Detailed evaluation of high-latitude carbon cycle processes in JULES.

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National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

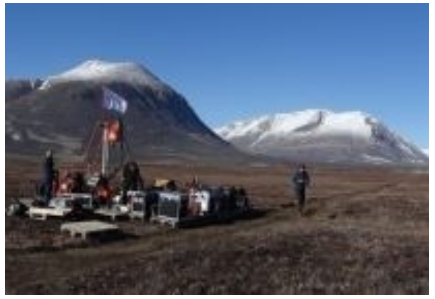
PAGE21: Permafrost in the Arctic and Global Effects in the 21st century

30 second intro to permafrost!

- Ground that is continuously frozen for 2 years or more.
- Surface of soil thaws each summer = *Active layer.*

- Carbon stored in permafrost may be released under climate warming = *Permafrost carbon feedback.*

The Sites: PAGE21 'primary' sites



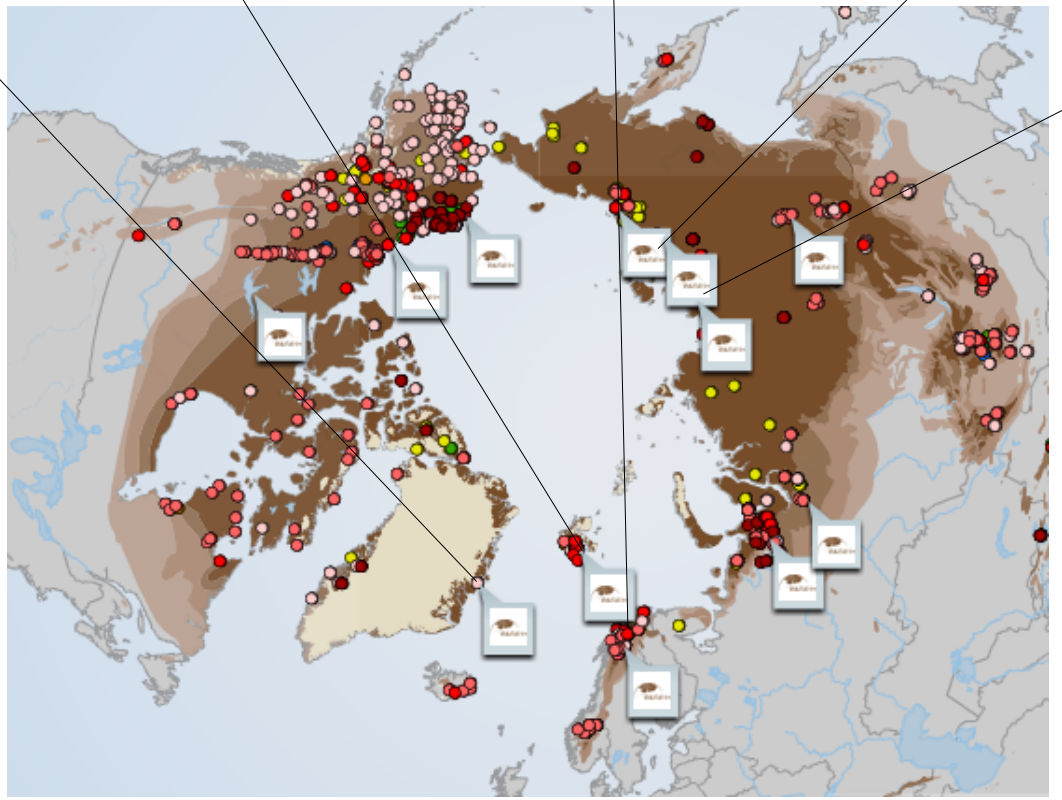
Zackenberg

Bayelva

Abisko

Kytalyk

Samoylov

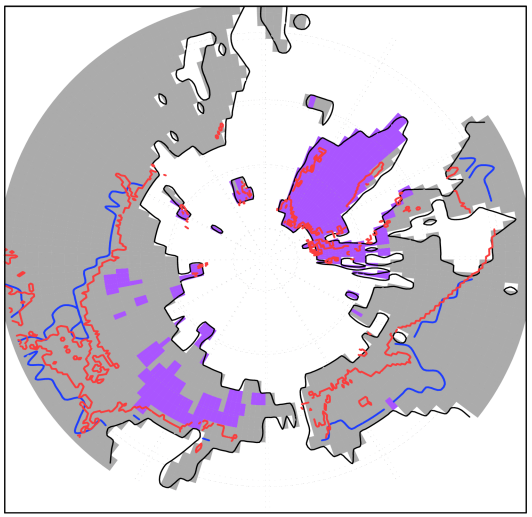


PAGE21

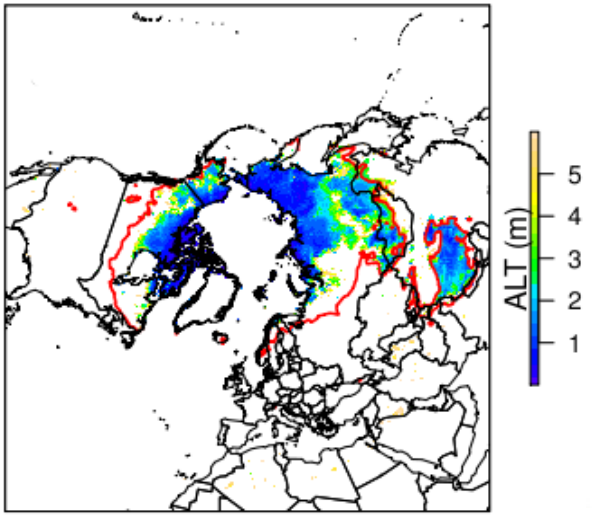
The PAGE21 Models

- Three land surface models from major ESM's.
- Permafrost / high-latitude processes improved during the project.

