Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Assimilation of ground based GNSS data at German Met-Service (DWD) -Status Quo-

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* Since March 2011 Karolin has joined WMO as a young professional

Outline

- Introduction
- Experiences with assimilation into regional model COSMO-DE (realised by Karolin Eichler)
- Remarks and Plans

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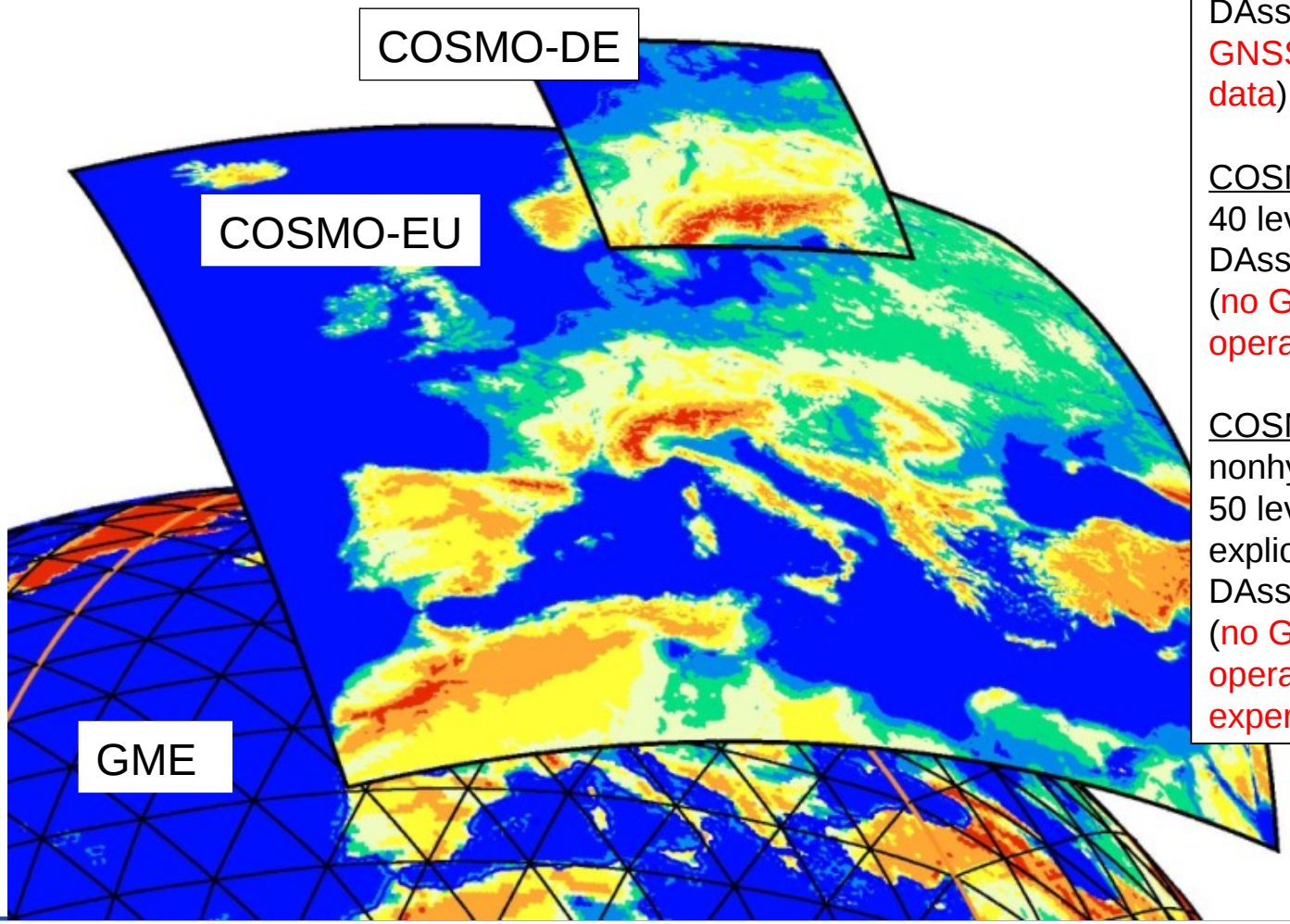
Operational NWP-models at DWD



