# Land surface model calibration:

## Results from new experiments

J. Helmert, H. Asensio, G. Vogel, B. Ritter

# History

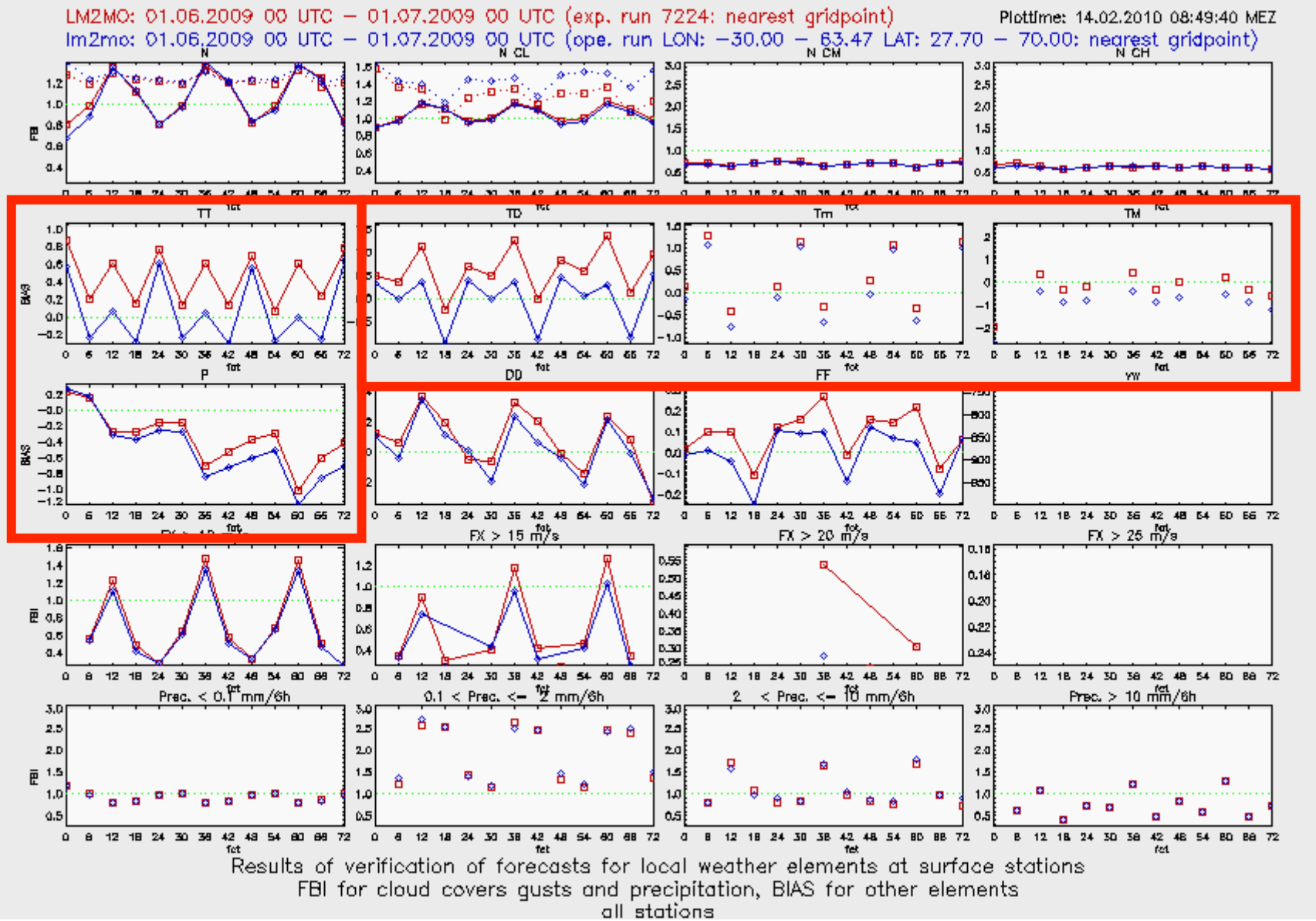
# Tested adaptions in int2lm and TERRA EXP 7224

- COLOBOC Spring Meeting 2010

- Aerosol climatology
- Emissivity
- Vegetation  climatology (LAI, PLCOV)
- Minimum stomatal resistance

- Non-uniform root distribution
- Ground water with upward diffusion
- Soil moisture dependent heat conductivity

# Verification 7224



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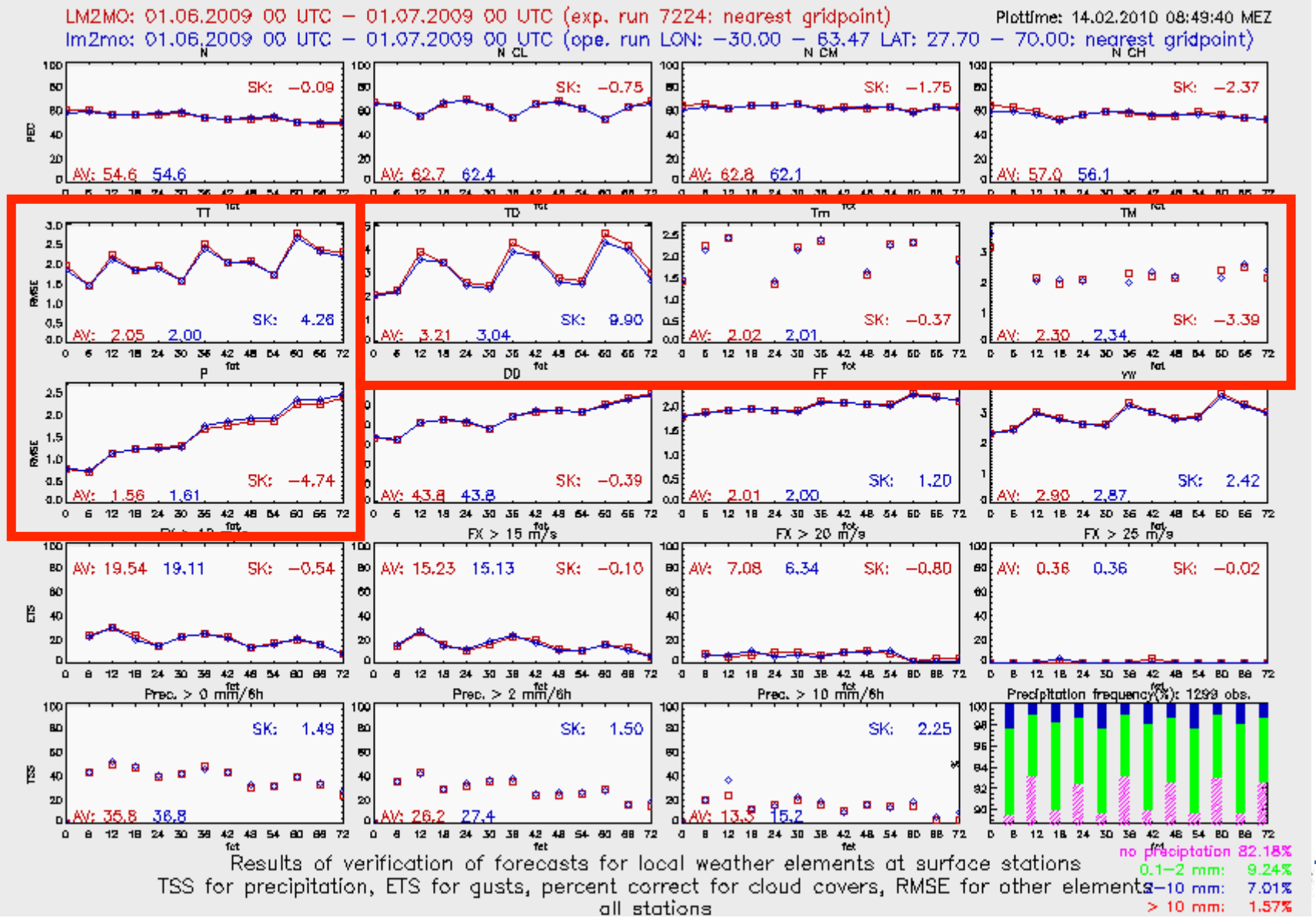


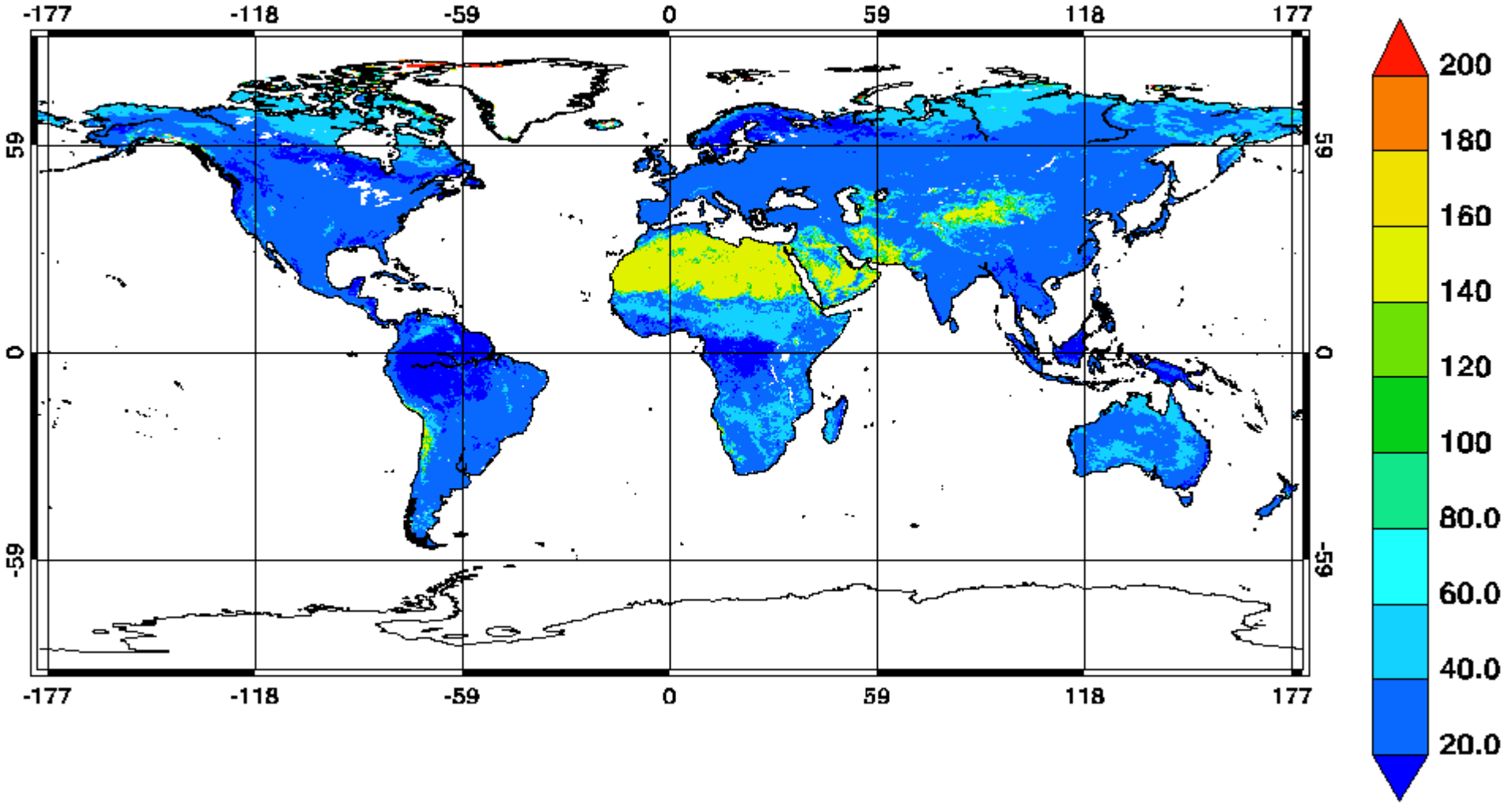
# Global experiments on the impact of the minimum stomatal resistance and vegetation albedo

# PRS_MIN/LAI_MX ROUTI 1999-2007

***PRS_MIN = 150 s/m***

Deutscher Wetterdienst
*Wetter und Klima aus einer Hand*

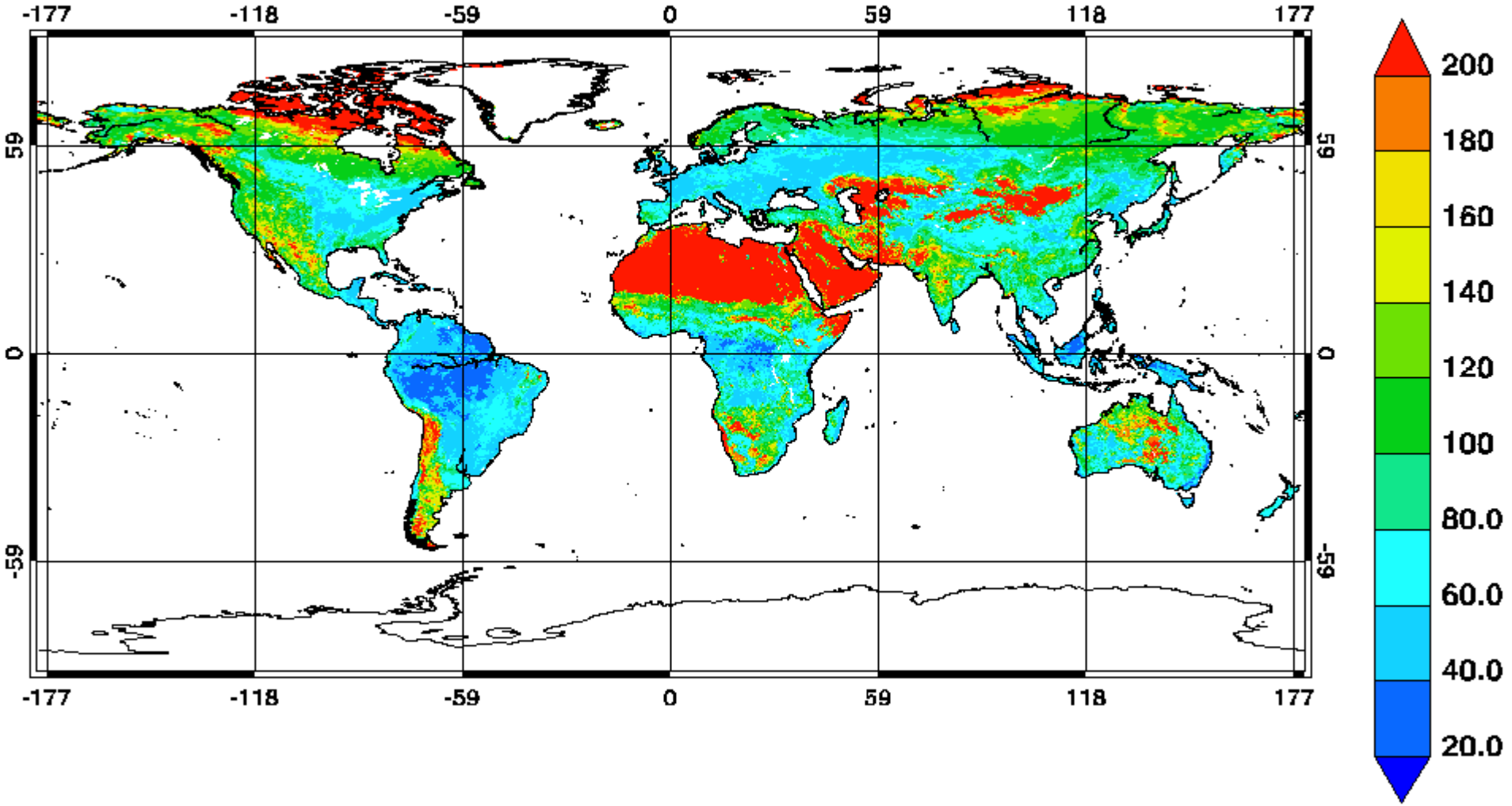
mean: 43.63 std: 35.99 min: 16.67 max: 300.00



# PRS_MIN/LAI *June* ROUTI 2007-

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

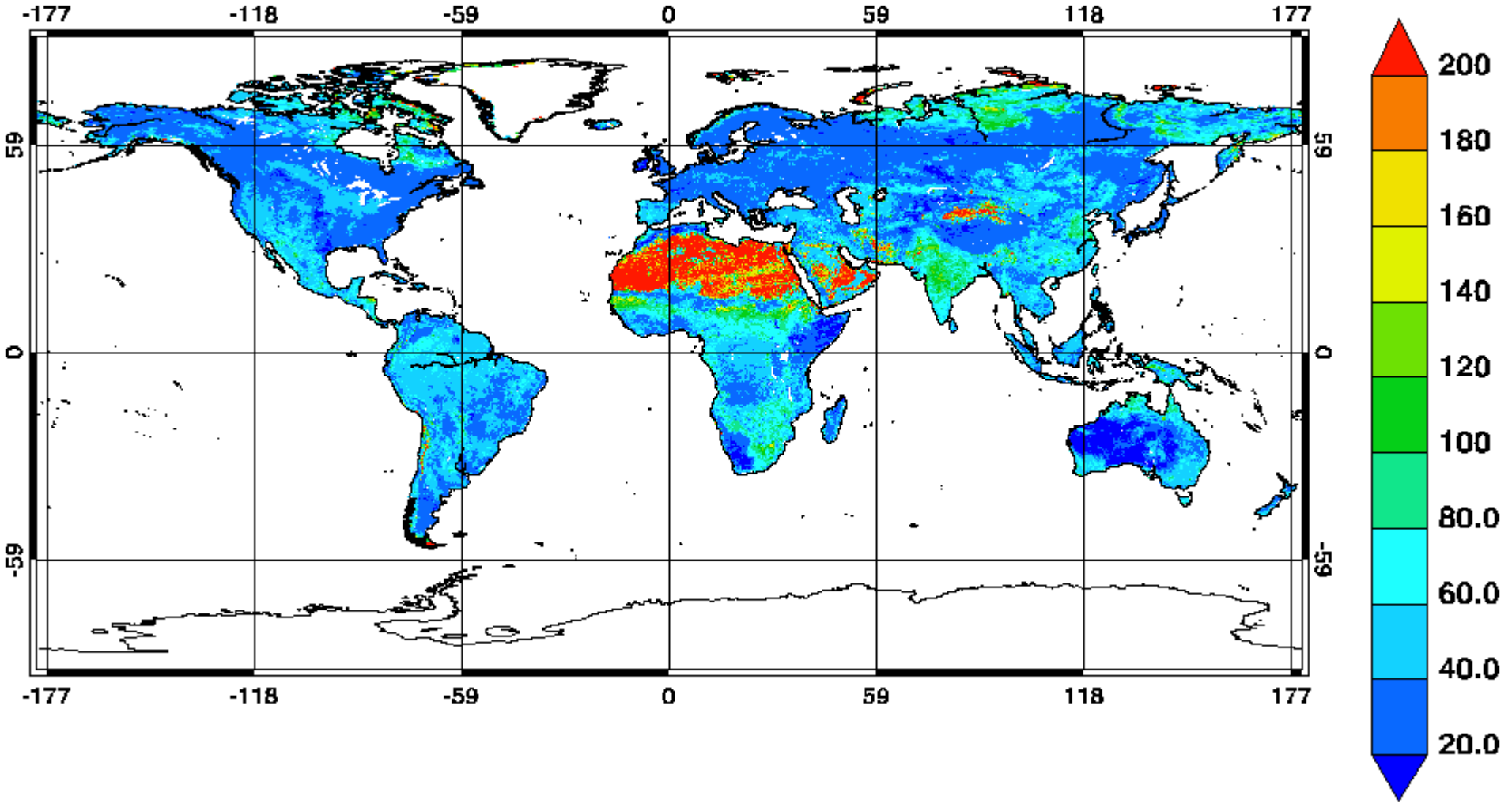
mean: 117.84 std: 86.13 min: 35.00 max: 3277.53



