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Event code: # SIOS



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Event code: # SIOS



You can use your smartphone/laptop to ask questions to the presenters during the talks

Questions will be answered after the talks, there will also be the possibility to ask questions in the room



14:30 – 14:40: Heikki Lihavainen - Introduction

14:40 – 14:50: Vito Vitale – Simple technology to improve capabilities of autonomous observations and/or new sets of measurements

14:50 – 15:00: Ilker Fer – Water-column observations at high latitudes using ocean gliders

15:00 – 15:10: Rune Storvold: The new SIOS Research Aircraft at Svalbard, sensors, capacities and opportunities for Arctic Science

15:10 – 15:20: Shridhar Jawak: Role of emerging technologies in Earth observation and remote sensing to complement the sustained observing system in Svalbard

15:20 – 16:00: Interactive Q and A session using SliDo



Event code: # SIC

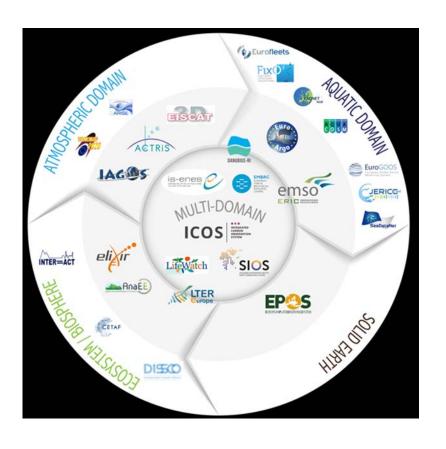
SIOS – an international collaboration to create a regional observing system for Arctic Earth System Science

The regional scope

 The Norwegian archipelago Svalbard and surrounding waters





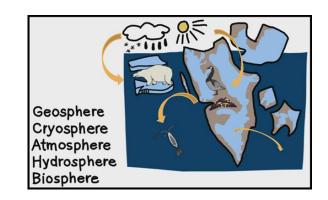


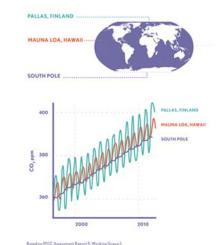


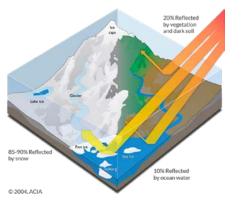
SIOS – an international collaboration to create a regional observing system for Arctic Earth System Science

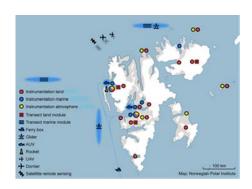
The Observing System

- A cooperating international research infrastructure for improved knowledge of environmental and climate change in the Arctic
- Focus to answer Earth System Science questions
- Systematic long term observations stable over time, yet dynamic as new questions from society arise
- Minimizing environmental footprint, optimizing measurements and resources, new technologies, remote sensing
- Open, free and harmonized data









New technologies and innovations:

- New instrumentations
- Improved measurements/observations
- New methodologies and approaches
- Integration of various data (e.g. remote sensing and in situ)



New technologies and innovations:

- Decrease environmental impact
- Cost efficient, cheaper to buy and/or to maintain
- Improve spatial and/or temporal resolution
- New applications
- Research and development
- Help to adapt to future conditions caused by a changing Arctic.



This session will explore the needs and possibilities but also barriers of new technologies and innovative observing methods in the Arctic.

Unleashing the potential of Arctic research



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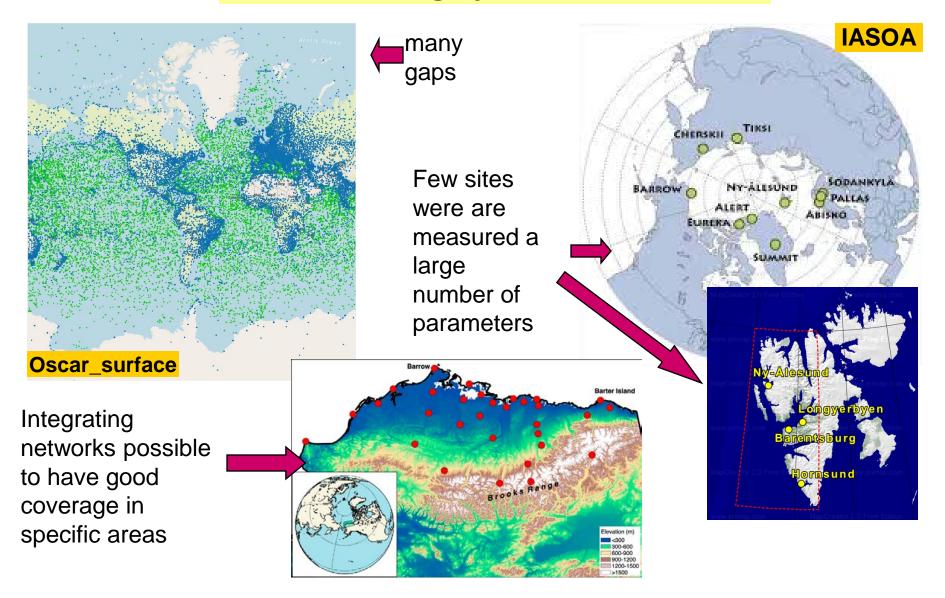
Event code: # SIC

Simple technology to improve capabilities of autonomous observations and/or new sets of measurements

Vito Vitale Senior Scientist CNR — Institute of Atmospheric Sciences and Climate (ISAC)



The observing system in the Arctic





GCOS currently specifies 54 ECVs:

Our needs

ATMOSPHERIC

Surface: air temperature, wind speed and direction, water vapour, pressure, precipitation, surface radiation budget

Upper-air: temperature, wind speed and direction, water vapour, cloud properties, Earth radiation budget, lightning

Composition: carbon dioxide, methane, other long-lived greenhouse gases, ozone, aerosol, precursors for aerosol and ozone

OCEANIC

Physics: temperature: sea surface and subsurface; salinity: sea surface and subsurface; currents, surface currents, sea level, sea state, sea ice, ocean surface stress, ocean surface heat f ux

Biogeochemistry: inorganic carbon, oxygen, nutrients, transient tracers, nitrous oxide, ocean colour

Biology/ecosystems: plankton, marine habitat properties

TERRESTRIAL

Hydrology: river discharge, groundwater, lakes, soil moisture, evaporation from land Cryosphere: snow, glaciers, ice sheets and ice shelves, permafrost

Biosphere: albedo, land cover, fraction of absorbed photosynthetically active radiation, leaf area index, above-ground biomass, soil carbon, fire, land surface temperature Human use of natual ressources: water use, greenhouse gas fluxes

ECV are identified based on the following criteria:

Relevance: The variable is critical for characterizing the climate system and its changes.

Feasibility: Observing or deriving the variable on a global scale is technically feasible using proven, scientifically understood methods.

Cost effectiveness: Generating and archiving data on the variable is affordable, mainly relying on coordinated observing systems using proven technology, taking advantage where possible of historical datasets.



Challenges/Barriers

instruments are few times developed considering extreme conditions; even if this occur weakenesses can be found	
due geography (an ocean surrounded by lands) very difficult to observe central Arctic (also from satellite); need to extend marine and	
atmospheric measurements. difficulty to have access to measurement sites (always or for large	ASK FOR REMOTE STATIONS
part of the year); for environmental reasons impossible to realize new manned stations	
limitations for both power supply and communication	
need to observe a larger complexity (we have one more important sphere, cryosphere, that strongly interact with othere spheres) as well as the vertical dimension (marine/atmosphere column)	ASK FOR MULTI- DOMAIN OBSERVA TIONS
□	



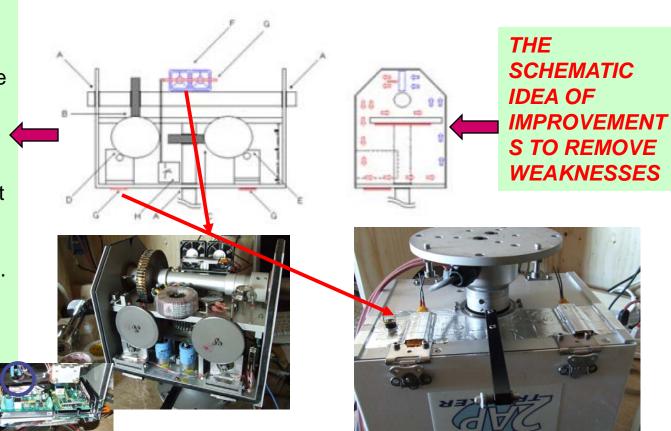
Assure the work of a solar tracker

WEAKNESSES

(1) Position of the heaters and the absence of ventilation, tend to produce strong T stratification

(2) step motor drivers at the base can produce strong thermal stress on delicate electronic comp.

(3) No pre-heating of the tracker limits on-site maintenance



A heating self-regulating element of 50 W (G) was installed on the upper part, while two fans (F) force air flow inside the tracker.

The supplemental internal heating element and fans are independently powered at 12V DC. Our independent heating system is regulated through a thermostat (H) located near the sensible step motor drivers.

On the external side of the case bottom, two heating elements of 70W/220V (G) were installed, powered through the 2AP power cable.



