




Strategic Research Initiative 2015-2019

# Land-Atmosphere Interactions in Cold Environments

An interdisciplinary research area at the University of Oslo

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**Department of Geosciences**  
**University of Oslo**

**Coordinator:** Lena M. Tallaksen  
**Co-leaders:** Frode Stordal, John Burkhart



**UiO : LATICE**  
... a Climate Science Project

Real Time Data and Project Information:  
<http://www.mn.uio.no/latice>

The logo for the UiO LATICE project is located in the bottom left corner. It features a red circular emblem on the left containing a figure, followed by the text 'UiO : LATICE' in a bold, sans-serif font. Below this, it says '... a Climate Science Project'. To the right of the text is a square QR code. The entire logo area is enclosed in a black rectangular box with a red border.

*CHES All Staff, Solstrand, March 22nd-23rd 2017*

# Motivation

- Global warming
- High latitude amplification
- Warming is strongest in winter

2016:

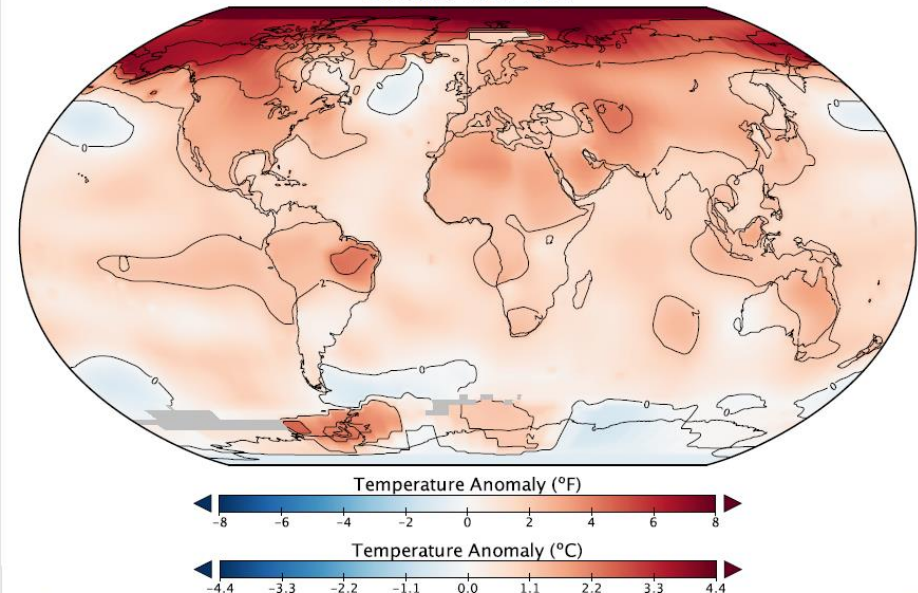
0.99°C / 1.8°F  
above 1951-80  
average