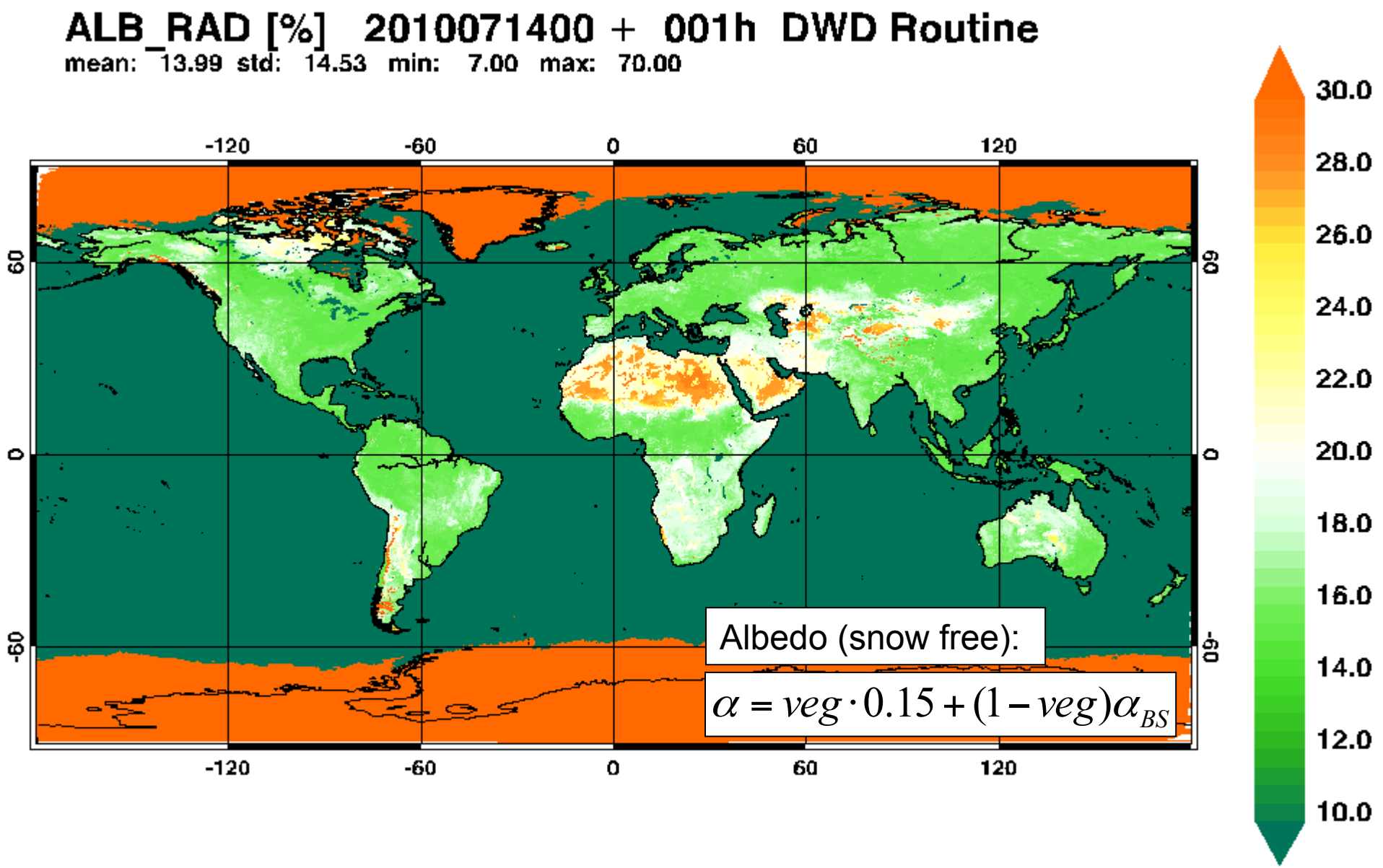
## PRS_MIN/LAI *June* EXP
## Masson (2003) - Ecoclimap

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

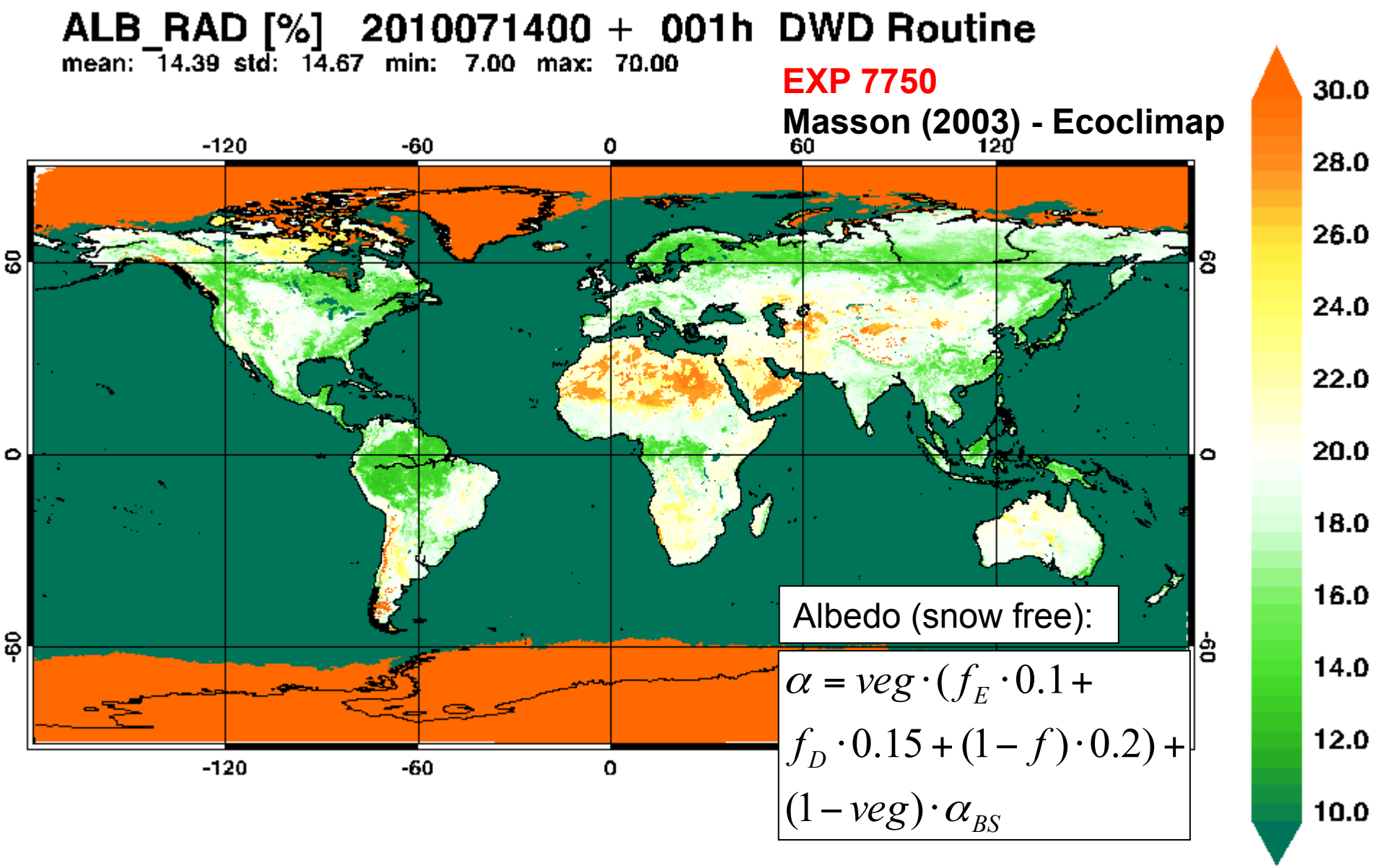
mean: 59.67 std: 47.84 min: 7.46 max: 3006.84



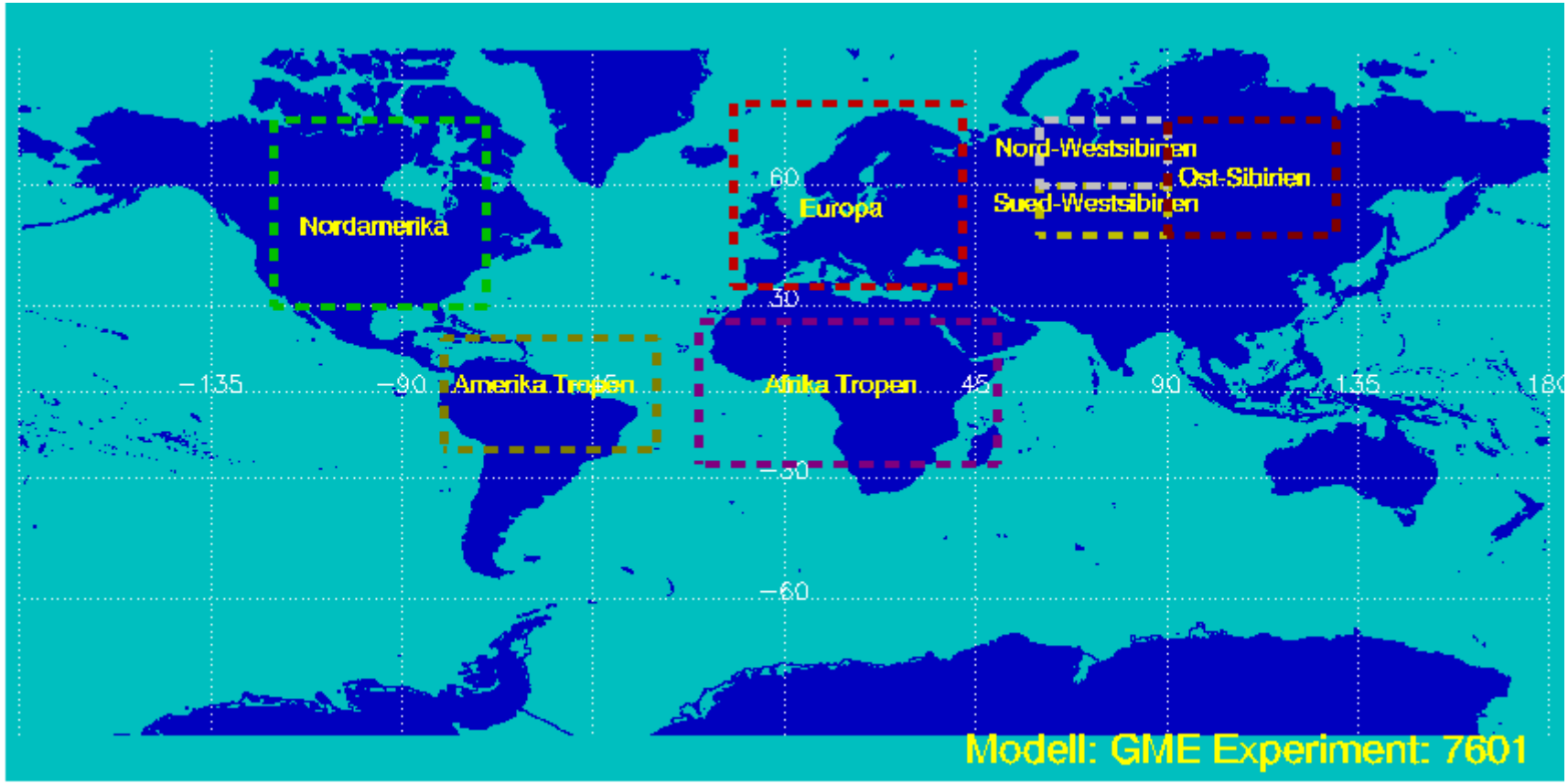
# Vegetation albedo ROUTI



# Vegetation albedo EXP



# Global Verification

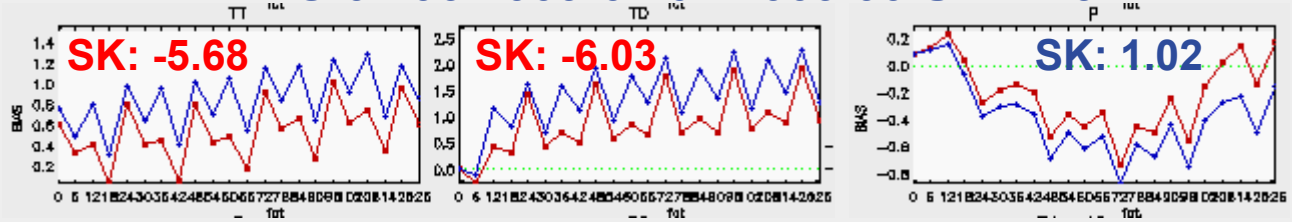


# Global Verification

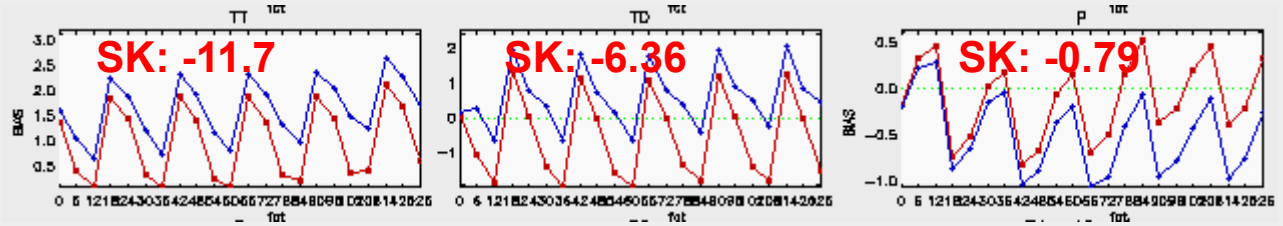
CONSORTIUM FOR SMALL SCALE MODELING
COSMO
Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

## EXP 7750 ECOCLIMAP+ALBEDO 02.06.2009-01.07.2009 00 UTC i192f

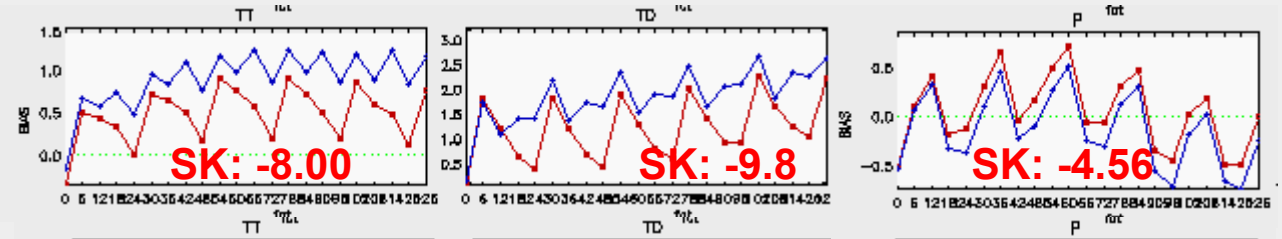
Europe



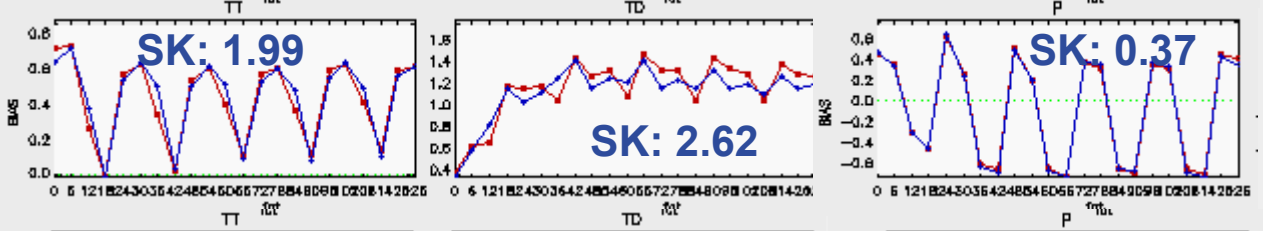

East Sibiria



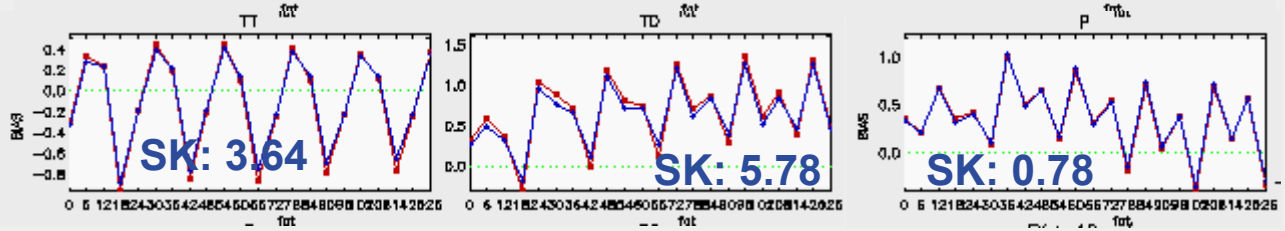

North America




Tropics Africa




Tropics America



# Conclusions of GME EXP 7750

- PRS/LAI ratio and vegetation type albedo have strong impact on the split-up of fluxes

