Assimilation of IASI Radinaces over Sea and Land into the Regional NWP Model COSMO-EU

Marc Schwärz, Christoph Schraff, and Reinhold Hess

German Weather Service (DWD), Offenbach, Germany

International TOVS Study Conference
April 14-20, 2010

I got great support from many people

special thanks to

- colleagues at DWD: Thomas Hanisch, Klaus Stephan, Jochen Förstner, and Ulrich Pflüger
- EUMETSAT

Outline

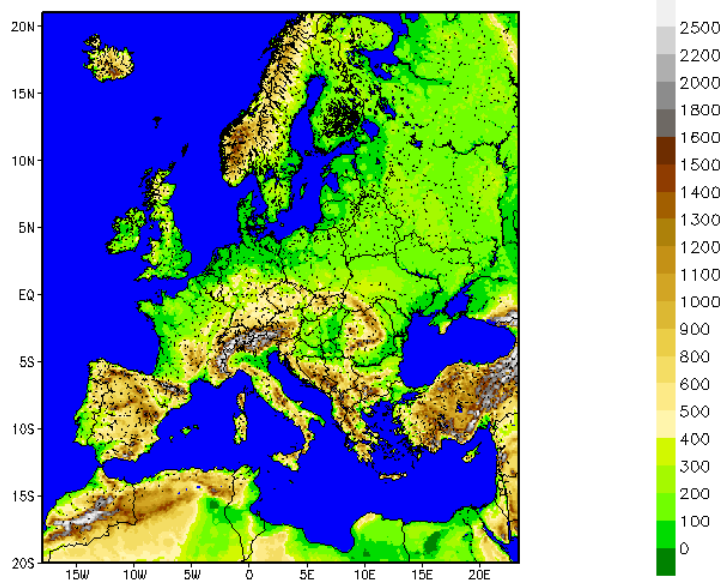
Outline

Outline

Outline

Outline

Local Model COSMO-EU



domain of cosmo-eu

assimilation scheme of COSMO

- nudging scheme (Newtonian relaxation)
- influence according to nudging weights
- depending on: temporal and spatial distance

big problems within the nudging scheme

no direct use of nonlinear obs. (i. e., satellite obs.)

- hence: combination of nudging with a 1DVar

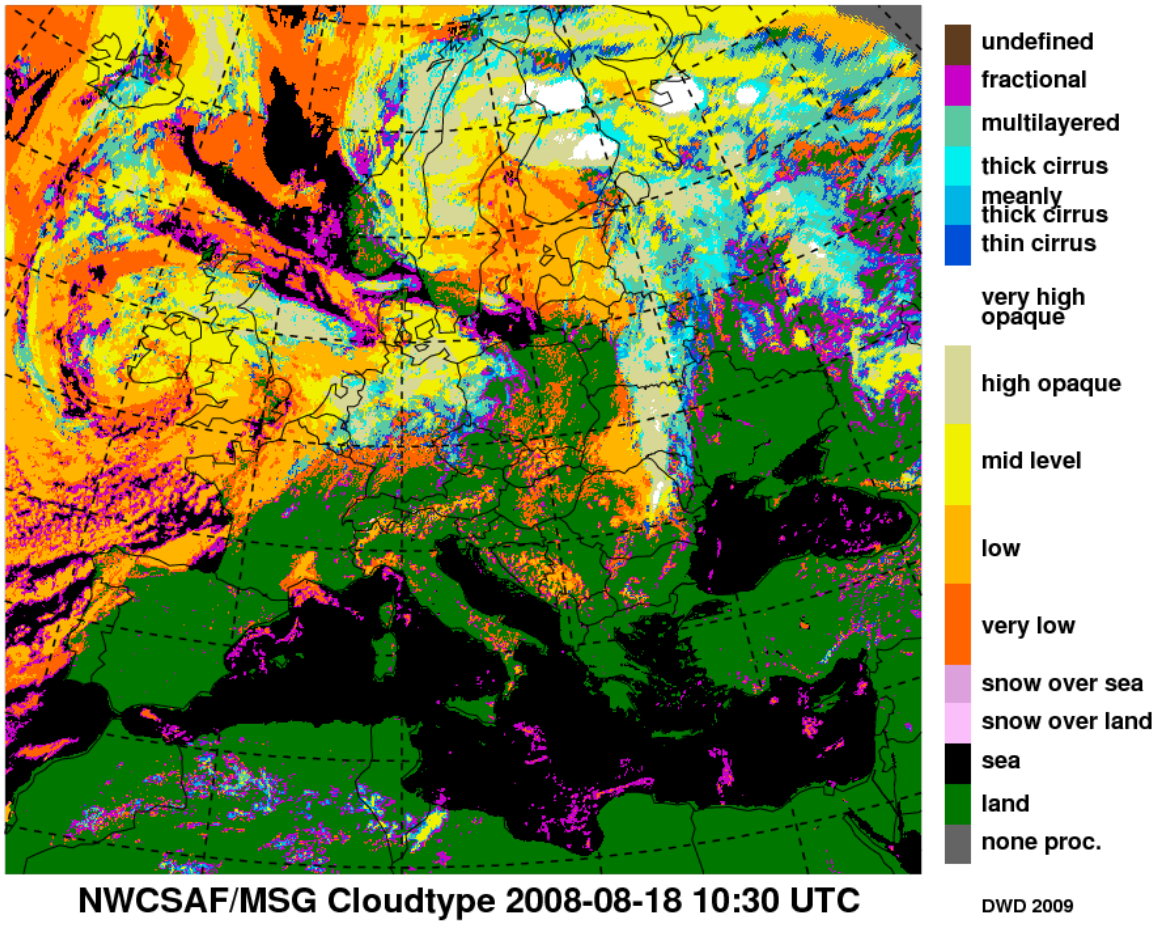
Outline

data preparation

interesting parts of this step

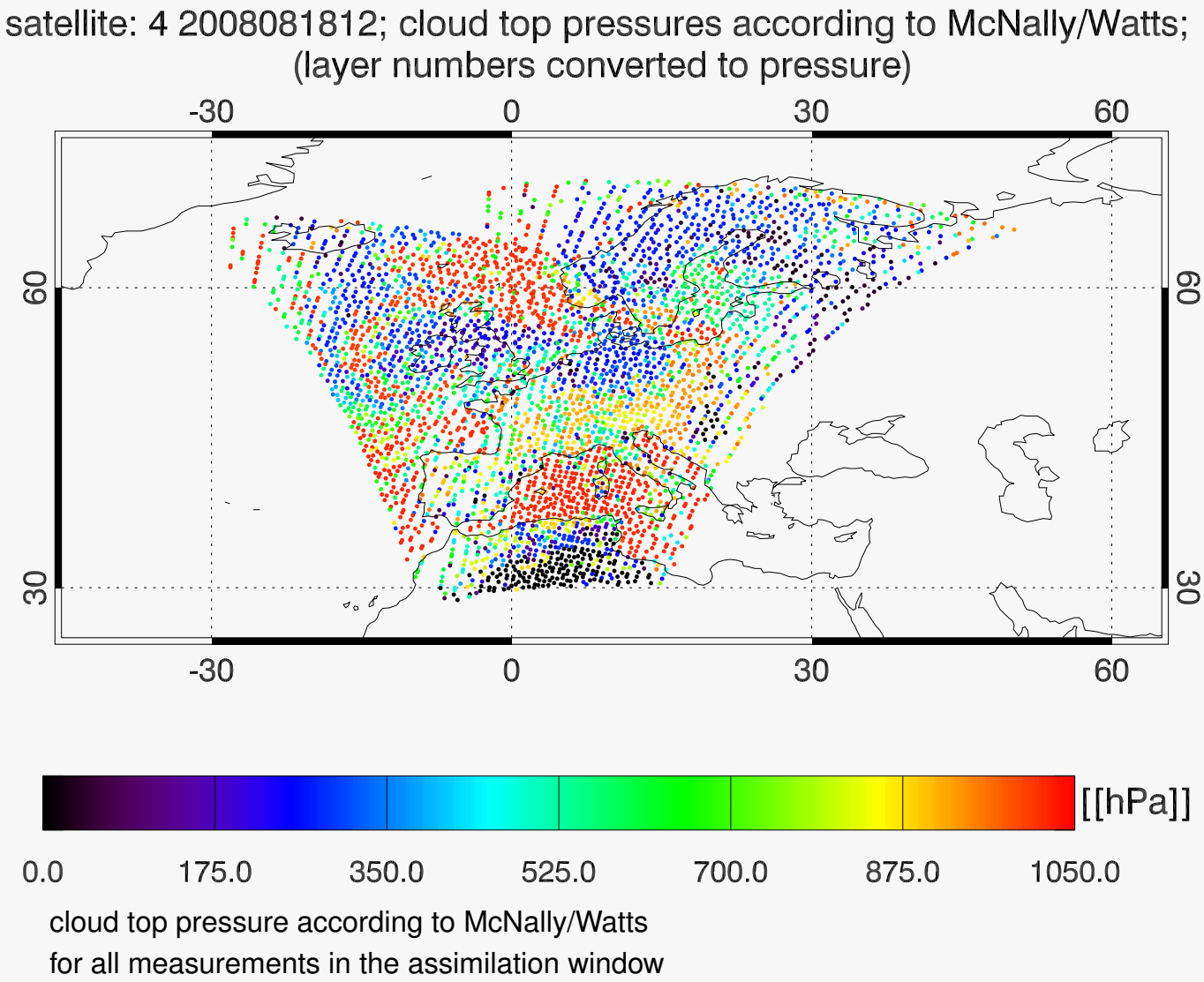
- bias correction (Harris and Kelly (2001)
- cloud detection (McNally and Watts (2003)
- channel selection

