General global model performance over the Southern Pole and Concordiasi data impact at ECMWF

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ECMWF

Verification for polar regions

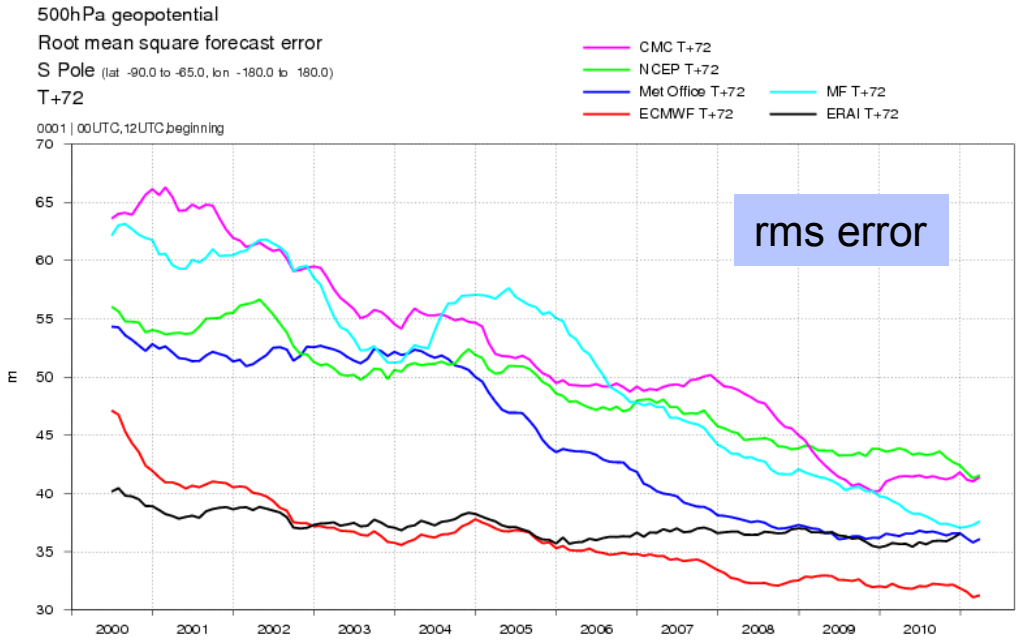
(Slides from David Richardson)

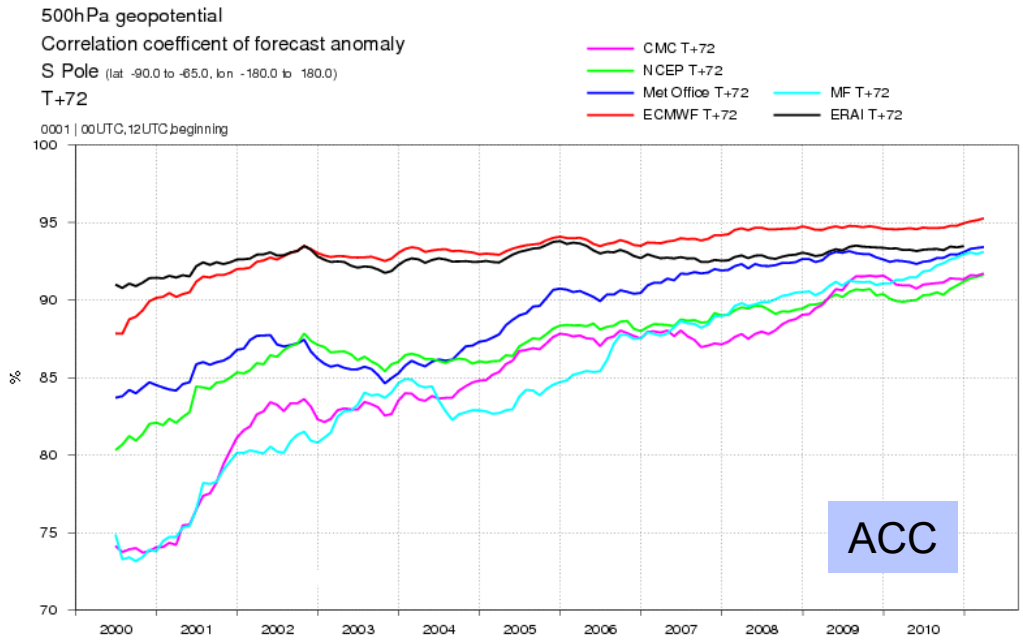
http://www.ecmwf.int/products/forecasts/wmolcdnv/poles.html

- Scores computed for polewards of 65°
  - NB proposed for CBS is polewards of 60°
- Verification at ECMWF using available fields from other centres
- Done for Z500 only
- All verification against analysis (each centre against own analysis)
- ERA-Interim scores shown as reference (ERA is fixed model and assimilation system)

Comparison with other centres (2000-2011) S pole

- Day 3 forecasts (T+72)
- Z500, 12-month moving average
- Each centre verified against own analysis
- ERA-I shown for reference

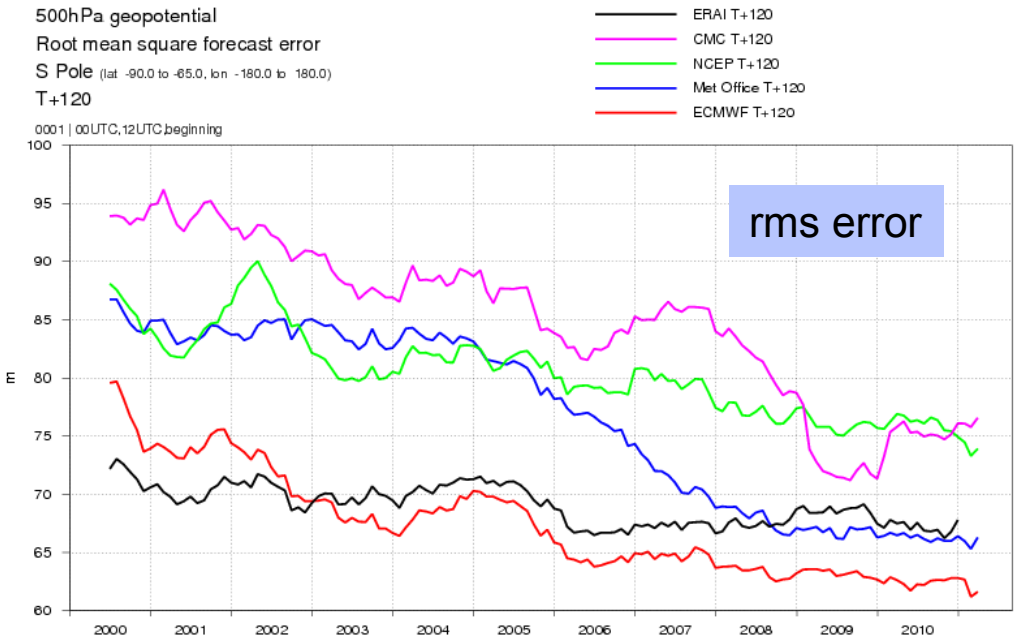


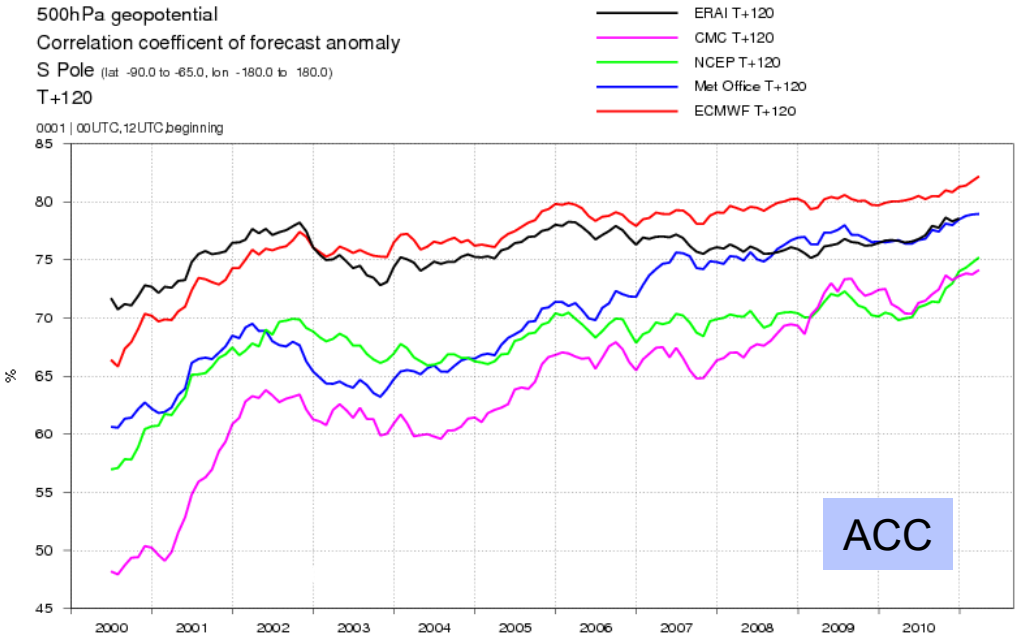


Comparison with other centres (2000-2011) S pole

- Day 5 forecasts (T+120)
- Z500, 12-month moving average
- Each centre verified against own analysis
- ERA-I shown for reference

