

Sensitivity of hydrological fluxes and states to groundwater representation in continental scale simulations over Europe.

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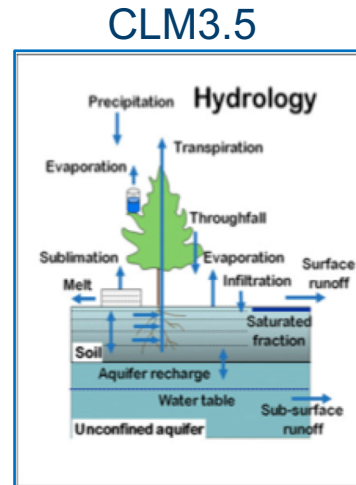
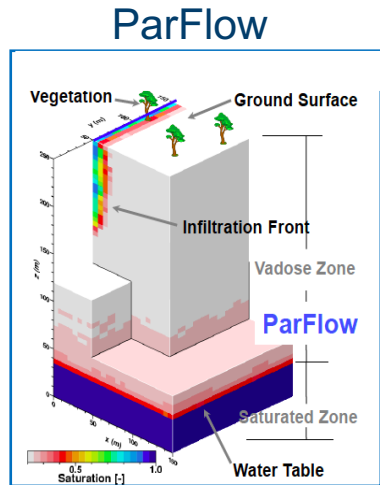
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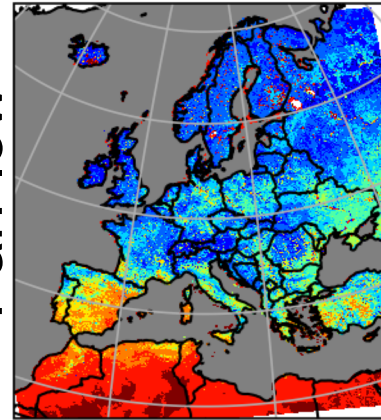
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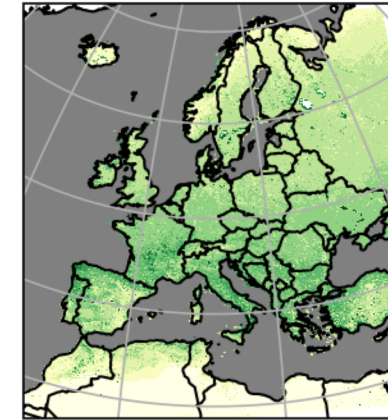
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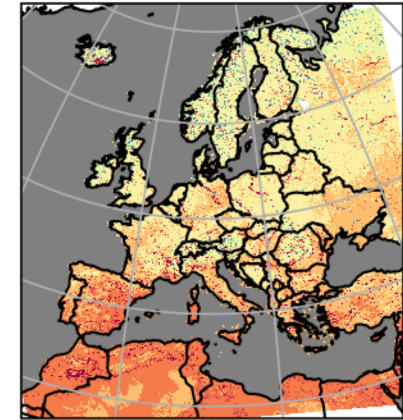
Soil Moisture (1997 - 2006)



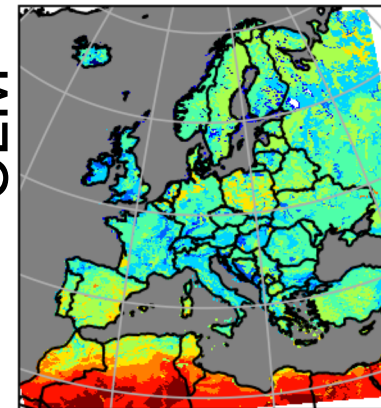
ET (1997 - 2006)



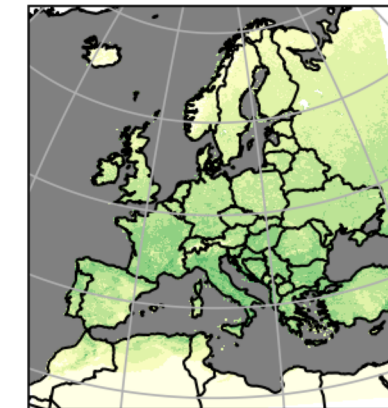
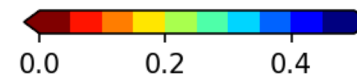
WTD (1997 - 2006)



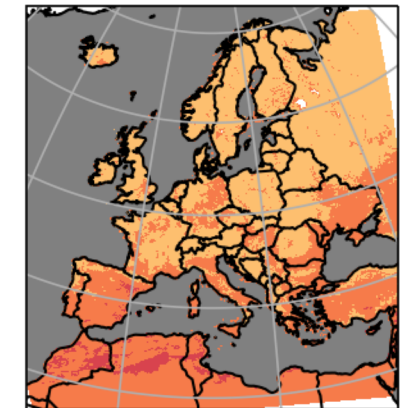
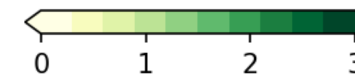
CLM



