Biodiversität und Klima Forschungszentrum

LOEWE – Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz

Layered soils in TERRA-ML

Frank Kalinka & Bodo Ahrens

IAU, Uni Frankfurt

SOILVEG WG meeting,
1st of March, 2010, Langen/Germany

COSMO-CLM

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Overview

- Motivation
- What have been done?
- First results
- Problems, tasks, solutions
- Outlook

Frank.Kalinka@iau.uni-frankfurt.de | 01.03.2010

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Motivation or:
why do we need a good "**S**oil – **V**egetation – **A**tmosphere – **T**ransfer" model (SVAT) like TERRA-ML?

- lower boundary conditions for atmospheric models (essential for RCM/ GCM/NWP)

- Providing simulations/predictions of surface runoff
  - do floods and/or droughts occur more often?

- Importance to agriculture

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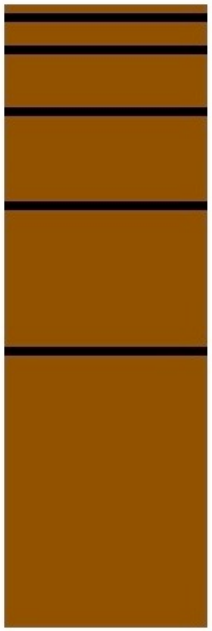
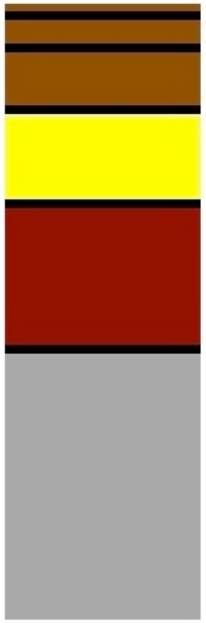
Motivation

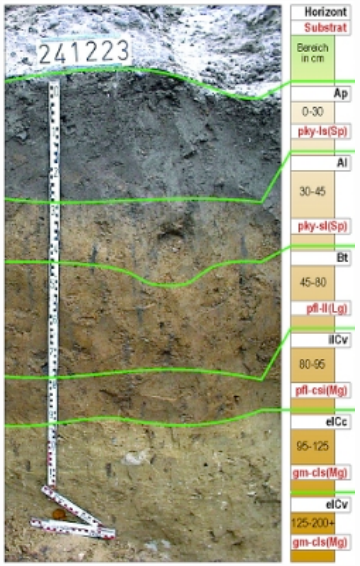
old



new



reality



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What have been done?

- implemented: 2-D-soiltypes e.g. FAO
- New: possibility to add a 3-D-soiltype in TERRA “stand-alone”, e.g.:
  - “Bodenübersichtskarte” (BüK-1000) for Germany (Federal Institute for Geosciences and Natural Resources, Germany (BGR))
  - Dataset Harmonized World Soil Database (HWSD, version 1.1) (FAO/IIASA/ ISRIC/ISSCAS/JRC, March 2009, 30 arc-second raster)
- First results under assumption of different soil types (sensitivity studies) in different depths for the Main-Basin (next slide)

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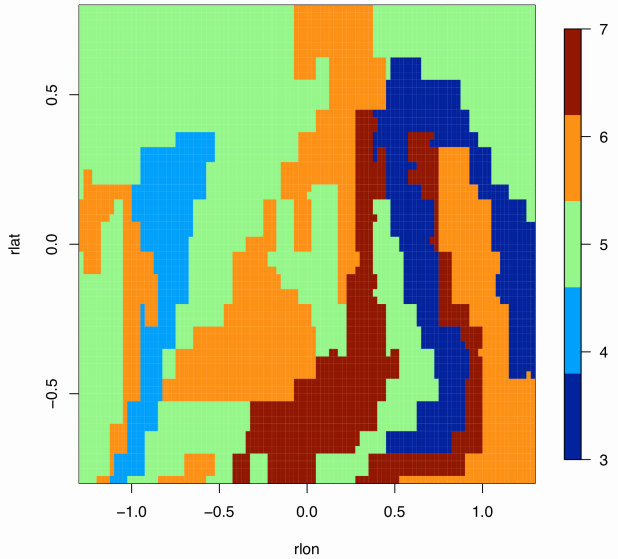
Targed Area

Soiltyp mask (FAO)



