

CESM Land Model / Biogeochemistry Model
Winter Working Group Meeting
February 6th, 2023

Evaluation of WRF-CTSM with the Hillslope Hydrology configuration

Preliminary results

Iris Mužić

PhD student at the University of Oslo and
CICERO Center for International Climate Research
Norway

Acknowledgements

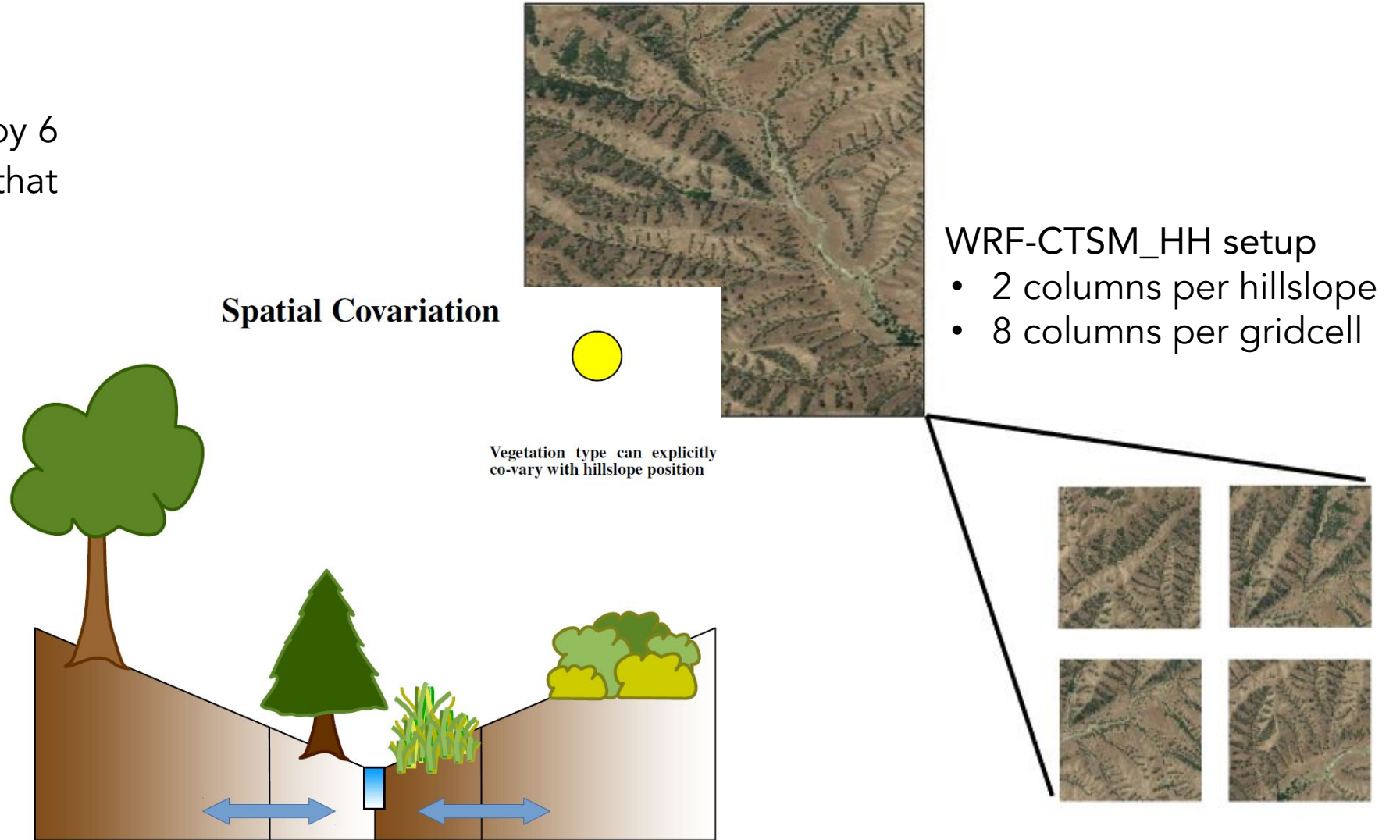
- David Lawrence
- Sean Swenson
- Negin Sobhani
- Erik Kluzek
- Bill Sacks

- setting up and using
 - WRF-CTSM on the Norwegian cluster
 - WRF-CTSM with the Hillslope Hydrology configuration

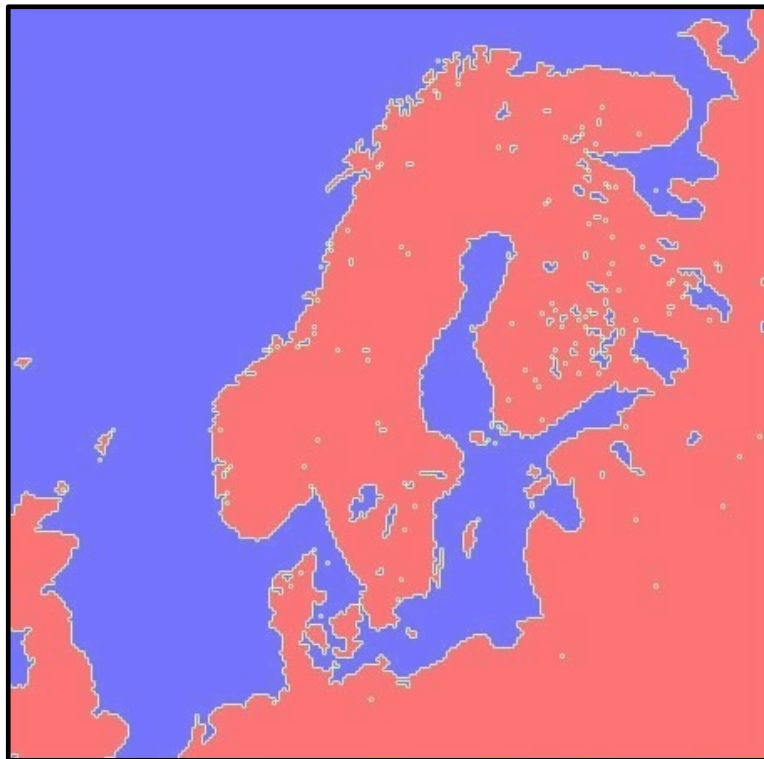
Hillslope Hydrology configuration

- every column is described by 6 “geomorphic parameters” that are derived from a DEM
 - height, distance, width, area, slope and aspect

