

Accounting for the situation- dependence of the AMV observation error in the ECMWF system

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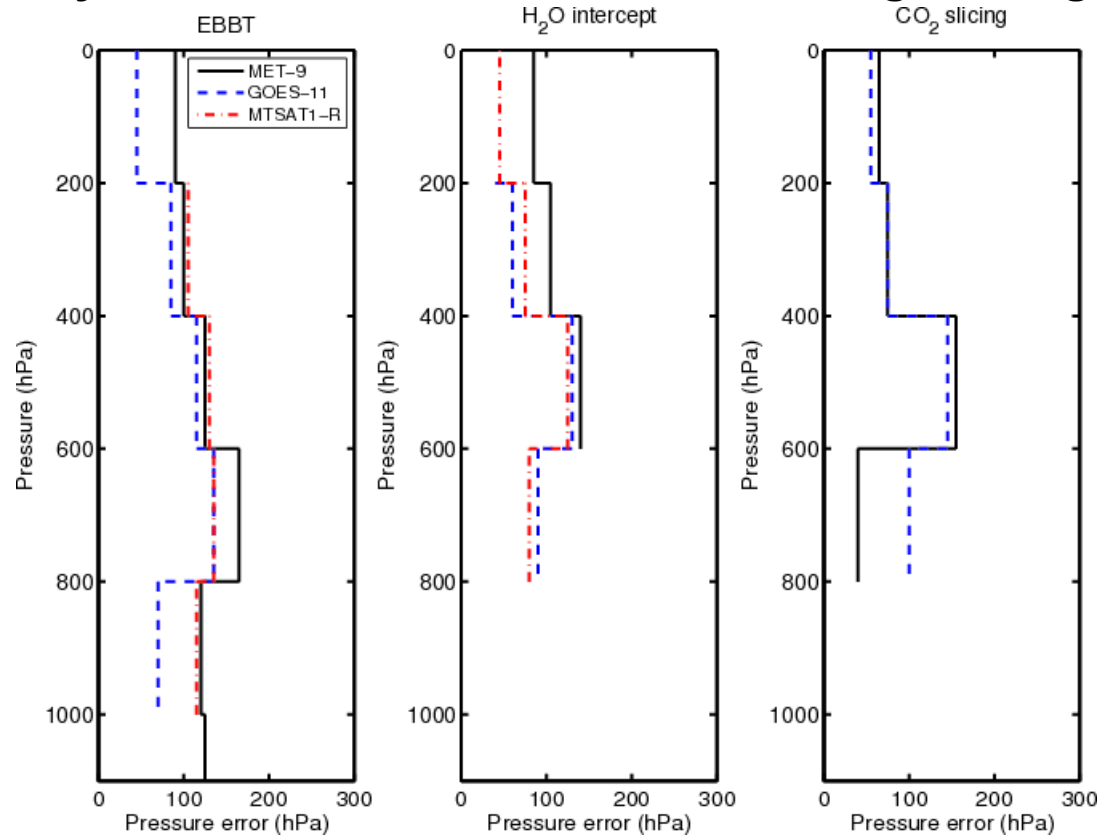
Motivation

- **AMV observation errors are highly situation dependent.**
- **Errors originate mainly from two sources**
 - errors in the wind vector derivation (tracking error)
 - errors in the height assignment
- **Significant especially in regions where wind shear is strong.**
- **Met Office has introduced an approach to estimate situation dependent observation errors. The method is investigated in the ECMWF system.**

Forsythe M, Saunders R, 2008. AMV errors: A new approach in NWP. Proceedings of the 9th international winds workshop.

Height errors in the ECMWF system

- Height errors have been estimated from best-fit pressure statistics (Feb – Mar 2010, May – June 2010).
- Defined separately for all satellites, channels and height assignment methods.



