

Land surface model calibration:

Results from new experiments

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

History

Tested adaptations in int2lm and TERRA EXP 7224

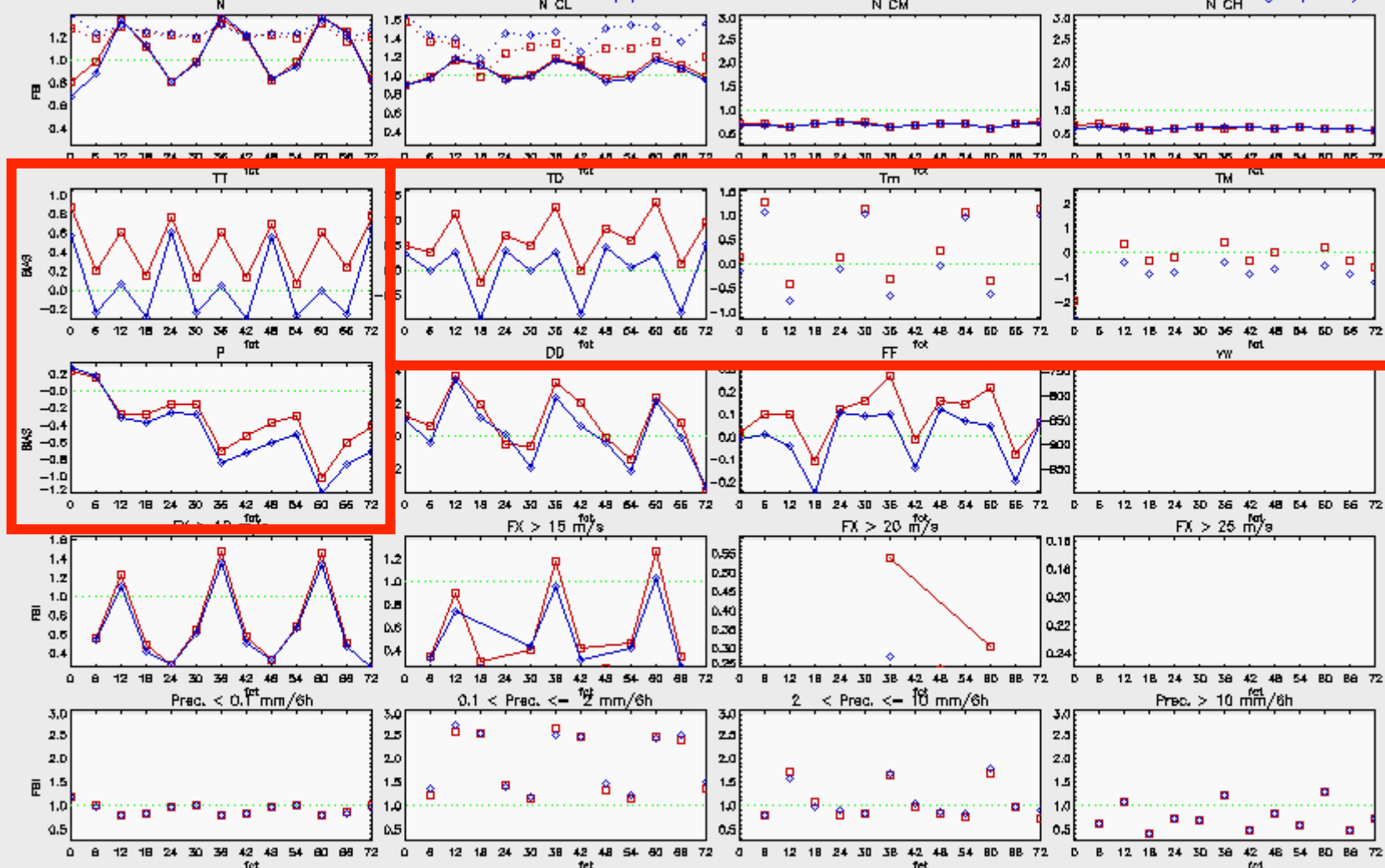
- COLOBOC Spring Meeting 2010
- Aerosol climatology
- Emissivity
- Vegetation climatology (LAI, PLCOV)
- Minimum stomatal resistance
- Non-uniform root distribution
- Ground water with upward diffusion
- Soil moisture dependent heat conductivity

Verification 7224

LM2MO: 01.06.2009 00 UTC – 01.07.2009 00 UTC (exp. run 7224: nearest gridpoint)

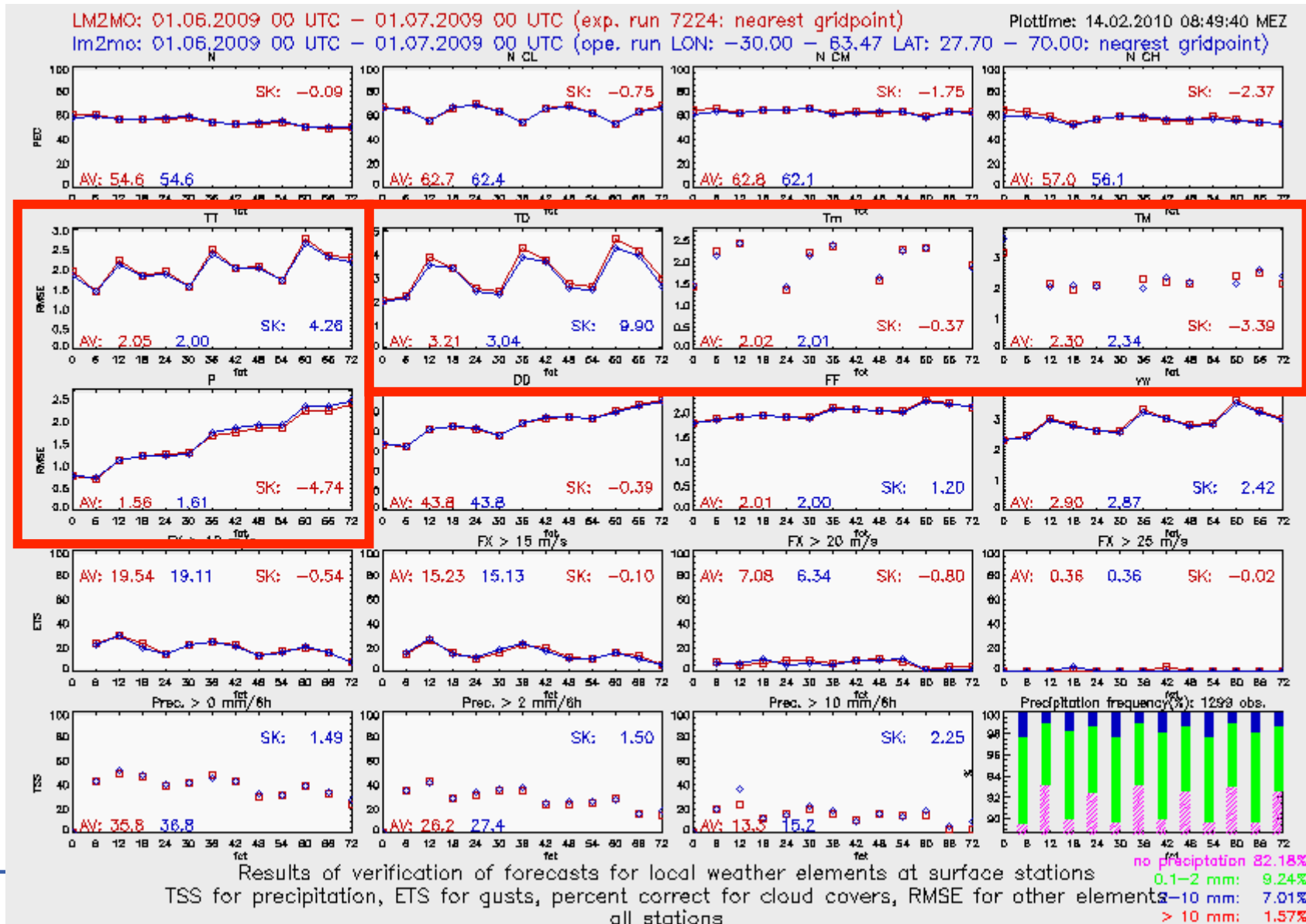
Plottime: 14.02.2010 08:49:40 MEZ

lm2mo: 01.06.2009 00 UTC – 01.07.2009 00 UTC (ope. run LON: -30.00 – 63.47 LAT: 27.70 – 70.00: nearest gridpoint)



Results of verification of forecasts for local weather elements at surface stations
 FBI for cloud covers gusts and precipitation, BIAS for other elements
 all stations

Verification 7224

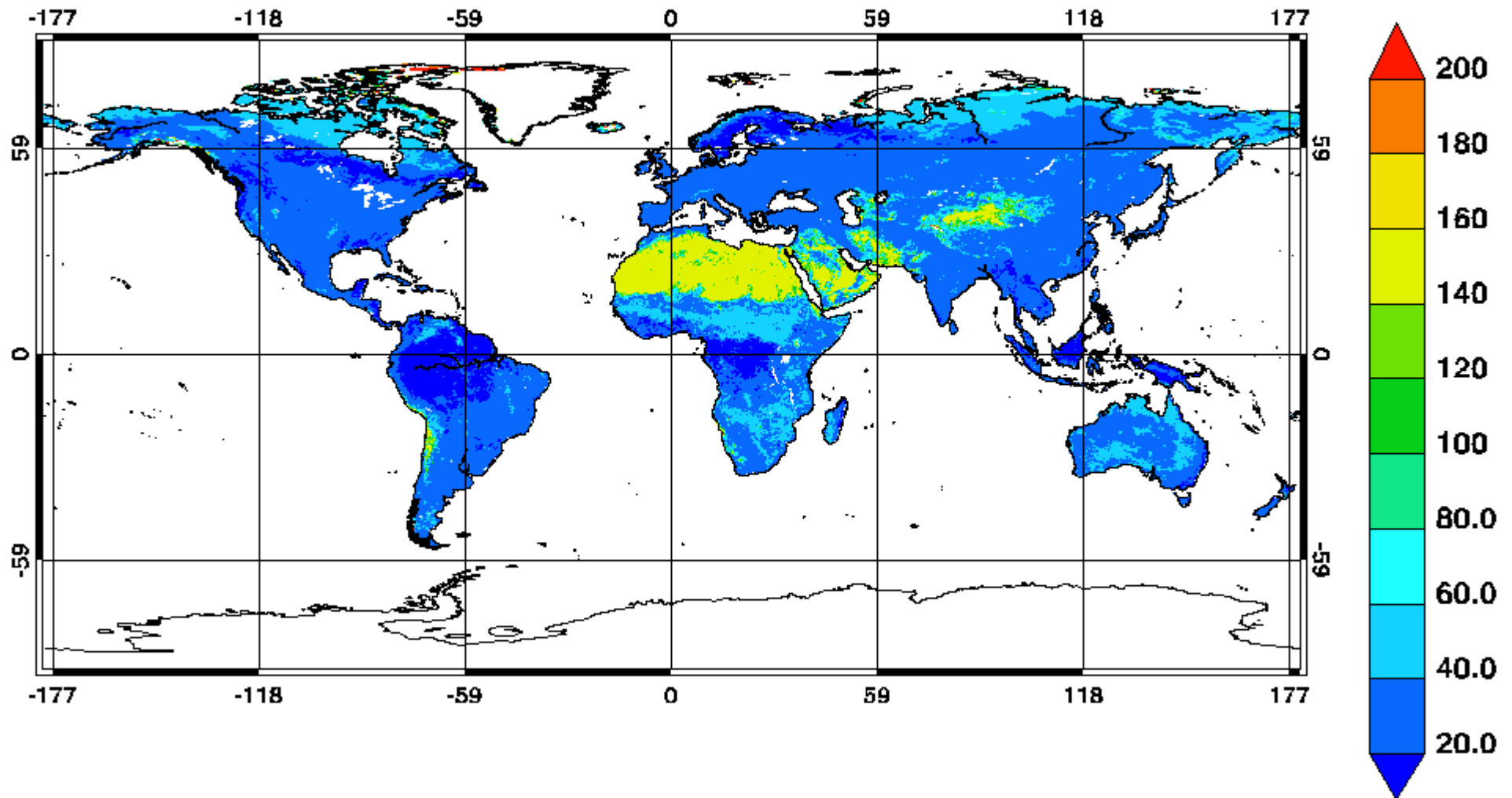


Global experiments on the impact of the minimum stomatal resistance and vegetation albedo

