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CONSORTIUM FOR SMALL SCALE MODELING
COSMO

Soil and Surface Activity Review

Jean-Marie Bettems / MeteoSwiss

COSMO General Meeting
Sibiu, September 3hd , 2013

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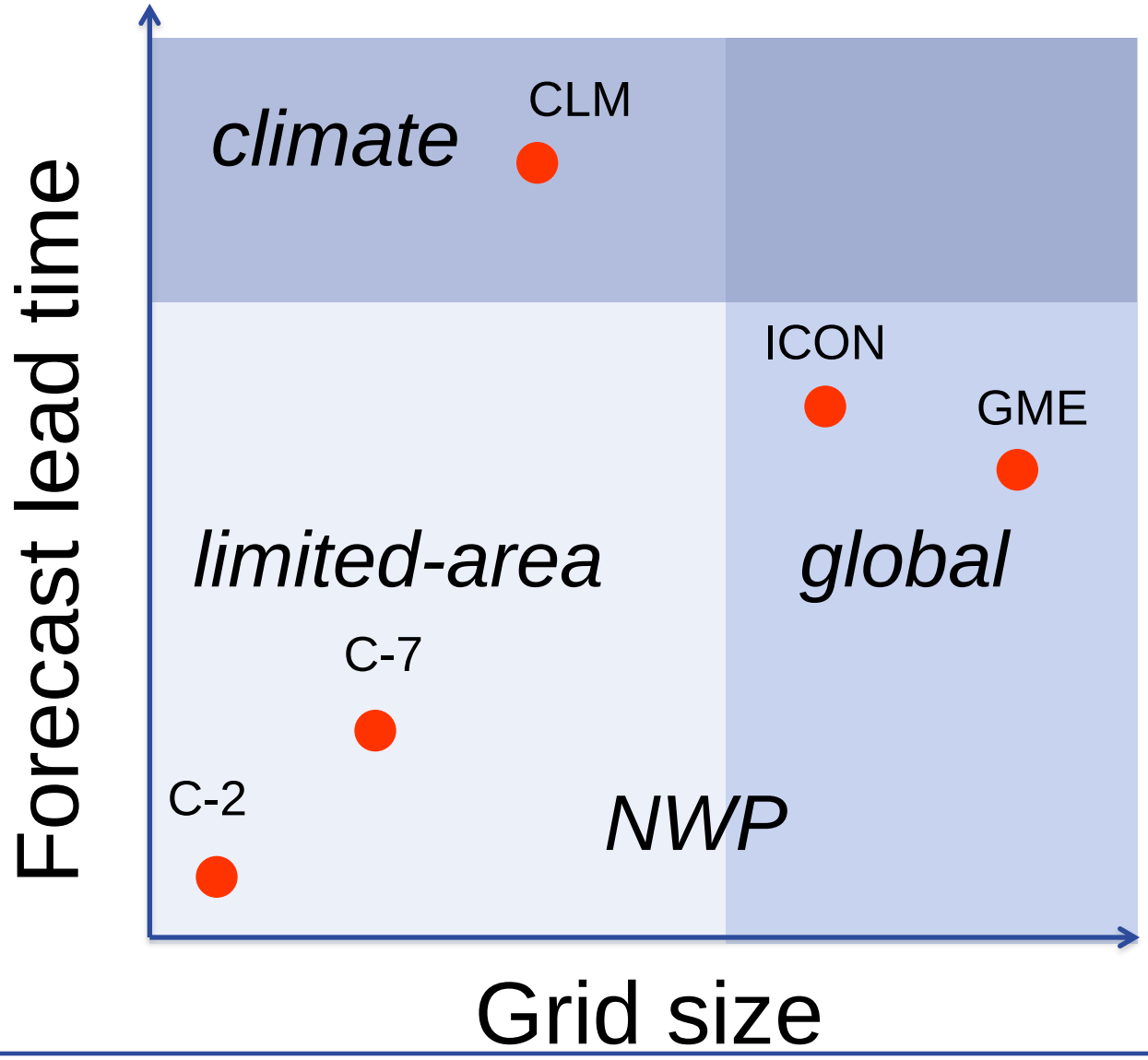
TERRA at DWD