cloud detection comparison: Seviri cloud mask



seviri cloud mask at 2008-08-18 10:30 UTC

cloud detection comparison: McNally/Watts



cloud top pressure according to McNally/Watts
for all measurements in the assimilation window

channel selection

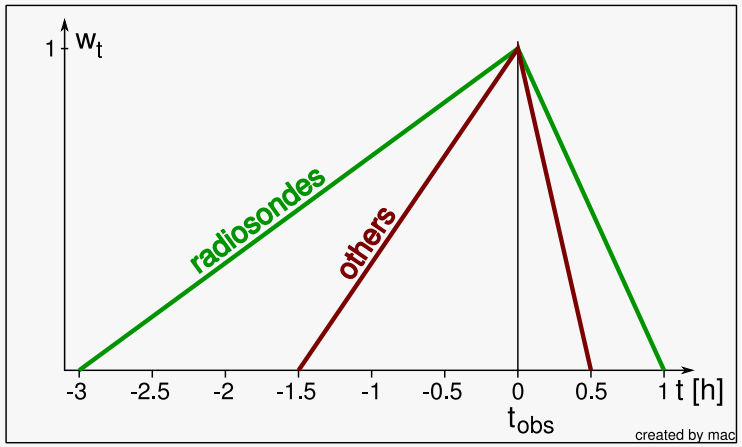
currently two sets:

- **1:** only 112 temperature channels from the 15 μm (666.66 cm^{-1}) band (649 cm^{-1} to 759,25 cm^{-1}) and 18 channels of the 6.25 μm (1600 cm^{-1}) wv band (1212.75 cm^{-1} to 1560.25 cm^{-1})
- **2**: temperature channels as 1 but with 70 additional channels from the 6.25 μm (1600 cm^{-1}) wv band (1212.75 to 1560.25 cm^{-1})

temporal weighting distance

1DVar step

- implementation inside COSMO
- performed 4 times with the current model state as first guess
- 1 $\frac{1}{2}$ h, 1 h, $\frac{1}{2}$ h before, and at observation time



temporal influence of the observations

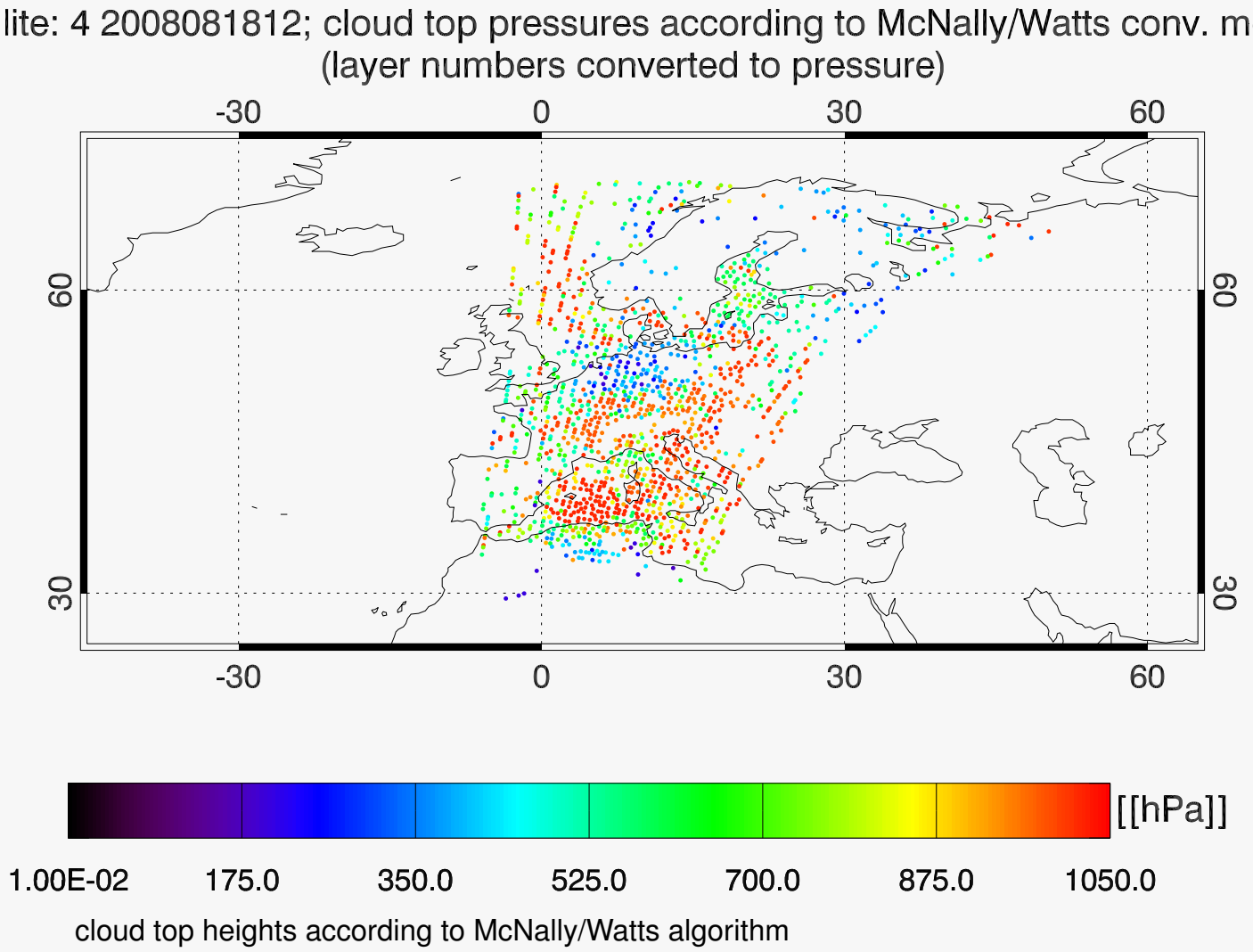
w_t: temporal influence

- **radiosondes:** from 3 h before to 1 h after
- **others:** from 1.5 h before to 0.5 h after