Wind error due to error in height

- Typical value for the height error is 70 – 120 hPa.
- Default value set to 80 hPa.
- Height error estimates are translated to wind error using the model first guess wind profile

$$E_{vp} = \frac{\sqrt{\sum W_i (v_i - v_n)^2}}{\sum W_i}, W_i = \exp\left(-\frac{(p_i - p_n)^2}{2E_p^2}\right) * dP_i$$

p_i and v_i : pressure and wind on model level

p_n and v_n : pressure and wind at observation location

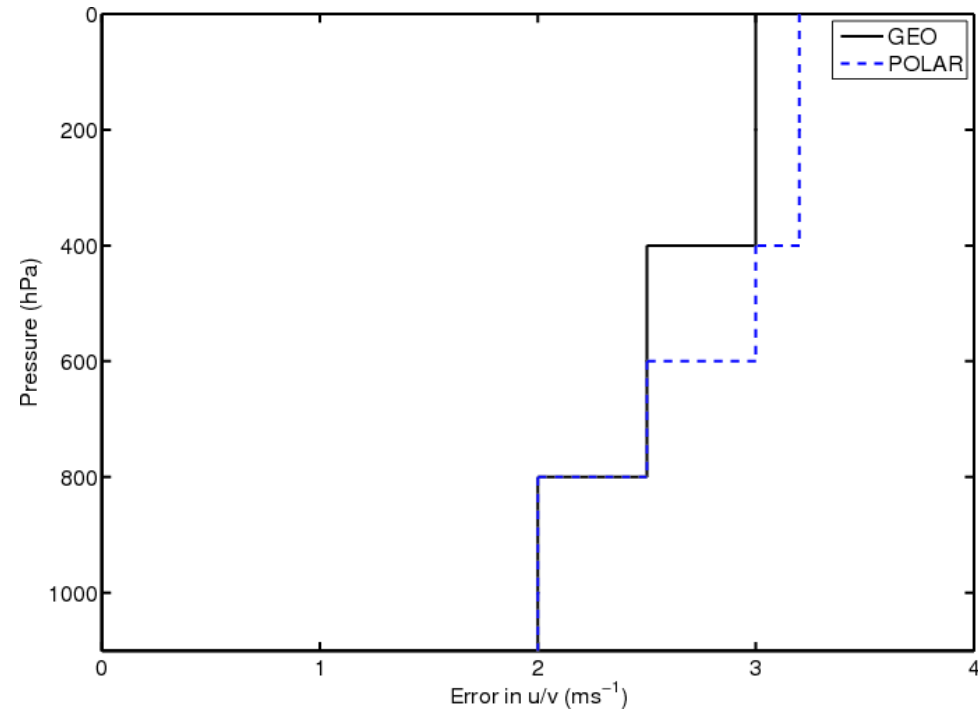
E_p : error in height assignment