PRS_MIN/LAI_MX ROUTI 1999-2007

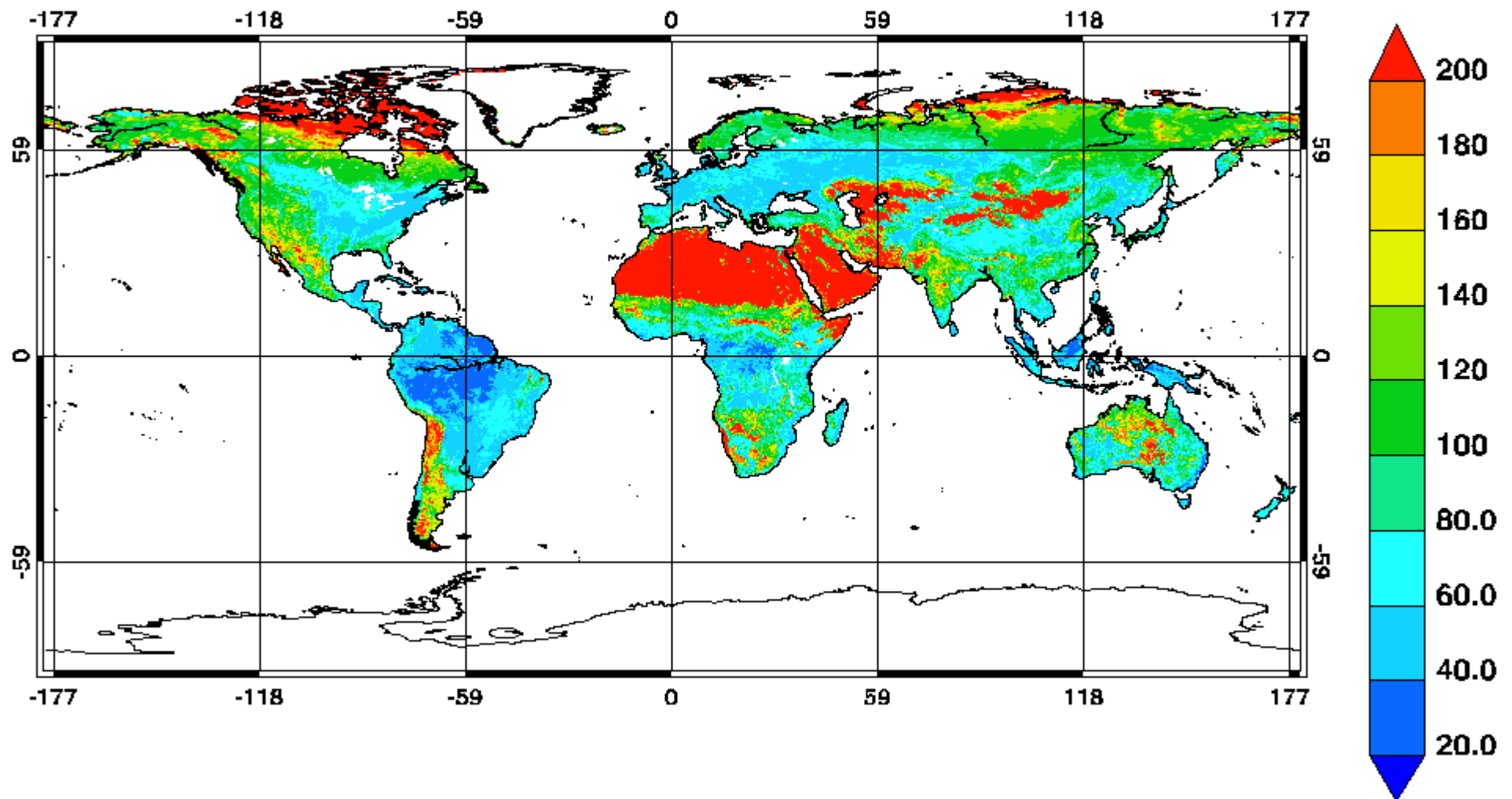
PRS_MIN = 150 s/m

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



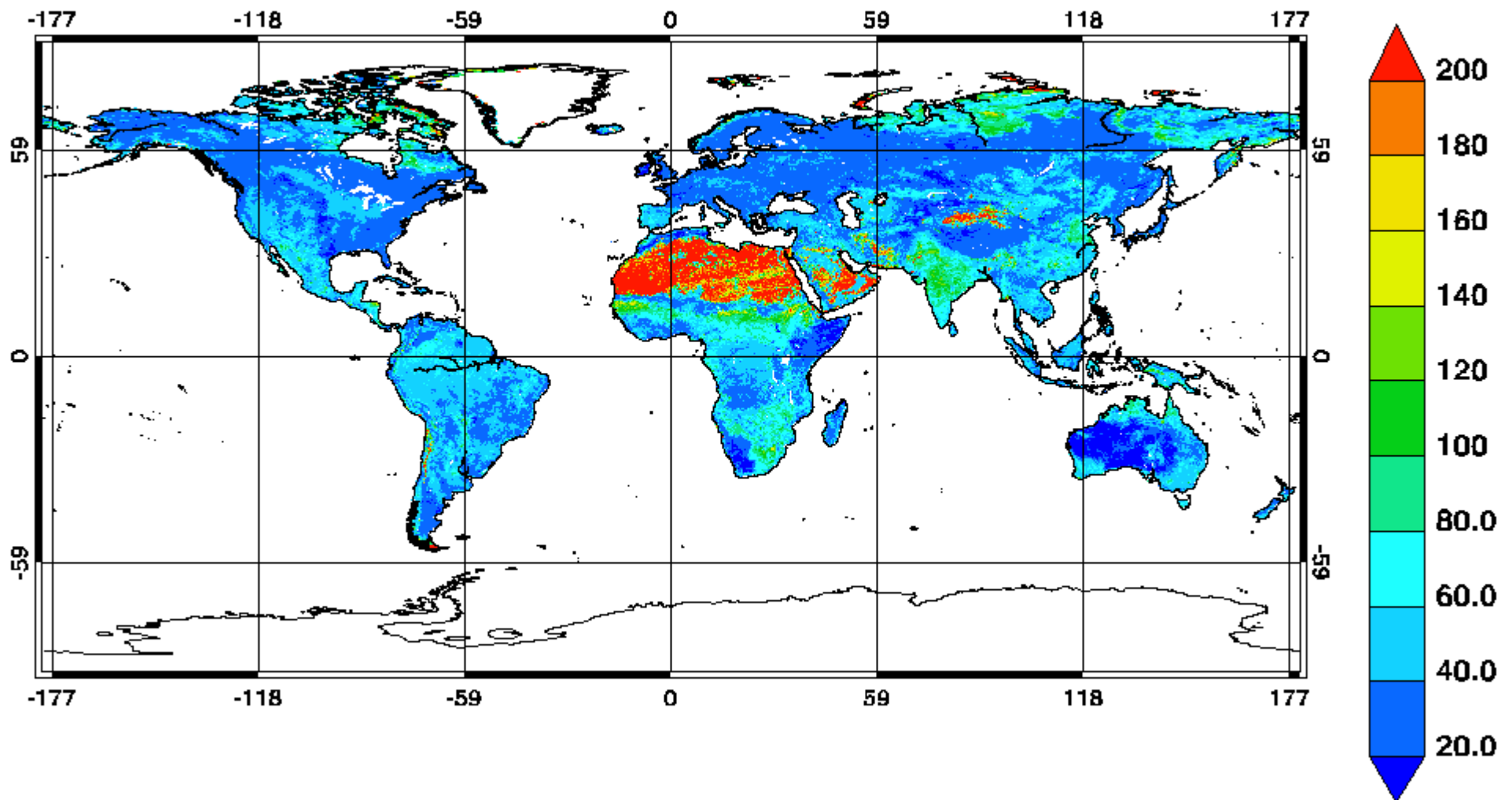
PRS_MIN/LAI June ROUTI 2007-

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



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

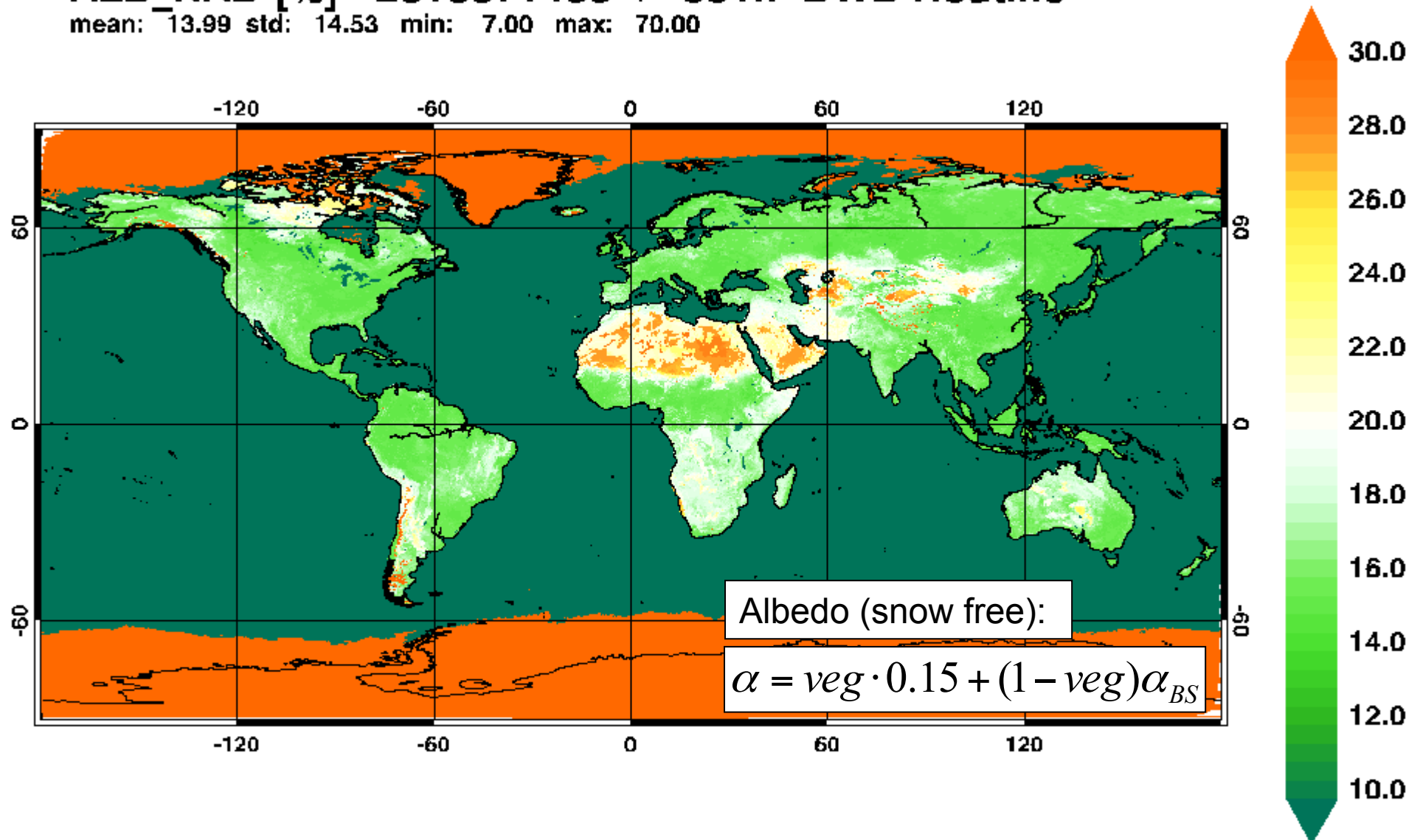
mean: 59.67 std: 47.84 min: 7.46 max: 3006.84



Vegetation albedo ROUTI

ALB_RAD [%] 2010071400 + 001h DWD Routine

mean: 13.99 std: 14.53 min: 7.00 max: 70.00



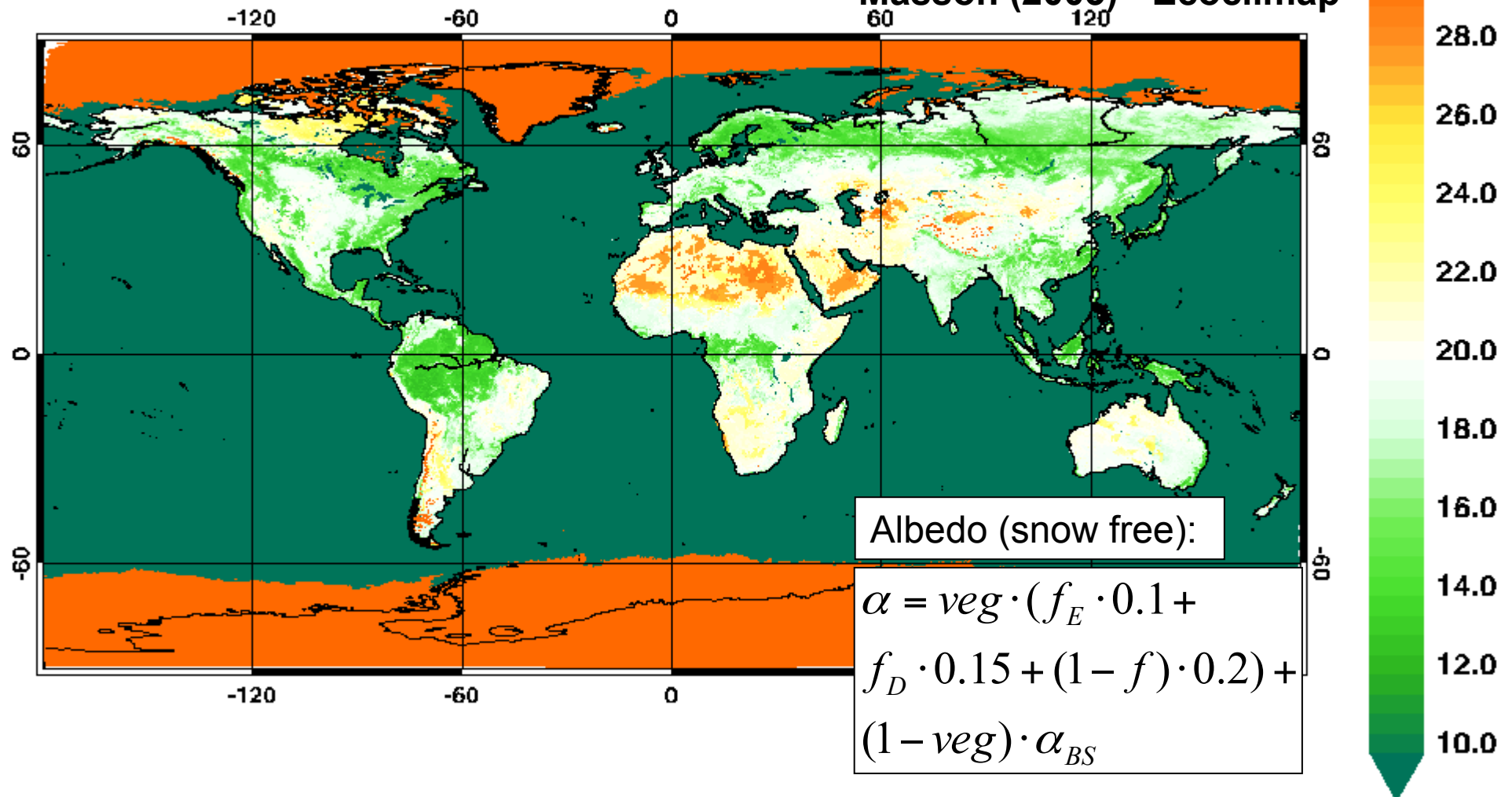
Vegetation albedo EXP

ALB_RAD [%] 2010071400 + 001h DWD Routine

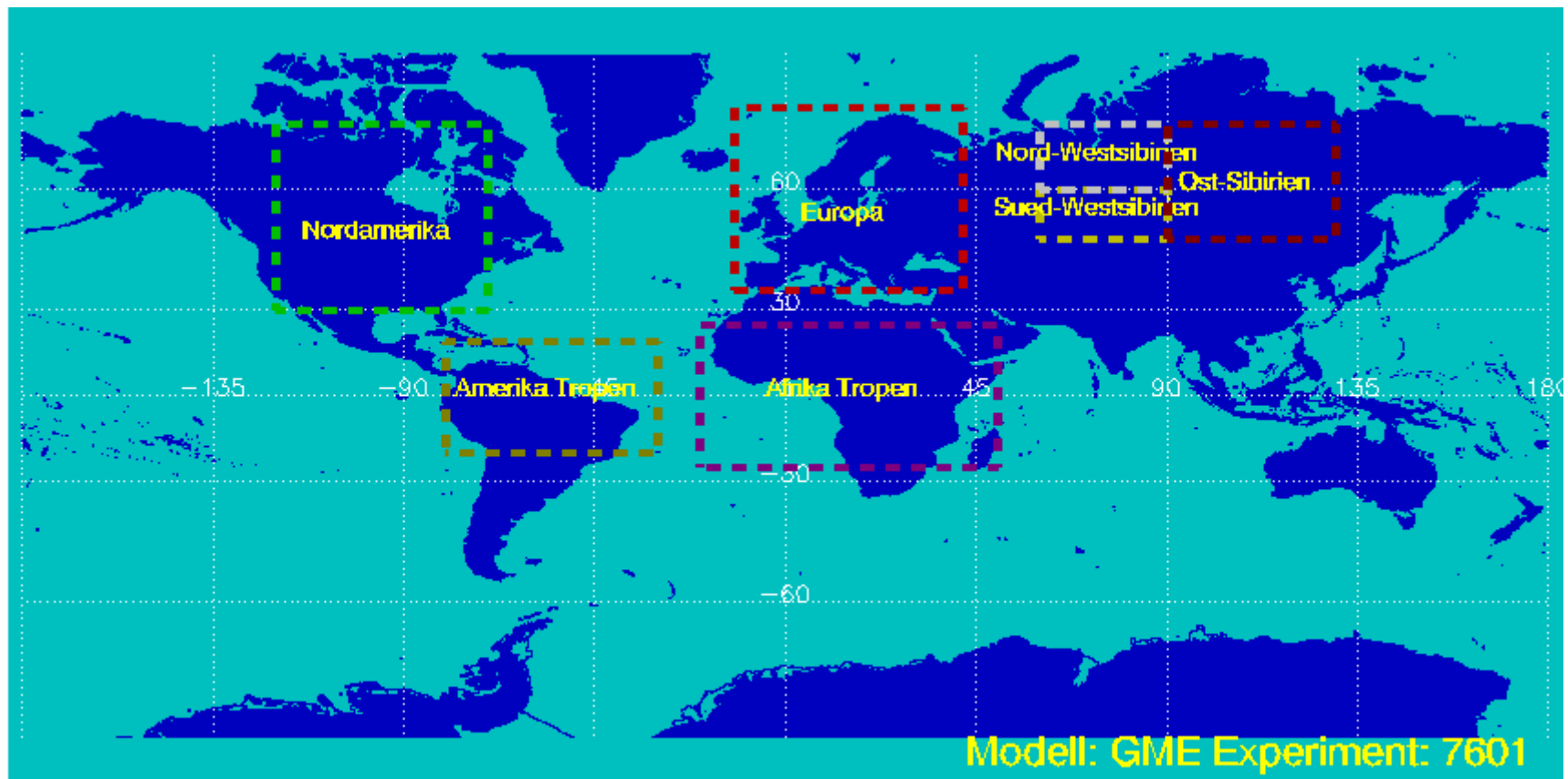
mean: 14.39 std: 14.67 min: 7.00 max: 70.00

EXP 7750

Masson (2003) - Ecoclimap



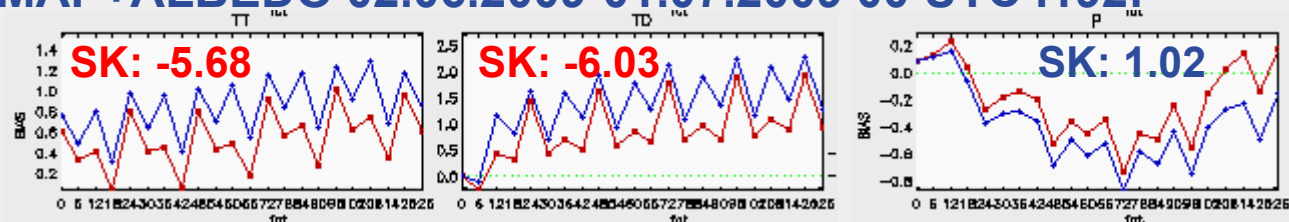
Global Verification



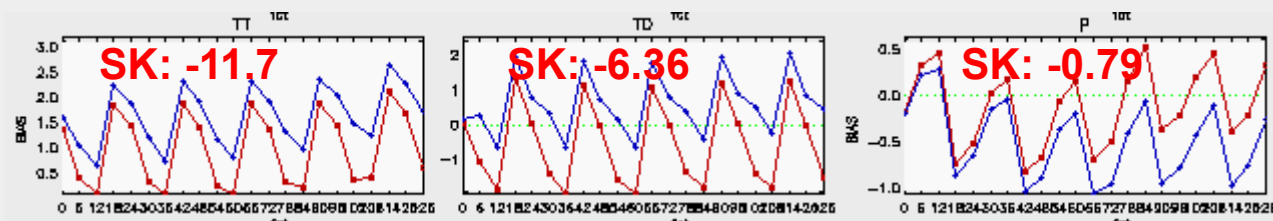
Global Verification

EXP 7750 ECOCLIMAP+ALBEDO 02.06.2009-01.07.2009 00 UTC i192f

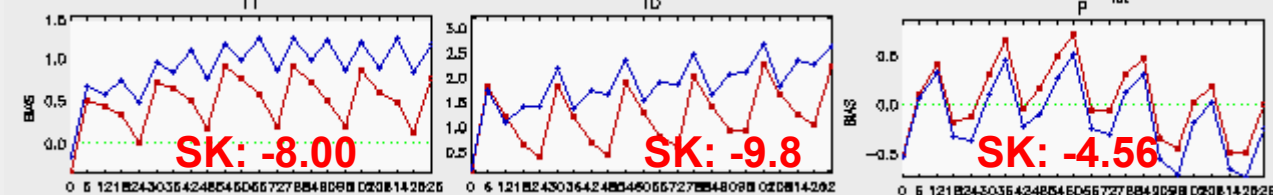
Europe



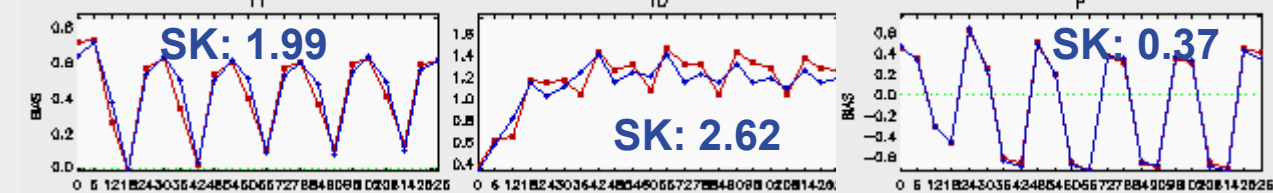
East Siberia



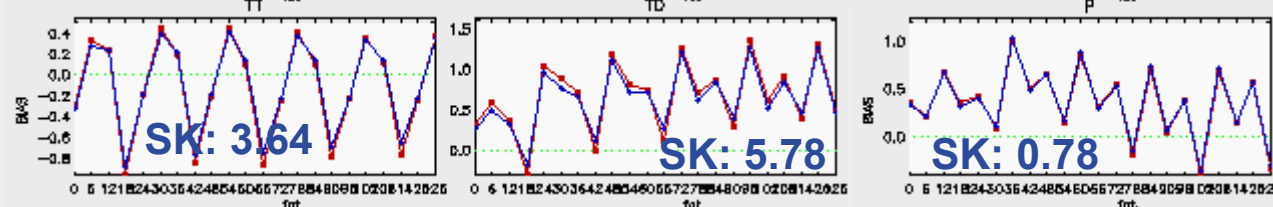
North America



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

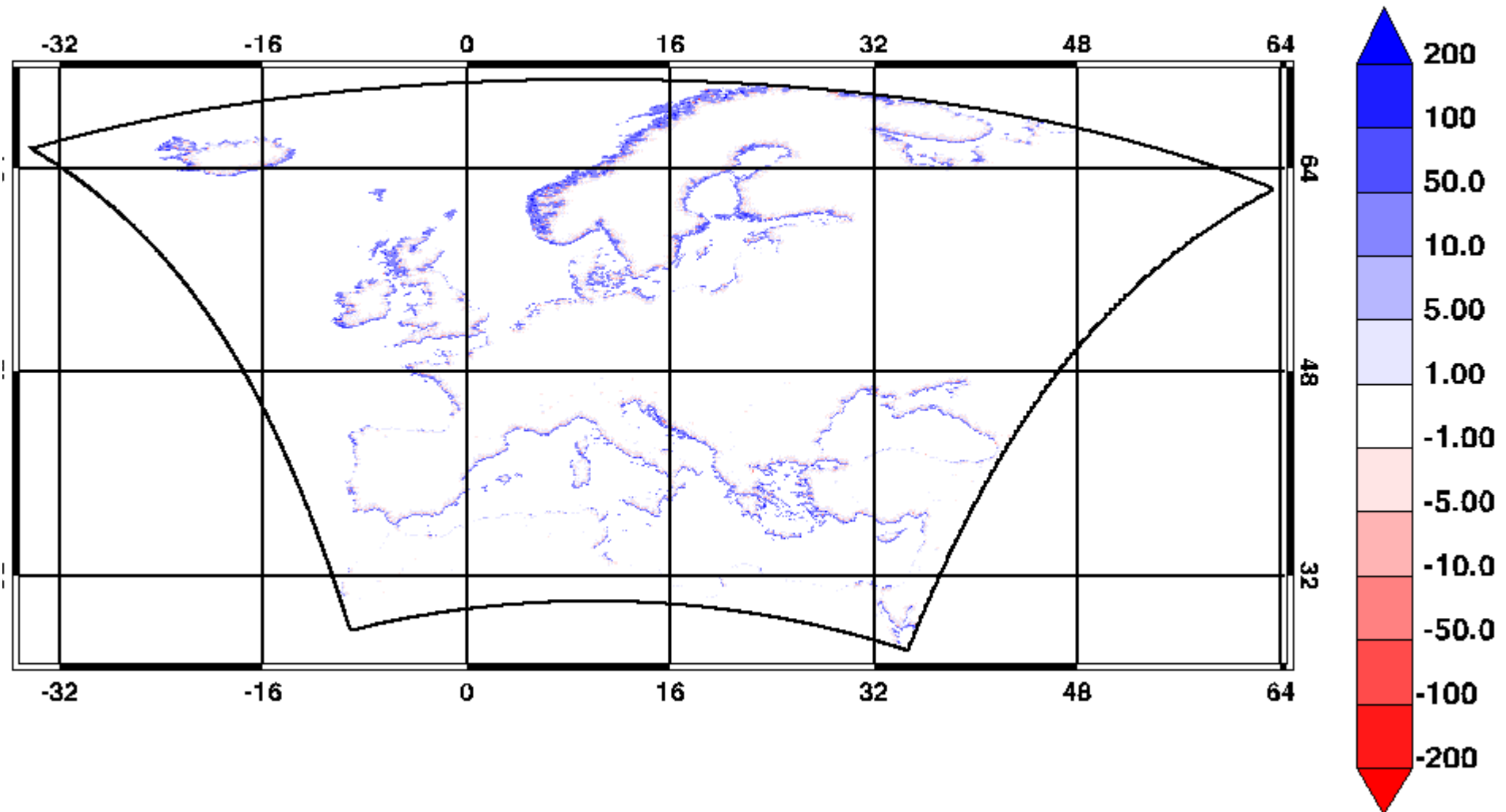
Tested adaptations in int2Im and TERRA EXP 7928/8010