Warmest year of  
NASA GISTEMP  
record



January 2017 | NOAA/NASA – Annual Global Analysis for 2016

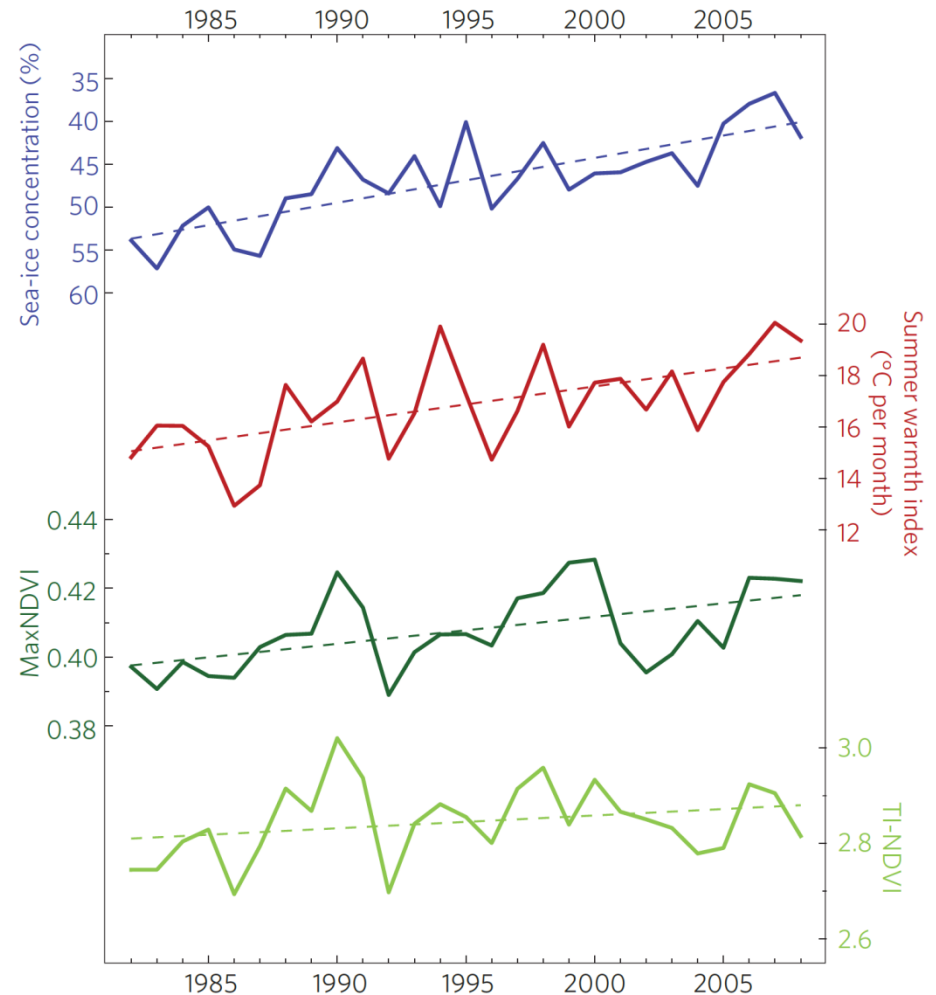
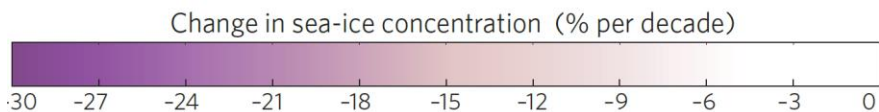
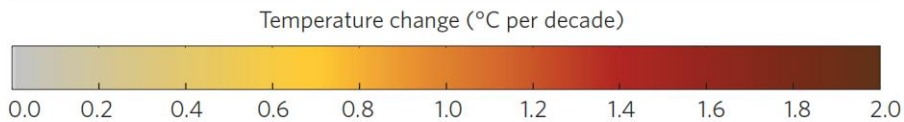
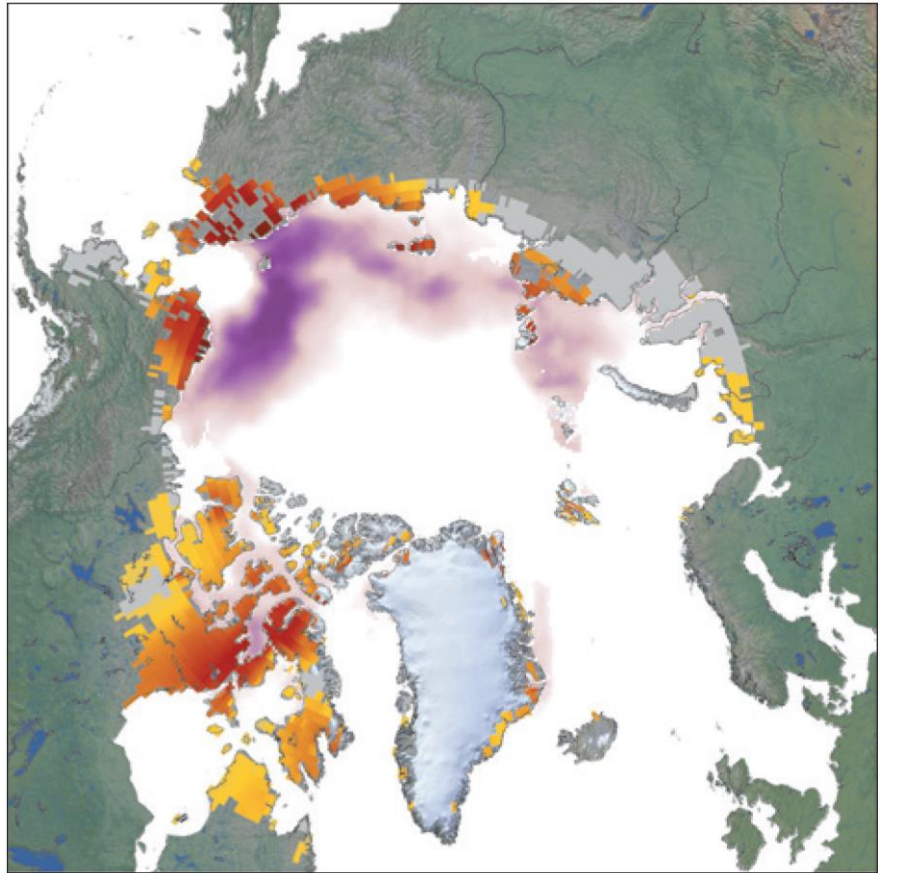
GISTEMP Annual Mean 2016  
Baseline 1951-1980



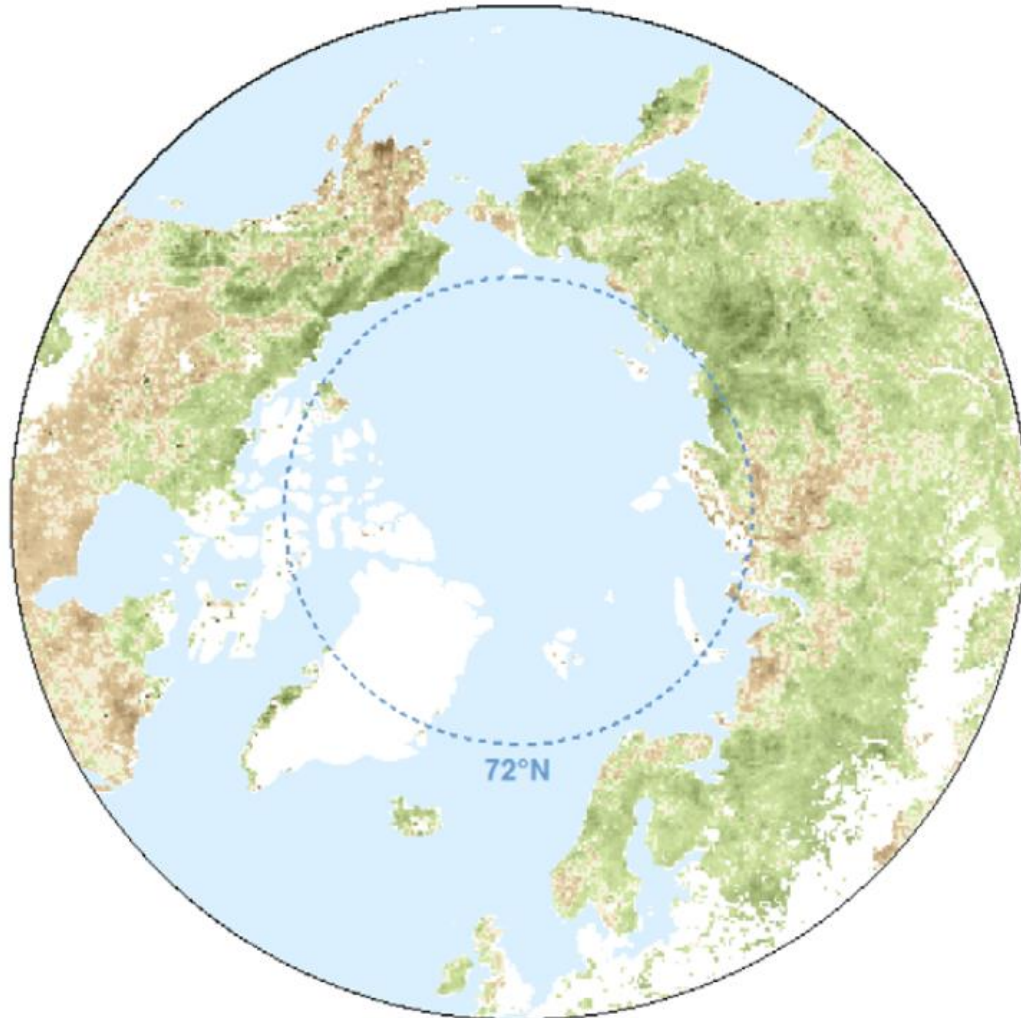
- The role of the (changing) land-surface (interactions and feedbacks)



