Hydrological Models and Climate Models
- a plea for close collaboration-

S. Attinger, O. Rakovec, S. Thober, R. Kumar, P. Shrestha, H. Najafi, L. Samaniego et al.
Droughts and Floods

Two of the most devastating consequences of climate change

- 3 billion people affected in the last two decades
- Human suffering
- Huge economic losses
Hydrological model mHM

- grid-based seamless hydrological model
- state variables and fluxes like: soil moisture, streamflow, ET, groundwater recharge
- unique feature: Multiscale Parametrization Scheme (MPR)

Soil moisture drought hindcast skill

- GCMs (NMME) models exhibit higher skill in drought hindcasting compared with statistical (ESP) models

Precipitation forecast of NMME was poor.

Skill of drought forecast originates from the capability of the models to forecast temperature.
Prediction Modeling Chain (European Project EDgE)
SM drought Index (EDgE-project)

GCMs performed much better than statistical models

Hydrological models 5km, GCMs 0.25 deg

No bias correction


Soil moisture sub-seasonal forecast DE

Realistic compared with GCM

https://www.ufz.de/moses/index.php?en=47304

https://www.ufz.de/index.php?en=37937
Flood Forecast Modeling Chain ULYSSES

ECMWF SEAS5 Ensemble

Hydrological Models

$N=25$, $\text{Lead} = 6 \text{ m}$
New ULYSSES flood forecast

- Bias correction, downscale full ensemble IFS (0.2deg). Initial conditions ERA5-land
- The IFS-mHM forecast is skillfull. Lead time 1 month!
- Other LSM/HM are not skillfull.
Flash flood forecast DE (1 km)

Bias correction of the IFS PRECIP is NEEDED to catch the observed Q records

Needed: realtime meteo data (DWD) HYRAS 1 h to generate initial conditions
The ECMWF IFS model got the event, but...

Magnitude of the precip is underestimated!

Timing is fundamental for flash forecast

Resolution should be 1-2 km at most. Convection permitting mech. needed.

Samaniego et al. 2021, AGU.

NWP Resolution .2 deg
Disagg. 1 km
Summary

- Existing prediction modelling chains of GCMs combined with HMs show high skills in predicting soil moisture droughts (temperature + initial hydrological conditions)

- Skillful flood forecasting systems are the next step: need hourly precipitation, convection resolving GCMs and a fast online coupling with GCMs --> Destination Earth Project (DestinE)