Evaluating the impact on NWP of sea level atmospheric pressure data over the ocean from drifting boys

By

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Goals of the GDP

The overall objectives of the GDP are to:

1) maintain a network of at least 1250 Lagrangian drifters (5°X5°) that, through the Argos and Iridium satellite systems, returns data of meteo-marine variables including near-surface ocean currents, sea surface temperature (SST), sea surface salinity (SSS), sea-level atmospheric pressure (SLP), sea-level winds (SLW) and subsurface temperature (Tz).

2) to provide a data processing system for the scientific use of the data.

Why the GDP buys barometers?

- SVPB drifters array provide global SLP measurements for:

a) Correction of inverse barometer effect (1hPa=1cm)-of interest for oceanographers;

b) NWP-of interest for NWS'. Co-operation between Oc-Met;

- Hurricane drifter array: targeted deployments of drifting temperature chains (0-150m), and drifters with sea-level wind and air pressure sensors-of interest for oceanographers and meteorologists.

Implementation of the barometer array

- GDP-SIO buys 290 barometer upgrades/year;
- An additional 190 barometers are purchased every 2nd year by GDP-SIO;
- Another 100 GDP-AOML drifters are upgraded to barometer every year by WS (Australia, New Zealand, South Africa, etc.;)
- ~80 SVP/year are purchased/deployed by E-SURFMAR;
- Total: 565 barometers/year (=> $565K/year, $400K/year from NOAA's GDP funds);
- While the DBCP has recommended outfitting the whole GDP array with barometers by 2012, the current funding level suggests that this target will be delayed or not met even in years to come.
- Drifters are deployed by VOS or by Research or Operational Agencies;
- $500K additional would be required to fit each drifter with a barometer.

Workshop held on May 21, 2012 in Sedona, AZ, between GDP and NWP users

Three possible ways to assess the impact of SLP on NWP

- Impact of observations (fast and cheap, uses adjoint. Addressed with this talk)*
- OSE (long and expensive)**
- OSSE (longest and most expensive)***

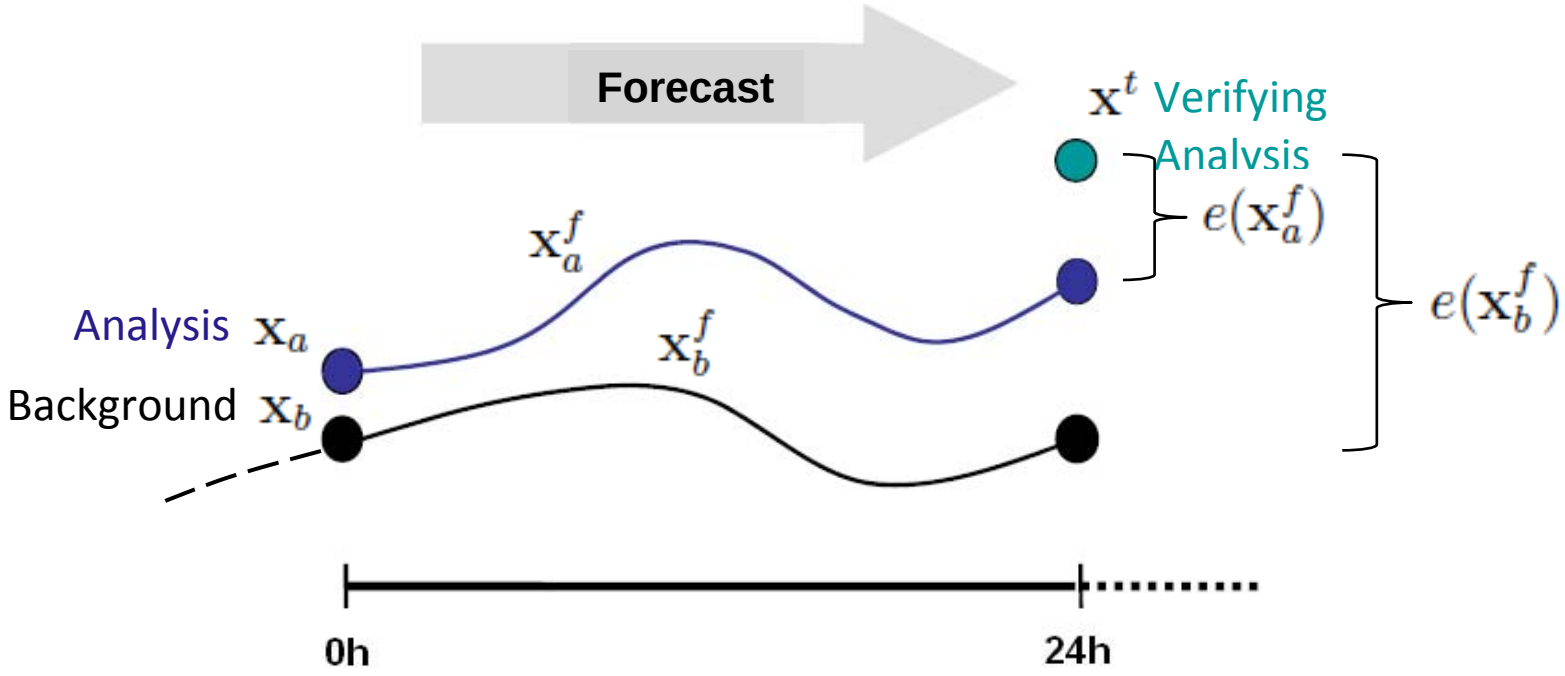
*based on a definition of total energy norm.

**also called data denial. Compares denial with control runs. Can use to assess the resilience of the system (self-compensating effects)

***requires generation of synthetic observations.

Definition of Observation Impact

following Langland and Baker (2004); extended for nonlinear analysis schemes by Trémolet (2008)



