

Snow model validation in Norway at the Land Atmosphere Interaction in Cold Environments (LATICE) Finse site

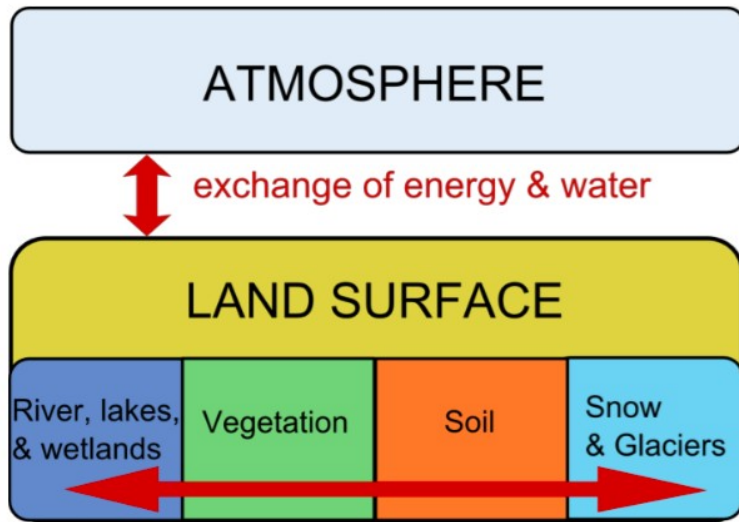
J. F. Burkhart, T. V. Schuler, L. Tallaksen,
S. Filhol, J. Hulth, S. Decker
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UiO • **University of Oslo**



LATICE: Land-Atmosphere Interactions in Cold Environments: The role of Atmosphere - Biosphere – Cryosphere – Hydrosphere interactions in a changing climate



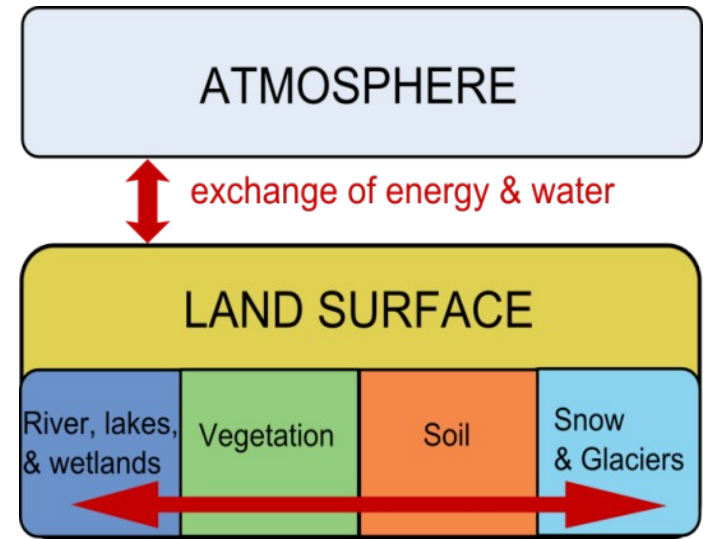
Advancing Atmosphere and Land Modeling for Improved Understanding of the Hydrologic Cycle at the Watershed Scale

LATICE Science Team

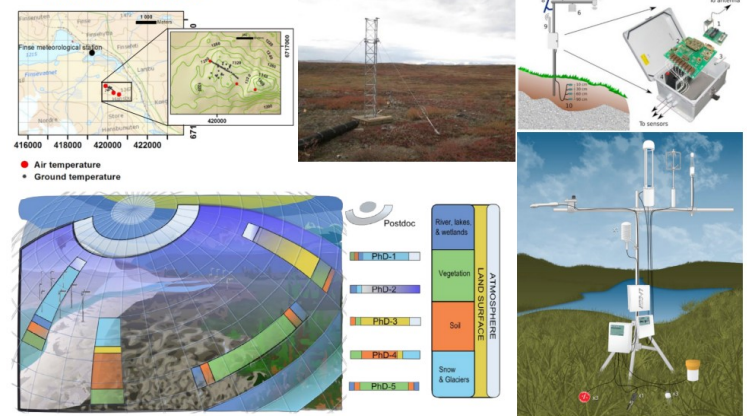


LATICE - In short

- Improve Earth Surface Modeling
- Surface-Energy Balance
- Land-Atmosphere feedbacks at regional scale
- Cold environments (snow, ice, permafrost, vegetation)
- Modeling studies driving observational experiments
- Bridging across scales



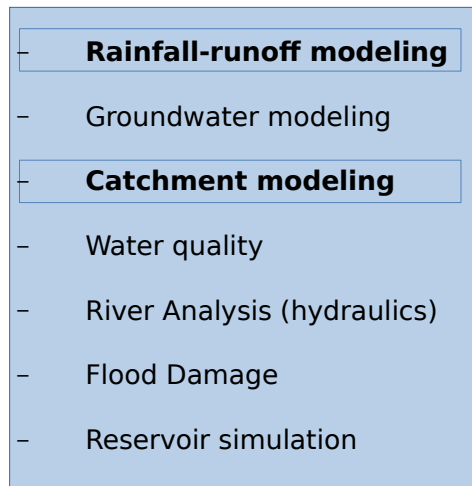
High resolution measurement infrastructure at Finse:
LATICE-FLUX