- 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

DIFF Z [m] 2010062712 ROUTI-EXP7928

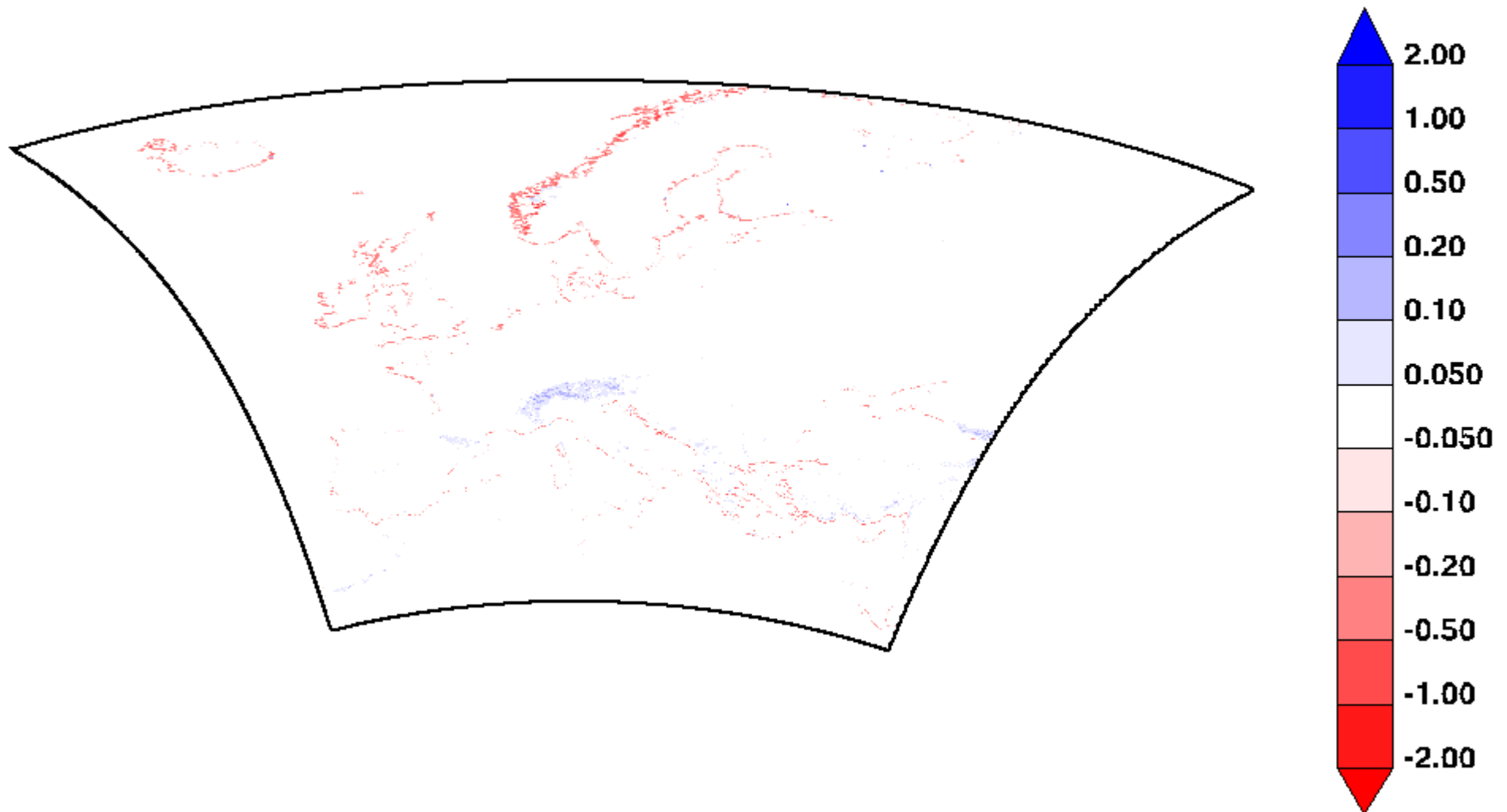
mean: 1.06 std: 7.84 min: -157.72 max: 328.53



External Parameters

DIFF Z0 [m] 2010062712 + 001h ROUTI-EXP7928

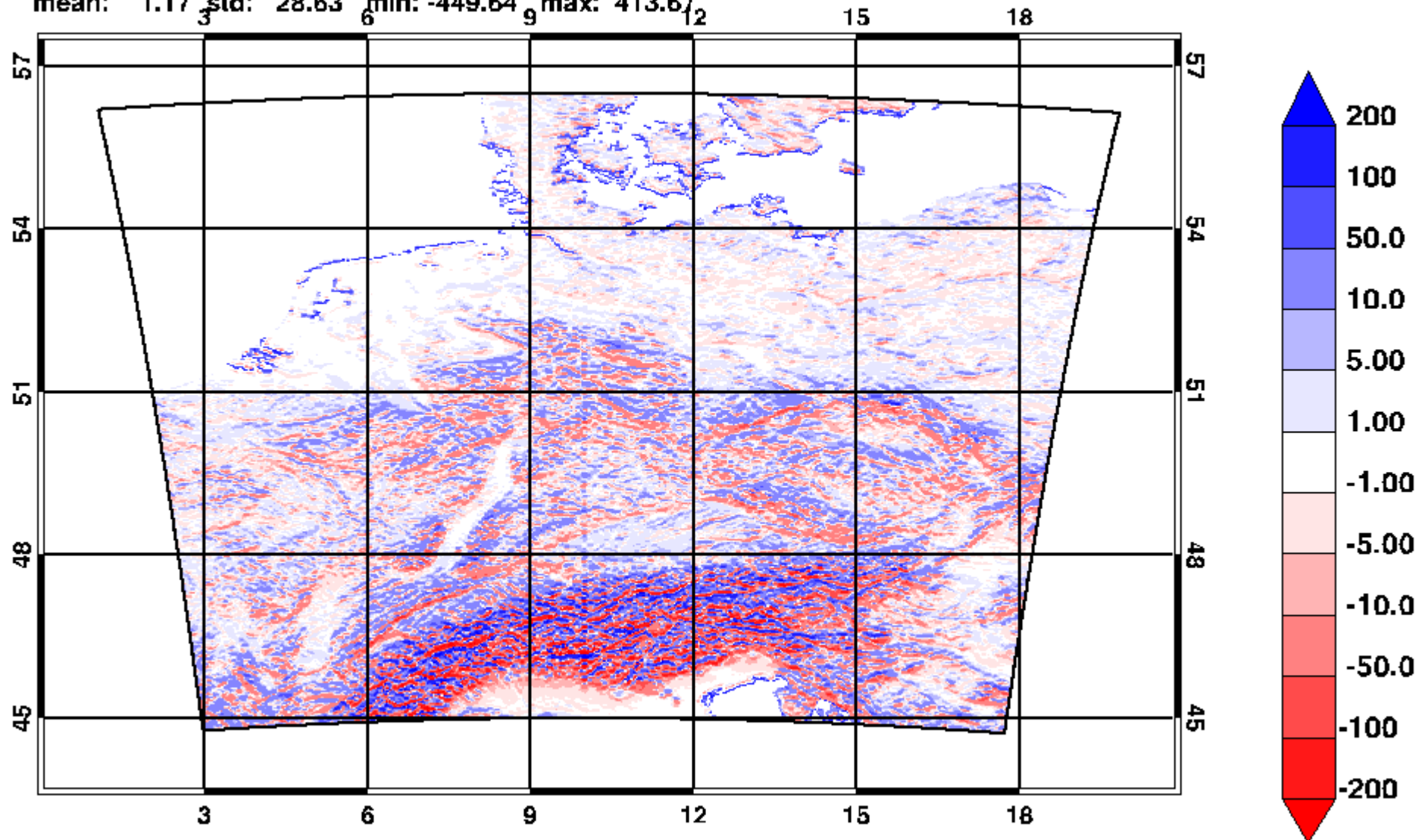
mean: -0.00 std: 0.04 min: -1.69 max: 2.57



External Parameters

DIFF Z [m] 2010062712 ROUTI-EXP8010

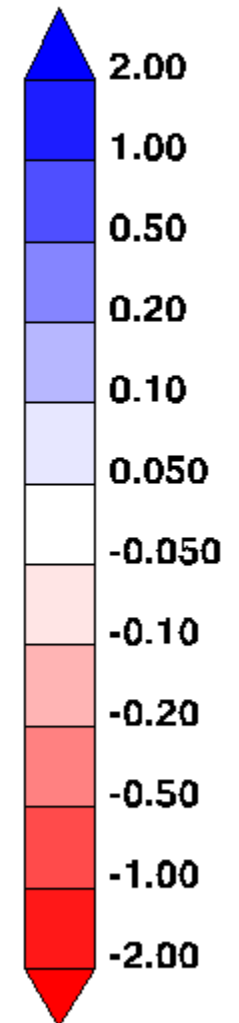
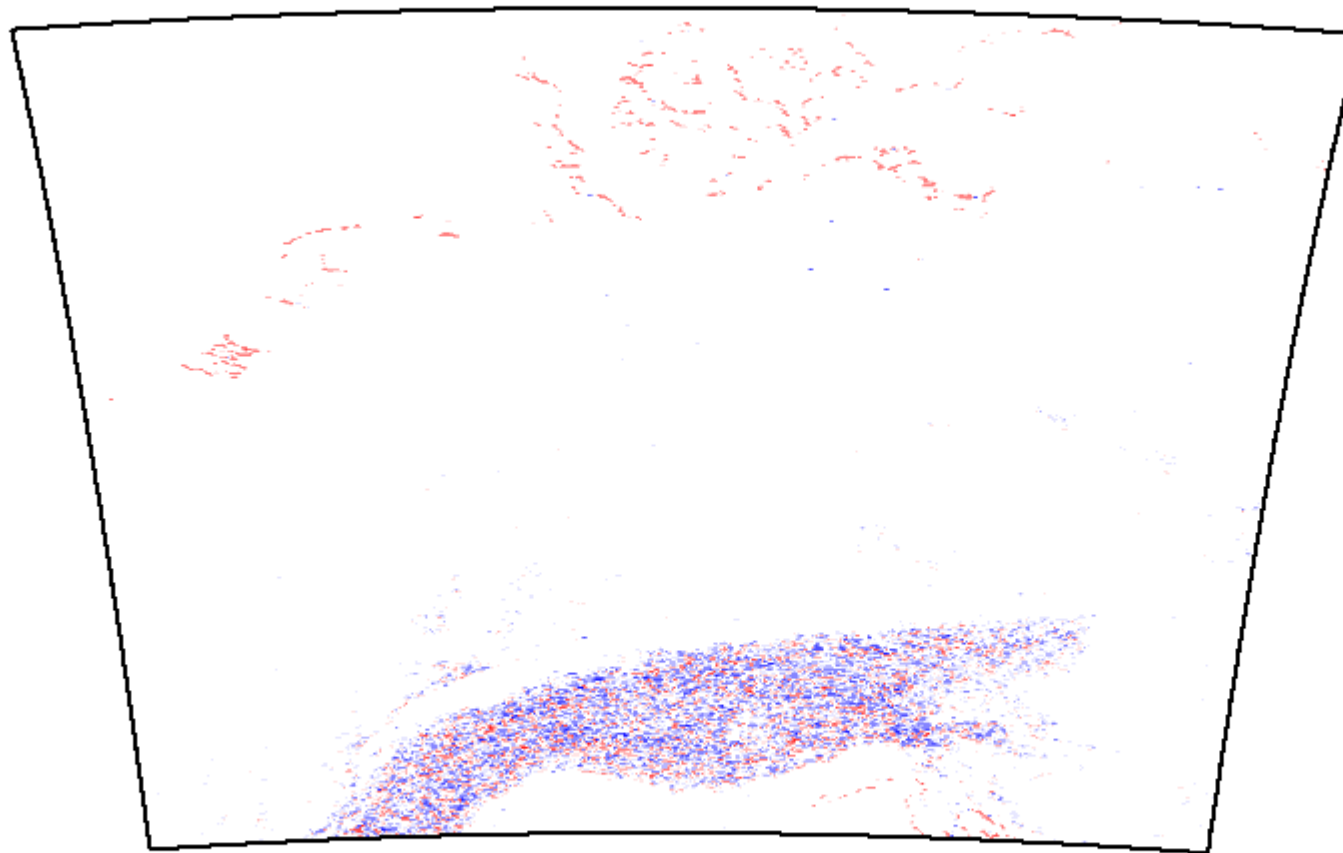
mean: 1.17₃ std: 28.63₆ min: -449.64₉ max: 413.67₁₂



