The Svalbard Integrated Arctic Earth Observing System (SIOS) ESFRI initiative

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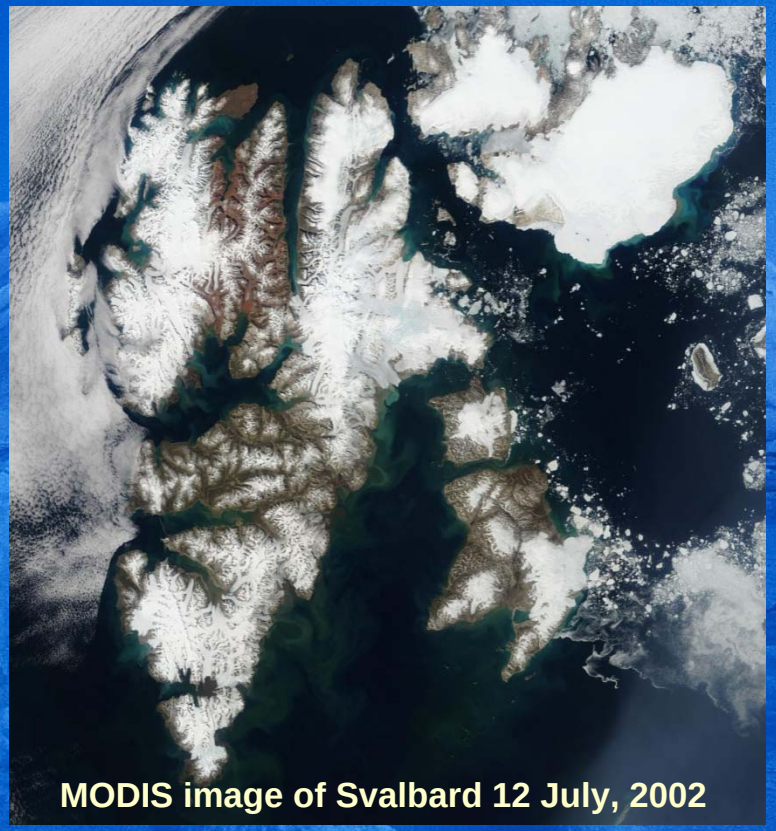
Research Council of Norway

The main goal of SIOS

- Establish an (**Arctic) Earth System Observing Facility** in and around Svalbard, which covers meteorological, hydrological, cryospheric, oceanic, other geophysical as well as marine and terrestrial biological processes from a set of observational platforms, including use of satellite data.
- Strengthen coordinated European Arctic research and establish an important node in the envisaged Sustained Arctic Observing Networks (**SAON**).
- One of 44 proposals in the 2008 roadmap of the European Strategy Forum on Research Infrastructures **(ESFRI)**