Representative Hillslopes



Setup



10.5 km resolution

- initial and boundary conditions from ERA5

Spin-up period (2002-2017)

WRF-CTSM

- 16 years of WRF-CTSM

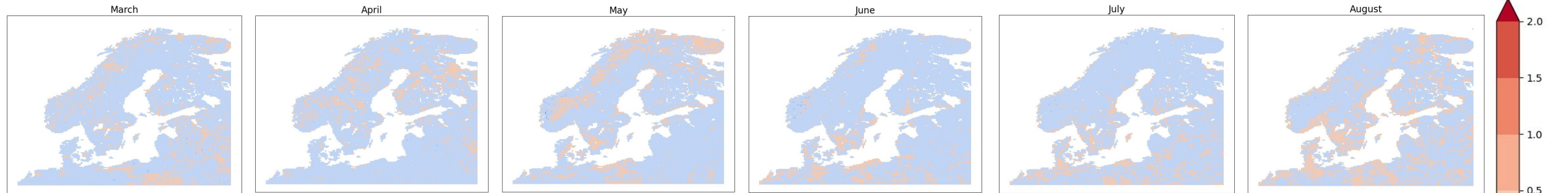
WRF-CTSM_HH

- 14 years of WRF-CTSM + 2 years of WRF-CTSM_HH

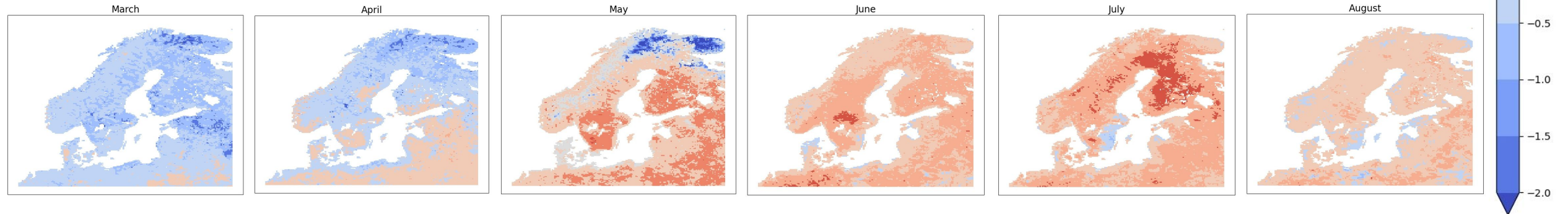
The role of the spin-up period length

WRF-CTSM_HH – WRF-CTSM 2 m temperature
spring and summer 2018