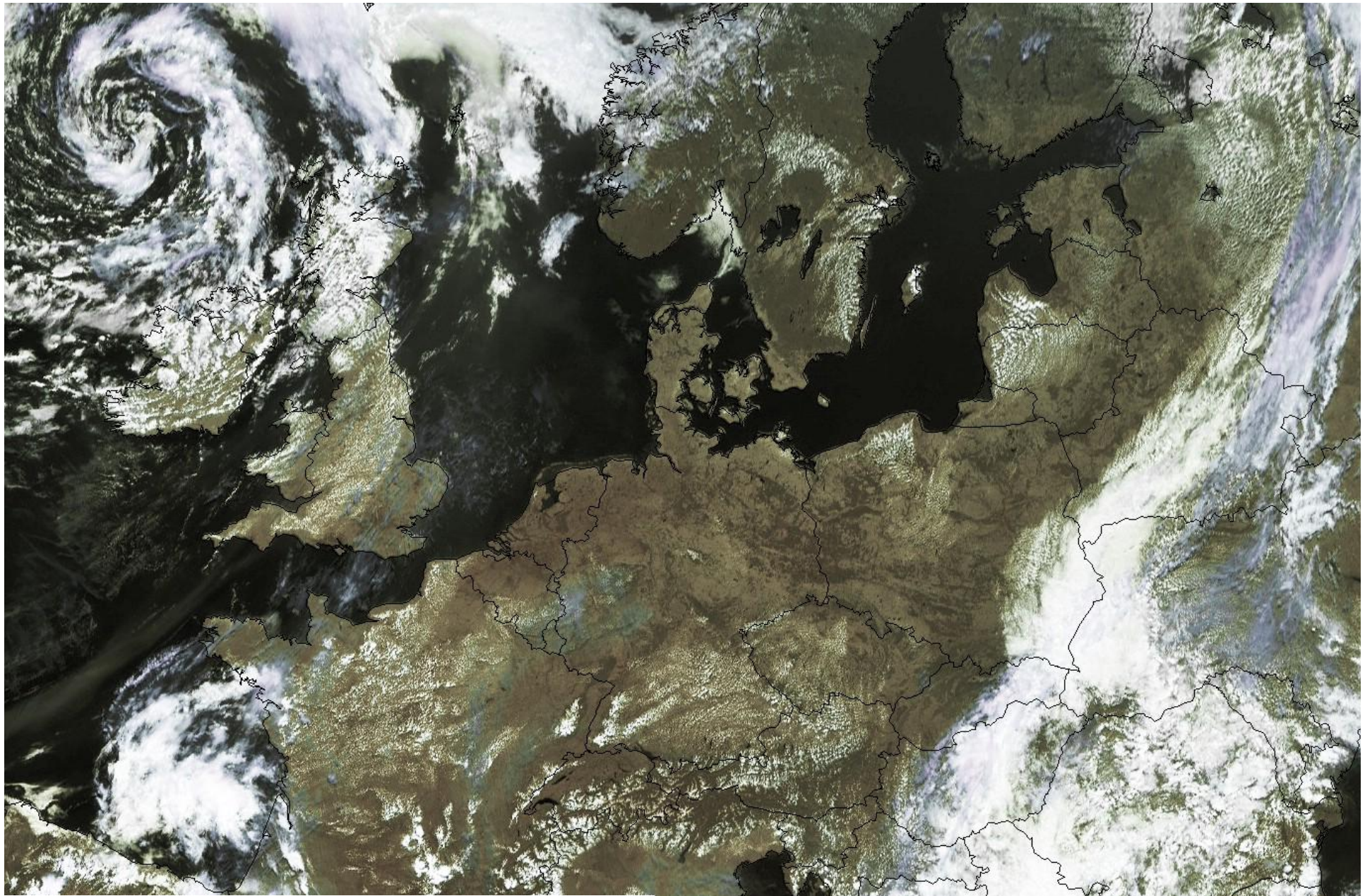
External Parameters

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

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



- 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



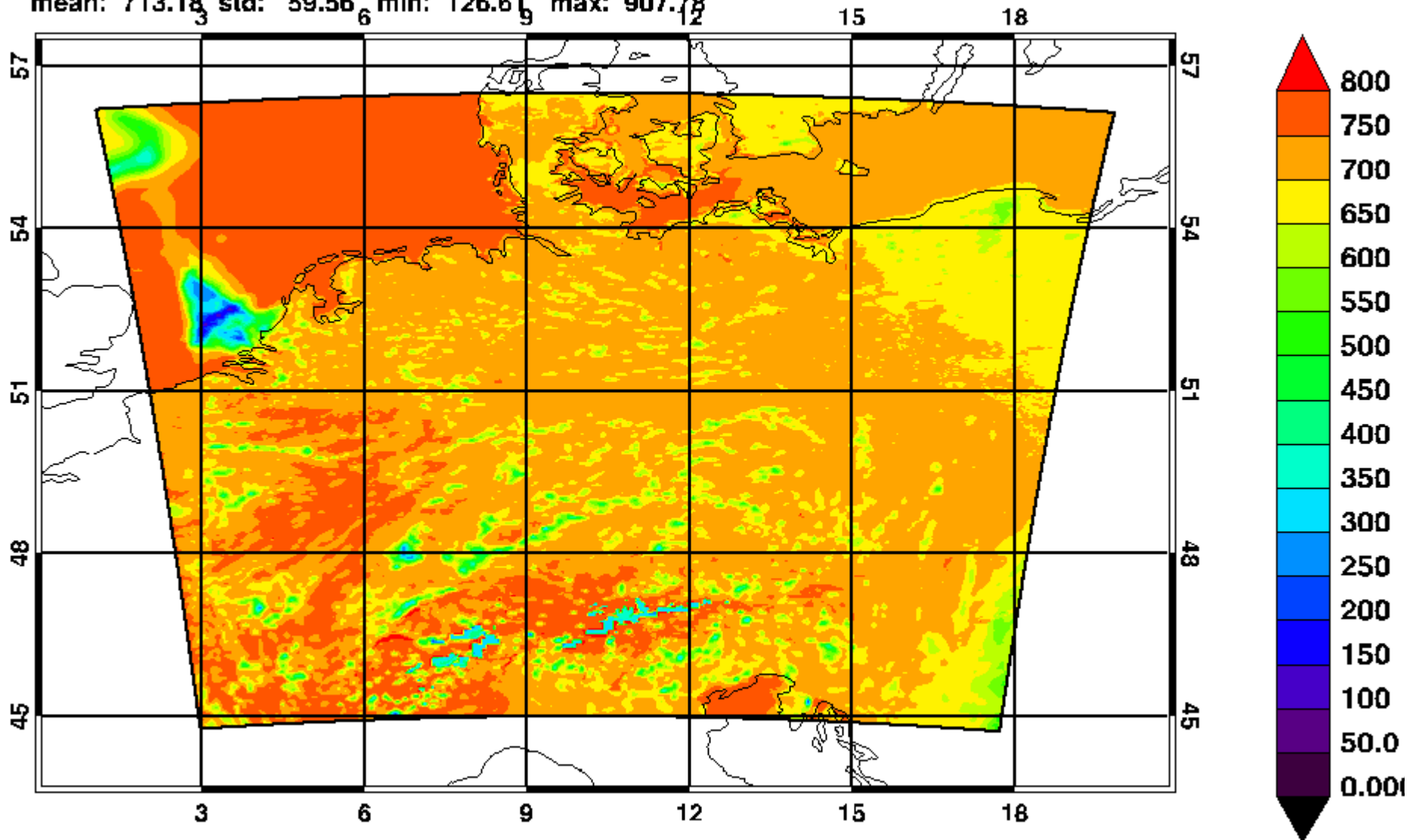
COSMO-DE L65 „Cloud-free“



Solar Radiation Budget

ASOB_S [W/m2] 2010062712 + 001h DWD Routine**

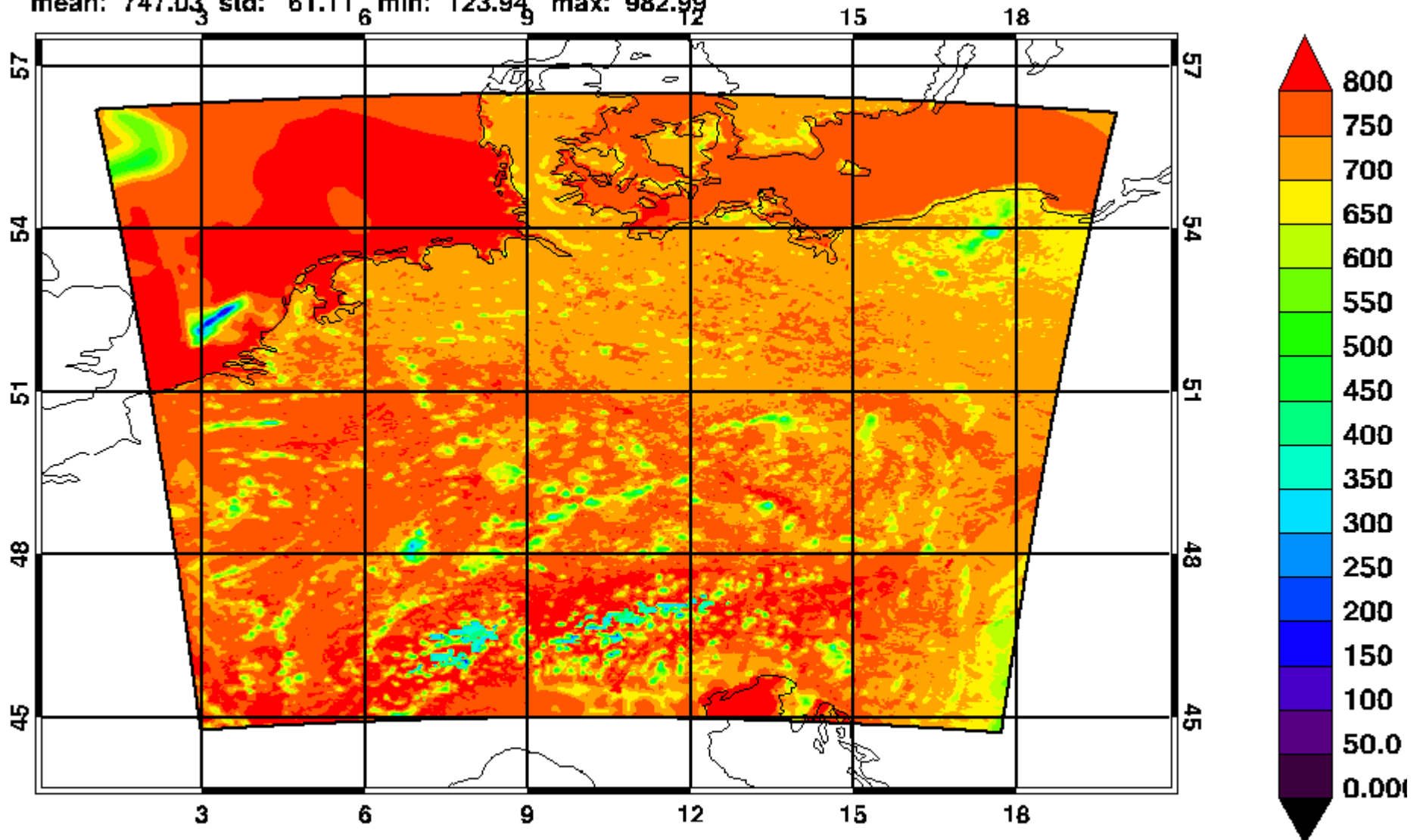
mean: 713.18₃ std: 59.56₆ min: 126.61₉ max: 907.78₂



Solar Radiation Budget

ASOB_S [W/m2] 2010062712 + 001h DWD Expld:08010**

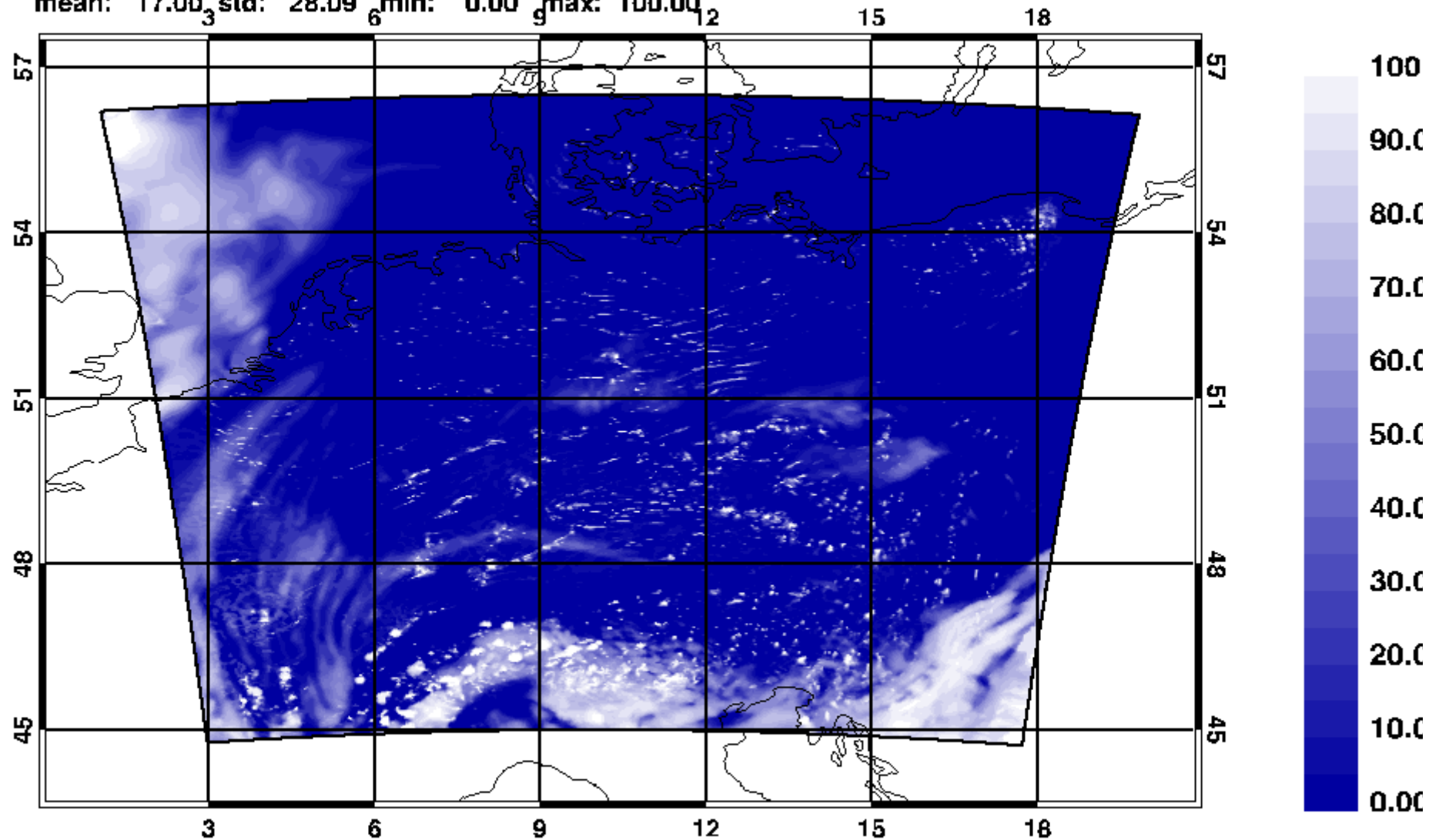
mean: 747.03₃ std: 61.11₆ min: 123.94₉ max: 982.99₁₂



Total Cloud Coverage

CLCT [%] 2010062700 + 012h DWD Routine

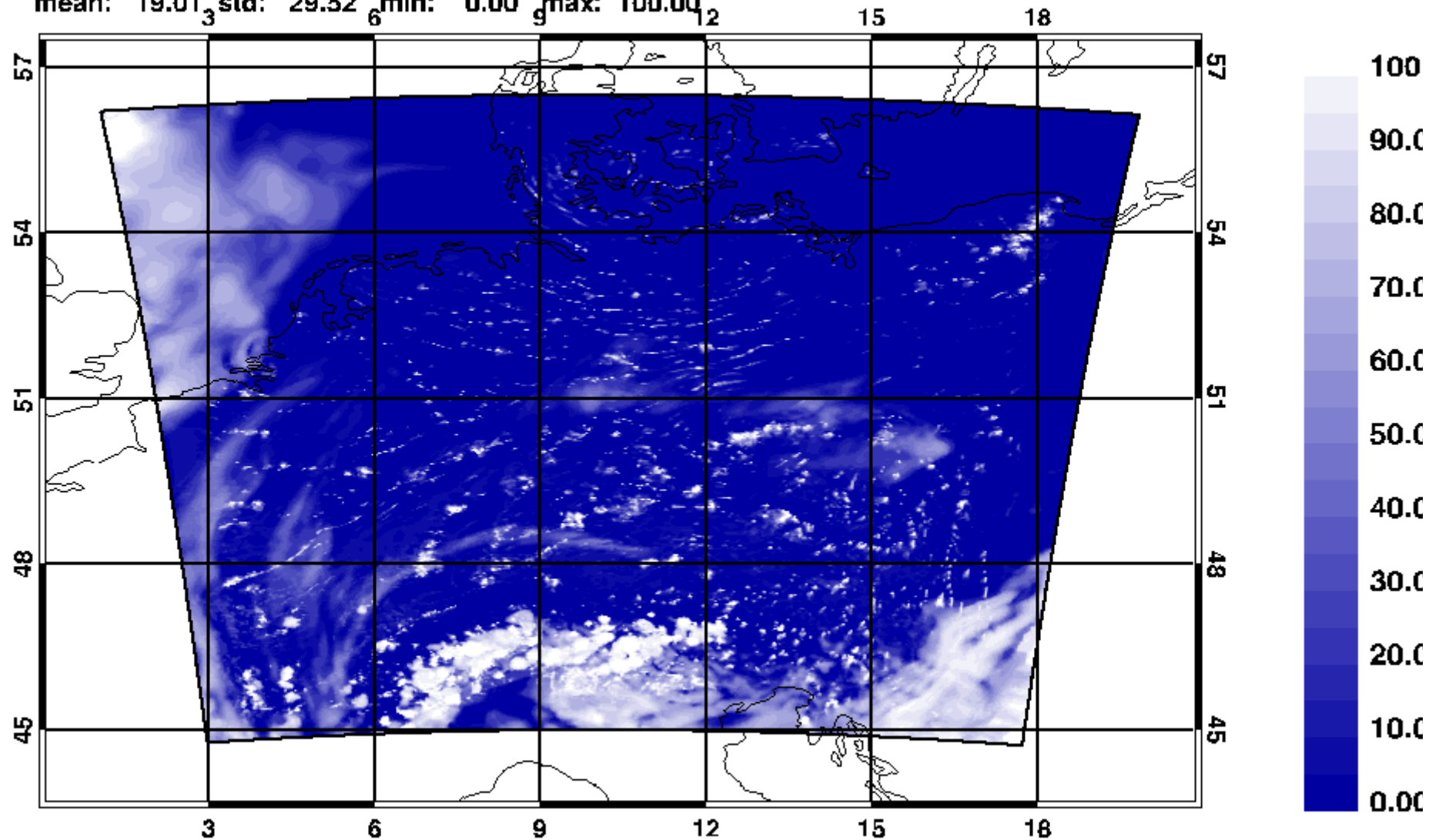
mean: 17.00₃ std: 28.09₆ min: 0.00₂ max: 100.00₁₈



Total Cloud Coverage

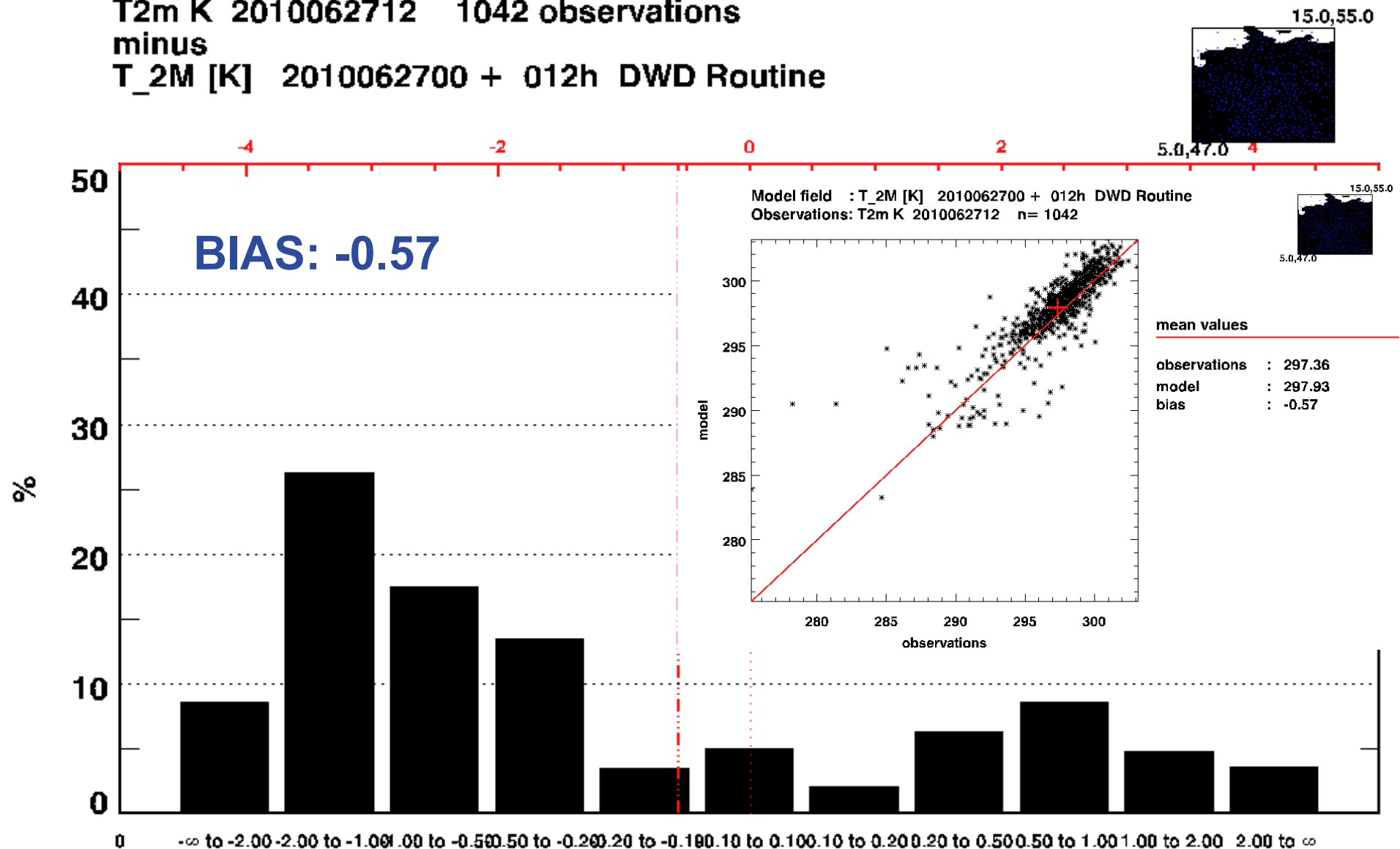
CLCT [%] 2010062700 + 012h DWD Expld:08010

