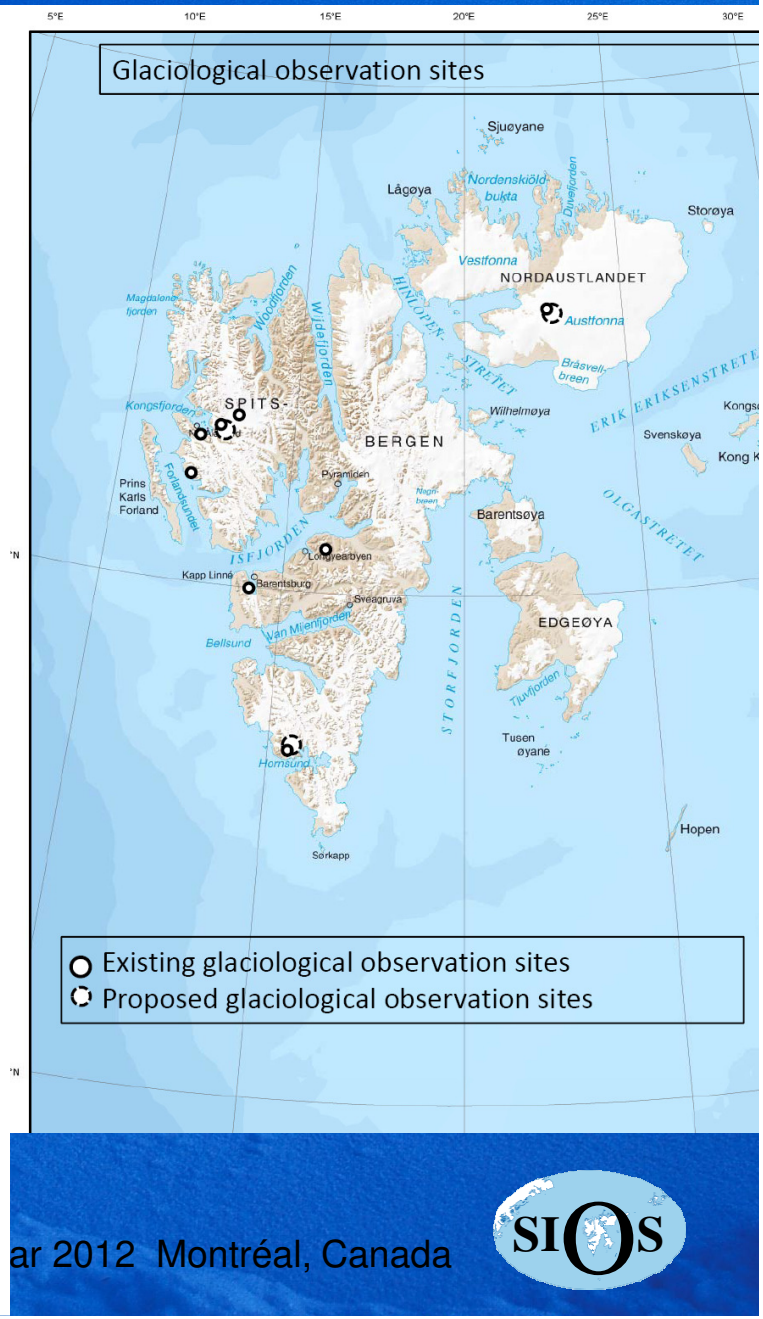
Infrastructure Inventory – Gap Identification

Table 5. KT 5 – Glacier and ice cap evolution (mass balance and dynamics)

Location	Parameters	Platform	Operator	Start	Op. secured until	Country
Weather stations						
Hansbreen	Ice temperature profile: 30m	Automatic Weather Station (AWS)	UoS, IGF PAN	2008-present		Poland
Hansbreen	T, RH, wind speed & direction, p, snow height, global/reflex radiation, albedo, upward/ downward LWR, net radiation	Automatic Weather Stations (AWS)	UoS, IGF PAN, UWr	2007-present		Poland
East Lovenbreen	met. parameters	Glacier climate station	CNRS-CEPE	2006		France
Nordaustlandet, Austfonna, Etonbreen	Global/ reflex radiation, albedo, upward/ downward long-wave radiation, net rad.	Automatic Weather Station (AWS)	UiO	2004-present		Norway
Aldegondabreen (Grønfjorden)	Air temperature, RH, wind velocity, incoming global and reflective radiation, ice temperature profile: 3m	Automatic Weather Station (AWS) with 4th measurement levels	AARI	2006-present (not every year)		Russia
Kongsvegen stake 6, 78.78041, 13.15416	T, H, upward/ downward long-wave /short-wave radiation, wind speed,	Automatic Weather Station (AWS)	NPI	2000		Norway

