ETH zürich

The impact of land-surface scheme parametrization on numerical weather prediction forecasts and climate simulations

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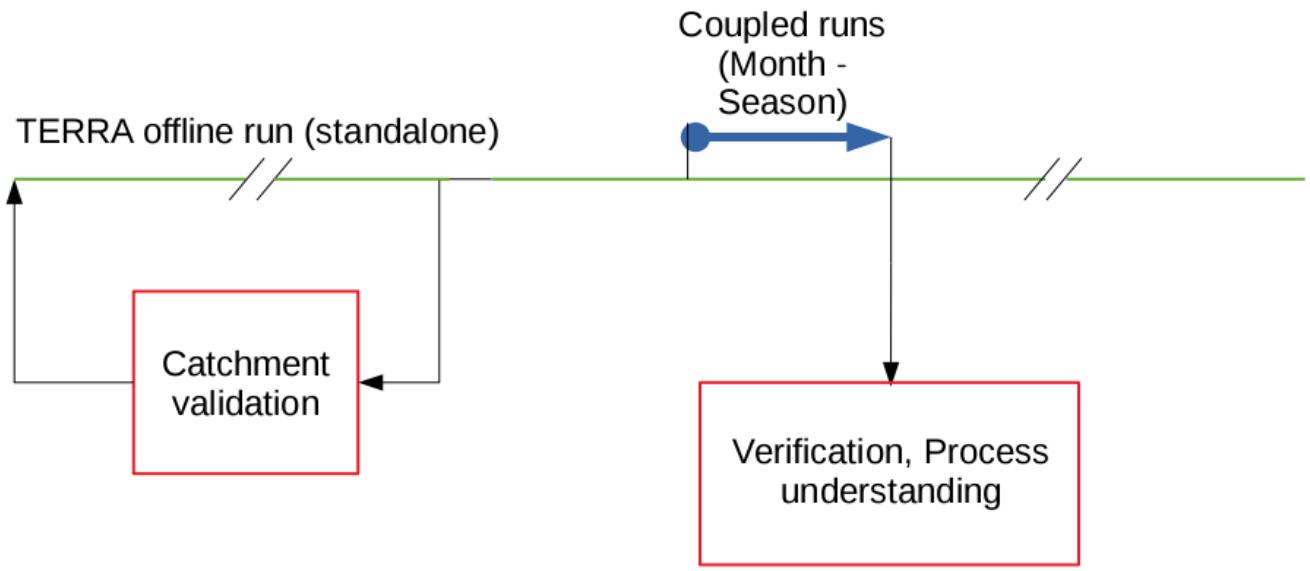
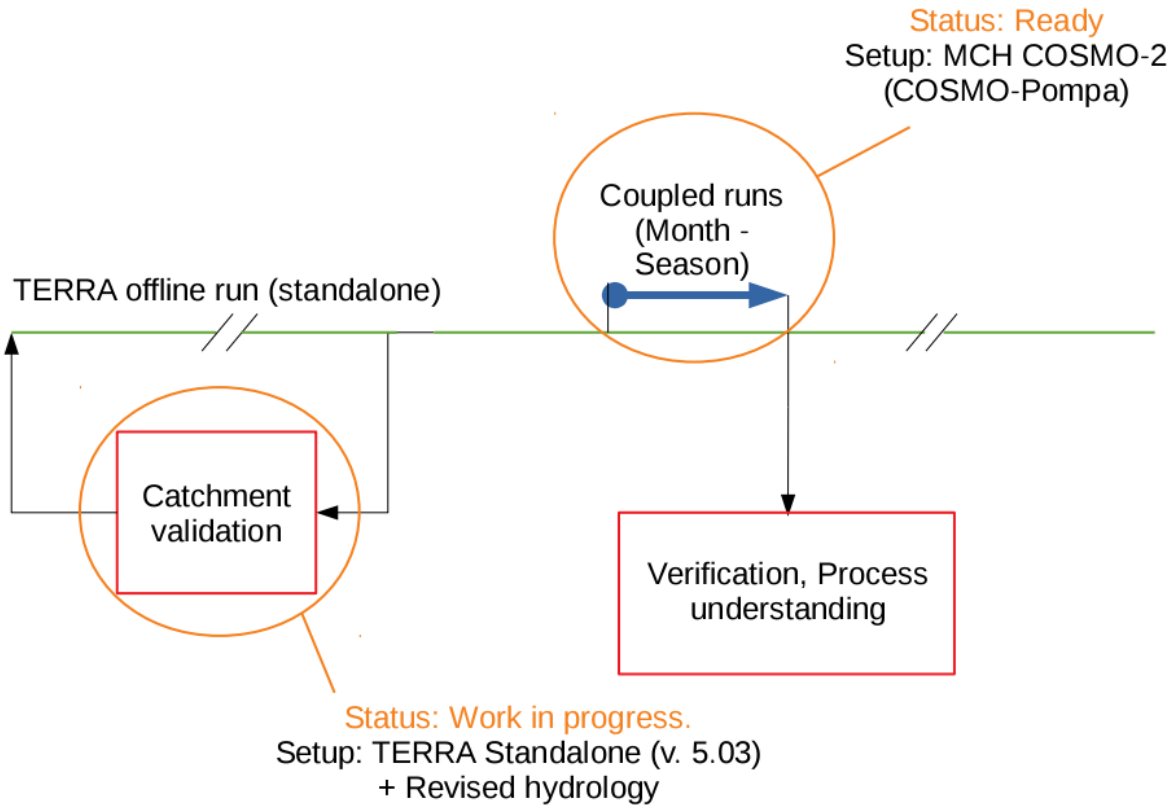
Research questions/ goals