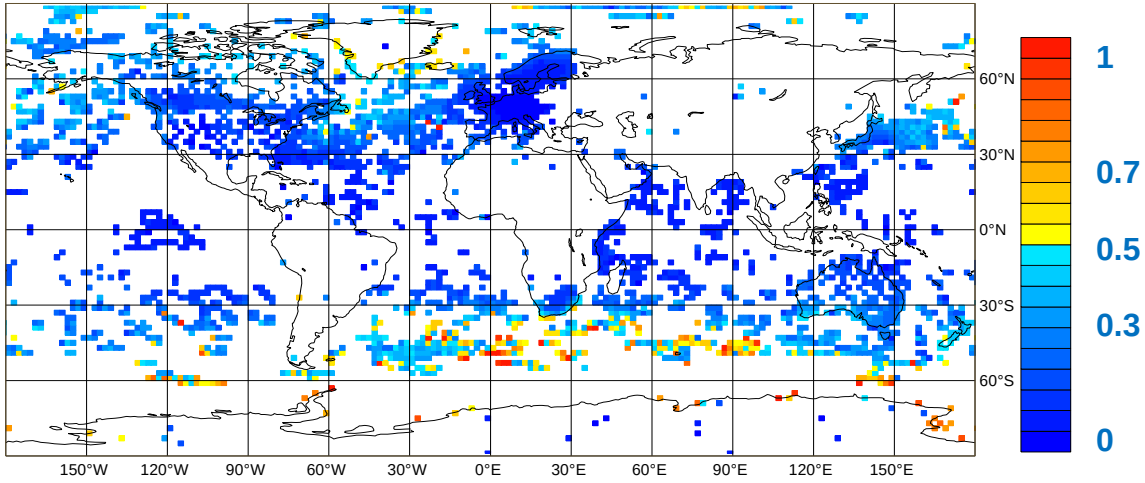
Observation Impact: $\delta e = e(\mathbf{x}_a^f) - e(\mathbf{x}_b^f)$

$\delta e < 0$ …the observation(s) improve the forecast

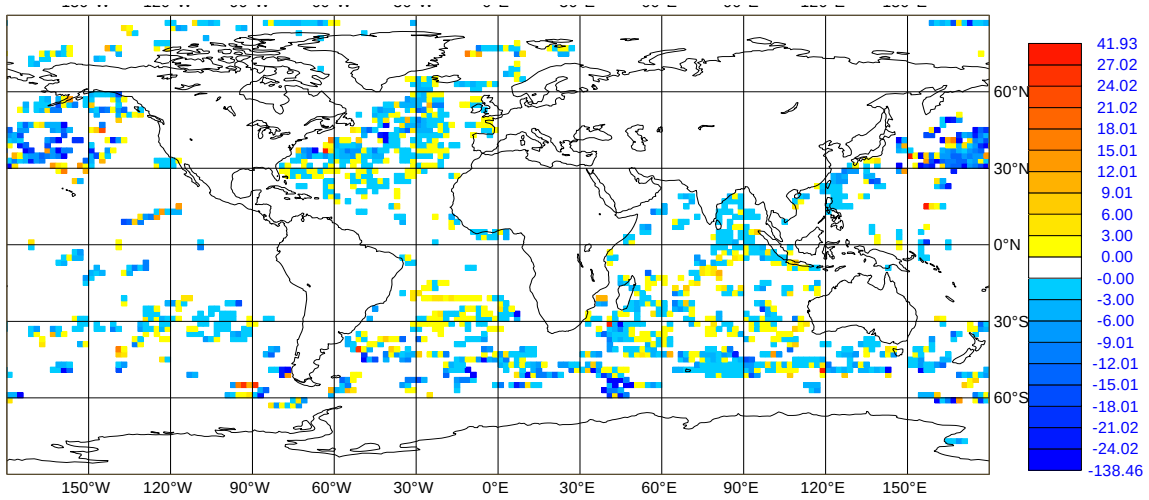
Credit Ron Gelaro, NASA

BUOYS-SHIP DFS and FEC Monthly Average

DFS



FEC



Min=-138
Max=41
Mean=-2.5

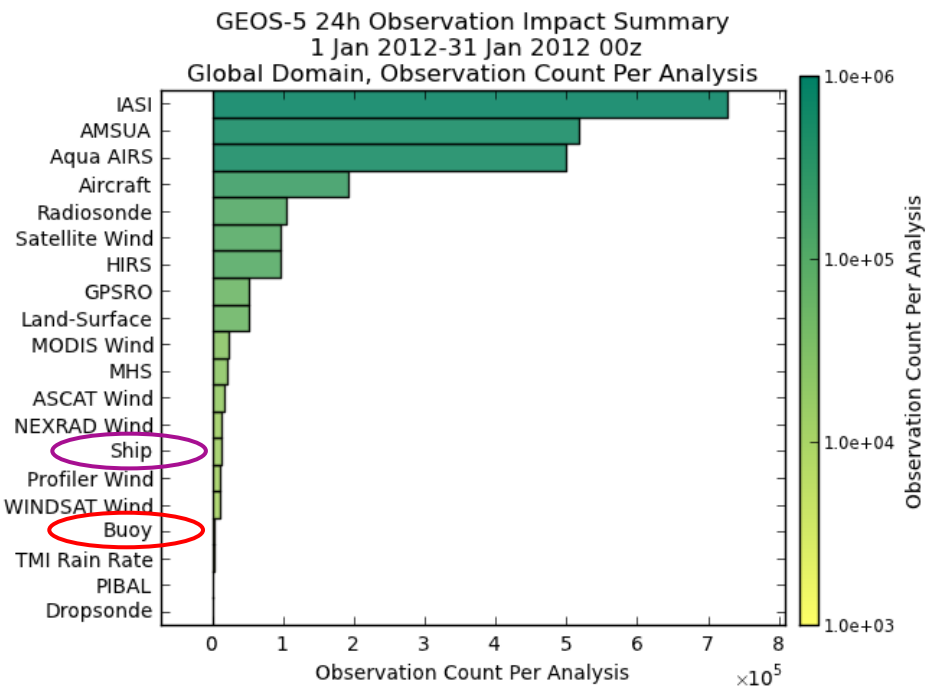
Credit Claudia Cardinali, ECMWF

ECMWF

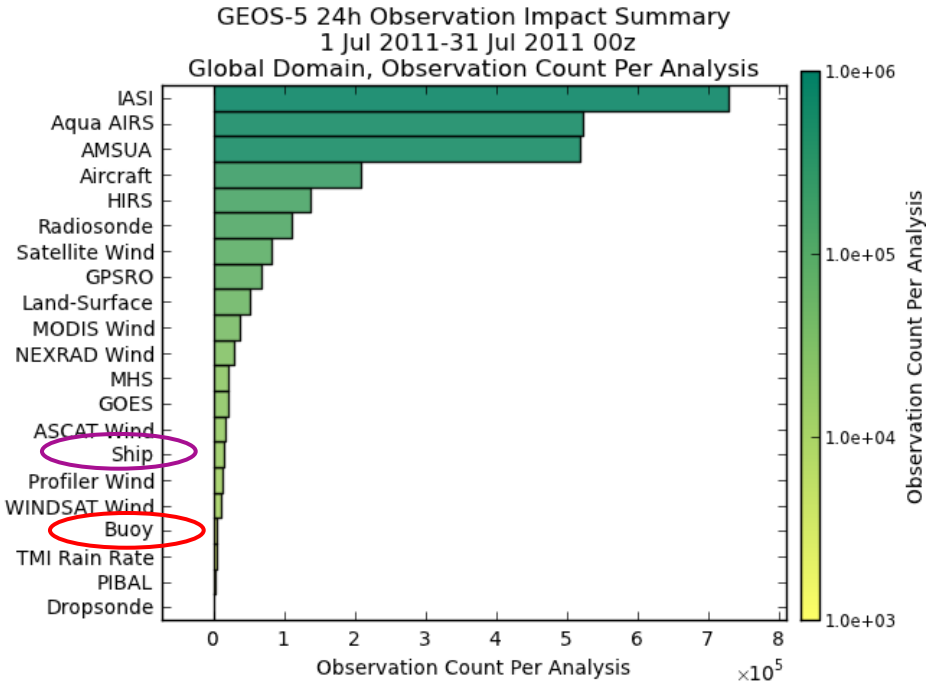
Summary of All Data Counts (Used)