Marine observation sites





22 - 27 April, 2012

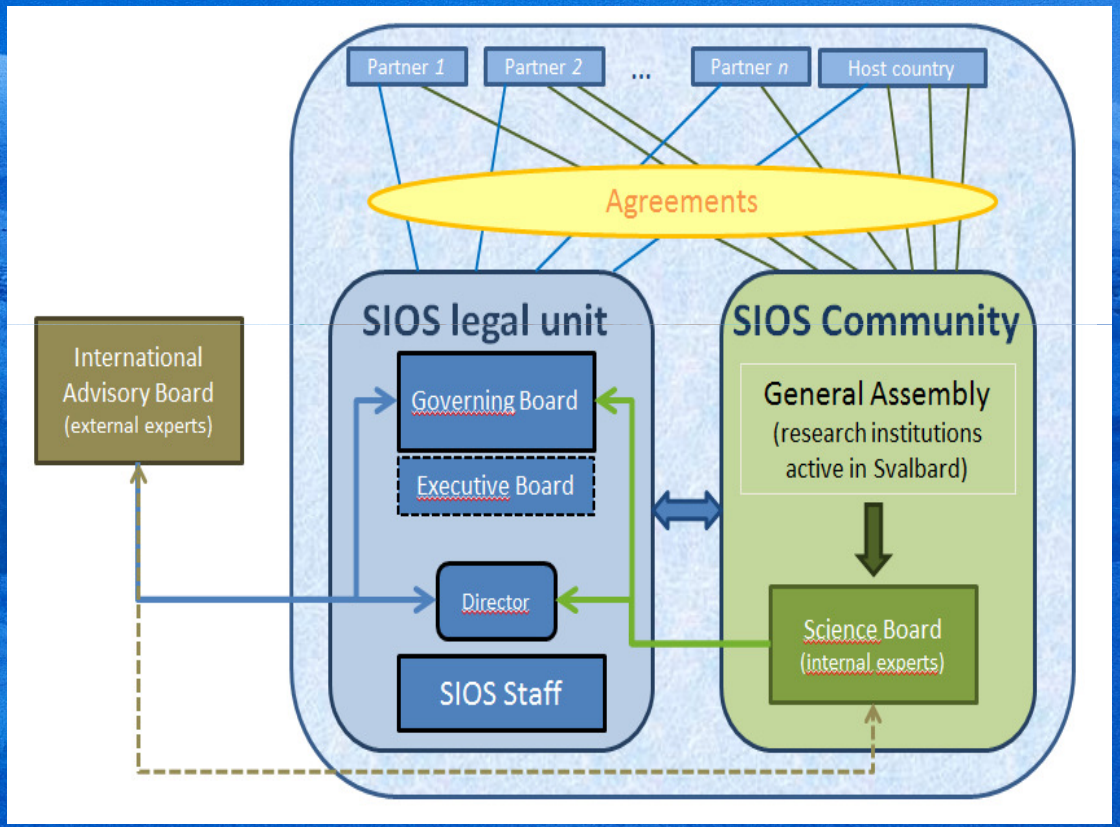
ar 2012 Montréal, Canada

SIOS

What has been achieved so far (2)?

First SIOS infrastructure and governance model draft:

- SIOS legal entity mainly consisting of the SIOS Operational Centre; observational infrastructure linked via MoUs
- Most new scientific infra-structure also owned and operated by participating nations, but option of commonly owned new scientific infrastructure and logistics
- Two organisational units in SIOS Operational Centre
- All full members of the SIOS consortium have to contribute financially to the SIOS legal unit
- Contributions to scientific infrastructure have to be valued in voting rules or access conditions