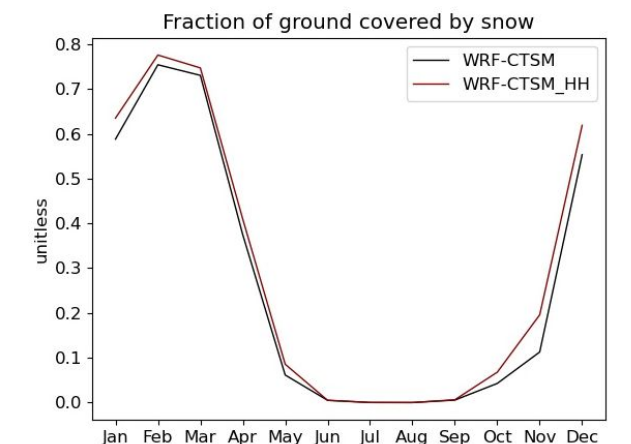
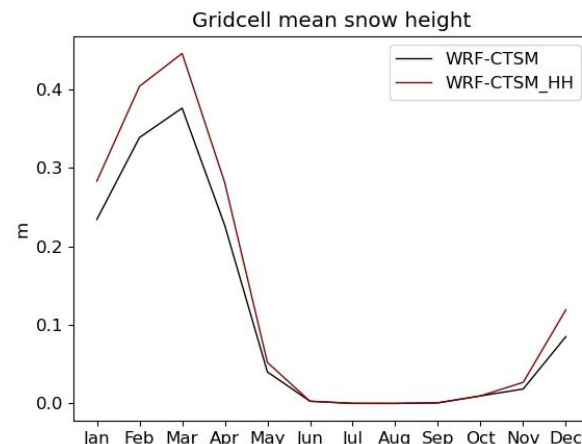
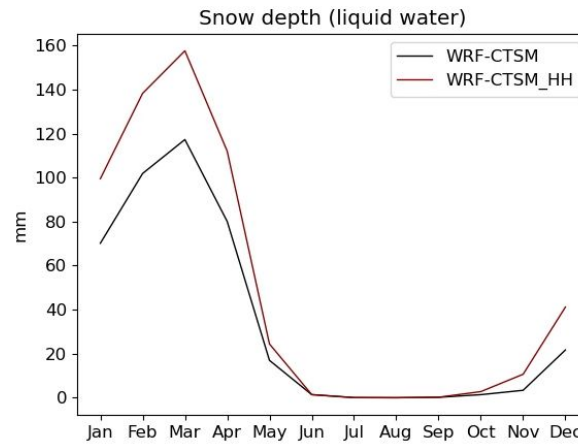
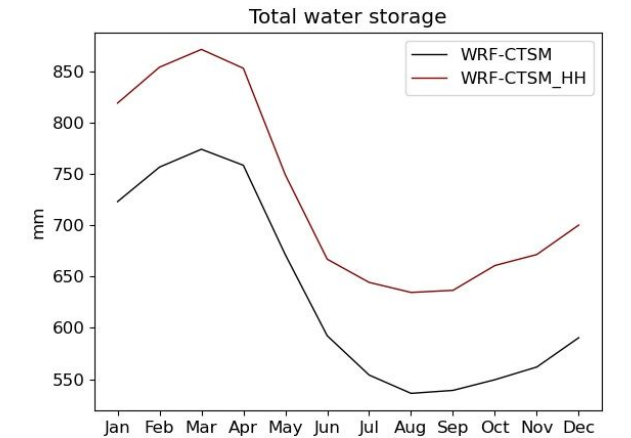
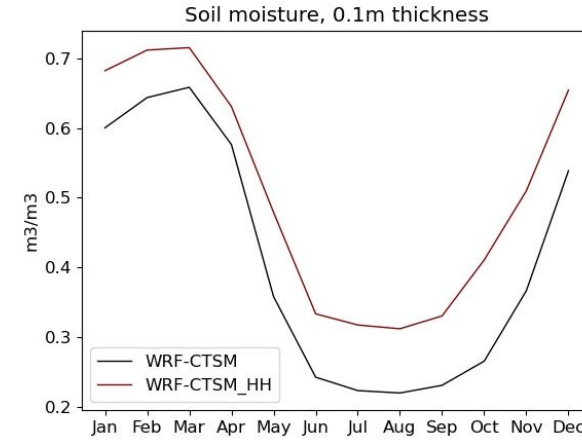
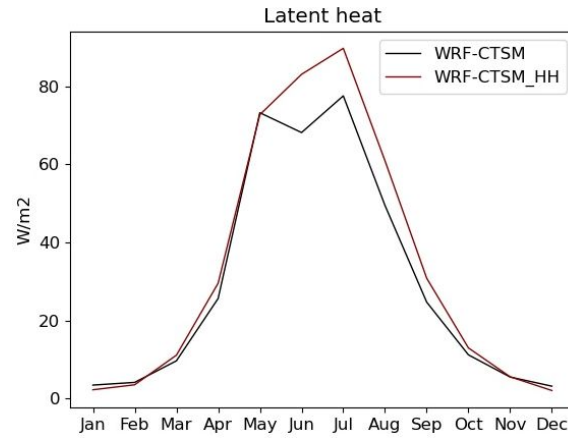
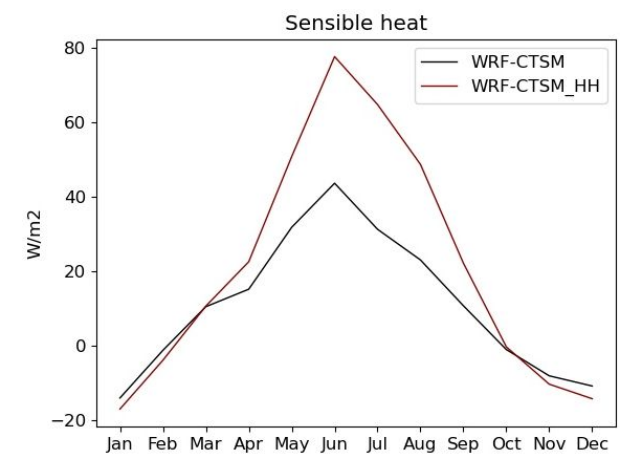
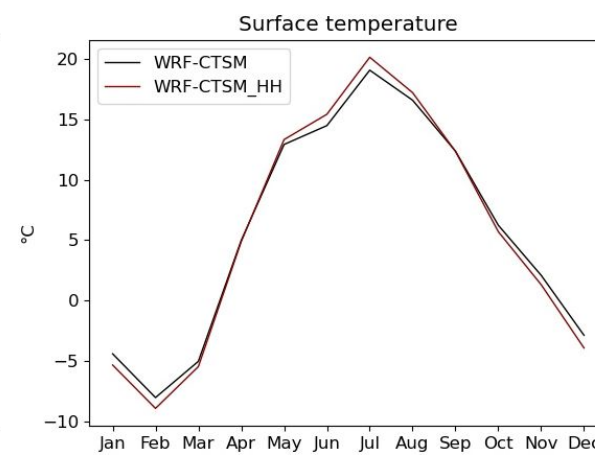
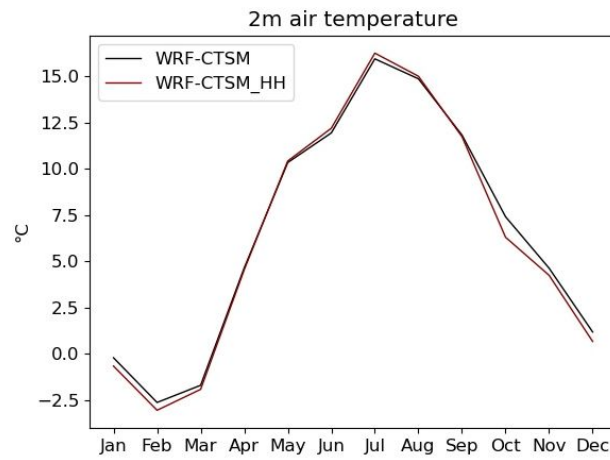
3 months long spin-up



