Oslo, 30 December 2021

LATICE – Annual letter 2021

Dear all,

The year is coming to an end and it is time to thank you all for your contribution to making it one more interesting and exiting LATICE year, despite it being yet another year impacted by the pandemic. Our high level of activity and the many achievements are due, not only to LATICE, but also to the many projects that are closely associated with it.

Although we were better prepared this time when a new lockdown came in force at the start of the year, it has affected us all in many ways, from cancelled fieldwork, seminars and travels – to working from home with less interactions and informal meeting places. It has been difficult to plan activities as regulations have been changing on short notice, and our international collaboration has been suffering for the second year in a row. With rising numbers again now in December, it is difficult to foresee what the next year will bring, but we all hope for more normal days that will allow us to engage further with the international community.

The LATICE 2021 annual meeting was successfully organized as a physical meeting in Drøbak, 3-4 November with a few participants joining on Zoom. It featured a new structure, including parallel discussion sessions to coordinate ongoing activities and initiate new proposals, a plenary session on land-atmosphere interactions, short updates on current research, and in-person and remote poster viewing. We missed as last year the physical presence of our international advisory board members, Roy Rasmussen, NCAR and Eleanor Blyth, CEH Wallingford, but were grateful for their commitment to join the meeting online providing inspiring talks and valuable feedback as always.

Significant time has been devoted to two main LATICE activities (see below for further details), the development of a common modelling platform for CLM/FATES and the continuation of LATICE Flux sites and associated sites. The latter encompasses various infrastructure and field investigations, with important contribution from associated projects. These datasets are vital for improved representation of high latitude surface processes in land surface models (LSMs) as well as in hydrological models. LATICE was a key contributor to the Infrastructure proposal Fram-CI (led by John Burkhart), which would have represented a major step forward on the flux-enabled real time infrastructure in place at Finse. Unfortunately, it was not funded (this year), neither was INES2, which would have secured funding for the development of NorESM – including CLM, vital for the integration of our modelling work.

A special highlight this year was the PhD defense of our LATICE PhD, Sara Marie Blichner, who successfully defended her thesis " From trees to cloud seeds: Modelling the climate influence of biogenic volatile organic compounds with the Norwegian Earth System Model" for the degree of Philosophiae Doctor, on 15 April. As with many other activities, it was an online event, so we missed out celebrating with Sara, but enjoyed very much listening in on the discussion. Congratulations!

https://www.mn.uio.no/geo/english/research/groups/latice/news/disputation-sara-marie-blichner.html

Sara now works as a Post-Doc at the Stockholm University and her PhD work has been cited in the latest IPCC report.

Some further highlights and details of activities in 2021 (our seventh year) are presented below.

Observations at LATICE Flux sites and associated sites

Our flux measurements sites operated well during the last year. Apart from a few days with data logging issues at Finse, all sites reported useful measurements from most of the sensors. We decided to keep the mobile flux tower running at Iškoras throughout 2022 to keep providing baseline estimates for carbon and energy exchange, as well as for meteorological and soil conditions. At the Hedmark twin sites, one of which was restored during the autumn this year, several meteorological sensors caused problems that still need to be addressed. Still, we can be satisfied with the overall data collection, also at the Hedmark site.

In May 2020, we got the housing for our cold climate container delivered to Blindern. With power, plumbing, network, and the chillers (which cool the cooling liquid to about -50 ^{o}C) now in place, the first simple experiments can be conducted. The very first experiment is already planned for January next year (providing stable winter conditions for high latitude vegetation). We will extend the facilities of this new lab in 2022 to enable a diverse range of new experiments on land-atmosphere interactions. The container is expected to provide novel insights into high-latitude processes.

A number of related activities benefit from the data collected and experience gained through the establishment of the LATICE Flux sites. This includes Postdocs, PhD and master students, as well as interns, both from UiO and abroad. In September, we confirmed our commitment to host Michael Bekken as part of his application to the Fulbright Program, starting in August 2022, if successful. Michael aim to analyse the carbon flux as a function of latitude comparing the observed flux across sites.

We were happy to learn at the LATICE annual meeting that flux measurements at the Hurdal ICOS site north of Oslo, is now finally operating (since September) after several years of technical challenges. We anticipate a fruitful collaboration with NIBIO (and PI Holger Lange) responsible for the site. The tower is located in an area dominated by Norway spruce, complementing existing LATICE flux sites representing higher latitude ecosystems. Also, we welcome the flux measurements recently started by NMBU at a grassland site near their campus in Ås, and look forward to future collaboration with the group.

