



Max-Planck-Institut
für Meteorologie

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



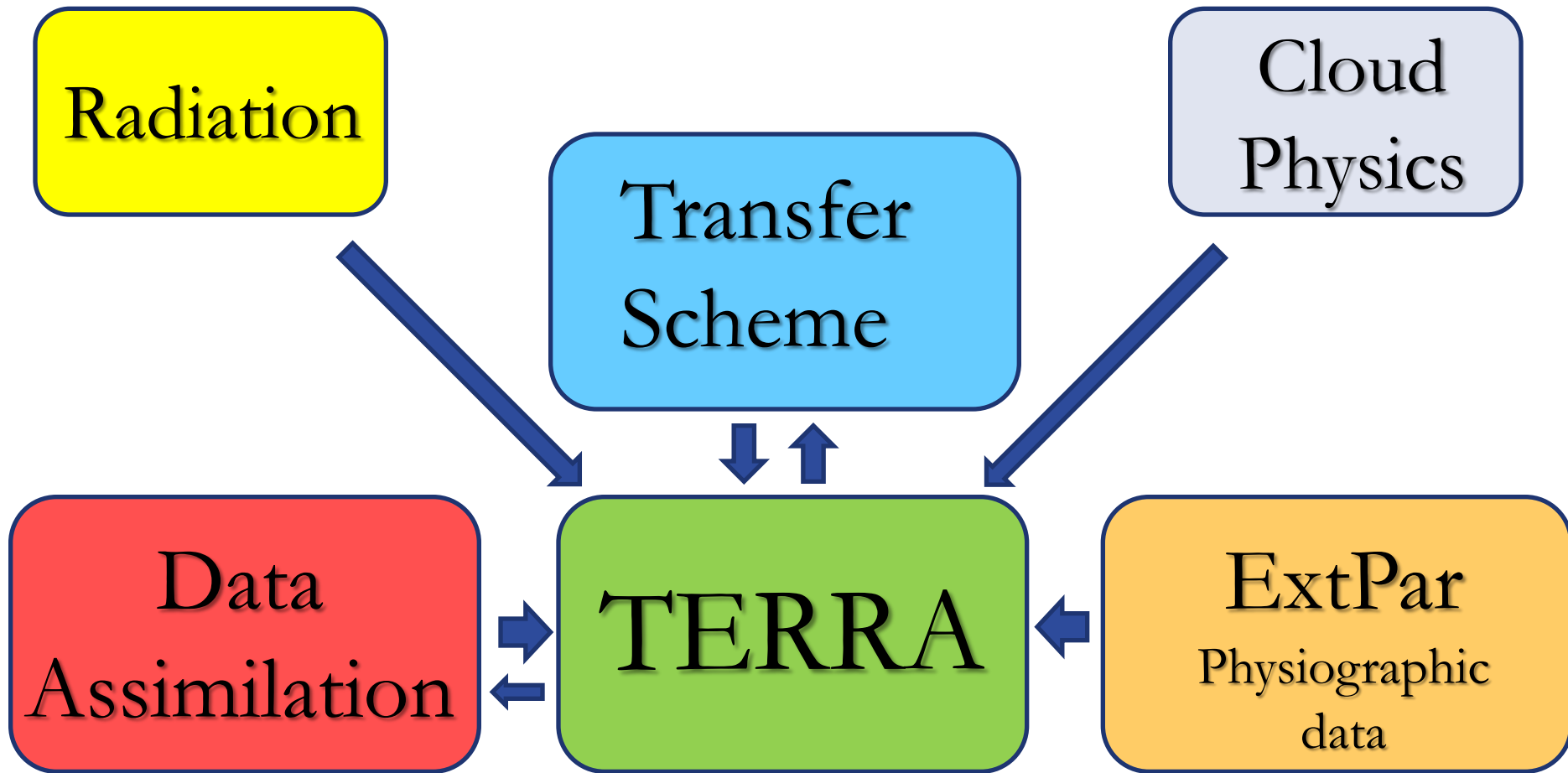
TERRA

Soil Vegetation Atmosphere Transfer
across
Models and Scales

COSMO/CLM/ART - User Seminar, WG3b, March 2015



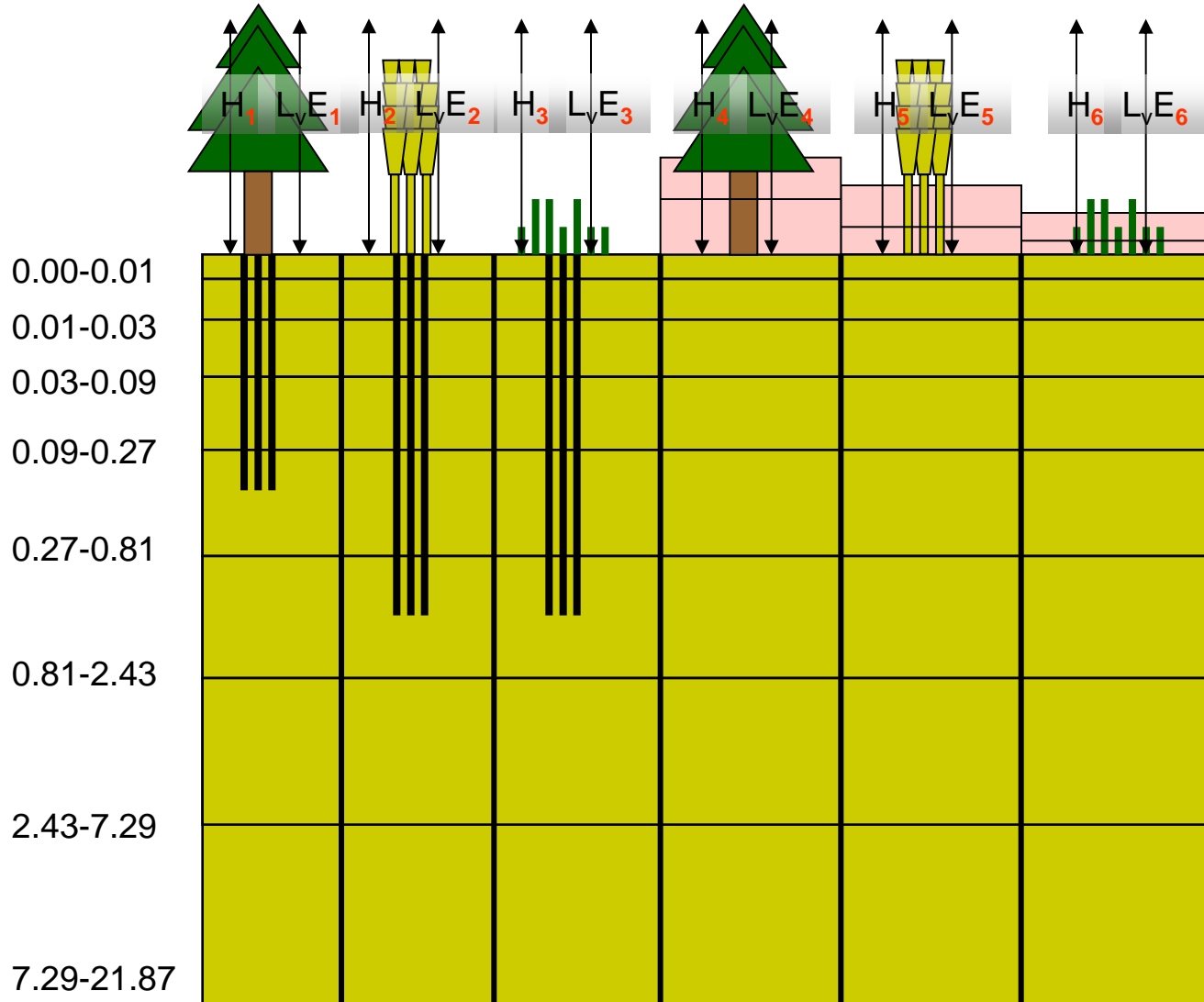
TERRA – Dependencies



Demand for ICON soil model developments results from COSMO/GME
drawbacks of the scheme