16 years long spin-up

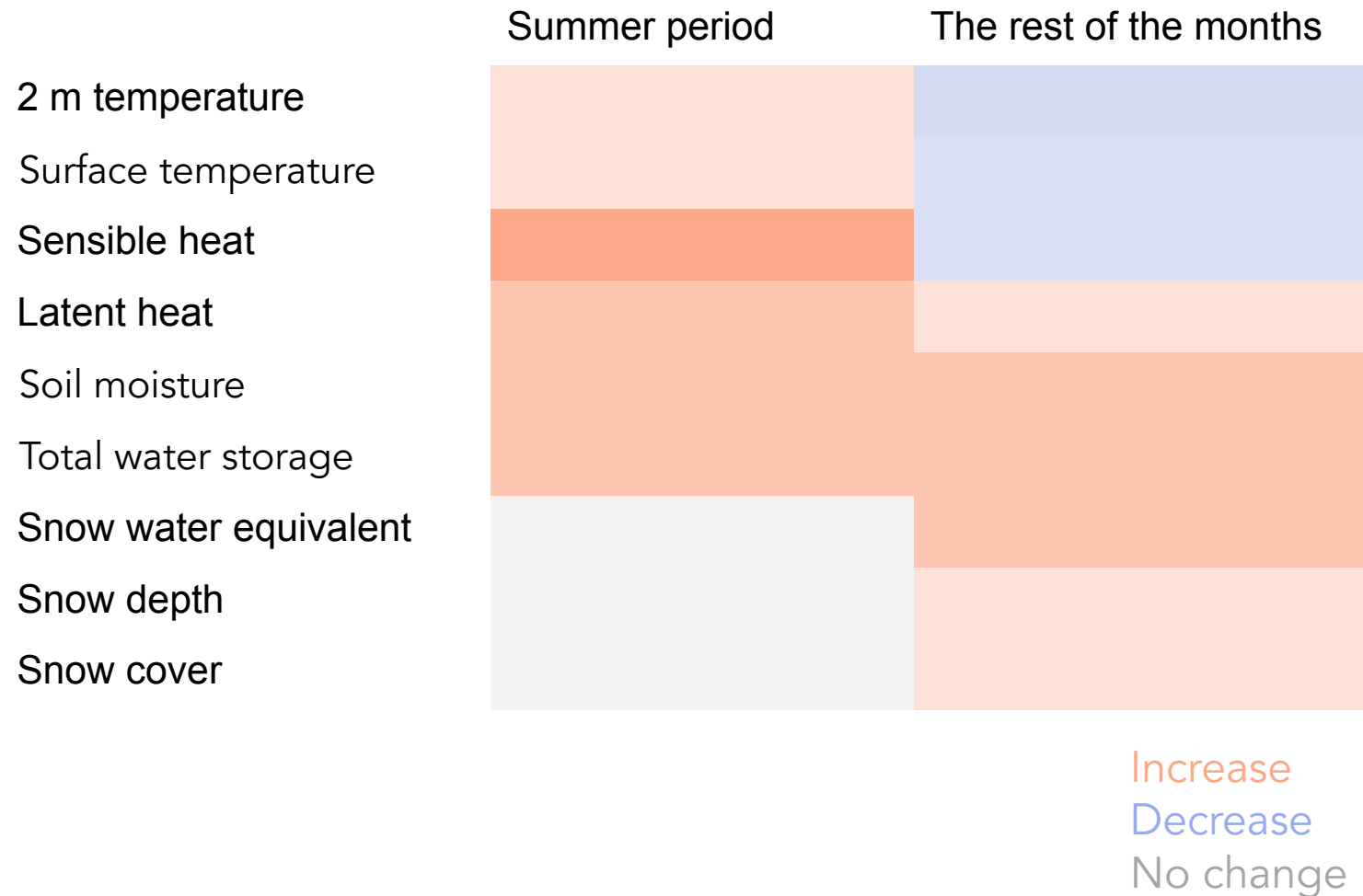


Overview of considered variables 2018



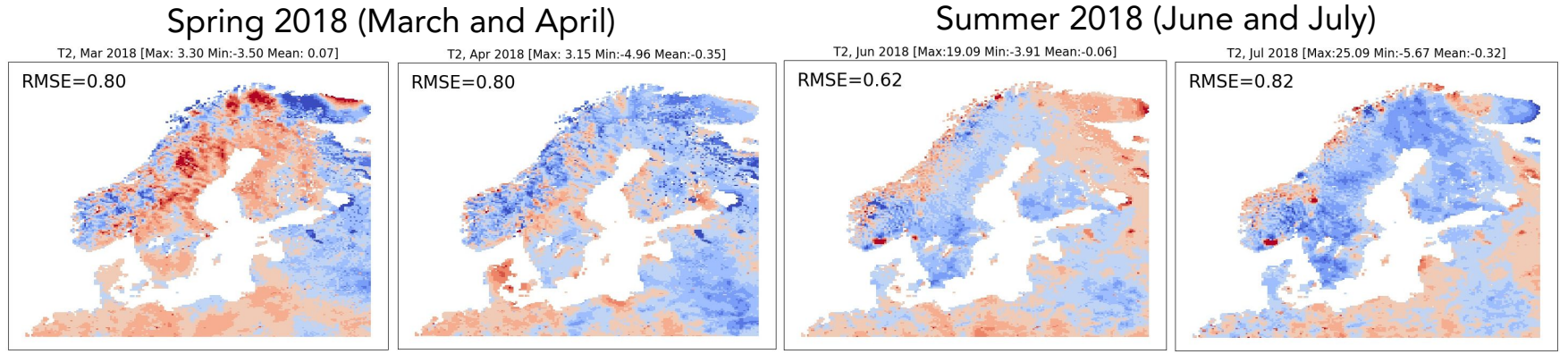
Summary of the differences between model configurations for the year 2018

WRF-CTSM_HH – WRF-CTSM

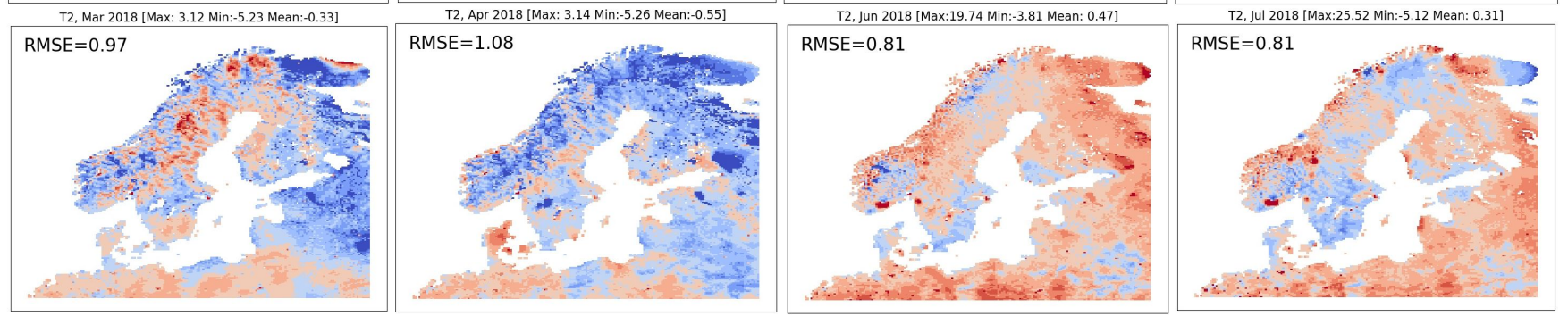


2 m temperature
absolute differences
(16 years long spin-up)