dP_i : layer thickness

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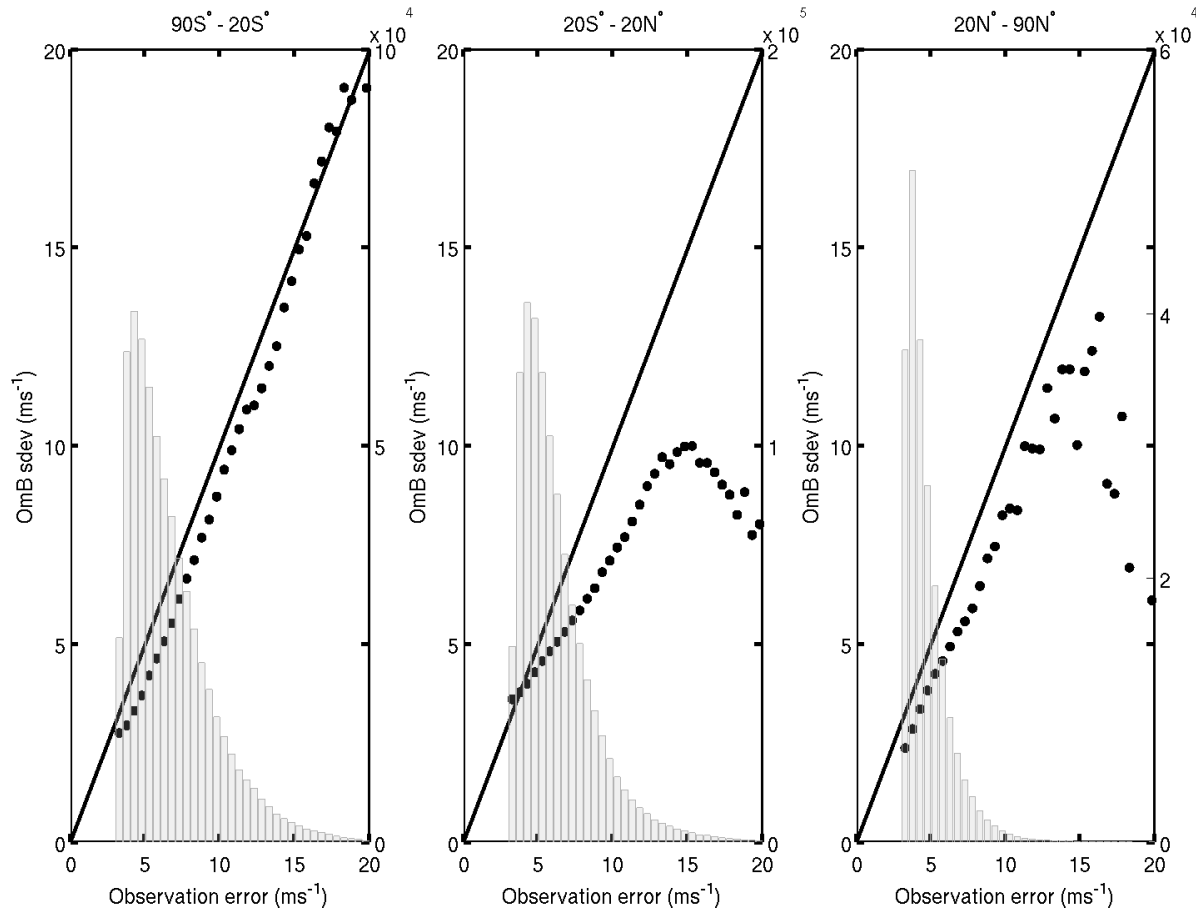
Wind error due to error in tracking

- The tracking errors have been estimated from cases where the error due to error in height is small.
- Defined for geostationary and polar AMVs.
- Varies between 2 and 3.2 m/s
- Default value set to 2.5 m/s.
- $[\text{Total } u/v \text{ error}]^2 = [\text{Tracking error}]^2 + [\text{Error in } u/v \text{ due to error in height}]^2$