- **Development of a validation framework to assess the quality of individual LSM components and the respective coupling to the atmosphere.**
- **Understanding soil - PBL interactions for different experiments (hydrology, skin resistance, snow model) on NWP timescales for selected cases.**
- **Impact on cloud formation and thermally driven flows**

Framework Overview



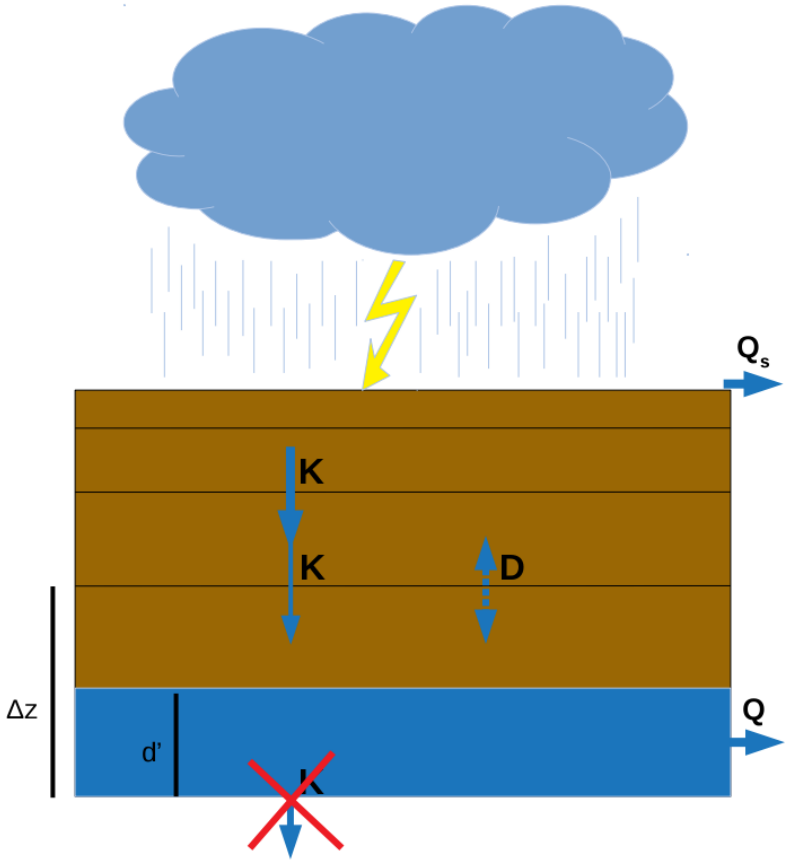
Framework Overview



Status and current activity

- Mainly working on first research goal.
- Focus on revised hydrology (Schlemmer et al. 2018)
- Data availability for direct validation of soil variables (soil moisture, soil temperature, fluxes) is sparse, i.e. for high resolution simulations → Lots of thinking on how we can validate the land surface alone.
- Catchment based runoff validation for new hydrology.
- Station based validation for fluxes.
- Framework is making heavy use of TERRA standalone (thank you to Yiftach, Guy and the original developers @GUF!)