SWC(m^3/m^3)



ET (mm/day)



WTD (m)

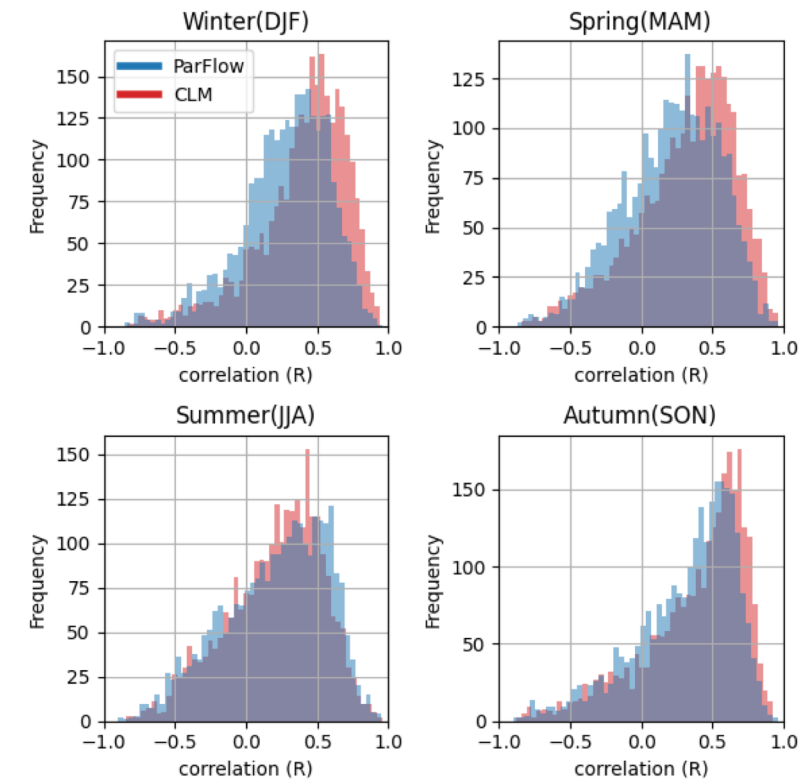
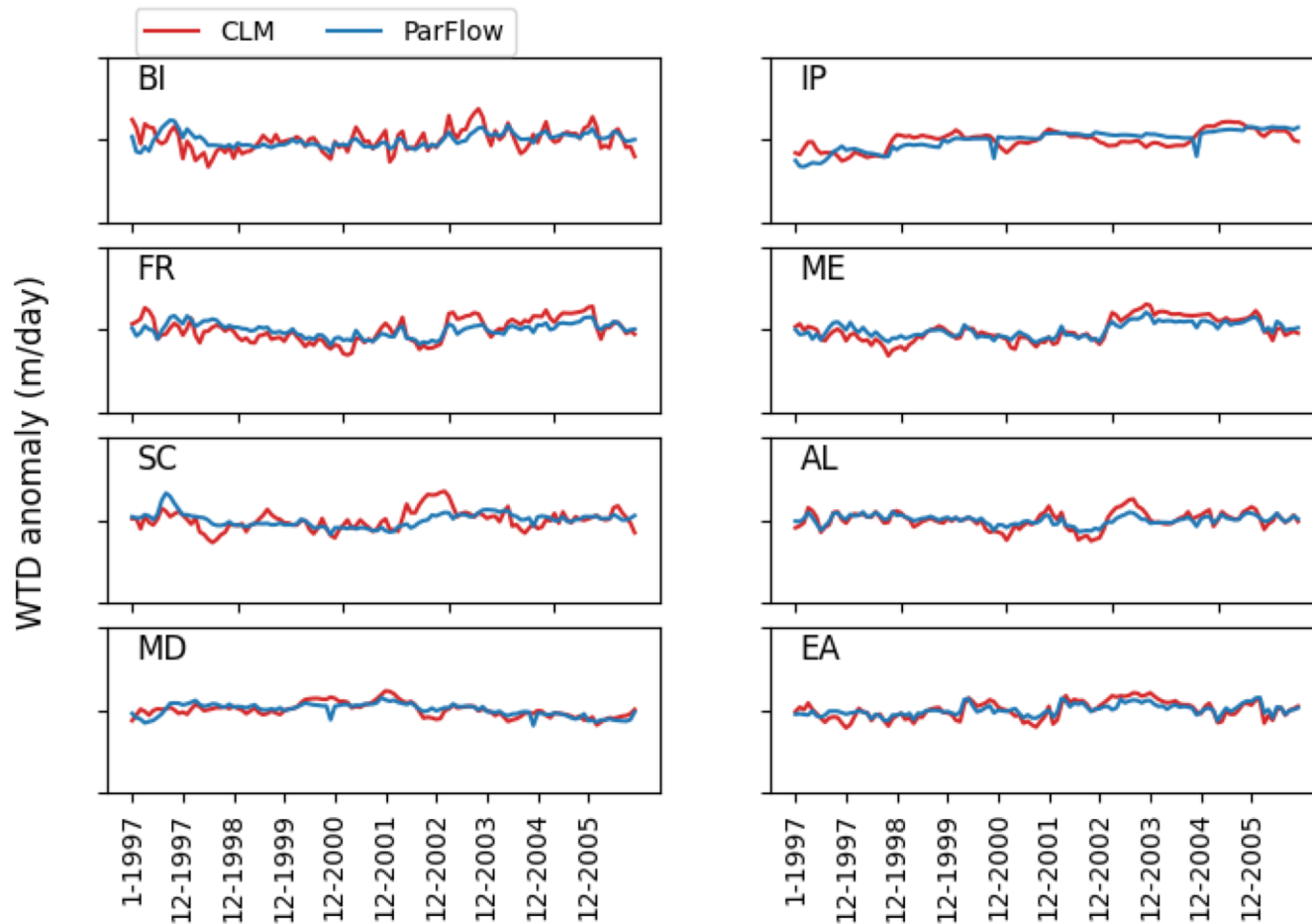
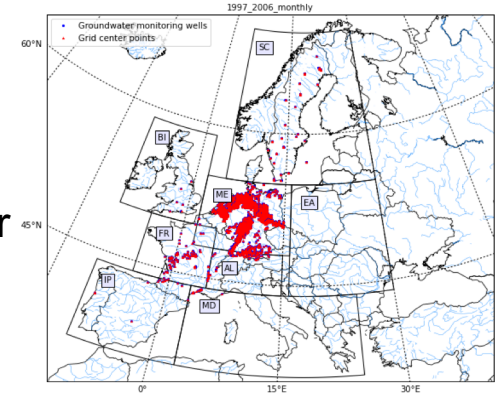