A PCL-based control unit

We developed a PCL-based control unit, based on two electronic boards (power board + control board) and dedicated firmware providing the intelligence to drive three selected heating technologies (heating resistances, peltier cells, heat pipes) to regulate/control the temperature at which instruments should operate. The system is able to control non only the target temperature but also as much as possible thermal gradients internal to the heated box.



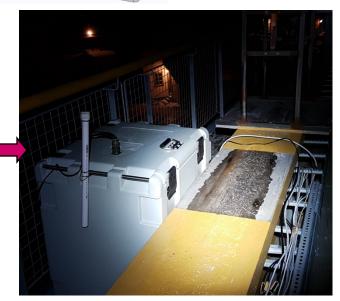






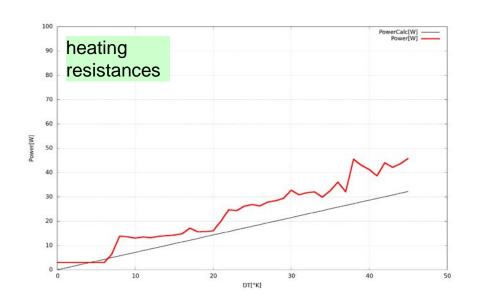


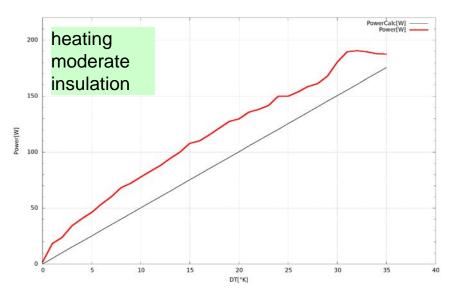
A test system installed on the roof of Sverdrup Station (Ny Alesund (winter 2017)





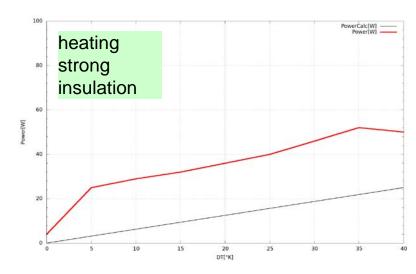
The control unit performances





Comparison of effective and theoretical Qt heat transferred

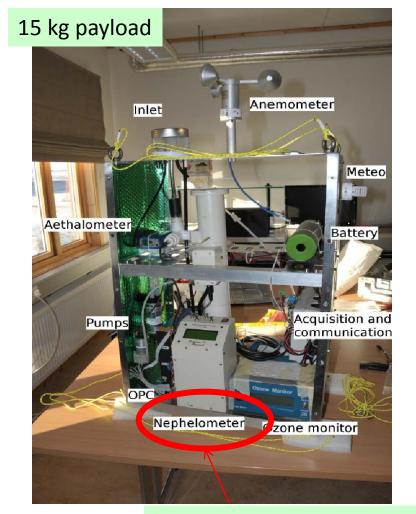
- ➤ Our control unit is able to drive with a good efficiency the heating/cooling devices up to temperature differences DT between internal and external temperatures of about 40° C.
- ➤ difference in the graphs provide a quantitative estimates of the efficiency of the system as a whole, removed power not used for thermal regulations. On average was of about 3 W for test systems based on heating resistances, while ranged from 10 W to 20 W for the test systems based on Peltier cells and different insulation.





AGAP - An atmospheric gondola for aerosol profiling

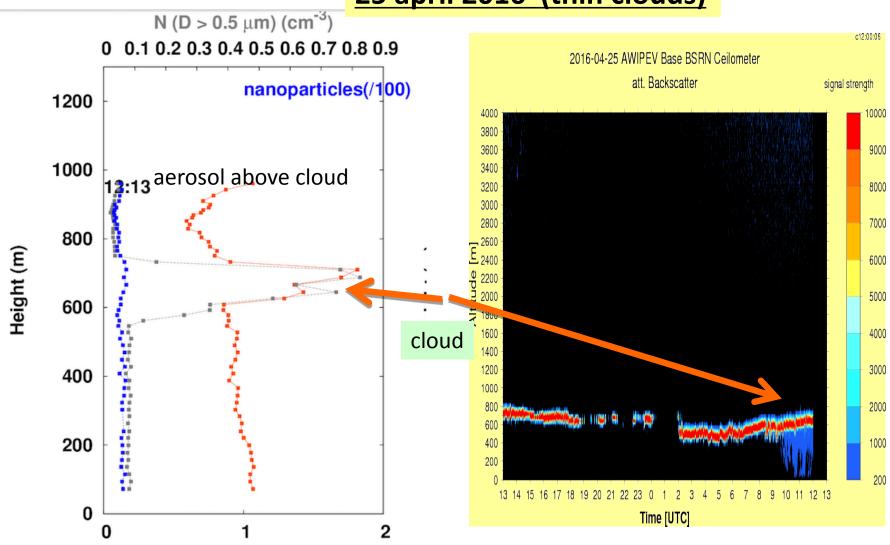






Aerosol in and above cloud

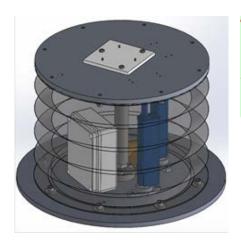
25 april 2016 (thin clouds)



N (0.28 < D < 0.5 μ m) (cm⁻³)



Radiation measurements on a ship



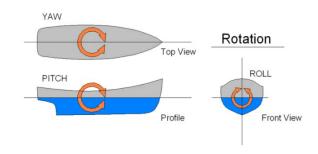
TARGET: development of a system able to mantain the

horizontal reference

APPLICATIONS: radiation measurements on a mobile platform (ship,

buoy), telemetry etc.







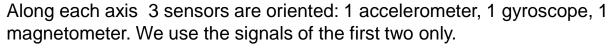








The Inertial measurement UNIT

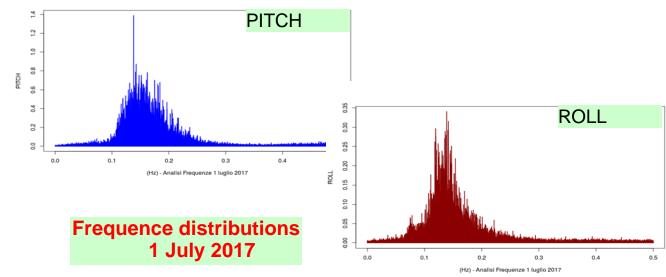


the accelerometers allow, by detecting the gravitational acceleration, to calculate the angles of roll and pitch.

The gyroscopes measure the angular velocity [degree / s], and processed able to remove acceleration component induced by translation movements on the axis.

The IMU unit is connected to the custom board CPU, and provides all the data necessary to the PID algorithm to calculate the movements along the axes (dirention and speed).

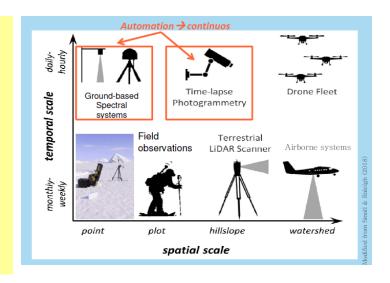






VIS-NIR characterization of snow-ice surfaces

spectroradiometric measurements with an integrated suite of instruments are the key to obtain information a different spatial scales and identify the different type of snow surfaces in satellite images



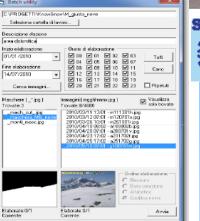
The new IIA web cam on CCT will collect panoramic photos from which derive snow cover fraction







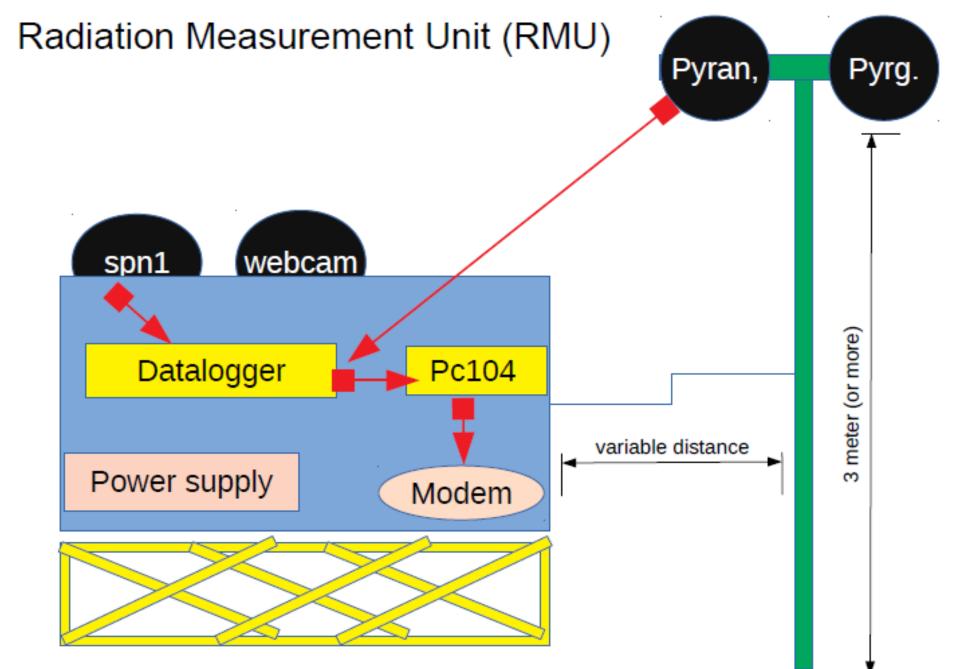




SnownoSnow software returns automatically "fraction of snow cover areas"

bard.org







Calibration of CCT sensors













How SIOS can help

provide a powerful platform to share knowledge and experiences among research groups and (more important) disciplines
fostering integration of measurements (e. g. for several ECVs) also introducing new technologies
providing more opportunity to test technologies and carry out inter- comparisons
facilitate access to infrastructures and geographycal areas (e. g. marine areas around Svalbard)







