Soil Parameter Model Intercomparison Project (SP-MIP)

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Background and purpose

- Large spread among LSMs with respect to water-balance variables (evapotranspiration, soil moisture, runoff, …)
- To which degree is this spread related to soil model parameters?

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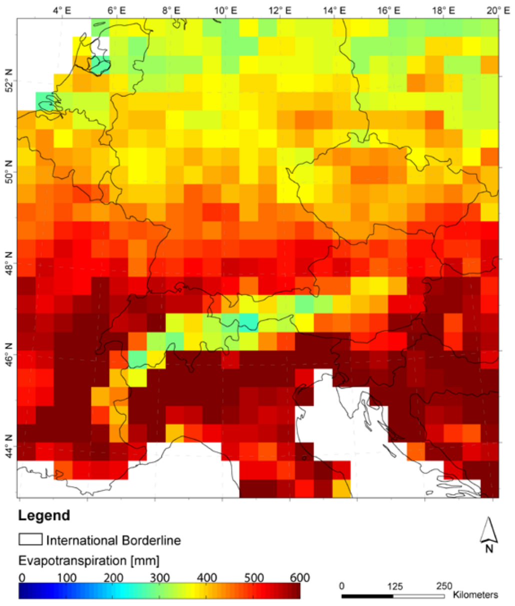

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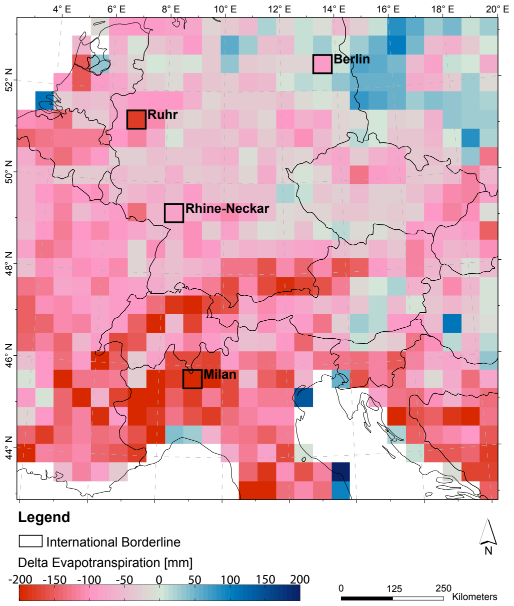
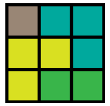


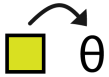
Zabel et al. (HESS, 2012)

Soil parameters in LSMs

- Two main sources for model spread in terms of soil parameters



Step 1. Spatial information is obtained on soil class/texture (e.g. map of soil classes)



Step 2. Deriving model parameters for each class (using e.g. lookup tables)

- *SP-MIP aims at quantifying the differences between LSM model results that stem from either of these two preparation steps for soil parameters.*

Proposed experiments

- Closely follow the LS3MIP protocol (van den Hurk et al. 2016)
- 0.5° GSWP3 forcing, 1979-2014 (Kim et al. 2017, in prep.)
- 4 experiments, leading to 7 model runs

Proposed experiments

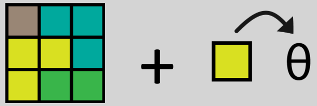
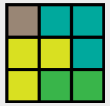
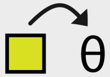
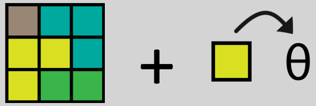
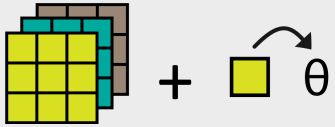
- Experiment 1: Soil-hydraulic parameters provided by SP-MIP
    - Baseline for model spread coming from everything else than soil parameters.
- Experiment 2: Soil-hydraulic parameters derived from common soil textural properties
    - Model variability related to the step of transferring soil textural information to soil hydraulic properties.

Proposed experiments

- <u>Experiment 3</u>: Reference run with all models in their status quo
  - Model variability related to the use of different soil maps.

- <u>Experiment 4</u>: Spatially uniform soil parameters (loamy sand, loam, clay, silt)
  - Importance of spatial variability for model spread.
  - Sensitivity of each model to soil hydraulic parameters.
  - Importance of spatial variability for water (and energy balance) outputs.

Summary

	Scenario	SP-MIP	Participating models
Experiment 1 (1 run)	Common soil parameter maps		
Experiment 2 (1 run)	Common soil texture maps		
Experiment 3 (1 run)	Default soil parameter maps		
Experiment 4 (4 runs)	Spatially uniform soil parameters (loamy sand, loam, clay, silt)		

Soil texture maps provided by SP-MIP

- USDA dominant soil class at 0.5° resolution (from SoilGrids.org)