Reminder: CCLM revised hydrology (Schlemmer et al. 2018)



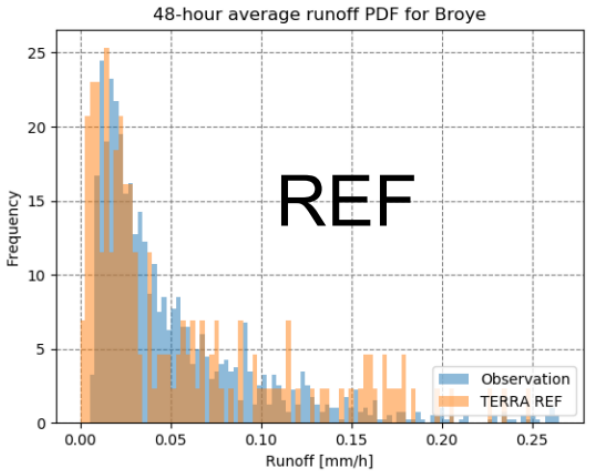
- Zero flux lower boundary condition
- Exponential decrease of saturated hydraulic conductivity with depth
- Diagnostic water table
- Runoff depends on slope and water table with tuning parameter (length scale) l_g:

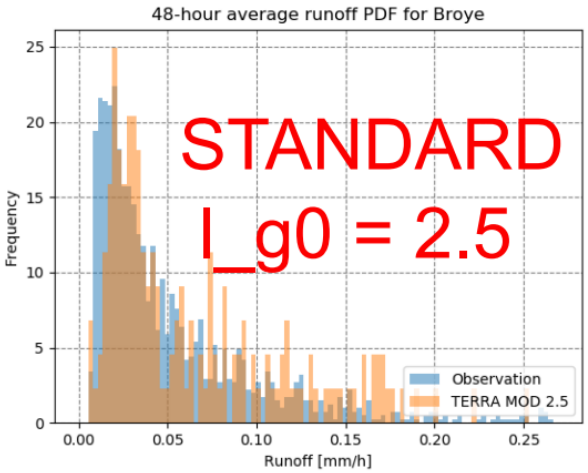
Q ~ K(z)*l_g*s_oro

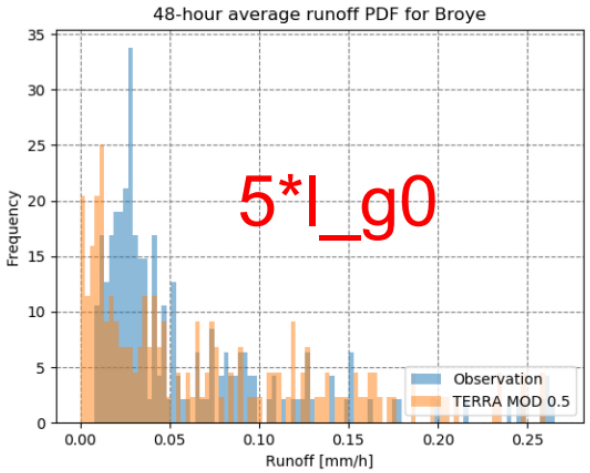
Catchment based runoff validation for km-scale simulations

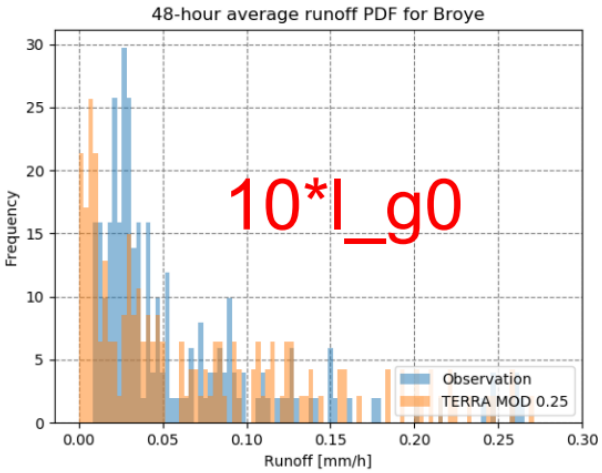
- Data for direct validation of soil moisture and fluxes is sparse and highly scale dependent.
- Runoff estimate is critical to get terrestrial water storage right.
- Scaling parameter l_g (scaling runoff to sub-gridscale slope) is so far unconstrained on the kilometer-scale.
- Cheap: For parameter calibration, we need to run stand-alone only over selected catchments.

