Evaluation of one-way coupling between a regional climate model and a land surface model

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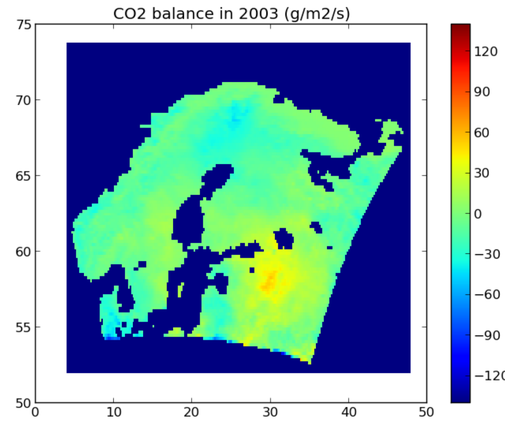
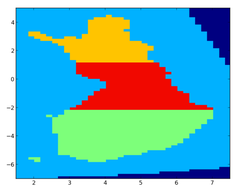
JSBACH land system model was driven with REMO regional climate model data for a north European domain with a resolution of 0.1667◦. Models were run for years 1980-2011 with hourly input and output resolution. We explore

1) 2 metre (2m) and lowest predicted level (LL) climatic variables from REMO as drivers for JSBACH
2) comparability of common energy balance terms produced by both REMO and JSBACH
3) differences in GPPs predicted by JSBACH with both climatic drivers from REMO.

Frequencies are shown for Finland from 2003 to 2011.





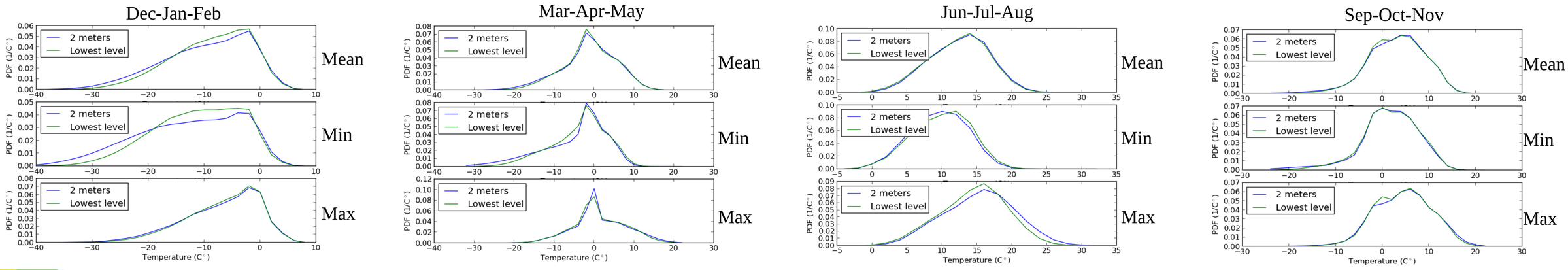


Fig 1. Frequency of seasonal daily mean, minimum and maximum air temperature (T) for Finland. In winter T2m and TLL deviate from each other especially in below zero values. In spring the maximum T2m and TLL deviate from each other close to 0 C◦ which is critical temperature for snow accumulation, snow melting and the startup of photosynthesis. Both snow melting and recovery of plants benefit from higher T that are more frequent in maximum T2m. In summer the minimum and maximum values show higher range in T2m while daily means are very similar in both. In autumn the differences between T2m and TLL frequencies close to 0 C◦ may effect soil temperatures and leaf senescence.

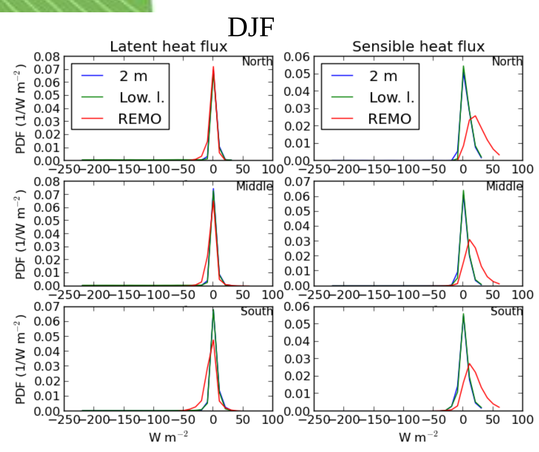


Fig 2a. Daily average latent (QLe) and sensible (QH) heat flux for north, middle and south of Finland. In winter REMO predicts more positive QH than JSBACH. 2m and LL forcings in JSBACH produce very similar QLe and QH.

