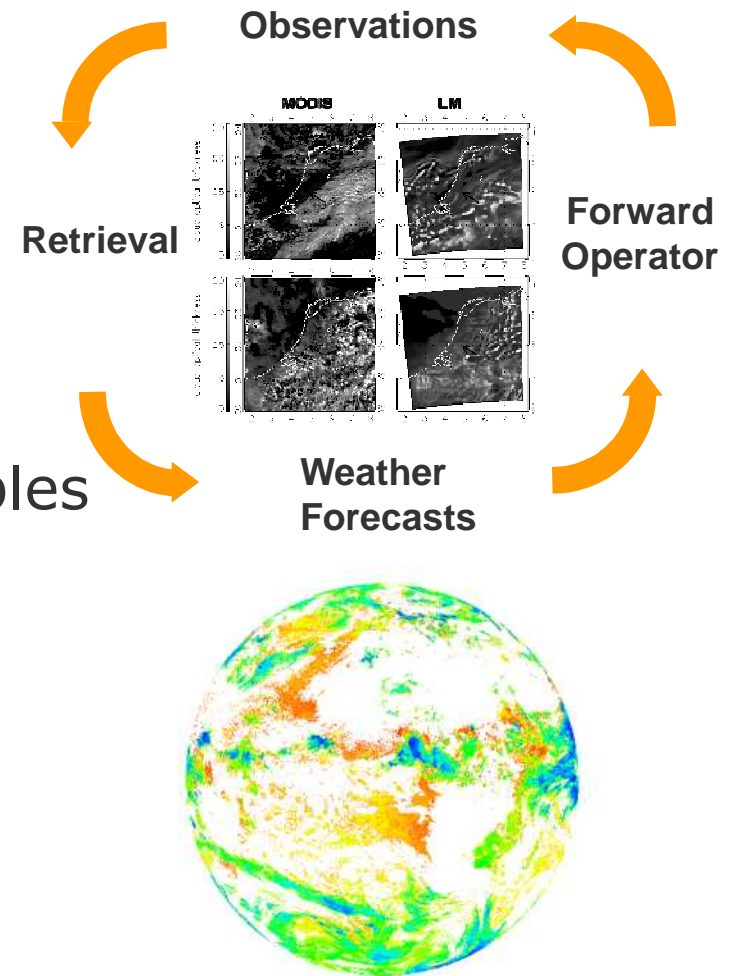




Long Term Evaluation of COSMO Models using ground based networks and Satellite Data

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+ QUEST Team

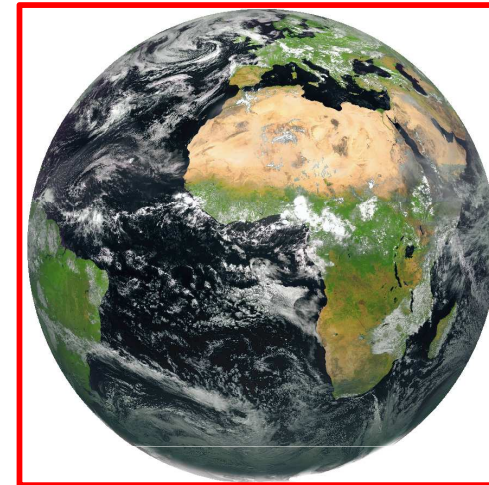
- Long term evaluation
- General Observation Period (**GOP**) 2007+2008
- Evaluation of water cycle variables
 - diurnal cycle
 - weather type classification
 - cloud tracking



Long-term evaluation of water cycle variables

- Analysis of the process chain from the water vapor to surface precipitation
- Use of ground-based networks
 - GPS (integrated water vapor IWV)
 - RANIE (gauge/radar precipitation)
 - ceilometers (cloud base height)
- METEOSAT Second Generation (MSG) SEVIRI instrument provides high spatial and temporal resolution information
- SEVIRI products like cloud mask (CM), cloud top pressure (CTP)

MSG View



[81W,81S,81E,81N]

SEVIRI (instrument) Data

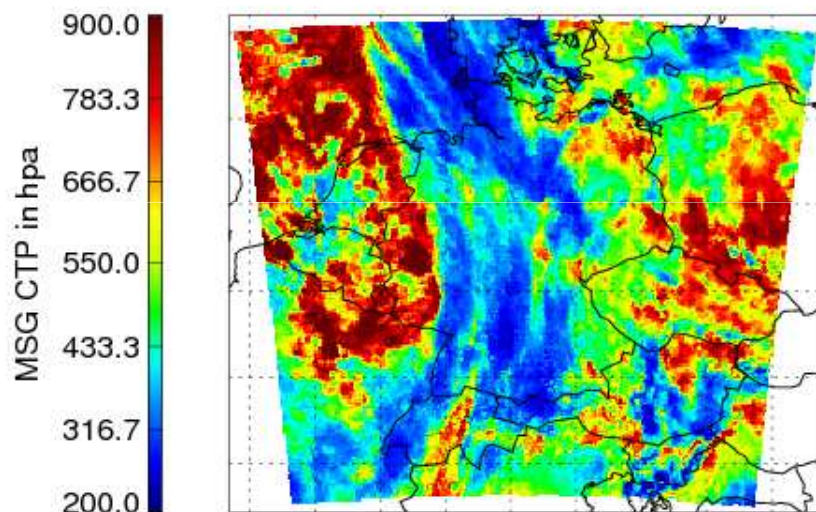
Spinning Enhanced Visible
and Infrared Imager

- scan rate : 15-min repeat
- channels : 4 VIS, 8 IR
- resolution : 3km (1km HRV)
at SSP

Cloud Top Pressure (CTP)

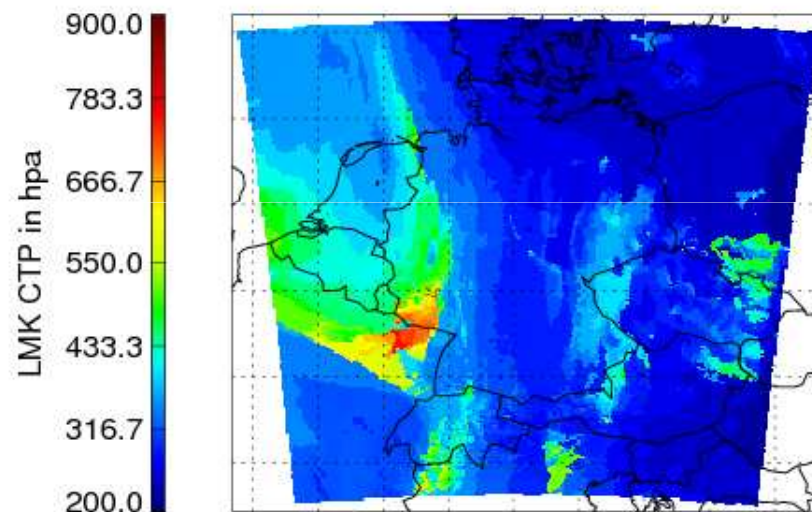
MSG

2008/01/05 12:00UTC



COSMO-DE

2008/01/05 12:00UTC



Why does COSMO-DE show so many clouds at low CTP (high altitude)?

