ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

# Comparison between FAO and JRC soil map within COSMO-CLM

## COLOBOC/SOILVEG workshop

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# Outline

1. Introduction
2. Experiment with different soil maps
3. Overall response in mean summer climate
4. Respective role of soil parameters

# Soil map in COSMO-CLM

The soil class defines a set of parameters (water holding capacities, hydraulic conductivity and diffusivity, albedo, etc.)

Based on the FAO world soil map (1974)

More recent product:
European soil database by the European Commission Joint Research Centre (JRC) (Liederkerke et al., 2006)

**Goal: test the sensitivity of COSMO-CLM to the soil type distribution**

# Experiment

2 simulations using both maps

- **CTL** using FAO soil map
- **EXP** using JRC soil map

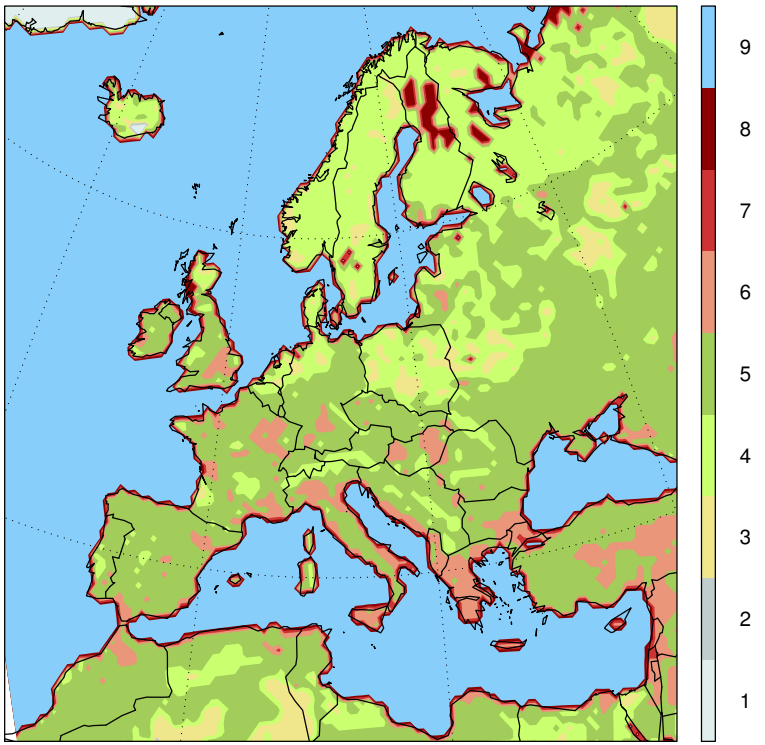
Model configuration:

- Version 4.8
- Resolution: 0.44° ($\sim$ 50km), 32 vertical layers
- Initial/boundary conditions: ERA40
- Time period: run 1980-2006, analysed 1986-2005
- Land-surface scheme: TERRA-ML