- This study Investigates the influence of groundwater on soil moisture, ET fluxes and water table depth over Europe.
- We used ParFlow model with lateral groundwater flow and CLM3.5 model without groundwater representation.
- Validation with observational data of water table depth, ET and surface soil moisture shows that both models capture the interannual variability in the hydrologic states and fluxes well.
- ParFlow simulate more realistic water table distribution, with shallow groundwater in valleys and deeper under hilltops.

Validation of water table depth

- Comparison of ParFlow and CLM simulated monthly water table depth anomaly (1997 – 2006) over PRUDENCE regions.
- CLM shows more stronger direr and wetter anomalies than ParFlow.

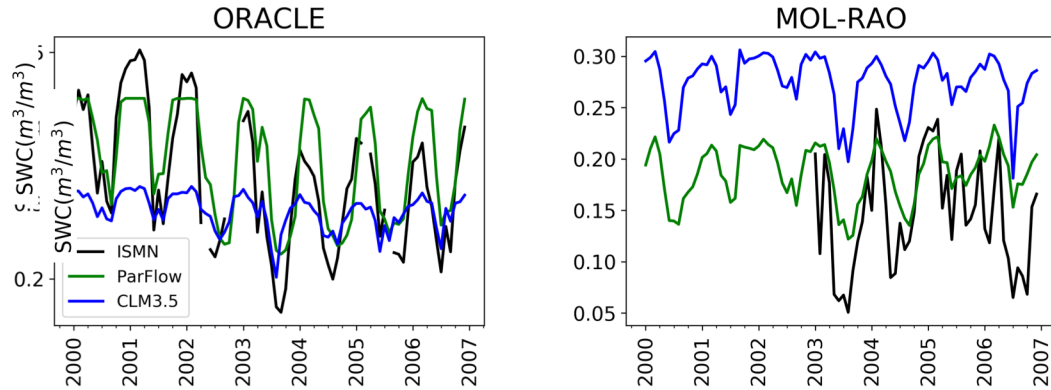
Locations of water table depth wells (2741 locations)