Water-column observations at high latitudes using ocean gliders

http://norgliders.gfi.uib.no

Ilker Fer

Geophysical Institute, Bergen, Norway



A Slocum glider

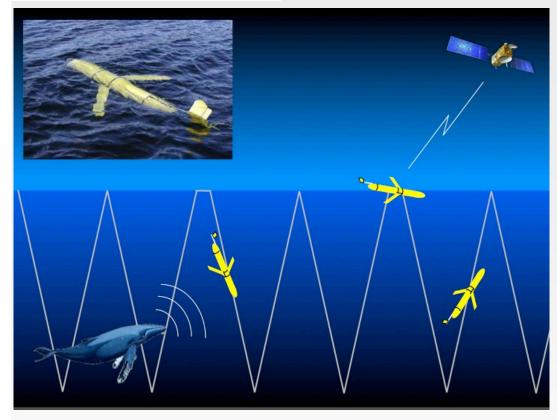
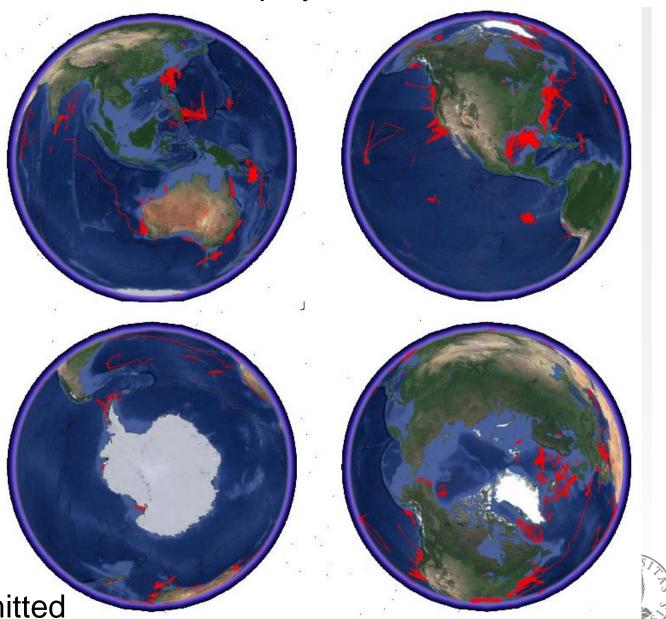


Image from Boomer Science

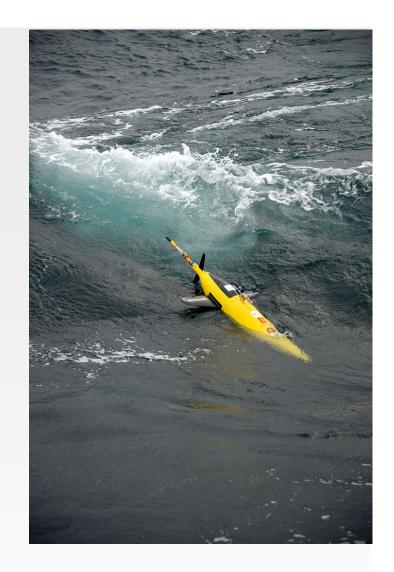
Testor et al.

OceanObs'19 submitted

Glider tracks of deployments until Oct. 2018



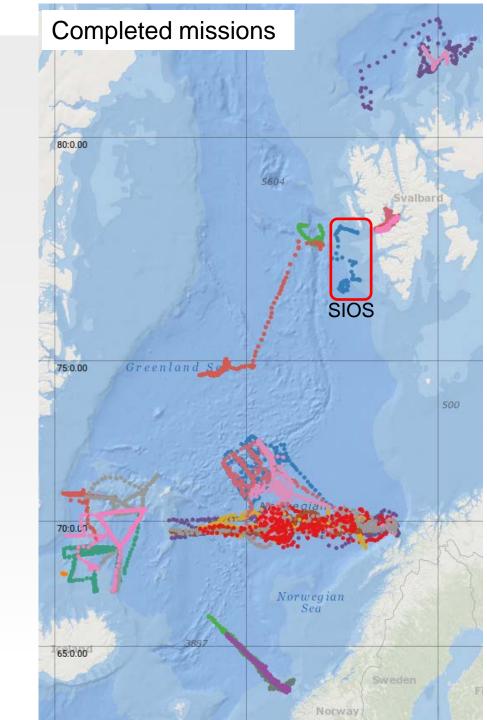
- Aid in oceanographic observations:
 - sustainable, fine resolution observations even in severe weather conditions
 - upper 1000 m, 4-6 h cycle,20-25 km/day horizontal speed
 - 3-12 mon. deployments
- Significantly improve under-sampling:
 - equipped with a multitude of sensors
 - fine resolution and long term sampling
- Impact ocean modeling:
 - NRT data to ocean modelling and forecast
 - improved hurricane intensity forecast models
 - improved state estimates





NorGliders: Norwegian National Facility for Ocean Gliders

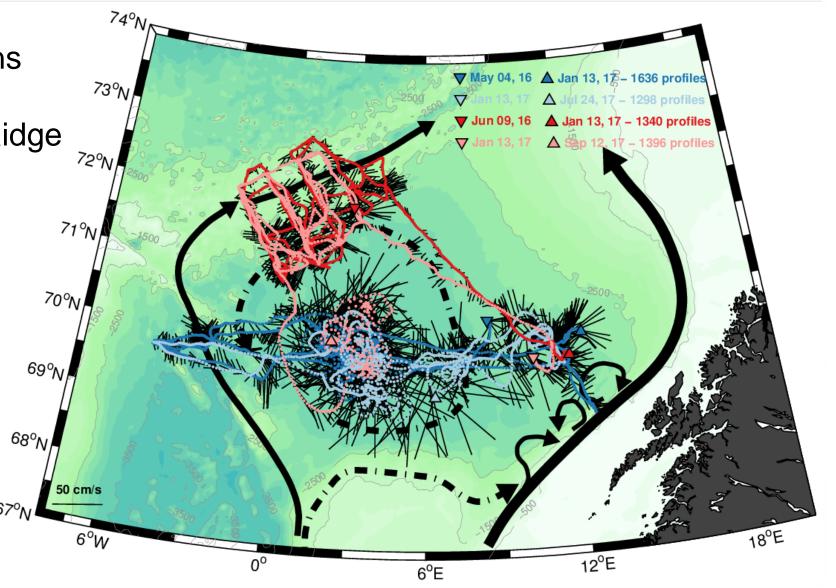
- http://norgliders.gfi.uib.no, lead Ilker Fer
- Formerly NACO (Norwegian Atlantic Current Observatory), NFR-funded infrastructure project in 2011
- As of today, 5 Kongsberg Seagliders, 2 TDW Slocums
- Piloting tool & Glider Portal developed at GFI
- A Glider Lab and 24/7 operation team of pilots
- Near real-time data delivery
- Completed missions in Norwegian Sea, Svalbard, Iceland and Greenland Seas

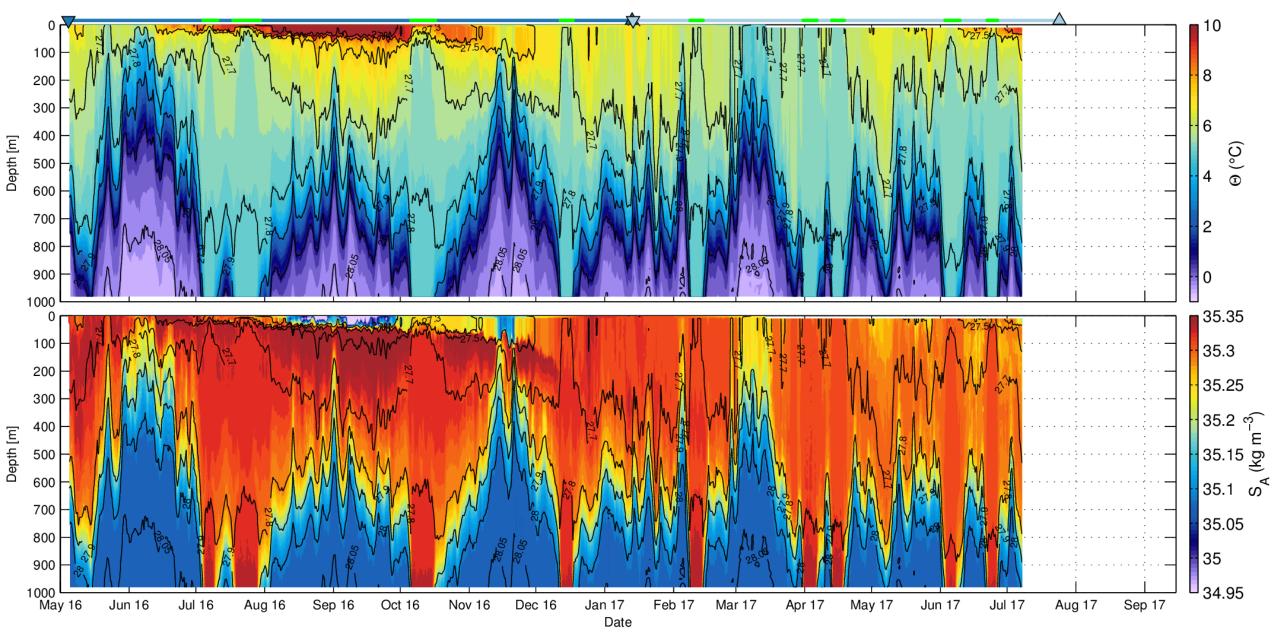


Water mass transformations and vortex dynamics:

Lofoten Basin and Mohn Ridge

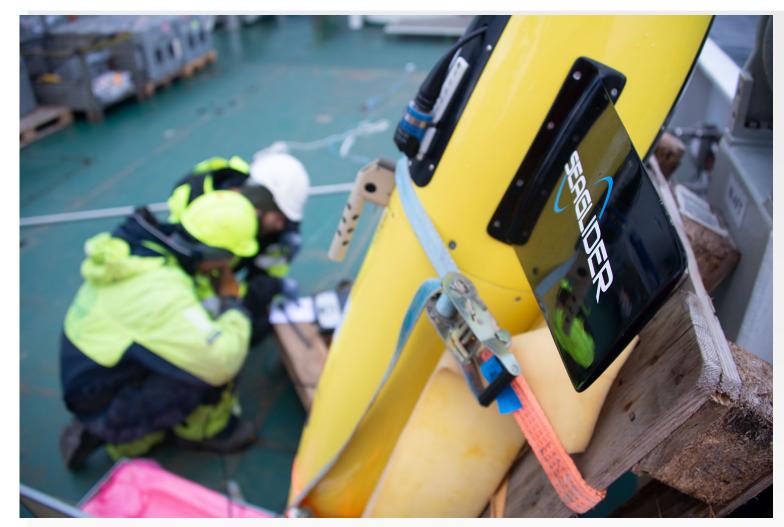


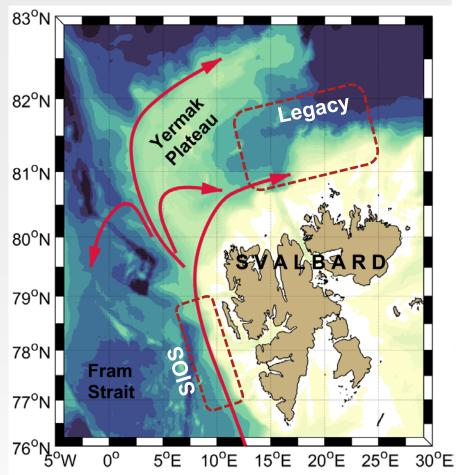




Provided by Anthony Bosse (UIB)



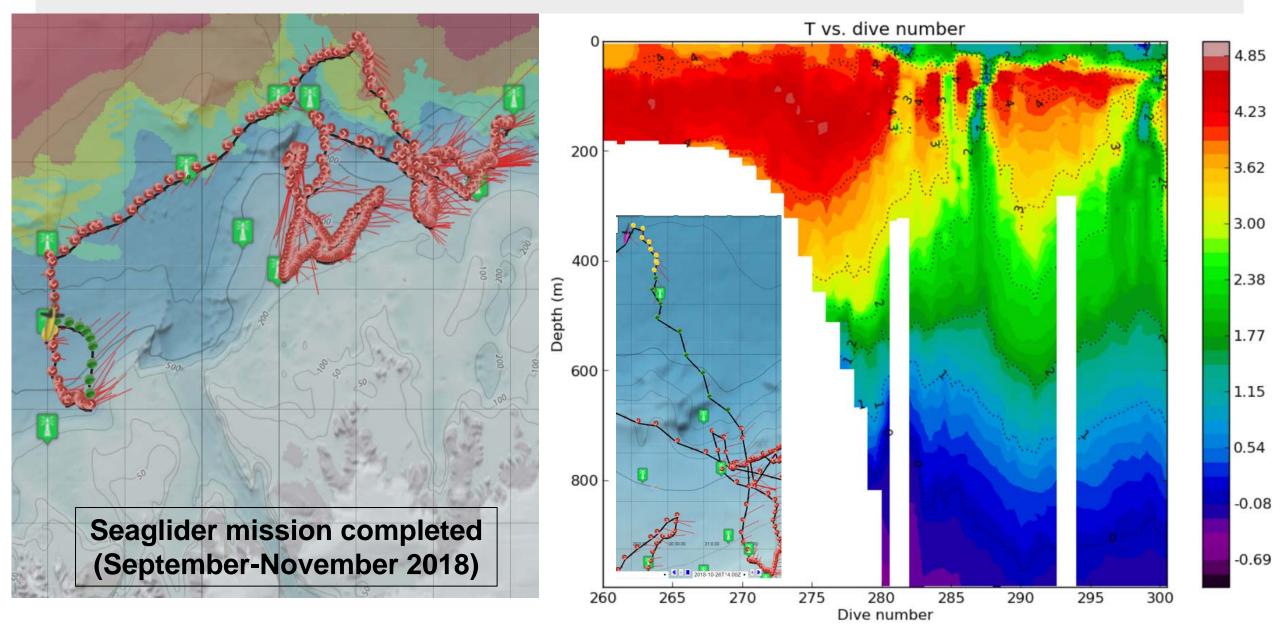




Recent Seaglider missions: the Nansen LEGACY, north of Svalbard SIOS, west of Spitsbergen

Real time data at: http://gp.gfi.uib.no/

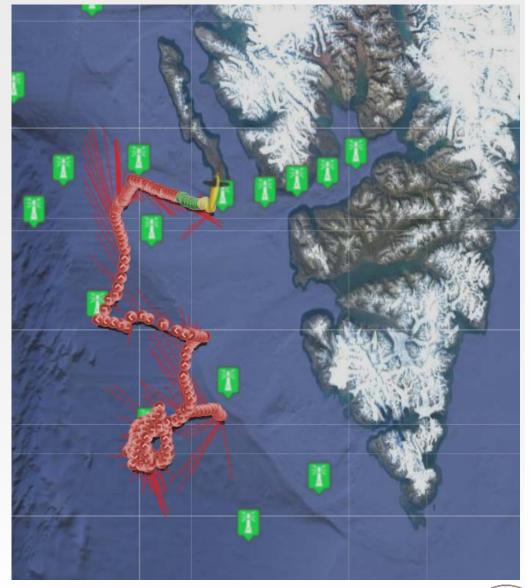




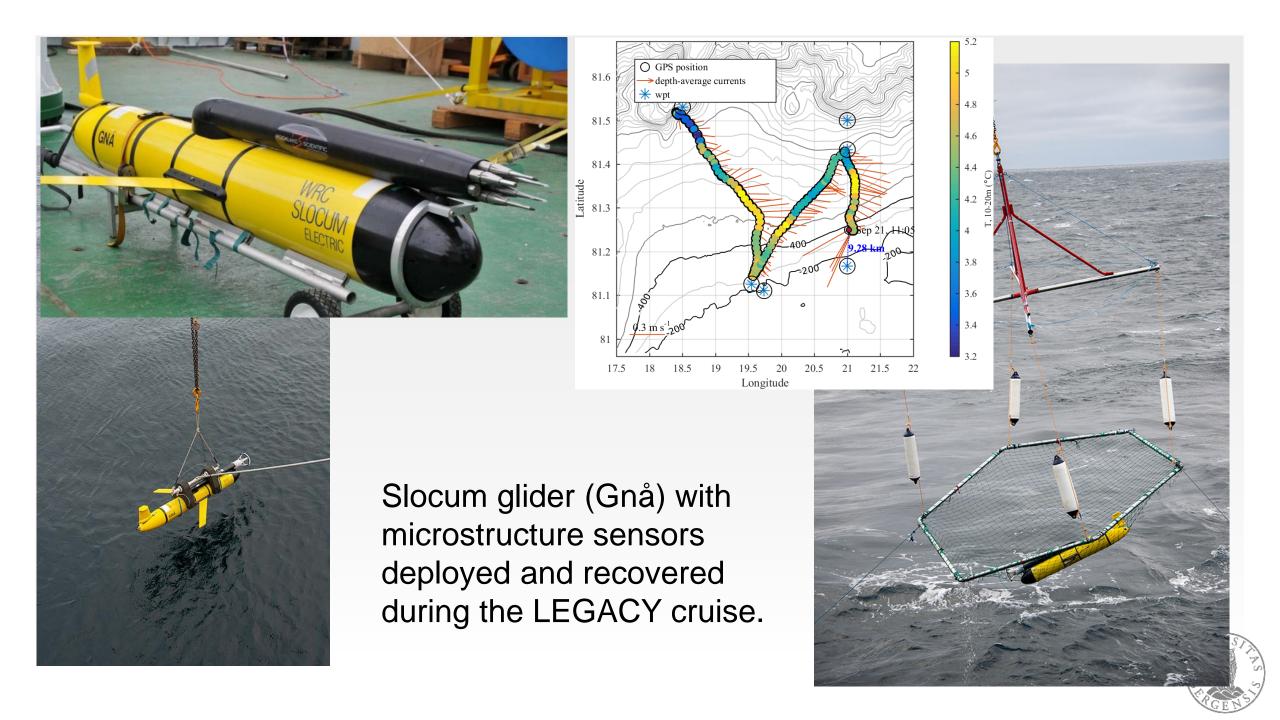


Status in SIOS InfraNOR

- 1 Slocum glider is contracted (delivery May) and will be operated West of Spitsbergen
- One Seaglider from existing NorGliders infrastructure was deployed in Oct 2018 to start SIOS operations (see map)
- Due to a failure in the conductivity sensor, mission was interrupted and glider recovered (13 Nov 18)
- The new glider is planned to be deployed in summer 2019







