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CONSORTIUM FOR SMALL SCALE MODELING
COSMO

COSMO Surface Aspects

Overview of WG3b activities

Detlev Majewski (DWD) on behalf of Jean-Marie Bettems (MeteoSwiss)

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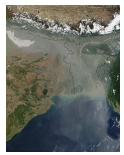
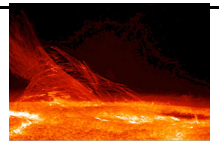
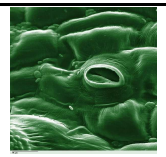
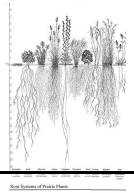
TERRA and external parameters at DWD

J.Helmert / DWD

Developments

parameter / model	COSMO	COSMO new	GME
aerosol 	Fixed (Tanre)	Climatology (Tegen)	Climatology (Tegen)
emissivity 	Constant	Field (land use based)	Field (land use based)
vegetation cycle 	Empirical function	NDVI climatology	NDVI climatology
minimum stomatal resistance 	Constant	Field (ECOCLIMAP)	Field (ECOCLIMAP)
vegetation albedo 	Constant	Field (forest)	Constant
root profile 	Uniform	Exponential	Exponential
minimum turbulent diffusion tkhmin, tkmmin (m^2/s)	1., 1.	0.1, 0.1	0.4, 1.

source of pictures: wikipedia

History

- Operational implementation in **GME :**
  vegetation climatology *(2007)*,
  aerosol climatology *(2009)*

- New **EXTPAR** software for external parameters
  Numerical experiments within the **COLOBOC** project (*2009-2011*)

- Experiments in parallel-suite of **COSMO-EU (7 km) 29.03. - 21.08.2012**
  (Reduced minimum diffusion coeff. since 19.06.2012)
- Experiments in parallel-suite of **COSMO-DE (2.8 km) 23.04. - 21.08.2012**
  (Reduced minimum diffusion coeff. since 19.06.2012)

COSMO-EU , 19.07. – 19.08.12

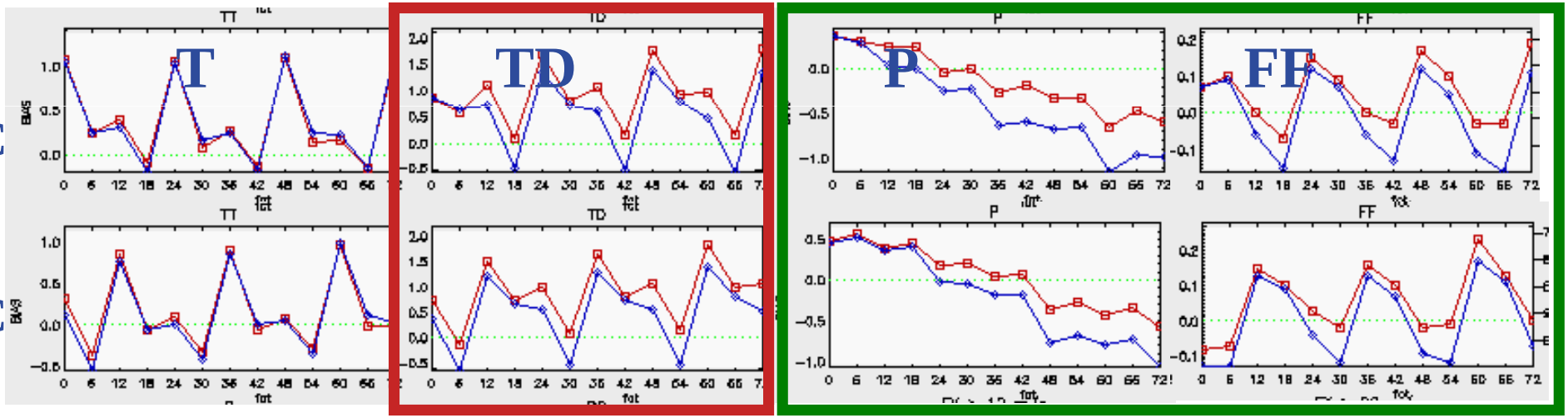
ROUTI vs. ROUTP

CONSORTIUM FOR SMALL SCALE MODELING
COSMO
Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

BIAS

00 UTC

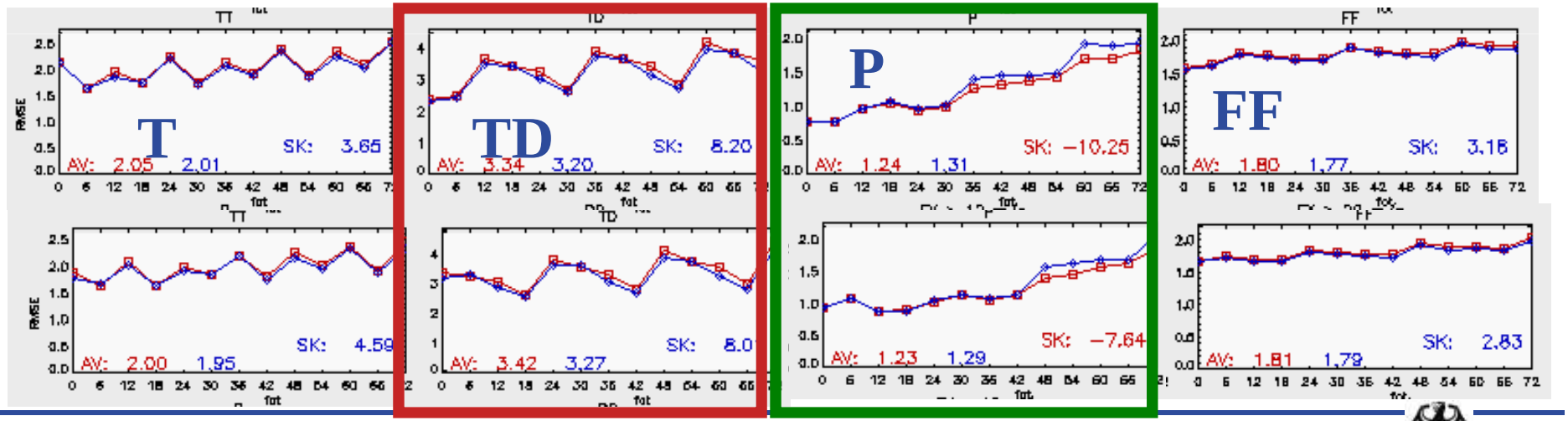
12 UTC



RMSE

00 UTC

12 UTC



Results

- More **realistic** physics package
- **Unified** package between GME and COSMO
- Improves **robustness** of forecasts in severe weather situations (consistency between successive runs)