mean: 19.01₃ std: 29.52₆ min: 0.00₁₂ max: 100.00₁₈



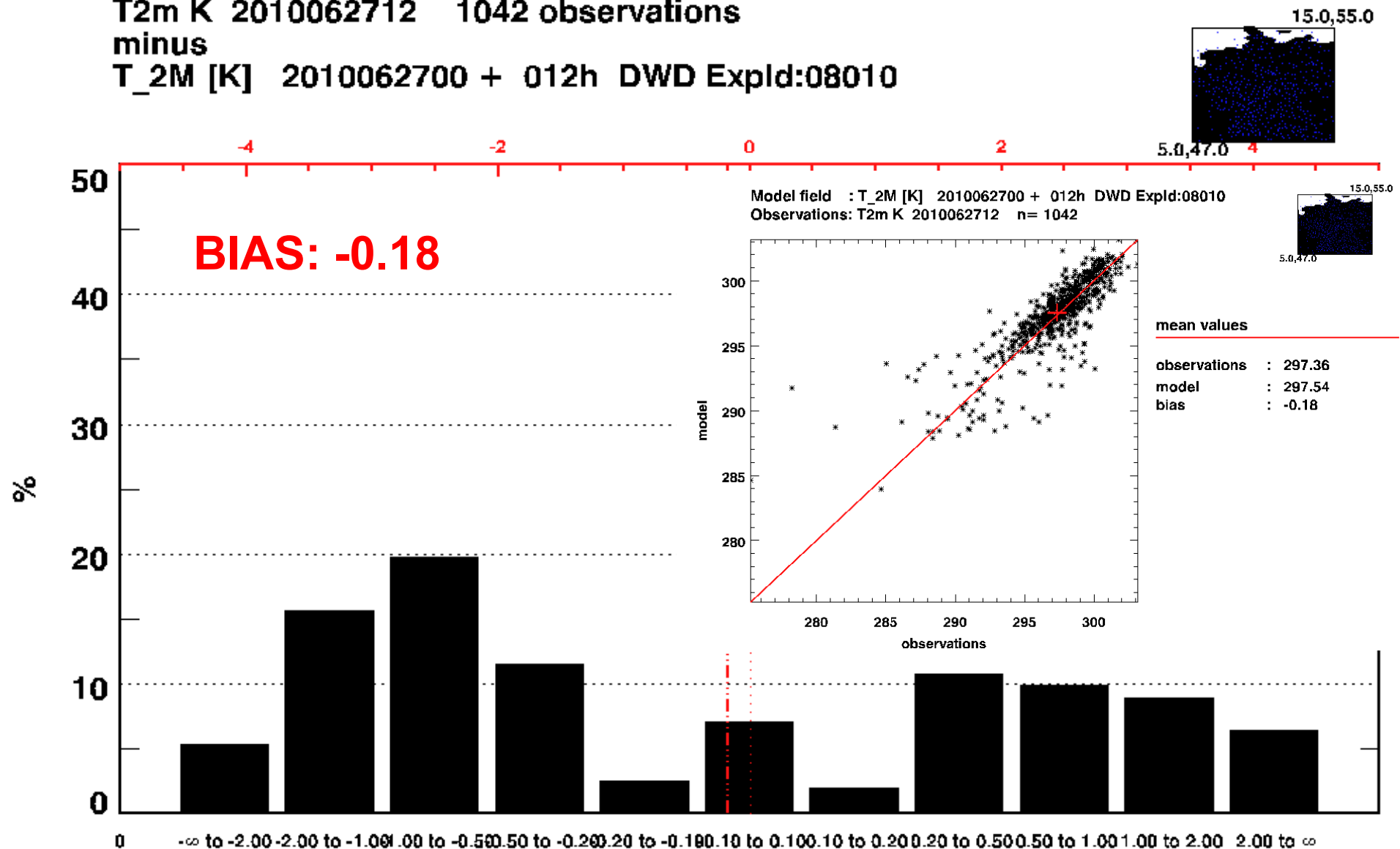
COSMO-DE L65 Validation „Cloud-free“

T2m K 2010062712 1042 observations
minus
T_2M [K] 2010062700 + 012h DWD Routine

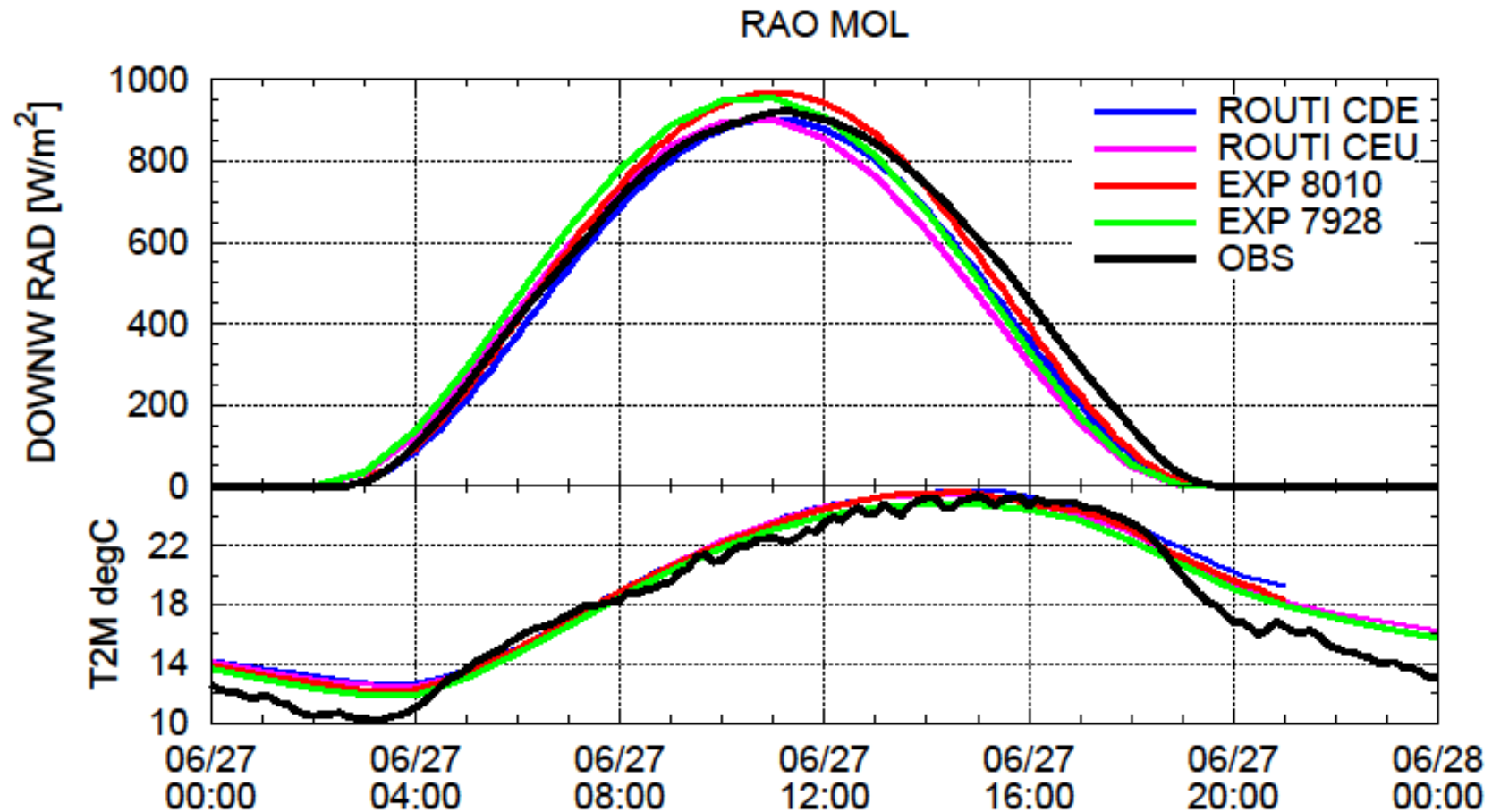


COSMO-DE L65 Validation „Cloud-free“

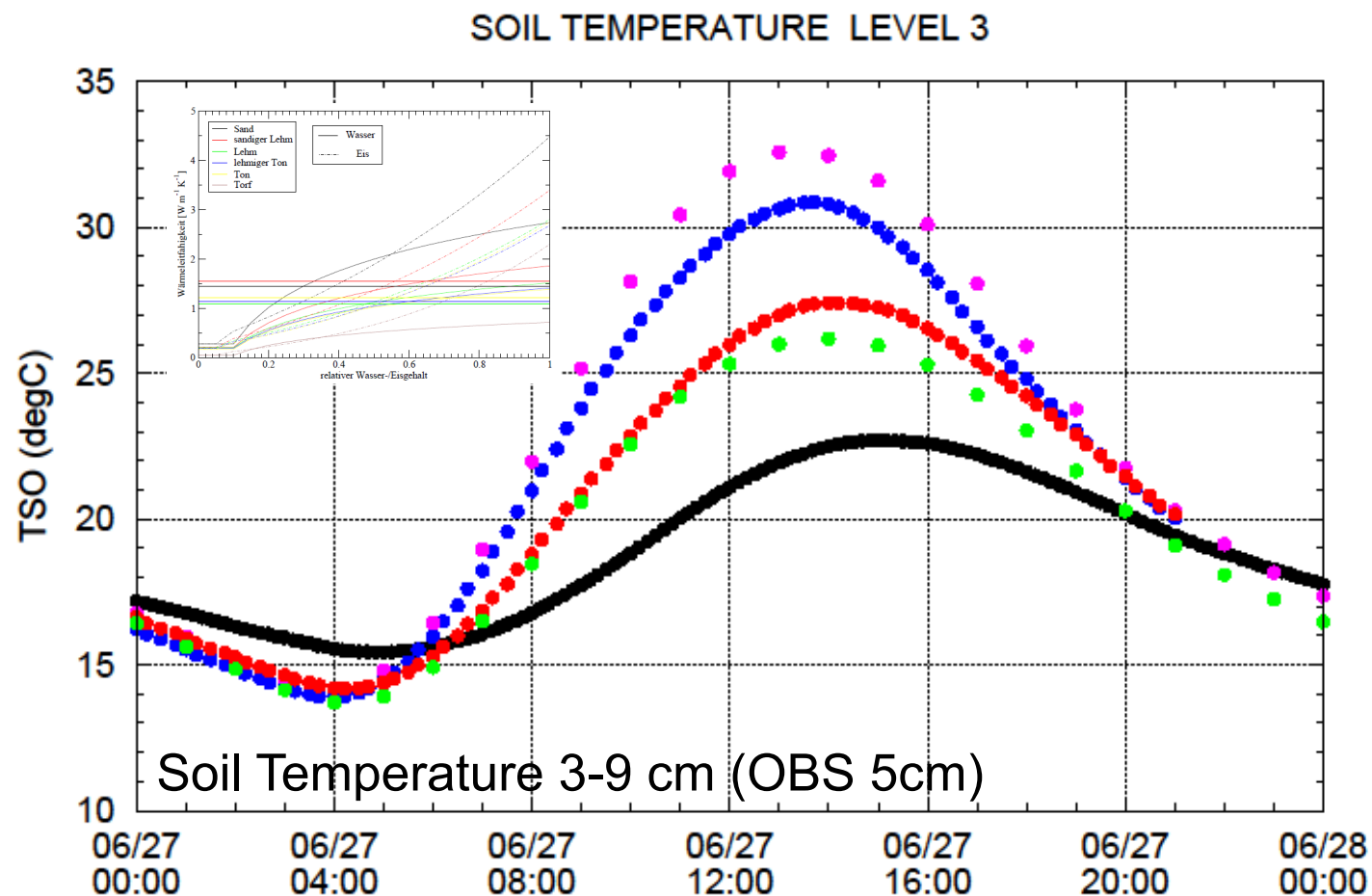
T2m K 2010062712 1042 observations
minus
T_2M [K] 2010062700 + 012h DWD Expld:08010



