

Integrating soil and subsurface processes in OLAM-SOIL: *A global soil and Earth systems modeling platform*

Robert Walko and Roni Avissar - *University of Miami*

Simone Fatichi and Dani Or - *Swiss Federal Institute of Technology, ETH Zurich*

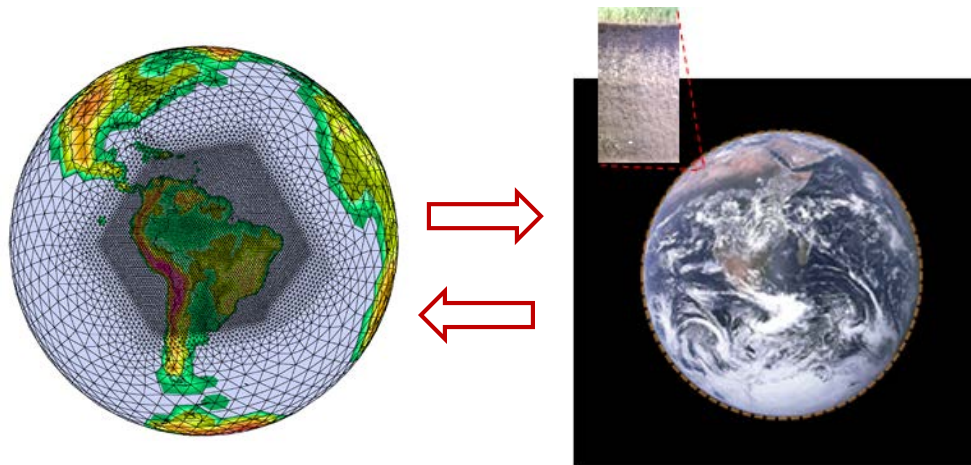
Teamrat Ghezzehei - *University of California, Merced*

Tom Hengl - *ISRIC World Soil Information, Wageningen*

Harry Vereecken and Stefan Kollet - *Agrosphere, Forschungszentrum Jülich (Uni. Bonn)*

Michael Young - *Bureau of Economic Geology, U. Texas at Austin*

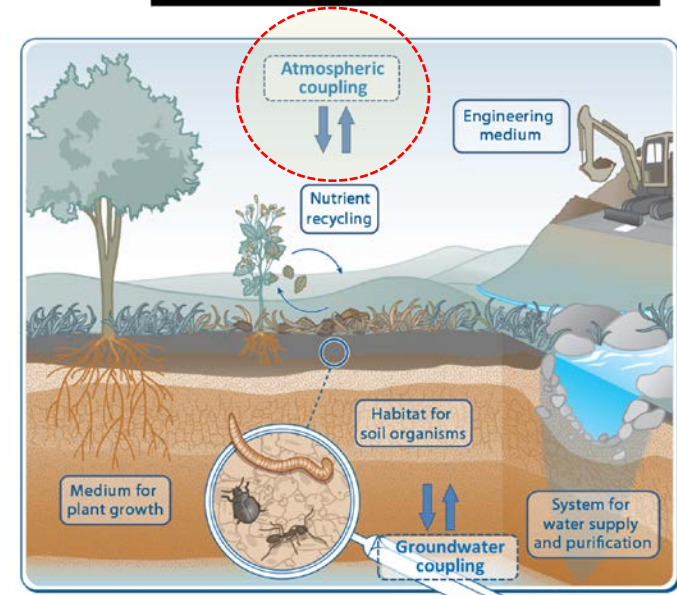
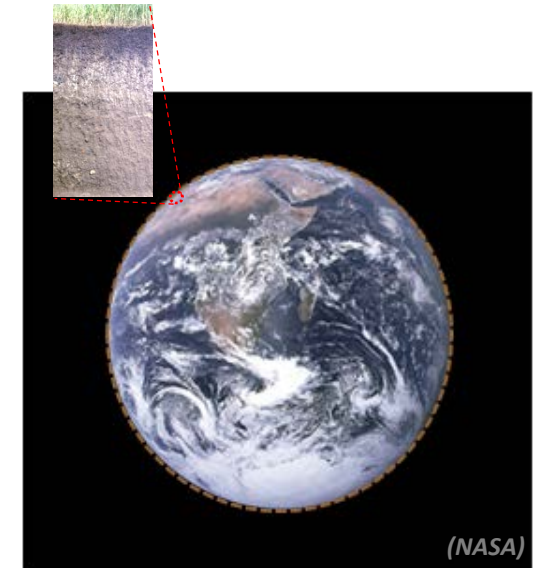
Roland Baatz - *ISMC and Agrosphere, Forschungszentrum Jülich*