GME:
60 levels, 30km resolution
DAss: 3d Var (includes GNSS-radio-occultation data)

COSMO-EU:
40 levels, 7km resolution
DAss: nudging
(no GNSS data used operationally)

COSMO-DE:
nonhydrostatic
50 levels, 2.8 km resolution
explicit convection
DAss: nudging + LHN
(no GNSS data used operationally, but experimental trials)

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Assimilation of IWV into COSMO-DE

- Nudging DA requires prognostic variables to be assimilated
- IWV values obtained from ZTD are applied
- As IWV is not a prognostic variable a pseudo observation of specific humidity is created by scaling the simulated profile ($q_{v_{gs}}$)

$$q_{v_{ob}} = q_{v_{gs}} \cdot \frac{IWV_{ob}^{(corr)}}{IWV_{gs}}$$

- If a layer is already saturated, the increment is shifted to other model layers
- Redundancy Check by ranking the processing centre

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Experiences of IWV assimilation at DWD

1. Summer experiment (July 2009):
   - ➔ Beneficial on assimilation
   - ➔ Slightly beneficial on forecasts
   - ➔ Less data available due to short cut off (NRT mode)
   - ➔ QRT data would increase benefit on forecast
1. Winter experiment (January 2010):
   - ➔ Detrimental on assimilation
     - ➔ tremendous overestimation of precipitation
     - ➔ To fast dissolving of high fog
   - ➔ Even so slightly beneficial on forecast
   - ➔ Assimilation leads to unrealistic increase of cloud ice (saturation over ice is lower than over water)
   - ➔ Rejecting data in cloud icy model layers might fix the problem but might also reduce the impact in general

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Retry of Winter experiment with less cloud ice

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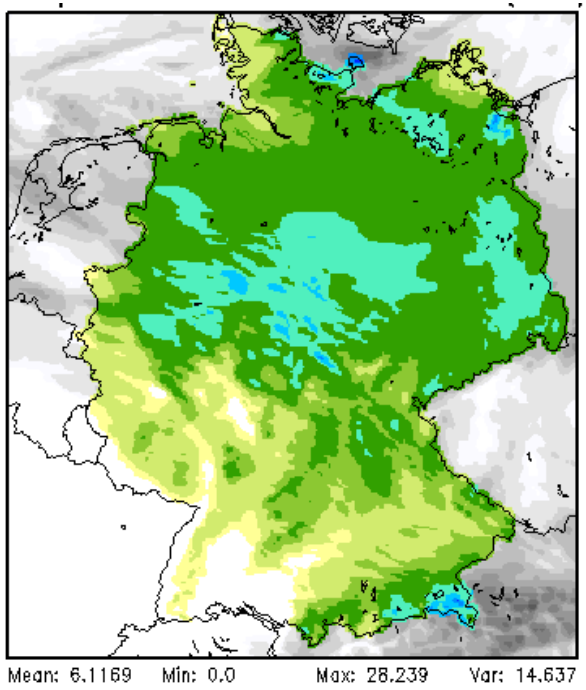
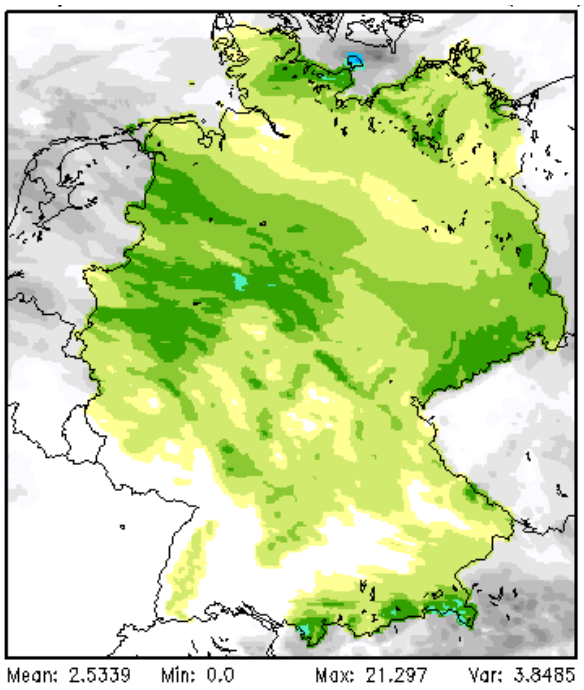
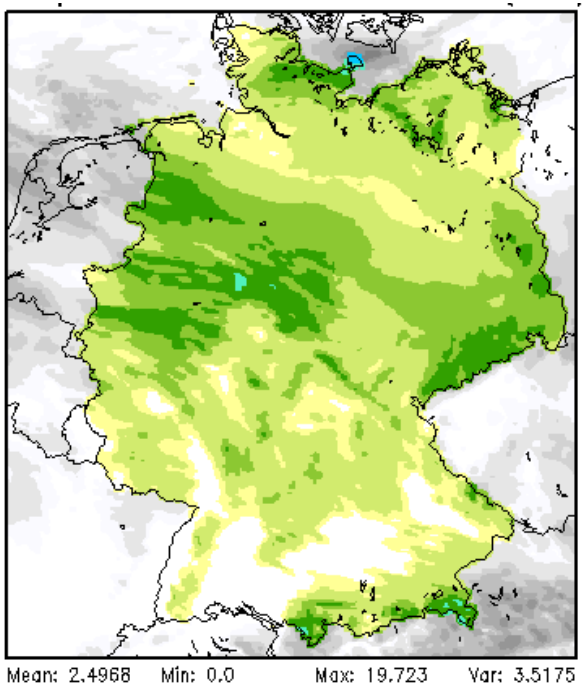
24h precipitation sum at 02.01.2010