- Positive impact on T_2M and TD_2M in temperate zones

- Neutral or small negative impact in tropics

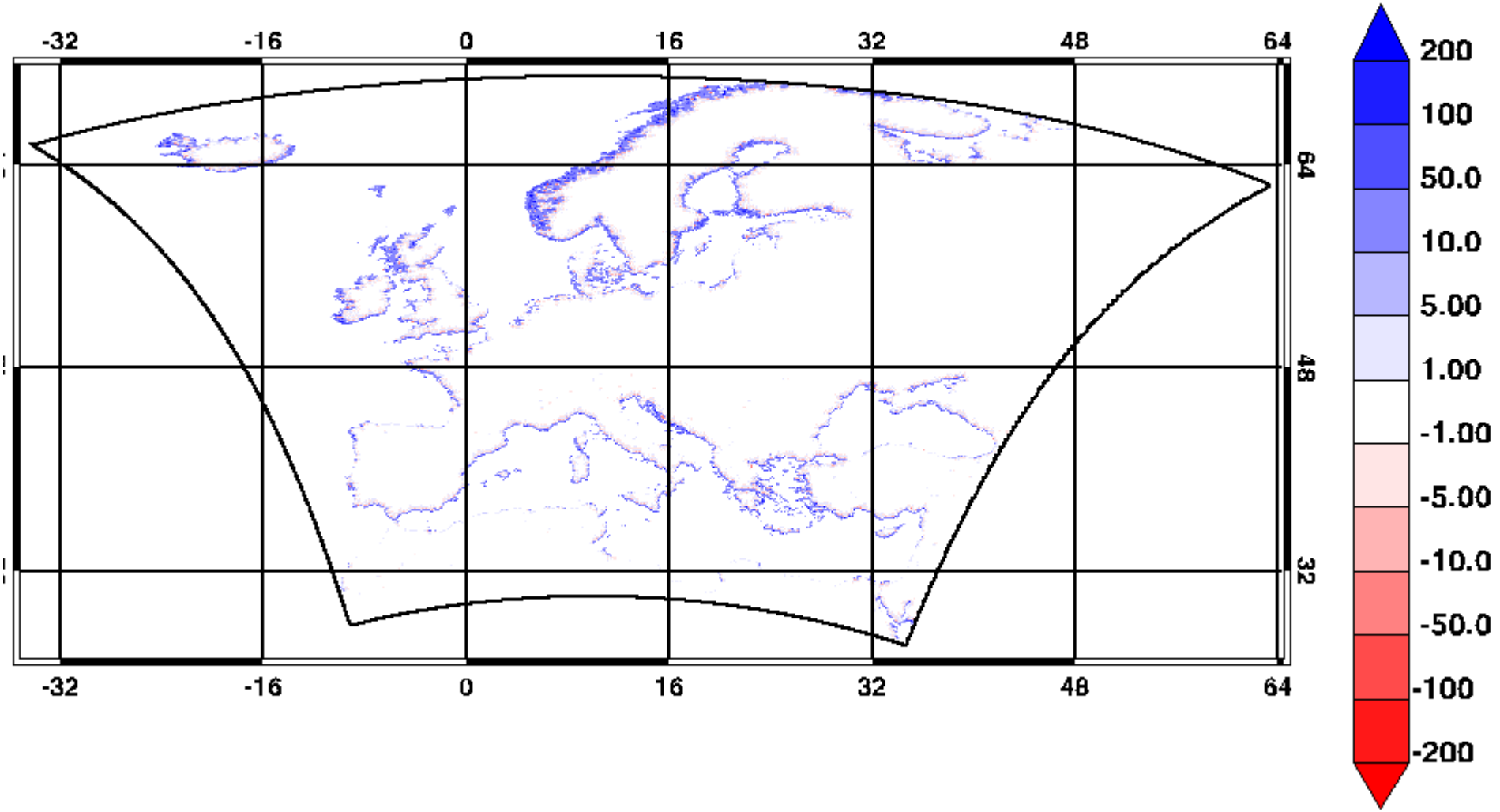
# COSMO Experiments

# Tested adaptions in int2lm and TERRA EXP 7928/8010

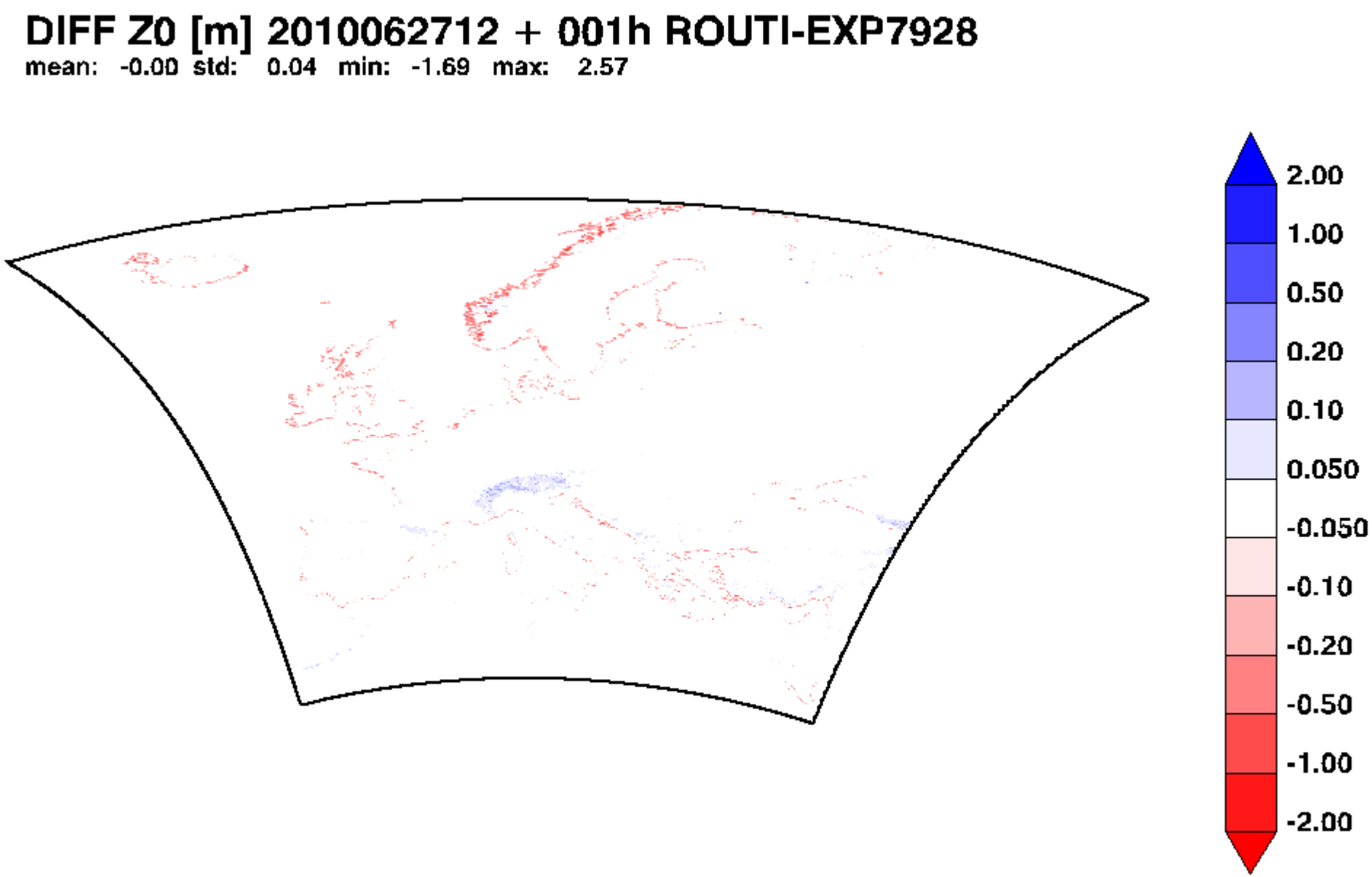
- Aerosol climatology
- Emissivity
- Vegetation  climatology (LAI, PLCOV)
- Minimum stomatal resistance (ECOCLIMAP)
- Vegetation type albedo
- COSMO-DE with 65 vertical levels (EXP 8010)
  Summer period : 25.06.2010-17.07.2010

- Non-uniform root distribution
- Ground water with upward diffusion
- Soil moisture dependent heat conductivity

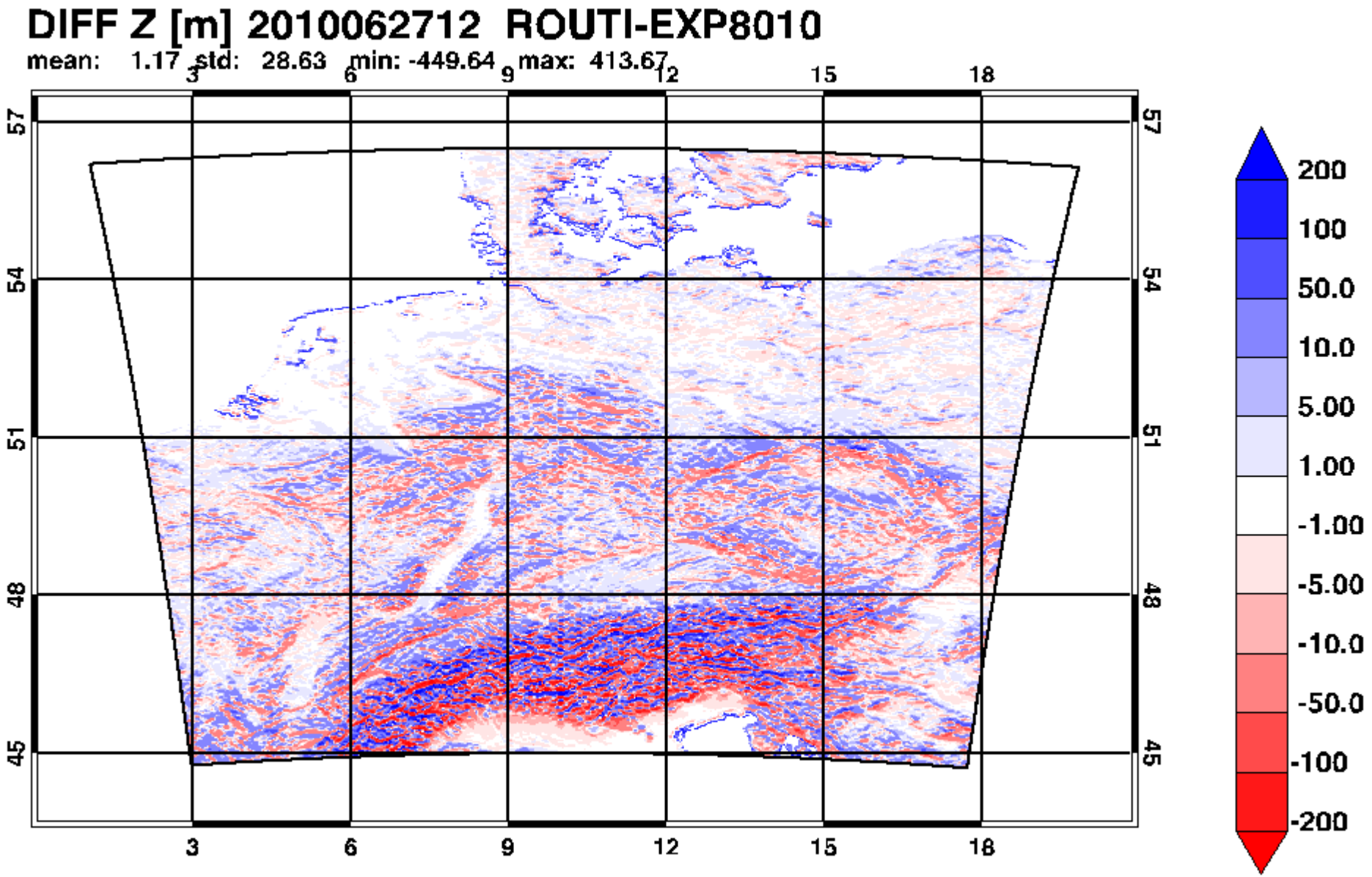
# External Parameters



# External Parameters



# External Parameters



# External Parameters

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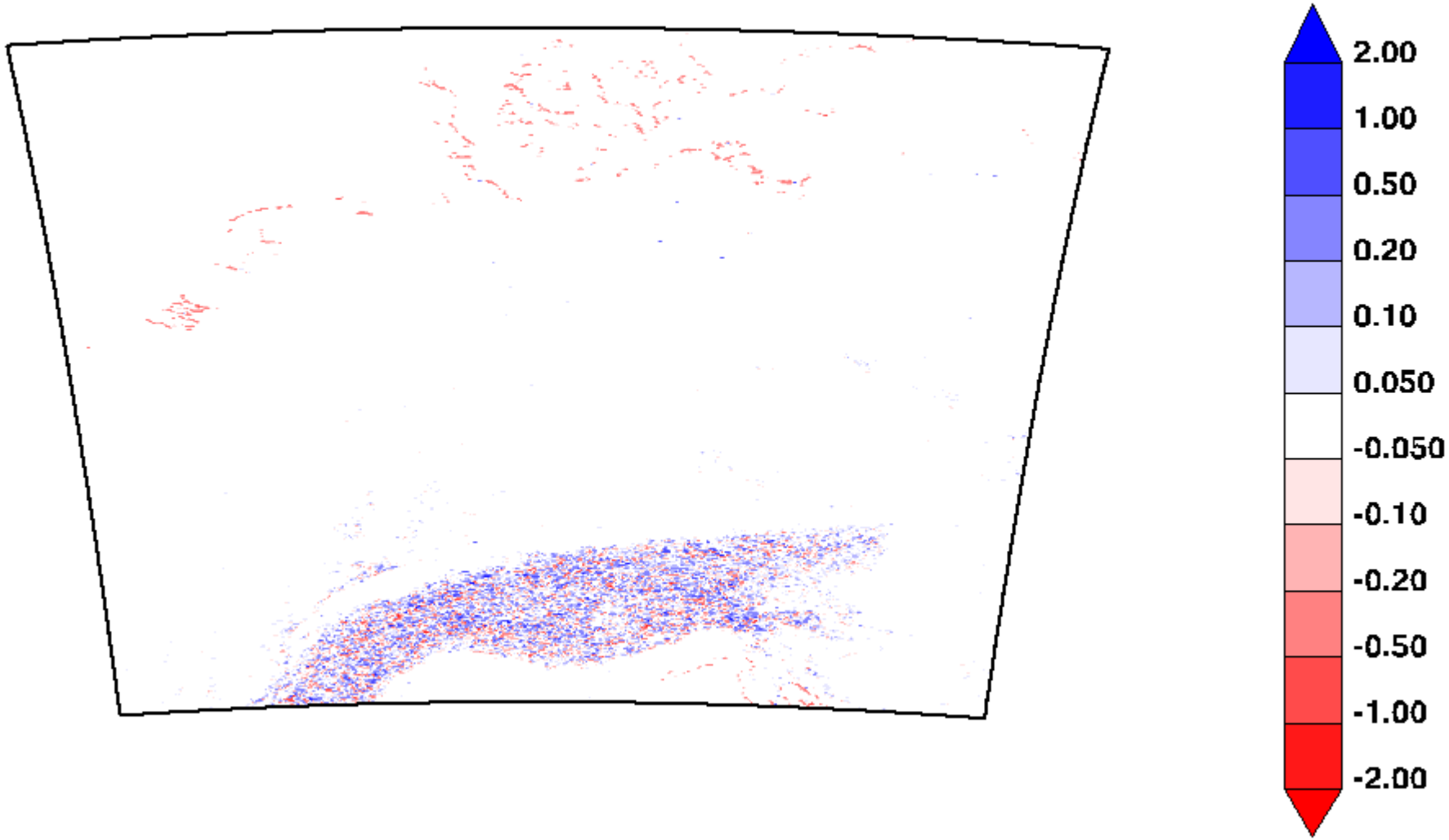
Wetter und Klima aus einer Hand
DWD

**DIFF Z0 [m] 2010062712 + 001h ROUTI-EXP8010**

mean: 0.00 std: 0.09 min: -1.73 max: 3.29

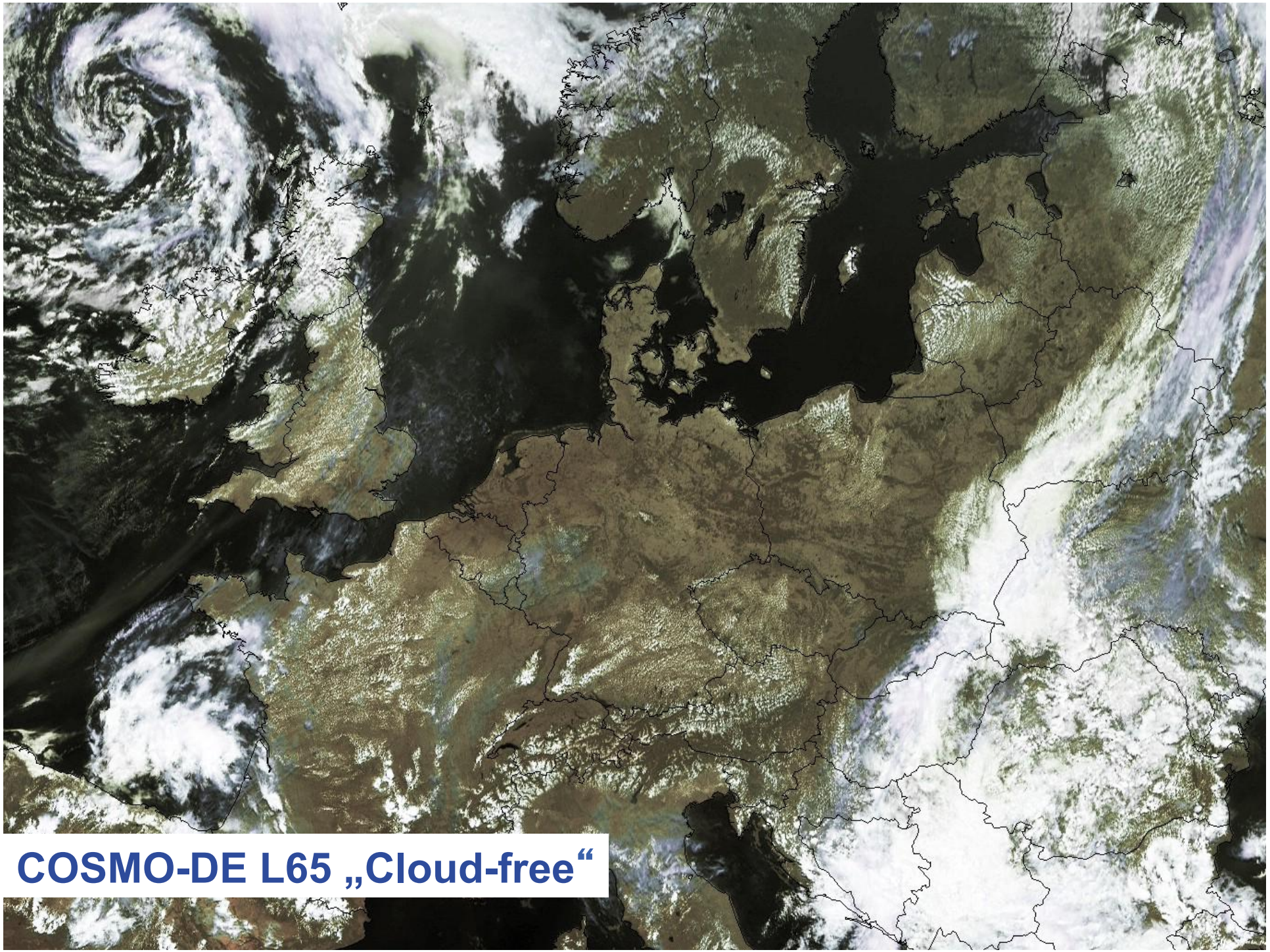


# COSMO-DE L65 EXP 8010

- Aerosol climatology
- Emissivity
- Vegetation  climatology (LAI, PLCOV)
- Minimum stomatal resistance (ECOCLIMAP)
- Vegetation type albedo
- COSMO-DE with 65 vertical levels (EXP 8010)
  Summer period : 25.06.2010-17.07.2010

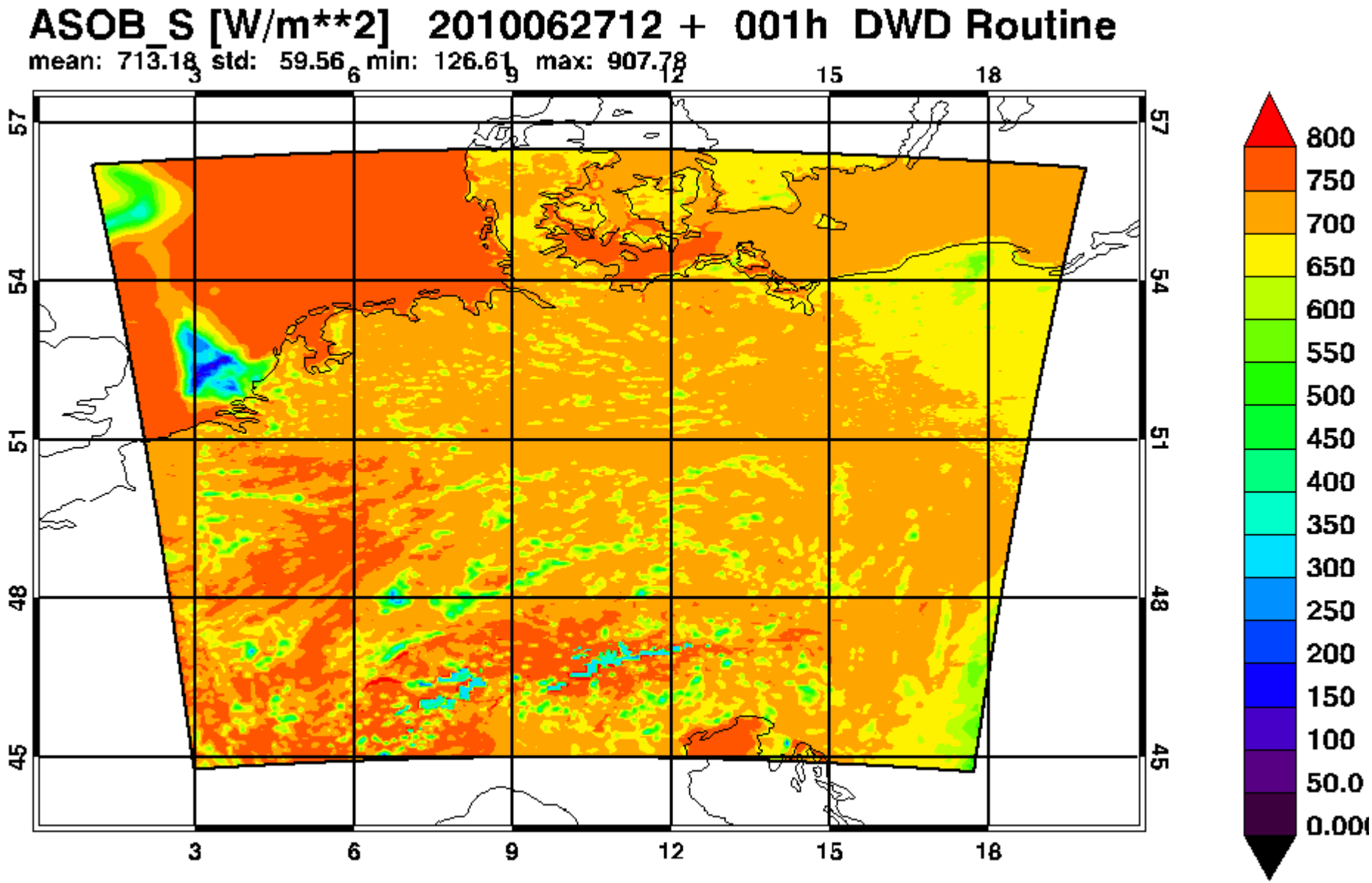
- Non-uniform root distribution
- Ground water with upward diffusion
- Soil moisture dependent heat conductivity

