LATICE - Land-ATmosphere Interactions in Cold Environments

UiO : LATICE

The role of Atmosphere - Biosphere – Cryosphere – Hydrosphere interactions in a changing climate

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

Climate change is impacting the high latitudes more rapidly and significantly than any other region of the Earth. A warmer climate has already led to thawing of permafrost, reduced snow cover and a longer growing season; changes, which in turn influence the atmospheric circulation and the hydrological cycle.

LATICE aims to advance the knowledge base concerning land atmosphere interactions and their role in controlling climate variability and climate change at high northern latitudes through:

- Improving parameterizations of processes in earth system models controlling the interactions and feedbacks between the land (snow, ice, permafrost, soil and vegetation) and the atmosphere at high latitudes, including the boreal, alpine and artic zone.
- Assessing the influence of climate and land cover changes on water and energy fluxes.
- Integrating remote earth observations with in-situ data and suitable models to allow studies of finer-scale processes governing land-atmosphere interactions.
- Addressing observational challenges through the development of novel observational products and networks.

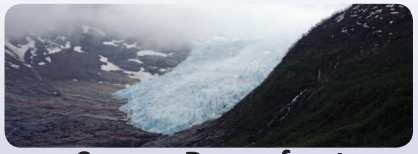
LATICE is recognized as a strategic research area by the Faculty of Mathematics and Natural Sciences at the University of Oslo who is providing funding for five PhDs and one Postdoc during the period 2015 - 2019.

Sensors - Design

The development of new techniques for the measurement and characterization of ecohydrological fluxes including snow water, soil moisture, and water vapor at high spatial resolution is a key part of LATICE. Building on existing technologies in our infrastructure (see side panel) with novel technologies, the activity addresses distinct challenges of temporal and spatial scale within land-surface observations. Two areas of specific interest are:

Advanced sensor technologies
Through our collaboration with the Department of Informatics we are bringing novel radar technologies developed for biomedical imaging to the field of geosciences. We envision developing radar arrays for snow water and soil moisture monitoring that will provide a 4-D view of the dynamics of the systems.

Datascapes
A grand challenge today is management and handling of large volumes of data. As we probe with our observations at finer resolution at both temporal and spatial scales, new methodologies for model calibration and validation are required. Developing such new calibration tools and methodologies is a core activity within LATICE.

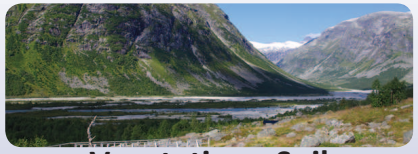


Snow - Permafrost

Increasingly the role of snow in ESMs is recognized as a dominate variable in the regulation of energy and chemical exchanges at global and local scales through modulation of albedo, insulating cover, and providing an exchange surface for chemistry. LATICE will enable refinement of current snow parameterizations in land-surface models with the intention to develop new more efficient physical or hybrid statistical representations of snow distribution. Two areas of specific interest are:

Snow hydrology
In order to develop new snow parameterizations, better measurements of the evolution of snow packs, including changes in stratigraphy and the overall snow water equivalence are required. Snow also is a critical store of water throughout the year. Through LATICE we will seek novel methods for calibrating hydrologic models that treat the snow pack equally to discharge.

Snow distribution and permafrost/carbon dynamics
Variability in snow cover drives feedbacks on biogeochemical cycles. A LATICE objective is the characterization of snow distribution in ESMs, and to explore sensitivity of permafrost distribution in order to evaluate impacts to carbon turnover (GHG emissions) within the ESMs.



Vegetation - Soil

Vegetation plays an important role in the climate system in the boreal zone. LATICE will improve its representation in ESMs through field and modelling studies. Exchange of energy, water and chemical compounds between the atmosphere and underlying vegetation and soil will be modelled and measured (flux towers) for different seasons and surface conditions. Two areas of specific interest are:

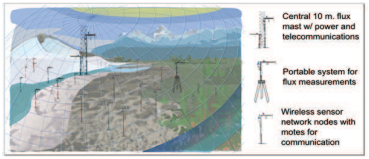
Vegetation ecology modelling
Vegetation migrates as climate change and nature-types and their migration are mapped and monitored through field campaigns and remote sensing. Their distributions are projected based on climate scenarios using a dynamic vegetation modelling approach.

Climate impacts of biogenic emissions
Formation of aerosols and ozone from Biogenic Volatile Organic Components (BVOCs) and impacts on atmospheric chemistry and physics are studied, in particular cloud formation. At the same time the uptake of ozone in plants will be modelled.

Infrastructure

Our system for land surface – atmosphere interaction infrastructure includes a central 10 m. flux mast, a portable Eddy-Covariance system, and a distributed wireless sensor network. The distributed wireless sensor network consists of an array of small distributed lightweight towers and communications equipment. All devices connected to the system will have access to telemetry for dissemination of data in real-time. The primary components of the system include:

1) A 10m. mast instrumented for CO_2 and H_2O flux measurements.
2) A portable flux system (tripod based) for use on campaigns and for calibration and inter-comparison with the tower on a regional scale.
3) A wireless sensor network for distributed hydrometeorological and snow depth observations.



PhD Research School

LATICE is a key contribution to the National Research School on "Changing climates in the coupled earth system" (CHESS). Lectures, workshops and summer schools will be organized in diverse locations and funds will be available for PhDs in Norway to work and study abroad. CHESS will also support various "hands on" courses in proposal and article writing, presentation techniques and teaching.

UiO : Department of Geosciences
Terije Koren Bernsten, John Burkhart, Bernd Etzelmuller, Jon Ove Methlie Hagen, Andreas Kaab, Jon Egill Kristiansson, Kistin Kuger, Thomas Vikhmar Schuler, Frode Stordal, Lena Merete Tallaksen, Sebastian Westermann, Chong-Yu Xu

UiO : Department of Informatics
Tor Sverre Lande, Svein-Erik Hamran, Dag Wisland

UiO : Natural History Museum
Anders Bryn, Rune Halvorsen

latice-proj@geo.uio.no