Conclusions

- Capacity to integrate across scales, from the coast to the open ocean, and from physics to biology
- Provide enhanced data collection and improved transfer of knowledge to policymakers; support sustainability
- Complement in situ and satellite observations; serve forecasting and state estimates
- Help improve our understanding of water mass transformations, ocean circulation, physical-biological interactions, and key processes
- Ice-avoidance capability and improved under-ice navigation capability reduce Arctic application limitations



Arctic Frontiers 2019



The new SIOS Research Aircraft at Svalbard, sensors, capacities and opportunities for Arctic Science

BODØ

Dr. Rune Storvold, Research Director, NORCE





Aircraft Performance

Dornier 228-212NG

Normal range: 2400 km

Max endurance: 6:45 hours

Max T/O Mass: 6200 Kg

Max altitude: 15000 feet

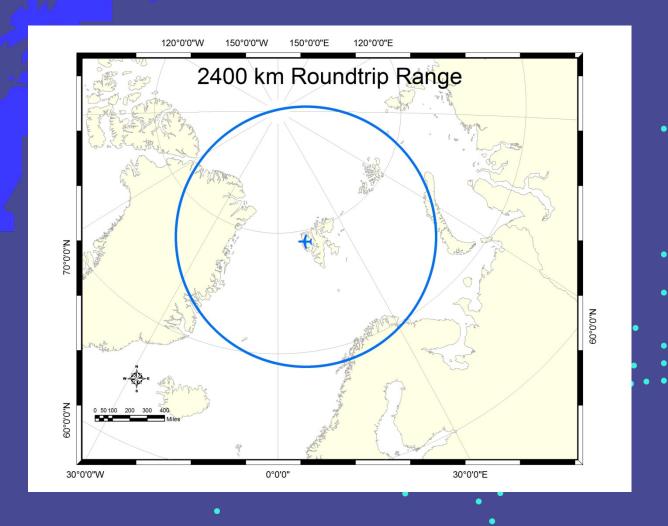
Cruise speed: 180 knots

Maximum speed: 200 knots

Seat capacity: 2 pilots / 17

passengers





Sensor Systems

- GNSS (Applanix POS AV V6 410)
- Hyperspectral Imager (VNIR-1800)
- Radionor UAV-179
- Kongsberg AIS
- Phase One IXU150 (51 Mpix)
- (FFI Radar, X-band SAR)





Sensor Systems

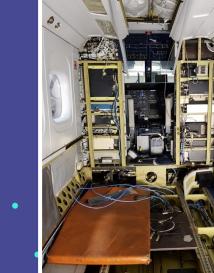
Space prepared for future expansion:

- Hyperspectral (SWIR 900 2500nm)
- Thermal camera
- Laser scanner



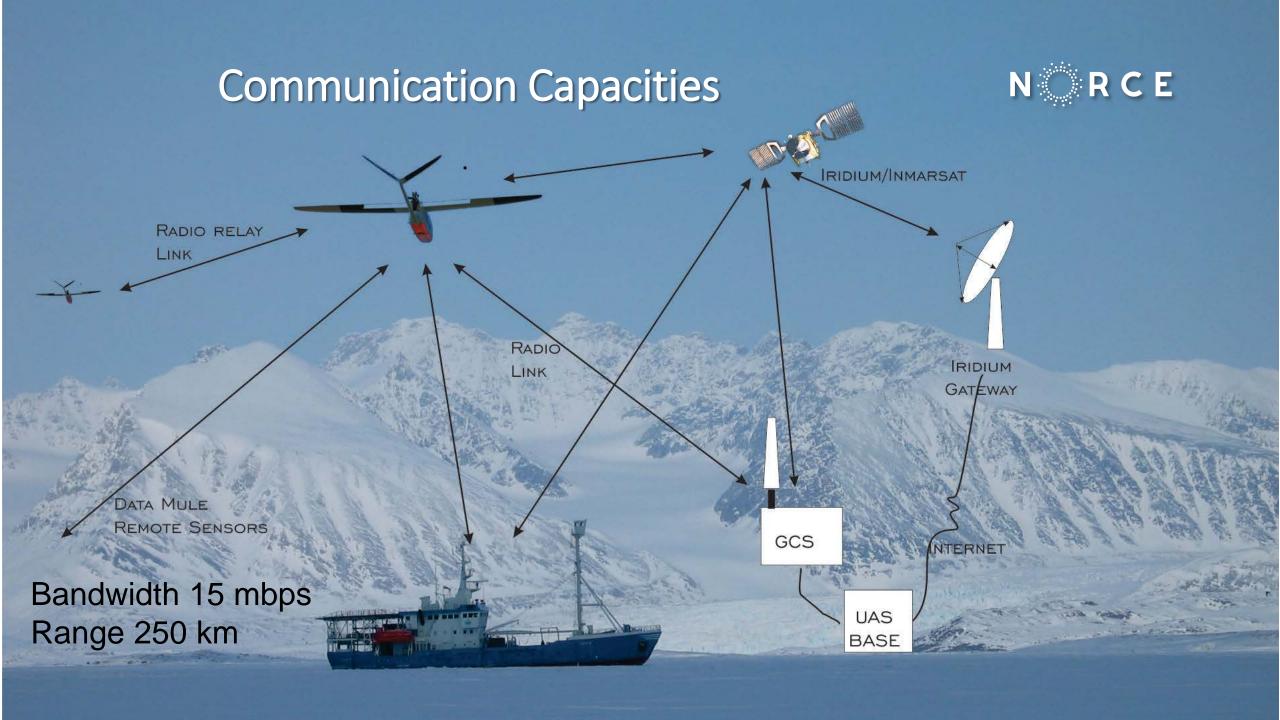










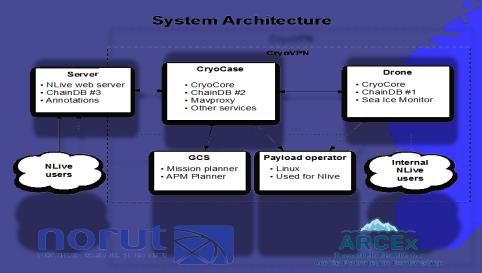


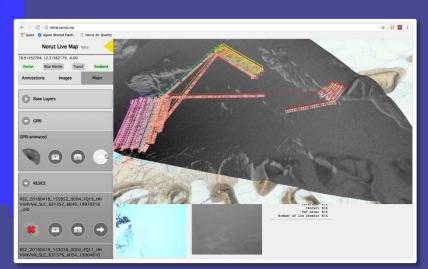
Real Time Mission Control



<u>CryoCore:</u> Real time control, logging and monitoring of payload and communication systems

Nlive: Sharing and collaborating with own and external sensor data (satellite data, drone data, ground sensors etc.)