old run



new run



control run

Overestimation of precipitation can be reduced, but slight impact remain

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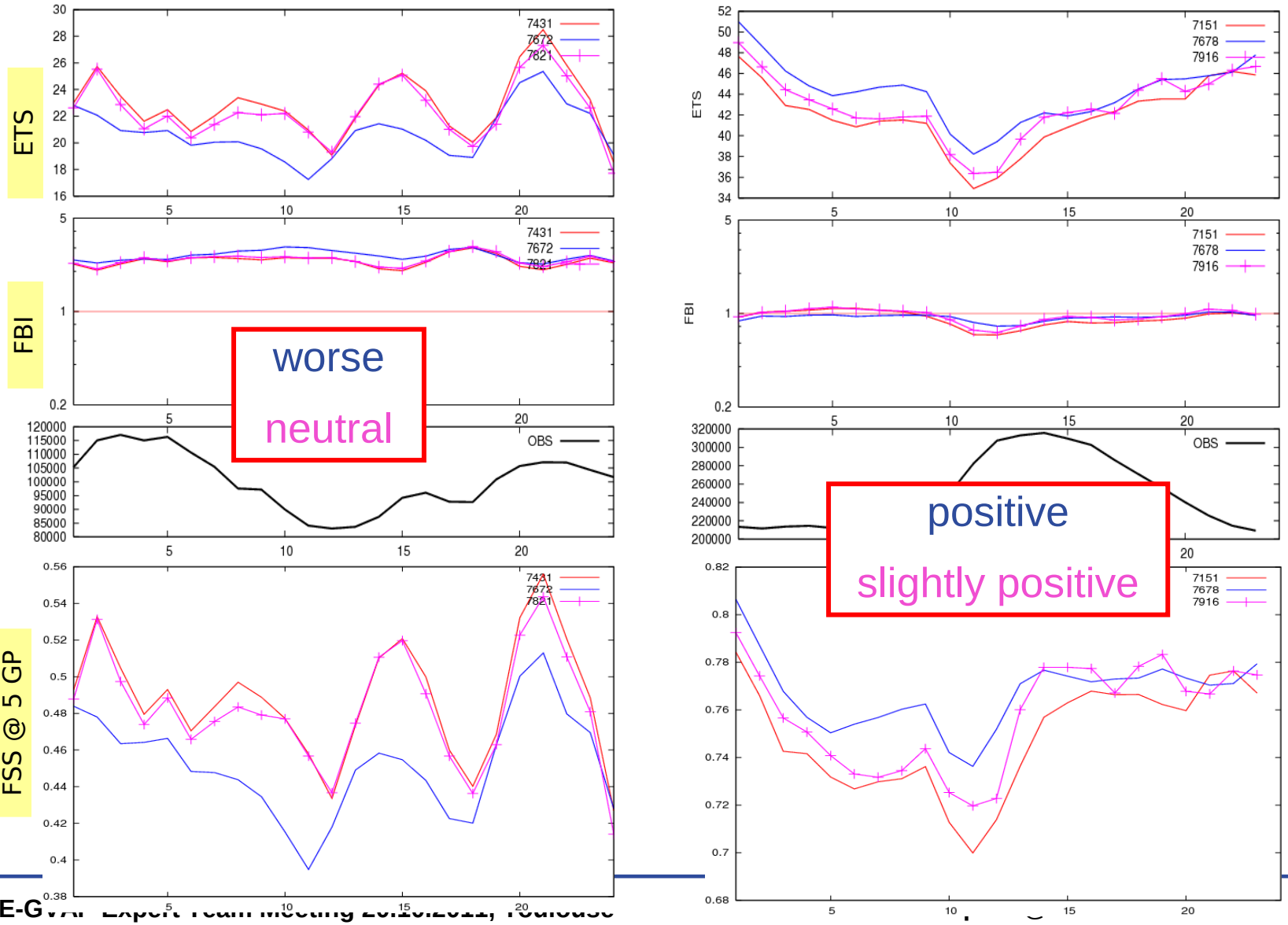
Verification against Radar
Assimilation, scores for (threshold 0.1mm/h)