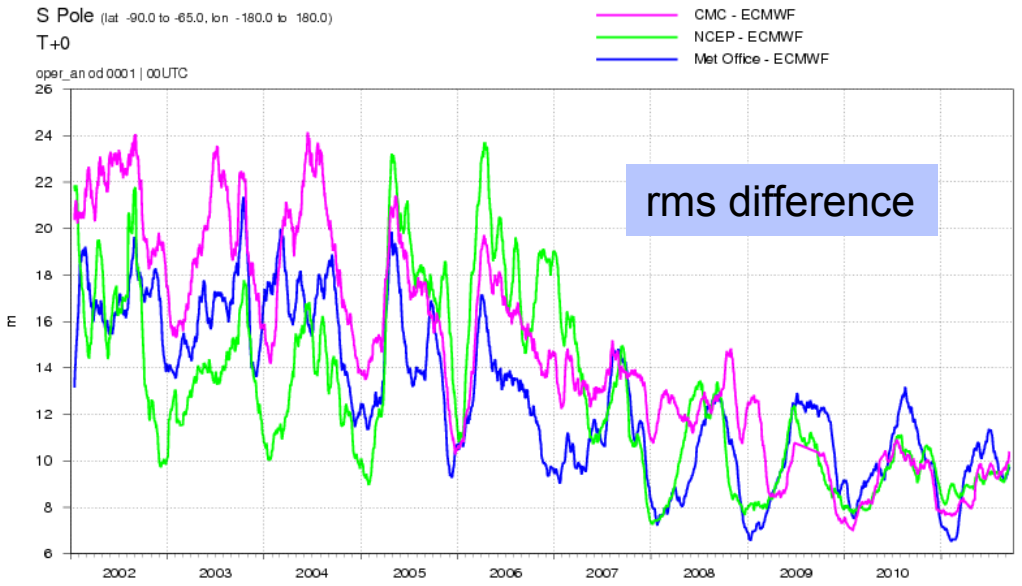
- NB some dates missing for CMC in 2009 – affects these scores for 2009 (other years OK)

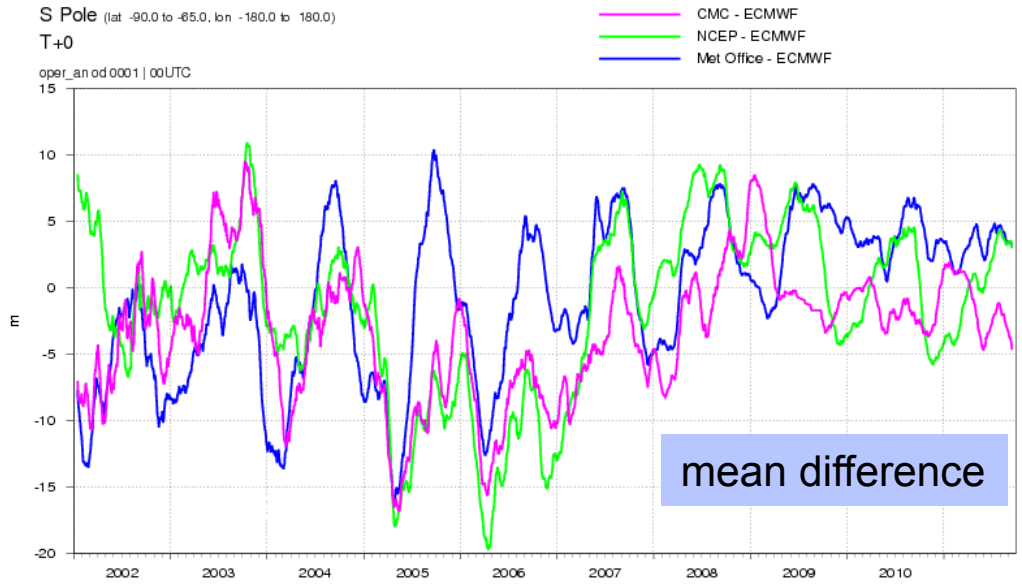




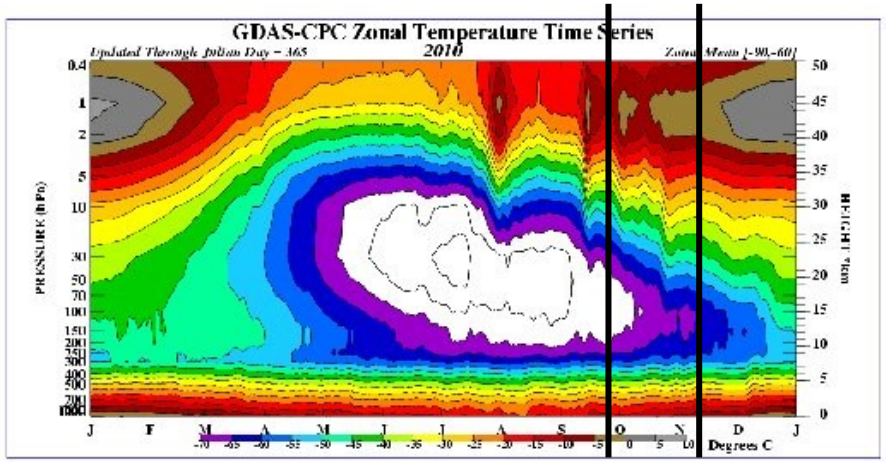
Comparison between analyses (S Pole)

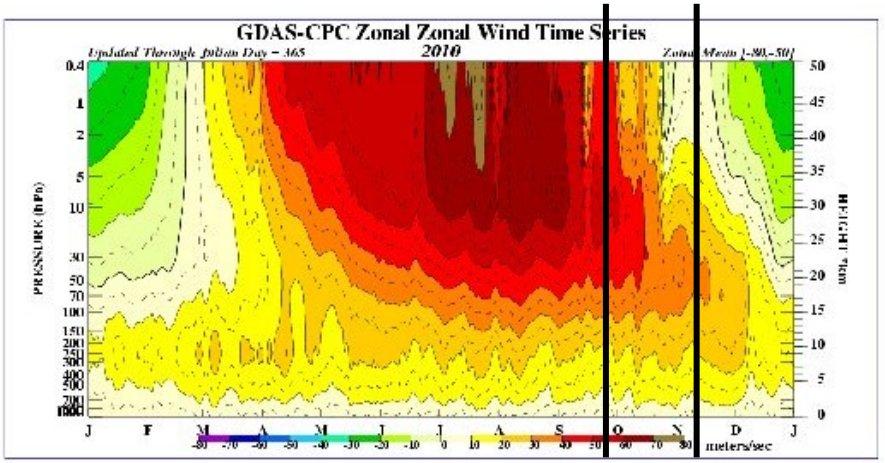
- Differences between the analyses of different centres
- Z500 30 day moving average
- Decrease over last decade in the difference between the analyses of different centres