Gridspacing: 0.025°x0.025°

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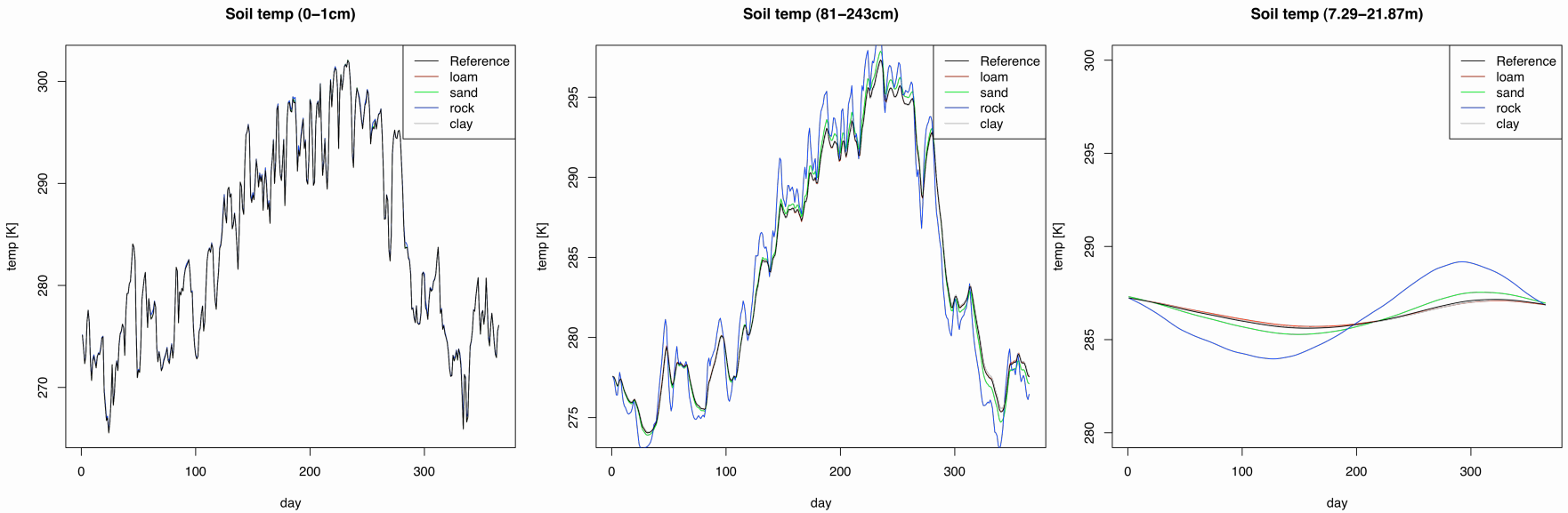
Assumption of rock/loam/clay/sand in layers below 0.81m: Soil -Temperatures



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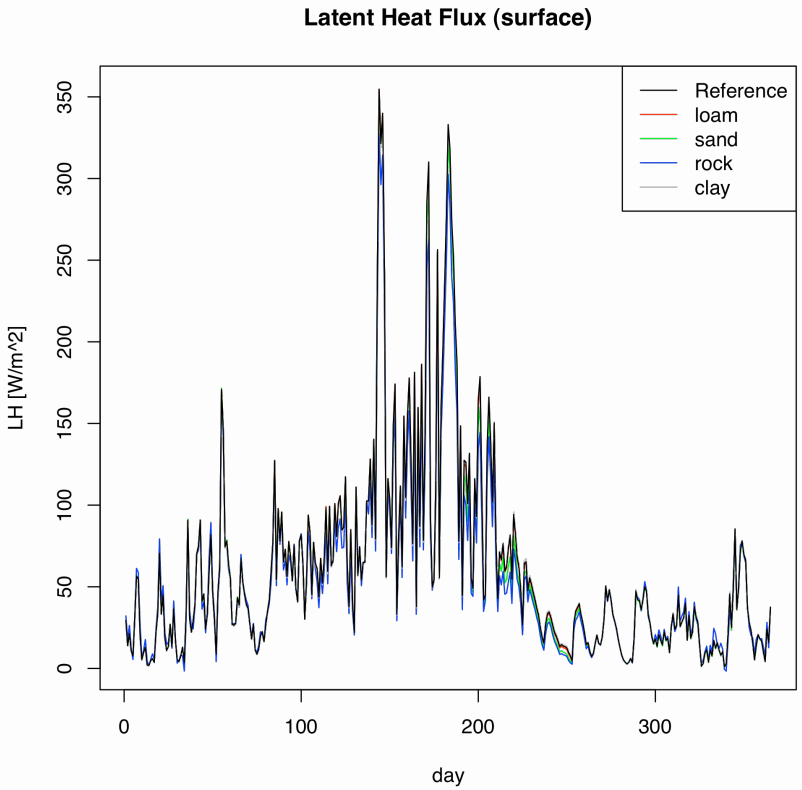
Assumption of rock/loam/clay/sand in layers below 0.81m: latent heat flux