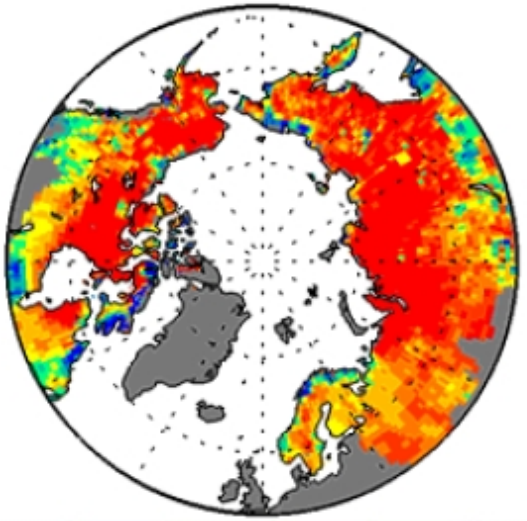
JSBACH
Germany



JULES
UK

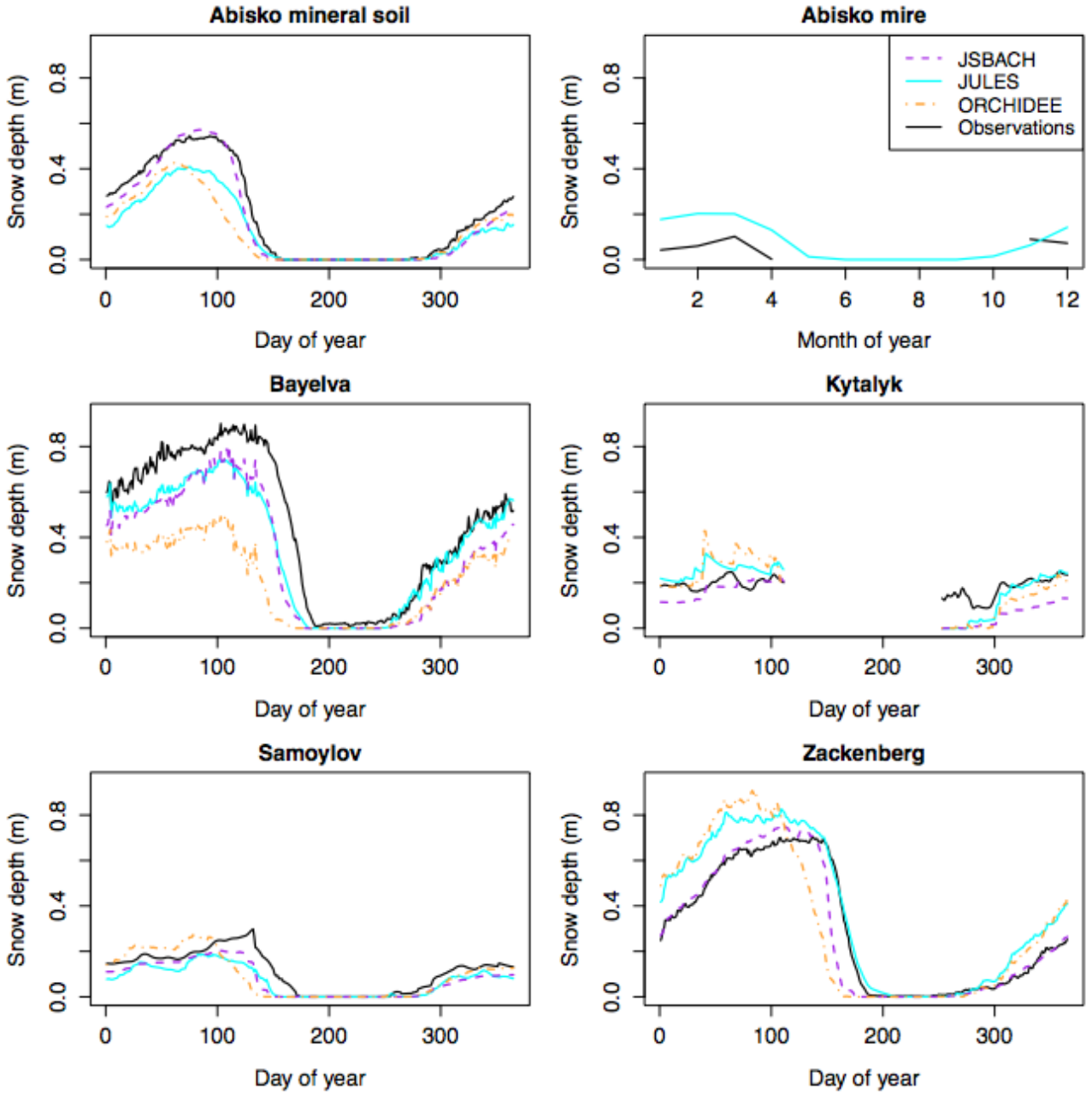


ORCHIDEE
France



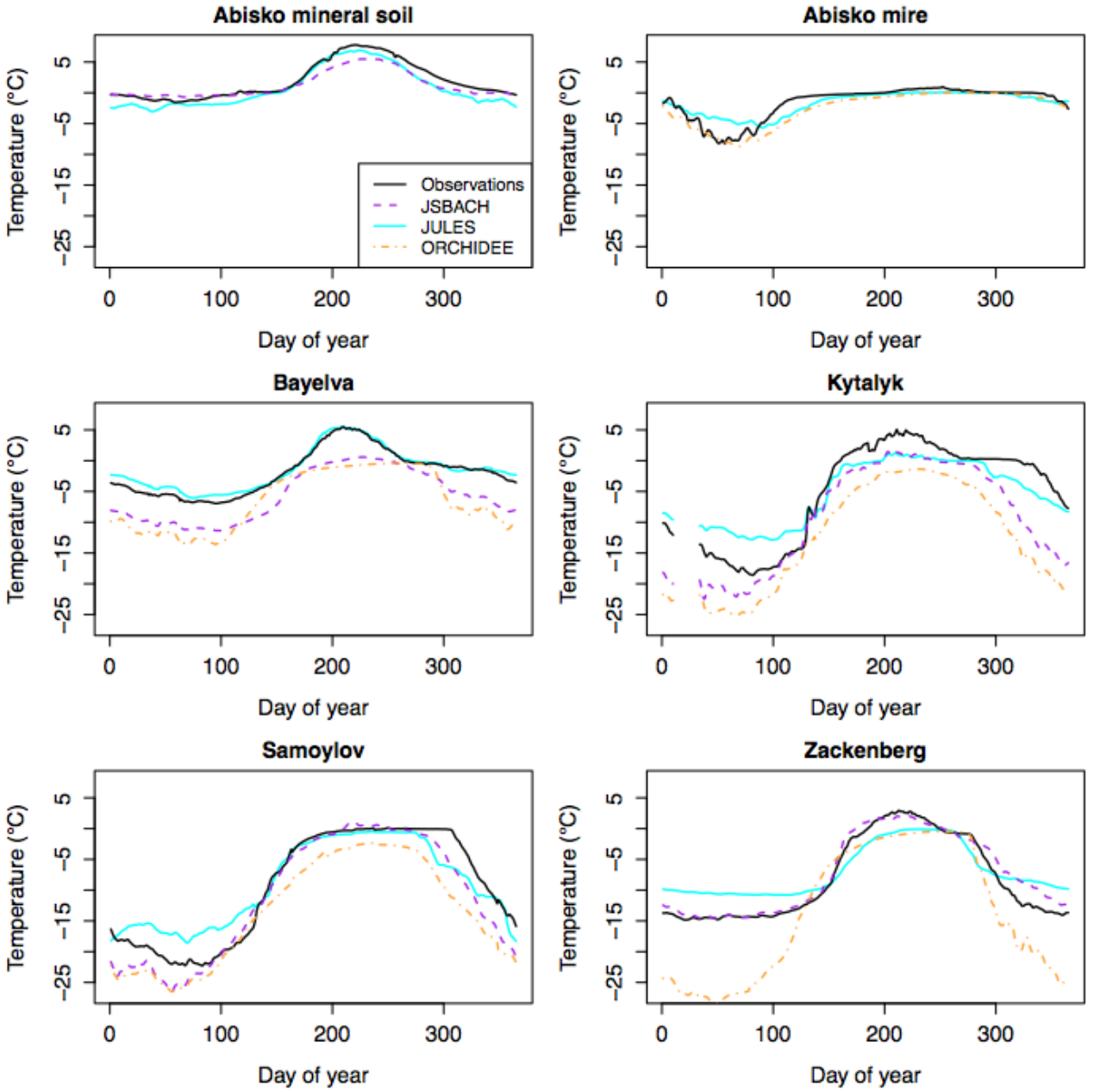
Physics - snow

Physical simulation is reasonable! But still more work to do.



