Characterising height assignment error by comparing best-fit pressure statistics from the Met Office and ECMWF system

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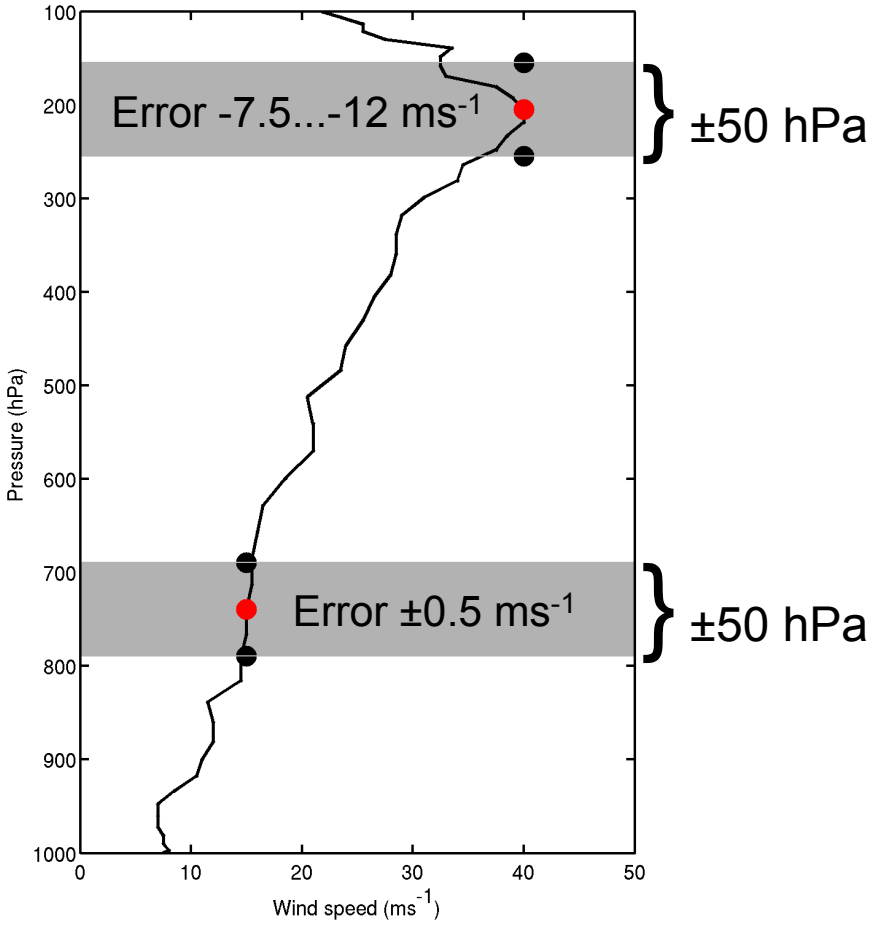
Motivation

- **Uncertainty in height assignment is one of the largest error sources for AMVs.**
- **This uncertainty should be taken into account in data assimilation to ensure effective and realistic use of the data.**

