icon\_extpar\_0027\_R03B08\_N02\_20220601\_tiles.g2 2 edzw 10101 an unstructured\_grid 0 surface 0 ROOTDP grid\_simple N: 659025 Min: 0 Max: 1.803 Mean: 0.445 Std: 0.419





# Land surface modeling for NWP at DWD – current status and future plans

Linda Schlemmer, Jürgen Helmert, Roland Wirth, Jan-Peter Schulz, Gernot Geppert, Martin Lange, Günther Zängl, Roland Potthast, ...





#### **Overview**

- → Land-surface model for NWP purposes
  - → Ongoing Developments
- ➔ ICON seamless
  - ➔ Integrating ICON-LAND into icon-nwp
  - → Initial Conditions for Seasonal Forecasting (CERISE)





#### **Overview**

- → Land-surface model for NWP purposes
  - ➔ Ongoing Developments

→ Mires

#### → Urban Areas

- ➔ ICON seamless
  - → Integrating ICON-LAND into icon-nwp
  - → Initial Conditions for Seasonal Forecasting (CERISE)





#### Mires

- Motivation: Improvement of gust forecasts
- Peatlands in TERRA new mire scheme (Yurova et al., 2014)
- ➔ Modification in TERRA: Evaporation
  - Soil heat conductivity
  - Soil water budget
- Needs high-res physiographic data
  - Avoid treatment of "inactive" dry bogs
  - land surface data good enough as proxy for "active" mires?



Jürgen Helmert, Alla Yurova, Denis Blinov, Inna Rozinkina, Michael Baldauf, Ulrich Schättler, Jean-Marie Bettems, and Dmitrii Mironov



## Representation of Urban Areas – TERRA\_URB

Wouters et al. (2016, 2017)





Modification of

- soil heat capacity and thermal conductivity
- aerodynamic roughness length and thermal roughness length
- Evapotranspiration from water storage on impervious surface fraction
- infiltration/runoff partitioning on impervious surfaces
- Anthropogenic heat emissions
- albedo and emissivity  $\rightarrow$  effect on radiation

Jan-Peter Schulz, Paola Mercogliano, Marianna Adinolfi, Carmela Apreda, Francesca Bassani, Edoardo Bucchignani, Angelo Campanale, Davide Cinquegrana, Carmine De Lucia, Rodica Dumitrache, Giusy Fedele, Valeria Garbero, Witold Interewicz, Amalia Iriza-Burca, Adam Jaczewski, Pavel Khain, Yoav Levi, Bogdan Maco, Alan Mandal, Massimo Milelli, Myriam Montesarchio, Mario Raffa, Alfredo Reder, Leenes Uzan, Hendrik Wouters, Andrzej Wyszogrodzki

9

Urban heat island effect for Milan, Rome, Naples and Tunis in Aug-Sep 2020





### **Overview**

- → Numerical Weather Prediction (NWP) at DWD
- → Land-surface model for NWP purposes
  - → Current status
  - → Ongoing Developments
- ICON seamless
  - ➔ Integrating ICON-LAND into icon-nwp
  - → Initial Conditions for Seasonal Forecasting (CERISE)





## **ICON** seamless

ICON genealogy:

Dynamical core +

→ ICON-ESM (ECHAM physics, including ICON-LAND (JSBACH))

Discontinued for climate applications (RUBY), but transferred into SAPPHIRE (high-resolution global runs, stripped-down physics)

ICON-NWP (COSMO physics, new physics routines, including TERRA)
 Transferred into ICON seamless (ICON-NWP + ICON-O + ICON-LAND)





#### **ICON-Seamless - Uniform model for weather and climate**

**ICON-Seamless** = model and data assimilation for

- ✓ Numerical Weather Prediction (NWP)
- ✓ Climate Prediction (seasonal, decadal)
- ✓ Climate Projections (global and regional)
  based on NWP physics
- One consistent model (incl. atmosphere, ocean, land, air chem.)
- Configurations for different applications
- Project started in November 2020

→in collaboration with MPI-M, KIT, DKRZ, MPI-BGC ...



70 Jahre Deutscher Wetterdienst

Wetter und Klima aus einer Hand





### ICON-LAND + VDIFF integrated into ICON-NWP

-> Roland Wirth















# ParFlow in ICON-LAND

# Interface ICON-LAND + turbulent diffusion

Integration of ParFLow into ICON-LAND via external coupling using YAC





#### GLORI DT: GLObal-to-Regional ICON Digital Twin

<sup>2023-03-16</sup> Stefan Kollet, Linda Schlemmer, Reiner Schnur

ICCARUS WG meeting









## **ICON-Land in ICON-nwp**

- 1. Modularize TERRA  $\rightarrow$  ongoing
- 2. Port TERRA modules into ICON-LAND (or reuse existing modules)

Keep skin temperature, mires, TERRA\_URB, (infiltration)

3. Harmonize Tile Structure and blending height (transfer scheme part of ICON-LAND)





## **ICON Time Stepping**









#### **CopERnIcus climate change Service Evolution – CERISE**

- Consortium of 12 European partner institutions.
- ➔ Develop new
  - land and coupled land-atmosphere data assimilation approaches,
  - land surface initialization techniques.
- → Implement them in pre-operational demonstrators for
  - reanalysis,
  - seasonal prediction.

The CERISE project (grant agreement No 101082139) is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Commission. Neither the European Union nor the granting authority can be held responsible for them.