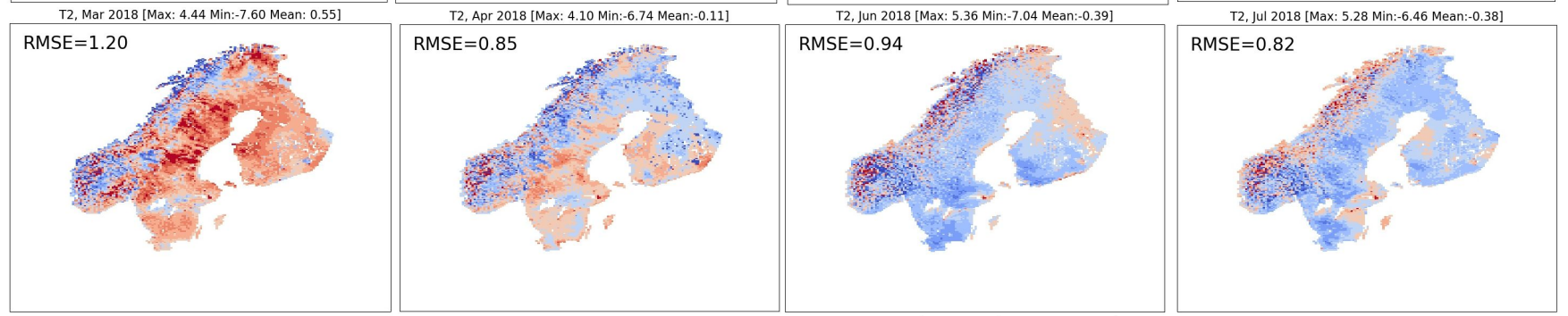
WRF-CTSM – E-OBS



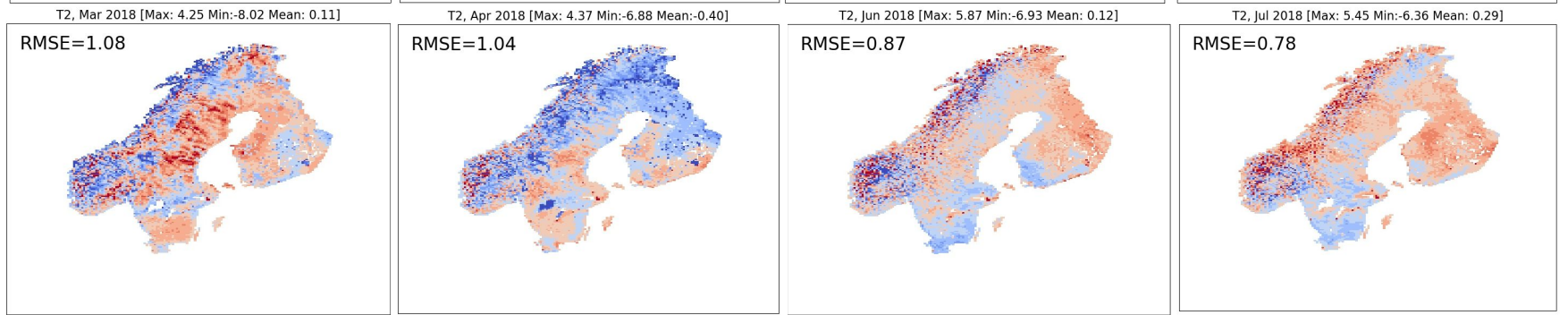
WRF-CTSM_HH – E-OBS



WRF-CTSM – NGCD

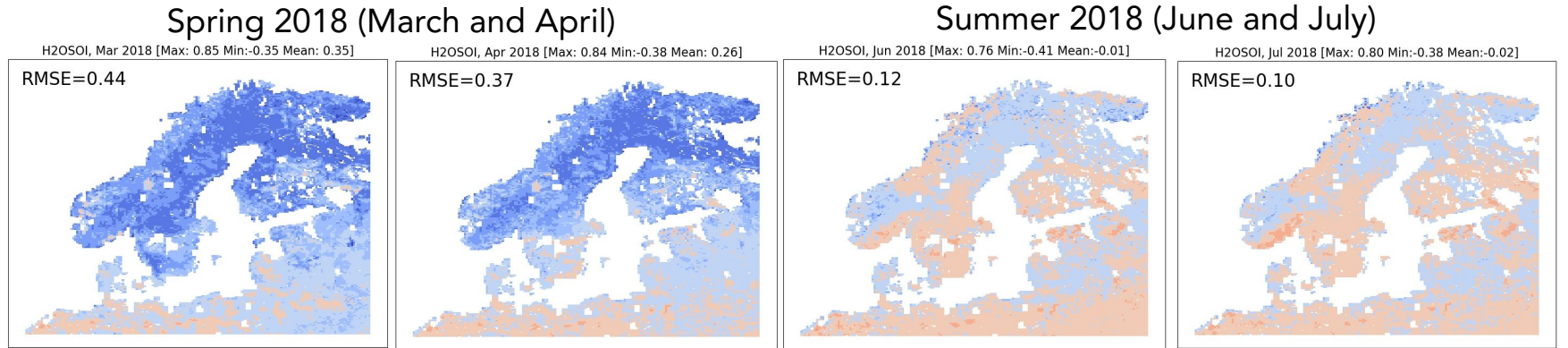


WRF-CTSM_HH – NGCD

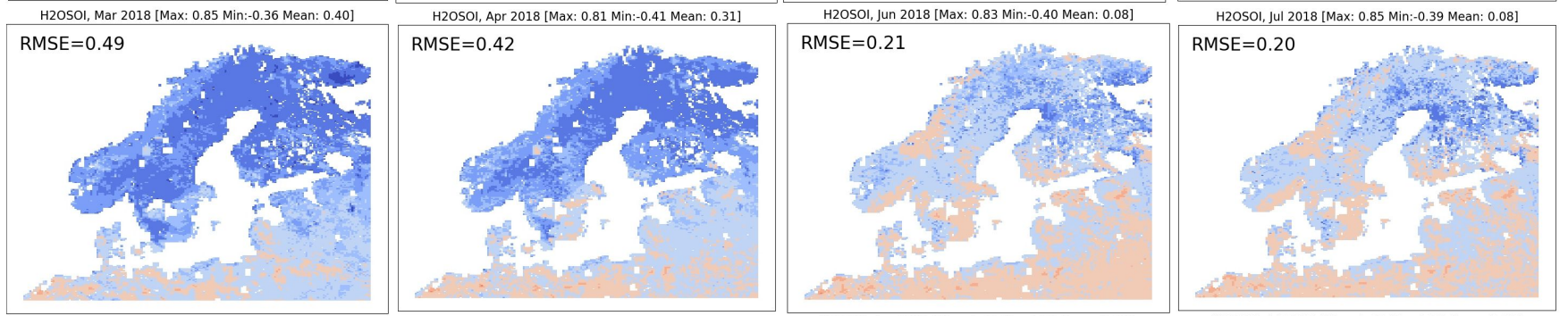


Surface soil moisture
absolute differences
(16 years long spin-up)

