

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

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data preparation
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I got great support from many people

special thanks to

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

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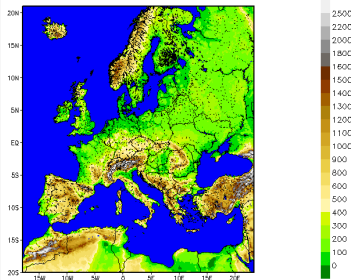
Local Model COSMO-EU

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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

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

- hence: combination of nudging with a 1DVar



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data preparation

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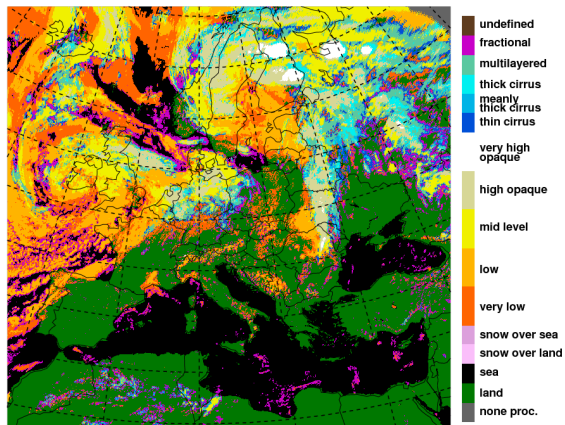
summary

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



NWCSAF/MSG Cloudtype 2008-08-18 10:30 UTC

DWD 2009

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

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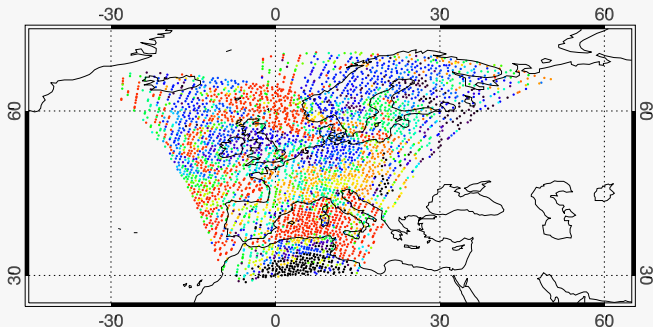
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summary



cloud detection comparison: McNally/Watts

satellite: 4 2008081812; cloud top pressures according to McNally/Watts;
(layer numbers converted to pressure)



0.0 175.0 350.0 525.0 700.0 875.0 1050.0

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

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channel selection

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EUMETSAT

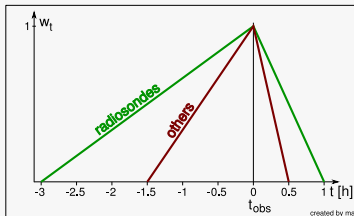
currently two sets:

- **1:** only 112 temperature channels from the $15 \mu\text{m}$ (666.66 cm^{-1}) band (649 cm^{-1} to $759,25 \text{ cm}^{-1}$) and 18 channels of the $6.25 \mu\text{m}$ (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 $6.25 \mu\text{m}$ (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



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

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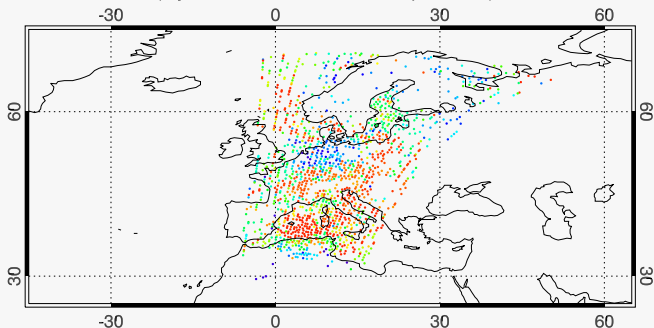
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cloud top heights – all converged measurements

lite: 4 2008081812; cloud top pressures according to McNally/Watts conv. me
(layer numbers converted to pressure)