J.Helmert, G.Vogel / DWD

Application Scales

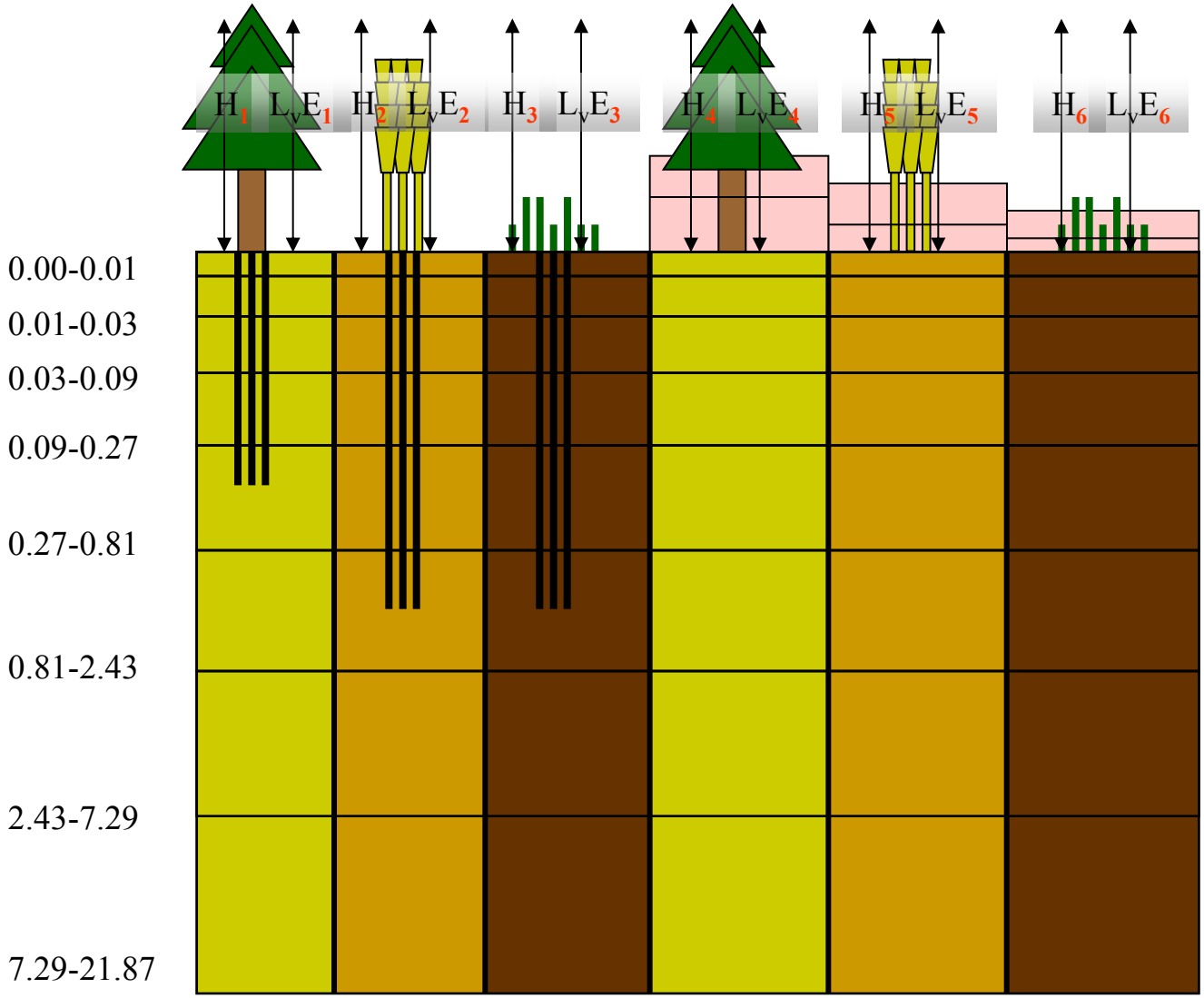


Available new features

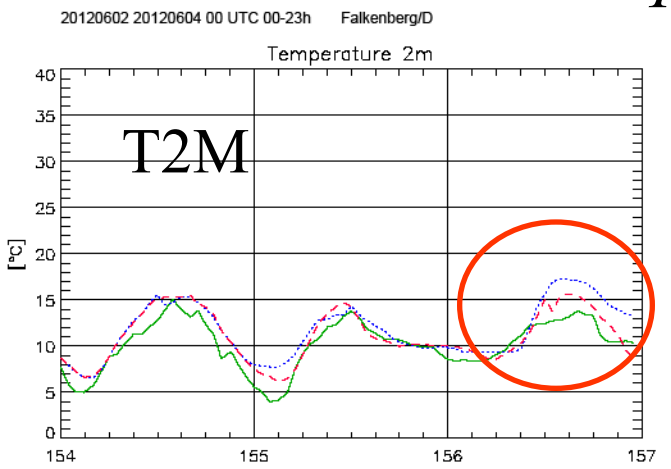
- **Surface heterogeneity** (TILE approach)
- **Multi-layers snow** model
- Vegetation (**interception**, **NDVI climatology**)
- Application of high-resolution **external parameters**

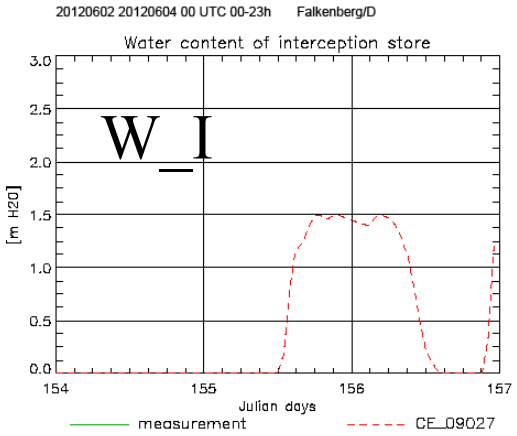
  (GlobCover-land use, HWSD heterogeneous soil)
- One source code – many usages: 3D, **standalone** (2D)**, SCM** (1D)
- Comprehensive model **evaluation**