# Arctic vegetation vs sea ice



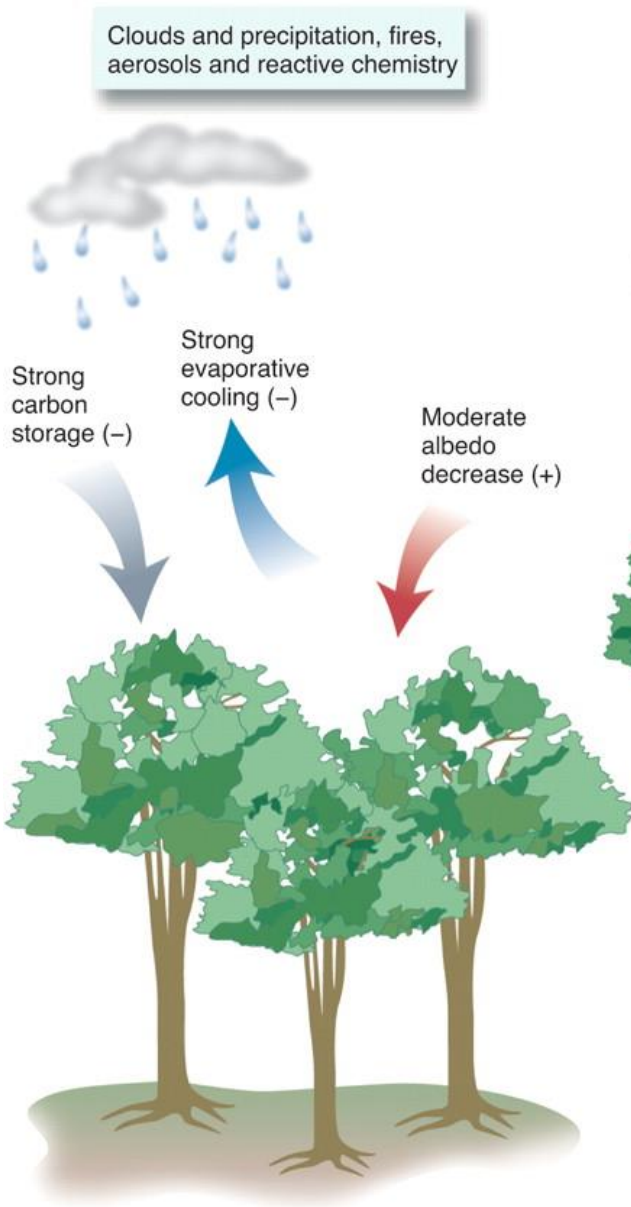
# High latitude **greening** and **browning** 1982 - 2008



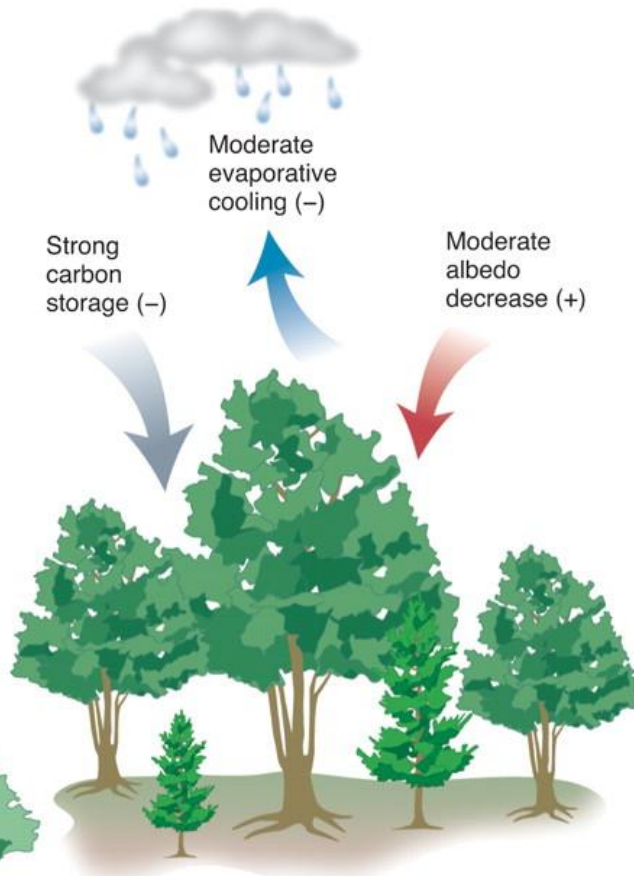
NDVI  
Normalized Difference  
Vegetation Index