MODIS image of Svalbard 12 July, 2002

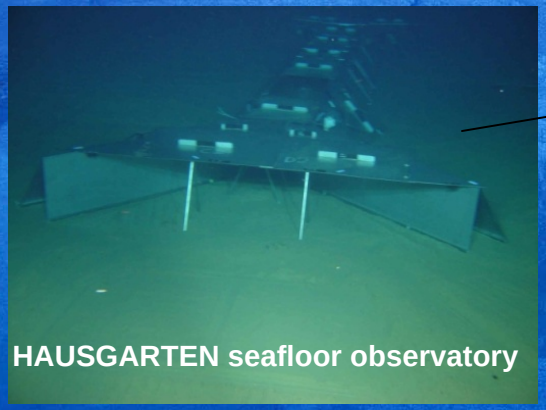
Geographical target area of SIOS

- 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

The Research Council of Norway

SIOS

Existing Major Research Sites



The SIOS Knowledge Centre

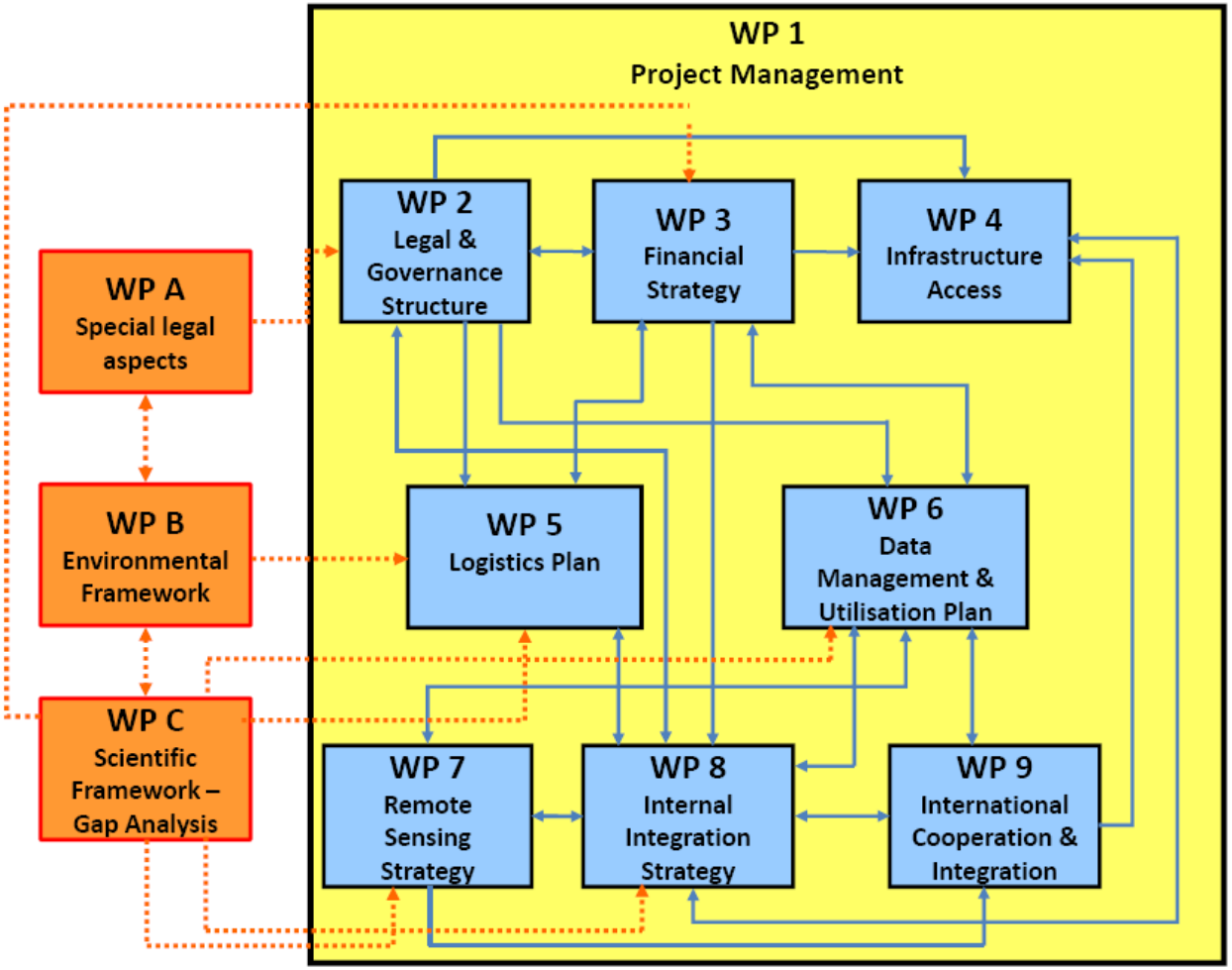
The main integrating element and exhibition window of SIOS

- 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 on graduate and under-graduate levels
- Public outreach activities
- Coordination and service functions

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
- 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
- Germany
- Poland
- Italy
- UK
- Russia
- France
- Finland
- Netherlands
- Sweden
- Denmark

- Korea
- China
- Japan

Associated:

- India
- Czech Republic
- USA
- Spain
- Canada

The SIOS consortium

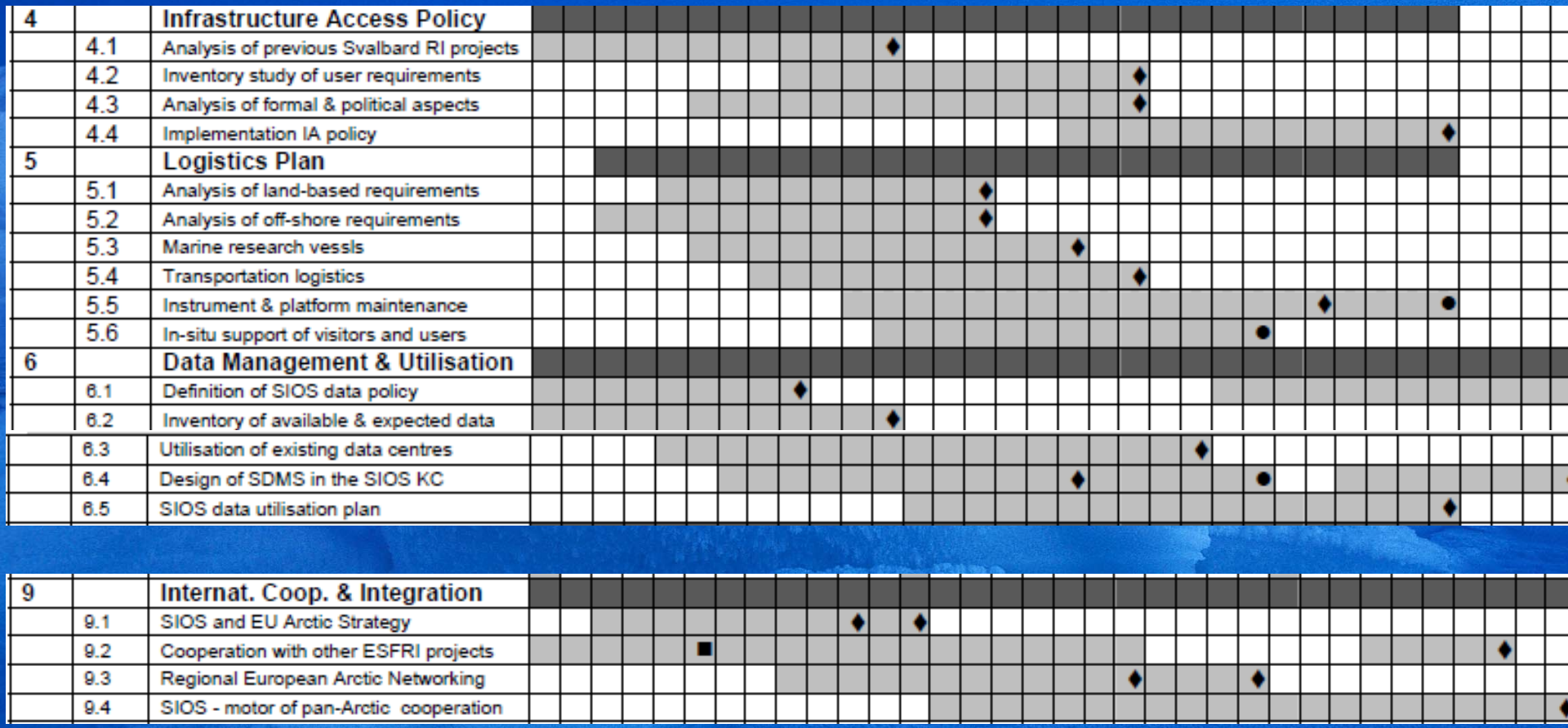
- **Alfred Wegener Institute for Polar and Marine Research, Germany**
- **Institute of Geophysics - PAS, Poland**
- **National Research Council, Italy**
- **National Environmental Research Council, UK**
- **Arctic and Antarctic Research Institute, Russia**
- **Finnish Meteorological Institute, Finland**
- **Aarhus University - National Environmental Research Institute, Denmark**
- **University of Groningen, Netherlands**
- **Korea Polar Research Institute, Korea**
- **Polar Research Institute of China, China**
- **Institut Polaire Paul Emile Victor, France**
- **Institute of Oceanology – PAS, Poland**
- **Polar Geophysical Institute – RAS, Russia**
- **ITM, Stockholm University, Sweden**
- **National Institute of Polar Research, Japan**
- National Centre of Ocean & Antarctic Research, **India**
- Institute of Botany – Czech Academy of Sciences, **Czech Republic**
- Ministry of Science and Innovation, **Spain**
- National Science Foundation, **USA**
- Scottish Association for Marine Science, **UK**
- EISCAT Scientific Association
- Arctic Centre, University of Lapland, **Finland**
- University of Leicester, **UK**
- Kola Science Center – RAS, **Russia**
- Geophysical Survey – RAS, **Russia**
- University of Helsinki, **Finland**

