Deutscher Wetterdienst
Wetter und Klima aus einer Hand

State of VERSUS at DWD, long term trends, systematic model errors …

Ulrich Damrath

Content

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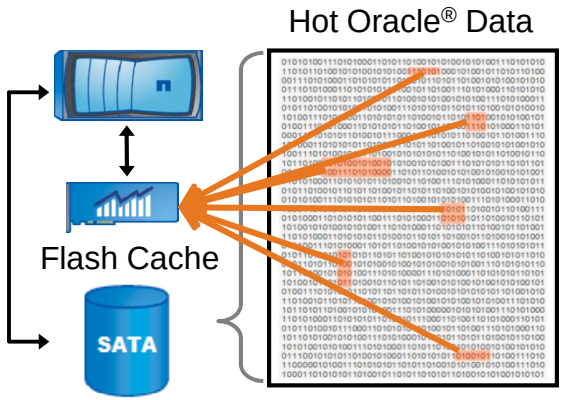
- Current state of VERSUS
  - Modified server status
    - NetApp FAS 3070 replaced by NetApp 3270
    - old: 2 x 4 GBit/s
    - new: 4 x 3 GBit/s
    - **Important: flash cash 1Tb** (100 k€)
    - Speed up: ~ 100%
      - Conditional verification CDE for one month: 20 seconds
      - Conditional verification CEU for one month: 1200 - 5500 seconds (depends on flash cash state)
    - mySql cashes play now a minor role!
  - Some problems
  - Some important results
  - Intranet web page
- Long term trends
  - COSI
  - Precipitation
    - Trend using SYNOP reports
    - Trend using high density precipitation measurement network
- Fuzzy-Verification of precipitation forecasts
- Verification of vertical structures
- FABEC

Higher Performing Oracle Databases

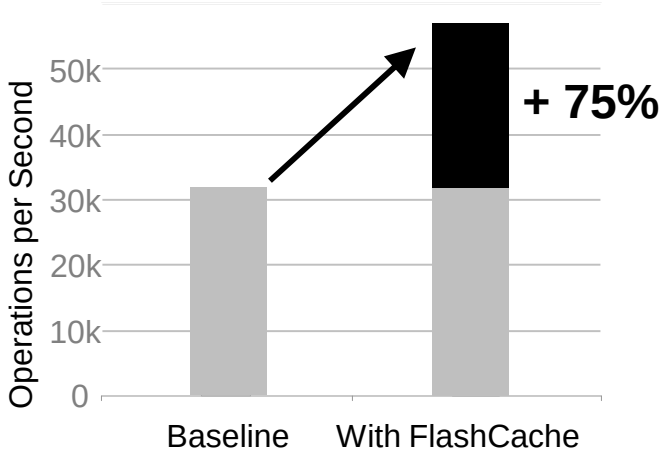
Benefits for applications

- Frequent data in fast cache
- Increases I/O throughput by 75%
- Average response time improved by 30%



Benefits for infrastructure

- Enable SATA as primary disk technology
- Reduce storage footprint
- Save 55% of expected budget
- Self-managing cache



Some problems

- Consistency of results
  - ➔Number of cases in the standard verification
- Functionality
  - ➔Horizontal distribution of errors of wind components (posted to the forum)
  - ➔Right score on the right place (posted to the forum)

Month		Counts				Counts		
201112	T2M CEU geographical distribution:	289858	Maximum:	31	time series:	266708	Relationship:	.92013
201201	T2M CEU geographical distribution:	312364	**Maximum:**	**32**	time series:	287638	Relationship:	.92084
201202	T2M CEU geographical distribution:	290780	**Maximum:**	**30**	time series:	267988	Relationship:	.92161
201203	T2M CEU geographical distribution:	307308	**Maximum:**	**32**	time series:	283184	Relationship:	.92149
201204	T2M CEU geographical distribution:	303450	**Maximum:**	**31**	time series:	279572	Relationship:	.92131
201205	T2M CEU geographical distribution:	313472	**Maximum:**	**32**	time series:	288660	Relationship:	.92084
201206	T2M CEU geographical distribution:	302856	**Maximum:**	**31**	time series:	278806	Relationship:	.92058
201207	T2M CEU geographical distribution:	293398	**Maximum:**	**30**	time series:	270268	Relationship:	.92116
201112	T2M CDE geographical distribution:	47531	Maximum:	31	time series:	43735	Relationship:	.92013
201201	T2M CDE geographical distribution:	50012	**Maximum:**	**32**	time series:	46043	Relationship:	.92063
201202	T2M CDE geographical distribution:	47083	**Maximum:**	**30**	time series:	43385	Relationship:	.92145
201203	T2M CDE geographical distribution:	50414	**Maximum:**	**32**	time series:	46463	Relationship:	.92162
201204	T2M CDE geographical distribution:	48577	**Maximum:**	**31**	time series:	44755	Relationship:	.92132
201205	T2M CDE geographical distribution:	50180	**Maximum:**	**32**	time series:	46210	Relationship:	.92088
201206	T2M CDE geographical distribution:	46941	Maximum:	30	time series:	43221	Relationship:	.92075
201207	T2M CDE geographical distribution:	46758	**Maximum:**	**30**	time series:	43074	Relationship:	.92121

??? And no chance to change it!!!

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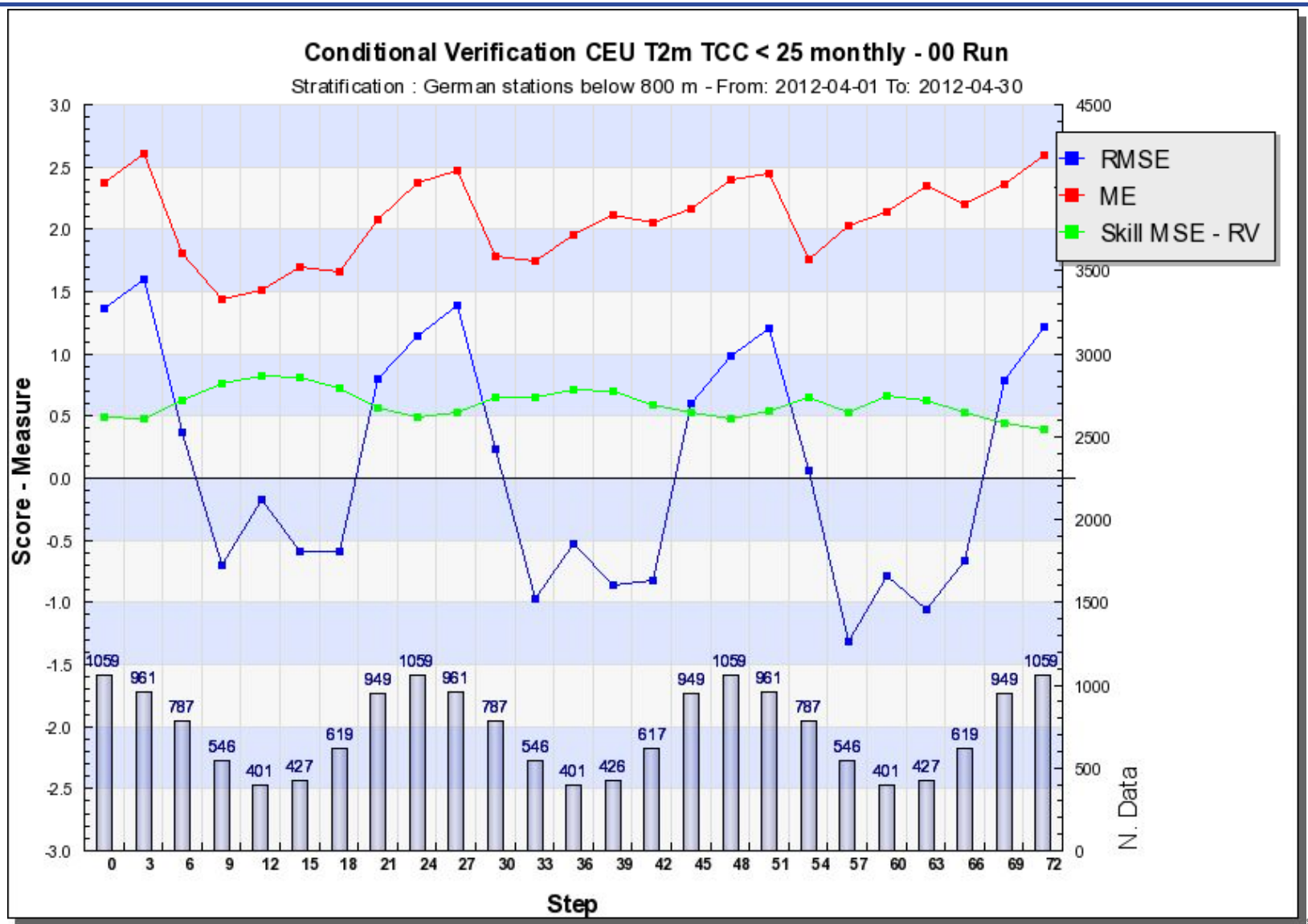
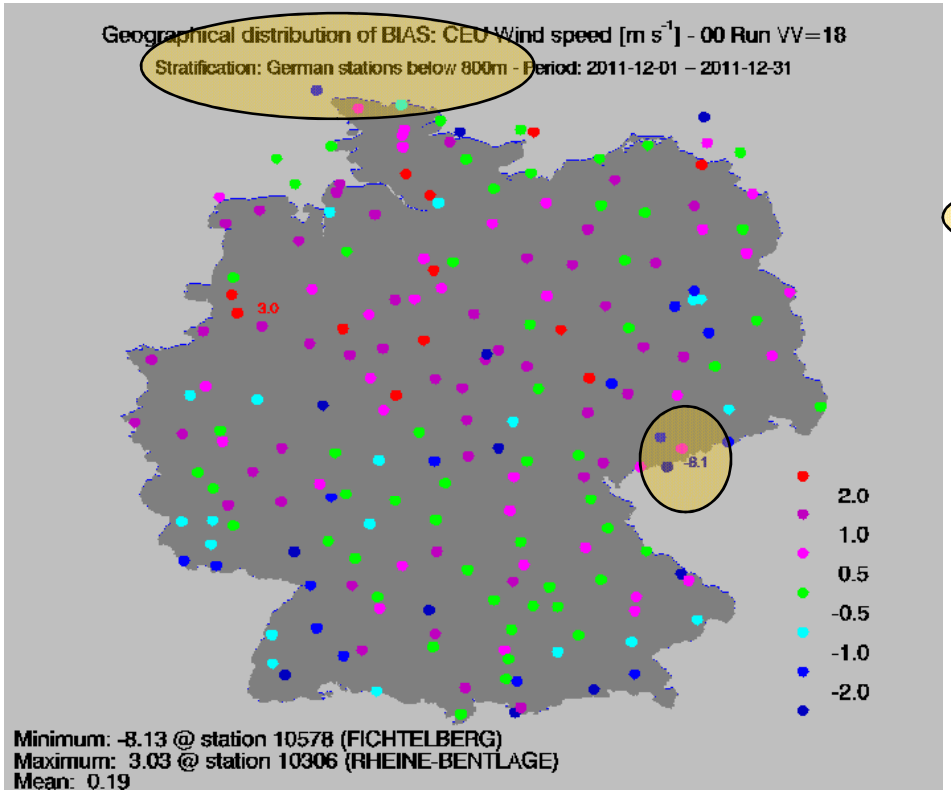
Wetter und Klima aus einer Hand



800 m: yes or no???

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Source: http://en.wikipedia.org/wiki/Fichtelberg

Criteria: CEU horizontal distribution of Wind 10m errors 3h-steps
Index: ME
Frequency: Monthly - From: 2011-12-01 To: 2011-12-31
Step Index Value Number Value Station
From: 2011-12-01 To: 2011-12-31
0 -7.03003 20 FICHTELBERG-10578
3 -7.17631 20 FICHTELBERG-10578
6 -7.17186 22 FICHTELBERG-10578
……..

VERSUS results with related aspects

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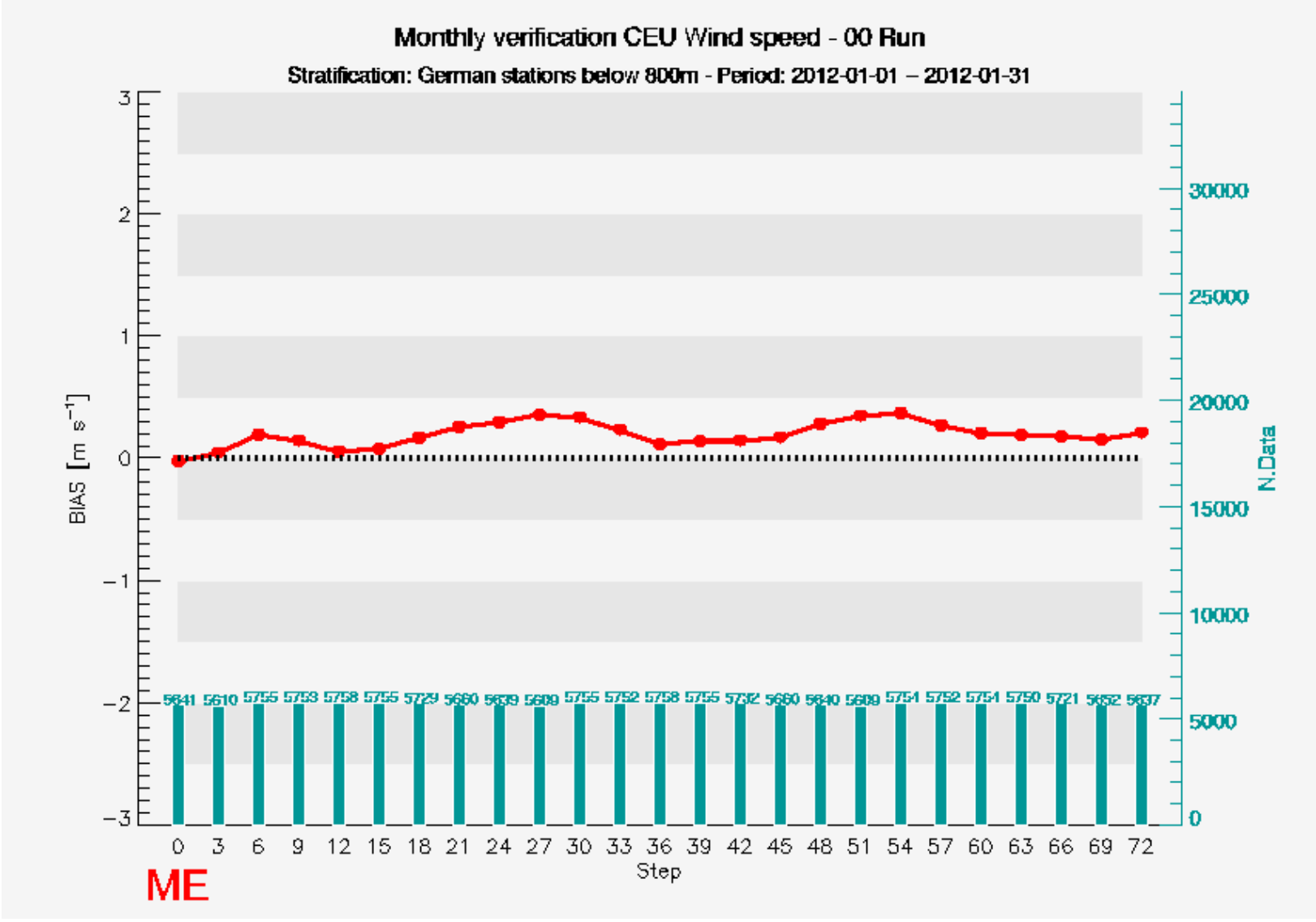
Wetter und Klima aus einer Hand

- Wind
  - ➔Seasonal behaviour of errors
  - ➔Forecast quality depending on elevation of station
- Temperature
  - ➔The COSMO-DE problem during summer and ist influence on other parameters
- Conditional verification
    - ➔TCC < 25%
    - ➔TCC > 75%

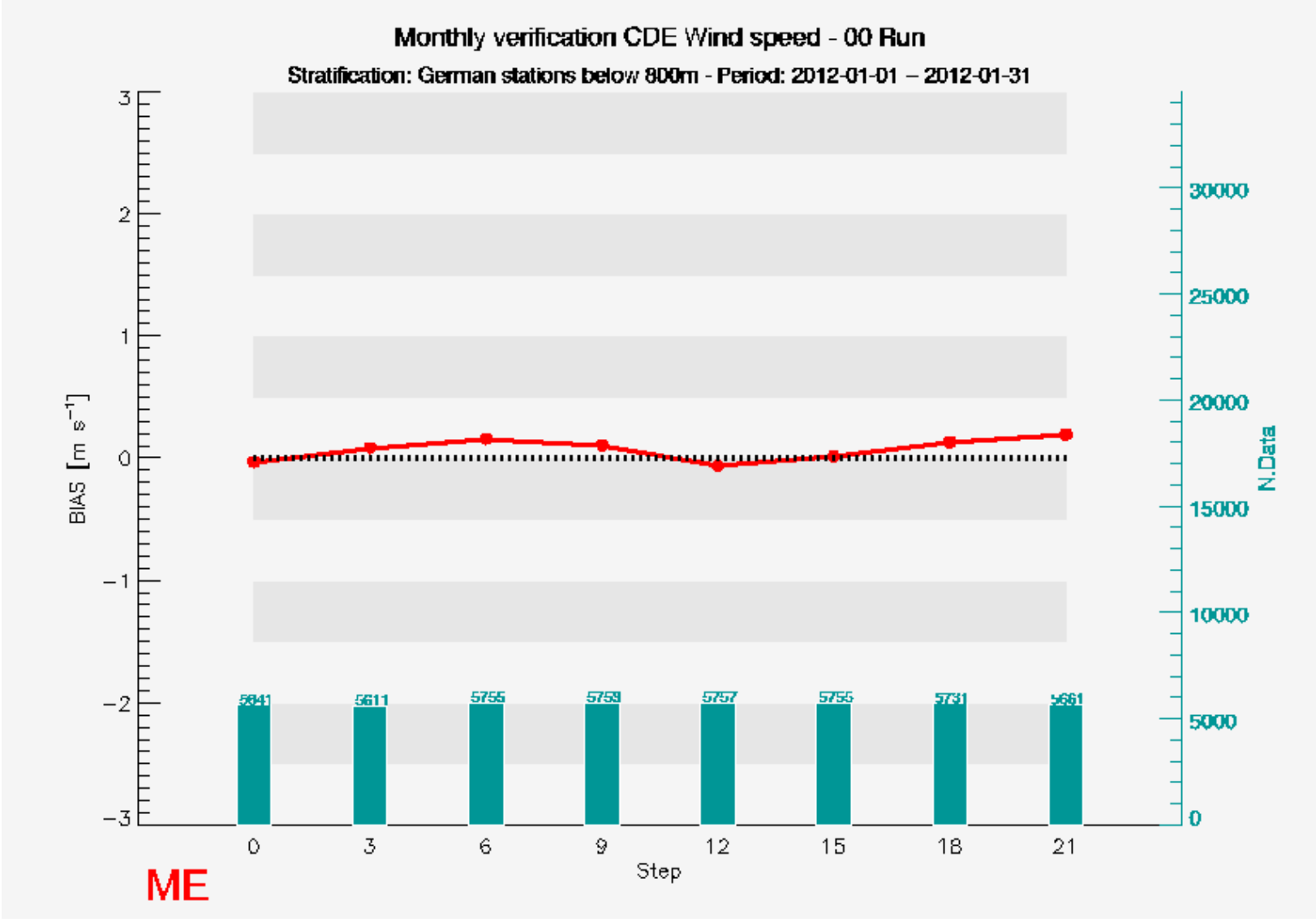
CEU: Windspeed 10m, January 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



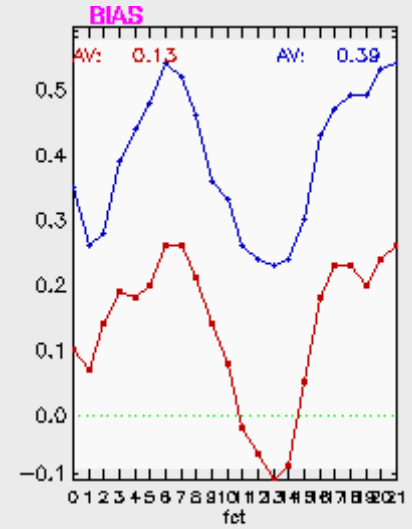
CDE: Windspeed 10m, January 2012

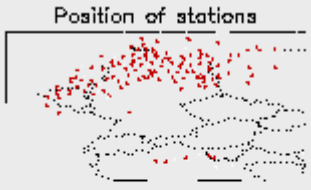
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



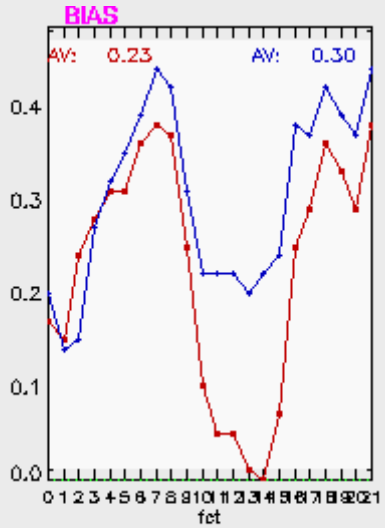
CEU + CDE: Windspeed 10m, January 2012

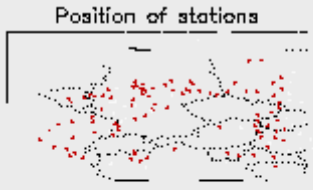
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



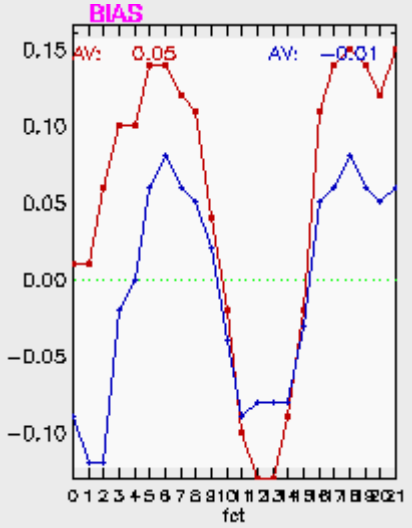


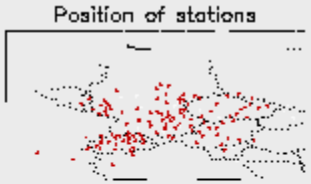
Stations below 100 m



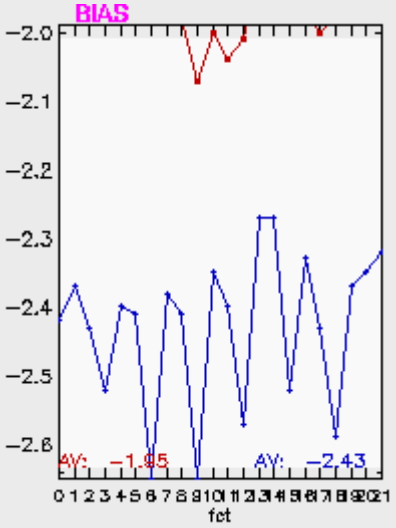


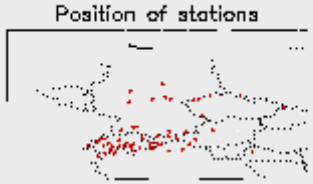
Stations 100 – 300 m





Stations 300 – 800 m





Stations above 800 m

CEU + CDE: Windspeed 10m, 06 UTC, January 2012

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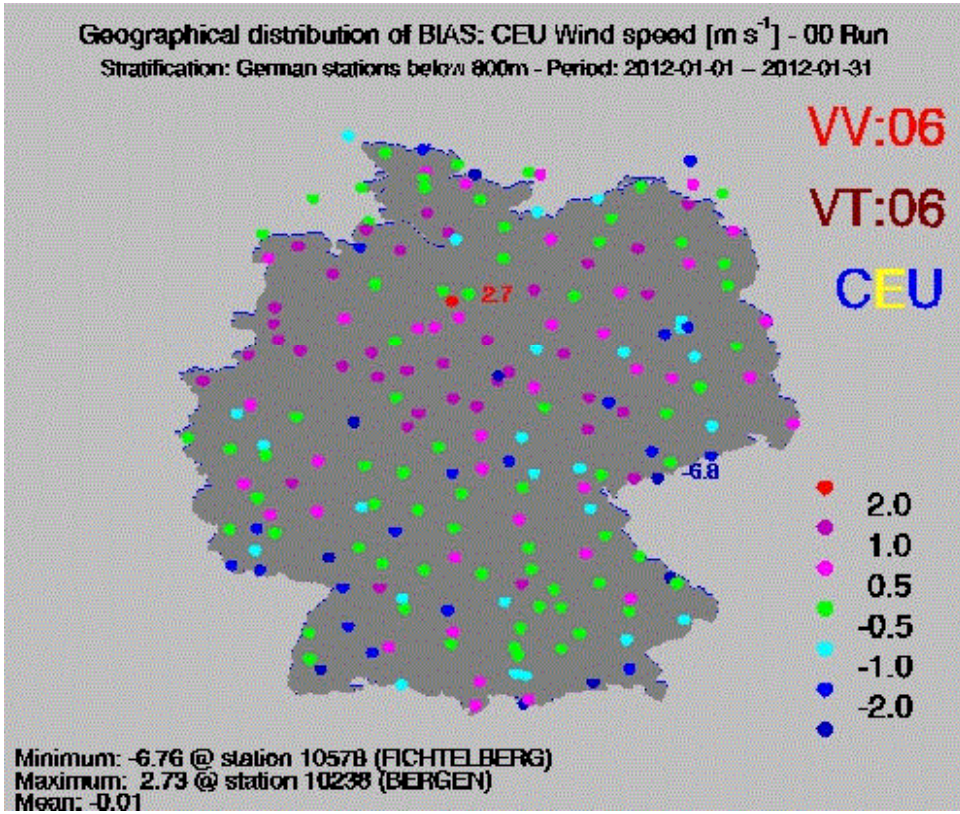
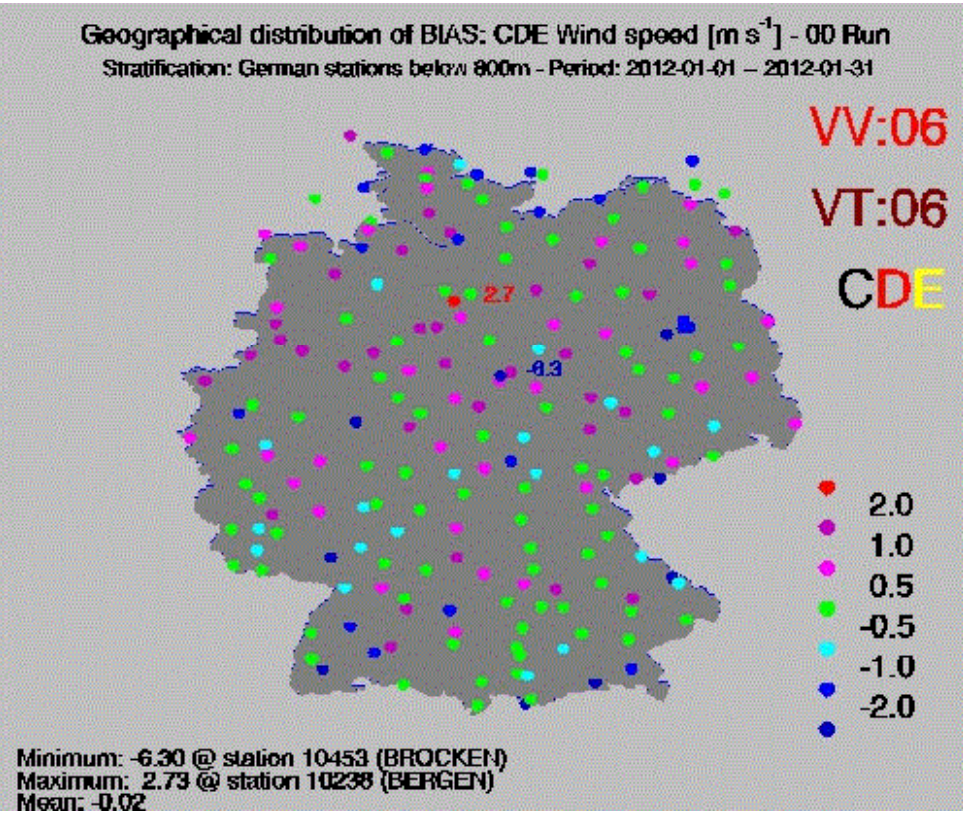
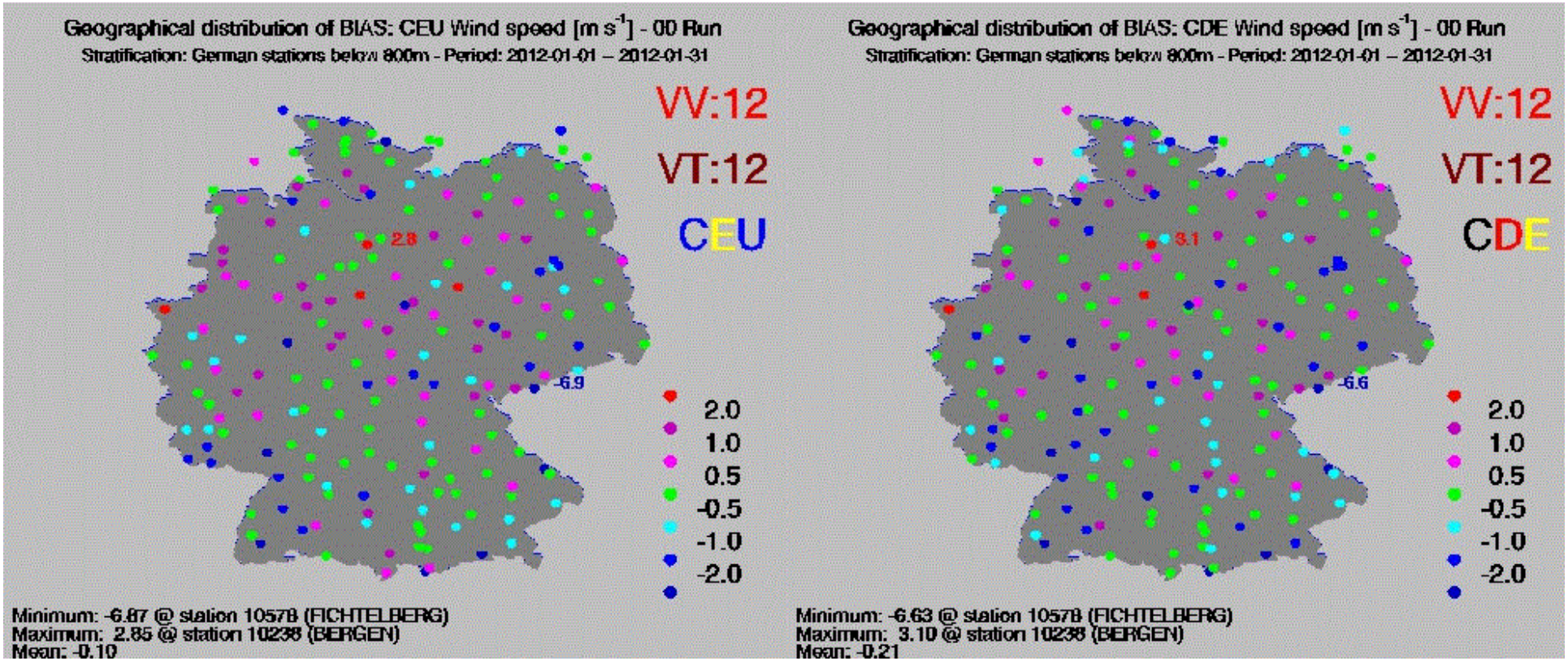
Wetter und Klima aus einer Hand





