JULES Hydrology Community Activities

JULES HYDROLOGY MODULE – Module leaders: Anne Verhoef & Nic Gedney; TABLE as per June 2017

Research/Application area	Names (Affiliation)	Brief description of work
Catchment and large-scale hydrology: Routing, lateral flows, wetlands and inundation	- Elias Nkiaka (Uni Leeds) - Sarah Shannon (Uni Exeter) - Eleanor Blyth, Alberto Martínez de la Torre (CEH) - Simon Dadson, Toby Marthews (Uni Oxford) Huw Lewis (UKMO) - Nic Gedney (UKMO) - Graham Weedon (UKMO) - Charlie Williams, Emily Black (Uni Reading); Simon Dadson (Uni Oxford) - Emily Black, Anne Verhoef, Peter Cook (Uni Reading), David Macdonald and others (BGS)	- Hydrology of **Logone Catchment** (C-Africa) - **Glacier model** in JULES; impact of glacier retreat on river run-off. - **JULES hydrology performance** over the UK (testing runoff generating options) - **RFM implementation**; large-scale inundation modelling - Large-scale **wetlands**. - **River flow** multi-spectral evaluation. - **Paleo-hydrology** (Testing the importance of lake/wetland-climate feedbacks for African hydroclimate variability) - **Water balance and groundwater recharge in West-Africa** (BRAVE project)
Impacts: Irrigation; climate change; land use change	- Rich Betts (UKMO); Lamprini Papadimitriou (TU Crete) - Pete Falloon, Ron Kahana, Karina Williams (UKMO) - Pete Falloon, Ron Kahana (UKMO), Michael Holloway (Lancaster) - Camilla Mathison (UKMO) - Emma Bergin, Wouter Buytaert (Imperial)	- EU HELIX project (**high-end climate impacts**), focusing on water availability and droughts - IMPREX (EU H2020): **improving prediction of hydrological extremes** - NERC NUCAT-2050: **nutrient transfers** in small UK catchments under climate change - **Integrated impacts** (crops, rivers, glaciers, irrigation) South Asia - NERC HYDROFLUXES **Hydrology and fluxes of the Upper Ganges basin** (landuse change and agriculture)

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Soil water balance & moisture dynamics: Soil hydraulics & infiltration; plant water stress/root water uptake; groundwater	- Heather Rumbold (nee Ashton), Richard Gilham (UKMO)	- Evaluation of JULES **soil moisture** using the Land Validation Toolkit (LVT, from NASA) and global observations. - Evaluation of JULES (stream flows, soil moisture, evaporation) coupled with hydrological models (e.g. RFM) over the UK. - Testing the feasibility of coupling JULES-SHETRAN. - Ongoing work with **high resolution soil hydrology**.
	- Rafael Rosolem (Uni Bristol)	- NERC AMUSED project (In-situ SMC/**Cosmic rays**/RS) as well as incorporation of **macropore flow** into JULES
	- Chloe Largeron (previously Ania Mueller)/Hannah Cloke/Anne Verhoef (Uni Reading)	- NERC SINATRA project (**infiltration-flooding from intense rainfall**), now TENDERLY follow-on project
	- Beena Balan Sarojini (now at ECMWF, replacement to be appointed), Azin Howells, Anne Verhoef, Pier Luigi Vidale, Hannah Cloke (Uni Reading), Chris Jackson (BGS)	- NERC IMPETUS drought project: prediction of 'soil moisture & groundwater drought'; work on **plant water stress description in JULES**, also linked to JPEG led by Williams and Harper
	- Pier Luigi Vidale, Anne Verhoef (UoR) - Becky Oliver (CEH) - Karina Williams (UKMO) and Anna Harper (Uni Exeter)	- Investigations into the effect of **hydraulic parameterisations via new soil maps and PTFs** - **Wetland** vegetation PFT - modelling the effect of the amount of available water in the soil on vegetation functioning and productivity; leaders of **plant water stress JPEG**
Organic and chalk soils	- Eleanor Burke, Karina Williams (UKMO), Sarah Chadburn (Uni Exeter)	- **organic soil properties**
	- Christina Bakopoulou (Imperial) - Rafael Rosolem, Shams Rahman (Uni Bristol)	- JULES in **chalk catchments** - Simple **macroporosity** parameterization and inclusion of **soil-chalk layers** into JULES, and their influence on surface energy fluxes