- Case studies: Cloud-free 20100627
  Cloudy sky 20100705

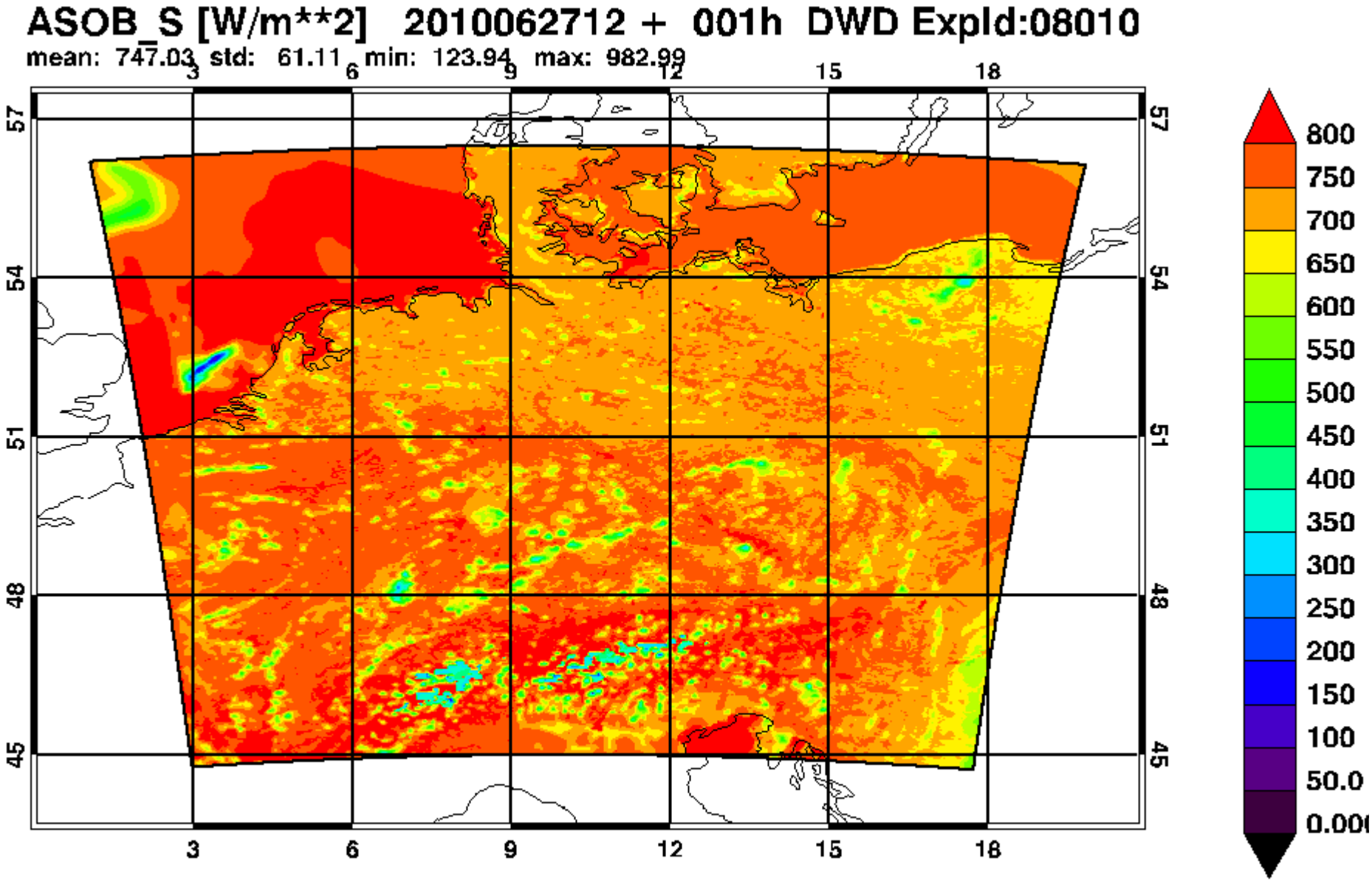

COSMO-DE L65 „Cloud-free“

# Solar Radiation Budget

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

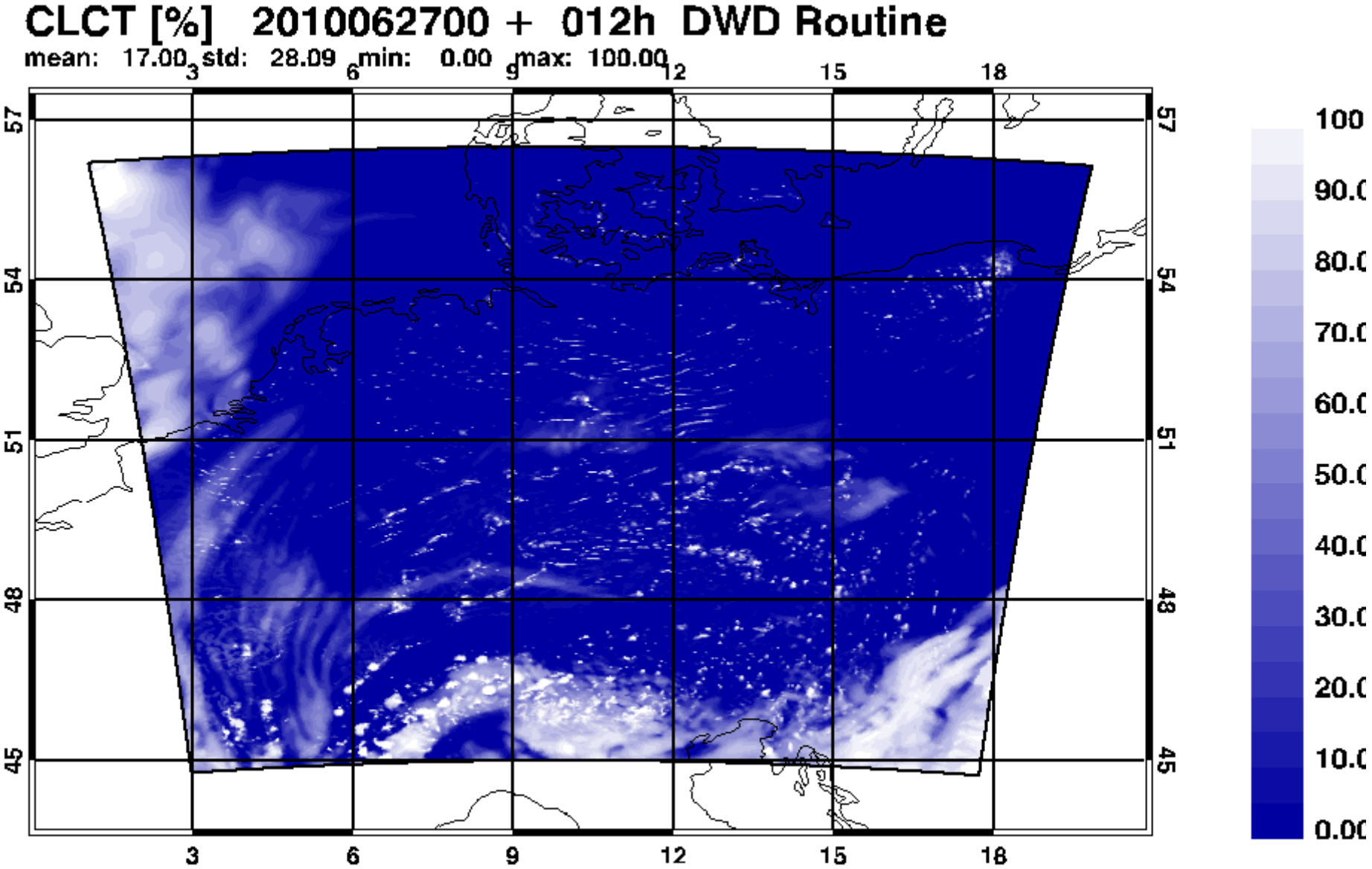


# Solar Radiation Budget



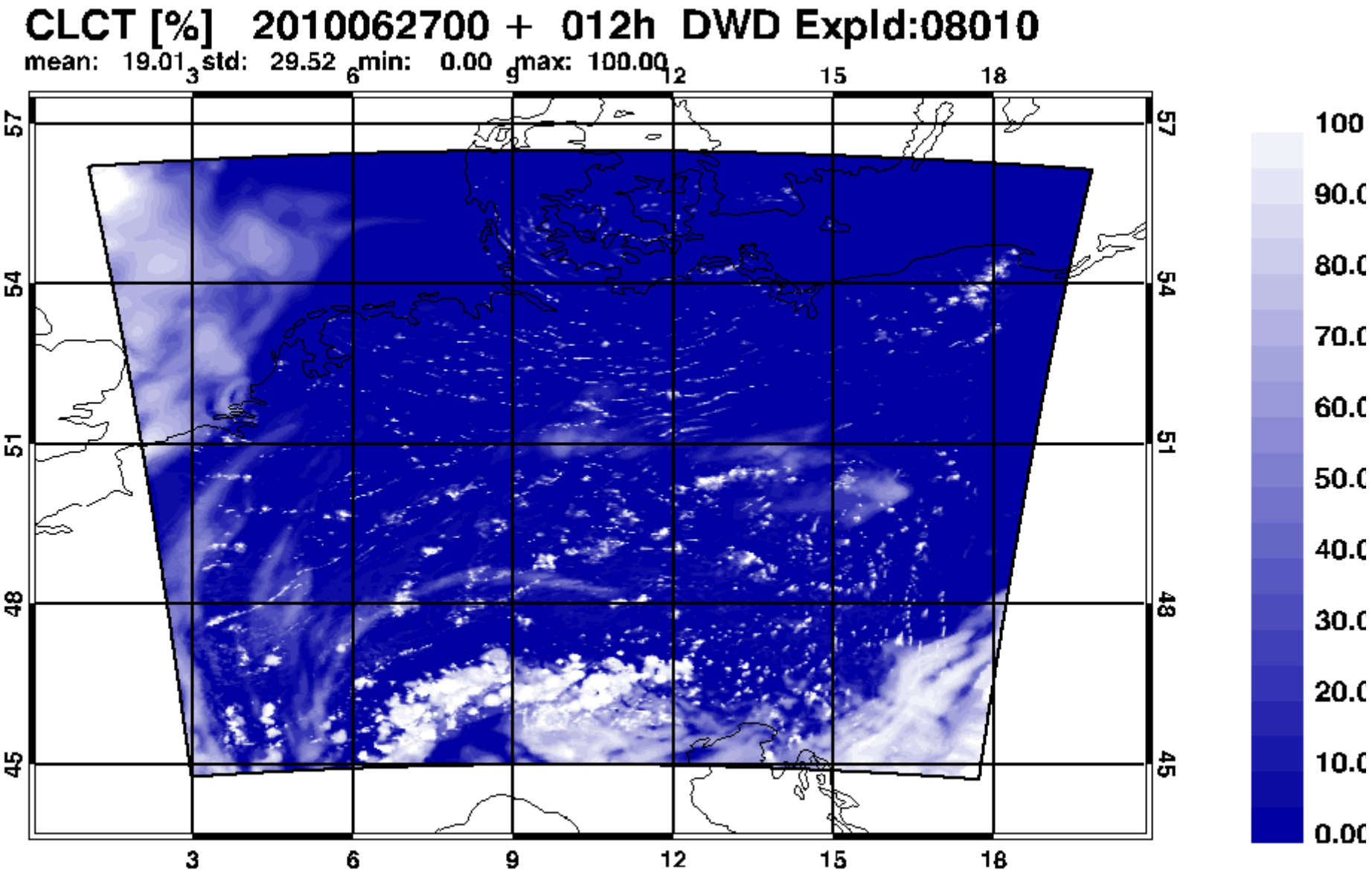
# Total Cloud Coverage

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

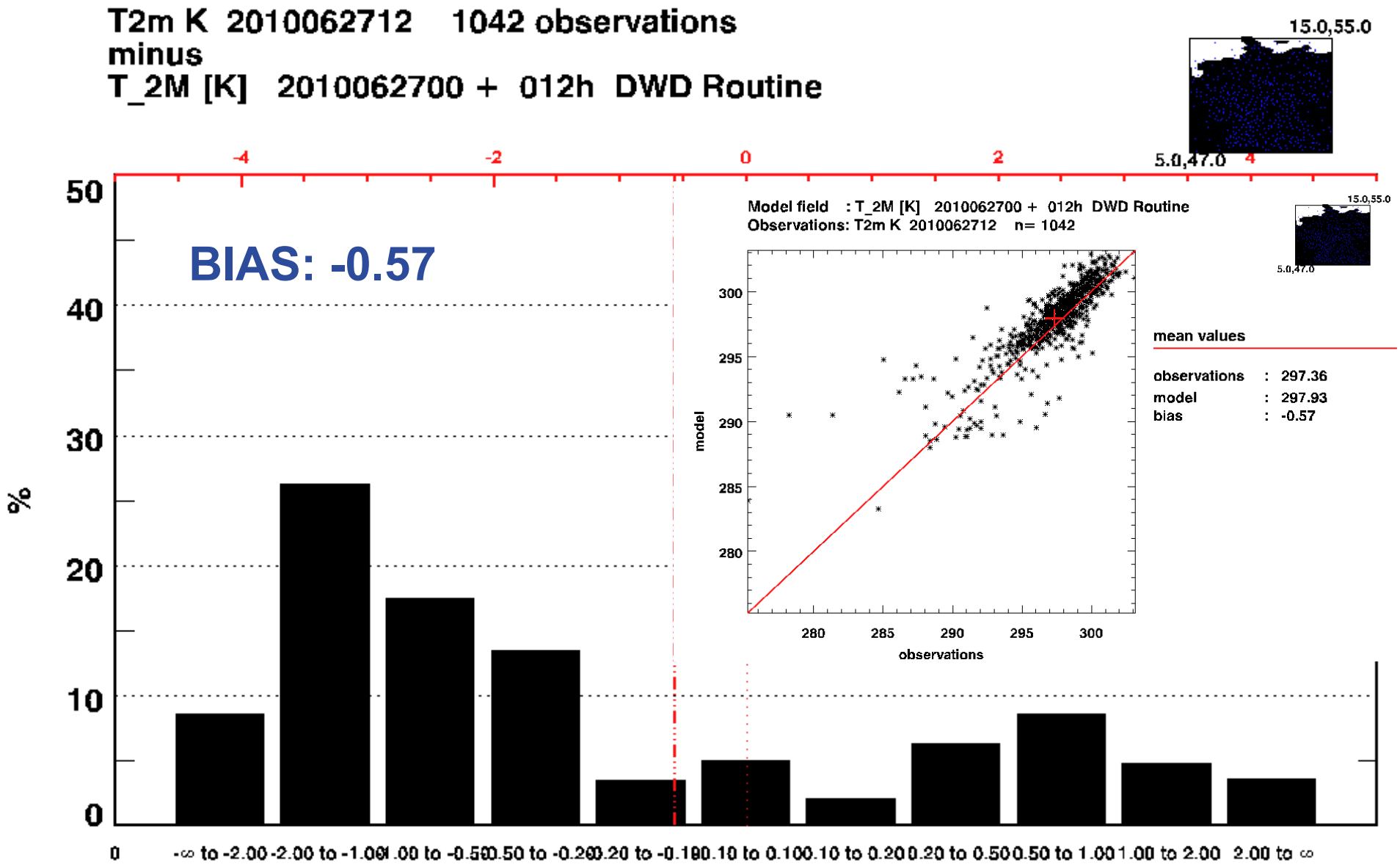


# Total Cloud Coverage

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



# COSMO-DE L65 Validation „Cloud-free“



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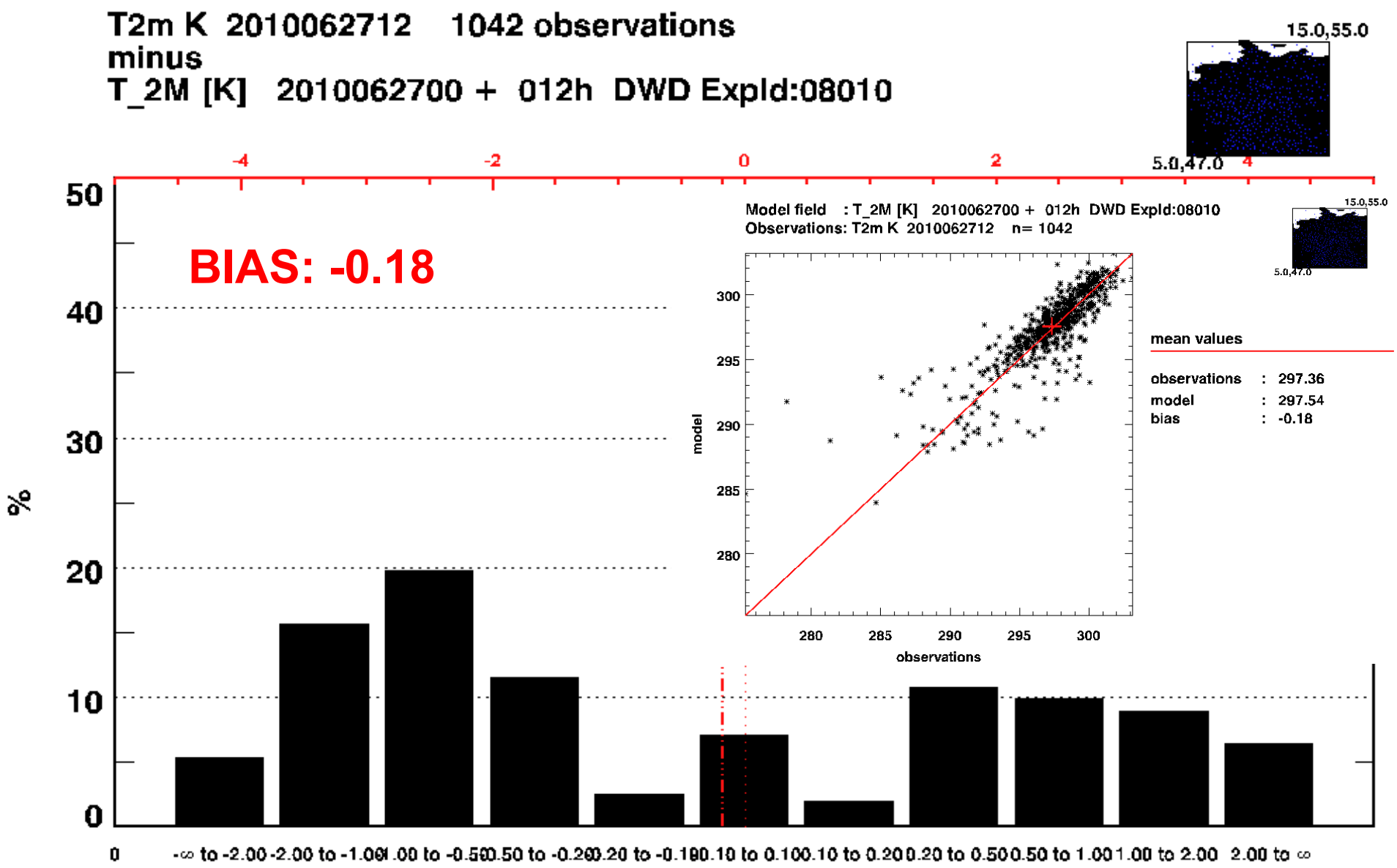

