SIOS, SDMS & Data delivery chains for SIOS Core Data

Ocean Data Dojo, Bergen, 1.11.2022

Ilkka Matero, Science integration and data officer, SIOS-KC

SIOS
SVALBARD INTEGRATED ARCTIC EARTH OBSERVING SYSTEM

The Svalbard Integrated Arctic Earth Observing System (SIOS)

- **A consortium** of institutions with research infrastructure in & around Svalbard

Independent organisation
run by an international Board of Directors

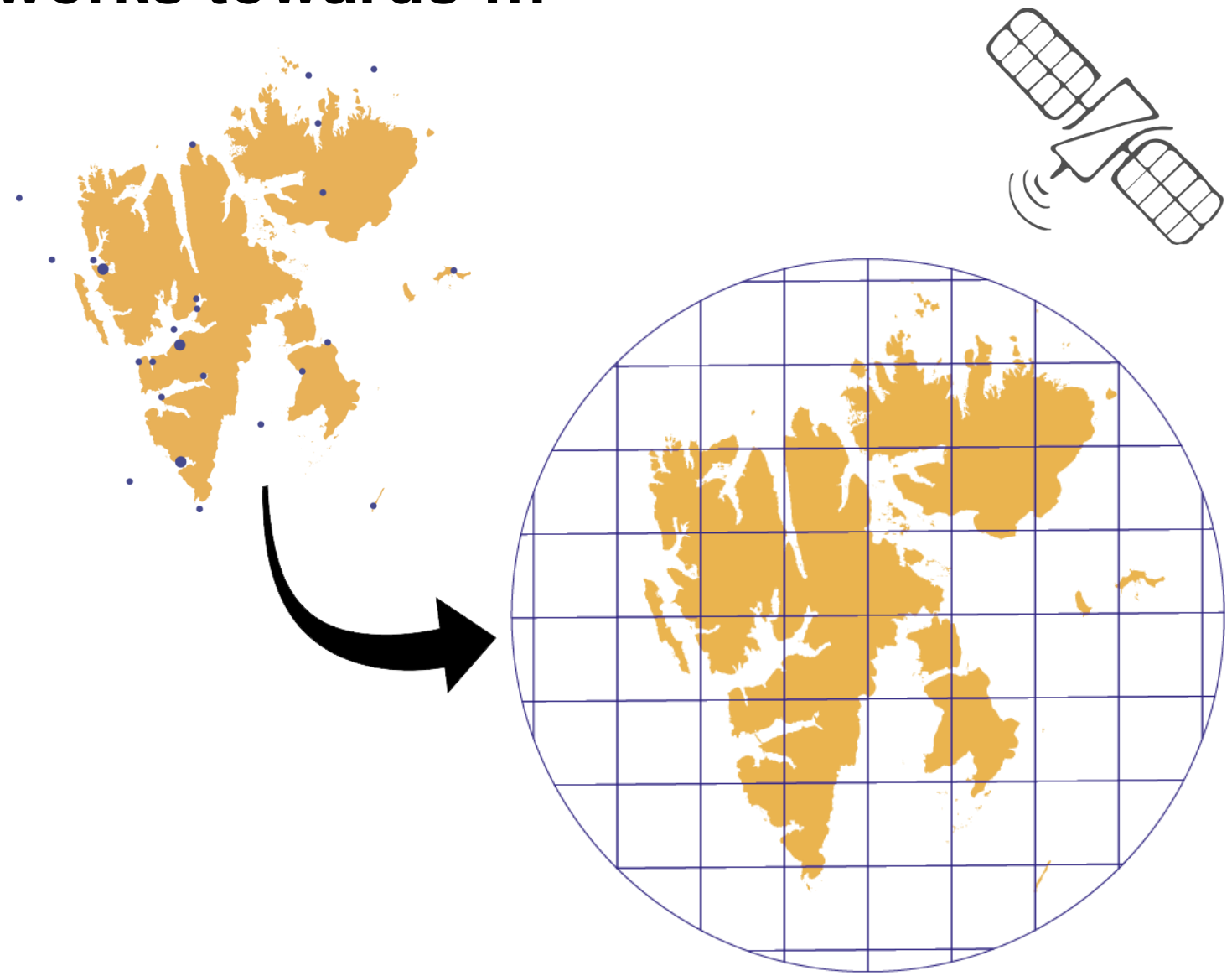
- **An observing system** for Earth System Science (ESS)