JULES Hydrology Community Activities

'Cold processes': Snow; soil freezing and permafrost; artic regions	- Eleanor Burke (UKMO) - Sarah Chadburn - Homero Paltan Lopez (Uni Oxford) - Cécile Ménard (CORES) - Richard Essery (Uni Ed.) - Andrew Ireson (Uni Saskatchewan) - Helen Johnson (UKMO)	- **Permafrost link** with wetlands and runoff - Water fluxes/wetlands in relation to **soil freezing and thawing** - JULES capturing **climate variability in cold regions** (Arctic); sensitivity of surface hydrology/river dynamics to climate variability - Data assimilation and evaluation of **snow processes in JULES** - **Snow modeling** - **Cold processes & sub-surface flows** in Canadian Boreal forest. - The effect of **black carbon on the timing of snowmelt**

Camilla Mathison: New rose stem tests have been added to protect some of the hydrology code (trip, rfm and the irrigation code specifically). Maybe if they are considered less of a technical thing then people working on the code are aware of their worth and perhaps consider doing other rose stem tests that protect their specific area of code/interest.

JULES HYDROLOGY COMMUNITY MEETINGS

Meetings: 16 November 2016 (CEH-Wallingford; general) & 12 January (UoR; infiltration sub-meeting)

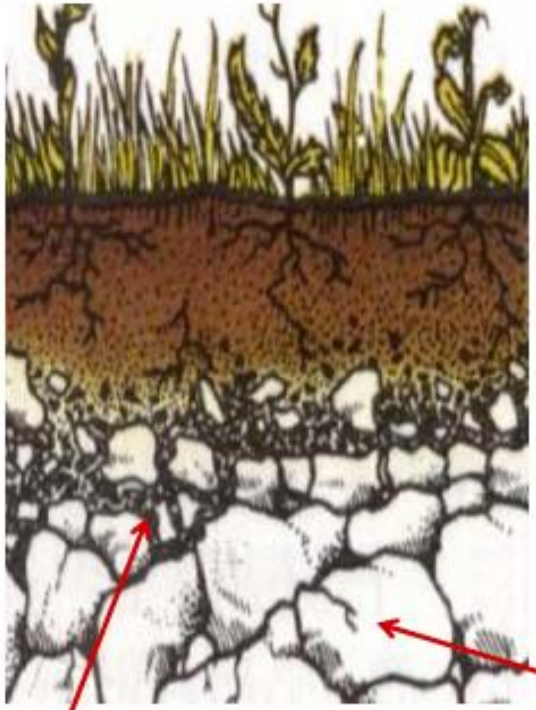
- A very well-attended JULES Hydrology meeting took place on 16 November 2016, at CEH-Wallingford.
- Very fruitful meeting consisting of about a dozen talks, ranging from representation of **bypass flow in chalk**, to **river routing** and **plant water stress parameterisations**.
- There were also in-depth discussions, e.g. on how to best represent **groundwater flow in JULES**.

Towards a simple representation of chalk hydrology for large-scale land surface modelling