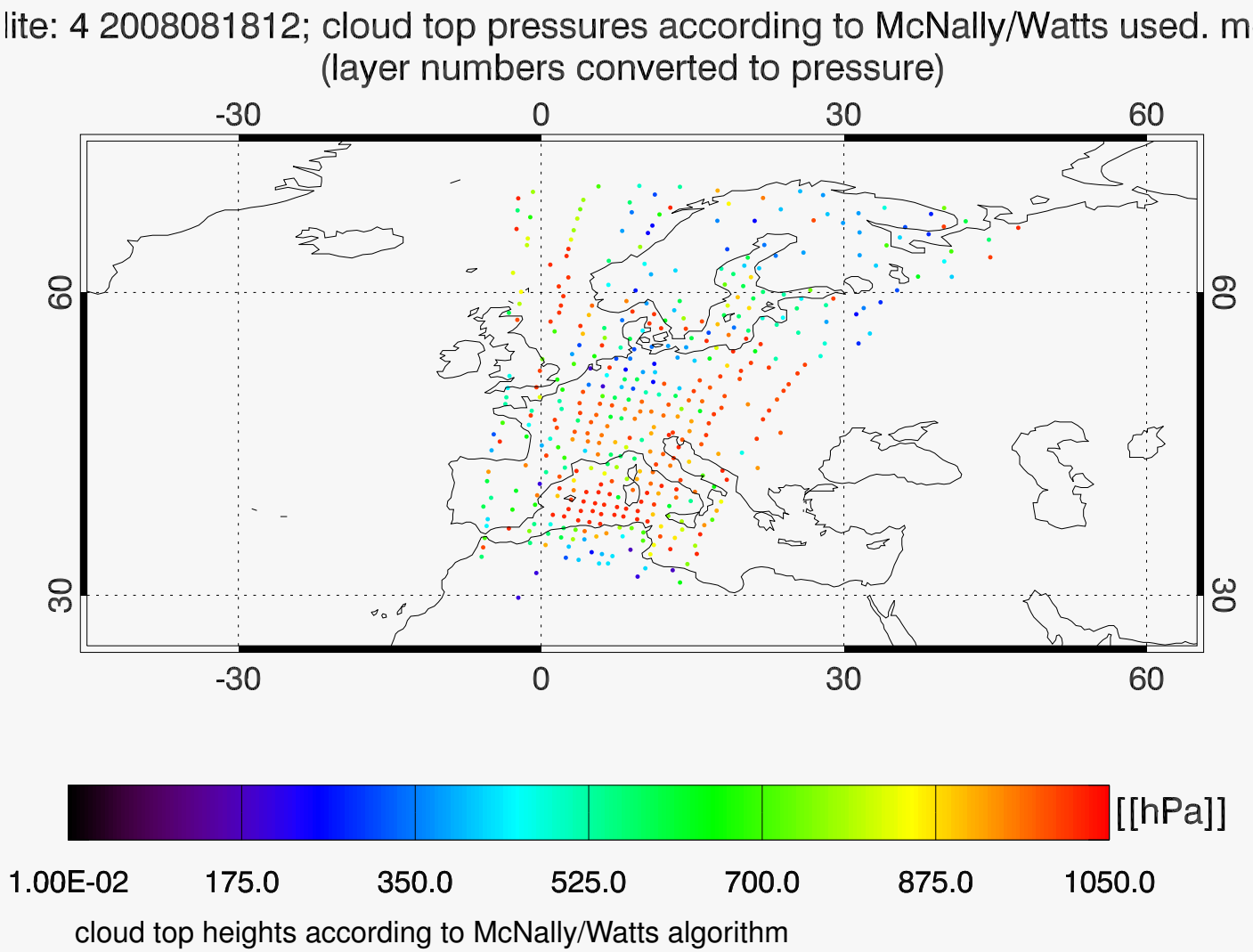
1DVar setup

- first guess creation (bilinear interpolation of the model fields to the observation point having the nearest available ECMWF forecast at model top)
- background error covariance matrix (calculated via NMC method)
- measurement error covariance matrix (c.f., Andrew's talk)
- RT model: RTTOV 9.3
- data thinning – implementation of a new method based on cloud top heights and surface conditions

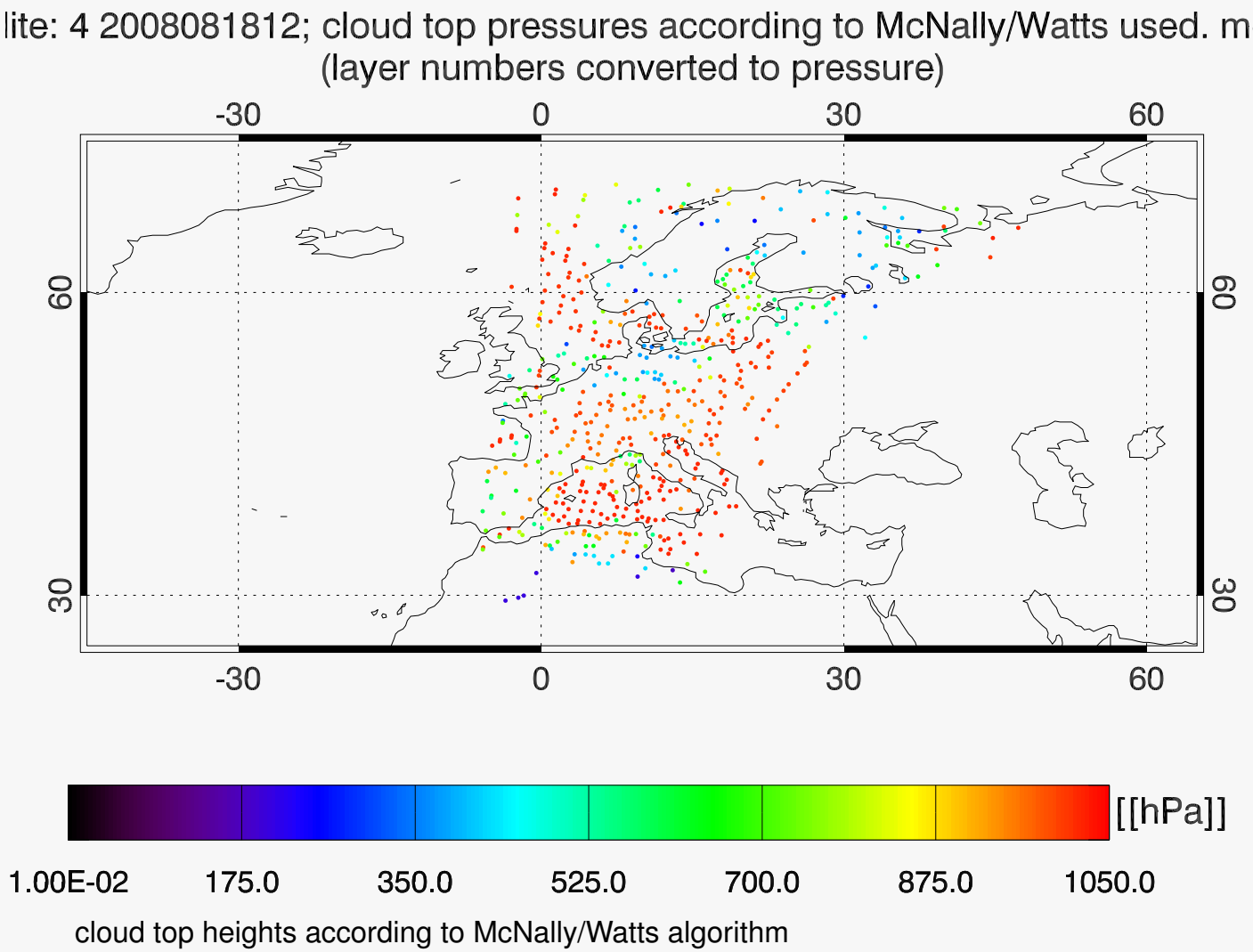
cloud top heights – all converged measurements



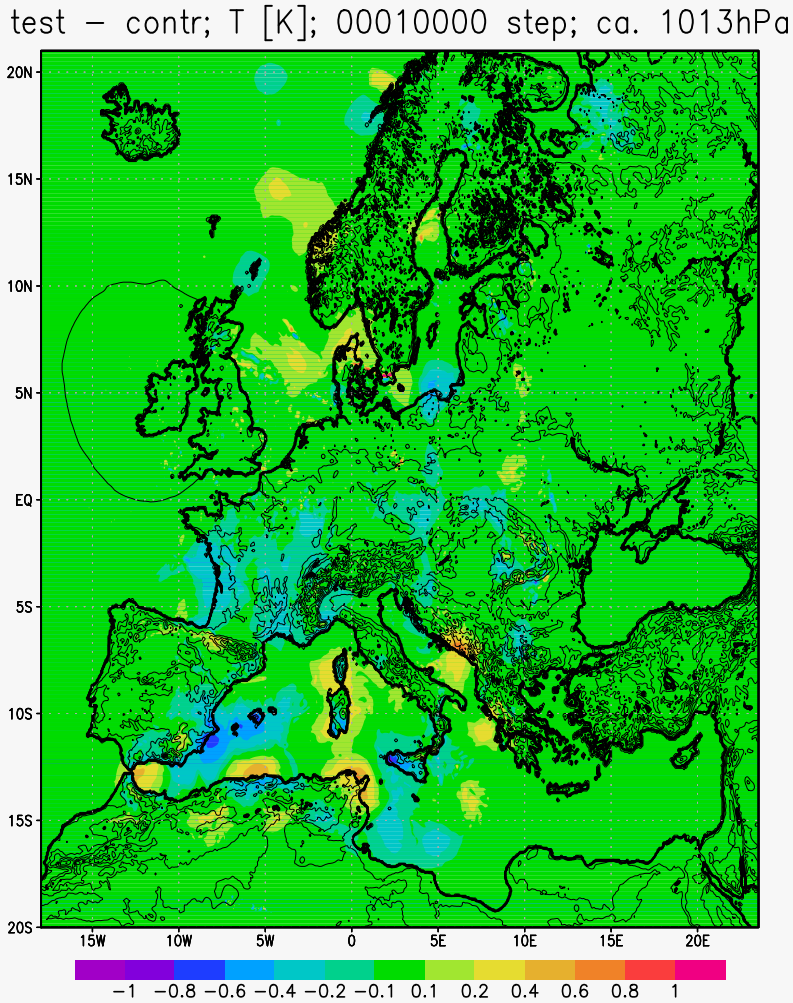
cloud top heights – simple geographic thinning