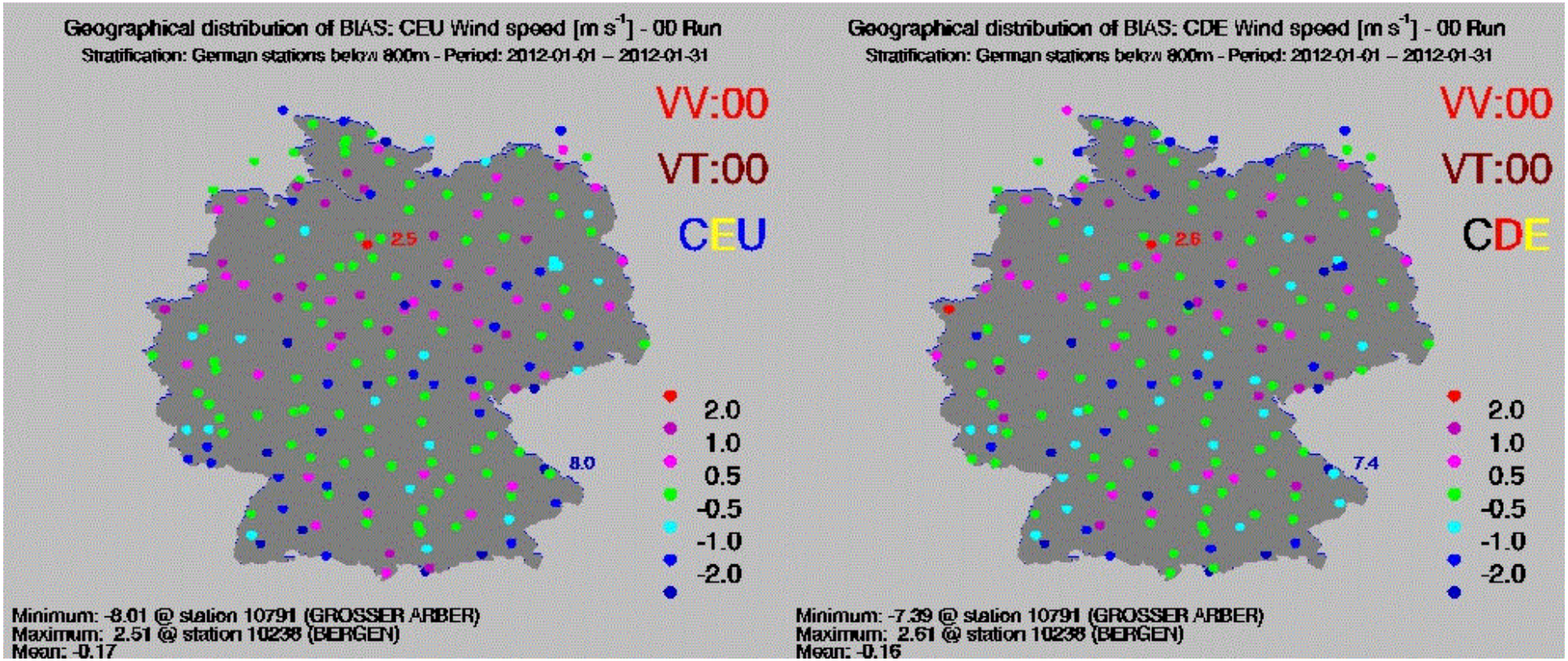
CEU + CDE: Windspeed 10m, 15 UTC, January 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



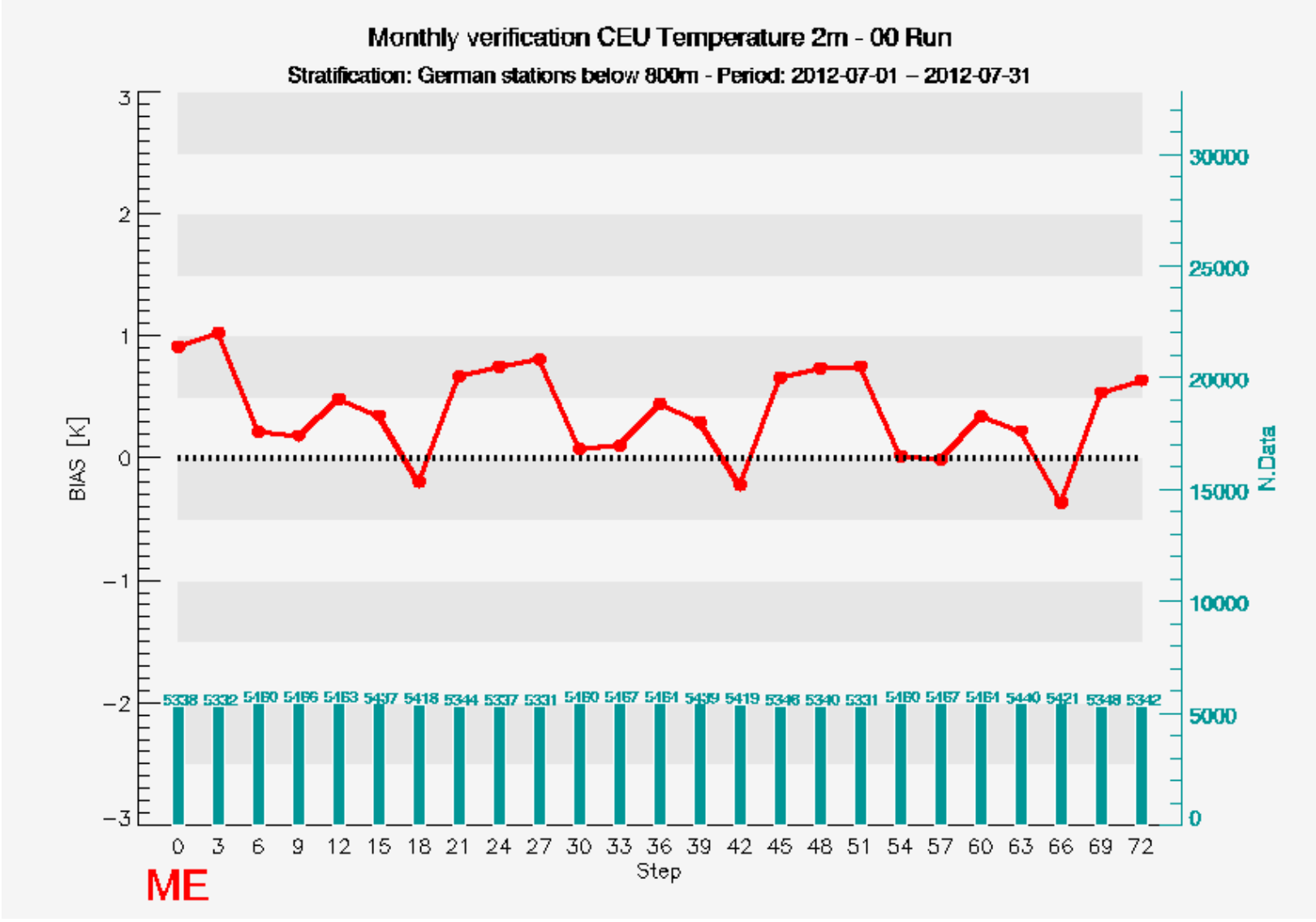
CEU + CDE: Windspeed 10m, January 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



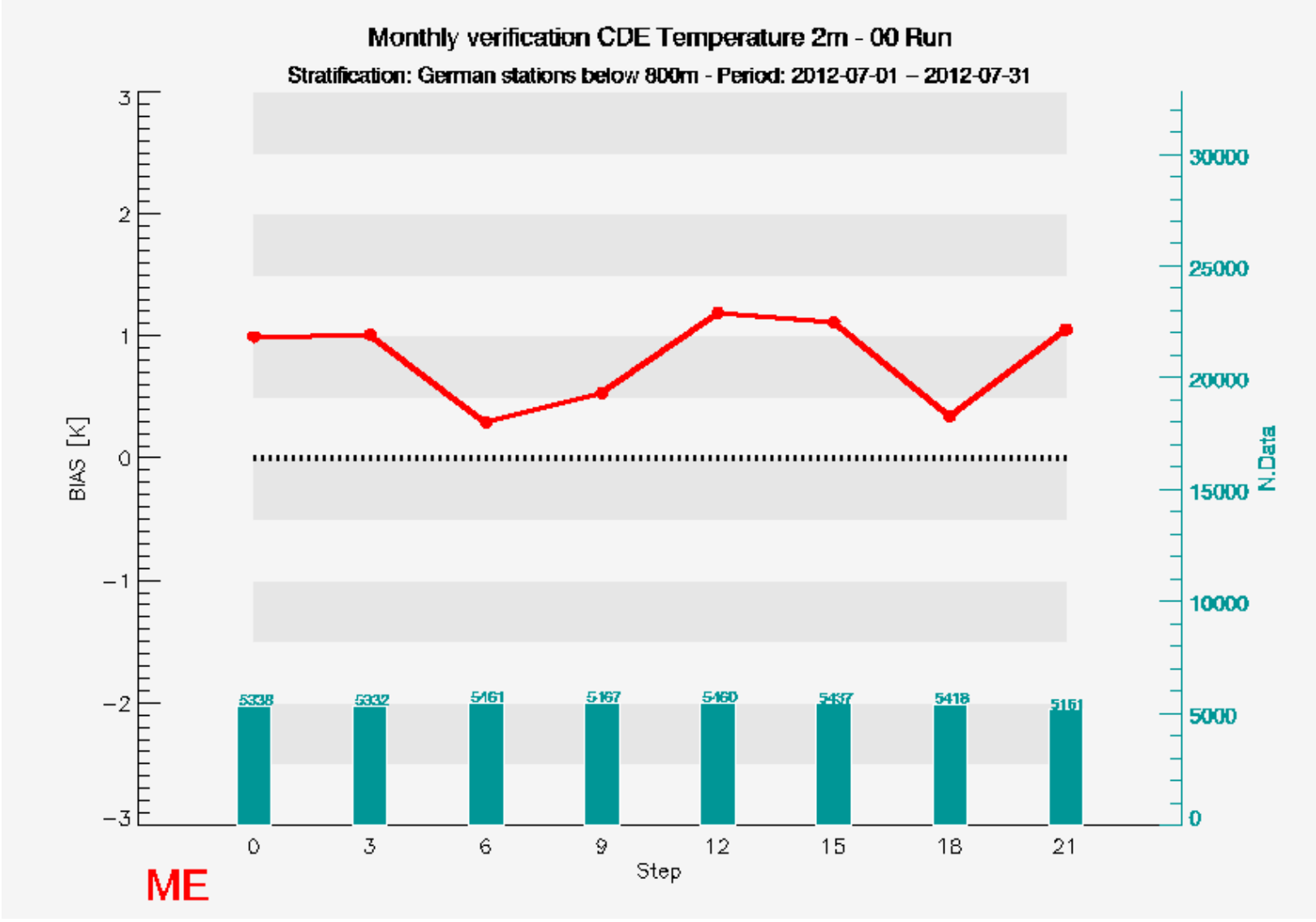
CEU: Temperature 2m, July 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



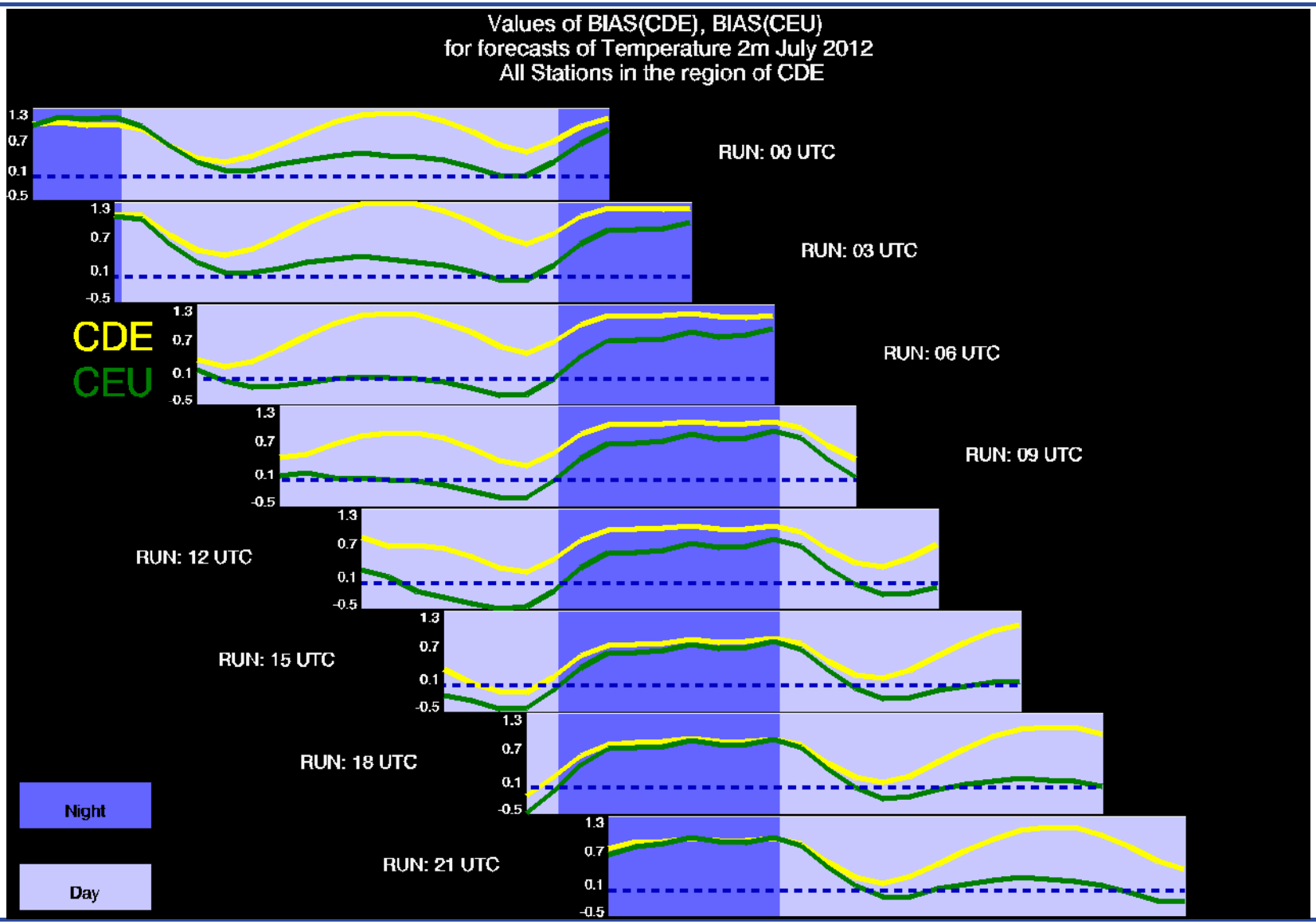
CDE: Temperature 2m, July 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



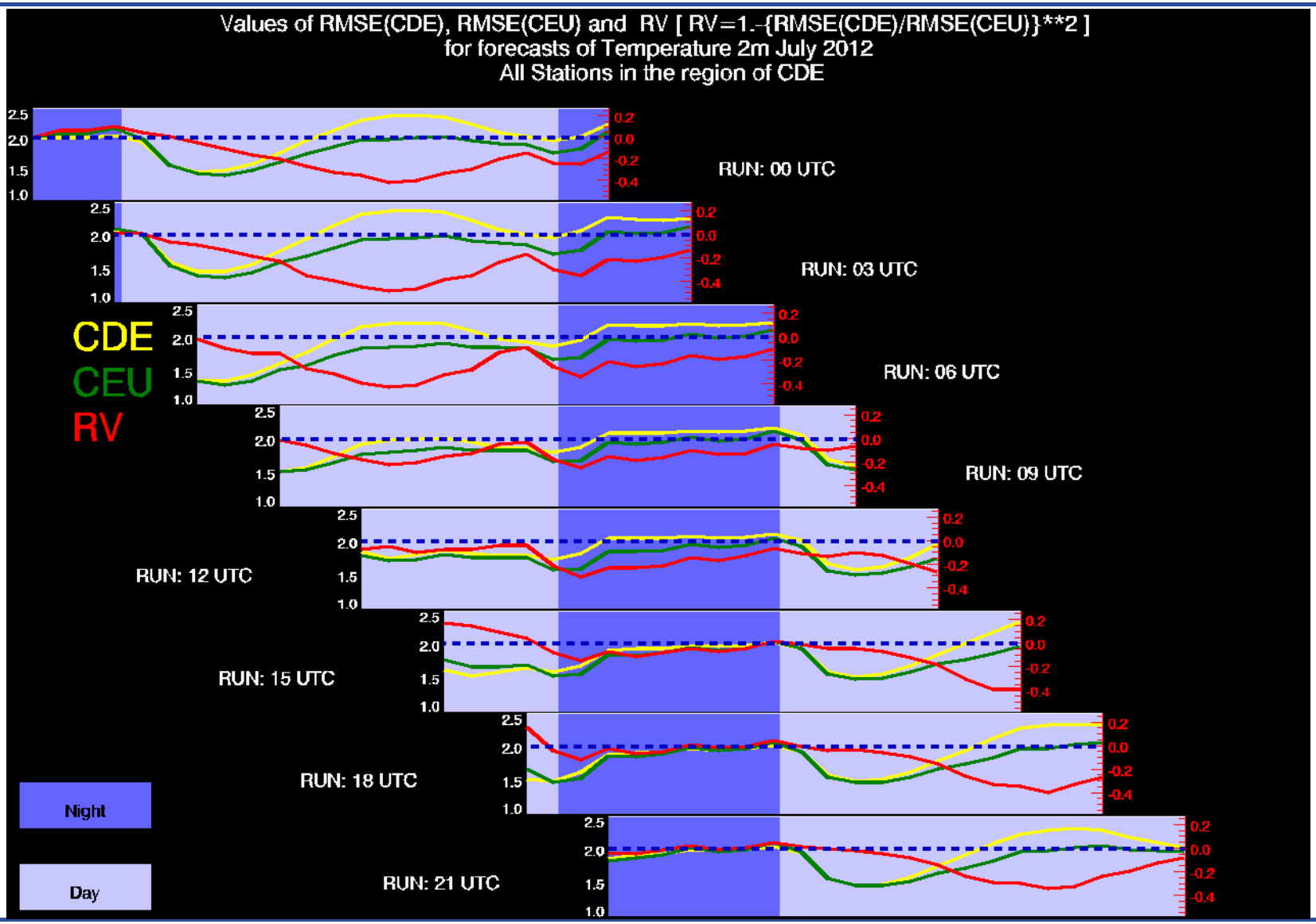
CEU + CDE: Temperature 2m, July 2012, Bias

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



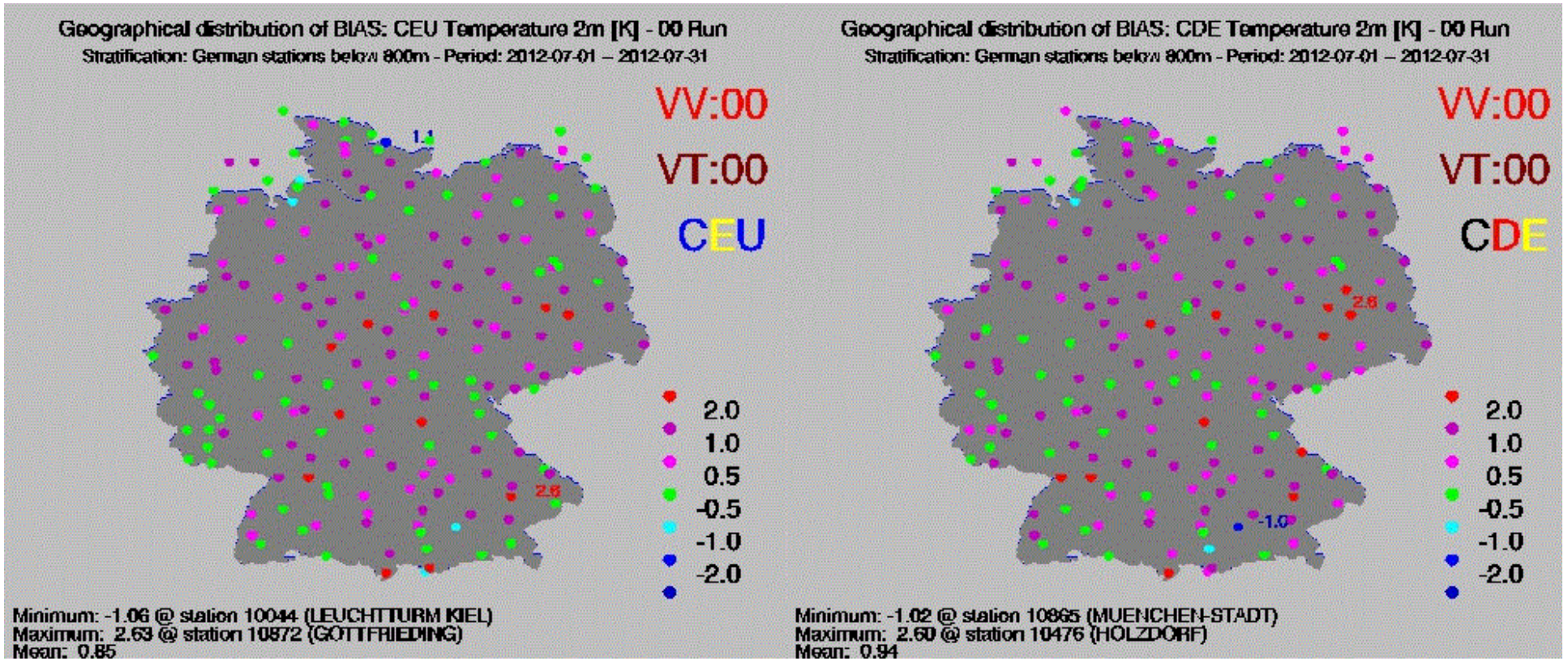
CEU + CDE: Temperature 2m, July 2012, RMSE

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



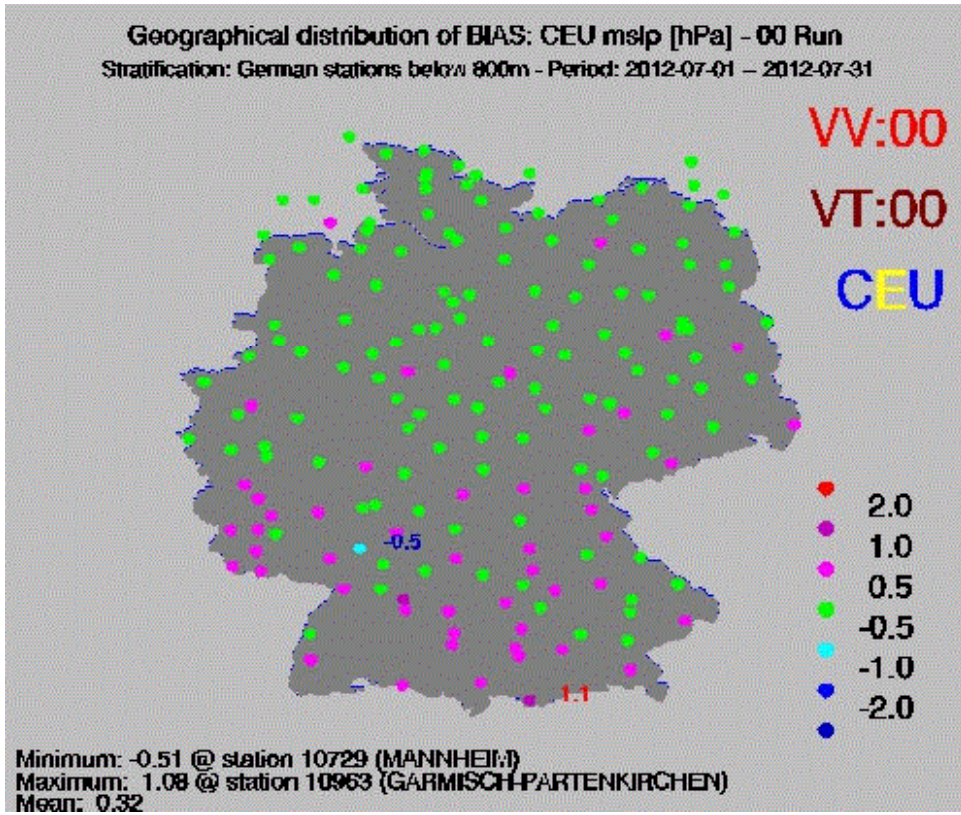
CEU + CDE: Temperature 2m, July 2012

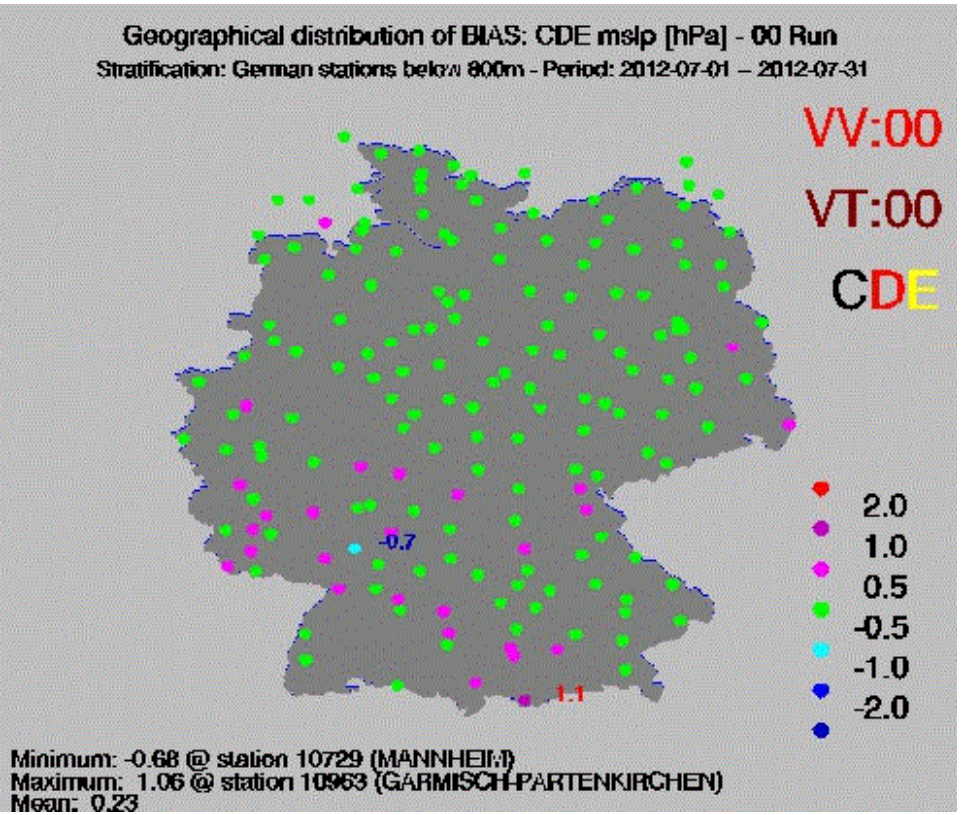
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



CEU + CDE: Pressure reduced to NHN, July 2012

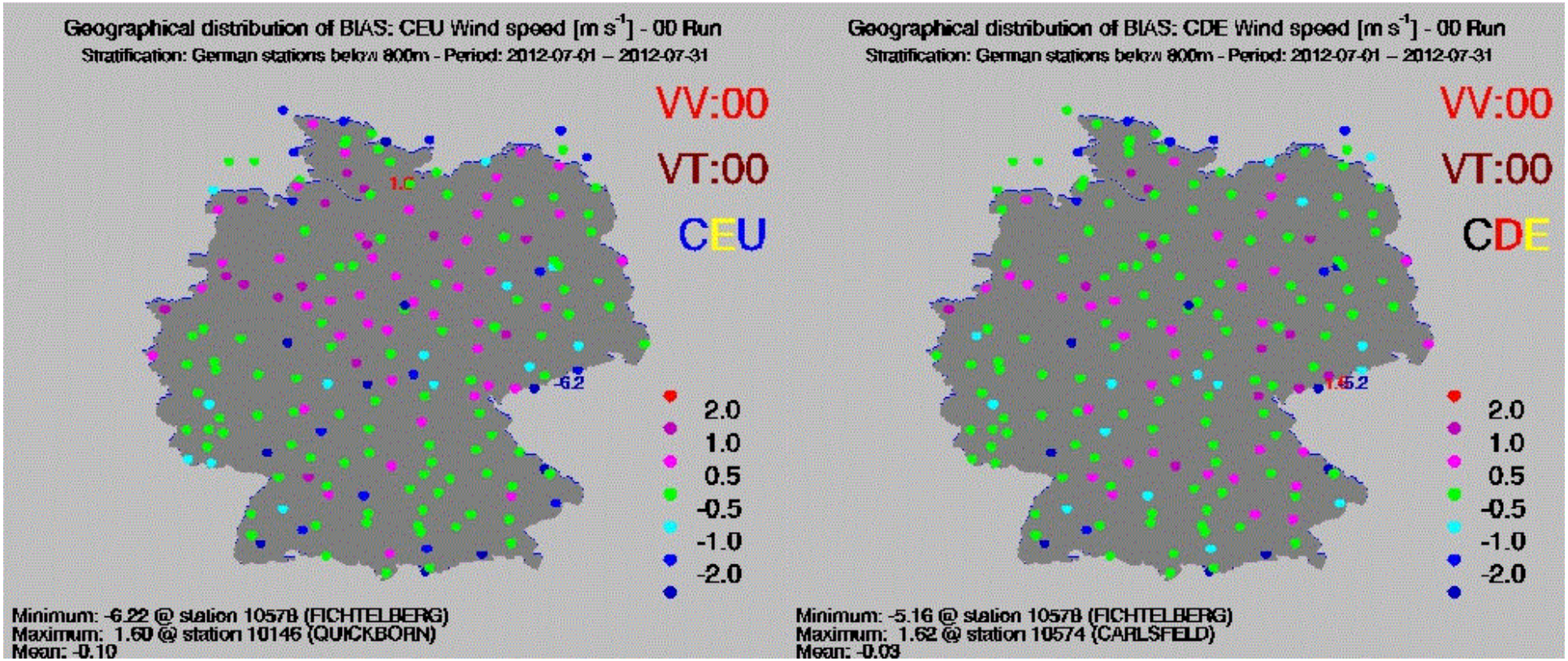
Deutscher Wetterdienst
Wetter und Klima aus einer Hand





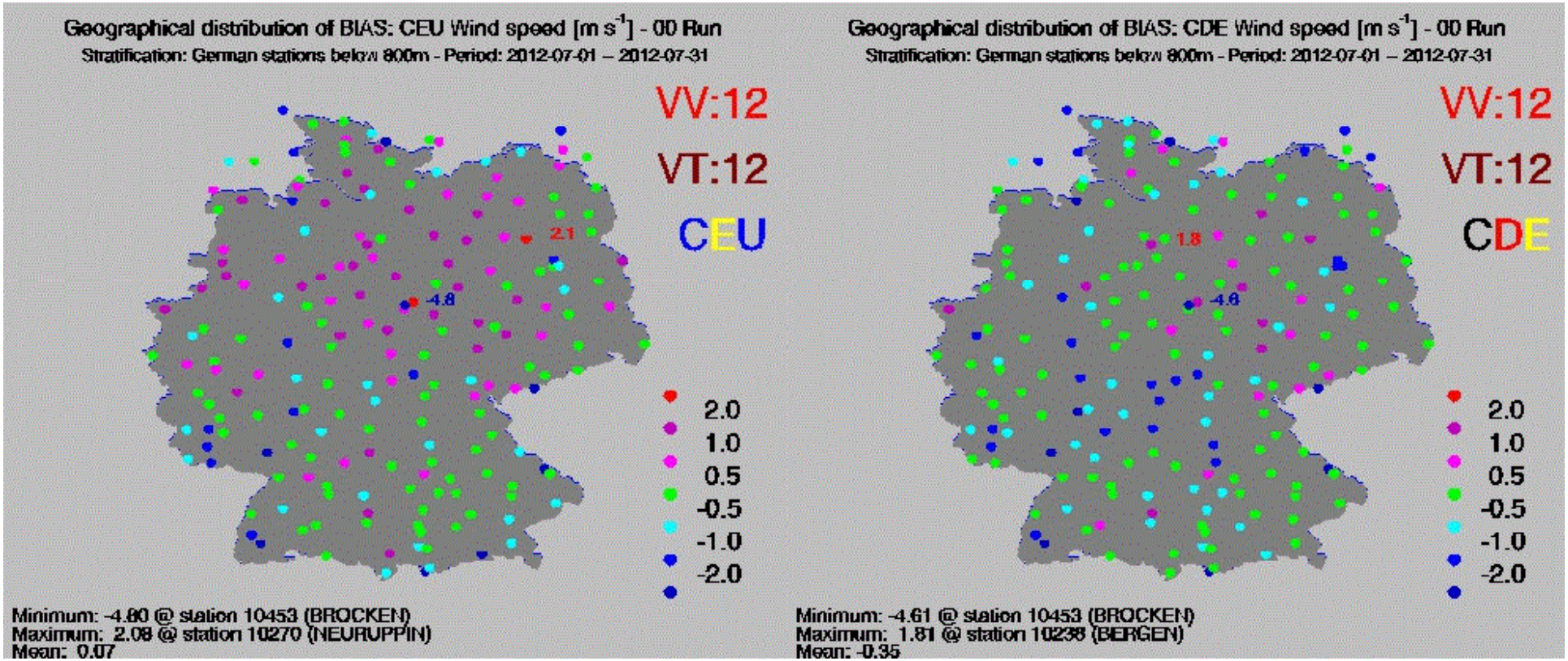
CEU + CDE: Wind 10m, July 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