**OLAM-SOIL Workshop EGU
Vienna, April 2018**

Soil – Earth's life support system → going global

- Soil is arguably the most biologically active compartment of the biosphere hosting largest pool of biodiversity
- Soil is a giant recycling system providing human needs for food and supports global biomass stocks
- Soil functions as Earth's life support body, a thin film of life covering terrestrial surfaces
- Nearly all contemporary societal challenges (from climate change to food security) involve a significant “**soil**” component
- In the past few years the soil and critical zone community is reaching out to other disciplines and scientific platforms (e.g., **GEWEX-SoilWat**) to improve integration and provide better context for broader consideration of key soil processes
- The newly established **International Soil Modeling Consortium (ISMC)** provides an opportunity for considering soil systems modeling in a global context → OLAM-SOIL an ideal platform for going global



Why we need to study soil processes in a global context?

1. **Soil is important** – all key societal challenges (climate change, food security, water resources, environmental protection) contain an important soil component, but require a large scale view
2. **Society does not care about pore or column scale processes** – Earth system models (ESM) and decision makers need to know how processes work at large scales
3. **No global soil model (yet)** – problems are addressed a profile at a time with limited spatial context and no systematic process integration as routinely done in climate models and ESM
4. **Climate and ESM need informed soil physics** – as climate models mature they recognize that many critical land-atmosphere processes must be revised to represent soil physical processes
5. **Discipline survivable** - a global context of soil physics is important for the future of the discipline
6. **New opportunities in large scale soil science** - many new satellite and spatial information are available and waiting for scientific interpretation and integration
7. **How do we expand the scale of our activities?**
 - a) Link with other disciplines – climate, ESM
 - b) Train students to think of large scales
 - c) Frame problems and publish on large scale issues
 - d) Other ideas ???

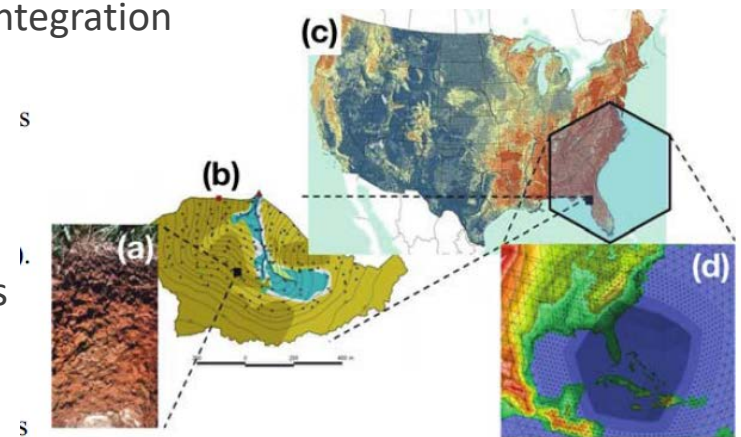


Fig. 2. An illustration of OLAM's zooming capabilities and the range of soil process scales (continental to pedon).