Rafael Rosolem

Bristol University

Acknowledgements: Shams Rahman and Joost Iwema



Very thin layer of soil with some mixture of chalk

Bedrock chalk and flint. Highly fractured – water runs straight trough

Fracture

Low porosity = 10^{-4}

High permeability = 10^{-5}–10^{-4} m s^{-1}

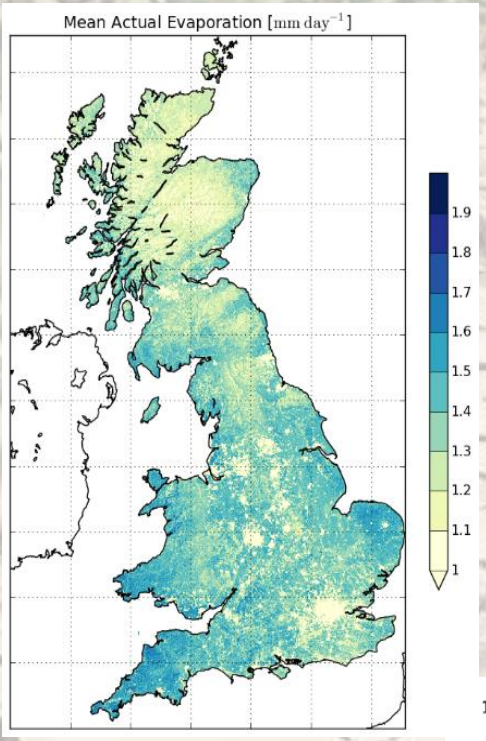
Matrix

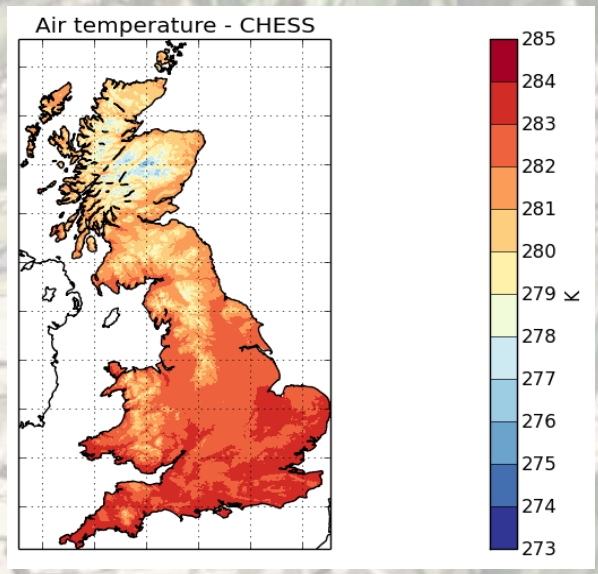
High porosity = 0.30-0.40

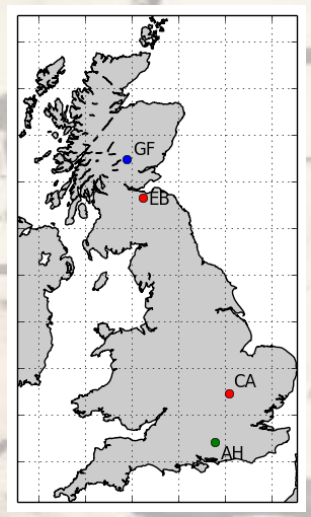
Low permeability = 10^{-9}–10^{-8} m s^{-1}

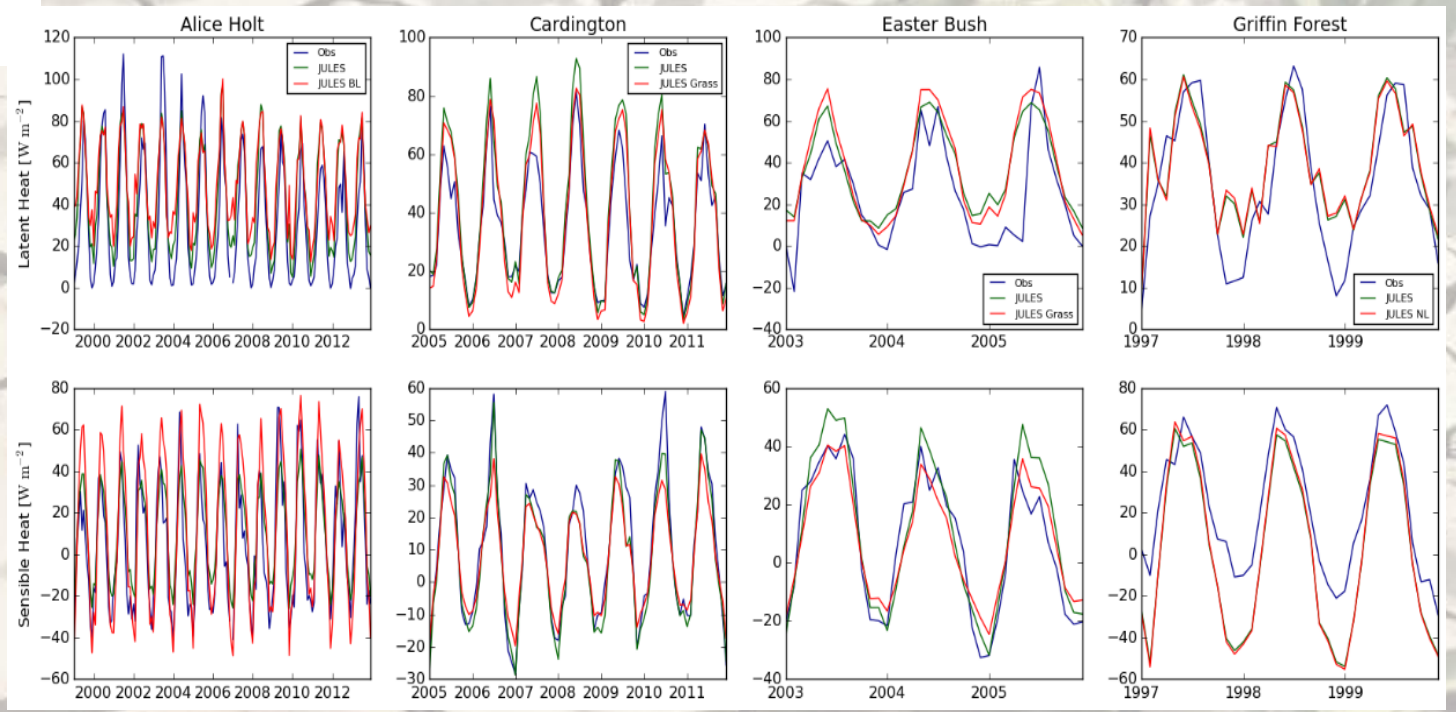
Performance of JULES Evapotranspiration in the UK