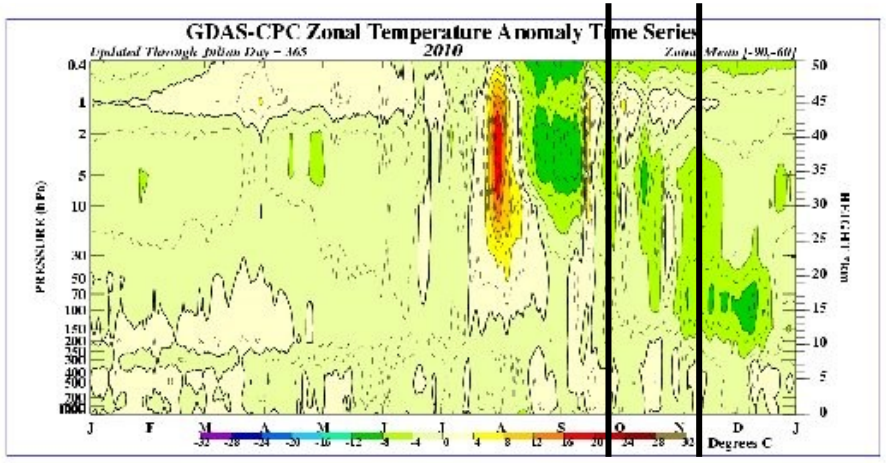


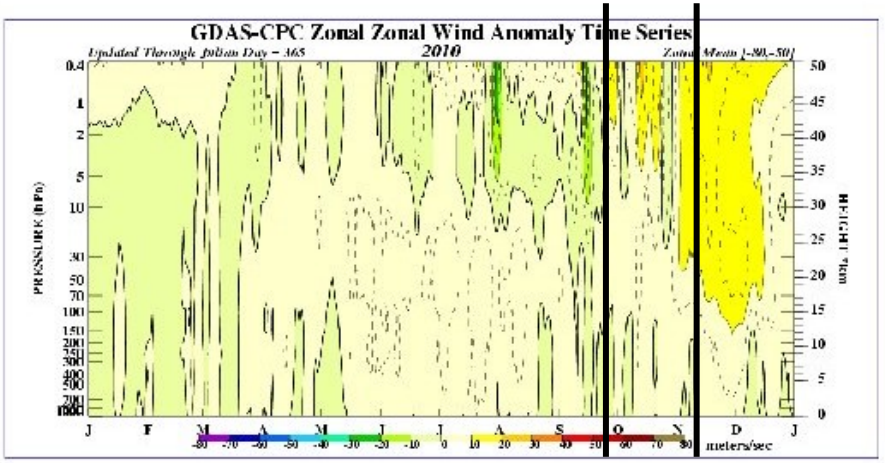


Concordiasi 26 Sep-23 Dec 2010
(slides from Carla Cardinali)









Forecast sensitivity to observation: Equations
from a Roger Daley idea

$$\frac{\partial J}{\partial \mathbf{y}} = \frac{\partial \mathbf{x}_a}{\partial \mathbf{y}} \frac{\partial J}{\partial \mathbf{x}_a}$$

J is a measure of the forecast error (as defined through e.g dry energy norm)

$$\frac{\partial J}{\partial \mathbf{x}_a}$$

Forecast error sensitivity to the analysis
Rabier F, *et al*. 1996

$$\frac{\partial \mathbf{x}_a}{\partial \mathbf{y}} = \mathbf{K}$$

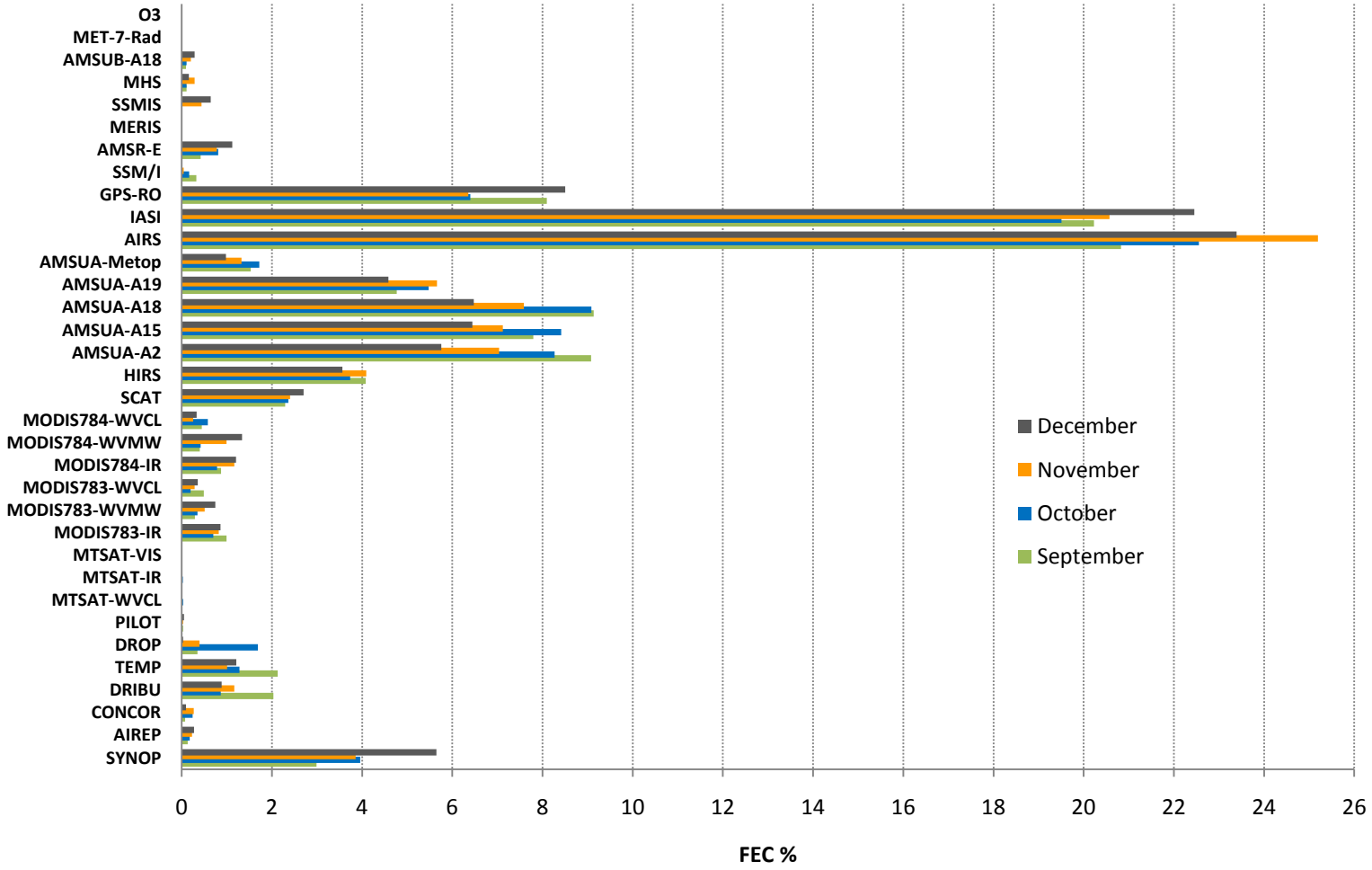
Analysis sensitivity to the observation
Cardinali *et al.* 2004

$$\delta J = \frac{\partial J}{\partial \mathbf{y}} \left(\mathbf{y} - \mathbf{H}\,\mathbf{x}_b \right)$$

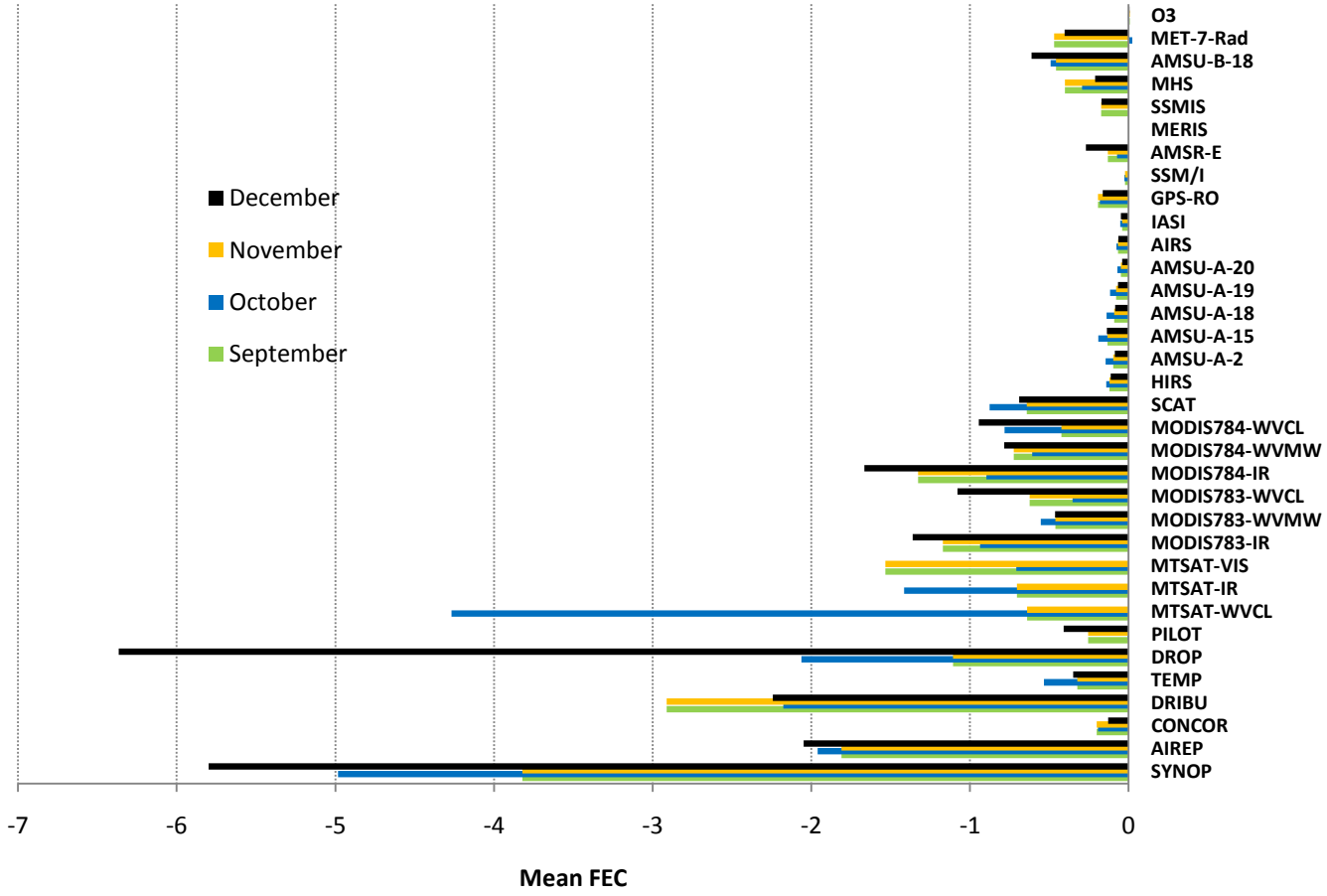
Compute the forecast impact or forecast error variation δJ (FEC)