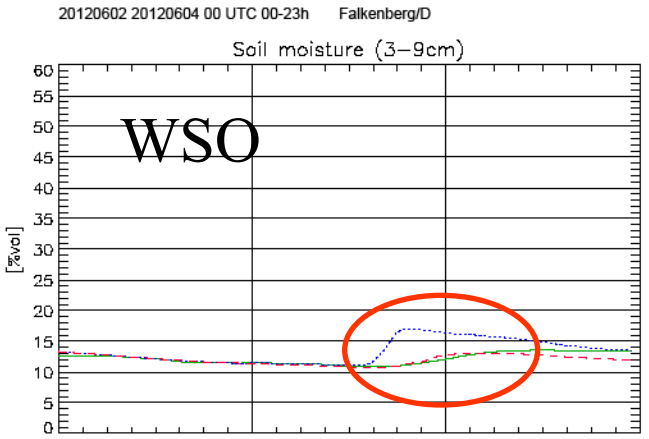
TERRA Tiles: HET-SOIL

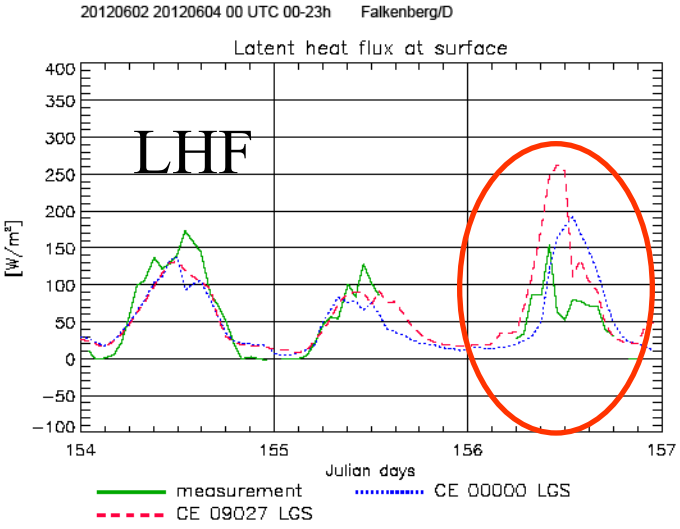


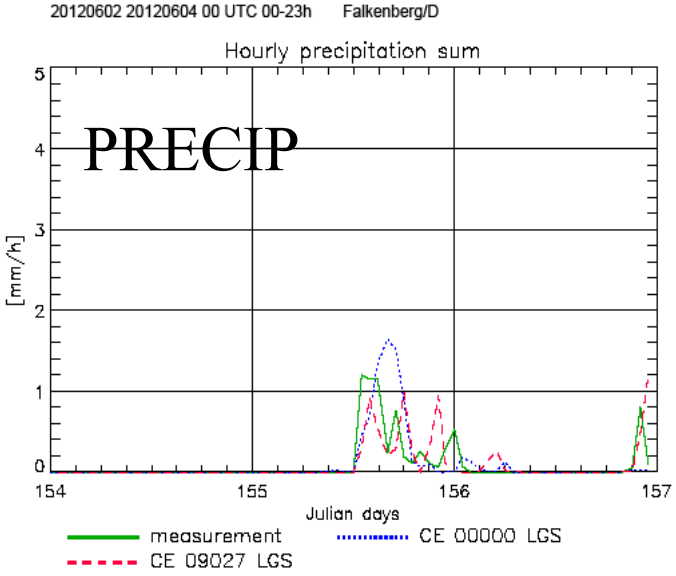
$$W_{i,mx} = 0.0004LA \quad [\mathrm{m}\ H_2O]$$
$$I$$