Global Domain

January 2012



July 2011



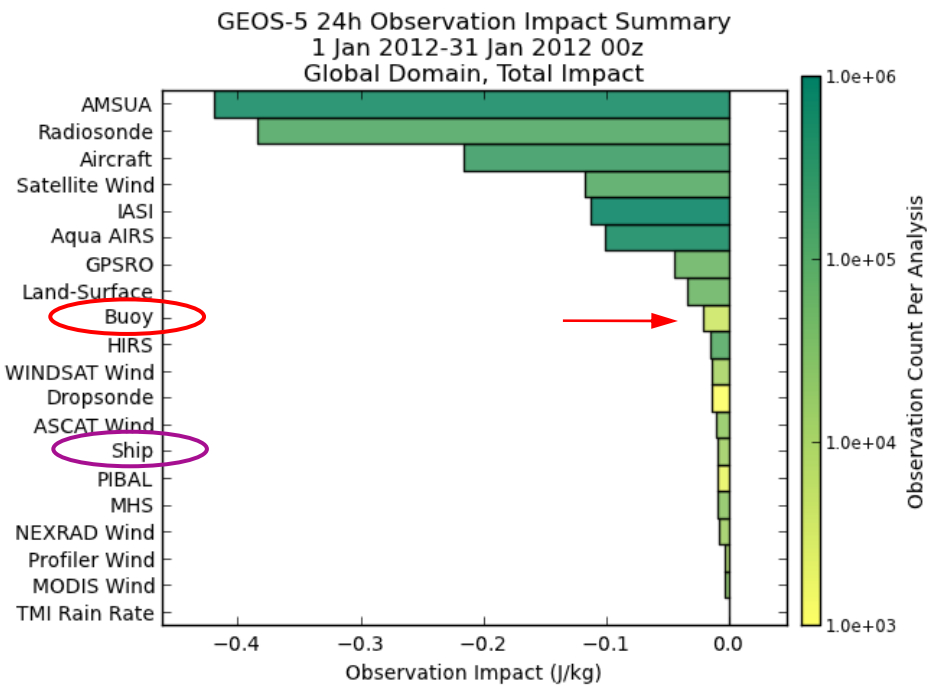
- Buoys are among the least numerous data types assimilated

Credit Ron Gelaro, NASA

Summary of Observation Total Impact

Global Domain

January 2012



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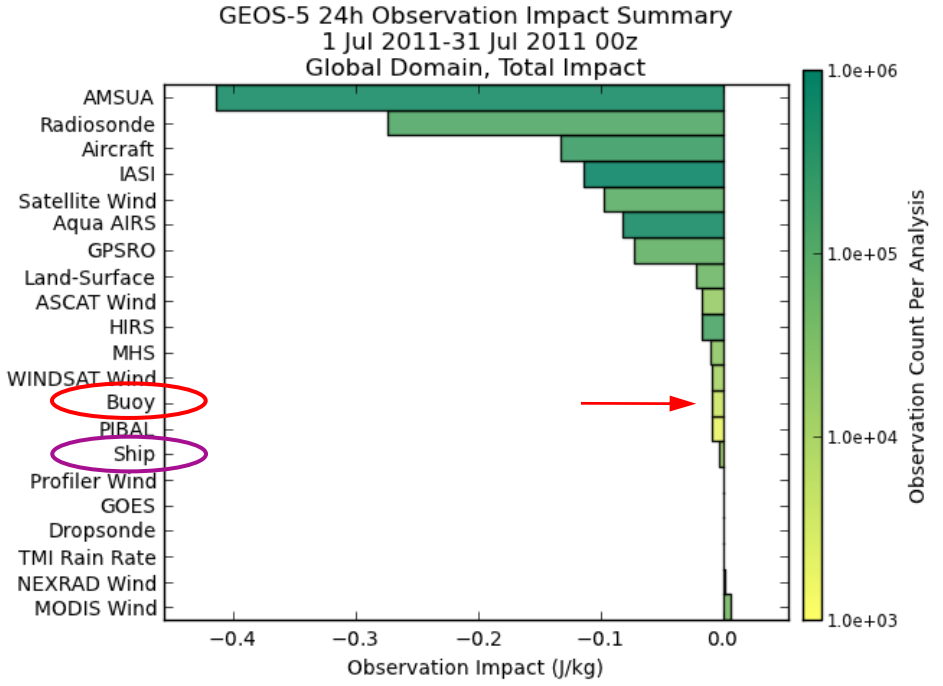


- Shading indicates observation count (buoys are among the least numerous data types assimilated)