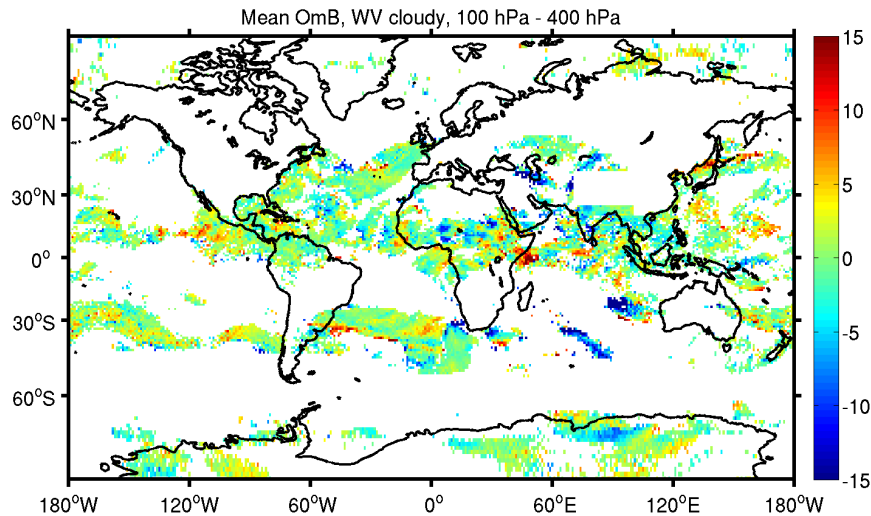
Situation dependent observation errors

Example: Meteosat 9, WV channel, CO2 slicing

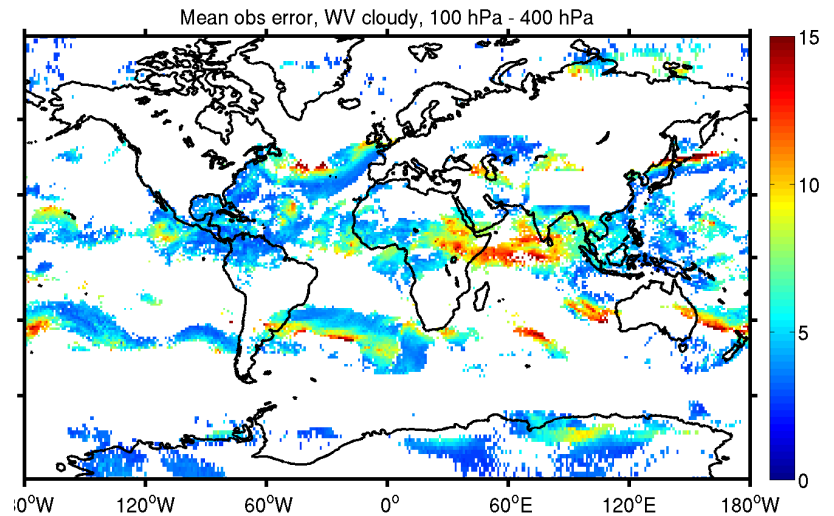


Example: Cloudy WV, 100 – 400 hPa, 25 Aug 2010, 12 UTC

Observation - Background



Situation dependent observation errors



Experimentation

- **Set of data assimilation experiments for 07 – 08 / 2010**

- How should the first guess check be modified?
- How to use observation error due to error in height assignment to exclude suspicious observations?
- What is the impact?

- **Results**

- **Control, operational setup**
- **Experiment:**
 - **Situation dependent observation errors**
 - **Simplified and relaxed first guess check**
 - **Criteria $\sigma_{\text{due to error in height}} < 2 \sigma_{\text{tracking}}$**

Model first guess check

- Observation y is compared to the model counterpart Hx_b .

$$\frac{1}{2} \left(\left[\frac{(Hx_b - y)^2}{\sigma_b^2 + \sigma_o^2} \right]_u + \left[\frac{(Hx_b - y)^2}{\sigma_b^2 + \sigma_o^2} \right]_v \right) \leq L$$

- Current operational implementation

- Asymmetric: additional penalty applied to observations which under-report the wind speed compared to model background
- Geographical dependence in the rejection limit L

- Under investigations

- Remove asymmetry and geographical dependence
- Define the rejection limit

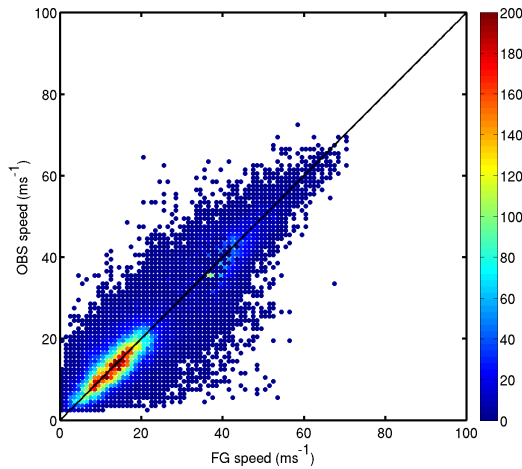
First guess check example: Met-9 WV 100-400 hPa