Eleanor Blyth, Alberto Martinez de la Torre, Emma Robinson









JULES HYDROLOGY WORKING GROUPS

At the November 2016 meeting, three **JULES Hydrology Working Groups** were established

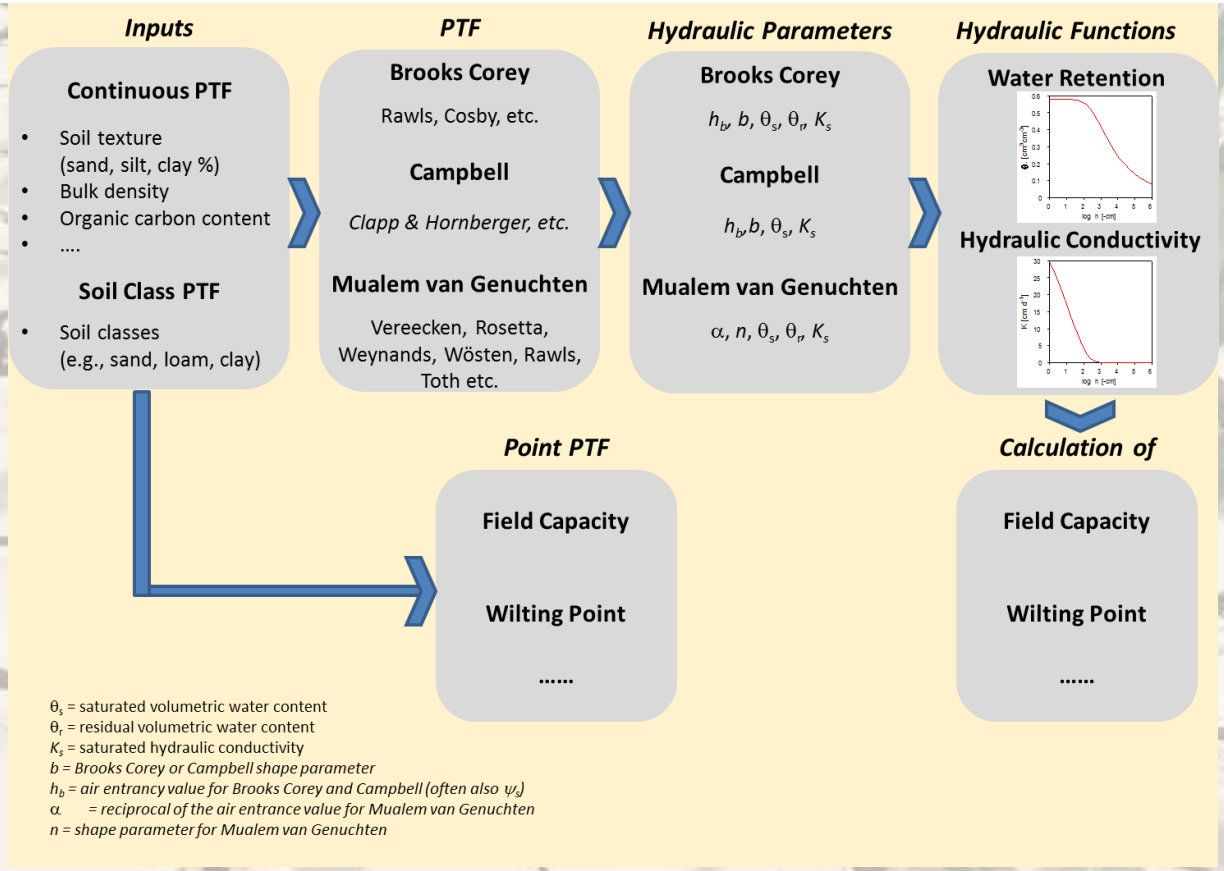
1. **River routing** and related issues: lead *Simon Dadson* (meeting took place 25 January 2017, in Oxford)
2. **Soil spatial resolution**, switches related to soil fluxes, averaging of soil hydraulic properties etc: Lead *Sarah Chadburn*
3. JULES Hydrology **model configurations**: Lead *Toby Marthews* (a follow-on teleconference has since taken place, 12 December, 2016)