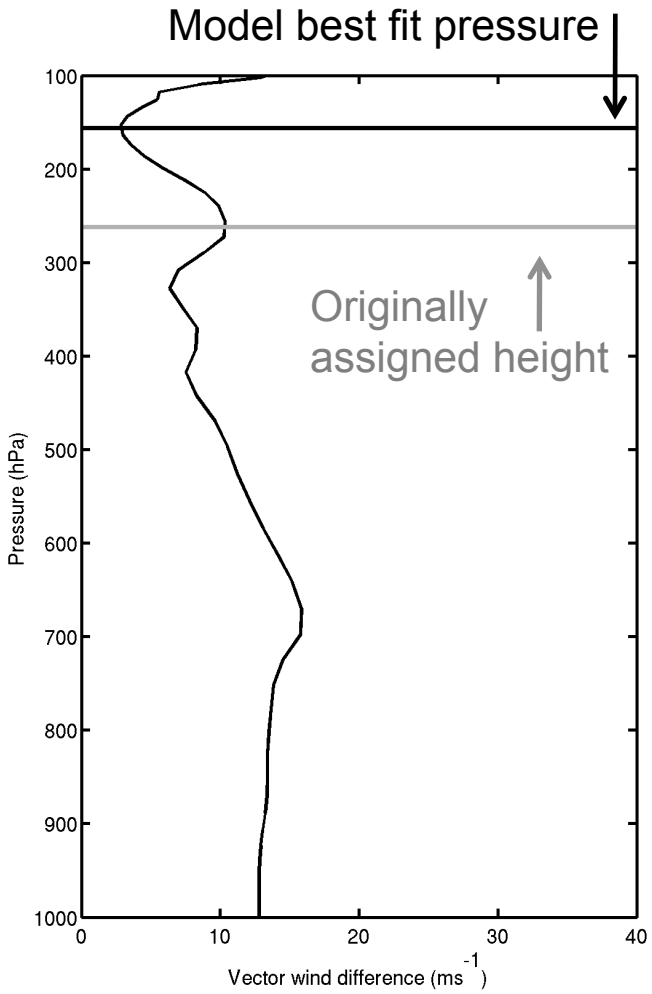


Height assignment method characteristics

- Equivalent black-body temperature (EBBT)
  - Works best for opaque clouds.
  - Assigned height for semitransparent and small clouds often too low.
- Cloud base method
  - Used only for low level clouds.
- CO_2 slicing, H_2O intercept
  - Corrections for the semi-transparency of the cloud
  - Challenges with low broken clouds, thin cirrus clouds, clouds in two or more layers.
  - WV radiances originate primarily from upper troposphere, height determinations below 600 hPa typically rejected.

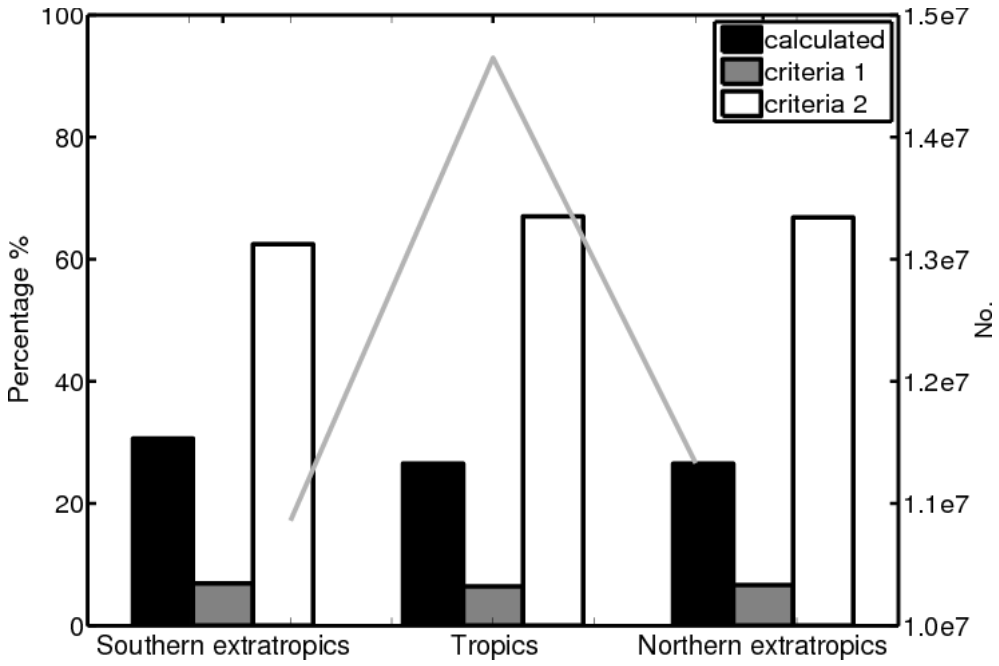
Best-fit pressure

- **Pressure level where the vector difference between the observed and model wind is the smallest.**
- **Not calculated if**
  1. **Difference between the observed and model wind is > 4m/s.**
  2. **Difference < +2 m/s outside of ±100 hPa from the best-fit p level**
- **Minor difference in approaches**
  - **ECMWF: the minimum closest to the assigned height.**
  - **Met Office: the actual minimum.**



How often calculated?