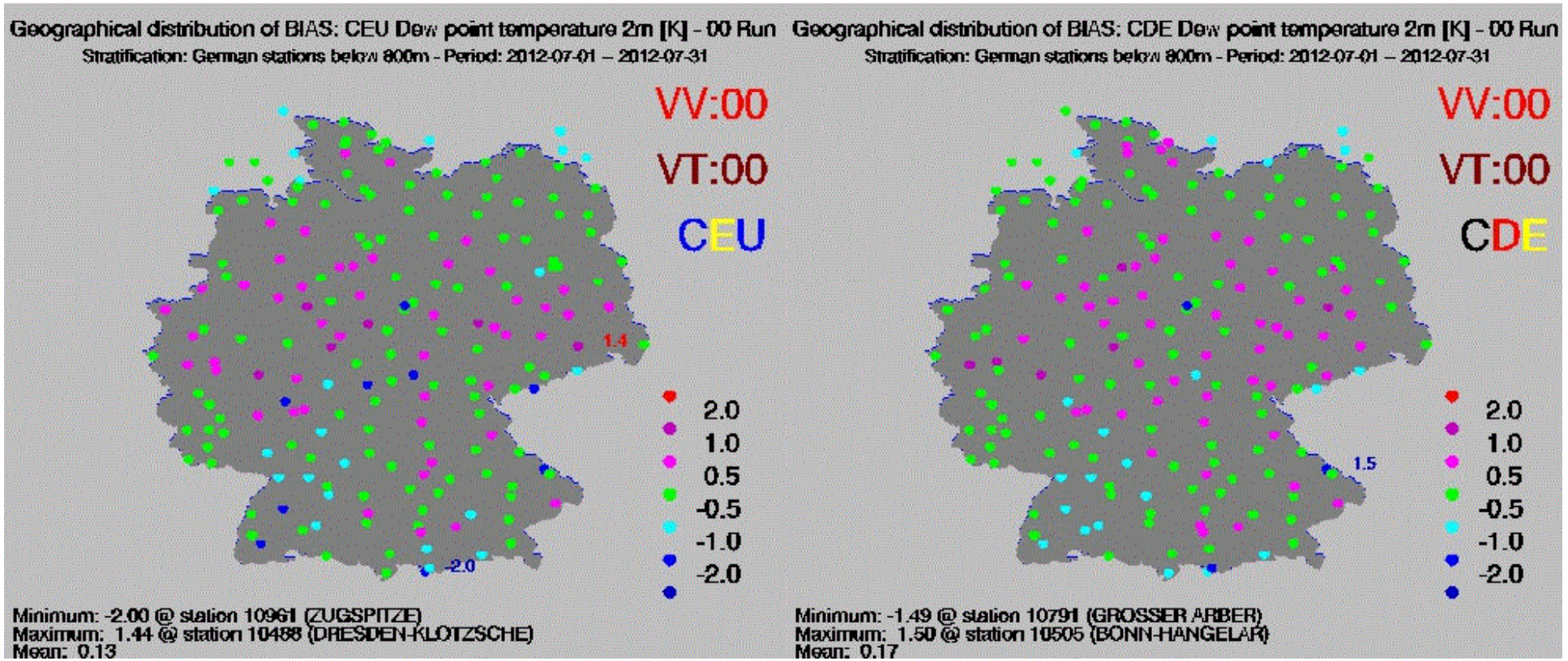
CEU + CDE: Wind 10m, July 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



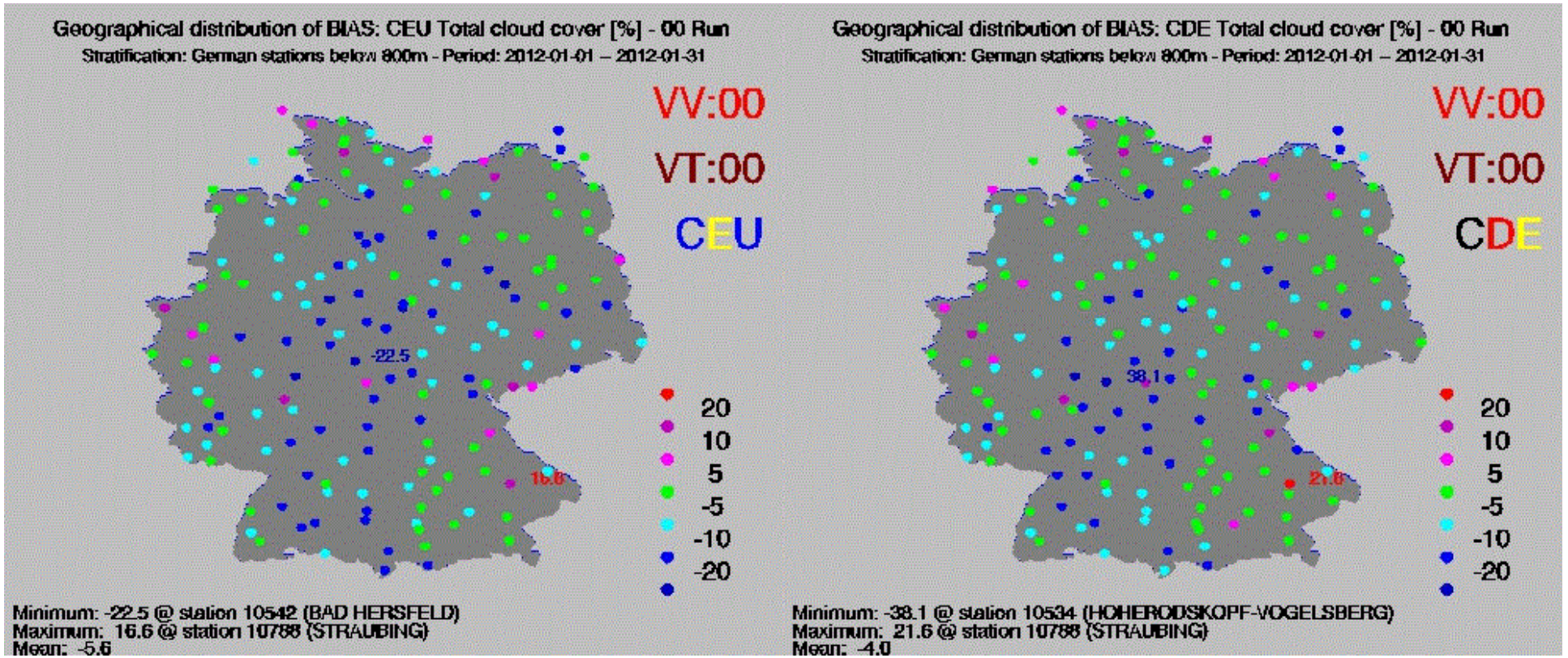
CEU + CDE: Dew point temperature 2m, July 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



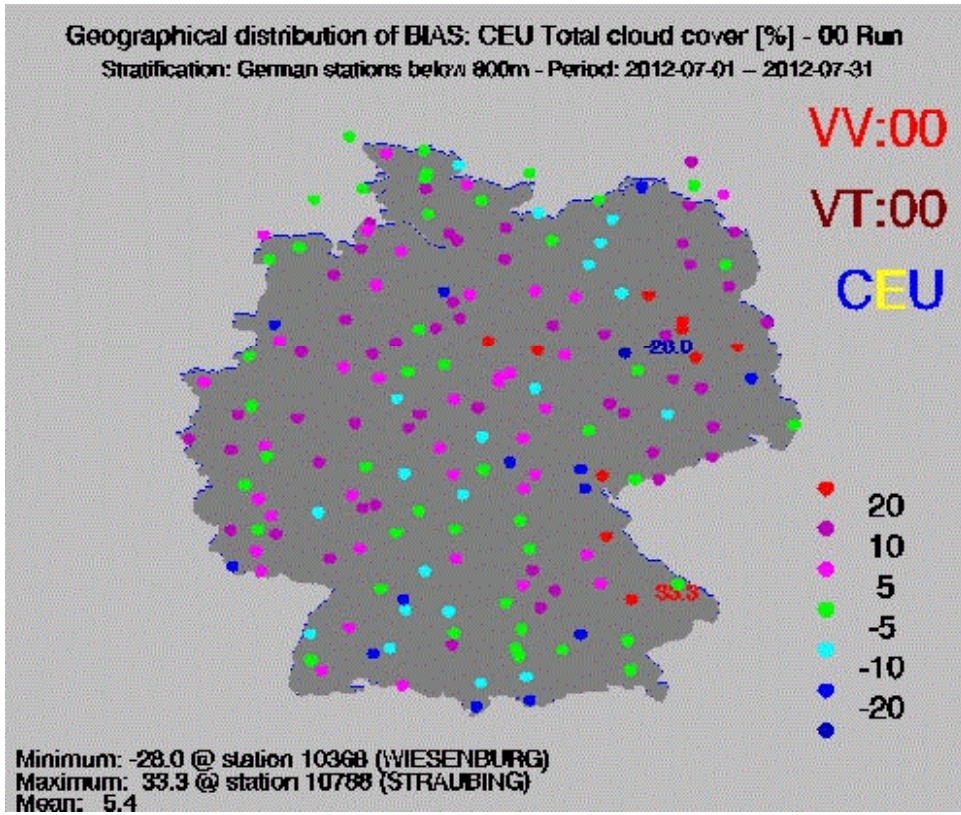
CEU + CDE: TCC, January 2012

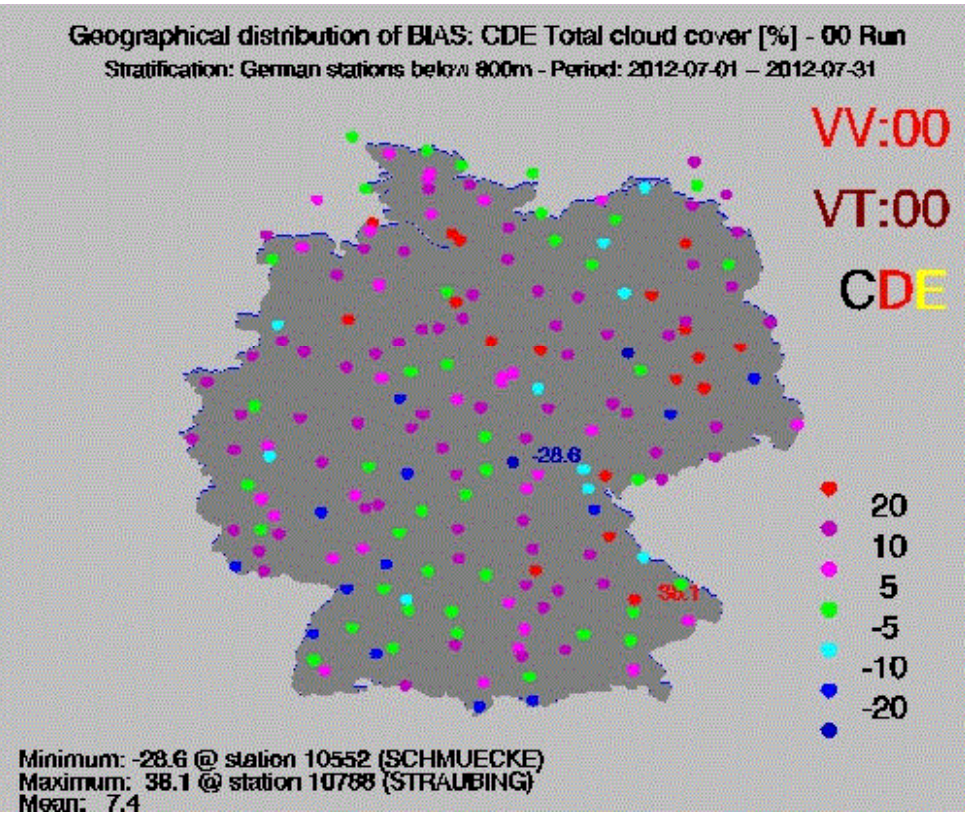
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



CEU + CDE: TTC, July 2012

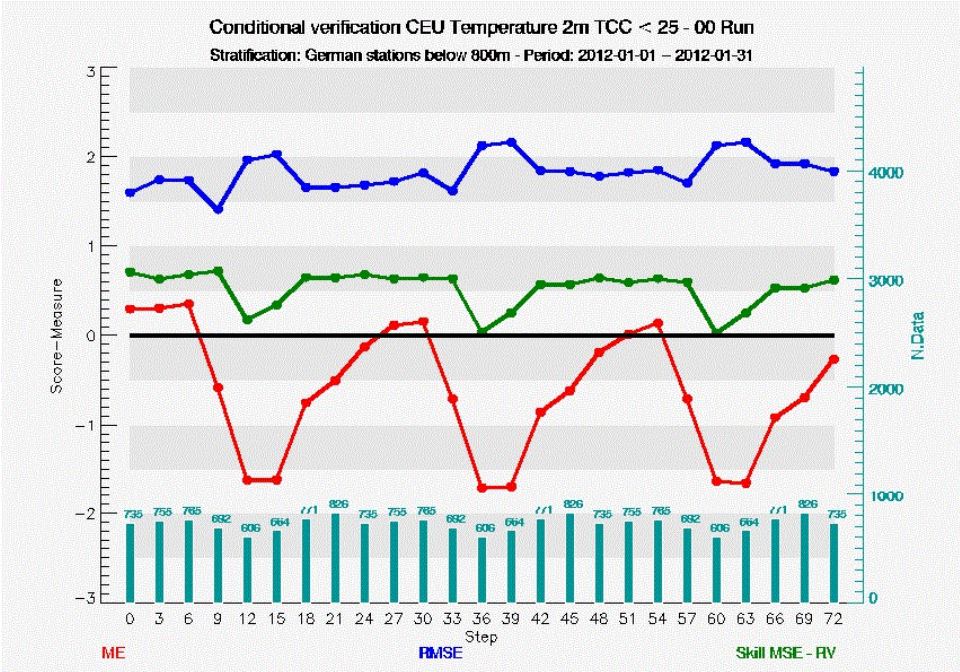
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

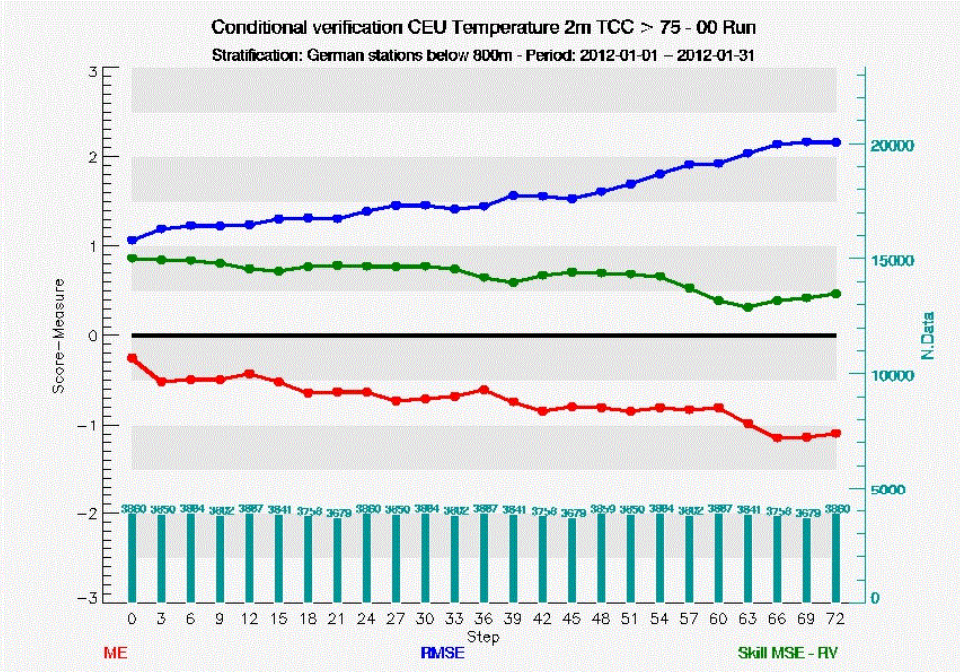




CEU: Temperature 2m, January 2012, BIAS depending on TCC

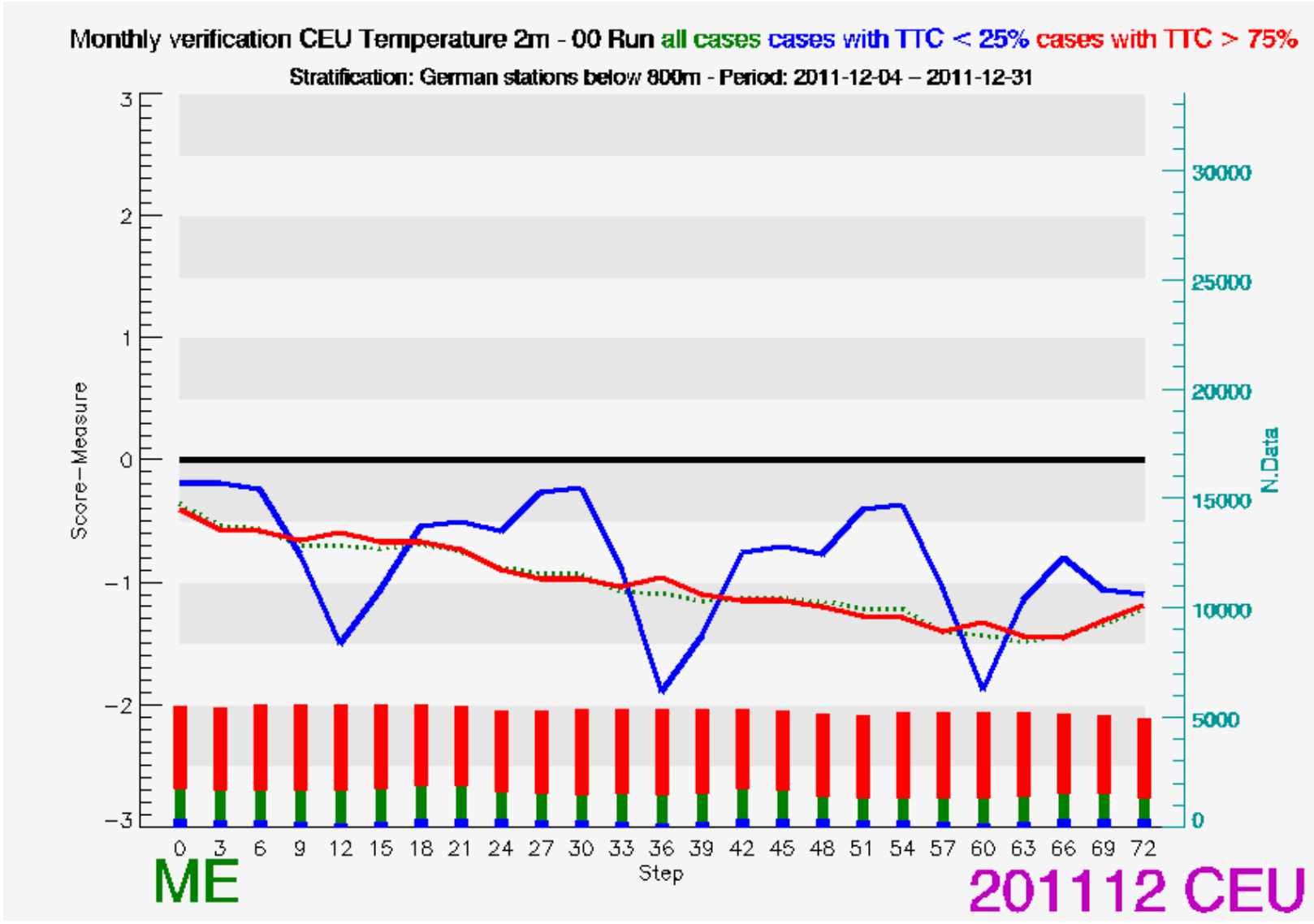
Deutscher Wetterdienst
Wetter und Klima aus einer Hand





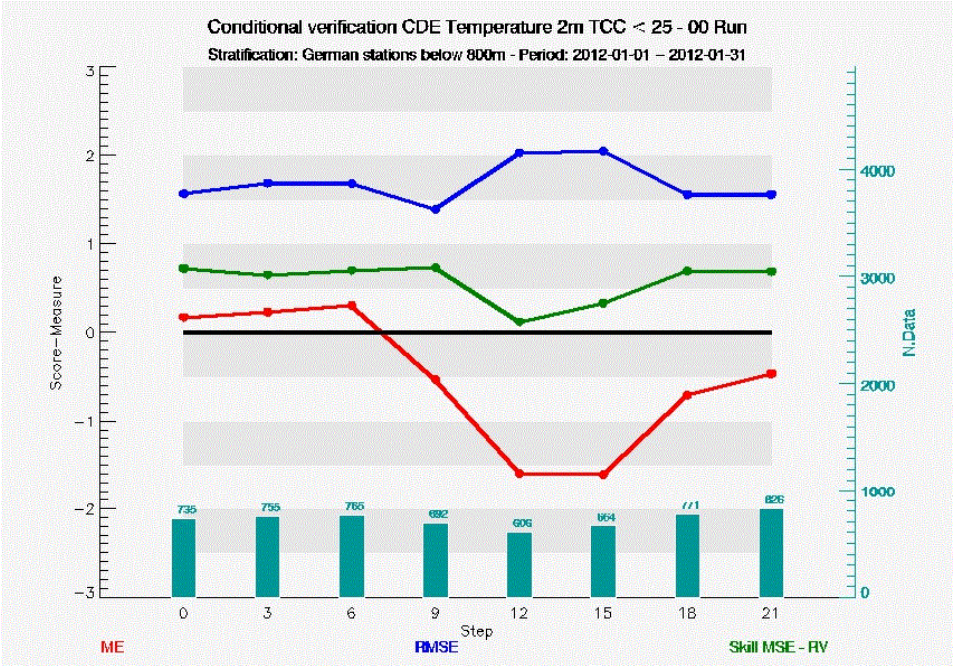
CEU: Temperature 2m, BIAS depending on TCC

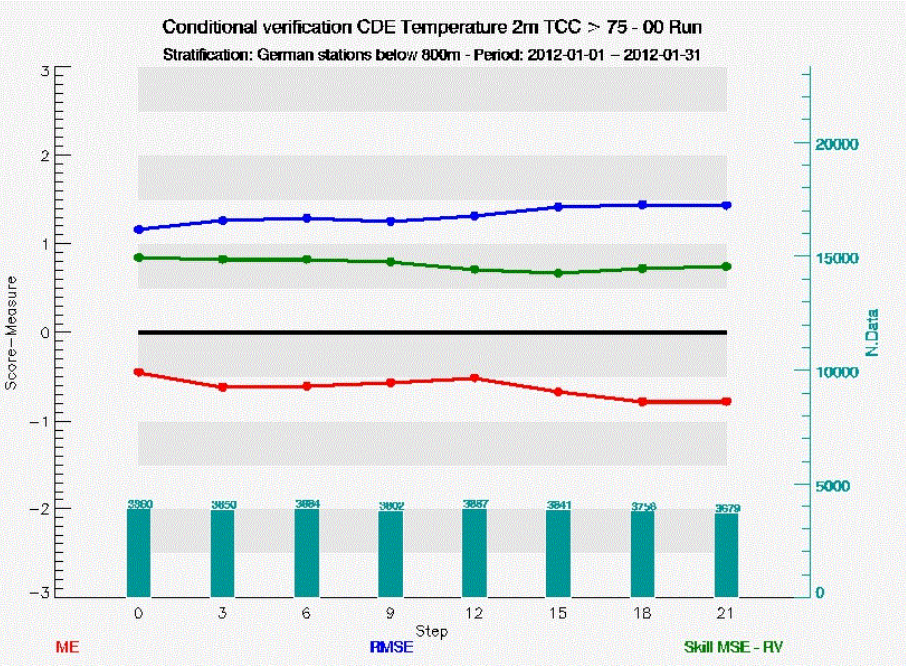
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



CDE: Temperature 2m, January 2012, BIAS depending on TCC

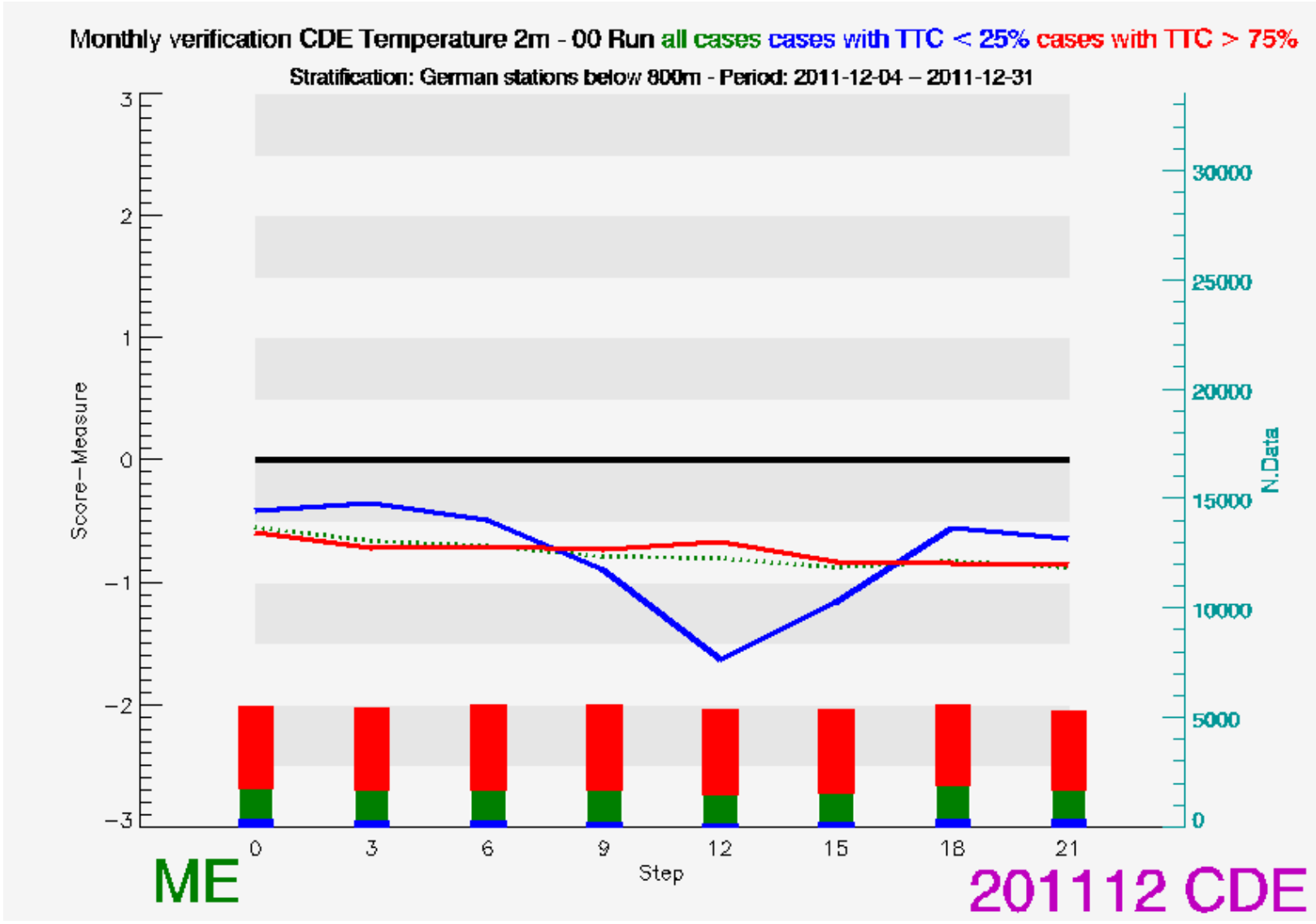
Deutscher Wetterdienst
Wetter und Klima aus einer Hand





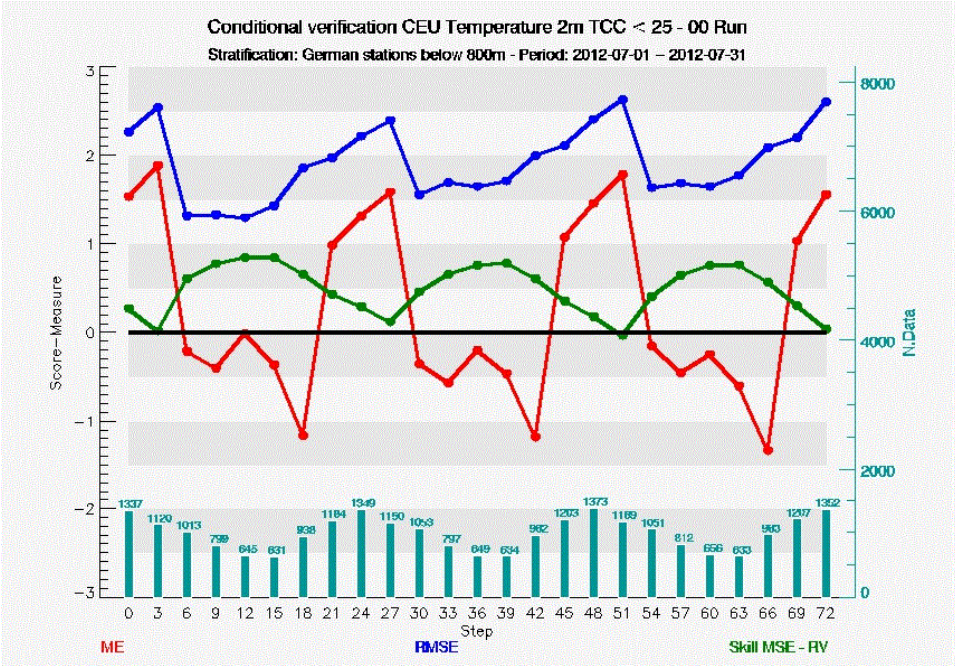
CDE: Temperature 2m, BIAS depending on TCC

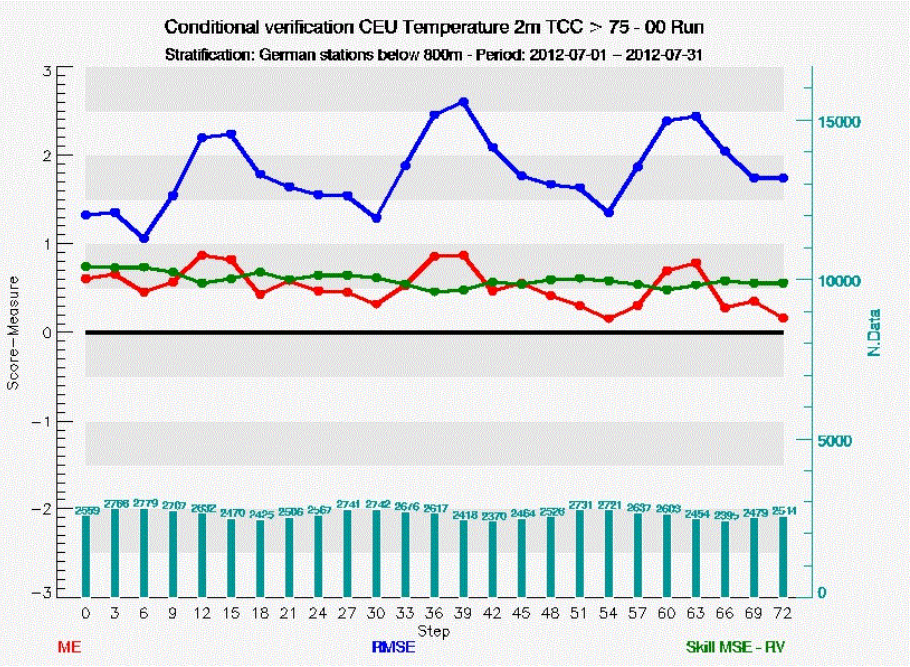
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