$$< \frac{\partial J}{\partial \mathbf{x}_a} \mathbf{x} > = < \frac{\partial J}{\partial \mathbf{x}_a} \mathbf{x} - \mathbf{x} > = < \frac{\partial J}{\partial \mathbf{x}_a} \mathbf{K} \left(\mathbf{y} - \mathbf{H}\,\mathbf{x} \right) > = < \mathbf{K} \frac{\partial J}{\partial \mathbf{x}_a} \left(\mathbf{y} - \mathbf{H}\,\mathbf{x} \right) > = < \frac{\partial J}{\partial \mathbf{y}} \mathbf{y} >$$

Concordiasi 2010
Total Observation Impact (Forecast Error Contribution) below 54° S

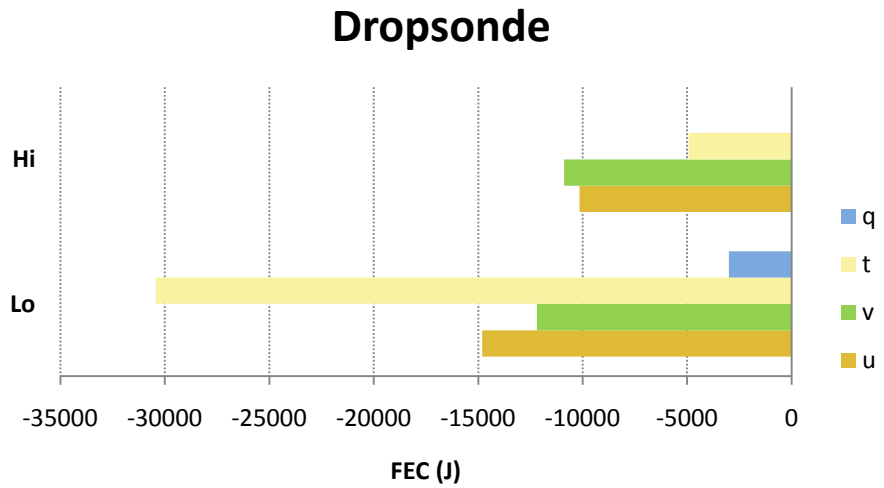


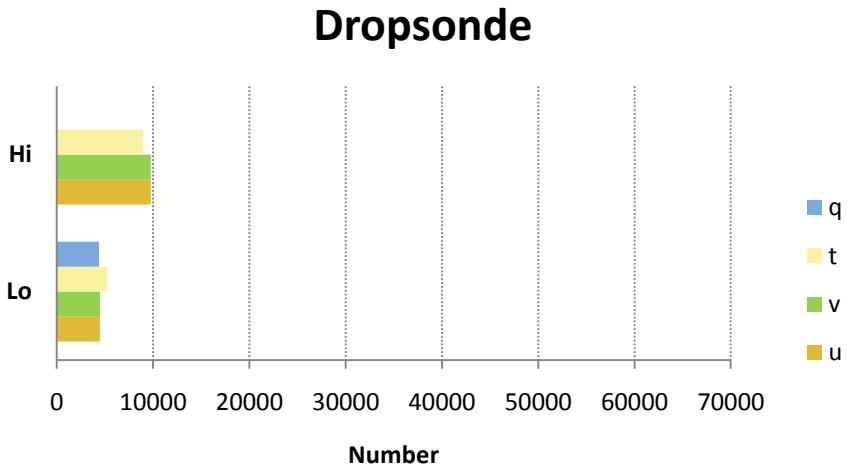
Concordiasi 2010
Mean Observation Impact below 54 ° S



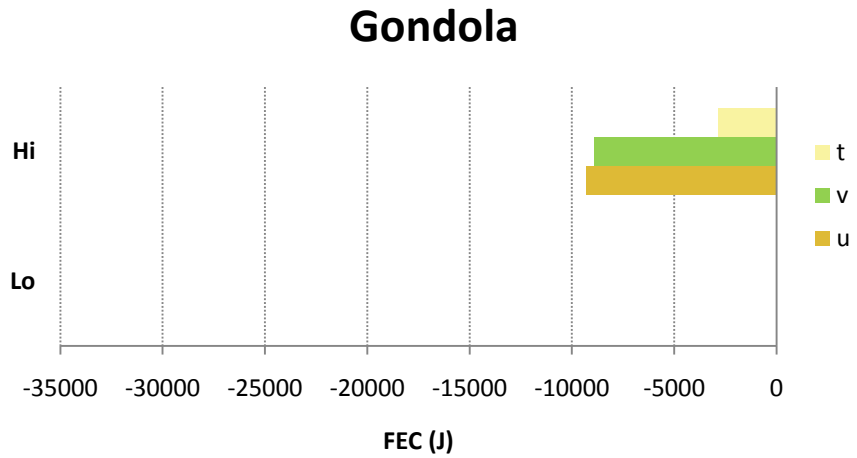
Same as previous but normalized by number of observations