- **Degraded** RMSE for T_2M and TD_2M
- **Improved** scores for pressure, mean wind bias and strong gusts

Other aspects

- MODIS based climatology of **surface albedo** (5km grid)
  - Neutral impact in COSMO-EU experiments
- Revision of **rainfall interception** is underway
  - Implemented, performance is being evaluated

- High resolution **soil data** (Harmonized World Soil Dattabase: http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/),
  - Currently no resources available
  - Status of work in the CLM community unclear

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Parameterization of mire in TERRA (COSMO Priority Task)

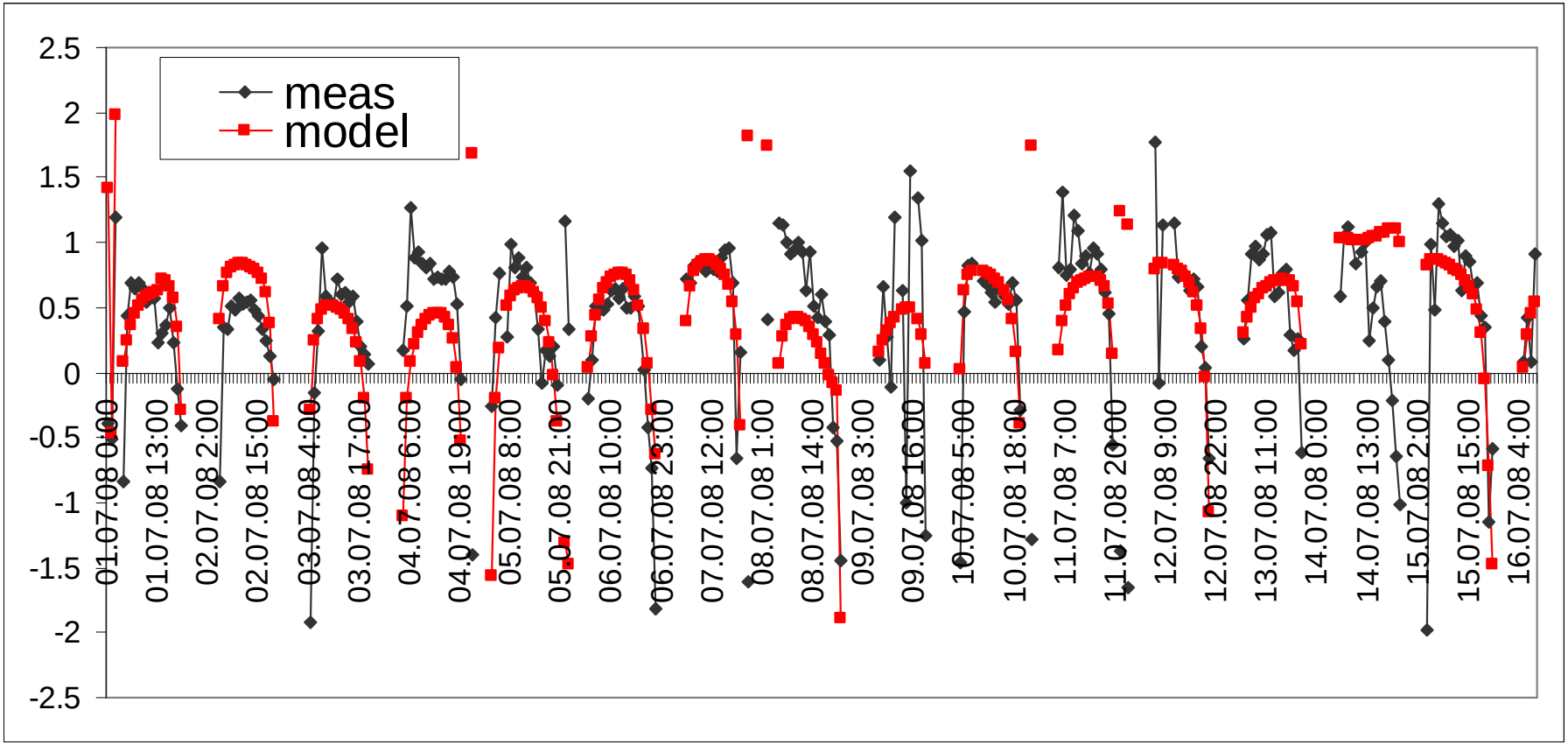
A.Yurova / RHM

Mire in TERRA

- ✓ Compilation of a **database** of the mire distribution based on satellite vegetation classification (GEM, Bartalev) and national peat surveys (Vompersky et al.)
- ✓ Prescription of **peat thermal properties** in TERRA with dependencies of thermal conductivity on soil water content using the organic soil thermal conductivity database
- ✓ Formulation of a **shallow water table** and modified **evapotranspiration**

- More advanced parameterization is **needed** for the vertical structure of **hydraulic conductivity and diffusivity**
- **Dynamic ground water table** available has a consequence of this Priority Task