Hydrologic Modeling in LATICE

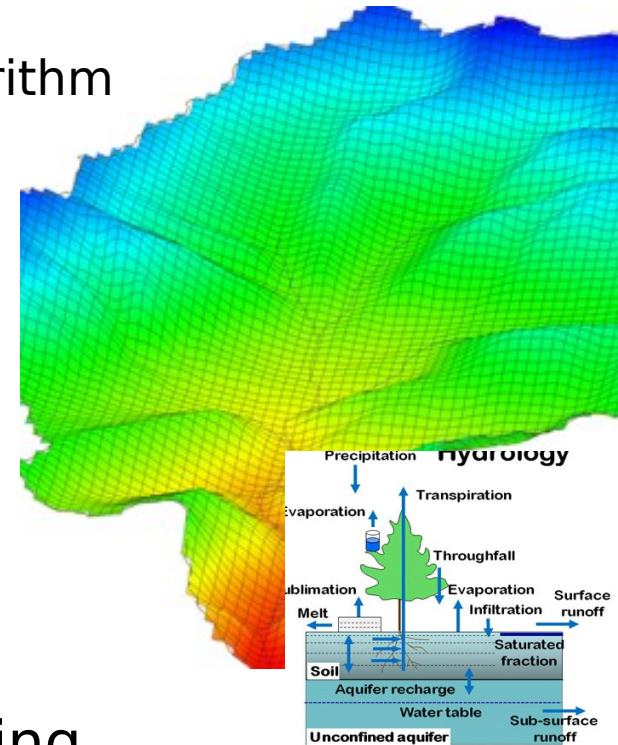
- Several Platforms: Shyft, WRF-Hydro, CLM, WASMOD

Emphasis on Shyft which provides flexibility in algorithm selection

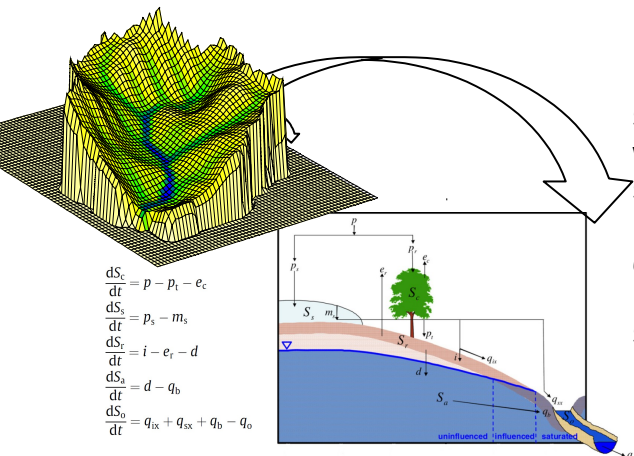


Snow modules are critical:

- Gamma Snow (Energy Bal)
- AeroSnow (in progress)
- Skaugen Snow (Skaugen, 2016)
- HBV Snow



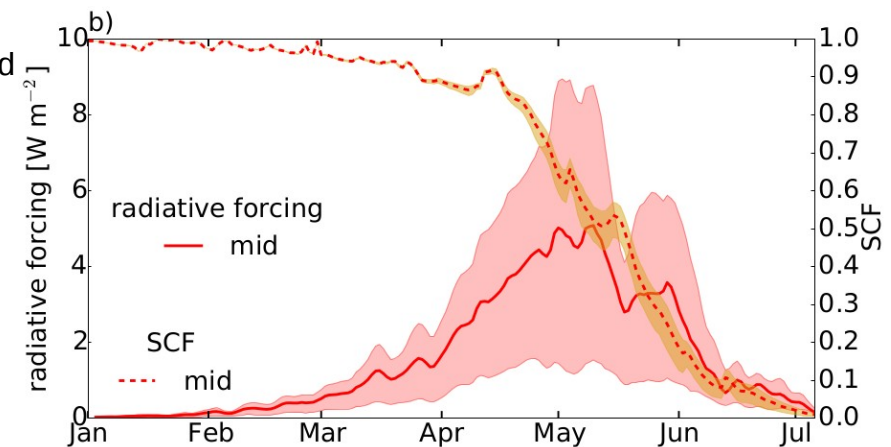
- Surface Energy Balance for Land Surface Modeling



Distributed representation of physical processes. Each land surface cell becomes a vector and we apply operator splitting on a system of ODEs:

$$dS/dt = F(s, v, t)$$

s=state, v=inputs, t=time



Motivations for Establishing the Site

96% of electricity from hydropower in Norway

- Developing competencies in blowing snow modeling/instrumentation
- Improving climate modeling downscaling for high elevation catchments and precipitation on glacier in Norway
- Improve current state of mountain hydrology
- => Linking modeling/grid scale to observation scale
- Logistic: access, research station, knowledge of local snowpack