Focus on processes,
eg. environmental and climate change

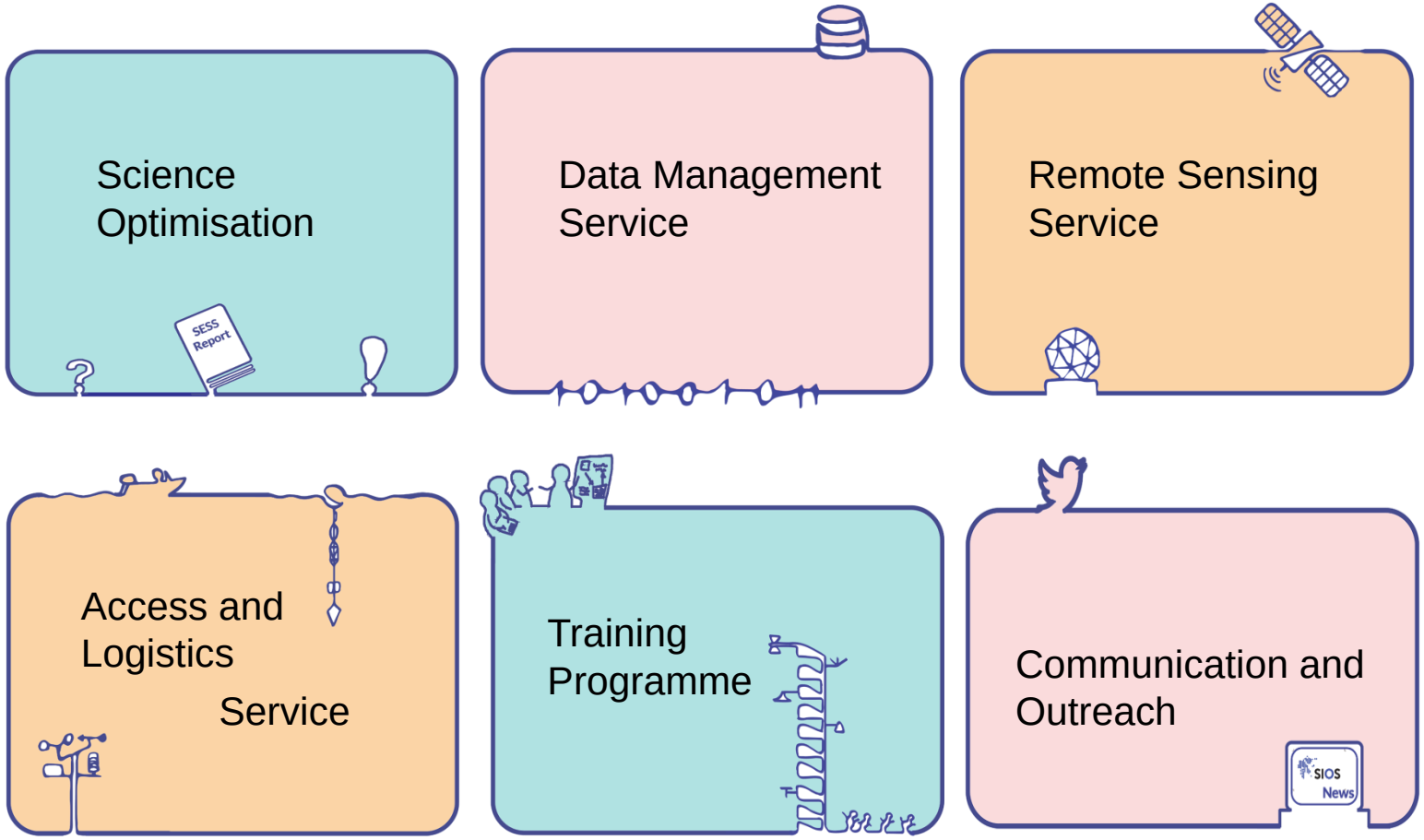
SIOS

www.sios-svalbard.org

SIOS works towards …

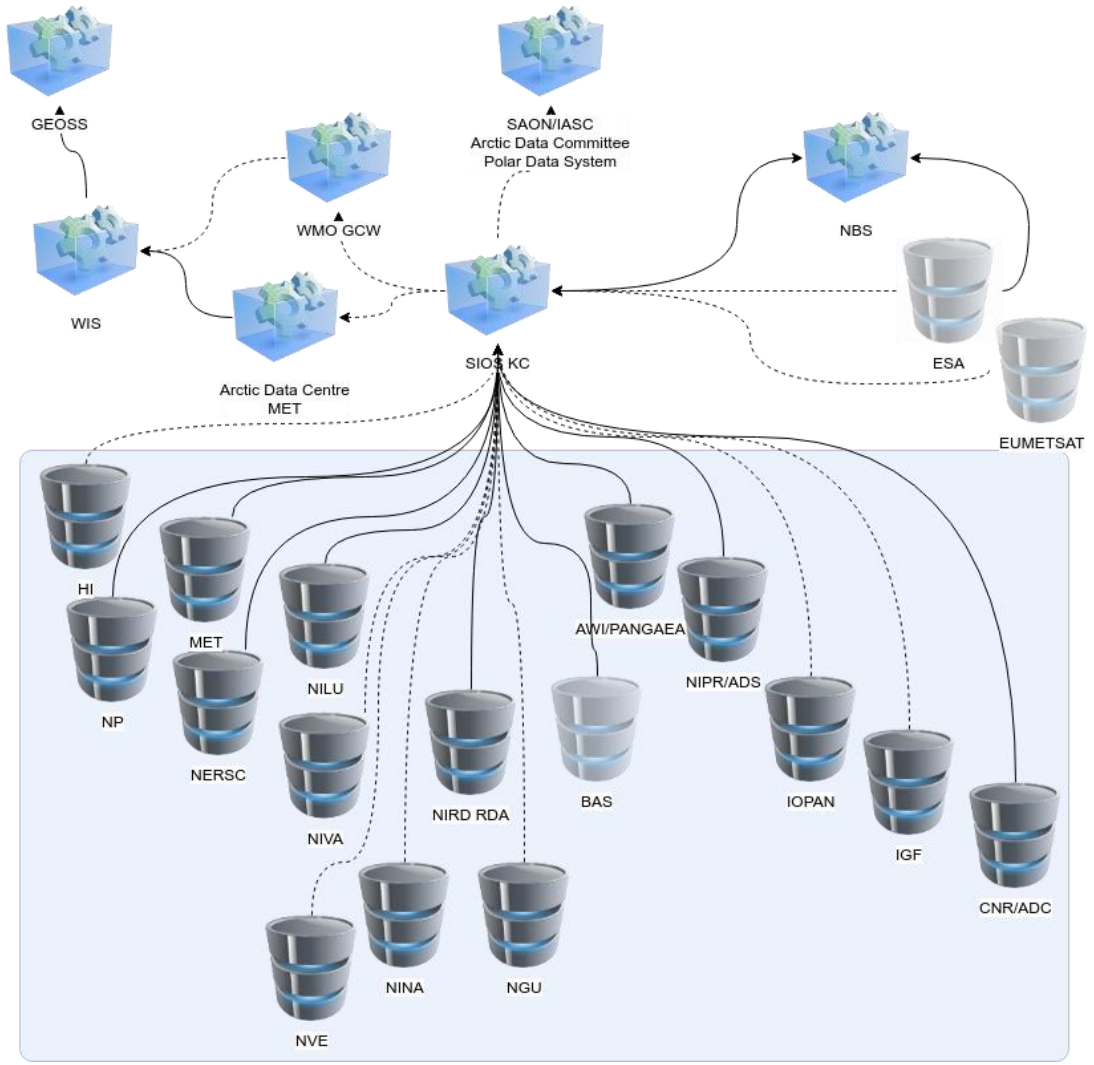


SIOS Knowledge Centre (SIOS-KC)



SIOS Data Management System (SDMS)

- Virtual data centre
- **Not hosting** datasets
- **Harvest metadata** on datasets from collaborating data centres
- **Make** datasets **available** to users through central data access portal