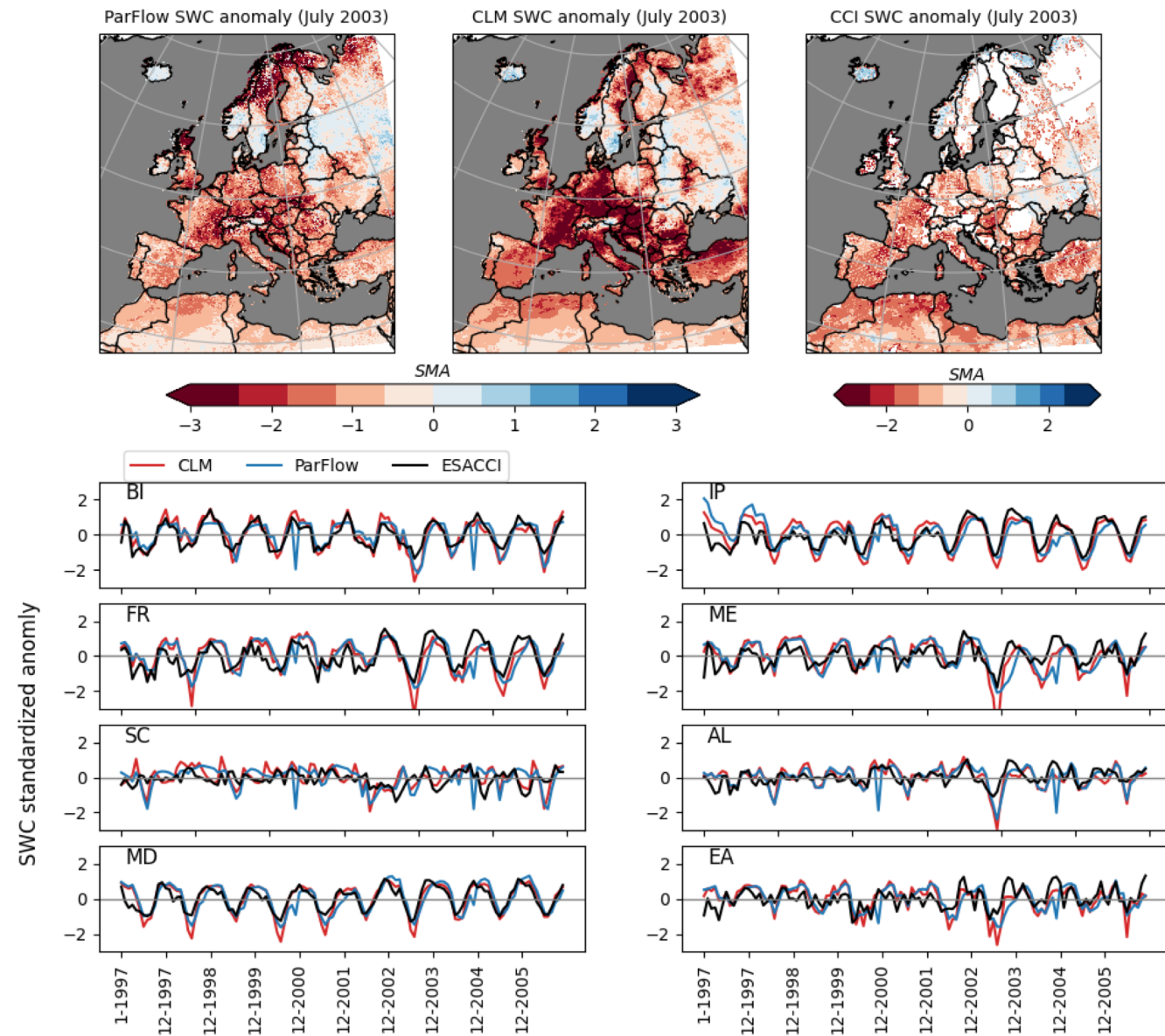
Histogram frequency of the Pearson correlation between models simulated water table depth anomaly and in-situ WTD anomalies for different seasons ((1997 – 2006).

Validation of surface soil moisture

Comparison of SM simulated by ParFlow and CLM with in-situ observations from ISMN soil moisture network for 2000–2006.