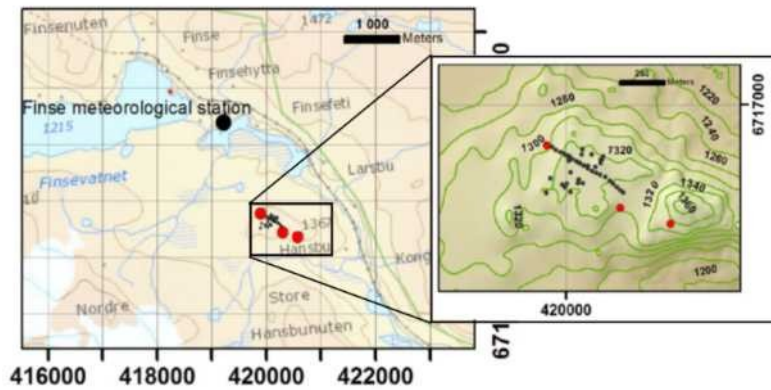
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Practical details:
<http://finse.uio.no> & INTERACT
LATICE Project:
<https://mn.uio.no/latice>

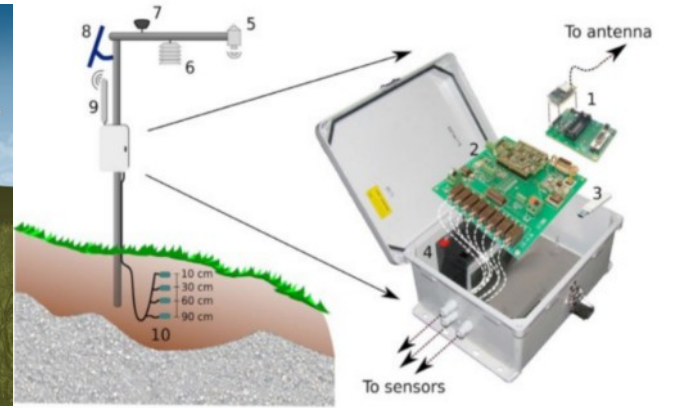




High resolution measurement infrastructure at Finse: LATICE-FLUX



- Air temperature
- Ground temperature



UiO LATICE-FLUX

- eddy-covariance system

UiO LATICE-WSN

- Distributed snow and hydrologic mxs

Met Norway

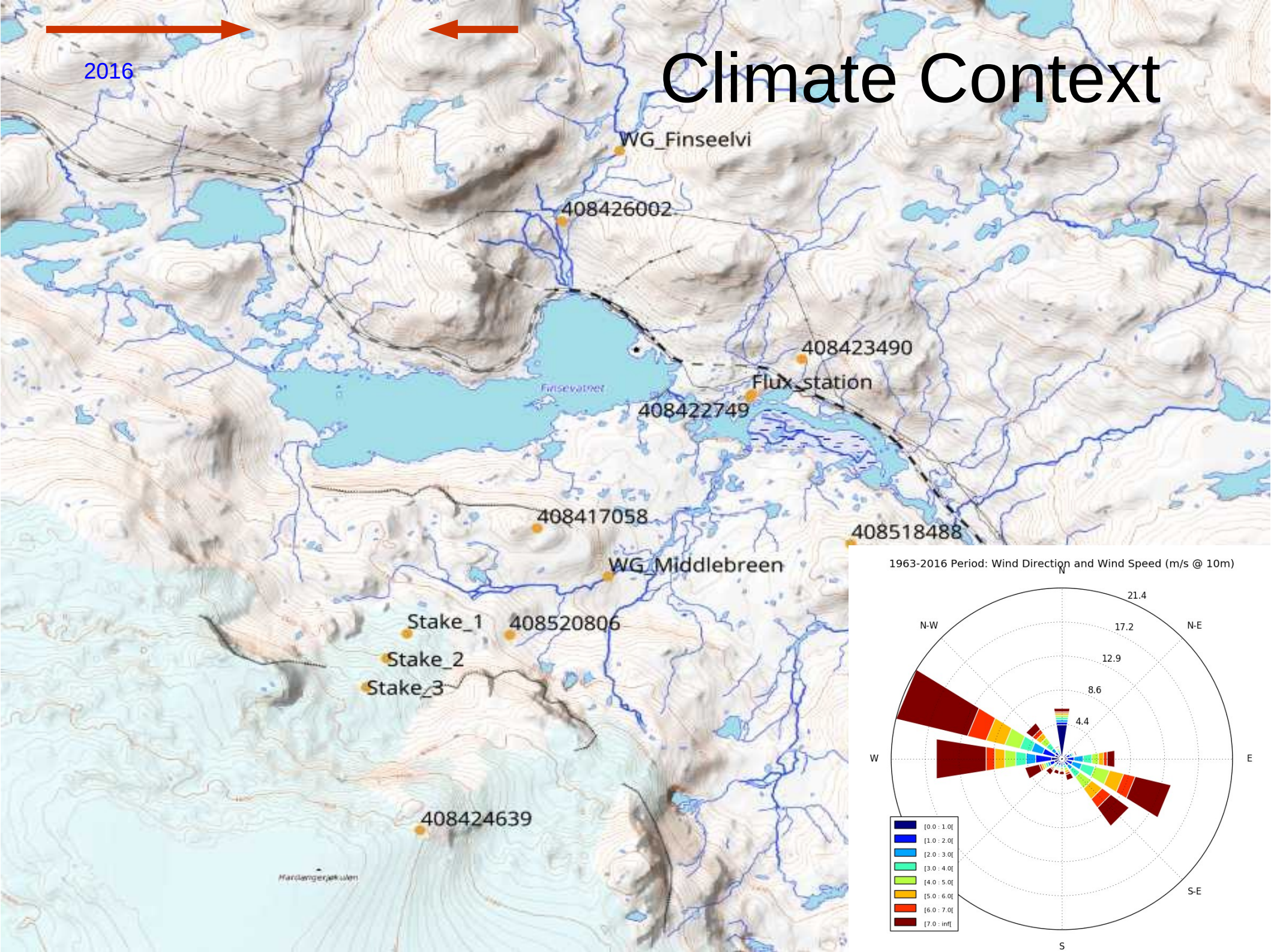
- Climate Reference Station NVE & Hydropower Co.