Land surface and Hydrological model developments

The CLM group at GeoHyd/MetOs led by Kjetil, Hui and Yeliz, operates in close contact with the CLM group at NCAR. The UiO group continues their regular online meetings with the attendance of group members from Oslo and Bergen. The competence within the group on the CTSM (new name of CLM) model and FATES is steadily increasing. Development of the NorESM LandSites Platform (available in the NorESM GitHub repository) is aimed at ensuring workflow reproducibility and greater user accessibility (work led by Hui Tang). It simplifies and streamlines model simulations for selected sites and facilitates integration between model development and local atmospheric, ecological and hydrologic observations. The momentum gained last year for the NorESM LandSites Platform development and applications continues with a focus on releasing a minimum version of the platform. Starting this year, as part of Iris Mužić's (previously LATICE intern) PhD research, focus is also on the newly coupled WRF-CTSM model. Iris started her PhD position at CICERO in 2021 and is now working on implementation of the coupled WRF-CTSM model in the Nordic region. Terje Berntsen and Yeliz Yilmaz are co-supervisors, strengthening the links between CICERO and LATICE partners.

Activities related to the LATICE-MIP have gained increased attention this year with the establishment of a new group working on evaporation (LATICE-MIP ET). This is in addition to the ongoing efforts on snow cover dynamics (LATICE-MIP Snow). The initial site-level model intercomparison initiative (led by Yeliz Yilmaz) aimed to utilize flux measurements from the Finse, Iškoras, and Bayelva sites. It has now been extended with data from the Hedmark twin sites. The LATICE-MIP Snow group currently focuses on snow cover preparing data in the form of Earth observations from satellites and drones for spatially representative validation of output from land surface model (LSM). Following this first phase, other LSM groups will be invited to take part in the snow MIP using our field measurements and satellite-based observations. This to encourage a broader international adoption of the data and their integration into larger MIP efforts.

The LATICE-MIP ET group (led by Kolbjørn Engeland) was initiated to improve knowledge about evaporation (ET) as a component of the water cycle in Norway. It was motivated by the large uncertainties in simulated annual water balance as demonstrated by recent studies. This initiative involves researchers from several organizations (MET, NIBIO, NVE and UiO) with expertise on different type of models. Two hydrologic models (HBV and Shyft) and two land surface models (CLM and SURFEX) will be compared at three spatial scales: the point scale encompassing several flux sites (Finse, Hedmark, Hurdal, Iškoras and Ås), the catchment scale, and the regional scale covering all of mainland Norway. During November 2021, test simulations were performed for all sites and models. Ongoing activities include adapting model parameters to represent local surface conditions (within the flux tower footprints) and preparing local observations. Expanding on this research interest, a joint proposal (led by Kjetil Aas and Lena Tallaksen) was submitted to the Faculty call for PhD within Sustainability. The proposal WATERUSE, addresses how land use and land cover changes in Norway have affected the water balance and hydro power potential. It was unfortunately not funded in this first call.

New associated projects and initiatives

dScience – dScience is a center developing and supporting new and important interdisciplinary research within computational science and data science across UiO. In its Machine Learning Program, the Department of Geosciences together with the Department of Technology Systems got support for a new Phd project on “Swarm intelligence for observing systems in climate science - developing a reinforcement learning framework for surface flux mapping with drones”.

DroneLab - The DroneLab is a newly established core facility at the MatNat Faculty, coordinated by the Department of Geosciences. It consists of drone and sensor hardware, and is supported by a group of technicians and researchers to provide the necessary know-how on drone operations and data processing.

BioGov - The project *“Biogeochemical processes governing boreal C cycling (BioGov)”* was funded as part of the “Fellesløftet” funding scheme of the Research Council. The project is coordinated by Dag Hessen and is affiliated with CBA. The primary objective of BioGov is to contribute to improved validity and accuracy of NorESM through more well-constrained model description of biogeochemical processes and kinetics governing boreal C cycling under climate change. This is achieved by integrating disciplinary approaches across scales in collaborative field and model laboratory studies, ultimately improving decadal to centenary climate prediction. Biogov focuses on the high risk of mobilization and loss of soil

organic carbon in the boreal biome as a consequence of warming, permafrost thaw, and changes in hydrological processes.

SNOWDEPTH - The project "Global snow depths from space-borne remote sensing for permafrost, high-elevation precipitation, and climate reanalyses" has been funded by RCN. This researcher project for young talents is led by Désirée Treichler from the GeoHyd section and two LATICE researchers, Kristoffer Aalstad and Yeliz Yilmaz, are contributing partners. The project aims to directly measure snow depths globally at high spatial resolution from ICESat-2 space-borne laser altimetry data. This global snow depth data will fill a large data and knowledge gap within hydrology and cryosphere/climate sciences.

New team members

Nikki Vercauteren, a new associated professor at the MetOs section, joined the LATICE team this year and gave an invited talk at our annual meeting in November. She is an atmospheric scientist and her research activities evolve around understanding energy exchange processes across scales in the atmosphere, as well as understanding lake- and land-atmosphere interactions and other near-surface dynamical processes. Based on common research interest, a joint proposal (led by Nikki V.) was submitted along with Norbert Pirk and Kristoffer Aalstad to the Faculty call for PhD within Sustainability. The topic was land-surface fluxes in heterogeneous environments and a stochastic data-model fusion approach. It was unfortunately not funded in this first call.

Alouette van Hove and Clare Webster started autumn 2021 at the GeoHyd section, in their respective PhD and Postdoc positions. Alouette's project is closely connected with the dScience Center and the RCN Spot-On project, aiming to introduce swarm intelligence for our drone flux measurements. Clare research revolves around measurements and modeling of snow albedo in forest canopies. Her work also includes the establishment of the Drone Lab at the Department of Geosciences.