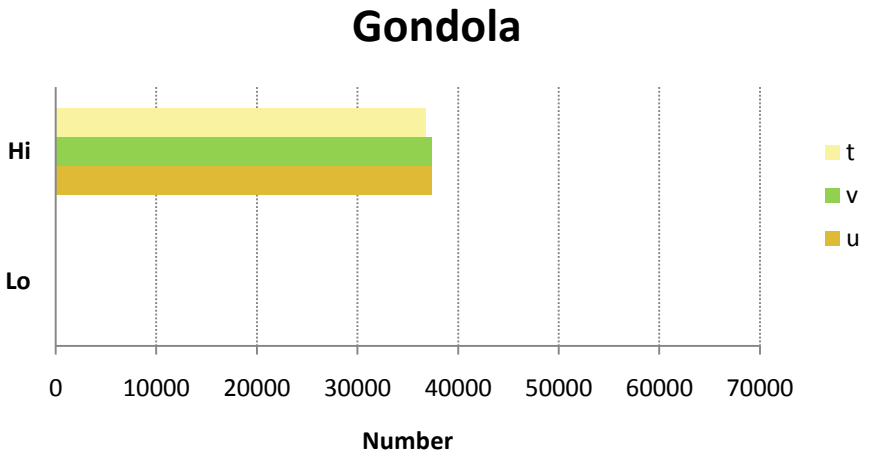
Concordiasi Sep-Dec 2010



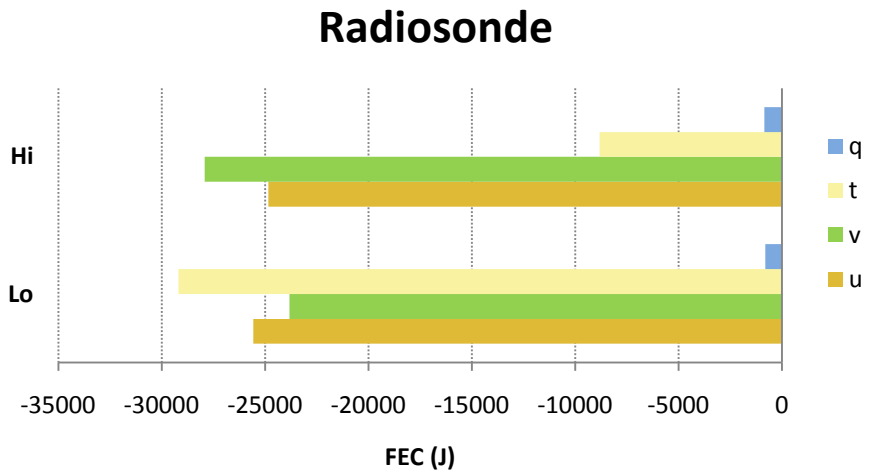


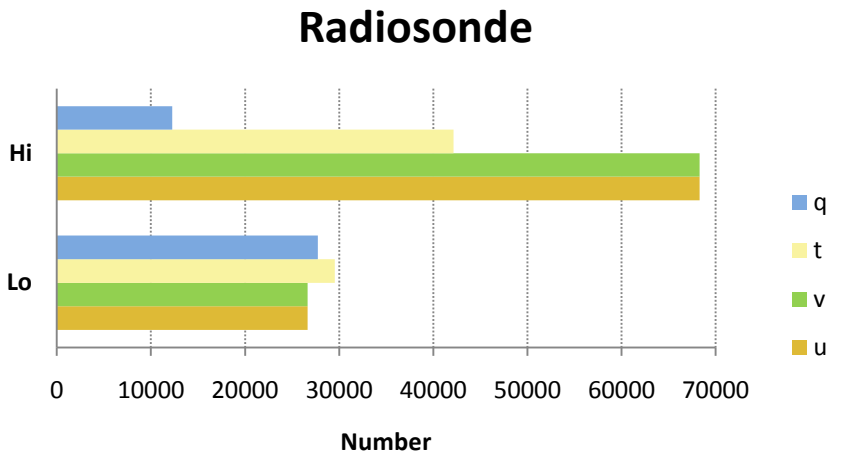
HI: < 400 hPa **LO: > 400hPa**



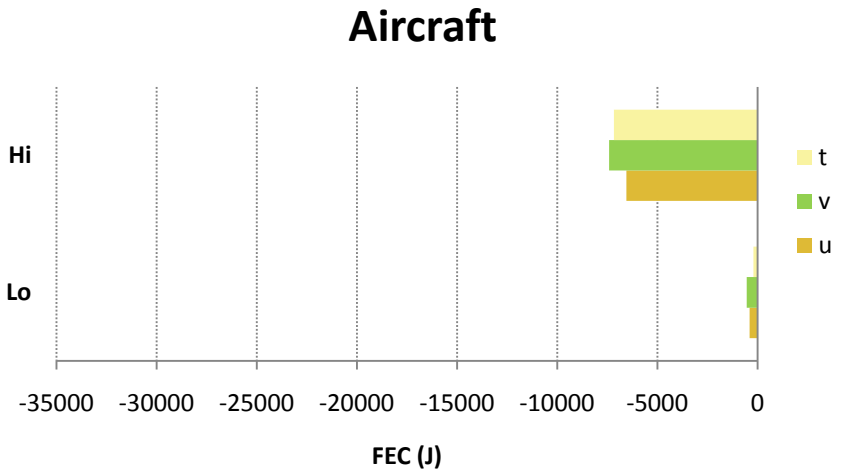


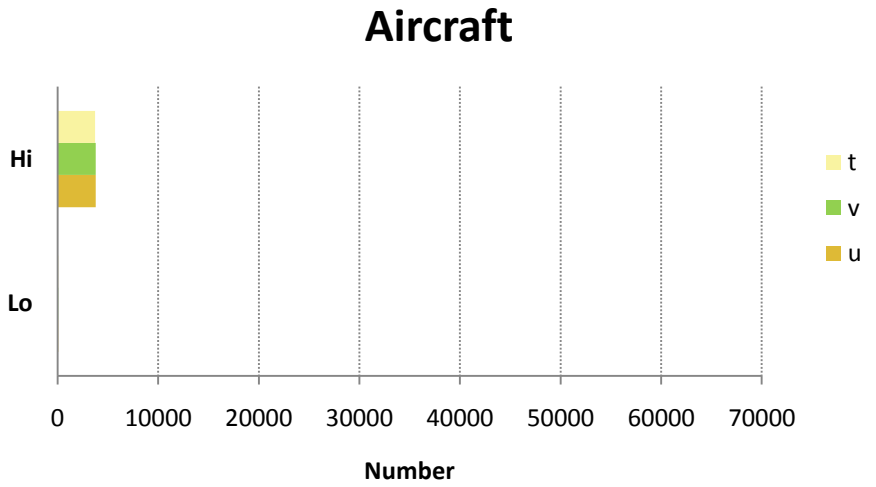
Concordiasi Sep-Dec 2010





HI: < 400 hPa **LO: > 400hPa**

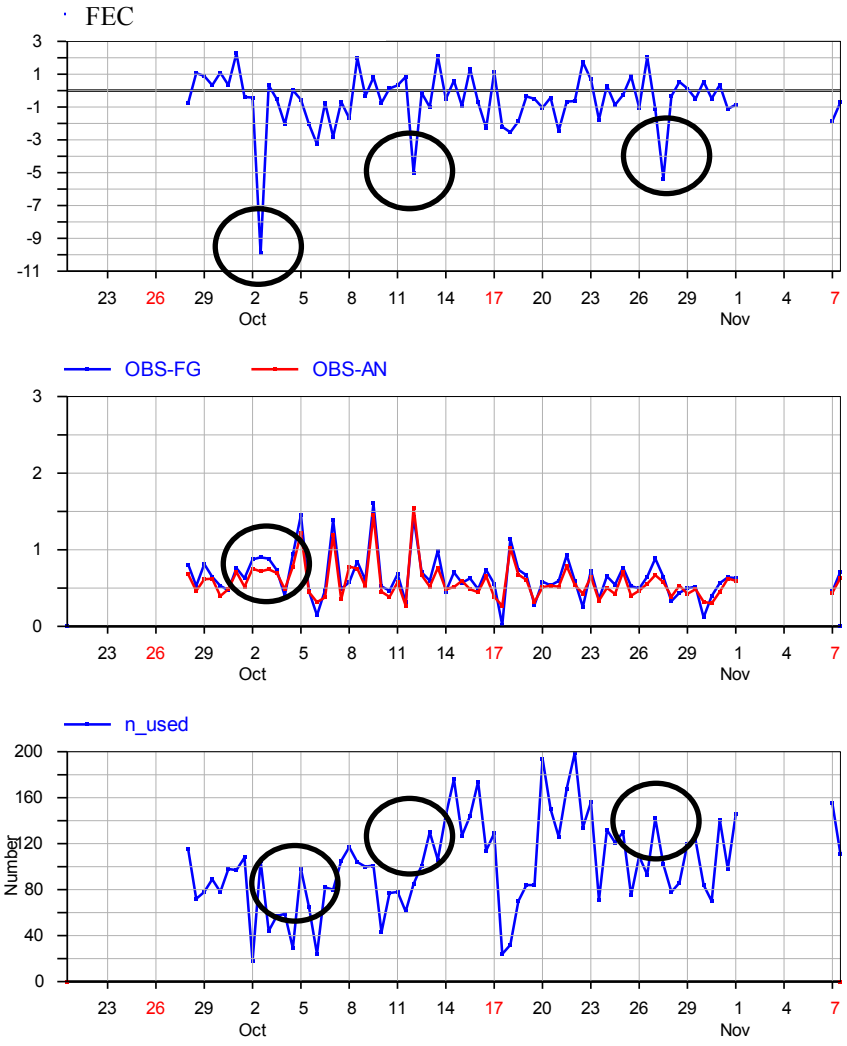