- Discharge (?)

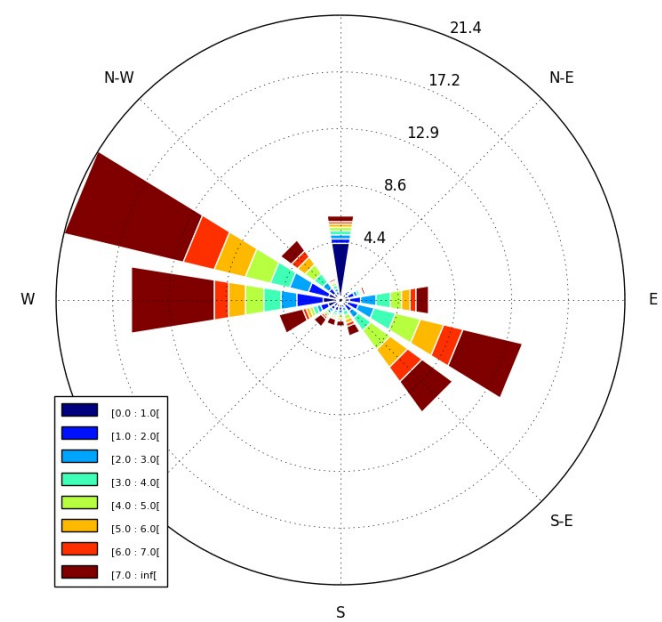


Climate Context

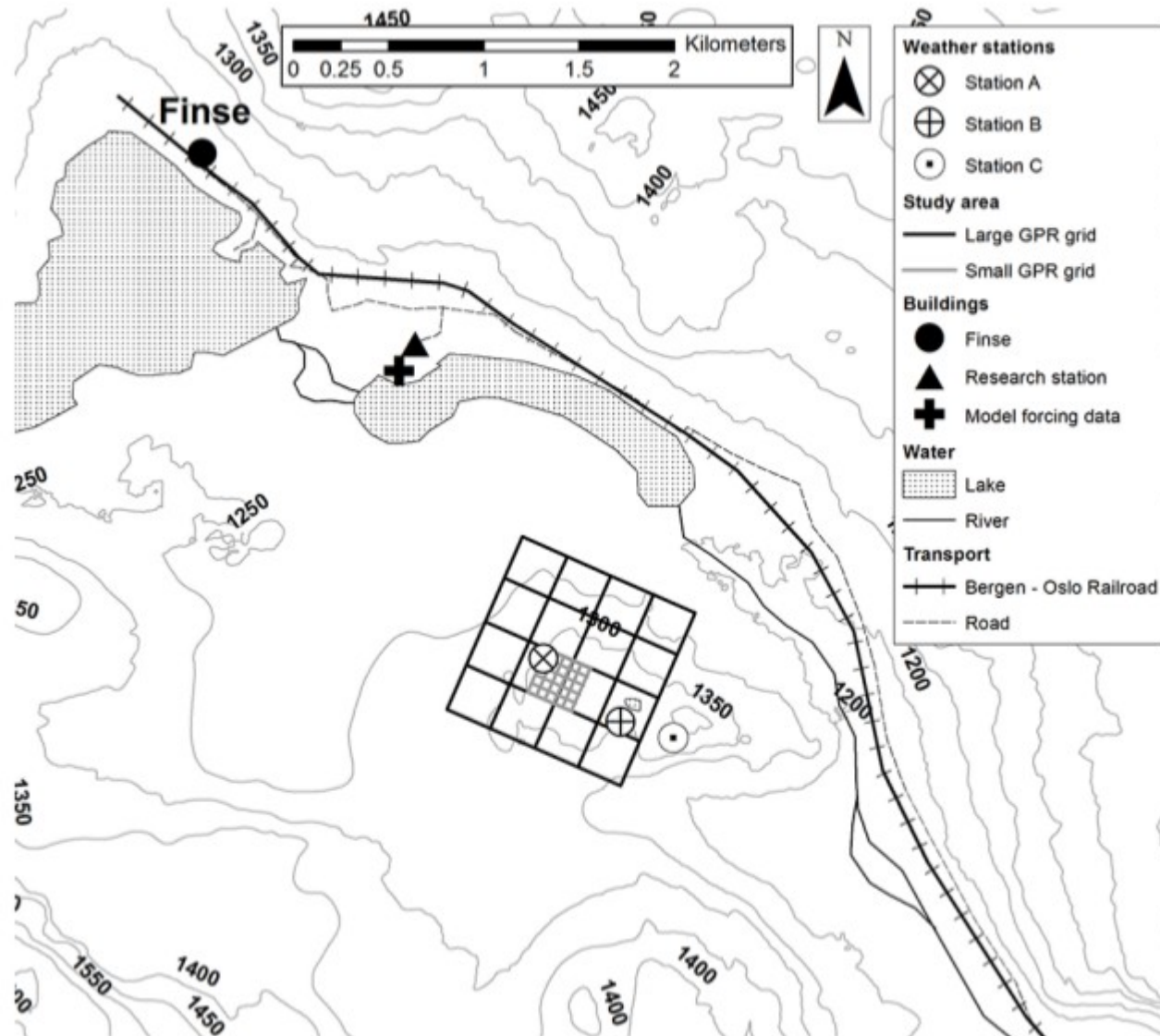
2016