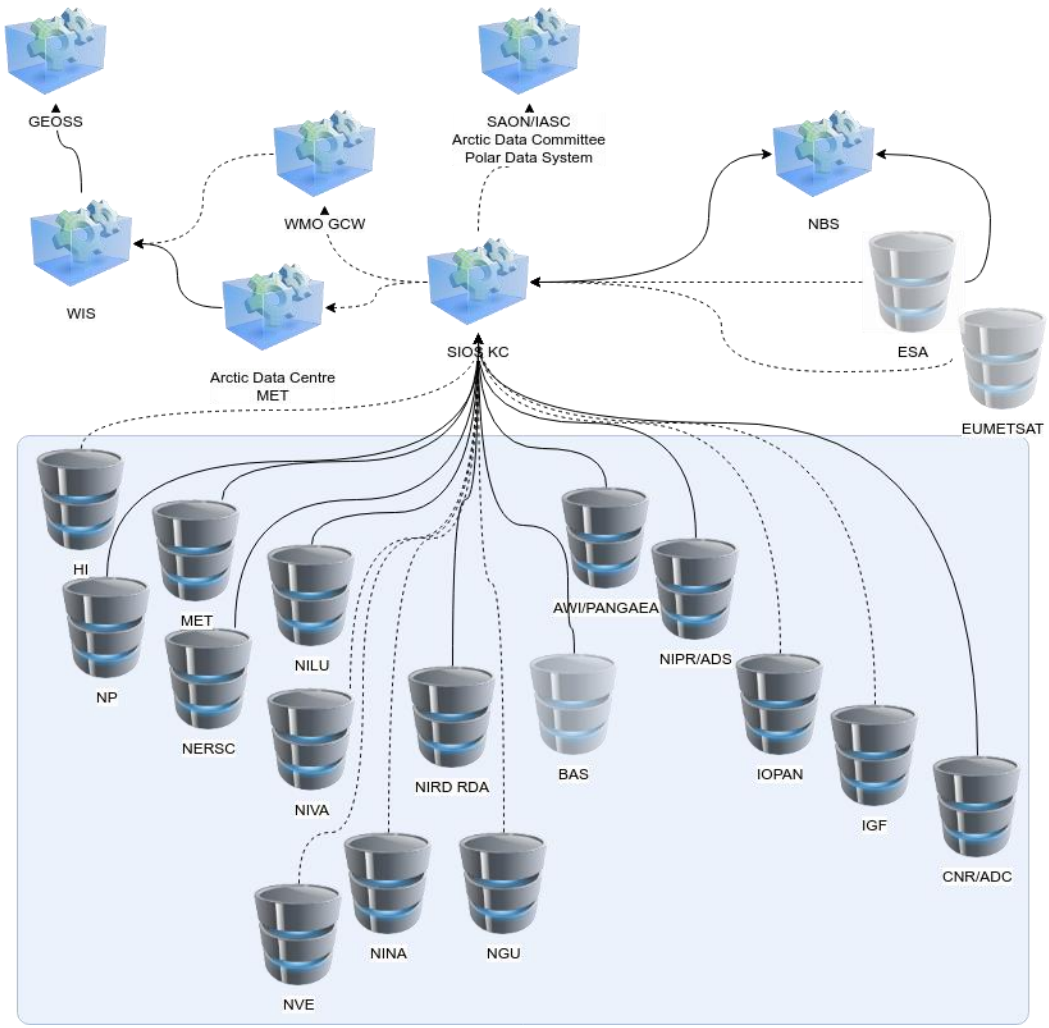
Key SDMS functions in order of priority

1. Data discovery, finding and linking to relevant datasets across distributed data repositories

2. Retrieval of data, the process of downloading data identified in the previous step

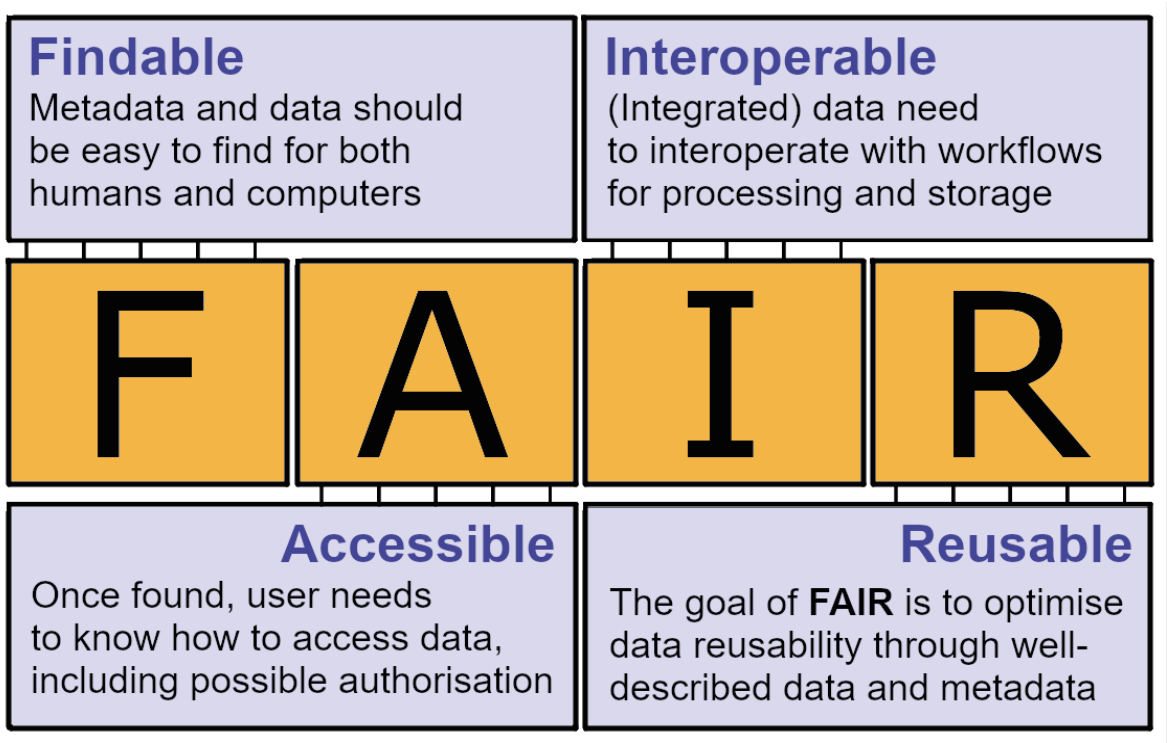
3. Visualisation of data, graphical interpretation of a dataset (as a map, a time series or appropriate)