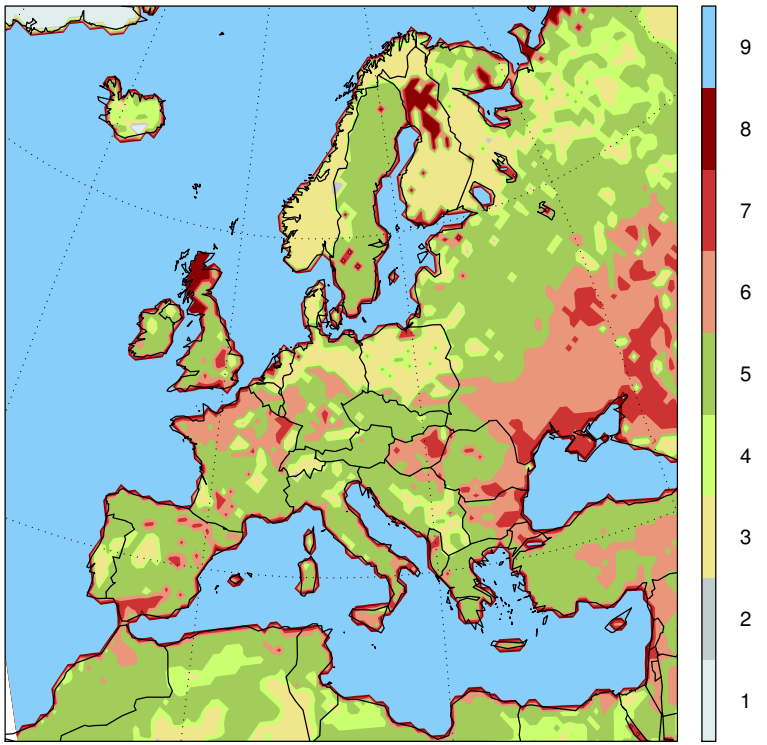
# FAO and JRC soil maps

**1** ice **2** rock **3** sand **4** sandy loam **5** loam **6** loamy clay **7** clay **8** peat **9** sea water

FAO



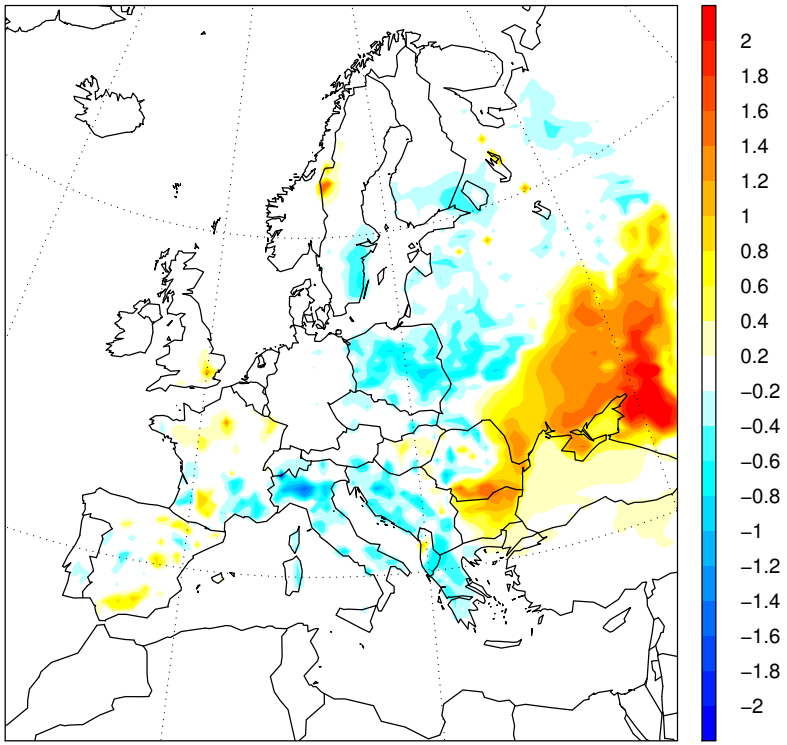

JRC



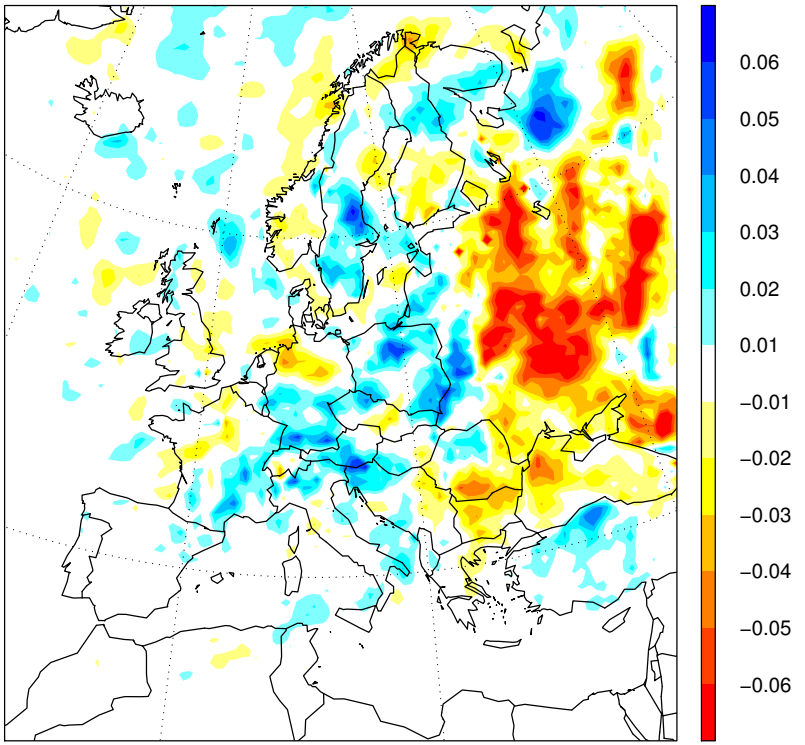
# Overall response - mean summer climate (JJA)

## EXP-CTL

2m-Temperature (°C)



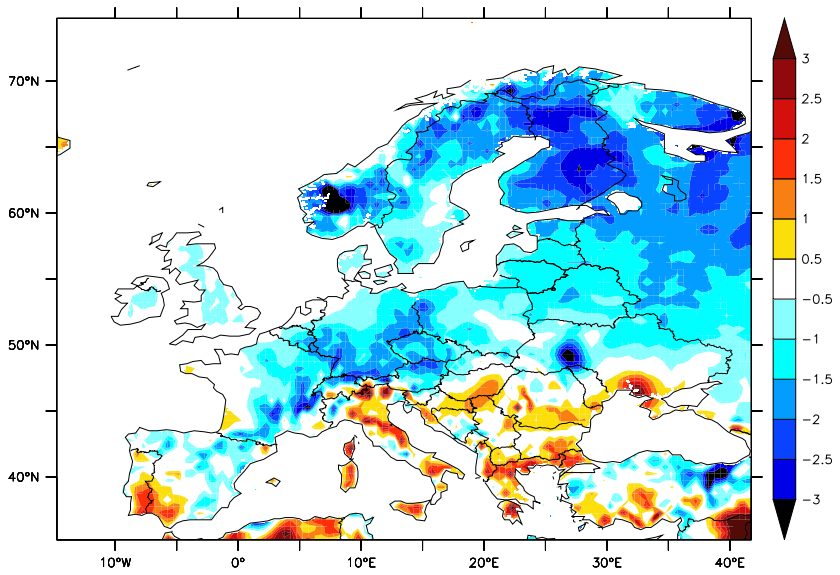

precipitation (mm/3hrs)



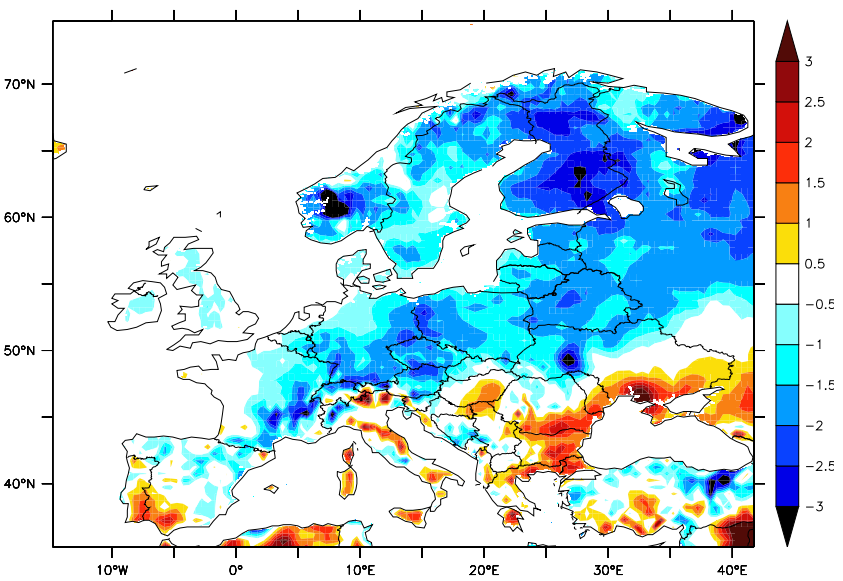
# Comparison with CRU dataset - mean summer climate (JJA)

2m-Temperature (°C)