cloud top heights – thinning based on surface type and CTH

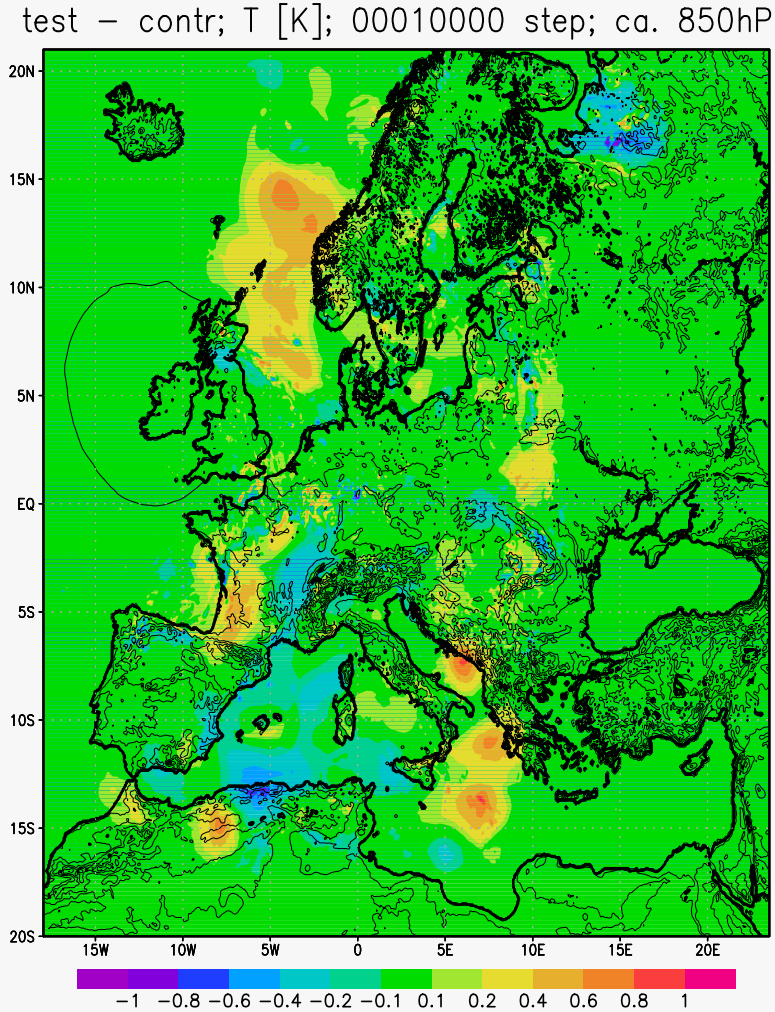


1 hour impact of IASI data – temperature



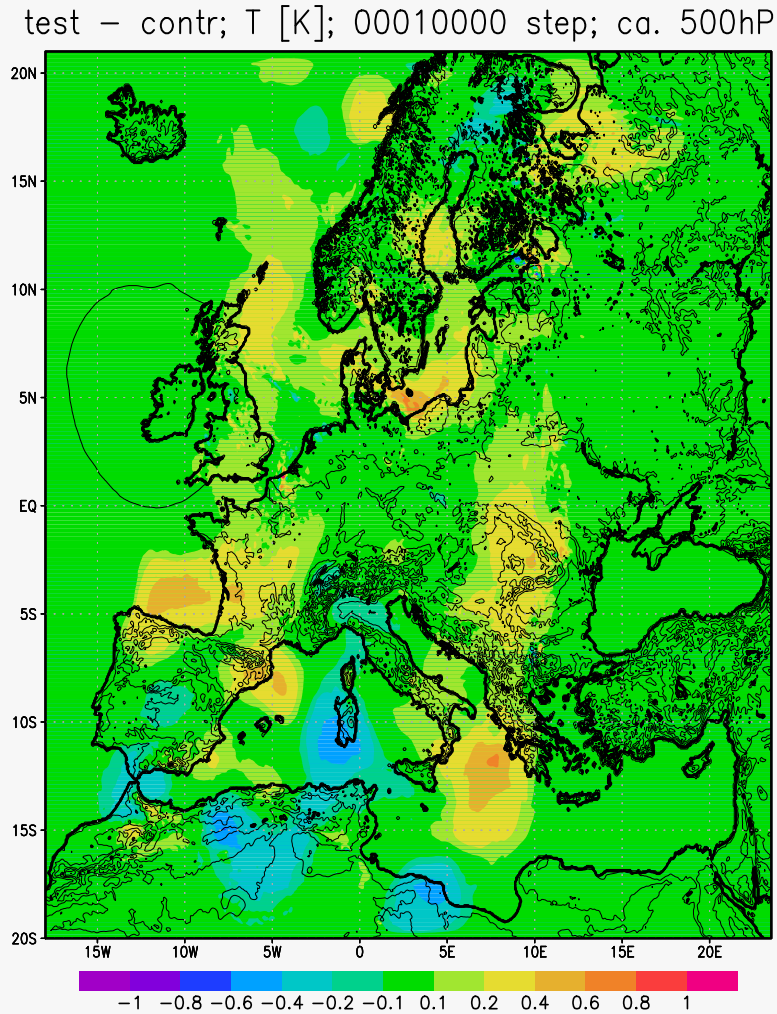
impact of one overflight at 1013 hPa
each 2*nd* measurement used – new thinning

1 hour impact of IASI data – temperature



impact of one overflight at 850 hPa
each 2*nd* measurement used – new thinning

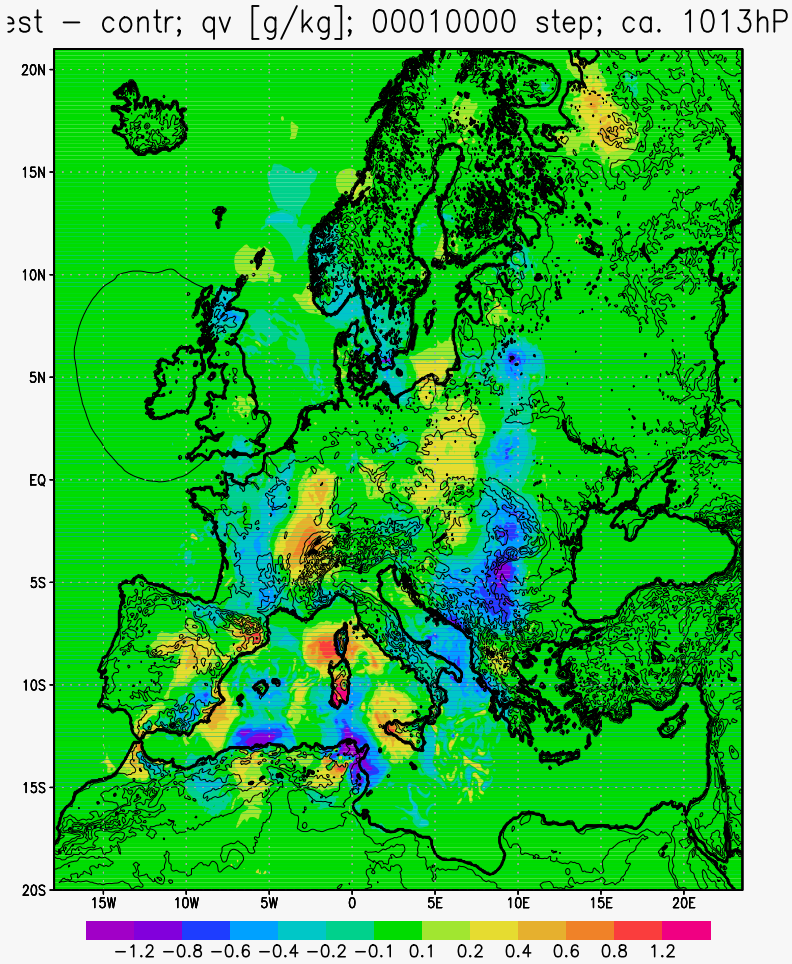
1 hour impact of IASI data – temperature



impact of one overflight at 500 hPa

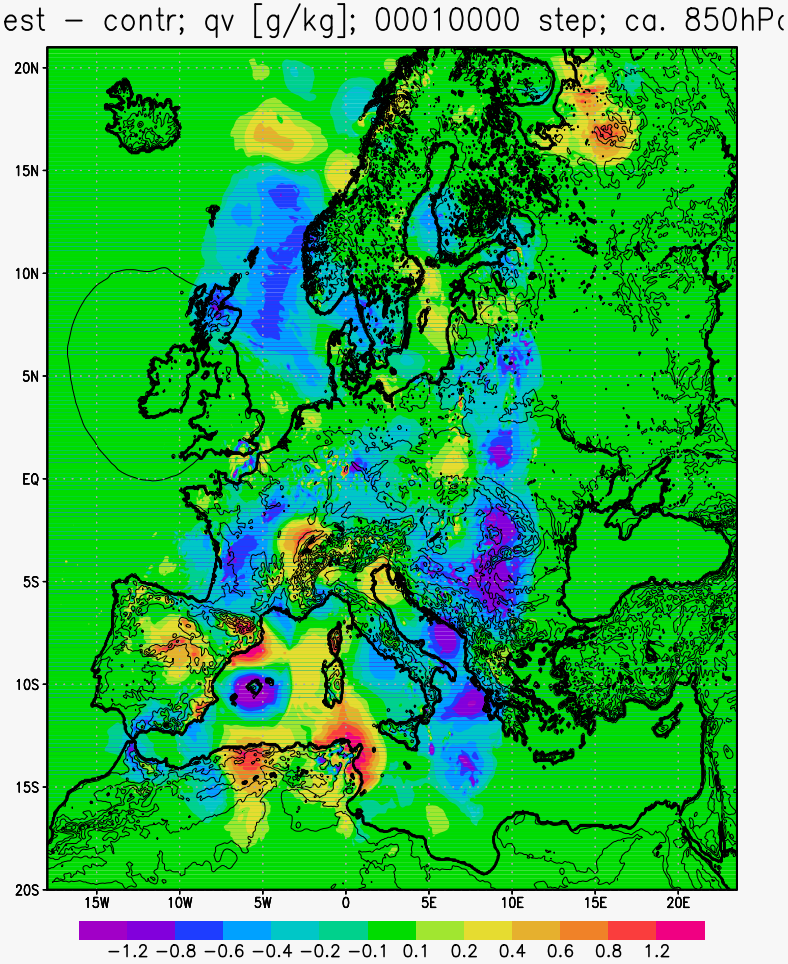
each 2*nd* measurement used – new thinning