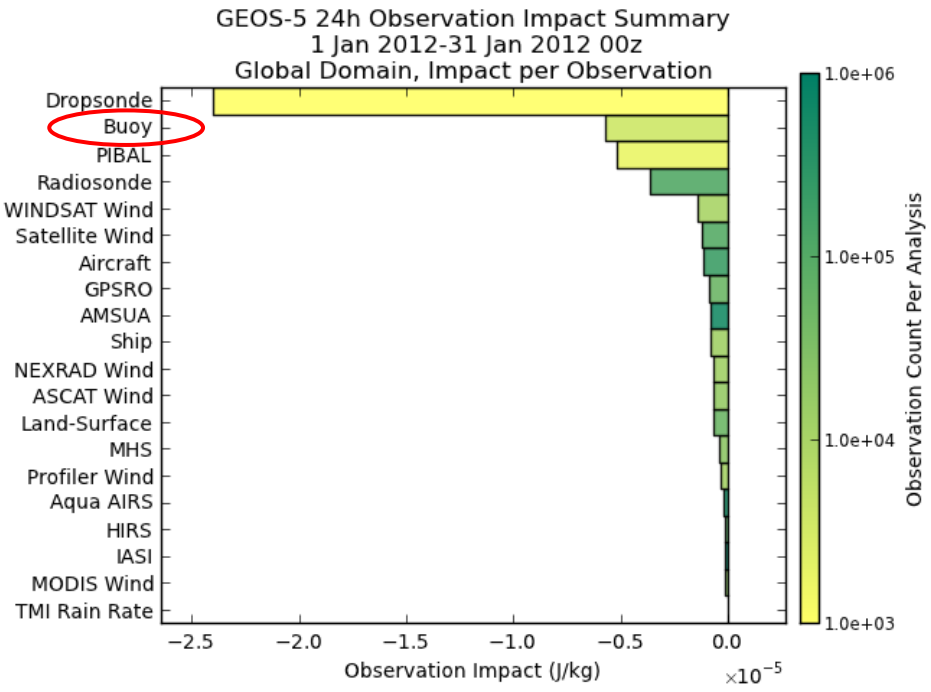
Credit Ron Gelaro, NASA

Credit Ron Gelaro, NASA

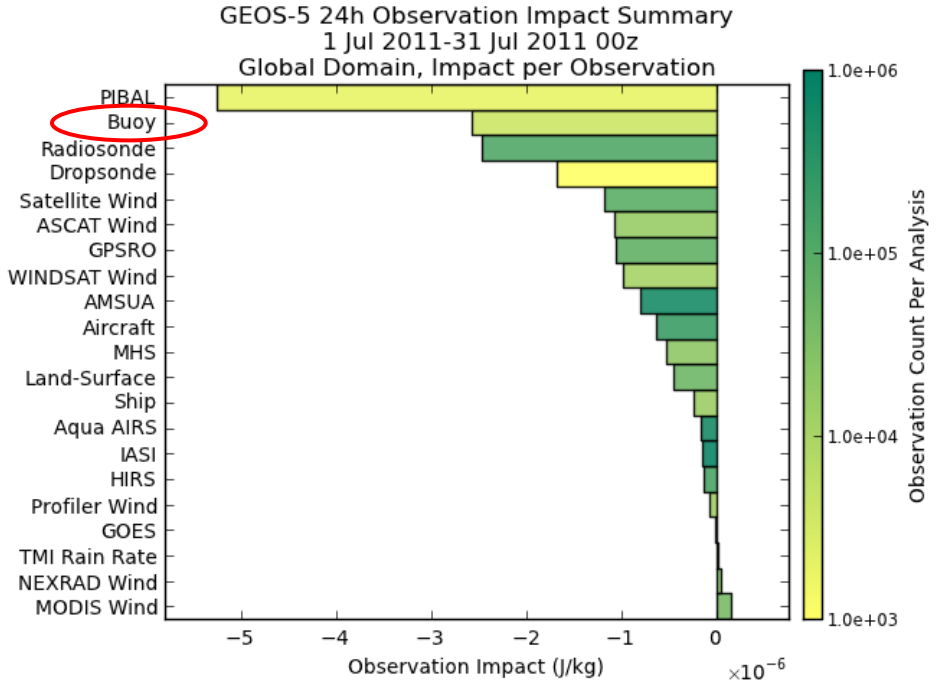
Summary of Impact Per Observation

Global Domain

January 2012



July 2011



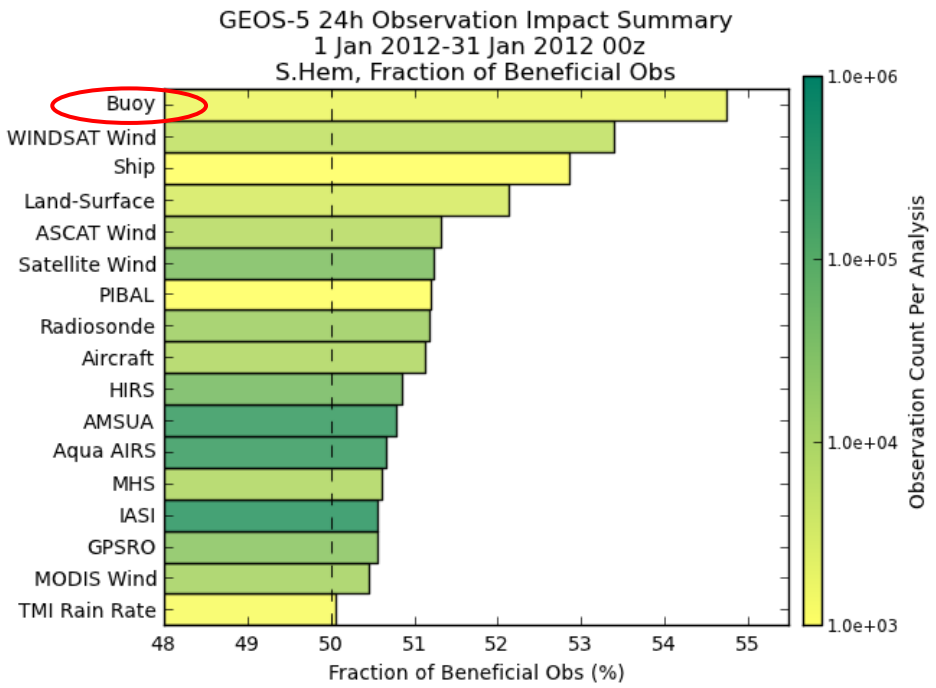
- On a per-ob basis, buoys have among the largest beneficial impacts of all observation types in terms of the 24h global error metric