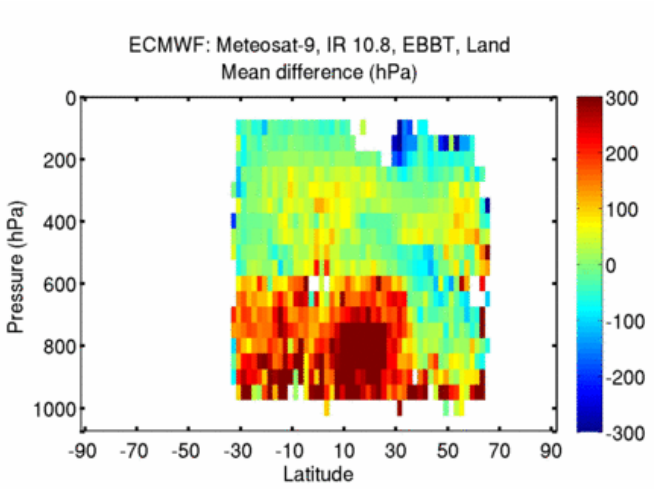
- Best-fit pressure calculated in 25-30% of the cases.
- No good agreement between observed and model wind in ca. 7% of the cases.
- Multiple or broad minima in 63-68% of the cases.

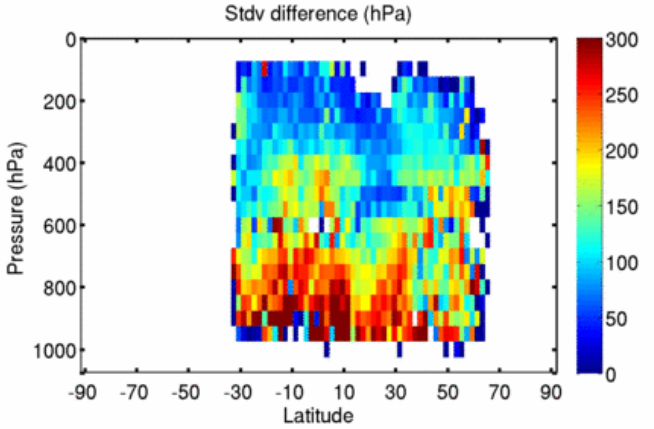


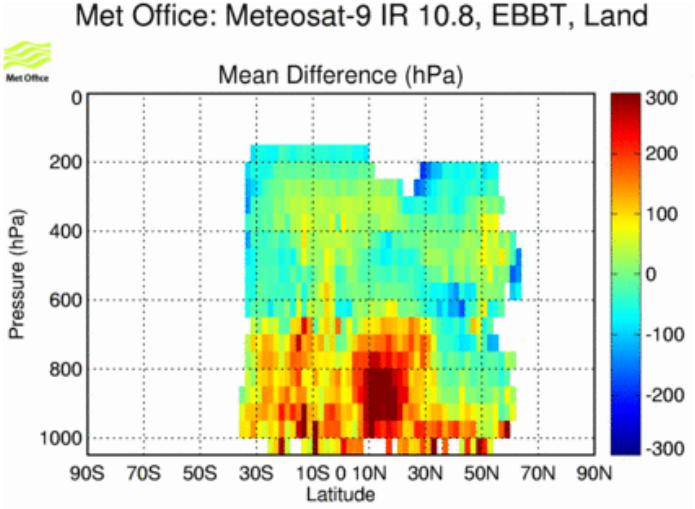
Comparison study

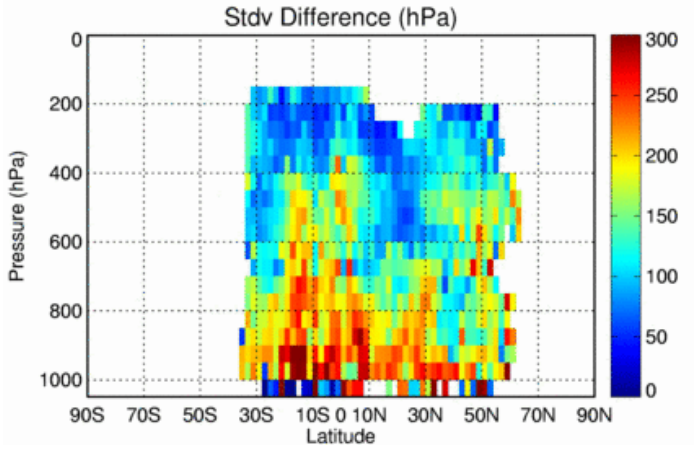
- **Study the usability of the best-fit pressure in characterising the height assignment error.**
  - **Met Office and ECMWF systems**
  - **February – March 2010, 37 000 000 AMV observations**
  - **QI > 80 for geostationary AMVs, QI > 60 for polar AMVs**
  - **Satellite, channel, height assignment method, surface type (land/sea)**
  - **Bias and standard deviation: assigned height – best-fit pressure**
  - ***http://research.metoffice.gov.uk/research/interproj/nwpsaf/satwind_report/investigations/bfpress/10_03/intro.html***

