

# Impact of observations in the Southern Polar Area during the Concordiasi field experiment

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ECMWF

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NASA/GMAO

R. Langland

NRL

A. Cress

DWD

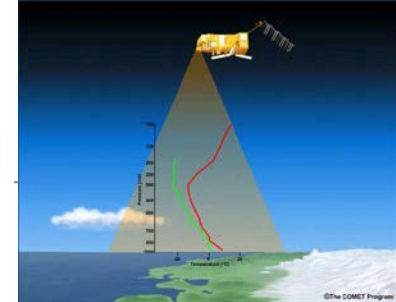
# Concordiasi = CONCORDIA-IASI

A French-US initiative for climate / meteorology over Antarctica

Improve the use of space-borne atmospheric sounders over polar regions, in particular IASI on board MetOp

Benefit from the continental French-Italian station

Concordia



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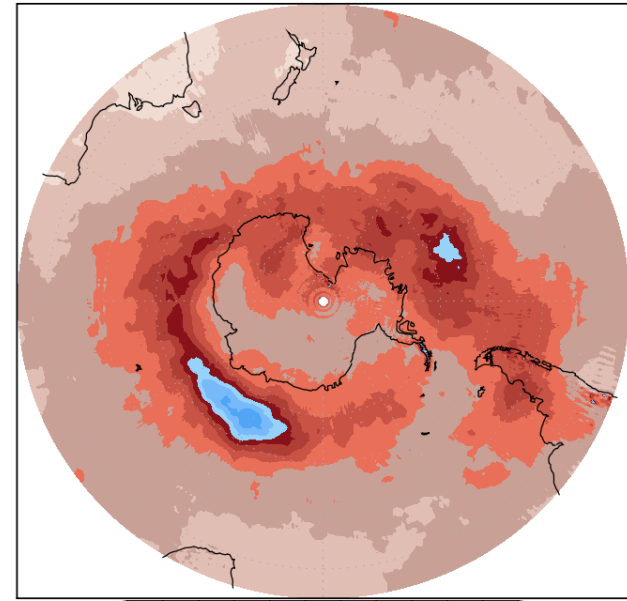
# Analysis Uncertainty 45°S to 70°S

To the north: Geostationary satellite winds, ship surface obs, commercial aircraft routes

To the south: Antarctic raobs and land surface data, MODIS and AVHRR winds

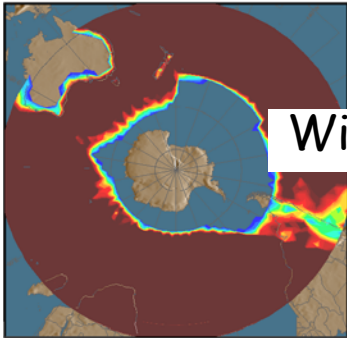
## Analyses differences

Mean Z500 variance ECMWF NOGAPS METFRANCE GEOS5



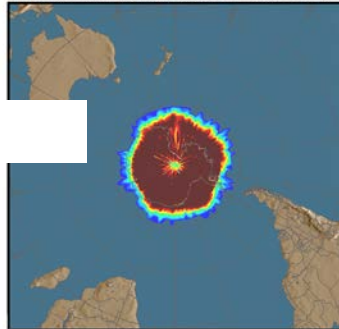
00UTC27Sept - 12UTC16Nov 2010 100 analyses

Sfc-10 hPa No. Sat Wind Obs 505286  
24 of 30-Day ALL SSEC, ALL CHAN, VT 2011082000-201109

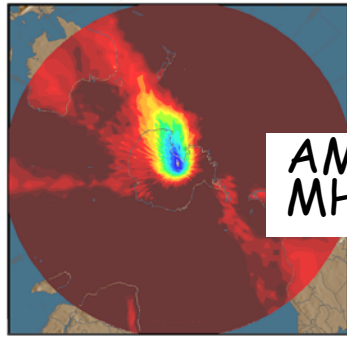


Winds

Sfc-10 hPa No. Sat Wind Obs 153848  
24 of 30-Day ALL MODIS, ALL CHAN, VT 2011082000-20110918

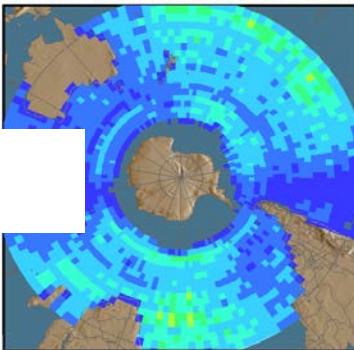


No. AMSU Obs 3.50306e+06  
All NOAA, All Chan Min, Max: 0, 1915, Mean: 805.302, SDEV

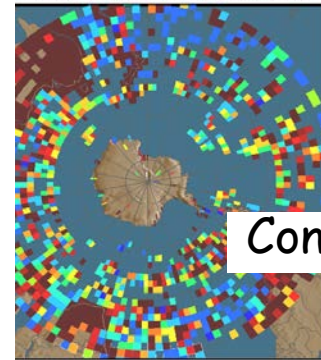


AMSU/  
MHS

All Satellites, All Chan No. MHS Obs 133108  
25 of 30-Day VT 2011090600-2011100500  
Min, Max: 1, 243, Mean: 56.3063, SDEV: 39.898

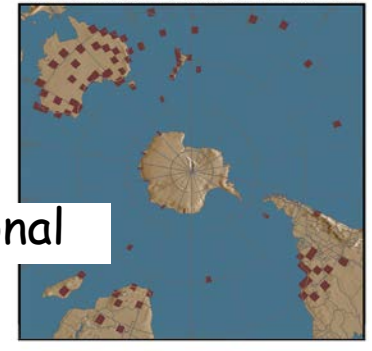


No. All Surface Obs 146738  
-Day All Surface, VT 2011082000-2011091800  
Min, Max: 0, 3037 Mean: 33.7329, SDEV: 145.77