Trends were calculated  
using the Theil–Sen  
analysis of GIMMS3g

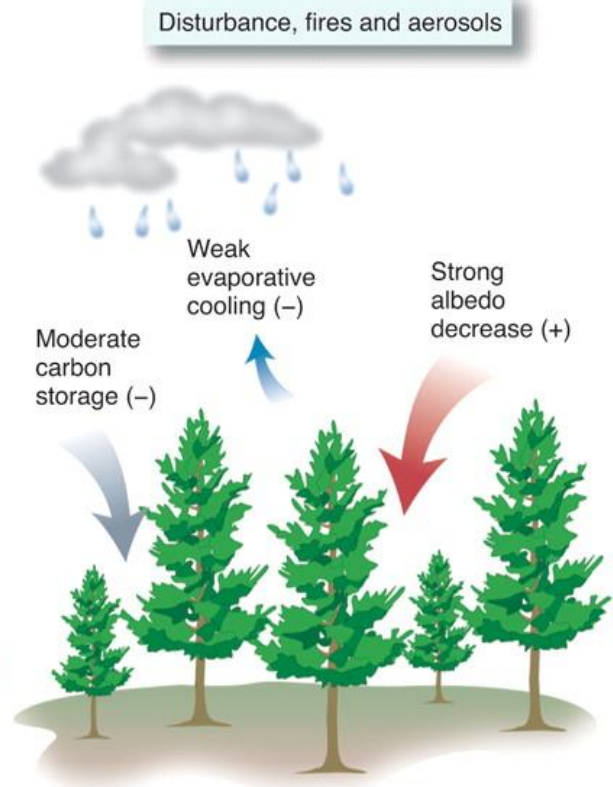
### A Tropical forests



### B Temperate forests



### C Boreal forests



# Biogeochemical and biogeophysical effects of forests

# LATICE – what is our focus?

## Changing climate and land cover

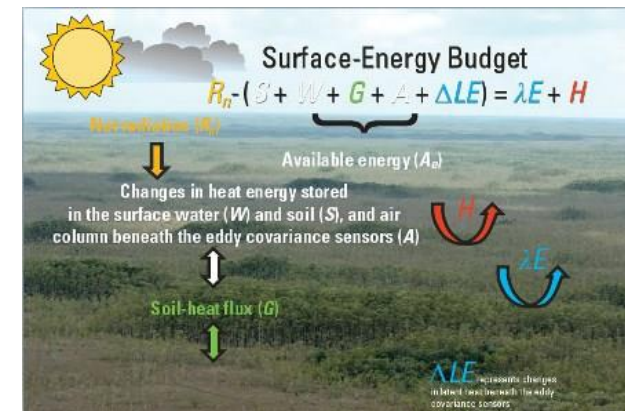
- Snow and ice
- Permafrost
- Vegetation and soil

## Methodology

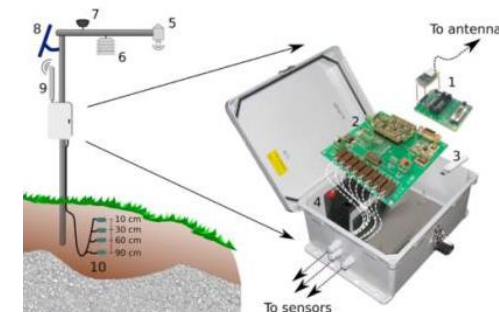
- Integrated observations across scale
- Observation based modelling approach
- Bridging modelling scales

## Goal

- Improve ESMs (NorESM)



Source: USGS





# LATICE – Who are we?

## GEOFAG (GEO)

### Atmosphere

Terje Koren Berntsen  
Frode Stordal

### Cryosphere

Bernd Etzelmüller  
Jon Ove Methlie Hagen  
Andreas Käab  
Thomas V. Schuler  
Sebastian Westermann

### Hydrosphere

John Burkhart  
Lena M. Tallaksen  
Chong-Yu Xu  
Kolbjørn Engeland (II)

## NATURHISTORISK MUSEUM (NHM)

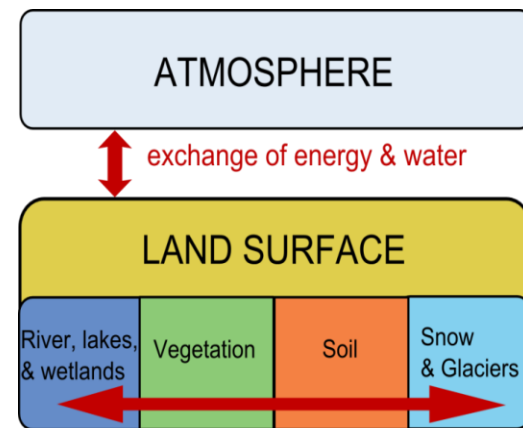
### Biosphere

Anders Bryn  
Rune Halvorsen  
Vegar Bakkestuen (II)

## IFI

### Environmental sensors

Tor Sverre Lande  
Svein Erik Hamran (II)  
Dag Wisland (II)



# LATICE PhDs



1. Peter Horvath



4. Sven Decker

1. Ecological Climatology and Distribution Modelling (validating different approaches of vegetation modelling), NHM

2. Imaging radar instrument for eco/cryo hydrological data collection, IFI

3. Modelling the importance of Biogenic Volatile Organic Compounds (BVOC) emissions in the boreal zone, GEO

4. Closing the water balance in glaciated and non-glaciated catchments, GEO

5. Modelling the role of permafrost in the carbon cycle, GEO



2. Håvard Eriksrød



3. Sara Blichner



5. Håvard Kristiansen



# LATICE Postdocs

1. Hui Tang

Dynamic vegetation modeling and its coupling with climate models in the Arctic region (2014-2018)



2. Jonathan Rizzi

Climate change impacts in cold environments (2014-2016), new (2017-2018)



3. Norbert Pirk

Model sensitivity to changes in surface conditions (2017-2019)