CEU: Temperature 2m, July 2012, BIAS depending on TCC

Deutscher Wetterdienst
Wetter und Klima aus einer Hand





CEU: Temperature 2m, July 2012, BIAS dependening on TCC

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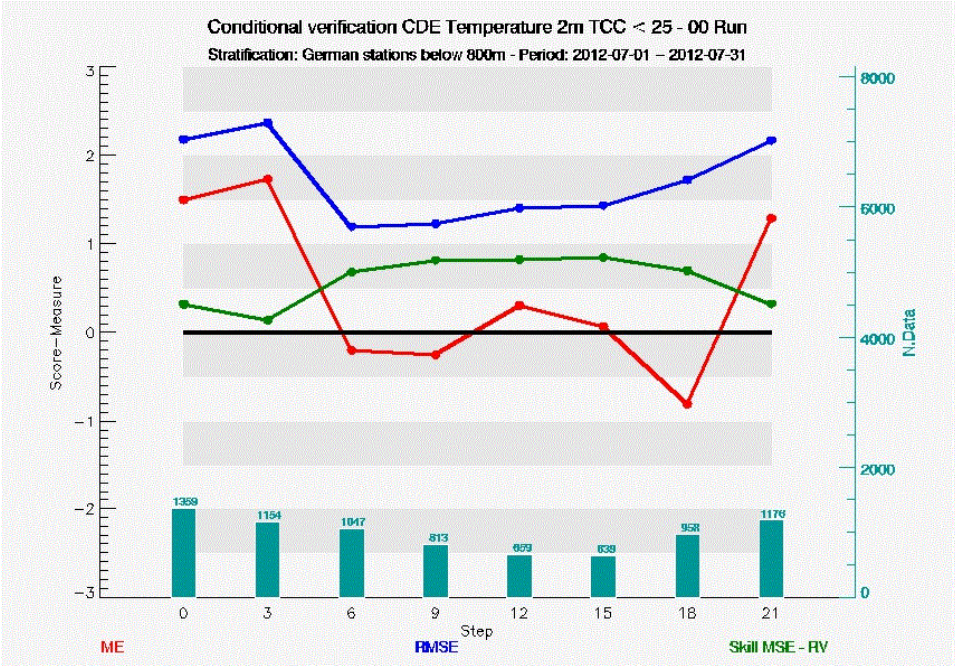
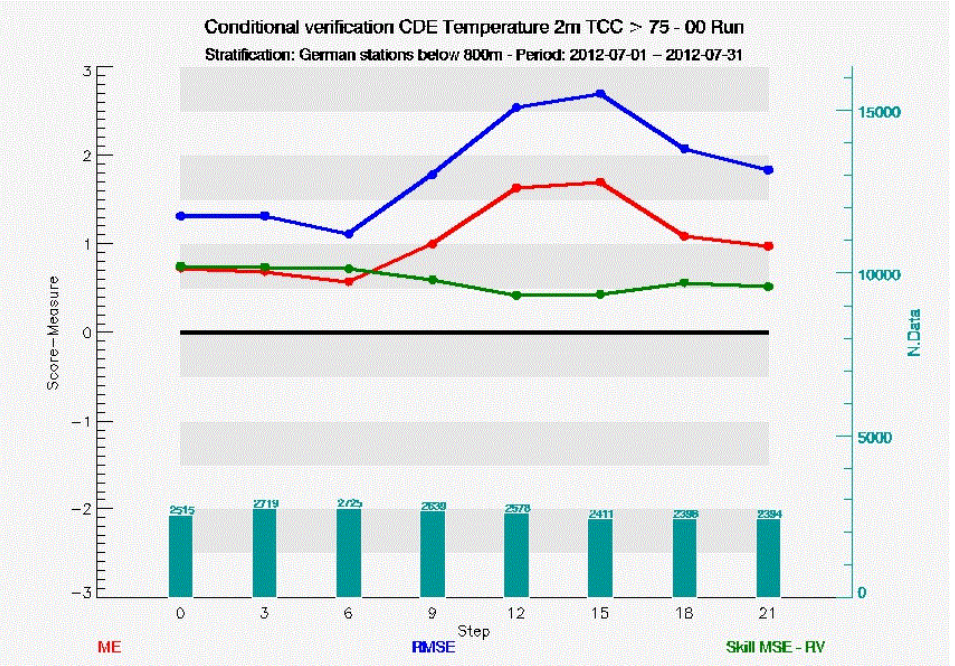




Presentation of VERSUS results in the DWD Intranet

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Results got from the verifcation system VERSUS in the framework of COSMO (Consortium for Small Scale Modeling)

Please note that due to problems in different levels the data are partly not complete.
Data are available whithout gaps starting with March 2012.
The table headers contain the abbreviations MO and TS.
The choice of MO allows a animation of graphics with the horizontal distribution of the errors,
with TS a time series of the sum of errors for each time step is shown.

Deutsche Version dieser Seite

CEU Horizontal distribution of BIASes for months
CEU Standard verification of continuous elements for seasons
CEU Standard verification of categorical elements for seasons
CEU Conditional verification of temperature forecast 2m for seasons
CEU Conditional verification of temperature forecast 2m for months

CDE Horizontal distribution of BIASes for months
CDE Standard verification of continuous elements for seasons
CDE Standard verification of categorical elements for seasons
CDE Conditional verification of temperature forecast 2m for seasons
CDE Conditional verification of temperature forecast 2m for months

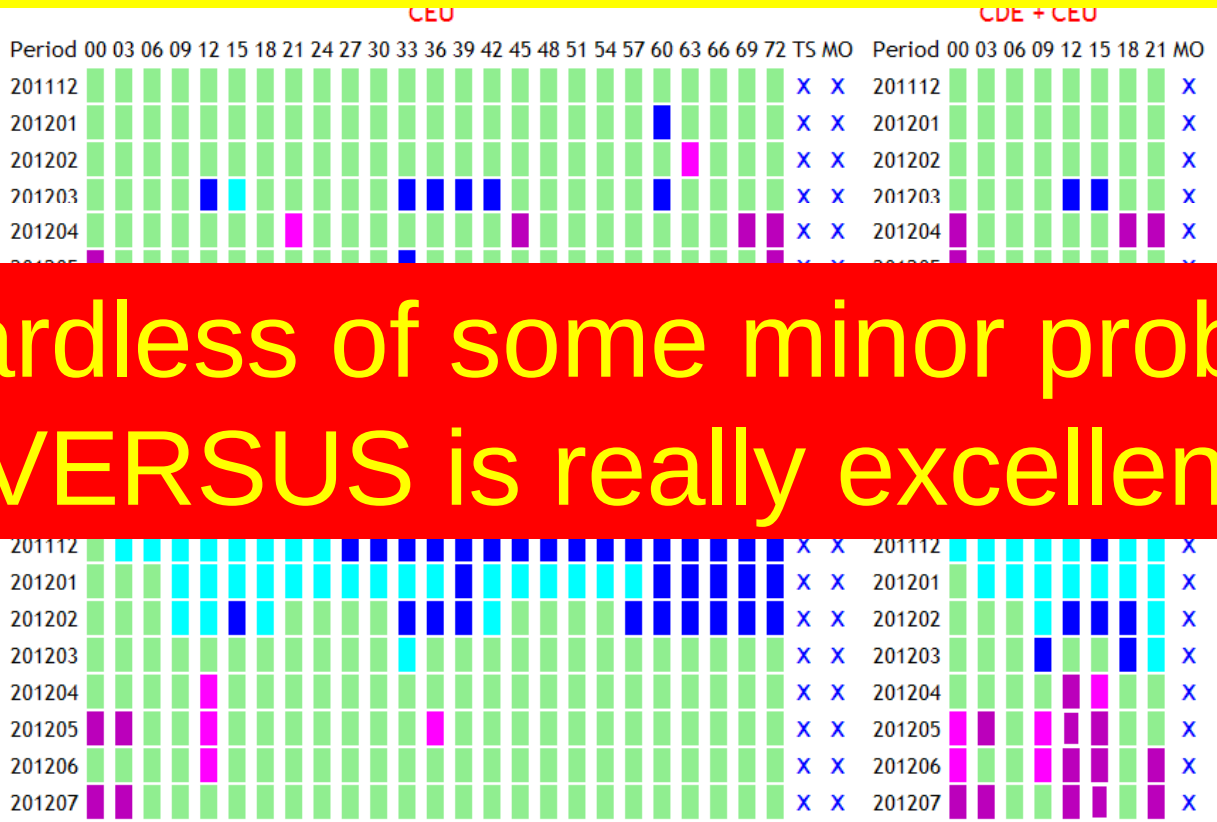
Solution:

- Presentation of X‘s vor with a background that contains a crude information on the content of the graphics,
  - ➔ Here: Most frequent value of blue, red, green … points
- Steps:
  - ➔ Get the most frequent color and store it in an ascii-file.
  - ➔ Creation of html-file:
    - ➔ Read the relevant value from the ascii-file
    - ➔ Set a class of a link (like: <a class=VERSUS_CLASS_3 ..
  - ➔ Definition of class VERSUS_CLASS_3 in a css-file as
    - ➔ a.VERSUS_CLASS_3:link {color:purple;text-decoration:none;border-color:lightgreen;border-width:1;background-color:lightgreen;border-style:solid}
    - ➔ a.VERSUS_CLASS_3:visited {color:purple;text-decoration:none; font-style:italic; border-color:lightgreen;border-width:1;background-color:lightgreen}
- Result: next slide with an overview about interesting cases with a color that marks an alarm or a situation with no alarm

Presentation of VERSUS results in the DWD Intranet

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

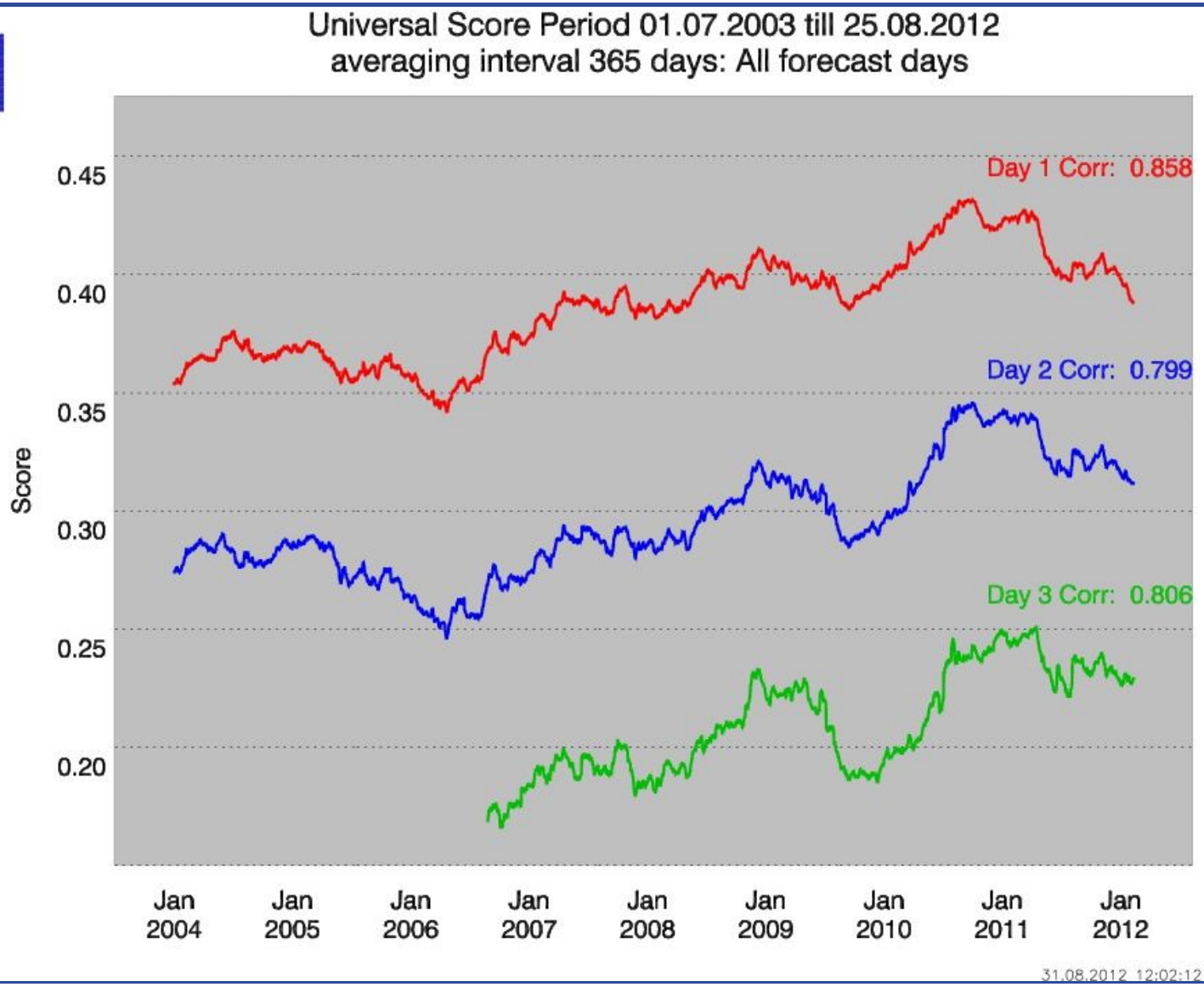
Graphics per month: 178
Clicks to produce the basic information: 114
Clicks (graphic) $^{-1}$: 0.64



Regardless of some minor problems:
VERSUS is really excellent!

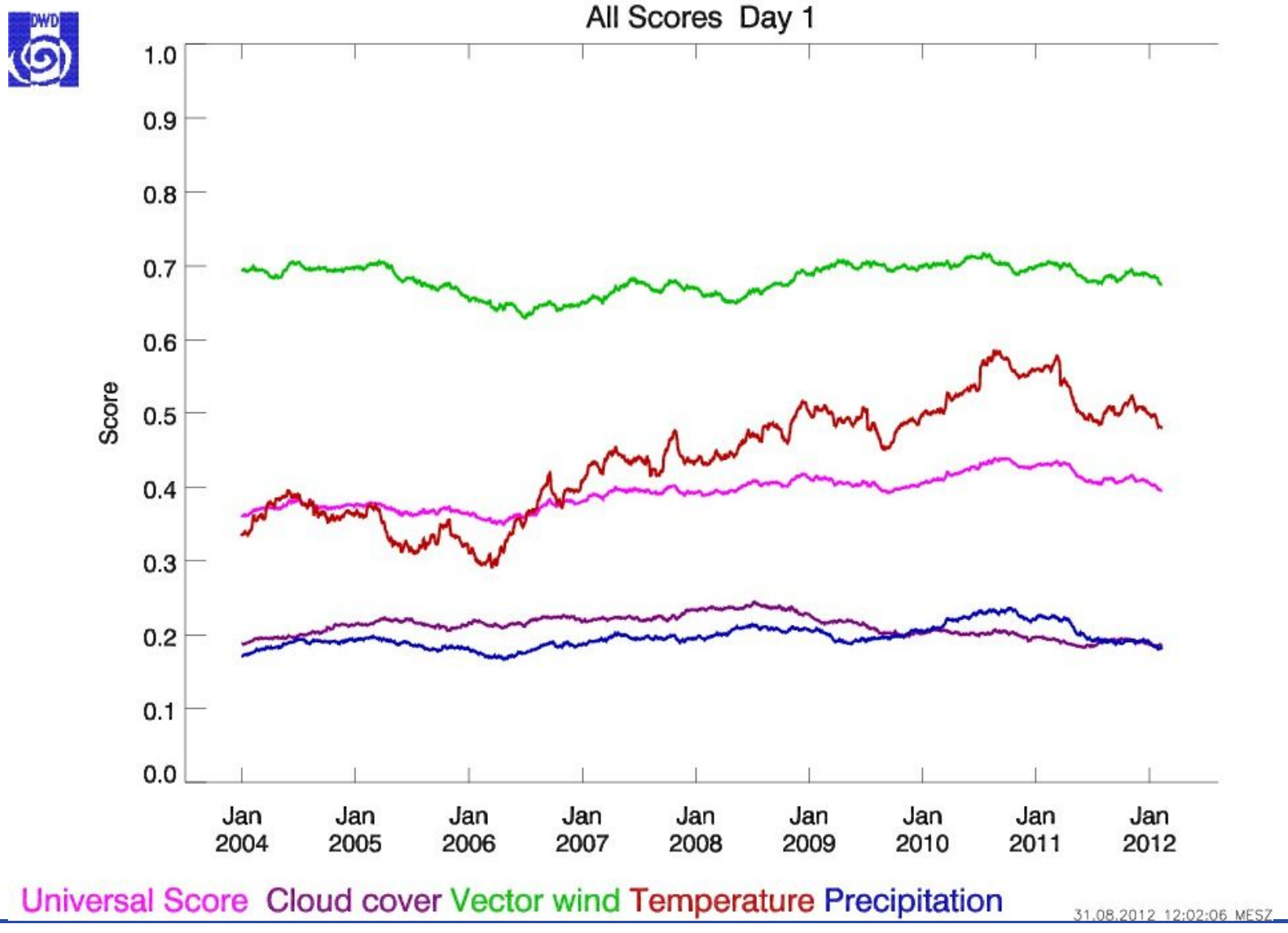
COSI – long term trends: Overview

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



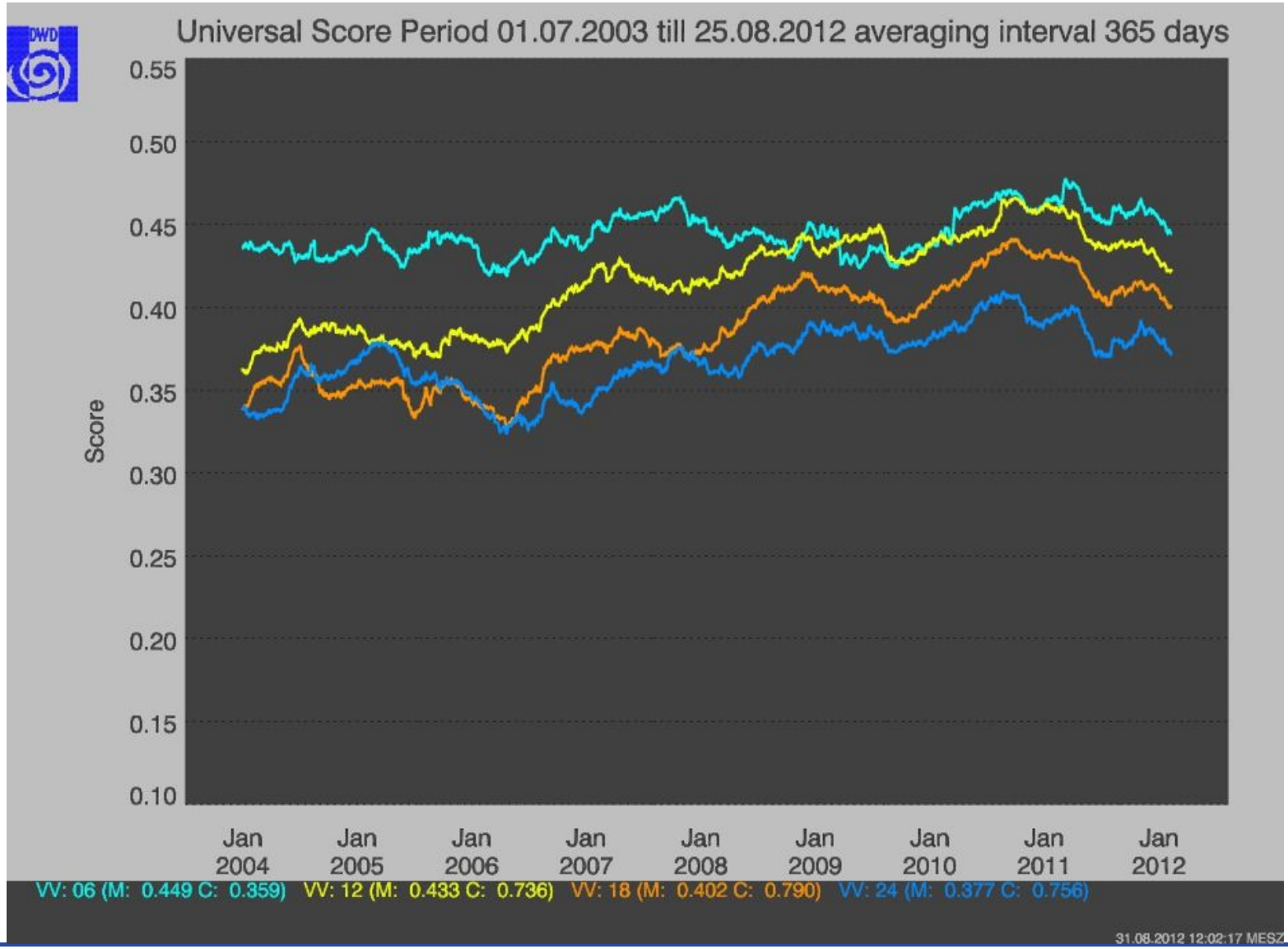
COSI – long term trends: Day 1

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



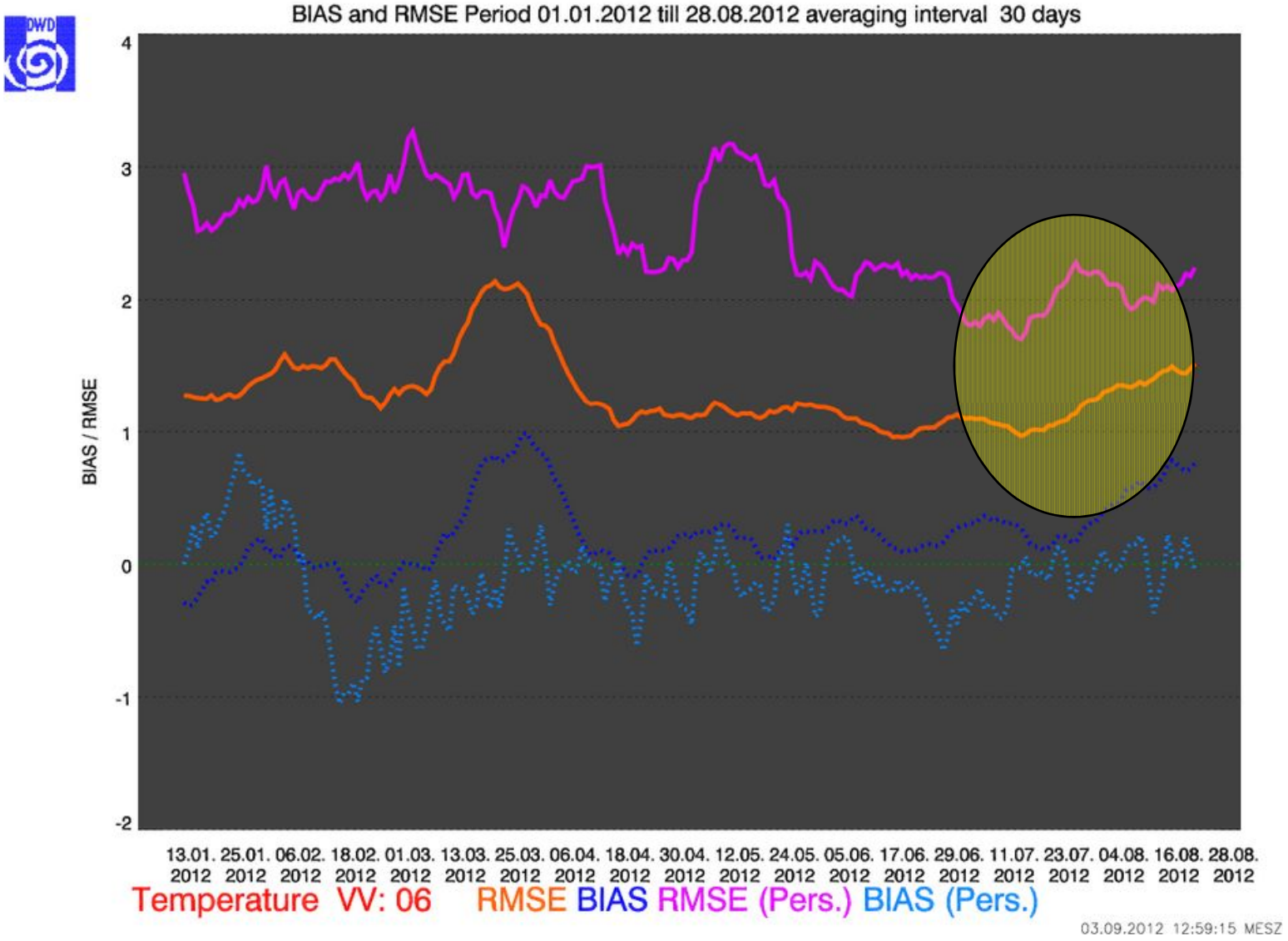
COSI – long term trends: Day 1

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



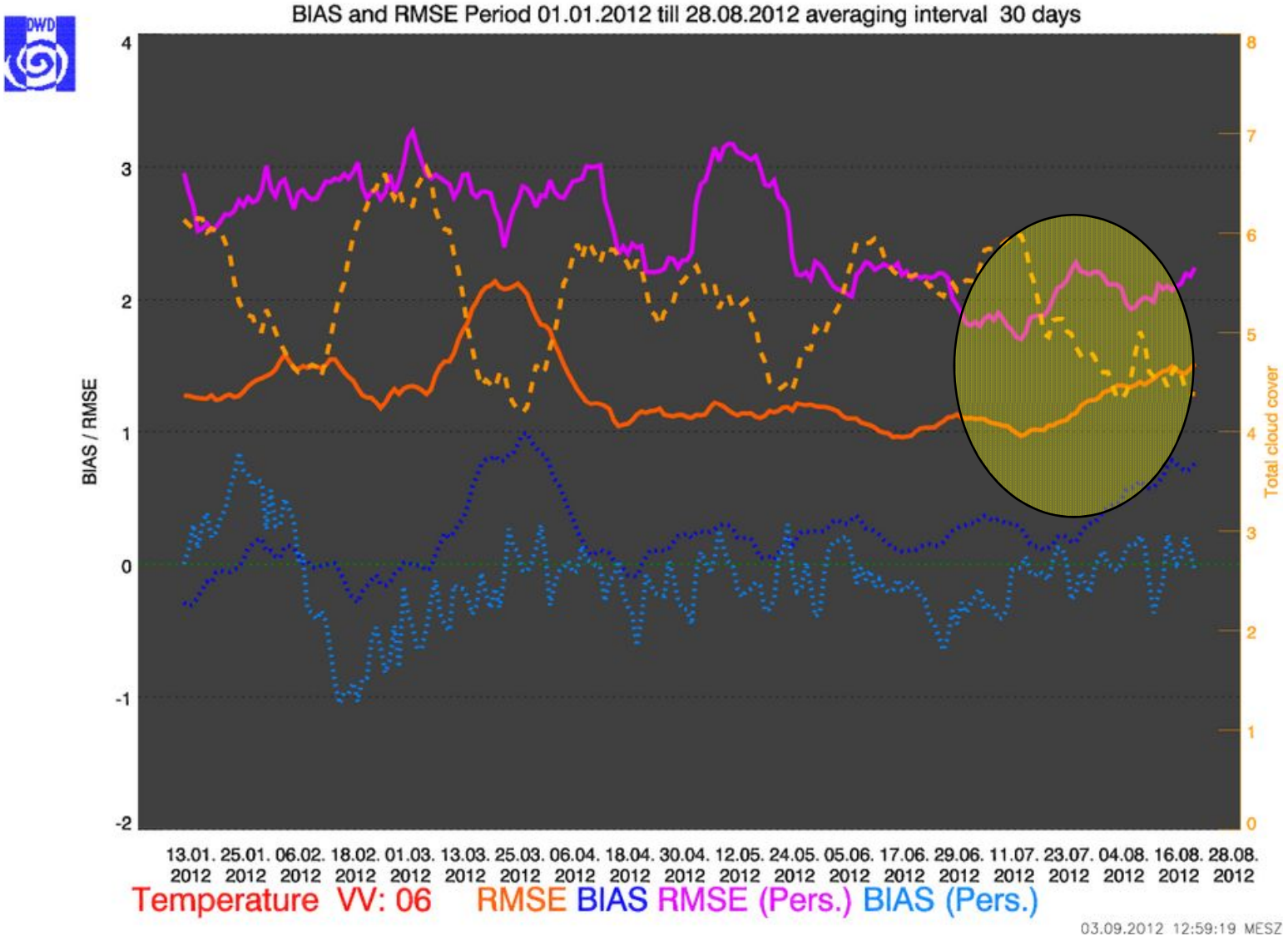
COSI – long term trends: Day 1
Temperature at the end of the night

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



COSI – long term trends: Day 1
Temperature at the end of the night together with TCC (???)

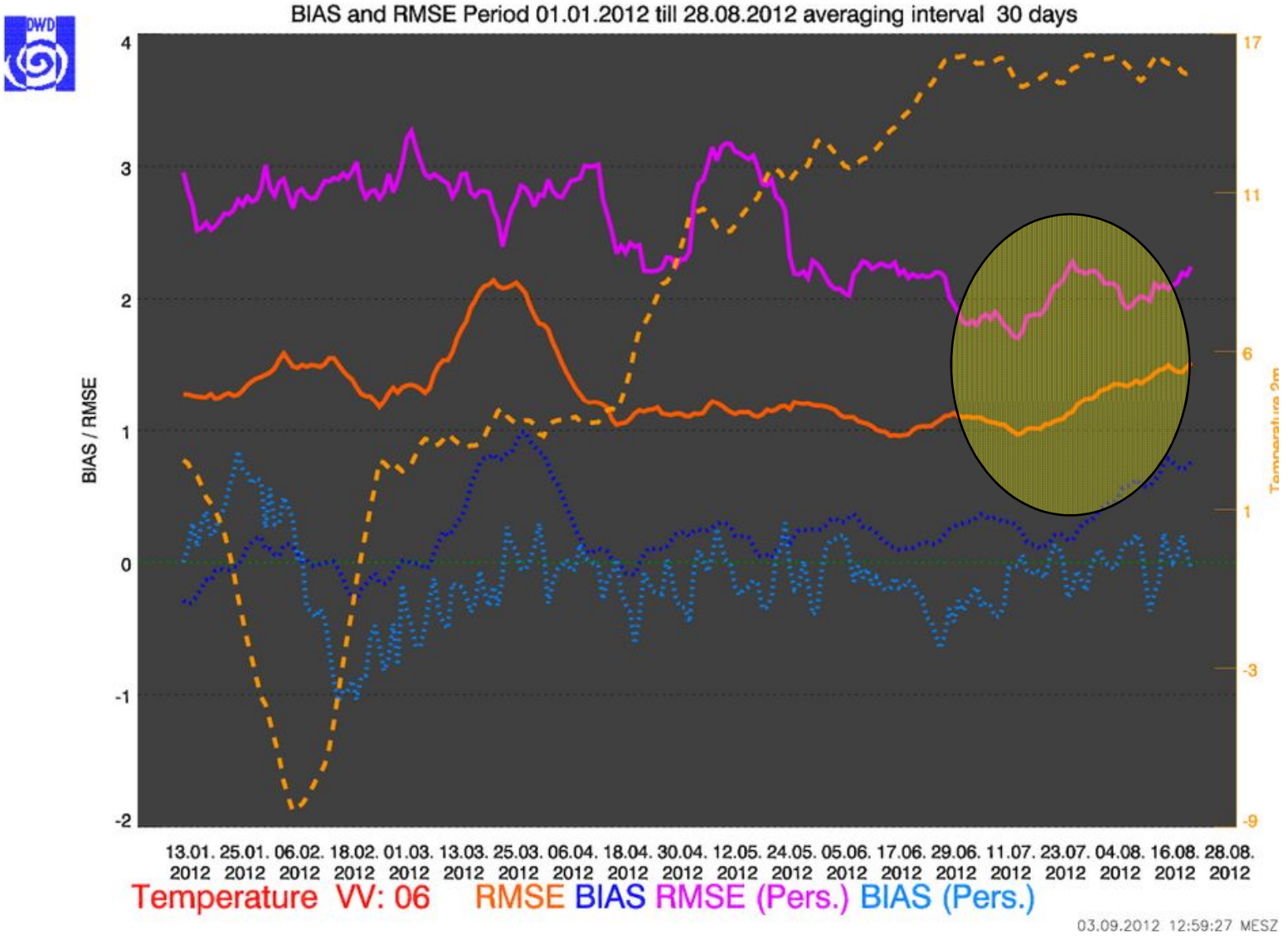
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



COSI – long term trends: Day 1

Temperature at the end of the night together with T2m (???)