- TILE approach   



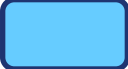





TERRA Tiles



Demand for ICON soil model developments results from COSMO/GME
drawbacks of the scheme

- TILE approach   









Demand for ICON soil model developments results from COSMO/GME
drawbacks of the scheme

- TILE approach   
- Multi-Layer Snow model 
- Improved soil heat conduction 
- Improved snow cover diagnostics 
- Advanced look-up table for land-use parameters 
- Exponential root density profile 

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- `llake = .true.`
- `itype_lndtbl = 3`
- `itype_root = 2`

- TILE approach implemented
- Multi-Layer Snow model improved
- Improved soil heat conduction
- Improved snow cover diagnostics
- Advanced look-up table for land-use parameters
- Exponential root density profile

Stronger coupling between TERRA , data assimilation and surface transfer scheme

- TILE approach in data assimilation    
- Snow analysis (Multi-Layer-Snow) + TILES  
- COST-ES1404 Snow  



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- About COST
- COST Actions**
- Participate
- Events
- Media
- e-COST**

- ▶ All Actions
- ▶ Biomedicine and Molecular Biosciences (BMBS)
- ▶ Chemistry and Molecular Sciences and Technologies (CMST)
- ▶ Earth System Science and Environmental Management (ESSEM)**
 - In Detail
 - **Actions**
- ▶ Food and Agriculture (FA)
- ▶ Forests, their Products and Services (FPS)
- ▶ Individuals, Societies, Cultures and Health (ISCH)
- ▶ Information and Communication Technologies (ICT)
- ▶ Materials, Physics and Nanosciences (MPNS)
- ▶ Transport and Urban Development (TUD)
- ▶ Trans-Domain Proposals

e-COST
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ESSEM COST Action ES1404


A European network for a harmonised monitoring of snow for the benefit of climate change scenarios, hydrology and numerical weather prediction

Descriptions are provided by the Actions directly via e-COST.

Snow cover is an essential climate variable directly affecting the Earth energy balance. Snow cover has a number of important physical properties that exert an influence on global and regional energy, water and carbon cycles. Its quantification in a changing climate is thus important for various environmental and economic impact assessments. Proper description and assimilation of snow cover information into hydrological, land surface, meteorological and climate models are critical to address the impact of snow on various phenomena, to predict local snow water resources and to warn about snow-related natural hazards. This induces a challenging problem of bridging information from micro-structural scales of the snowpack up to the grid resolution in models. European research teams have developed different snow measurement practices, instrumentation, algorithms and data assimilation techniques customised to their purposes. However, they lack harmonised approaches, validation and methodologies. The Action will co-ordinate efforts to address these issues, through establishing harmonized monitoring practices, enhancing the use of observations by promoting new observing strategies, bringing together different communities, facilitating data transfer, upgrading and enlarging knowledge through networking, exchange and training, and linking them to activities in international agencies and global networks.

Earth System Science and Environmental Management COST Action ES1404

- ▶ **Description**
- ▶ Parties
- ▶ Management Committee



General Information*

Chair of the Action:
[Dr Ali NADIR ARSLAN](#) (FI)

Vice Chair of the Action:
[Dr Patricia DE ROSNAY](#) (UK)

Science officer of the Action:
[Dr Deniz KARACA](#)

Administrative officer of the Action:
[Ms Tania GONZALEZ OVIN](#)

Downloads*

- [Action Fact Sheet](#)
- [Download AFS as RTF](#)
- [Memorandum of Understanding](#)
- [Download MoU as PDF](#)

Websites*

Domain website:
<http://www.cost.eu/essem>














* content provided by e-COST.
Data is synchronised once per night.

Working Group 3

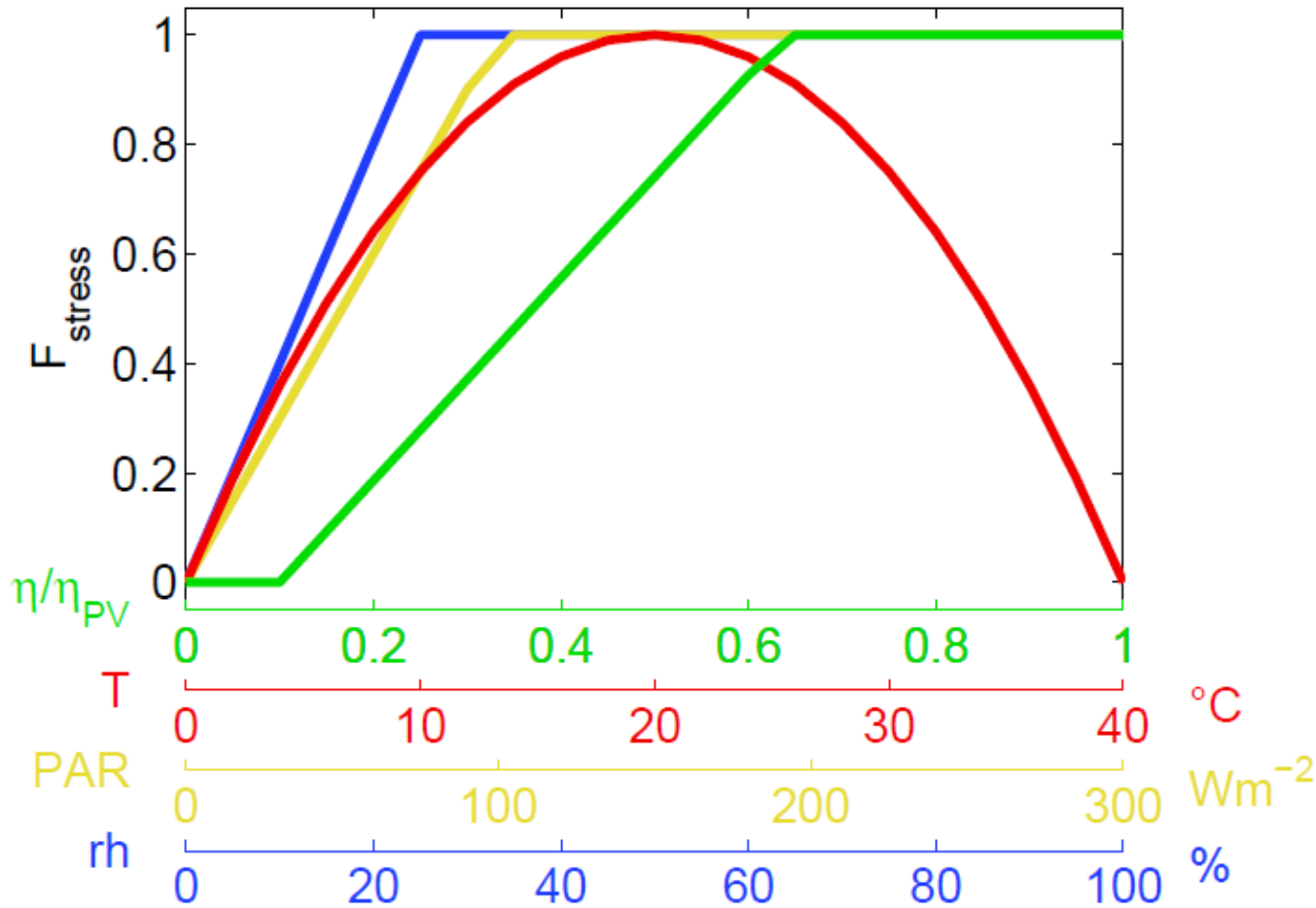
- Review of DA methods for snow
- combining remote sensing with in-situ measurements
- including national measurement networks



Stronger coupling between TERRA , data assimilation and surface transfer scheme

- TILE approach in data assimilation    
- Snow analysis (Multi-Layer-Snow) + TILES  
- COST-ES1404 Snow  
- Resolved roughness layer for canopy   
- Consideration of ambient humidity in plant stomatal resistance  

TERRA – Outlook

















(Ament, 2006)

$$r_{stom}^{-1} = r_{stom}^{max-1} - \left(r_{stom}^{min-1} - r_{stom}^{max-1} \right) F_{rad} F_{\eta} F_{temp} F_{hum}$$