- Only dropsondes in January and PIBALS in July have larger impact per ob

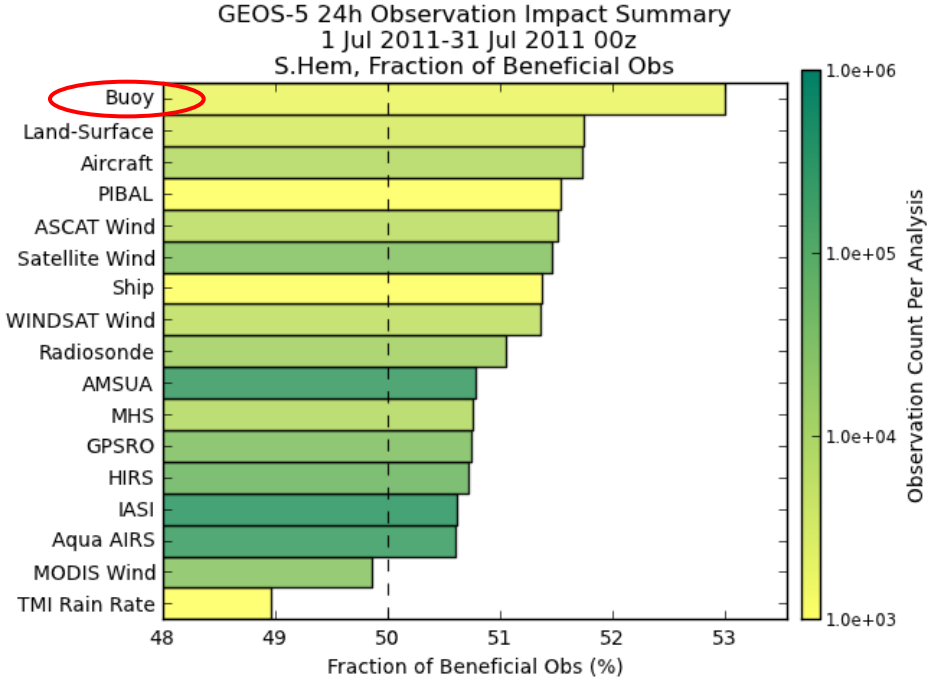
Fraction of Beneficial Observations

S. Hemisphere

January 2012



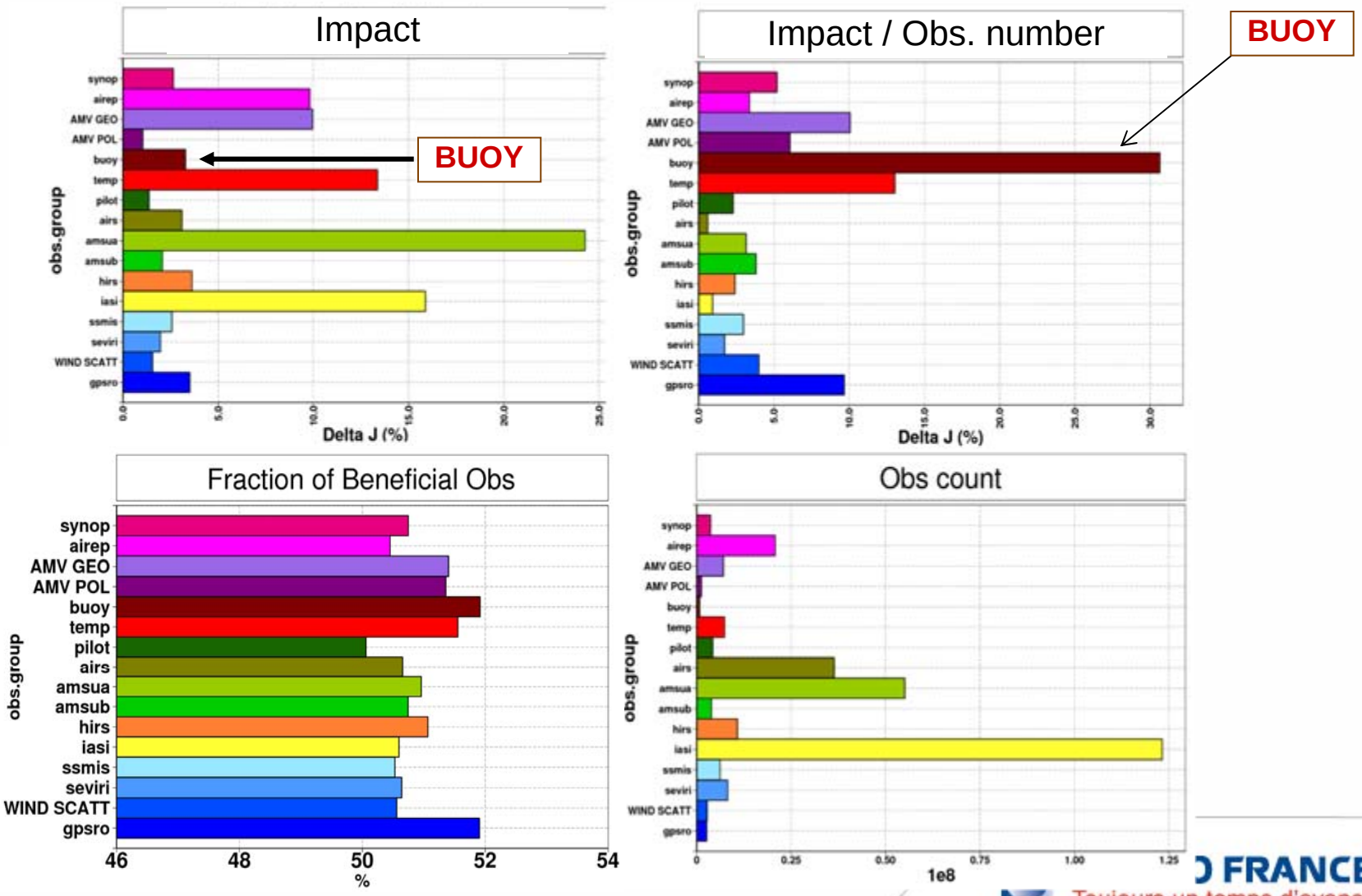
July 2011



- Buoys have the largest or nearly largest fraction of beneficial observations in most locations (globe, NH, SH) in both seasons