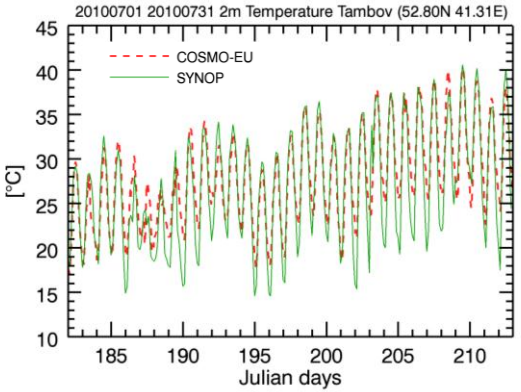


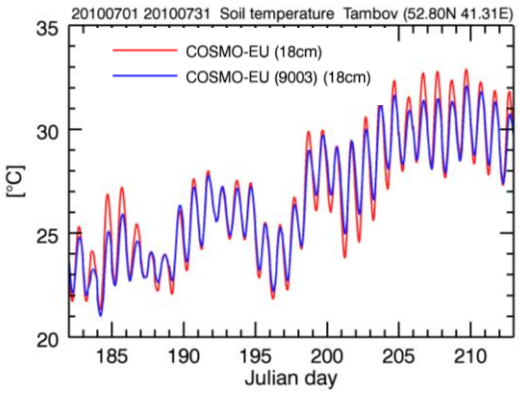


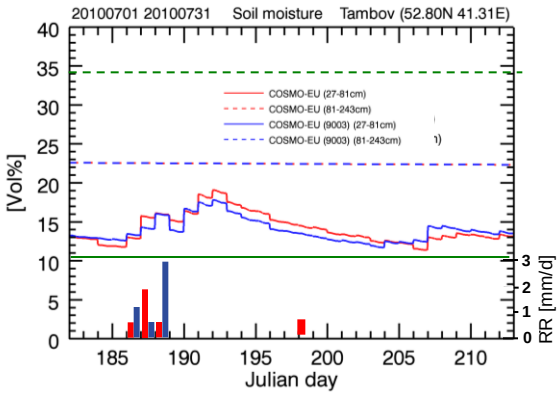


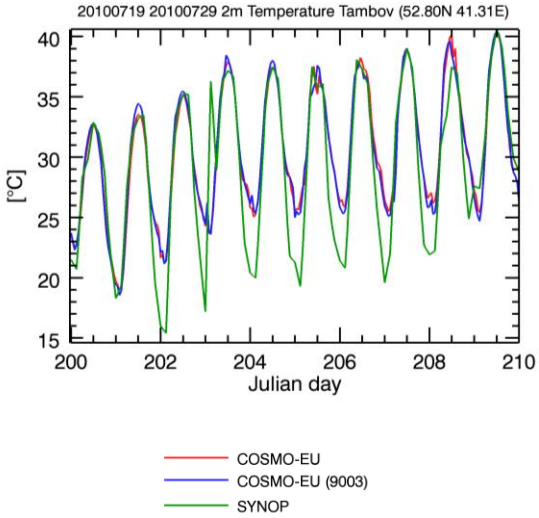
Offline sensitivity studies on root parameterisation in the TERRA module

G. Vogel









Findings:

- daily temperature maximum (2m) well captured
- SMA artificially increases soil moisture in upper layers
- Morning temperatures strongly overestimated

How can we improve the model behaviour?

- more realistic **thermal conductivity**
- **shading effect** by vegetation should be considered
- improved parameterisation of **soil water uptake by roots**, but time-constant exponential root profile is sufficient

An important remark

All new developments at DWD are implemented in **TERRA / ICON**, this includes the previous list of new features.

These features will be automatically available *once* the shared ICON / COSMO library is finalized.

→ The shared library is urgently needed!

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TERRA at IMGW

Large project to improve soil model in COSMO

Work in IMGW – PIB :

- November 2012 – first meeting after General Meeting in Lugano 2012.
- February 2013 – IMGW-PIB and IA PAN signed a contract.
- IMGW and IA PAN have cooperated formally since March 2013.
- March 2013 – meeting in Lublin, the concept of early experiments.
- June 2013 – we have started to cooperate with Satellite Remote Sensing Center.
- August 2013 – meeting with EUROTECH company – plans to start a collaboration.
- During COSMO year we have been working on theoretical aspects of soil physics

Collection of observations

Information come from Product User Manual – PUM – 14 (Product H14 – SM-DAS-2)
„EUMETSAT Satellite Application Facility on Support to Operational Hydrology and Water Managment (page 6 documentation)

…is produced by a specific production chain which is being developed by ECMWF.
Its production is based on Simplifield Extand Kalman Filter

Based on the radar scatterometer embarked on Met-Op

Product is assimilated in the ECMWF LDAS

From meteorological stations

SYNOP
T2m RH2m
Snow Depth

Noaa/NESDIS
IMS snow cover

SM-OBS-1:
ASCAT
Surface SM

Surface:
0-2cm

ECMWF NRT
Atmospheric conditions

Data Assimilation:
EKF Soil Moisture
Analysis

Quality Control → use data when:
-Topographic complexity ≤ 20
- Wetland Fraction ≤ 15
- Noise level ≤ 8
- Snow free conditions
- Unfrozen soil

SM-DAS-2:
Soil Moisture
Profile

Root zone:
4 layers
0-7cm
7-28 cm
28-100 cm
100-289cm

Swath surface product SM-OBS-1 → Global Daily root zone product SM-DAS-2

Theoretical research

- Based on data I pointed out that hydraulic conductivity should depend on temperature too.