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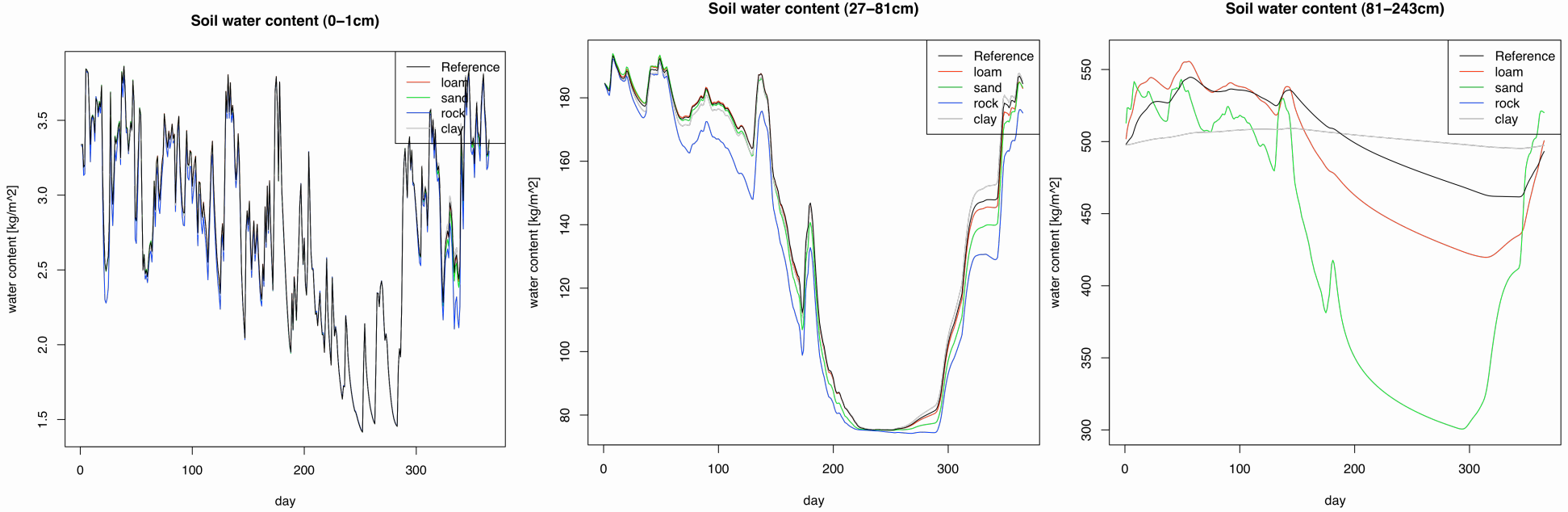
Assumption of rock/loam/clay/sand in layers below 0.81m: soil -moisture



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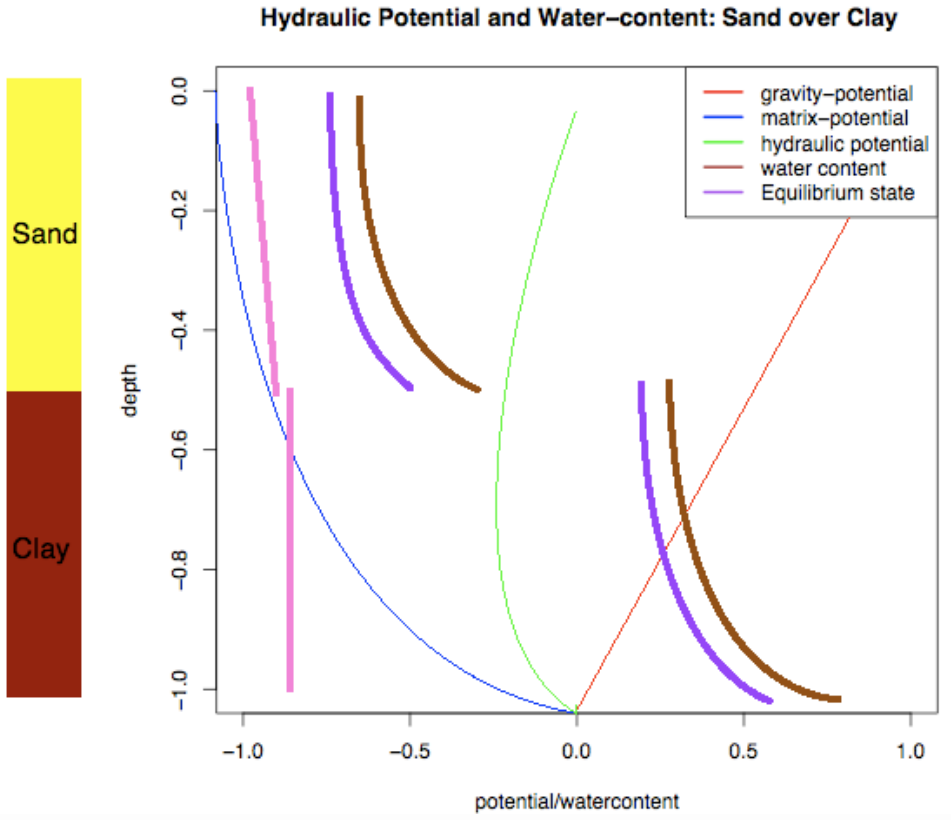
Problems