Research Applications

N R C E

Sea-ice properties and dynamics

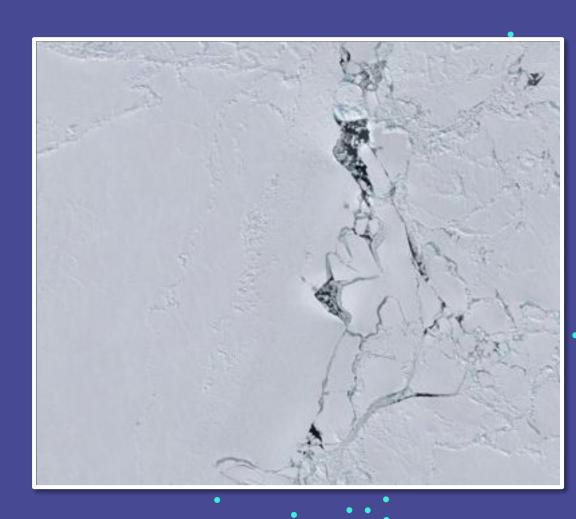
Vegetation mapping, arctic biomass

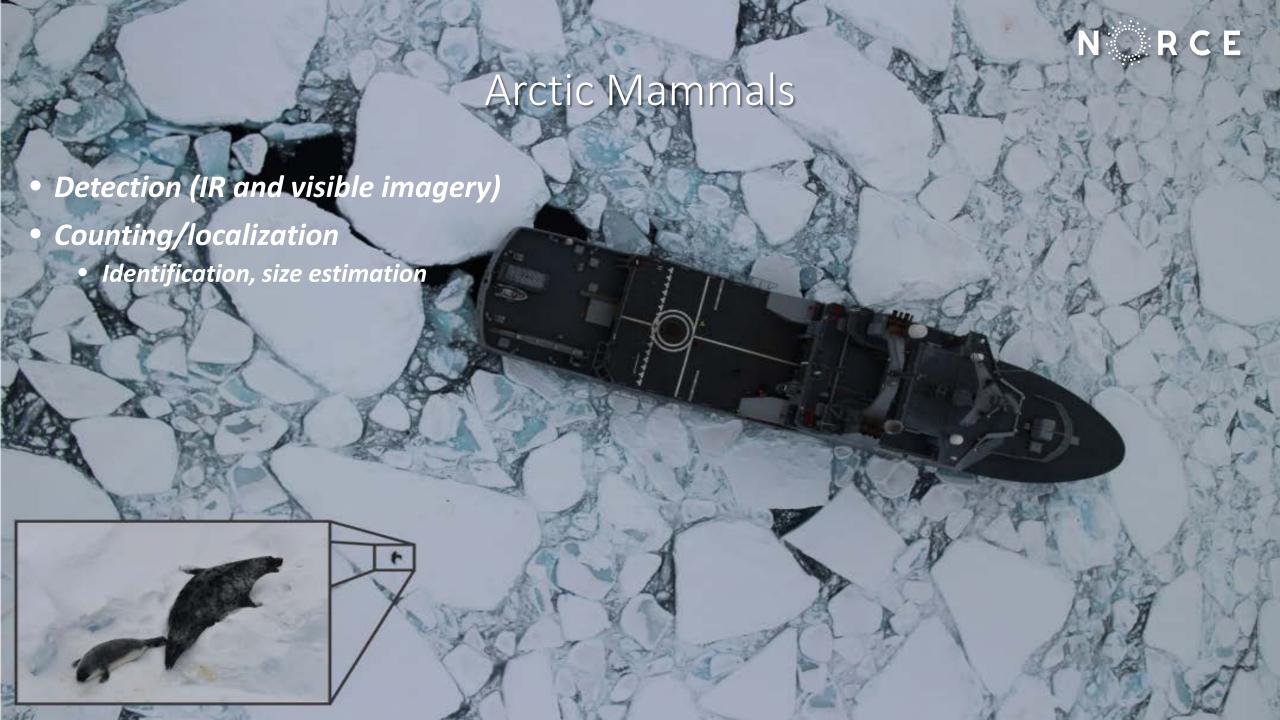
Ecosystems, population mapping

Glaciology, dynamics, mass balance

Snow cover, albedo

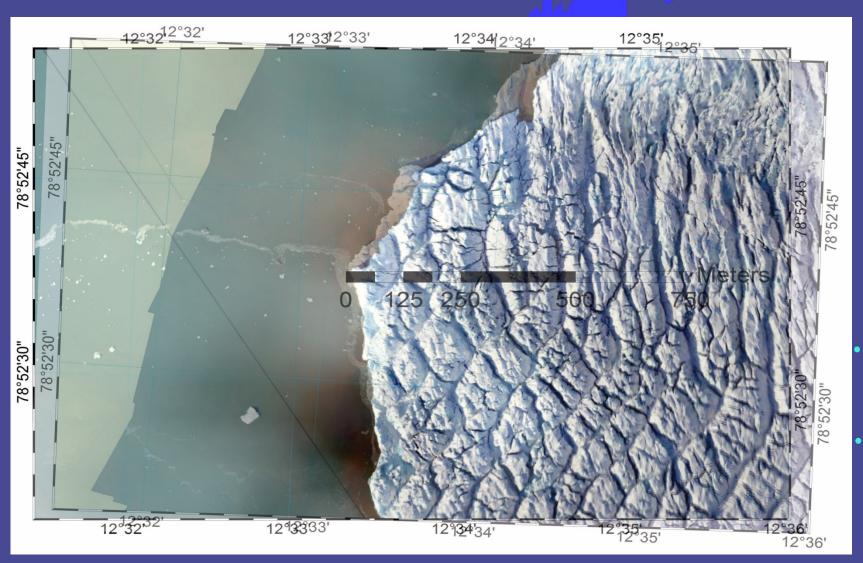
Ocean Color, primary production, algae blooms





Kronebreen 23. apr – 1. may 2015





Role of emerging technologies in Earth observation and remote sensing to complement the sustained observing system in Svalbard

Building a coherent observing system - the role of innovation and technology



Smart Arctic!

The role of innovation and technology in building a coherent observing system







Smart Arctic!

The role of innovation and technology in building a coherent observing system







Synergize
 Data from various sources

- (1) Infrastructure
- (2) Science
- (3) Safety/logistics

S

Synergize
 Data from various sources

Instigate
 Immediate benefits of merging

- (1) Infrastructure
- (2) Science
- (3) Safety/logistics





Synergize
 Data from various sources

Instigate
 Immediate benefits of merging

Operationalize
 Integration of products

- (1) Infrastructure
- (2) Science
- (3) Safety/logistics





Synergize
 Data from various sources

Instigate
 Immediate benefits of merging



Operationalize
 Integration of products

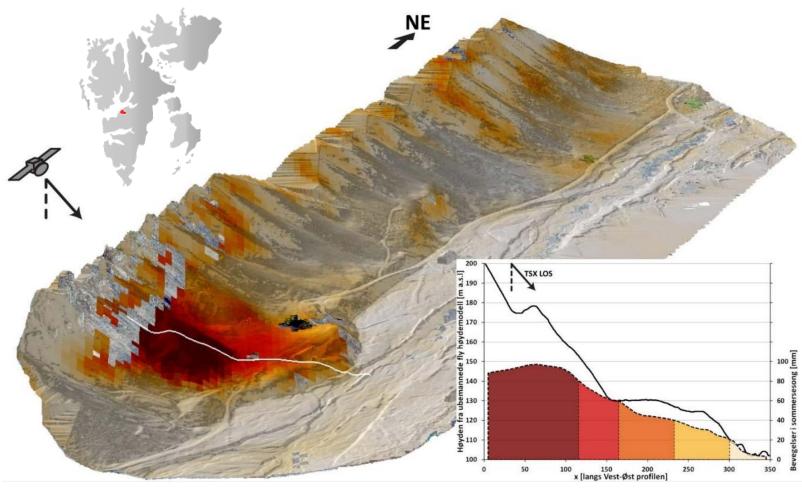


Synthesize
 New knowledge about Svalbard

- (1) Infrastructure
- (2) Science
- (3) Safety/logistics



Satellite based surface movements!



3D overview of Sverdrupbyen and the left side of the Longyear Valley from unmanned aerial elevation model and InSAR results from TerraSAR-X sensor in ascending geometry. Profile - height (black line) - and average movements in summer season (dotted line of colors per class of deformation, each 20 mm).

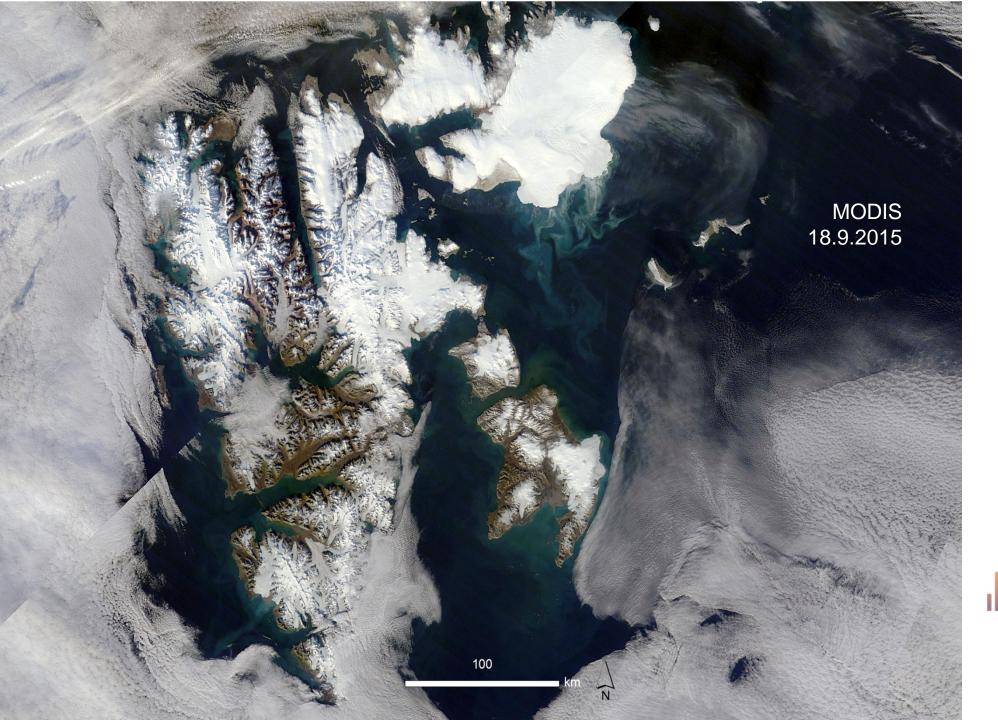
InSAR Based surface movements coupled with in situ ground validation.

The movements, averaged over **8 cm** during the summer seasons, are linked to internal deformation of a rock breach and surface depression.

