Finse - Infrastructure and research activities

UiO : University of Oslo

The Hive Initiative

J. F. Burkhart, S. Filhol, A. Fouilloux, T. Schuler, J. Hulth

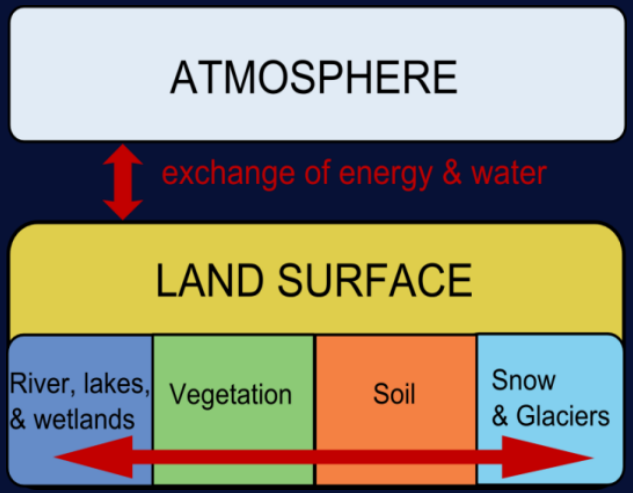
and

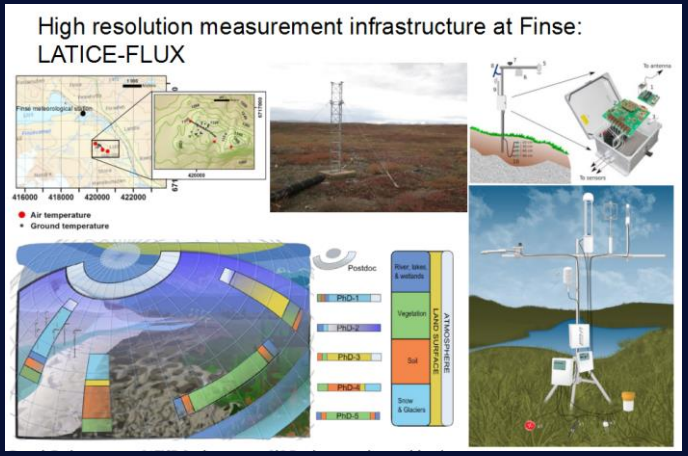
UiO : LATICE

Land-ATmosphere Interactions in Cold Environments

Describe activities at Finse related to achieving LATICE objectives:

- 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





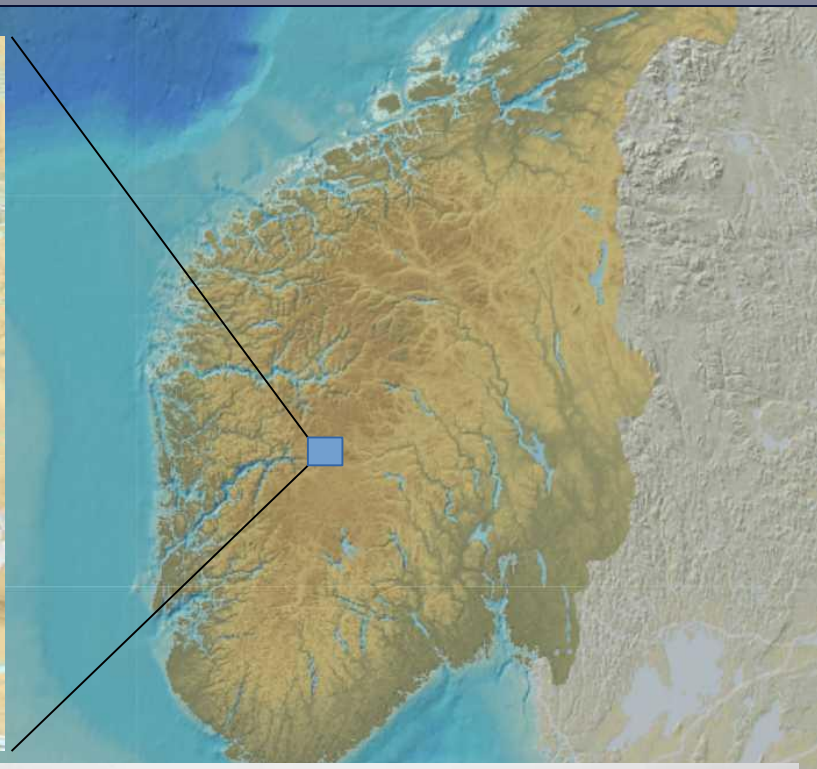
Aim

Why Finse?

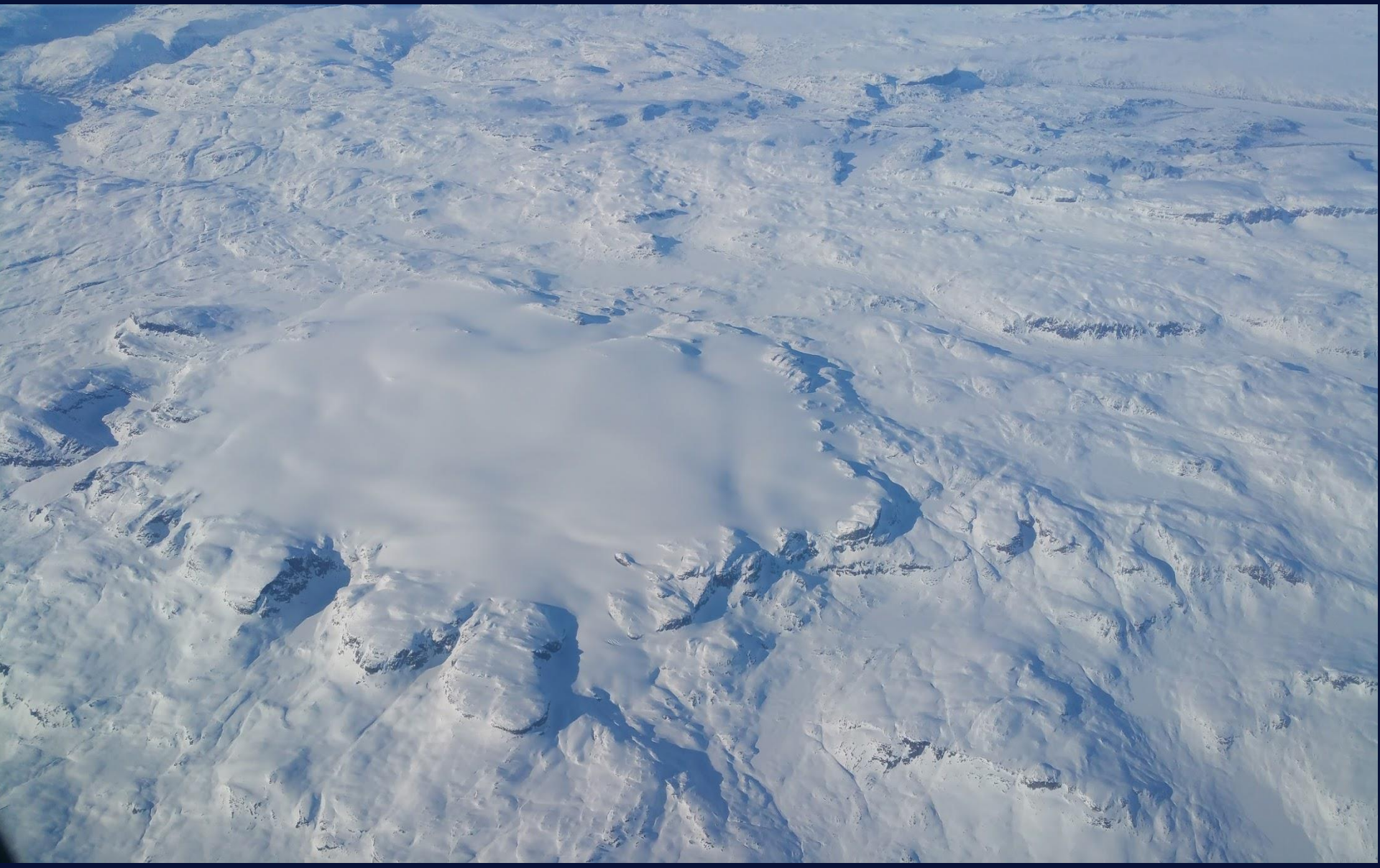
- Several existing sites in Norway for 'earth system' studies
- No history of hydrometeorology
- Complex environment, high winds, alpine
- Logistics: limited road access