1.00E-02 175.0 350.0 525.0 700.0 875.0 1050.0

cloud top heights according to McNally/Watts algorithm

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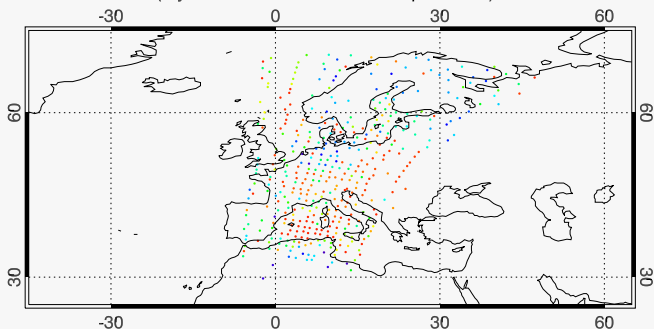
s'n'o

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cloud top heights – simple geographic thinning

lite: 4 2008081812; cloud top pressures according to McNally/Watts used. me
(layer numbers converted to pressure)



1.00E-02 175.0 350.0 525.0 700.0 875.0 1050.0

cloud top heights according to McNally/Watts algorithm

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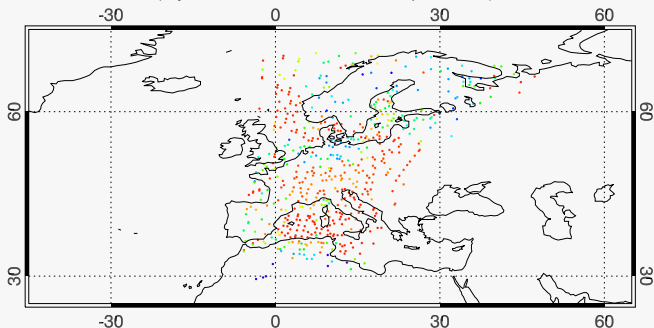
s'n'o

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cloud top heights – thinning based on surface type and CTH

lite: 4 2008081812; cloud top pressures according to McNally/Watts used. mc
(layer numbers converted to pressure)



1.00E-02 175.0 350.0 525.0 700.0 875.0 1050.0

cloud top heights according to McNally/Watts algorithm

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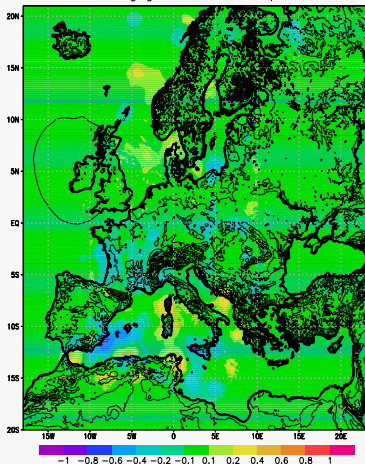
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1 hour impact of IASI data – temperature

test – contr; T [K]; 00010000 step; ca. 1013hPa



impact of one overflight at 1013 hPa

each 2nd measurement used – new thinning

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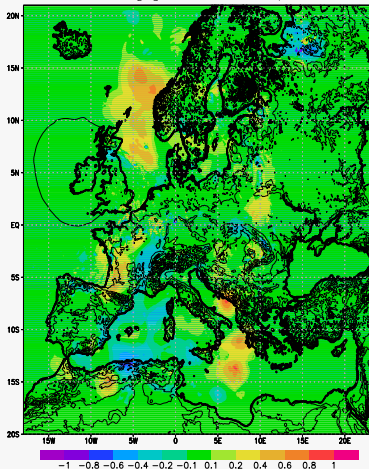
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1 hour impact of IASI data – temperature