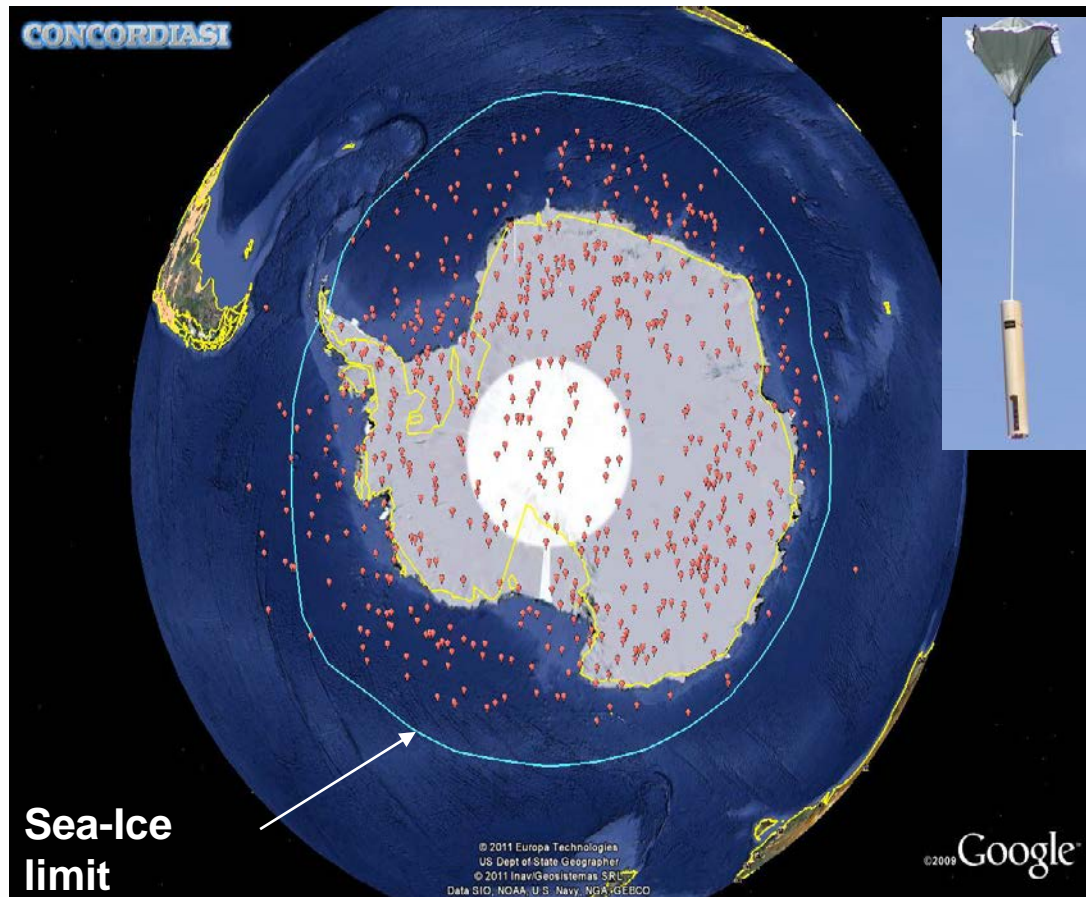
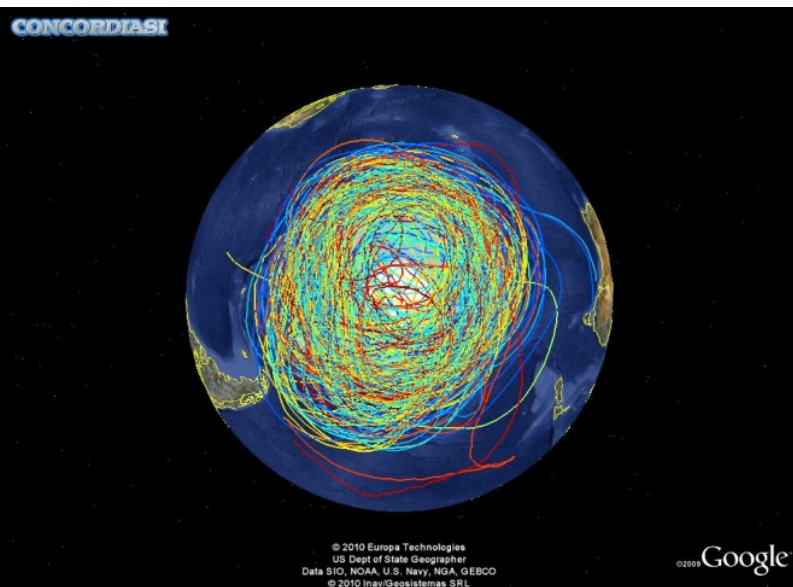
Conventional

Sfc-10 hPa No. All Radiosonde Obs 346809  
24 of 30-Day Mandatory & Significant Levels, VT 2011082000-20110918  
Min, Max: 0, 7563 Mean: 79.7262, SDEV: 620.909





# 640 Dropsondes (20100923-20101201)



**13 driftsondes launched**

**Flight-level data and dropsonde observations on GTS**

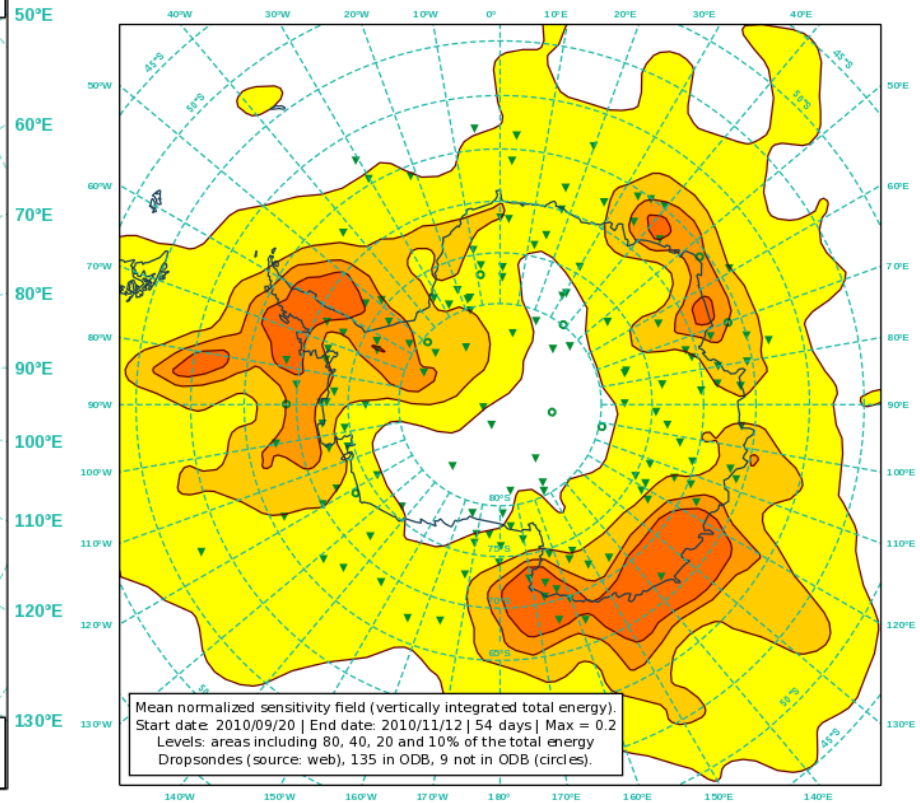
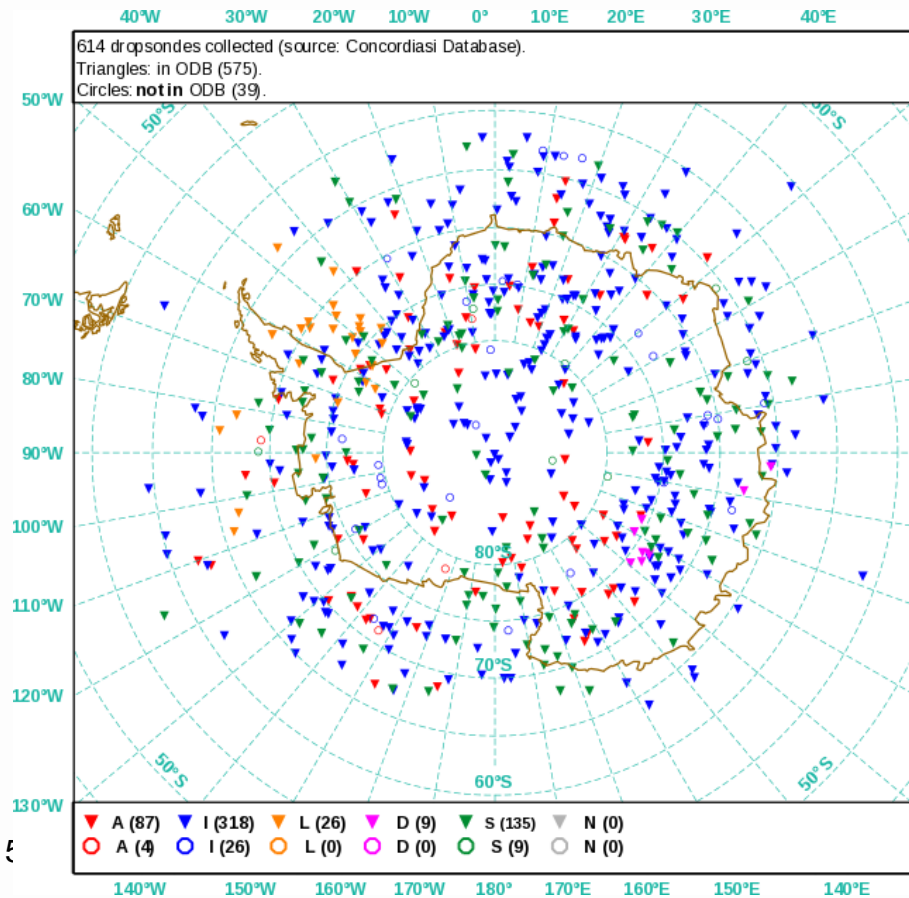
# Dropsondes to calibrate the assimilation