CTL-CRU

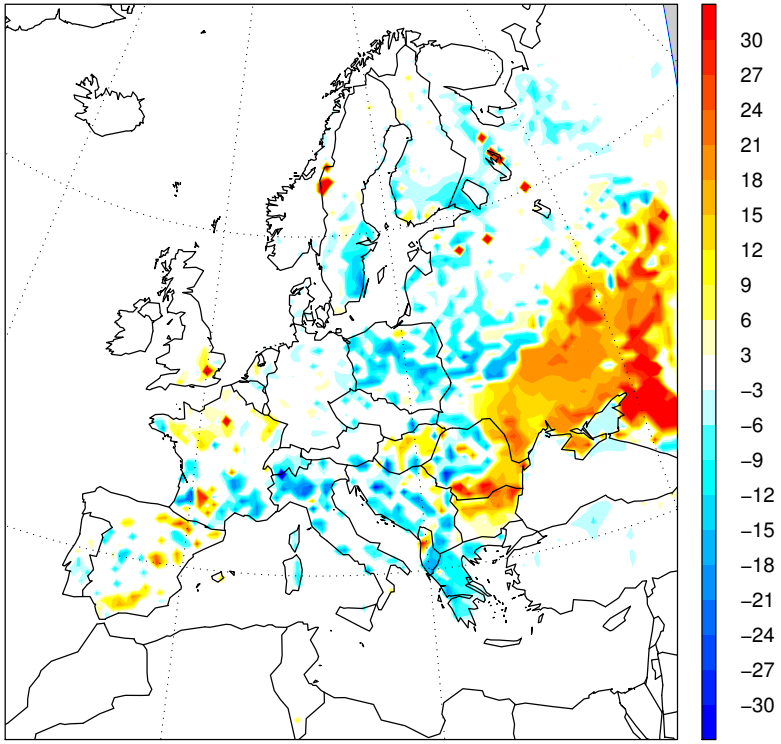



EXP-CRU

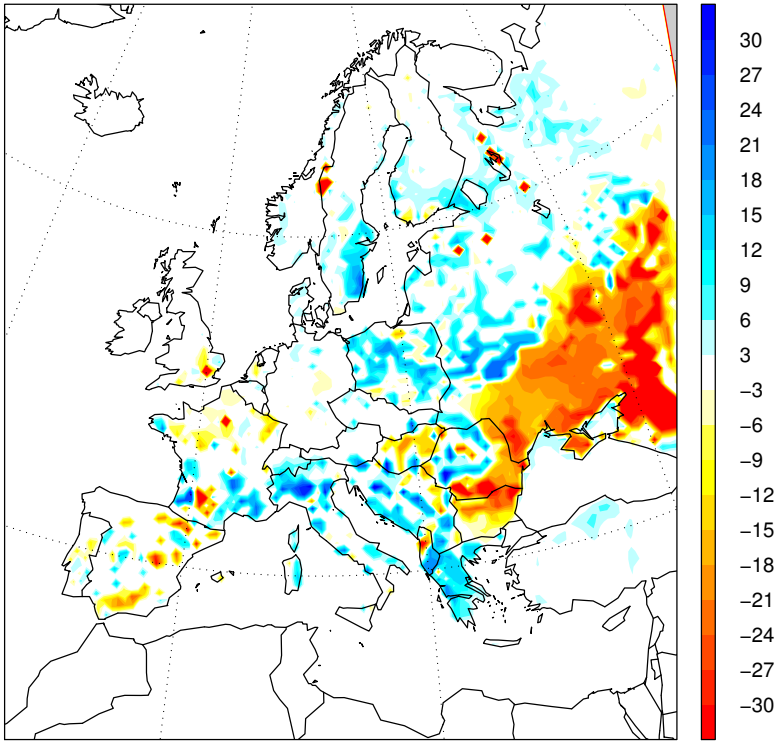


# Changes in surface turbulent fluxes

sensible heat flux

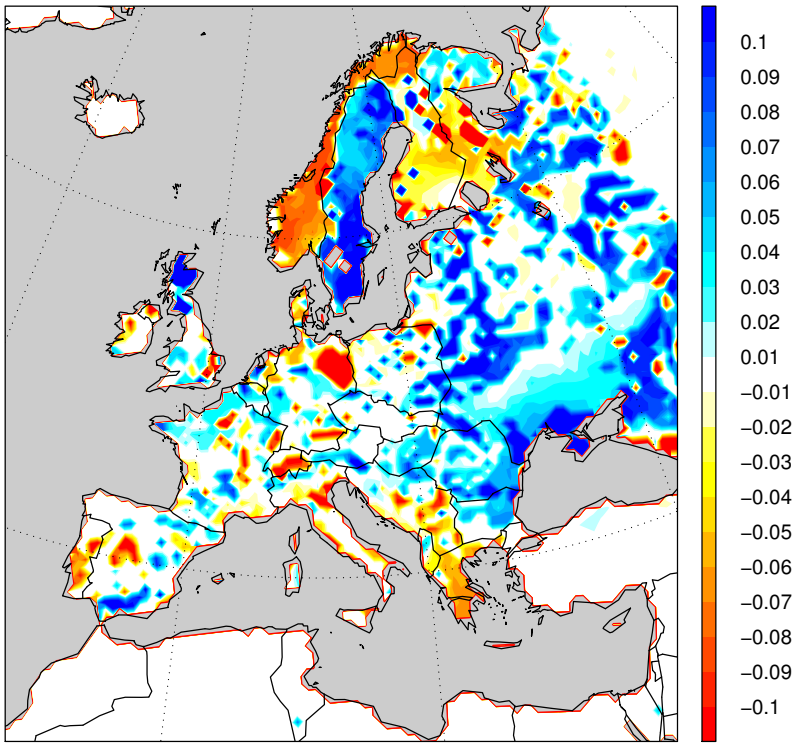



latent heat flux

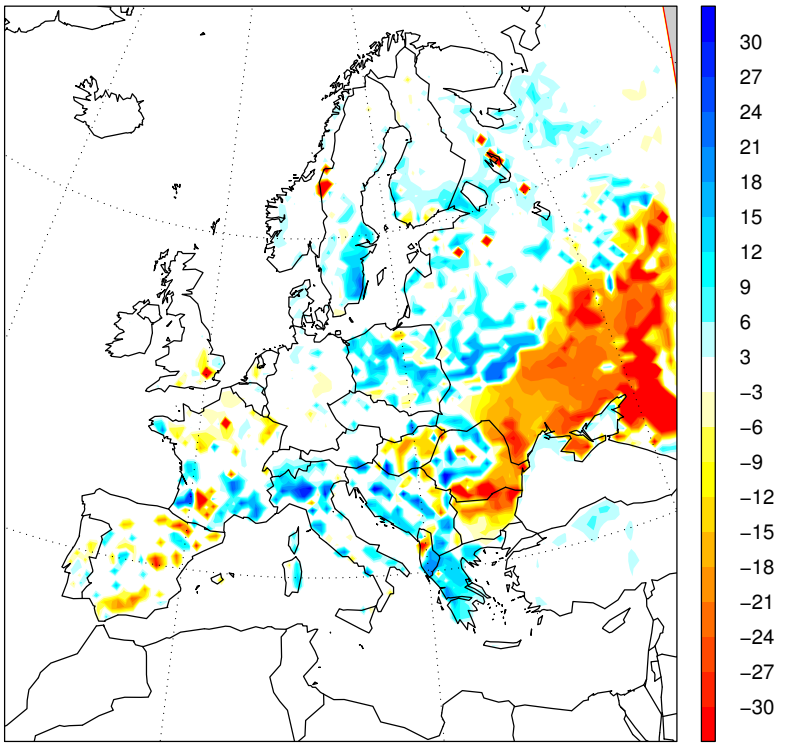


# Soil moisture

soil moisture content (rootzone)