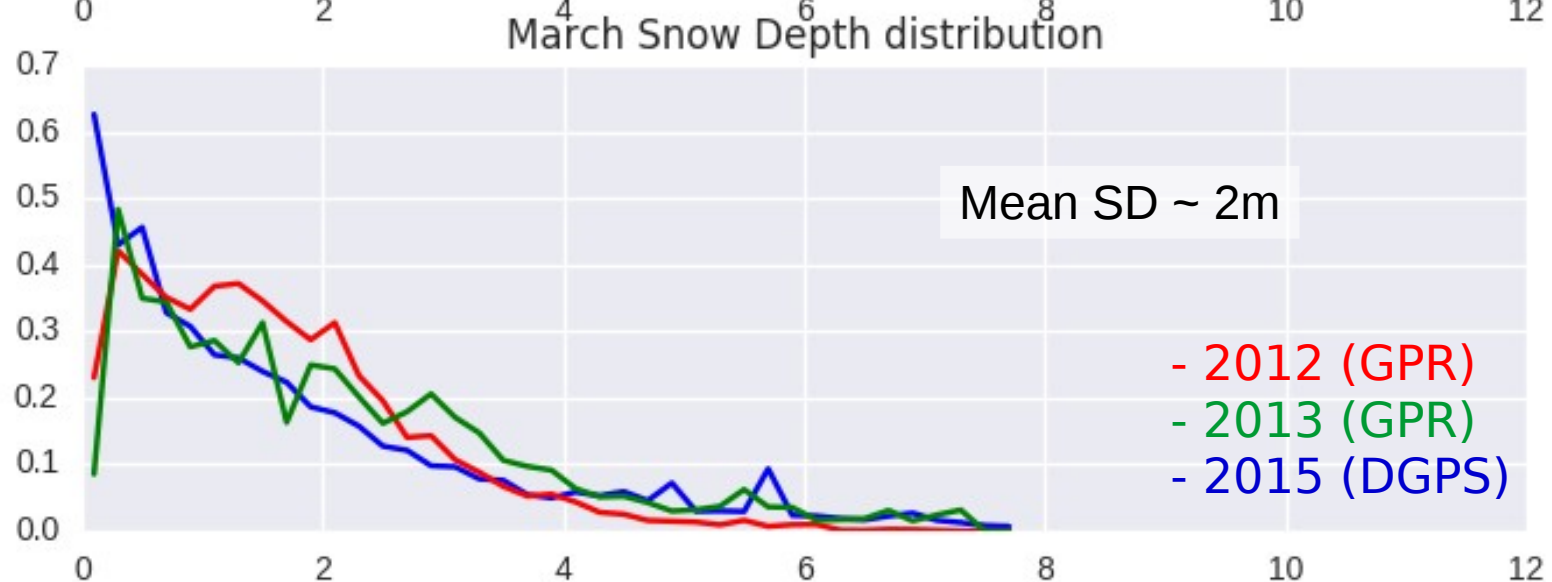
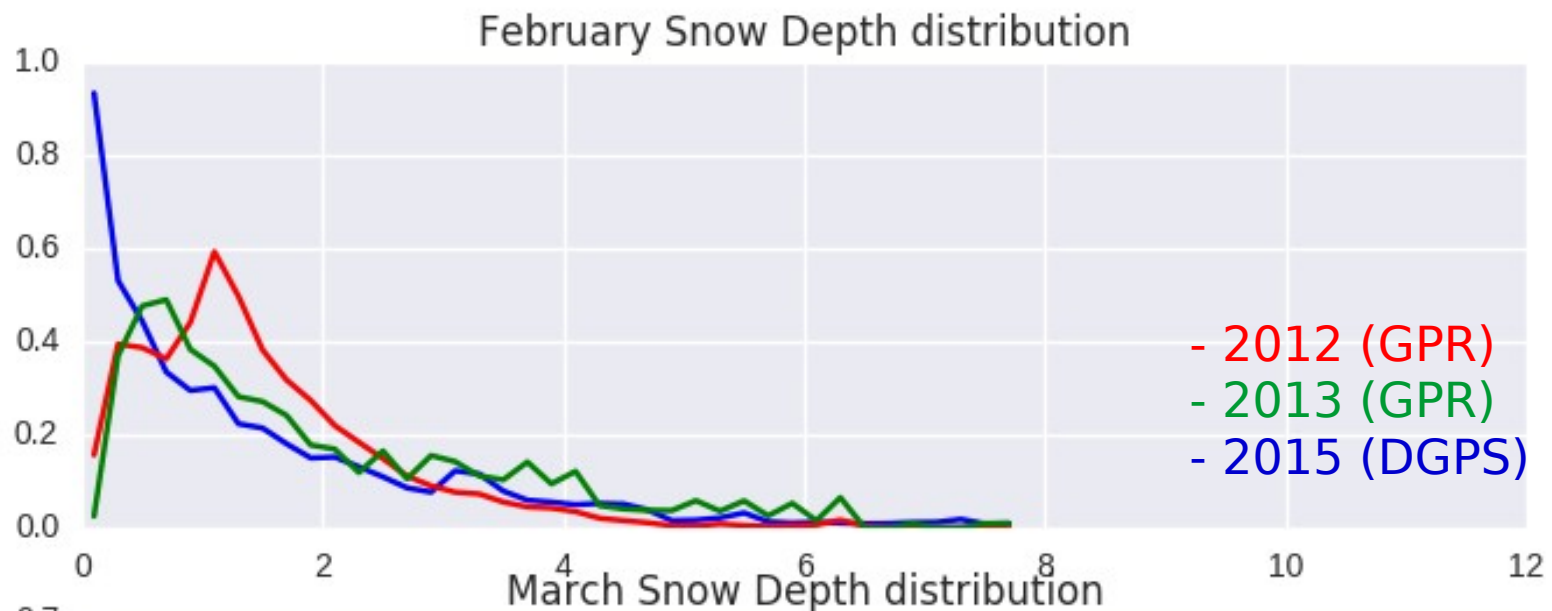
1963-2016 Period: Wind Direction and Wind Speed (m/s @ 10m)