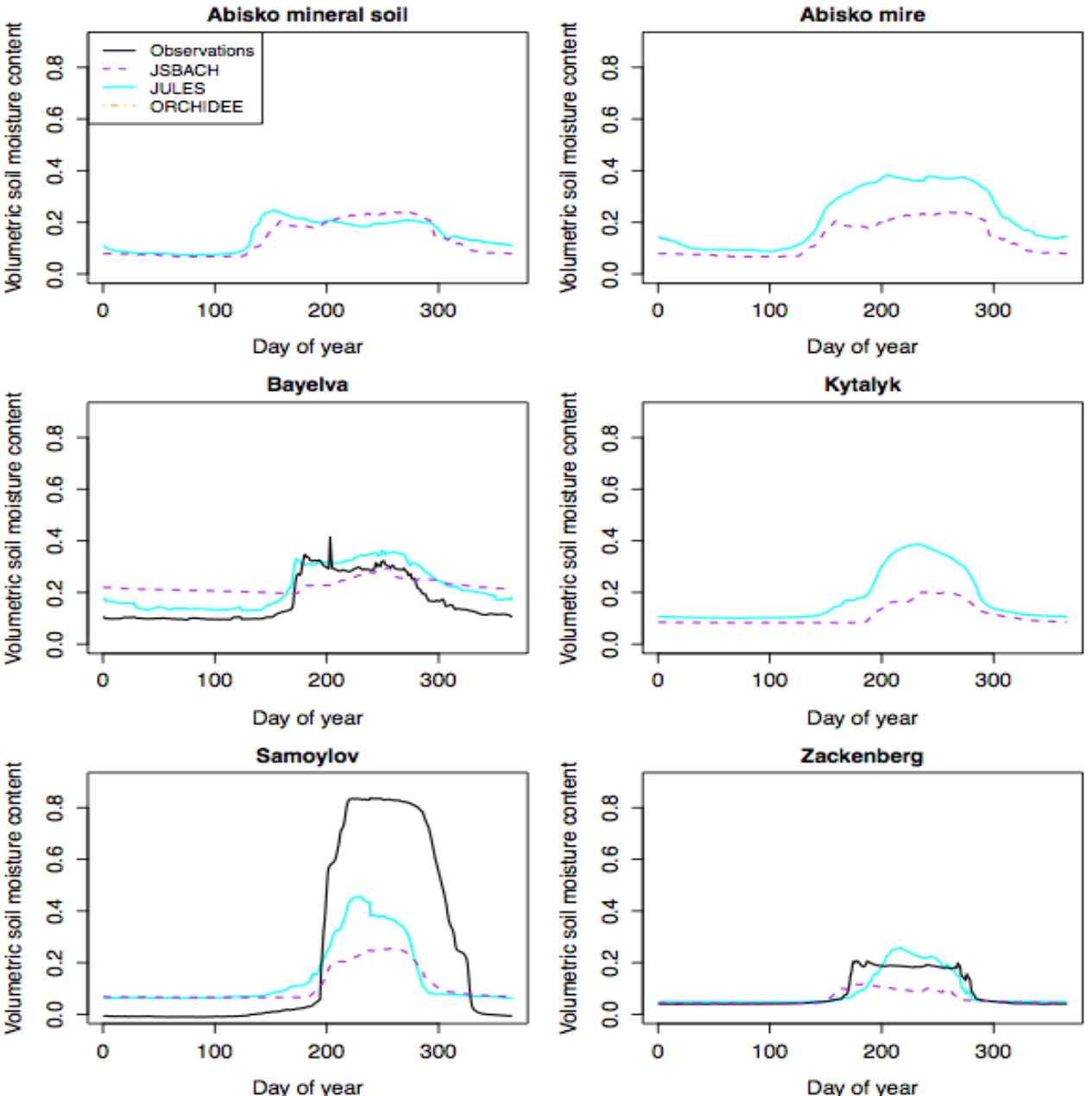
Physics – soil temperature

Physical simulation is reasonable! But still more work to do.