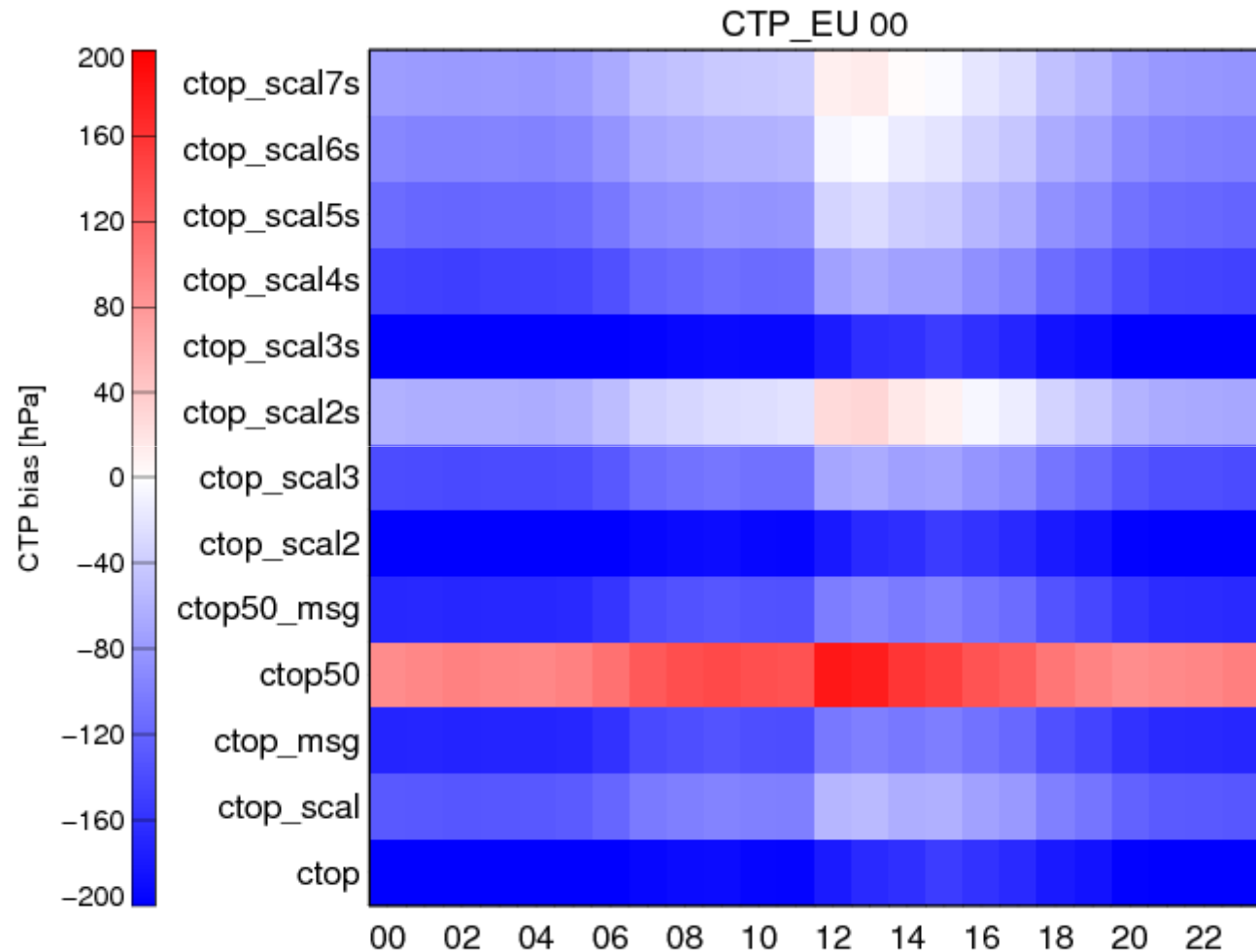
CTP is not a direct model variable but has to be derived from cloud cover, cloud ice & water and snow using thresholds

Mean CTP Bias (Model-Obs) May 2008

13 different methods to derive CTP from COSMO-EU output

Worst result using only cloud cover

Best results for grid scale clouds with additional thresholds for snow and ice mass mixing ratio



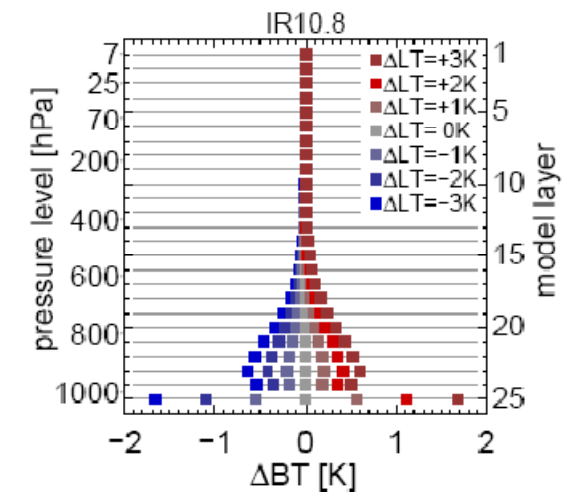
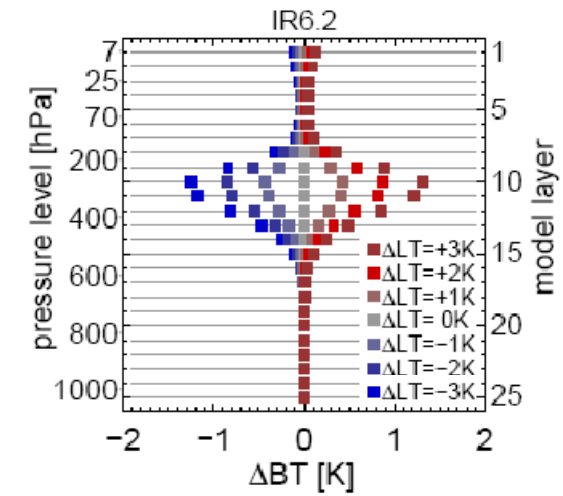
→ better use better constrained variables (i.e., BT) in long-term evaluation

BT (brightness temperatures)

Gas absorption takes place at different wavelength, higher temp. values belong to less absorption or less quantities of the absorbing gases.