$$K = K_0 e^{f(\theta)} \left(\frac{T}{T_0} \right)^{\varepsilon}$$

$$\frac{\partial \theta}{\partial t} = K_0 e^{f(\theta)} \left(\frac{T}{T_0} \right)^{\varepsilon} \left[\frac{\partial f(\theta)}{\partial z} \frac{\partial \theta}{\partial z} + \frac{\varepsilon}{T} \frac{\partial T}{\partial z} + \frac{\partial^2 \theta}{\partial z^2} \right]$$

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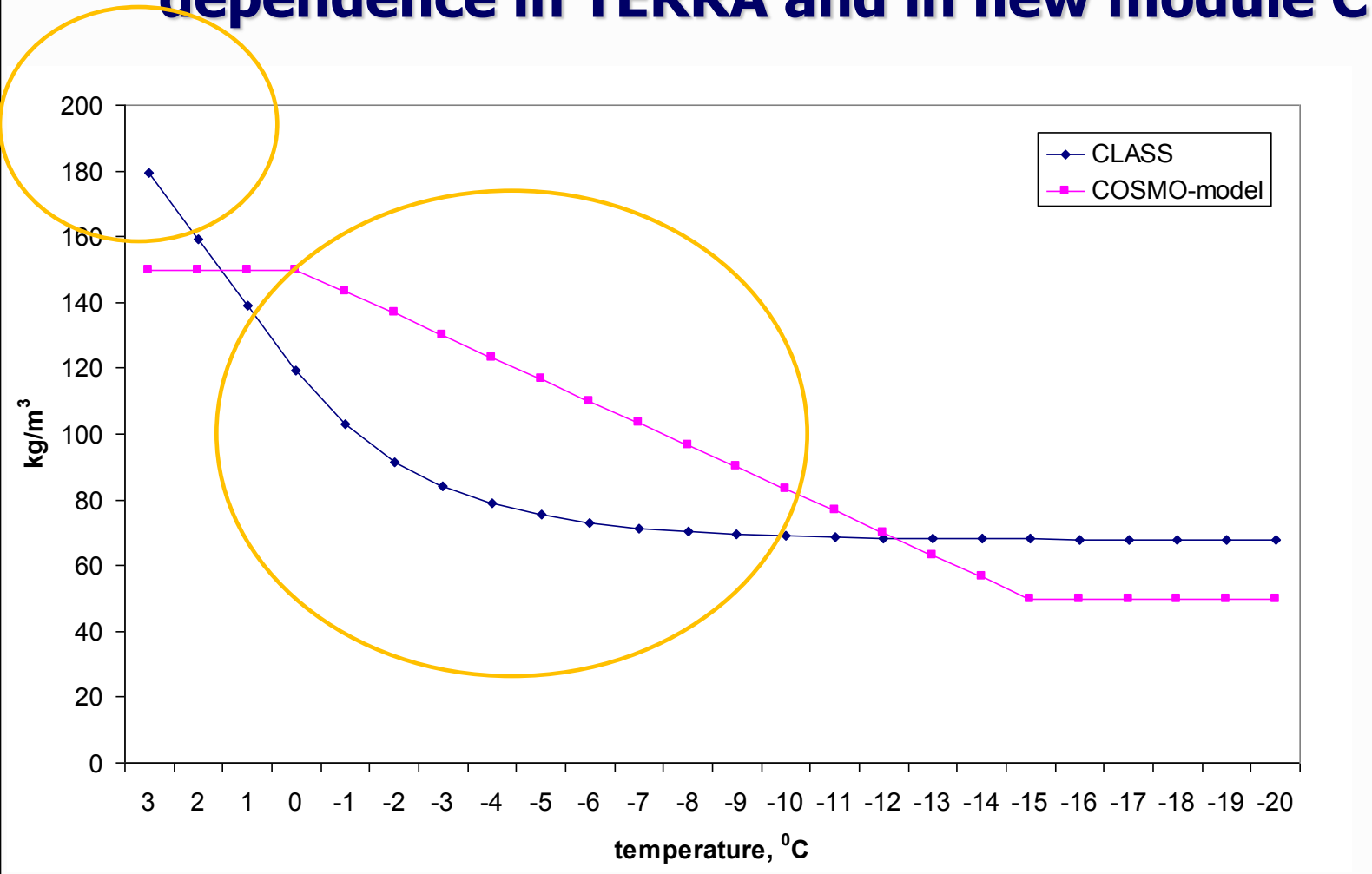
Soil and surface activities at RHMN