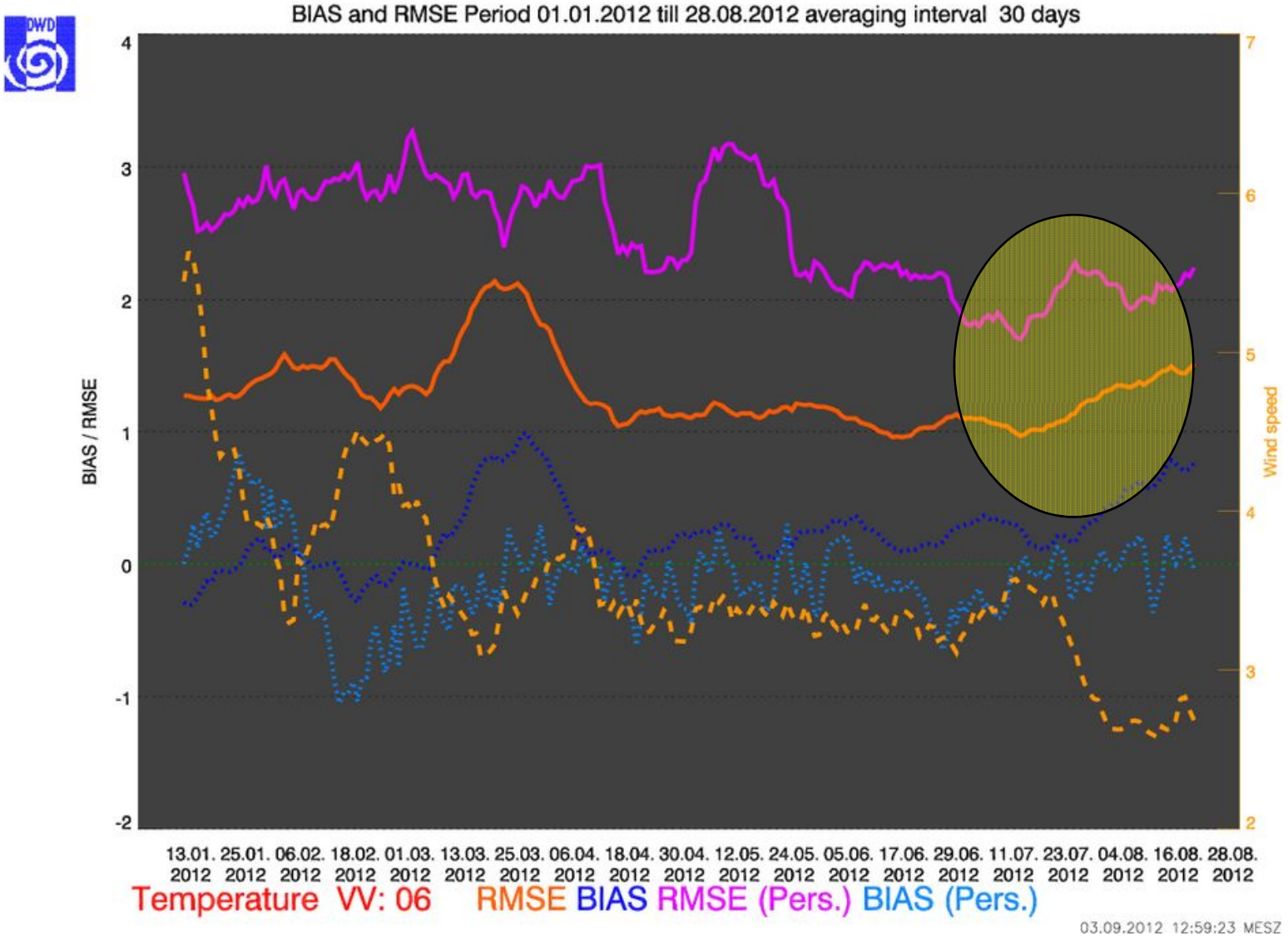
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



COSI – long term trends: Day 1

Temperature at the end of the night together with WS (!!!)

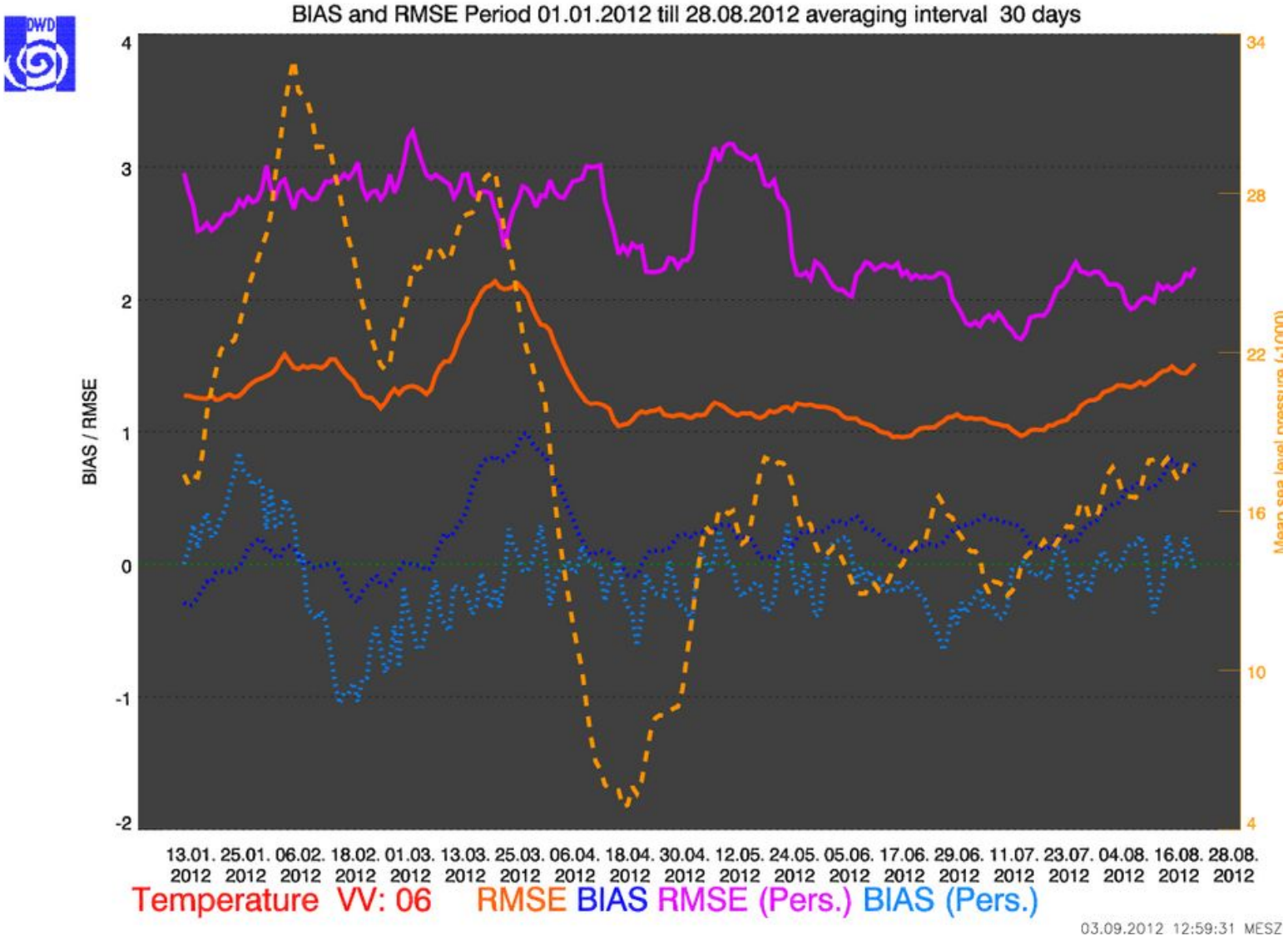
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



COSI – long term trends: Day 1

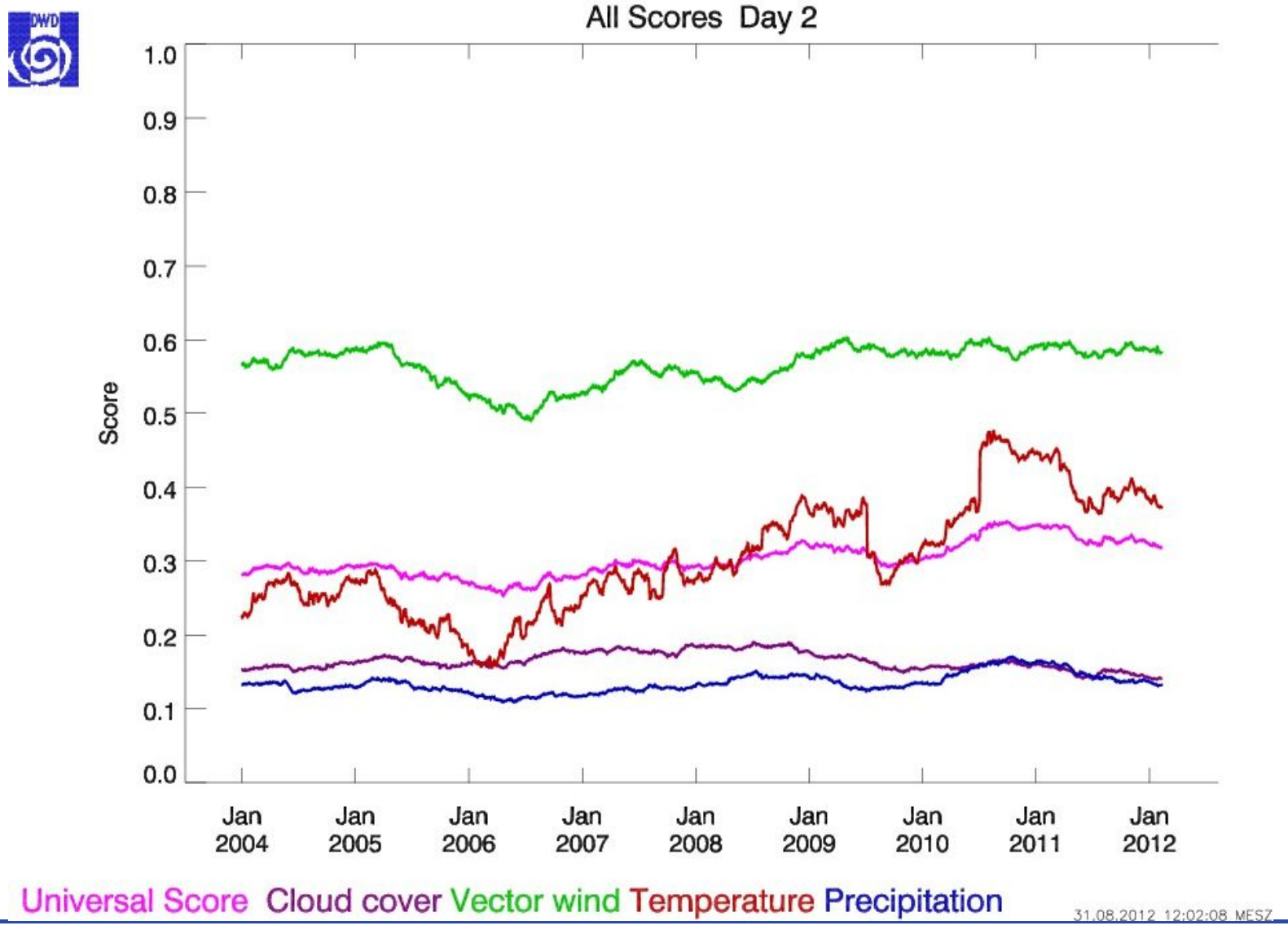
Temperature at the end of the night together with mslp (!!!)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



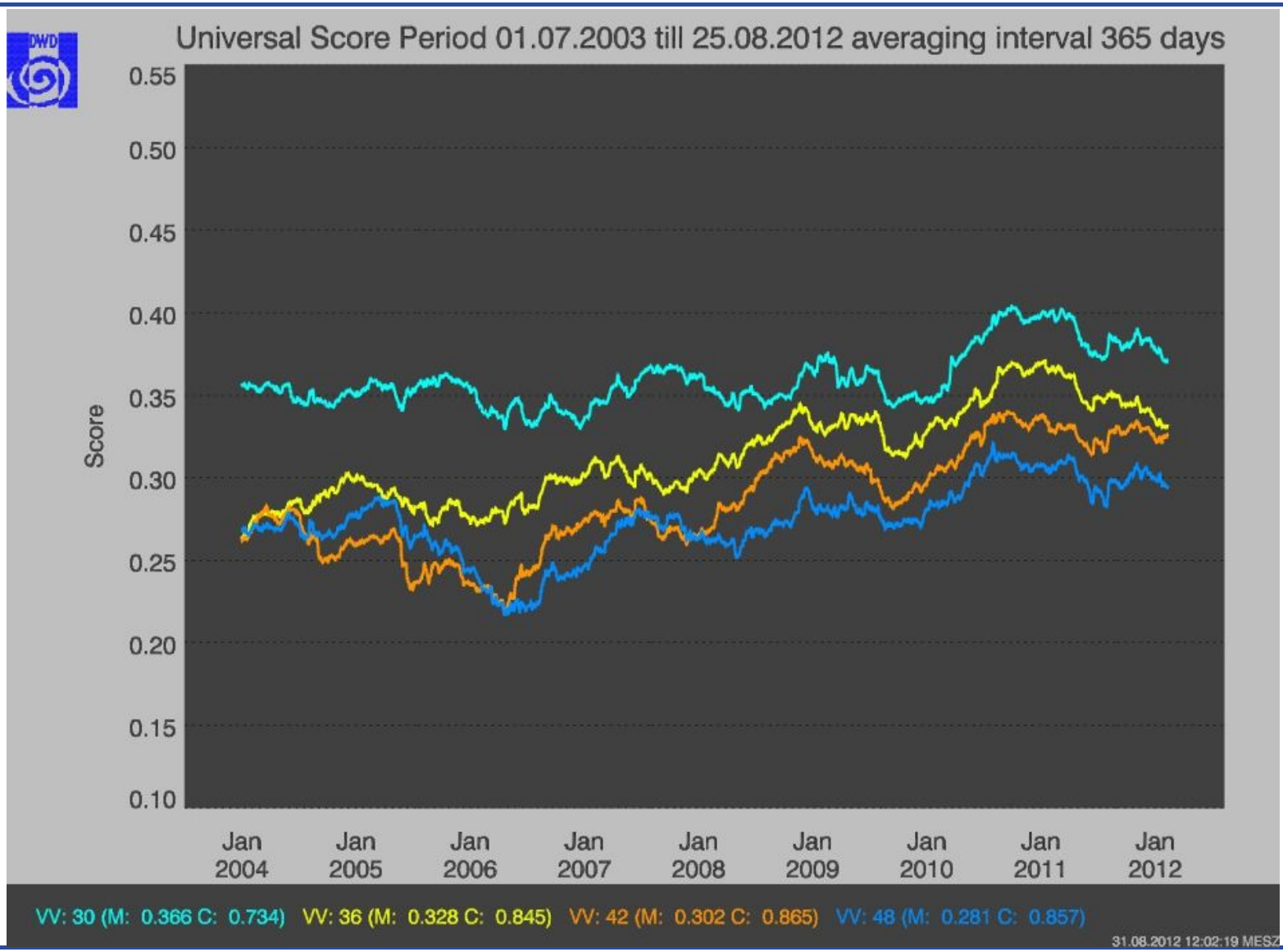
COSI – long term trends: Day 2

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



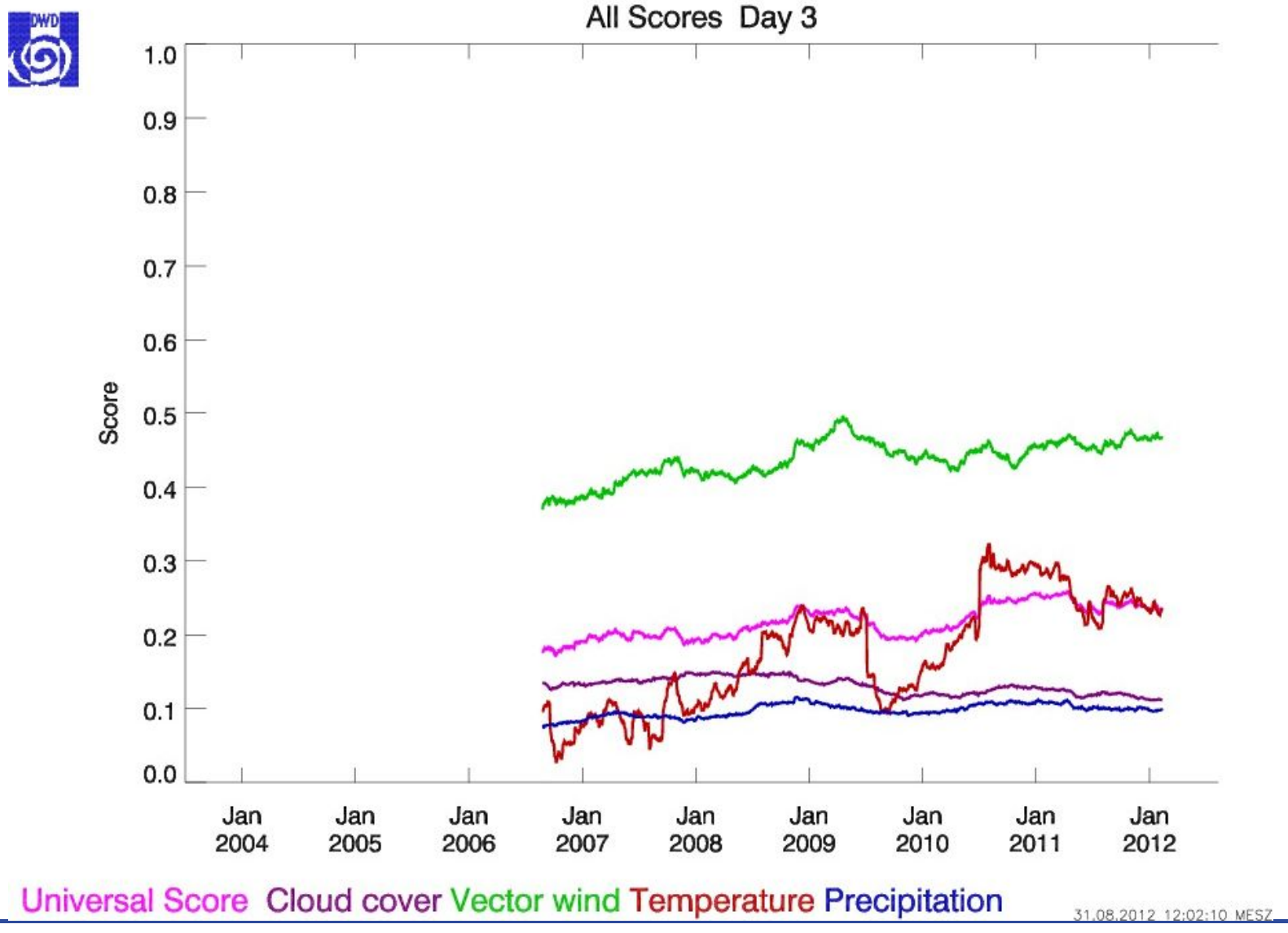
COSI – long term trends: Day 2

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



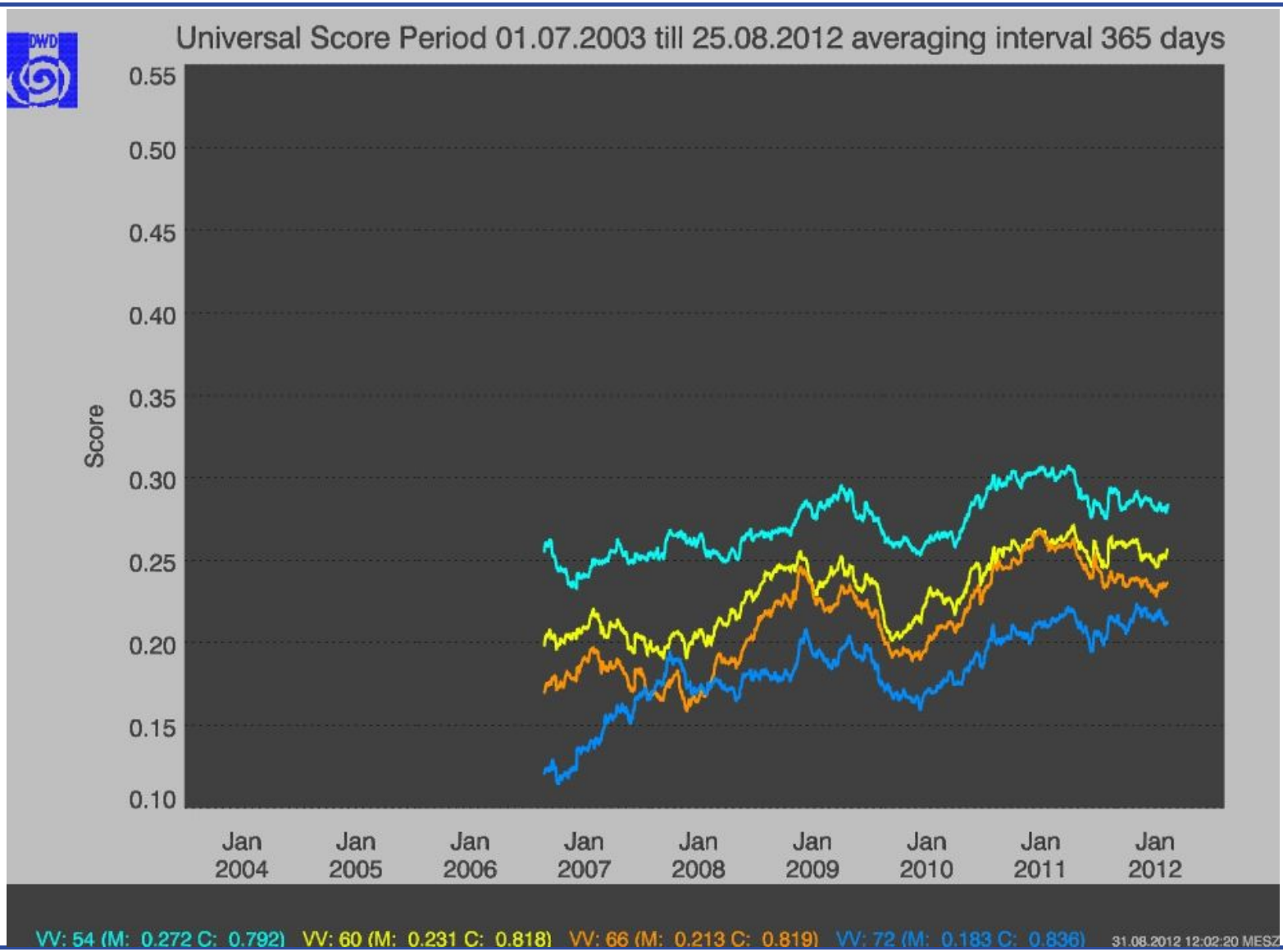
COSI – long term trends: Day 3

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



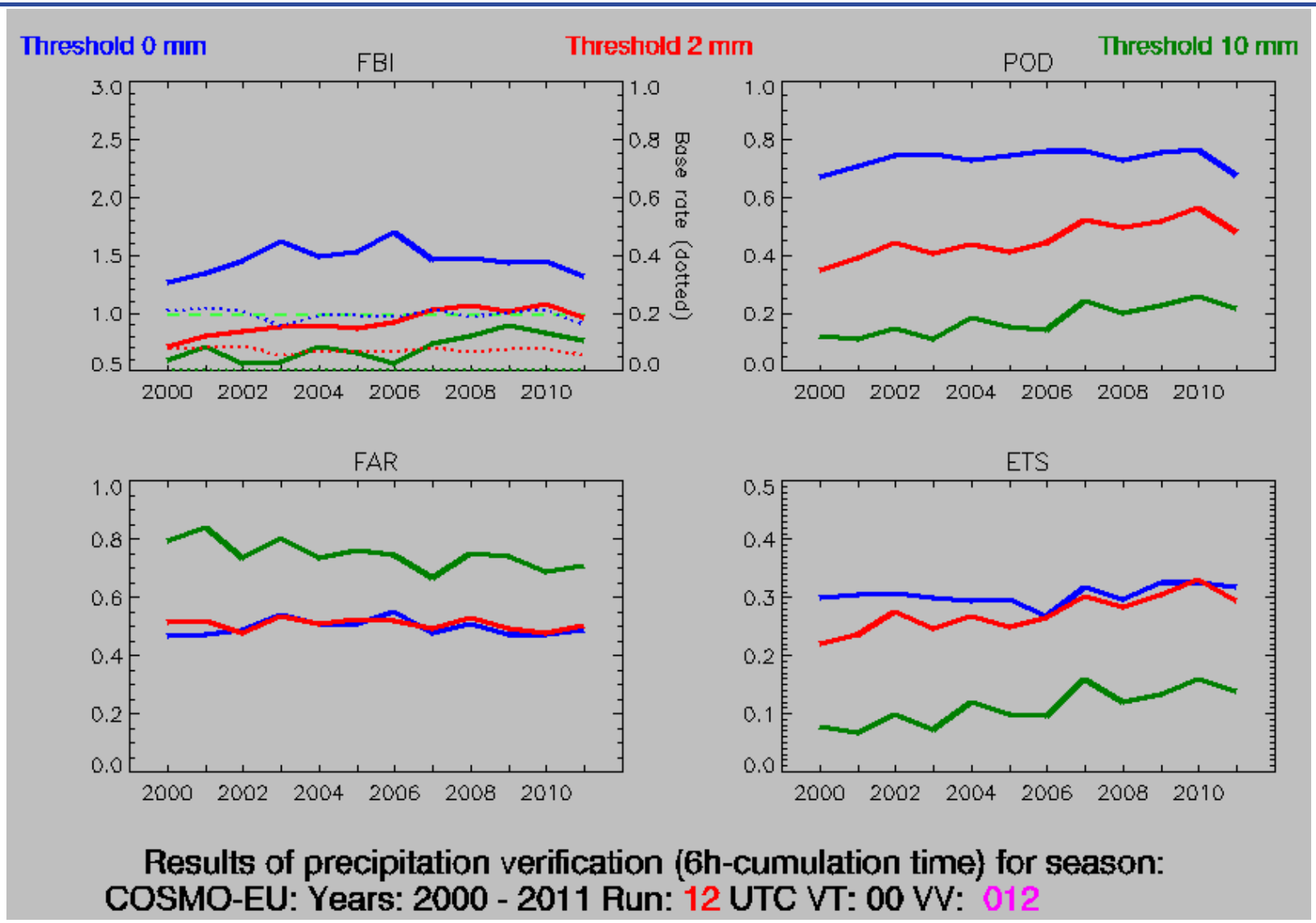
COSI – long term trends: Day 3

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



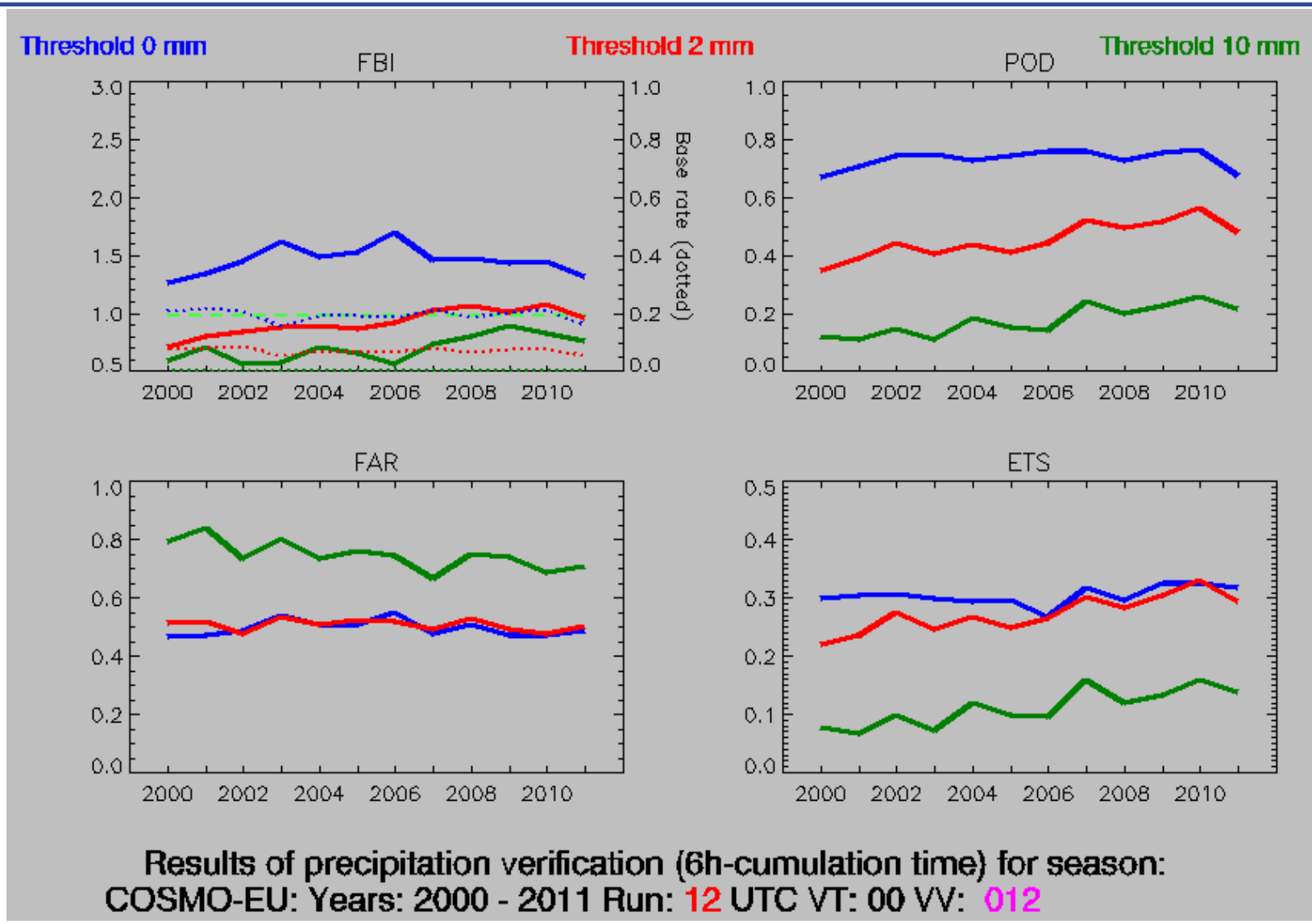
Long term trend of QPF quality (SYNOP observation network): Major change in the model: 29.06.2011: Introduction of Bott-Advection