Examples :

- Water Vapor absorption at 6.2 μm
 - sensitive to middle and higher layers
 - increase of H_2O leads to a BT decrease
- Cloud/Surface Detection at 10.8 μm
 - sensitive to lower troposphere layers
 - higher Temperatures indicates lower clouds or no clouds

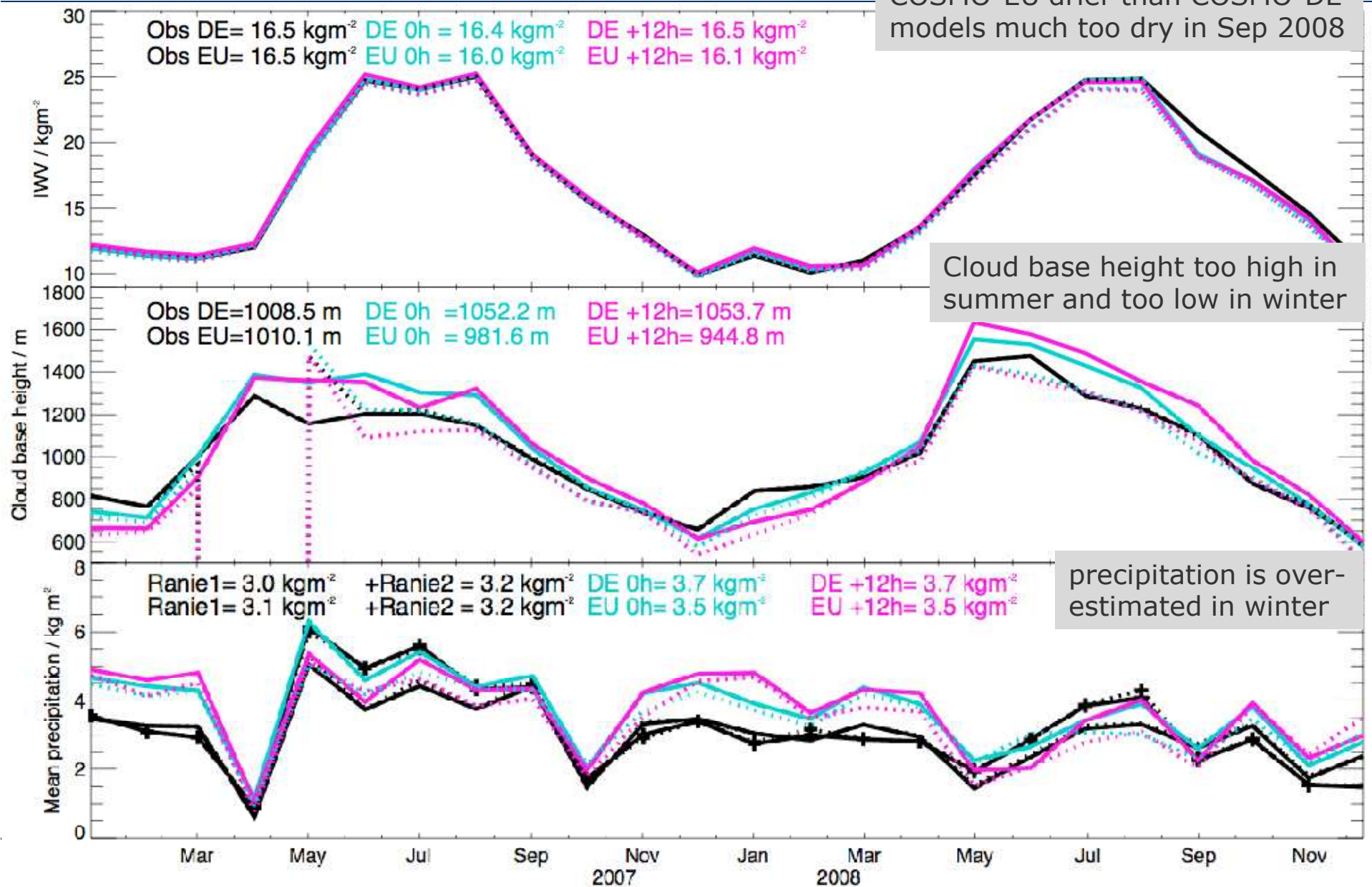


images: M.Stengel, diploma thesis

EXAMPLARY RESULTS

LTE : GOP (2007-2008)

COSMO-EU drier than COSMO-DE models much too dry in Sep 2008

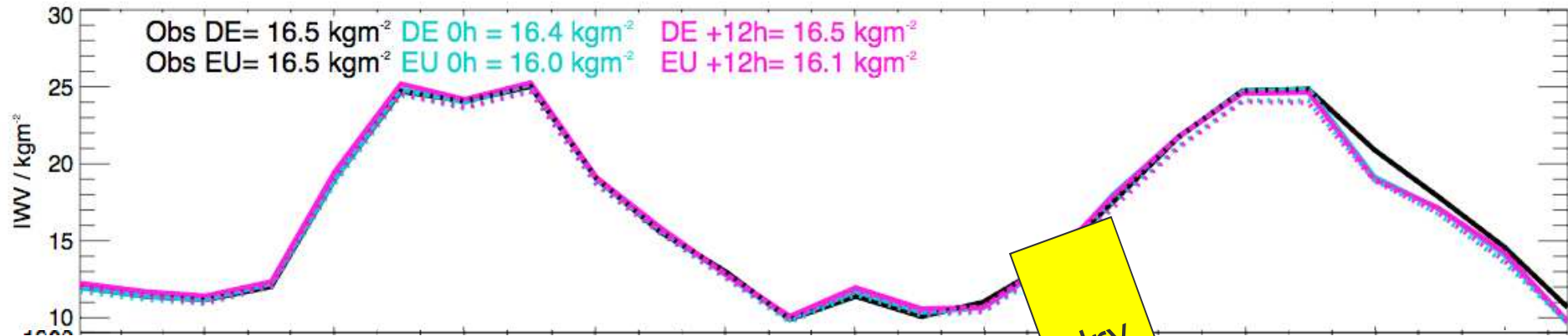


Cloud base height too high in summer and too low in winter

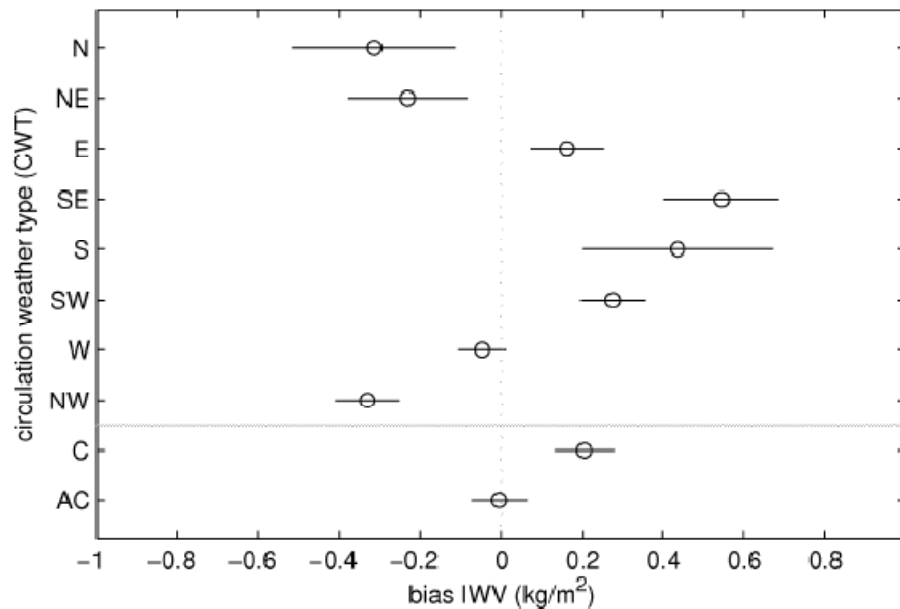
precipitation is over-estimated in winter