Potential *GEWEX-SoilWat* synergism - examples

- **Integration of *Critical Zone Observatories* (CZO) and similar eco-hydrological observatories within GEWEX** (eLTER-H2020 - European Long-Term Ecosystem Research Infrastructure; TERENO; ICOS; CUAHSI) – design; sensors; monitoring protocols; data repository [in coordination with GHP]
- **Formation of a global lysimeter network** – to inventory, standardize, and expand coverage of lysimeter observations; links with CZO's (lead – FZ Julich and Wageningen) [in coordination with GHP]
- **Integration of the *International Soil Modelling Consortium*** – coherence and better links between climate and soil modelers with respect to models, data sets for model testing, etc. (lead – FZ Julich) [in coordination with GLASS]
- **Development of linkages with the *Global Soil Map* initiative** [all panels]
- **Simple and low-cost soil moisture monitoring networks** (e.g., TxSON) for highly resolved soil moisture information [GHP and GDAP]
- **Integrating human interactions affecting soil-water processes** [GLASS, others]
- **Incorporation of near surface and small-scale soil processes** (evaporation physics; plants-soil interactions; biogeochemical processes) [GLASS]



Who is interested in *GEWEX-SoilWat* activities?

- **Core group of highly motivated professionals:** a wide range of people from all over the world were contacted and expressed keen interest and enthusiastic support
- **Professional and scientific societies:** the Soil Science Society of America (SSSA) – the primary dedicated professional society for soil science. Interest groups formed at AGU (Soil systems and critical zone processes Technical committee); The Geological Society of America - Soils and Soil Processes Interdisciplinary Interest Group); EGU-Soil Systems Section; others
- **National agencies and projects:** USDA/ARS; existing and future US-NSF, China and European CZO networks; eLTER H2020; Global soil map initiative
- **Academic centers and industry:** for example - *Water for Food* – NE; *World Food Centers* – ETH and UC Davis); Soil water sensor manufacturers (*Decagon*; *RainBird*; *Campbell Scientific*; *Delta-T*)



World Food Center



Planning workshop: *GEWEX-SoilWat UFZ Leipzig June 2016*

- To provide a scientific basis, scope and integration of *SoilWat initiative* with existing GEWEX structures and activities, we plan a dedicated planning workshop hosted by UFZ in Leipzig-Halle (*June 28-30, 2016*) - the objective is to engage the GEWEX and Soil community members in the planning and in the workshop
- **Discussion areas/potential topics and core group** (tentative):
 1. Integrating (sub-) surface modeling in hydrological and climate models (Conveners: *Dani Or, Harry Vereecken, Eleanor Blyth, Matthias Cuntz, Bill Kustas*)
 2. Model complexity and utility (simple vs complex models) (Conveners: *Martin Best, Gab Abramovitz, Aaron Boone, Jan Vanderborght, Jasper Vrugt, Alex Mcbratney*)
 3. Groundwater-surface-atmosphere interactions (Conveners: *Marc Bierkens, Remko Uijlenhoet, Gerrit de Rooij, Stephan Kollet*)
 4. Human interactions affecting soil-water processes (Conveners: *Taikan Oki, Howard Wheeler, Katja Frieler, Jacob Schewe, Shmuel Assouline, John Crawford, Michael Young*)
 5. Soil observations for hydro-climate research (Conveners: *Jan Hopmans, Sonia Seneviratne, Steffen Zacharias, Hendricks-Franssen Harrie-Jan, Colin Campbell, Todd Caldwell*)

On the Need to Establish an International Soil Modeling Consortium, ISMC

The ISMC Team: H. Vereecken, A. Schnepf, J. Vanderborght, M. Young, D. Or,
J.W. Hopmans, M. Javaux, R. Kunkel

The International Inaugural Conference on Soil Modeling, Austin, 29 March-1 April

Motivation for community-based ISMC

- Modelling soil processes is fragmented and dispersed
- Exchange between different soil disciplines is lacking
- An improved “position“ and visibility of soil research and modelling in the Earth Sciences Community is needed. We need to reach out to other modelling communities in the field of terrestrial systems, climate systems, ecology, ...
- The scientific community lacks easy-to-access and available standardized and high quality data and protocols for calibration and validation
- A better exchange of ideas, expertise and need for development of joint activities through cross-cutting topical areas
- → **ISMC as a community effort**

Objectives of the ISMC

- Address scientific gaps and promote soil science research
- Develop a platform for soil model intercomparisons
- Identify interactions with other relevant platforms
- Establish data platforms for model development and validation
- Enhance the integration of soil modelling expertise in neighbouring disciplines (climate, land surface, ecological, crop and contaminant models)
- Develop cross-topical areas as hubs for innovation and exchange of ideas, models, data and expertise