4. Transformation of data: reformat, reproject, subset and combine datasets



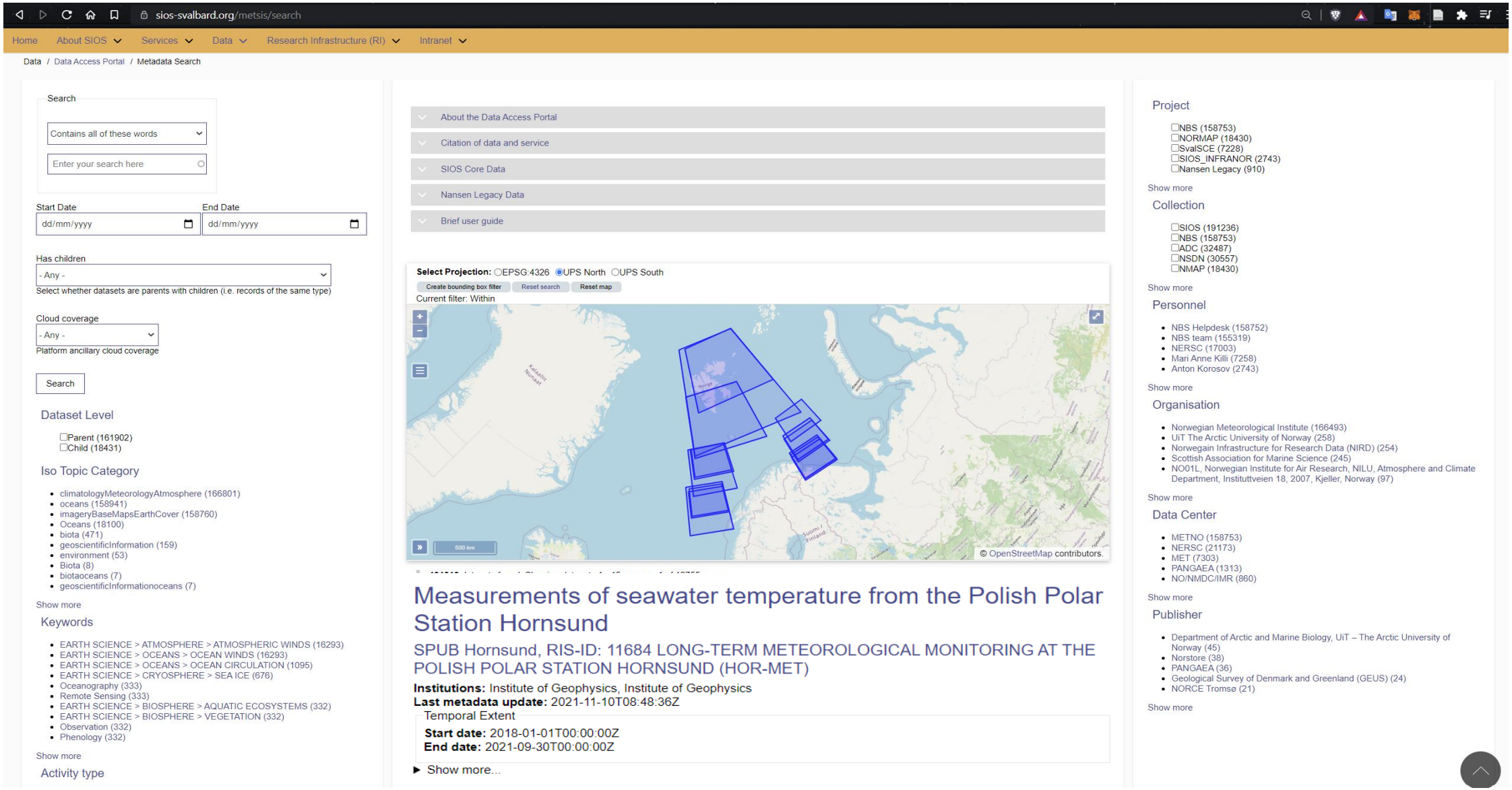
SIOS Data Sharing Principles

- All of the data, metadata and products within SIOS shared openly and fully
- Made available through the SDMS with minimal delay and at minimum cost
- Compliance with FAIR* principles for scientific data management & stewardship



*Wilkinson et al. 2016 - doi: 10.1038/sdata.2016.18

Data Access Portal



SIOS

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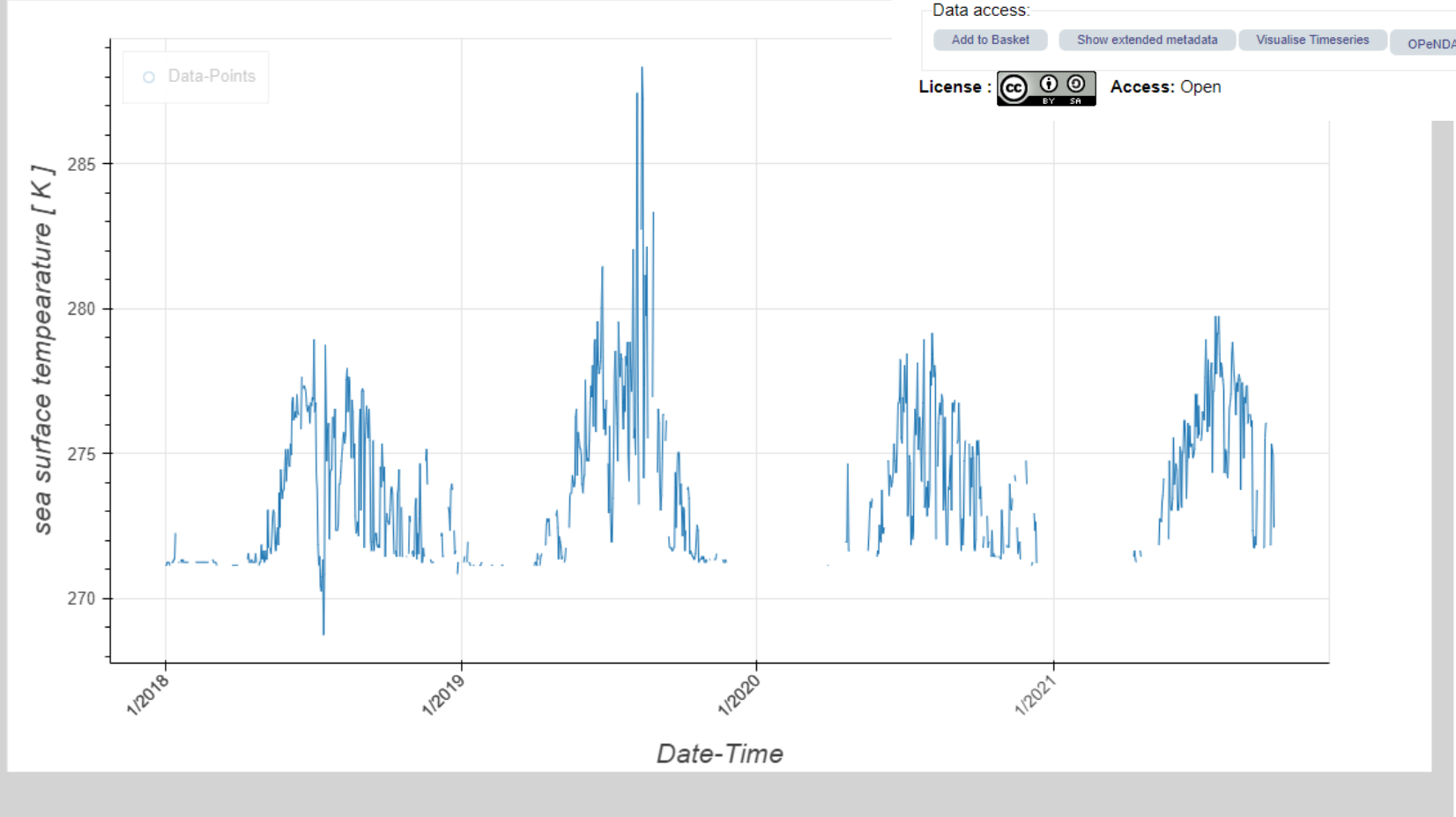
SST data from Hornsund

Dynamic visualisation of time series

Timeseries Plot

Select variable: seaWtrTemp

Frequency: --



Measurements of seawater temperature from the Polish Polar Station Hornsund

SPUB Hornsund, RIS-ID: 11684 LONG-TERM METEOROLOGICAL MONITORING AT THE POLISH POLAR STATION HORNSUND (HOR-MET)

Institutions: Institute of Geophysics, Institute of Geophysics
Last metadata update: 2021-11-10T08:48:36Z

Temporal Extent

Start date: 2018-01-01T00:00:00Z
End date: 2021-09-30T00:00:00Z

▶ Show more...