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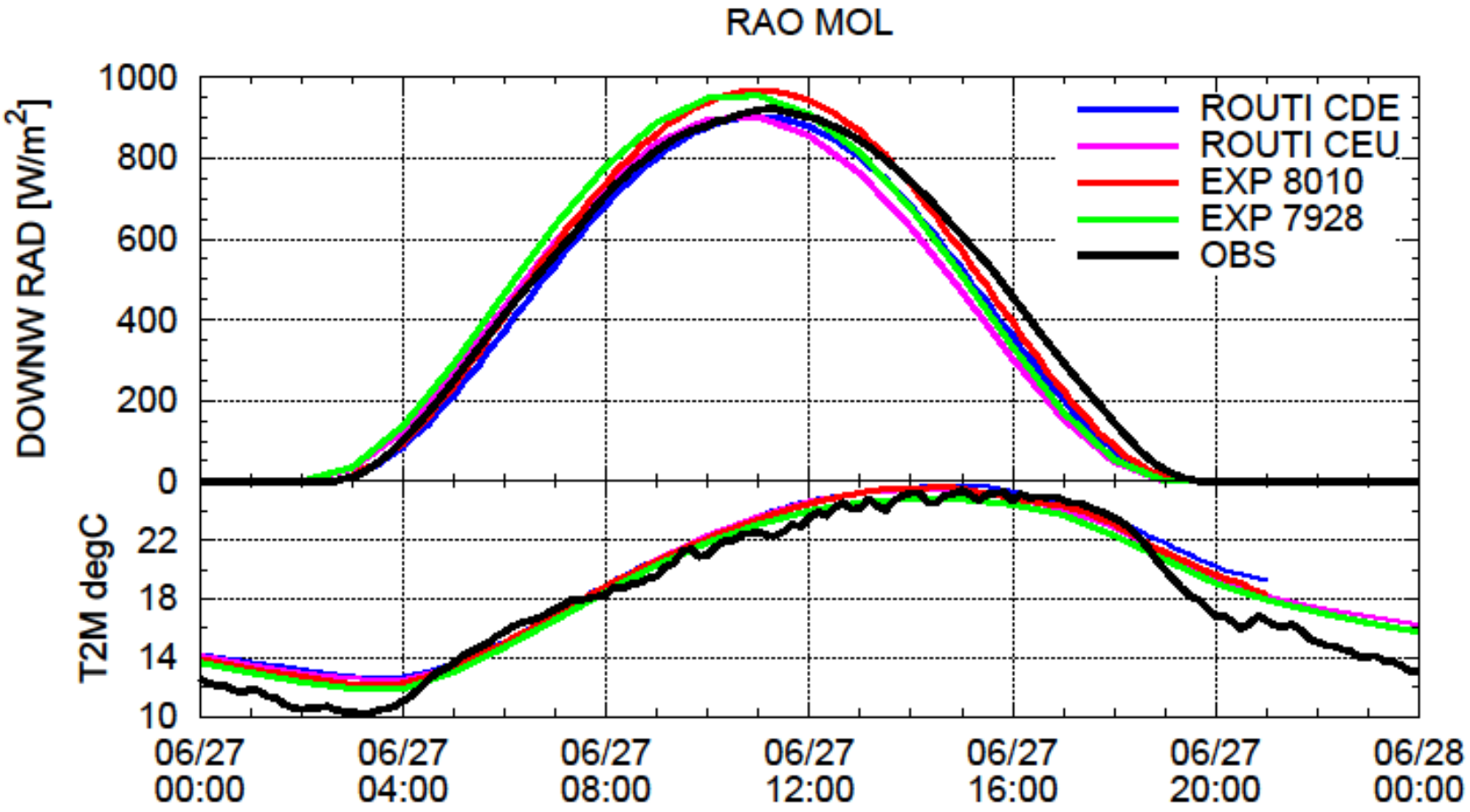
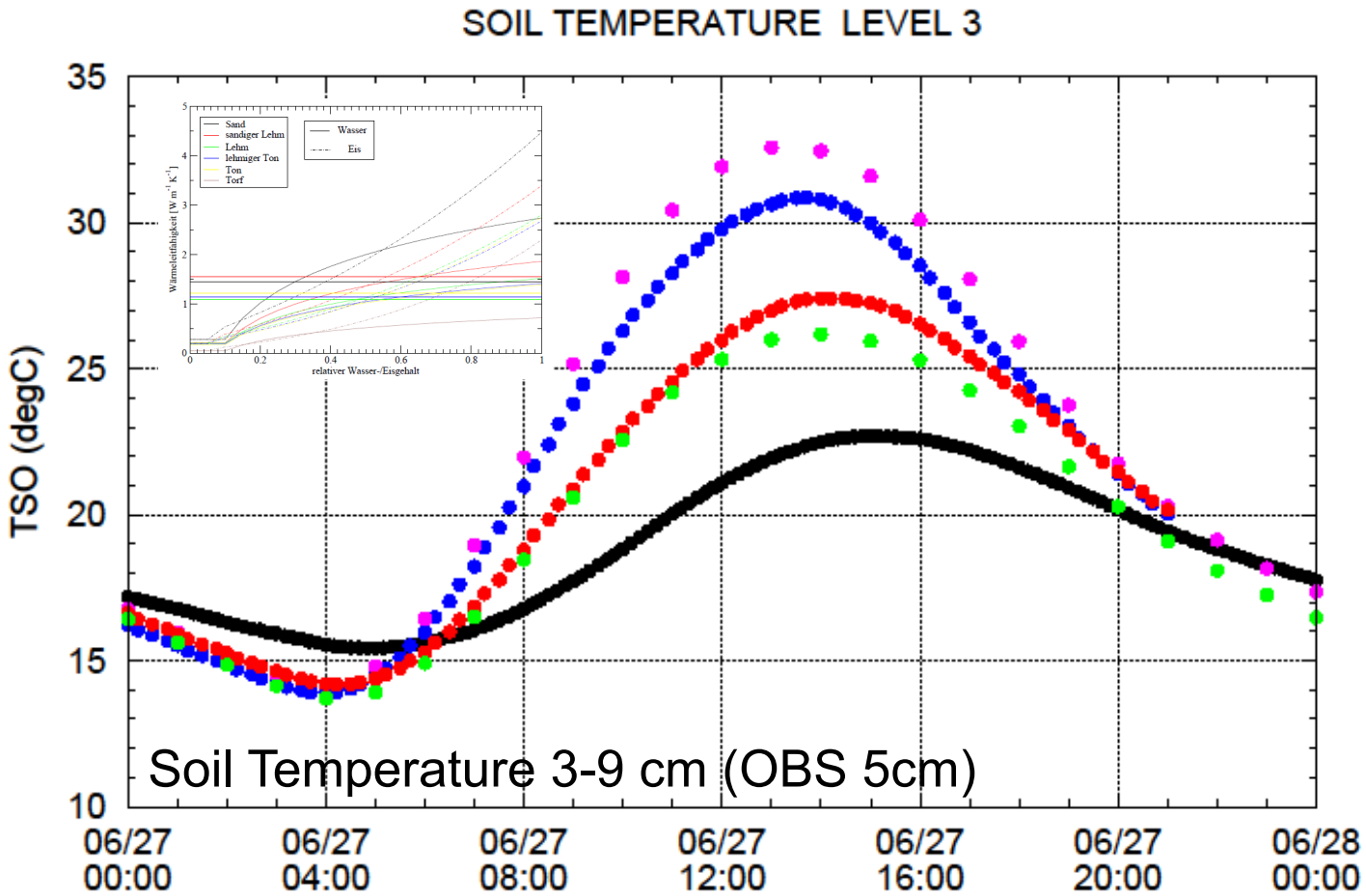
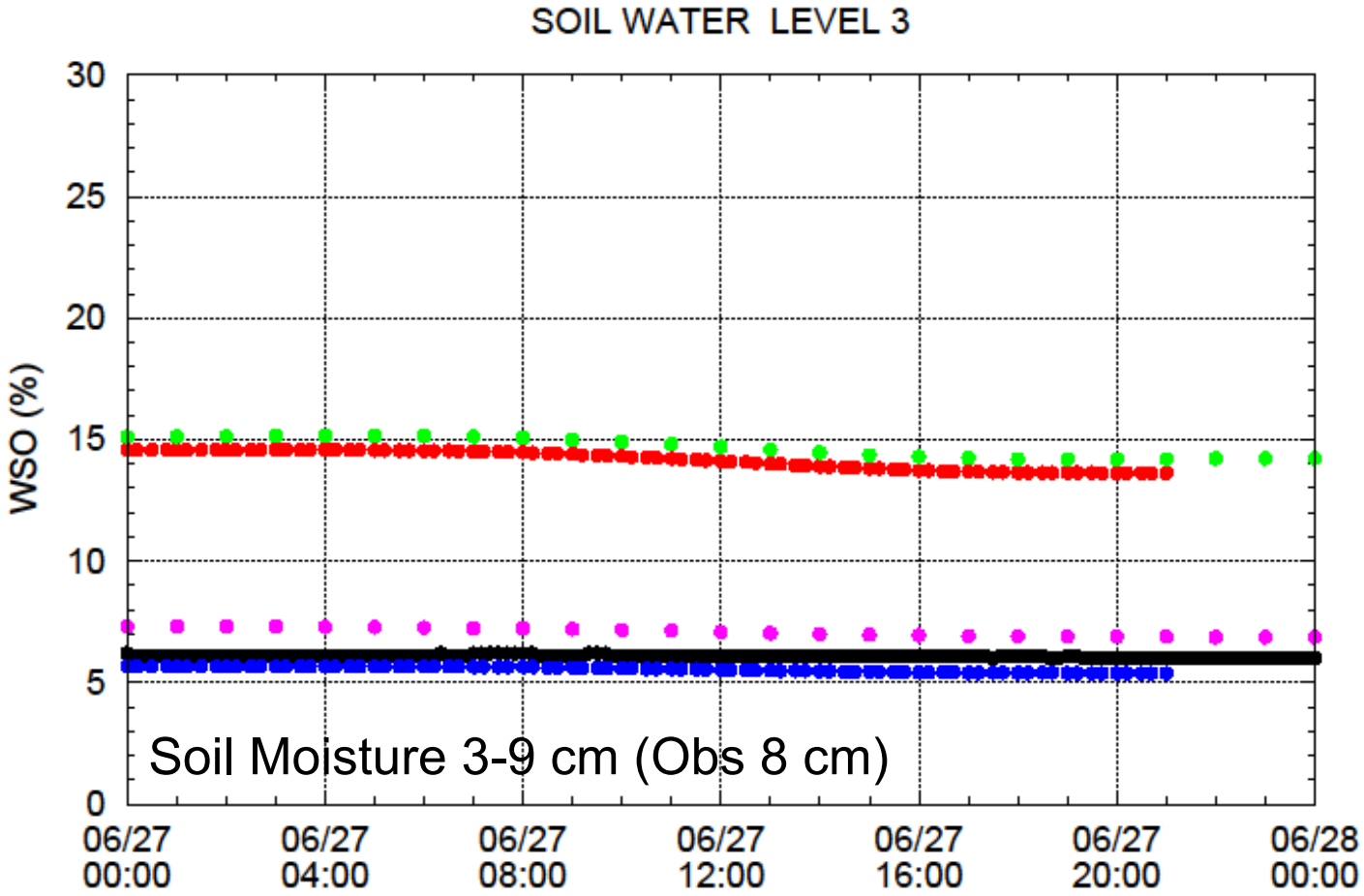