Deutscher Wetterdienst

Winter experiment

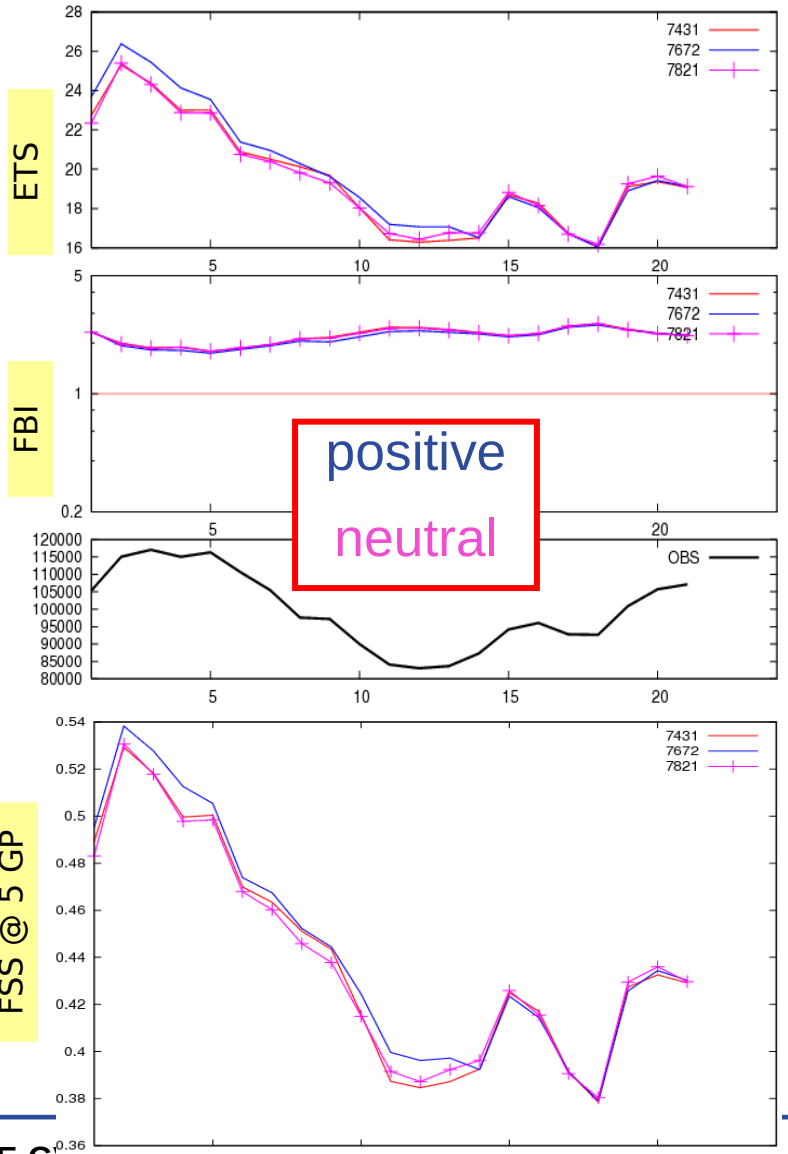
Summer experiment

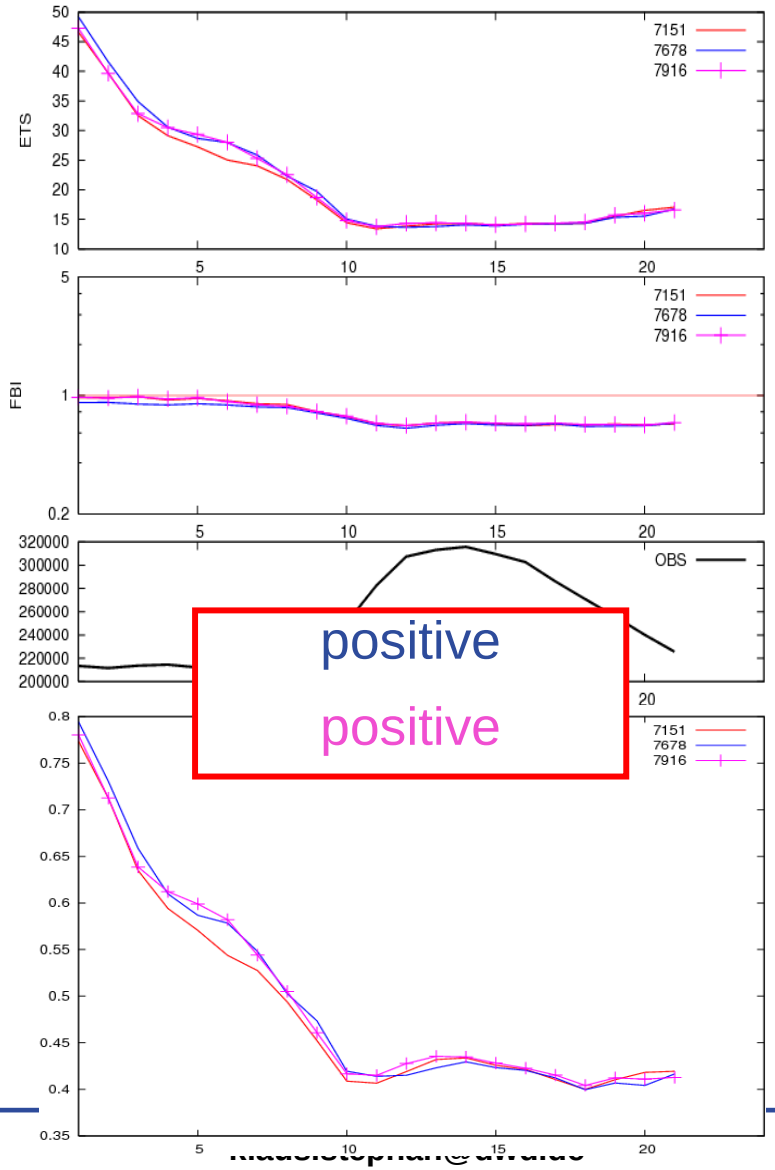


Verification against Radar
00 UTC forecasts, scores for (threshold 0.1mm/h)

Winter experiment

Summer experiment





Control

Old run

New run

Conclusion

- Reduction of cloud ice production leads to a better analysis but also lower the impact on forecast in Winter. Problem of faster dissolving high fog remains.
- In Summer benefit on assimilation become smaller, but impact on forecast remains slightly positive

- Rejecting all data when model has cloud ice, seems to be to extreme. A better choice might be the evaluation of the saturation deficit concerning the cloud ice content. Then more date will be used in assimilation again.