Most of the sondes are dropped when coinciding MetOp overpasses

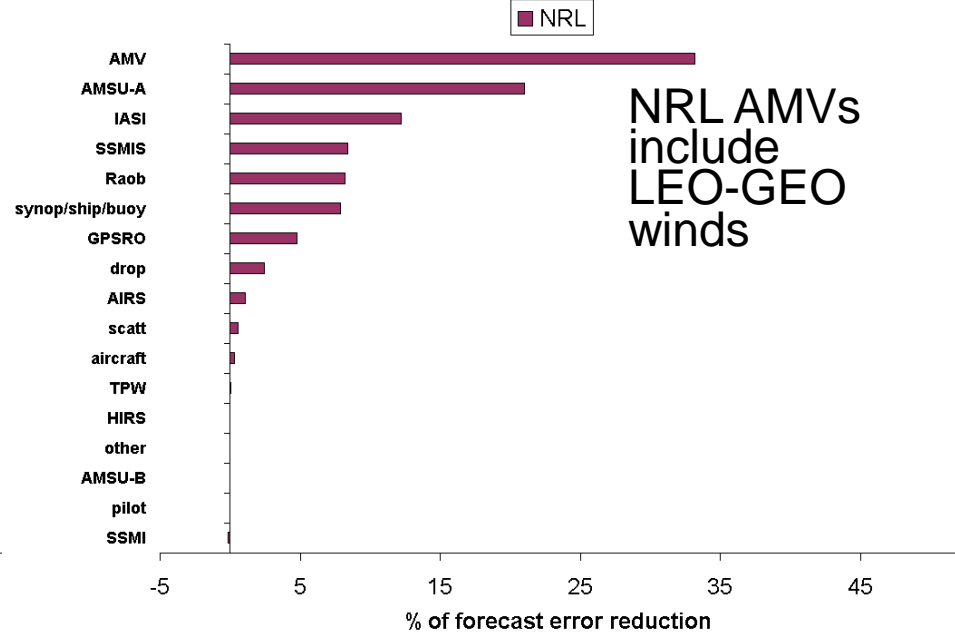
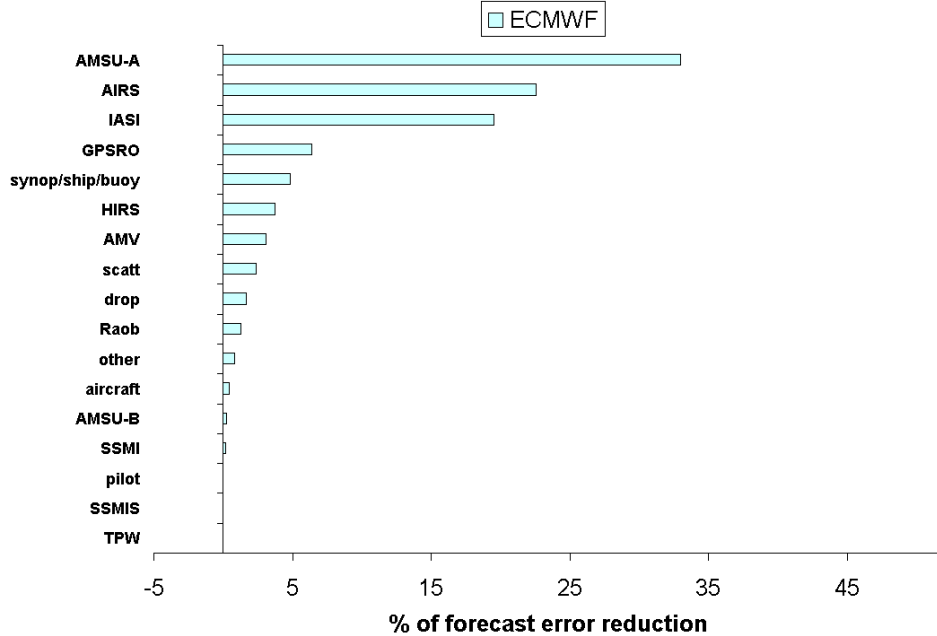
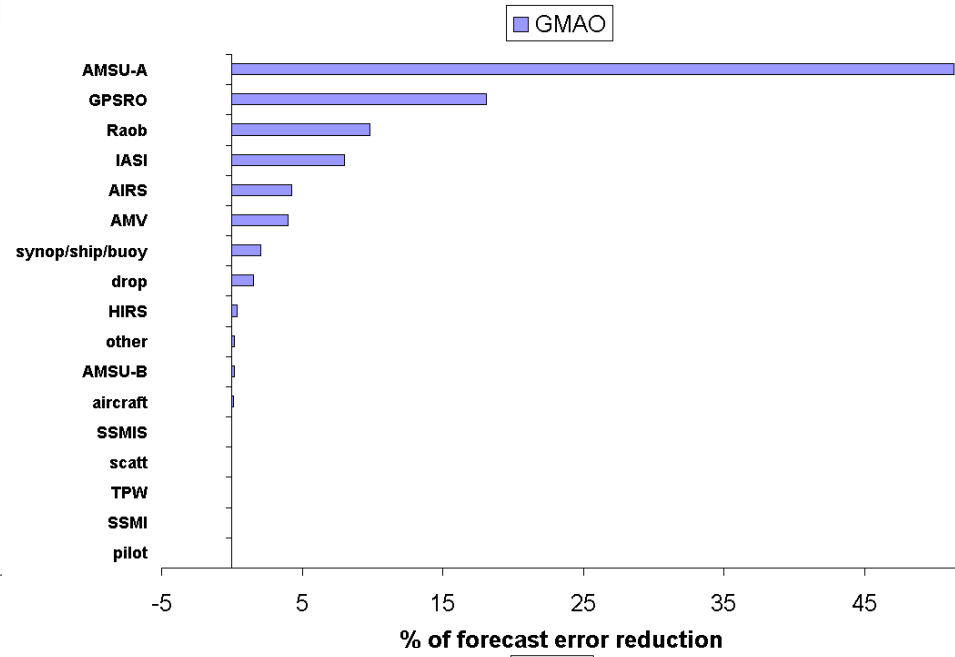
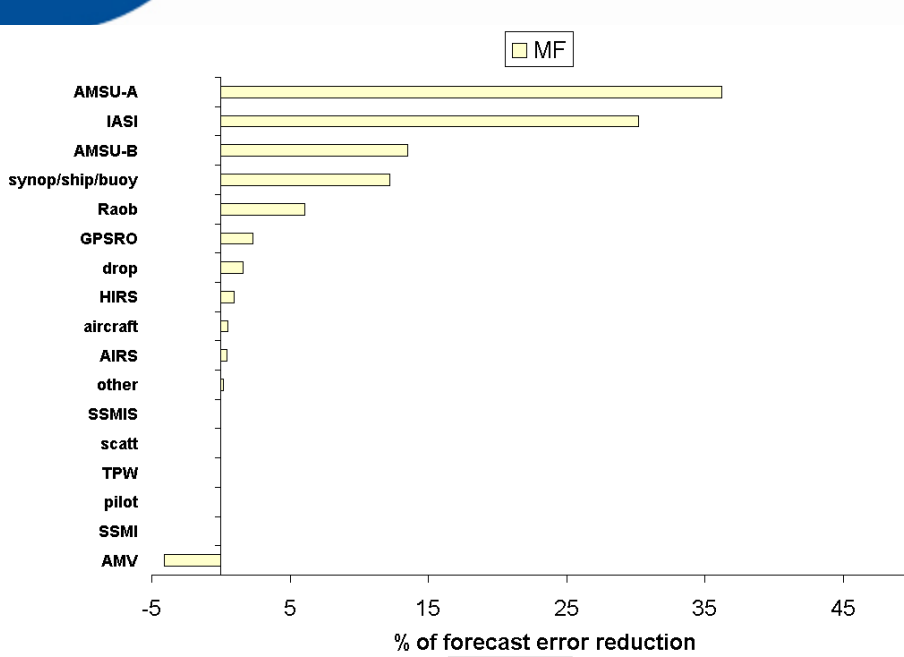
Part of the dropsondes are deployed in sensitive areas