Stronger coupling between TERRA , data assimilation and surface transfer scheme

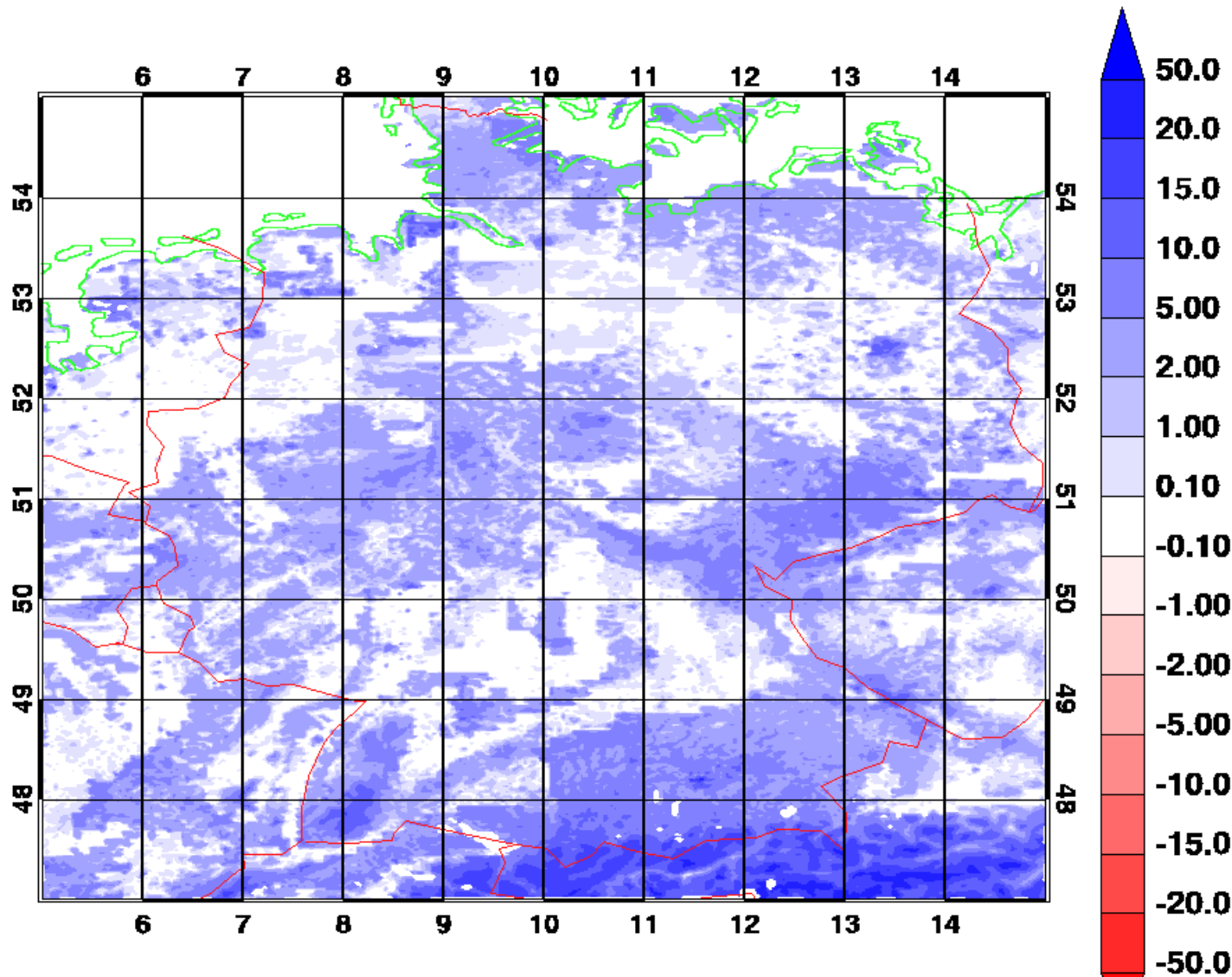
- TILE approach in data assimilation    
- Snow analysis (Multi-Layer-Snow) + TILES  
- COST-ES1404 Snow  
- Resolved roughness layer for canopy   
- Consideration of ambient humidity in plant stomatal resistance  
- Improved physiographic data (SRNWP collaboration) 
- Common interface (JSBACH,CLM, Veg3d) and offline mode

Revised Infiltration

- COSMO-DE changed land-use data set 20120418
- Enhanced LAI in GlobCover increased evapotranspiration
- Problem: dry out of root zone soil possible
- Shutdown of latent heat flux
- Solution: Enhanced infiltration parameterization
- Experiment start 2013040100 – 5 months assimilation
- Full experiment start 2014051000 for summer 2014 V5.0.1.1

Revised infiltration

FRAC W SO - PWP [%] LV 5 2013082300 Imk DWD
mean: 2.98 std: 3.90 min: -0.00 max: 28.80

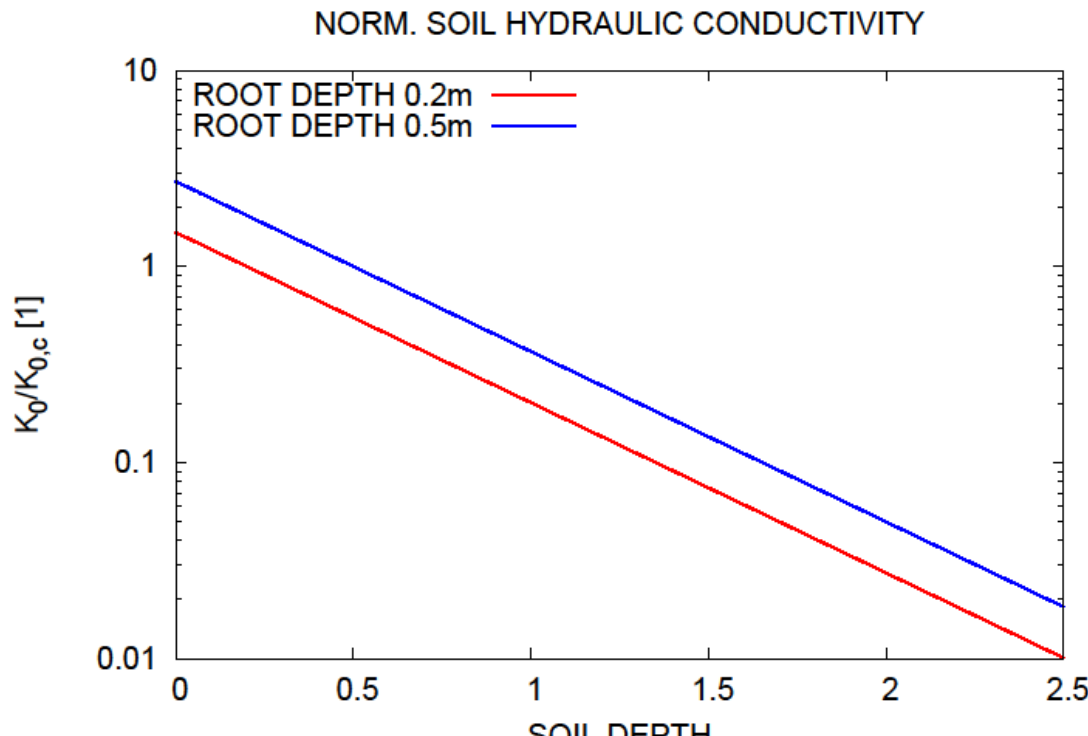


Revised infiltration

$$I'_{max} = \begin{cases} f_r S_{orc} \rho_w K_0(z) & 0 : T_{sfc} \leq T_0 \\ & : T_{sfc} > T_0 \end{cases} \quad (10.3)$$