Richards equation:

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z} F = \frac{\partial}{\partial z}(K_\theta \frac{\partial(\Psi_m + \Psi_z)}{\partial z})$$

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z}\left[D_\theta \frac{\partial \theta}{\partial z} - K_\theta\right]$$



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Problems

Zeng & Decker (2009):

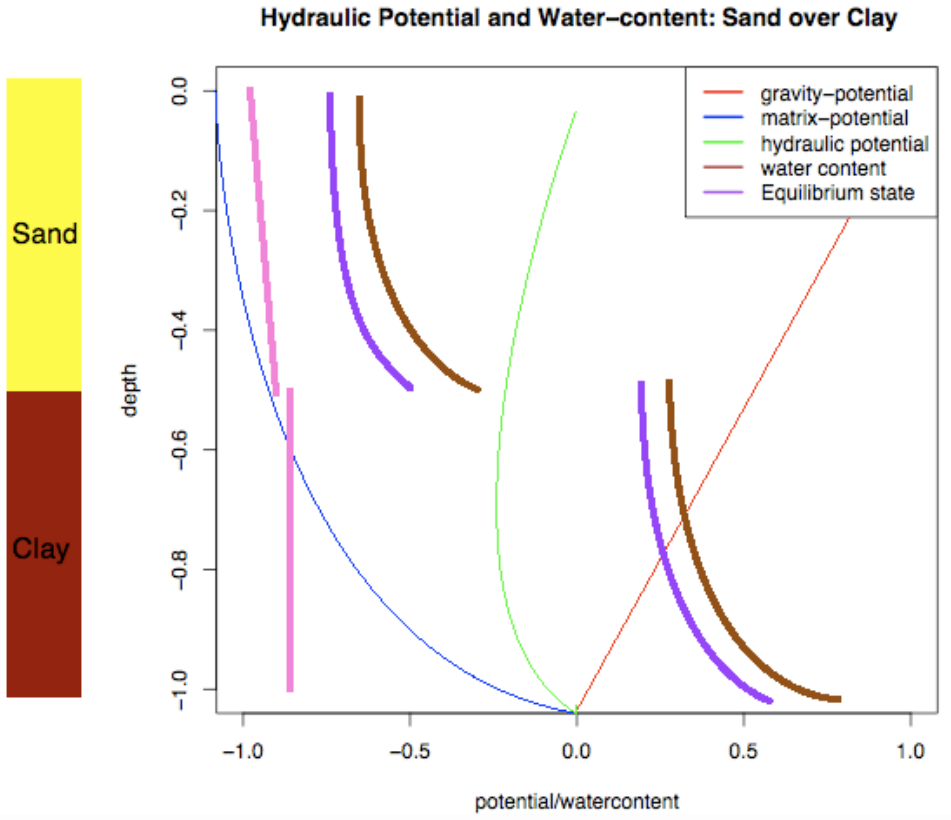
(Problems with water table depth within the model domain)

$$\frac{\partial\theta}{\partial t} = \frac{\partial}{\partial z}(K_\theta \frac{\partial(\Psi_m + \Psi_z - C)}{\partial z})$$

$$\frac{\partial\theta}{\partial t} = \frac{\partial}{\partial z}(D_\theta \frac{\partial\theta}{\partial z} - K_\theta - K_\theta \frac{\partial C}{\partial z})$$

$$with\ C = equilibrium\ state$$

$$= \Psi_E + \Psi_z = ???$$



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Outlook / open issues

- Including the modified form of the Richards equation into the code → equilibrium test cases
- Implementation of BüK-1000
- Implementation and usage of “coupler” MESSy to TERRA-standalone (cooperation with Astrid Kerkweg, University of Mainz)
- Implementing the upcoming stand-alone version of the dynamic vegetation model of JSBACH (MPI-M Hamburg) to MESSy-TERRA