Inaugural workshop: *ISMC Austin April 2016*

- The ***International Soil Modelling Consortium***: inaugural conference in Austin (March 29 to April 1, 2016 - <https://soil-modeling.org/austin-workshop/program>); A white paper on challenges and perspectives in modelling soil processes (45 authors) submitted to VZJ (a basis for WGs discussions)
- ***WG 1: ISMC Structure and Governance*** (Conveners: Dani Or, Sonia Seneviratne, Rainer Horn, Harry Vereecken)
- ***WG 2: Mission of ISMC and its links to other communities*** (Conveners: Michael Young, Jan Hopmans)
- ***WG 3: Model inter-comparison and modelling platforms*** (Conveners: Andrea Schnepf, Jan Vanderborght)
- ***WG 4: Linking data to modelling*** (Conveners: Yakov Pachepsky, Harry Vereecken)
- ***WG 5: Cross-cutting topics*** (Conveners: Lead Gerrit De Rooij, Kurt Roth, Peter van Oevelen, Mathieu Javaux)

Review and Analysis



Core Ideas

- A community effort is needed to move soil modeling forward.
- Establishing an international soil modeling consortium is key in this respect.
- There is a need to better integrate existing knowledge in soil models.
- Integration of data and models is a key challenge in soil modeling.

Modeling Soil Processes: Review, Key Challenges, and New Perspectives

H. Vereecken,* A. Schnepf, J.W. Hopmans, M. Javaux, D. Or, T. Roose, J. Vanderborght, M.H. Young, W. Amelung, M. Aitkenhead, S.D. Allison, S. Assouline, P. Baveye, M. Berli, N. Brüggemann, P. Finke, M. Flury, T. Gaiser, G. Govers, T. Ghezzehei, P. Hallett, H.J. Hendricks Franssen, J. Heppell, R. Horn, J.A. Huisman, D. Jacques, F. Jonard, S. Kollet, F. Lafolie, K. Lamorski, D. Leitner, A. McBratney, B. Minasny, C. Montzka, W. Nowak, Y. Pachepsky, J. Padarian, N. Romano, K. Roth, Y. Rothfuss, E.C. Rowe, A. Schwen, J. Šimůnek, A. Tiktak, J. Van Dam, S.E.A.T.M. van der Zee, H.J. Vogel, J.A. Vrugt, T. Wöhling, and I.M. Young

The remarkable complexity of soil and its importance to a wide range of ecosystem services presents major challenges to the modeling of soil processes. Although major progress in soil models has occurred in the last decades, models of soil processes remain disjointed between disciplines or ecosystem services, with considerable uncertainty remaining in the quality of predictions and several challenges that remain yet to be addressed.

ISMC website: <https://soil-modeling.org/>

International Soil Modeling Consortium — ISMC

https://soil-modeling.org

Site Map Contact Accessibility Search Site

Log in Register

160 registrations on February, 2016

You are here: [Home](#)

NEWS HOME MODELS MESSAGE BOARD NEWS EVENTS IMPRINT

INTERNATIONAL SOIL MODELING CONSORTIUM

Soil is one of the most critical life-supporting compartments of the Biosphere. Soil provides numerous ecosystem services such as a habitat for biodiversity, water and nutrients, as well as producing food, feed, fiber and energy. To feed the rapidly growing world population in 2050, agricultural food production must be doubled using the same land resources footprint. At the same time, soil resources are threatened due to improper management and climate change. Soil is not only essential for establishing a sustainable bio-economy, but also plays a key role also in a broad range of societal challenges including

1. climate change mitigation and adaptation
2. land use change
3. water resource protection
4. biotechnology for human health
5. biodiversity and ecological sustainability
6. combating desertification