Motivations for Establishing the Site

High resolution measurement infrastructure at Finse Alpine Research Center: LATICE-FLUX



High resolution measurement infrastructure at Finse Alpine Research Center: LATICE-FLUX



Why Finse?

- 'built-in' collaboration between UiB and UiO
- High interest from Met Norway for collaboration on 'climate tower'
- Strong interest in glacial dynamics from NVE and hydropower community
- Complex environment, high winds, alpine – unique
- Logistics: limited road access – train access!!

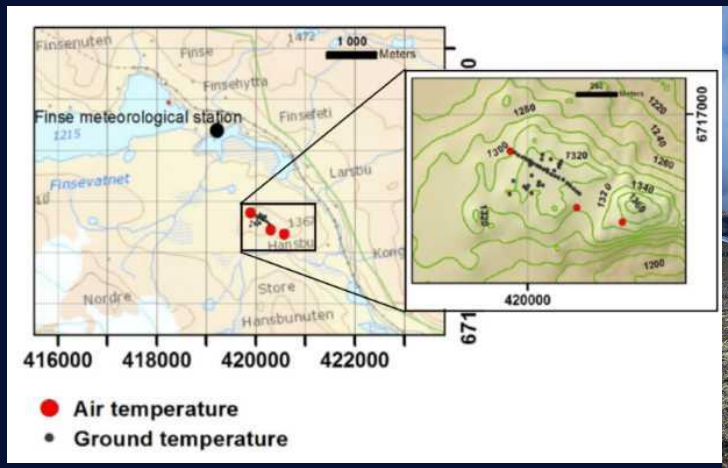
Motivations for Establishing the Site

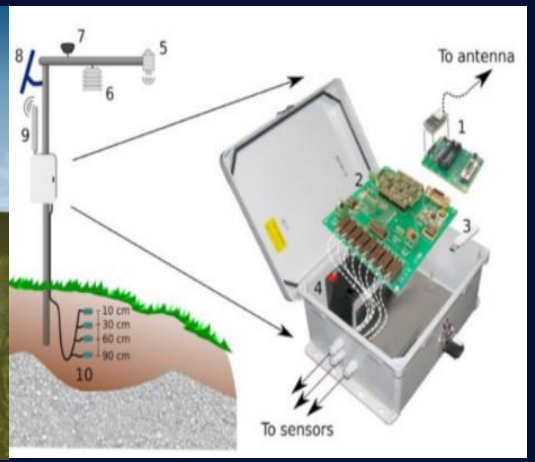
Competency

- 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
- Distributed hydrometerological observations

Motivations for Establishing the Site

High resolution measurement infrastructure at Finse: LATICE-FLUX





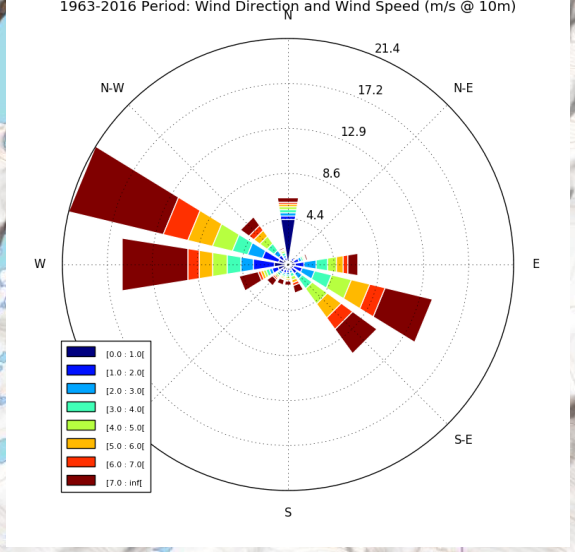
UiO LATICE-FLUX
- eddy-covariance system

UiO LATICE-WSN
- Distributed snow and hydrologic mxs

Met Norway
- Climate Reference Station

NVE & UiO
- Discharge

ATICE Research Locations



Wasp node

Wasp node

Finse research station

408520806-tmp

stream gauge

AWS location (2016)

Snow stake 2

0 0.5 1 1.5 2 km

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 hight (e.g. Campbell SI-111).

Snow depth sensor; Laser type HMS30 from LUFFT; in ab 5 m hight (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 / H20 flux

CSAT 3D anemometer

Total radiation instrument: CNR4 in approx 4-5 m high (near eddy-cov instrument hight).)

Soil Measurements:

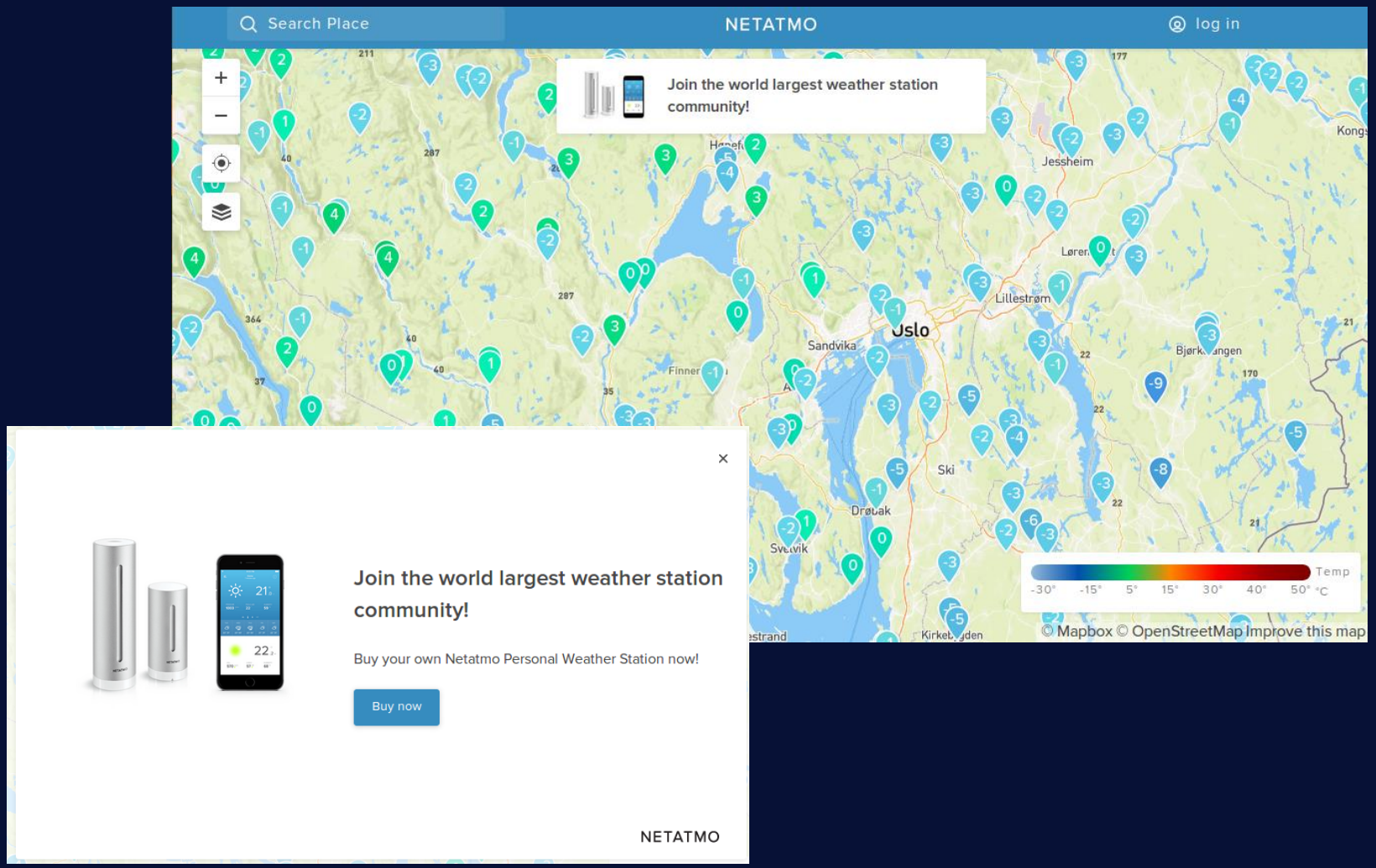
4 thermistors, 2 heat plates; 1 soil moisture 2-5 cm deep depending on the surface consistency

The Wireless Network

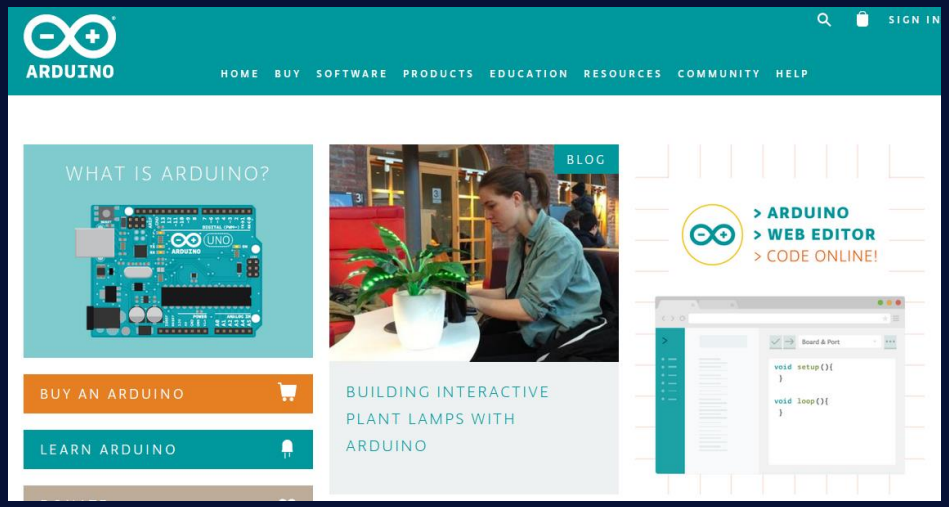
Logger specifications:

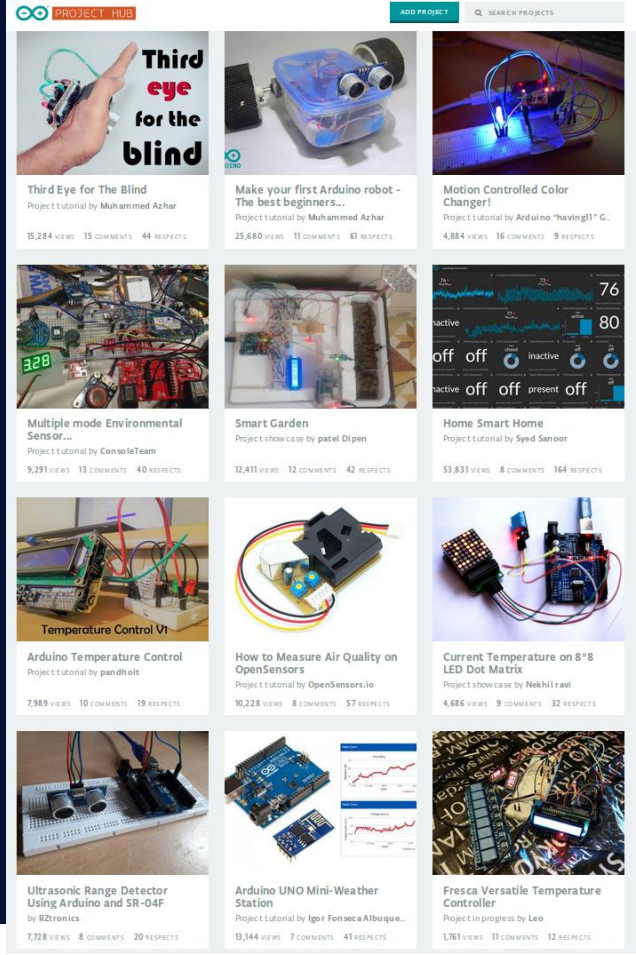
- Arduino based
- Low power consumption
- C++ programming
- Open source software/hardware
- Analog/digital sensors
- Low cost