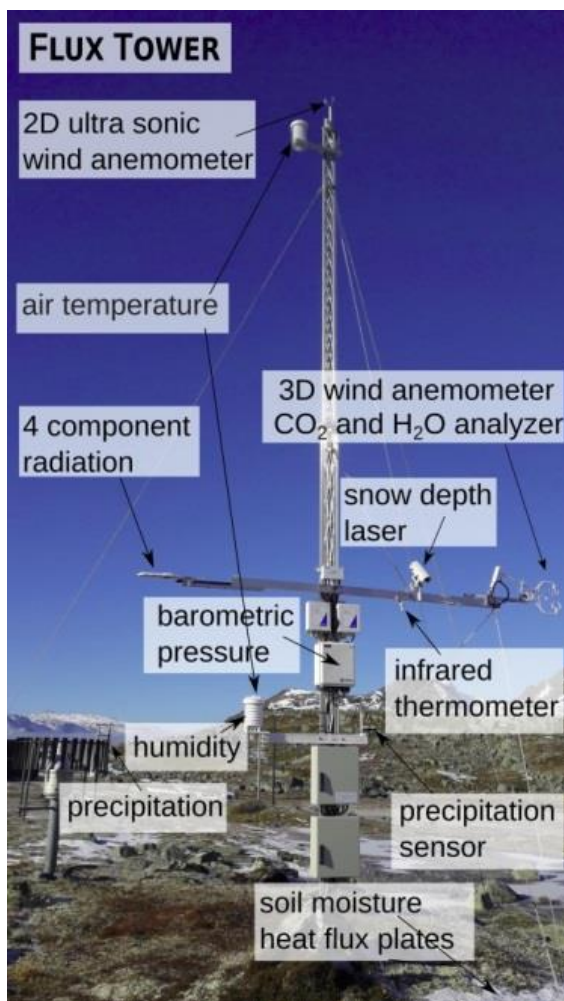


## NorESM – An integrating tool

- ❑ The **Norwegian Earth System Model (NorESM)** will be used as a common tool to study interactions across processes and scales.
- ❑ WRF – regional weather and climate model
- ❑ Hydrological models (SHYFT)
- ❑ Distributed terrestrial models



# LATICE-Flux



## Primary\* & Portable Tower:

### LI-7500A Open Path CO<sub>2</sub>/H<sub>2</sub>O

Analyzer

Biomet System 4 – Tower (net radiation, humidity, soil heat flux, precipitation sensor, soil temperature/moisture)

4 component radiation

Sonic anemometer

## Wireless Sensor Network (distributed measurements)

Snow depth

Snow/precipitation radar platform

Soil temperature/moisture

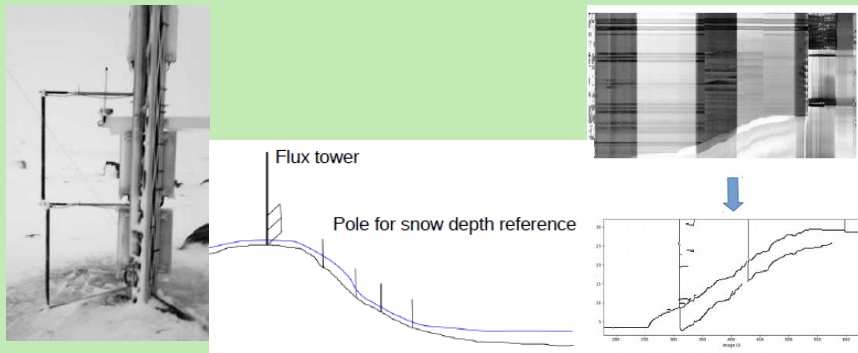
piezometers (?)

Net radiation

Temperature / Humidity

2 LATICE PhDs + 1 PostDoc on third party funding

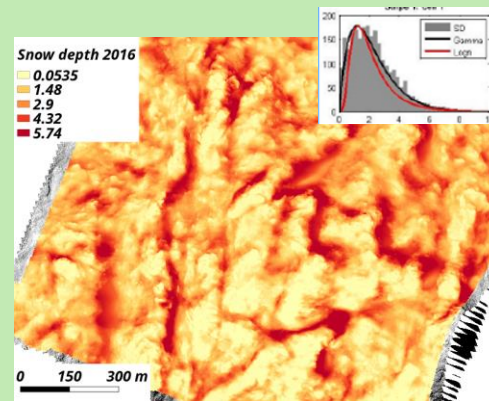
## Process study of drifting snow



Monitoring the flux

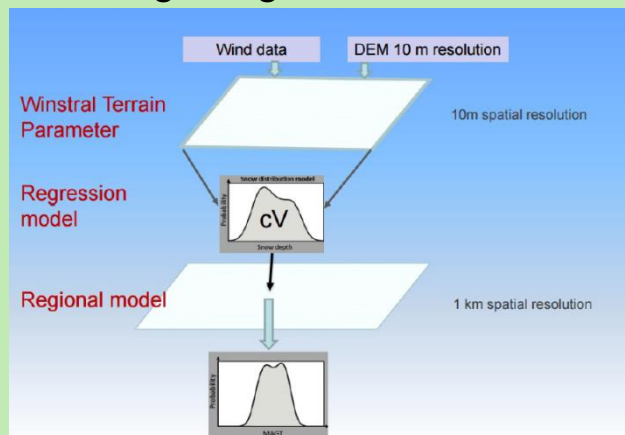
Evolution of the snowdrift

## Mapping snow distribution in the landscape



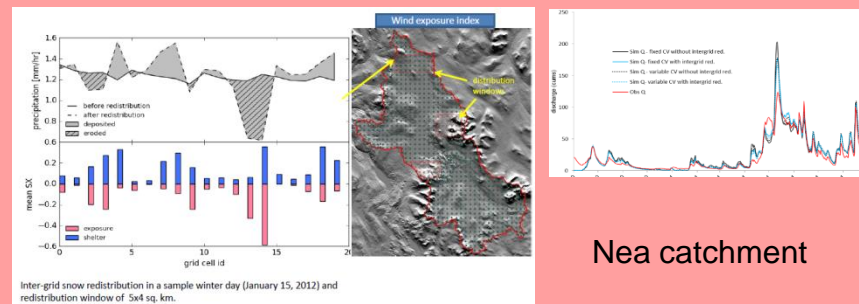
Snow depth distribution in 1 km<sup>2</sup> field, UiO drone  
Gisnås et al., 2016