Results: Bowen ratio Degero Stormyr mire, July 2008, SCLM simulations



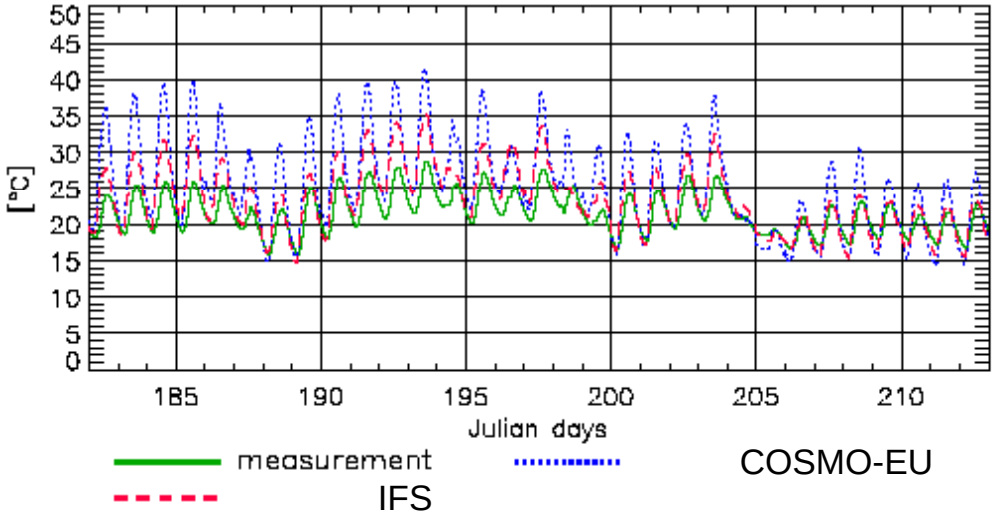
The influence of thermal soil and vegetation characteristics on the ground heat flux and temperature

J.-P. Schulz and G.Vogel / DWD

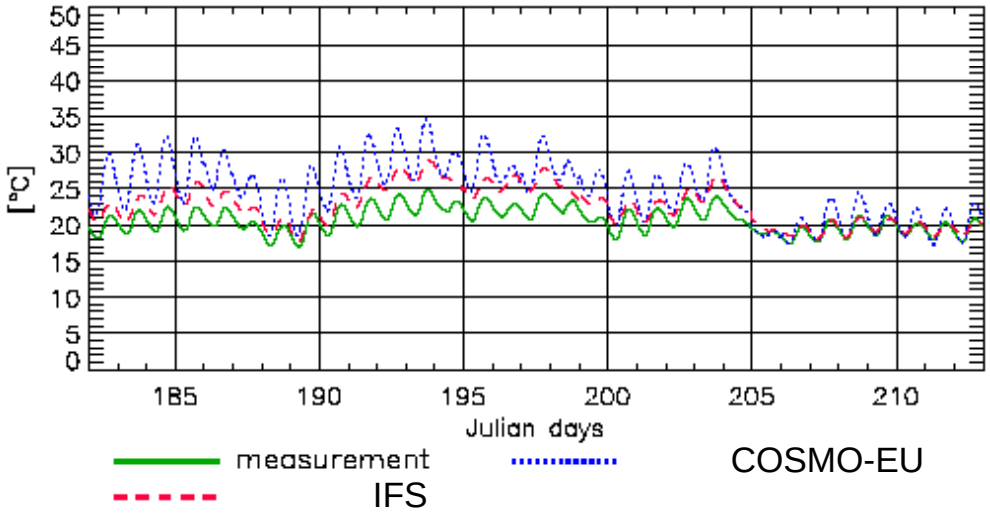
Monitoring, Validation and Development, I

J.-P. Schulz and G. Vogel

-6 cm



-18 cm



Lindenberg: July 2010

Soil temperature

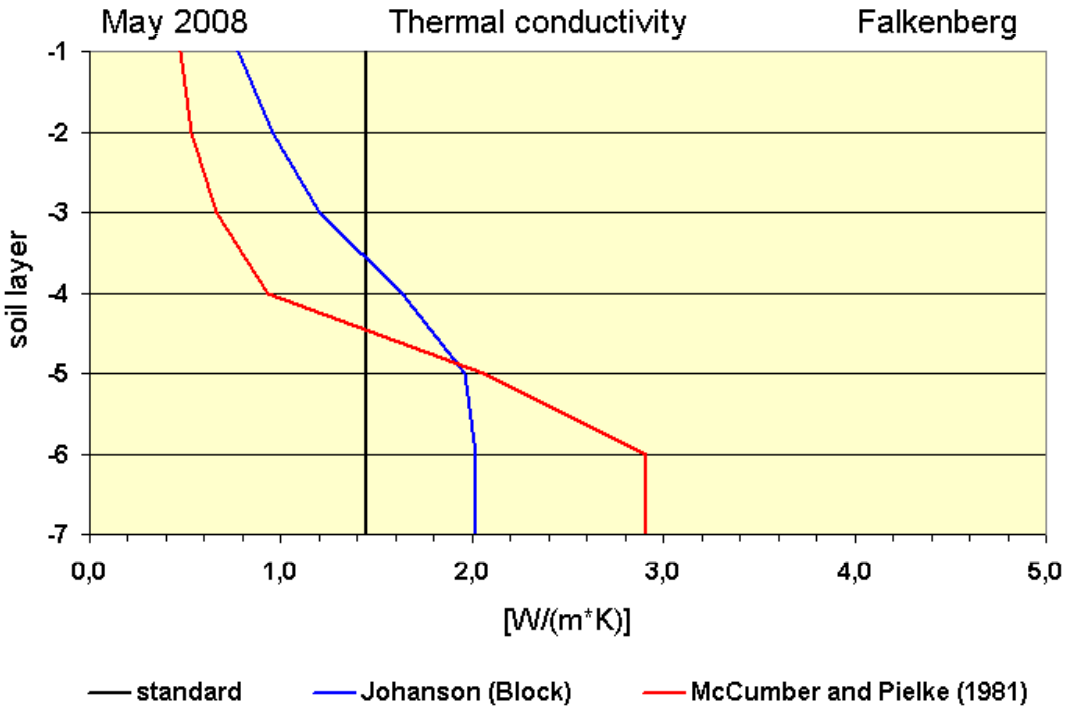
The amplitudes of the diurnal cycles of the soil temperature at different depths are largely overestimated in COSMO-EU. In the IFS model this error is also seen, but less pronounced.