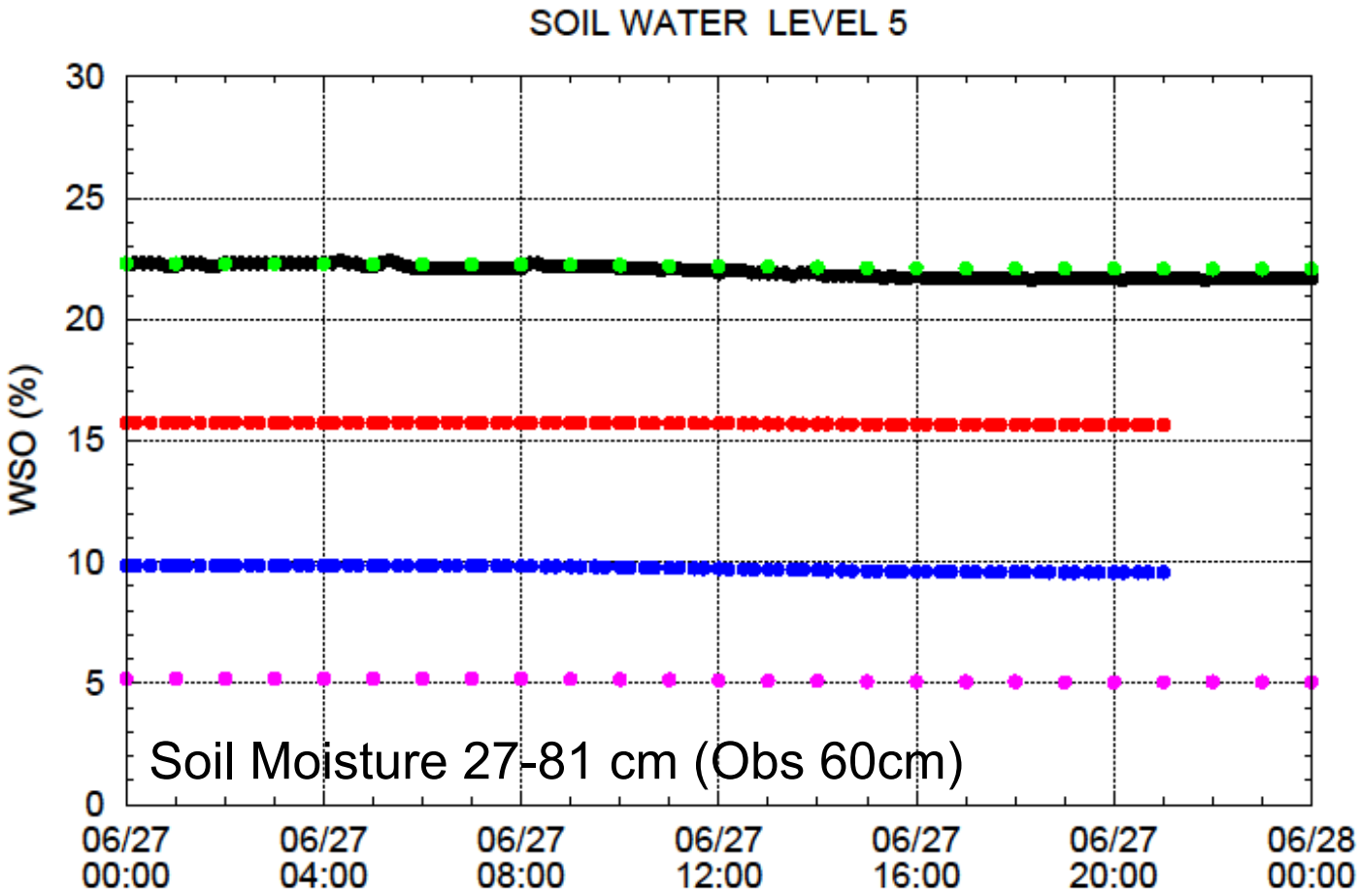
# COSMO-DE L65 Validation „Cloud-free“

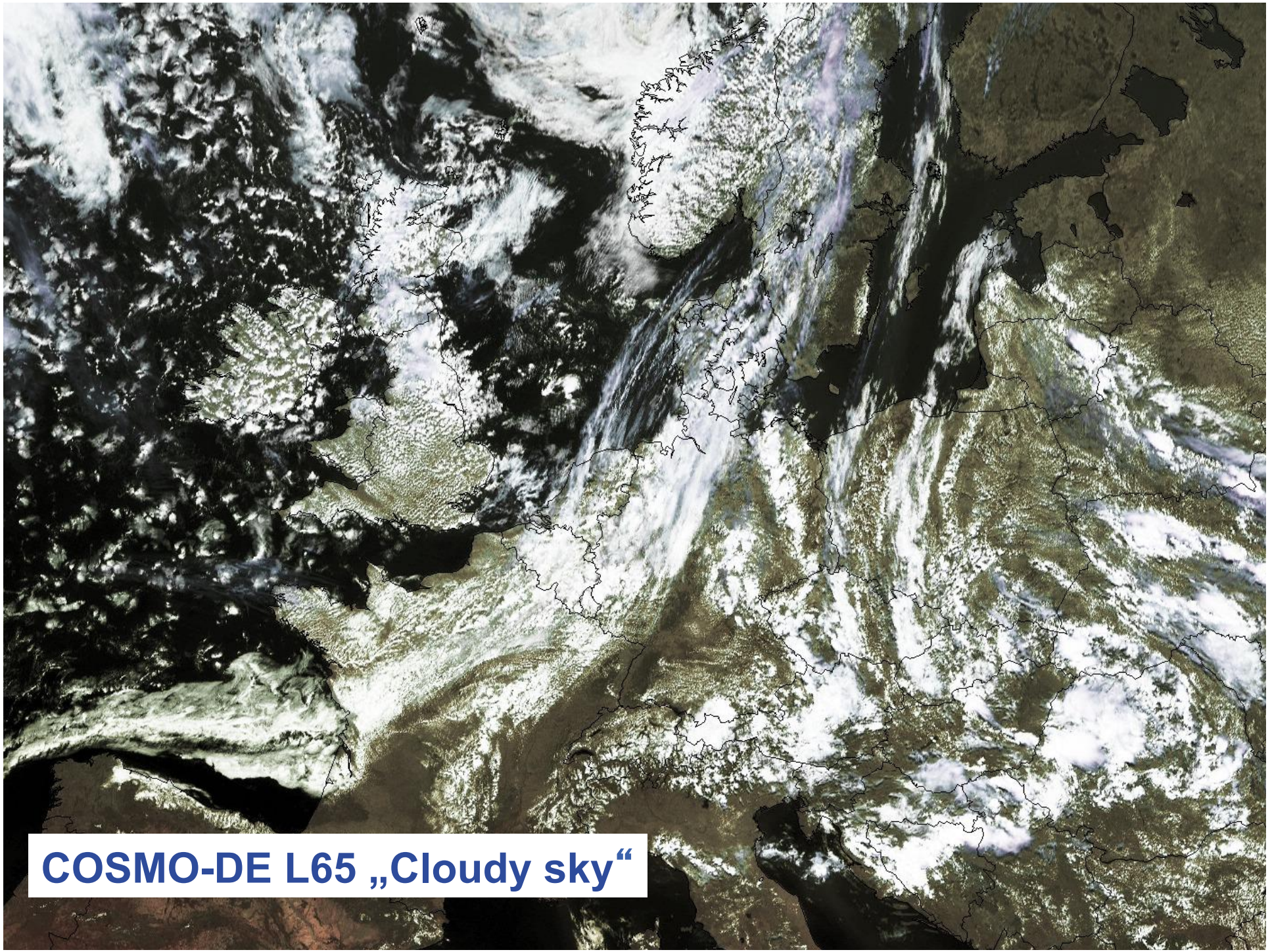


# COSMO-DE L65 Validation „Cloud-free“



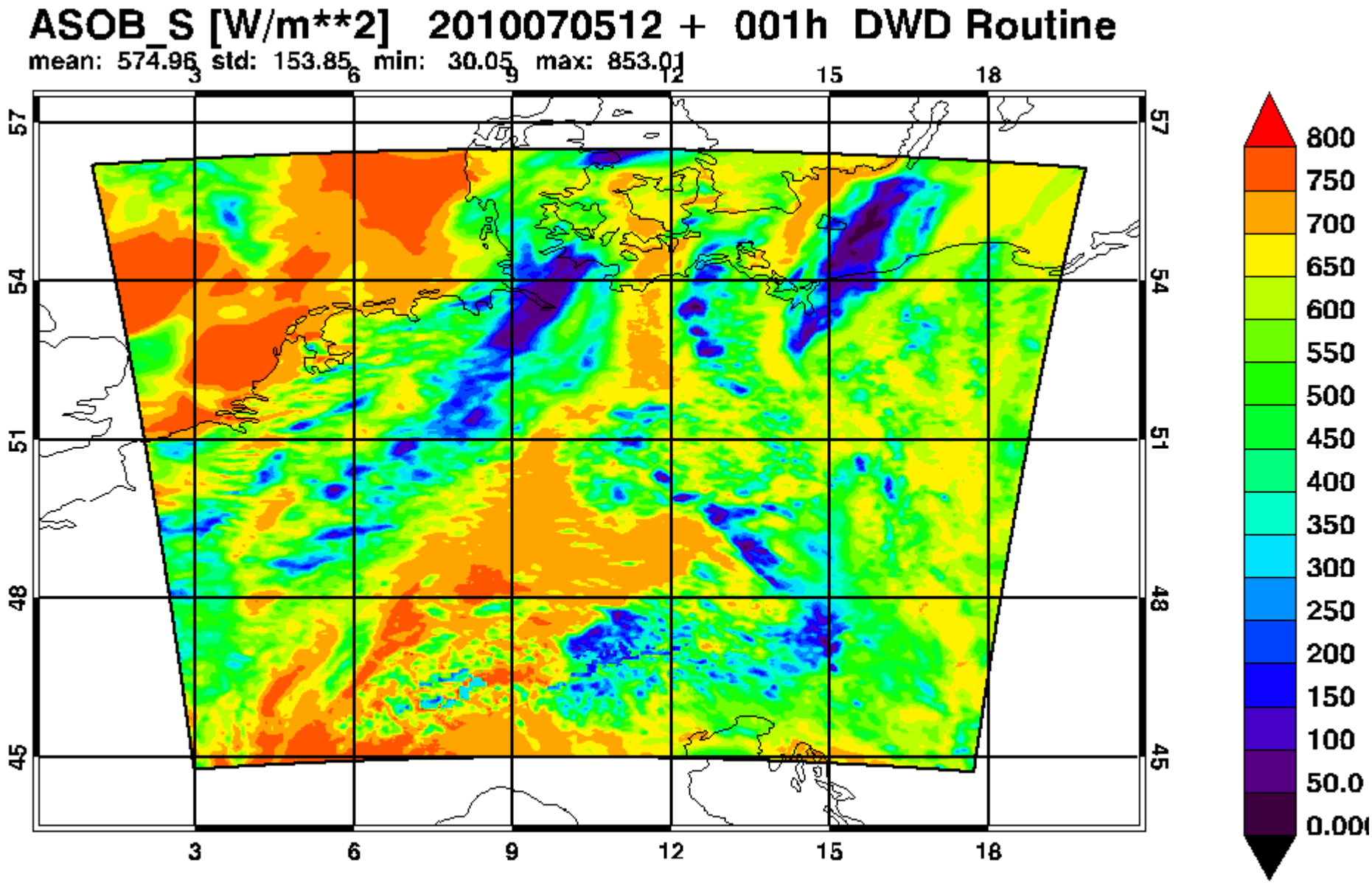
# COSMO-DE L65 Validation „Cloud-free“



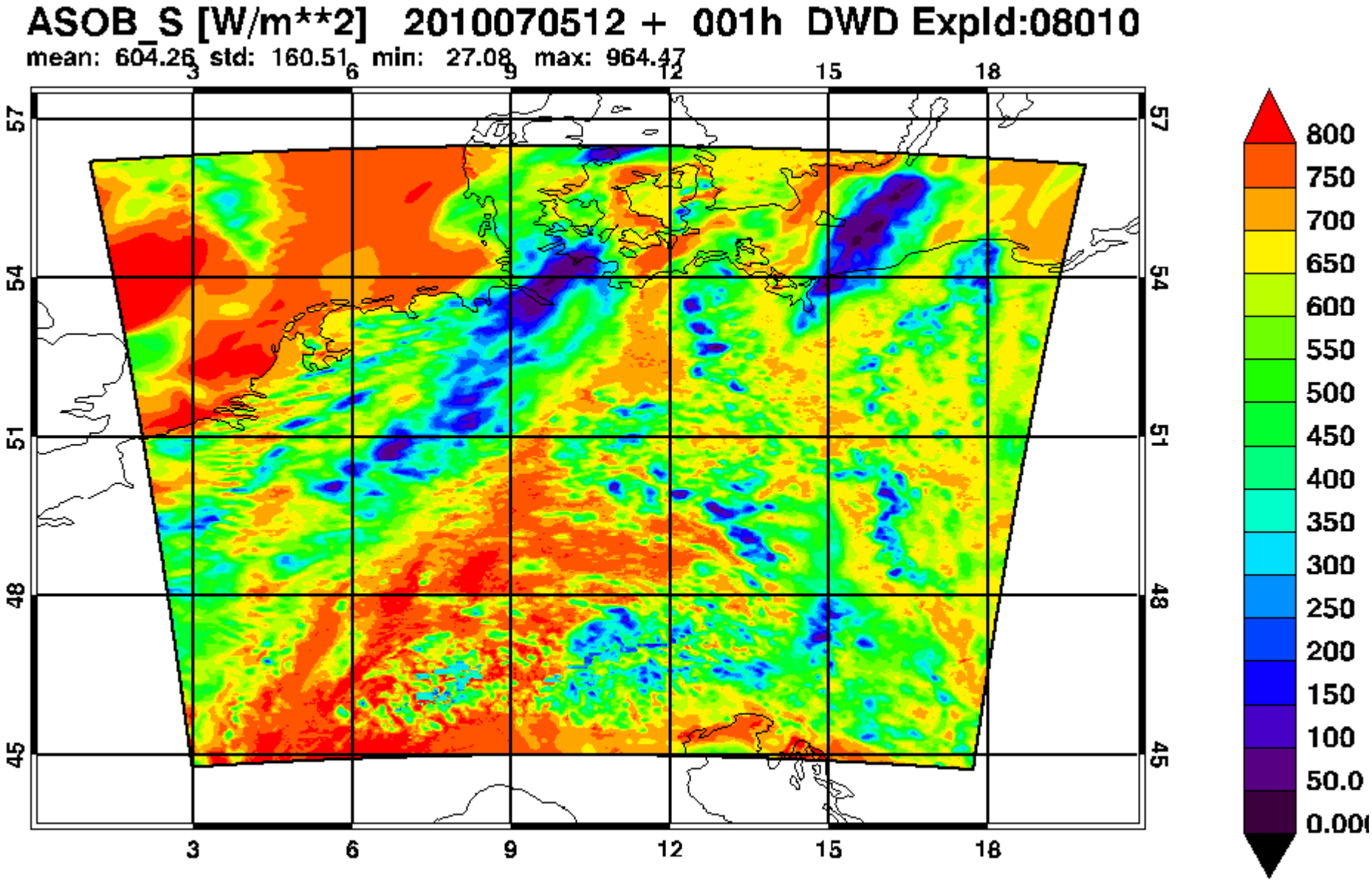

COSMO-DE L65 „Cloudy sky“

# Solar Radiation Budget

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

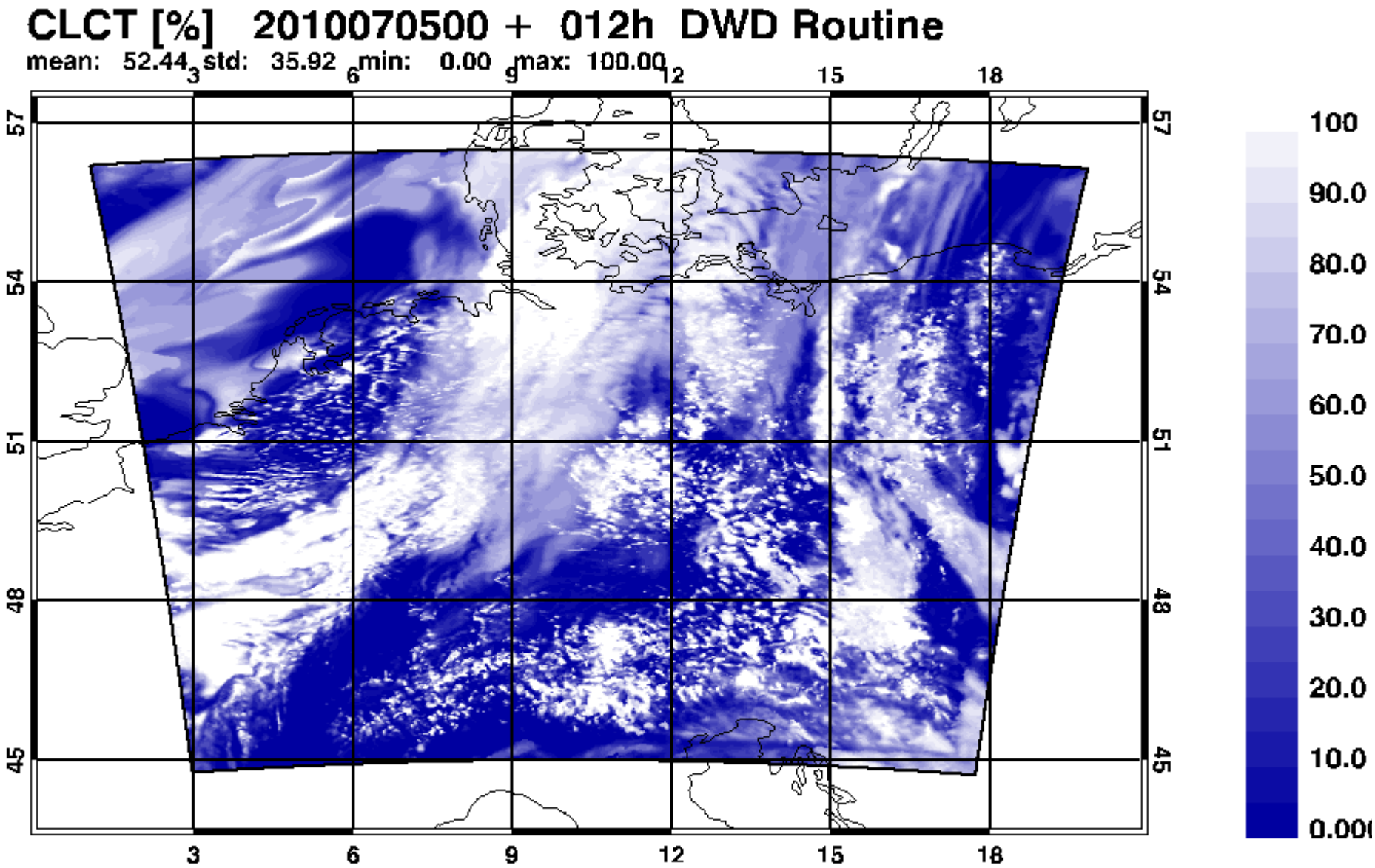


# Solar Radiation Budget



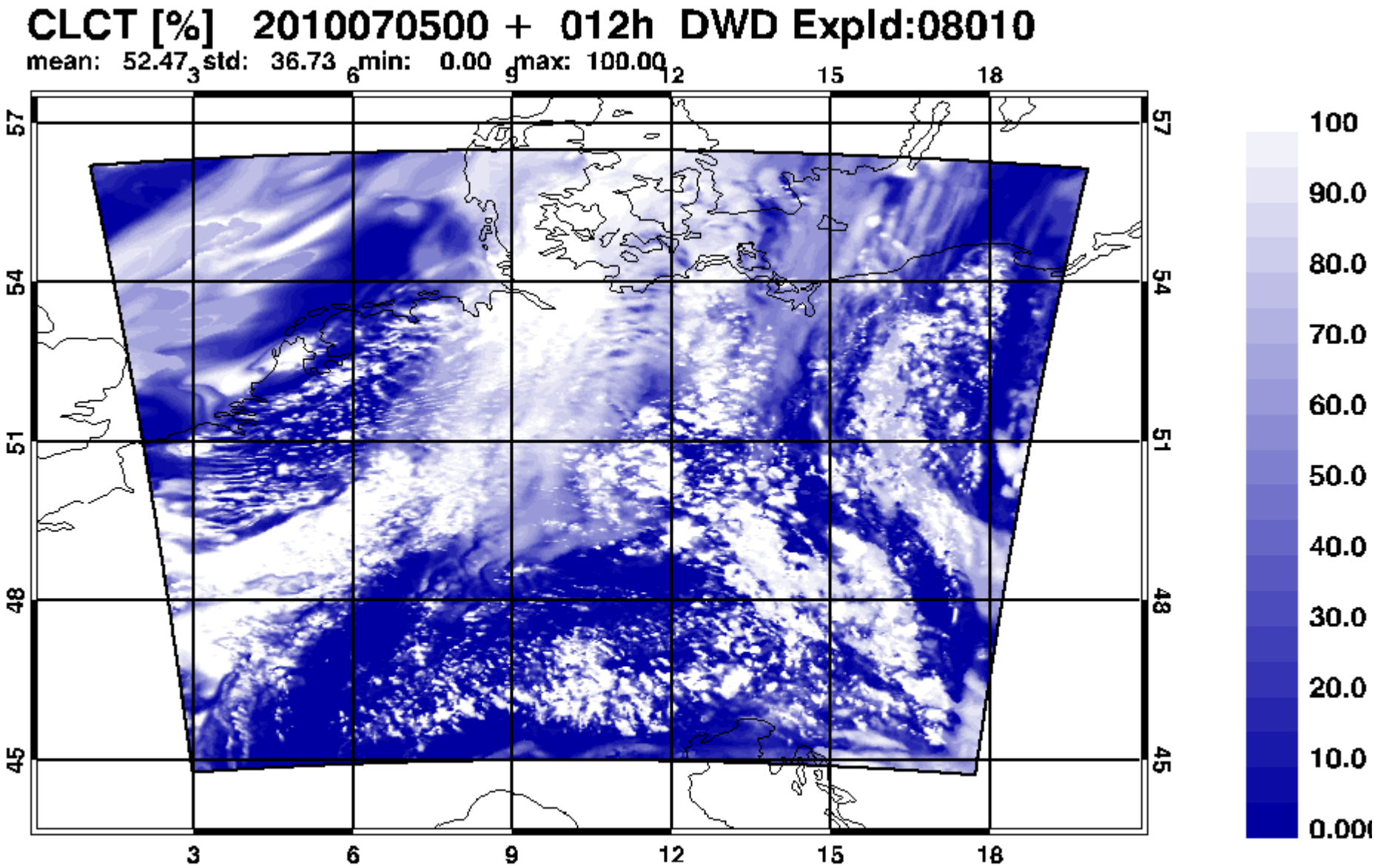
# Total Cloud Coverage

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

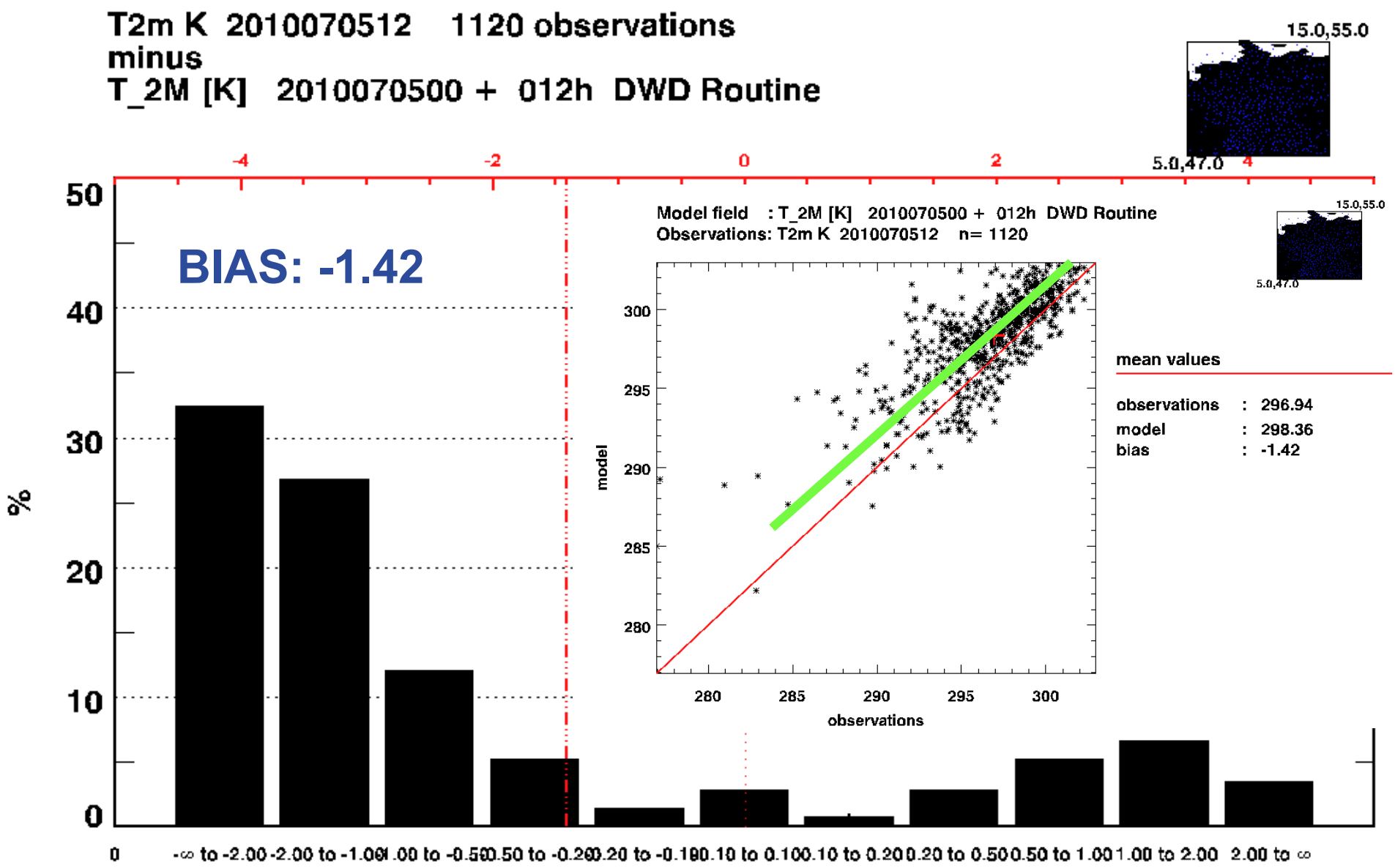


# Total Cloud Coverage

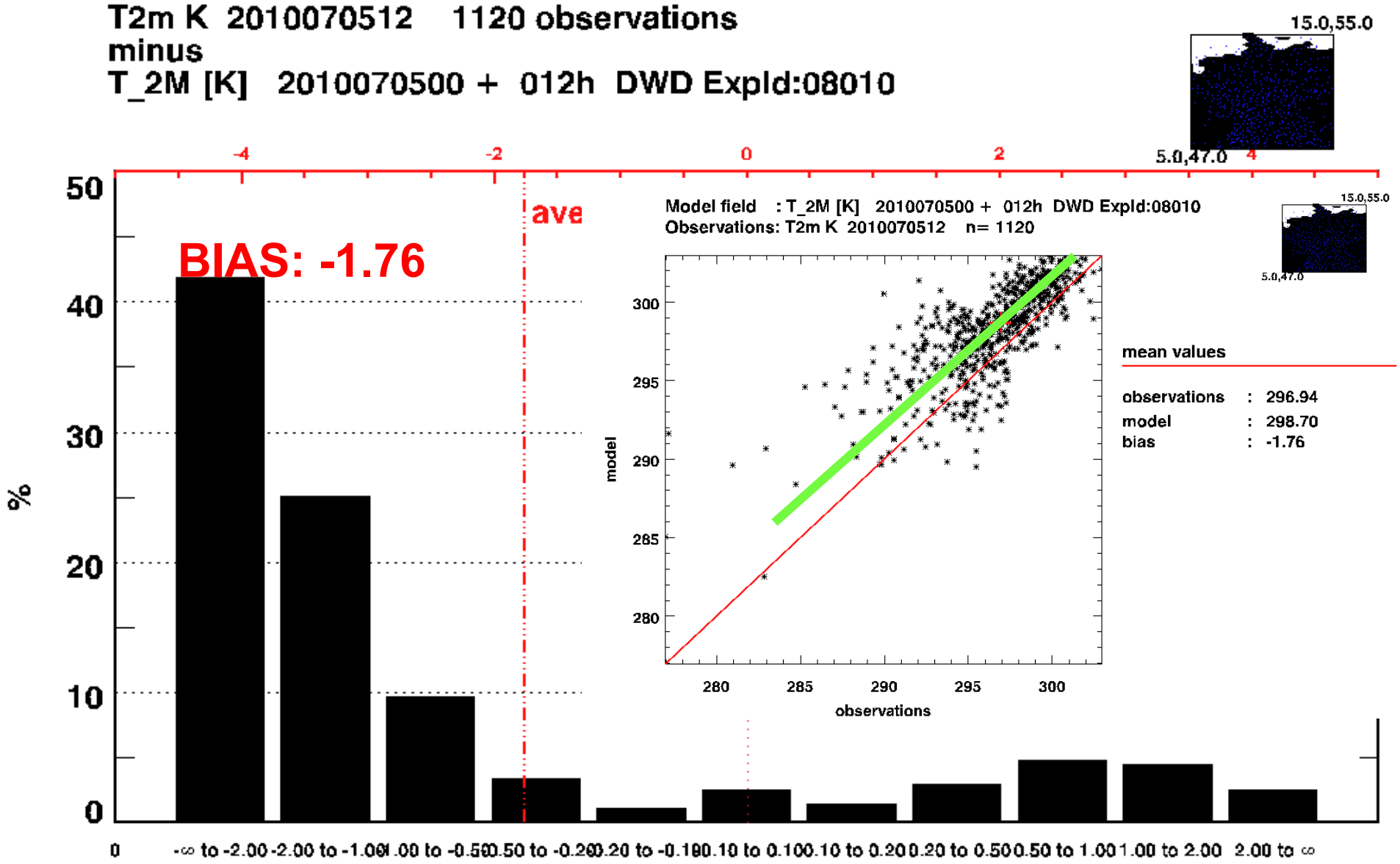
CONSORTIUM FOR SMALL SCALE MODELING
COSMO
Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD



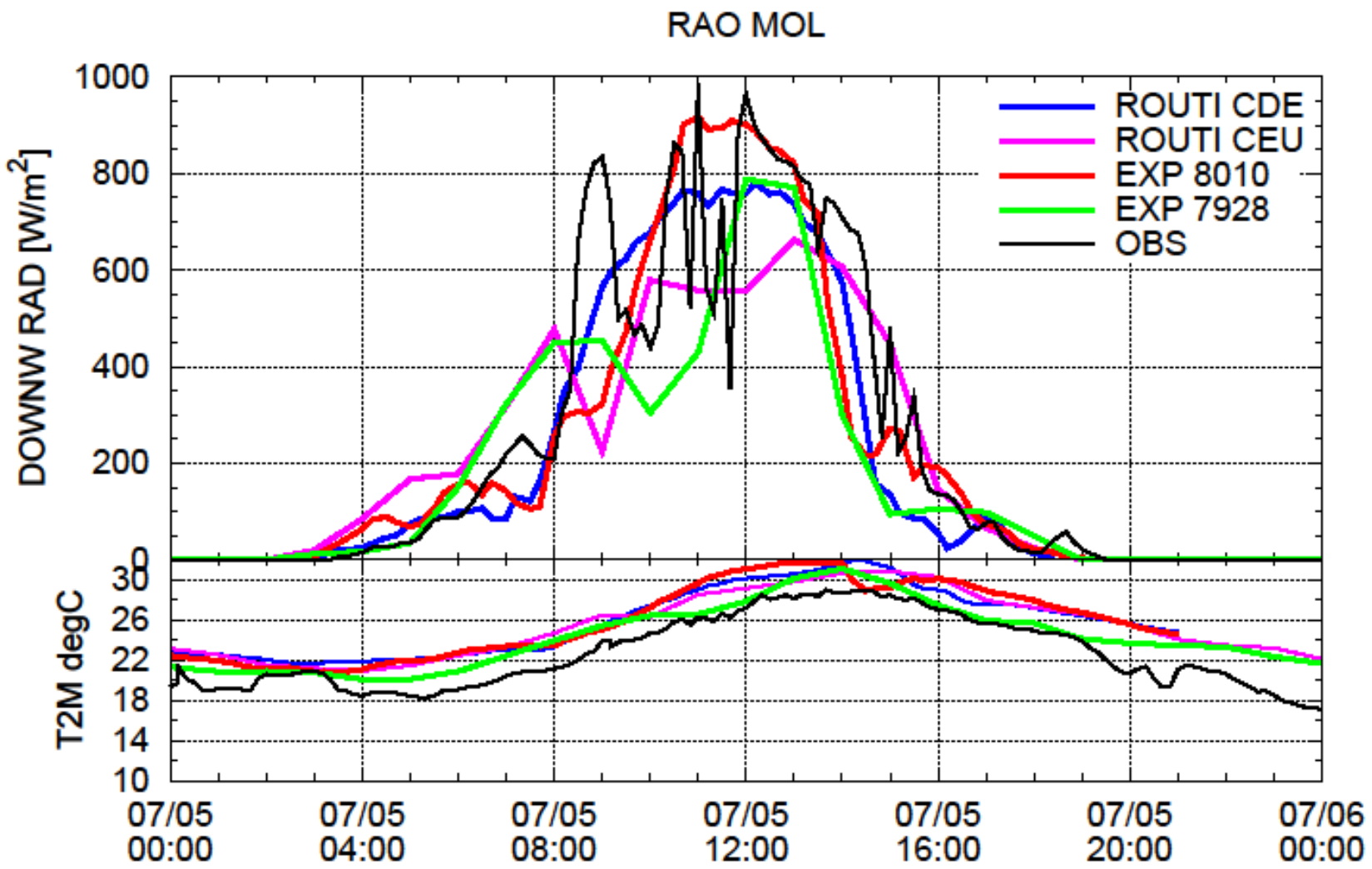
# COSMO-DE L65 Validation „Cloudy Sky“



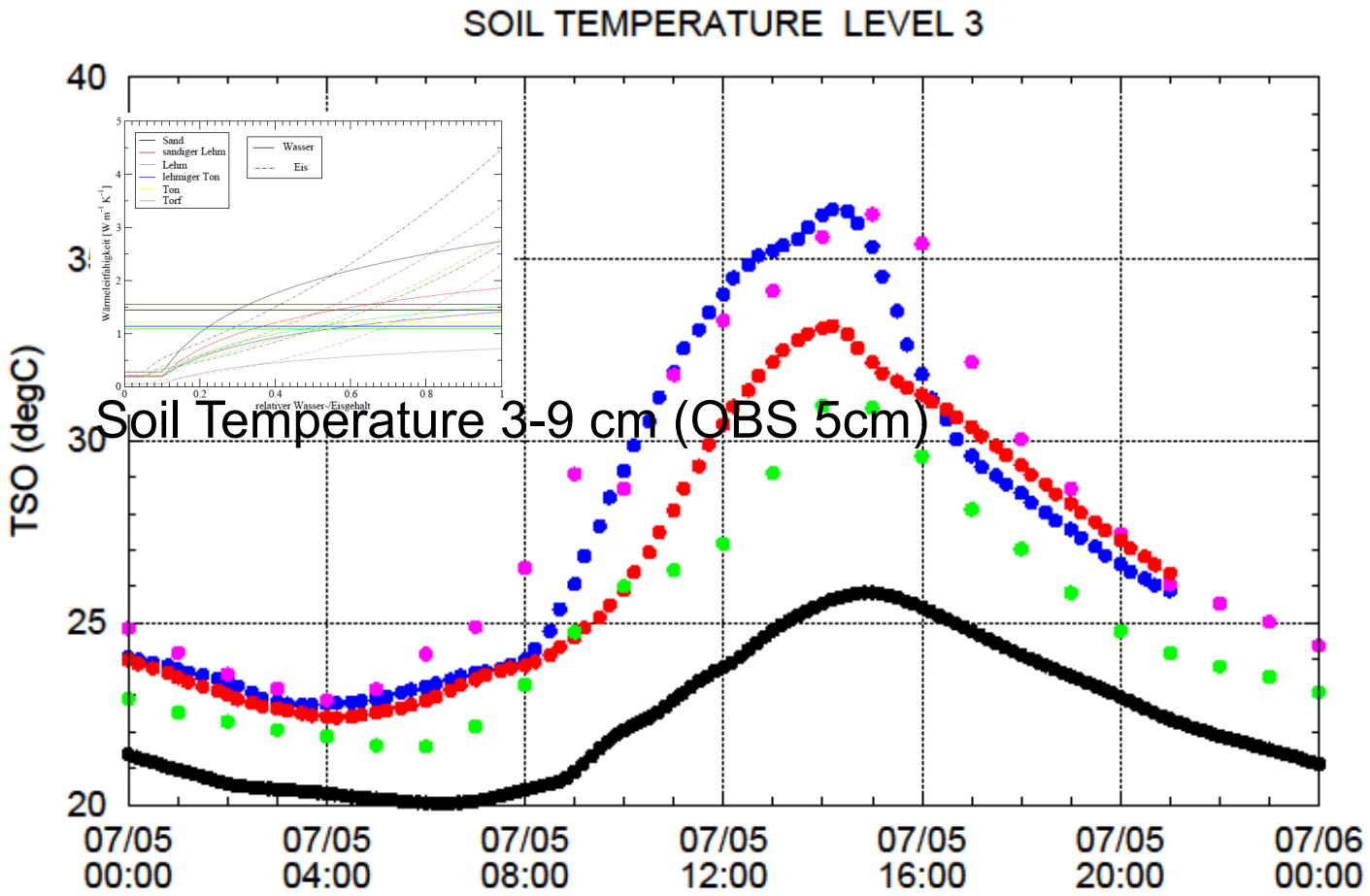
# COSMO-DE L65 Validation „Cloudy Sky“



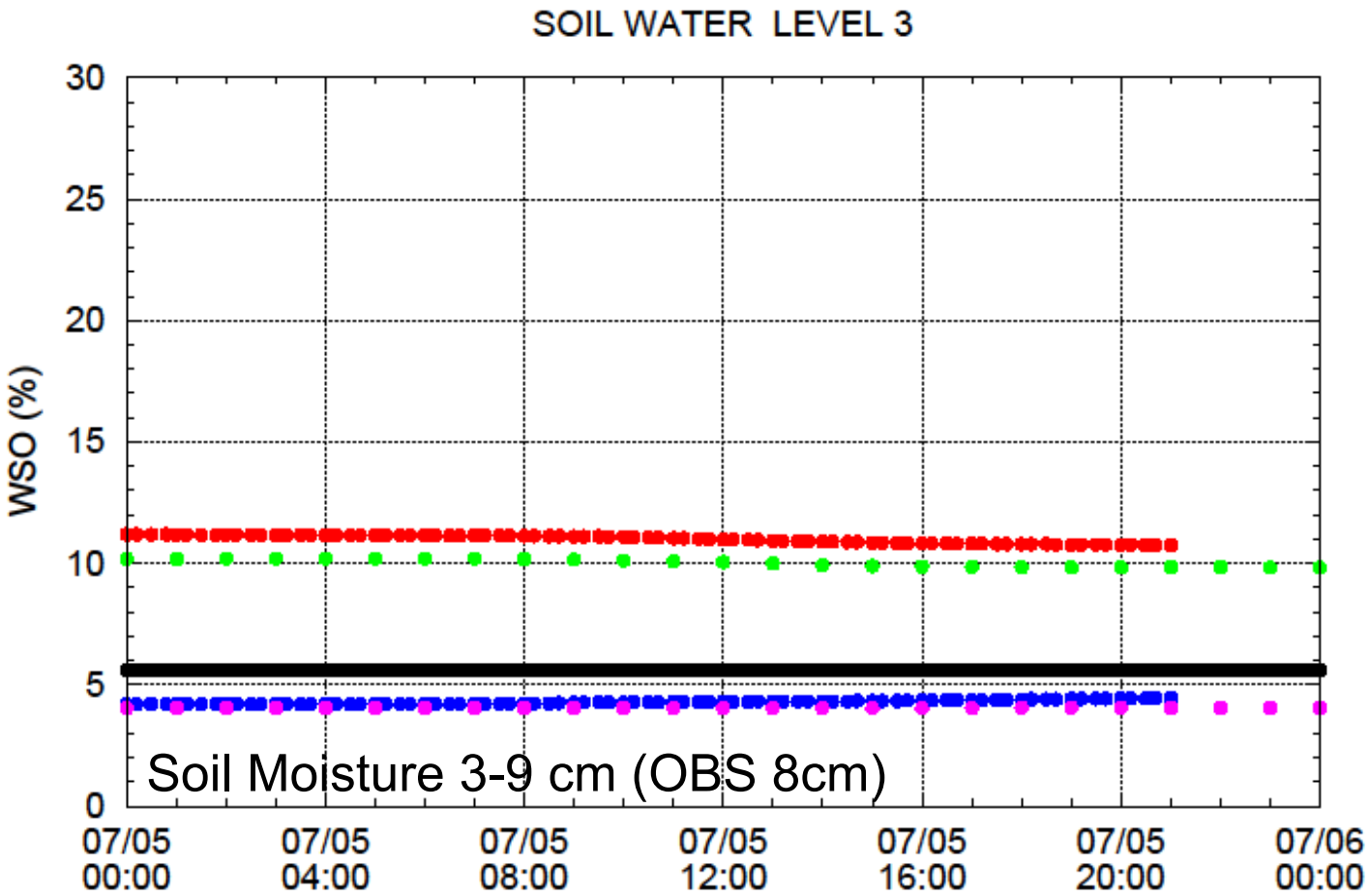
# COSMO-DE L65 Validation „Cloudy Sky“



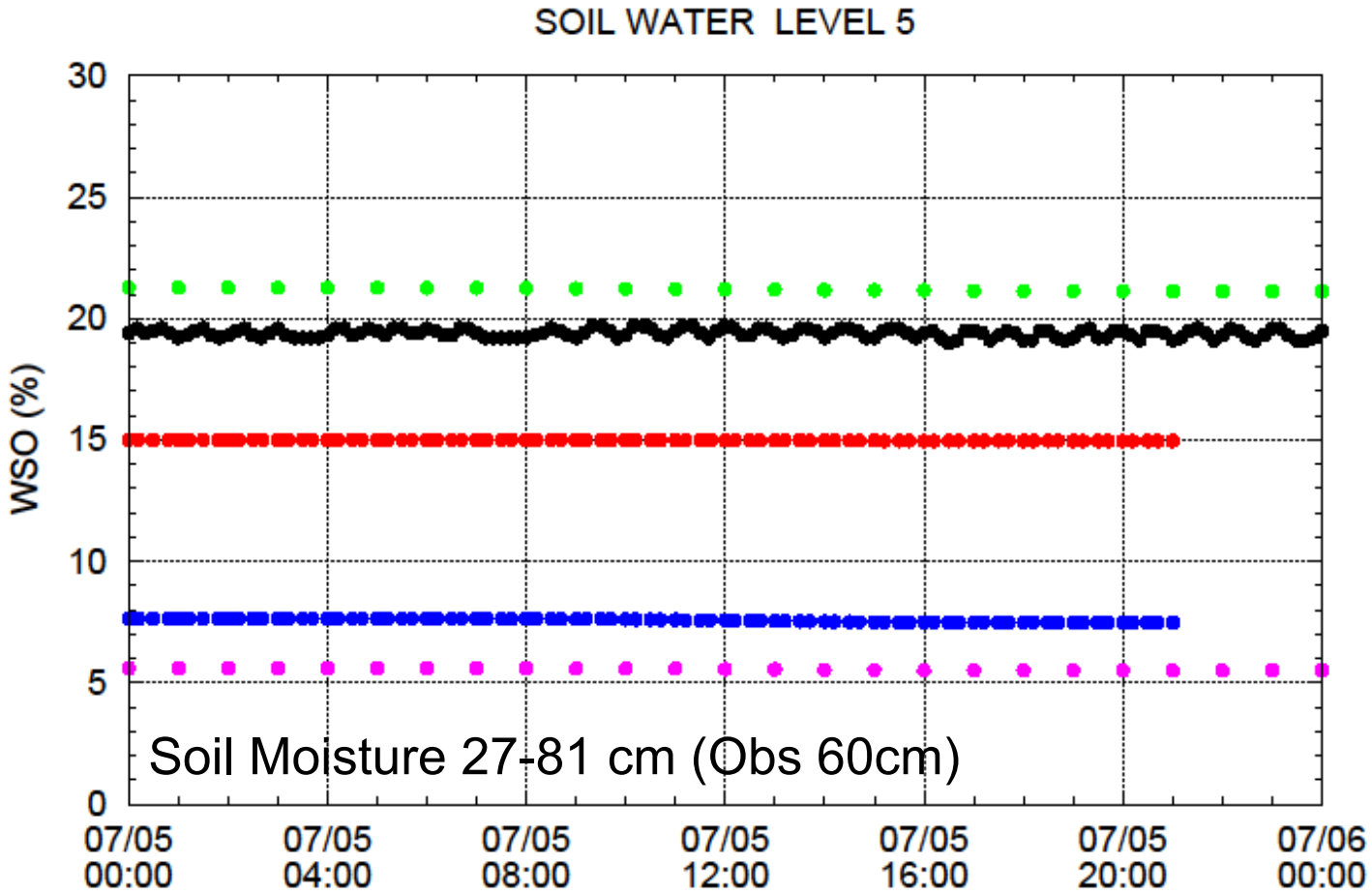
# COSMO-DE L65 Validation „Cloudy Sky“



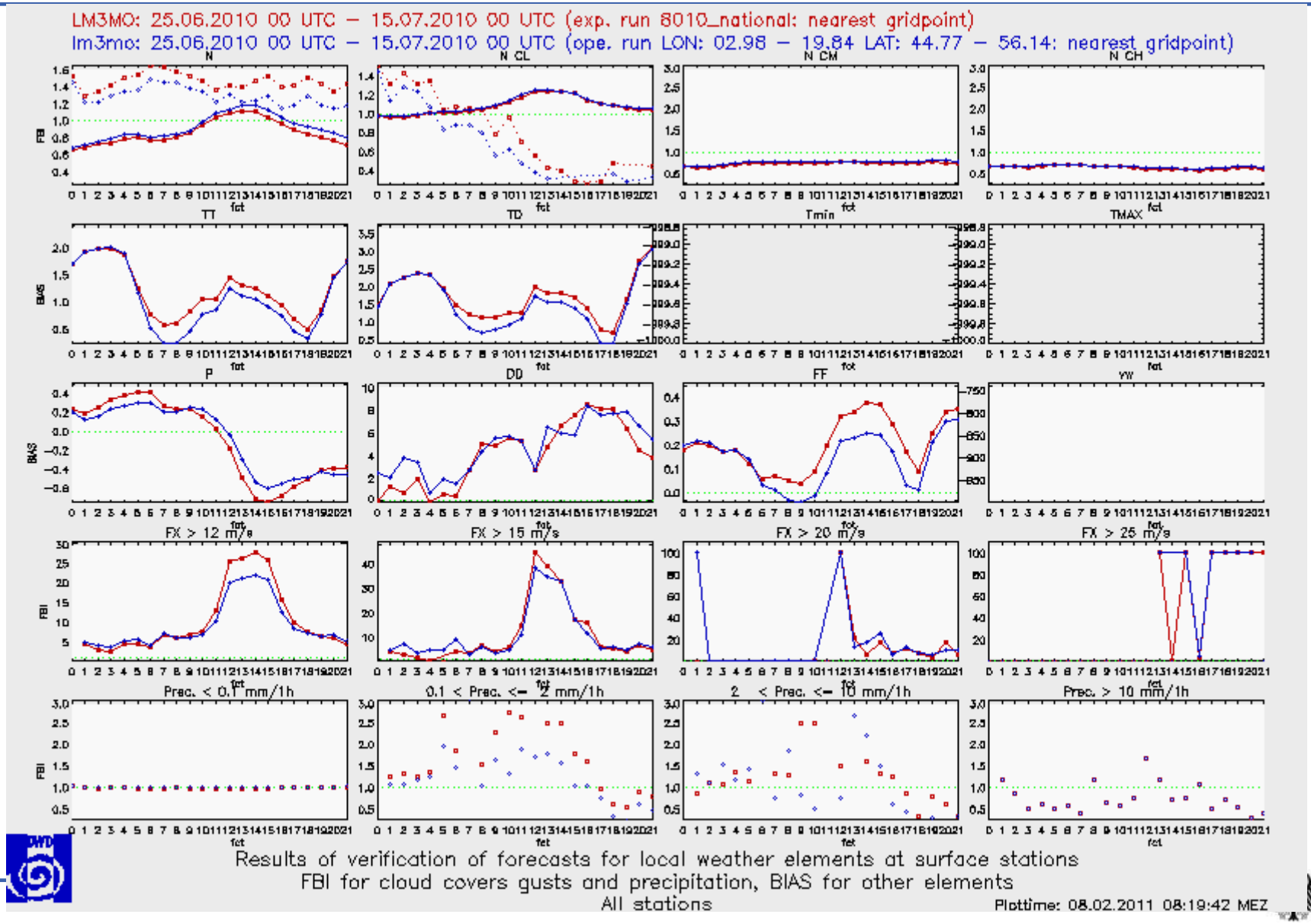
# COSMO-DE L65 Validation „Cloudy Sky“



# COSMO-DE L65 Validation „Cloudy Sky“



# Verification



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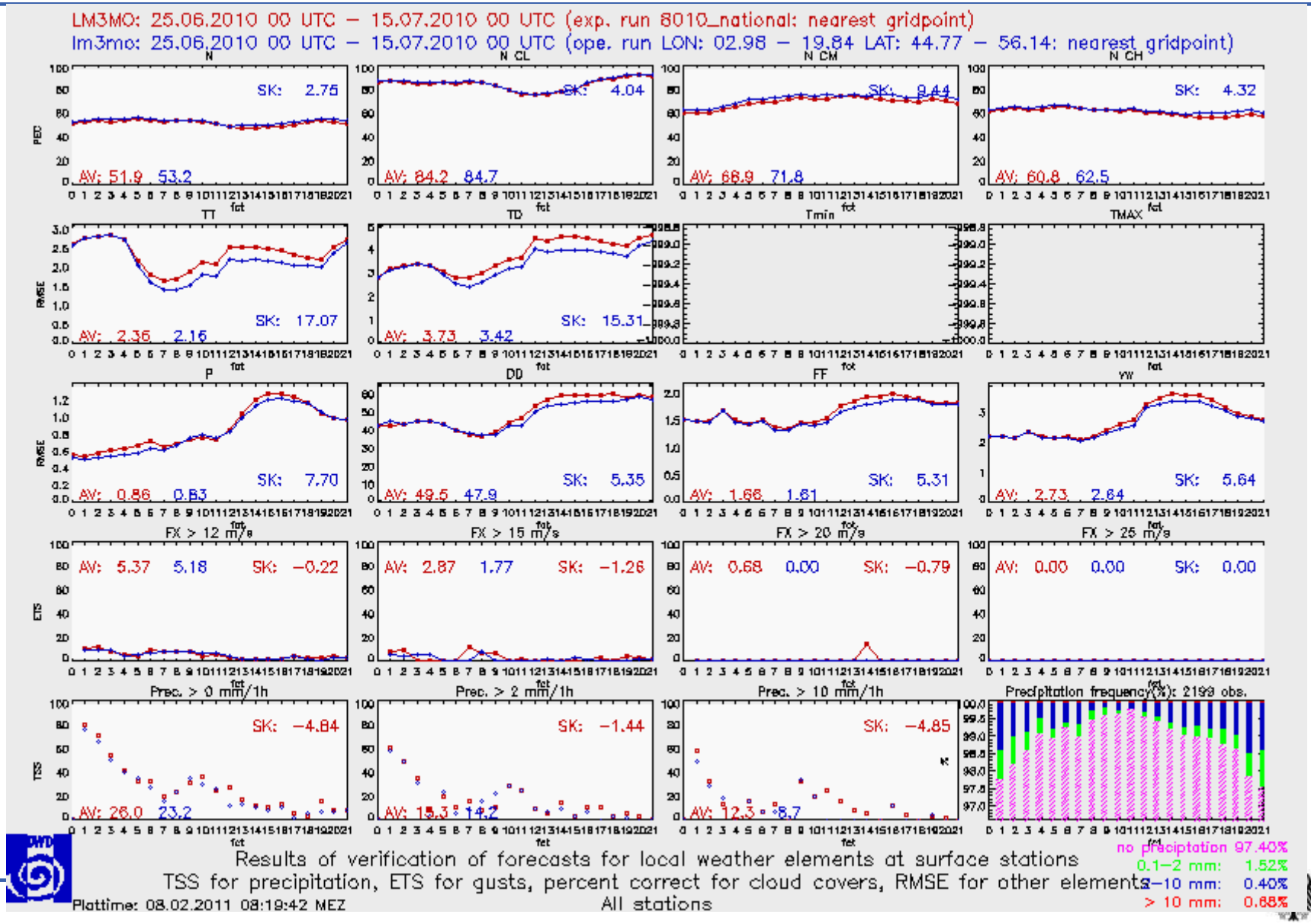

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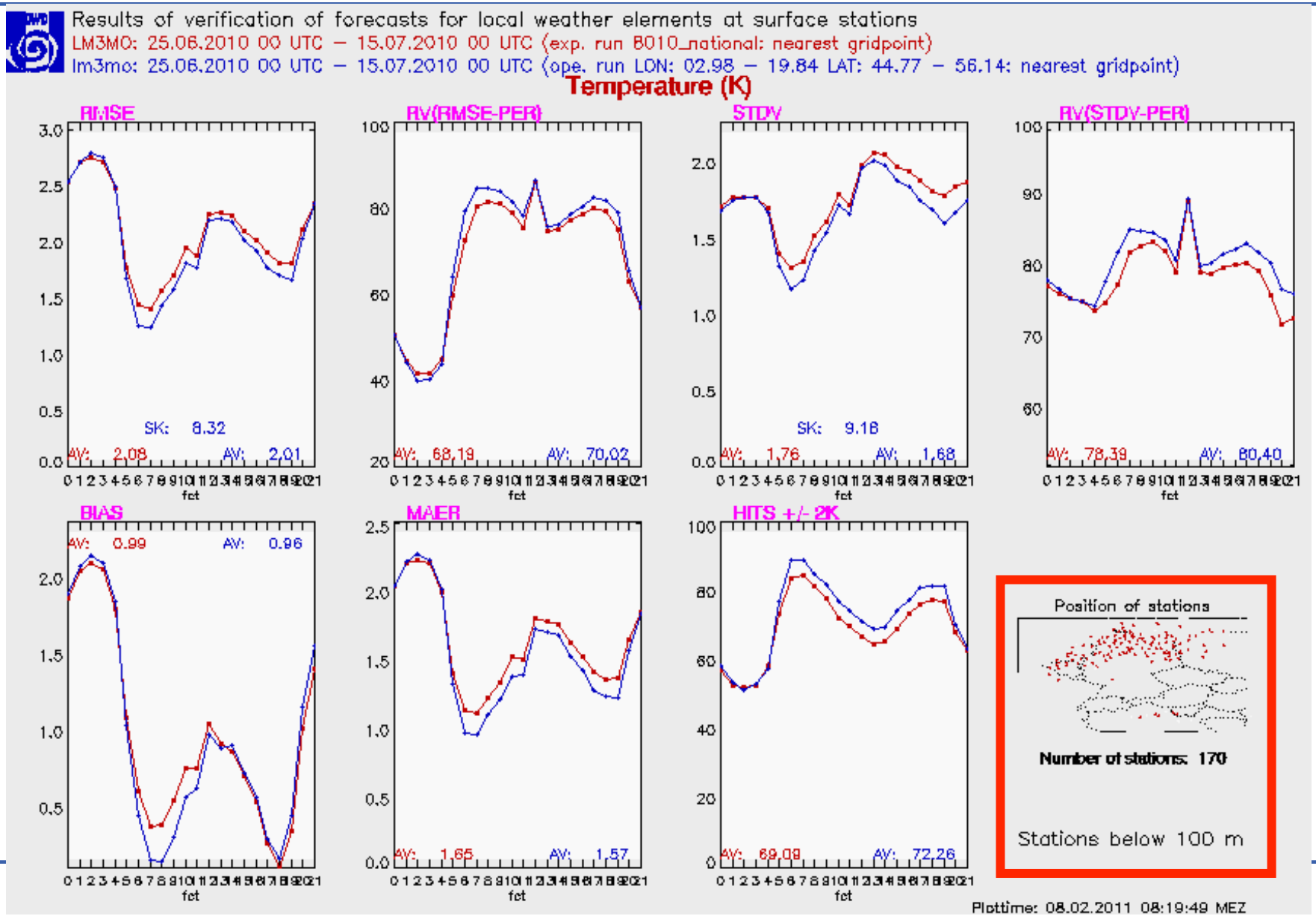

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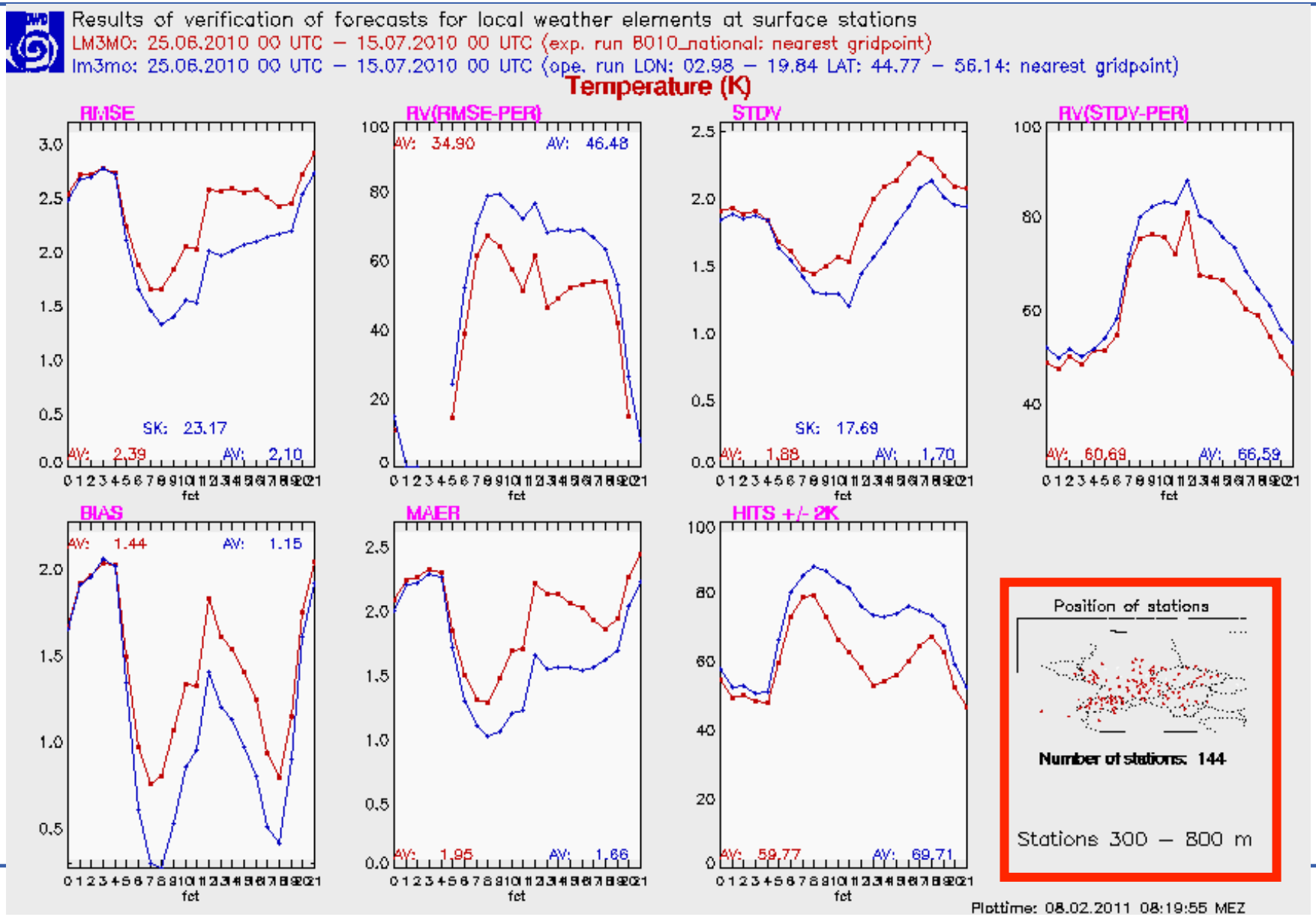


# Conclusions and Outlook

- COSMO experiments with vegetation type albedo and adaptions in land-surface scheme performed
- Expected decrease of T_2M bias in cloud-free situation
- Still uncertainties due to cloud impact and impact from differences of external parameter
- Improved post-processing required to avoid experiment initialisation from large-scale models

# Poster 1st March 2011

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

DWD

**Wetter und Klima aus einer Hand**
Deutscher Wetterdienst

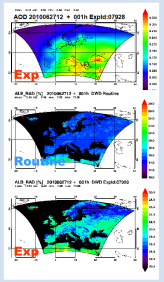
## *Application of a prescribed aerosol climatology in the radiative transfer scheme of the COSMO model*

J. Helmert, H. Asensio, B. Fay, B. Ritter

### Motivation

The treatment of the contribution of aerosols on the radiative transfer of numerical weather prediction (NWP) models is an complex issue due to the considerable variability of their optical properties in space and time. The operational NWP models employed at Deutscher Wetterdienst use a radiation scheme (Ritter and Geleyn, 1992) that considers the impact of aerosols on radiative transfer by scattering, absorption, and emission in all spectral intervals. Optical properties for the spectral intervals of different aerosol types are taken into account. The limited-area NWP models COSMO-EU und COSMO-DE apply the approach of Tanre et al. [1984], where the horizontal aerosol distribution is characterized by temporally fixed, smooth large-scale patterns. A prescribed temporal variation in the horizontal aerosol distribution based on Tegen et al. [1997] is used in the radiation scheme of the global NWP model GME since May 2009. This study further explores the capabilities of this approach in the evaluation of numerical experiments of limited-area models (COSMO-EU and COSMO-DE).