NEWS

ISMC session suggested for EGU 2015
Jul 08, 2014

ISMC session at AGU meeting now open for abstract submission
Jun 26, 2014

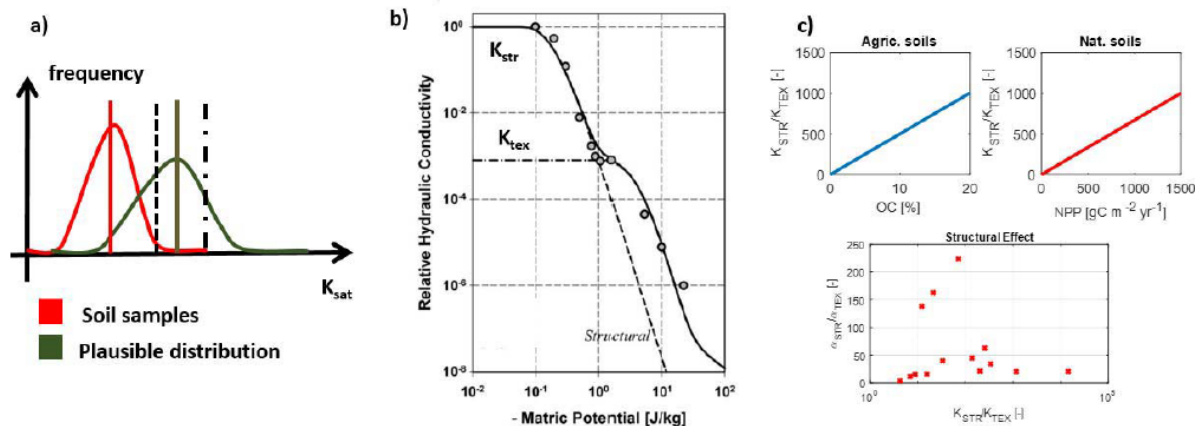
Complex Soil Systems Conference - Abstract accepted
Jun 25, 2014

Vacancy at FZJ, Agrosphere Institute
Jun 16, 2014

Vacancy at FZJ, Agrosphere Institute
Jun 16, 2014

More news...

The influence of soil structure on global climate...



- A simple addition of soil structure information by adjusting Ks for structured soils (correlated with vegetation cover) – changes the energy balance of surfaces globally!

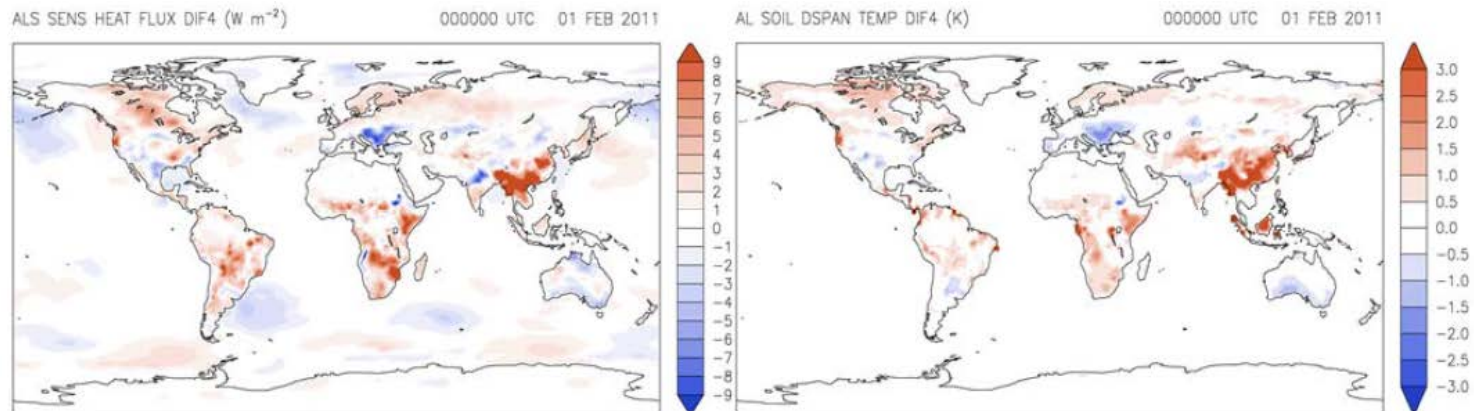


Fig. 6. Global changes in sensible heat flux (left, W/m^2) and diurnal surface temperature range (right, K) when soil structure effects on loamy soils are considered (results are averages over 10 years).