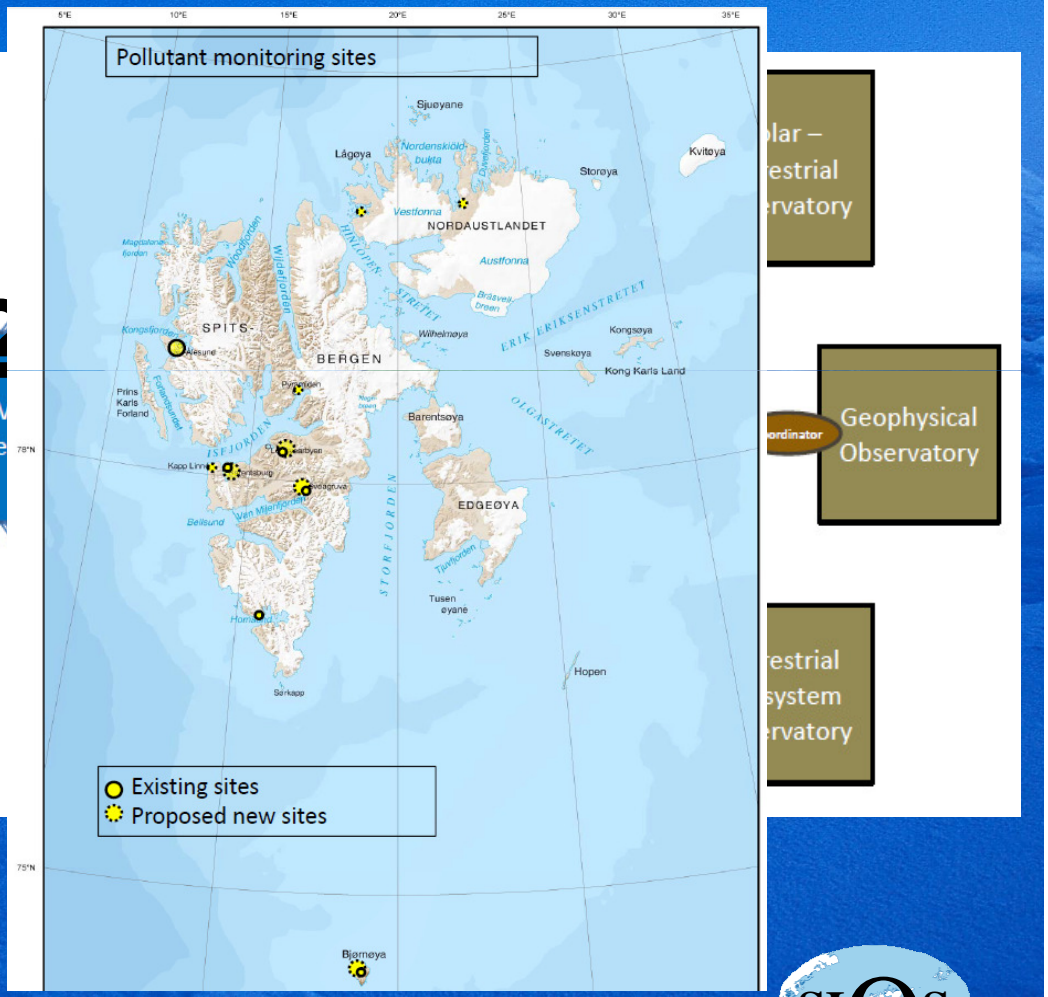


What has been achieved so far (3)?

SIOS Observational Network:

- Mainly organised following the scientific key topics, but combined where appropriate for practical reasons
- Observatory coordinators establishing or contributing to the internal Science Board
- Platforms/observatories to be designed and optimized by ad-hoc expert goups supported by the (external) Advisory Board

- Not clarified:
  - Current operational status o platforms/networks
  - Feasibility of SIOS vessel fleet
  - Additional elements?



What has been achieved so far (4)?

A number of basic assessments:

- Inventory and analysis of legal structure options (D2.1): ERIC preferred solution, but feasibility not clarified (political reasons)
- Assessment of previous Infrastructure Access projects in Ny-Ålesund and at other Arctic and sub-Arctic sites (D4.1)
- SIOS Preliminary Data Policy (D6.1)
- Assessment of research areas with great EO support potential (D7.1)
- Role of SIOS in the European Arctic Research Strategy (D9.2)

Svalbard Integrated Arctic Earth Observing System

SIOS | Norsk Romsenter NORWEGIAN SPACE CENTRE | NERSC Nansen Environmental and Remote Sensing Center

Assessment of research areas with great EO support potential

SIOS Deliverable D7.1

WP7: SIOS Remote sensing strategy

Nansen Environmental and Remote Sensing Center
in cooperation with
Alfred Wegener Institute for Polar and Marine Research, Germany
Istituto di Fisica Applicata, Firenze, Italy
Norwegian Space Center,
Norwegian Meteorological Institute
Norwegian Polar Institute
Norwegian Institute for Air Research
Norwegian Institute for Water Research
Norwegian Institute for Nature Research
Northern Research Institute (Norut)
Norwegian Mapping Authority

FINAL version 15 November 2011

What were the expected challenges 18 months ago?

- History of establishment of the various polar stations:

  → topics, character, size determined in advance at national level
  → cooperation opportunities investigated after establishment
  → Svalbard Treaty freedom

  SvalSat, Platåberget, Longyearbyen

  Can one build an integrated autonomous facility out of this?

- Choice of research sites: determined by historical factors (coal mining, not scientific suitability): all along the west coast; to a large degree cemented by today's environmental jurisdiction
  Will it be possible to build the required network with these practical limitations?

- Interdisciplinary character ("intellectual barriers"): between disciplines based on history (e.g., lower – upper atmosphere), ways of working and thinking, logistical approaches
  Can SIOS achieve what numerous previous initiatives didn't?

… and now ?

All challenges related to the vast number of existing and proposed scientific instrumentation, the many scientific disciplines under the SIOS umbrella, and the established (national) management structures

- Development of a SIOS legal organisation of ”over-critical mass”
- Establishment of a scientific investment plan
- Inventory of existing and expected SIOS data sets and current databases used
- Establishment of a scientific integration strategy

Conclusions

- SIOS-PP project on schedule in most aspects
- SIOS is indeed very complicated for the reasons identified previously:
  - Building on existing infrastructure and national stations
  - Covering many disciplines
  - Bound by environmental framework and logistical limitations
- The major decisions are lying still ahead and require strong engagement and bold approaches from all partners
- A success of this ambitious project is not self-evident!