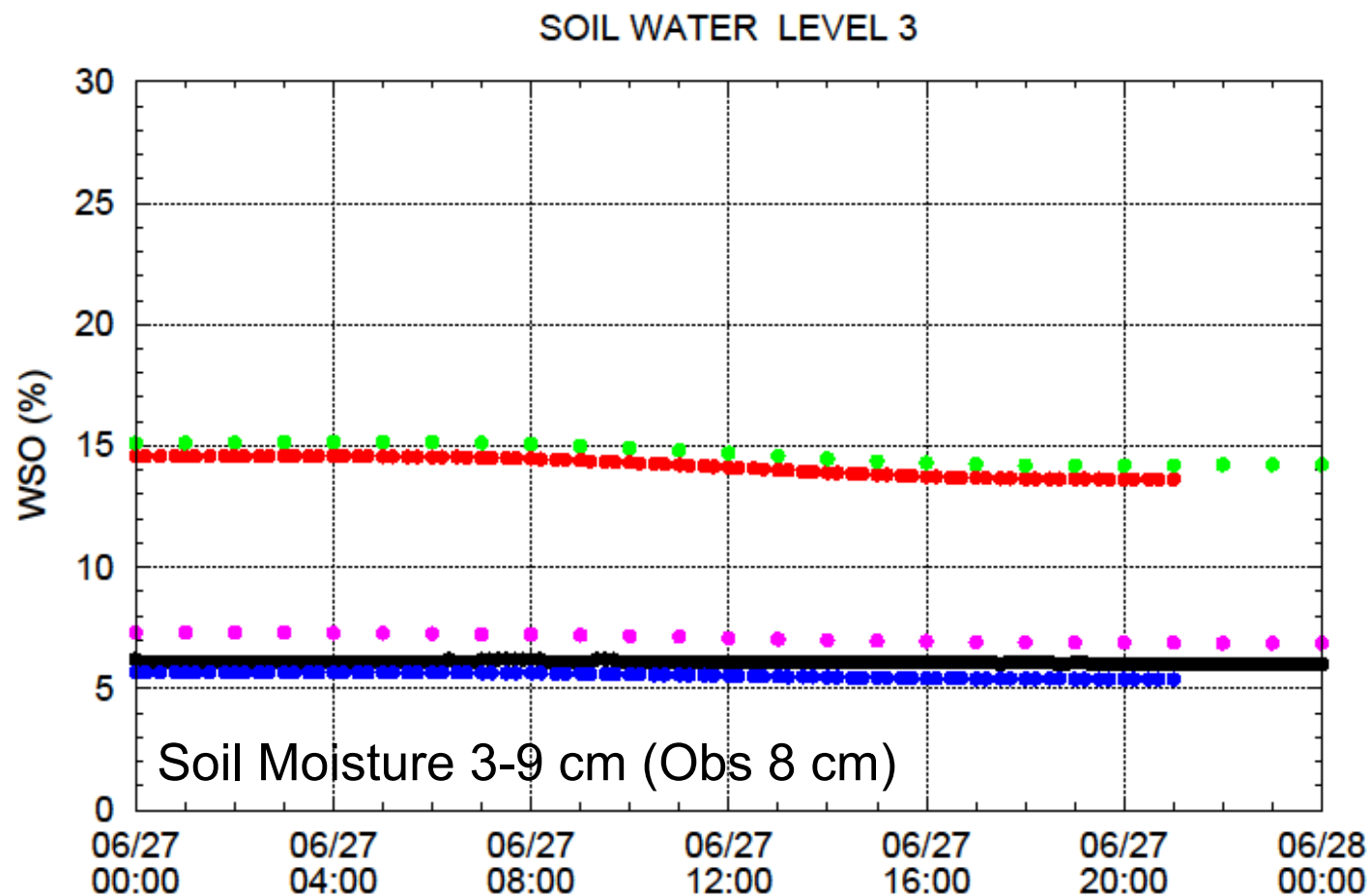
COSMO-DE L65 Validation „Cloud-free“



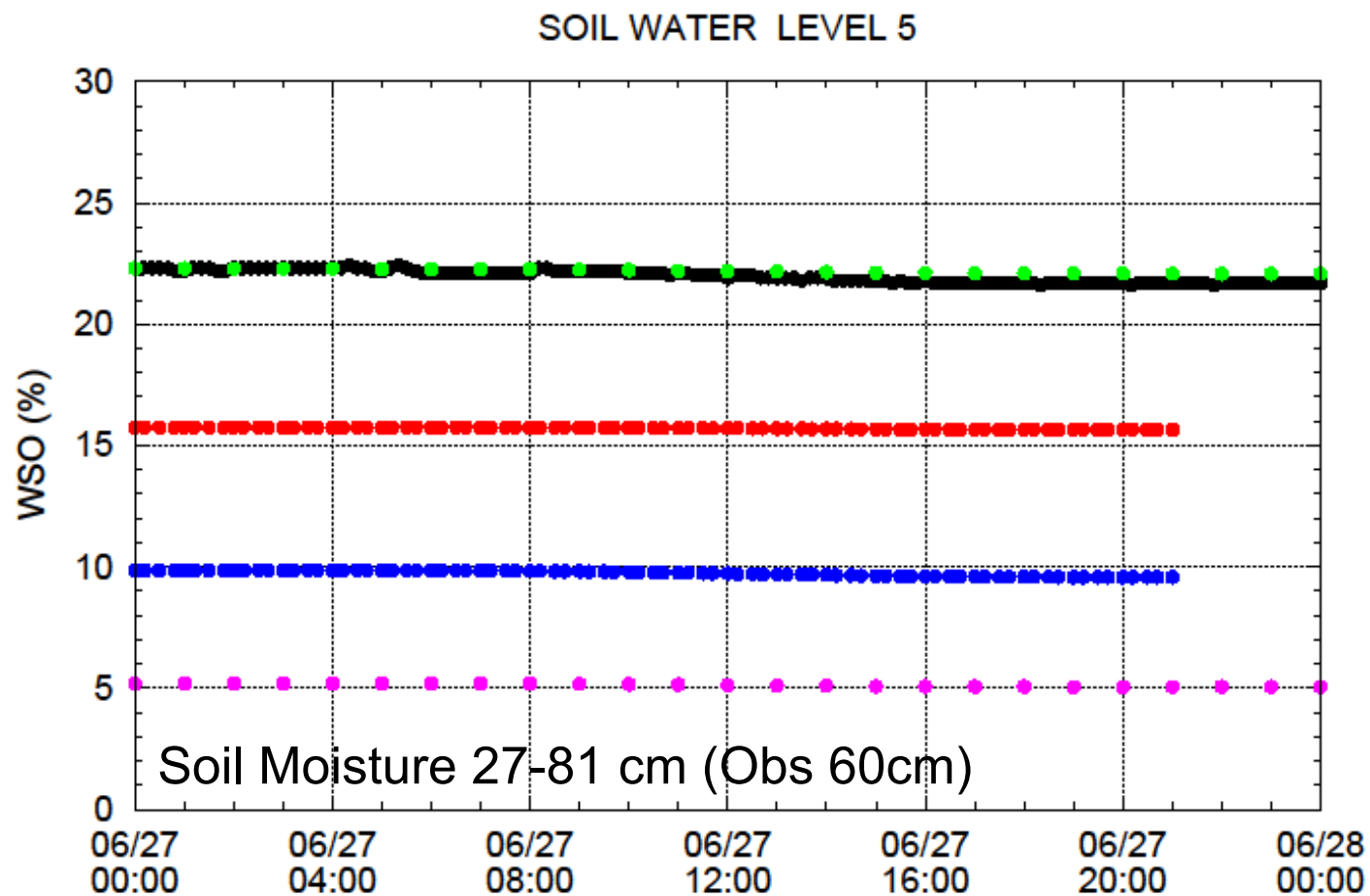
COSMO-DE L65 Validation „Cloud-free“

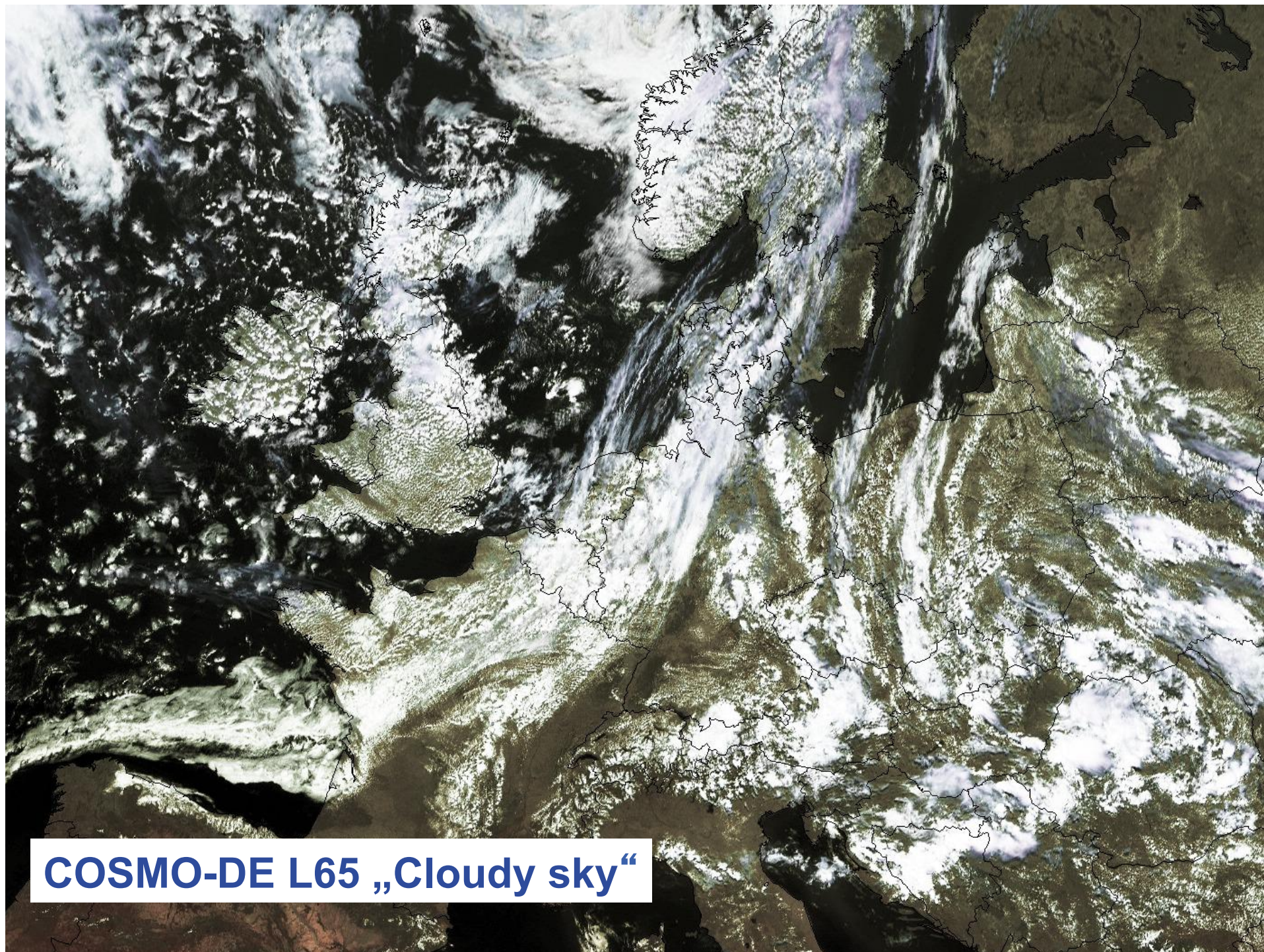


COSMO-DE L65 Validation „Cloud-free“



COSMO-DE L65 Validation „Cloud-free“



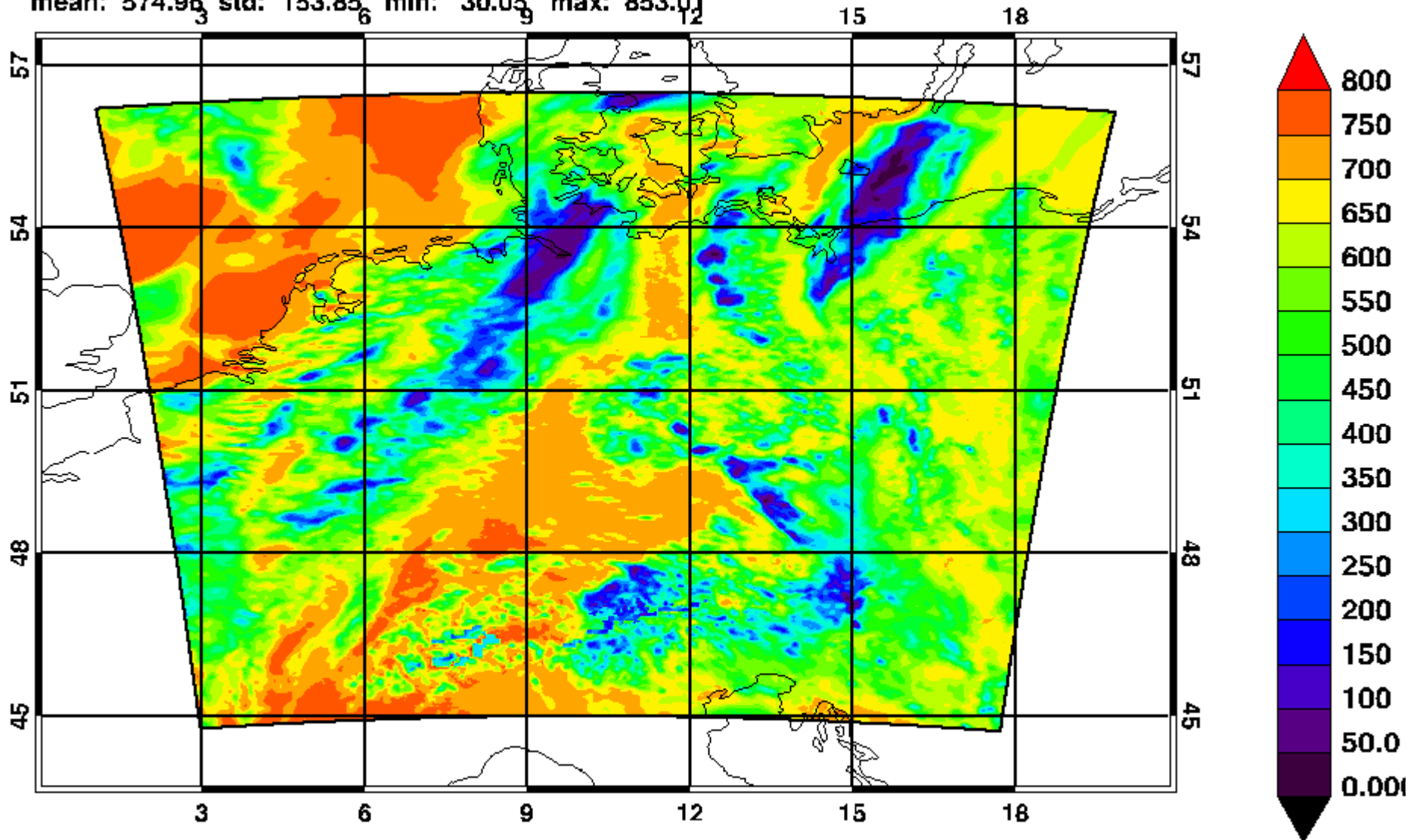


COSMO-DE L65 „Cloudy sky“

Solar Radiation Budget

ASOB_S [W/m2] 2010070512 + 001h DWD Routine**

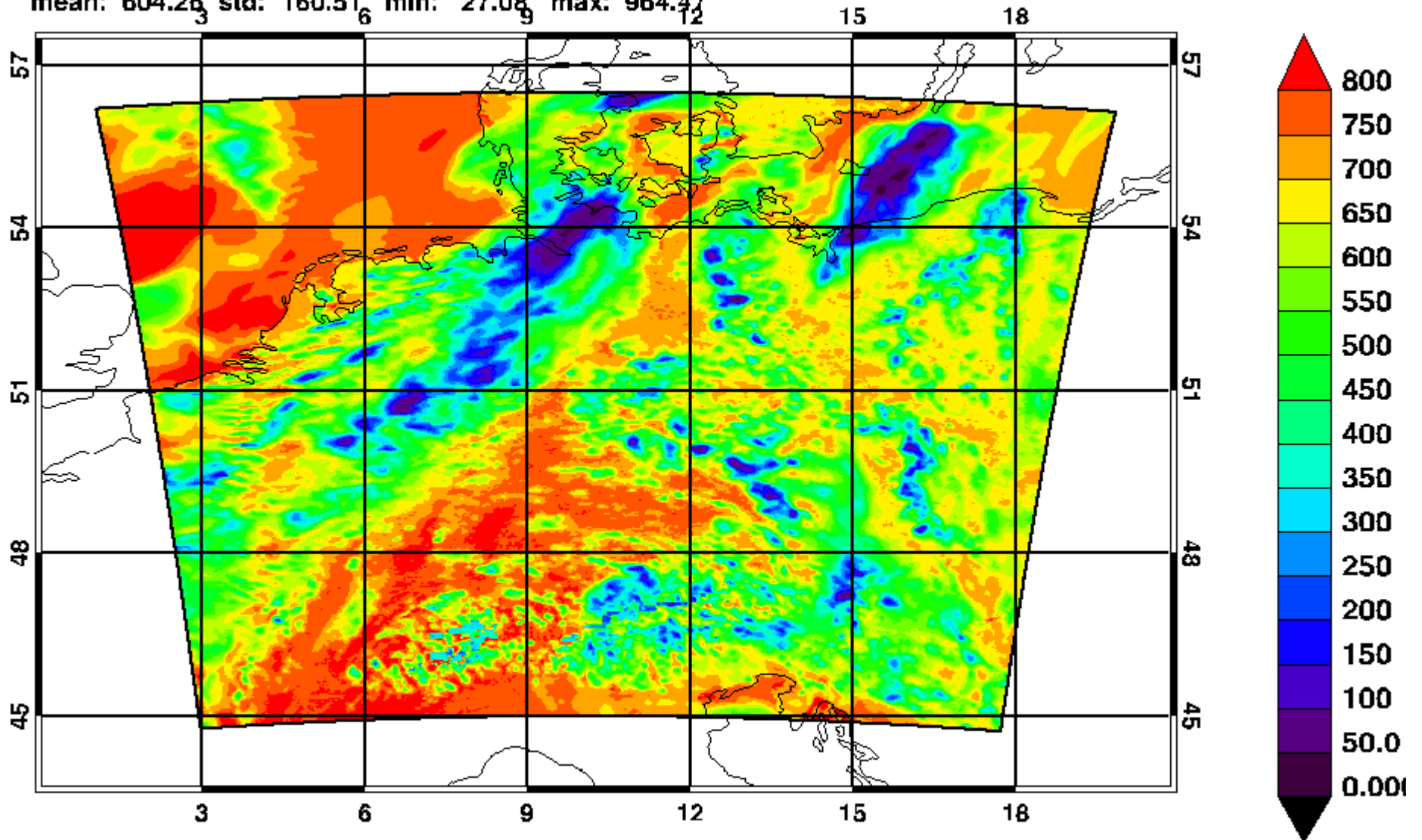
mean: 574.96₃ std: 153.85₆ min: 30.05₉ max: 853.01₂



Solar Radiation Budget

ASOB_S [W/m2] 2010070512 + 001h DWD Expld:08010**

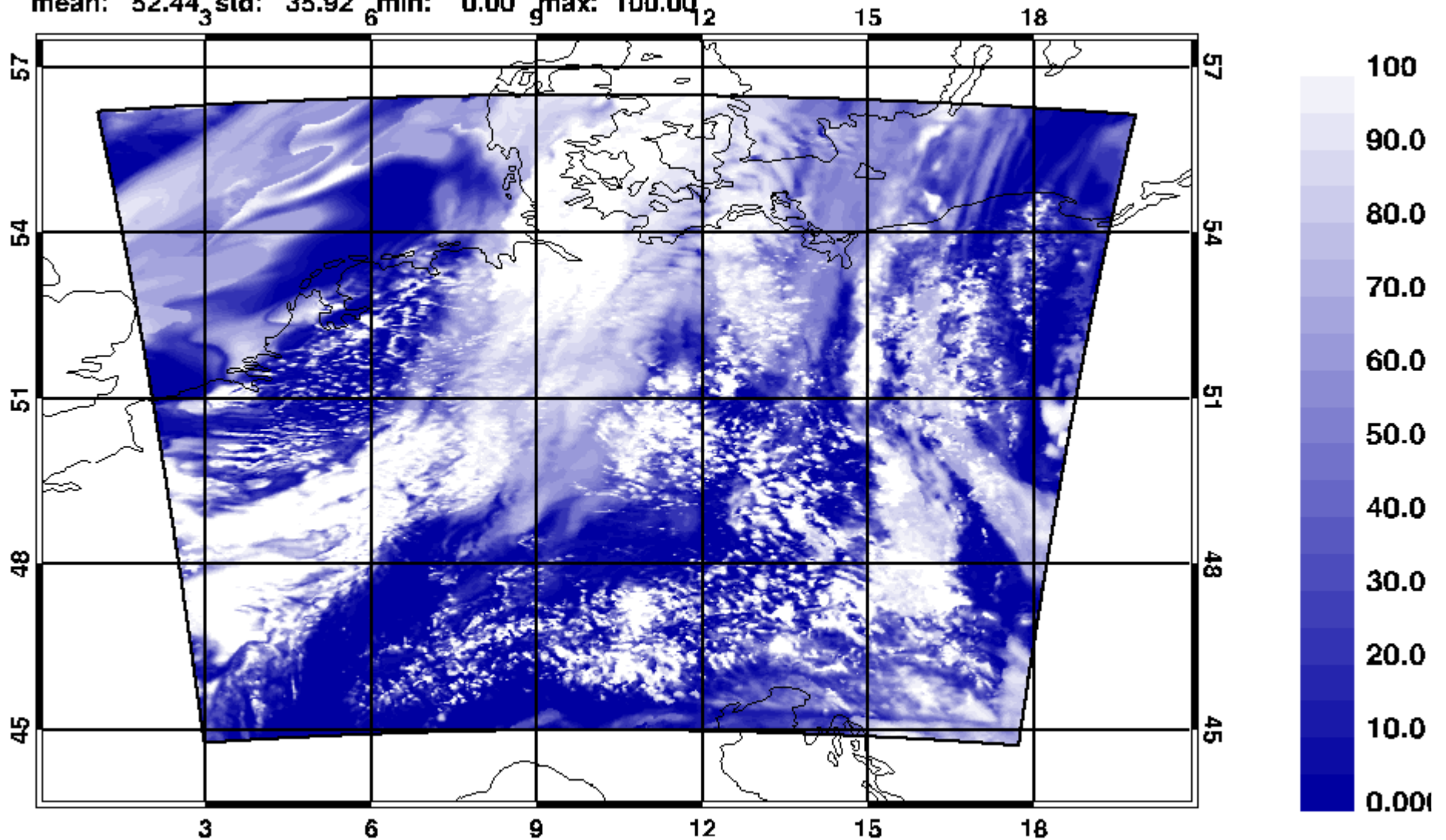
mean: 604.26₃ std: 160.51₆ min: 27.08₉ max: 964.47₁₂



Total Cloud Coverage

CLCT [%] 2010070500 + 012h DWD Routine

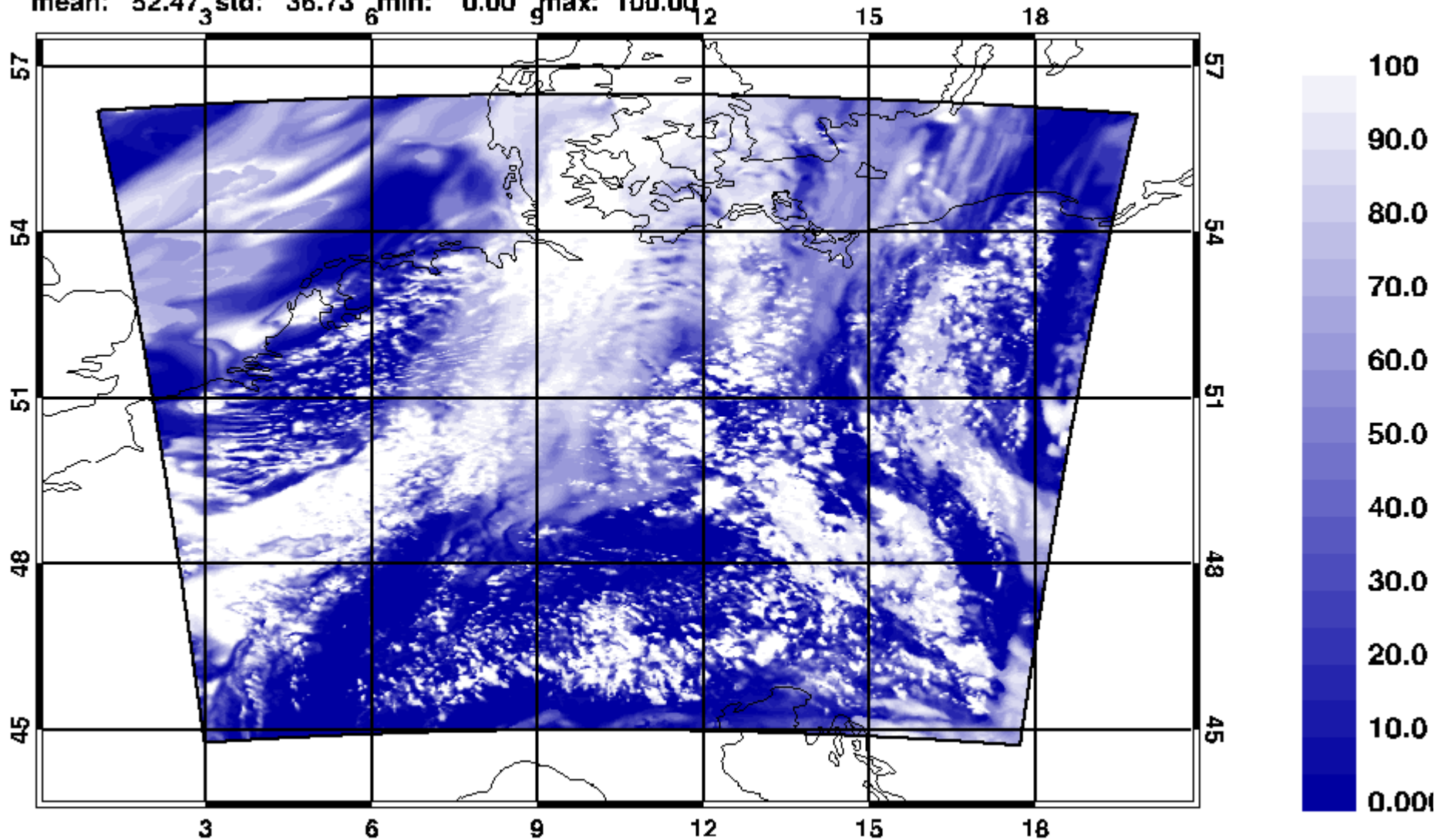
mean: 52.44₃ std: 35.92₆ min: 0.00₉ max: 100.00₁₂



Total Cloud Coverage

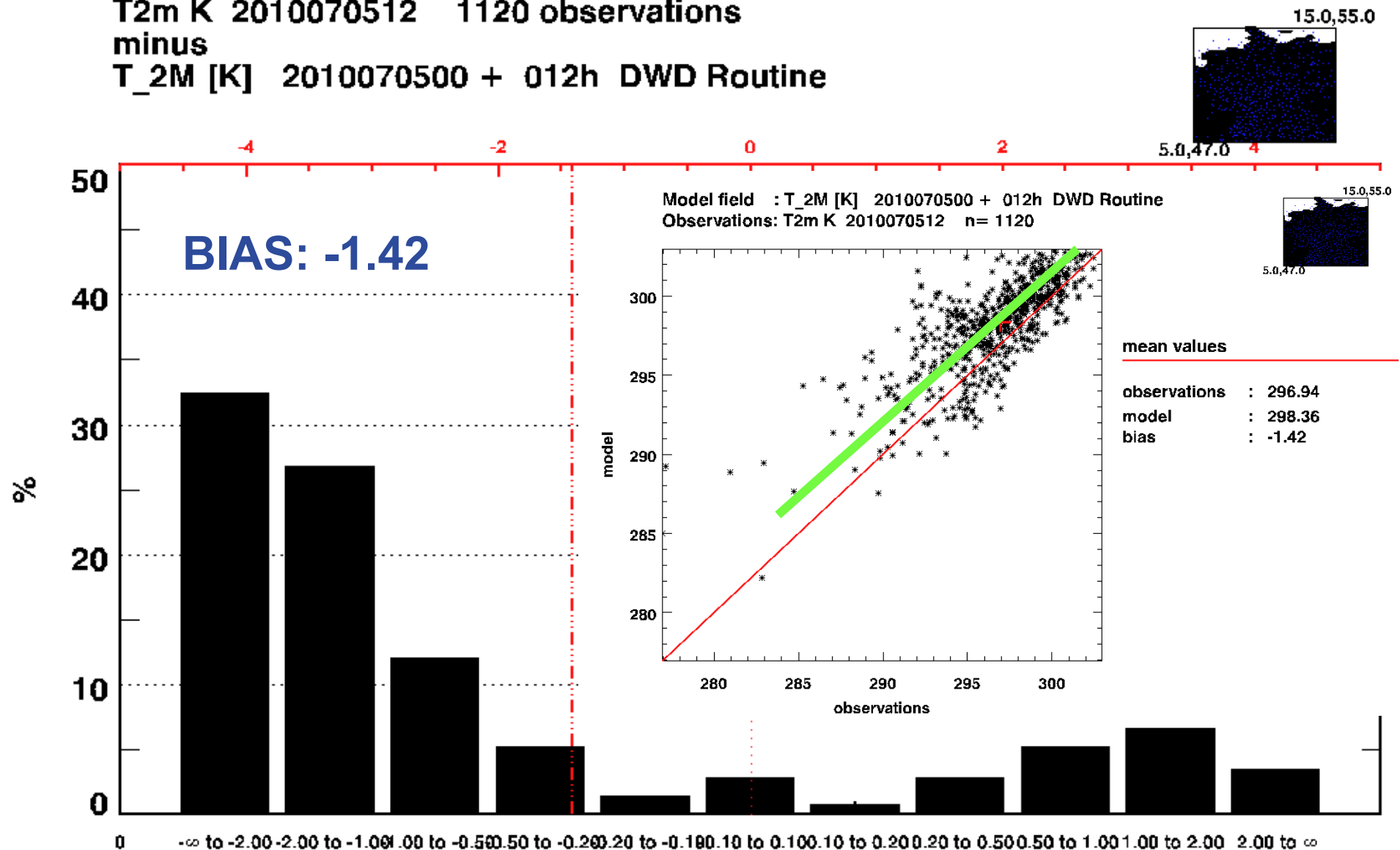
CLCT [%] 2010070500 + 012h DWD Expld:08010