Introduction



Introduction

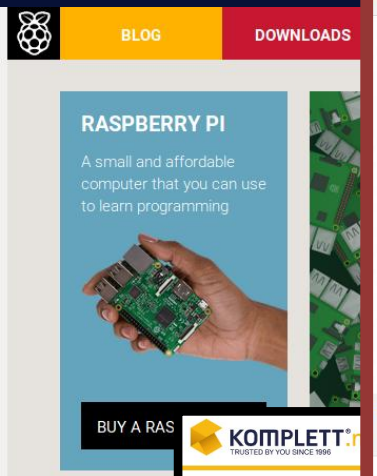


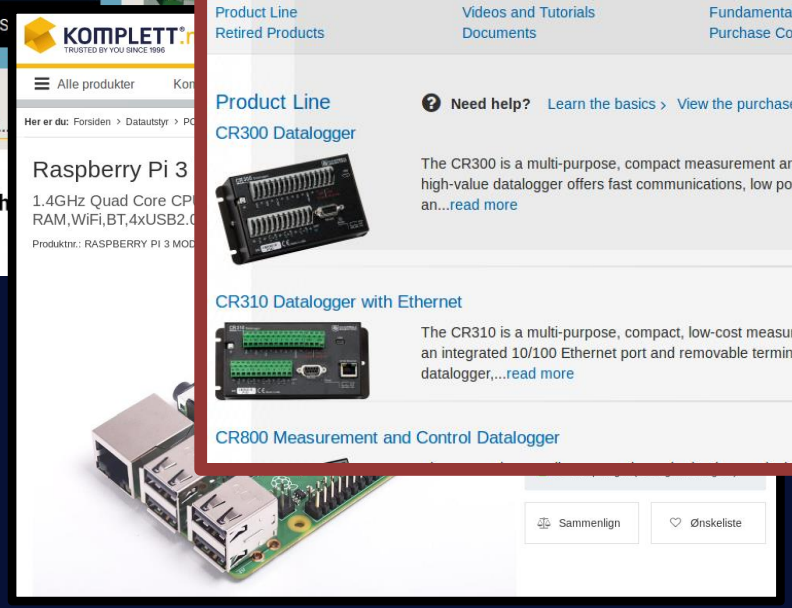


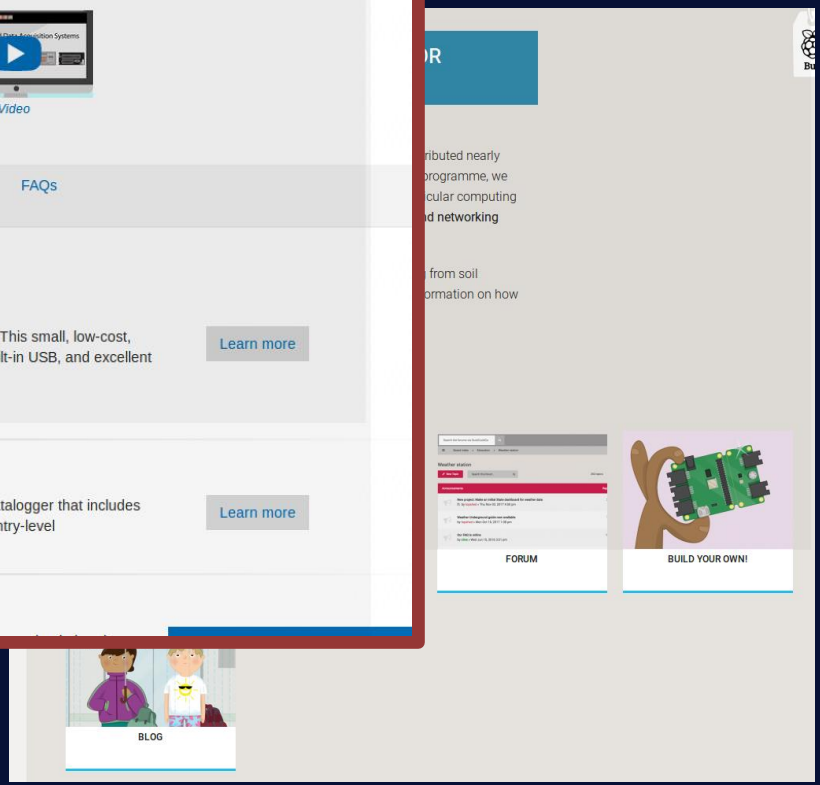
What is Arduino?

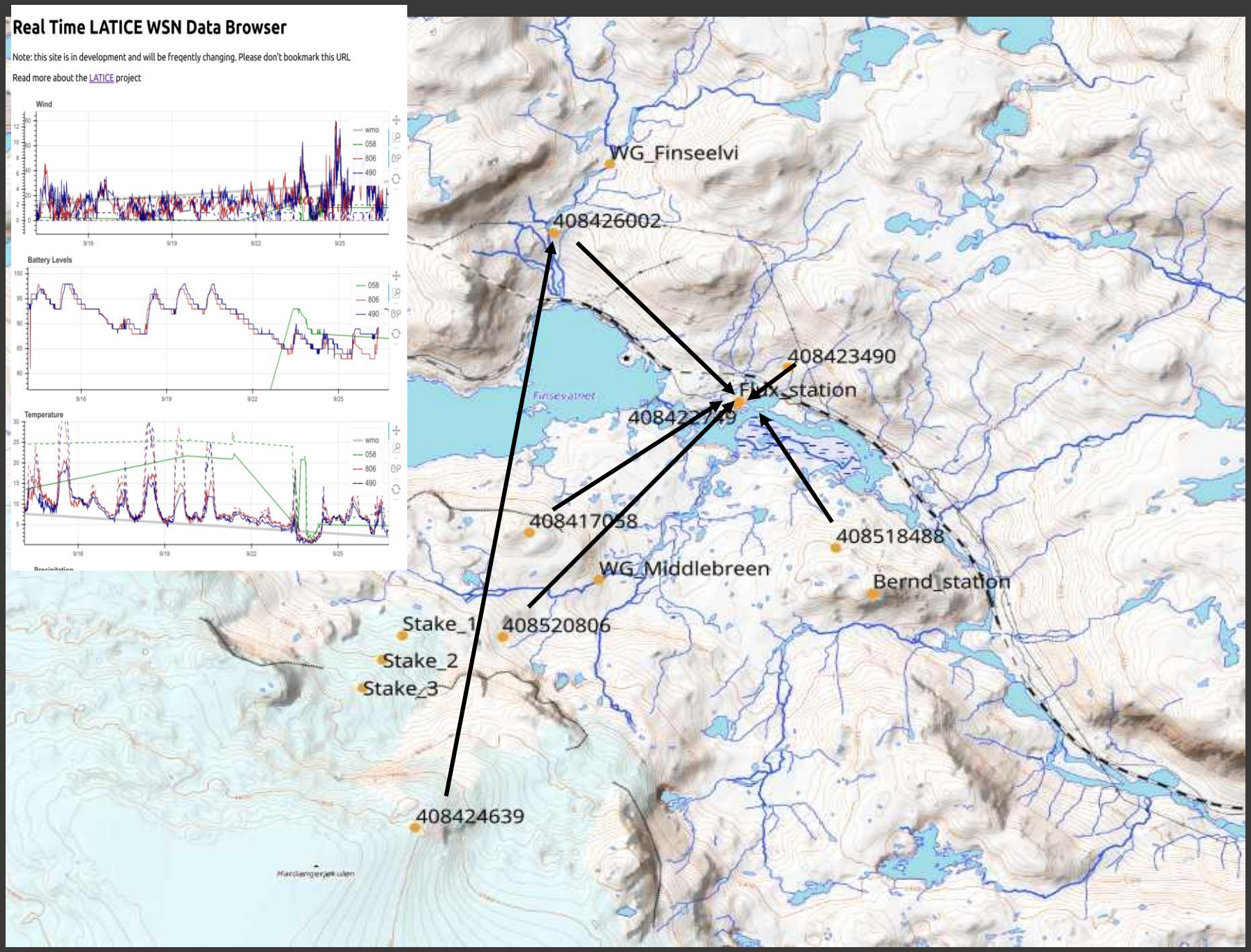
Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Introduction