Dataset Landing Page

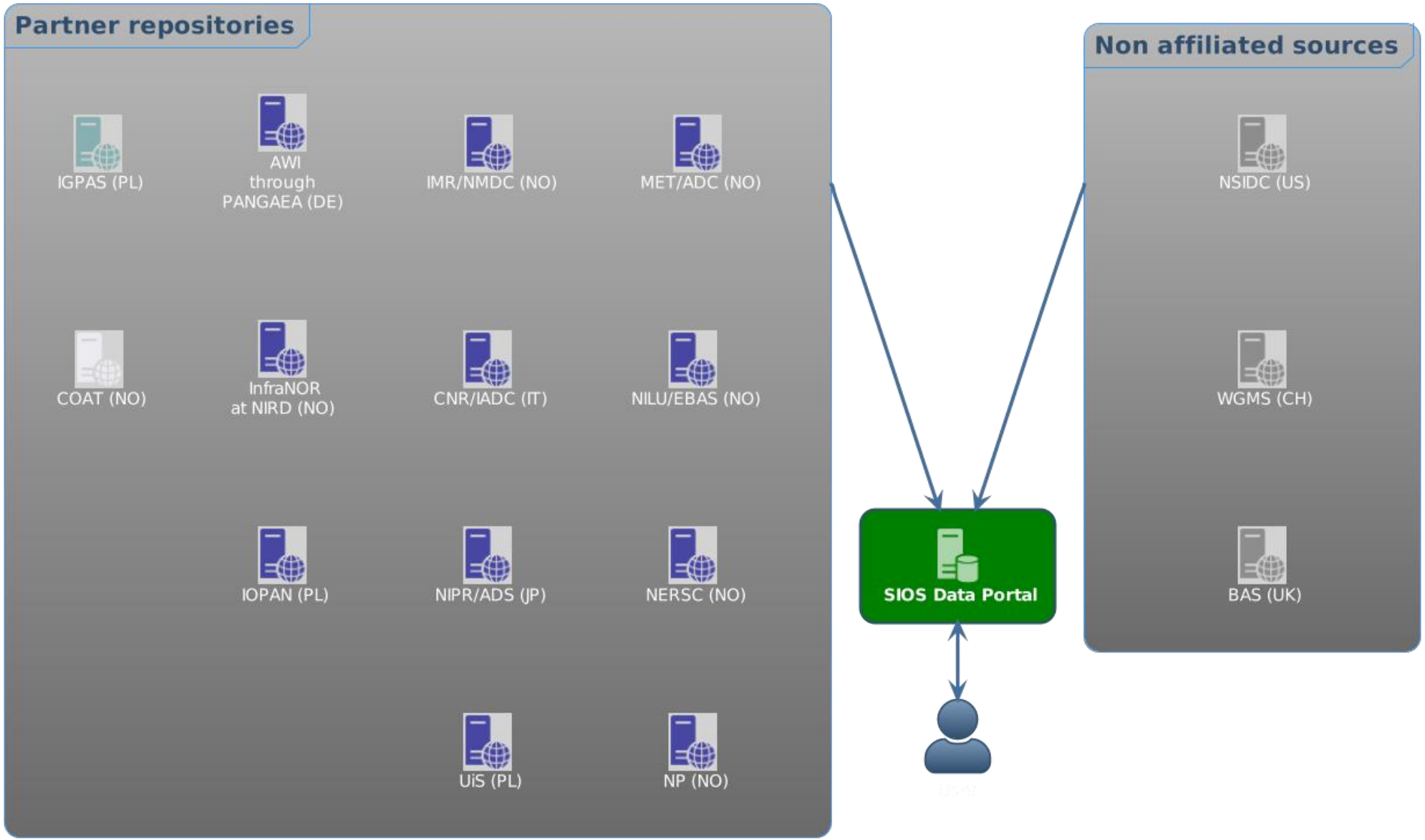
Data access:

Add to Basket | Show extended metadata | Visualise Timeseries | OPeNDAP | Download as ASCII | Export Metadata

License : **Access:** Open

SIOS

www.sios-svalbard.org


Partner repositories
IGPAS (PL)
AWI through PANGAEA (DE)
IMR/NMDC (NO)
MET/ADC (NO)
COAT (NO)
InfraNOR at NIRD (NO)
CNR/IADC (IT)
NILU/EBAS (NO)
IOPAN (PL)
NIPR/ADS (JP)
NERSC (NO)
UiS (PL)
NP (NO)
SIOS Data Portal
Non affiliated sources
NSIDC (US)
WGMS (CH)
BAS (UK)

Data delivery

- Uploading dataset to repository and connecting to SDMS
  - FAIRness varies depending on data publisher & repository
  - Some require rich metadata and others allow to dump in whatever

1. Regularly harvested data centres
2. Or non-affiliated data centre + add details through metadata collection form

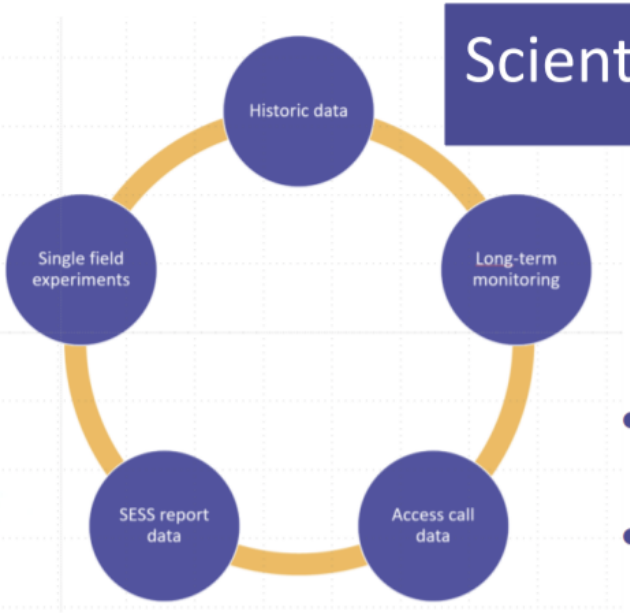
- Available upon request authors etc. – not accepted for SIOS Data

Data delivery – formatting and Dataset FAIRness

- Recommended formats for SIOS data, and required for SCD are
  - NetCDF4 that are compliant with the CF convention and ACDD
  - Darwin Core Archive (DwC-A) for biodiversity and species occurrence records

- Some major challenges with dataset FAIRness
  - Limited knowledge in what's required to make data FAIR by data producers
  - It takes time and effort. Priorities defined by getting ongoing project done, whether the datasets are openly available after is of limited concern
  - Datasets with automatic pipelines for data delivery (such as ARGO/AWS) have more mature practices than typical campaign-based datasets
  - It is tempting to prefer the path of least resistance when publishing data

Criteria for SIOS Core Data



Scientific requirements

- answer the key research questions in Earth System Science (ESS)
- characterised by the Essential Climate Variables (ECVs) defined by The Global Climate Observing System (GCOS), WMO standards and the Global Change Master Directory (GCMD) Keywords
- identified by The Science Optimisation Advisory Group (SOAG)

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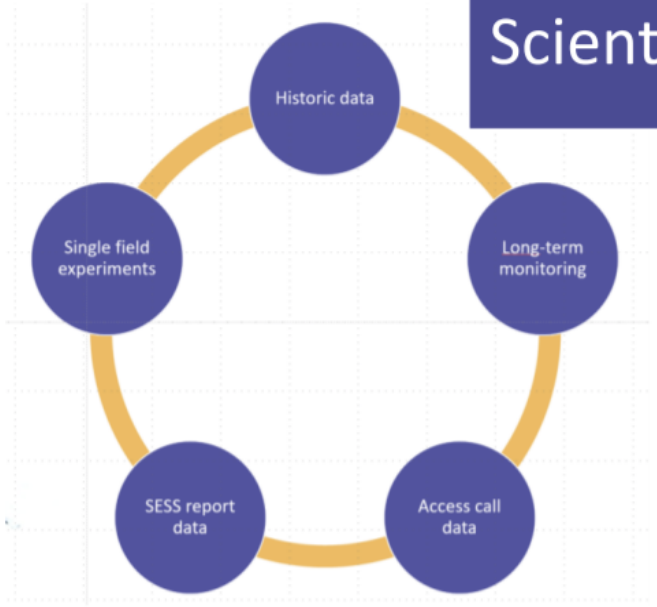
Criteria for SIOS Core Data



Scientific requirements

Members commitment

- Institutional commitment to maintain measurements for 5+ years

SVALBARD INTEGRATED ARCTIC EARTH OBSERVING SYSTEM

Criteria for SIOS Core Data

Scientific requirements

Members commitment

Data availability

- SIOS core data should be available through SIOS Data Access Point
- Data must be described with rich metadata
- Institutional commitment to provide timely access to data