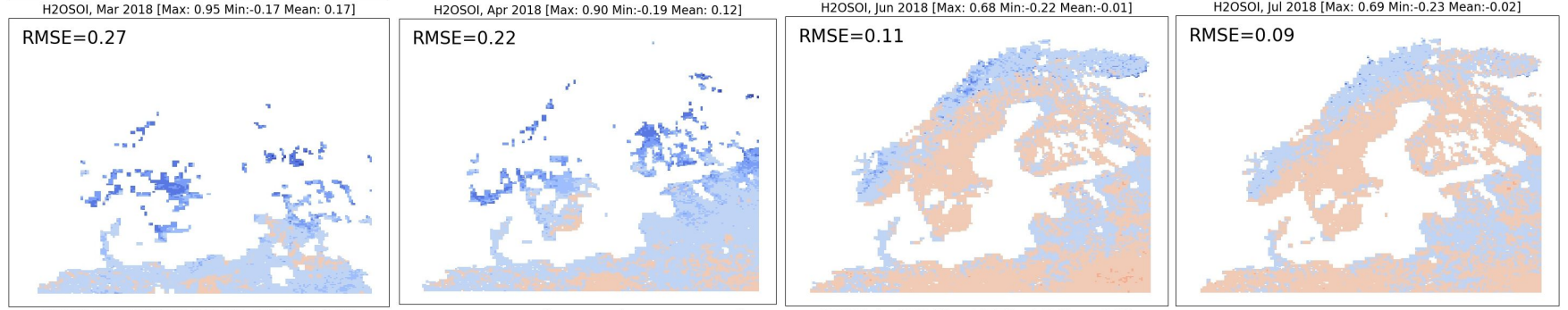
WRF-CTSM – GLEAM



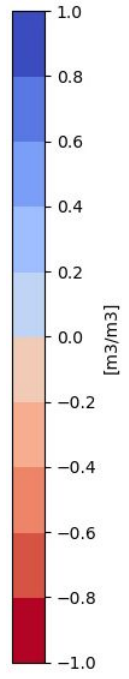
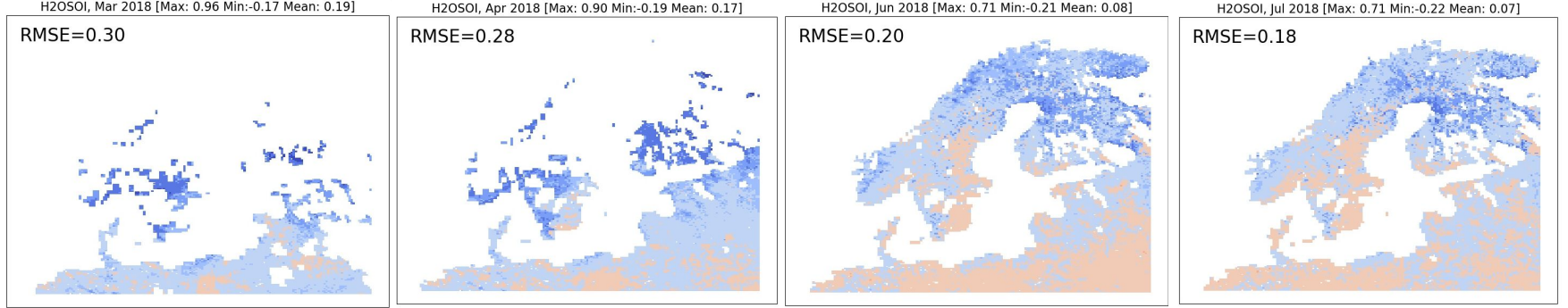
WRF-CTSM_HH – GLEAM



WRF-CTSM – ESA CCI SM

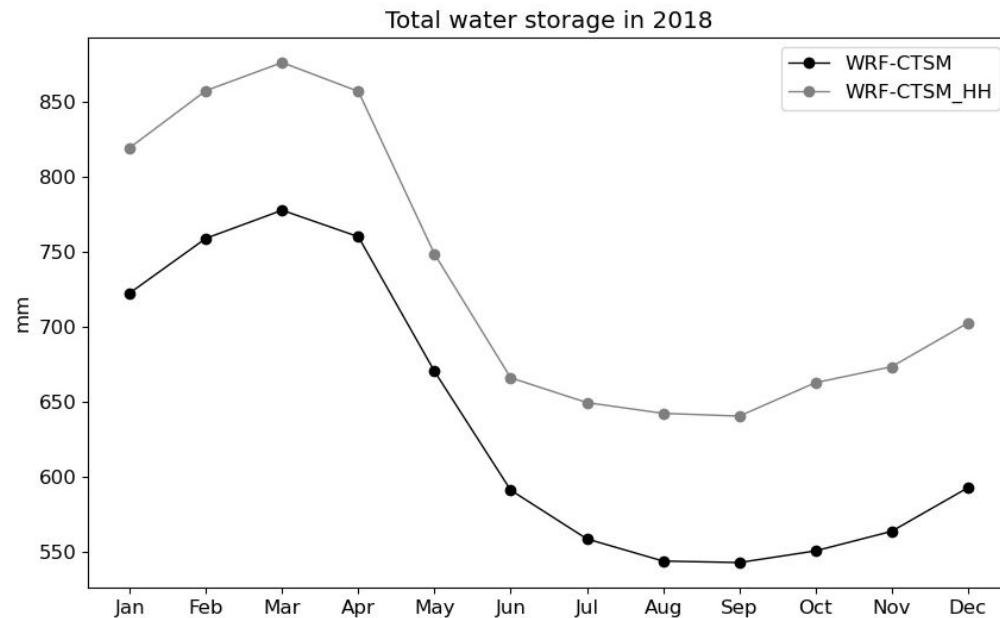
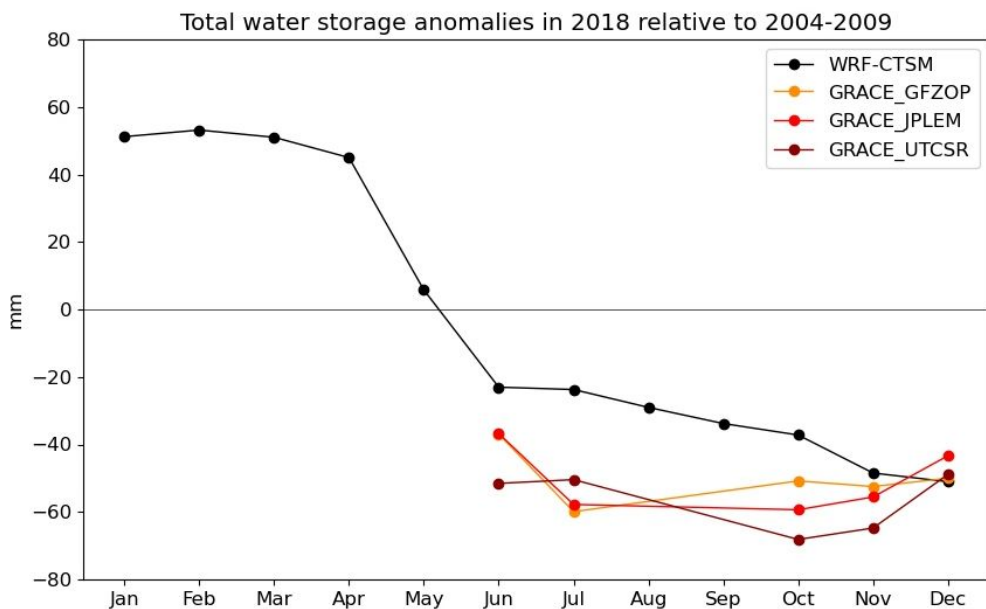