mean: 52.47₃ std: 36.73₆ min: 0.00₉ max: 100.00₁₂



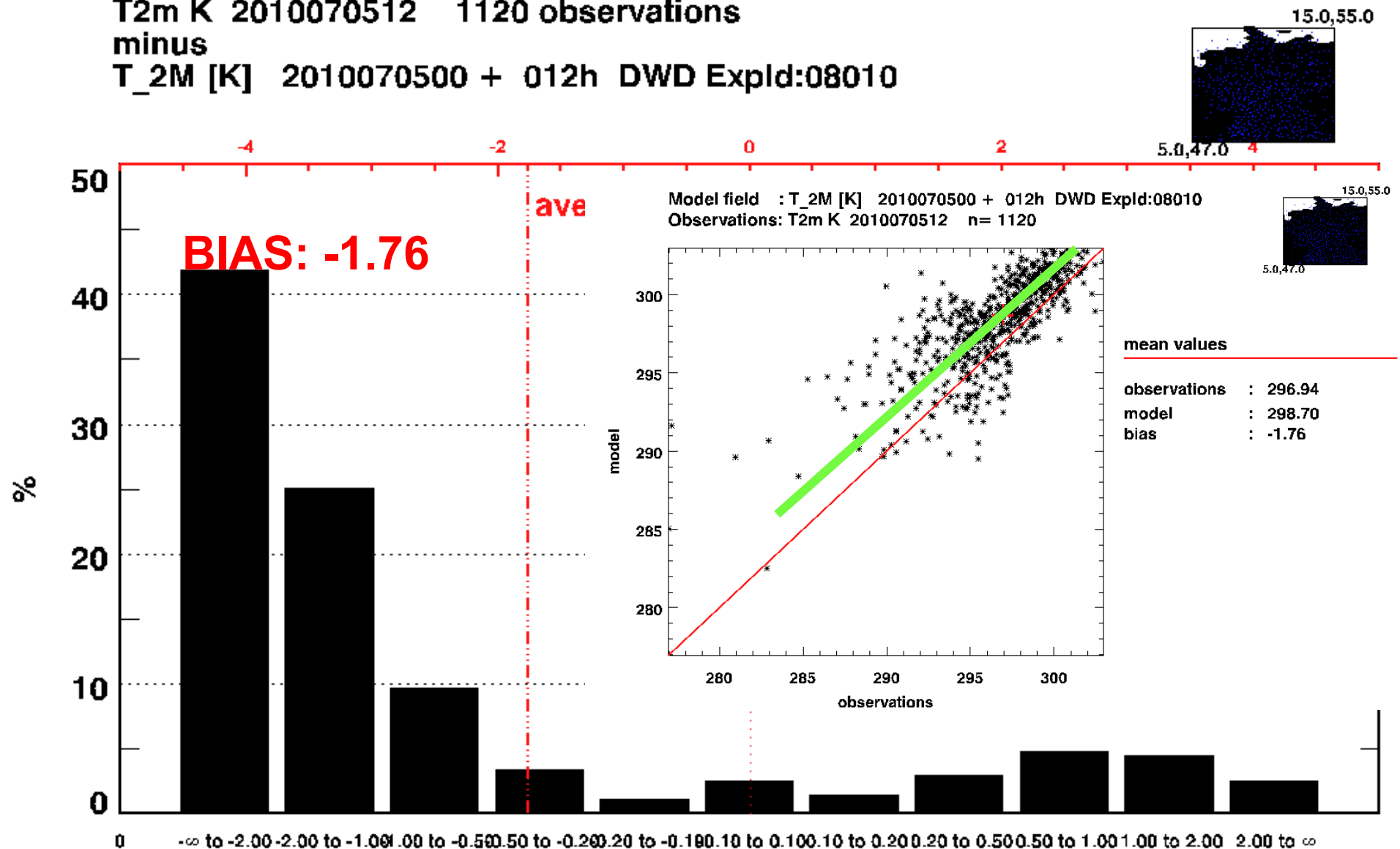
COSMO-DE L65 Validation „Cloudy Sky“

T2m K 2010070512 1120 observations
minus
T_2M [K] 2010070500 + 012h DWD Routine

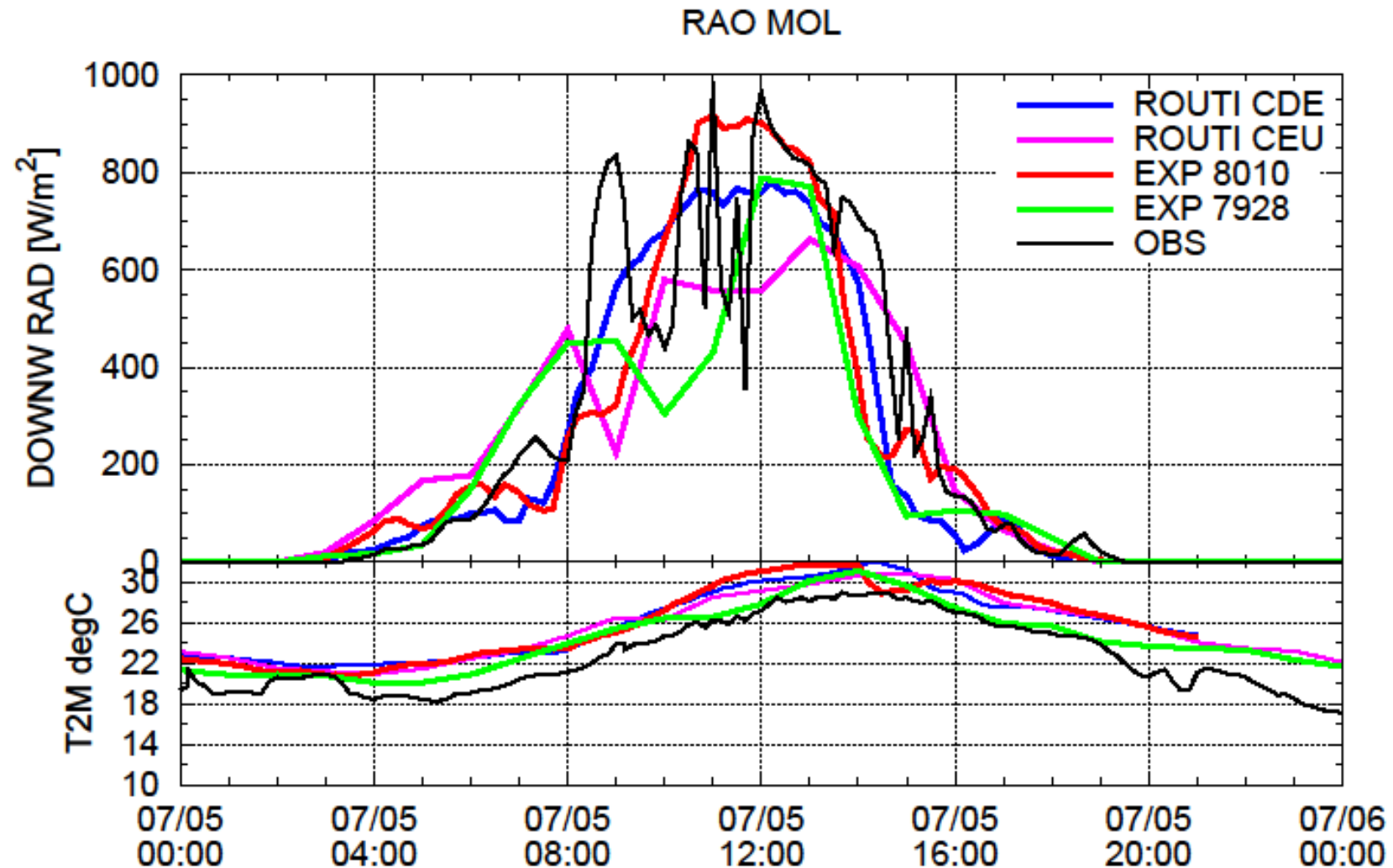


COSMO-DE L65 Validation „Cloudy Sky“

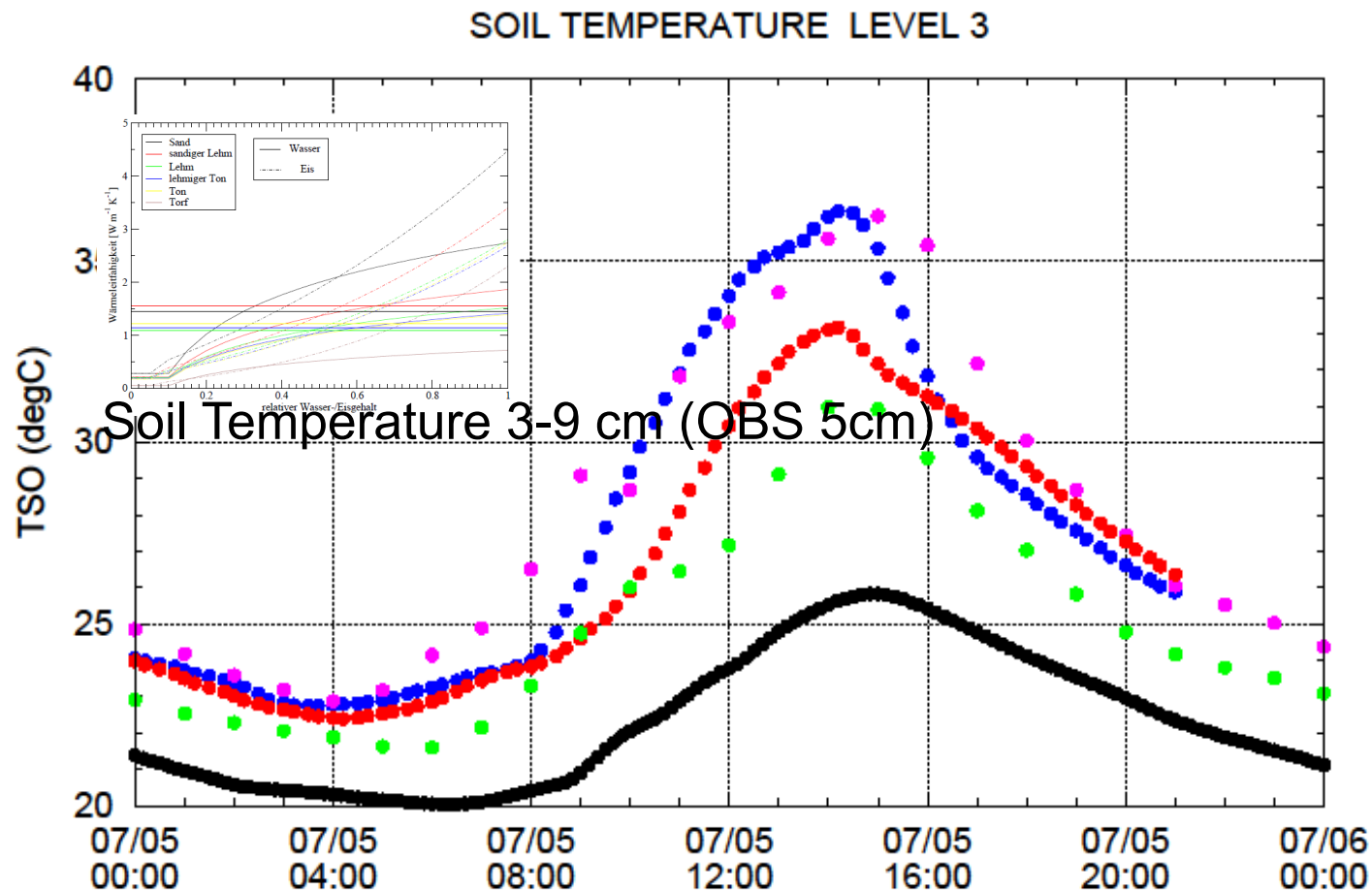
T2m K 2010070512 1120 observations
minus
T_2M [K] 2010070500 + 012h DWD Expld:08010