Some in the Weddell Sea or near Concordia

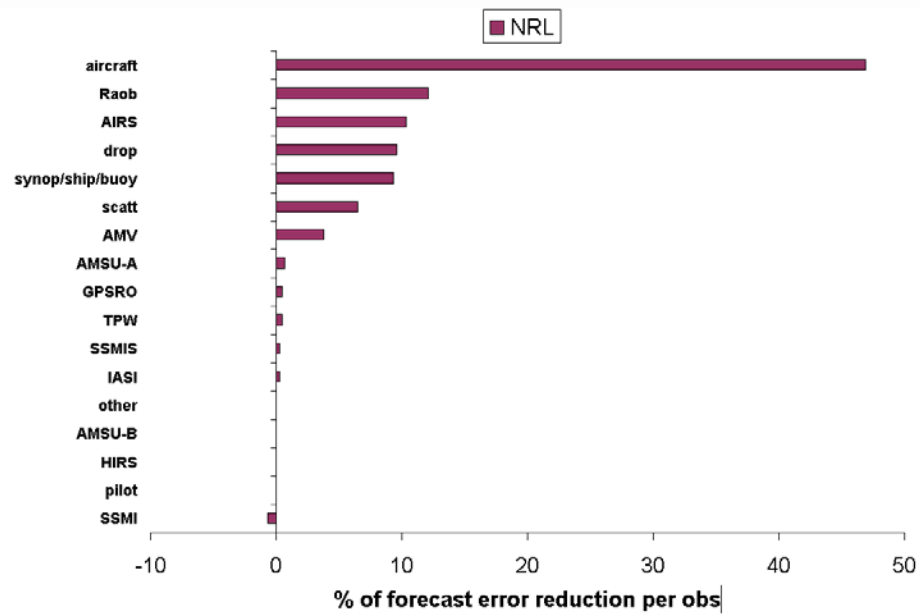
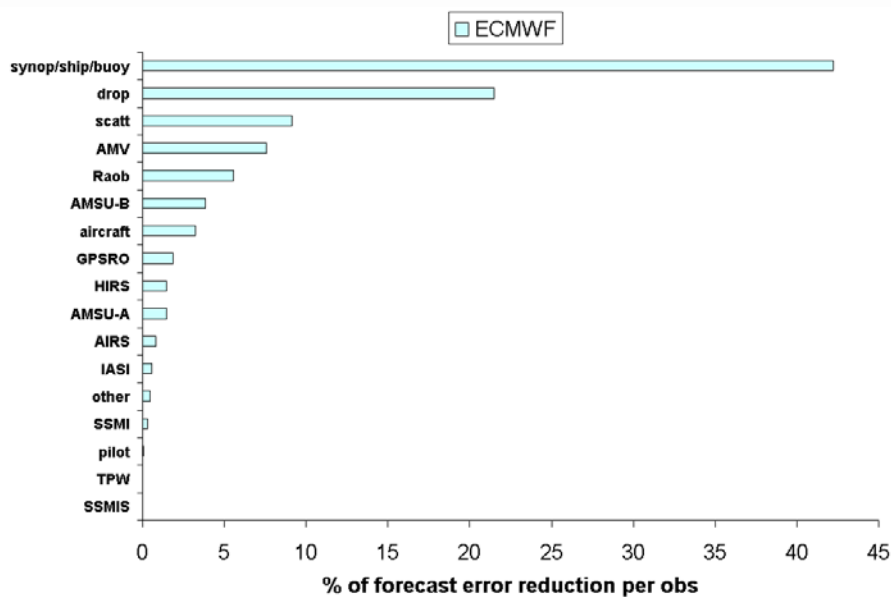
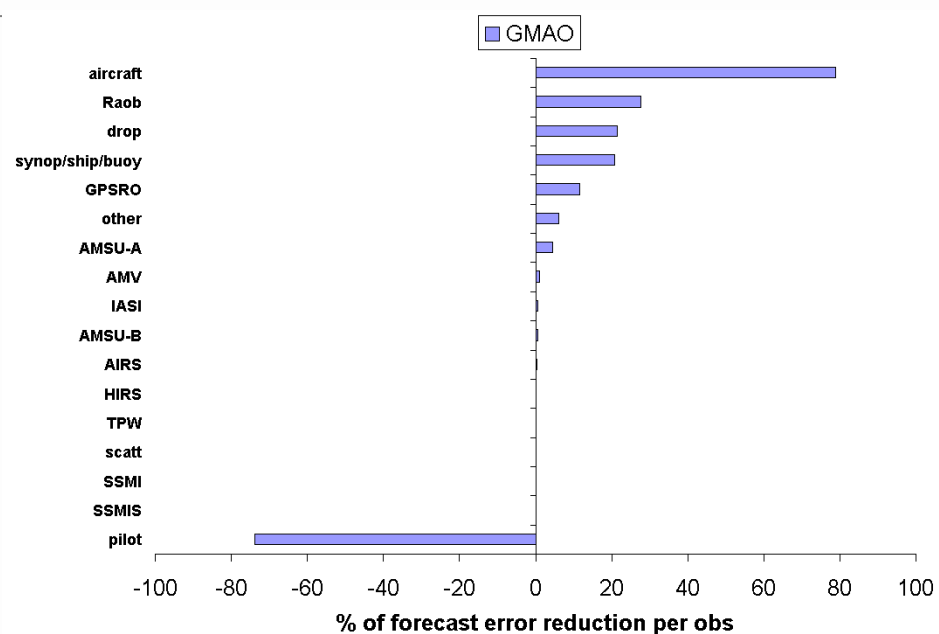
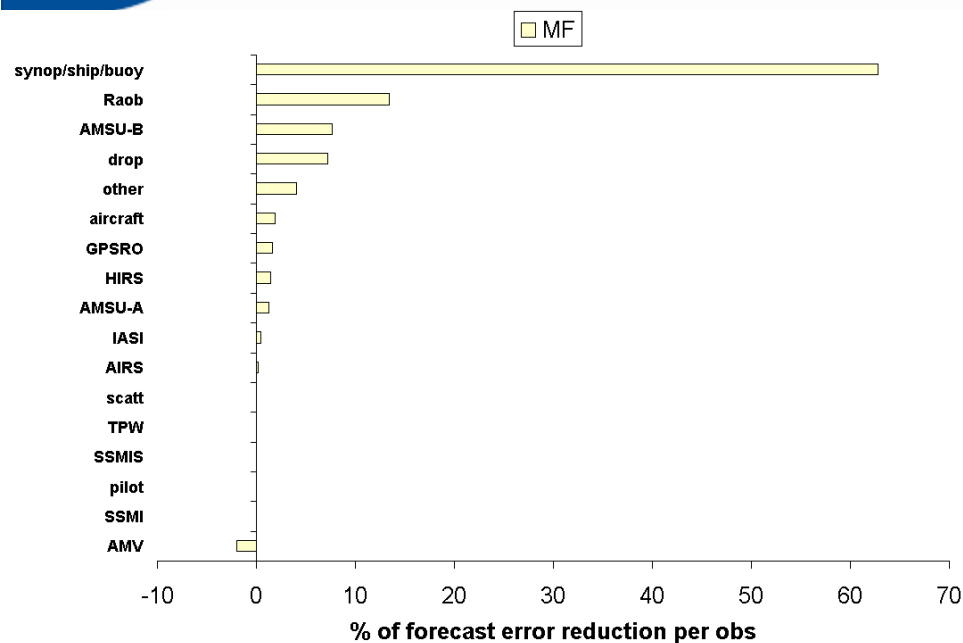
Sensitive areas