After blacklisting

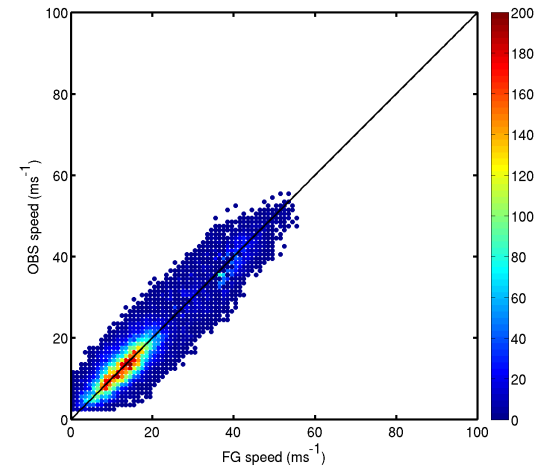
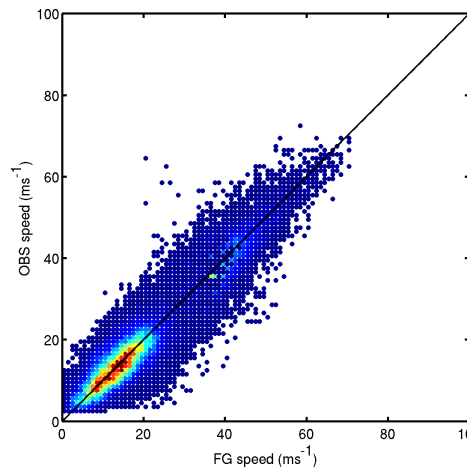
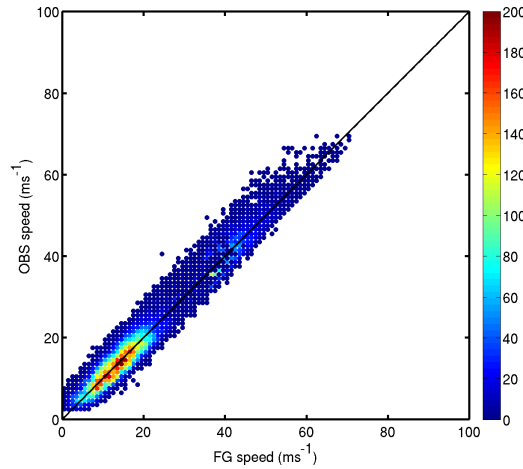
After first guess check