This error is associated with an overestimation of the ground heat flux.

Monitoring, Validation and Development, II

J.-P. Schulz and G. Vogel

Thermal Conductivity



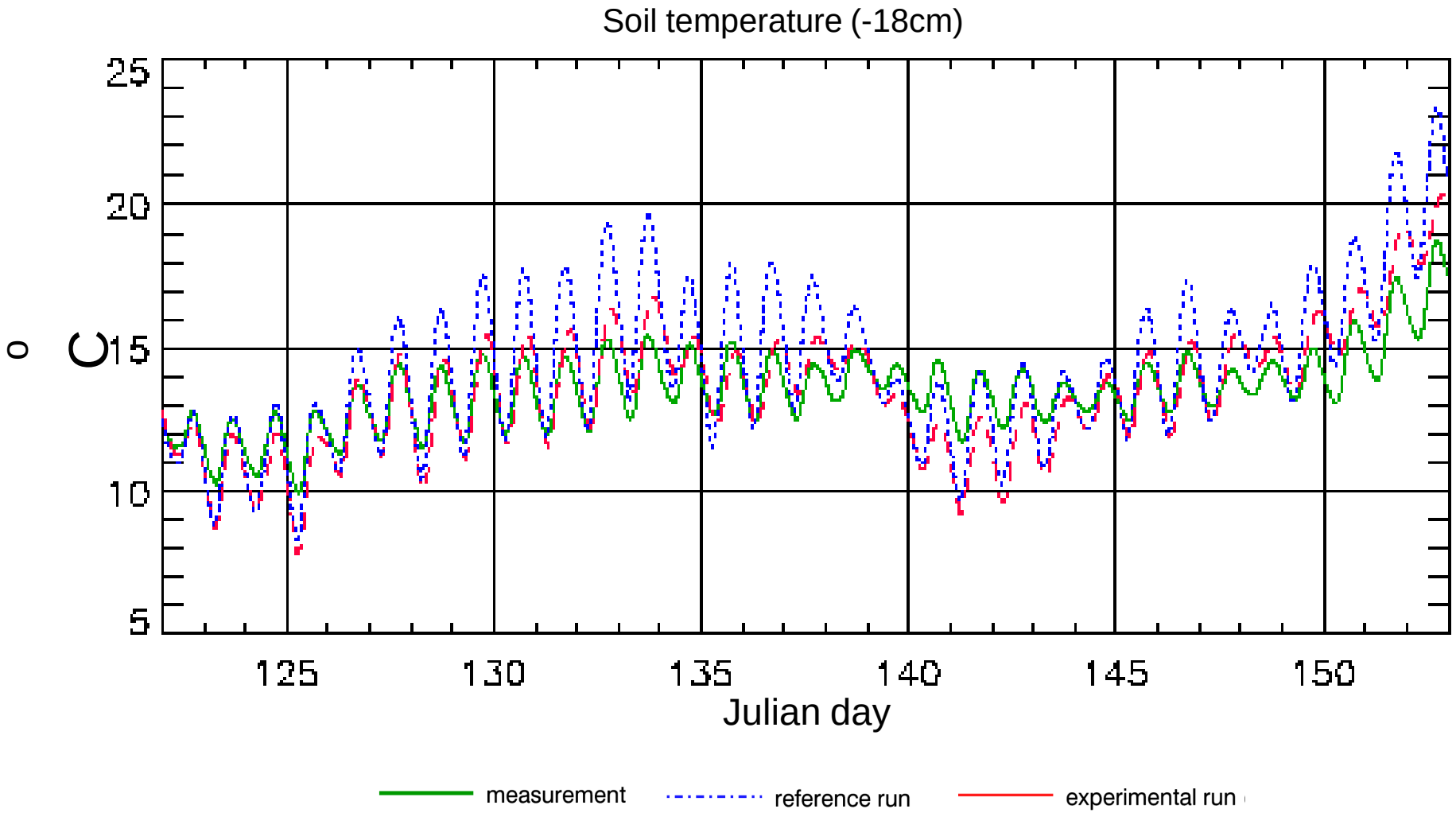
In the soil component of the COSMO model, the multi-layer TERRA scheme, the thermal conductivity is constant with time.
It represents a medium soil wetness, shown by the black line in the figure.

The blue and red curve show the vertical profile of the thermal conductivity, computed for the mean soil moisture profile for Falkenberg in May 2008.

Two different approaches were used, relating thermal conductivity to soil moisture content. In our offline simulation we used McCumber and Pielke (1981).

Monitoring, Validation and Development, III

Offline TERRA: Falkenberg May 2008



Two model modifications (**Shading and variable thermal conductivity**) give the best result for the soil temperature and its diurnal cycles.