test – contr; T [K]; 00010000 step; ca. 850hPa



impact of one overflight at 850 hPa

each 2nd measurement used – new thinning

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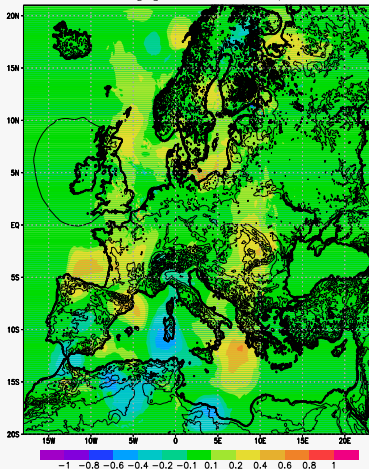
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1 hour impact of IASI data – temperature

test – contr; T [K]; 00010000 step; ca. 500hPa



impact of one overflight at 500 hPa

each 2nd measurement used – new thinning

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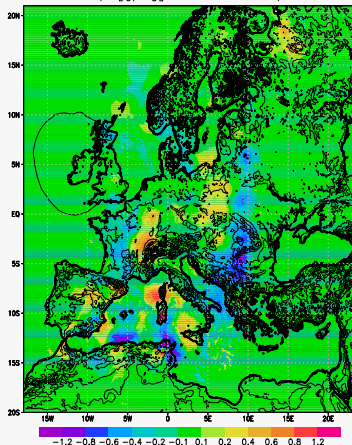
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1 hour impact of IASI data – humidity

3st - contr; qv [g/kg]; 00010000 step; ca. 1013hP



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

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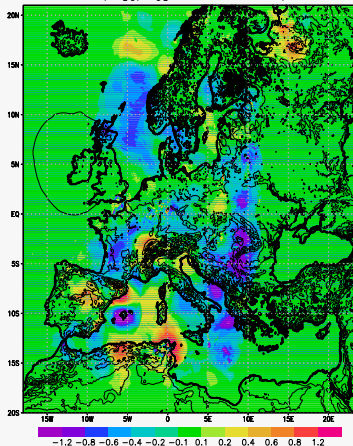
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1 hour impact of IASI data – humidity

est - contr; qv [g/kg]; 00010000 step; ca. 850hPa



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

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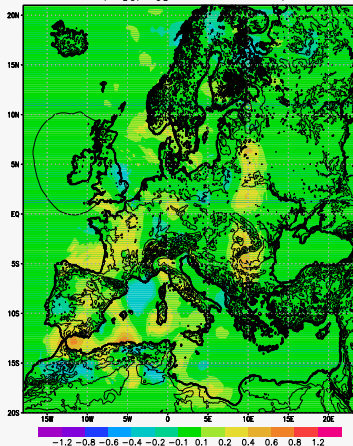
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1 hour impact of IASI data – humidity

est - contr; qv [g/kg]; 00010000 step; ca. 500hPa



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

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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 nudging process
- standard channles – obs. over sea and land
- additional humiddtiy channles – obs. over sea and land

period: 2. 10. 2008 – 10. 10. 2008

- 7186: IASi ass. using standard channel set

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upper air verification – Exp 7506 – geopotential

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Legend

SC TO SEA CLEAR

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— + 48 H

- - - + 48 H

— + 24 H

- - - + 24 H

— + 00 H

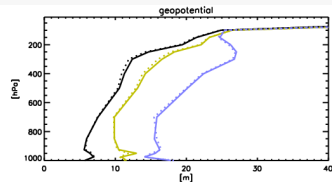
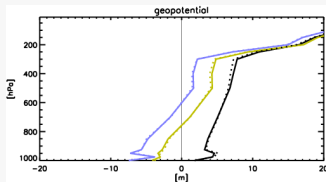
- - - + 00 H