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Remarks and Plans

- Since Karolin left, investigations are falling asleep
- But 2 new positions are starting in 2012 to investigate assimilation of STD measurements within our new LETKF assimilation schemes.
  Will it be possible to get STD data in 2013?
- Further investigation of ZTD assimilation via nudging with the objective to use the data operationally (next year)
- For operational purposes QRT data and quality information are appreciated.
- Additional GPS receivers will be installed (next year)
- COPS reanalyse is ready and will be evaluated, soon.

- Last but not least:

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Comaprison of MW-Radiometer, Radio Sonde and GNSS-IWV in LDB2 (Lindenberg)

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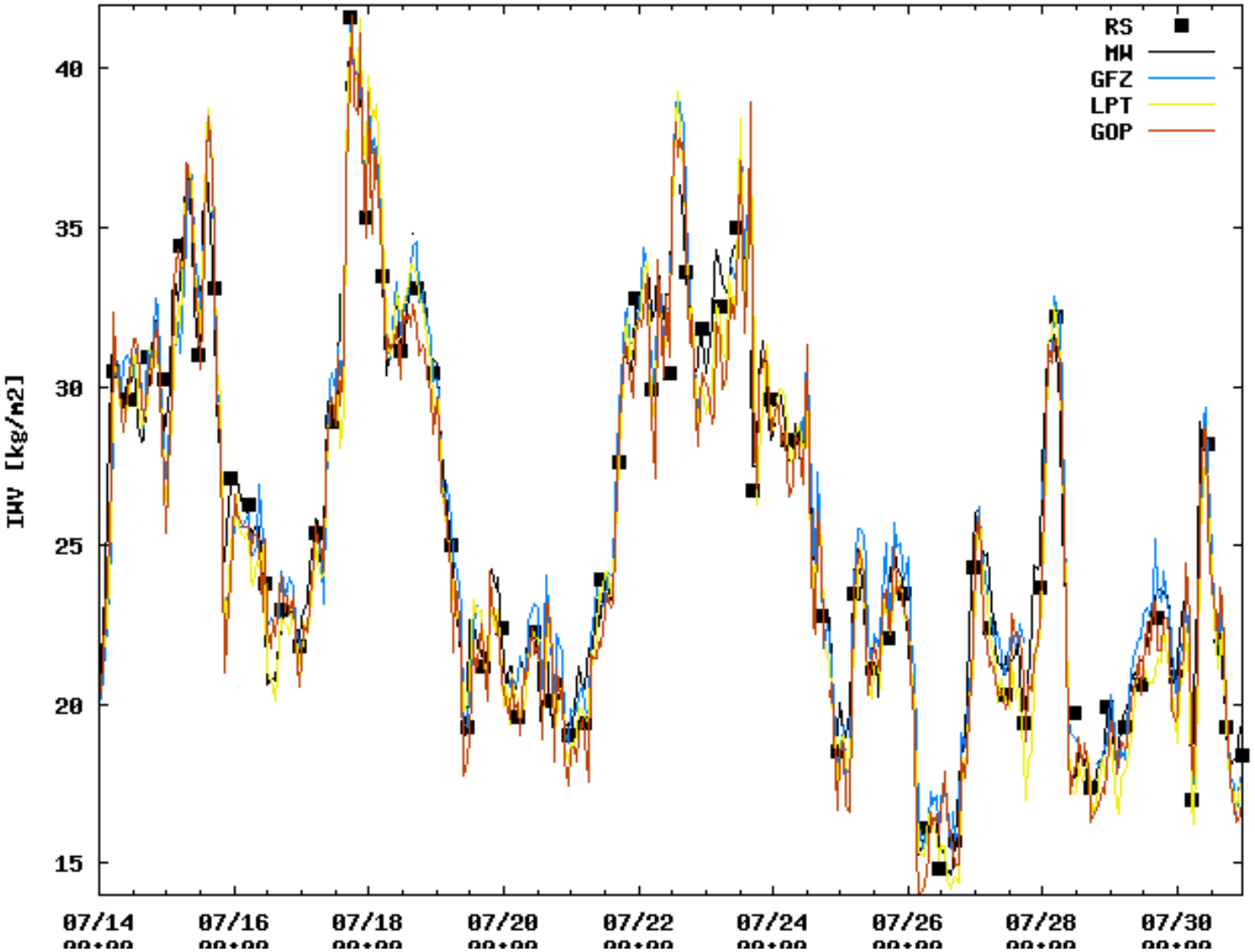
IWV 14-31 July 2010