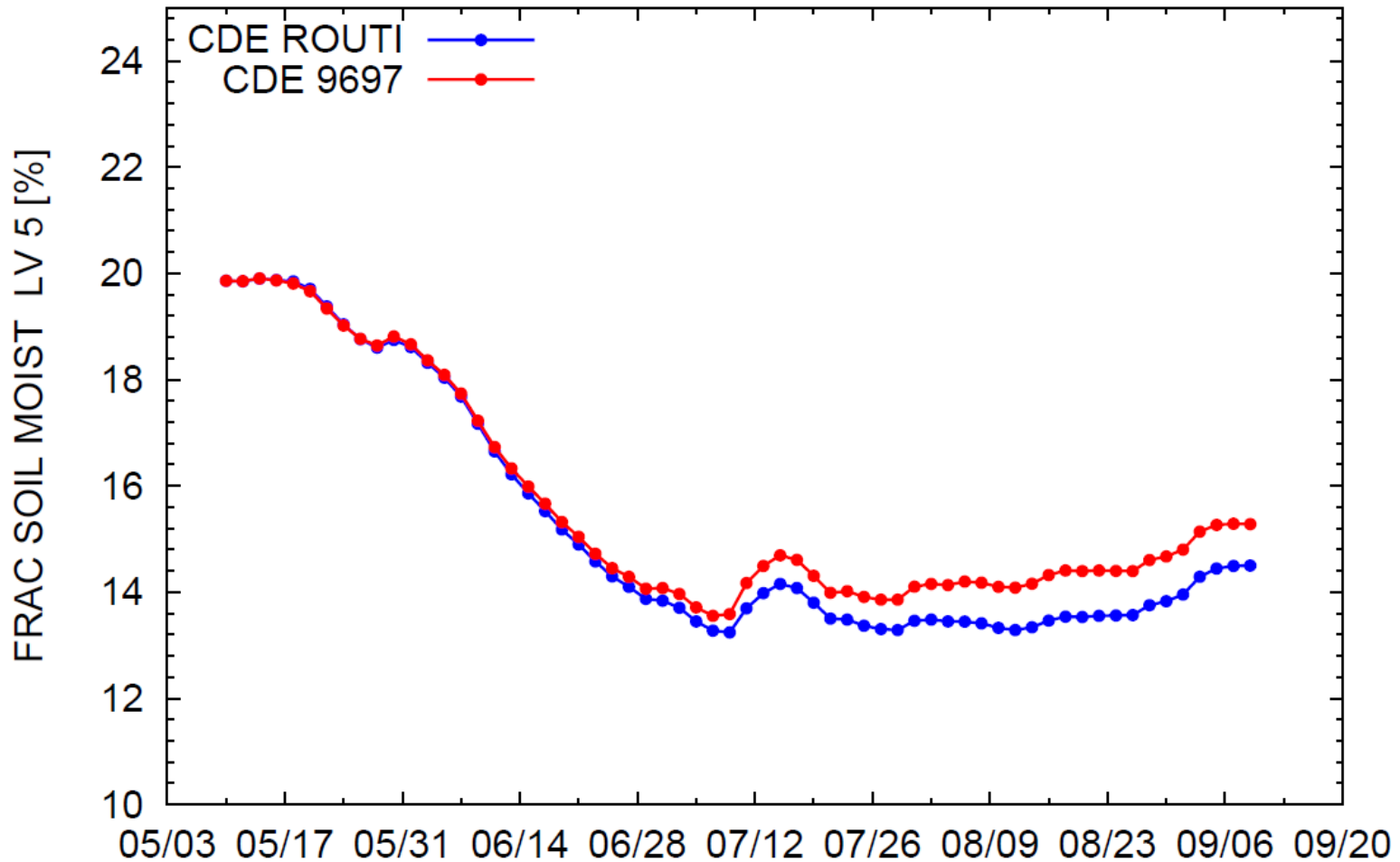
$$K_w(w_l) = K_0(z) \exp \left[K_1 (w_{PV} - \bar{w}_l) / (w_{PV} - w_{ADP}) \right]$$

$K_0(z) = K_{0,c} e^{-f(z-d_c)}$ Profile of sat. hydr. conductivity, Decharme (2006)



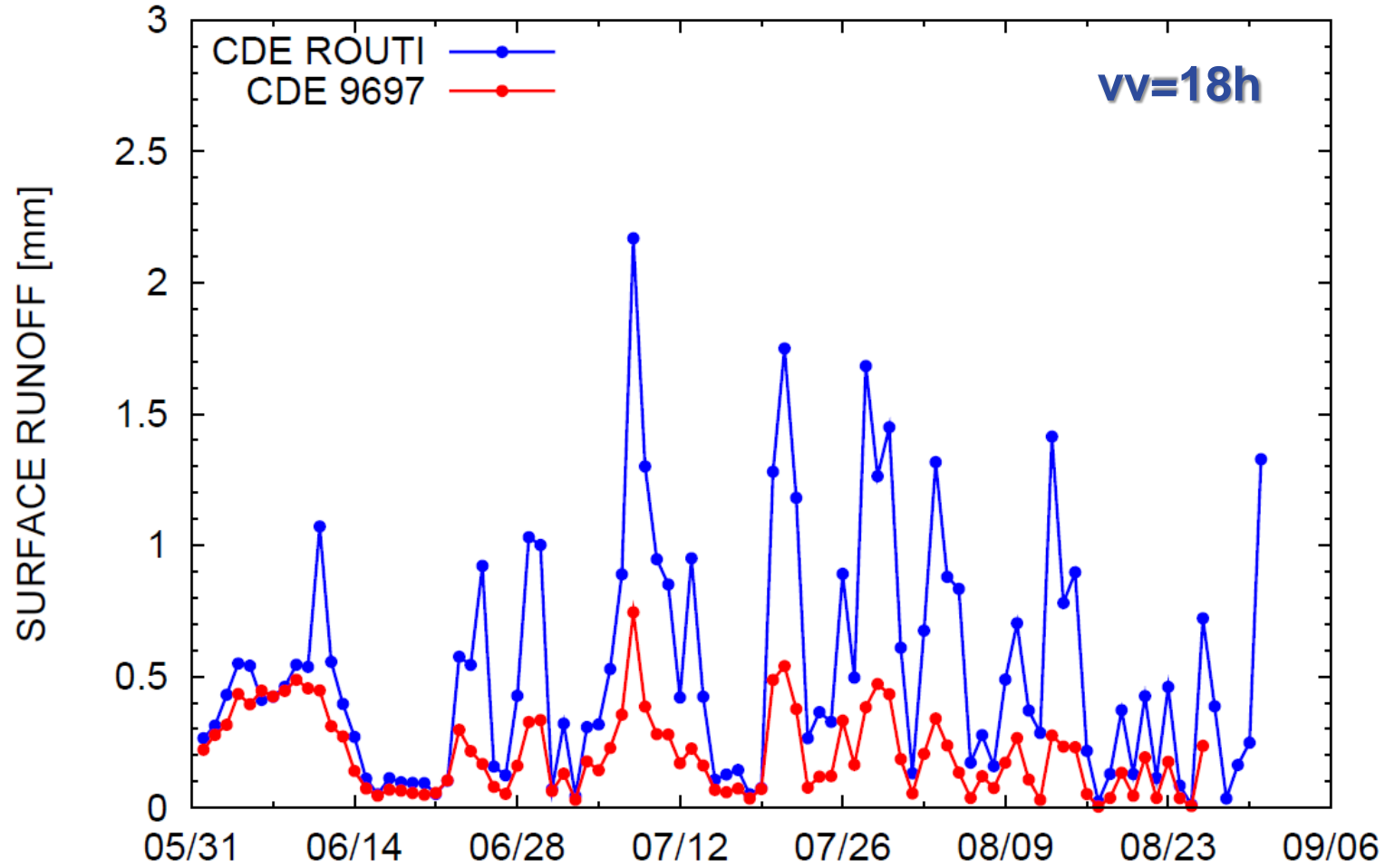
Revised infiltration CDE- domain average