Snow distribution knowledge

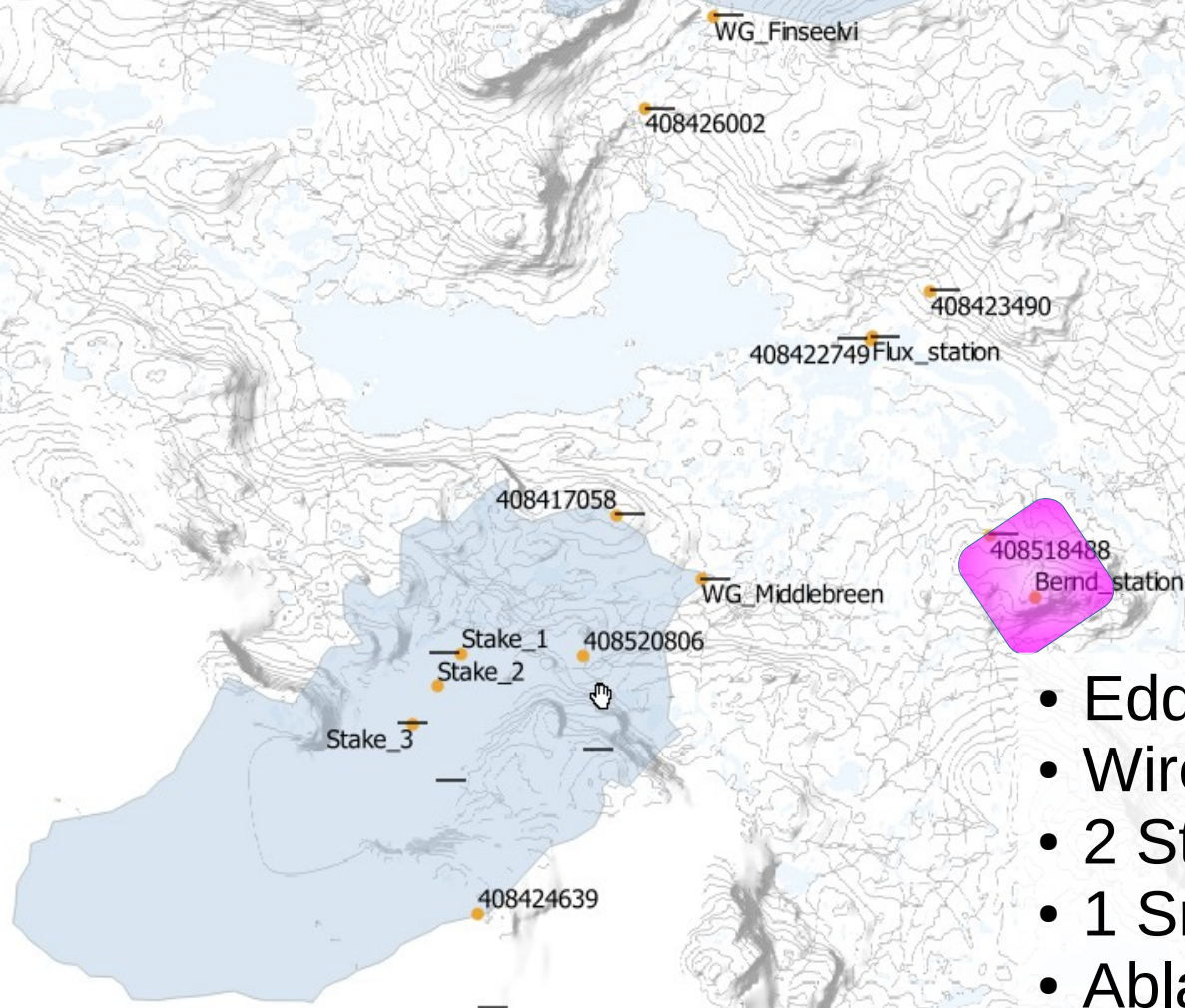


Snow Distribution





LATICE Research Locations



- Eddy covariance – flux station
- Wireless network
- 2 Stream gauging
- 1 Snow course
- Ablation stakes



Flux/Climate Tower

- Met Norway Climate Reference Station (see right)
 - Wind in 10 m: GILL 2-d sensor with 150 W heating power.
 - Air temperature: Pt_100 element in MET screen in 2 and 10 m.
 - Air Humidity; Vaisala HMP155 in MET screen in 2 m.
 - Ground surface temperature; IR sensor in approx 4-5 m high (e.g. Campbell SI-111).
 - Snow depth sensor; Laser type HMS30 from LUFFT; in ab 5 m high (measure direction free with angle between 15 to 45 deg).
 - Precipitation amount sensor; Geonor weight sensor.
 - Precipitation detector; Thies optical Yes/No sensor.