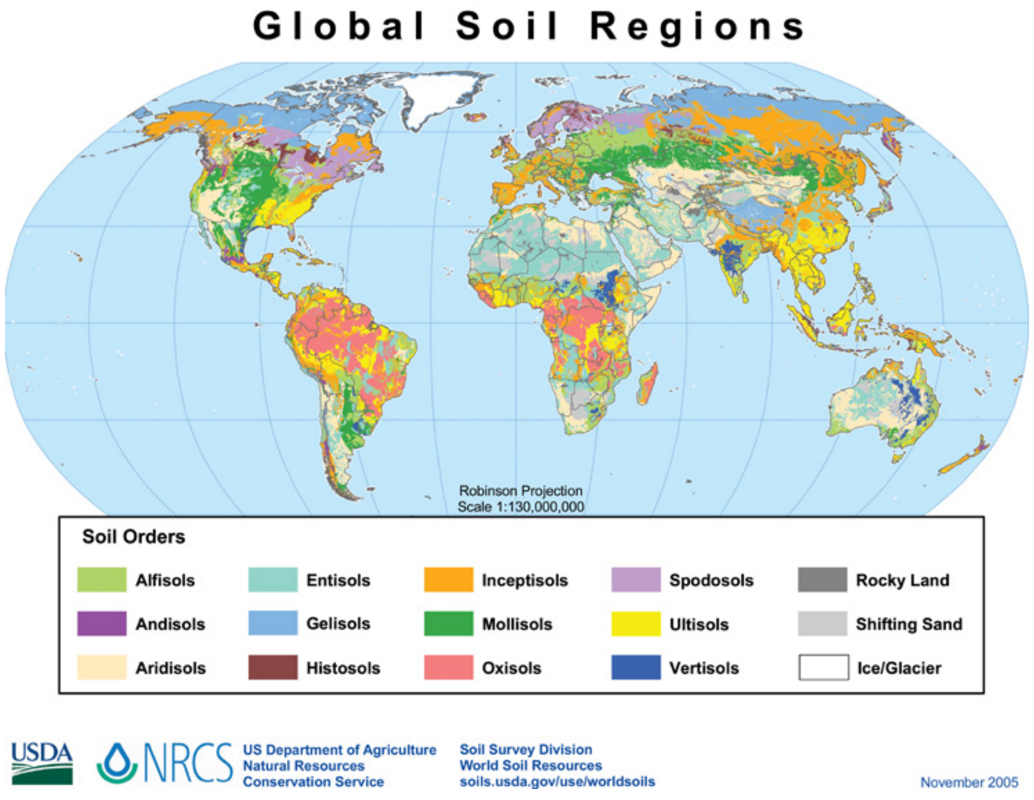


Table 4: Soil textural properties provided by SP-MIP for experiment 2.

Name	standard_name (cf)	long_name (netCDF)	Unit
fclay	fraction_clay	fraction of clay	–
fsilt	fraction_silt	fraction of silt	–
fsand	fraction_sand	fraction of sand	–
rhosoil	bulk_density	dry bulk density	kg m^{-3}
omsoil	organic_matter	organic matter content	g(C) kg^{-1}

θ Soil parameters provided by SP-MIP

- Two mathematical descriptions considered
  - Brooks-Corey (1964)
  - Mualem-van Genuchten (1980)

Table 3: Soil parameters for the considered water retention curves provided as input by SP-MIP for experiments 1 and 4.

Name	standard_name (cf)	long_name (netCDF)	Unit
he	air_entry_potential	air entry potential	m
mbc	brooks_corey_m	Brooks-Corey m parameter = Clapp-Hornberger b	–
thetar	residual_soil_moisture	residual soil moisture	$m^3\ m^{-3}$
thetas	saturated_soil_moisture	saturated soil moisture, porosity	$m^3\ m^{-3}$
ks	saturated_hydraulic_conductivity	Hydraulic conductivity at saturation or at air entry	$m\ s^{-1}$
lambdac	corey_lambda	Corey lambda parameter	–
alphavg	van_genuchten_alpha	van Genuchten alpha parameter	m^{-1}
nvg	van_genuchten_n	van Genuchten n parameter	–
mvg	van_genuchten_m	van Genuchten m parameter	–
thetafcbc	brooks_corey_field_capacity	Brooks-Corey field capacity	$m^3\ m^{-3}$
thetafcvg	van_genuchten_field_capacity	van Genuchten field capacity	$m^3\ m^{-3}$
thetapwpbc	brooks_corey_wilting_point	Brooks-Corey permanent wilting point	$m^3\ m^{-3}$
thetapwpvg	van_genuchten_wilting_point	van Genuchten permanent wilting point	$m^3\ m^{-3}$

Some issues and proposed solutions (1)

- Simulation grid
  - same as GSWP3 forcing
- Length of simulation
  - 1979-2014 (instead of 1901-2010)
- Outputs
  - Although space-consuming, daily output is needed
  - Reduced set of variables compared to LS3MIP, with variable names conforming to CMIP6
- Soil hydraulic parameters varying with depth
  - Only in the default run
  - Parameters kept constant with depth for other experiments

Some issues and proposed solutions (2)

- Organic matter
    - Model parameters given in Exp.1 and 4 will include OM
    - OM content information will be provided for Exp.2
- Fixed or prognostic LAI
    - Prognostic LAI will be required across all of the experiments
- Carbon
    - Only LAI will be included in the output
    - Analysis focused on energy and water cycle variables
- Calendar
    - Simulation time window: moved from May to late summer 2017