- **Research Council of Norway (coordinator)**
- **Norwegian Polar Institute**
- **University Centre in Svalbard**
- **Norwegian Space Centre**
- **University of Bergen**
- **University of Tromsø**
- **Norwegian Meteorological Institute**
- **Nansen Environmental & Remote Sensing Center**
- **Institute of Marine Research**
- **Norwegian Institute for Air Research**
- **Andøya Rocket Range**
- NORSAR
- Norwegian Institute of Water Research
- Kings Bay AS
- Akvaplan-niva AS
- University of Oslo
- Norwegian Institute of Nature Research
- Norwegian University of Science & Technology
- Norwegian Energy and Water Resources Directorate
- Kongsberg Satellite Services AS
- Northern Research Institute Tromsø
- Norwegian Mapping Authority
- Norwegian Ministry of Education and Research

SIOS-PP full partners

SIOS-PP associated partners

Task list - selection



4		Infrastructure Access Policy
	4.1	Analysis of previous Svalbard RI projects
	4.2	Inventory study of user requirements
	4.3	Analysis of formal & political aspects
	4.4	Implementation IA policy
5		Logistics Plan
	5.1	Analysis of land-based requirements
	5.2	Analysis of off-shore requirements
	5.3	Marine research vessls
	5.4	Transportation logistics
	5.5	Instrument & platform maintenance
	5.6	In-situ support of visitors and users
6		Data Management & Utilisation
	6.1	Definition of SIOS data policy
	6.2	Inventory of available & expected data
	6.3	Utilisation of existing data centres
	6.4	Design of SDMS in the SIOS KC
	6.5	SIOS data utilisation plan
9		Internat. Coop. & Integration
	9.1	SIOS and EU Arctic Strategy
	9.2	Cooperation with other ESFRI projects
	9.3	Regional European Arctic Networking
	9.4	SIOS - motor of pan-Arctic cooperation

The SIOS Gap Analysis Work

1) What are the crucial scientific questions (”Key Topics”) in your field in the Arctic, incl. links to other fields?

2) For which of those is Svalbard naturally suited as a field laboratory?

3) What infrastructure is available/what is needed to address the relevant questions adequately?

4) What can be the role of the Knowledge Centre in your field?

5) Proposal of working group for further gap analysis

6) Should one stick to the new structure or go back to the initial observatory structure? How can one integrate geographically spread units?

7) Special role of Remote Sensing!