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Current SCD datasets

29 of 51 variables are available as SCD
37 of 51 variables are described as SCD-C

SIOS Core Data SCD4 Oceans

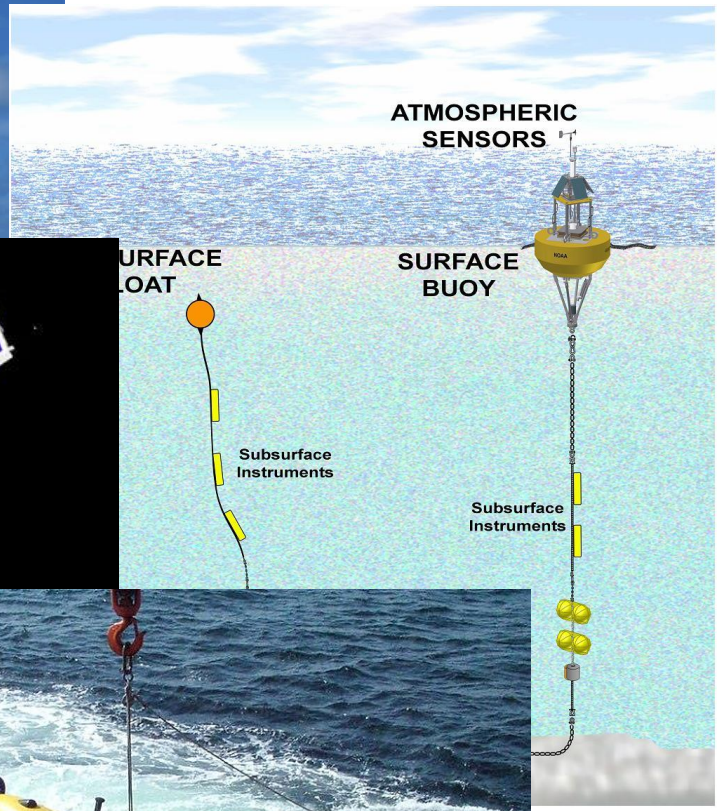
Submitted on Mon, 04/20/2020 - 16:11

- SCD 4.1 SEA SURFACE HEIGHT
- SCD 4.2 SEA LEVEL RISE
- SCD 4.3 OCEAN CURRENTS
- SCD 4.4 SEA SURFACE TEMPERATURE
- SCD 4.5 SALINITY
- SCD 4.6 OCEAN HEAT BUDGET
- SCD 4.7 SEA STATE
- SCD 4.8 WATER TEMPERATURE
- SCD 4.9 CHLOROPHYLL CONCENTRATIONS

VARIABLES	SCD	SCD-C
SCD 1.1. WIND SPEED	YES	YES
SCD 1.2. WIND DIRECTION	YES	YES
SCD 1.3. AIR TEMPERATURE	YES	YES
SCD 1.4. NET RADIATION	YES	YES
SCD 1.5. SHORTWAVE RADIATION	YES	YES
SCD 1.6. LONGWAVE RADIATION	YES	YES
SCD 1.7. 24 HOUR PRECIPITATION AMOUNT	YES	YES
SCD 1.8. HUMIDITY	YES	YES
SCD 1.9. UPPER AIR TEMPERATURE	YES	YES
SCD 1.10. UPPER LEVEL WINDS	YES	YES
SCD 1.11. CLOUD TYPES	NO	YES
SCD 1.12. CLOUD HEIGHT	YES	YES
SCD 1.13. WATER VAPOR FLUX	NO	NO
SCD 1.14. CARBON DIOXIDE	YES	NO
SCD 1.15. NITROGEN DIOXIDE	YES	NO
SCD 1.16. OZONE	YES	NO
SCD 1.17. METHANE	YES	NO
SCD 1.18. AEROSOL OPTICAL DEPTH/THICKNESS	YES	YES
SCD 1.19. AEROSOL PARTICLE PROPERTIES	NO	YES
SCD 1.20. CHEMICAL COMPOSITION	NO	YES
SCD 1.21. CO2, FLUX	NO	NO
SCD 1.22. CH4, FLUX	NO	NO
SCD 1.23. AEROSOL IN SITU ABSORPTION	NO	YES
SCD 1.24. AEROSOL IN SITU SCATTERING	NO	YES
SCD 1.25. BLACK CARBON	NO	YES
SCD 1.26. U/V WIND COMPONENTS	NO	NO
SCD 1.27. TURBULENCE	NO	NO
SCD 1.28. VERTICAL WIND VELOCITY/SPEED	NO	YES
SCD 1.29. All-sky (630.0 nm, 557.7nm, 427.8 nm., cloud observ	NO	YES
SCD 1.3. Nem(F2), hm(F2) - Peak values ionosphere F2 layer	NO	NO
SCD 2.1. GLACIER MASS BALANCE	YES	YES
SCD 2.2. GLACIER ELEVATION	YES	YES
SCD 2.3. ICE VELOCITY	YES	YES
SCD 2.4. PERMAFROST TEMPERATURE	YES	YES
SCD 2.5. ACTIVE LAYER	NO	YES
SCD 2.6. PERMAFROST	NO	NO
SCD 2.7. GROUND ICE	NO	YES
SCD 2.8. SNOW DEPTH	YES	YES
SCD 2.9. SNOW WATER EQUIVALENT	NO	YES
SCD 2.10. SNOW COVER	YES	YES
SCD 2.11. SNOW/ICE TEMPERATURE	YES	YES
SCD 3.1. SOIL MOISTURE/WATER CONTENT	YES	YES
SCD 4.1. SEA SURFACE HEIGHT	NO	YES
SCD 4.2. SEA LEVEL RISE	NO	NO
SCD 4.3. OCEAN CURRENTS	YES	YES
SCD 4.4. SEA SURFACE TEMPERATURE	YES	YES
SCD 4.5. SALINITY	YES	YES
SCD 4.6. OCEAN HEAT BUDGET	NO	NO
SCD 4.7. SEA STATE	NO	NO
SCD 4.8. WATER TEMPERATURE	YES	YES
SCD 4.9. CHLOROPHYLL CONCENTRATIONS	YES	YES

Data production

- Research vessels/ cruises
- Moorings/buoys
- Satellites
- Citizen science
- Drones/AUVs/ Drifters/gliders