FRACTIONAL SOIL MOISTURE 2014



Revised infiltration CDE- domain average

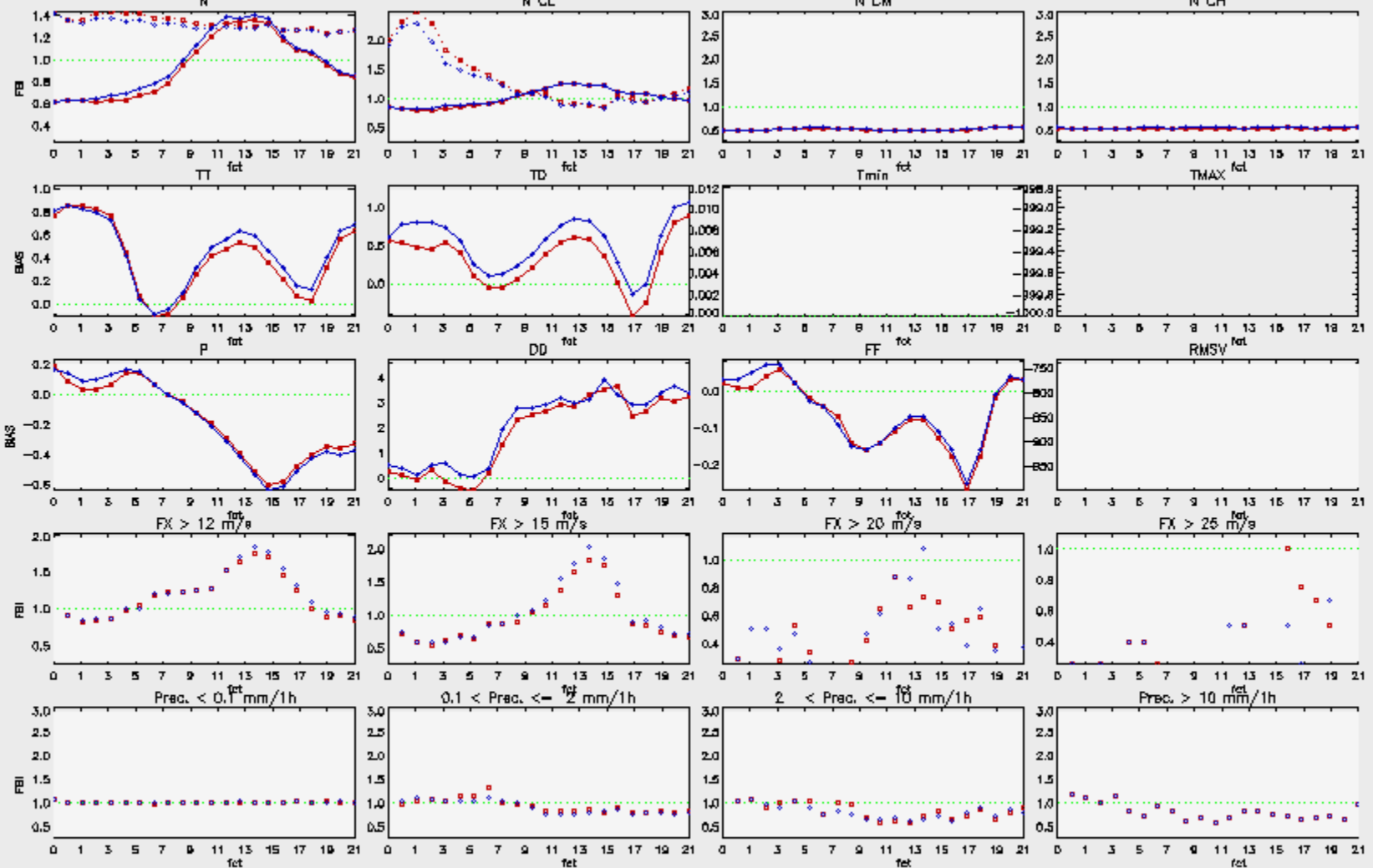
RUNOFF 2014



Revised infiltration CDE- Verification



LM3MO: 10.05.2014 00 UTC – 10.09.2014 00 UTC (exp. run 9697_national: Bodeninfiltration ohne SMA, COSMO-DE)
 lm3mo: 10.05.2014 00 UTC – 10.09.2014 00 UTC (ope. run LON: 02.98 – 19.84 LAT: 44.77 – 56.14: nearest gridpoint)



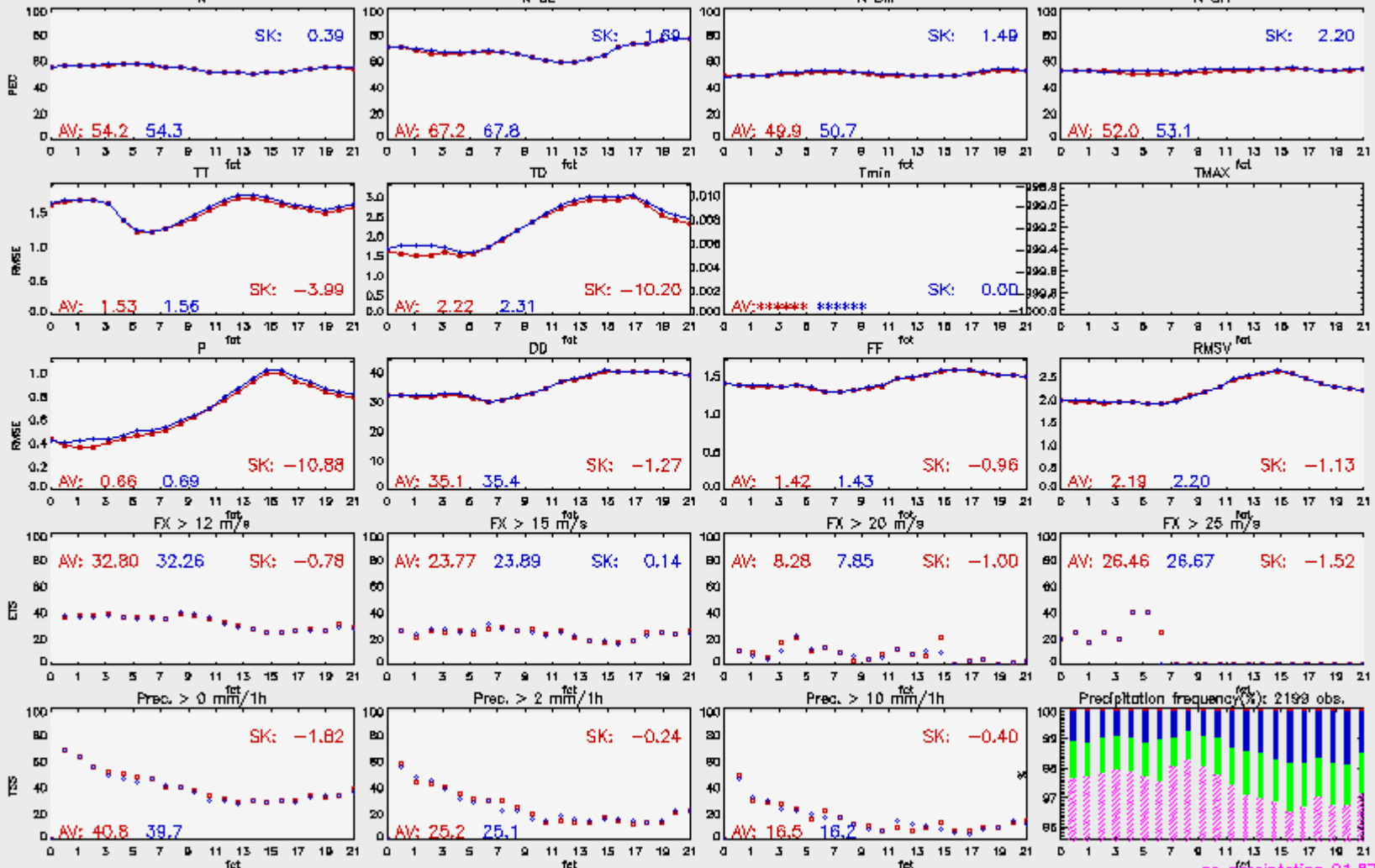
Results of verification of forecasts for local weather elements at surface stations
 FBI for cloud covers gusts and precipitation (cloud covers dotted: below 3 octa, solid: above 6 octa), BIAS for other elements
 All stations