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



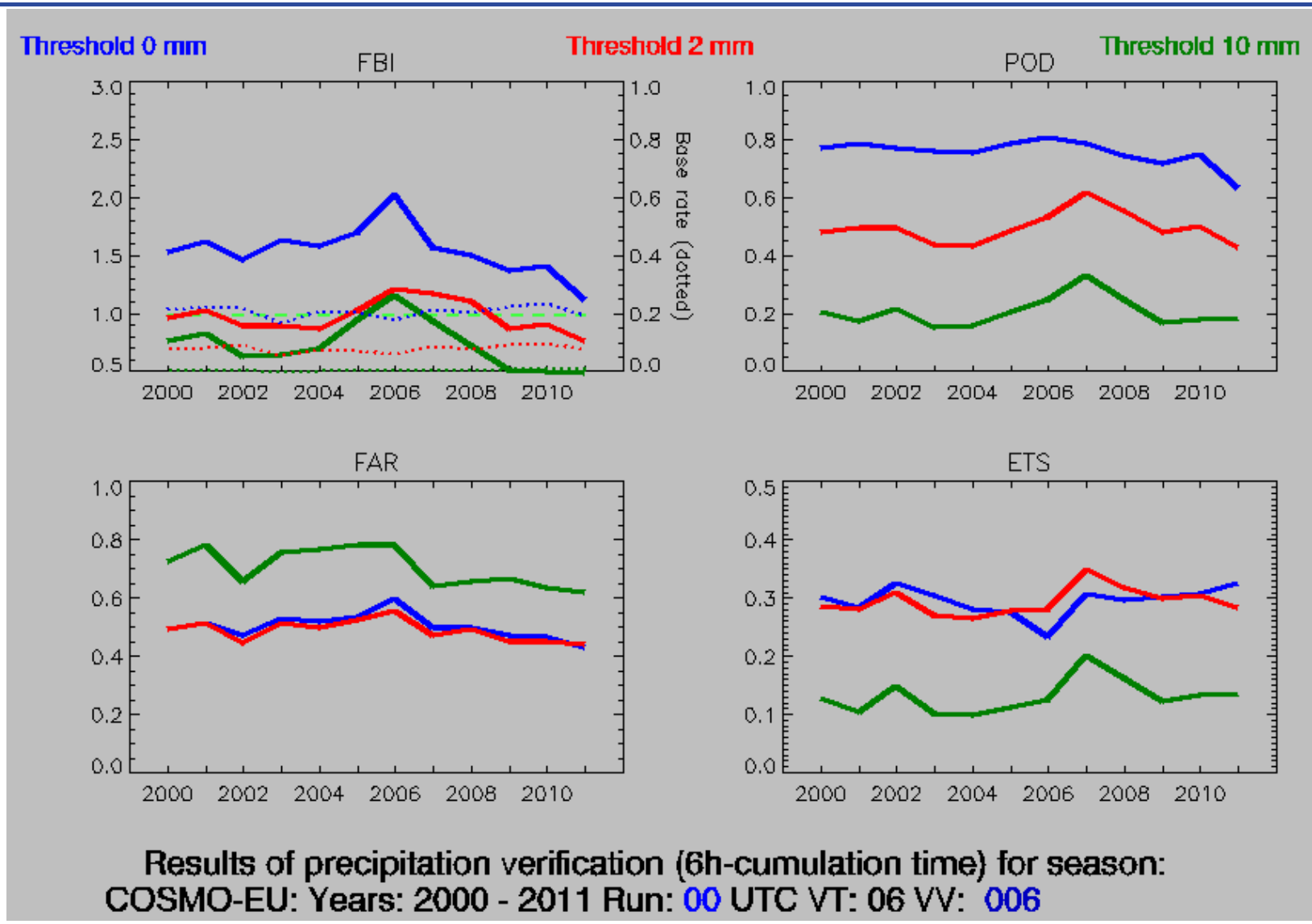
Long term trend of QPF quality (SYNOP observation network): Valid time 00 UTC since 2000

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



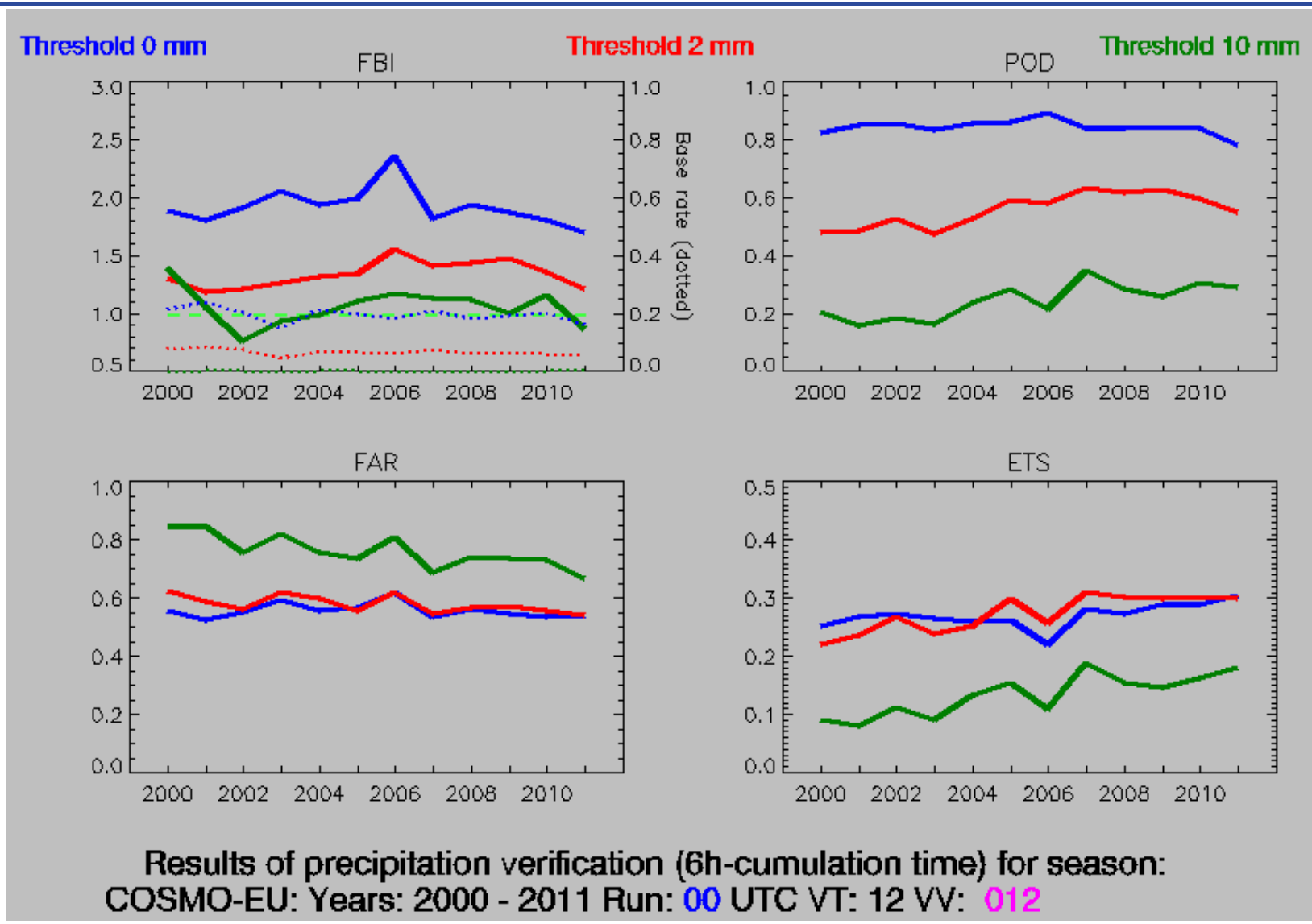
Long term trend of QPF quality (SYNOP observation network): Valid time 06 UTC since 2000

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



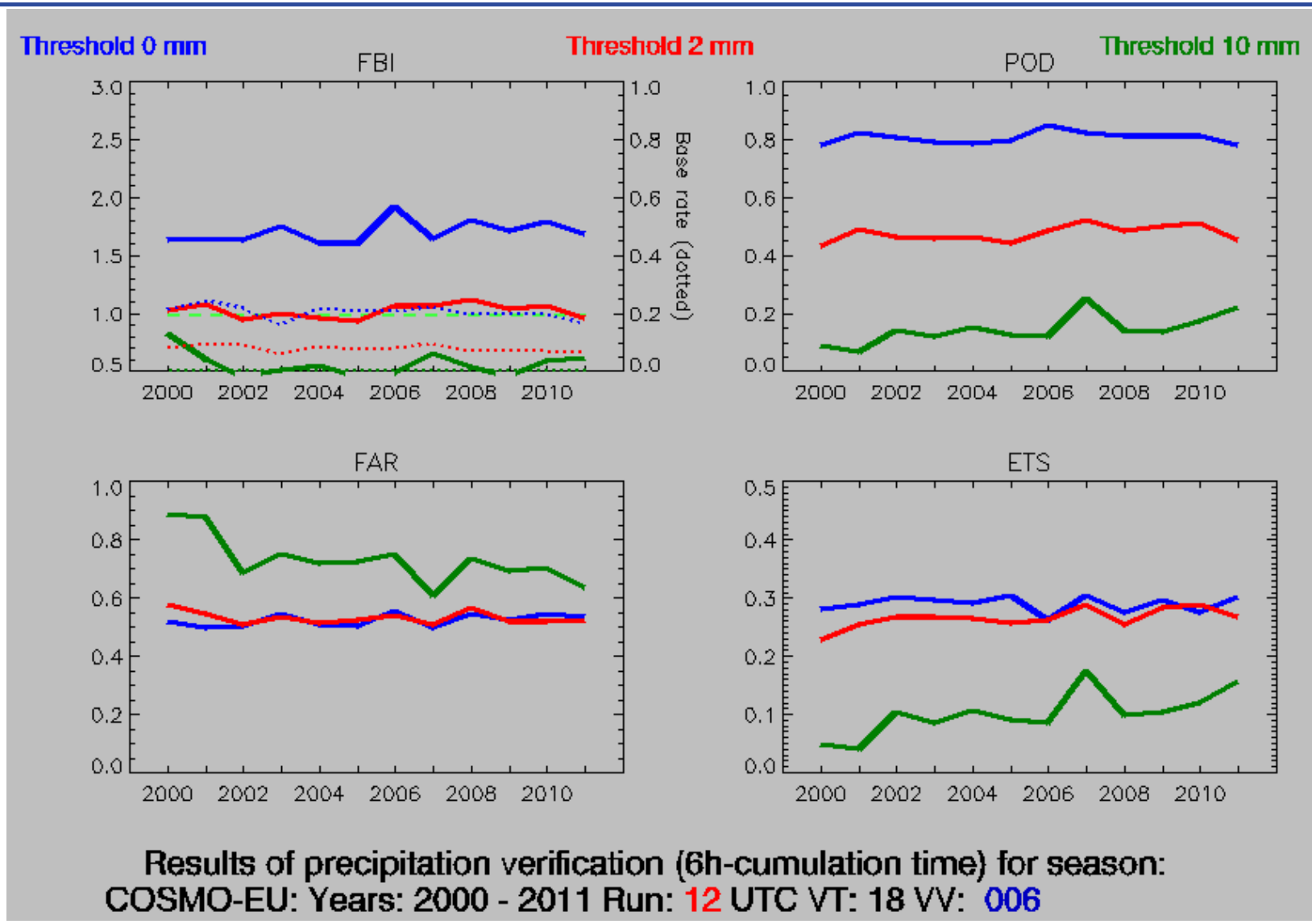
Long term trend of QPF quality (SYNOP observation network): Valid time 12 UTC since 2000

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



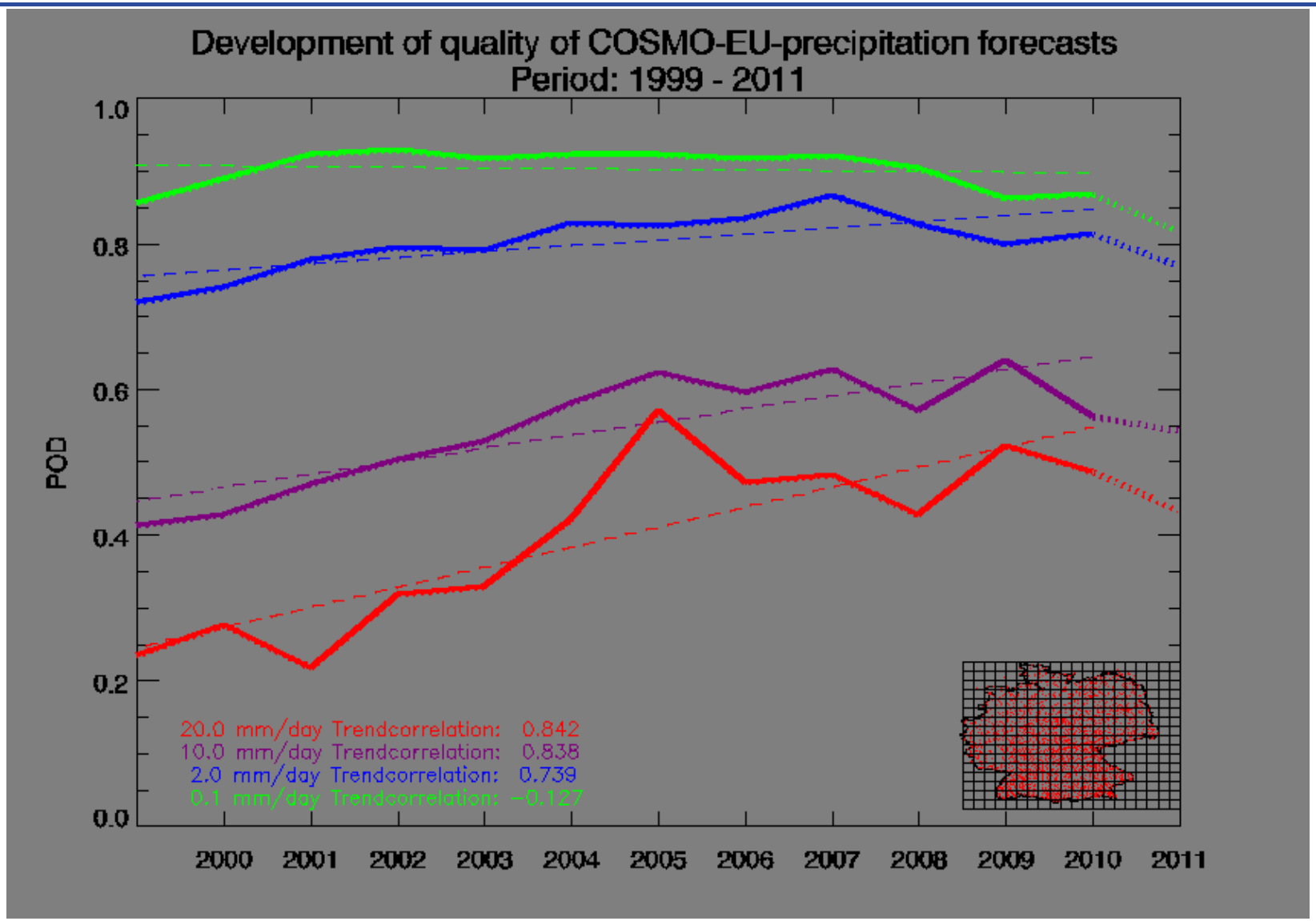
Long term trend of QPF quality (SYNOP observation network): Valid time 18 UTC since 2000

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



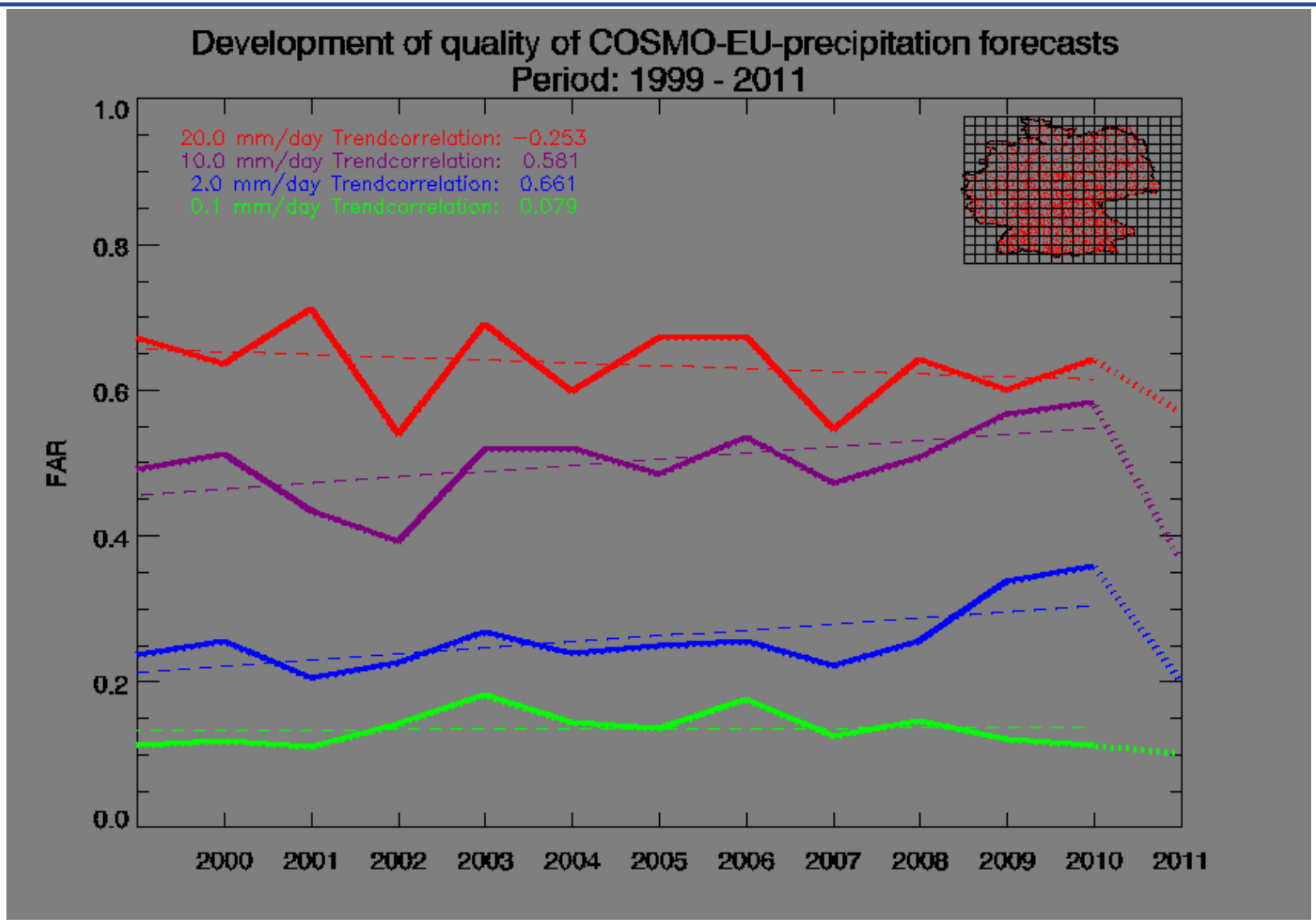
Long term trend of QPF quality (high density observation network): Probability of detection

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



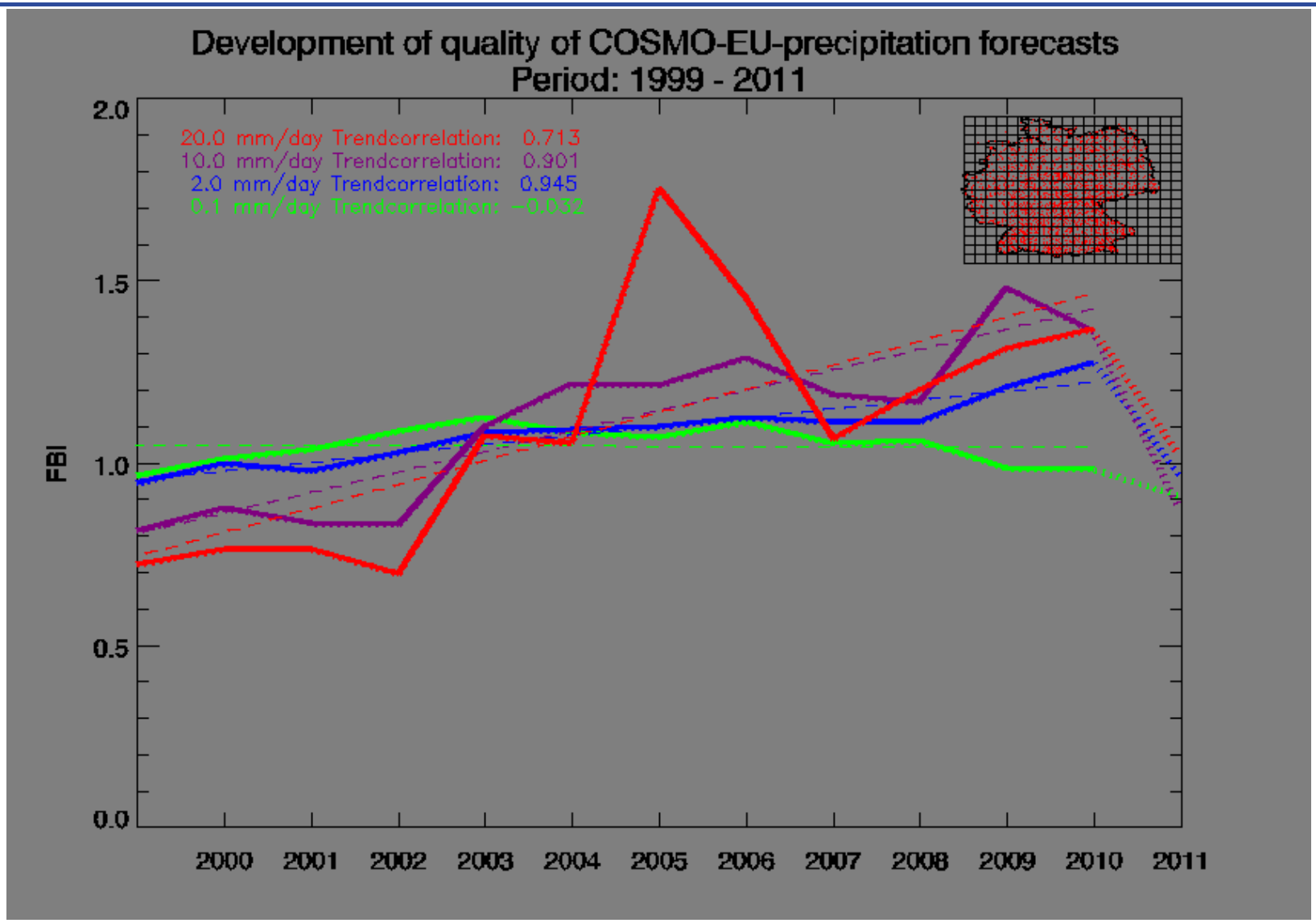
Long term trend of QPF quality (high density observation network): False alarm ratio

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



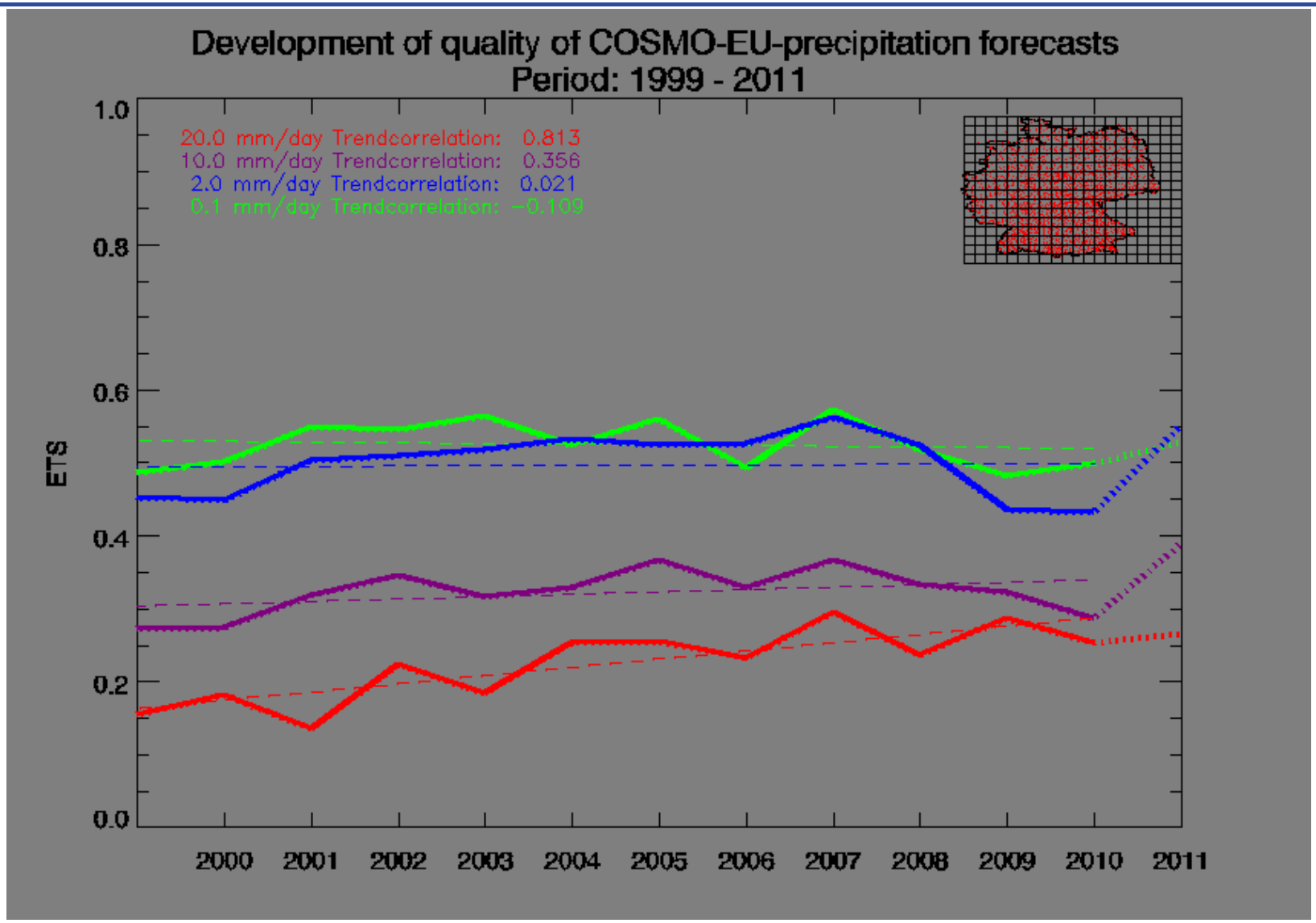
Long term trend of QPF quality (high density observation network): Frequency bias

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



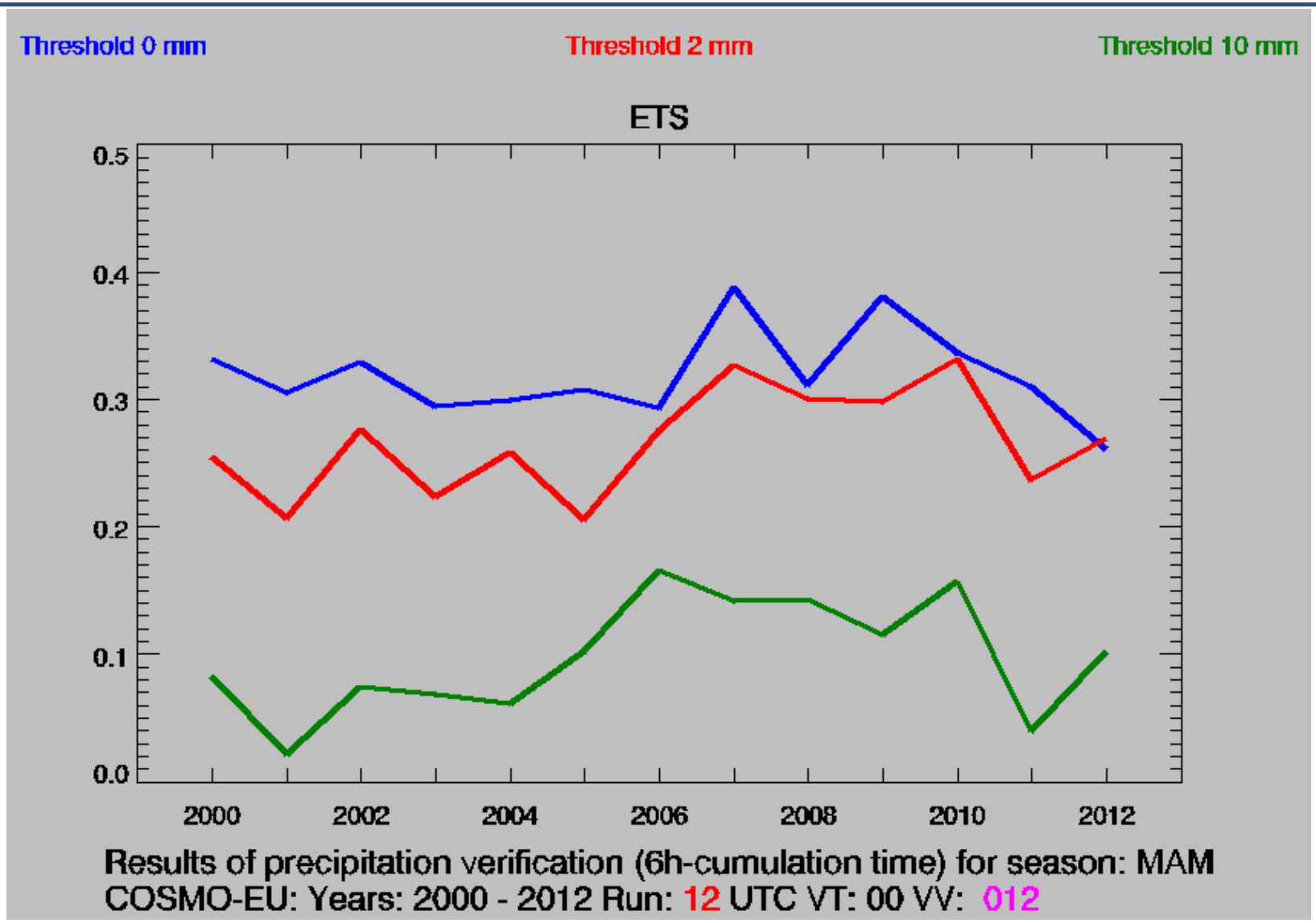
Long term trend of QPF quality (high density observation network): Equitable threat score

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



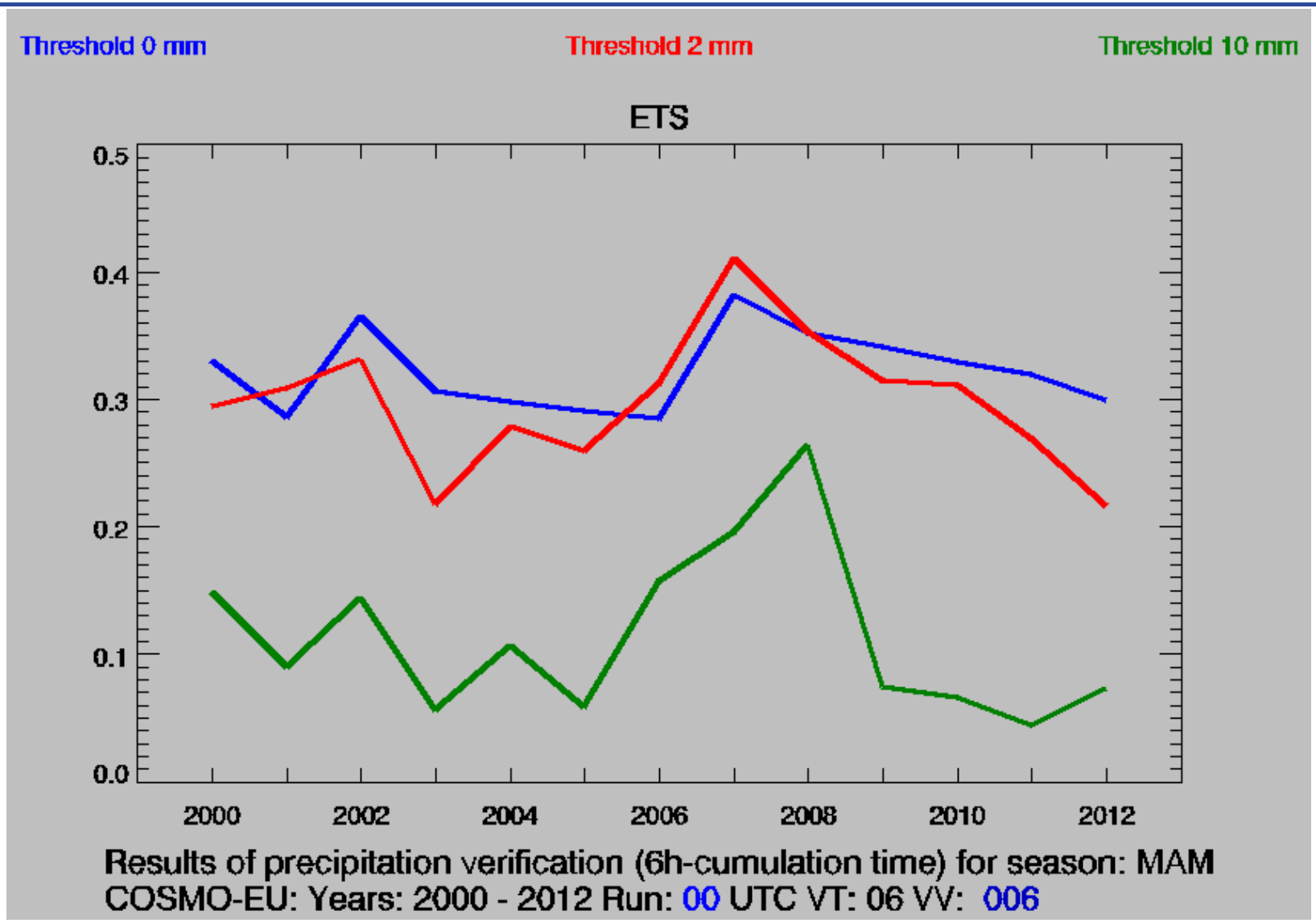
Long term trend of QPF quality (SYNOP observation network): Valid time 00 UTC, Spring, since 2000, Major change in the model: 29.06.2011: Introduction of Bott-Advection