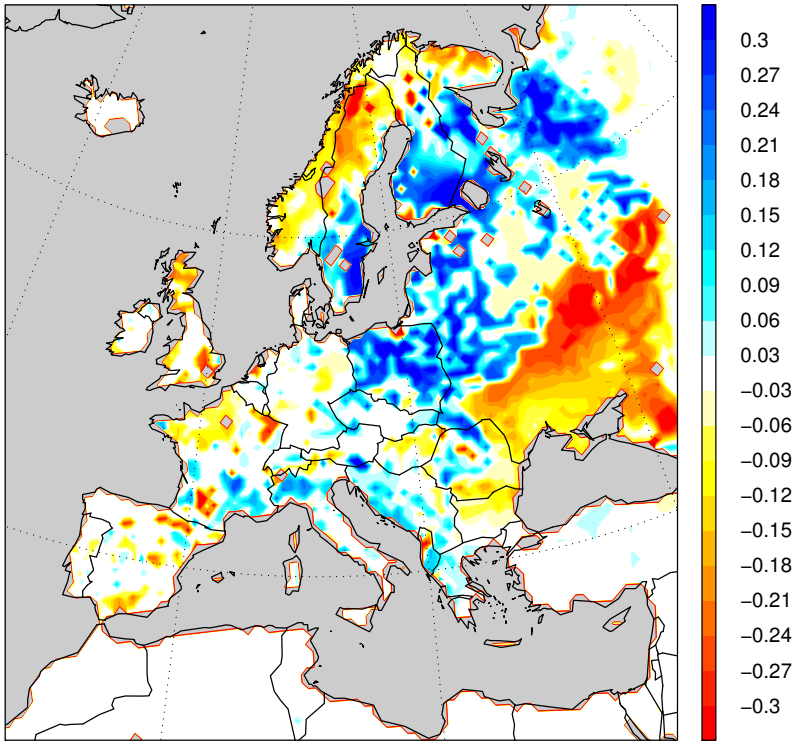



latent heat flux

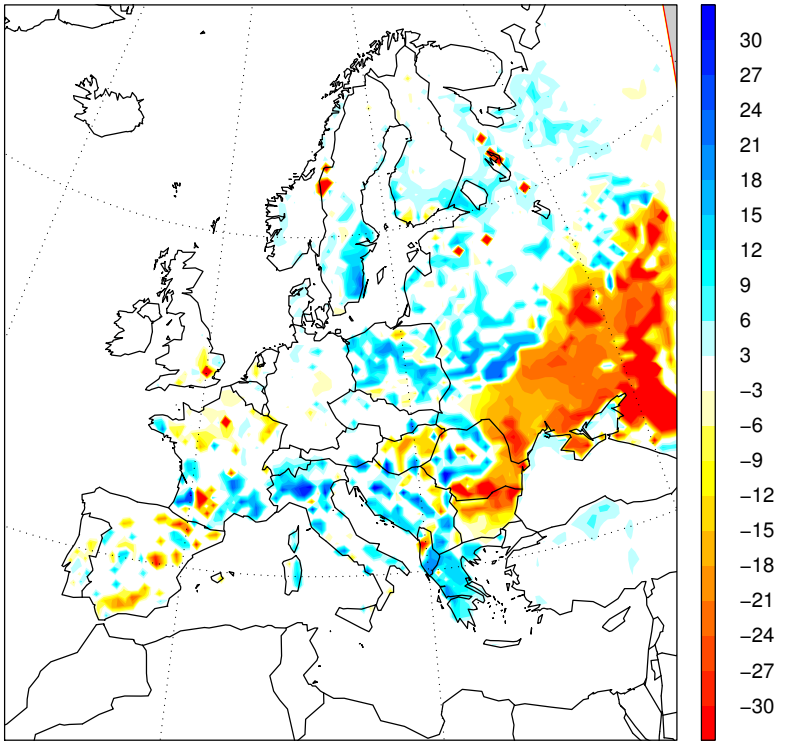


# Soil moisture index ($SMI = \frac{\theta - \theta_{PWP}}{\theta_{FC} - \theta_{PWP}}$)

soil moisture index (rootzone)