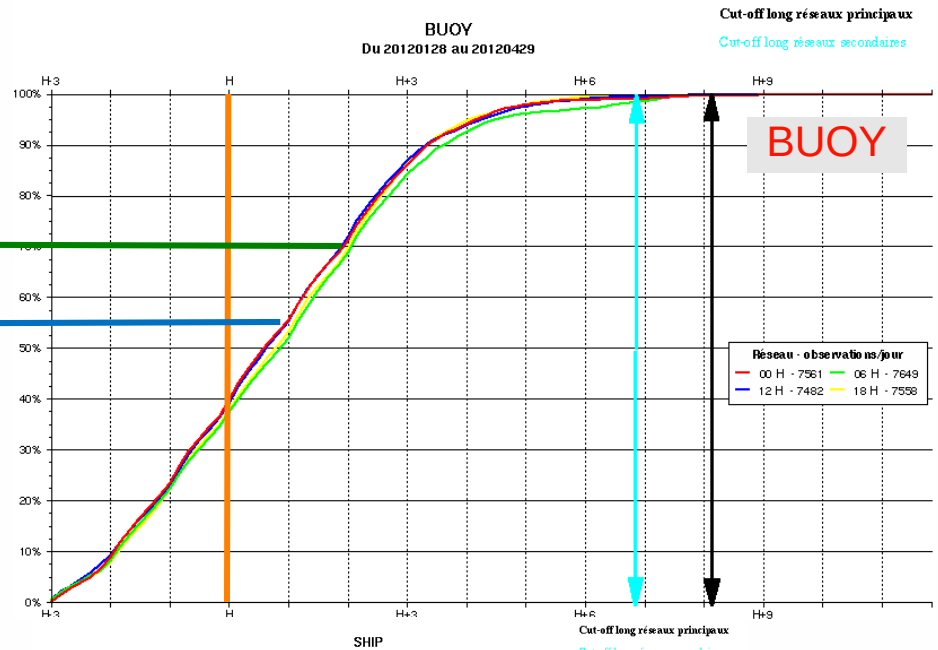
Credit Ron Gelaro, NASA

Forecast impact experiment from Dec. 2010 to Jan. 2011



Credit Jean Francois Mahfouf, MeteoFrance

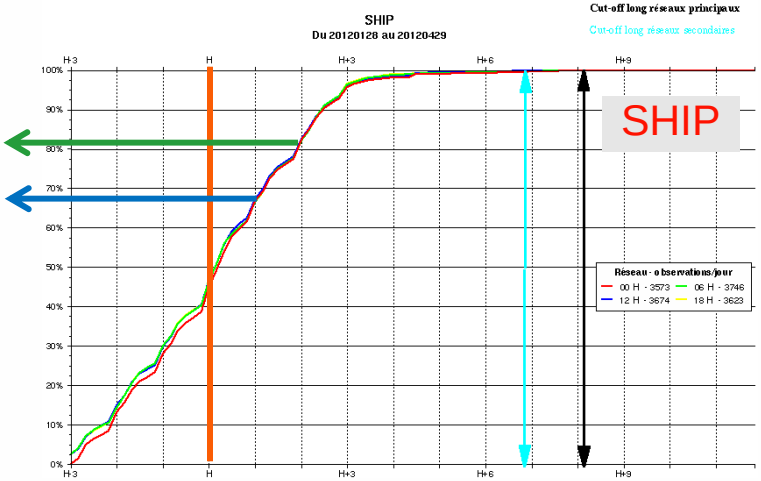
Timeliness of observations



BUOY

H+2 =>**70** %

H+1 =>**55** %



SHIP

H+2 =>**82** %

H+1 =>**67** %

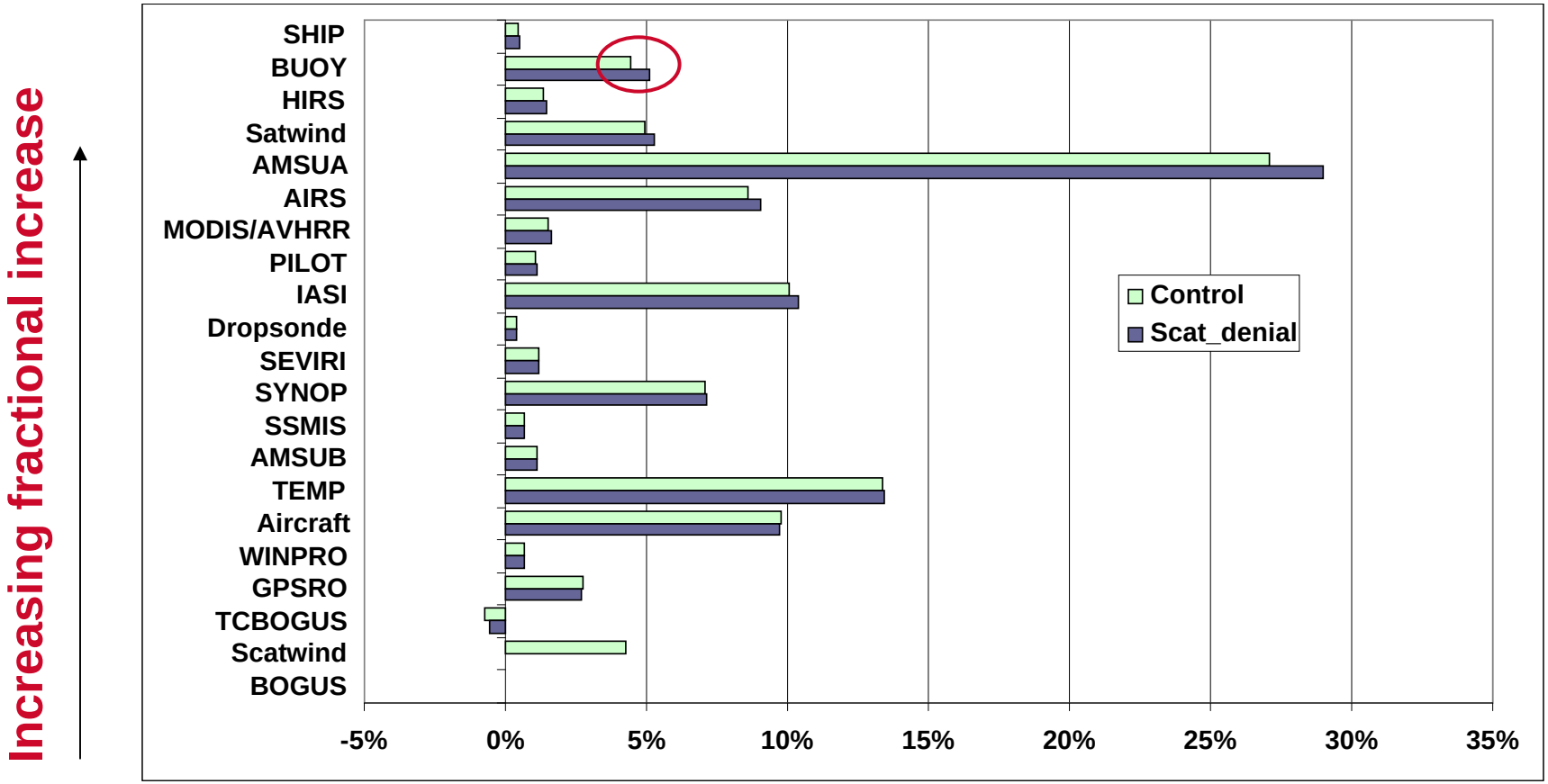
Credit Jean Francois Mahfouf, MeteoFrance

METEO FRANCE
Toujours un temps d'avance

Credit John Eyre, Met Office

Satellite surface wind impact

Forecast Sensitivity to Observations (FSO)

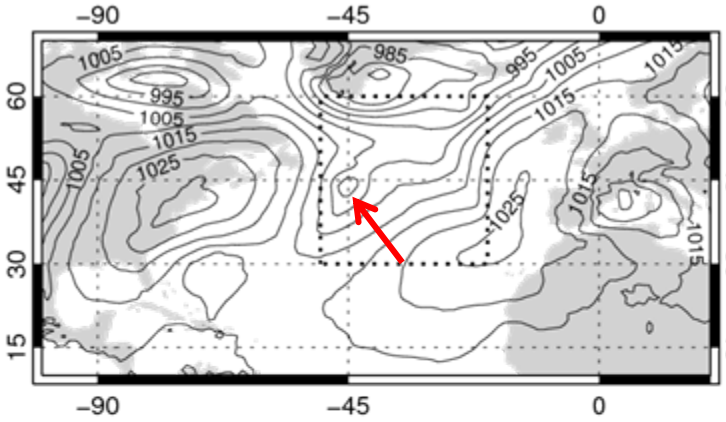


When ASCAT, ERS-2 and WindSat winds are denied, other surface-marine observations partially compensate

