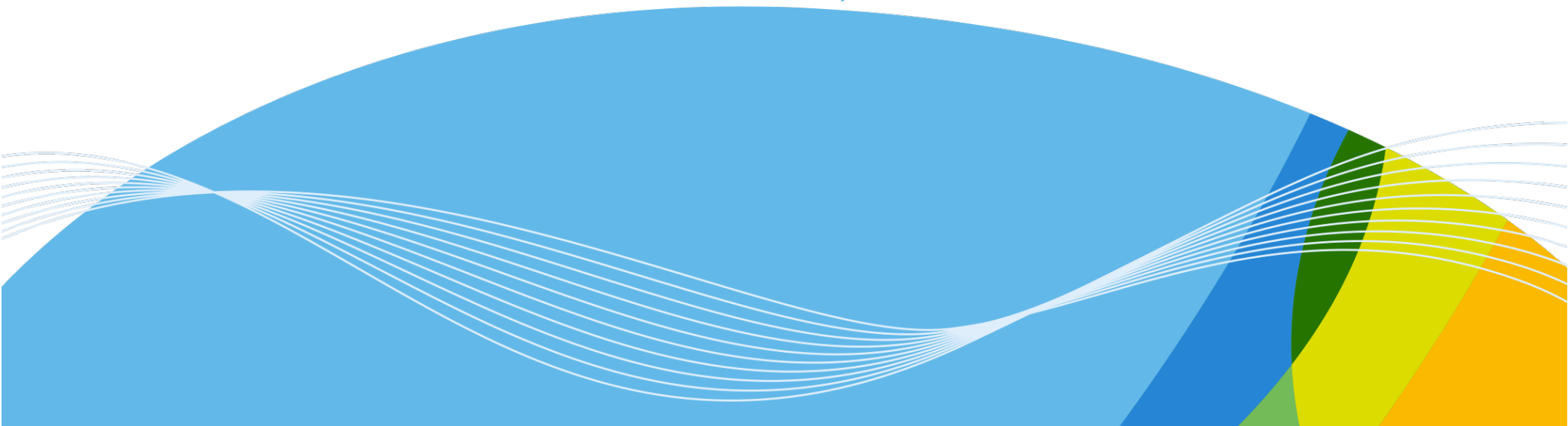




ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

CARBON CYCLE STUDIES IN NORTHERN REGION WITH A LAND SURFACE MODEL

**Tiina Markkanen & Tuula Aalto FMI
Contributions from UHEL, SYKE and LUKE**



Modelling vegetation-climate interactions

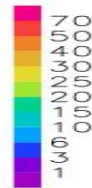
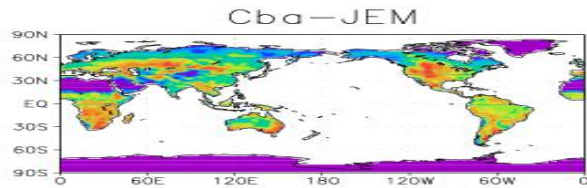
- Aim to study carbon, water and energy balances in northern latitudes
- JSBACH – a land surface model of Max Planck Institute Earth System Model MPI-ESM
 - vegetation and soil exchange of CO₂ and CH₄, ecosystem and soil carbon storages, hydrological cycle
 - soil carbon model Cbalance lately replaced by Yasso07
- Forced with: Regional and global climate models and data from various EC sites



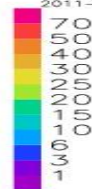
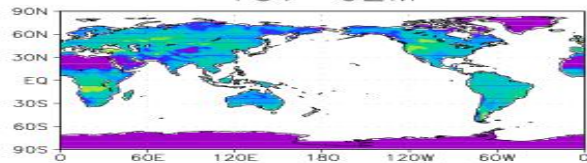
Soil carbon pools (kg m⁻²): Comparison of two soil carbon modules in JSBACH

CBALANCE

Total soil carbon (kg C m⁻²)

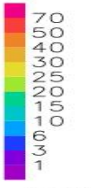
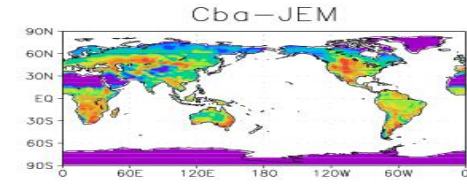