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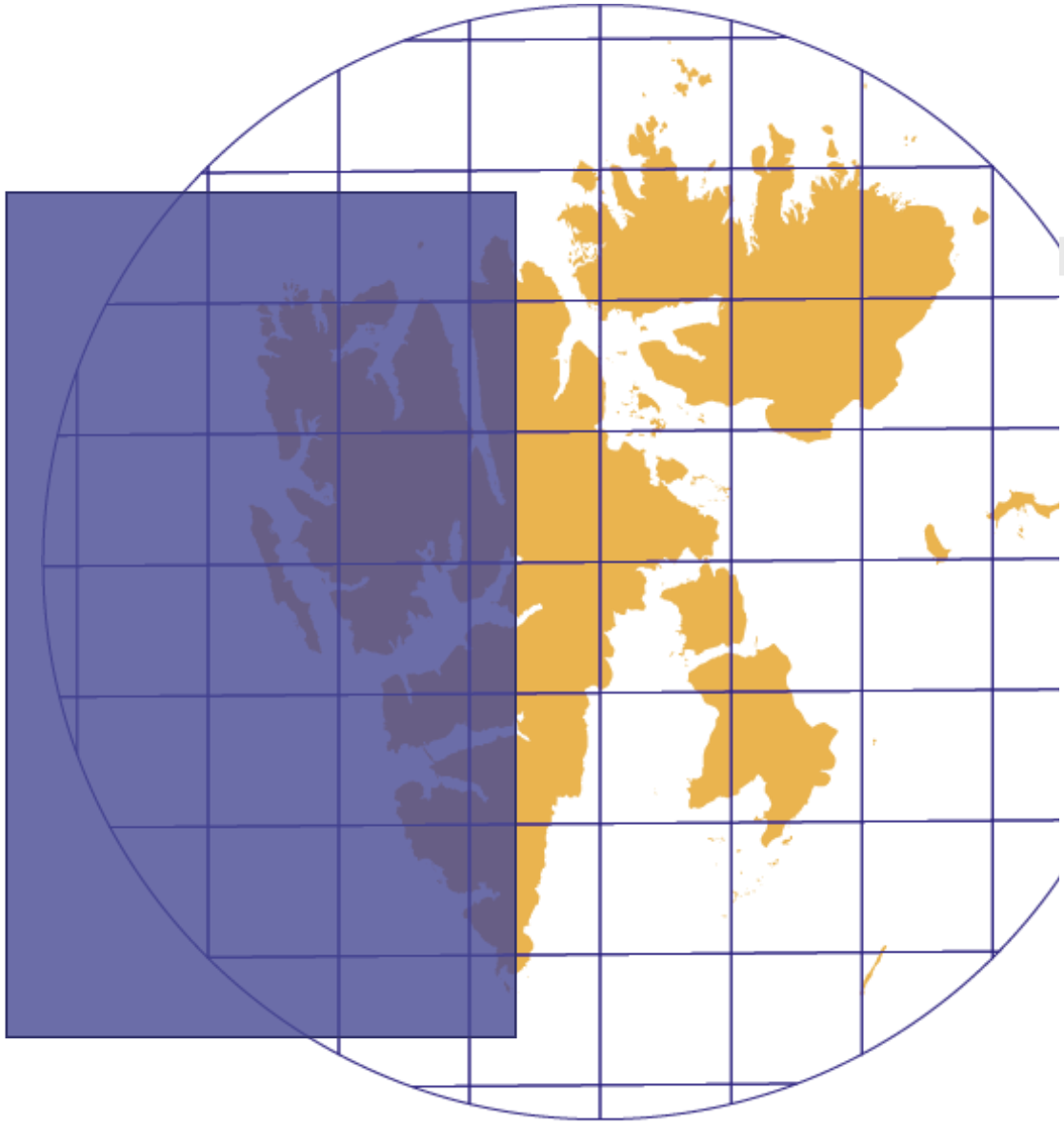
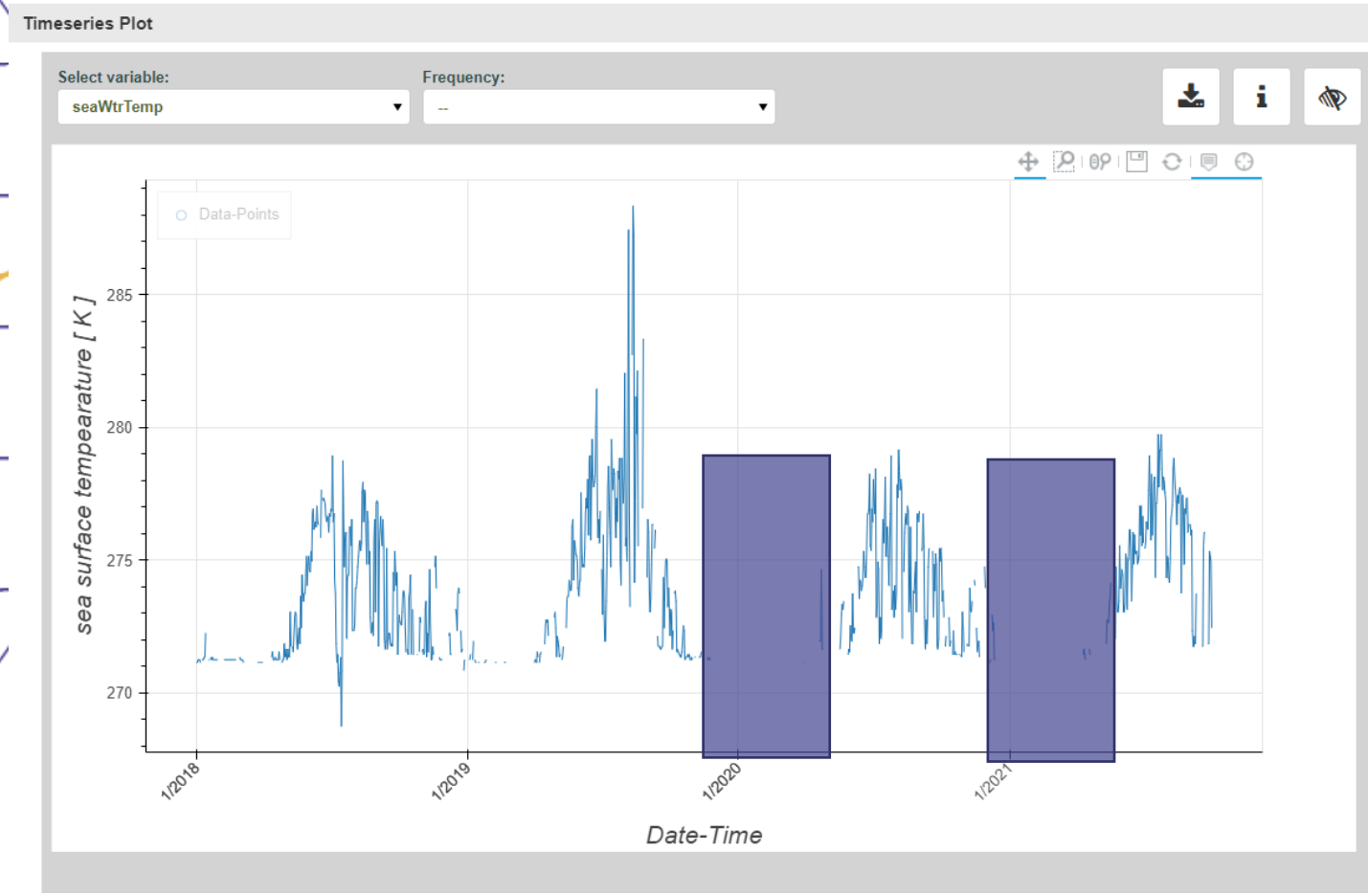
Data coverage





CHAPTER 6

Since 2005 a five-fold increase in the macroalgal cover has been observed in western Spitsbergen. In northern and eastern Svalbard, most rocky shores are still barren due to sea ice scouring. (Bohemanneset. Photo: Josef Wiktor, IOPAN)

Environmental status of Svalbard coastal waters: coastscapes and focal ecosystem components (SvalCoast)

HIGHLIGHTS

- First coastscape mapping of Svalbard
- Recent warming and sea-ice loss has increased intertidal species richness and biomass in western Svalbard
- Ecological losers include cold-adapted species that rely on sea ice
- The next decade's greatest environmental changes are expected in northeastern Svalbard