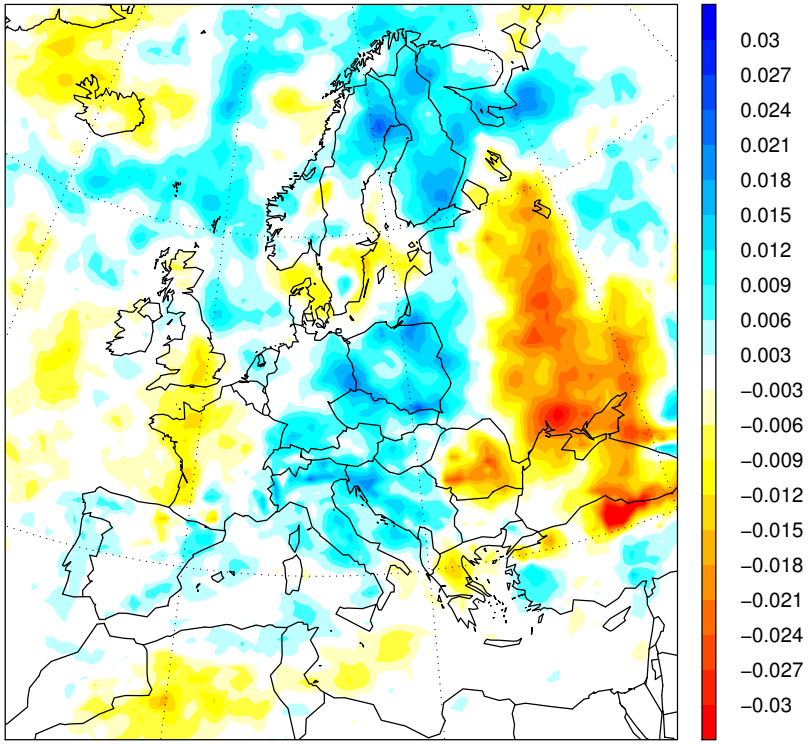



latent heat flux

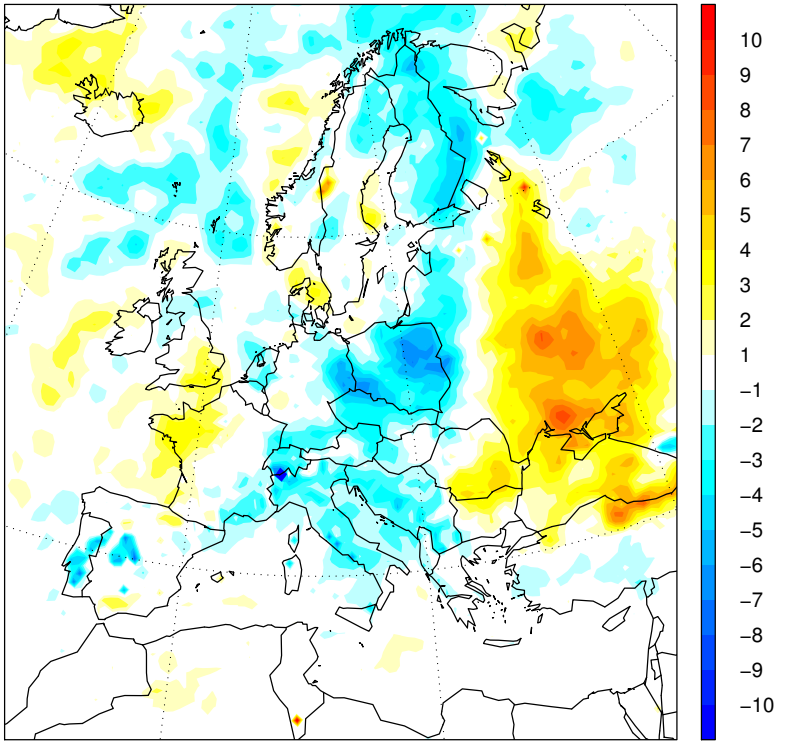


# Radiation changes

Cloud cover

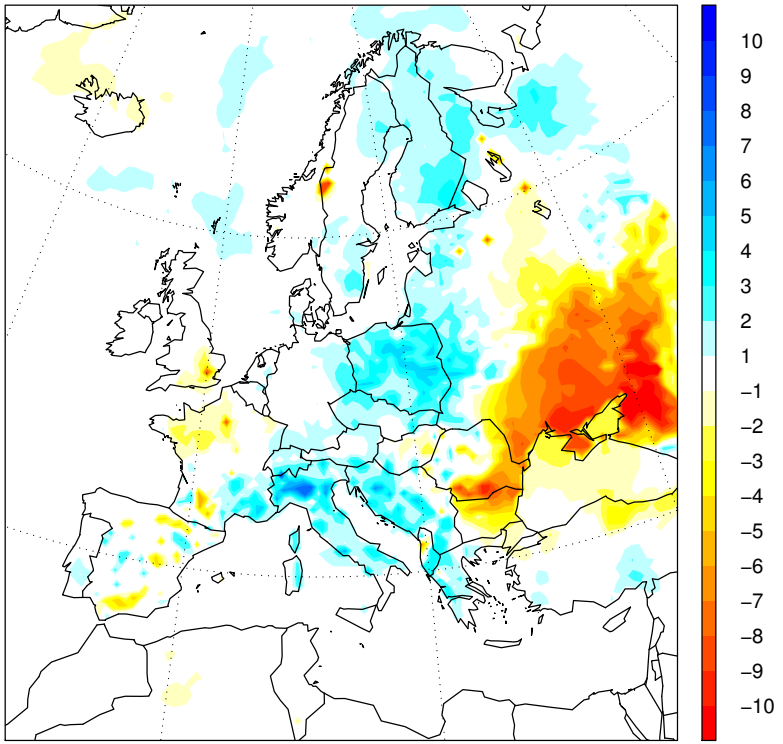



net shortwave radiation

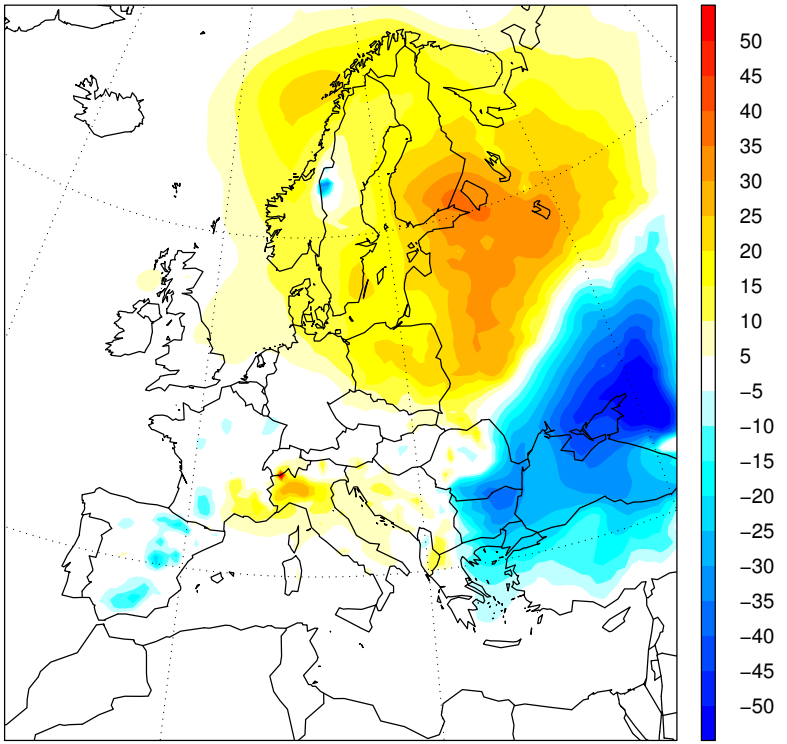


# Radiation changes (2), large-scale circulation

net longwave radiation

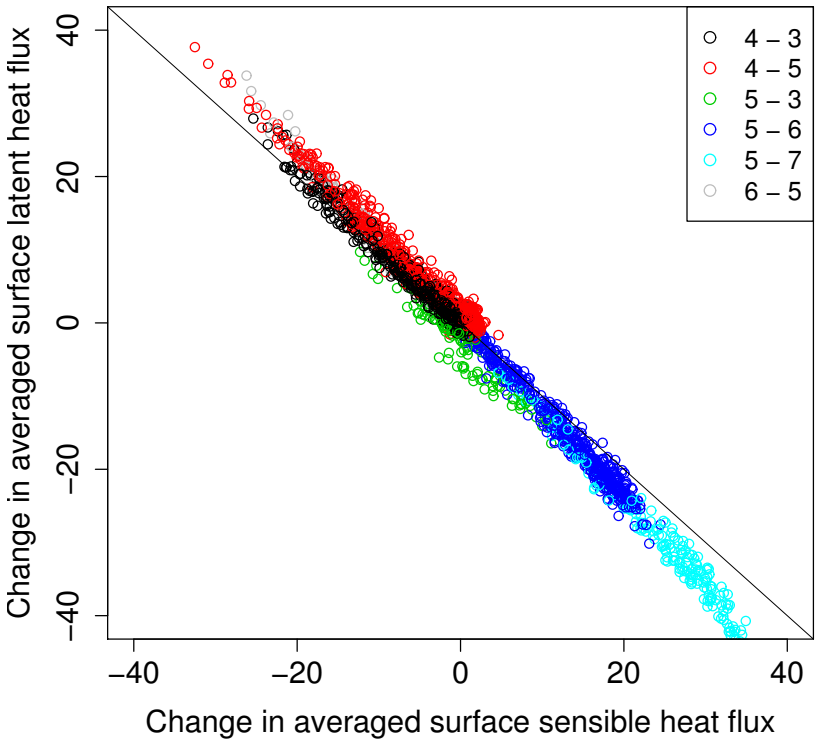



sea level pressure

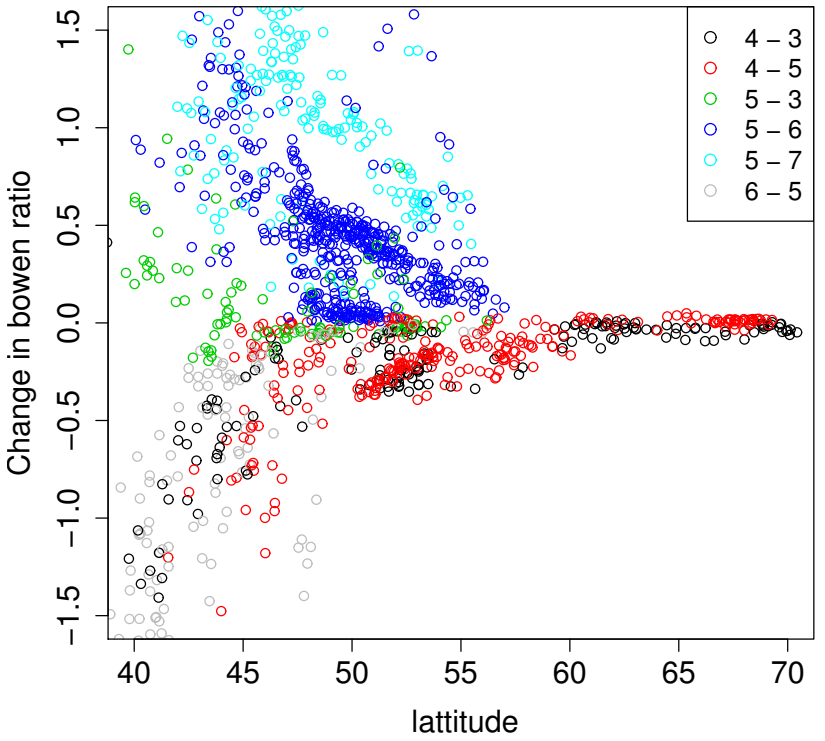


# Summary EXP-CTL: main changes

surface turbulent fluxes




bowen ratio / latitude



# Parameter investigation

- Different soil types lead to large changes in **flux partitioning**
- A given soil type corresponds to a **set of parameters**

$\rightarrow$ **Which parameter** is predominantly responsible for the observed change?