YO7-JEM

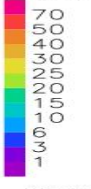
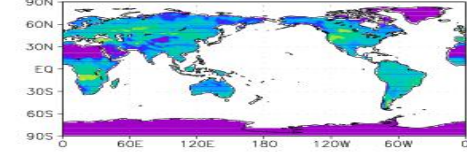


Yasso07

Total soil carbon (kg C m⁻²)



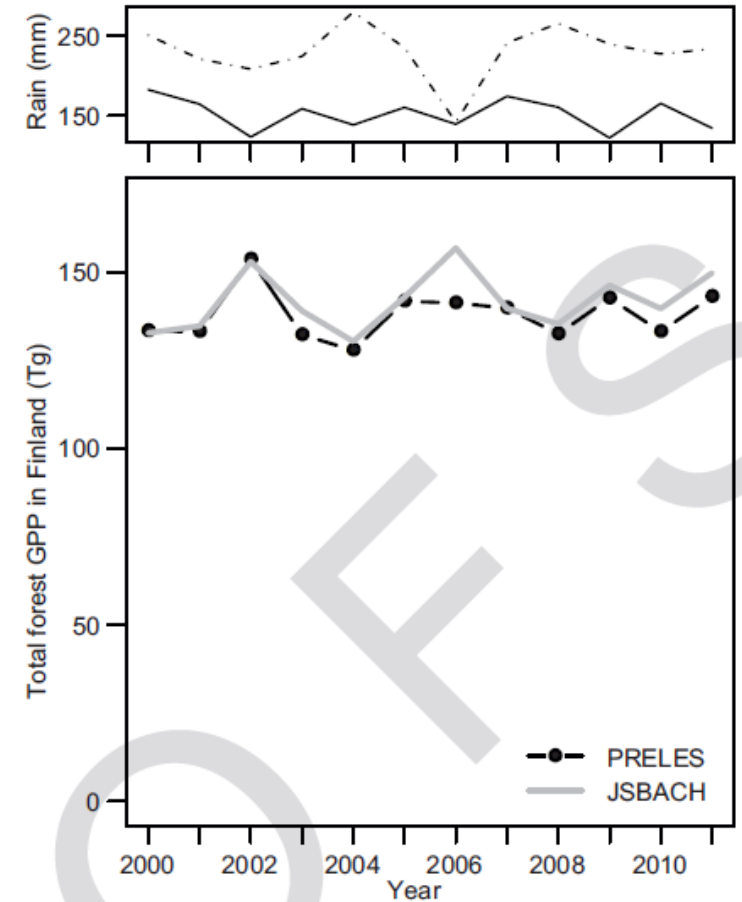
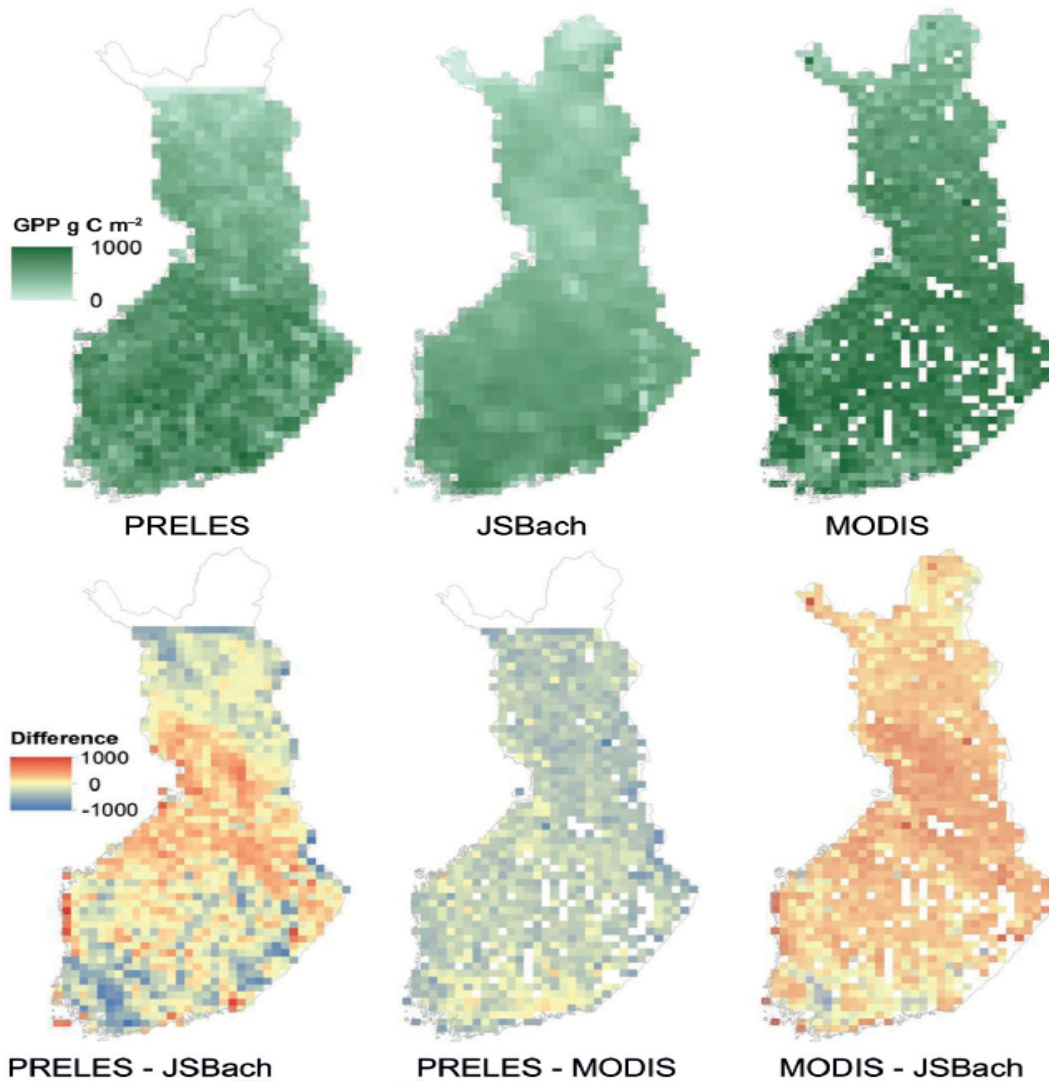
YO7-JEM



