ETH zürich

Activities at ETH Zurich: Developing and testing a new runoff formulation for TERRA.

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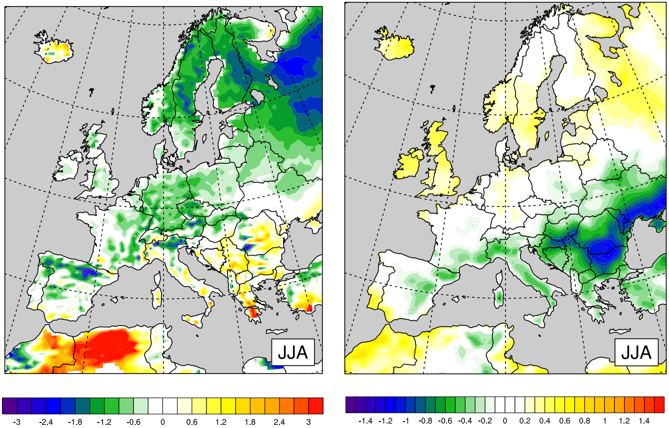
IAC C2SM Center for Climate Systems Modeling MeteoSwiss

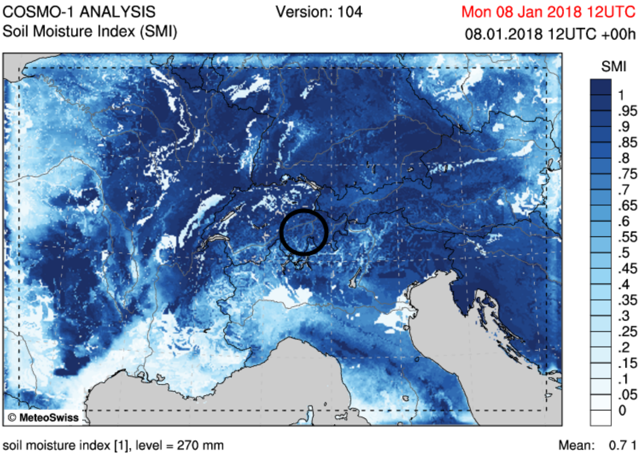
Motivation

- Bellprat et al., 2016 : 2m temperature bias is very sensitive to saturated hydraulic conductivity (soil parameter).
- Calibration suggests values far from literature values.
- Summer warm bias in south-eastern Europe is a well known phenomenon for years.
- Many LSMs have a free drainage boundary condition.

T2m bias and Difference to ref. (K)



Why hydrology? The role of orography.



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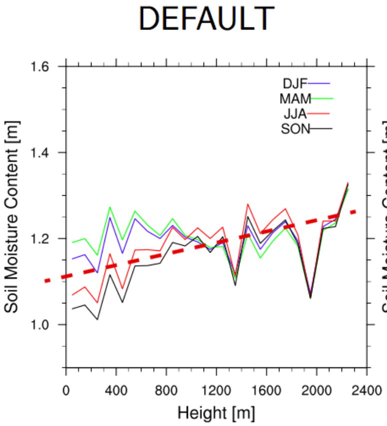
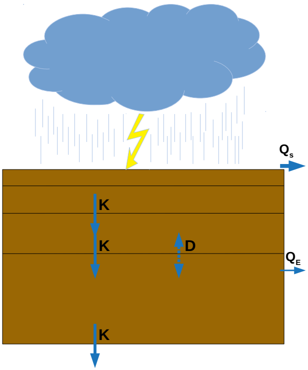


(Schlemmer et al., in preparation)

Standard implementation



Richards equation:

$$\frac{\partial\theta}{\partial t} = \frac{1}{\rho_w}\frac{\partial F}{\partial z}$$

F given by:

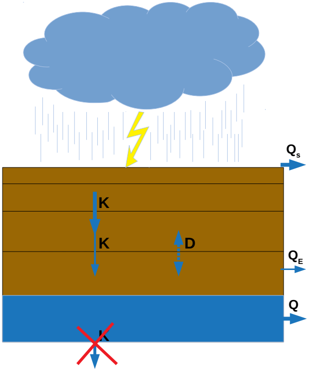
$$F = -\rho_w\left[-D(\theta)\frac{\partial\theta}{\partial z} + K(\theta)\right]$$

Solve Richard's equation implicitly

Free (gravitational) drainage.

No dependency on orography.

Schlemmer and Schär implementation



Diagnostic water table.

Subsurface runoff is given by:

$$Q = K_0(z) \times \gamma \times S_{oro} \times h_{wt}$$

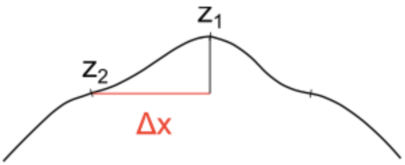
Allows for equilibration, if a saturated layer is found.

Saturated conductivity K_0 is depth dependent (Decharme, 2005)

Outlook

- Porting new runoff implementation to latest model version. (5.05, SAINT branch, ???)
- Possibly further developments targeting water partitioning at the surface (surface runoff vs. infiltration)
- Testing new runoff scheme with MeteoSwiss operational setup. Resolution t.b.d.
- Tests with newly implemented surface resistance formulation by J. P. Schulz, if possible.
- Further tests are possible, we are thinking snow, urban parameterization, roughness elements. It really depends on what is readily available.
- Not forget about possibilities in data assimilation.

Orography mask



(Schlemmer et al., in preparation)

Sub-grid orography derived by: $S_{oro} = \frac{max(z_1 - z_2, 0)}{\Delta x}$

Evapotranspiration bias

Evapotranspiration bias [mm/d] (left) and water table depth [m] (right).