RHMN

- Development of modeling of snow cover characteristics:
  - Initialization of snow fields (incl. **snow density** and **water eq.** using external obs. driven 1d model)
  - Derivation of **fresh snow depth**

- Other activities:
  - **Mire** parameterisation
  - Implementation of **FLAKE**
  - **Valday** data exchange

Fresh snow density values according to temperature dependence in TERRA and in new module CLASS



Implementation of mire parameterization

(Alla Yurova)

- The mire parameterization was implemented into TERRA in COSMO-RUSib
- The little improvement for T2m forecasts for area of northern western Siberia area was obtained. The tests for close areas with mire domination are in progress
- Code (modified TERRA) with documented additional lines available on request from alla.yurova@gmail.com
- Parameterization description submitted to WRR special issue
- Standing water version under development to implement rice paddies

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Some contributions from CLM Community

CLM Community

URBMIP

Name	TEB alongside TERRA_ML	TERRA-URB	TERRA-ML / BEP
Responsability	Kristina Trusilova	Hendrik Wouters	Sebastian Schubert
Features	inner building temperature snow model, water skin layer roofs/walls/roods, tiled urban fraction	Direct representation of the urban landcover in TERR-ML using a tile approach, new surface-layer transfer coefficients, thermal capacity, anthropogenic heat and impervious surface interception distribution	Street canyon model advanced double-canyon radiation scheme, shadows, radiation trapping, roof/wall/ground fluxes; coupled with the PBL scheme not only through surface fluxes but also by means of energy and momentum fluxes in layers above the surface
Input		Urban fraction (EEA), annual mean anthropogenic heat (NCAR)	Full 3D cityGML
References	Trusilova et al 2008, Masson 2001	Wouters et al. 2013, Wouters et al. 2012, Flanner 2010, Demuzere et al. 2008, De Ridder, 2012	Schubert et al. 2012, Martilli et al. 2002,Gröger et al. 2008
Aims	Urban climate of Europe and Germany	urban climate and its impact on Air-quality simulations Flanders Belgium	Urban climate of Berlin and Basel

CLM Community
TERRA_URB

- Urban parameterization in COSMO-CLM/TERRA-ML was successfully implemented and tested on 1km resolution over Belgium
- The temporal and spatial variatiability of the UHI intensity are very well reproduced
- Additional computational cost was negligible (+3% CPU-time)
- Number of needed extra parameters is small and readily available globally

➢ Proposal to the SMC to include this development in the official COSMO code (Kristina Trusilova from DWD as possible responsible person)