1 hour impact of IASI data – humidity



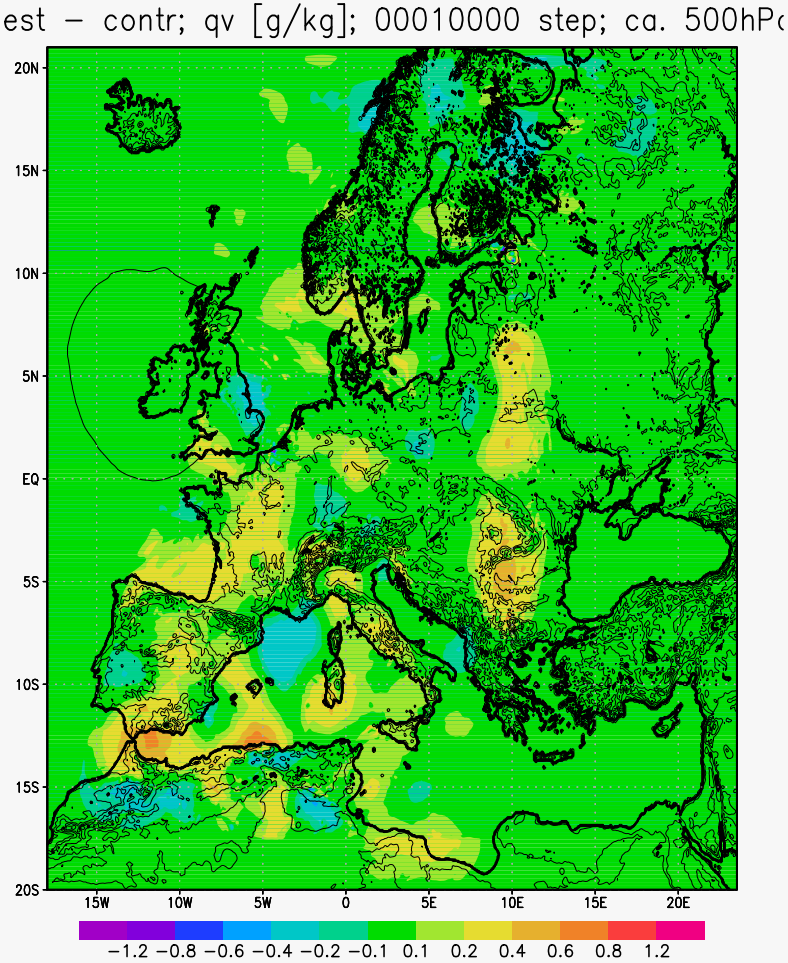
impact of one overflight at 1013 hPa
each measurement used – new thinning

1 hour impact of IASI data – humidity



impact of one overflight at 850 hPa
each measurement used – new thinning

1 hour impact of IASI data – humidity



impact of one overflight at 500 hPa
each measurement used – new thinning

Outline

Experiment setup

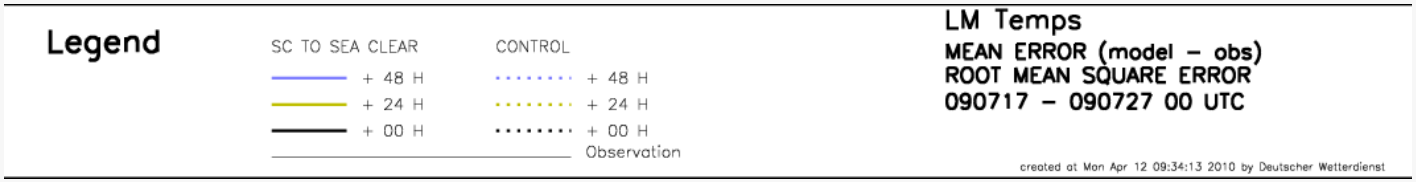
period: 17. 7. 2009 – 27. 7. 2009

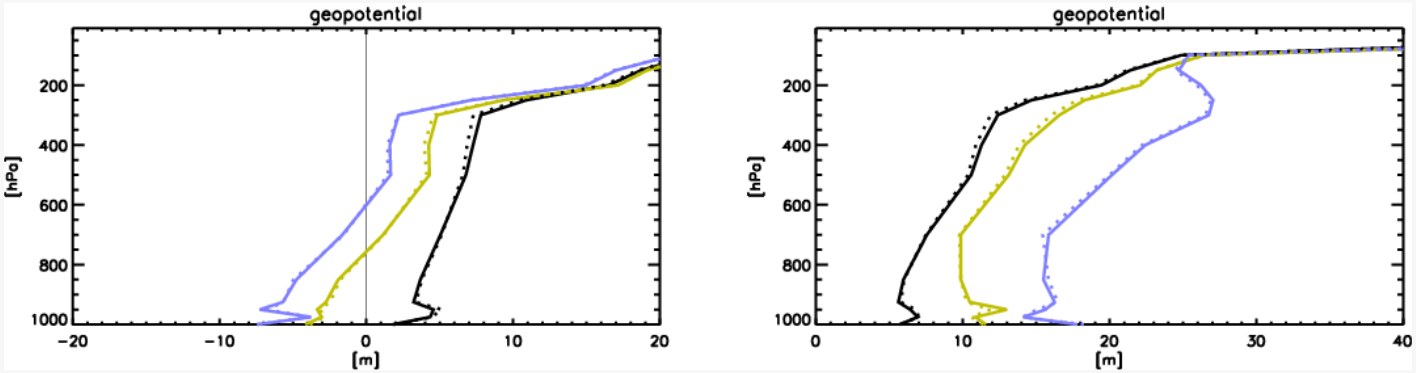
- standard channles – only clear air obs. over sea
- standard channles – only obs. over sea, inclusion of humidity profile in the nuding process
- standard channles – obs. over sea and land
- additional humidtiy channles – obs. over sea and land