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Snow and tiles

E.Machulskaya / DWD

Snow fraction

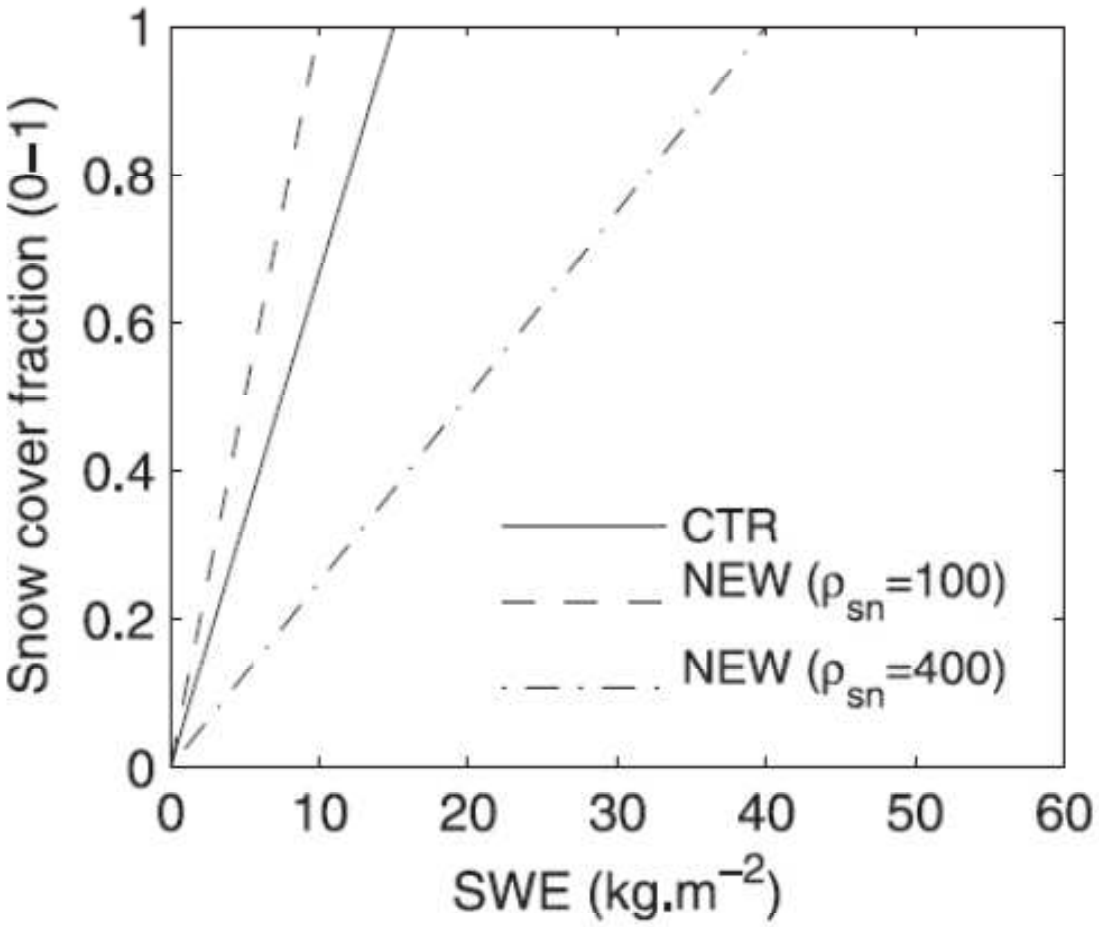


FIG. 2. Snow cover fraction as function of SWE as in the original HTESSEL snow scheme [solid line, Eq. (A2)], and new [Eq. (8)] for snow densities of 100 (dashed line) and 400 (dashed dotted line) kg m^{-3}.

Dutra et al. (2010)