## Modelling subgrid snow distribution



Gisnås et al., 2016; Aas et al., 2016

## Model application to hydrological test field

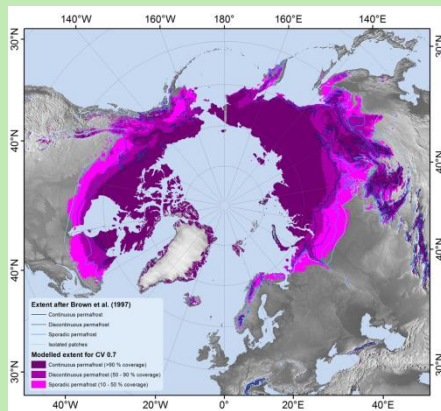


Inter-grid snow redistribution in a sample winter day (January 15, 2012) and redistribution window of 5x4 sq. km.

Nea catchment

1 LATICE PhD + 1 Phd, 4 PostDoc, 1 researcher on third party funding

## Remote sensing of permafrost (COUP, SatPerm, ESA GlobPermafrost)



New global permafrost extent product based on satellite data

[www.globpermafrost.info](http://www.globpermafrost.info)

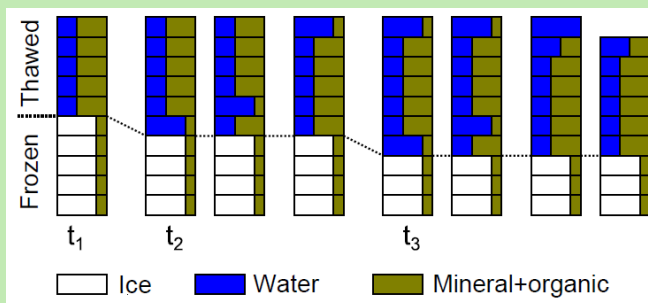
Westermann et al., 2015, Westermann et al., 2016a

## Landscape evolution in permafrost regions, including scaling (COUP, Permanor)



Degrading peat plateau observed from UiO drone  
Borge et al., 2017

## Modeling the permafrost-carbon feedback and improved ESM representation (COUP, Permanor)



Westermann et al., 2016b

## Hazards of degrading mountain permafrost for society (CryoWall)

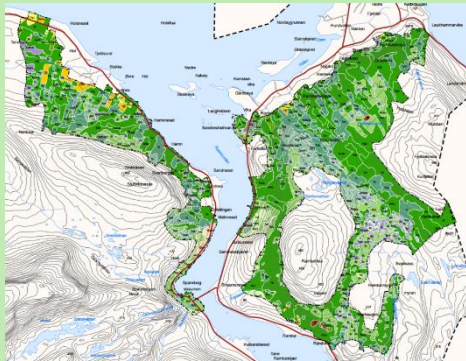


Florence Magnin during fieldwork in a vertical permafrost rockwall

Steiger et al. 2016

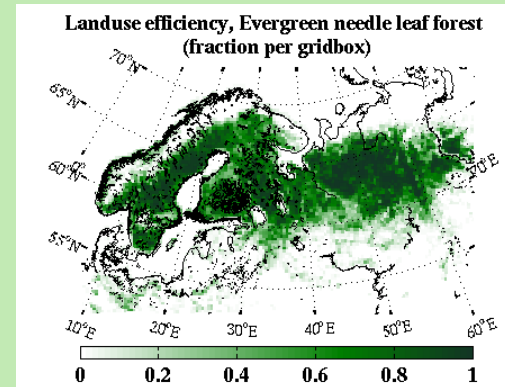
2 LATICE PhDs and 1 Postdoc + 1 PhD on third party funding