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



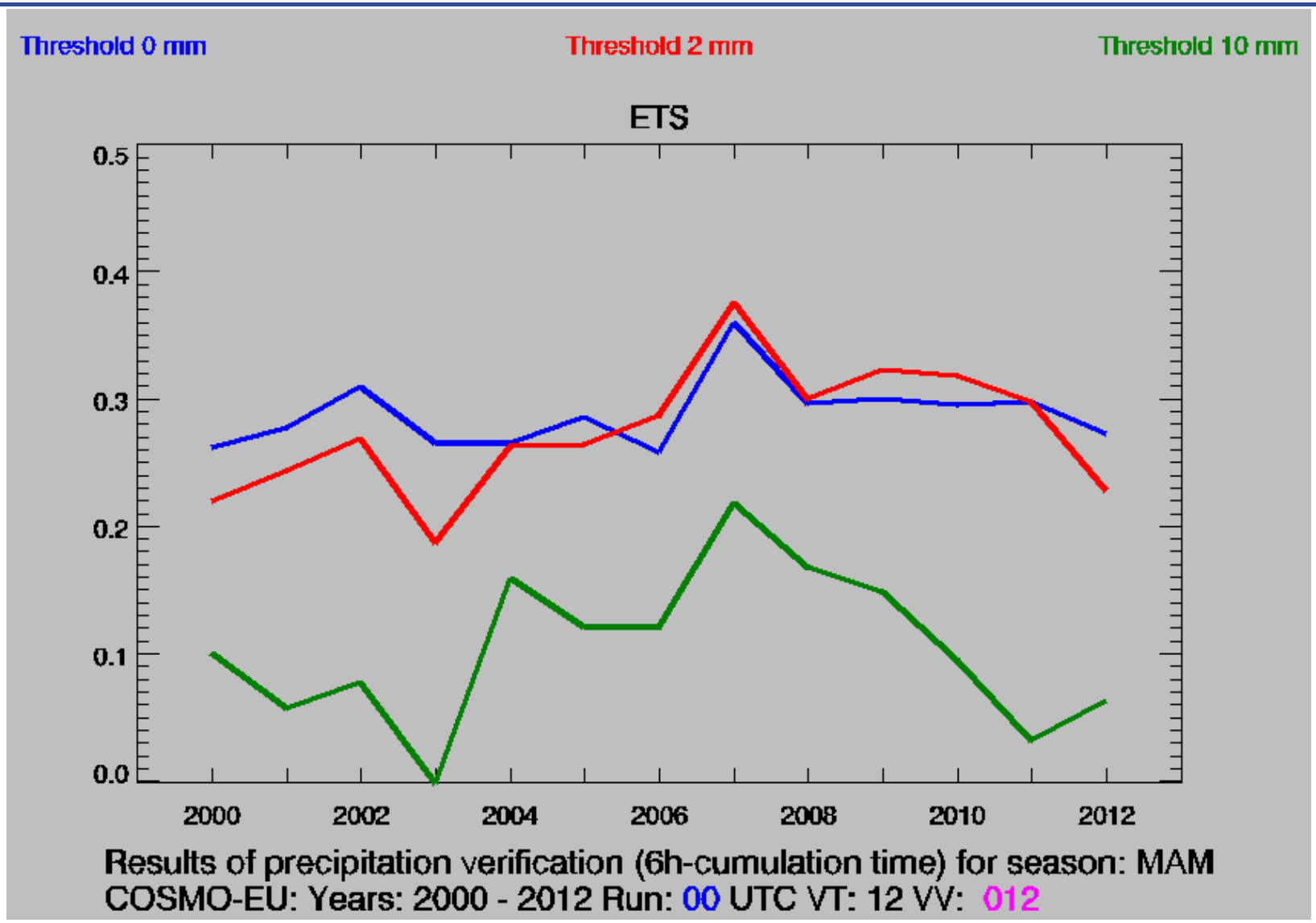
Long term trend of QPF quality (SYNOP observation network): Valid time 06 UTC, Spring, since 2000, Major change in the model: 29.06.2011: Introduction of Bott-Advection

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



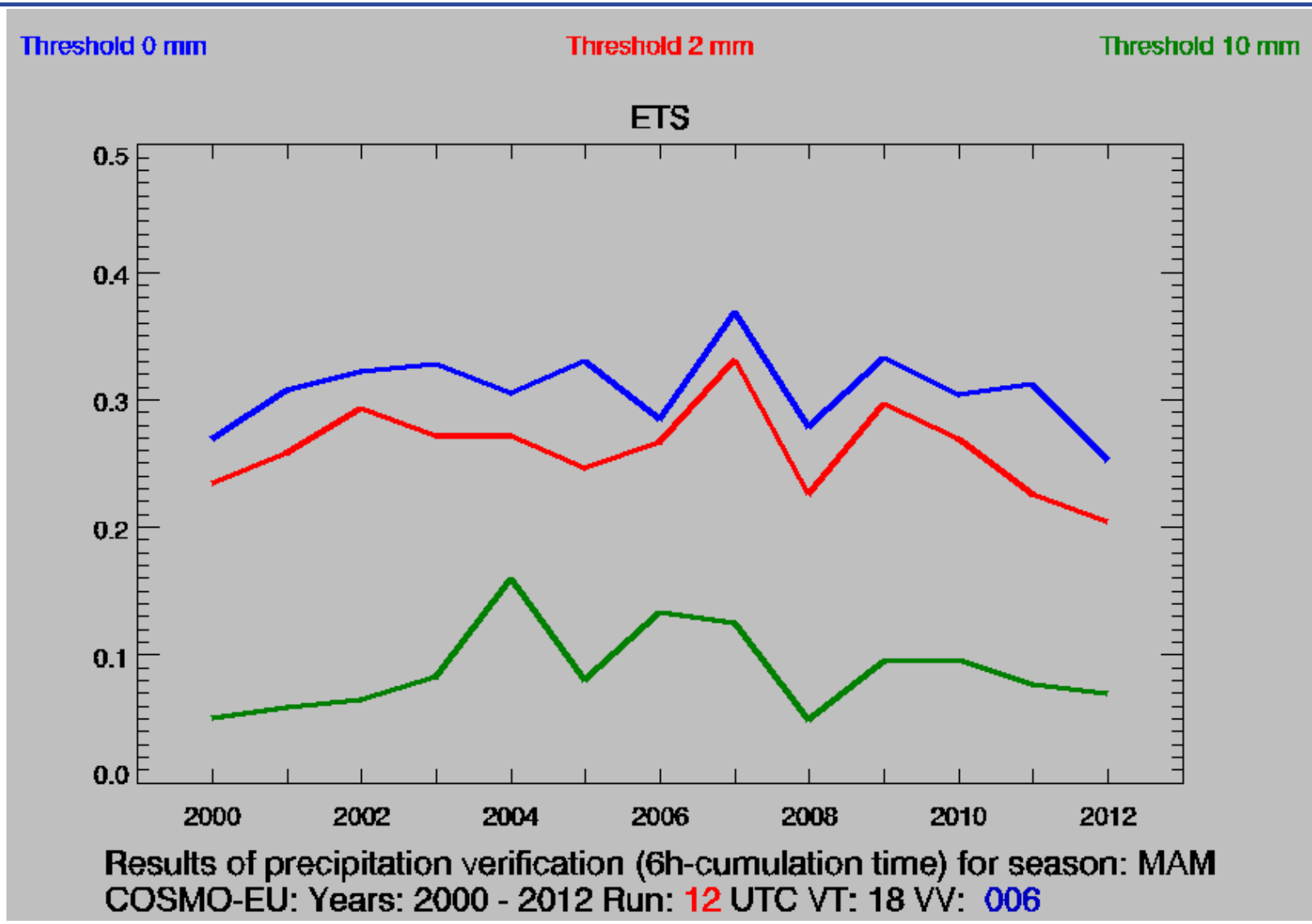
Long term trend of QPF quality (SYNOP observation network): Valid time 12 UTC, Spring, since 2000, Major change in the model: 29.06.2011: Introduction of Bott-Advection

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Long term trend of QPF quality (SYNOP observation network): Valid time 18 UTC, Spring, since 2000, Major change in the model: 29.06.2011: Introduction of Bott-Advection

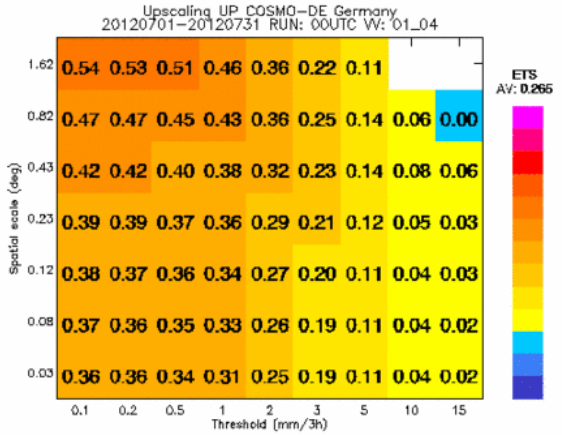
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

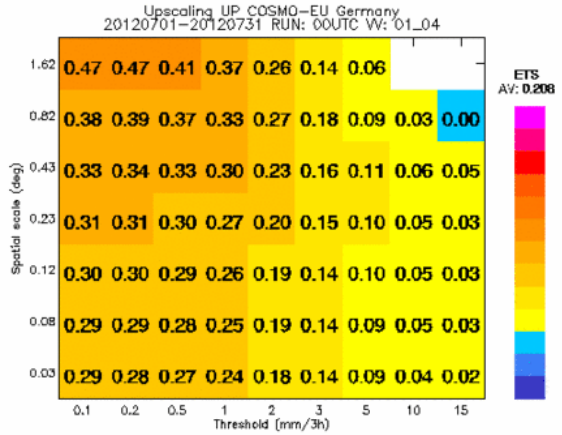


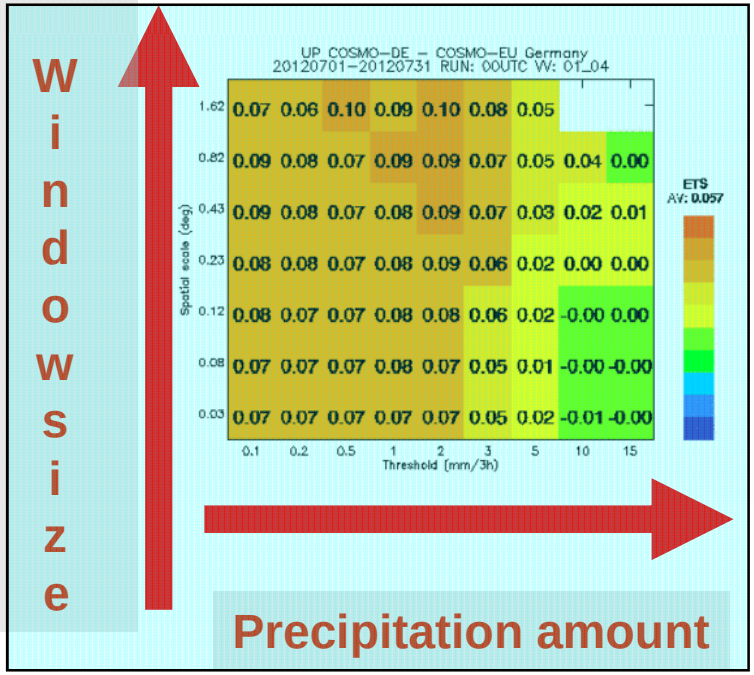
Presentation of Fuzzy-verification results

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

- Look at windows with different horizontal size
- Calculate scores that are representative for these windows

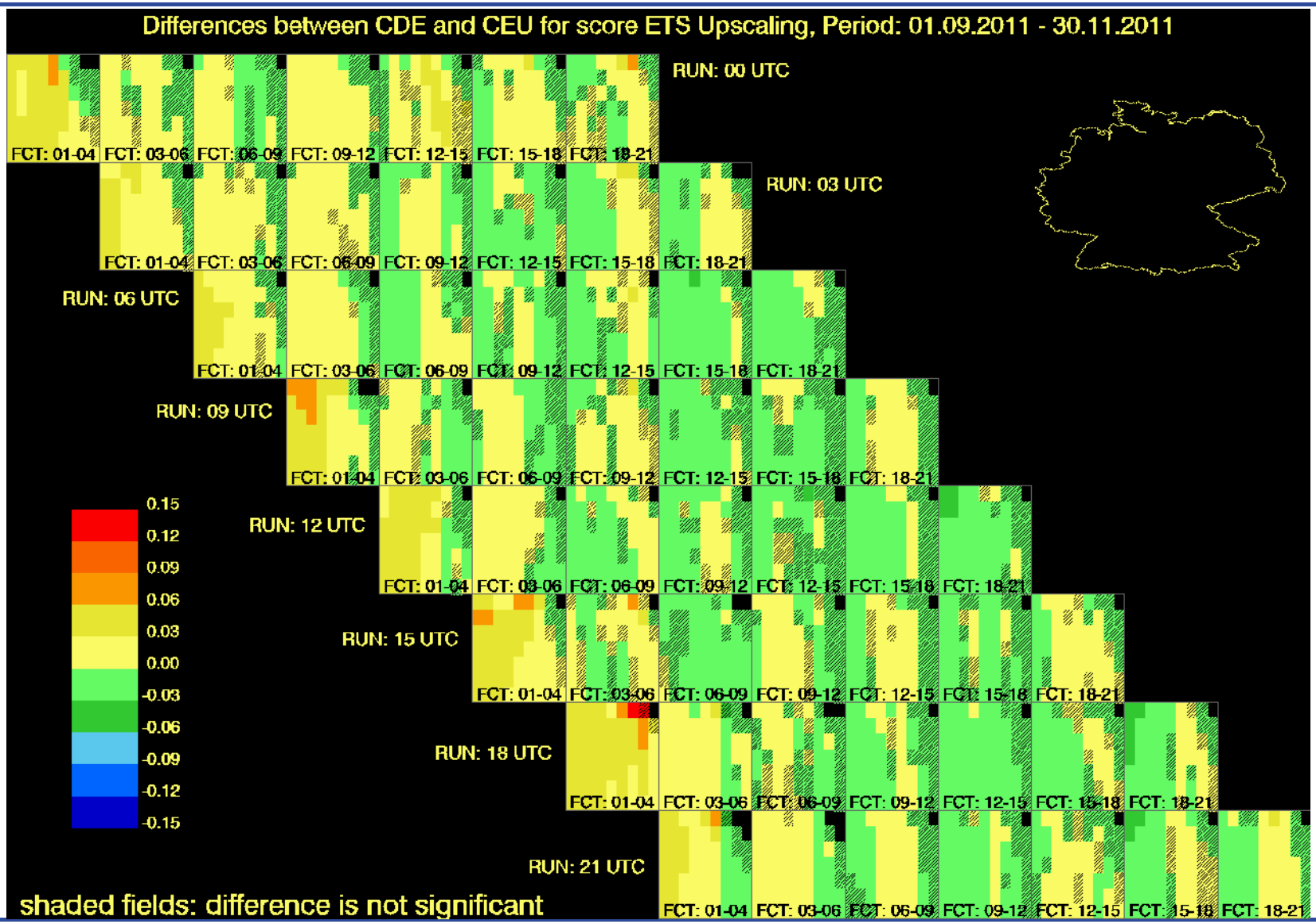






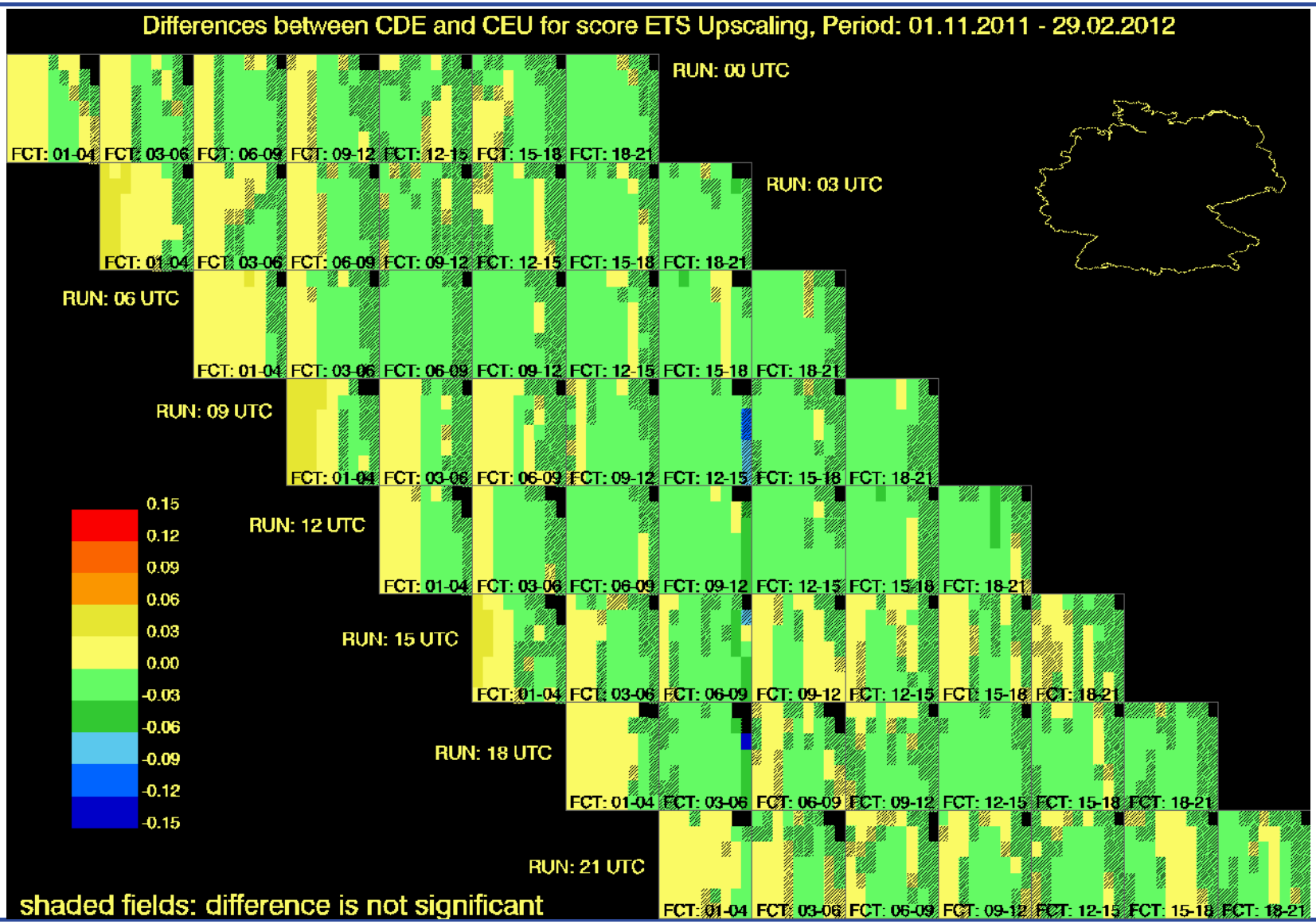
CEU + CDE: Fuzzy-Precipitation verification, Autumn 2011

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



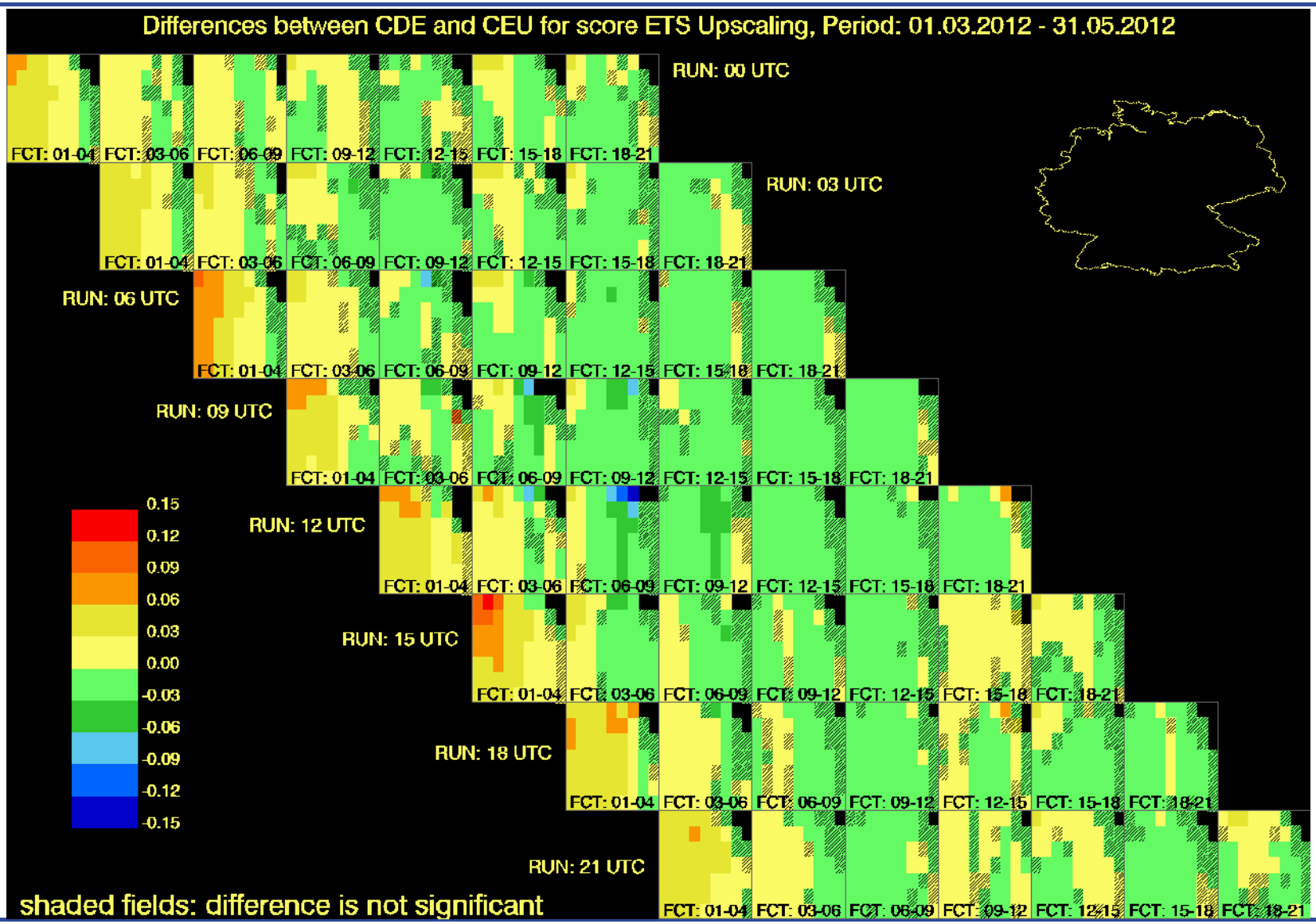
CEU + CDE: Fuzzy-Precipitation verification, Winter 2011/2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



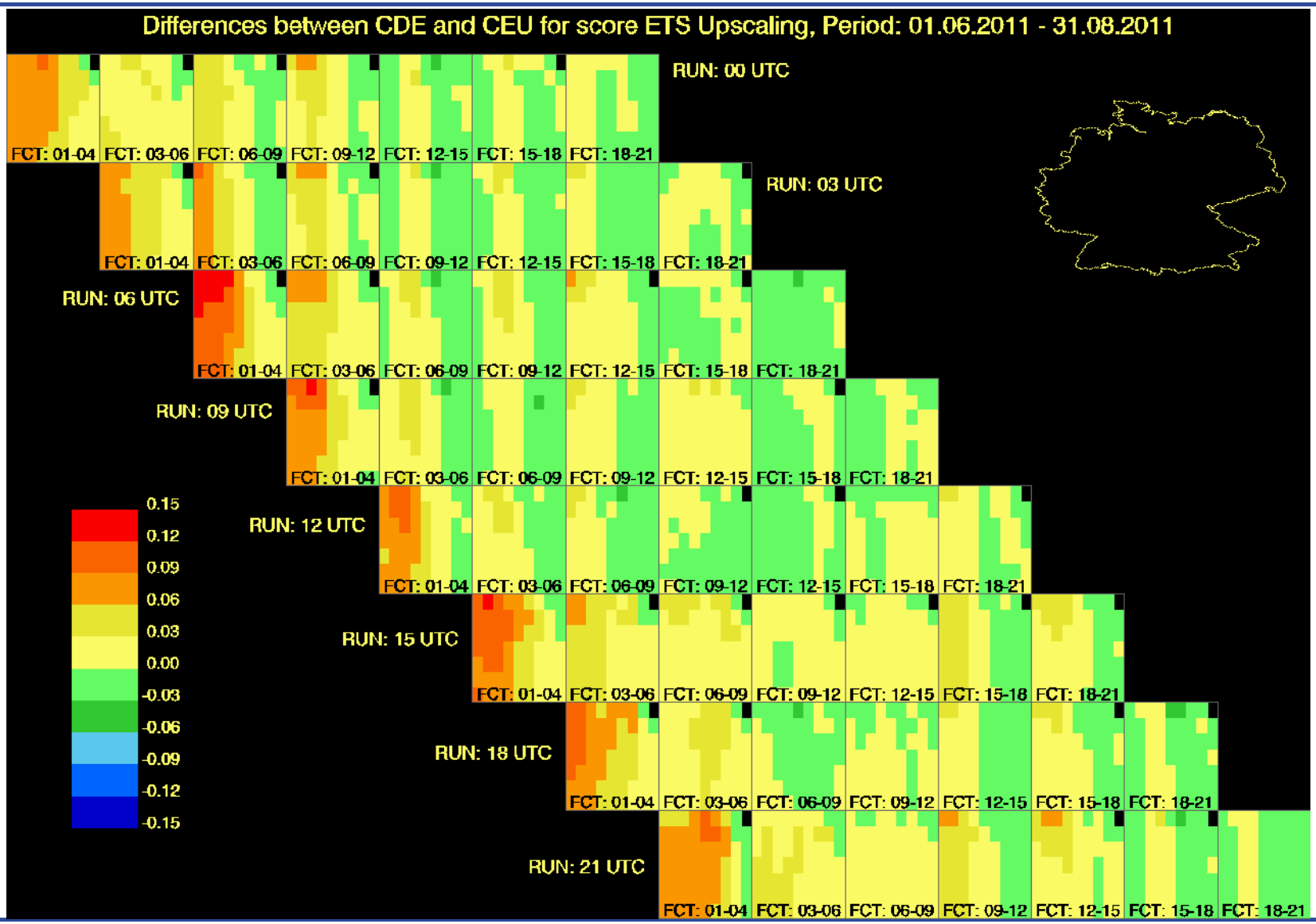
CEU + CDE: Fuzzy-Precipitation verification, Spring 2012

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



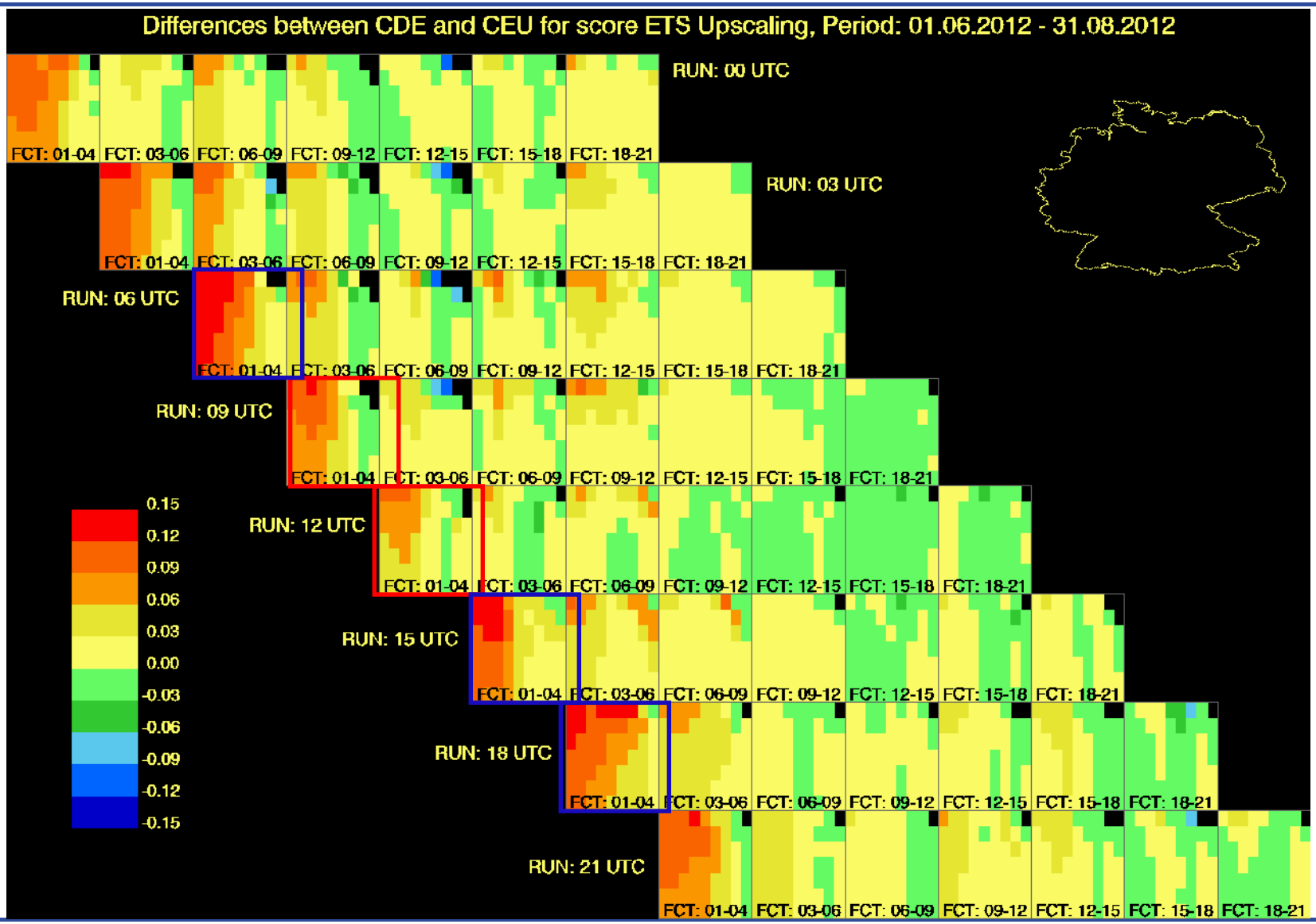
CEU + CDE: Fuzzy-Precipitation verification, Summer 2011