Meteosat-9, IR, EBBT, land









+ Too low

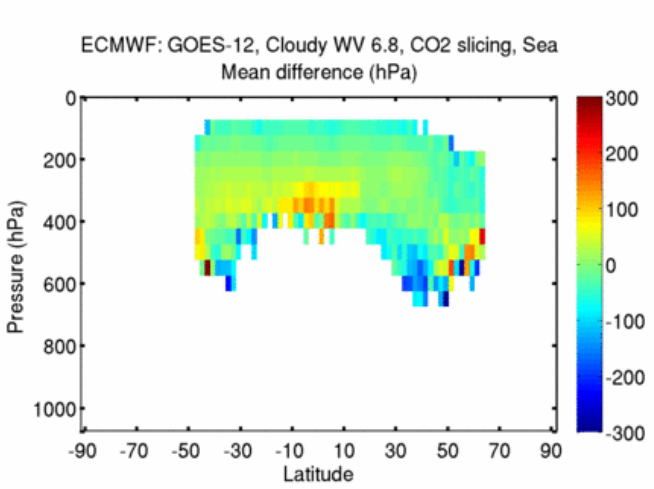
Good agreement

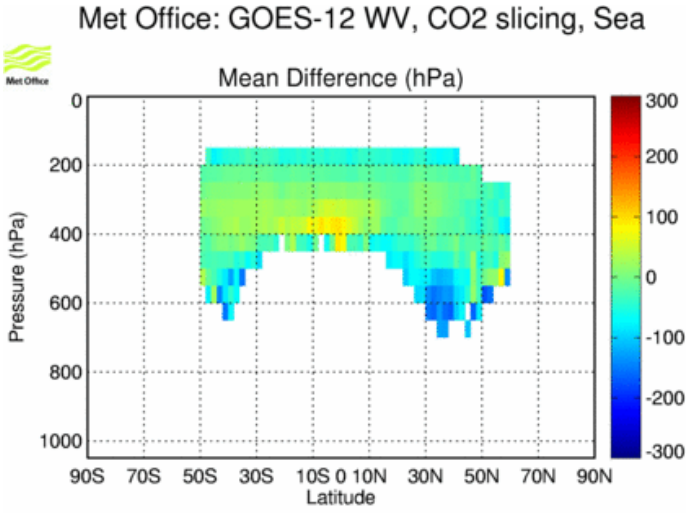
- Too high

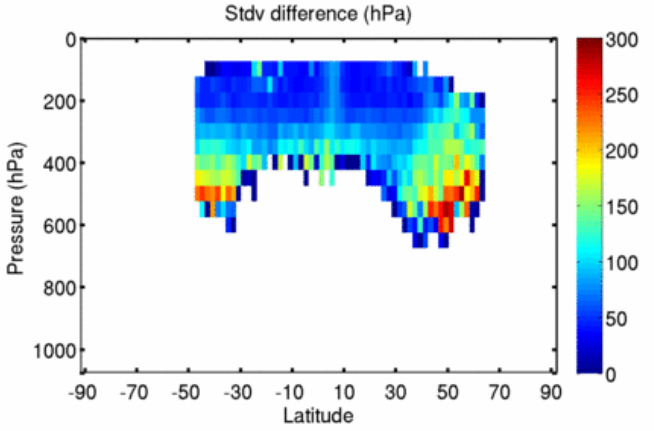
Summary of findings: EBBT

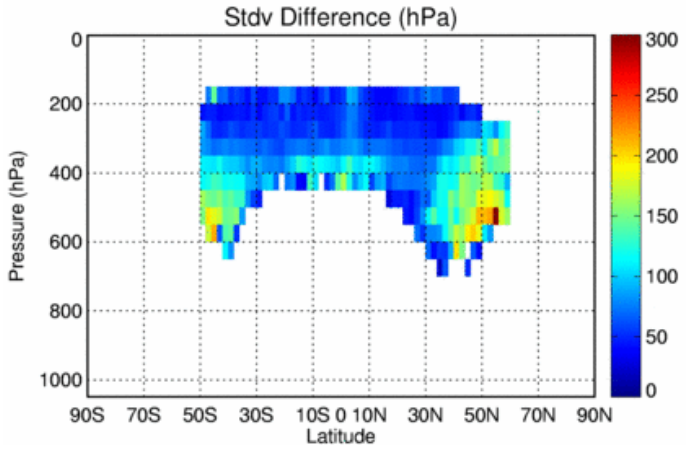
- **Meteosat-9**
  - Below 600 hPa strong positive bias over land. Known problems with semi-transparent clouds over the hot African surface.
- **GOES-11, GOES-12**
  - VIS channel AMVs negative bias between 800-600 hPa over sea. Known problems in height assignment in the stratocumulus inversion regions in the Pacific and Atlantic.
- **MTSAT-1R**
  - Positive bias at low levels.
- **Aqua, Terra**
  - Below 500 hPa positive bias and large sdevs especially on Northern hemisphere.