— Observation

LM Temps

MEAN ERROR (model - obs)
ROOT MEAN SQUARE ERROR
090717 - 090727 00 UTC

created at Mon Apr 12 09:34:13 2010 by Deutscher Wetterdienst



time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7509 – geopotential

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SC T+H SEA C+C

CONTROL

— + 48 H

- - - + 48 H

— + 24 H

- - - + 24 H

— + 00 H

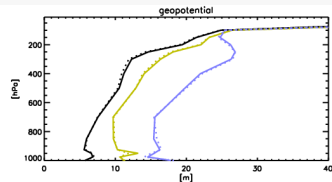
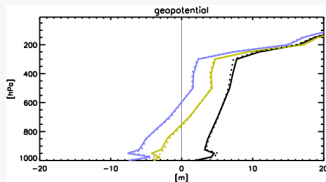
- - - + 00 H

— Observation

LM Temps

MEAN ERROR (model - obs)
ROOT MEAN SQUARE ERROR
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time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7510 – geopotential

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Legend

SC T+H L+S C+C

— + 48 H
— + 24 H
— + 00 H

CONTROL

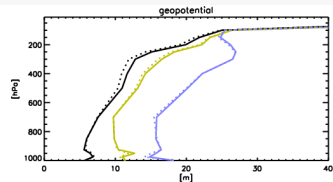
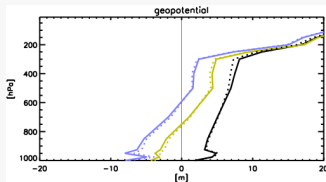
⋯ + 48 H
⋯ + 24 H
⋯ + 00 H

— Observation

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time period 10 days

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upper air verification – Exp 7506 – temperature

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SC TO SEA CLEAR

+ 48 H

+ 24 H

+ 00 H

CONTROL

+ 48 H

+ 24 H

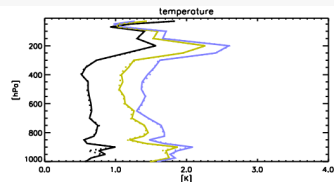
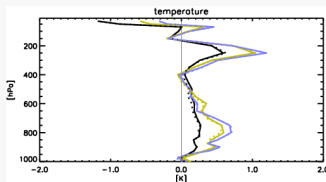
+ 00 H

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time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7509 – temperature

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SC T+H SEA C+C

+ 48 H

+ 24 H

+ 00 H

CONTROL

+ 48 H

+ 24 H

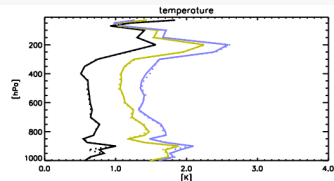
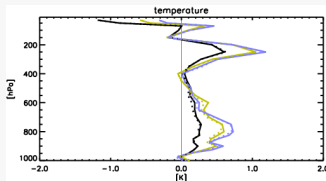
+ 00 H

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dotted: reference, solid: experiment

upper air verification – Exp 7510 – temperature

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SC T+H L+S C+C

— + 48 H
— + 24 H
— + 00 H

CONTROL

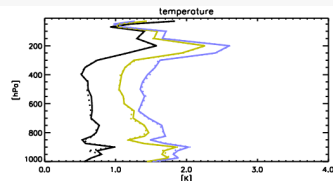
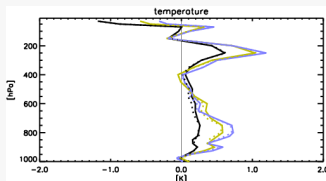
⋯ + 48 H
⋯ + 24 H
⋯ + 00 H

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MEAN ERROR (model - obs)
ROOT MEAN SQUARE ERROR
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created at Mon Apr 12 09:34:25 2010 by Deutscher Wetterdienst



time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7506 – relative humidity

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+ 48 H

+ 24 H

+ 00 H

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+ 48 H

+ 24 H

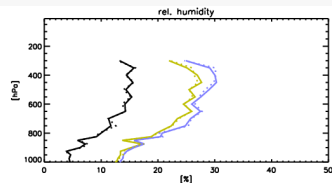
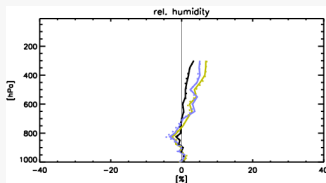
+ 00 H