# Parameter investigation - experimental setup

3 soil type conversions selected:

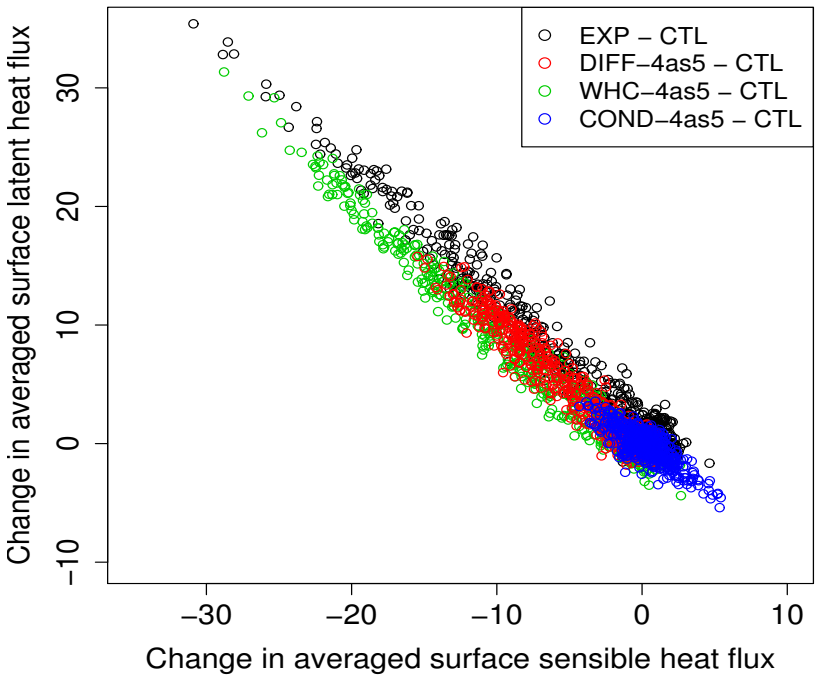
- sandy loam to loam ($4 \rightarrow 5$)
- loam to loamy clay ($5 \rightarrow 6$)
- loam to clay ($5 \rightarrow 7$)

Set of simulations with

- FAO soil map (CTL)
- one set of parameters of one soil type modified to another soil type (e.g. plant wilting point and field capacity of sandy loam set as those of loam). Set of parameters selected
  - **WHC** water holding capacities (field capacity, plant wilting point)
  - **COND** hydraulic conductivity ($K_0$, $K_1$)
  - **DIFF** hydraulic diffusivity ($D_0$, $D_1$)

# Results: sandy loam → loam

surface turbulent fluxes

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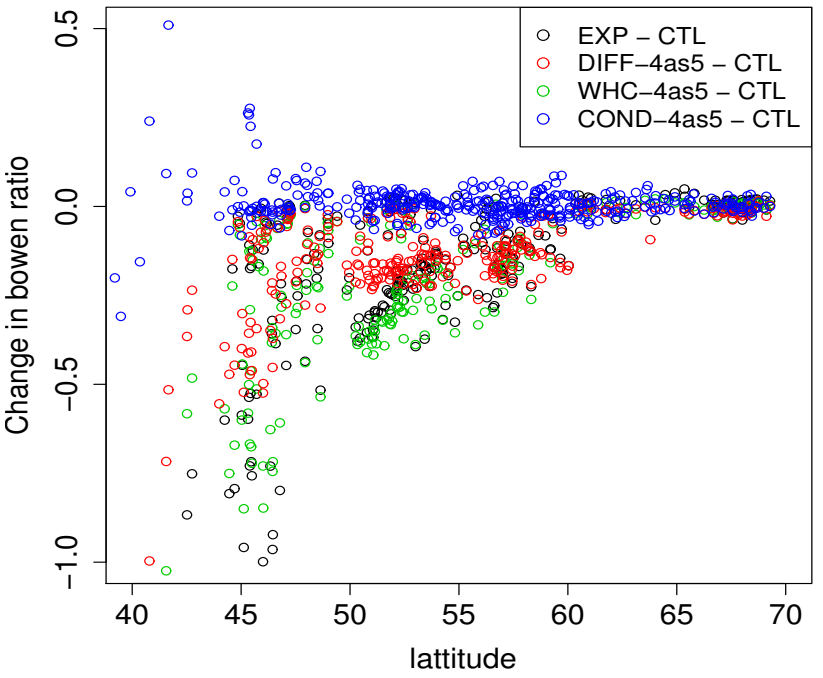


→ WHC play a major role, DIFF contribute

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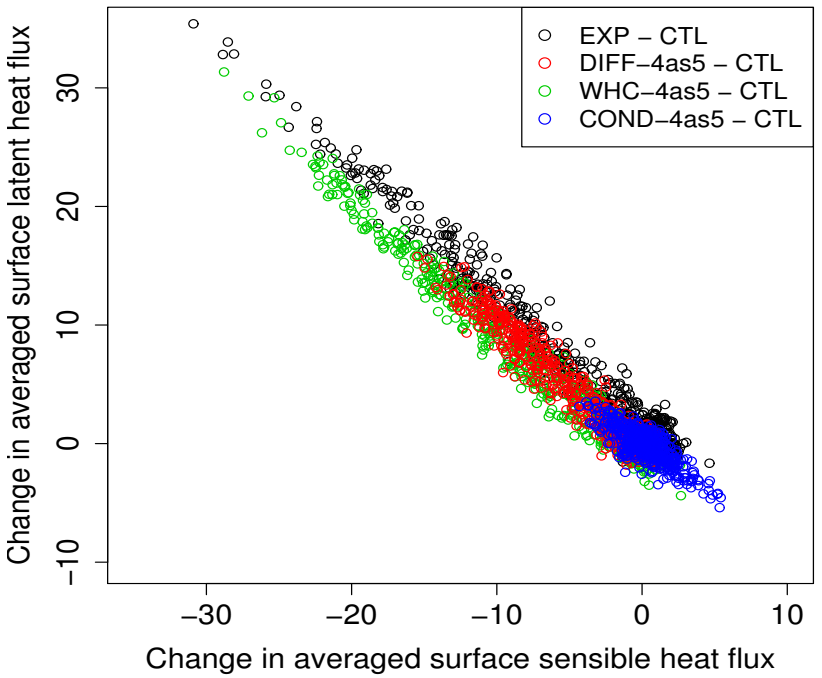


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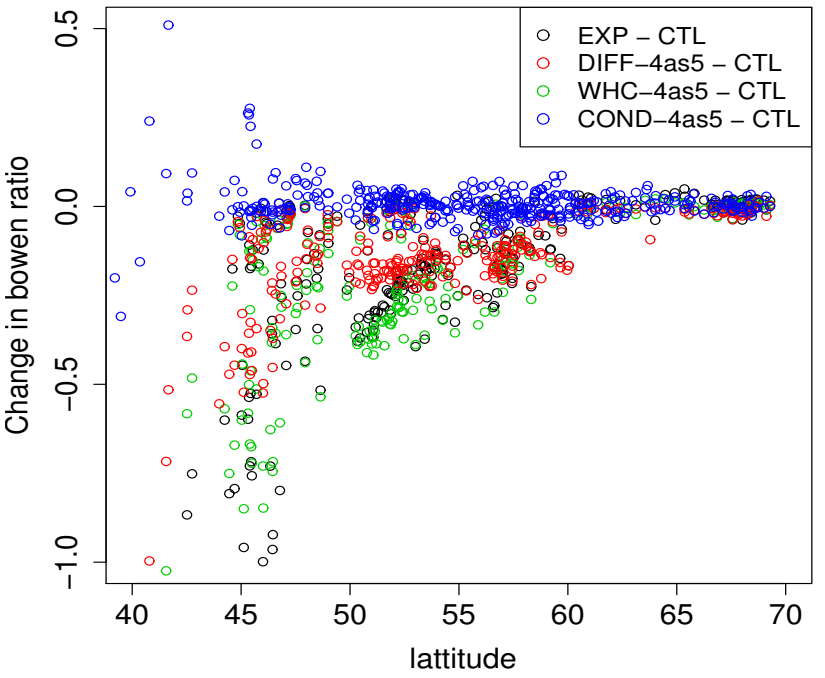


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# Results: loam → loamy clay