Global run coupled with Echam climate model → implications to the climate resolved



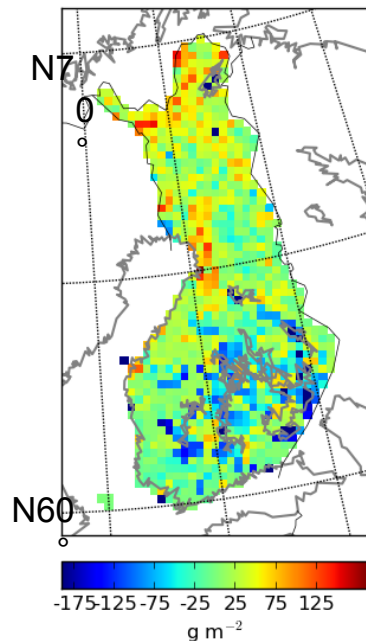
Gross primary production



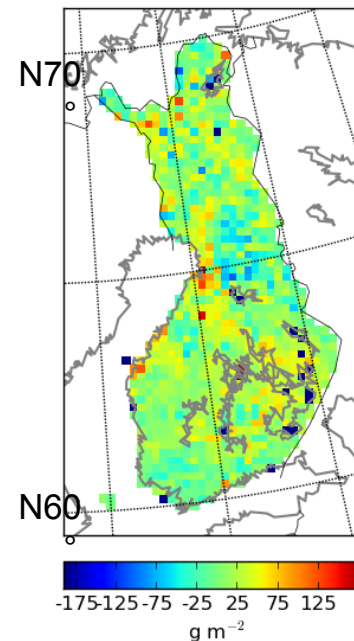
Impact of land cover data on GPP in Finland

JSBACH runs with three different land cover data showed significant differences in GPP in spring. This is because of differing fractions of evergreen and deciduous species.