WRF-CTSM_HH – ESA CCI SM

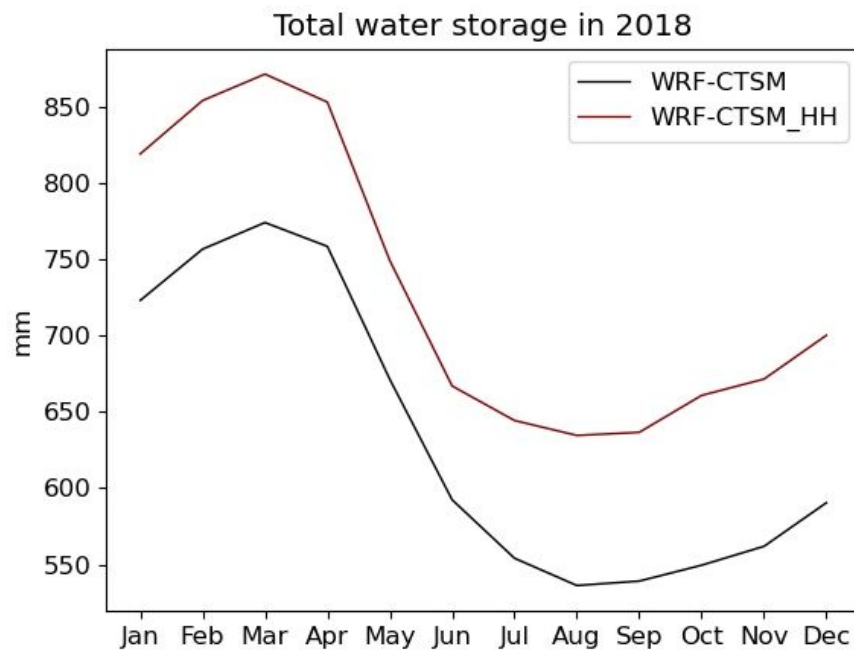
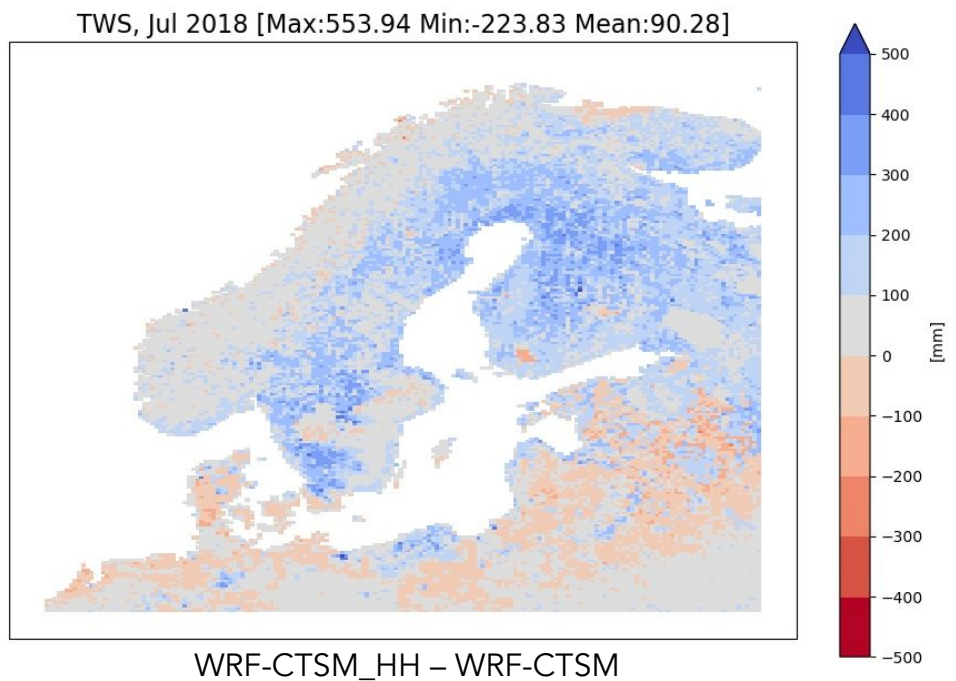


Total water storage

Non-mountainous area



The entire area



Conclusion

- the spin-up period of several years is required for reaching the soil equilibrium
- the differences in model configurations are larger in specific areas than in the regional mean
- most variables exhibit an increase when using the WRF-CTSM_HH configuration
- uncertainty in the observational datasets
- more years and variables should be evaluated against observational datasets to assess the skill of model configurations

Presentation at EGU (23-28 April 2023)

The relevance of coupled climate model WRF-CTSM for land-atmosphere interactions analysis
Iris Mužić, Øivind Hodnebrog, Terje Koren Berntsen, Yeliz Yilmaz, Jana Sillmann,
David Lawrence, Sean Swenson, and Negin Sobhani