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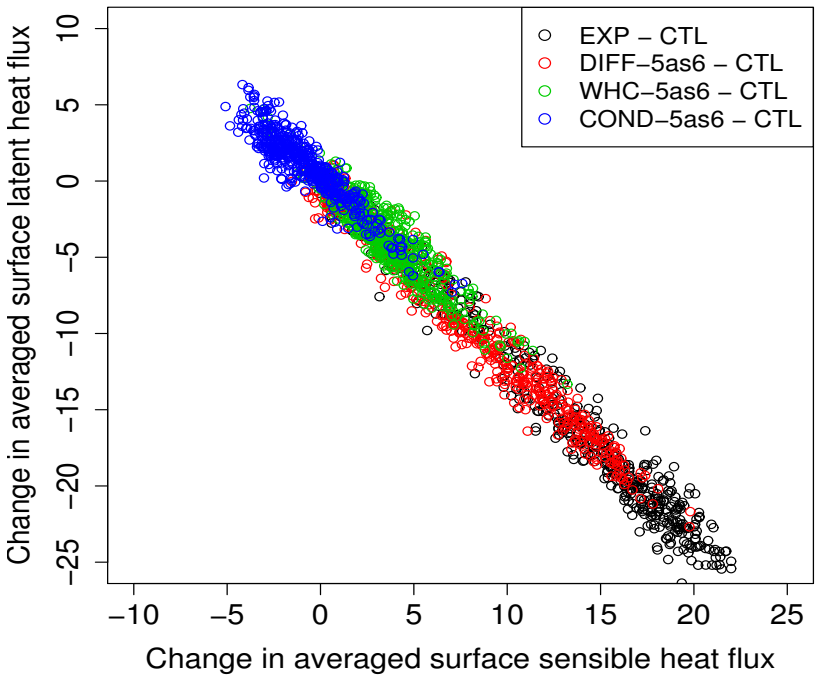


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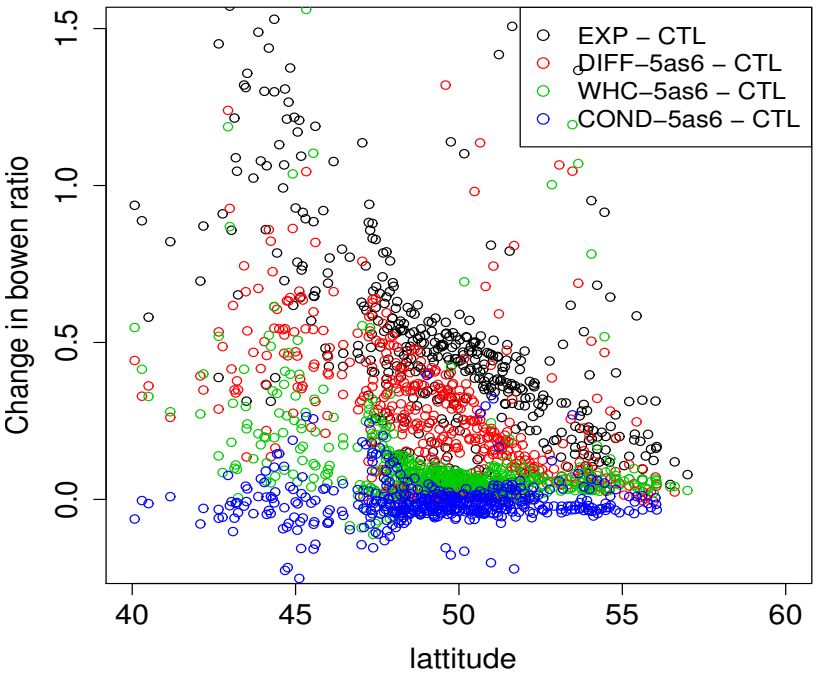


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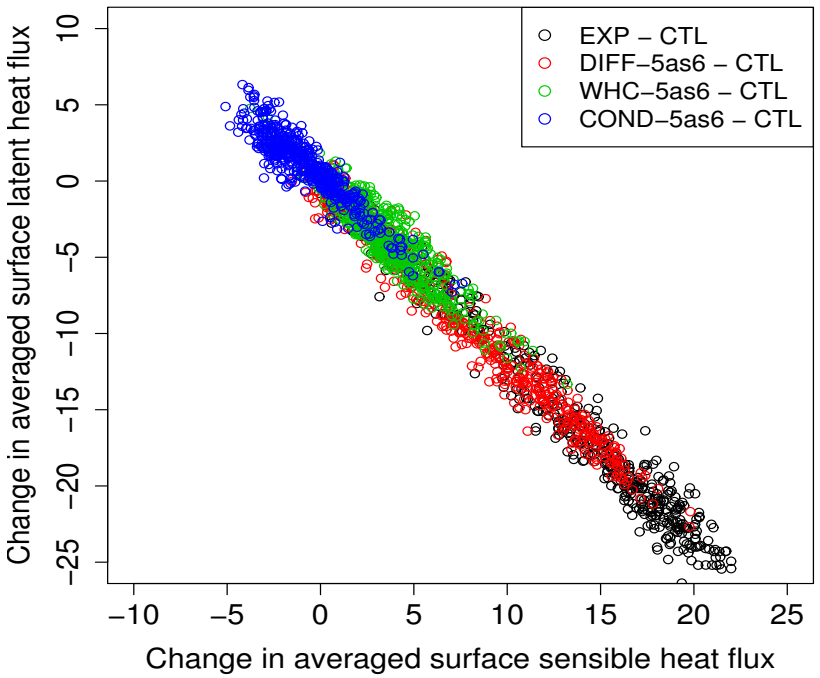


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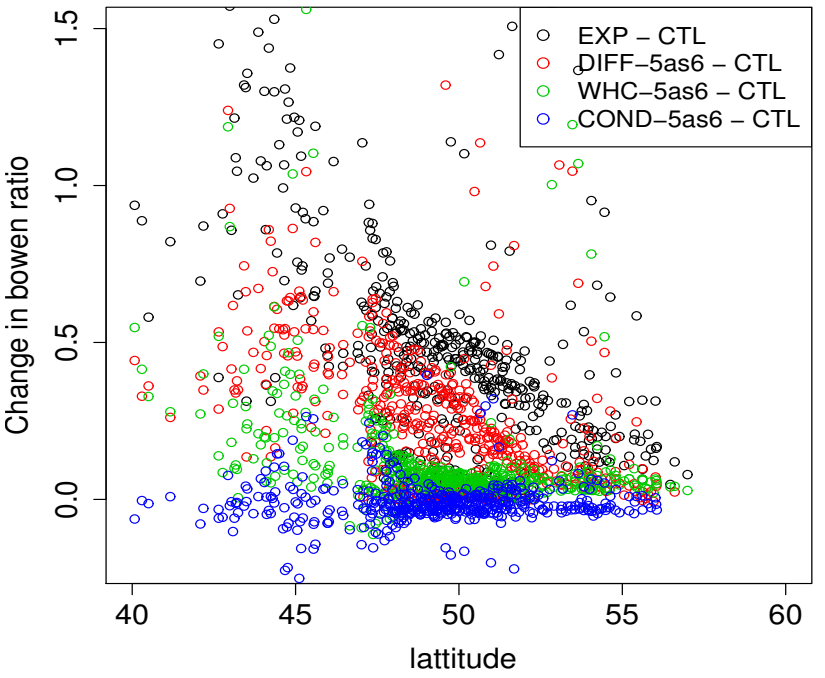