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



CEU + CDE: Fuzzy-Precipitation verification, Summer 2012

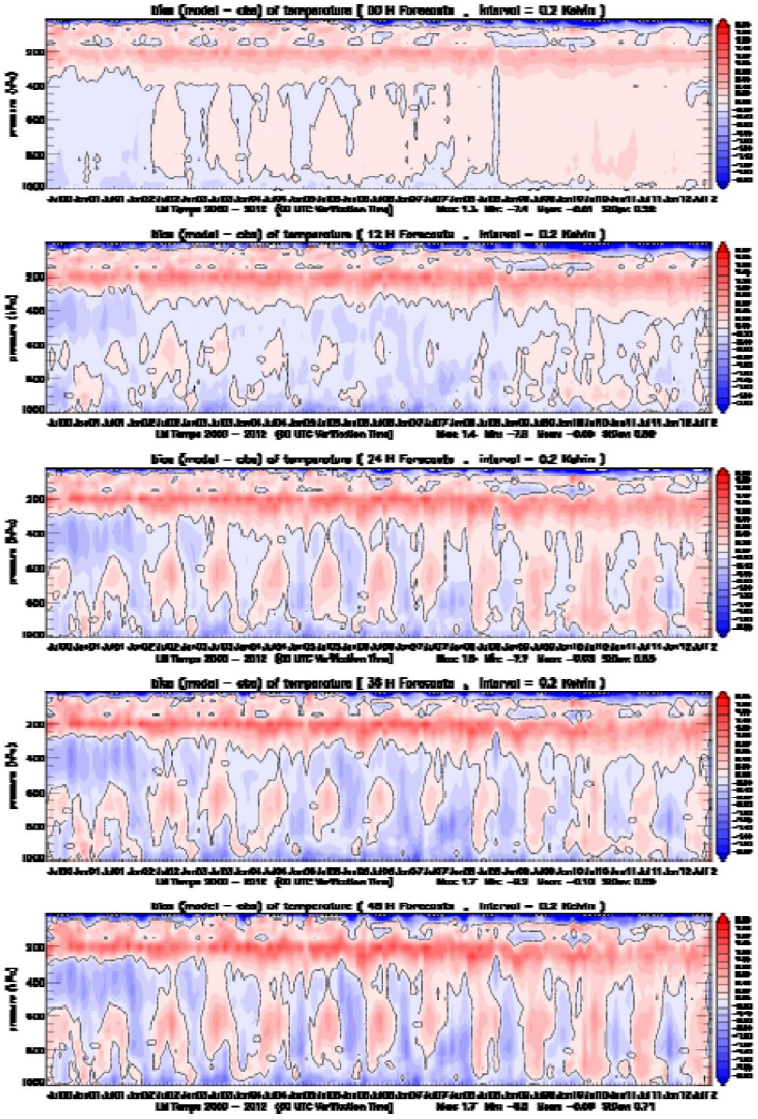
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



CEU: Verification of vertical profiles

BIAS Temperature last two years

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



VV=00

VV=12

VV=24

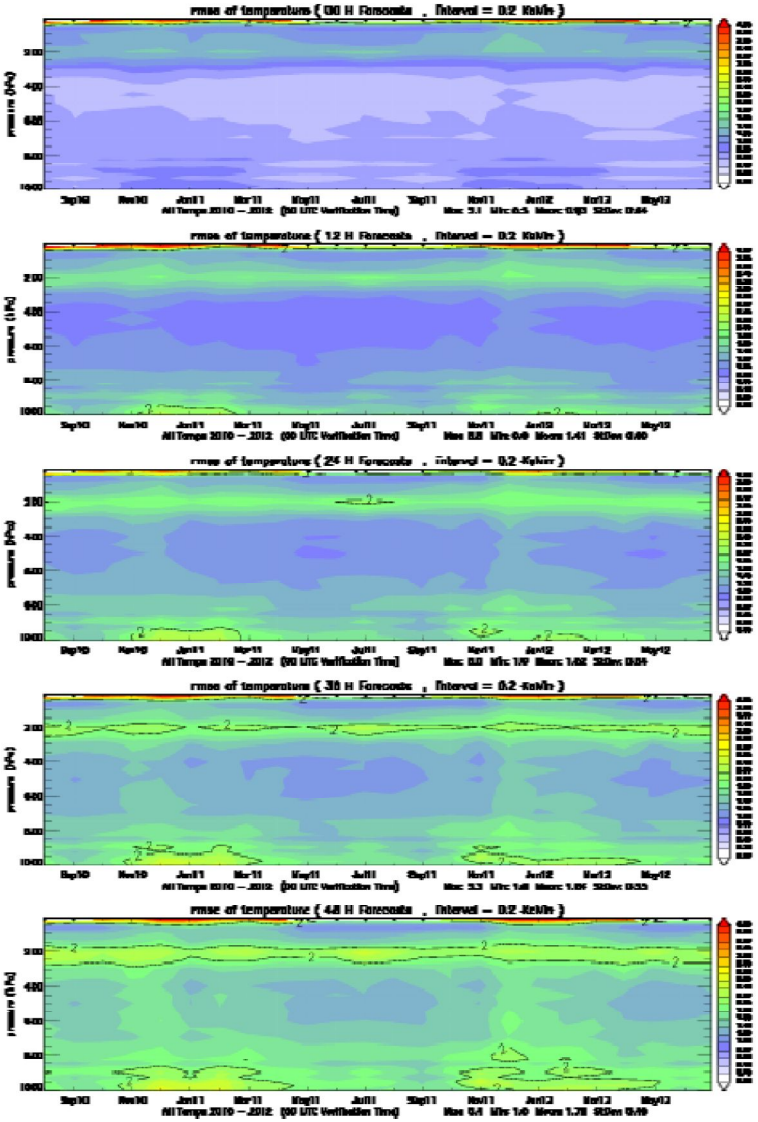
VV=36

VV=48

CEU: Verification of vertical profiles

RMSE Temperature last two years

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



VV=00

VV=12

VV=24

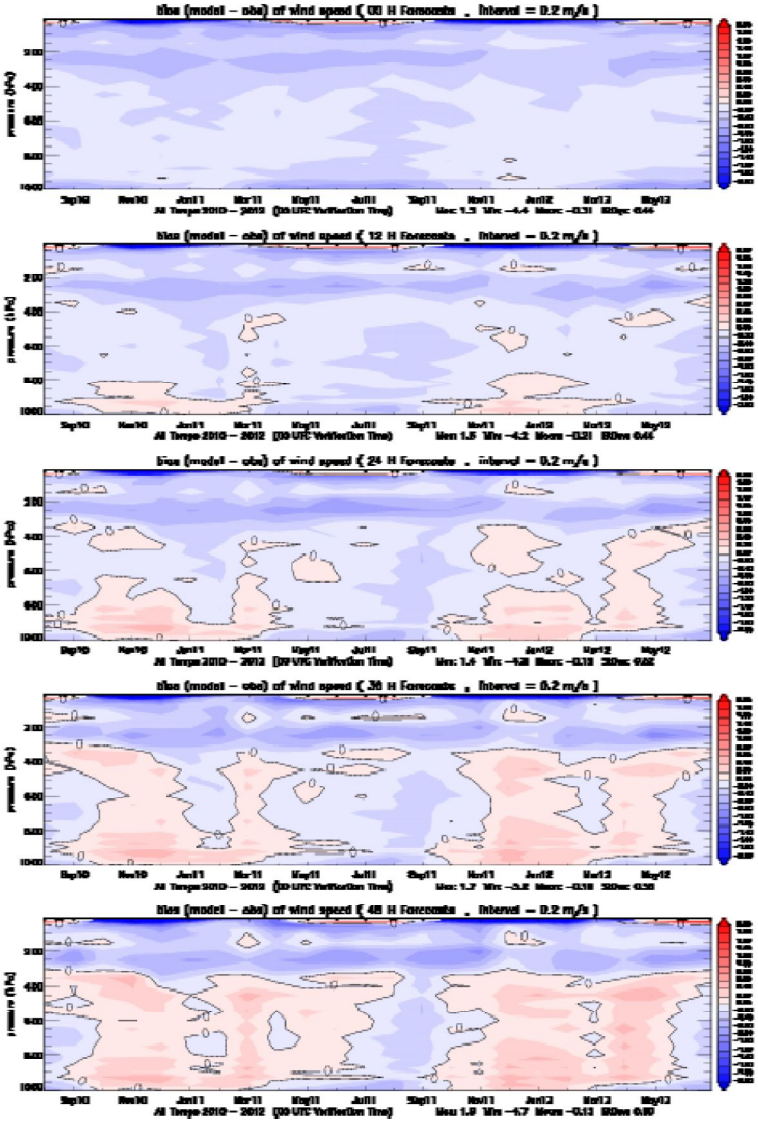
VV=36

VV=48

CEU: Verification of vertical profiles

BIAS Windspeed last two years

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



VV=00

VV=12

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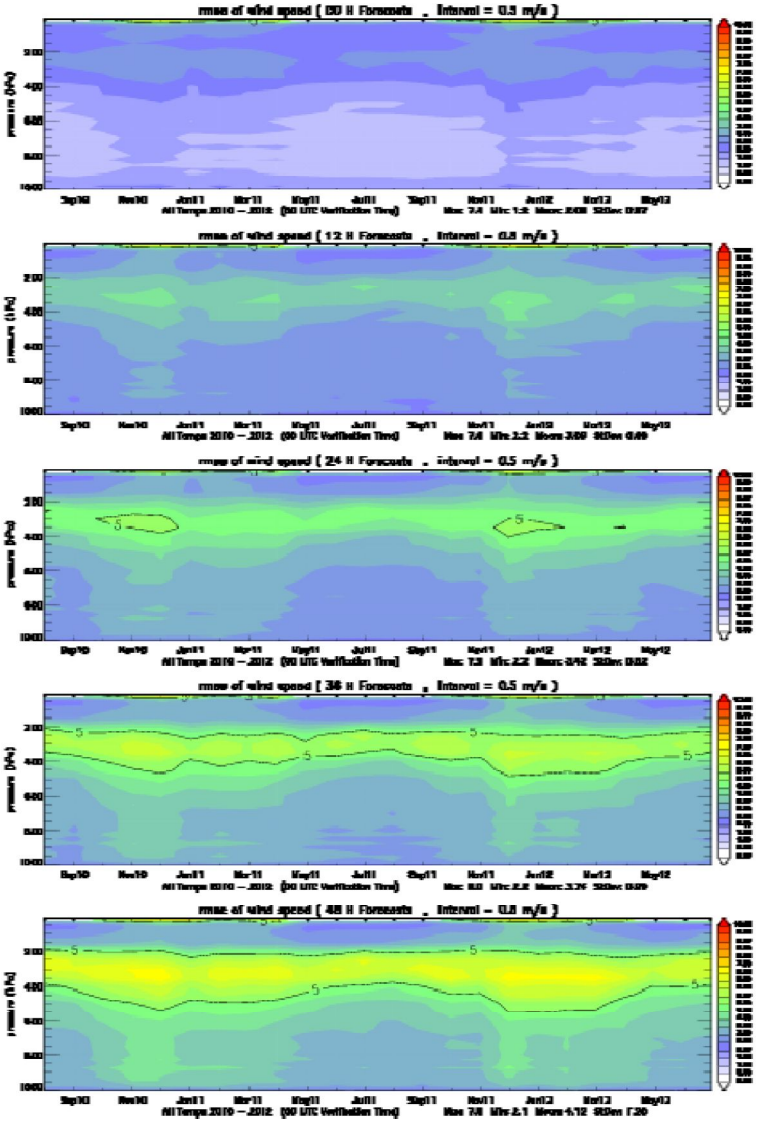
CEU: Verification of vertical profiles

RMSE Windspeed last two years

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



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VV=12

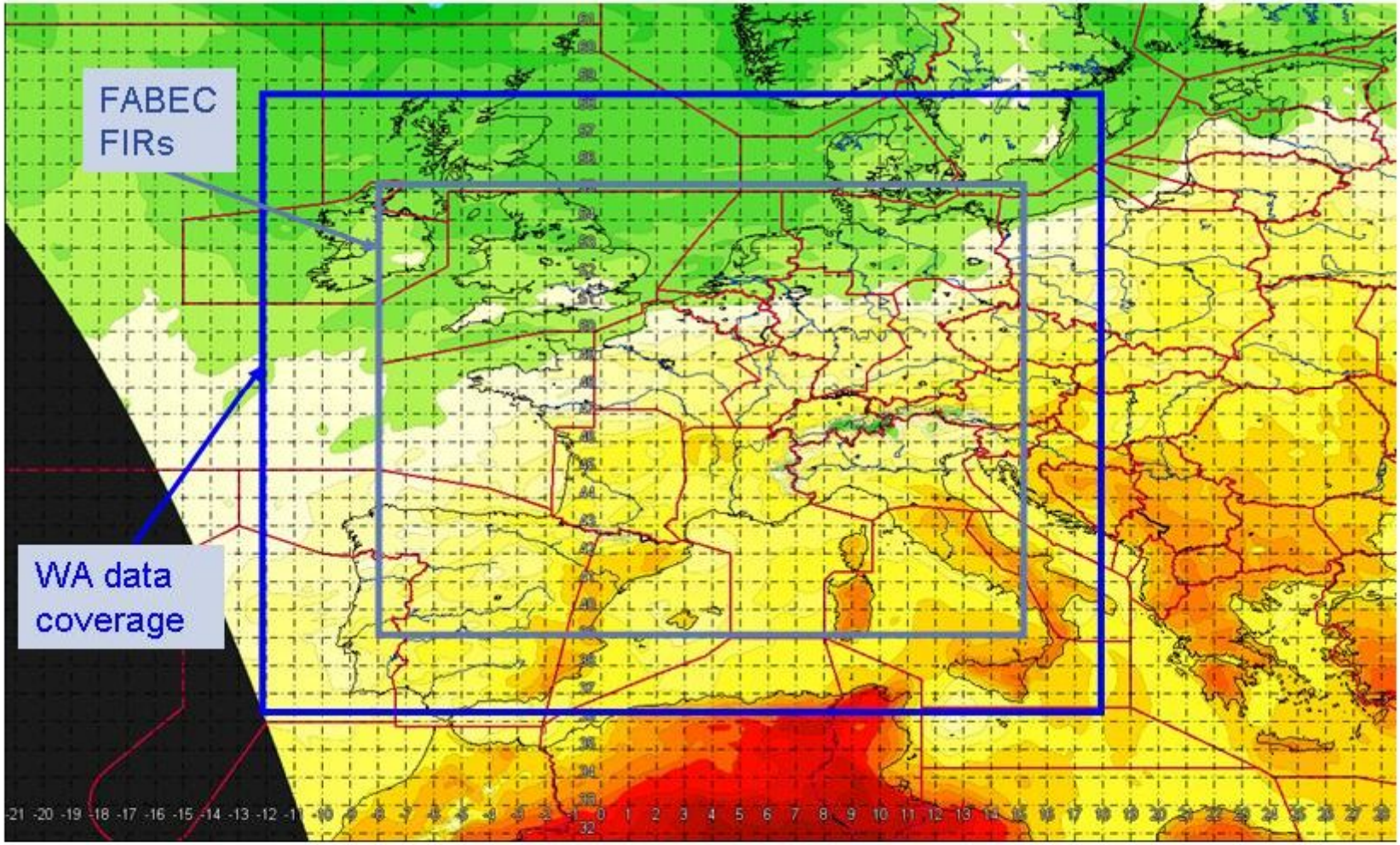
VV=24

VV=36

VV=48

WA data coverage

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

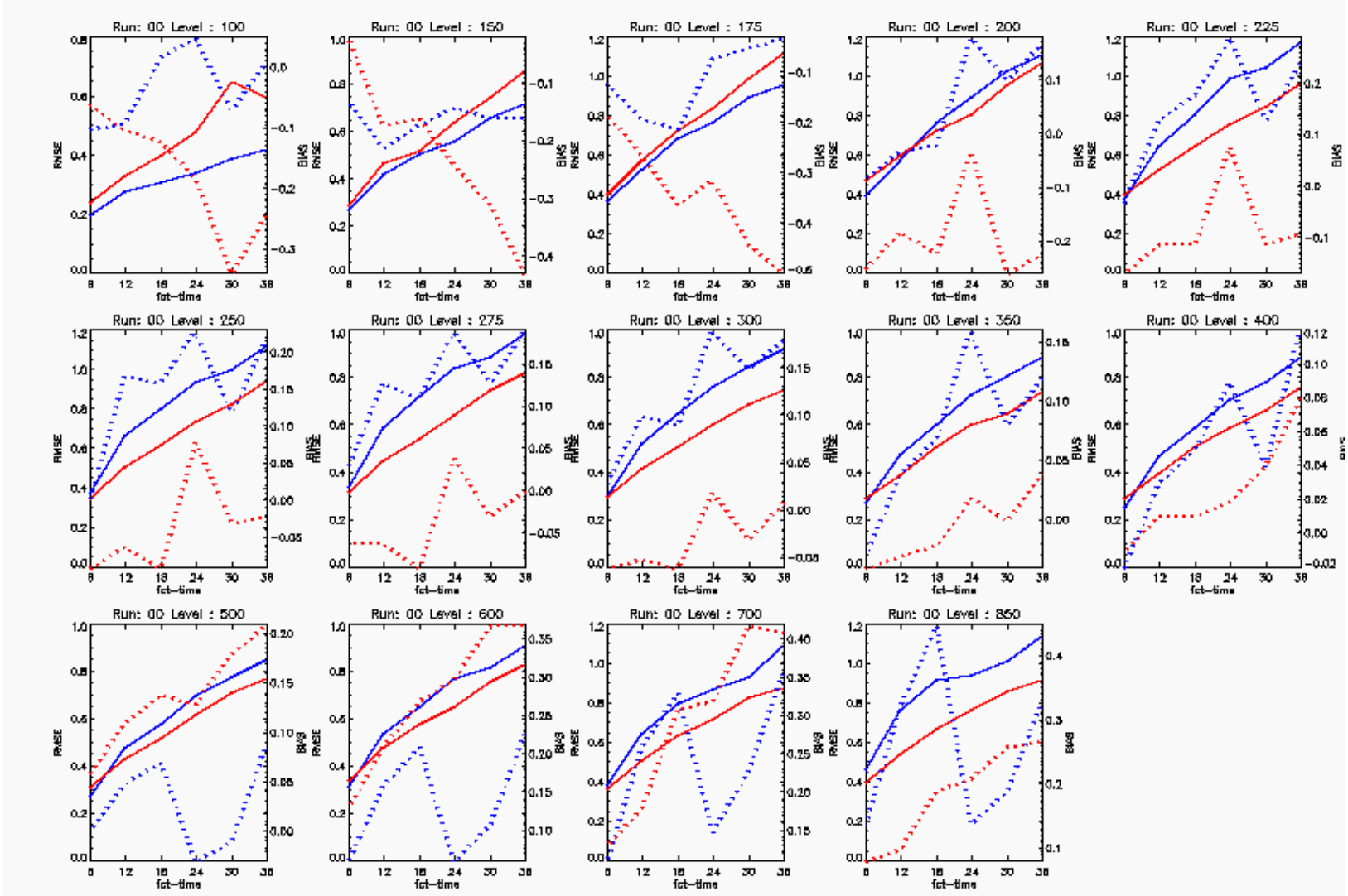


FABEC WA

Thomas.Wetter@dwd.de

Temperature 00-UTC-Run, pressure levels, May 2012, ARPEGE and COSMO-EU

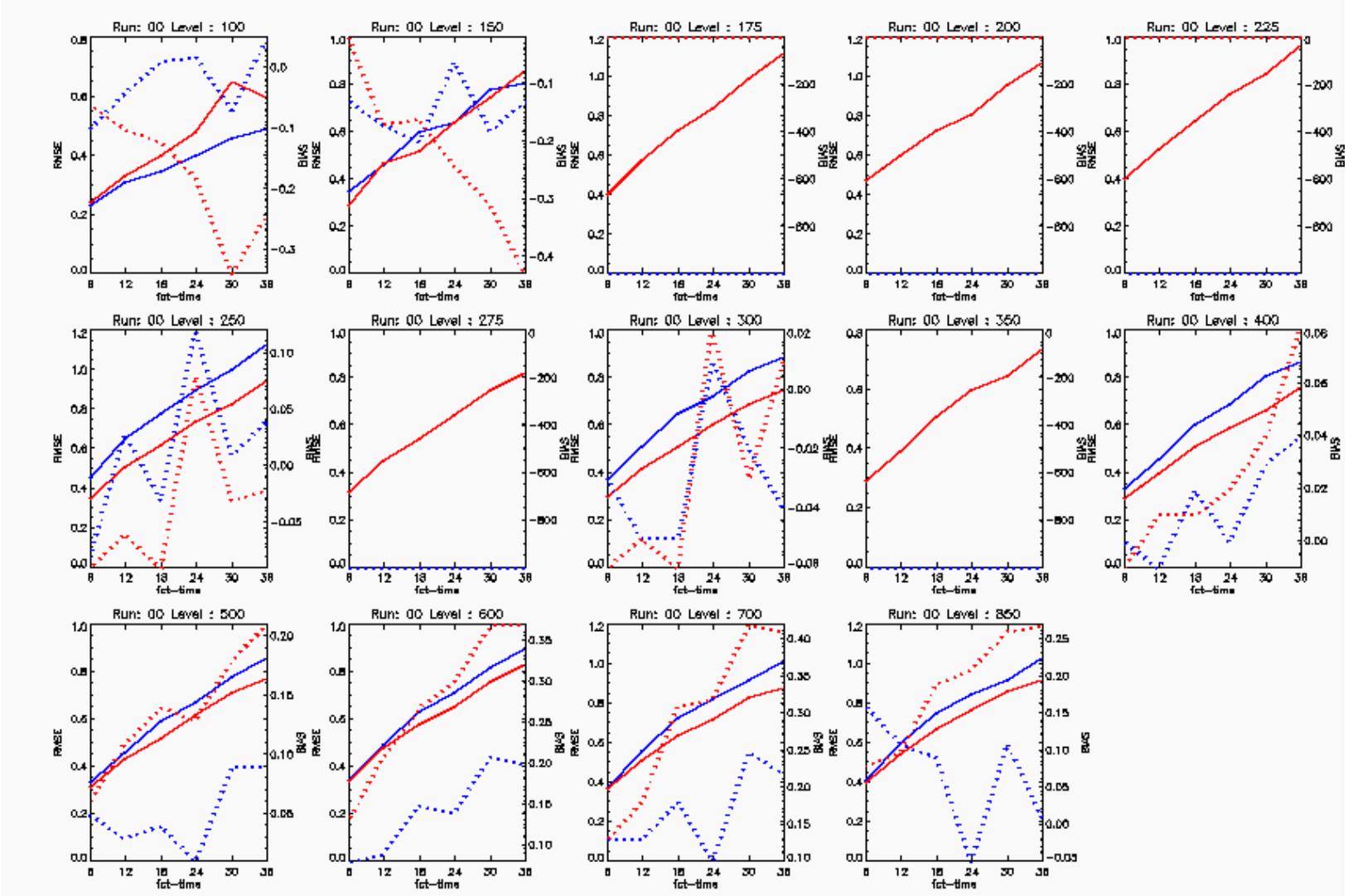
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Comparison of FABEC verification results, Element: T, Period: 20120501 - 20120531, left scale RMSE, right scale BIAS
ARPEGE COSMO-EU

Temperature 00-UTC-Run, pressure levels, May 2012, ARPEGE and GME

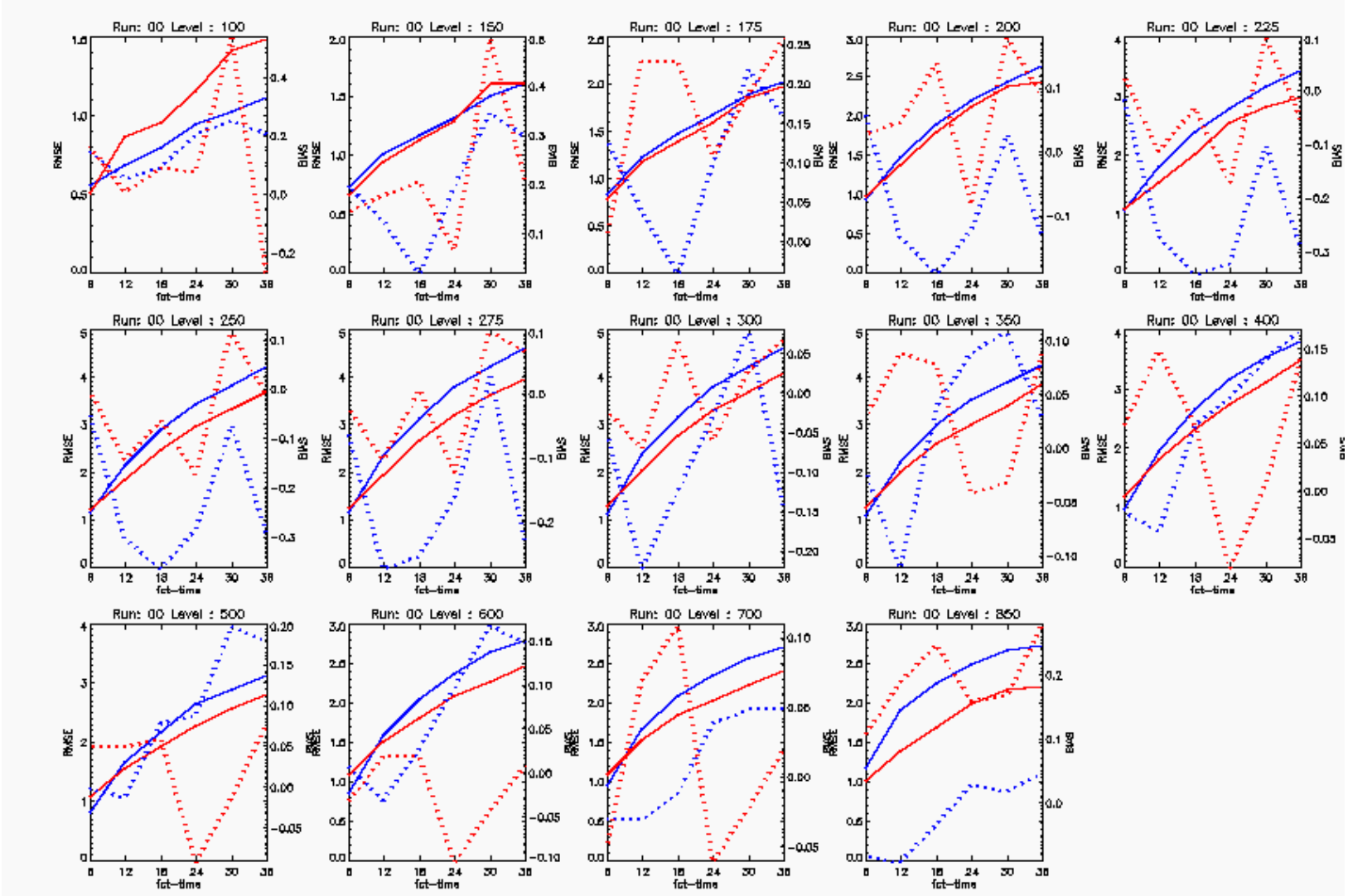
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Comparison of FABEC verification results, Element: T, Period: 20120501 - 20120531, left scale RMSE, right scale BIAS
ARPEGE GME

Wind 00-UTC-Run, pressure levels, May 2012, ARPEGE and COSMO-EU

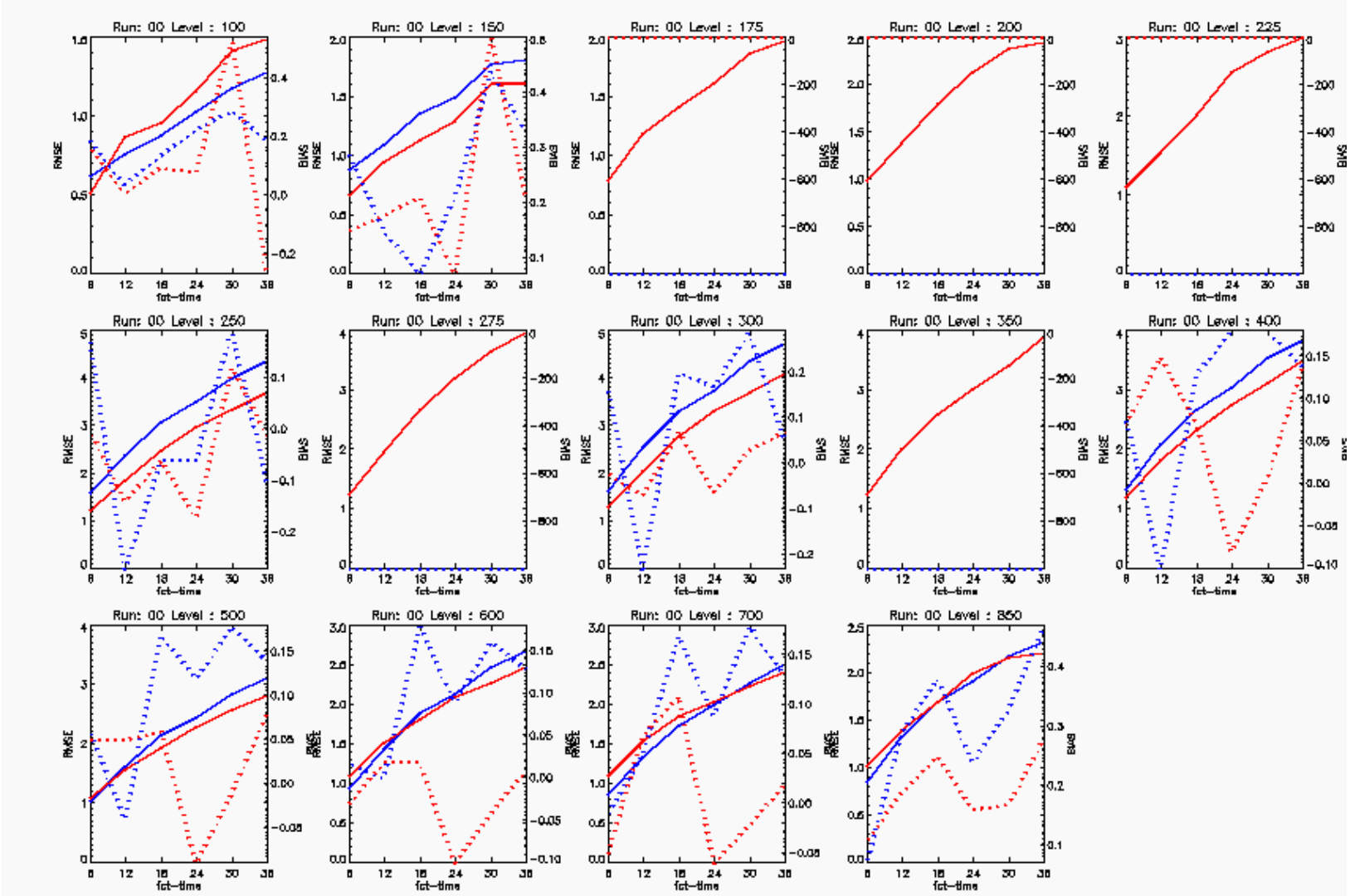
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Comparison of FABEC verification results, Element: FF, Period: 20120501 - 20120531, left scale RMSE, right scale BIAS
ARPEGE COSMO-EU

Wind 00-UTC-Run, pressure levels, May 2012, ARPEGE and GME

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Comparison of FABEC verification results, Element: FF, Period: 20120501 - 20120531, left scale RMSE, right scale BIAS
ARPEGE GME

Summary

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

- All things look fine and can be well interpreted.
  (at least to a certain degree)

- A tragedy (perhaps a bit provocative)
  - ➔ In general models with finer horizontal and vertical resolution should be used for operational purposes instead of models with coarser resolution.
  - ➔ The experiences with CDE and CEU for T2m during summer months and with CEU and GME for verification against analysis in the lower troposphere seem to violate this principle!