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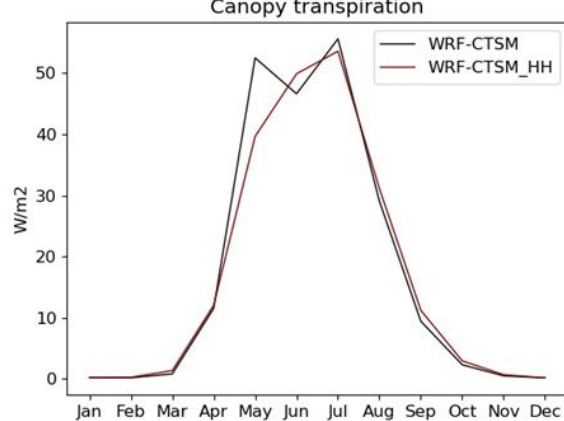
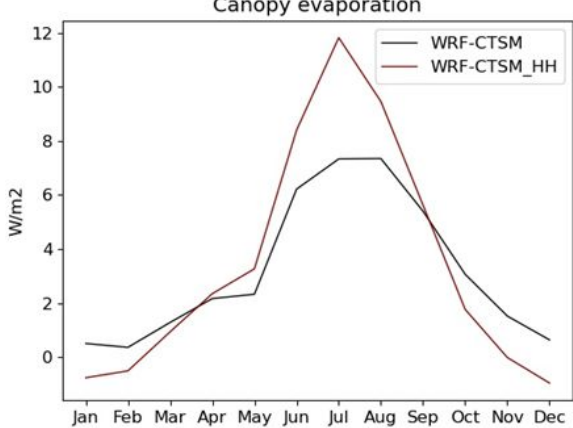
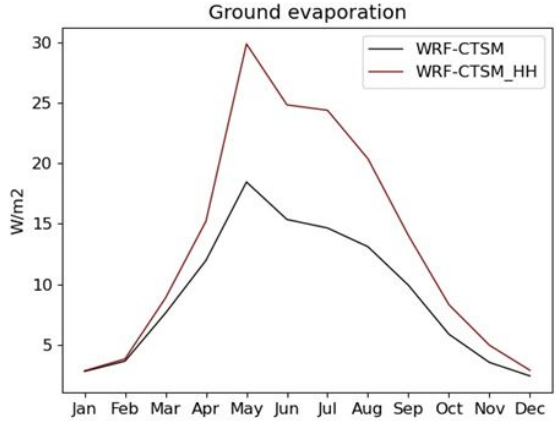
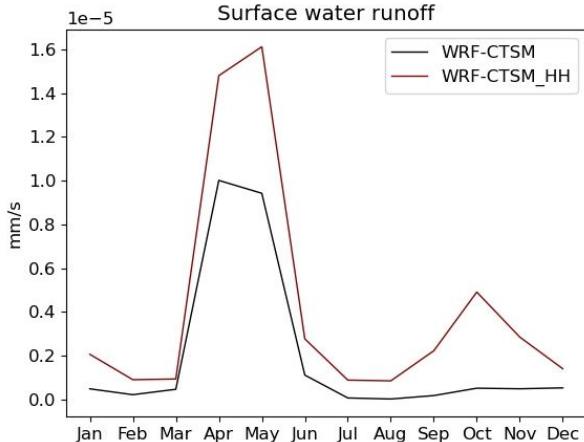
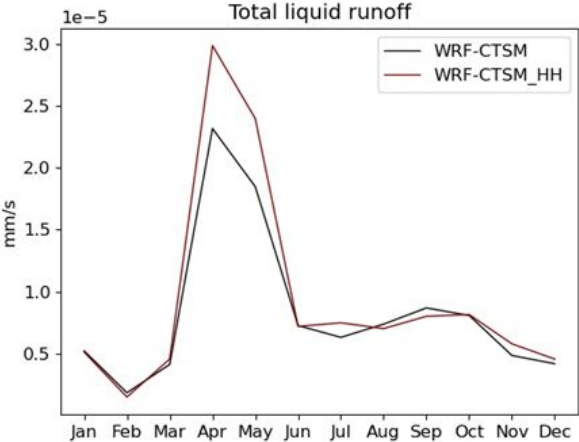
Thank you

Iris Mužić

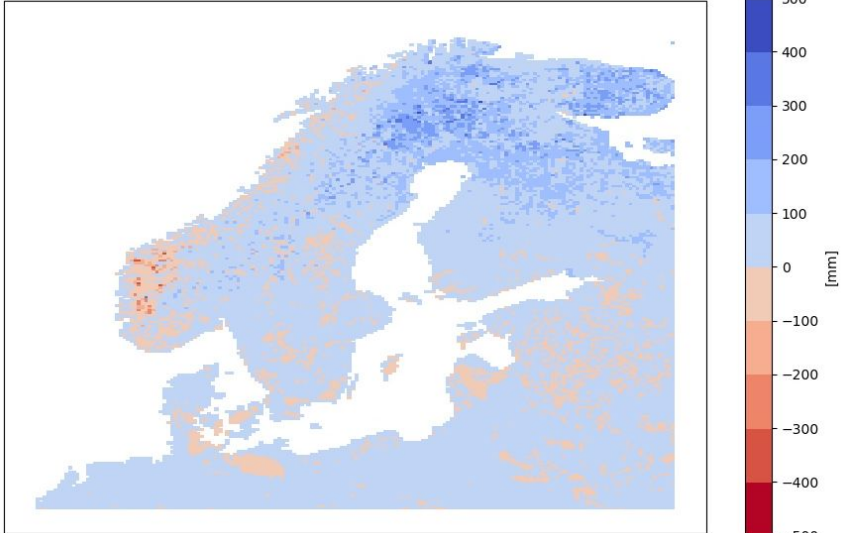
iris.muzic@cicero.oslo.no

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Additional



H2OSNO, Apr 2018 [Max:420.00 Min:-371.16 Mean:31.92]



WRF settings

Options / schemes	WRF configurations
Initial and boundary conditions	ERA5
Radiation	RRTMG (4)
PBL	MYNN (2)
Cumulus	Grell-Freitas (3)
Microphysics	WSM6 (6)
Spectral nudging	only applied to the upper air layers instead of at the PBL