TITLE SLIDE

ISMC-GEWEX-SoilWat initiative on comparing soil hydraulic & thermal properties description and pedotransfer functions in LSMs

Anne Verhoef, Harry Vereecken, Matthias Cuntz, Lukas Gudmundsson, Lutz Weihermuller, Carsten Montzka, Michael Herbst, Kris van Looy

JULES: Anne Verhoef (inputs from Imtiaz Dharssi, Toby Marthews, Pier Luigi Vidale, Heather Ashton, Karina Williams, Nic Gedney, Martin Best & John Edwards)

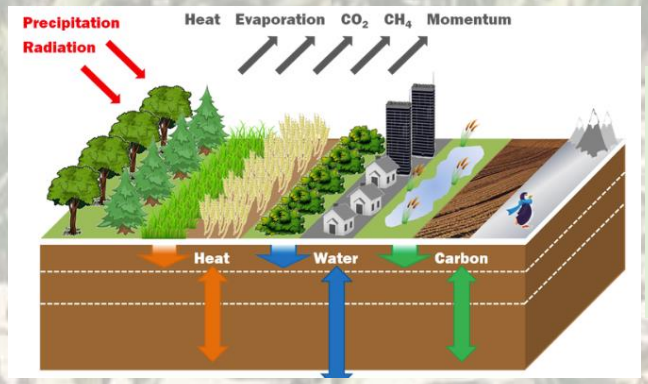


OVERVIEW

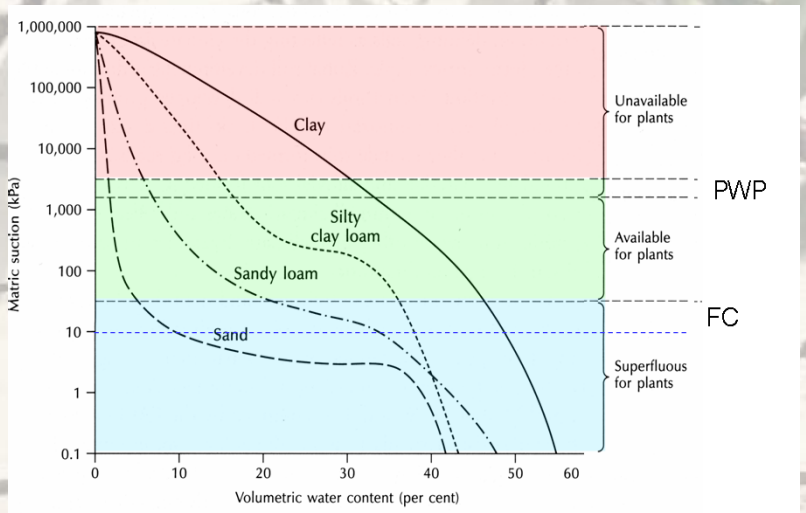
- GEWEX and the soil and critical zone communities: improve interactions and integration of soil and subsurface processes in present climate models

- Planning workshop aimed at designing and prioritizing interactions took place in June 28-30, 2016 in Leipzig

- Various initiatives: (1) Evaluation of pedotransfer functions and related functional descriptions for calculation of hydraulic and thermal soil properties in global climate and hydrological models. A joint GEWEX-SoilWAT-ISMC project, led by Harry Vereecken and Anne Verhoef



JULES land surface model



GLOBAL HYDRAULIC PARAMETER MAP PLUS DATA SET; MONTZKA ET AL.