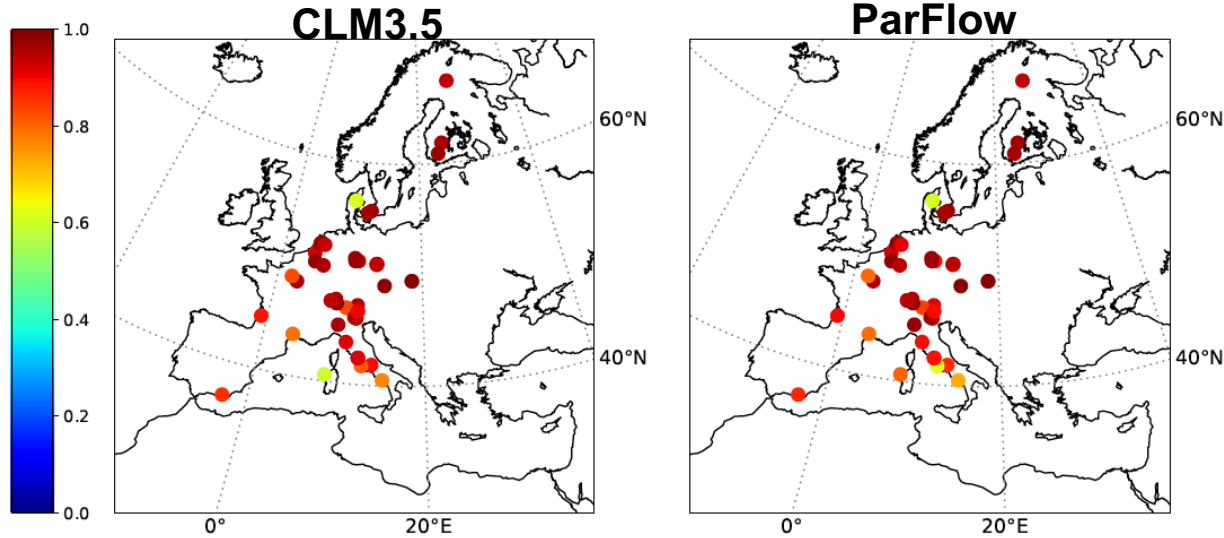
- Comparison with surface moisture from ESACCI shows ParFlow overall overestimates surface soil moisture, however ParFlow shows better performance with few available in-situ SWC observations.
- Regionally, SWC anomalies from both ParFlow and CLM compare well with the ESA CCI anomalies.
- Overall, CLM estimates much stronger dry anomalies than both ParFlow and ESACCI, particularly in drought years.



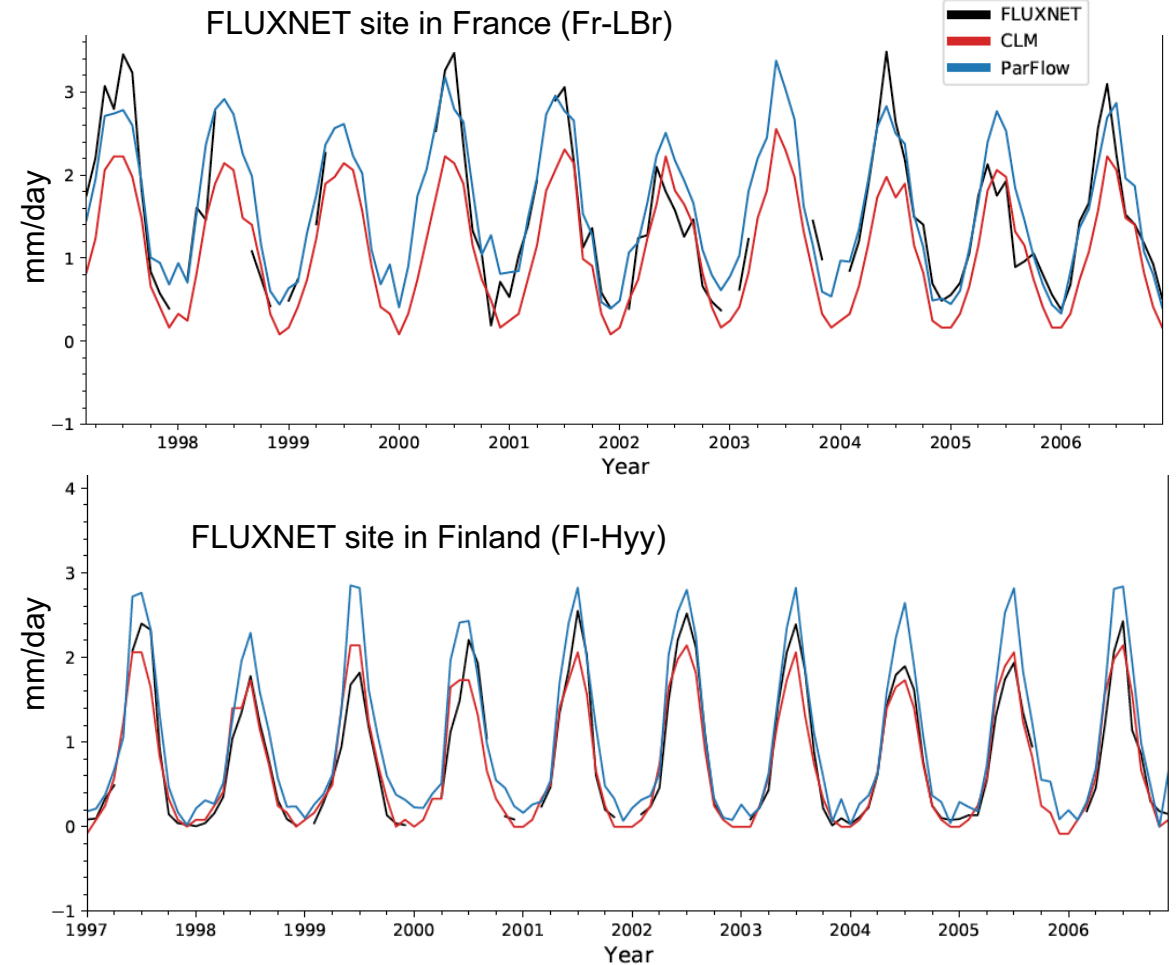
Comparison of SWC anomaly (July 2003) simulated by ParFlow, CLM with ESA CCI and monthly anomalies w.r.t 1997 – 2006 over PRUDENCE regions.

