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

Global run coupled with Echam climate model $\rightarrow$ implications to the climate resolved

Thum et al., JGR 2012
Gross primary production

Peltoniemi et al., 2015
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

from JSBACH model

Evergreen conifer

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:
- (f) Peat Bogs
  - (a) Coniferous Forest

Modeled air temperature

Observed air temperature trend:
- February
- March
- April

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