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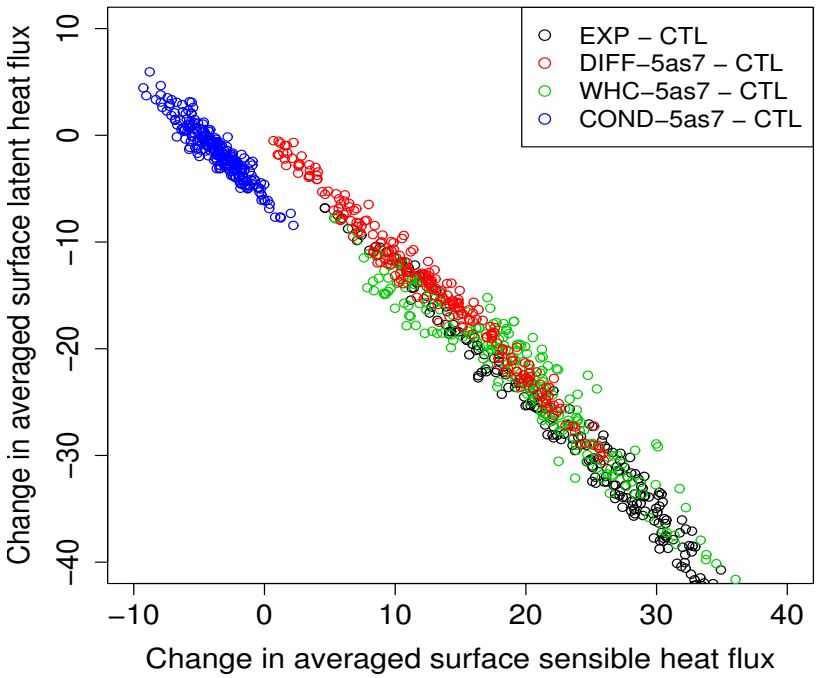


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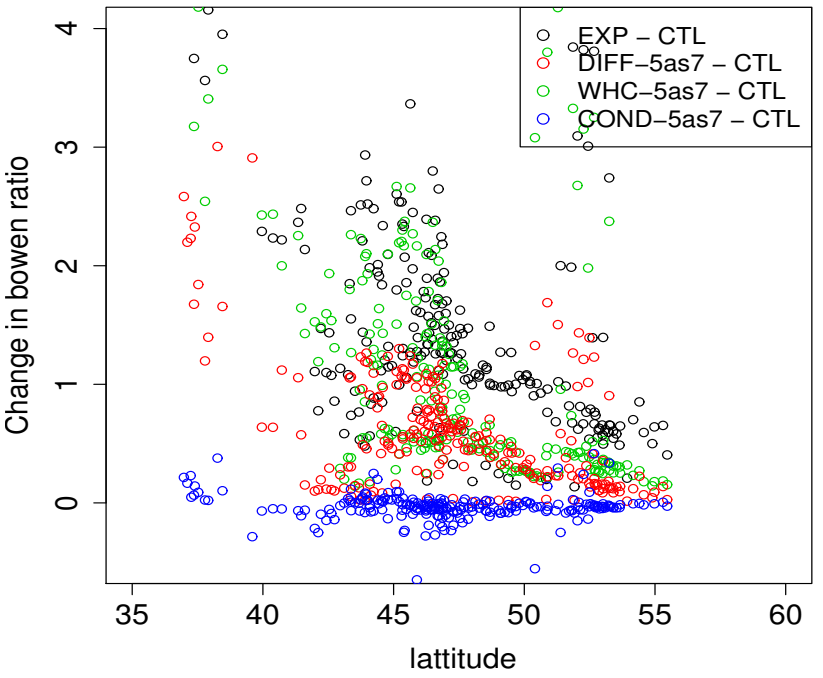


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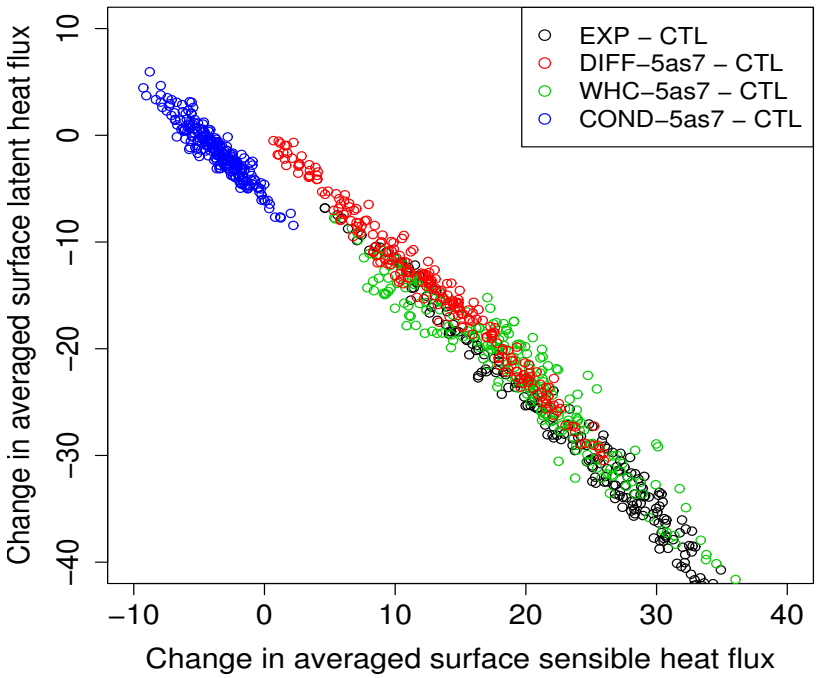


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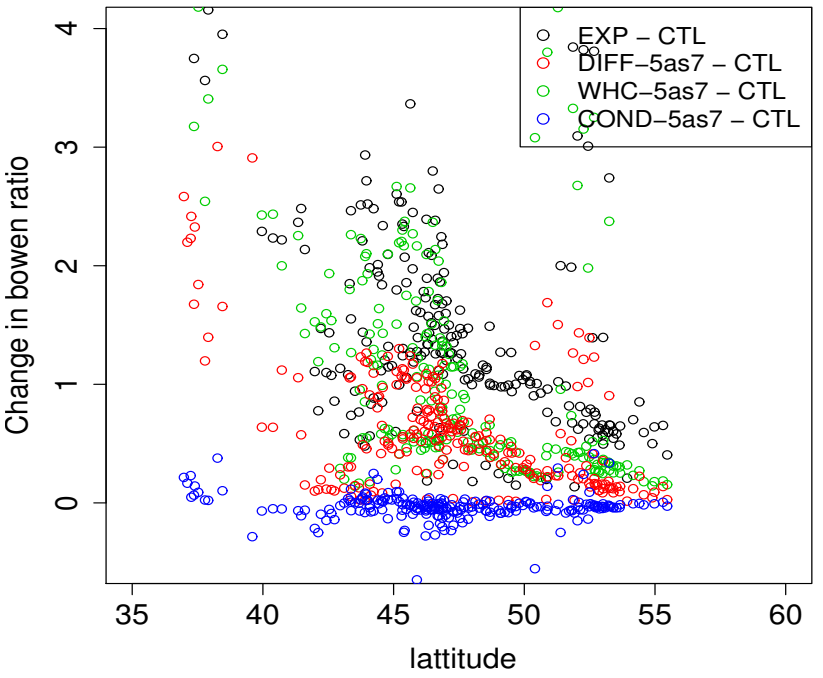


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# Parameter investigation - summary

- Hydraulic **conductivities** play a **minor role**
- Water holding capacities / hydraulic diffusivities can be both important depending on the change of soil type

Thank you for your attention!

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