15 year mean GPP differences:



Global Ecosystem Classification
-
GlobCover



Global Ecosystem
Classification -
Finnish HR Corine landcover

Törmä et al., 2015

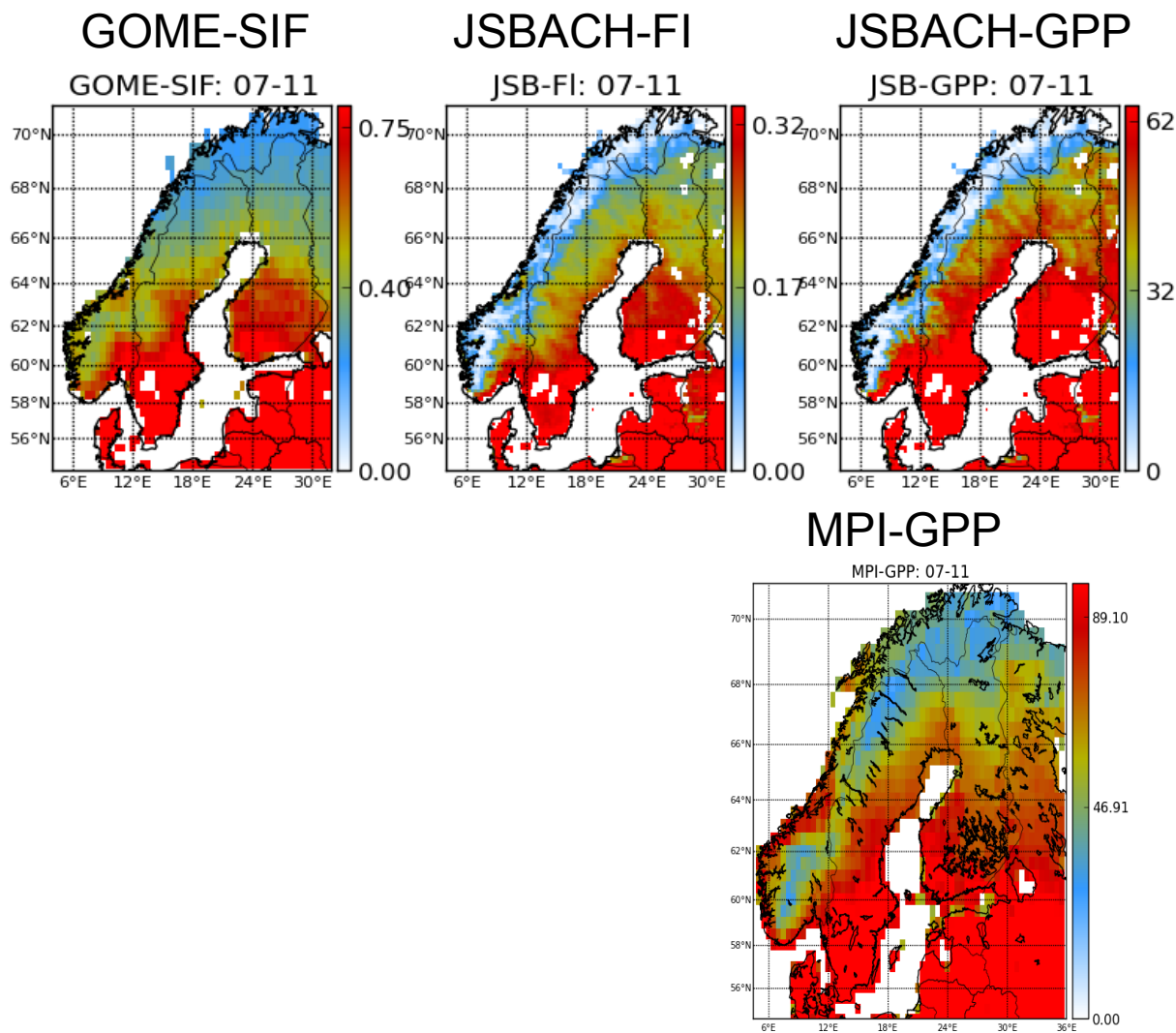


Chlorophyll Fluorescence & Gross Primary Production

- Chlorophyll fluorescence is a proxy for GPP

A chlorophyll fluorescence model by van der Tol et al. (2009) have been implemented to JSBACH