Distribution model of selected vegetation types in the boreal arctic zone



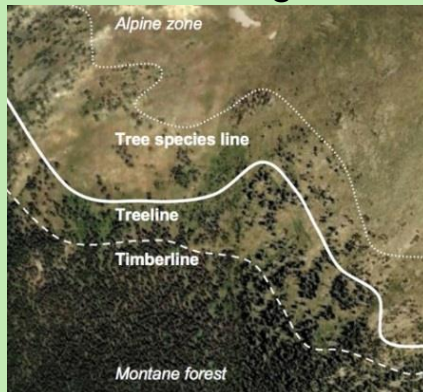
Skog og landskap

Modelling of climate-vegetation interactions and feedbacks



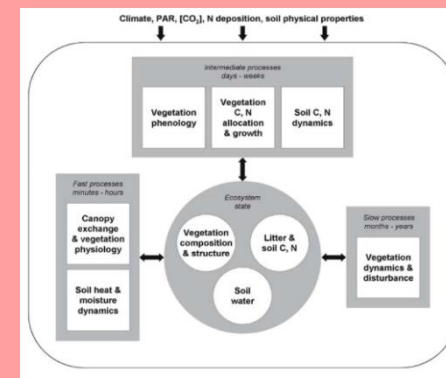
Rydsaa et et al 2016

Response of tree and forest line to climate change



Berdanier 2010

Improving parameterizations of the vegetation model

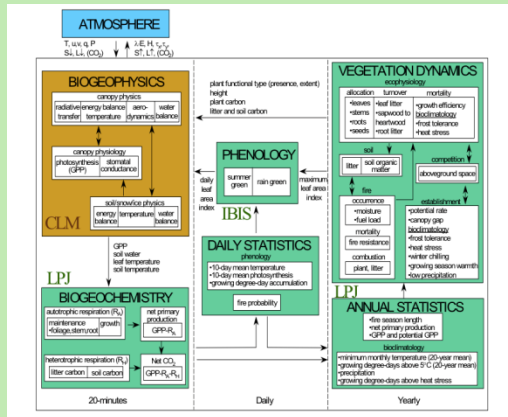


Prentice et al. 2007

# UiO : LATICE **Vegetation**

2 LATICE PhDs and 1 Postdoc + 1 PhD on third party funding

## Dynamical vegetation modelling CLM

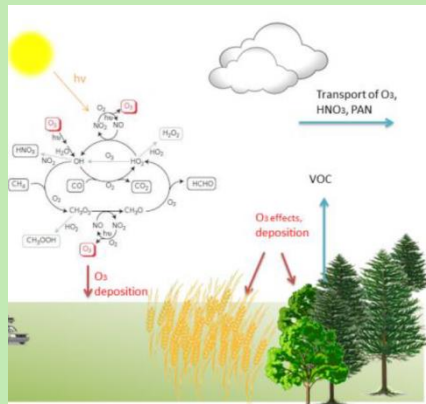


## Raindeer grazing Finnmarksvidda: impacts on surface fluxes

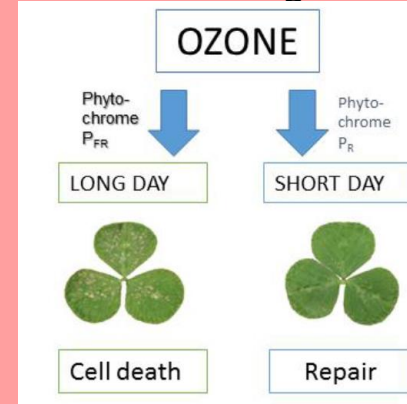


NORUT

## Biogenic Organic Compounds (BVOC): climate feedbacks in the boreal zone



## Double punch: ozone and climate stresses on vegetation



# ***The role of the vegetation in the climate system***

Network seminar on terrestrial vegetation ecological climatology

Lunch-to-lunch seminar at The Natural History Museum (UiO) in Oslo from Wednesday 9th to Thursday 10th of November 2016, for the LATICE network and other invited people/institutions.

Time and place: Nov. 9, 2016 11:30 AM - Nov. 10, 2016 01:00 PM, [the Natural History Museum, NHM](#)



Land-ATmosphere Interactions in Cold Environments - LATICE. Photo: Anders Bryn, NHM

Organizing Committee:

- [Anders Bryn](#), Natural History Museum, University of Oslo
- [Frode Stordal](#), Department of Geosciences, University of Oslo
- [Lena M. Tallaksen](#), Department of Geosciences, University of Oslo
- [Vigdís Vandvik](#), Department of Biology, University of Bergen

For more information see:

- [Invitation to the seminar](#)
- [Programme](#)

- NFR support (KLIMAFORSK)
- 45 participants
- Foster national collaboration
- Follow up through LATICE

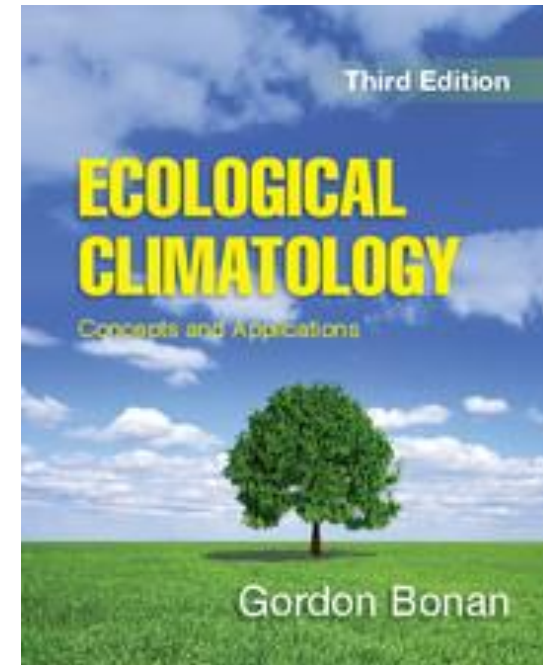




# UiO course: Ecological climatology



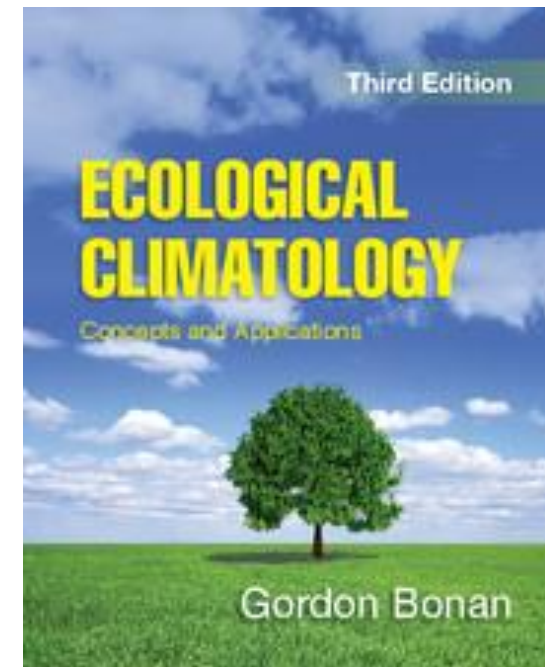
Overview of ecological climatology with main emphasis on terrestrial boreal, alpine and Arctic ecosystems. Focus on climate feedbacks involving these ecosystems.