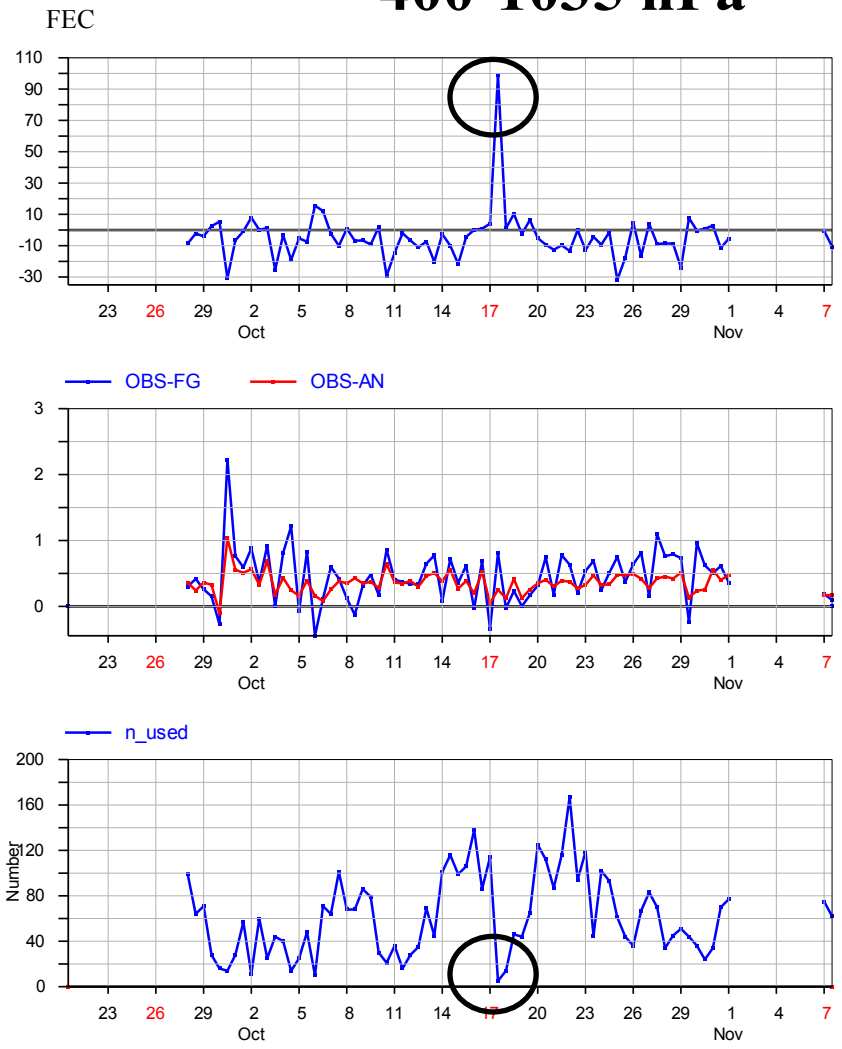
Dropsondes T-comp 60-90 S

26 Sep- 7 Nov 2010

0-400 hPa

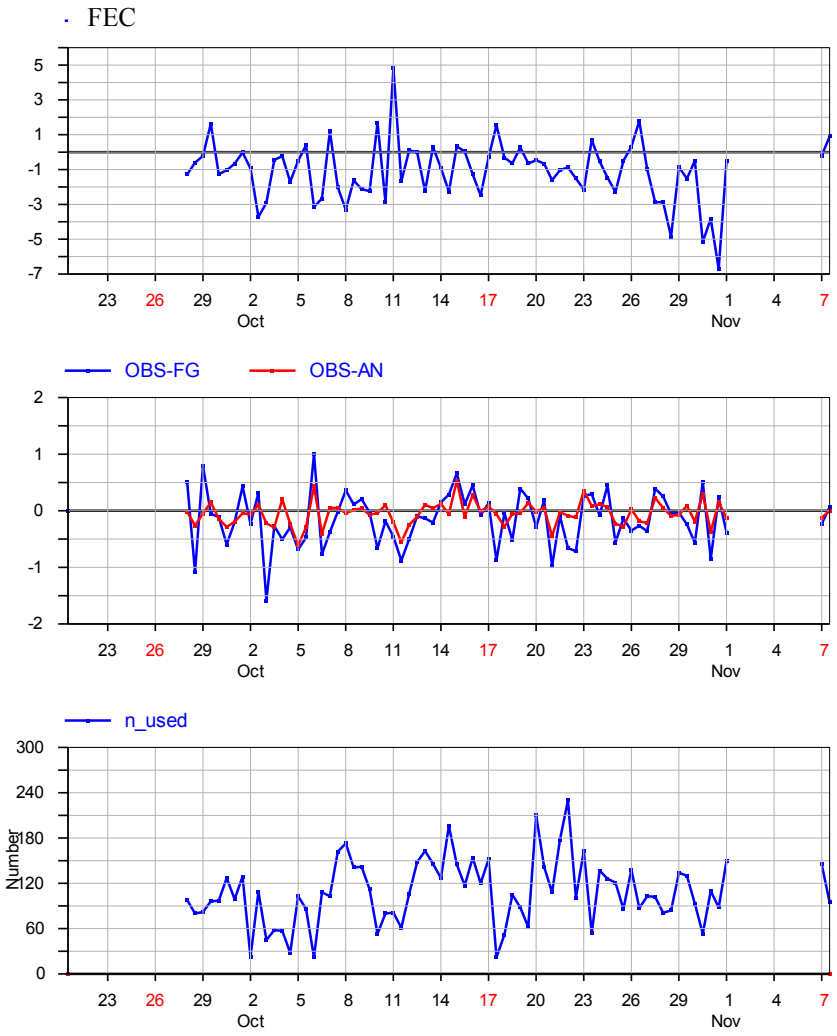


400-1035 hPa

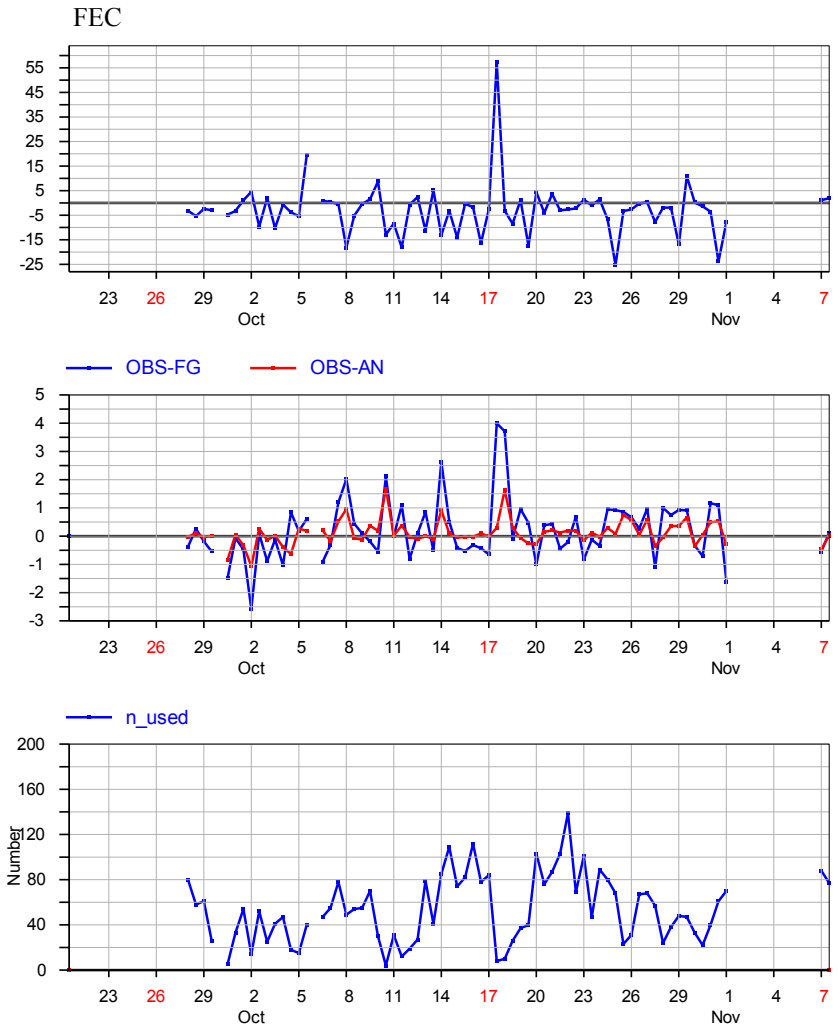


Dropsondes U-comp 60-90 S

0-400 hPa



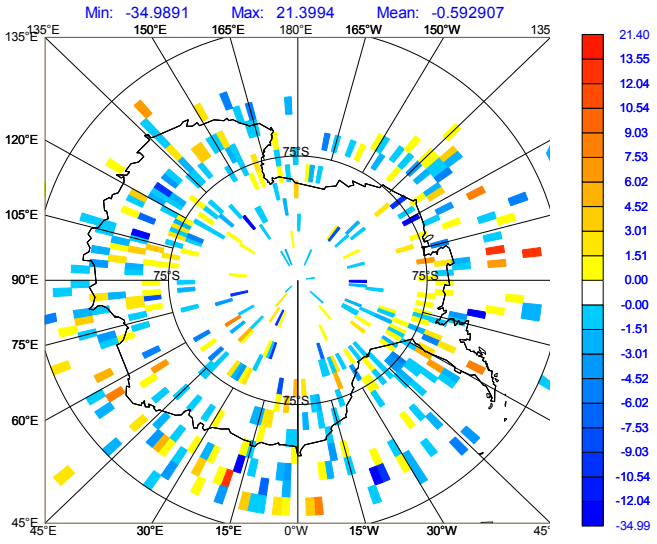
400-1035 hPa



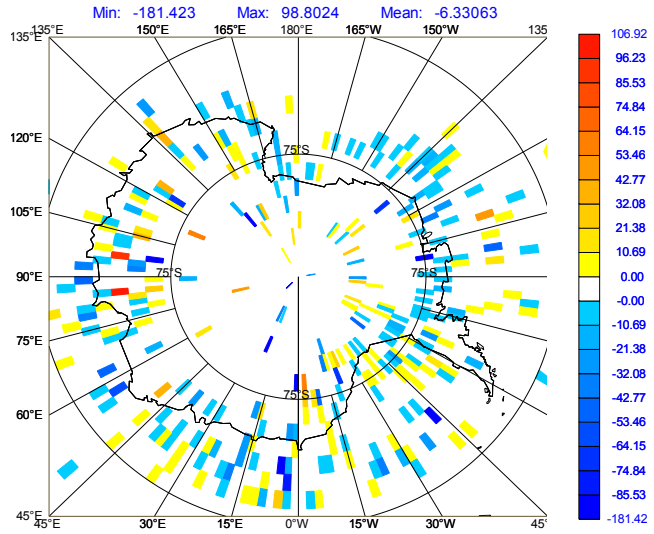
Dropsondes