period: 2. 10. 2008 – 10. 10. 2008

- 7186: IASI ass. using standard channel set

upper air verification – Exp 7506 – geopotential

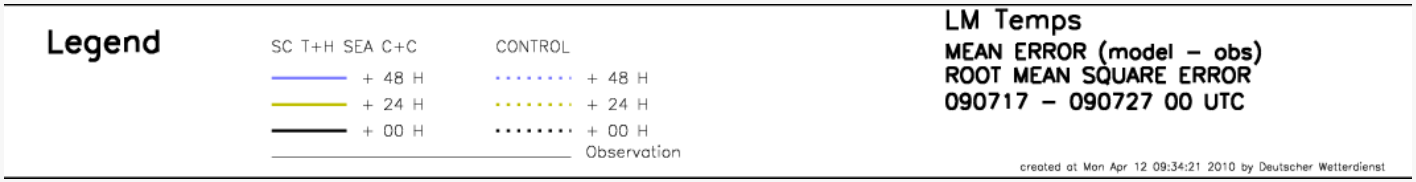


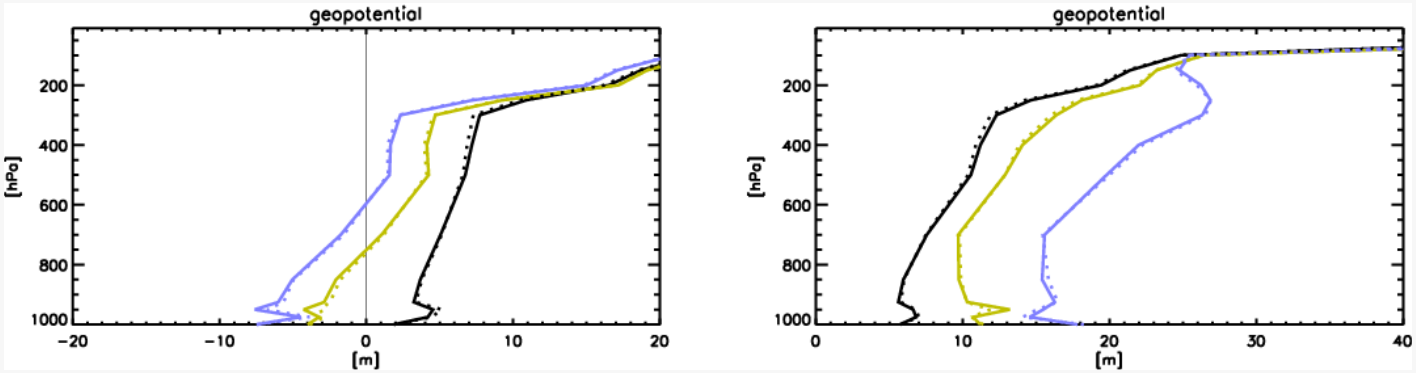


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7509 – geopotential

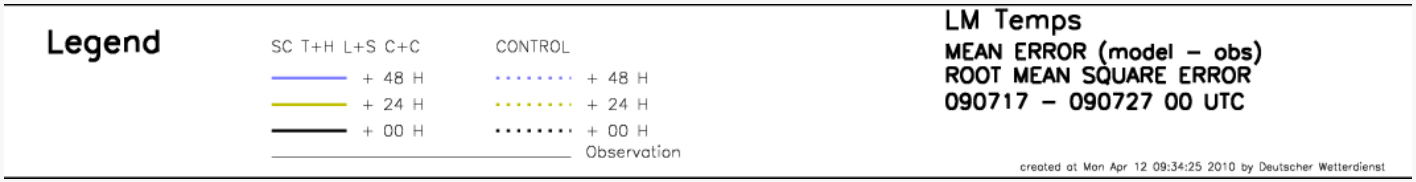


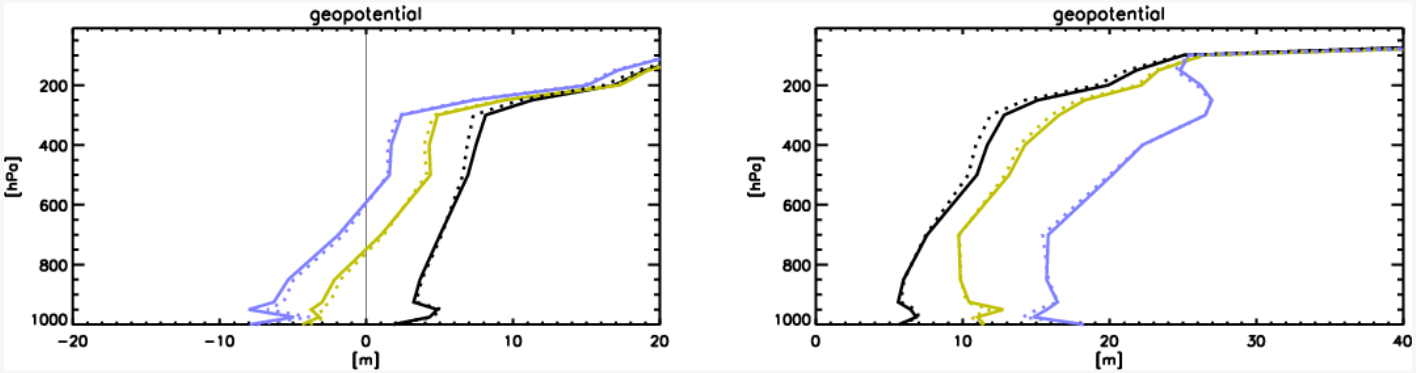


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7510 – geopotential

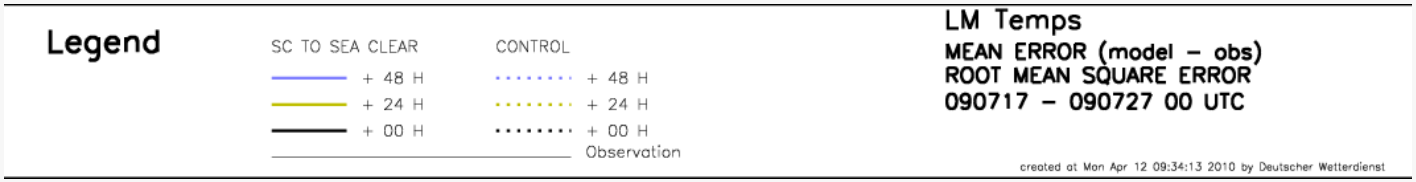


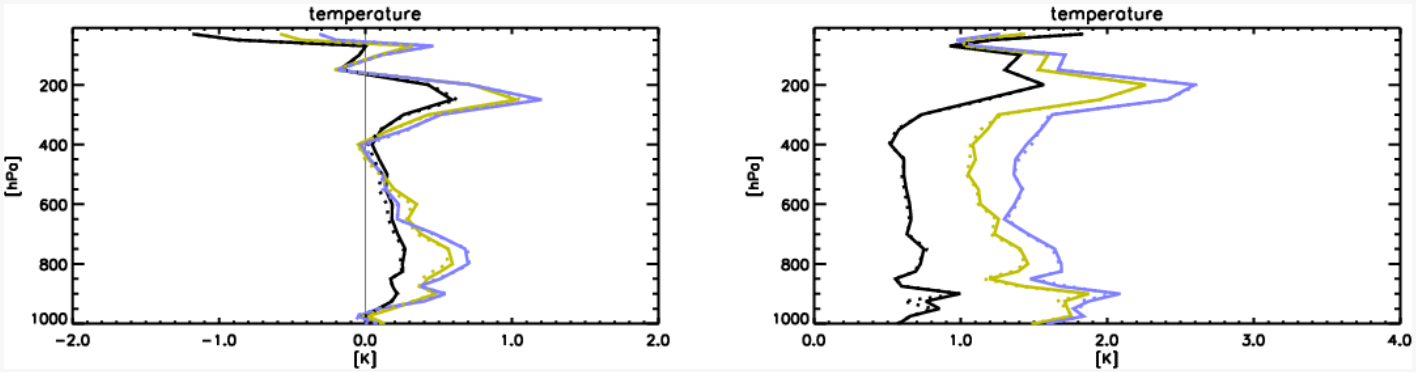


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7506 – temperature

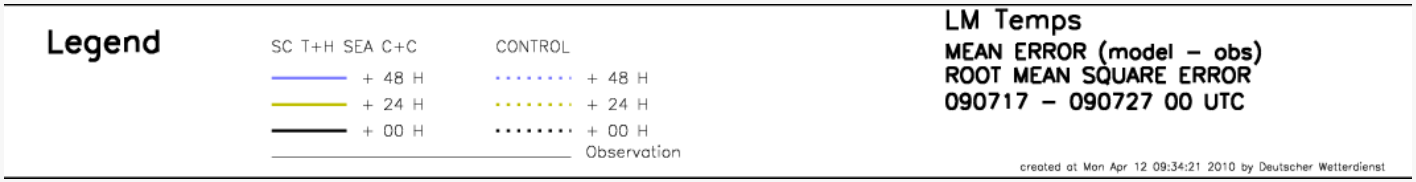


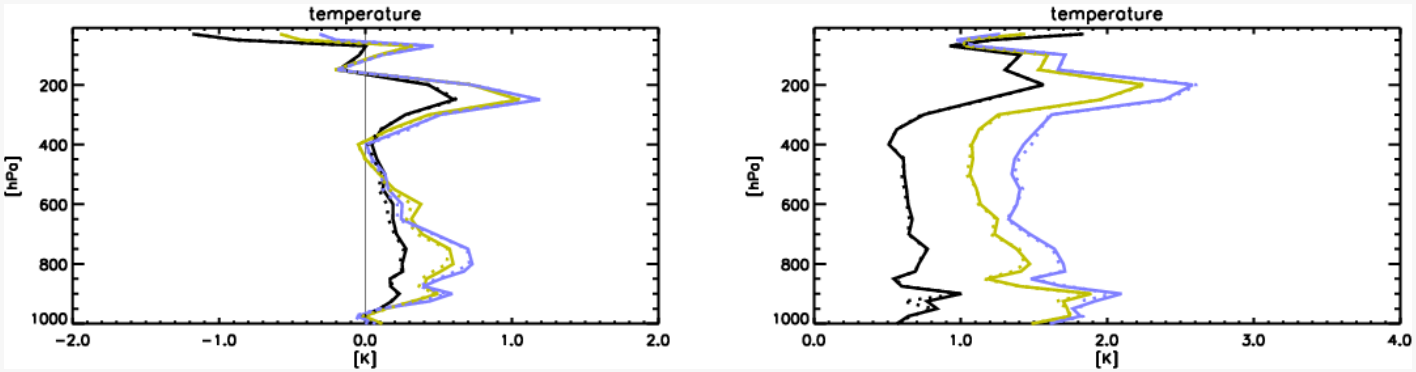


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7509 – temperature

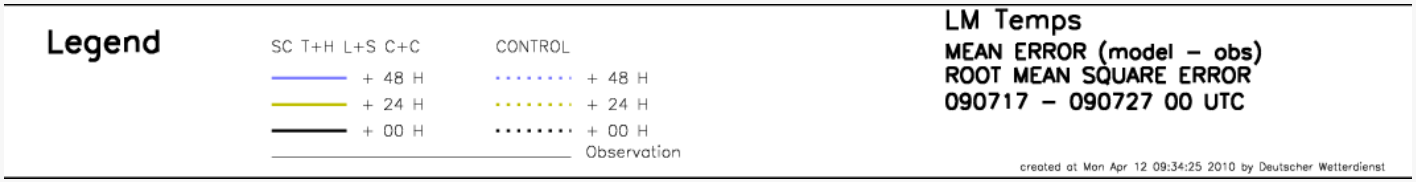