AUTHORS

JE Søreide (UNIS)
V Pitusi (UNIS)
A Vader (UNIS)
B Damsgård (UNIS)
[illegible] (UNIS)
[illegible] (UNIS)
AM Bailey (NPI)
KM Kovacs (NPI, UNIS)
C Lydersen (NPI)
S Gerland (NPI)
S Descamps (NPI)
H Strøm (NPI)
[illegible] (UNIS)
P Graczyk (NORCE)
D Moiseev (MMBI)
RK Singh (UQAR)
S Bélanger (UQAR)
J Elster (CPE USB)
J Urbański (GU)
M Moskalik (IG PAS)

Navn Etternavn, Svalbard

Tidewater glacier fronts are important feeding areas for seabirds and marine mammals. The Ice Front coastscape is particularly vulnerable to climate change. (Photo: Kit M Kovacs and Christian Lydersen, NPI)

RECOMMENDATIONS

- Monitor environmental and ecosystem trends in both warm and cold regions in Svalbard
- Improve international coordination and cooperation to develop and maintain the infrastructure and activities required to achieve a more holistic coastal observatory in Svalbard
- Generate a list of Svalbard-specific standard coastscapes (i.e. nature types)
- Agree on a list of essential focal ecosystem components (e.g. bio-indicators) to be monitored in these coastscapes
- Adopt new methods (e.g. molecular methods) and technology (e.g. autonomous observatories, remote sensing) to secure cost-efficient long-term data series

and biodiversity are under growing pressure as climate change and human activities increase in the region. More data on the rates of change in the physical, chemical and biological environments in these highly dynamic and heterogeneous coastscapes are urgently needed. Svalbard is warming more rapidly than anywhere else in the Arctic, and the Arctic is warming at 2-3 times the rate of other areas globally. Svalbard experiences steep climate gradients due to being situated at the interface between warm Atlantic and cold Arctic waters. Warming is creating a huge potential for increased colonisation by boreal species, with potential negative impacts on "native" species assemblages and food webs. Changes in physical drivers and biodiversity patterns must be documented to predict upcoming challenges and opportunities as the Arctic changes. This synopsis is the first joint effort across nations, institutes, and disciplines to address current gaps in knowledge and monitoring of Svalbard's coast – a result of the international workshop Svalbard Sustainable Coasts in Longyearbyen, February 2020. Another important task of this synthesis work was to look into the applicability of the defined coastscapes and biodiversity tools in the Arctic Coastal Monitoring plan, initiated by the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF, www.caff.is), for Svalbard.

SVALBARD INTEGRATED ARCTIC EARTH OBSERVING SYSTEM

State of Environmental Science in Svalbard:
Synthesizing the recommendations of the first 4 years

21 October 2022

Based on SESS reports

10 chapters published that focussed on marine environment

51 recommendations therein

Topics such as:

- Oceanic Circulation
- Ocean-atmosph. Interact.
- Plankton monitoring
- Sea ice thickness
- Microplastic pollution
- Svalbard coastal waters

Recommendations from marine WG

One of the key messages was that data harmonization is an important need for interdisciplinarity and collaboration

Recommendation: Extend the geographical and temporal coverage of research activities around Svalbard and include more biogeochemical measurements

Recommendation: Enhance year-round observations to resolve seasonal variability in the ocean around Svalbard

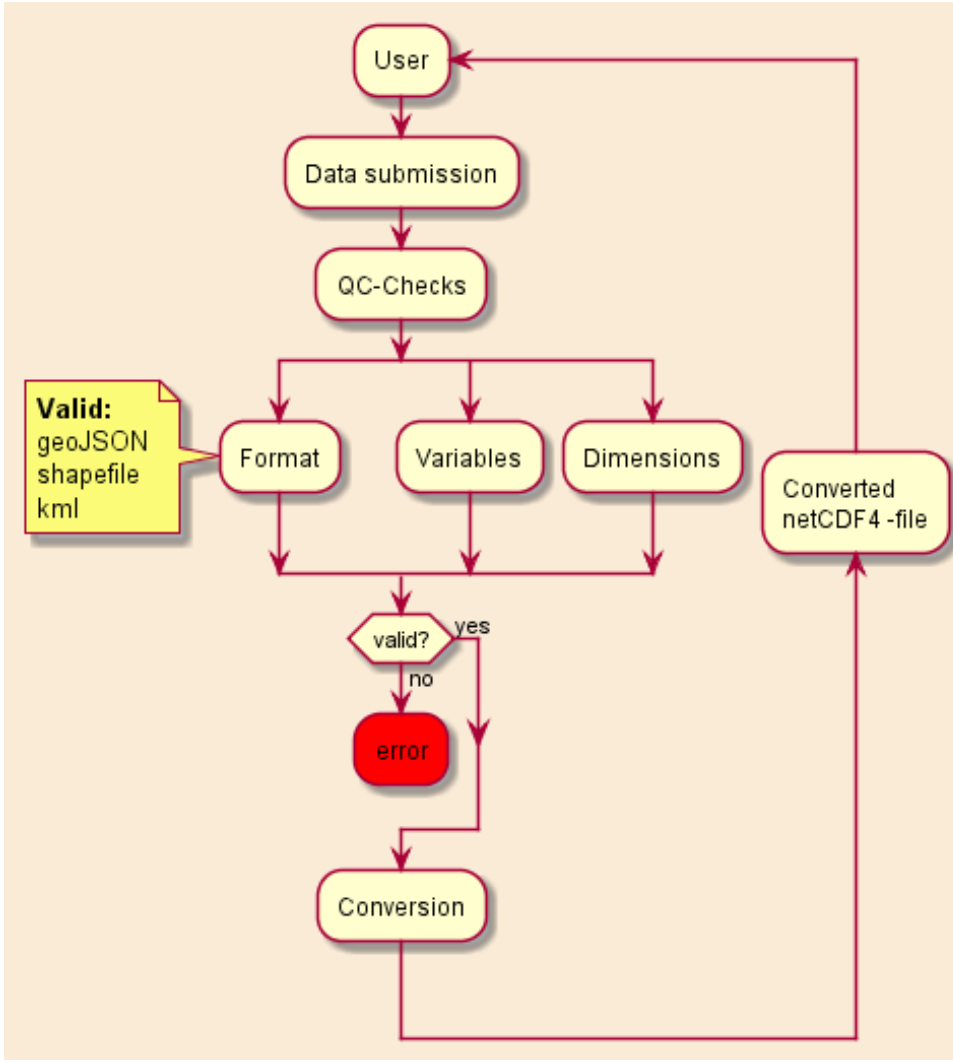
Recommendation: Support research activities exploring linkages between fjord, shelf and open ocean systems.

Recommendation: Establish long-term year-round monitoring of marine biota

Data delivery – current gaps to address

- Data publication in the community can be an afterthought instead of integral part of project planning
- Even with stressing out the importance of data management when funding (SESS) projects, the message gets lost during the project work
- Tools such as metadata template generator and Rosetta aim to address these gaps,

  -> make it easier for users to create metadata records
- Raising awareness of what are the benefits of making data FAIR



Summary

- Good data practices are developing in the community but still work to do
- Limitations in regional and seasonal coverage are biggest issues in data production
- Limited practices/skills/motivation in creating sufficient metadata is a limitation for data delivery/availability