T-comp
60-90 S

Mean FEC

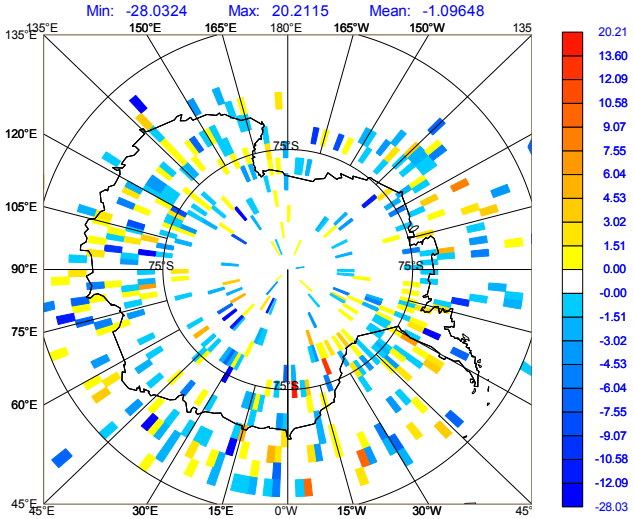
0-400 hPa

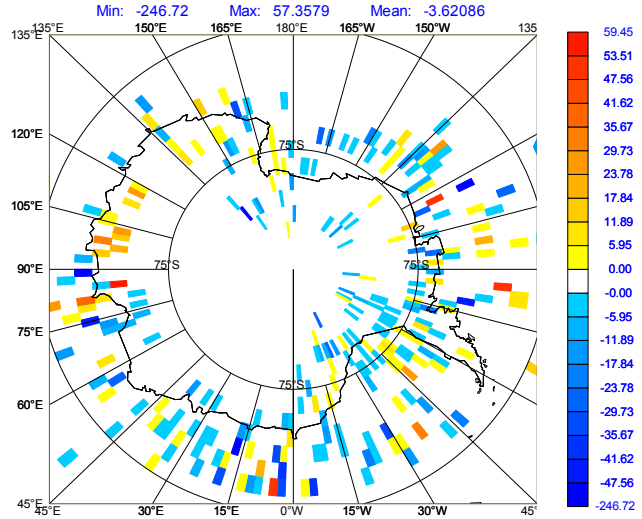


400-1035 hPa



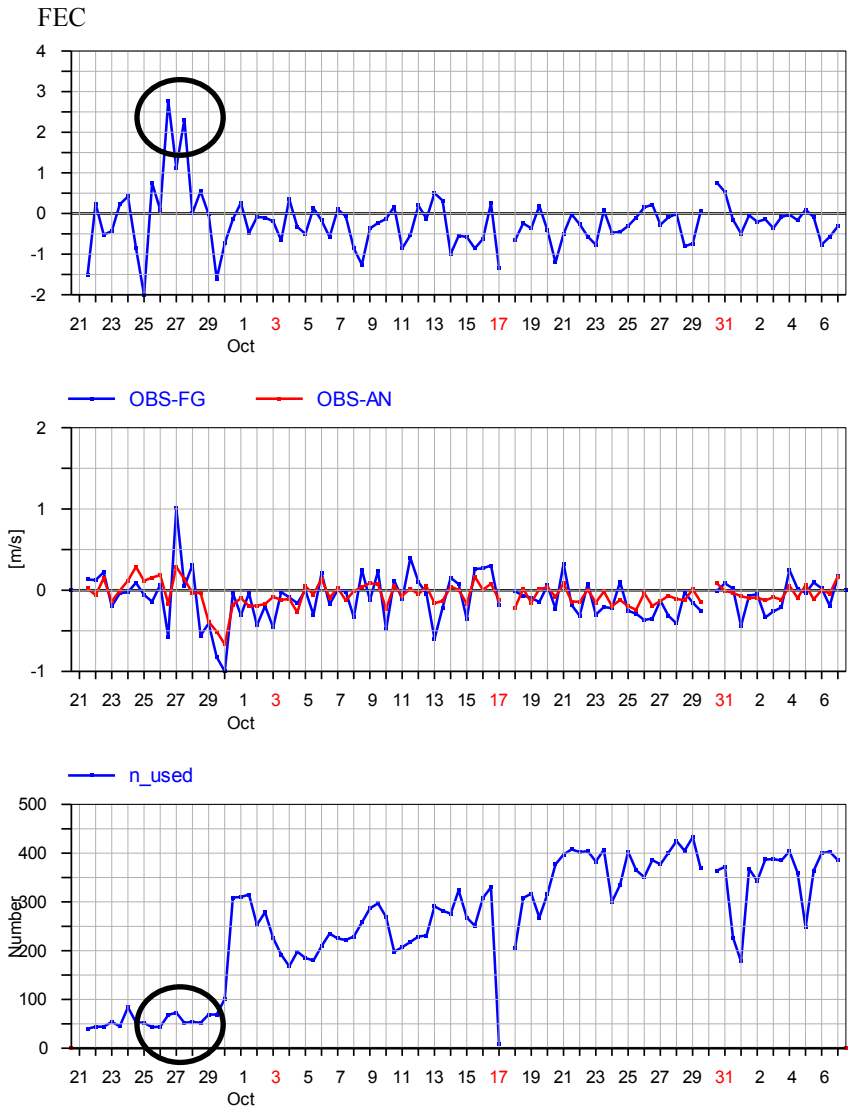
U-comp

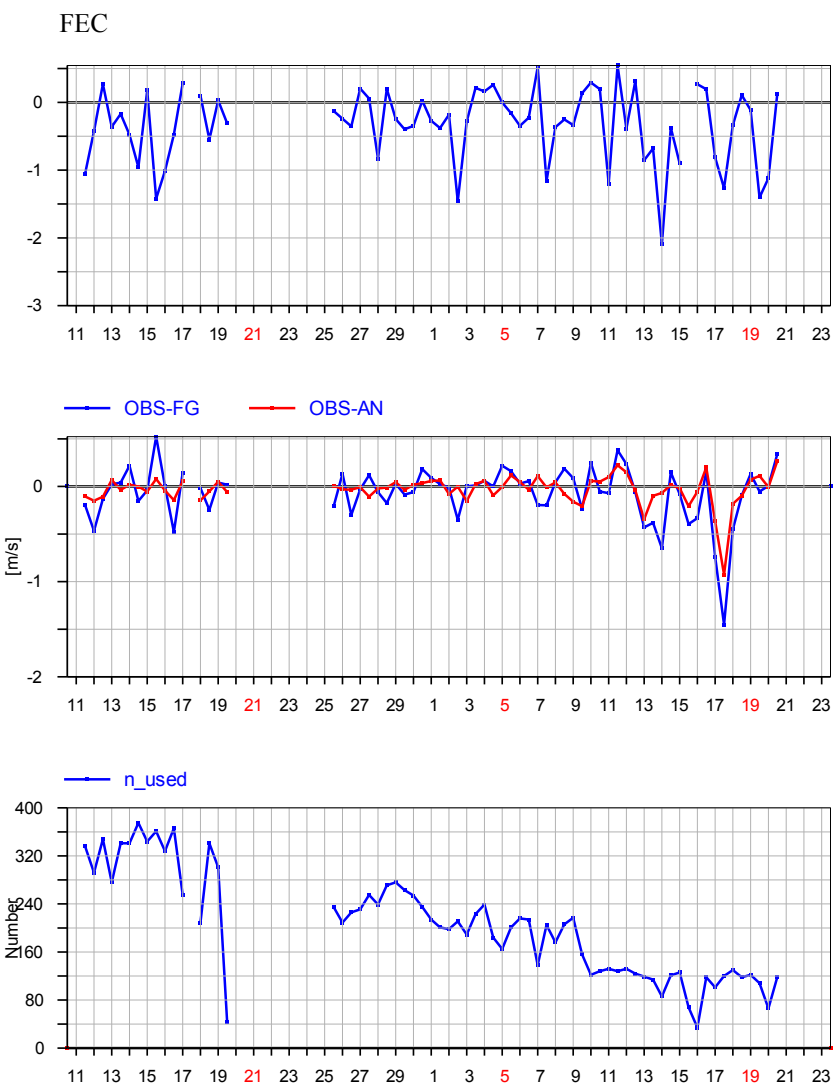




Gondola U-comp 60-90 S

0-100 hPa





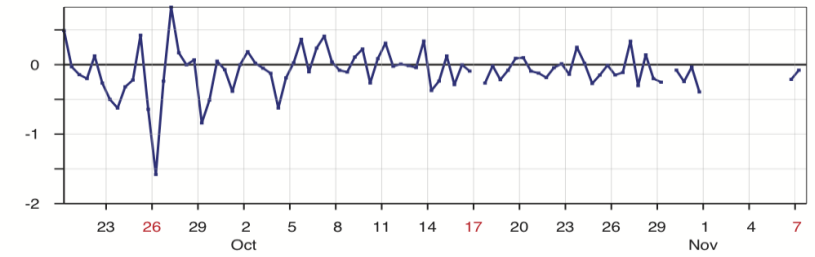
Comparison Gondolas and Dropsondes
T-comp
60-90 S