LTE: Weather type classification

IWV has no significant bias?



dry

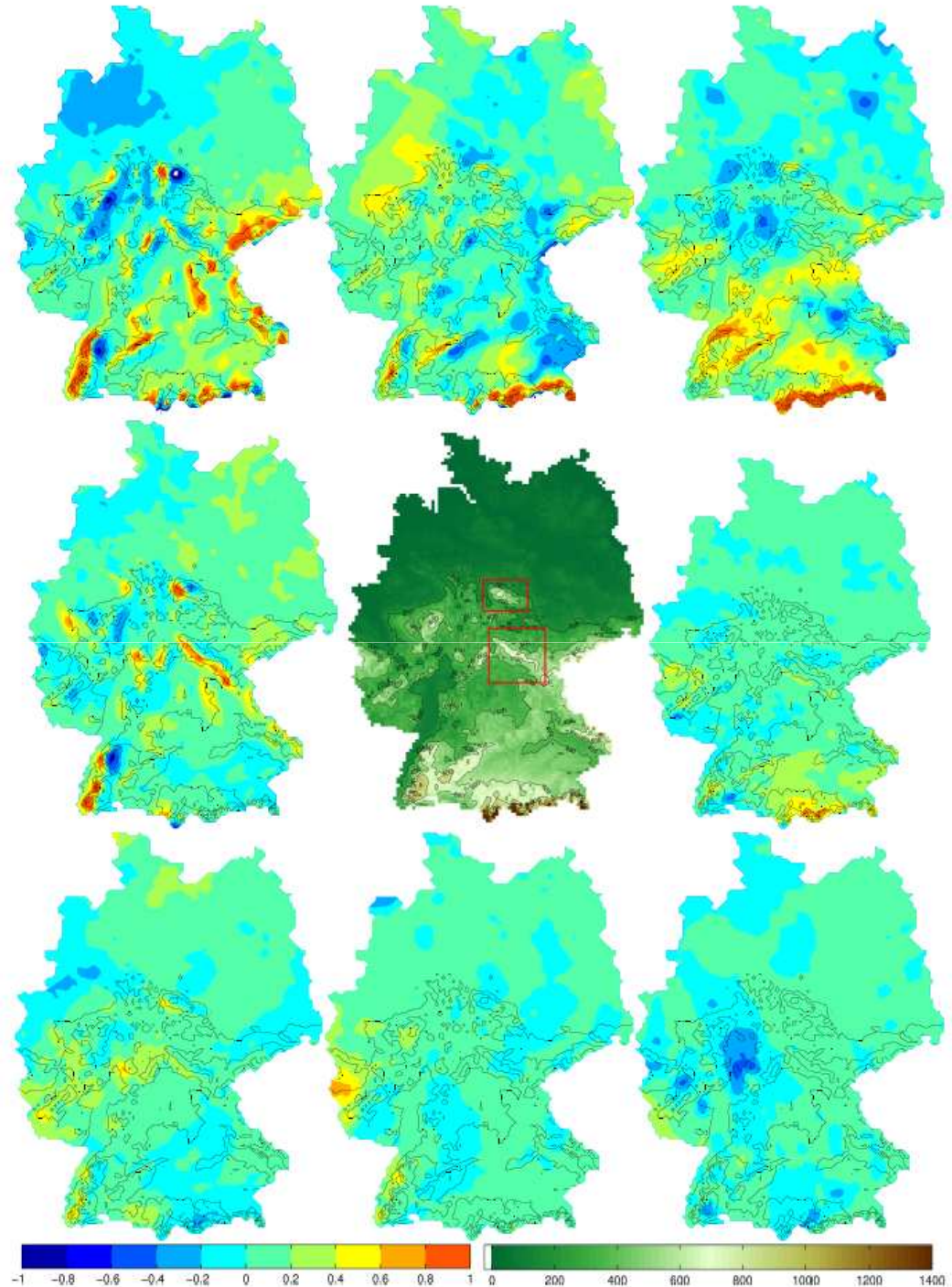


wet

Weather type classification

How does QPF depend on weather type?

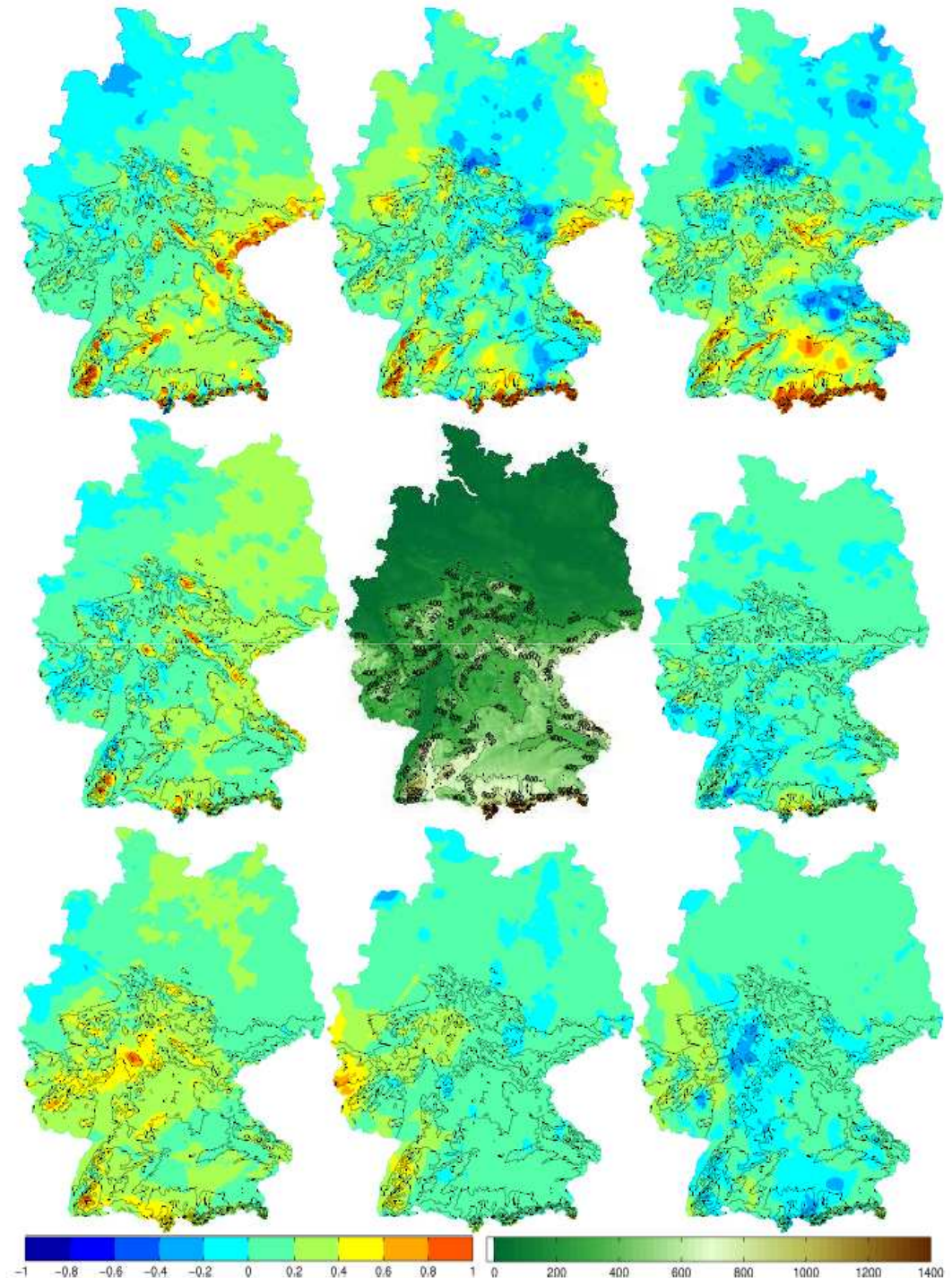
COSMO - EU shows positive biases on the windward sides and negative biases on the lee sides