- LATICE-FLUX adds eddy-covariance system
 - Li-COR 7200 CO₂ / H₂O flux
 - CSAT 3D anemometer
 - Total radiation instrument: CNR4 in approx 4-5 m high (near eddy-cov instrument high).)
 - Soil Measurements:
 - 4 thermistors, 2 heat plates; 1 soil moisture 2-5 cm deep depending on the surface consistency

The Wireless Network

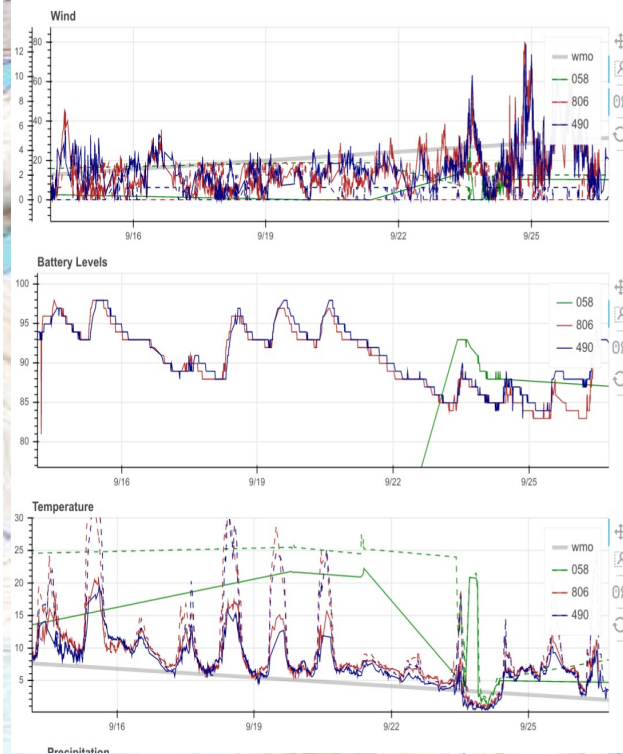


- Logger specifications:
- Arduino based
 - Low power consumption
 - C++ programming
 - Open source software/hardware
 - Analog/digital sensors
 - Low cost

Real Time LATICE WSN Data Browser

Note: this site is in development and will be frequently changing. Please don't bookmark this URL

Read more about the [LATICE](#) project





A statistical approach to represent small-scale variability of permafrost temperatures due to snow cover