Validation of ET with FLUXNET data

Pearson correlations between ParFlow and CLM simulated monthly ET and 65 FLUXNET sites.



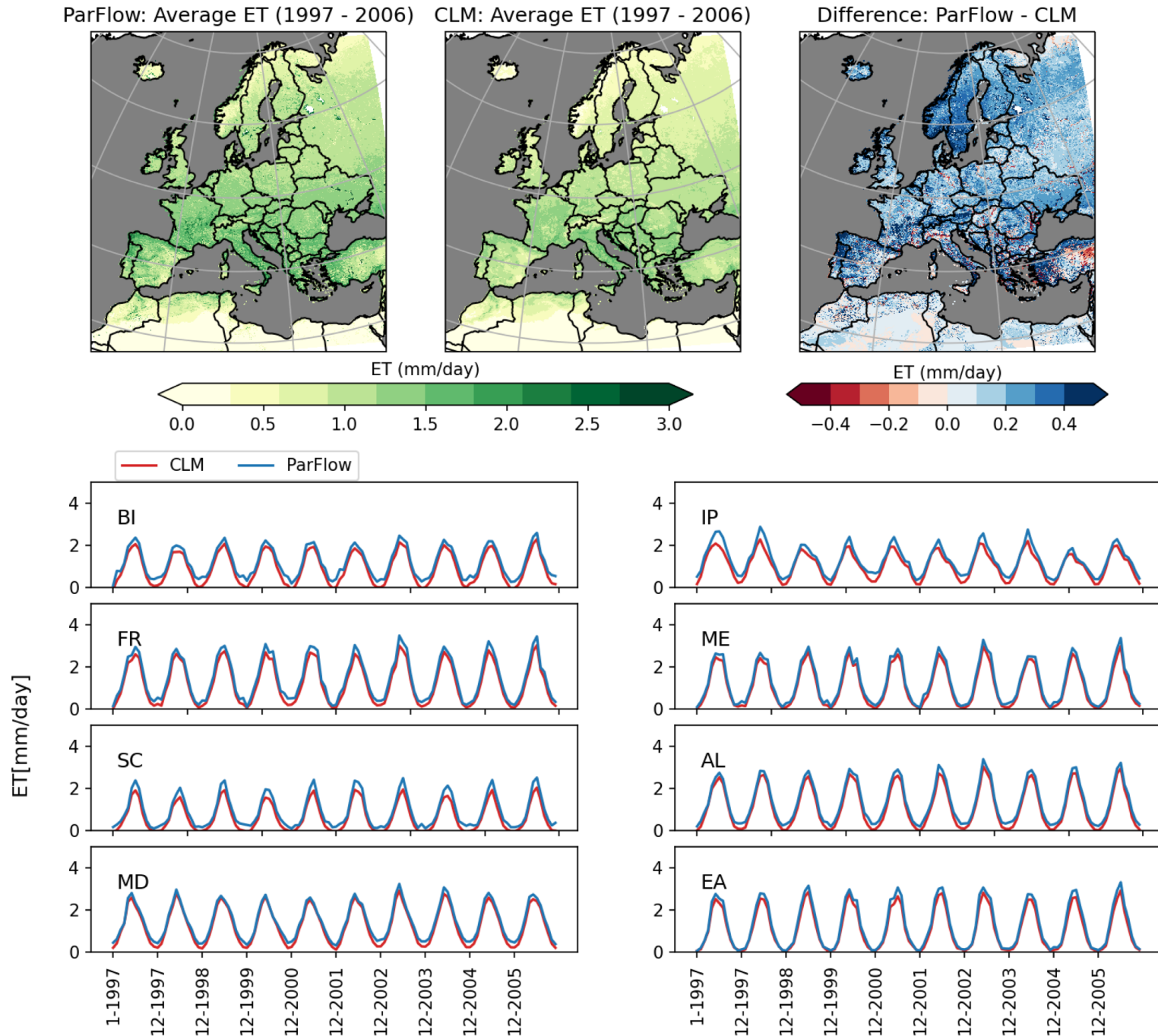
Comparison of ParFlow and CLM simulated ET show good agreement with observational ET data at FLUXNET sites.
In many sites, ParFlow summer ET compares well with observations.