Real Time LATICE WSN Data Browser
Note: this site is in development and will be freqently changing. Please don't bookmark this URL
Read more about the LATICE project
Wind
wmo
058
806
490
Battery Levels
058
806
490
Temperature
wmo
058
806
490
WG_Finseelvi
408426002
408423490
Flux_station
Finsevatnet
408417058
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WG_Middlebreen
Bernd_station
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Stake_3
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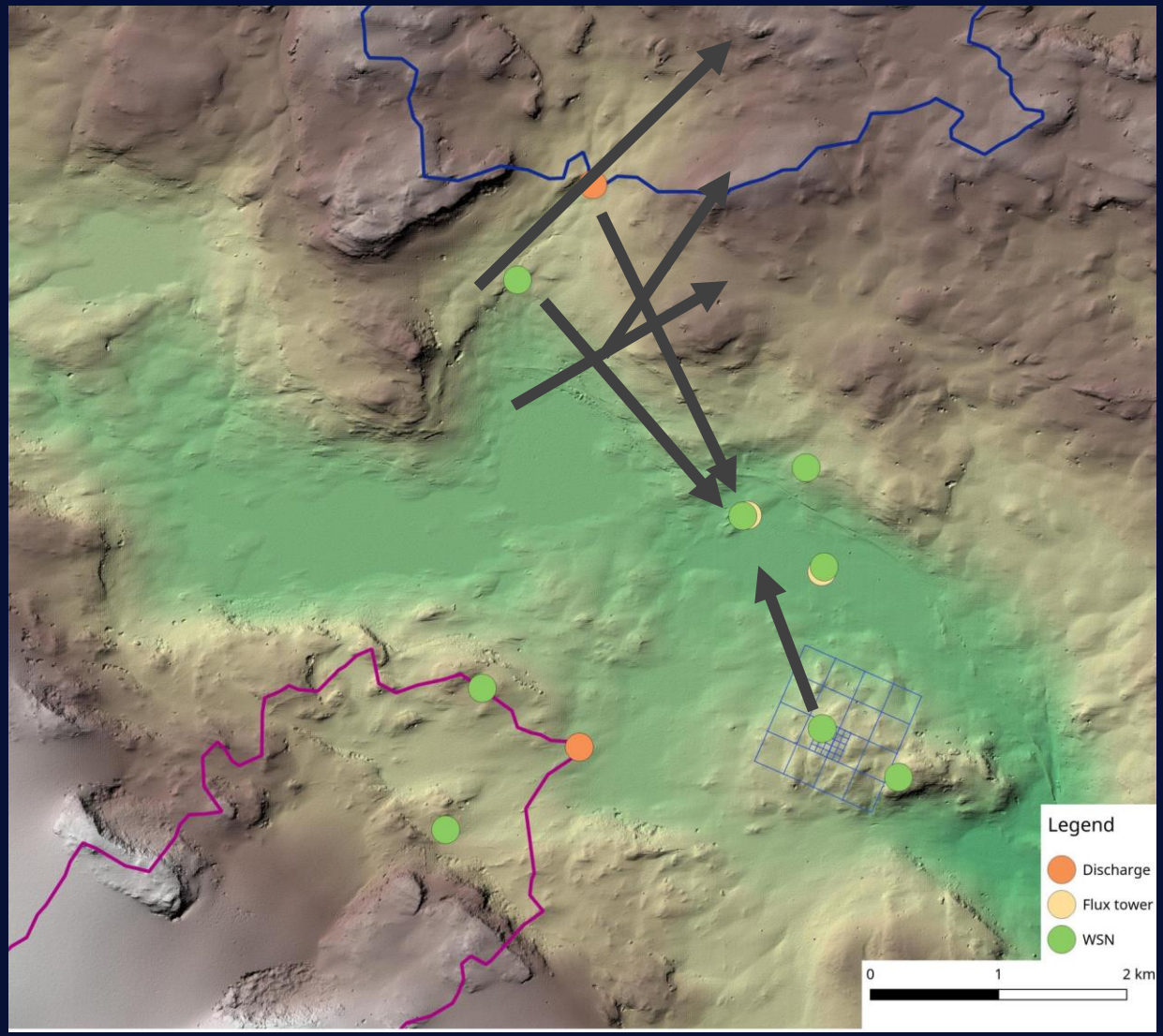
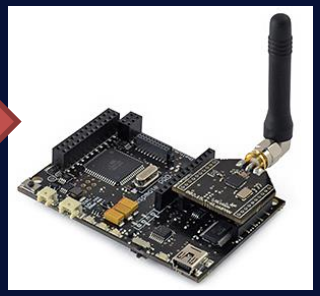
In house experience