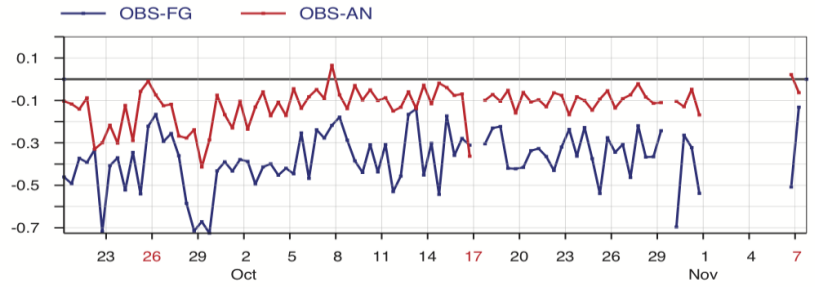
0-100 hPa

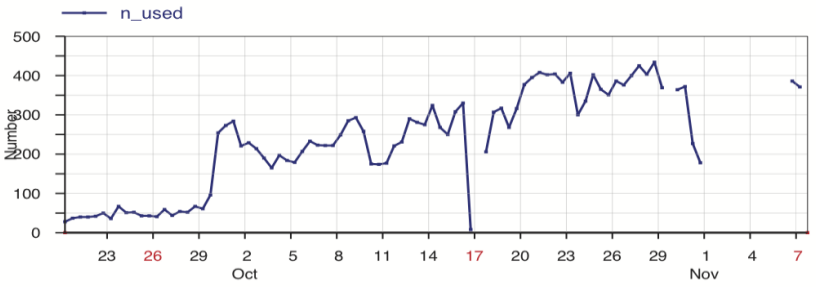
GONDOLAS

Level =0.00 - 100.00 hPa, Used data [time step = 12 hours]
Area: lon_w= 0.0, lon_e= 360.0, lat_s= -90.0, lat_n= -60.0 (over All_surfaces)
EXP = 9847

FEC



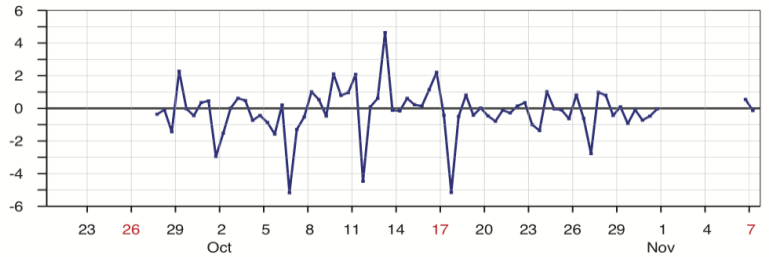


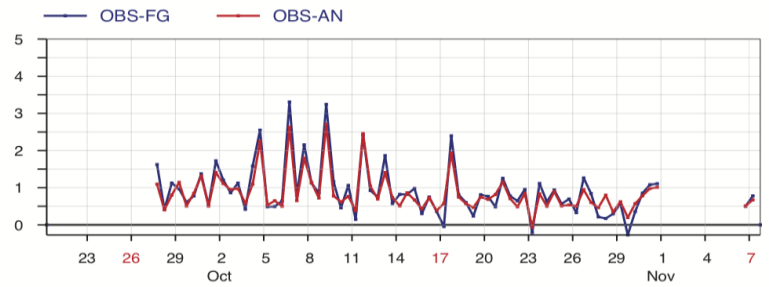


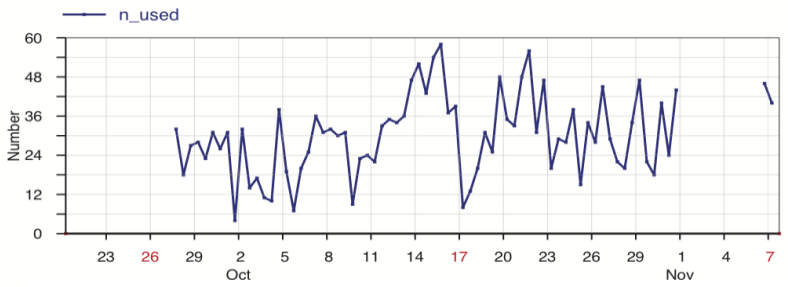
DROPSONDES

Level =0.00 - 100.00 hPa, Used data [time step = 12 hours]
Area: lon_w= 0.0, lon_e= 360.0, lat_s= -90.0, lat_n= -60.0 (over All_surfaces)
EXP = 9847

FEC

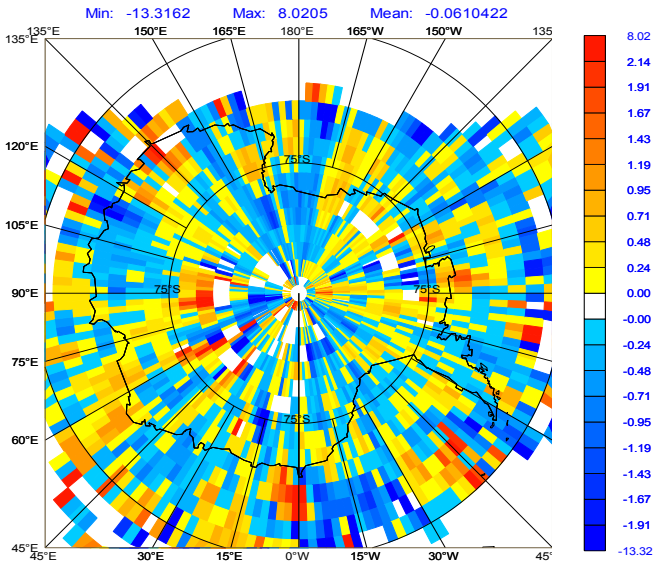




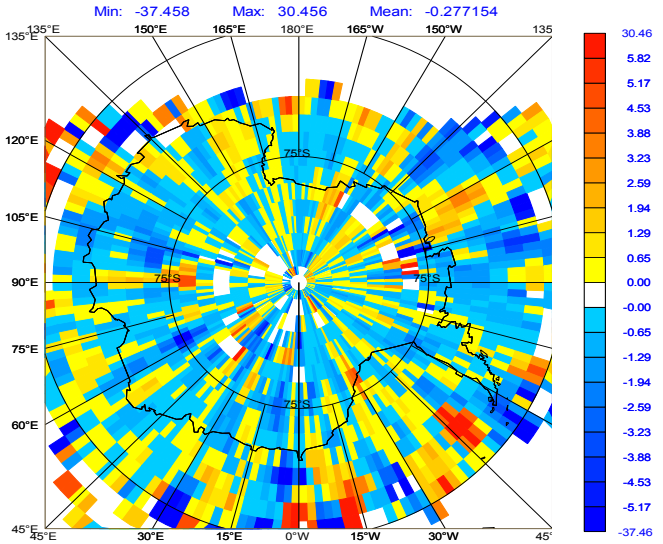


Concordiasi

T-comp
60-90 S



Mean FEC



0-100 hPa

U-comp

Conclusion

- **NWP models performance over the poles has considerably improved over the last decade**
  - **Makes them fit to contribute significantly to field campaigns such as Concordiasi**
- **Concordiasi dropsondes can have a large impact in terms of forecast error reduction**
  - **Primarily on the wind field at high level**
  - **Temperature as well in at low levels (NWP systems use less satellite data close to the surface)**
- **Statistics remain noisy**
  - **Large day-to-day variability around the zero line for FEC diagnostics**
- **Results need to be consolidated**
  - **Comparison with other Centres, OSE impact studies, etc.**

Thank You