Thum et al., to be submitted

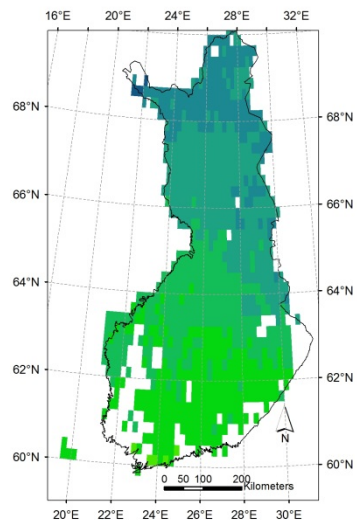
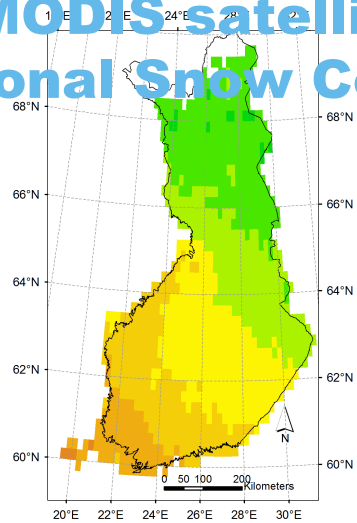
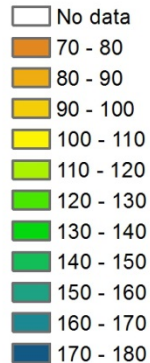


Growing season start day:

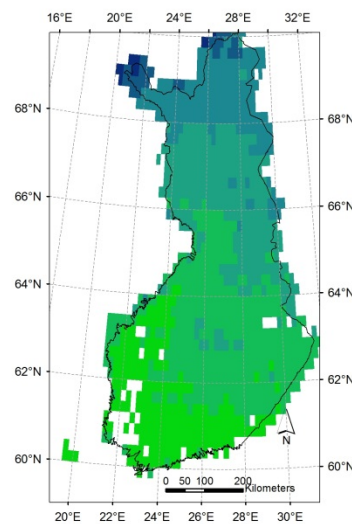
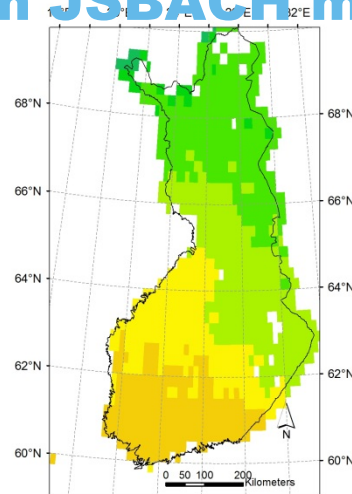
from MODIS satellite
 Fractional Snow Cover

Evergreen
 conifer

Start of season (day of year)



from JSBACH model



Deciduous

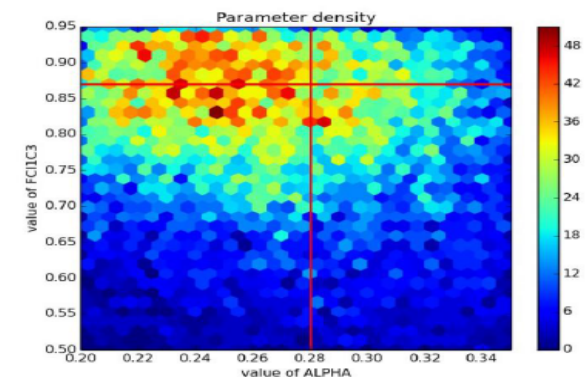
See also:
 Böttcher et al., RSE
 2014

Ongoing studies

Water balance studies:

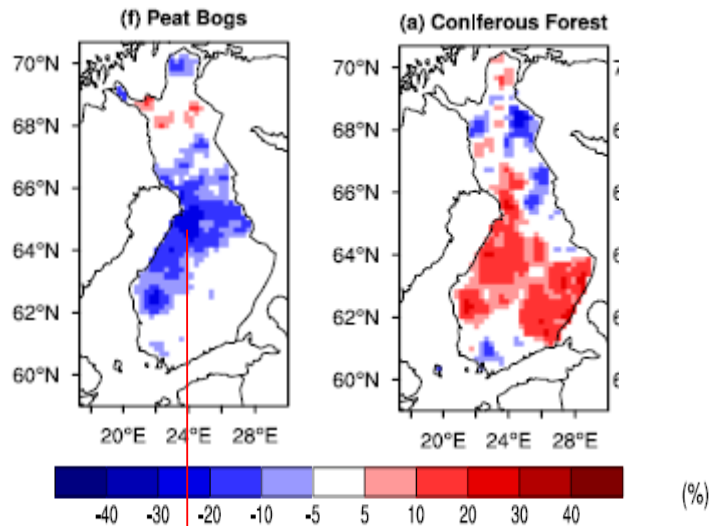
- Drought indices SPI, SPEI, SMI
- Water use efficiency (GPP/ET)

JSBACH model parameter optimisation by Monte Carlo simulations utilising in situ observed GPP & evapotranspiration fluxes

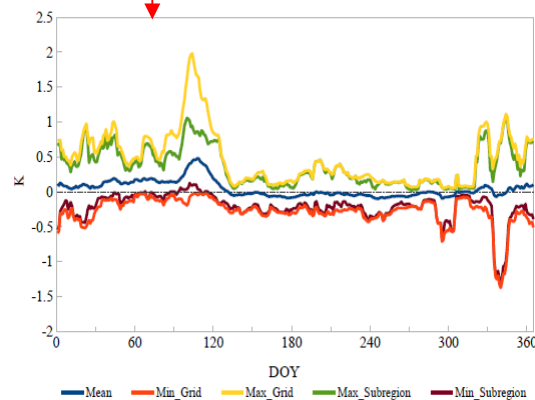


Peatland afforestation

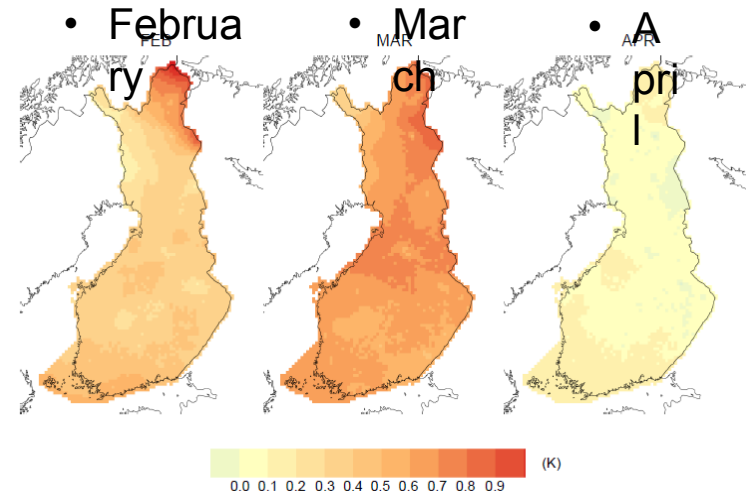
LUCC:



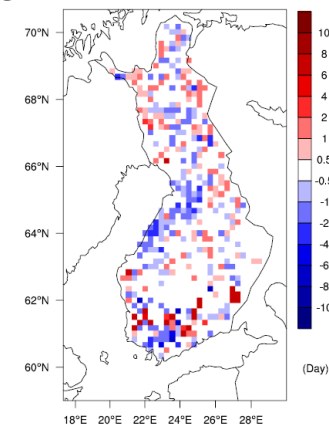
Modeled air temperature



Observed air temperature trend:



Change in snow clearance day:



Gao et al 2014, Biogeosciences

Model development and validation for northern regions – collaboration with PEEX

- Climate for current day runs and for bias corrections of scenarios:
precipitation, air & soil temperatures, humidity, wind speed, incoming radiation
- Land cover, plant functional types, bogs and fens
- Biomass storages in plants and in soil, LAI
- Physical soil characteristics (porosity, field capacity,...)
- Peat depth, water table level, active layer depth
- Fluxes: carbon, water, energy
- Comparison with other models