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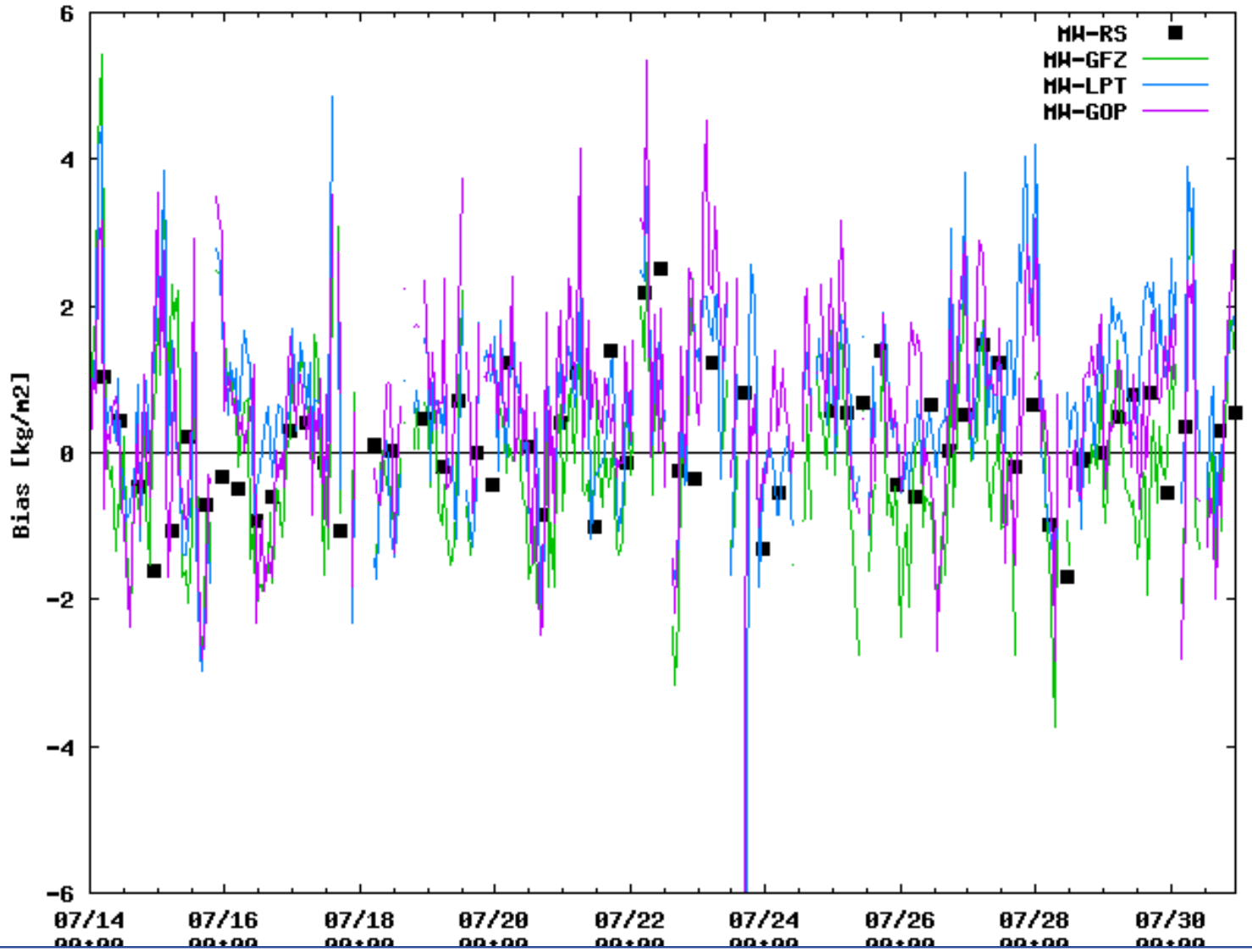
Differences to MW – Radiometer 14-31 July 2010



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Thank you for your attention!

Questions?

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