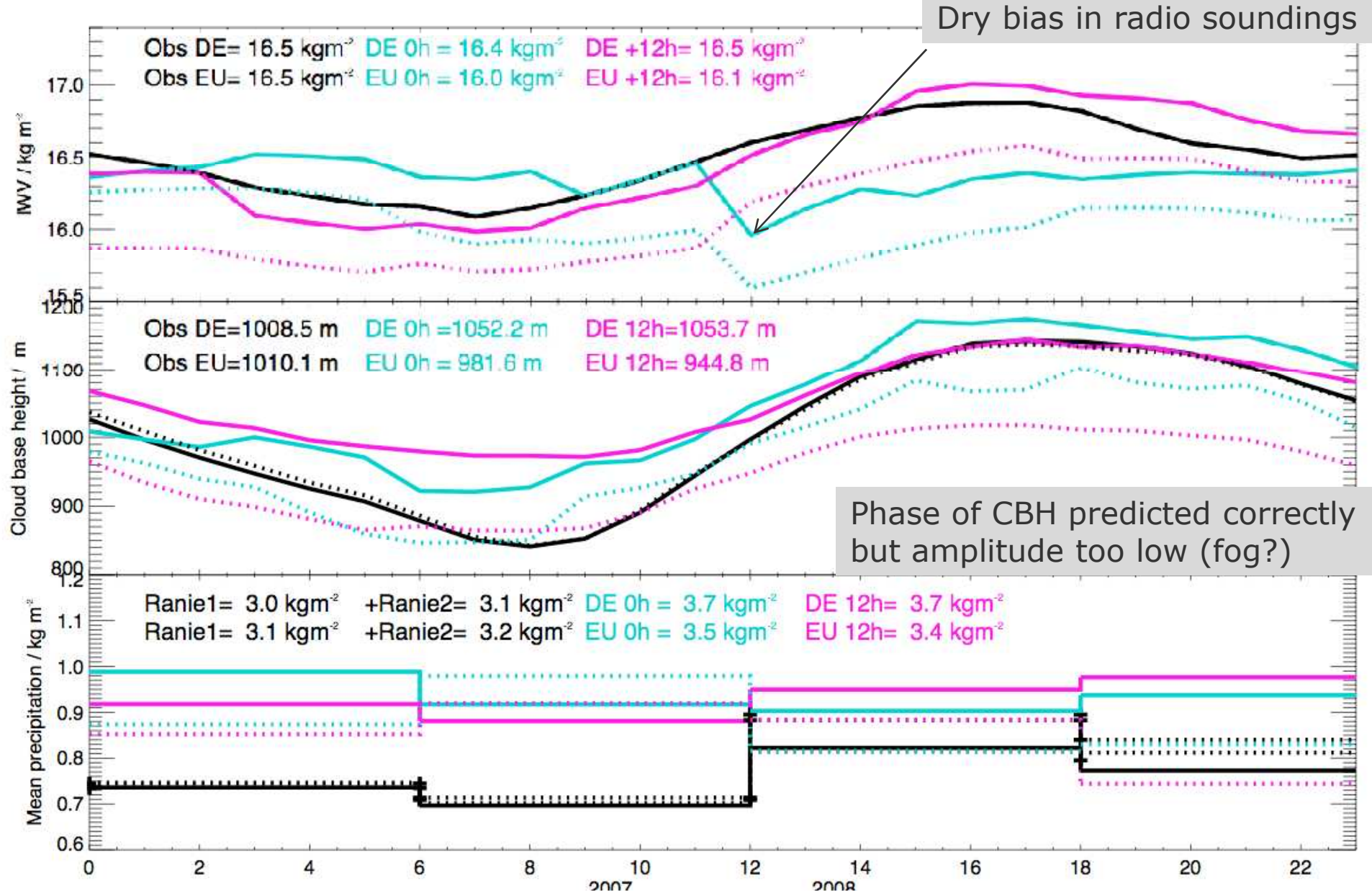
Weather type classification

**How does QPF
depend on
weather type?**

COSMO-DE
shows strong
overestimation
on hill crests

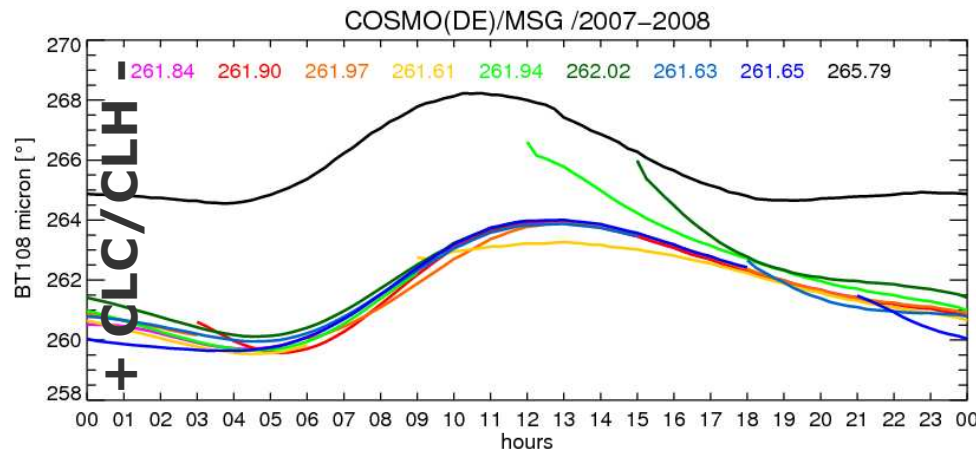


LTE: Diurnal cycle

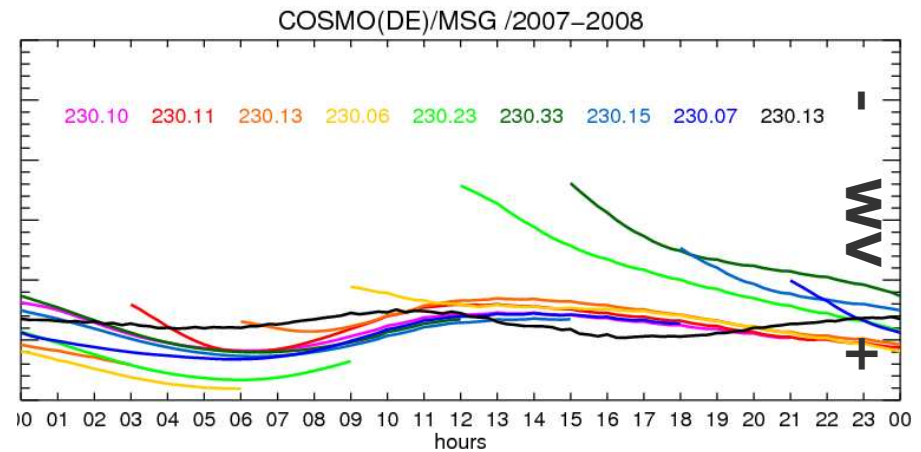


LTE: Diurnal Cycle of Brightness Temperatures

IR10,8 μm



IR 6,2 μm



- Possible reasons for Bias (4K) error in 10.8 μm BT
- ◆ **cloud fraction in COSMO is too high**
 - fraction of warm surface temperatures is to low