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MEAN ERROR (model - obs)
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time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7509 – relative humidity

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SC T+H SEA C+C

+ 48 H

+ 24 H

+ 00 H

CONTROL

+ 48 H

+ 24 H

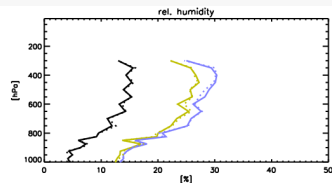
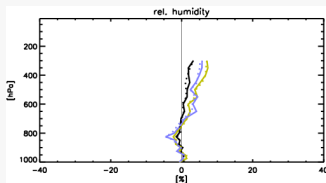
+ 00 H

Observation

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created at Mon Apr 12 09:34:21 2010 by Deutscher Wetterdienst



time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7510 – relative humidity

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+ 48 H

+ 24 H

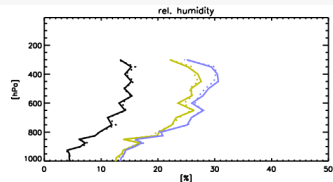
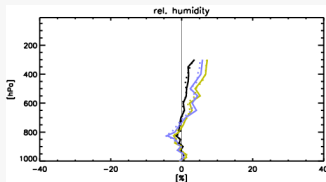
+ 00 H

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MEAN ERROR (model - obs)
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time period 10 days

dotted: reference, solid: experiment

upper air verification – Exp 7511 00 h – relative humidity

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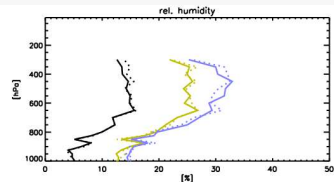
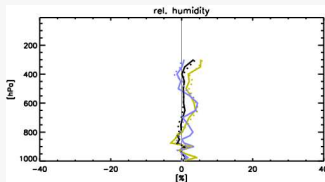
T+H chans T+H L+S C+C CONTROL



LM Temps

MEAN ERROR (model - obs)
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090717 - 090720 00 UTC

created at Mon Apr 12 09:34:28 2010 by Deutscher Wetterdienst



time period 4 days

dotted: reference, solid: experiment

upper air verification – Exp 7511 12 h – relative humidity

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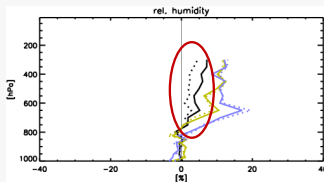
T+H chans T+H L+S C+C CONTROL



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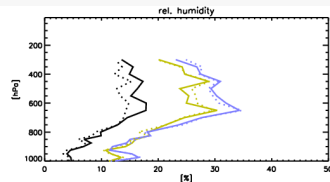
MEAN ERROR (model - obs)
ROOT MEAN SQUARE ERROR
090717 - 090720 12 UTC

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dotted: reference, solid: experiment



upper air verification – Exp 7186 – geopotential

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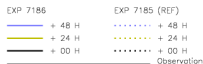
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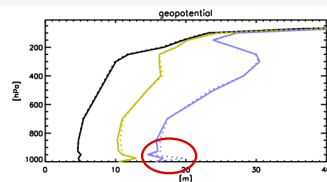
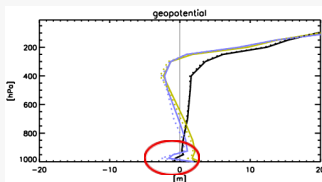
Legend



LM Temps

MEAN ERROR (model - obs)
ROOT MEAN SQUARE ERROR
081002 - 081010 12 UTC

created at Fri Jan 15 10:06:23 2010 by Deutscher Wetterdienst



time period 8 days

dotted: reference, solid: experiment

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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.

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ThanX!

for your attention!