SIOS Gap Analysis: Scientific Key Topics

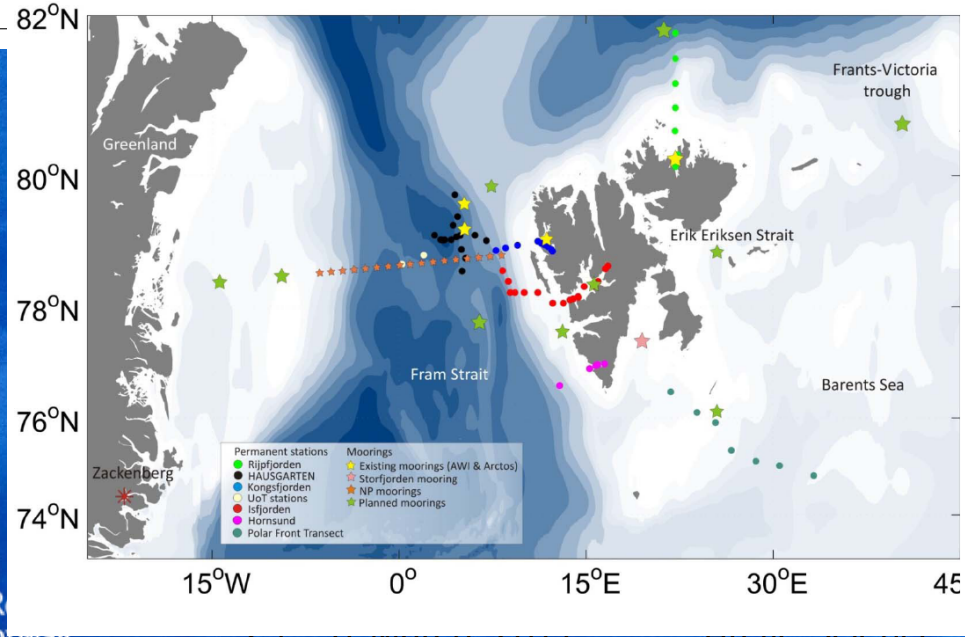
- **KT 1.** Vertical coupling in the arctic atmosphere downward from space
- **KT 2.** The Arctic lower atmosphere – boundary layer system: dynamical and radiation feedback processes
- **KT 3.** Oceanic and sea ice processes
- **KT 4.** Marine transport of energy, nutrients and pollution (horizontally, 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

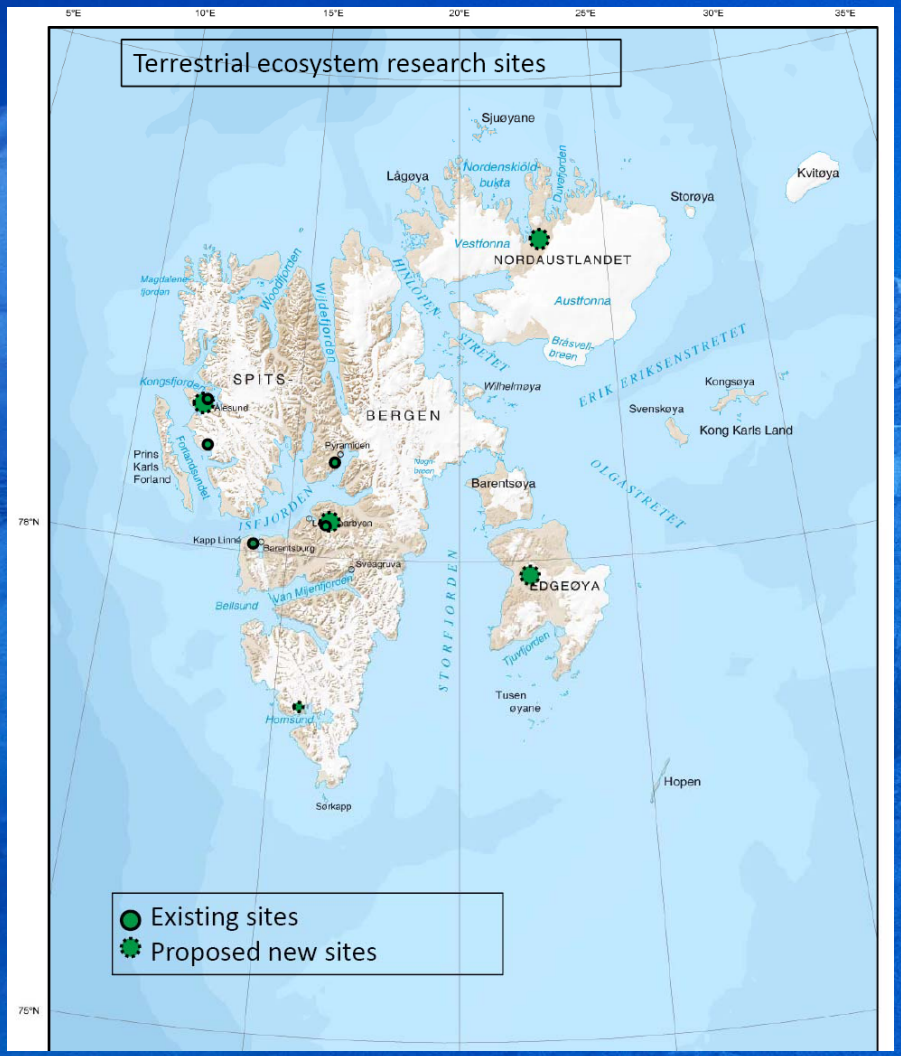
Table 5. KT 5 – Glacier and ice cap evolution (mass balance and dynamics)