In house experience

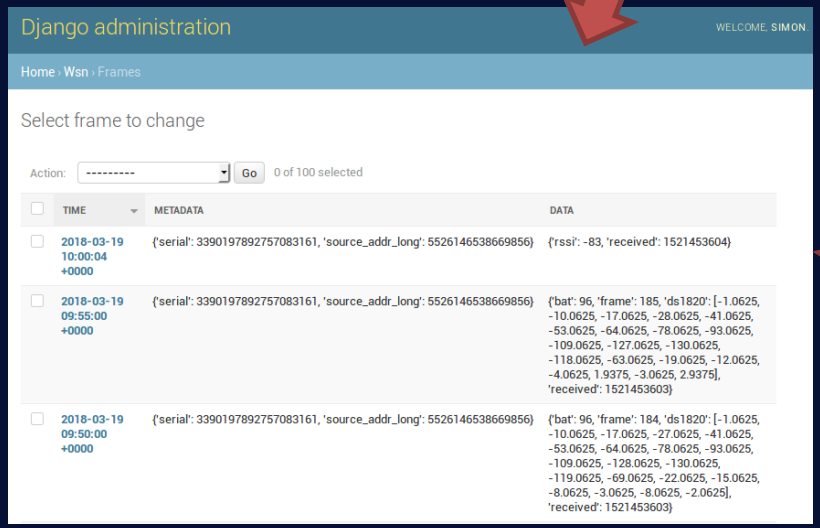
Sensor

Logger unit

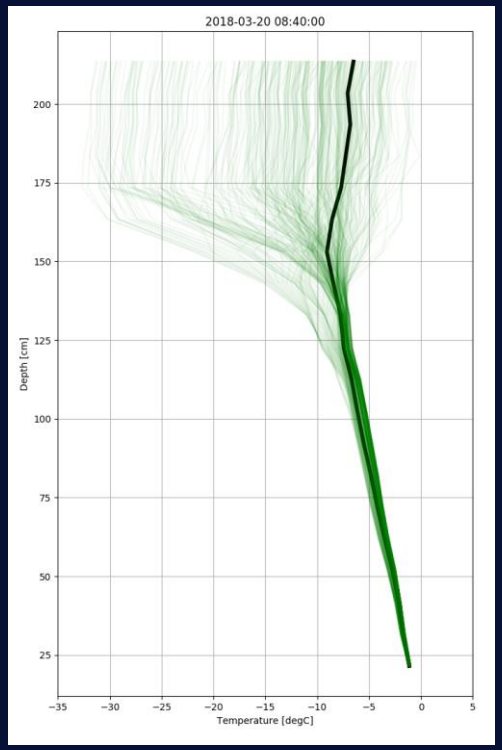


Local server

Database

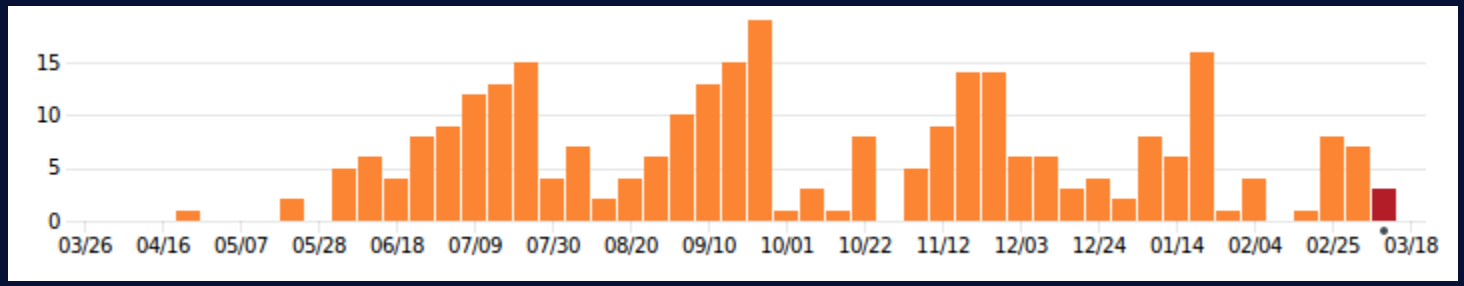


Finally... data visualisation

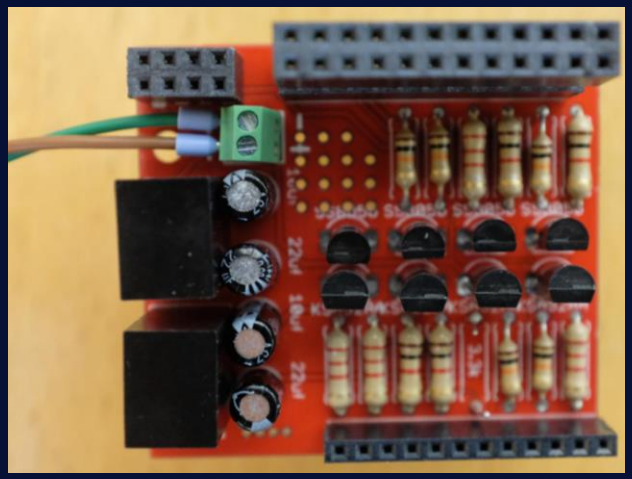


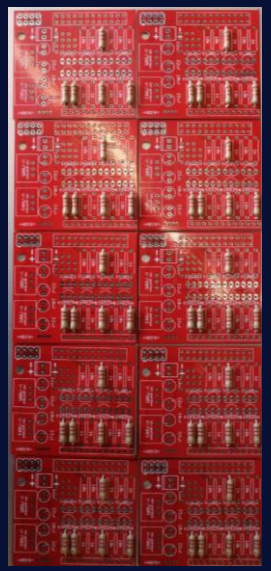
In house experience

Number of Git commit

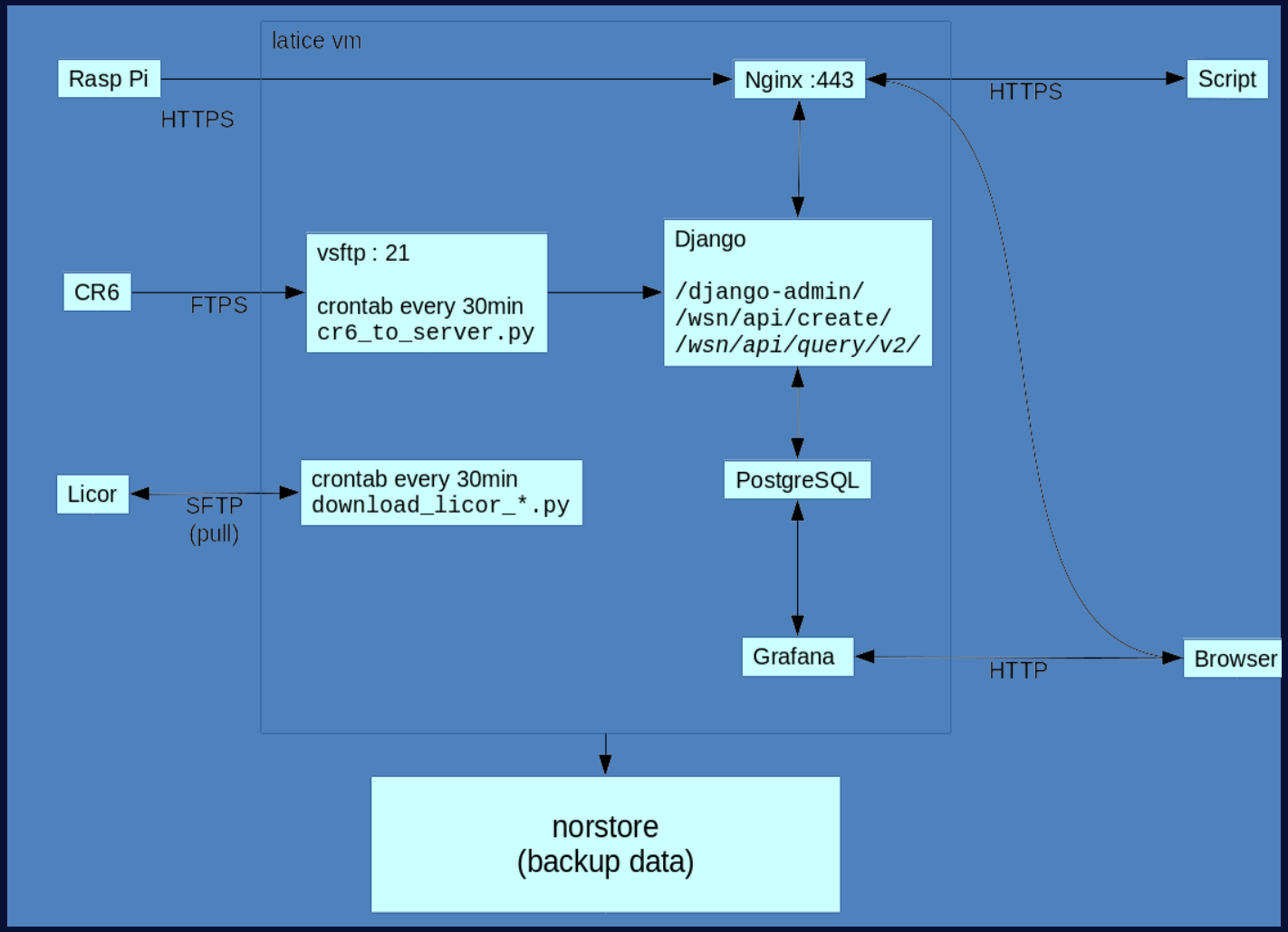


Hardware development





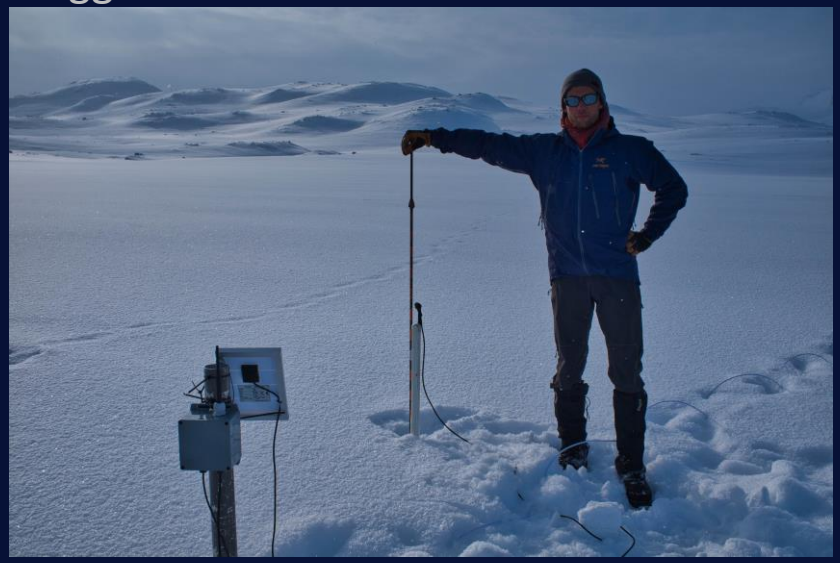
In house experience

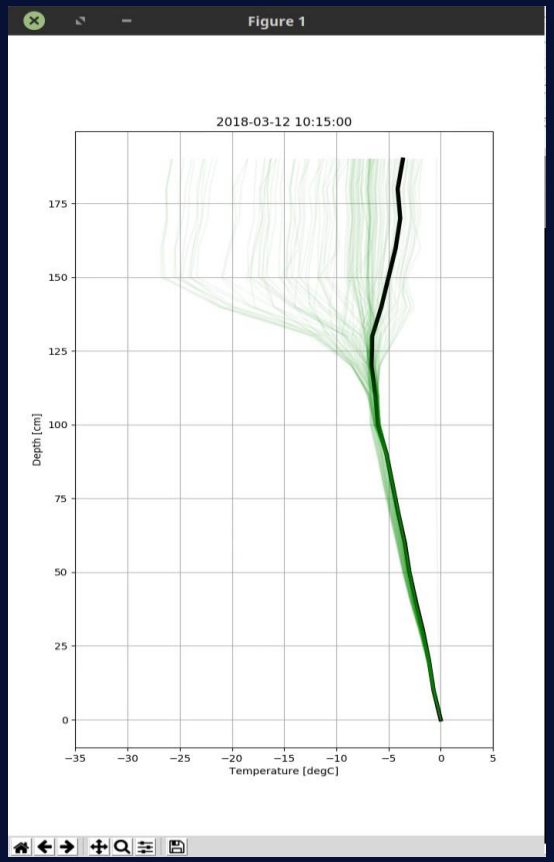


Specific Case I

Off the shelf

Custom made sensor and logger





Specific Case II

Custom time-lapse camera kit:

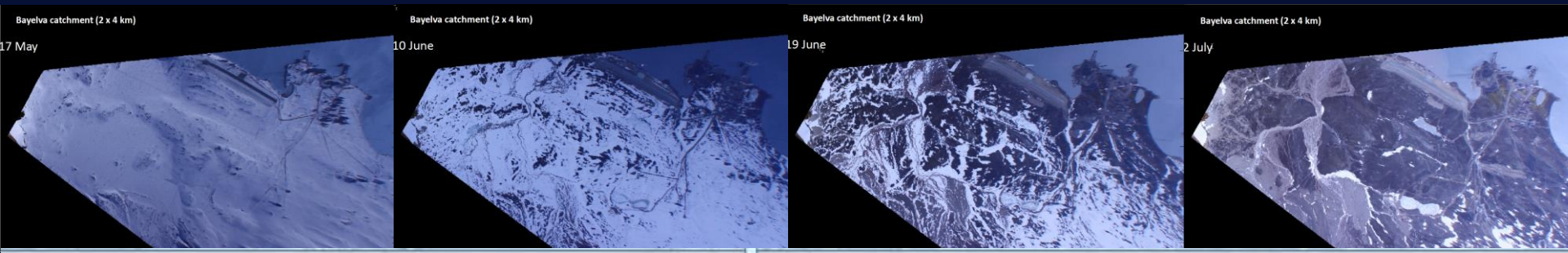
- Snow cover extent at melt in catchment with discharge measurements
- recording snow drift profile at the flux tower

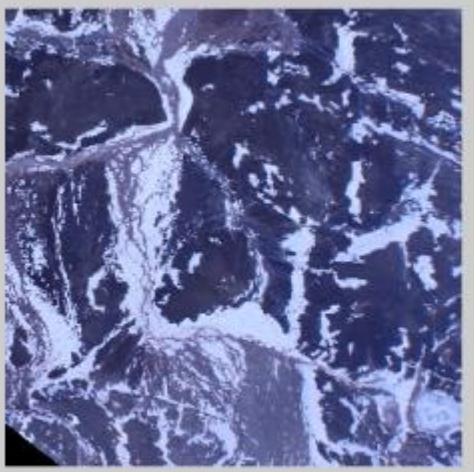
Kit consisting of:

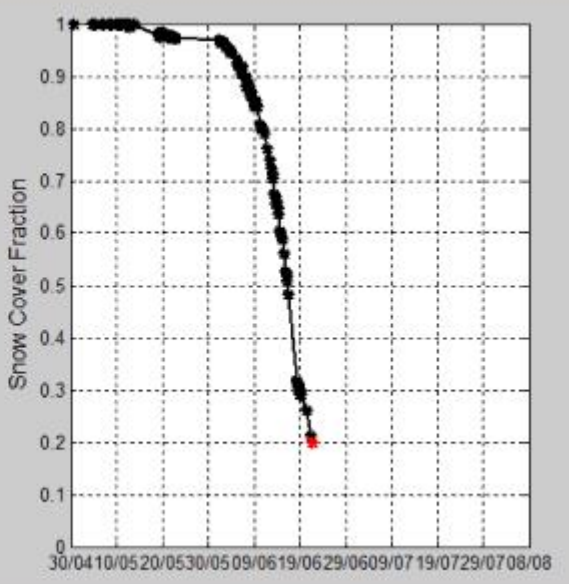
- High resolution camera (22MPix), and high dynamic range (critical for snow photography)
- Flexible and integrated in the wireless network
- Possible to trigger camera based on external sensor
- Complete kit <9000NOK

Characterize Coefficient of Variation in Ny Ålesund

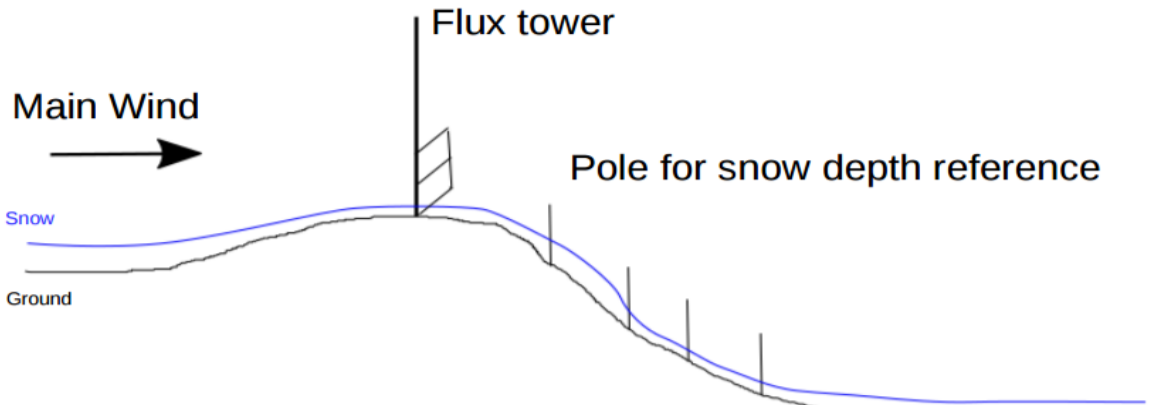
Sebastian Westermann, Kjersti Gisnås
& Kjetil Schanke Aas