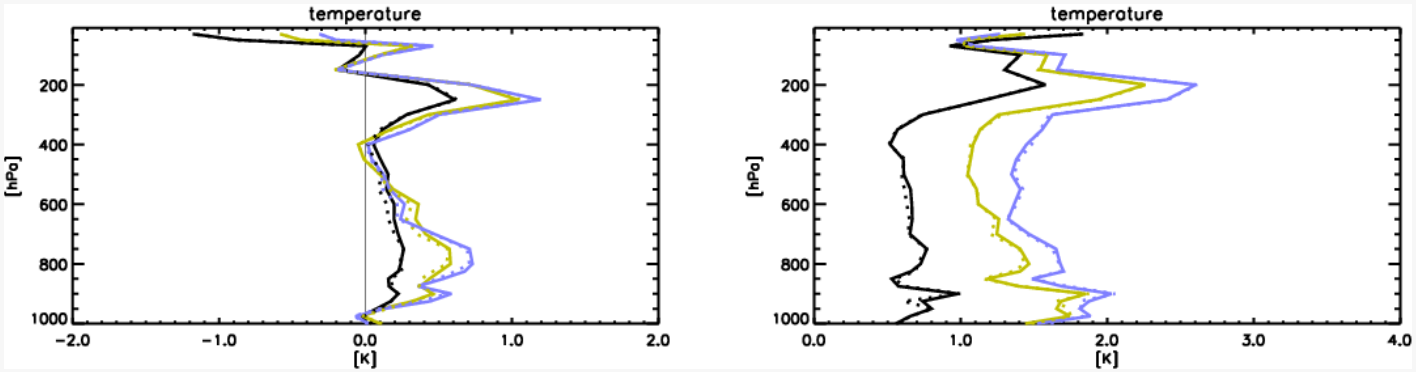


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7510 – temperature

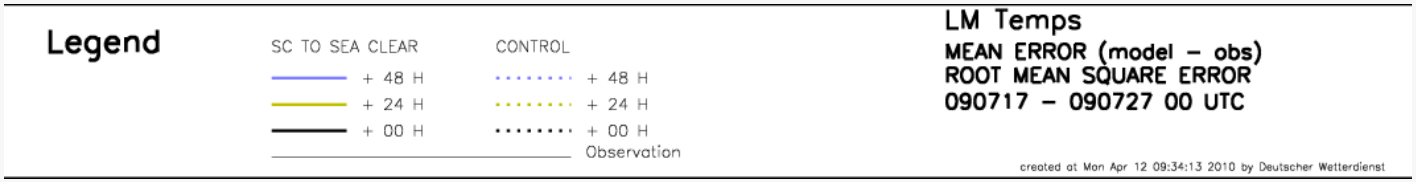


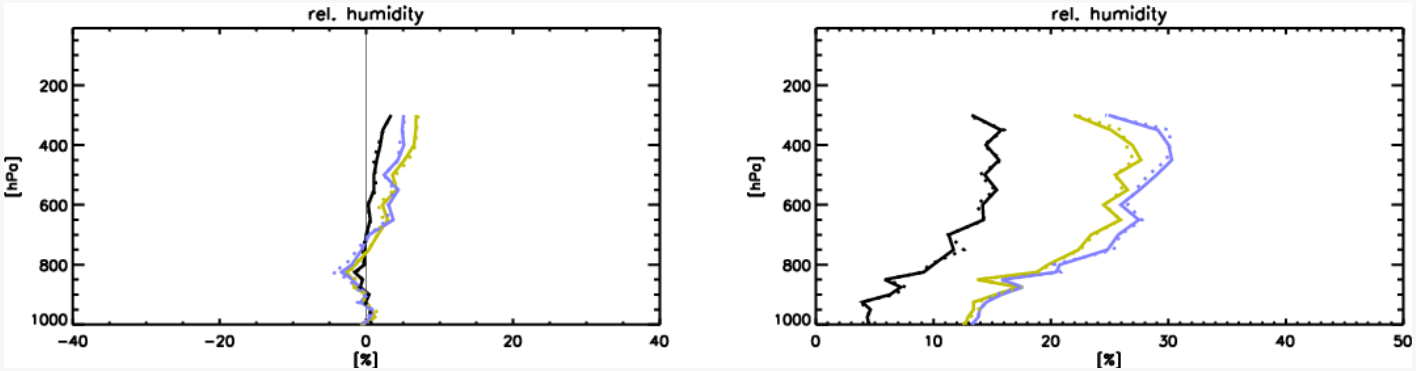


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7506 – relative humidity

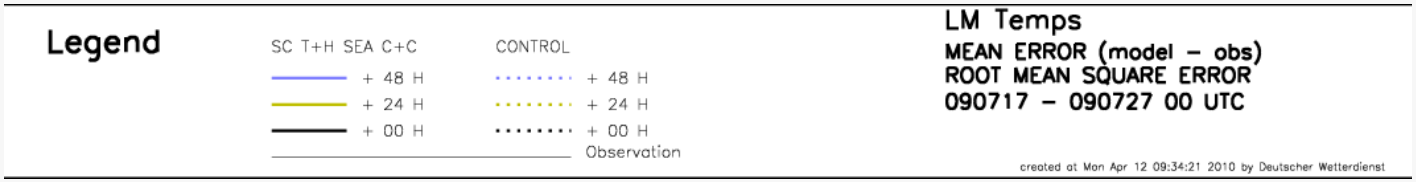


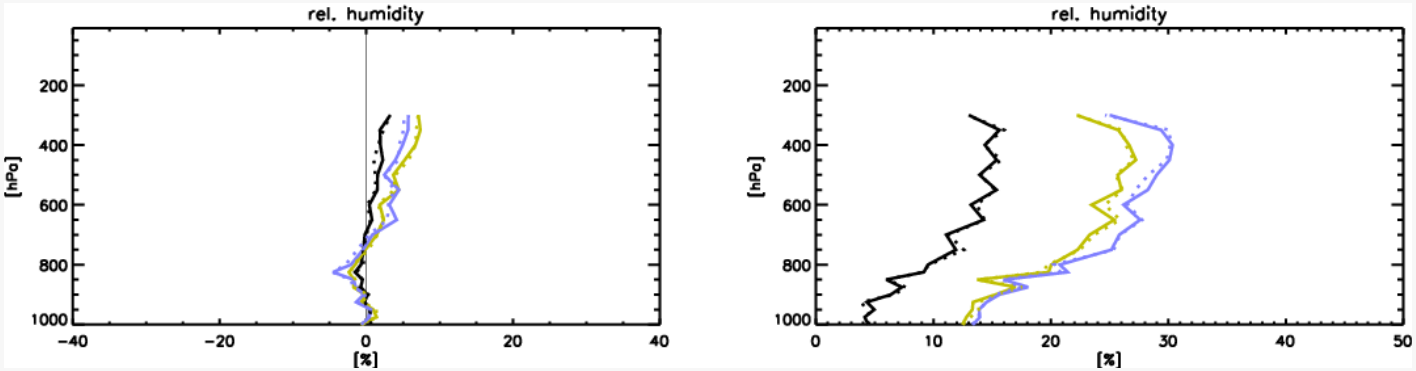


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7509 – relative humidity

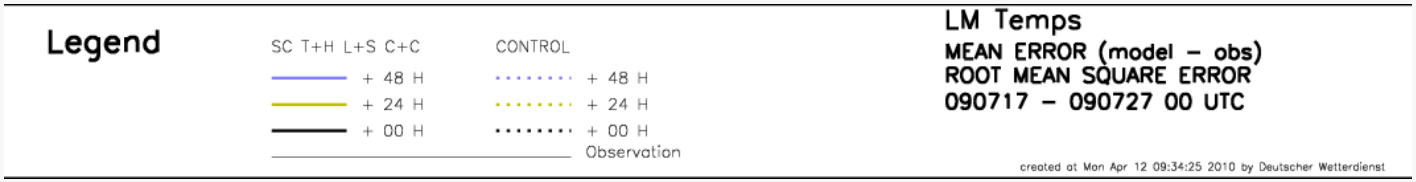


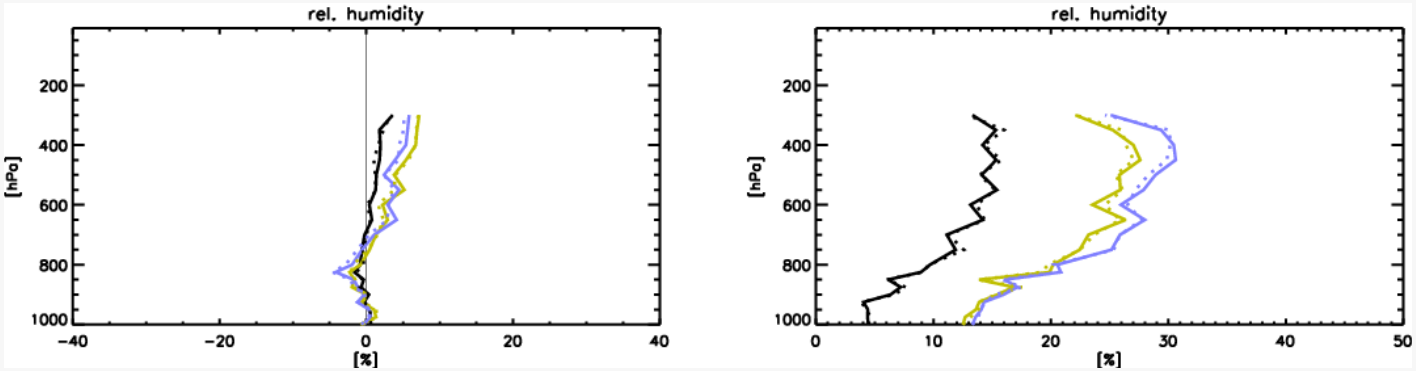


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7510 – relative humidity

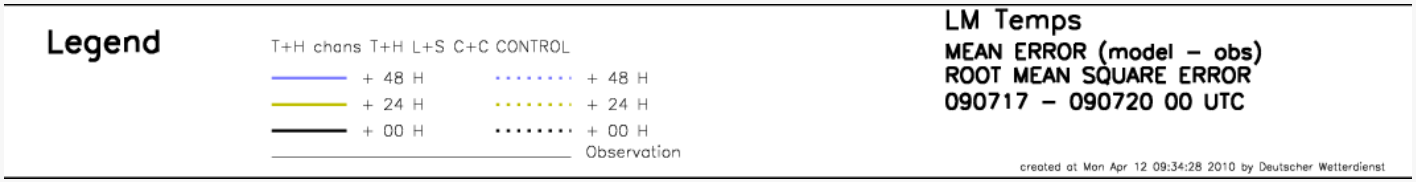


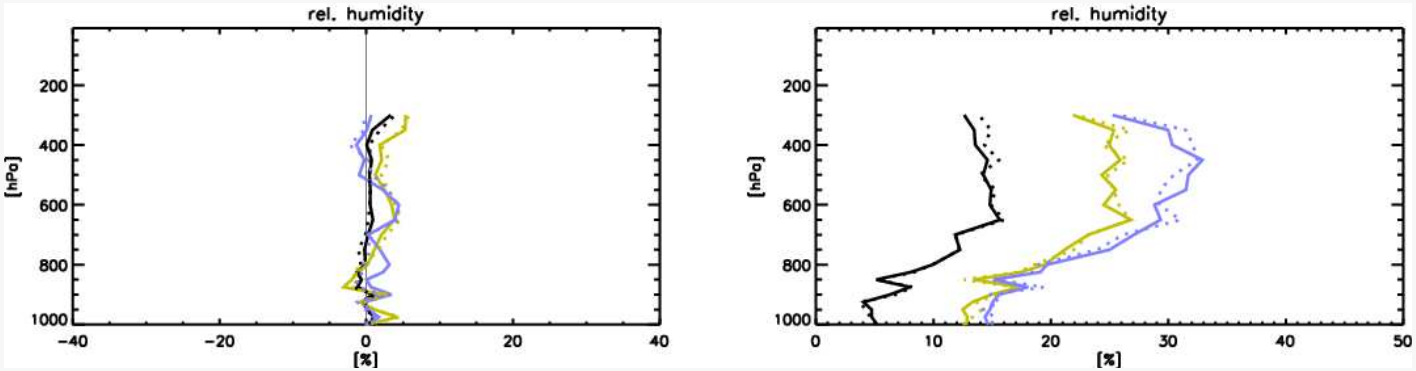


time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7511 00 h – relative humidity