During the summer of 2017 there was a big crack in the terrain and a small lake drained. This is a sign that changes in permafrost lead to increased deformation and, consequently, changes in the terrain that may affect infrastructure.

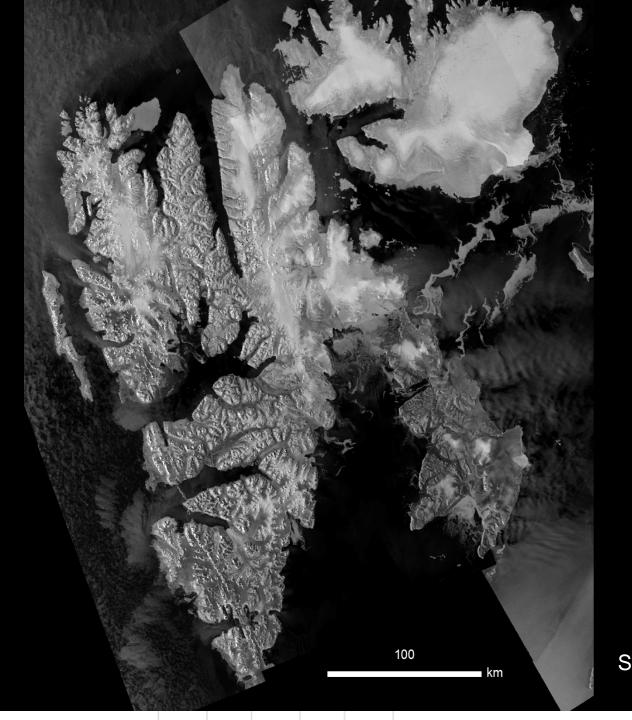






Science







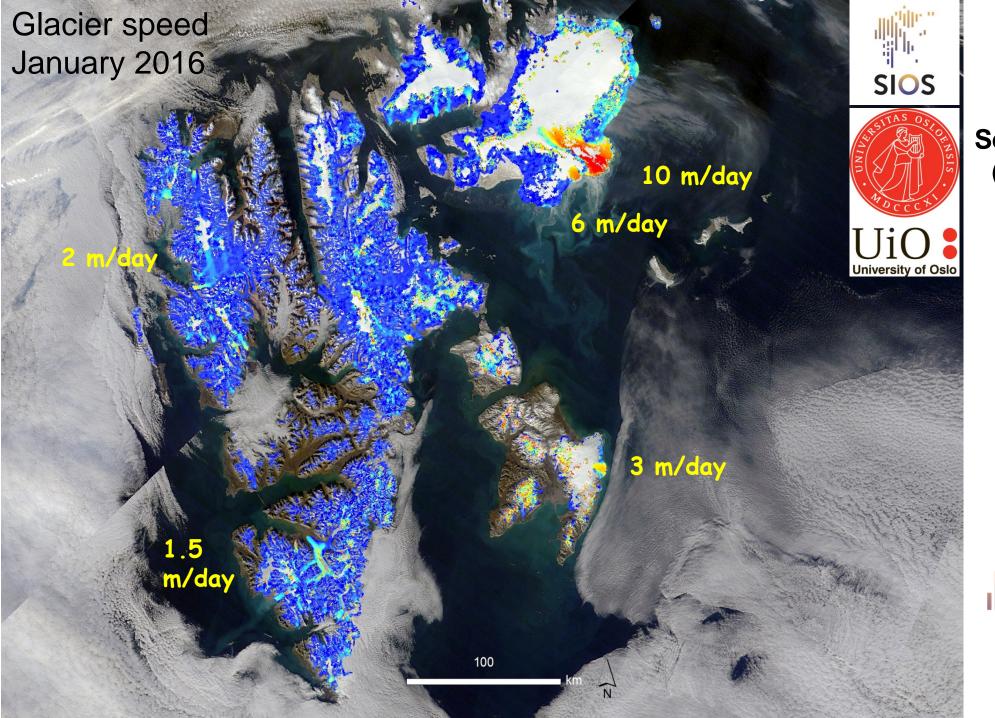


Repeat mosaics of Sentinel-1 satellite radar data



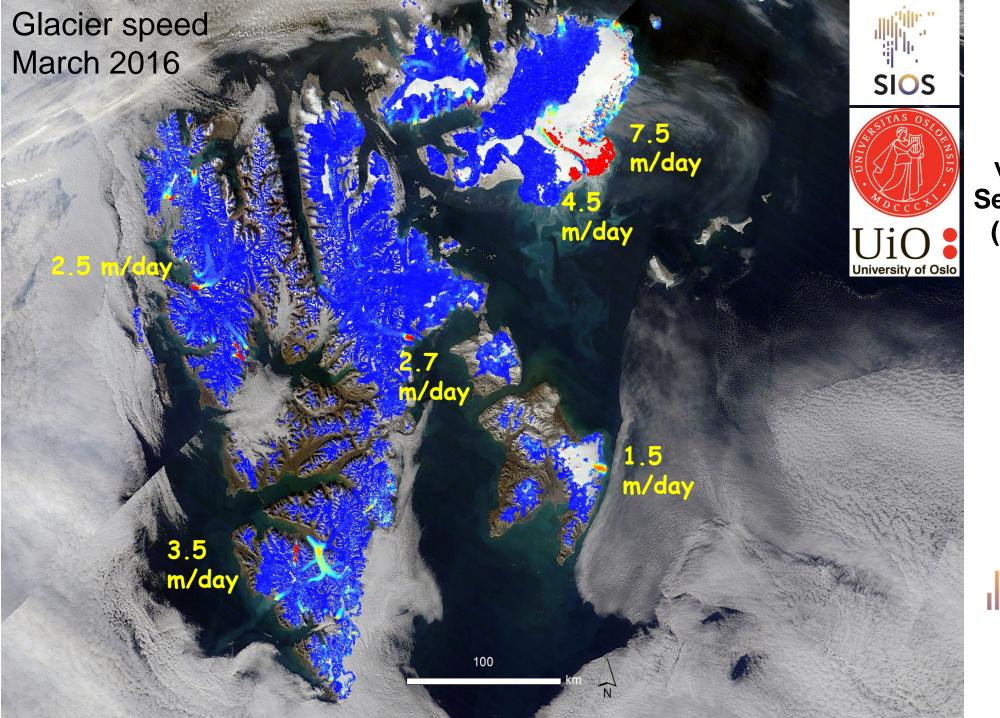






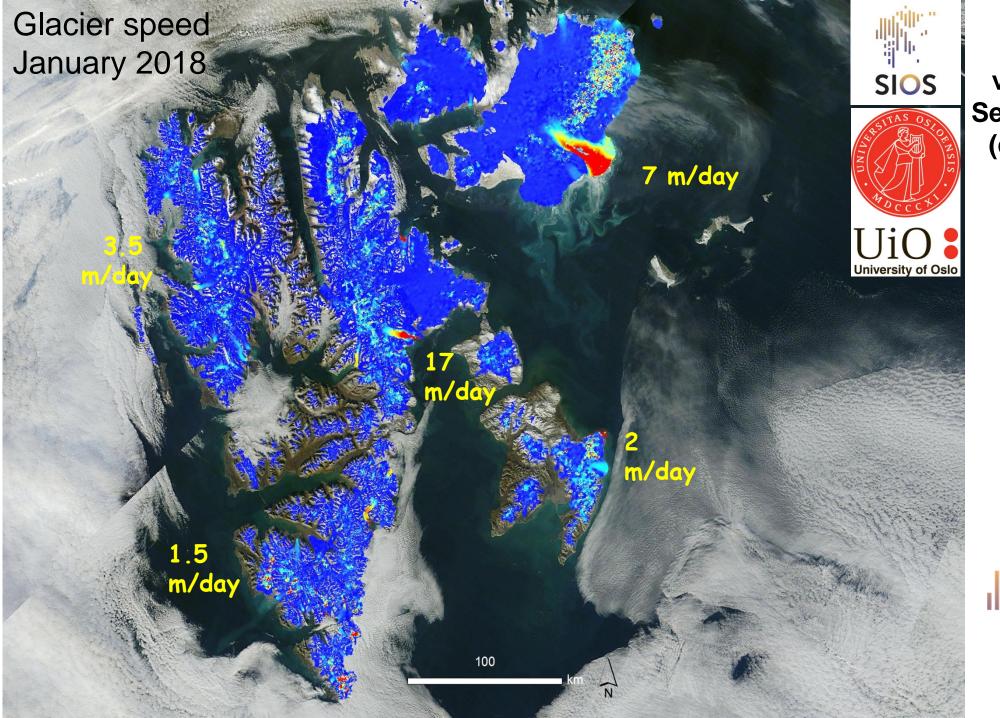
Seasonal and annual variations of glacier velocities from repeat Sentinel-1 satellite data (draped over a MODIS mosaic)





Seasonal and annual variations of glacier velocities from repeat Sentinel-1 satellite data (draped over a MODIS mosaic)





Seasonal and annual variations of glacier velocities from repeat Sentinel-1 satellite data (draped over a MODIS mosaic)