 - ◆ clouds are positioned too high (to cold)
 - ◆ too much water vapor

- Possible reasons for phase (3h) error
- ◆ **surface heating**
 - ◆ diurnal cycle of cloudiness

Mean values in K:

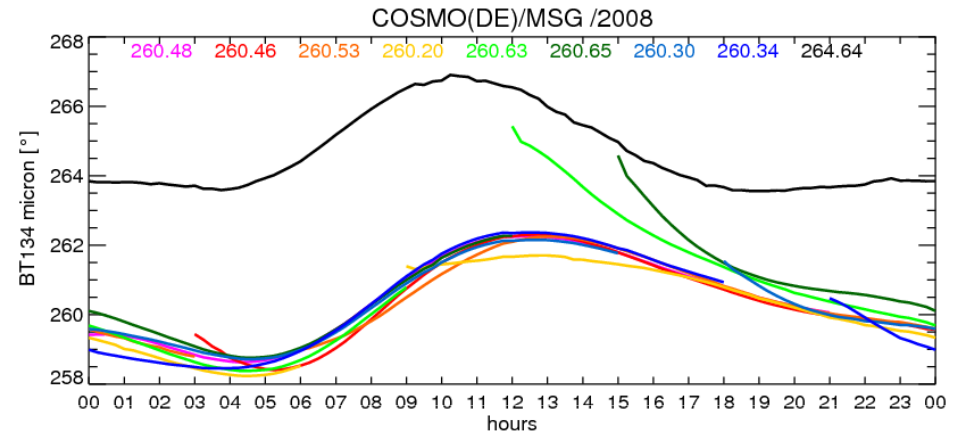
BT	LMK	MSG	Bias	Rmse
IR108	261,8	265,8	-3,9	15,6
IR062	230,1	230,1	0	3,4

How to distinguish surface and cloud influence?

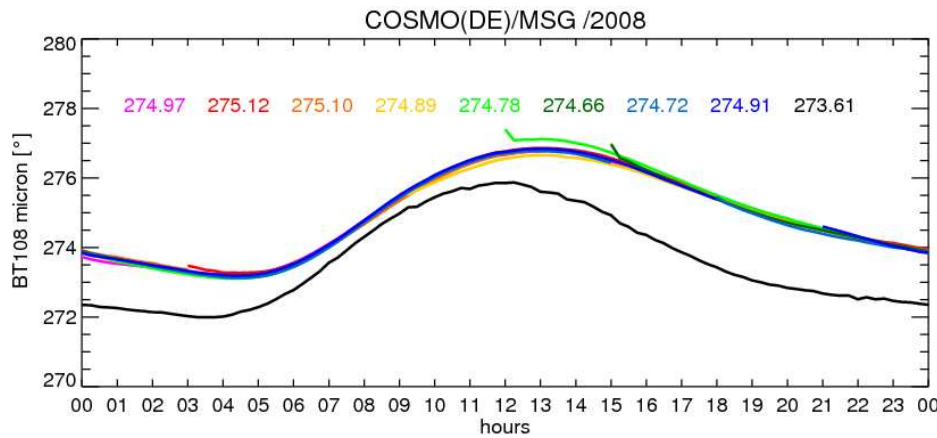
BT 10.8μm threshold : 260 K

BT	LMK	MSG	Bias	Rmse
A :	260,2	264,6	-4,3	16,1
B :	239,5	246,3	-7,5	14,5
C :	274,6	273,6	1,0	6,6