References:
Ritter, B., and J.-F. Geleyn (1992), A comprehensive radiation scheme for numerical weather prediction models with potential applications in climate simulations, Mon. Weather Rev., 120, 303– 325.
Tanre, D., J.-F. Geleyn, and J. M. Slingo (1984), First results of the introduction of an advanced aerosol-radiation interaction in the ECMWF low resolution global model, in Aerosols and Their Climatic Effects, edited by H. E. Gerber and A. Deepak, pp. 133– 177, A. Deepak, Hampton, Va.
Tegen, I., S. P. Harrison, K. Kohfeld, I. C. Prentice, M. Coe, and M. Heimann (2002), Impact of vegetation and preferential source areas on global dust aerosol: Results from a model study, J. Geophys. Res.,107(D21), 4576, doi:10.1029/2001JD000963.



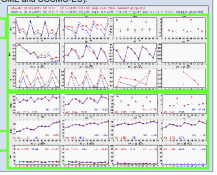

### Experiments

Numerical experiments performed with COSMO-EU and COSMO-DE for a summer period in June/July 2010 included the prescribed temporal variation in the horizontal aerosol distribution. To decrease the strong warm bias of T_2M shown in former experiments with the COSMO model with the new aerosol distribution, an adaption of the vegetation albedo has been implemented. In the land-surface scheme TERRA of the COSMO model different parameterization of the root-density distribution, soil heat conductivity, minimum stomatal resistance, and lower boundary condition of the soil water transport has been included in the experiments. Due to changes in the external parameters, the experiments were initialized from interpolations of the large-scale model (GME and COSMO-EU).

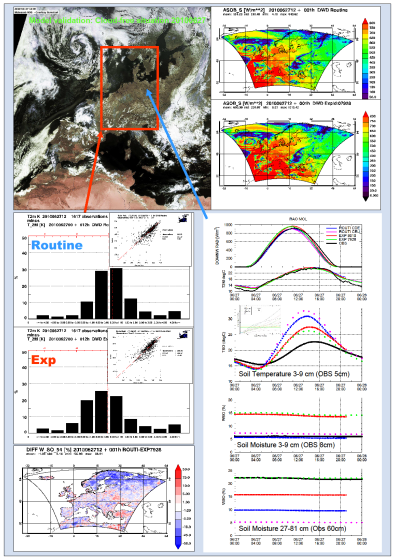
**Namelist switches:**

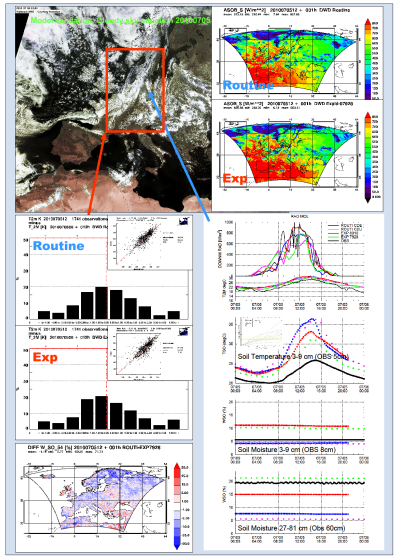
```
itype_aerosol   = 2
itype_root      = 2
itype_heatcond  = 2
itype_hydbound  = 3
lemiss          = .TRUE.
ltomata         = .TRUE.
itype_ndvi      = 1
```

**Bias**



**RMSE**

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