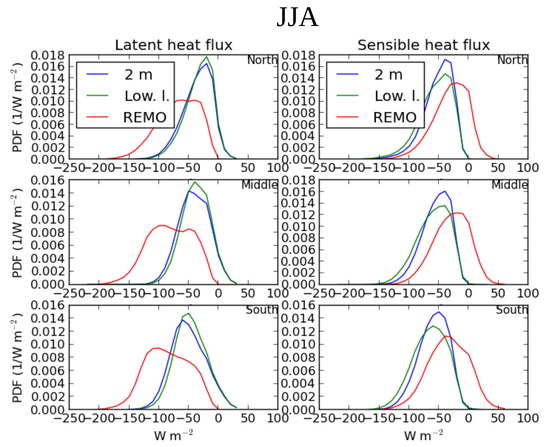


Fig 2b. In summer REMO predicts more negative QLe and more positive QH than JSBACH. JSBACH predicts positive Le very frequently. In JSBACH 2m forcing produce more extreme negative QLe values than LL forcing. These are compensated by QH PDF. Spring and autumn show transition between winter and summer (not shown).

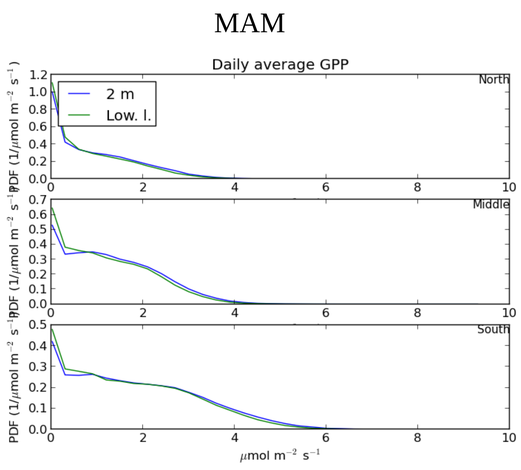


Fig 3a. Daily average GPP for north, middle and south of Finland. In spring high GPPs are more frequent with 2m forcings throughout the country. This was expected from the differences in T2m TLL frequencies (Fig 1).

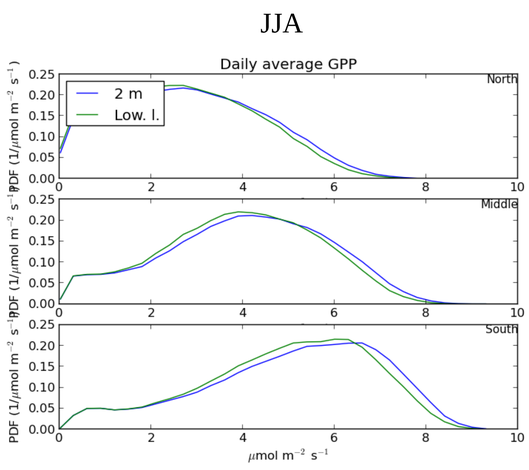


Fig 3b. In summer the high GPPs are much more frequent with 2m forcings throughout the country but especially in the south. This is in accordance with more frequent negative QLe in summer (Fig 2b) and driven by higher T values from 2m than from LL.

CONCLUSIONS

- Mean daily T2m and TLL are very similar while minimum and maximum T2m shows more extreme values than TLL.
- REMO predicts wider range of turbulent flux values than JSBACH in all seasons.
- Differences in frequencies of maximum T2m and TLL lead to more frequent large daily GPP and strong water loss in transpiration with 2m drivers in summer.
- North to south gradient in extreme values of GPP and transpiration is stronger than that of QLe

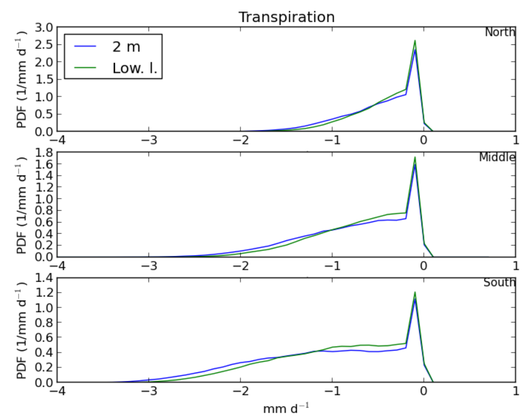


Fig 4. Transpiration (by green vegetation – evaporation from other surfaces not shown) gets more negative values with T2m than with TLL in summer. There is a strong north to south gradient in the magnitude of the water loss by transpiration.

ACKNOWLEDGEMENTS
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References for models:
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Raddatz T.J. (2007), Reick C.H., Knorr W., Kattge J., Roeckner E., Schnur R., Schnitzler K.-G., Wetzel P. & Jungclaus. Will the tropical land biosphere dominate the climate-carbon cycle feedback during the twenty first century? Clim. Dyn. 29: 565- -574.