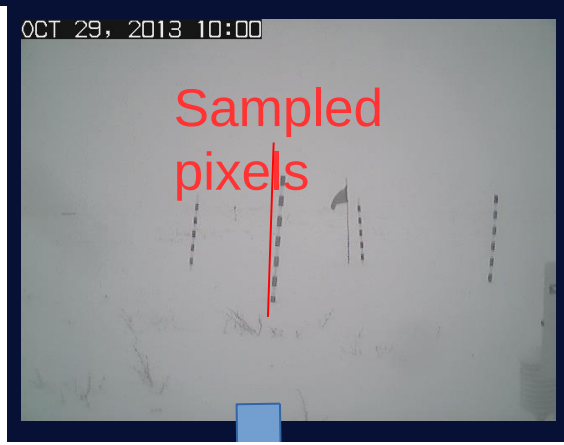


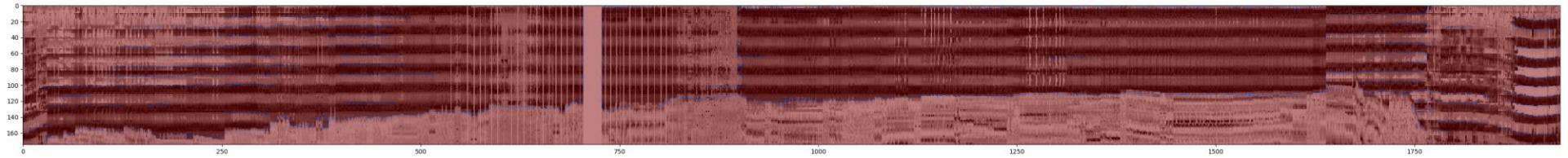




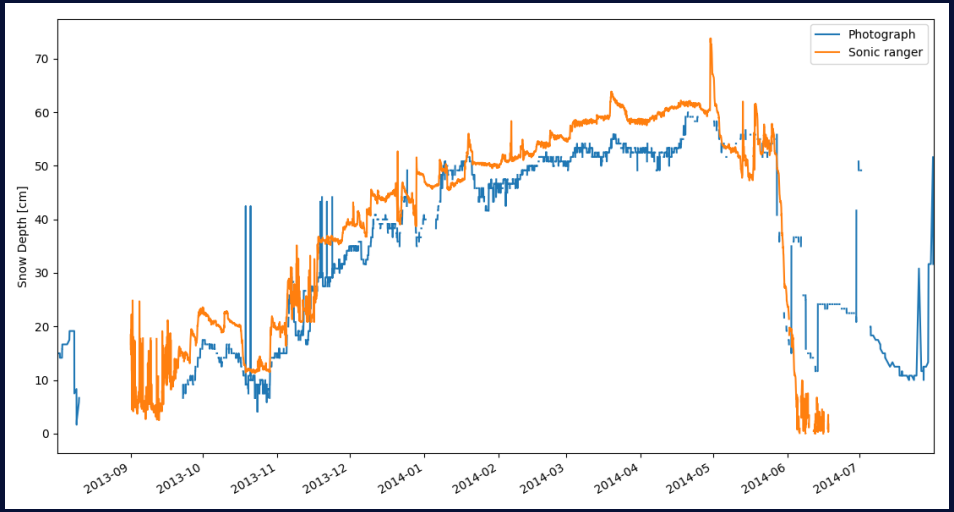
Drift monitoring by extracting snow depth from time-lapse camera







Testing method on data from Imnavait, Alaska



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

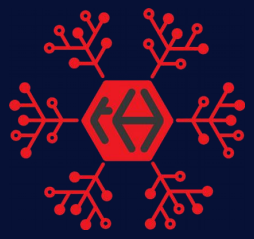
Synchronizing observations to an online open-access database in realtime

Snow Specific Capabilities:

Repeated snow depth mapping UAV/lidar

Installation of sensors for quantifying drifting snow flux

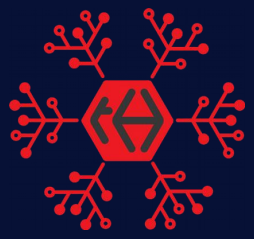
Installation of time-lapse cameras for snow drift monitoring, and Snow Cover Extent



The Hive Objectives

Establish a hub of individuals and groups at UiO interested and utilizing IoT technologies

- Share experiences and knowledge across research groups/departments
- Develop in-house technology adapted to our need
- Develop competences



Phase I

1. Identifying individuals and groups at UiO and associated to UiO:

Departments

Openzone, Simula, Research Bazar

2. Seminar at UiO:
Second half of August

3. Continue development @ Finse

Phase II

1. Seminars

2. Hackaton style projects:
Invite Geoscience/IFI students to form groups and project

3. Toward sharing ressources (labs,) for students, establish a UiO platform to share

Conclusion

1. Establishinging a UiO hub for sharing experiences and ressources across departments

2. Develop an in-house platform and workflow for that suites custom project ideas

3. initiate student projects involving geoscience-technology aspect

Thank you!

UiO : LATICE

Strategic Research Initiative

UiO : Science and Technology
Strategic Research Initiative

Contributing Projects & Funding:

The Research Council of Norway

ESCyM

HyCAMP

Contributions:

Snow Model Validation
Simon Filhol (UiO)

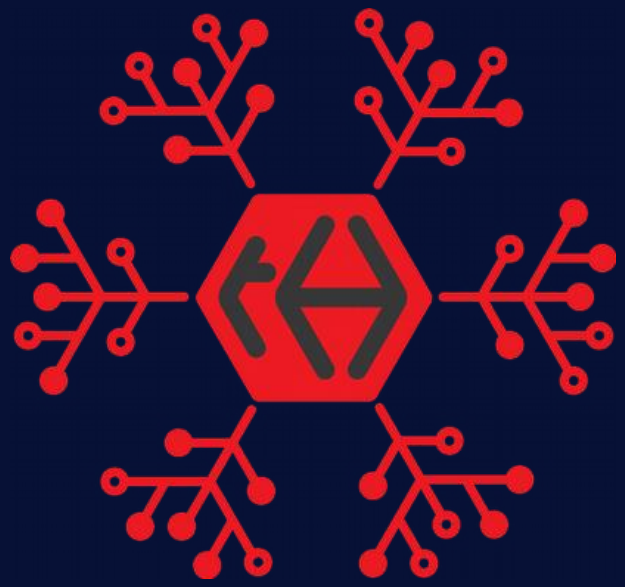
Snow Cover Fraction Mapping
Kjersti Gisnås (NGI)
& Kjetil Schanke Aas (UiO)

EvoGLAC

UNIVERSITAS BERGENSIS

CRYOMET

Thanks!



A particular thanks to:

- The Faculty of Mathematics and Natural Sciences to support this project as part of the eInfrastructure projects
- The Department of Geosciences
- the UH-IaaS infrastructure

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