Revised infiltration CDE- Verification



LM3MO: 10.05.2014 00 UTC – 10.09.2014 00 UTC (exp. run 9697_national: Bodeninfiltration ohne SMA, COSMO-DE)
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Results of verification of forecasts for local weather elements at surface stations
 TSS for precipitation, ETS for gusts, percent correct for cloud covers, RMSE for other elements

no precipitation 91.87%
 0.1–2 mm: 5.58%
 3–10 mm: 1.28%
 > 10 mm: 1.28%

Revised infiltration CDE- Verification

Legend

EXP 9697

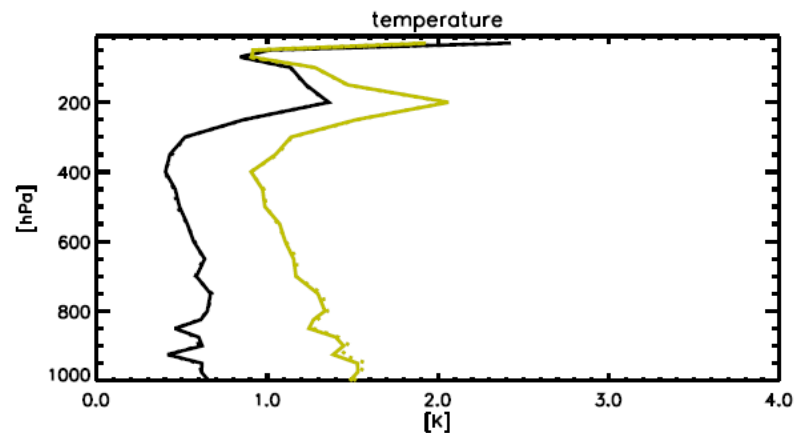
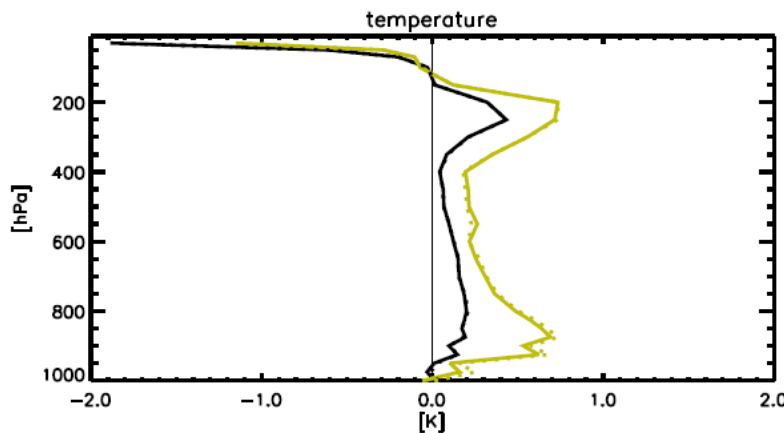
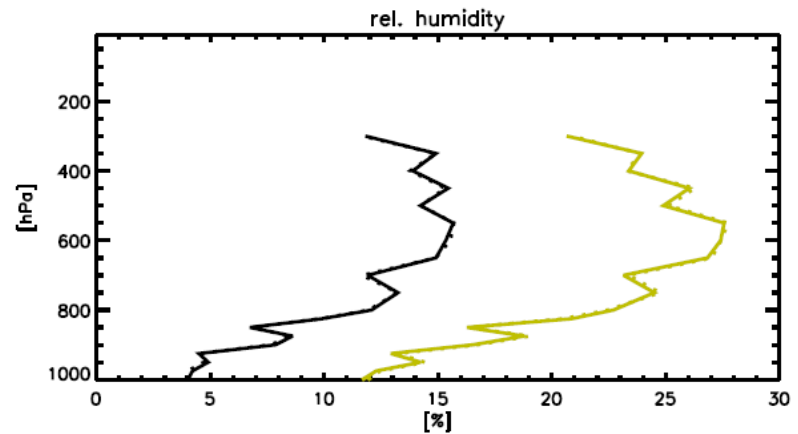
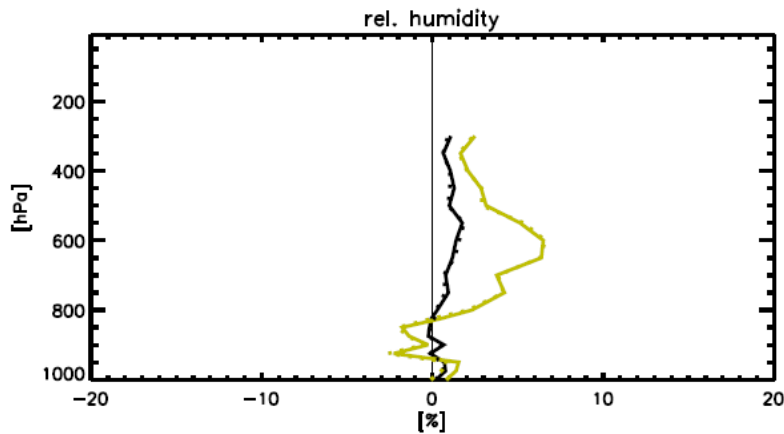
— + 24 H
 — + 00 H

Routine

⋯ + 24 H
 ⋯ + 00 H
 — Observation

LMK Temps (All)
 Column 1: MEAN ERROR (model - obs)
 Column 2: ROOT MEAN SQUARE ERROR
 Averaging Period:
 140511 - 140910 00 UTC