$\sigma_{\text{due to error in height}} < 2 \sigma_{\text{tracking}}$

Operational

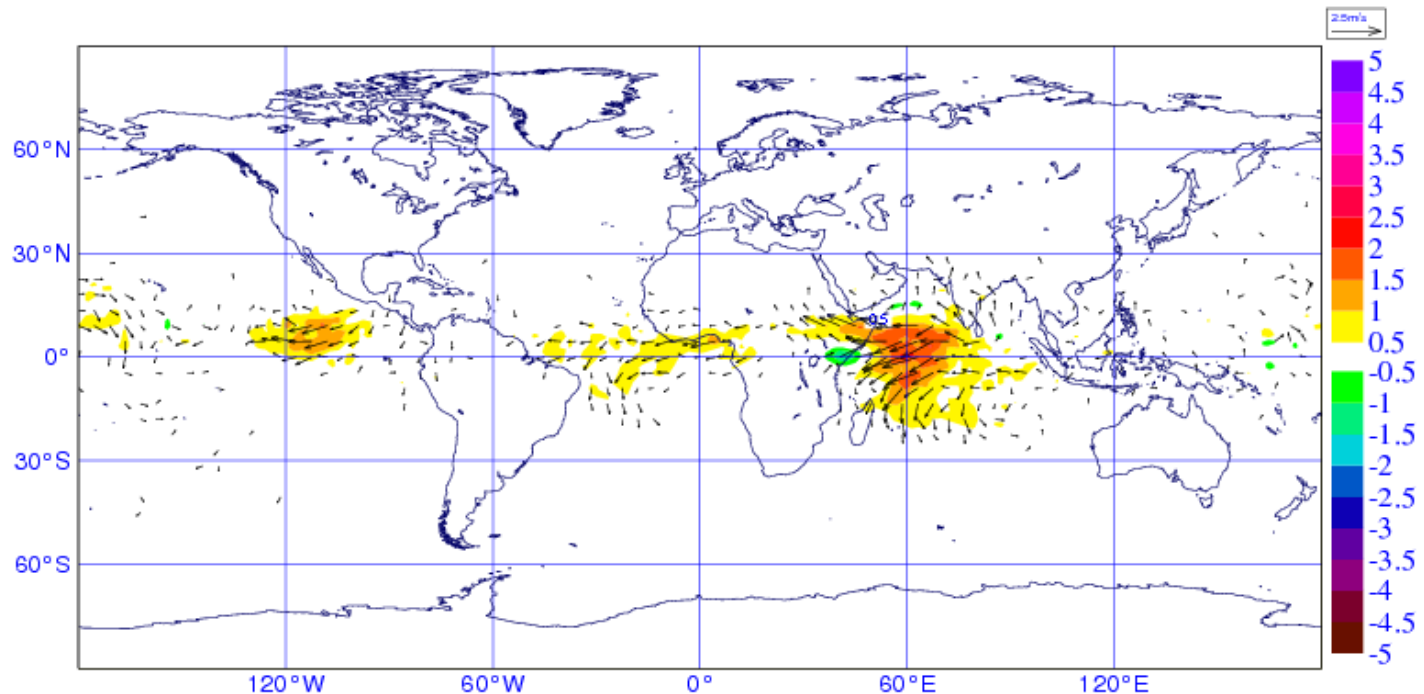


Under investigations



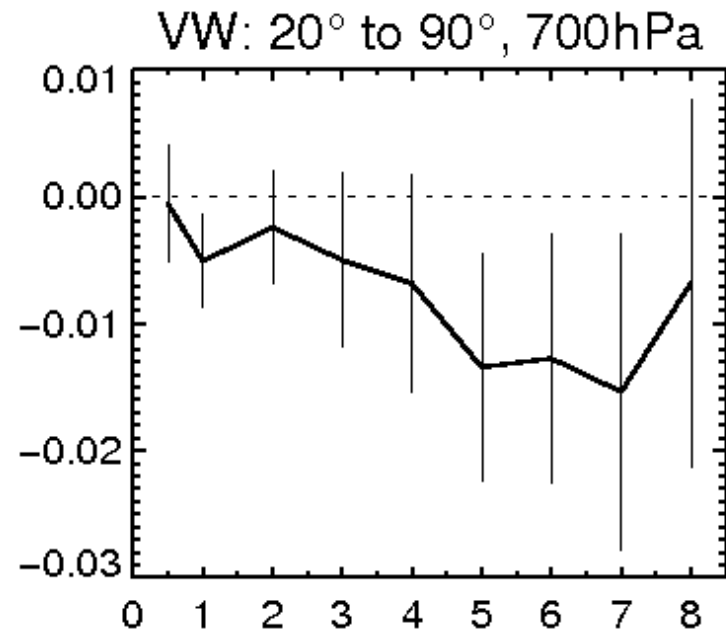
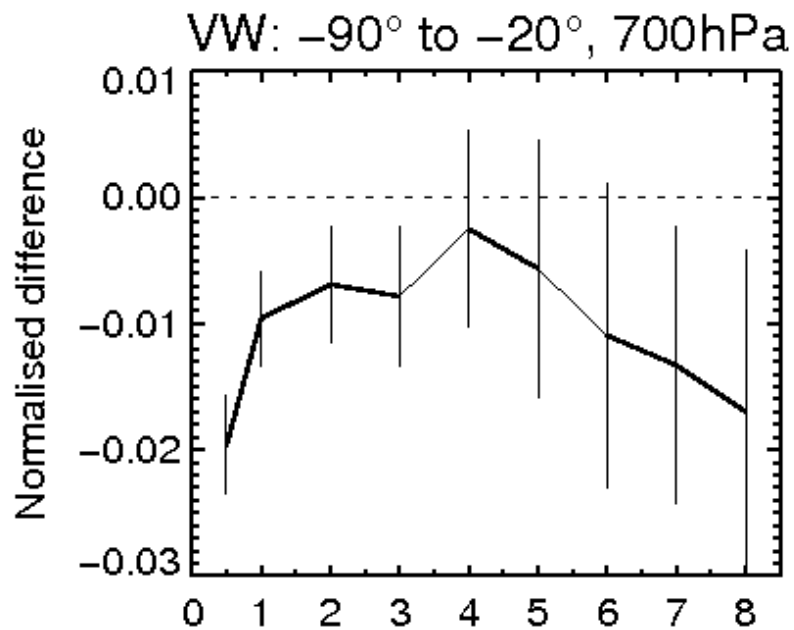
Vector difference of mean wind analysis