GOES-12, WV, CO_2 slicing, sea









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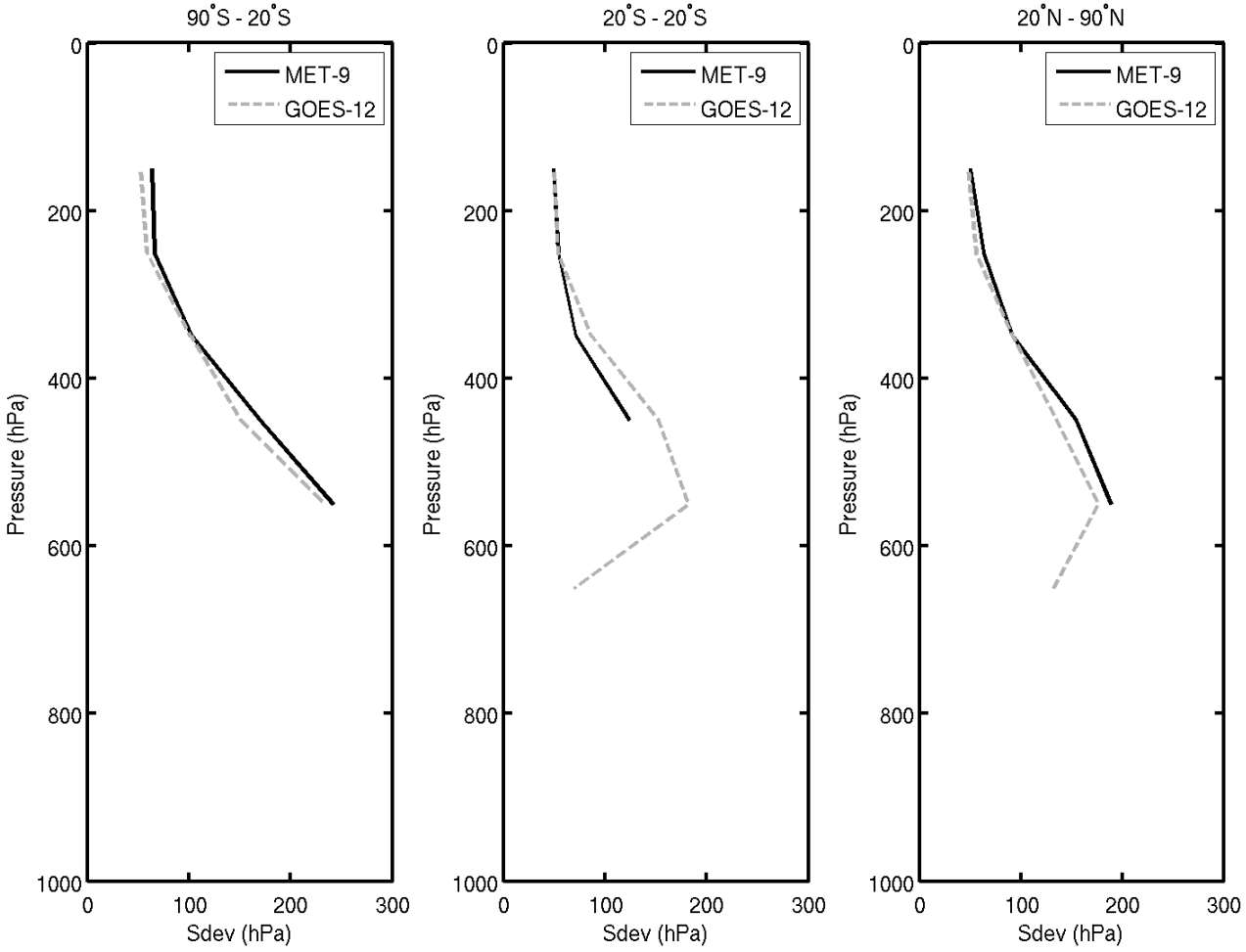
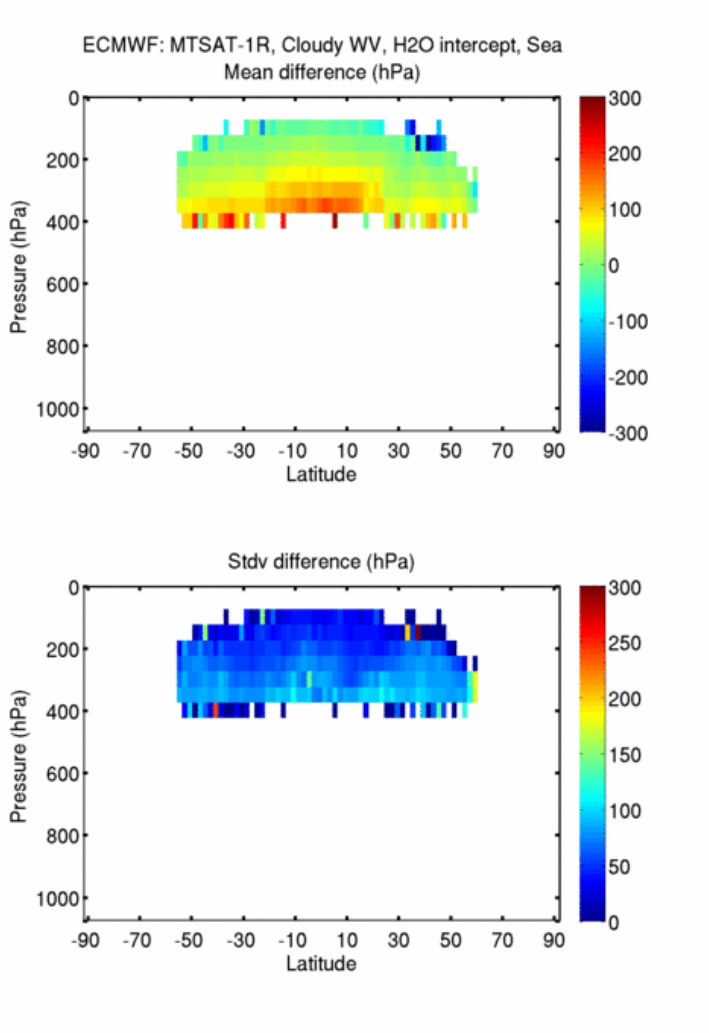
GOES-12 vs. MET-9, WV, CO_2 slicing, sea