The LATICE group currently contains four PhDs and one Postdocs funded by the Faculty. In addition, there are several other researchers, Postdocs and PhDs associated with the LATICE project, many of them contributing with important fieldwork at Finse and other high latitude sites in Norway. This year Adam Eindride Naas, a new PhD student at NHM joined the group. Adam will do his PhD as part of the project "Modelling Ecological state and Condition Maps to support knowledge-based decision-making in Area management and spatial Planning" (ECoMAP). We are pleased to have you all as part of the LATICE team.

Interdisciplinary teaching and training

GEO9915/5915 Ecological Climatology, led by Anders Bryn and Frode Stordal, was taught for the fourth time in spring 2021. The course addresses relationships between climate and ecology, with focus on climate related feedbacks within boreal, alpine and arctic terrestrial ecosystems. This year the course gathered ten master and seven PhD students. For the first time, there were more students from geosciences than from biosciences. As in previous years, several specialists from the LATICE community contributed with lectures in their fields of specialty.

GEO3032 Climate Change and Impacts was given for the second time in spring 2021. The LATICE leadership has contributed to the establishment and development of the course. LATICE participants gave several lectures in the course, which gathered more than 20 students.

Dissemination and Communication

The group has been active in dissemination and communicating the LATICE project and our research at various conferences and events, such as the online EGU and AGU conferences as well as invited talks at more targeted events, e.g. the CBA seminar series. Contributions from LATICE scientists at these events are provided at our LATICE website, labelled for instance, "vEGU21: Gather Online".

We have created a CRiStin project page for LATICE where all are encouraged to link their LATICE-relevant publications: https://app.cristin.no/projects/show.jsf?id=2492739

The exhibition "*Natur i endring*" (A changing nature) opened at the Norwegian Mountain Centre in Lom, June 2021, acknowledging among others the LATICE project. In July 2021, the minister of climate and environment, Sveinung Rotevatn, visited the Center and was given a guided tour by LATICE researcher Anders Bryn (NHM). The exhibition asks questions such as "*Which changes are caused by climate change, and what effects do human land use have? What can we do about it?"* and aims to provide some answers and new knowledge to visitors. The exhibition tells stories about the red fox moving into the mountains, the tree line moving upwards, all while people simultaneously are building more and more cabins and infrastructure. Visitors will learn how climate scientists measure the amount of snow and the soil temperature in alpine areas, and how studies of plant communities are executed. It is based on an exhibition originally made for the Climate House at the Natural History Museum (NHM), but largely expanded and with new activities especially aimed at a younger audience.

The sixth Conference on Modelling Hydrology, Climate and Land Surface Processes - from Earth System Modelling to Catchment Scale - held at Lillehammer - was this year organized jointly with the EMERALD project. One of its four sessions was specifically devoted to the research field: "Terrestrial ecology with links to climate and the hydrological cycle". This session was chaired by the coordinator of EMERALD and LATICE, Lena M Tallaksen. More than 70 participants registered to the hybrid conference, many of them LATICE and EMERALD members. They contributed actively with oral talks and posters and in the discussions. More details at: http://www.hydrologiraadet.no/6th-conference-on-modelling-hydrology-climate-and-land-surface-processes/

LATICE researchers presented their work (on Zoom) at the 2021 CESM Land Model & Biogeochemistry Working Group Meeting organized by NCAR in Boulder, CO, USA on 23-25 February 2021. This annual meeting is regularly held to provide a venue for CLM developers and users to meet and share experiences. The LATICE presenters and titles were Devaraju Narayanappa: *"Plan for Modelling Lateral Flow of Dissolved Organic Matter"*, Yeliz Yilmaz: *"Benchmarking CLM5 snow cover dynamics with MODIS and reanalyses over Fennoscandia"*, Stefanie Falk: *"OzoneLUNA: Ozone damage in CLM revisited"*, and Hui Tang: *"Implementing moss and lichen and their biophysical impacts in CLM-FATES"*. The full agenda is available at: https://www.cesm.ucar.edu/events/wg-meetings/2021/files/2021-Agenda-LMWG.pdf

Four online LATICE seminars were arranged during 2021, providing a discussion forum for new research initiatives, funding applications, interaction with related projects, and regular updates on field and modelling activities.

Thanks to you all, we have been able to maintain a high level of activities despite the pandemic, both in the field and within the modelling groups, endorsing LATICE's position as a natural hub for research within the field of land-atmosphere interactions at high latitudes.

We look forward to continue our joint effort in what we are sure will be another motivating LATICE year with exciting research results and new initiatives emerging. In particular, we aim to be active in engaging with the international community through conferences and invitations, if the situations allows. The friendly and open atmosphere that characterizes LATICE makes it a great project to coordinate and be part of, so thanks to you all for making it so.

With our best wishes for the New Year - Godt Nyttår!

Lena, Frode, Norbert, Yeliz, and Emiliano

LATICE coordination team