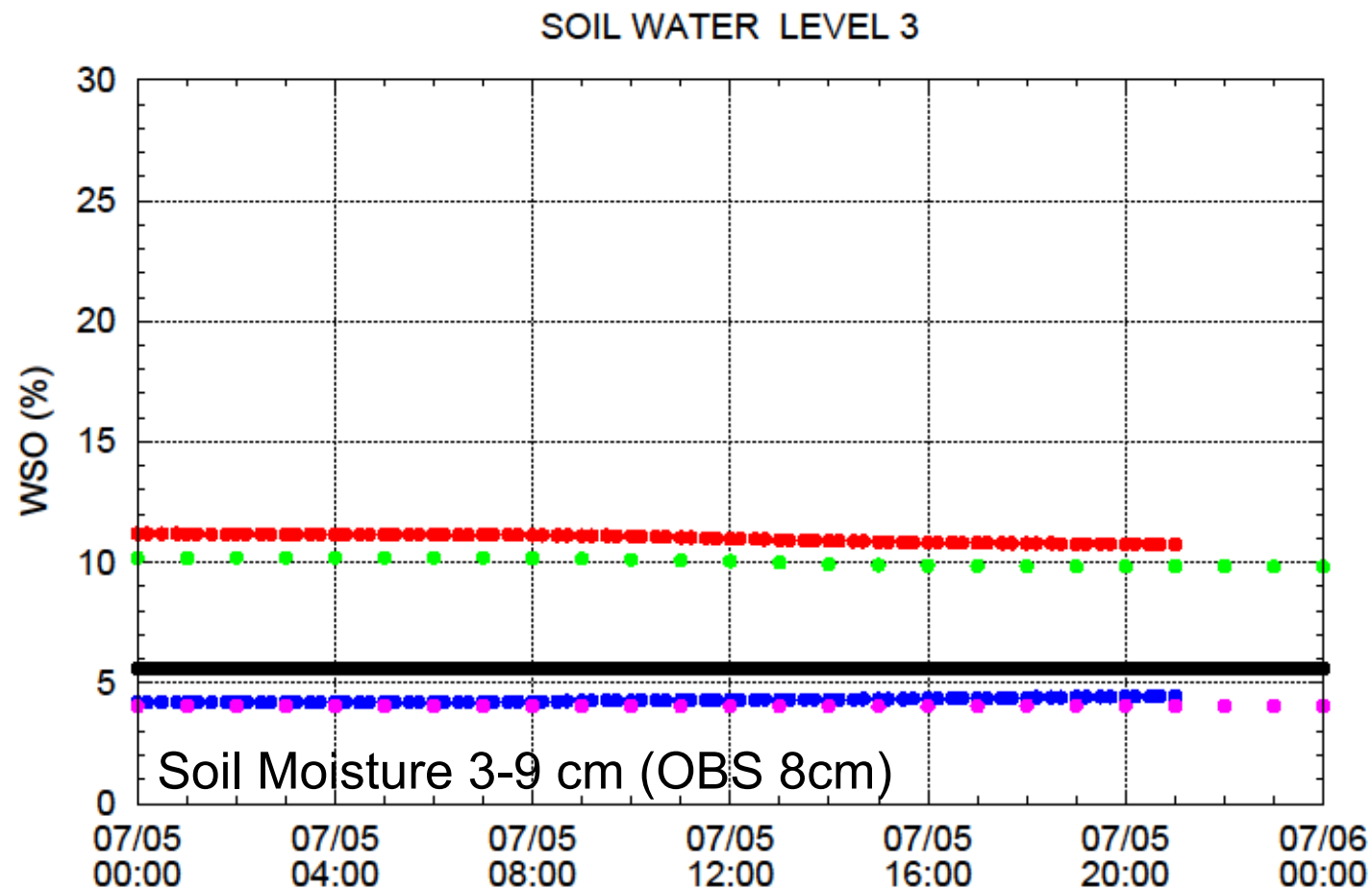
COSMO-DE L65 Validation „Cloudy Sky“



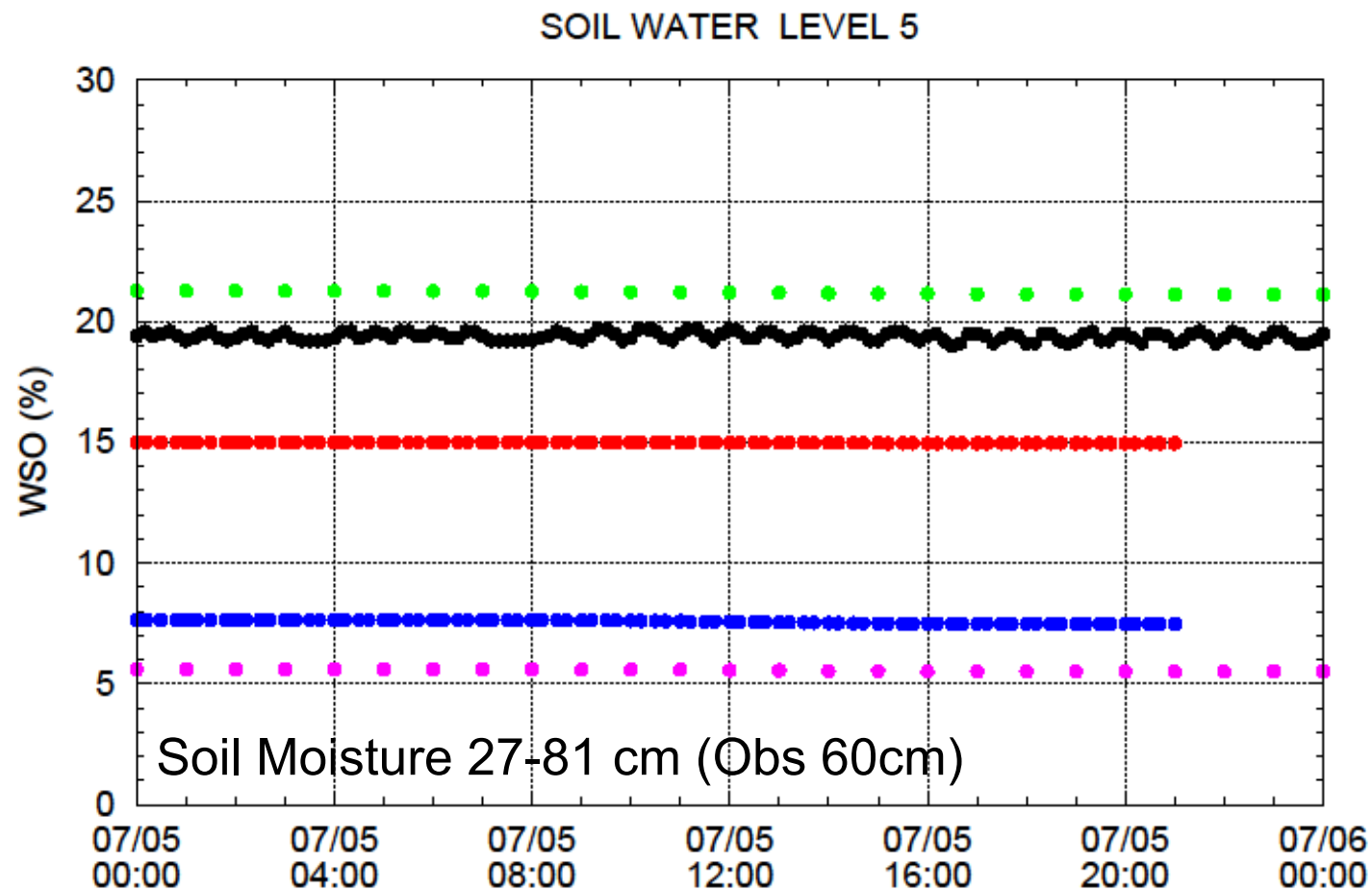
COSMO-DE L65 Validation „Cloudy Sky“



COSMO-DE L65 Validation „Cloudy Sky“



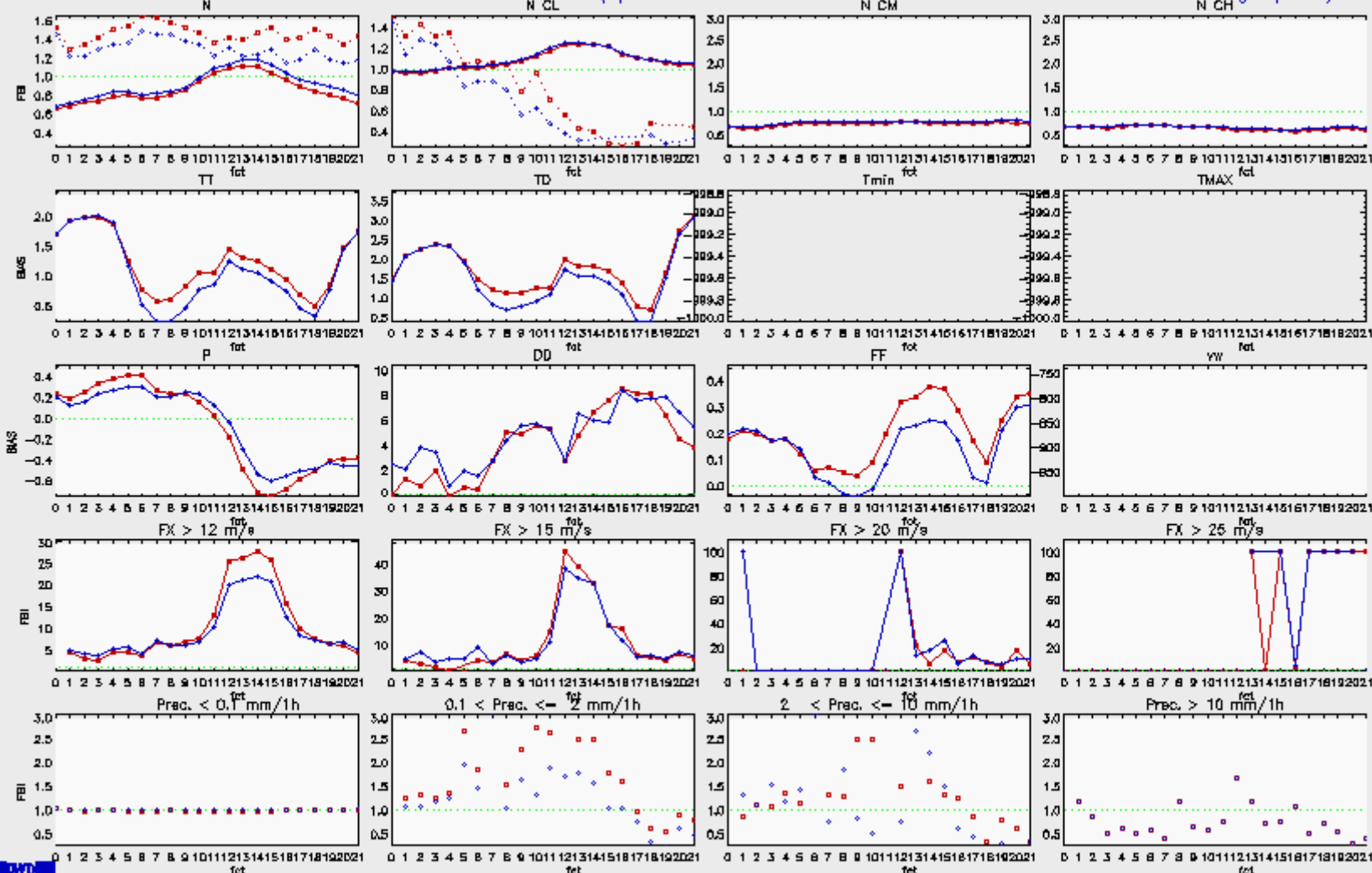
COSMO-DE L65 Validation „Cloudy Sky“



Verification

LM3MO: 25.06.2010 00 UTC – 15.07.2010 00 UTC (exp. run 8010_national: nearest gridpoint)

lm3mo: 25.06.2010 00 UTC – 15.07.2010 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, BIAS for other elements

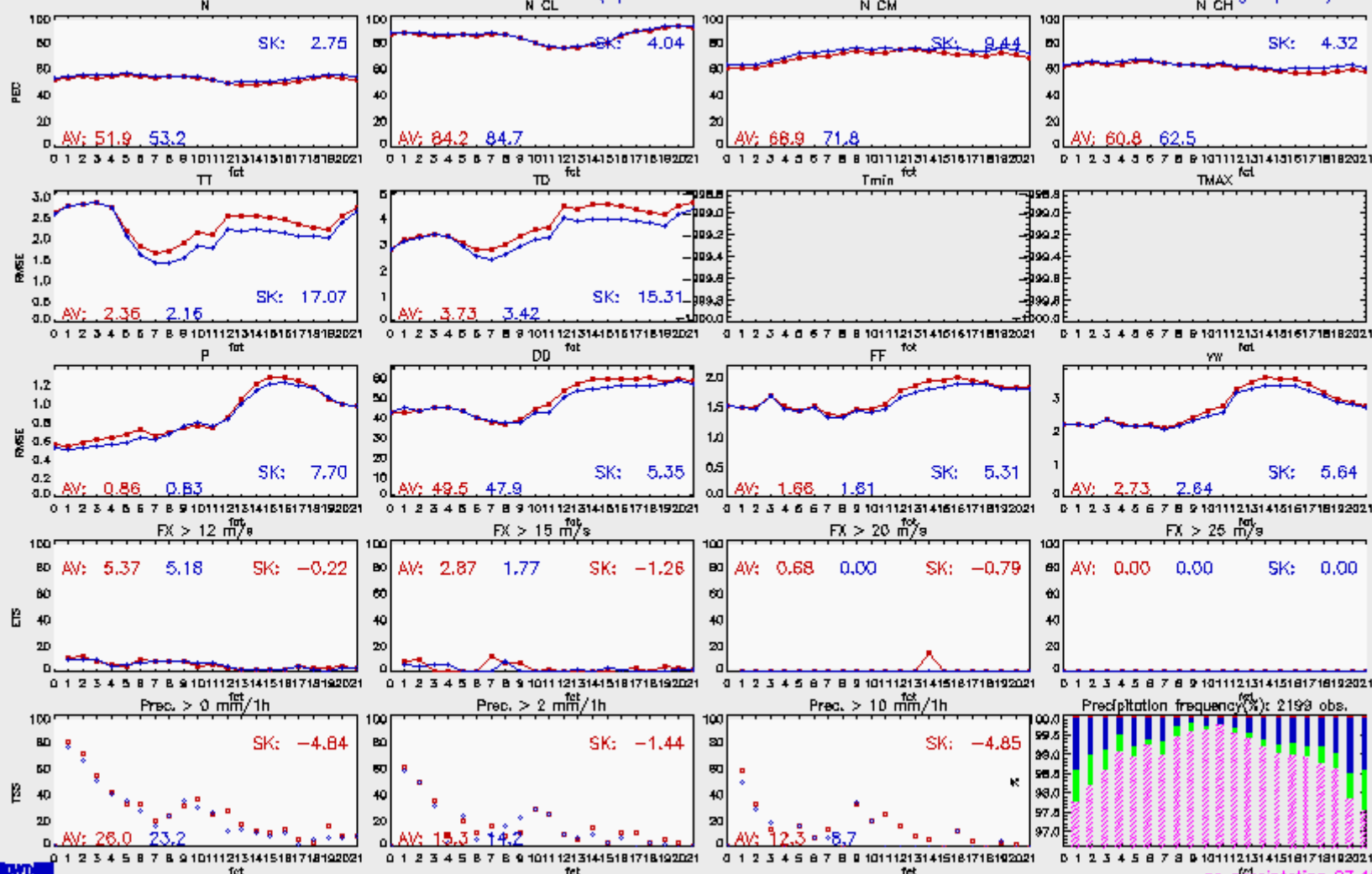
All stations

Plottime: 08.02.2011 08:19:42 MEZ

Verification

LM3MO: 25.06.2010 00 UTC – 15.07.2010 00 UTC (exp. run 8010_national: nearest gridpoint)

lm3mo: 25.06.2010 00 UTC – 15.07.2010 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
TSS for precipitation, ETS for gusts, percent correct for cloud covers, RMSE for other elements

Plattime: 08.02.2011 08:19:42 MEZ

All stations

no precipitation 97.40%
0.1–2 mm: 1.52%
3–10 mm: 0.40%
> 10 mm: 0.68%

Verification

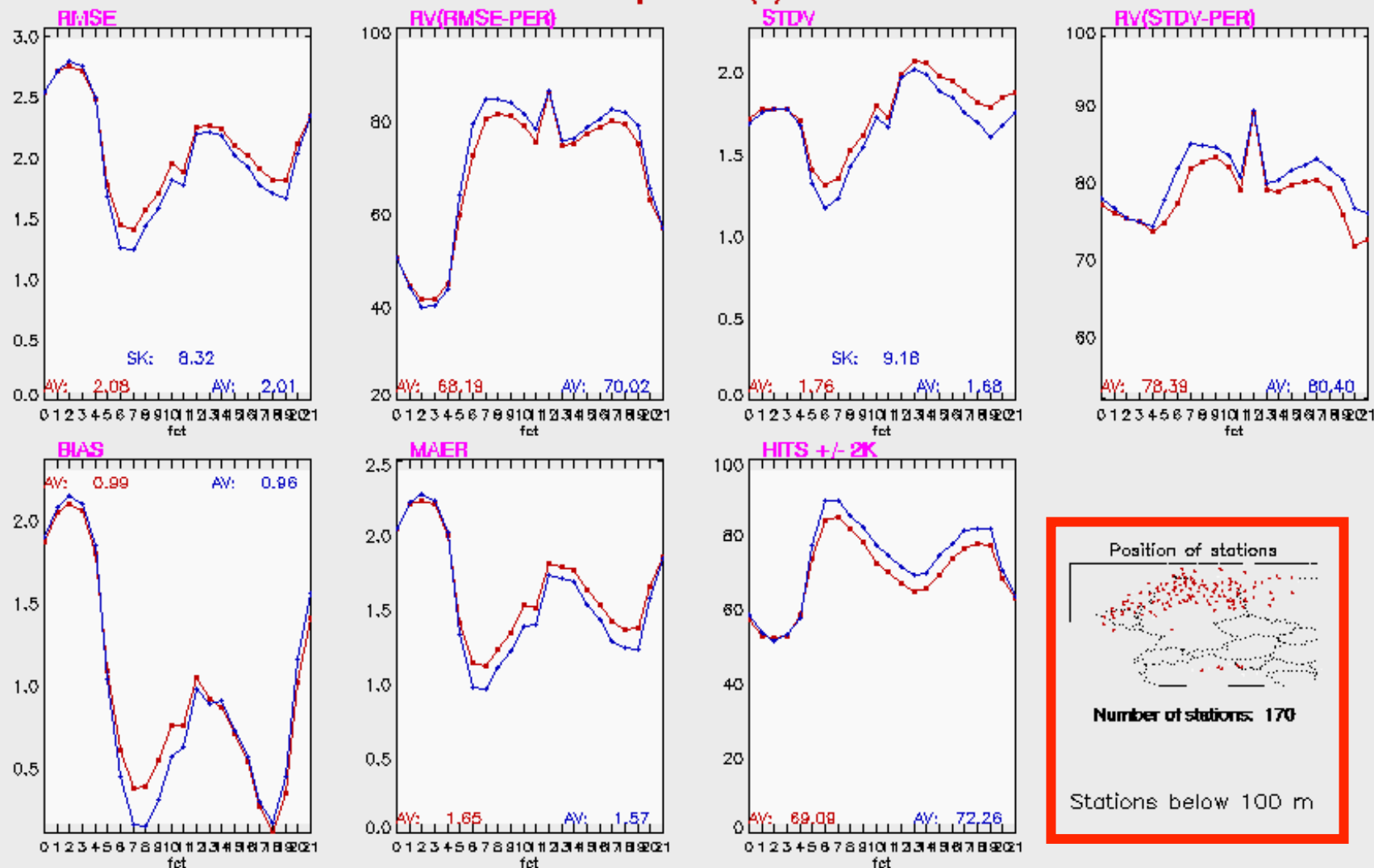


Results of verification of forecasts for local weather elements at surface stations

LM3MO: 25.06.2010 00 UTC – 15.07.2010 00 UTC (exp. run 8010_national; nearest gridpoint)

lm3mo: 25.06.2010 00 UTC – 15.07.2010 00 UTC (ope. run LON: 02.98 – 19.84 LAT: 44.77 – 56.14; nearest gridpoint)

Temperature (K)



Plottime: 08.02.2011 08:19:49 MEZ

Verification

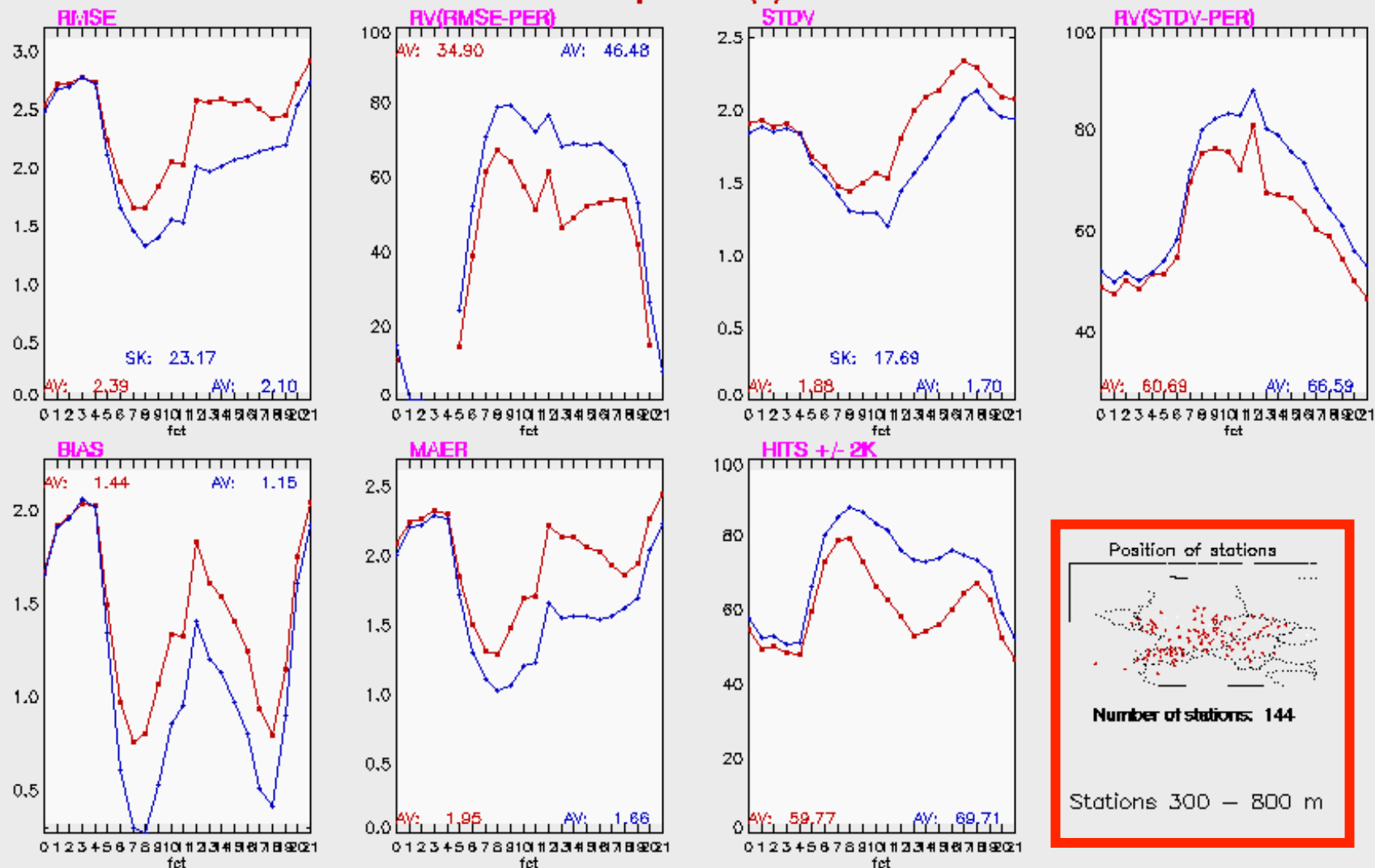


Results of verification of forecasts for local weather elements at surface stations

LM3MO: 25.06.2010 00 UTC – 15.07.2010 00 UTC (exp. run B010_national: nearest gridpoint)

lm3mo: 25.06.2010 00 UTC – 15.07.2010 00 UTC (ope. run LON: 02.98 – 19.84 LAT: 44.77 – 56.14; nearest gridpoint)

Temperature (K)



Plottime: 08.02.2011 08:19:55 MEZ

Conclusions and Outlook

- COSMO experiments with vegetation type albedo and adaptations 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

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 and COSMO-DE apply the approach of Tame 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 simulation, *Mon. Weather Rev.*, 120, 323–325.
 Tame, D., J. F. Geleyn, and J. M. Stingo (1984), First results of the introduction of an advanced aerosol-radiation interaction in the ECMWF low-resolution global model, in *Aerosols and Their Climate Effects*, edited by H. E. Suter and A. Deschamps, pp. 133–177, A. Deschamps, Hampton, VA.

Figure 1, S. P. Harrison, K. Kohfeld, I. C. Prentice, M. Cox, and M. Heimann (2002), Impact of vegetation and potential source areas on global dust aerosol: Results from a model study, *J. Geophys. Res.*, 107(D21), 4076, doi:10.1029/2001JD000984.

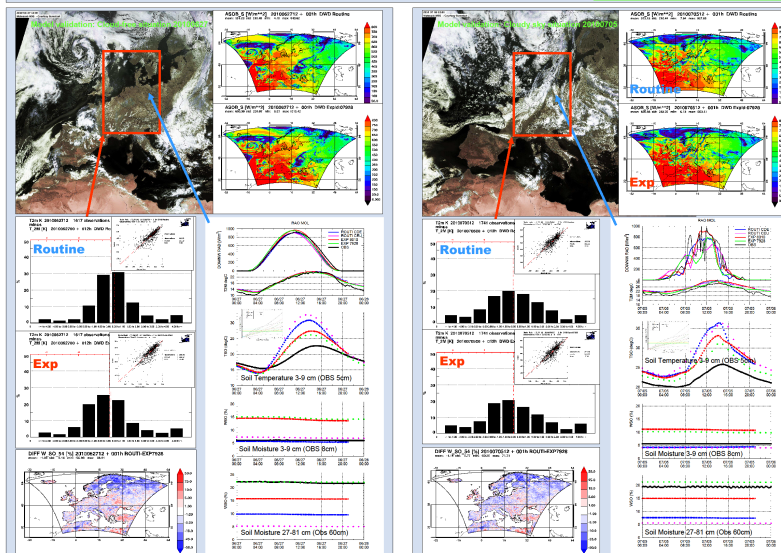
Experiments

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 adaptation 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).

Bias

Nameslist switches:
 type_aerosol = 2
 type_root = 2
 type_hydrobound = 3
 Lweta = 1.750E-01
 Lweta2 = 1.750E-01
 type_nutri = 1

RMSE



<http://www.dwd.de/forschung>