Example of observed and simulated monthly ET at two FLUXNET sites with complete observation period (1997 – 2007).

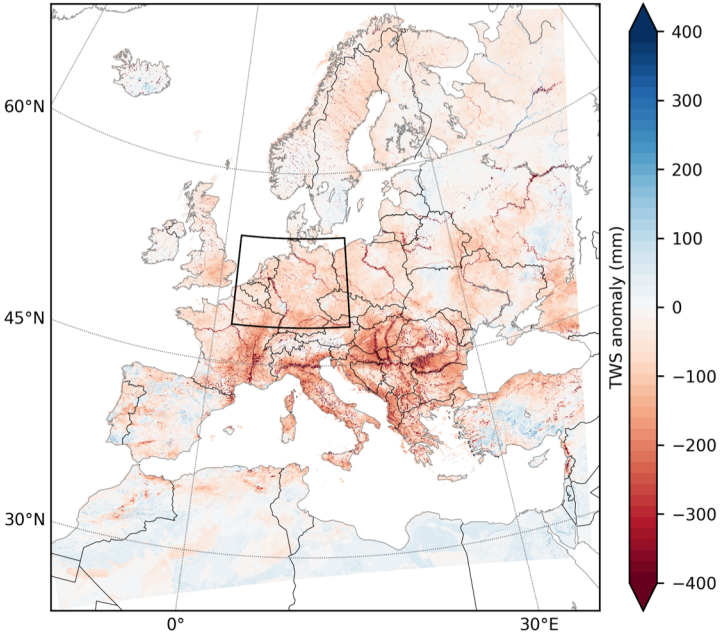
Comparison of ET

- On average, ET in ParFlow is 25% higher than CLM3.5 for time period of (1997 – 2006).
- ET enhancements is larger over northern (SC and BI region) and Southern Europe (IP and FR regions).
- Regional comparison shows that maximum ET increase occurs mostly in summer. Winter ET is slightly higher in ParFlow than CLM model.