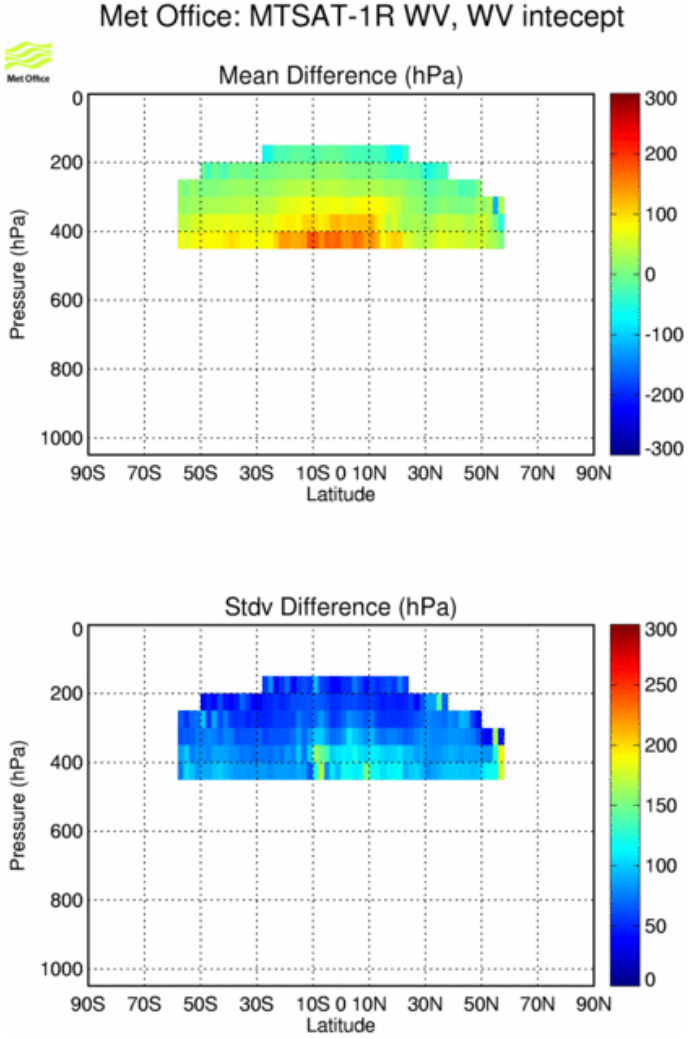


Summary of findings: H_2O intercept

- GOES-11/12 and Meteosat-9 share very similar characteristics in the statistics as the AMVs applying the CO2 slicing method.
- MTSAT-1R statistics are somewhat different
  - Below 300 hPa positive bias.