# At M-F/GMAO/ECMWF/NRL (obs south of 60 S)



# Impact per observation (obs south of 60 S)



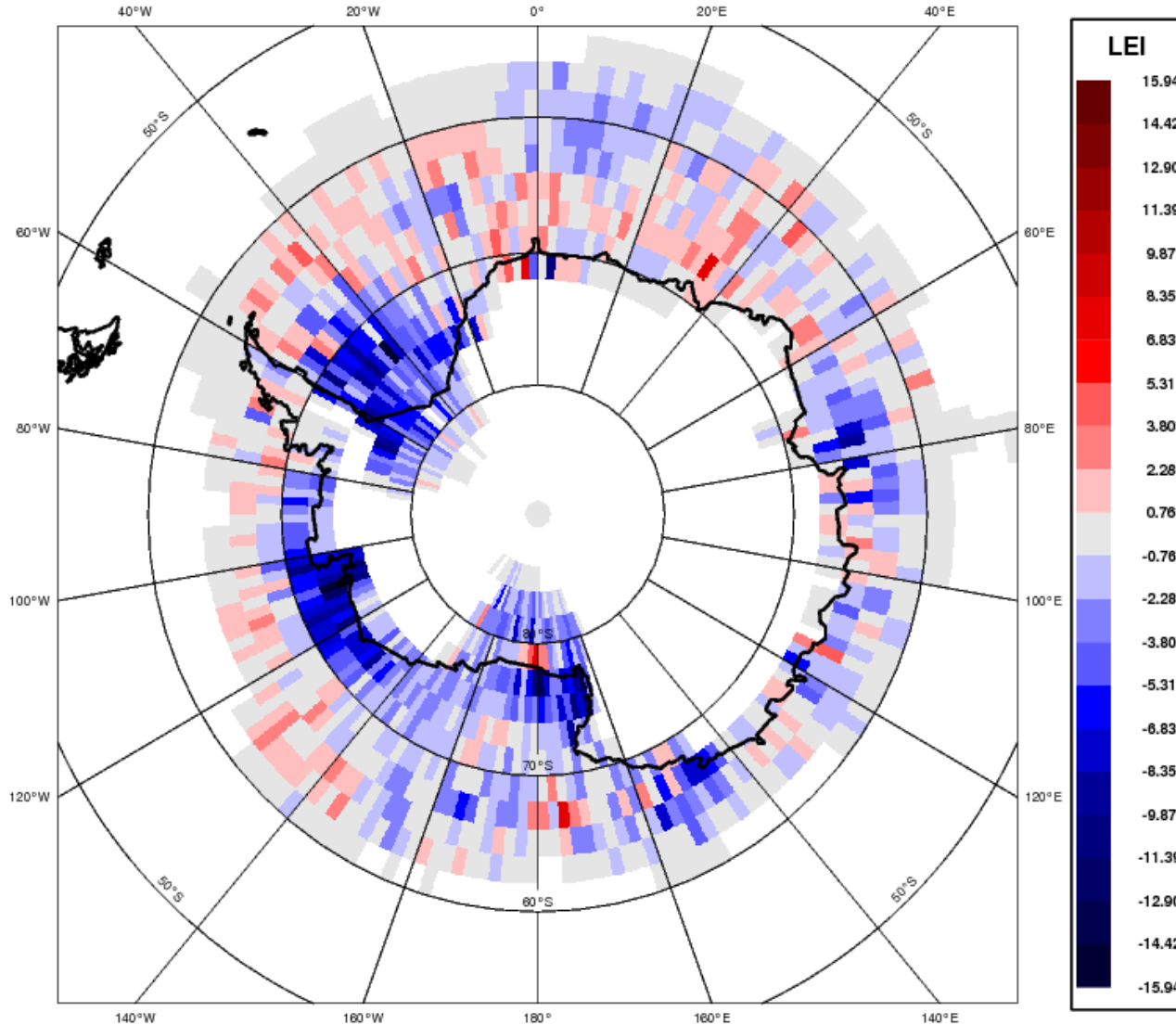
# Most important data types for different systems

	In decreasing order of importance
ECMWF	<b>AMSU-A, AIRS and IASI</b> , GPS-RO, Synop/Ship/Buoy, HIRS, AMV, scatt, Drop
NASA	<b>AMSU-A, GPS-RO, RAOB, IASI and AIRS</b> , AMV, Synop/Ship/Buoy, Drop, HIRS
NRL	<b>AMV, AMSU-A, IASI, SSMI/S, RAOB</b> , Synop/Ship/Buoy, GPS-RO, Drop, AIRS
MF	<b>AMSU-A, IASI and AIRS, AMSU-B</b> , Synop/Ship/Buoy, RAOB, GPS-RO, Drop, HIRS



# Large impact of AMSU-B over sea ice, used at Meteo-France

Averaged Linear Estimate of Impact (LEI): -1562.77 J/kg  
Experiment: B27Z / From 2010/09/27 at 00UTC to 2010/11/15 at 18UTC / H UTC cycles / Grid: 2° × 2°.  
Objective function : Total energy of the 24h forecast error.  
Observation type: amsub on sea ice, channel: 9999, level : all



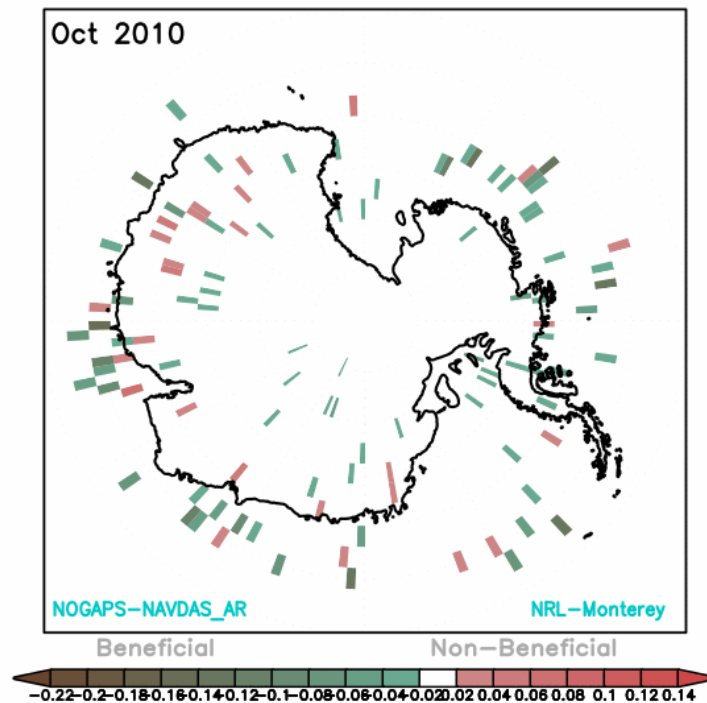
Fatima  
Karbou

# Sensitivity to dropsonde observations (NRL and MF)

Amount of dropsonde data deployed during part of Concordiasi  
26 September - 30 November 2010  
58,679 observation data (T, u, v, q)

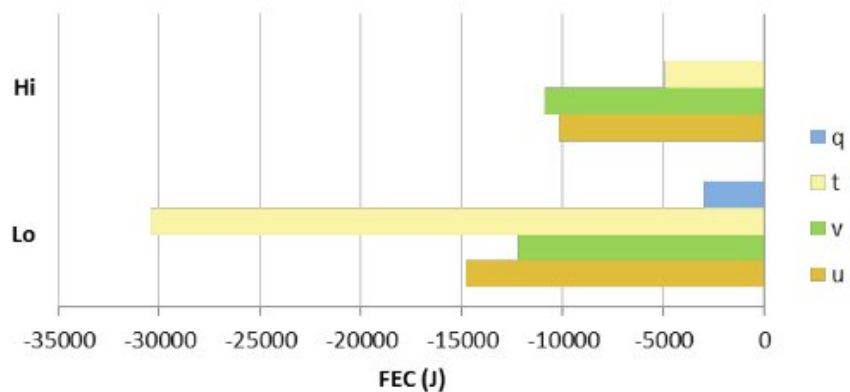
Approximately the same amount of data provided by  
three additional radiosonde stations with 00UTC and 12UTC daily  
soundings