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 4[lb] 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, wind dir.	Automatic Weather Station (AWS)	NPI	2000		Norway
Kongsvegen stake 1, 78.845177,12.670116	T, H, upward/ downward long-wave /short-wave radiation, wind speed, wind dir.	Automatic Weather Station (AWS)	NPI	2000		Norway
Holtedahlfonna, Stake 1, 78.93351, 13.31003	T, H, upward/ downward long-wave /short-wave radiation, wind speed, wind dir.	Automatic Weather Station (AWS)	NPI	2008		Norway
Holtedahlfonna, Stake 4.5E, 78.984056, 13.61760	T, H, upward/ downward long-wave	Automatic Weather Station	NPI	2008		Norway
Glaciological stati						
Hansbreen						

Marine observation sites



Further process

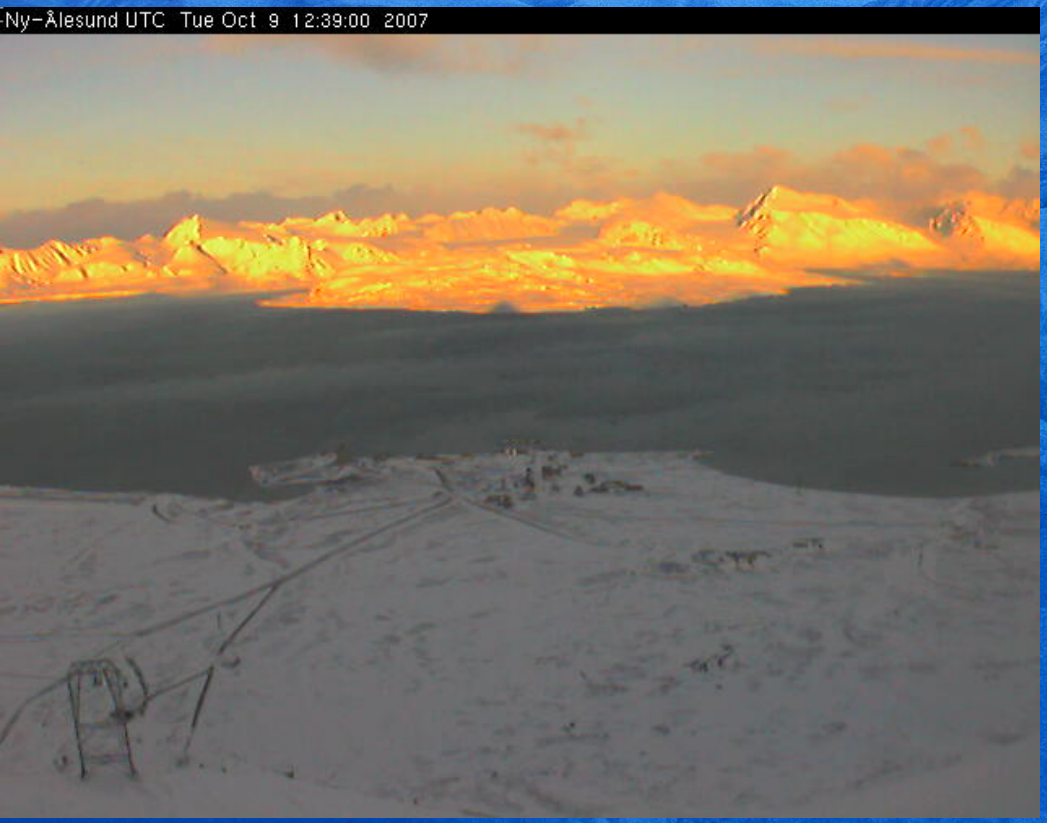


- Gap analysis has to be finalised quickly: envisaged end of May-early June 2011
- Infrastructure proposals will form basis for the further work with working out the investment and operational plan for the scientific infrastructure of SIOS
- **HOWEVER:** the infrastructure should be dynamic to allow for inclusion of new developments
- **IMPORTANT**: distinguish between basic long-term observation series and additional process-focused observations
- The latter are open for changes, the former should only be extended !
- Decisions to be made by SIOS body to be established (Science Board?) together with the (external) Advisory Board

Additional slides

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 an arctic region with especially large natural gradients and ongoing changes



- In Svalbard many elements of an "Arctic System" observing system already in place: **We needn't start from scratch!**
- Scientific activities in Svalbard are characterized by extensive inter-national cooperation with a strong European core **(ARCFAC)** and 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)

Major steps towards this goal:

1. **Assess** the present infrastructure and activities in Svalbard to identify **gaps and weaknesses** related to the needs of **Earth System Models (ESM)**. Invest in additional infrastructure and activities to close these gaps.
2. **Organize all relevant infrastructure** and all research and monitoring activities **into observation platforms** which are most appropriate w.r.t. practical and organisational aspects
3. **Establish a Knowledge Centre** in Longyearbyen for data collection/aggregation/access, education and outreach, cooperative efforts, and input to Earth System modeling
4. **Coordinate the SIOS initiative with other ESFRI environmental initiatives** as well as other global and Arctic observation systems and related modelling efforts

The SIOS Knowledge Centre

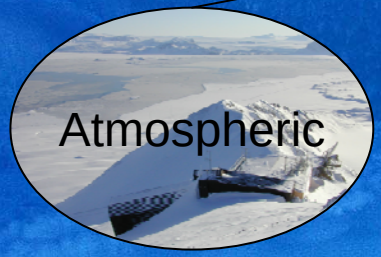
Selected end users: Policy makers, NGOs

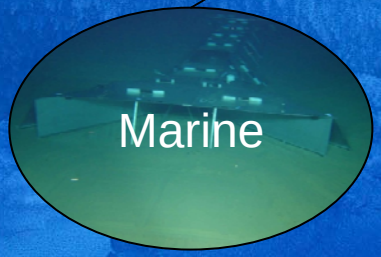
AMAP | IPCC | **EU** | EEA | KLIF | WCRP | +many others

Integrating platform

Knowledge Centre

Observational platforms





Selected contributing organizations

UNIS | NPI | AWIPEV | AARI | NERC | CNR | IGFPAS | +many others!

What are the challenges?

- 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

  Can one build an integrated autonomous facility out of this?


SvalSat, Platåberget, Longyearbyen

- 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?

… but more: the opportunities?

- Genuine interest of all nations present in Svalbard to integrate activities
- SIOS already influences other cooperation initiatives in Svalbard, e.g., Ny-Ålesund flagship projects
- Much more effective use of financial ressources
- Fronting as an EU large research infrastructure
- Already today great interest from countries not present in Svalbard: Denmark, USA, Canada
  ➔ excellent conditions for contributing to a pan-Arctic cooperation
- SIOS can be a true node/glue between most of the environment-related ESFRI projects: EMSO – ERICON AB – ICOS – LIFEWATCH – EISCAT-3D – EPOS – EURO-ARGO