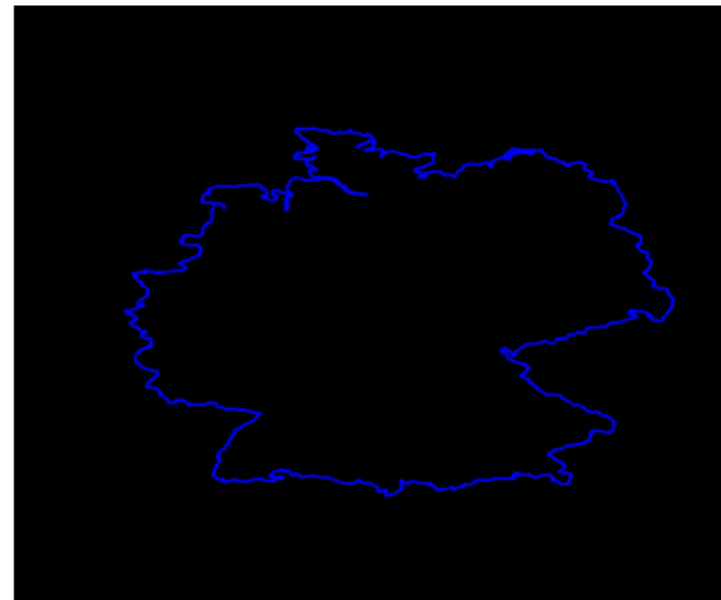
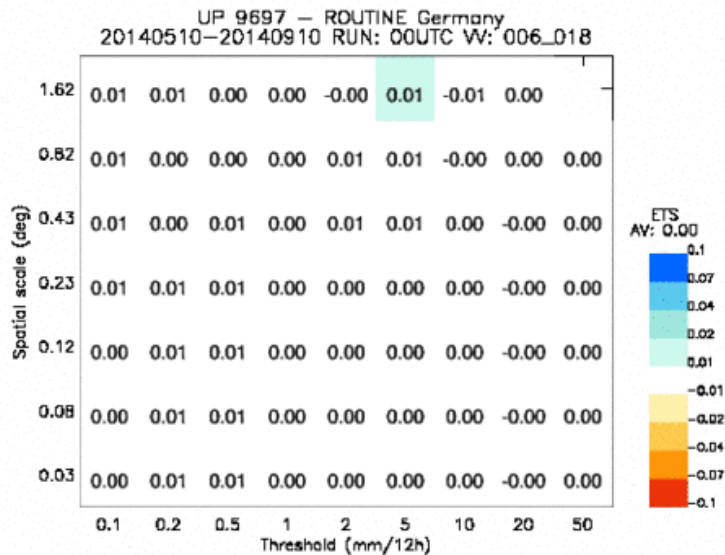
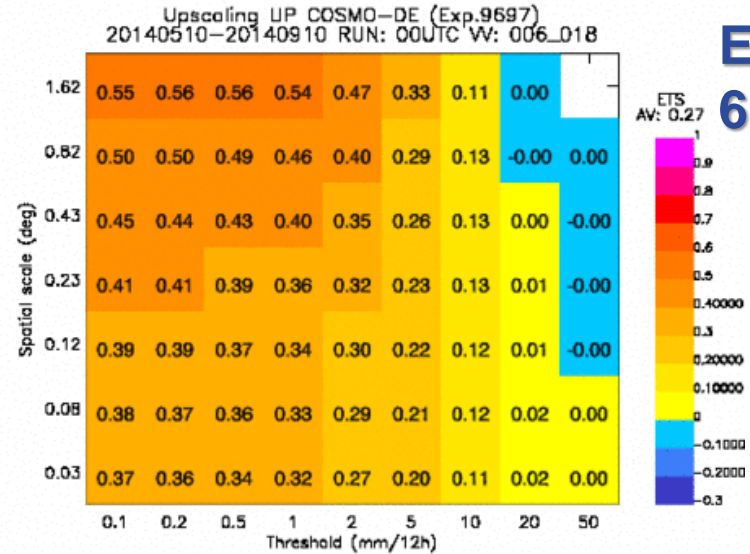
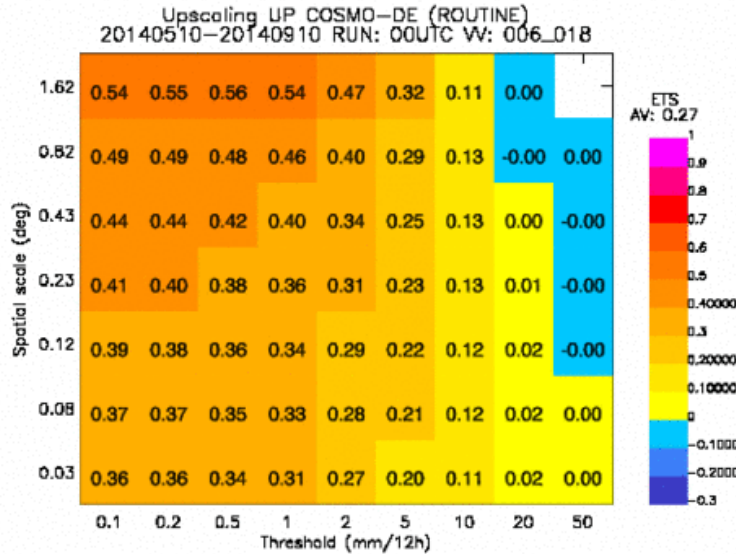
created at Mon Oct 6 12:16:18 2014 by Deutscher Wetterdienst



Revised infiltration CDE- Verification



**ETS Precip
6-18 UTC**





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TERRA

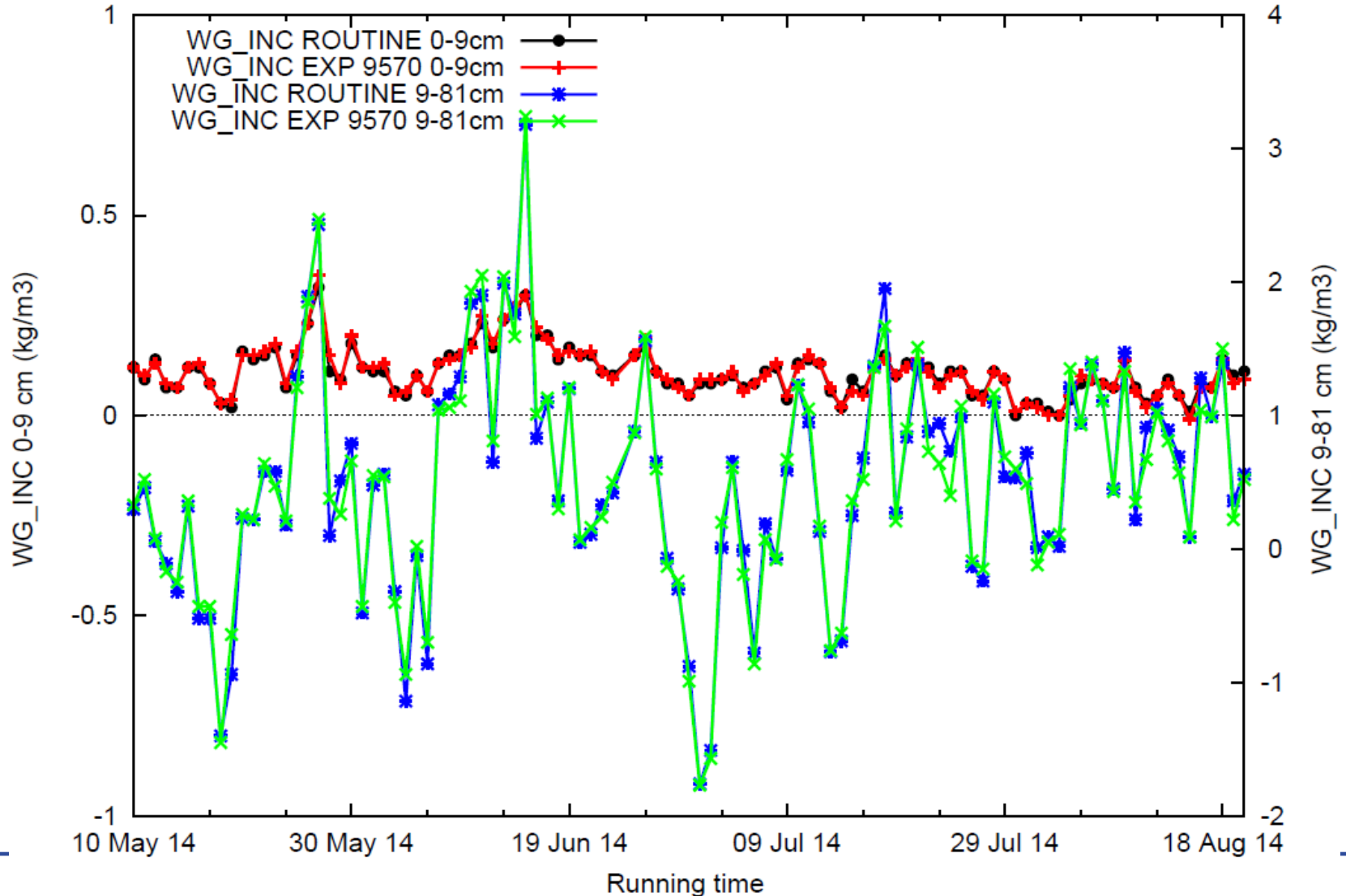
Soil Vegetation Atmosphere Transfer
across
Models and Scales