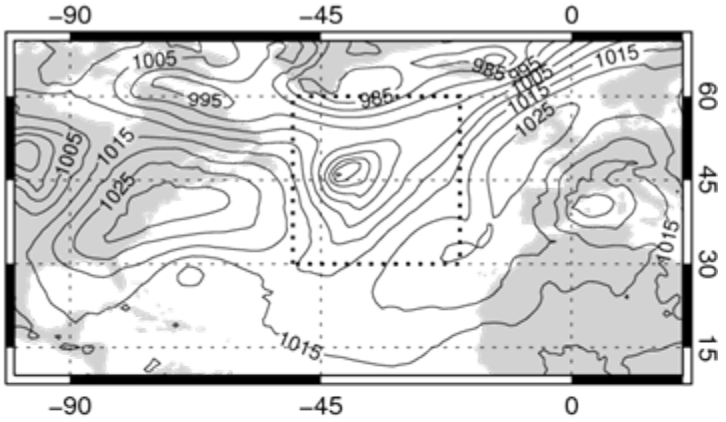
Credit Claudia Cardinali, ECMWF

6th November: Case of a rapidly developing cyclogenesis

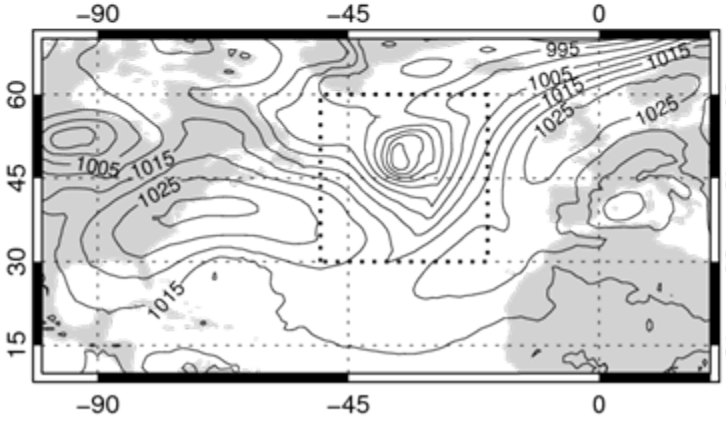
Analysis 00Z 6–Nov–2011



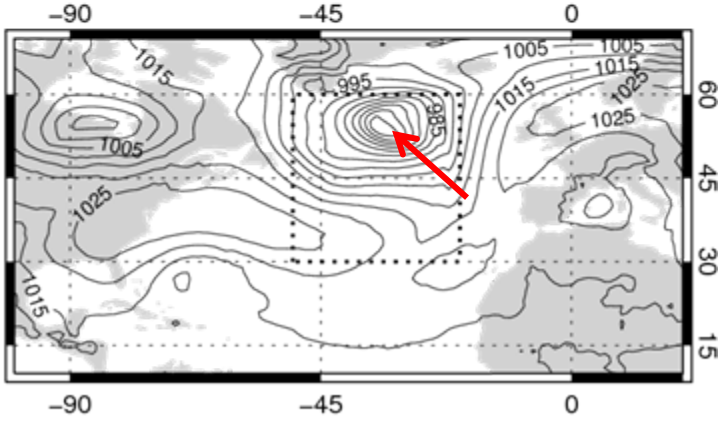
12Z 6–Nov–2011 **12h Forecast**



24h Forecast 00Z 7–Nov–2011



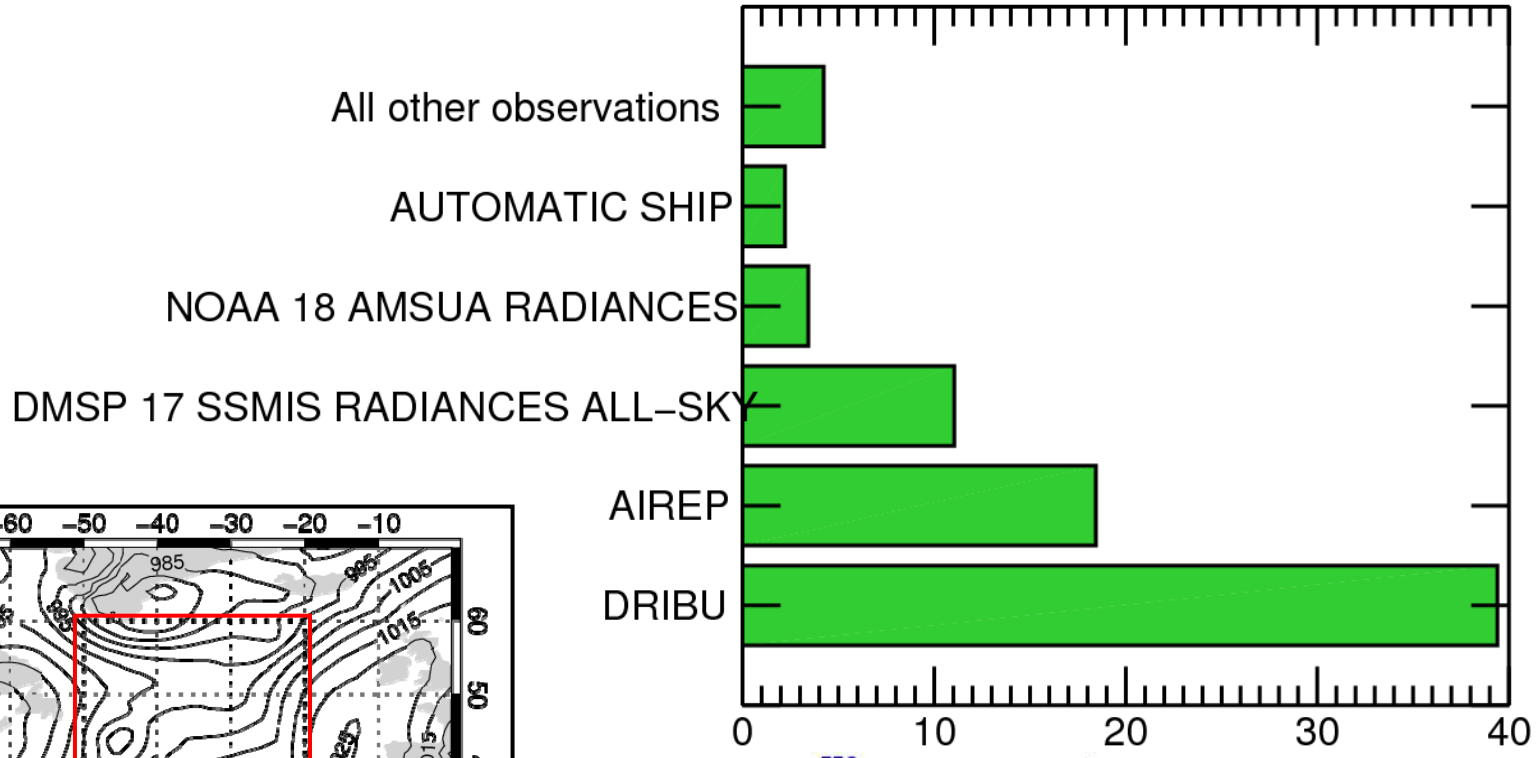
12Z 7–Nov–2011 **36h Forecast**

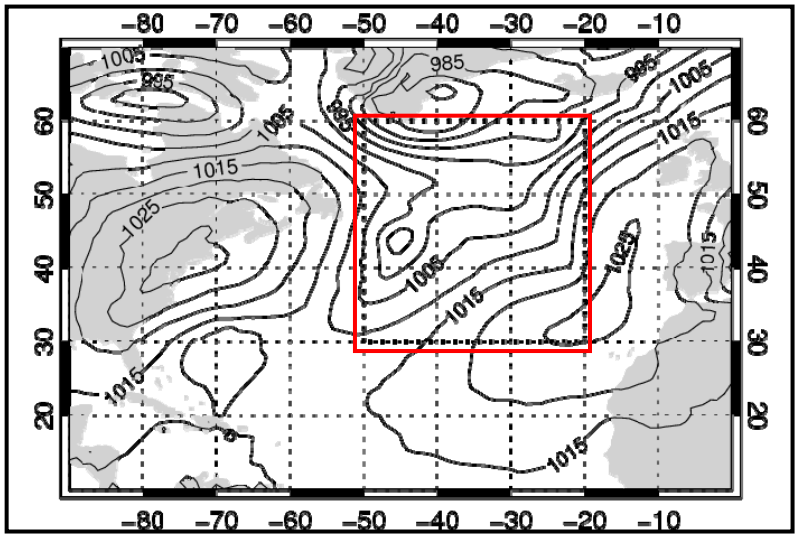


Minimum pressure from 990 to 950 hPa between 00Z 6/11 and 18Z 7/11

Credit Claudia Cardinali, ECMWF