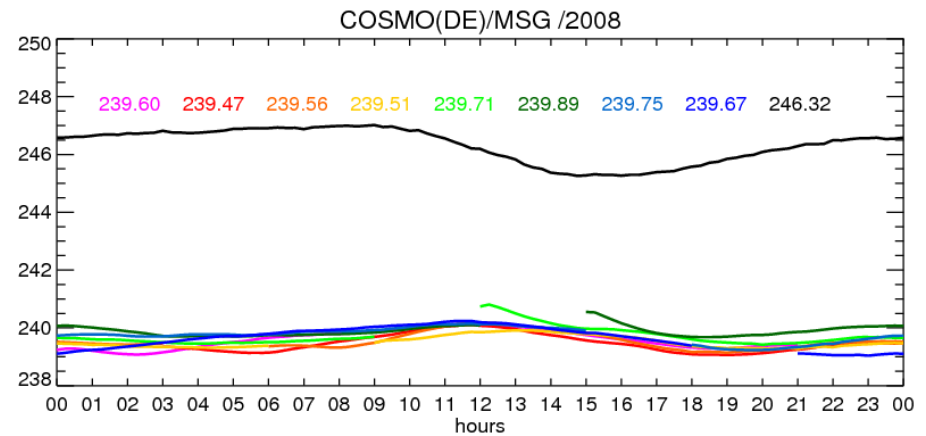
A : *no threshold*



C : *clear sky or low clouds*



B : *clouds*

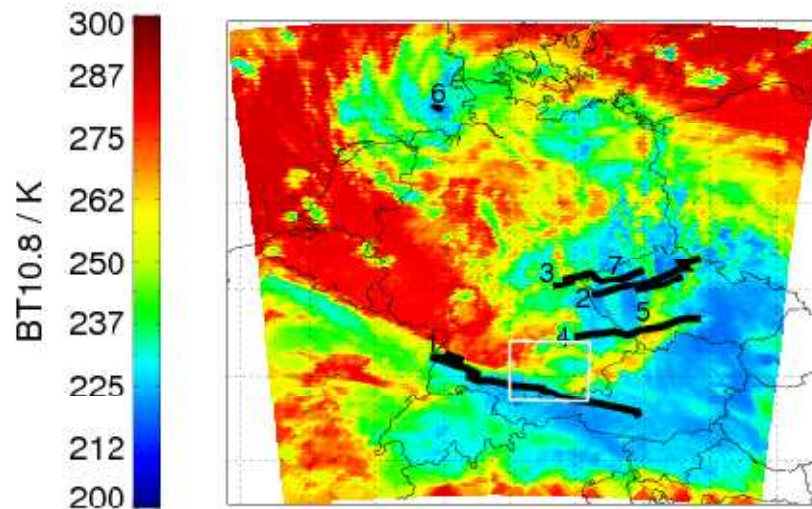


How to make sure that only cloudy pixels are compared?
→ no sub pixel cloudiness

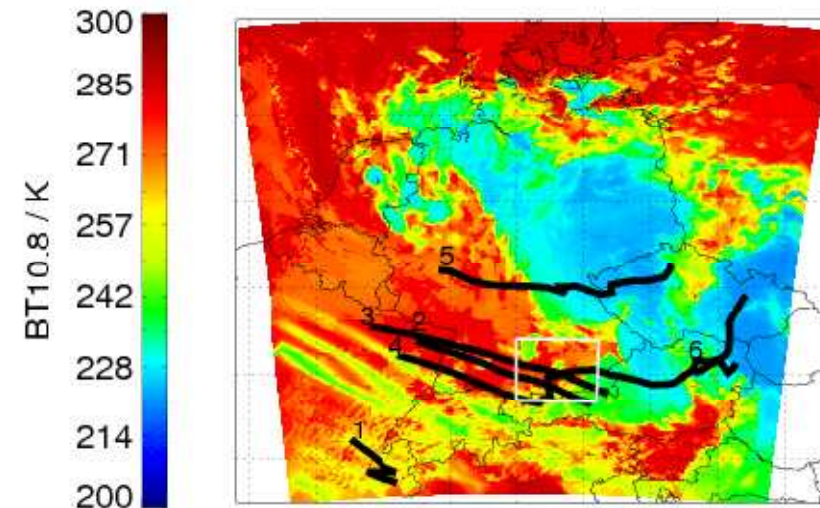
Exploit MSG high resolution via tracking of convective systems in observation and model

Example: 28.8. 2006

MSG



COSMO-DE



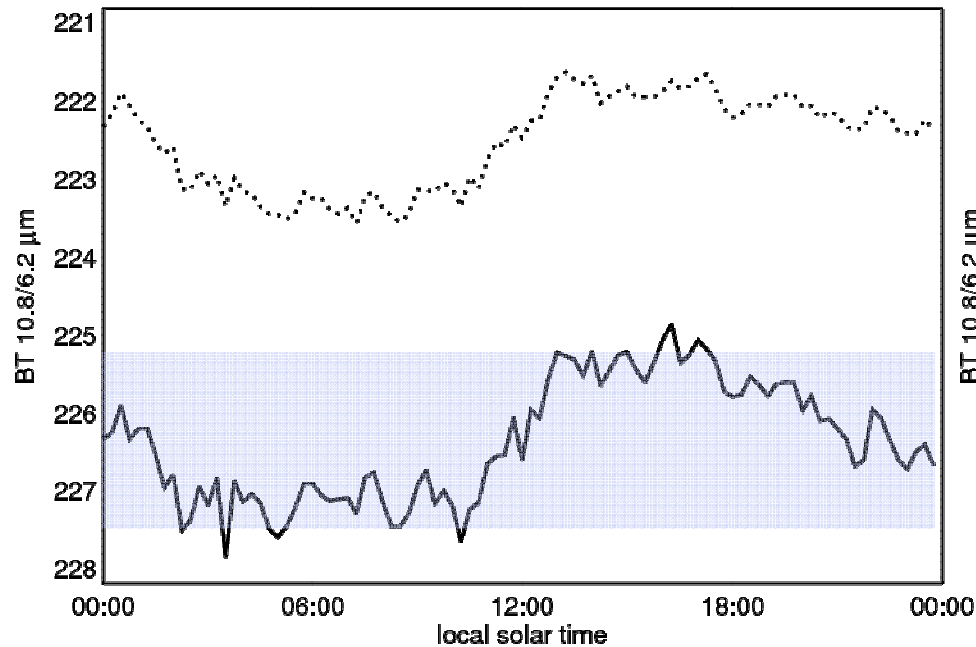
Cloud Tracking June 2008

Mean diurnal cycle of WV062 and BT108 brightness temperatures of all tracked clouds in June 2008 for MSG and COSMO-DE.

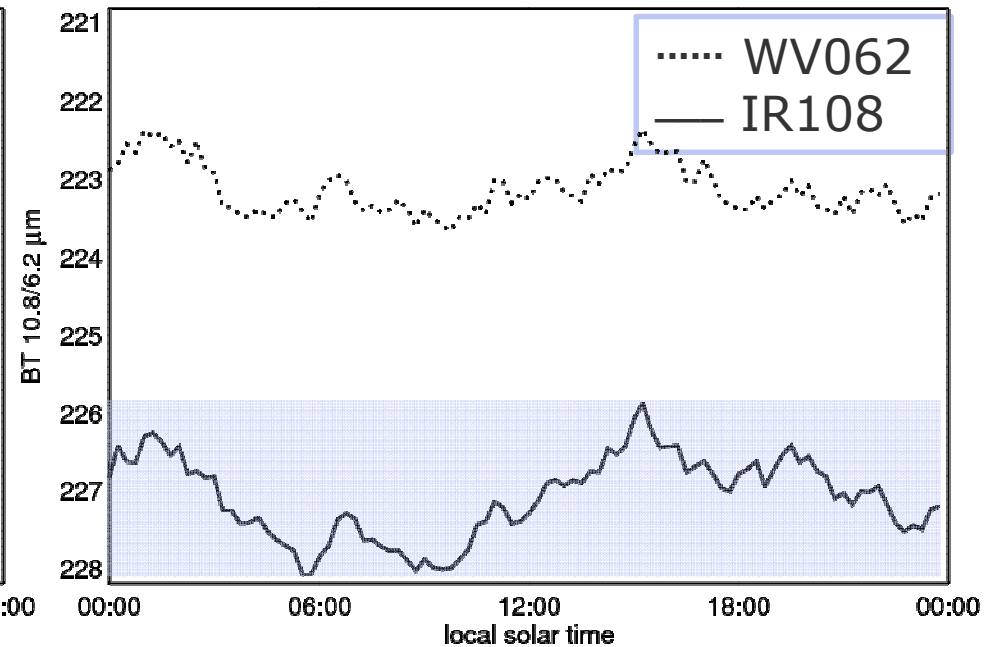
Very similar diurnal cycle for convective cores in model and observations