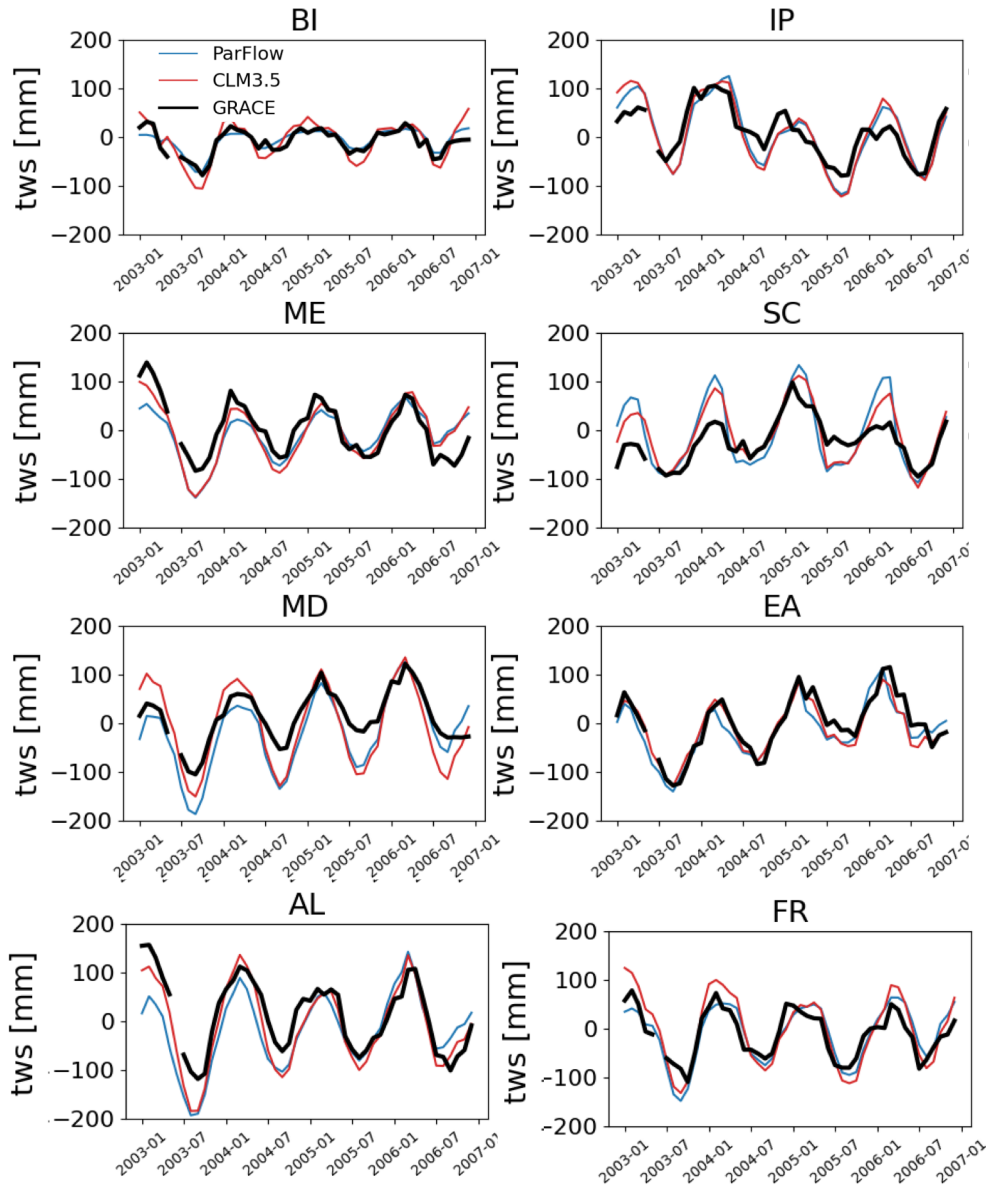
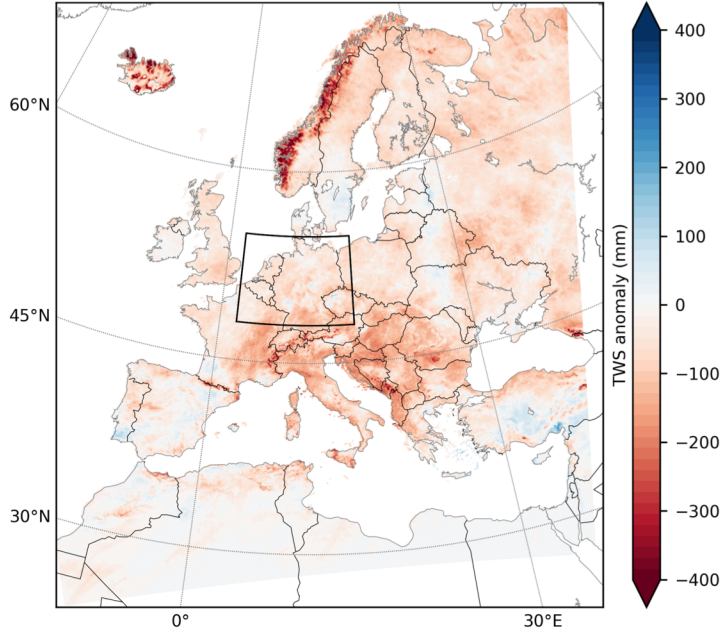


Comparison of Total Water Storage

ParFlow Total Water Storage
anomaly (July 2003)



CLM3.5 Total Water Storage
anomaly (July 2003)



Comparison of the total water storage anomaly (relative to 2003–2006) from ParFlow and CLM models with GRACE satellite dataset over PRUDENCE regions.

SUMMARY

- Our results show that both models capture the interannual variability in the hydrologic states and fluxes well when compared with observational data of water table depth, ET, surface soil moisture and total water storage.
- ParFlow simulates more realistic water table distribution, where local drainage is better resolved with shallow groundwater in valleys and deeper under hilltops.
- Our results show significantly wetter soil and enhanced ET in ParFlow when compared to CLM model over all regions. The spatial patterns of ET increase in ParFlow resemble those of water table depth and surface soil moisture.
- In next step, groundwater–soil moisture interactions will be further explored through comparisons with river flow observations and analyzing the groundwater recharge flux.

Thank You!

References

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Acknowledgements

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