00Z 6th November FEC in the 30° x30°

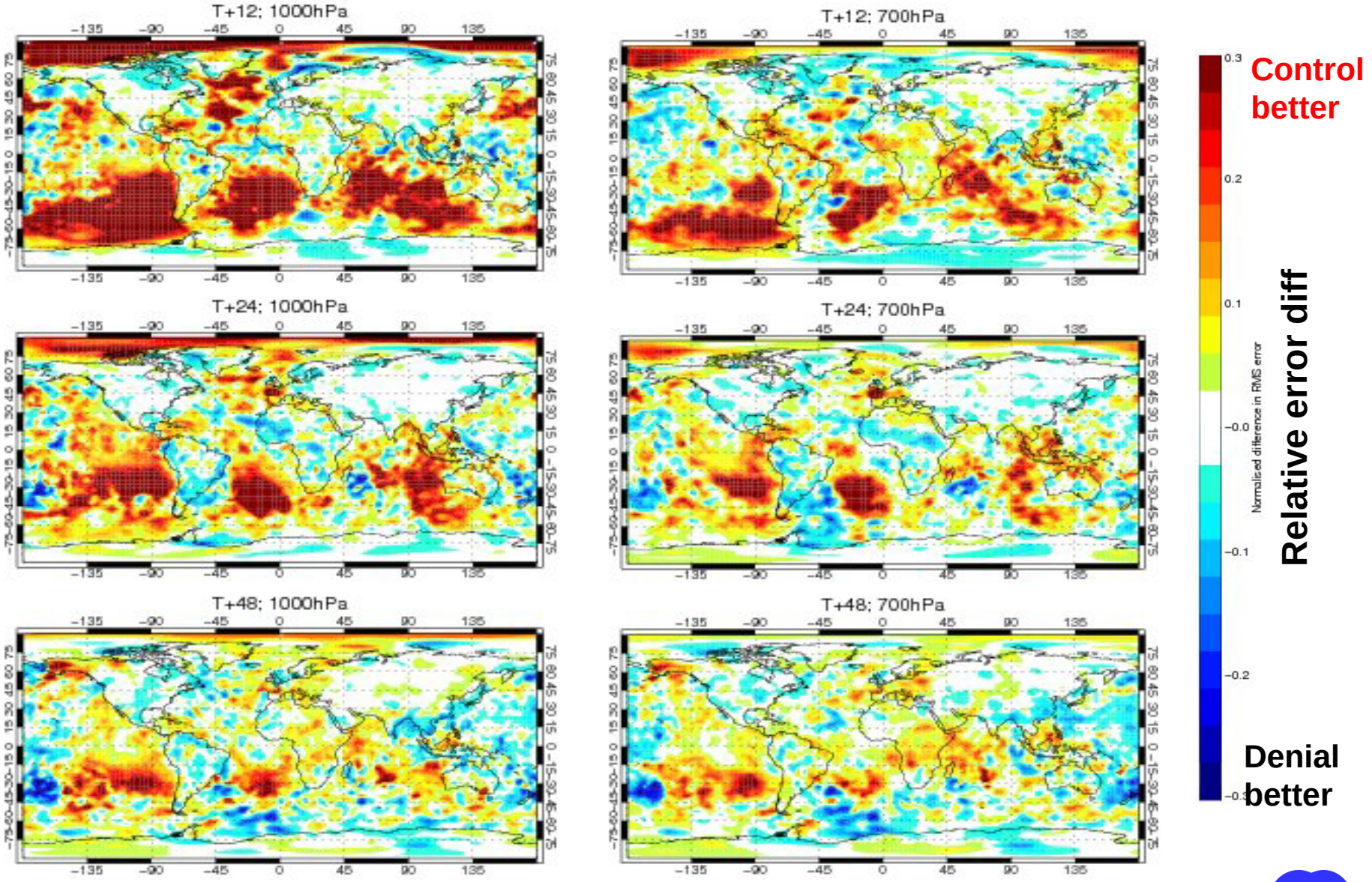




MSL pressure

Credit Claudia Cardinali, ECMWF

Results: SP-Denial versus Control



CONCLUSIONS

1. **Impact** of SLP from drifters on NWP is extremely positive;
2. Adopt alternate metrics of high relevance (i.e. surface Kinetic Energy => wind)
3. At least one OSE specific to drifter data should be run to have extra proof and to understand the effect of the reduction ($60-$80K, ~12% of array cost for one year);