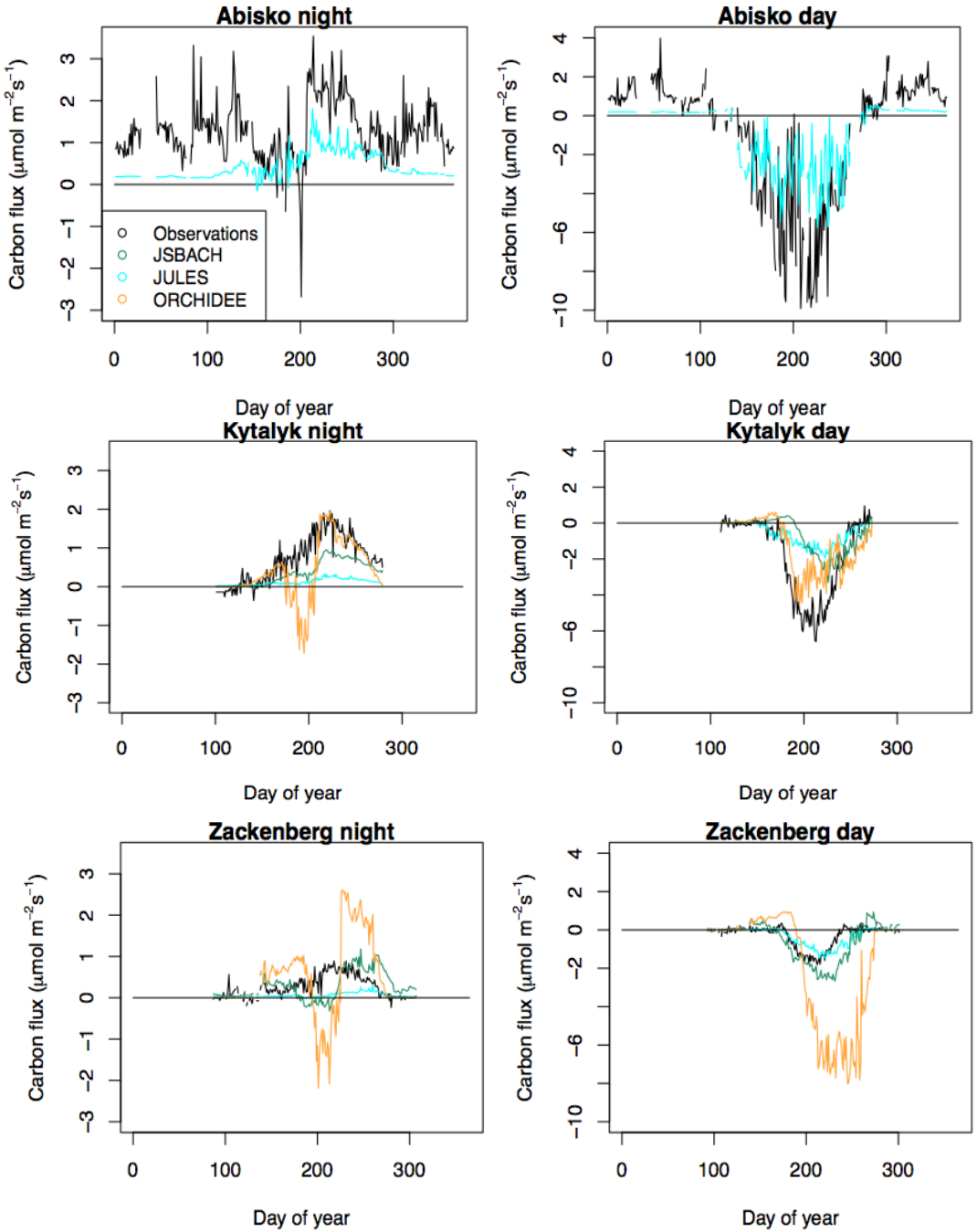
Physics – soil moisture

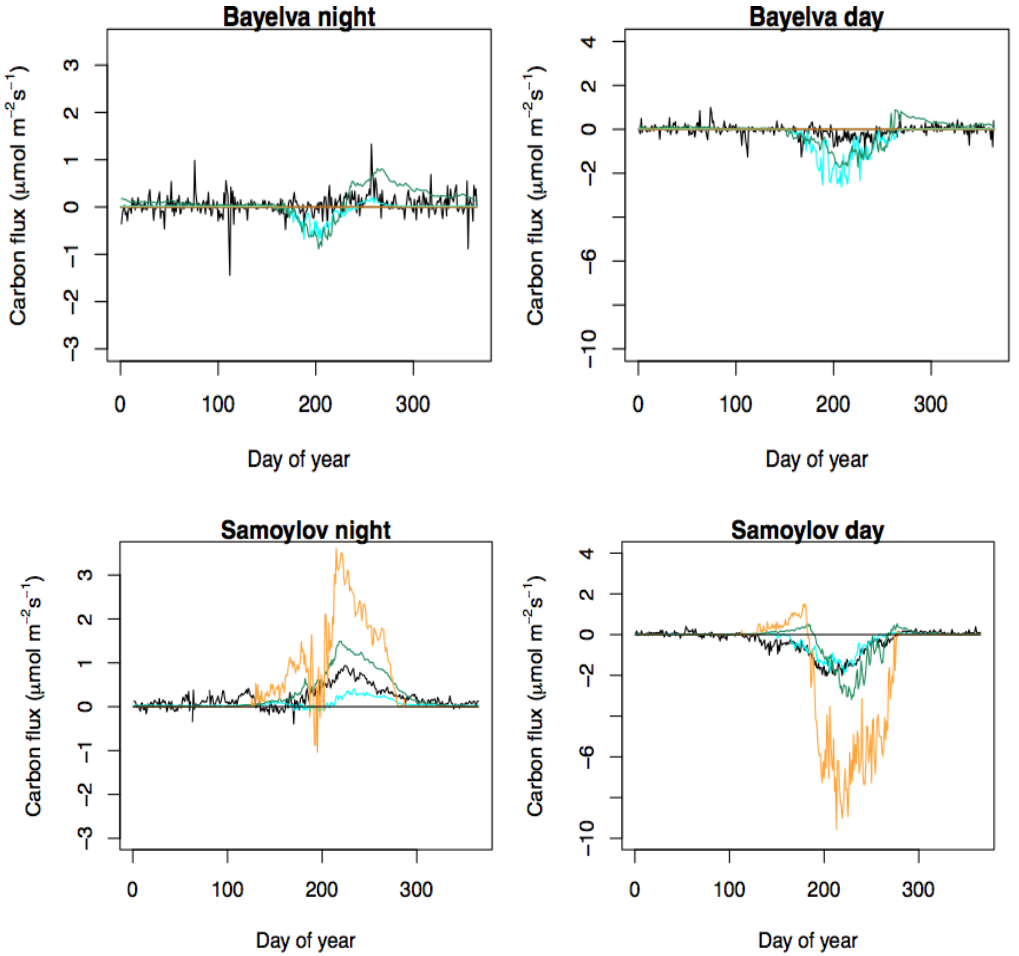
Physical simulation is reasonable! But **still more work to do.**



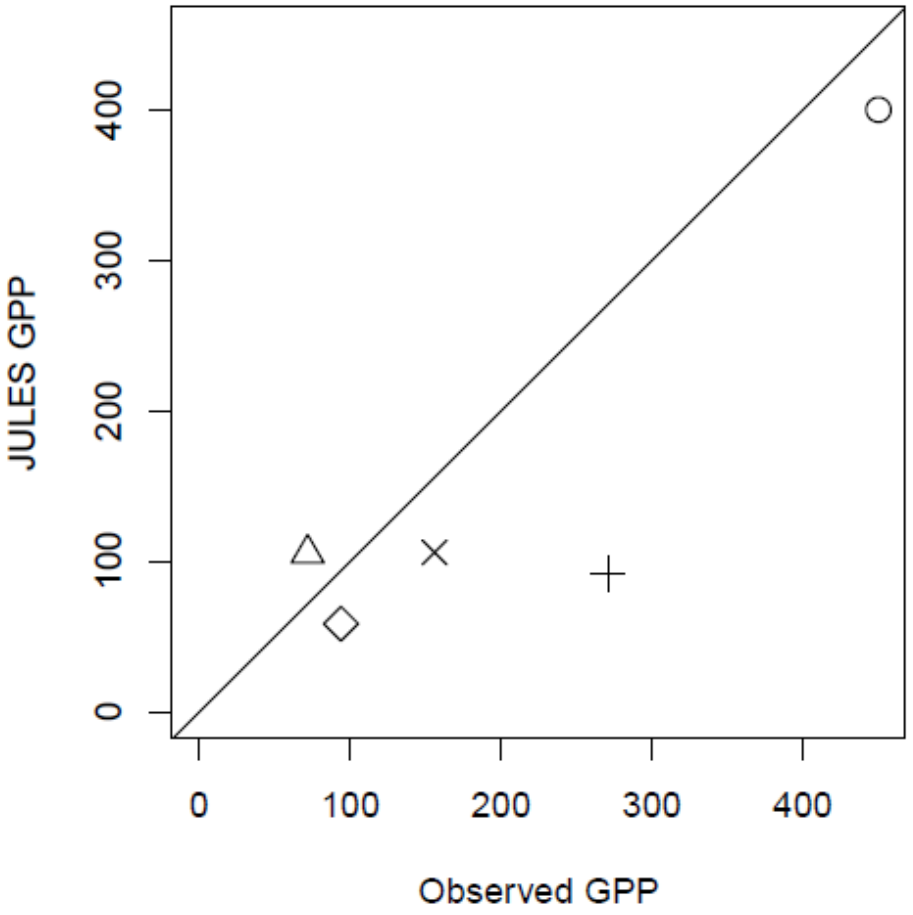
Carbon fluxes

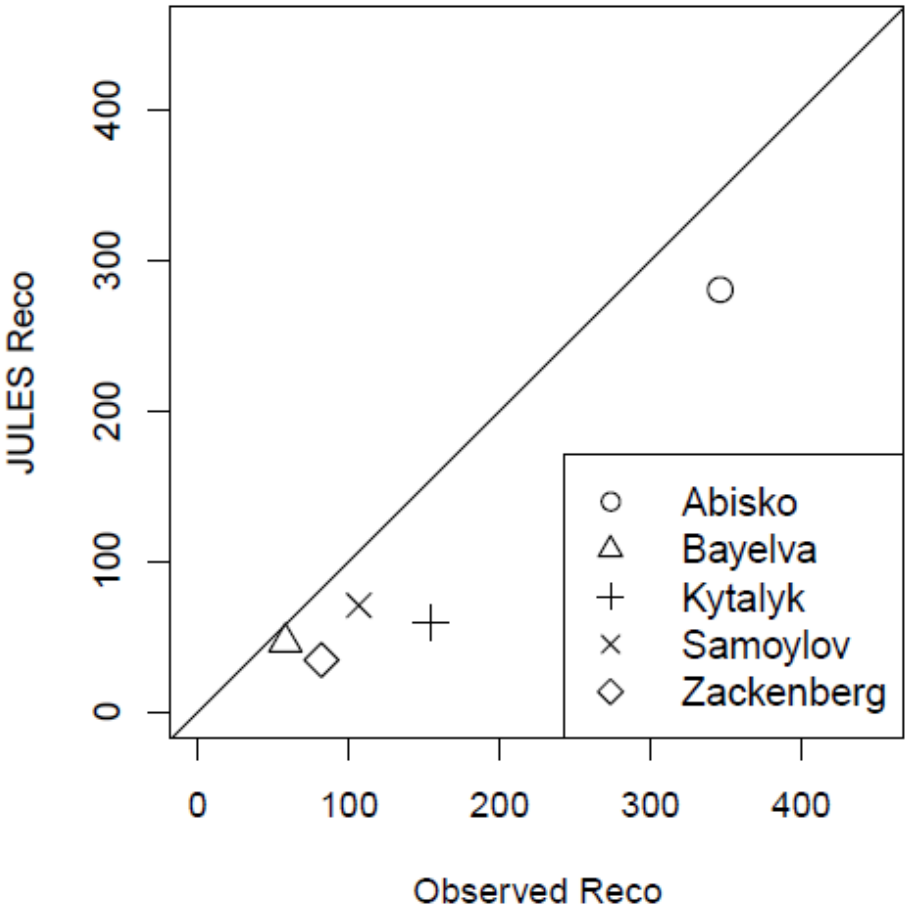
Initial assessment: Annual cycle.