$$f_{sn} = MIN\left(\frac{W_{sn}}{W_{cr}}, 1\right)$$

$$W_{cr} = 15mm$$

$$f_{sn} = MIN\left(\frac{W_{sn} / \rho_{sn}}{0.1}, 1\right)$$

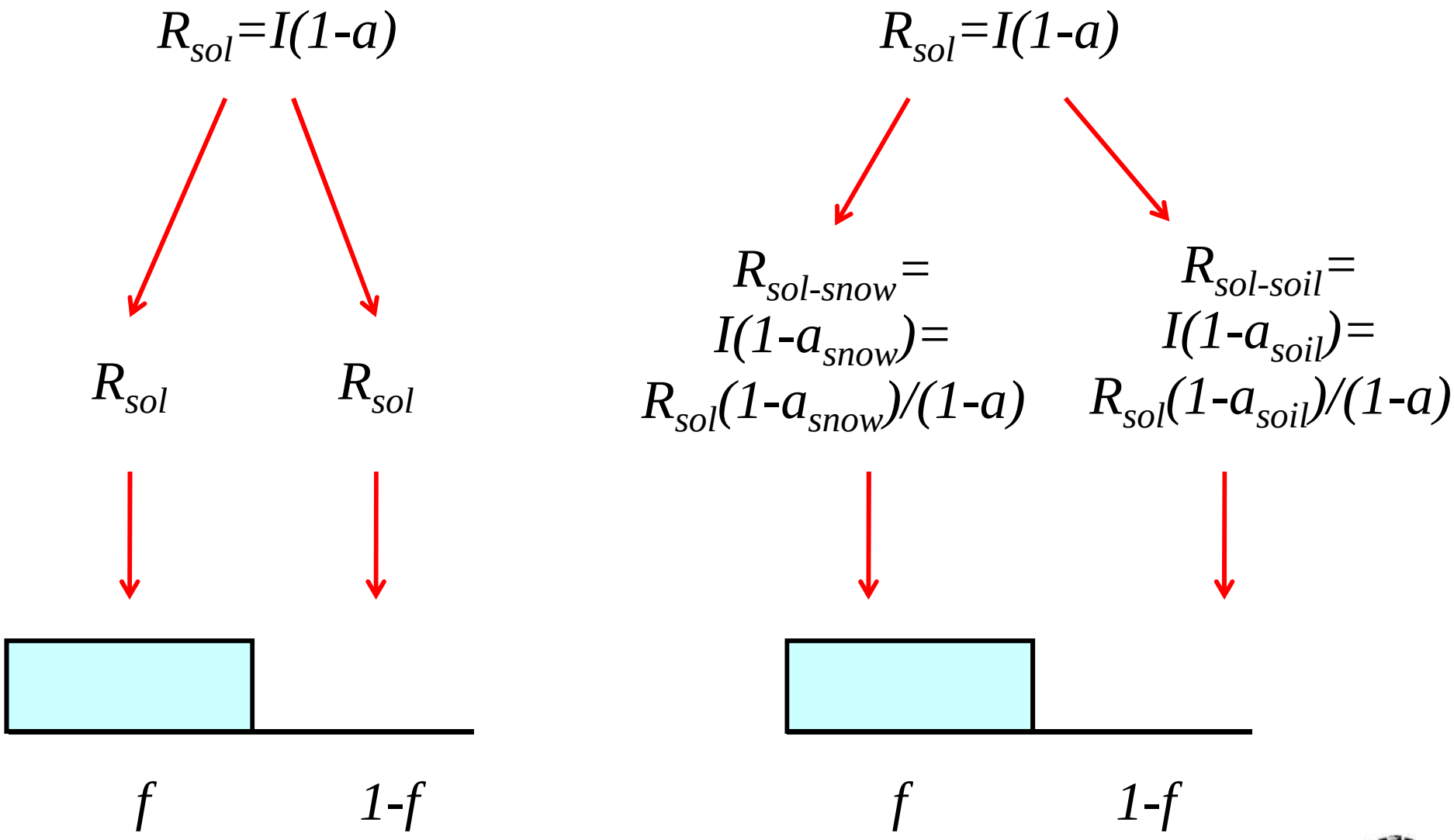
$$\Updownarrow$$

$$f_{sn} = MIN\left(\frac{H_{sn}}{H_{cr}}, 1\right)$$

$$H_{cr} = 0.1m$$

Distribution of the solar radiation

Albedo : $a = fa_{snow} + (1-f)a_{soil}$



Snow and tiles

- The dependence of **snow fraction** on snow height looks physically based; verification scores for COSMO-EU are positive; the new formulation is recommended.
- Experiments with **multi-layer snow model** are being performed, the results look satisfactory.
- **Tile approach** for snow is implemented into COSMO, the results of the experiments are being analysed. Full implementation is currently done for ICON.
- New **partitioning of the incoming solar radiation** between snow-covered and snow-free parts can be introduced; verification scores are neutral as compared to the routine.

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Other developments in the COSMO community

Developments at MeteoSwiss

- A master student will work at MeteoSwiss for **5 months,** starting mid of September 2012
  - The primary goal is to integrate the highly resolved topographic data **ASTER** (dx=30m) in the **EXTPAR** software
  - Depending on the remaining resources, more aspects of the external parameters could be tackled: parameters for **topo corrected radiation**, **scale separation** z0 / SSO

- Testing of a MODIS calibrated **phenology model** to better represent the inter-annual variability of the start of the vegetation season (R.Stöckli)

Developments at RHM

- **1d model** driven by SYNOP data for calculating snow water equivalent and **snow density** profiles

- Additional **plant level** (forest canopy) included in TERRA to **improve T2m skill in presence of partial snow cover**

Developments at IMGW

- Collaboration with the Institute of Agrophysics Polish Academy of Science to **replace TERRA with a completely new module**
  - Project planned for the period **08.2012 – 2015**
  - About **15** people involved

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Overview of ongoing land model developments within the CLM-Community

Synthesis collected by E. Davin

Sept. 2012

SOILVEG – TERRA

Person/institution in charge	Description of development	Version	Status
B. Ahrens (Uni Frankfurt)	New numerics for the Richards equation (necessary for multiple soil horizons and moving water tables)	Already implemented in TERRA stand-alone; will be tested in COSMO-CLM	Implementation in TERRA stand-alone in its final testing phase; implementation in COSMO-CLM in 2012
B. Ahrens (Uni Frankfurt)	Carbon cycle	Will be implemented first in TERRA stand-alone	to be finished June 2012 (stand-alone version)
B. Ahrens (Uni Frankfurt)	Dynamic vegetation	Will be implemented first in TERRA stand-alone	To be started in 2012
S. Schubert (PIK)	Urban scheme BEP (Martilli et al. 2002)	?	?
K. Trusilova (DWD)	Urban scheme TEB (Masson 2001)	COSMO-CLM v?	End 2012
H. Wouters (KU Leuven)	Urban parameterization into TERRA_ML (this includes thermal roughness lengths parametrization with the help of new stability functions momentum and heat. Albedo, emissivity and momentum roughness length will be derived from satellite data to represent urban surfaces)	TERRA stand-alone 4.11	Early 2013
J. Volkholz (PIK)	River routing model	?	?

SOILVEG – Community Land Model

Person/institution in charge	Description of development	Version	Status
E. Davin (ETHZ)	Community Land Model coupled to COSMO-CLM as subroutine	COSMO4.8-CLM11 CLM3.5	Implemented and evaluated
E. Davin (ETHZ)	Community Land Model coupled to COSMO-CLM using OASIS3 coupler	COSMO4.8-CLM19 CLM3.5/CLM4	Implemented and in testing phase, evaluated version end 2012

SOILVEG – VEG3D

Person/institution in charge	Description of development	Version	Status
G. Schaedler (KIT)	VEG3D coupled to COSMO-CLM as subroutine	COSMO4.8-CLM7	Implemented and under testing
G. Schaedler (KIT)	VEG3D coupled to COSMO-CLM with OASIS coupler	?	Planned

SOILVEG REQUEST

- Any **interest by the COSMO community** for some of these developments should be announced soon enough to plan the transfer of responsibility

- In this case a **focal point** should be nominated **within COSMO**, and this person should closely follow the concerned SOILVEG development