DROPSONDE Impact on 24h Fcst Error Norm

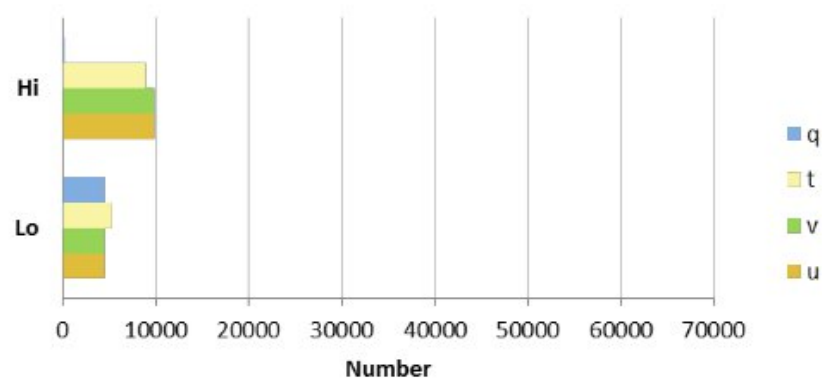


# Dropsonde and Radiosonde impact Sep-Dec 2010 at ECMWF

## Dropsonde



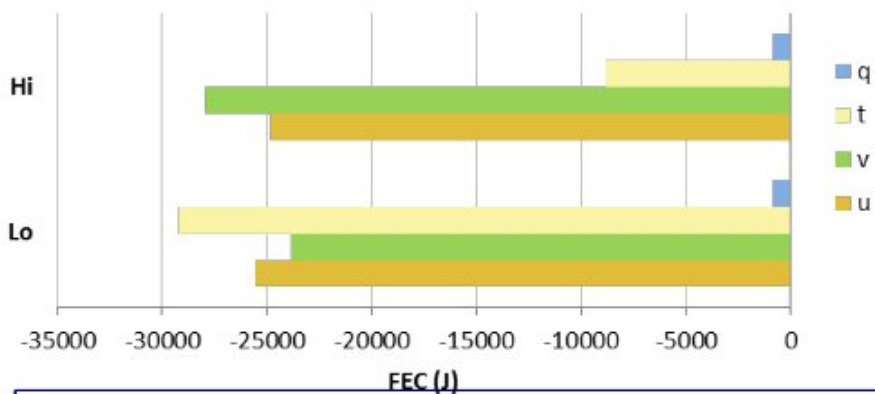
## Dropsonde



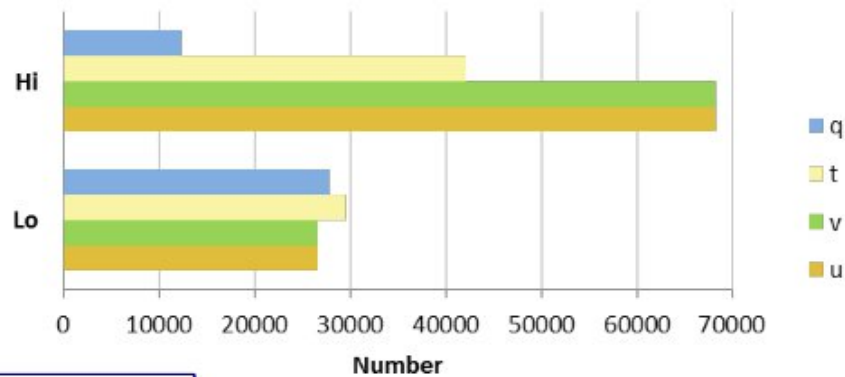
Hi: < 400 hPa

LO: > 400hPa

## Radiosonde



## Radiosonde

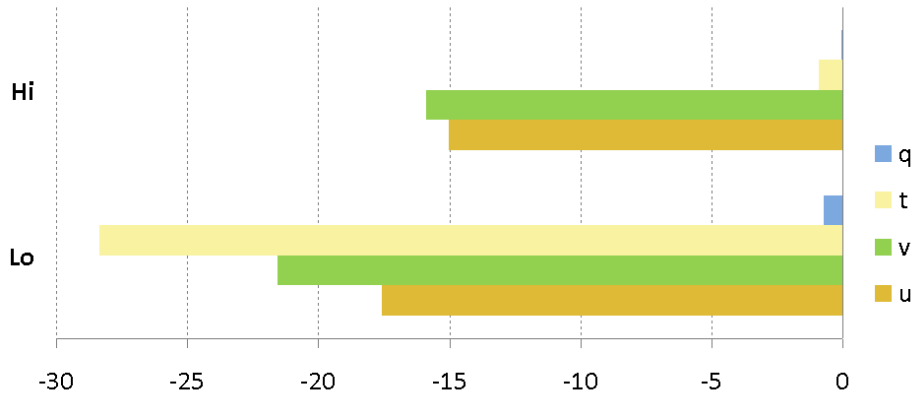


Hi: < 400 hPa

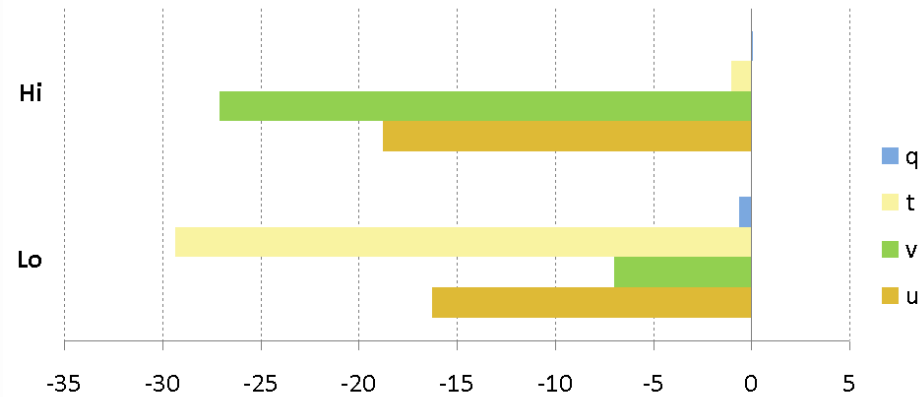
LO: > 400hPa

# Dropsonde impact 27Sept-16 Nov. 2010

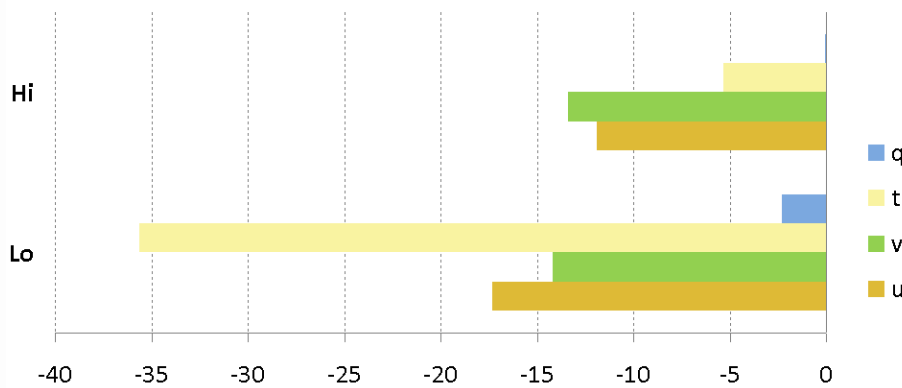
## Meteo-France



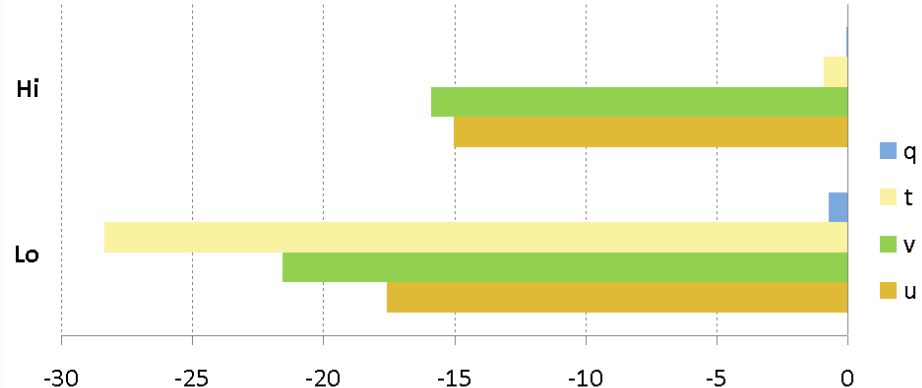
## GMAO



## ECMWF



## NRL



## Summary of dropsonde results

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Larger impact per observation at

higher latitudes (less other data)