Not logged in

PANGAEA.

Data Publisher for Earth & Environmental Science

SEARCH SUBMIT ABOUT CONTACT

Montzka, Carsten; Herbst, Michael; Weihermüller, Lutz; Verhoef, Anne; Vereecken, Harry (2017): A global data set of soil hydraulic properties and sub-grid variability of soil water retention and hydraulic conductivity curves, link to model result files in NetCDF format. doi:10.1594/PANGAEA.870605,

Supplement to: Montzka, C et al. (in prep.): A global data set of soil hydraulic properties and sub-grid variability of soil water retention and hydraulic conductivity curves. *Earth System Science Data Discussions*

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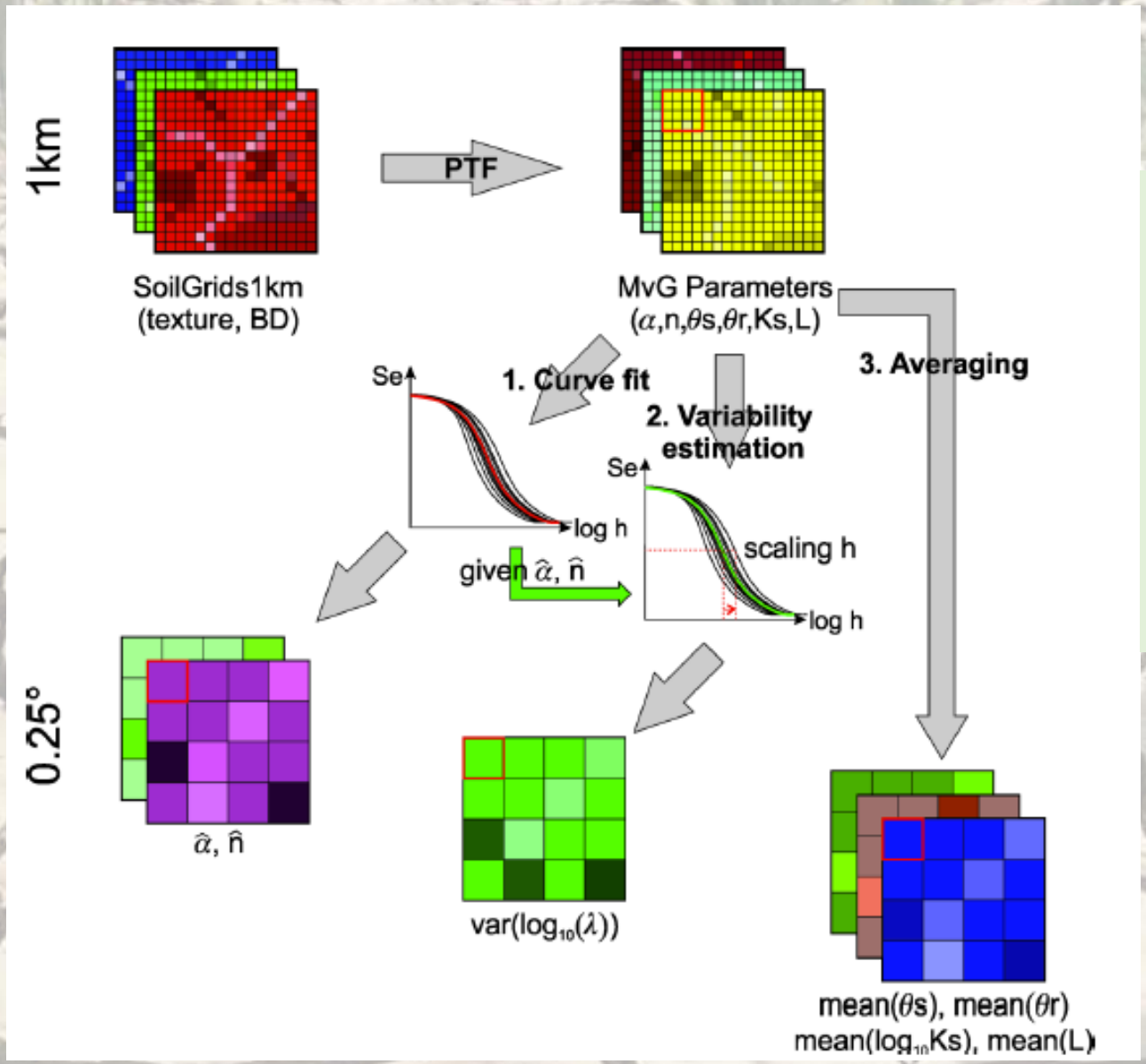
GLOBAL HYDRAULIC PARAMETER MAP PLUS DATA SET; MONTZKA ET AL.