First results: REF and STANDARD outperform other







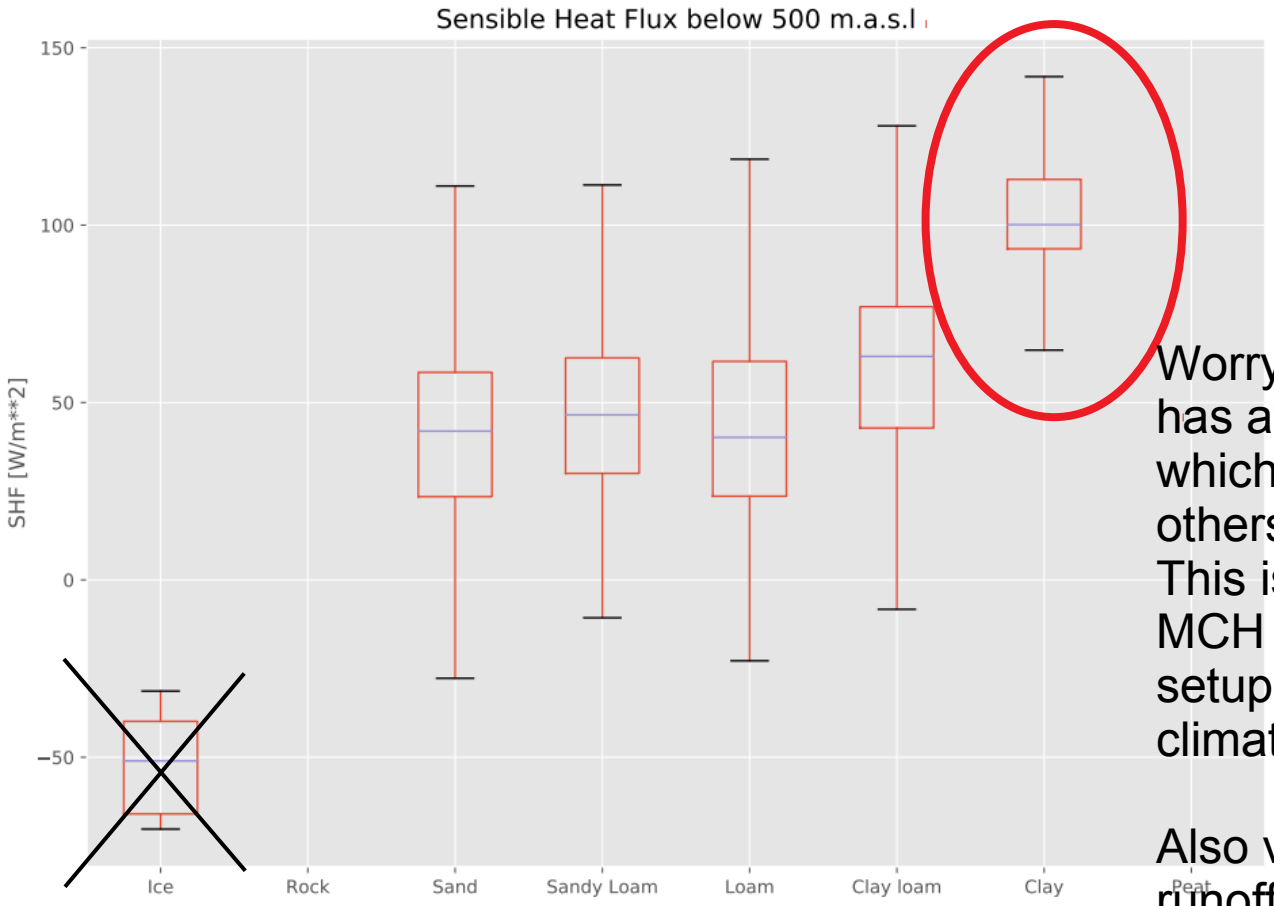


REF: Reference simulation with old hydrology

STANDARD: New hydrology with standard value for I_g

Conclusion: Calibrate closely around standard value.

Bonus side remark: Soil types... ;-)



Don`t worry (ice, wrongly captured by mask)

Worry here! Clay has average SHF which exceeds others by >20W/m^2 This is visible in the MCH operational setup and in our climate runs!

Also visible in runoff, soil moisture, LHF, T_s, ...

Conclusions, outlook and open questions

- Catchment based runoff validation is a reasonable tool to validate LSM hydrology.
- Further calibration of tuning parameter l_g to get best estimate for usage in coupled runs.
- Coupled runs for weakly forced periods are planned and set up (also including skin resistance formulation from Jan-Peter Schulz if external parameter field is available).
- Found a very high sensitivity of fluxes on soil types (i.e. for clay)! Seems unrealistic. Are you aware of this issue? Argument for tile approach?
- Is the revised infiltration documented somewhere?
- What further changes to TERRA are to be expected from the DWD side? On what time scales?