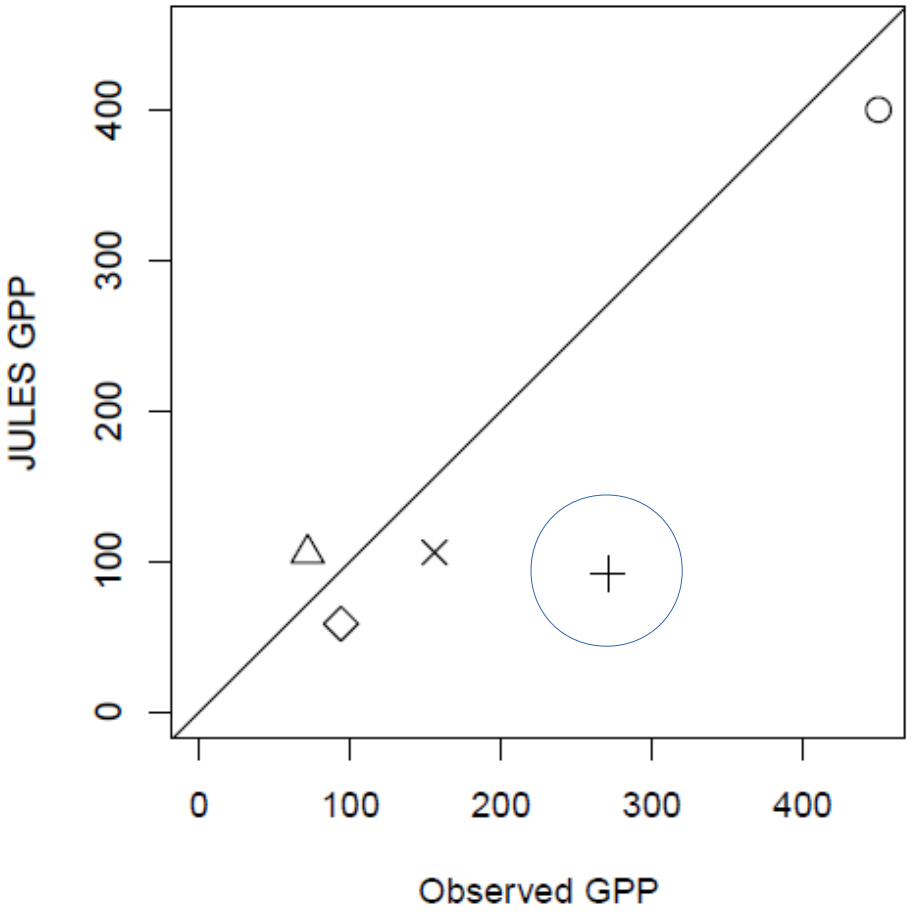


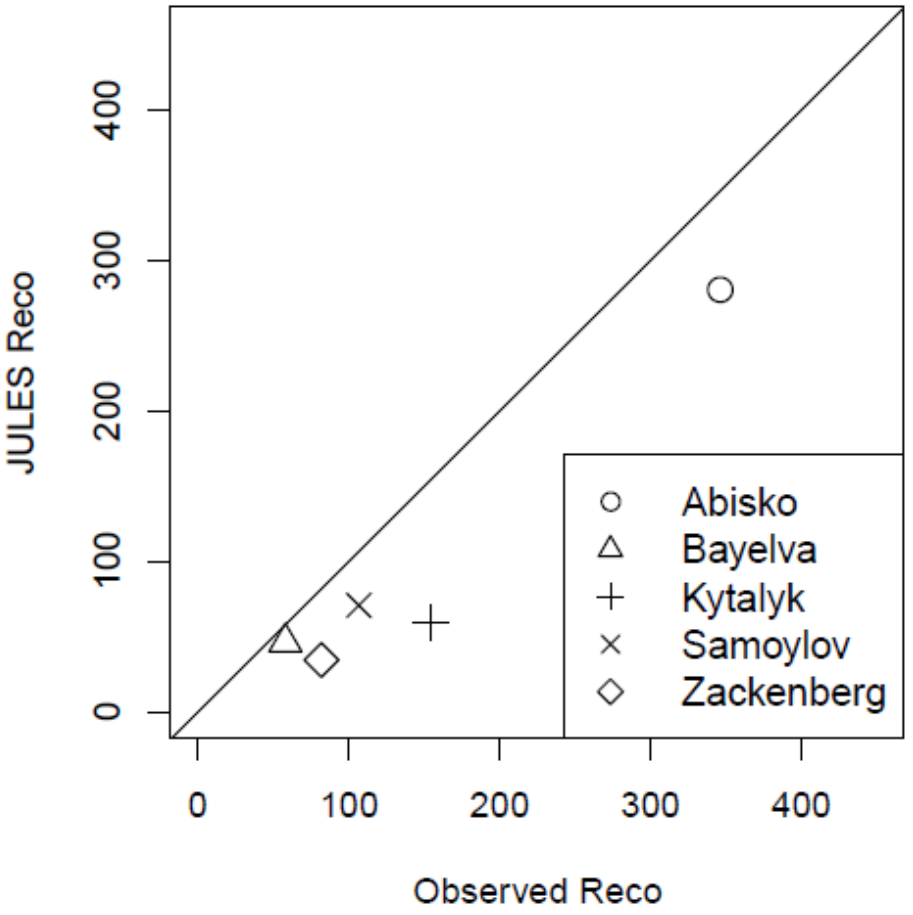
Overall biases in JULES





Overall biases in JULES