60-70 S (more active systems / largest analysis uncertainty)

Over Antarctic plateau where less other data are assimilated

More impact from winds at higher levels compared to lower levels

More impact from temperature at lower levels compared to higher levels



# Assimilation of gondola information at DWD

TEMP Verification GME/7894

TIME: 2010091700 - 2010093012

OBS minus FG (full)    OBS minus ANA (dotted)    Used

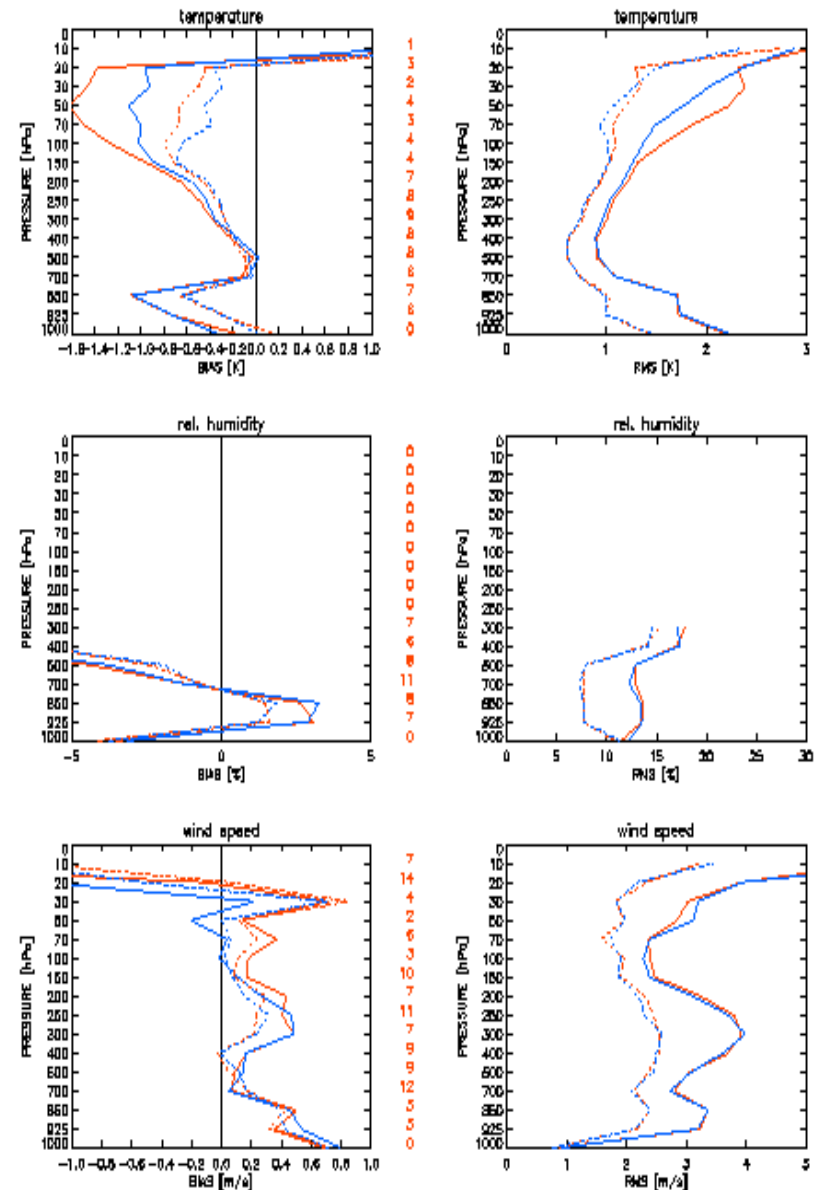
## Radiosonde Verification

- Bias (left); RMS (right)
- Antarctic region
- Comparison of Routine (red) against Experiment using stratospheric balloon measurements (blue)

## Results:

Temperature- and Windspeed bias reduced over Antarctica in the lower stratosphere

RMS of temperature is reduced considerably for both, OBS minus FG and OBS minus Ana



# Concluding remarks

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Over the Southern polar area, large uncertainty in a ring 45-70S

Large impact of satellite data: AMSU-A, IASI and AIRS, GPS-RO

Non-negligible impact of conventional data

In some systems, large impact of AMSU-B/MHS over sea-ice,  
large impact of MODIS winds

Potential large benefit of using IASI data down to surface  
over Antarctica

## Concluding remarks

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Both Concordiasi dropsonde and gondola information have a positive impact on forecast performance

Dropsondes have a larger impact at high latitudes (inside Antarctic continent)

Large impact of wind observations at high levels, of temperature information at lower levels

## Papers on Concordiasi so far...

Rabier, F., A. Bouchard, E. Brun, A. Doerenbecher, S. Guedj, V. Guidard, F. Karbou, V.-H. Peuch, L. E. Amraoui, D. Puech, C. Genthon, G. Picard, M. Town, A. Hertzog, F. Vial, P. Cocquerez, S. Cohn, T. Hock, H. Cole, J. Fox, D. Parsons, J. Powers, K. Romberg, J. VanAndel, T. Deshler, J. Mercer, J. Haase, L. Avallone, L. Kalnajsand, C. R. Mechoso, A. Tangborn, A. Pellegrini, Y. Frenot, A. McNally, J.-N. Thépaut, G. Balsamo and P. Steinle, 2010 : "The Concordiasi project in Antarctica" Bulletin of the American Meteorological Society. Bulletin of the American Meteorological Society, January 2010, 69-86.

Guedj S., F. Karbou, F. Rabier, A. Bouchard, 2010: Toward a better modelling of surface emissivity to improve AMSU data assimilation over Antarctica. IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, Vol. 48, NO. 4, 1976-1985.

Bouchard A, F. Rabier, V. Guidard & F. Karbou, 2010 : Enhancements of satellite data assimilation over Antarctica. MWR, June 2010, 138, 2149-2173.

Brun, E., D. Six, G. Picard, V. Vionnet, L. Arnaud, E. Bazile, A. Boone, A. Bouchard, C. Genthon, V. Guidard, P Le Moigne, F. Rabier, Y. Seity, 2011: Snow-atmosphere coupled simulation at Dome C, Antarctica. Journal of Glaciology. Vol. 52, No. 204, 2011