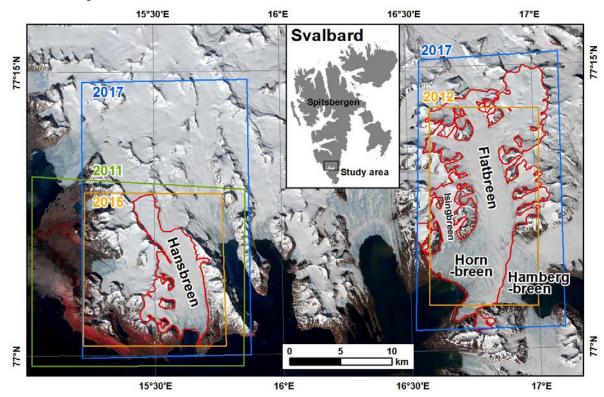








Study area and Data



Aerial photographs, WorldView-2, Pleiades



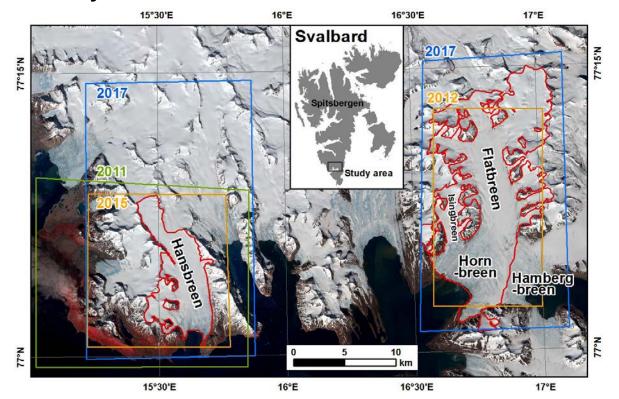




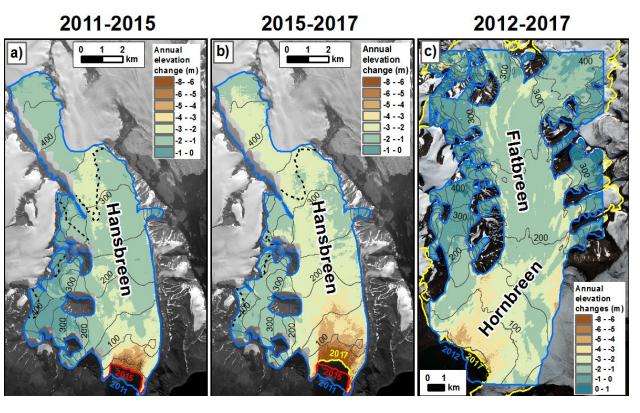




Study area and Data



Geodetic Mass Balance



Aerial photographs, WorldView-2, Pleiades

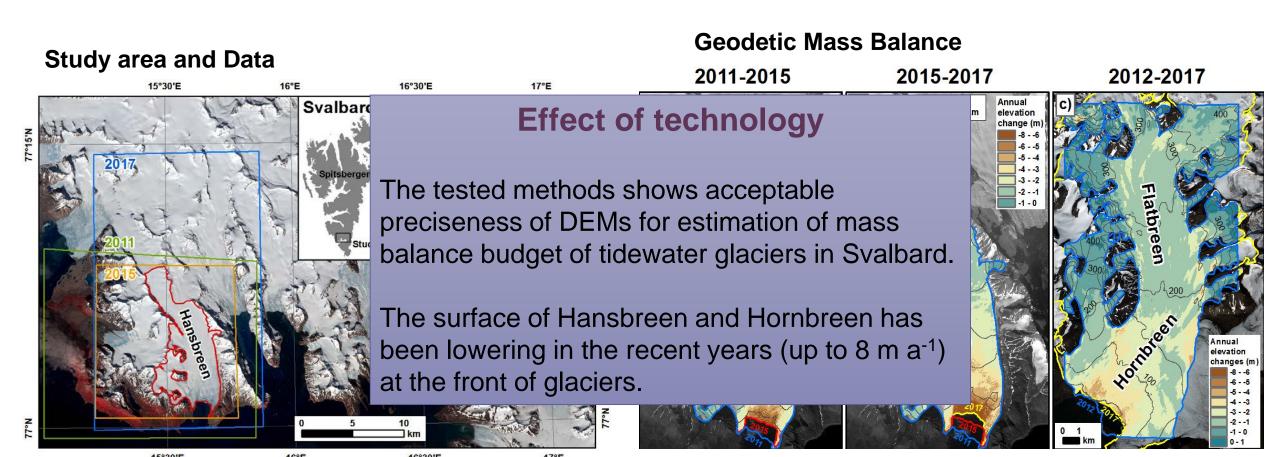








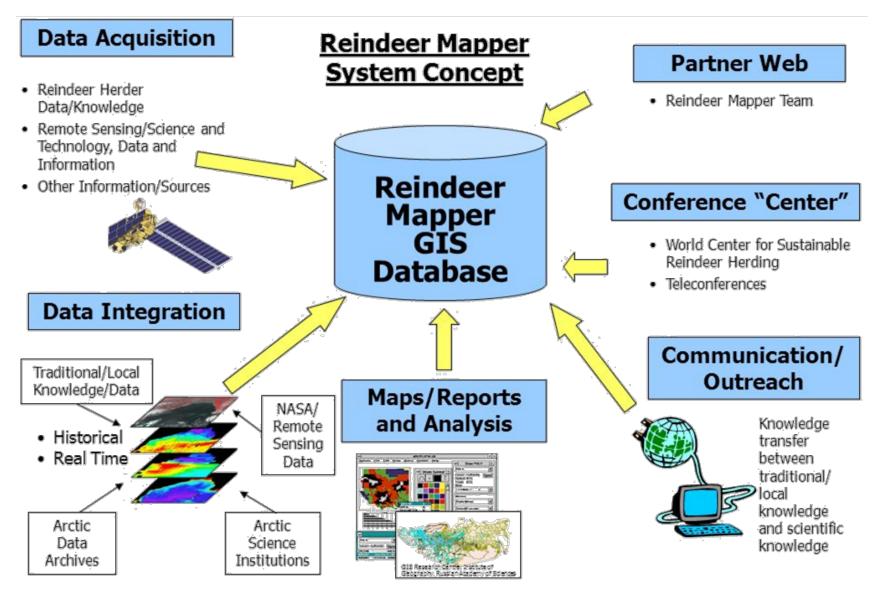




Aerial photographs, WorldView-2, Pleiades



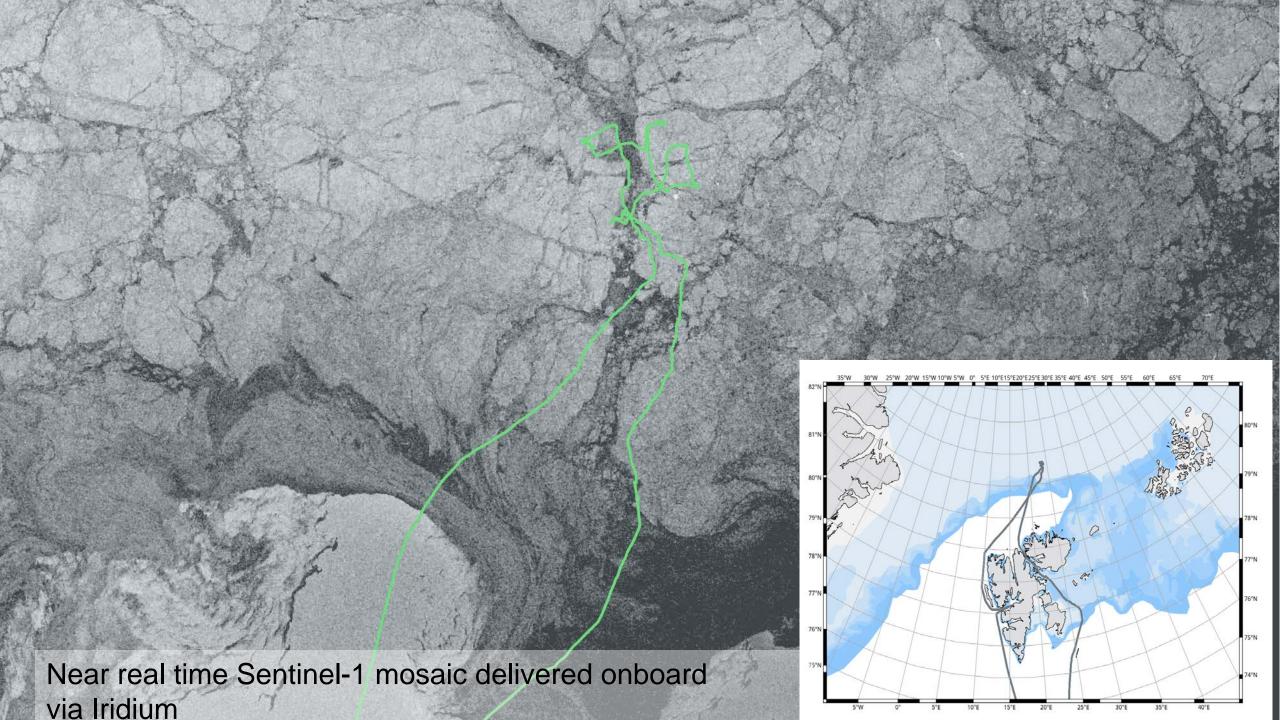
Not only glaciology!







Contact: mikhail.itkin@npolar.no





Panel discussion – questions from audience

Please submit your questions on Slido now!