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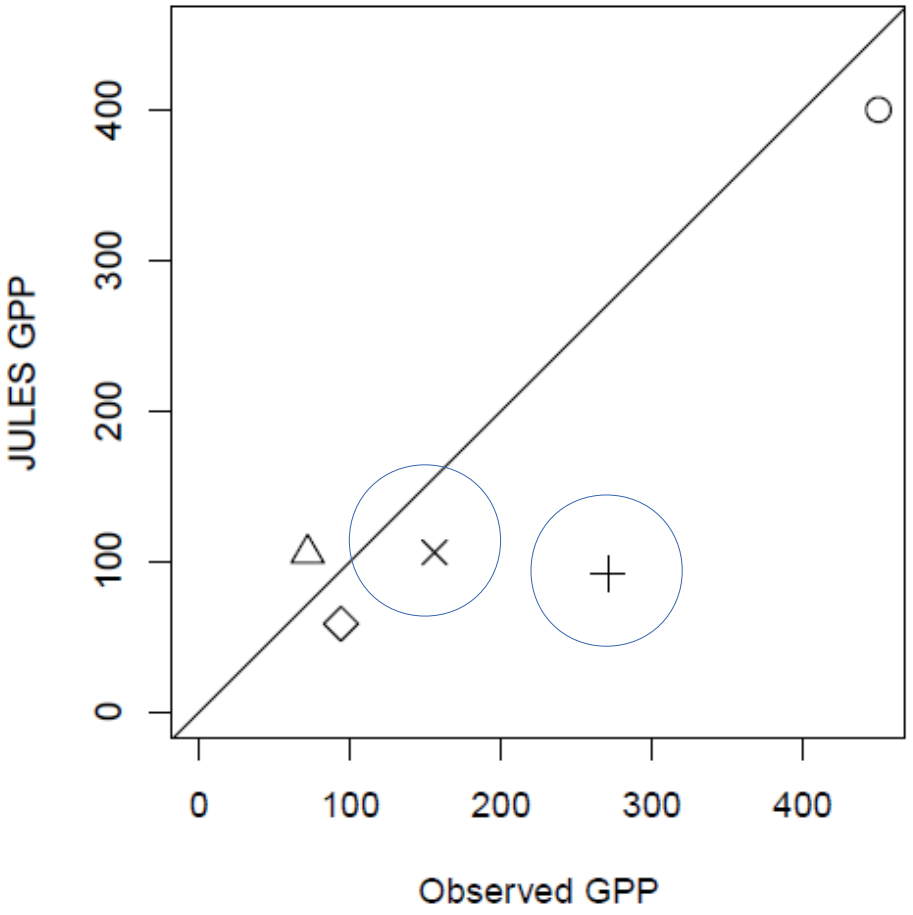
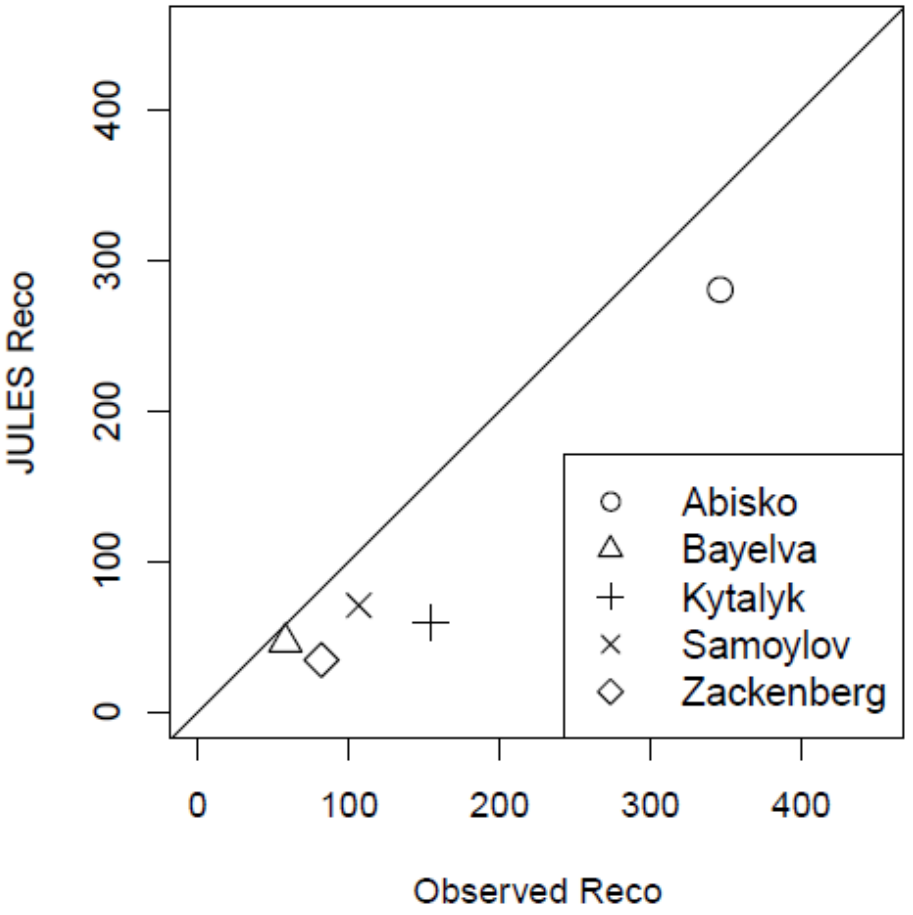
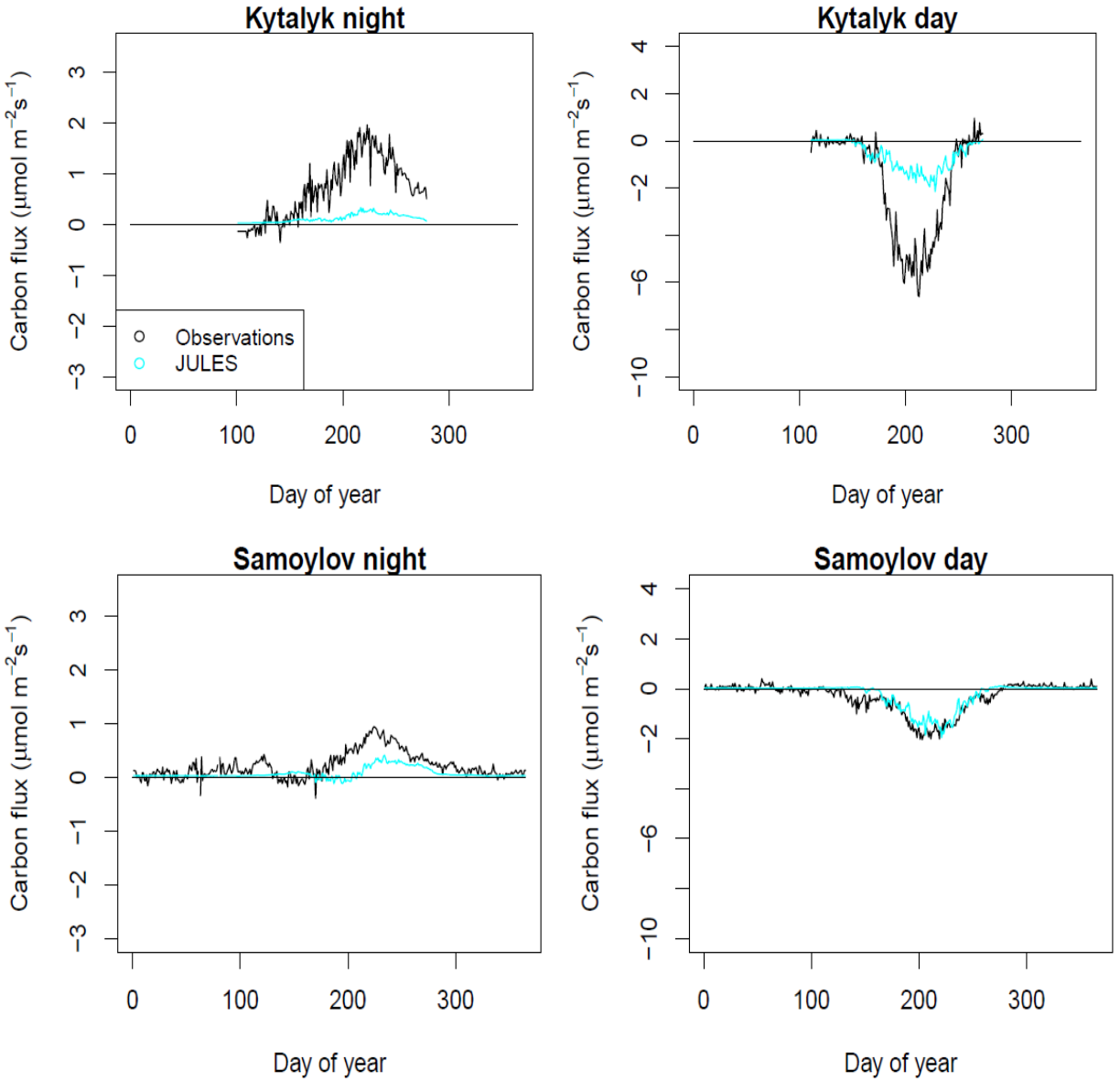