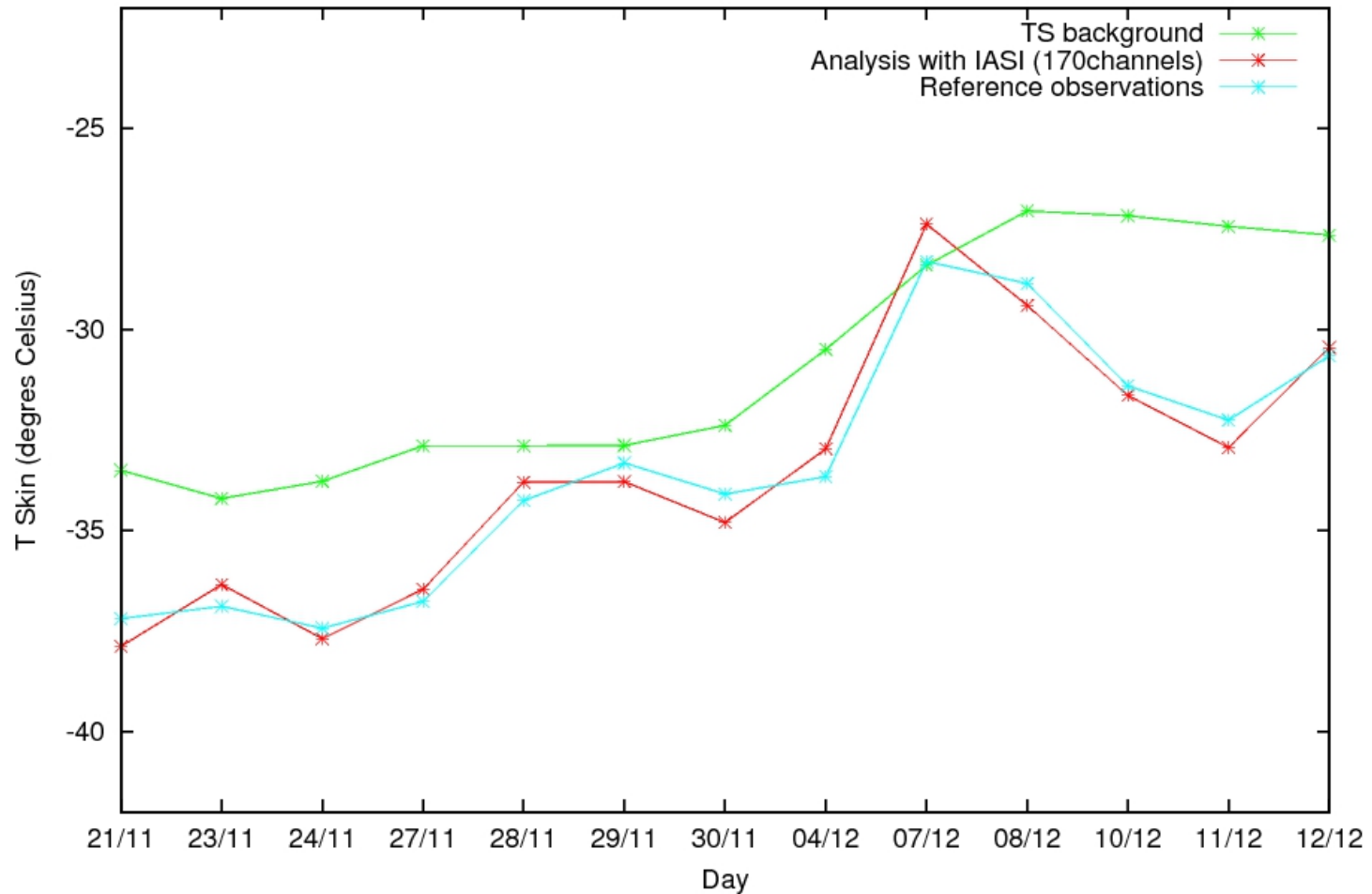
Vincensini, A., A. Bouchard, F. Rabier, V. Guidard, and N. Fourrié, 2011: IASI retrievals over Concordia within the framework of the Concordiasi programme in Antarctica. Accepted at IEEE- TGRS

Haase, J. S., J. Maldonado-Vargas, F. Rabier, P. Cocquerez, M. Minois, V. Guidard, P. Wyss, and A. V. Johnson (2012), A proof-of-concept balloon-borne Global Positioning System radio occultation profiling instrument for polar studies, Geophys. Res. Lett., 39, L02803, doi:10.1029/2011GL049982.

17 Genthon, C., M. S. Town, D. Six, V. Favier, S. Argentini, et A. Pellegrini, 2010. Meteorological atmospheric boundary layer measurements and ECMWF analyses during summer at Dome C, Antarctica, J. Geophys. Res., 115, D05104, doi:10.1029/2009JD012741

# IASI retrievals at Concordia

Temporal variation of T<sub>Skin</sub> - clear cases November and december 2009



**Good agreement of retrievals for Skin Temperature, compared to in situ data**

**(BSRN, manual measurements)**

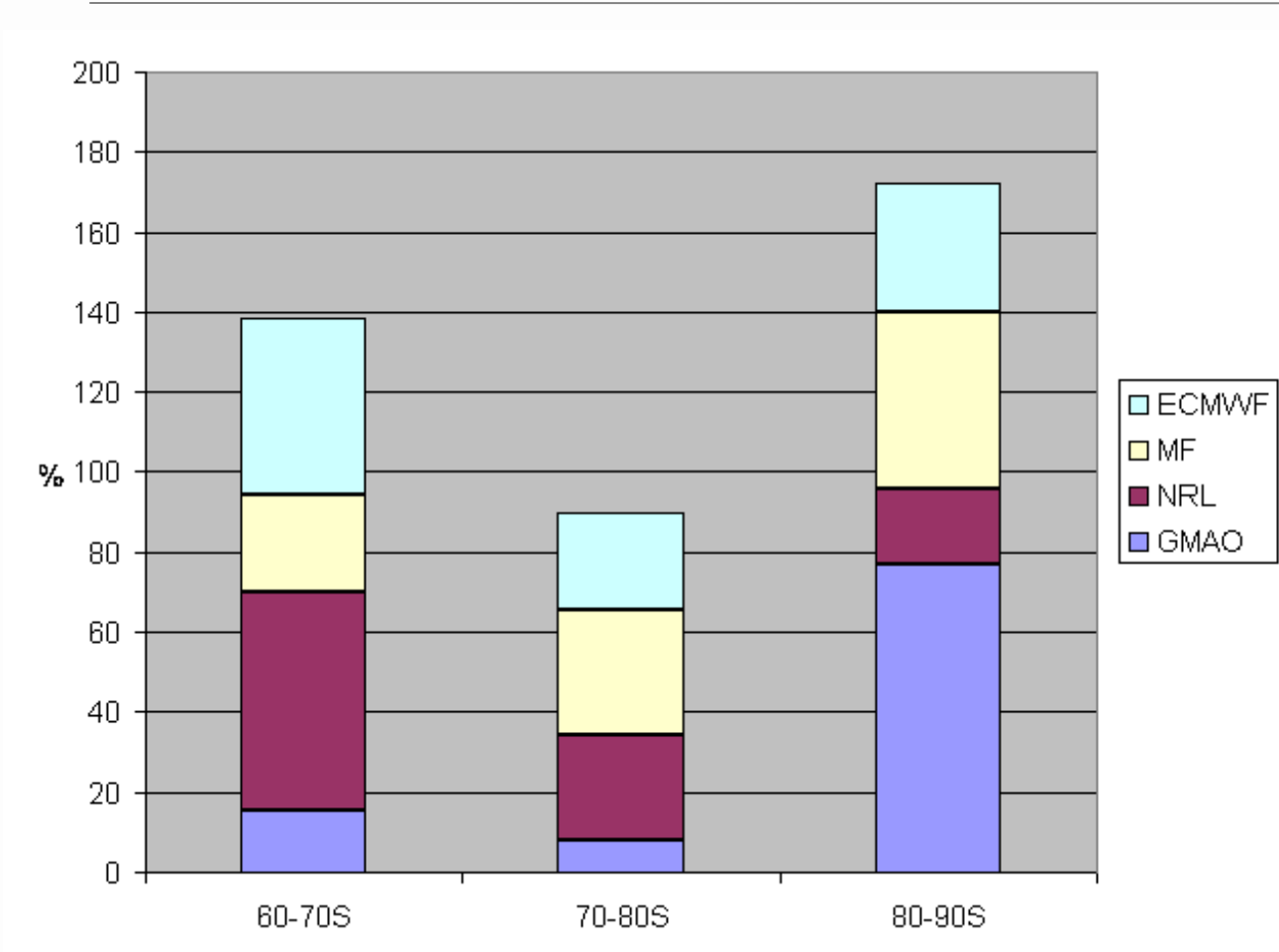


# Model uncertainty in the Southern Polar Area

# Impact of observations

# Impact of dropsondes

# Dropsonde impact per observation 27 Sept-16 Nov. 2010 at M-F/NRL/GMAO/ECMWF - Depending on latitude



Impact per observation, normalised to be 100% for each centre over the polar area (60-90S)

OSEs



# OSE at Météo-France: impact of both dropsonde and gondola information over 7 weeks

Significant impact in reduction of RMS(O-G)  
wrt radiosondes over Antarctica

	Without	With
U 200hPa (m/s)	2.53	2.47
V 200 hPa	2.60	2.53
U 250 hPa	2.87	2.75
V 250 hPa	2.73	2.67
T 500 hPa (K)	1.03	1.01

# The Concordiasi experiment