→ coldest temperatures around 17 UTC and amplitude of about 2 K

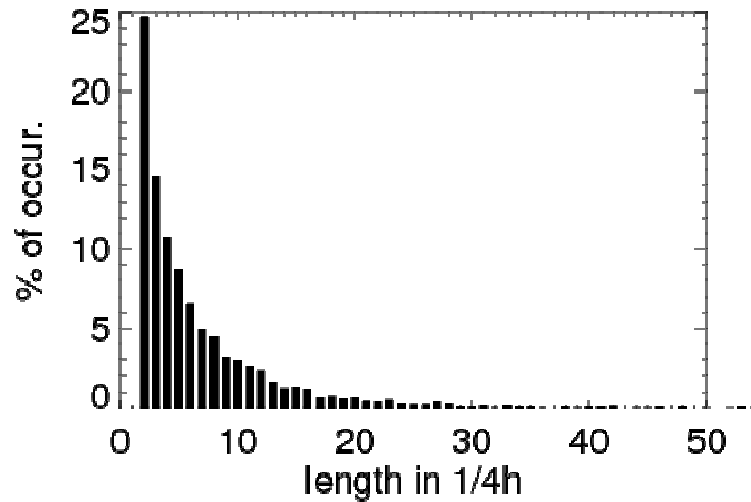
MSG (#2294)



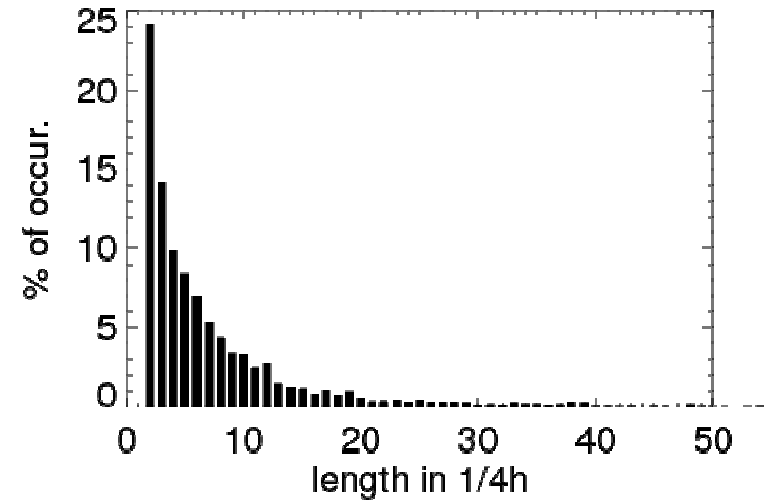
COSMO-DE (#3708)



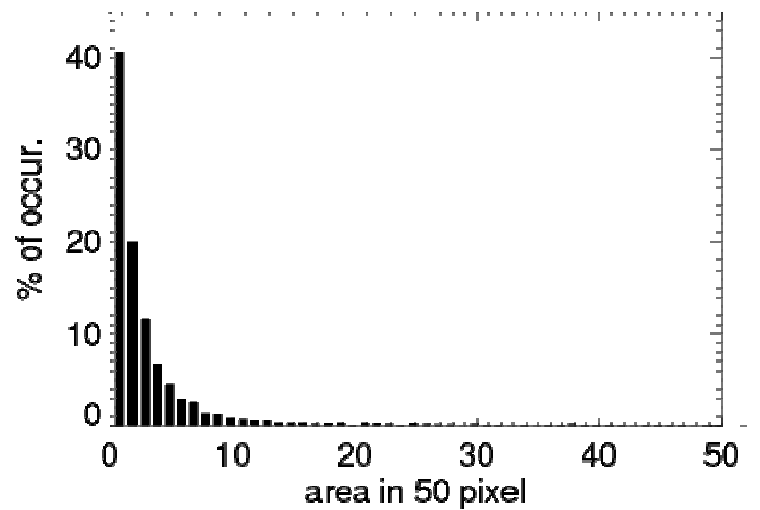
MSG 06/2008



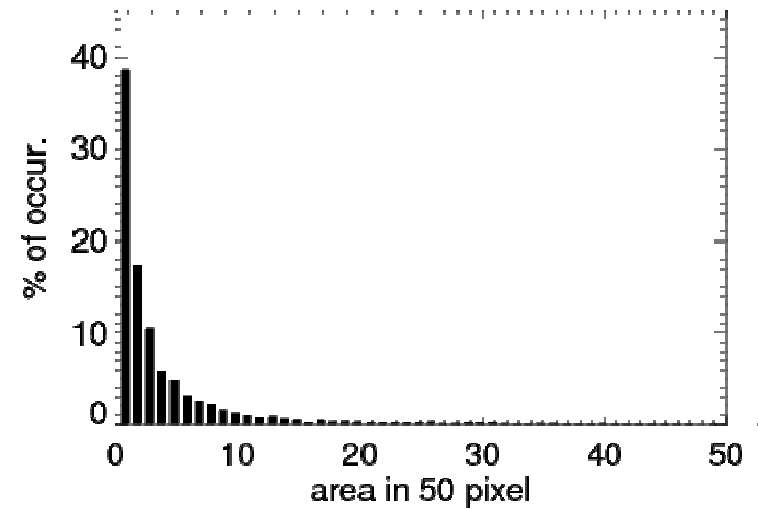
LMK 06/2008



MSG 06/2008



LMK 06/2008



- Clouds
 - Cloud base height too high in summer and too low in winter
 - Phase of CBH predicted correctly but amplitude too low (fog?)
 - Model produces too much clouds (cloud - cover)
 - Tracking of convective clouds shows good agreements in diurnal cycle, but the model is also tracking significantly more clouds
- water vapor
 - COSMO-EU drier than COSMO-DE models much too dry in Sep 2008
 - maritime advection causes dry bias over north Germany
 - Continental advection causes wet bias over south Germany
- precipitation
 - precipitation is overestimated in winter
 - COSMO-EU pos. bias on windward side and negative biases on the lee sides
 - COSMO-DE shows strong overestimation on hill crests

Thank You