Samoylov vs Kytalyk

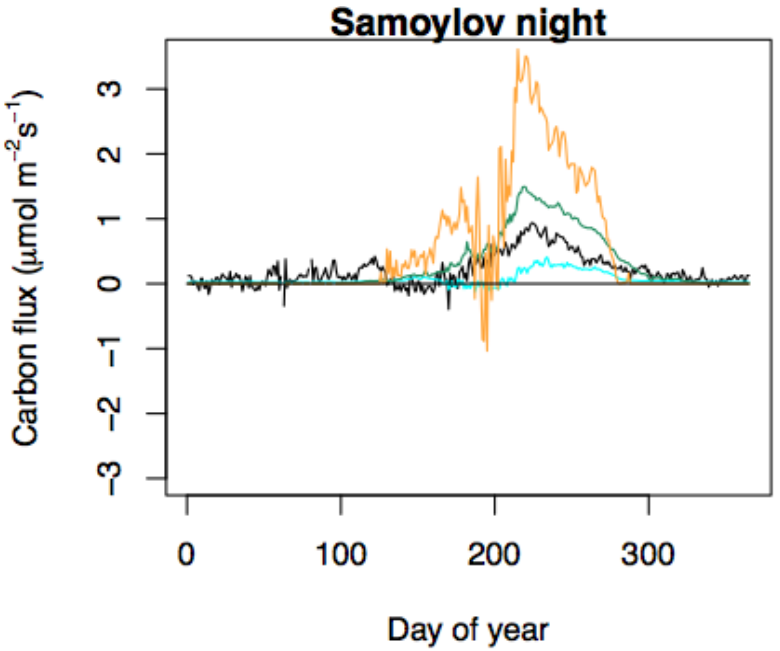
Nutrient limitation and vegetation type

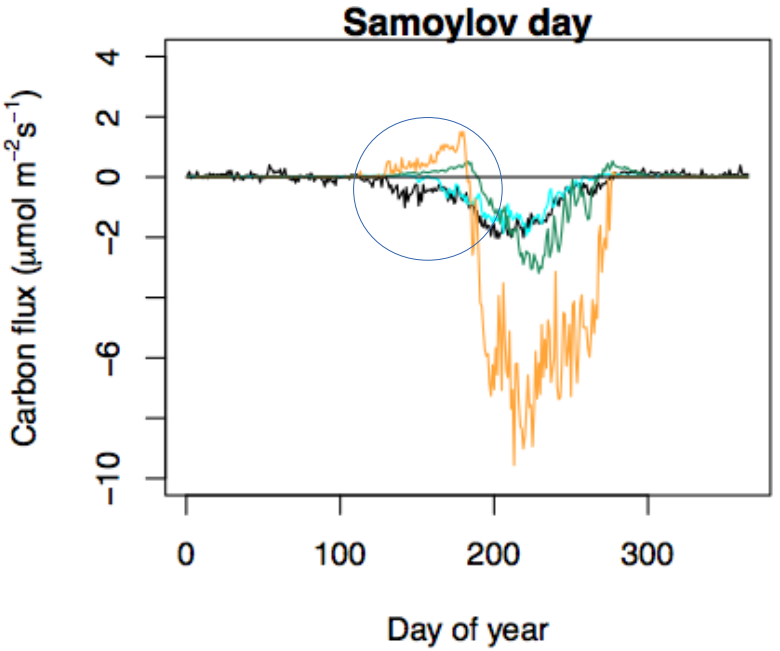


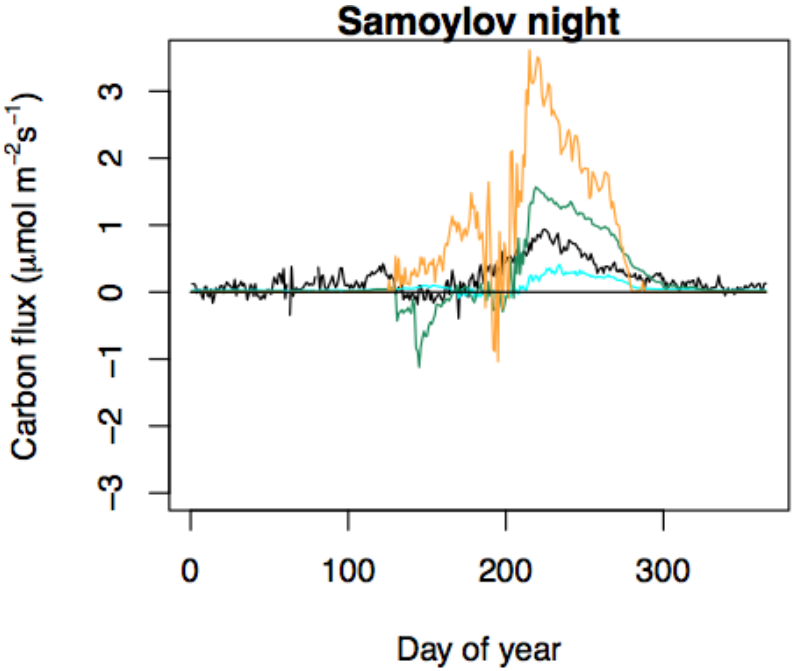
Simulation matches well at Samoylov: Right answer for wrong reasons.

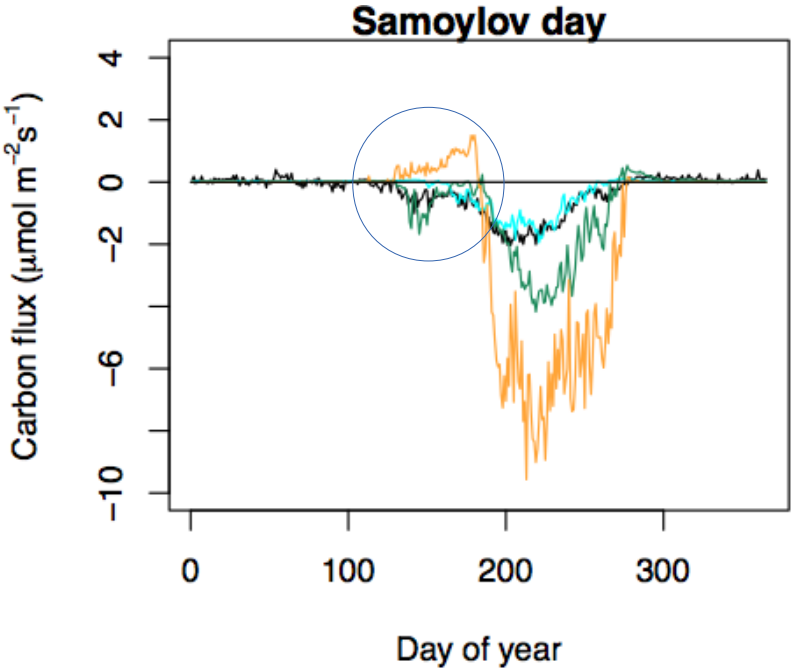
- Samoylov is nutrient limited, Kytalyk is not.
- Missing vegetation types *and* nutrient limitation.