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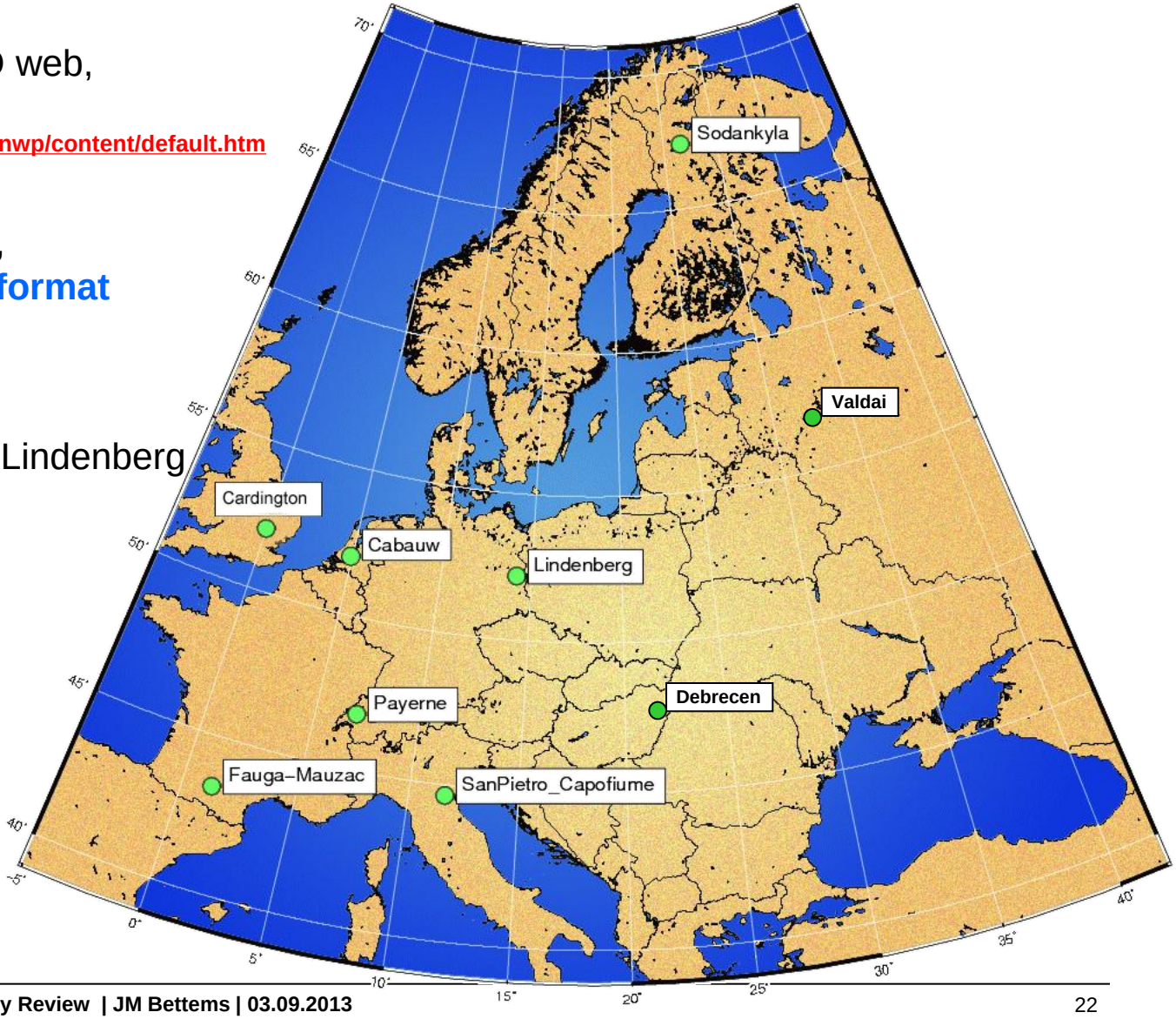
SRNWP data pool

Data pool action

- Access from COSMO web, password protected
  http://www.cosmo-model.org/srnwp/content/default.htm
- Currently **9 sites**, data from **2006-2012**, in a **common ASCII format**
- **Soil**, **surface** and **BL** observations
- Work done at DWD / Lindenberg (C.Heret)



Data pool action
Status

- Data available from start of the action to end 2012 from **Cabauw** (NL), **Capofiume** (IT), **Lindenberg** (DE), **Payerne** (CH), **Sodankyla** (FI)
- Waiting for (some) 2012 data from **Fauga-Mauzac** (FR), **Cardington** (GB)
- New site **Valdai** (RU)
  … but no fluxes measurements, no soil measurements
  … work in progress
- Very few data for **Debrecen** (HU)

Thank you for your attention!