EXP – Control, 200 hPa level, 1.7.2010 – 31.8.2010



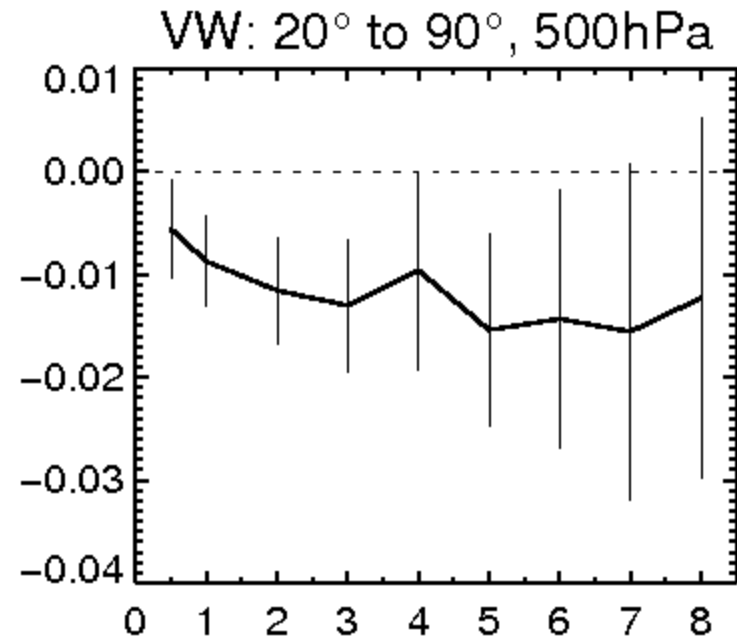
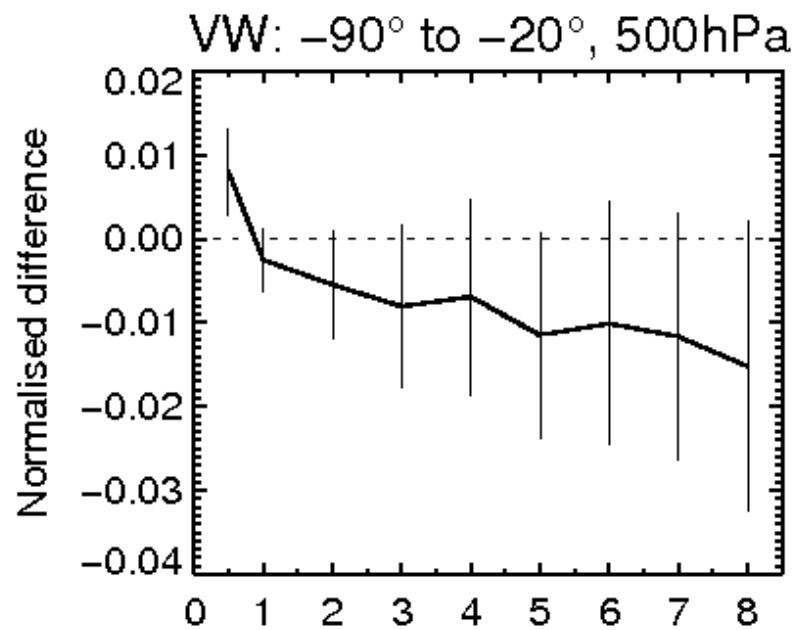
Normalised difference in VW RMS error

EXP – control, verified against own analysis



Normalised difference in VW RMS error

EXP – No AMVs, verified against own analysis



Summary

- **Development towards using situation dependent AMV observation errors in the ECMWF system.**
 - Tracking error
 - Error due to error in height assignment, highly situation dependent
- **Situation dependent observation errors are on average of the same magnitude than the old observation errors.**
- **Agreement with the OmB standard deviation is good.**

Summary

- **Results from the data assimilation experiments show encouraging results.**
 - **Simplifying the first guess check is possible without degrading the quality of the model analysis and forecasts**
 - **Situation dependent observation errors down-weight observations with large first guess departures.**
 - **$\sigma_{\text{due to error in height}} < n \sigma_{\text{tracking}}$ is an effective criteria to reject suspicious observations.**
- **Ongoing work**
 - **Define n**
 - **FSO (Forecast sensitivity to observation) experimentation**