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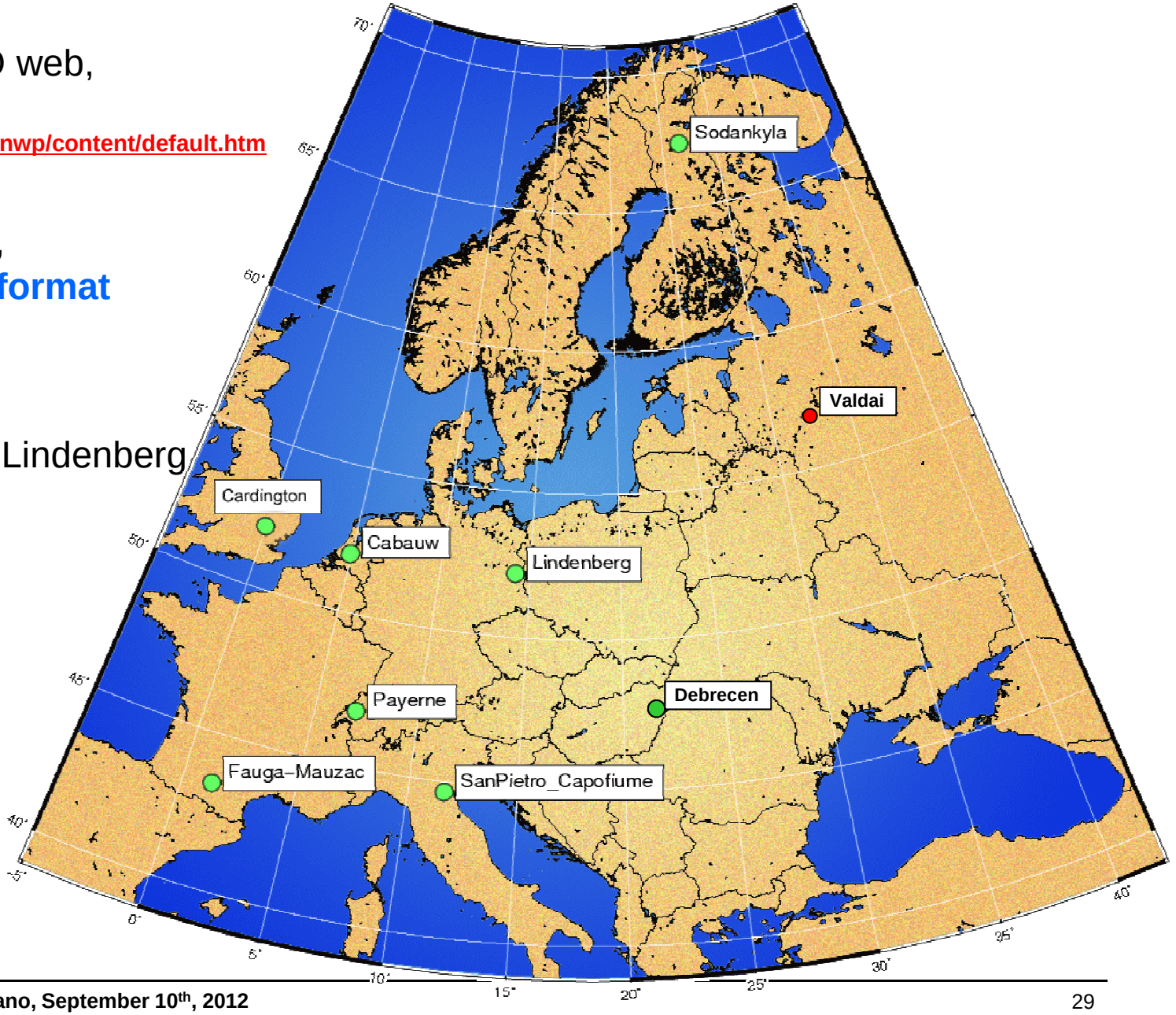
SRNWP data pool

Data pool action

- Access from COSMO web, password protected
  http://www.cosmo-model.org/srnwp/content/default.htm
- Currently **8 sites**, data from **2006-2011**, 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 2011 for **Payerne** (CH), **Capofiume** (IT), **Fauga-Mauzac** (FR), **Lindenberg** (DE)
- Waiting for 2011 data from **Debrecen** (HU), **Cabauw** (NL)
- Waiting for error correction of 2011 data from **Sodankyla** (FI)
- Sever quality issues with **Cardington** data (GB)

- Agreement for one new site **Valdai** (RU)

- **Use these data and send us feedback (srnwp_data_pool@cosmo-model.org) !**
- **Lobbying at the next EWGLAM meeting (data quality, importance of this action) !**

Thank you for your attention!

Consistent treatment of root parameterization

G.Vogel / DWD

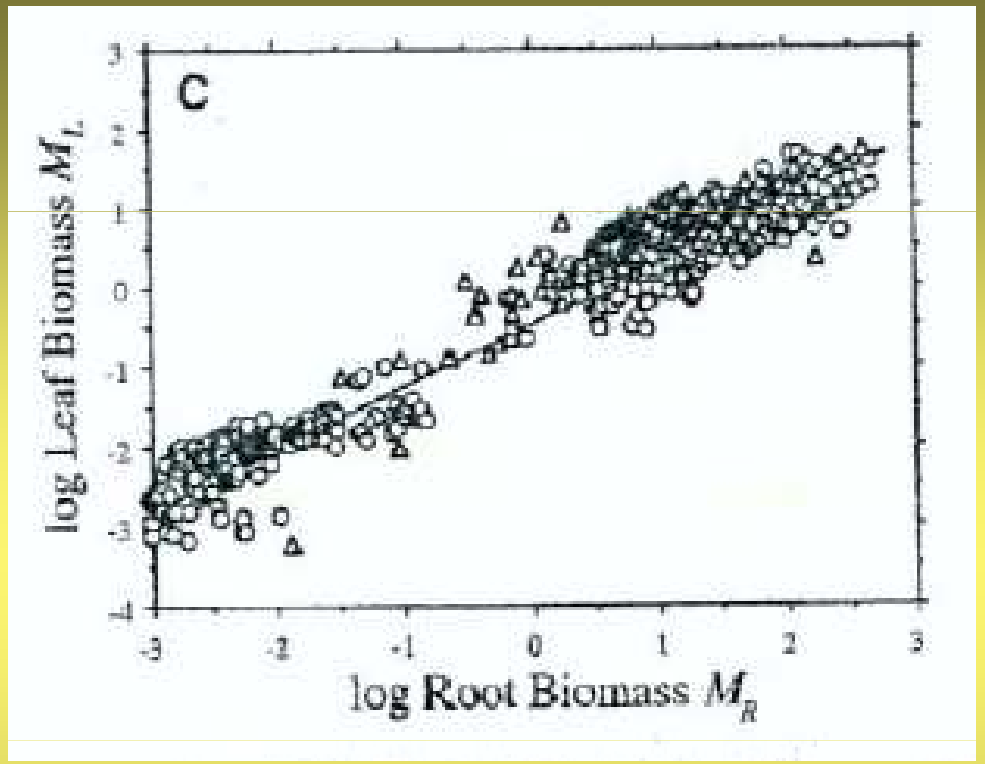
Root parameterization

Science 22 (2002), Vol. 295 no. 5559 pp. 1517-1520

Global Allocation Rules for Patterns of Biomass Partitioning in Seed Plants

Brian J. Enquist[1,2]* and Karl J. Niklas[3]