MTSAT-1R, WV, H_2O intercept, sea





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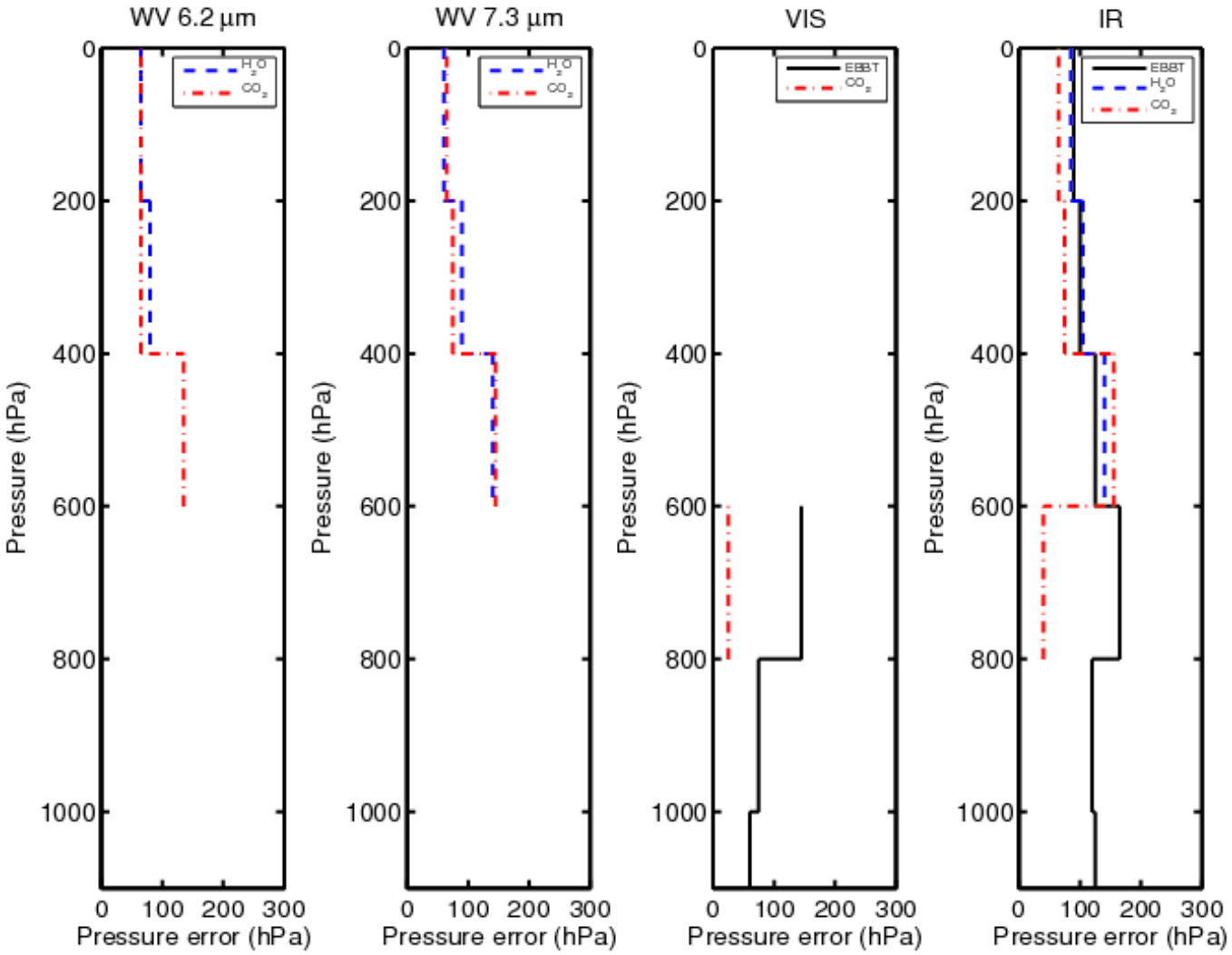
Comparison of methods: MET-9



Conclusions

- **Best-fit pressure statistics are rather similar for both systems.**
  - Some differences e.g. at mid levels where ECMWF shows occasionally more pronounced biases and standard deviations.
- **Largest biases and standard deviations found typically below 400 hPa height.**
- **Results are in good agreement with**
  - Known characteristics of the height assignment methods.
  - Earlier findings of the quality of the AMVs.
- **Best-fit pressure statistics give reliable information about the uncertainties in the AMV height assignment.**