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The Cryosphere

Open Access



The Cryosphere, 8, 2063–2074, 2014

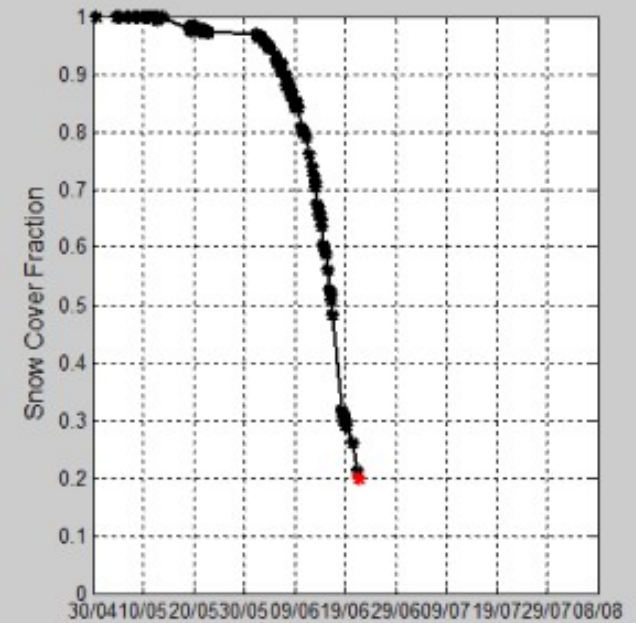
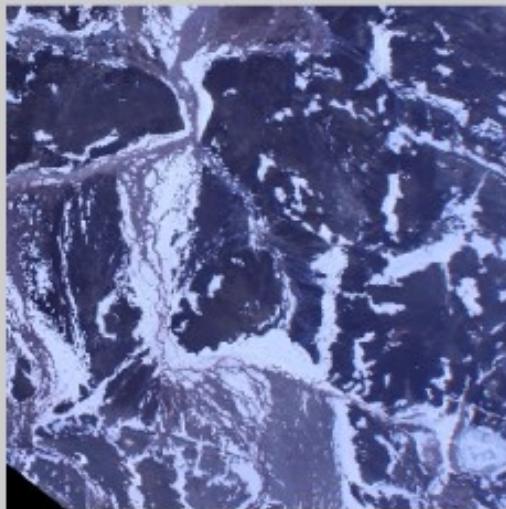
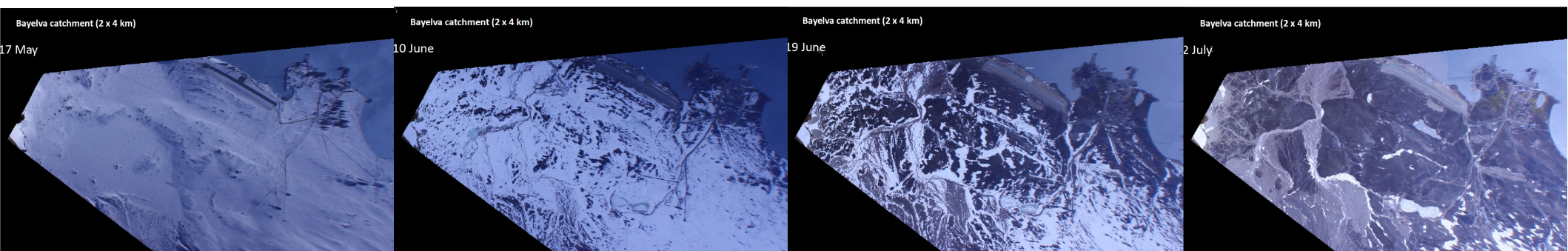
www.the-cryosphere.net/8/2063/2014/

doi:10.5194/tc-8-2063-2014

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Increase Resolution or Parameterize Smarter?
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 & **Kjetil Schanke Aas** (k.s.aas@geo.uio.no)



Summary and path forward...

Summary:

- A new site for physical sciences in Finse :
 - Blowing snow, hydrology, climate downscaling, ...
 - Development of innovative measurement techniques
 - Low-cost wireless AWS to capture better representation of spatial variability
 - Structure from Motion, UAV based, Time-lapsed based
- A seed for collaboration,
 - Existing ties between UiO and UiB
 - Collaboration between Geosciences and Informatics Departments
 - Collaboration between Academic, Operational Agencies (NVE, Met), Industry
 - Hopefully many more...

Future Developments:

- New Modeling Initiatives:
 - Explore model performance
 - Evaluate different validation approaches
 - Expand remote sensing capabilities / validation
- Wireless Network:
 - Obtaining a robust back bone network of station
 - Infill site with specialized stations for snow, hydrology
 - Synchronizing observations to an online open-access database in realtime
- Snow Specific Capabilities:
 - Repeated snow depth mapping UAV/lidar
 - Installation of sensors for quantifying drifting snow flux
 - Installation of time-lapse cameras for snow drift monitoring, and Snow Cover Extent

Thank you!

UiO : **LATICE** is a
Strategic Research Initiative
of  UiO : **University of Oslo**

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Contributing Projects & Funding:



Contributions:

Snow Model Validation
Simon Filhol (UiO)

Snow Cover Fraction Mapping
Kjersti Gislås (NGI)
& **Kjetil Schanke Aas (UiO)**