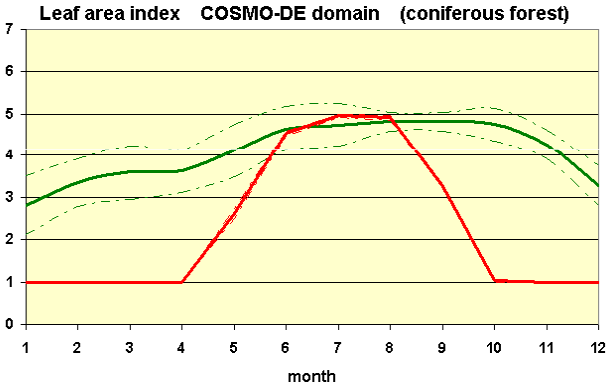
A general allometric model has been derived to predict intraspecific and interspecific scaling relationships among seed plant leaf, stem, and root biomass. Analysis of a large compendium of standing organ biomass sampled across a broad sampling of taxa inhabiting diverse ecological habitats supports the relations predicted by the model and defines the boundary conditions for above- and below-ground biomass partitioning. These canonical biomass relations are insensitive to phyletic affiliation (conifers versus angiosperms) and variation in averaged local environmental conditions. The model thus identifies and defines the limits that have guided the diversification of seed plant biomass allocation strategies.

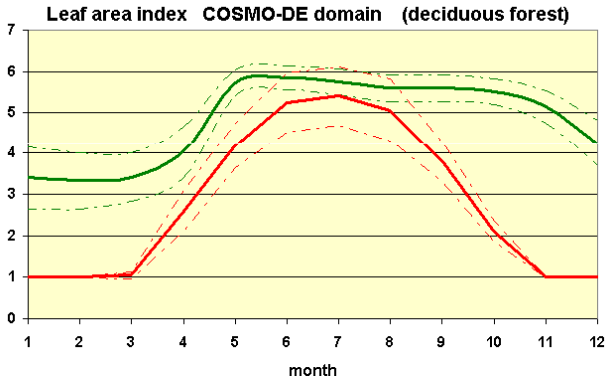


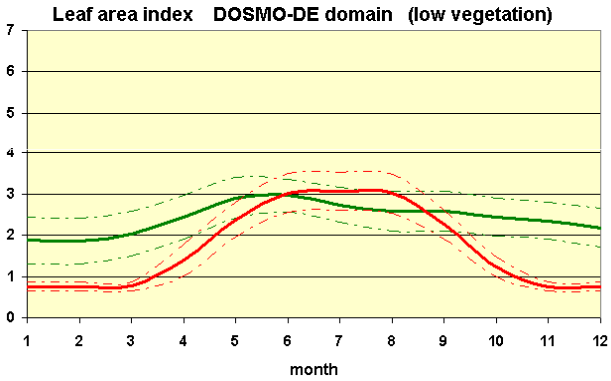
$$M_R \propto M_L^{4/3}$$

Root parameterization

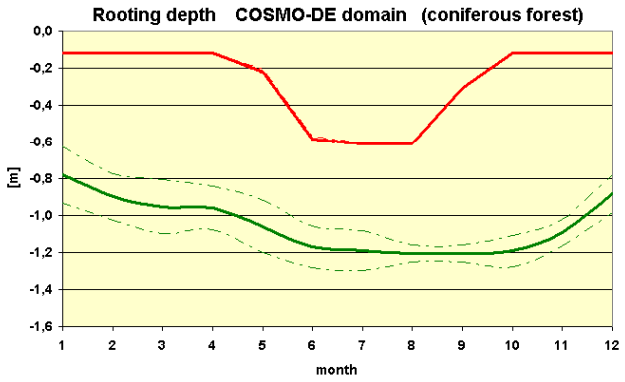
Leaf area index

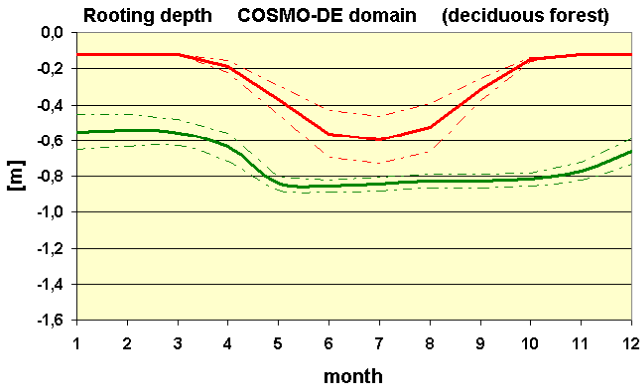


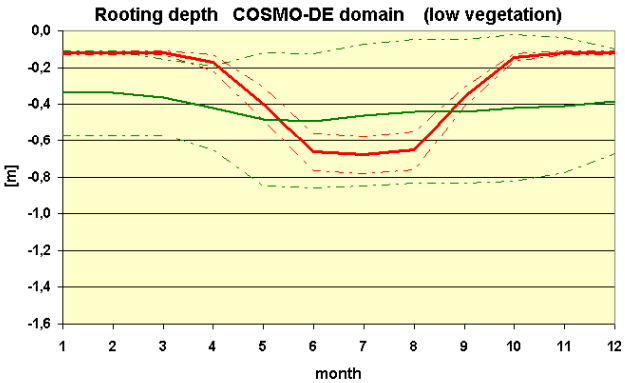




Root depth







Current parametrization

Arora and Boer (2003)

Root parameterization

- Based on an approach by Arora and Boer (2003) the **annual cycle of the rooting depth** is made consistent to LAI and plant cover by scaling the total root biomass with the ndvi-ratio.

- The current **transpiration scheme** of the TERRA module will be adapted to the new root parameterization.