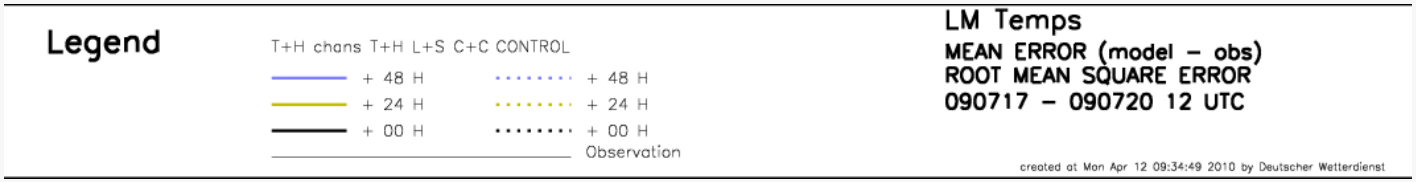


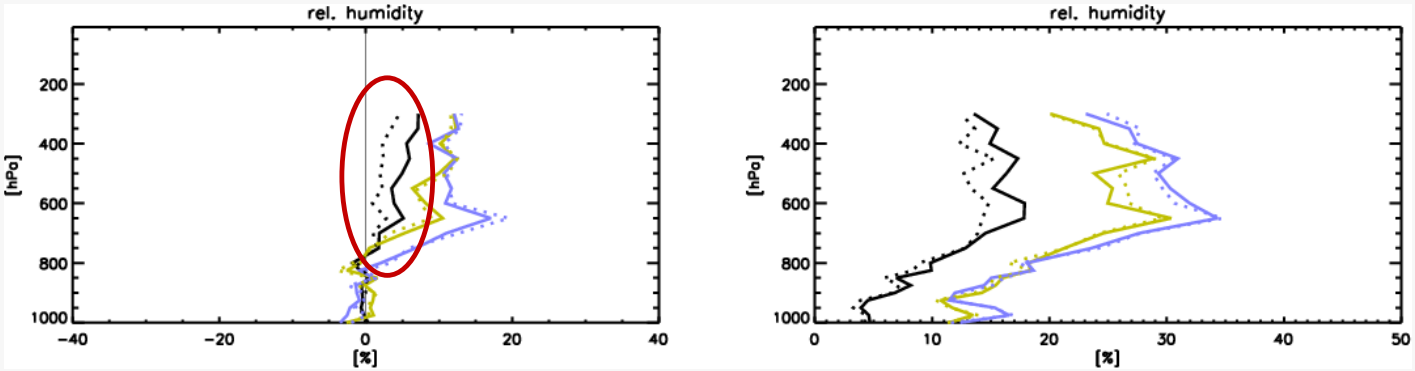


time period 4 days

dotted: reference, solid: experiment

upper air verification – Exp 7511 12 h – relative humidity

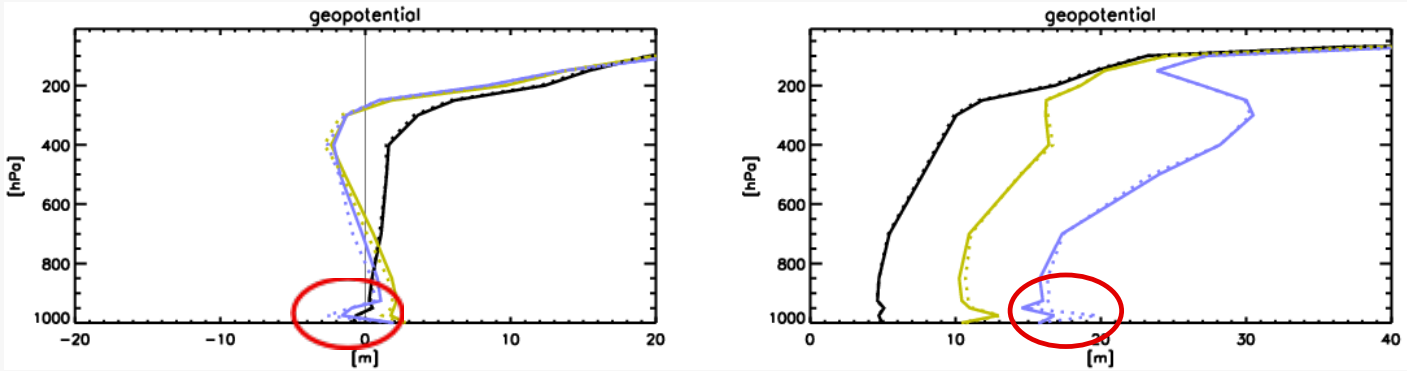




time period 4 days

dotted: reference, solid: experiment

upper air verification – Exp 7186 – geopotential



time period 8 days

dotted: reference, solid: experiment

Outline

Summary

in general

- positive impact if weather situation is stable in general (exp 7186)
- neutral impact if there is an advective situation
- 0 UTC runs perform better than the 12 UTC runs

problems

- additional humidity channels $\Rightarrow$ problems at 12:00 h analysis
- model is ignoring the additional information
- in general no significant change.

ThanX!

for your attention!