Including moss





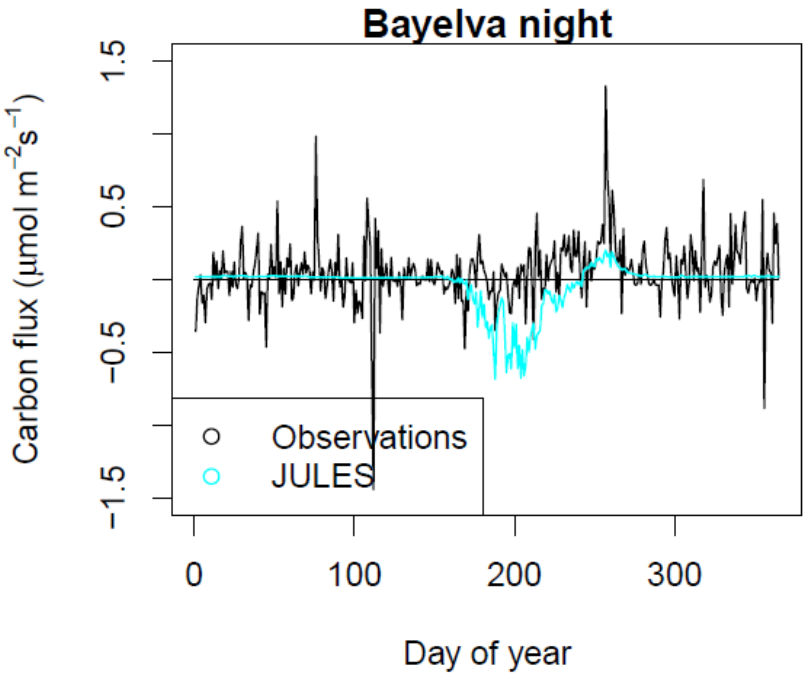


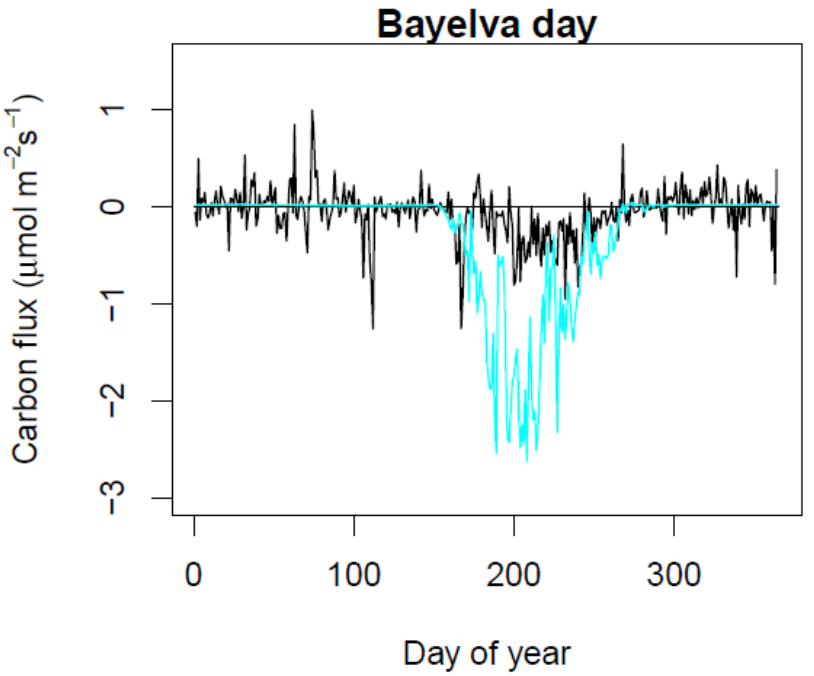


Including moss NPP at Samoylov Captures early peak. Shows some improvement!

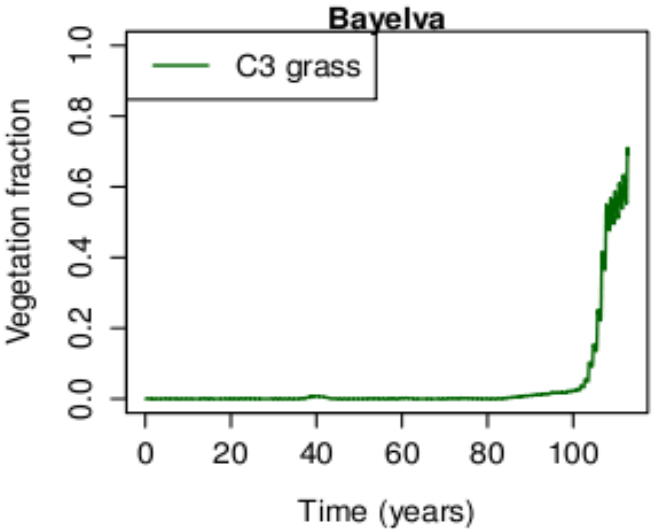
Example: Svalbard, Bayelva

Missing appropriate vegetation types (e.g. moss!)

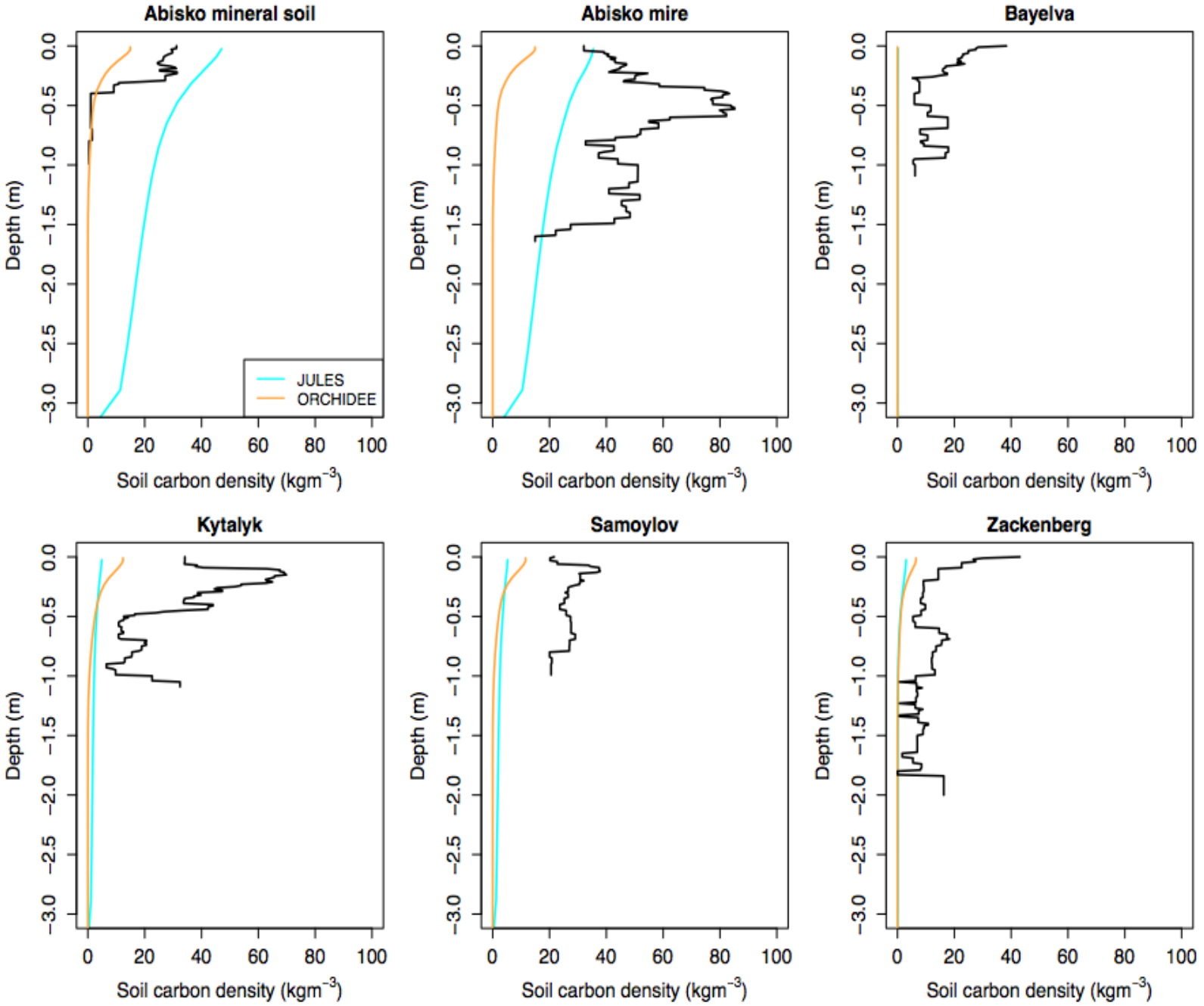




Vascular plants grow more than they should because the model does not account for the wind, cryoturbation and lack of soil.
In reality it would take many years to develop the soil matrix.



Soil carbon profiles



Mixing is important.

Missing inputs during spinup.

Conclusions

- Indicated priorities for model development:

  - Need *additional vegetation types and moss* (both for NPP and soil carbon).

  - Need to represent nutrient limitation.

  - Soil carbon profile mixing is important, and peat processes.

Thanks for listening!

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