# UiO course: Ecological climatology

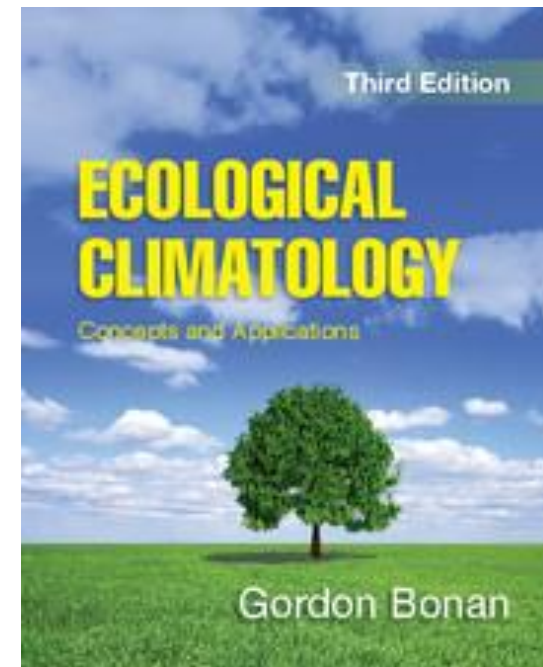
- Part of master programs in UiO Geo & Biosciences Departments
- Spring semester
- Biannual or annual, starting 2018
- 10 ECTS
- Block course with homework between blocks
- Offer to students across Norway and the Nordics





# UiO course: Ecological climatology

- Text book by Gordon Bonan: Ecological Climatology
- Starting with bio basics for geo students and vice versa
- Engage specialists in teaching
- Student presentations
- Theory and modelling exercises
- Field (and social) week in Finse



# Citizen science project

- Proposal for citizen science project upcoming
- Discussed with DNT



## Norsk rekord for liten bjørk

**Det er ikke så høyt, men det er veldig høyt for lite bjørk. Norges høyestliggende tre er et funnet. Kan det tenkes mer over havet?**

**LENN HUGD PETERSEN**  
I tid og tross ble det funnet en liten bjørk i et fjellkrevling, som skilte seg fra de andre bjørkene i området.



**NED: Nils Erik Skjolden** har fotografert den lille bjørken i fjellkrevlingen. (Foto: Nils Erik Skjolden/NTNU)



## Fremreid

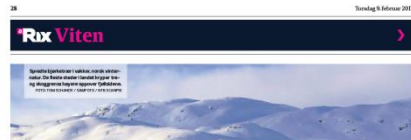
**En gammel, stor tre i et åpent område i et fjellkrevling. Det er en fremreid, som er en av de få treene som vokser i et fjellkrevling. Det er en gammel, stor tre i et åpent område i et fjellkrevling. Det er en fremreid, som er en av de få treene som vokser i et fjellkrevling.**

## Enn høyer?

**Et tre på 2,5 meter høyt er funnet i et fjellkrevling. Det er en av de høyeste treene som er funnet i et fjellkrevling. Det er et tre på 2,5 meter høyt i et fjellkrevling. Det er en av de høyeste treene som er funnet i et fjellkrevling.**



**REIDREID: Nils Erik Skjolden** har fotografert den store treen i fjellkrevlingen. (Foto: Nils Erik Skjolden/NTNU)



## Varmere klima gir god grunn for tre i høyden

**LITE TRE SATTE HØYDEREKORD**

## Det er ikke så høyt, men til tross for det ser veldig høyt til fjells. Norges høyestliggende tre er funnet. Kan du tenke deg hvor mange meter over havet?

**LENN HUGD PETERSEN**  
I tid og tross ble det funnet en liten bjørk i et fjellkrevling, som skilte seg fra de andre bjørkene i området.



**FESTE OMRÅDE: Nils Erik Skjolden** har fotografert den store treen i fjellkrevlingen. (Foto: Nils Erik Skjolden/NTNU)



## Noen høyer?

**Et tre på 2,5 meter høyt er funnet i et fjellkrevling. Det er en av de høyeste treene som er funnet i et fjellkrevling. Det er et tre på 2,5 meter høyt i et fjellkrevling. Det er en av de høyeste treene som er funnet i et fjellkrevling.**

## Den ble funnet 1382 meter over havet. Aldri før har det blitt registrert høyere.

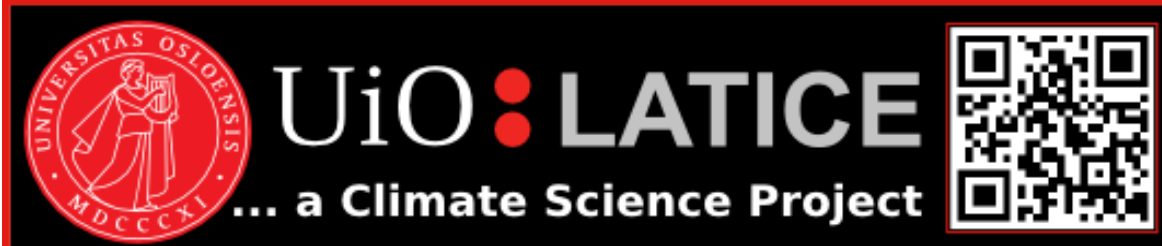
**LENN HUGD PETERSEN**  
I tid og tross ble det funnet en liten bjørk i et fjellkrevling, som skilte seg fra de andre bjørkene i området.



**DEN BLE FUNNET 1382 METER OVER HAVET: Nils Erik Skjolden** har fotografert den store treen i fjellkrevlingen. (Foto: Nils Erik Skjolden/NTNU)



**Thank you for your attention!**



**UiO LATTICE**  
... a Climate Science Project

**Real Time Data and Project Information:**  
**<http://www.mn.uio.no/lattice>**

The complex block features a black background with a red border. On the left is the red circular seal of the University of Oslo (UiO), containing a figure and the text 'UNIVERSITAS OSLOENSIS' and 'MDCCCXI'. To the right of the seal is the text 'UiO LATTICE' in white, with a red dot between 'UiO' and 'LATTICE'. Below this is the text '... a Climate Science Project'. On the far right is a white QR code. At the bottom, the text 'Real Time Data and Project Information:' is followed by the URL 'http://www.mn.uio.no/lattice' in white.

*CHES All Staff, Solstrand, March 22nd-23rd 2017*