Proposed method to aggregate soil hydraulic properties and sub-grid variability of soil water retention and hydraulic conductivity curves.

GLOBAL HYDRAULIC PARAMETER MAP PLUS DATA SET; MONTZKA ET AL.

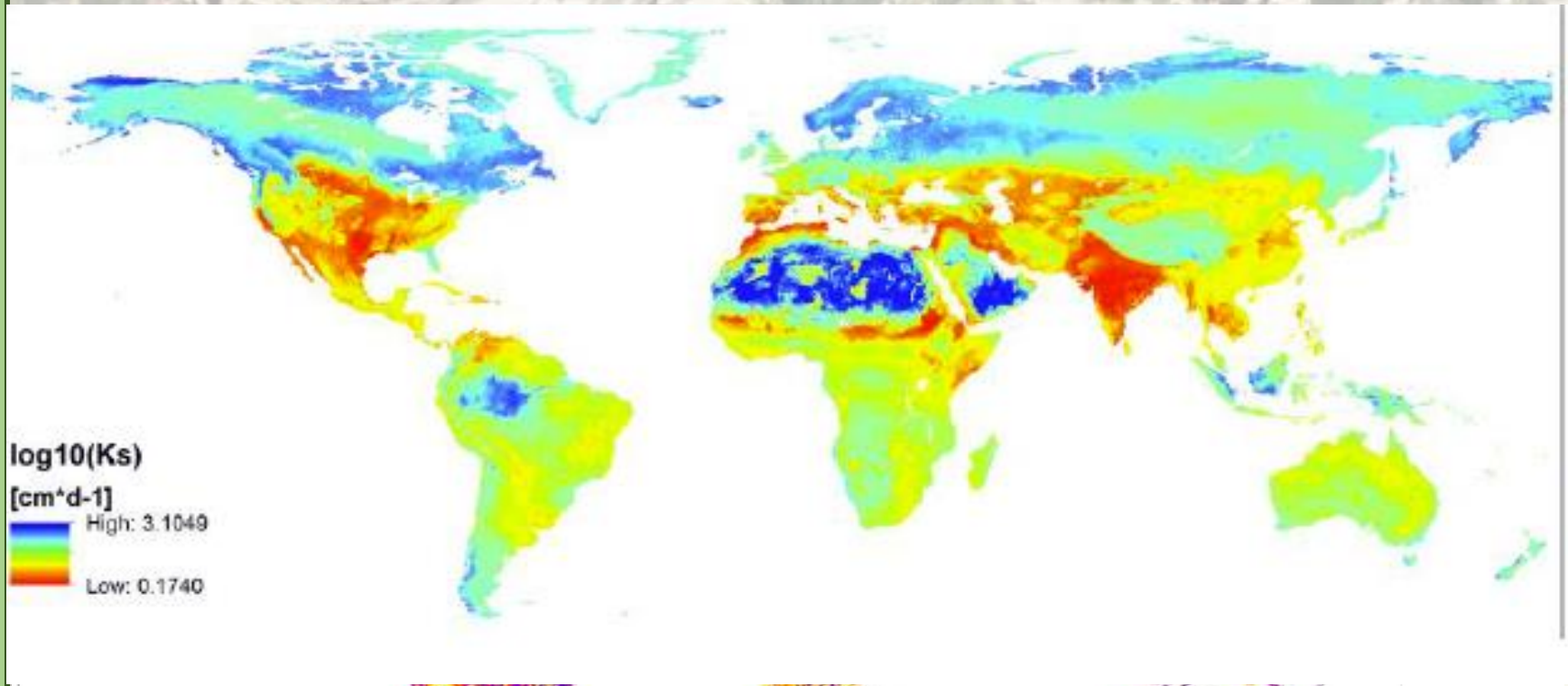


Figure 6: Global map of var$(\log_{10} \hat{\lambda}_i)$ calculated from SoilGrids1km data set and the Rosetta PTF (Schaap et al., 2001) for 0.25° resolution.