ICON-Meeting, Hamburg, 2015



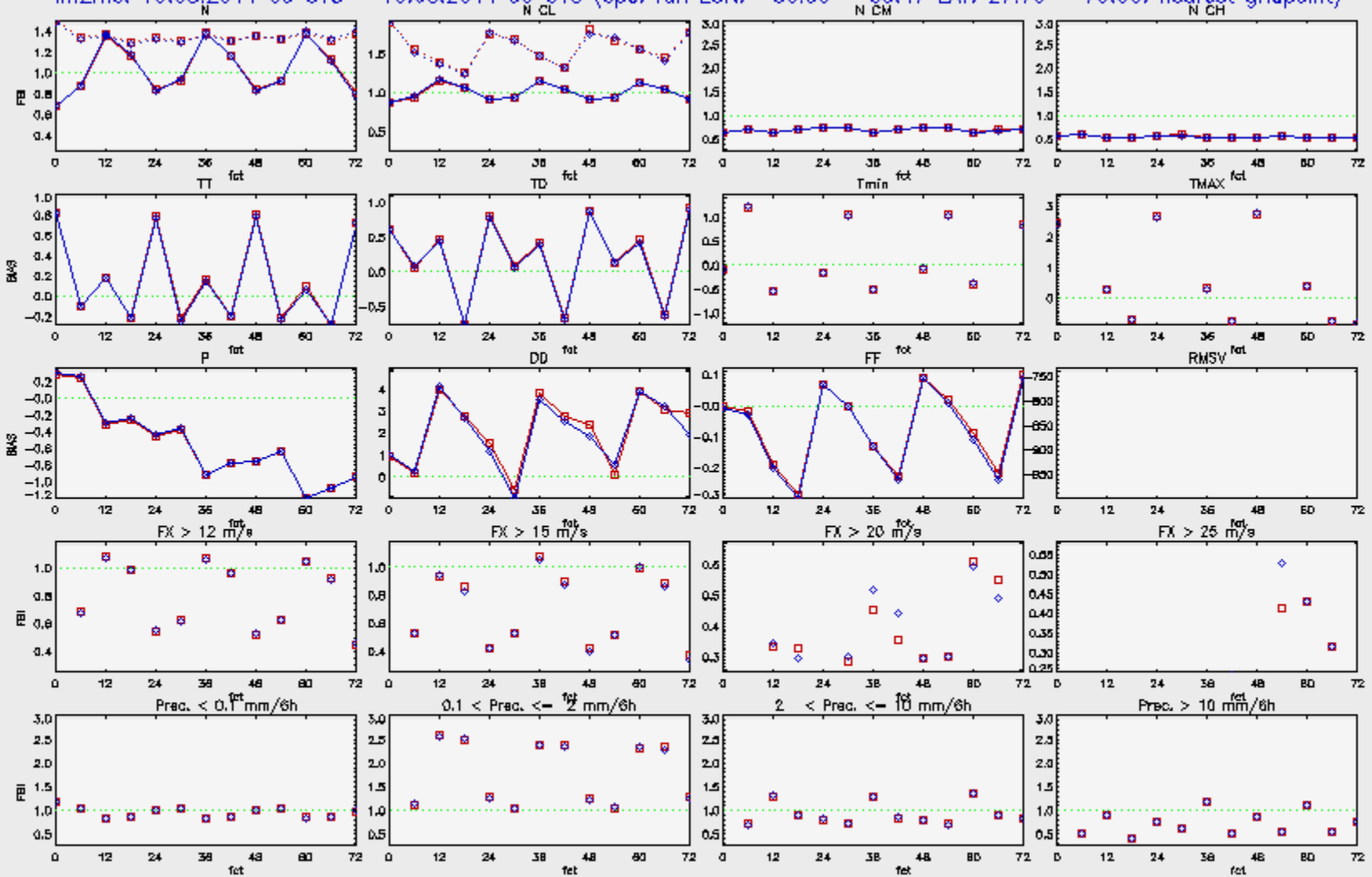
Revised infiltration CEU- SMA increments

Top and bottom layer soil moisture increment, C-EU domain



Revised infiltration CEU- Verification

LM2MO: 10.05.2014 00 UTC – 10.08.2014 00 UTC (exp. run 9570: GlobCOVER+increased Infiltration)
 lm2mo: 10.05.2014 00 UTC – 10.08.2014 00 UTC (ope. run LON: -30.00 – 63.47 LAT: 27.70 – 70.00: nearest gridpoint)



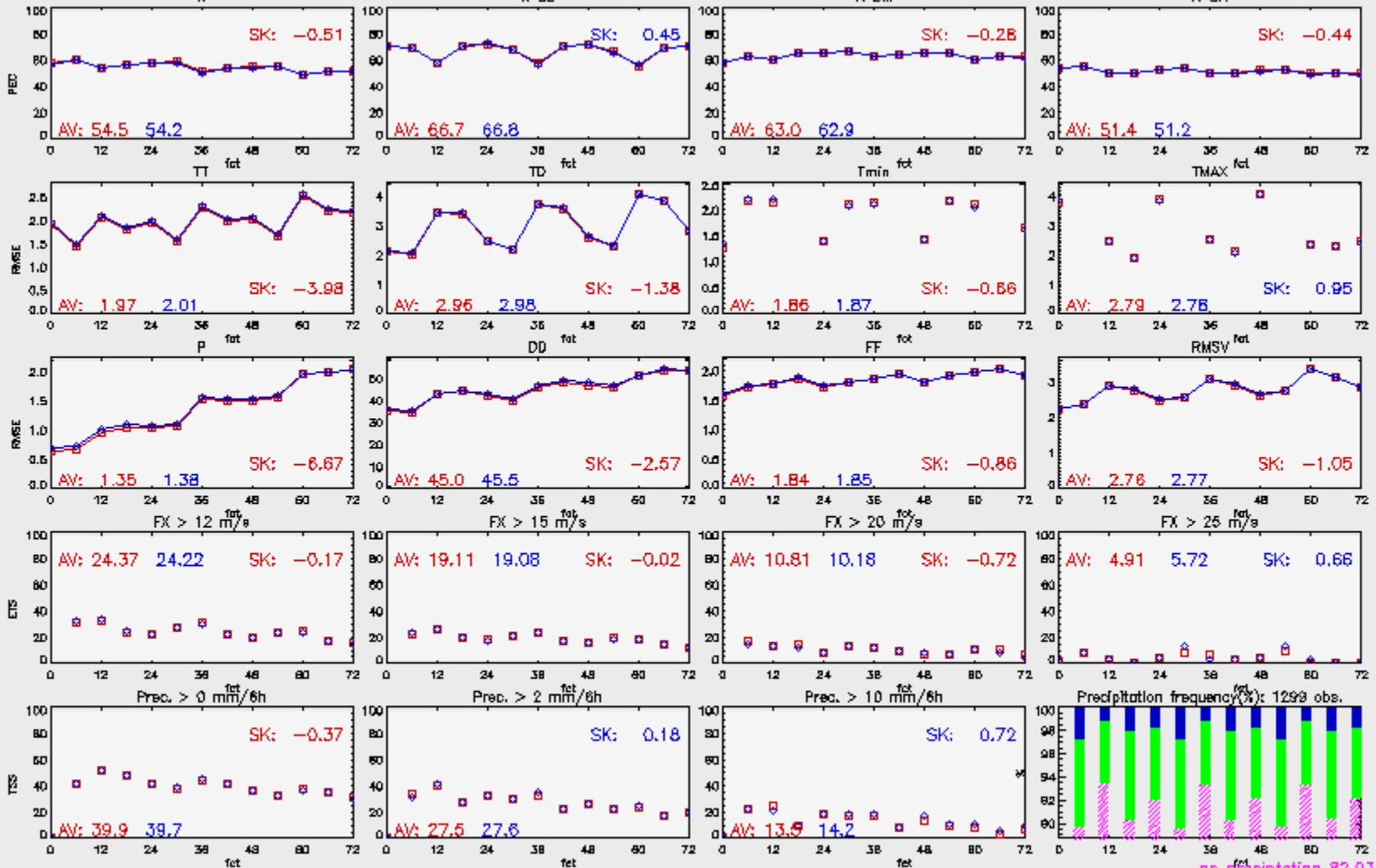
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Revised infiltration CEU- Verification



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Results of verification of forecasts for local weather elements at surface stations
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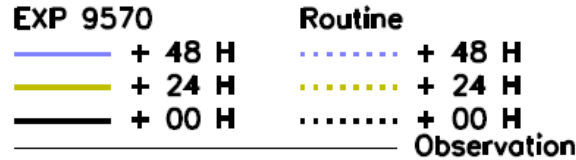
no precipitation: 82.93%
 0.1–2 mm: 8.80%
 3–10 mm: 6.88%
 > 10 mm: 1.81%

GLOBAL SKILL: -1.82



Revised infiltration CEU- Verification

Legend



LME Temps (All)
 Column 1: MEAN ERROR (model - obs)
 Column 2: ROOT MEAN SQUARE ERROR
 Averaging Period:
 140512 - 140825 00 UTC

created at Wed Feb 25 09:40:01 2015 by Deutscher Wetterdienst

