

École Doctorale des Sciences de l'Environnement d'Île-de-France
Année 2009-2010

Modélisation Numérique
de l'Écoulement Atmosphérique
et Assimilation d'Observations

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Cours 3
23 Avril 2010

5 - SCHEMA DES INTERACTIONS PHYSIQUES DANS LE MODELE

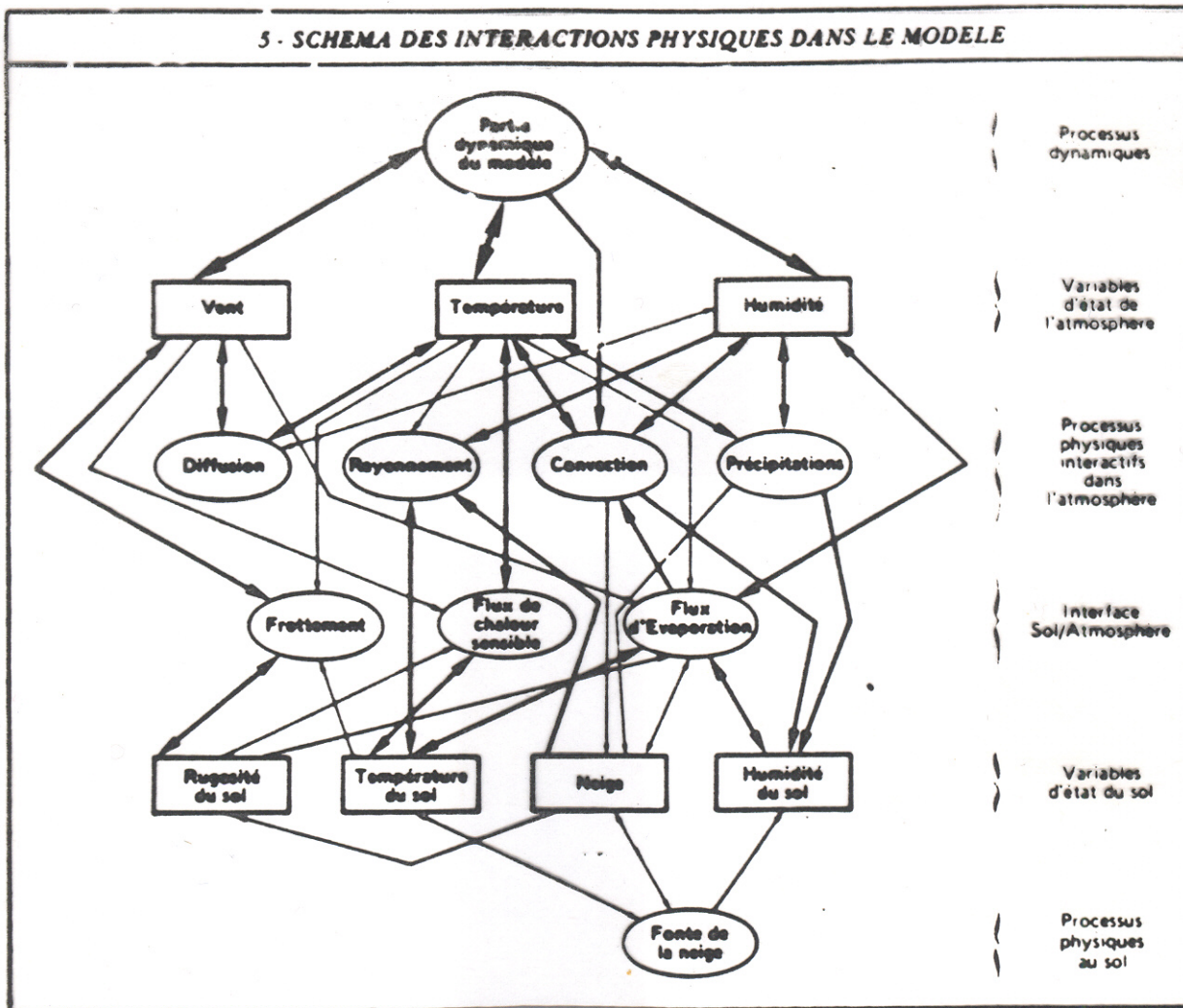




Fig. 1: Members of day 7 forecast of 500 hPa geopotential height for the ensemble originated from 25 January 1993.

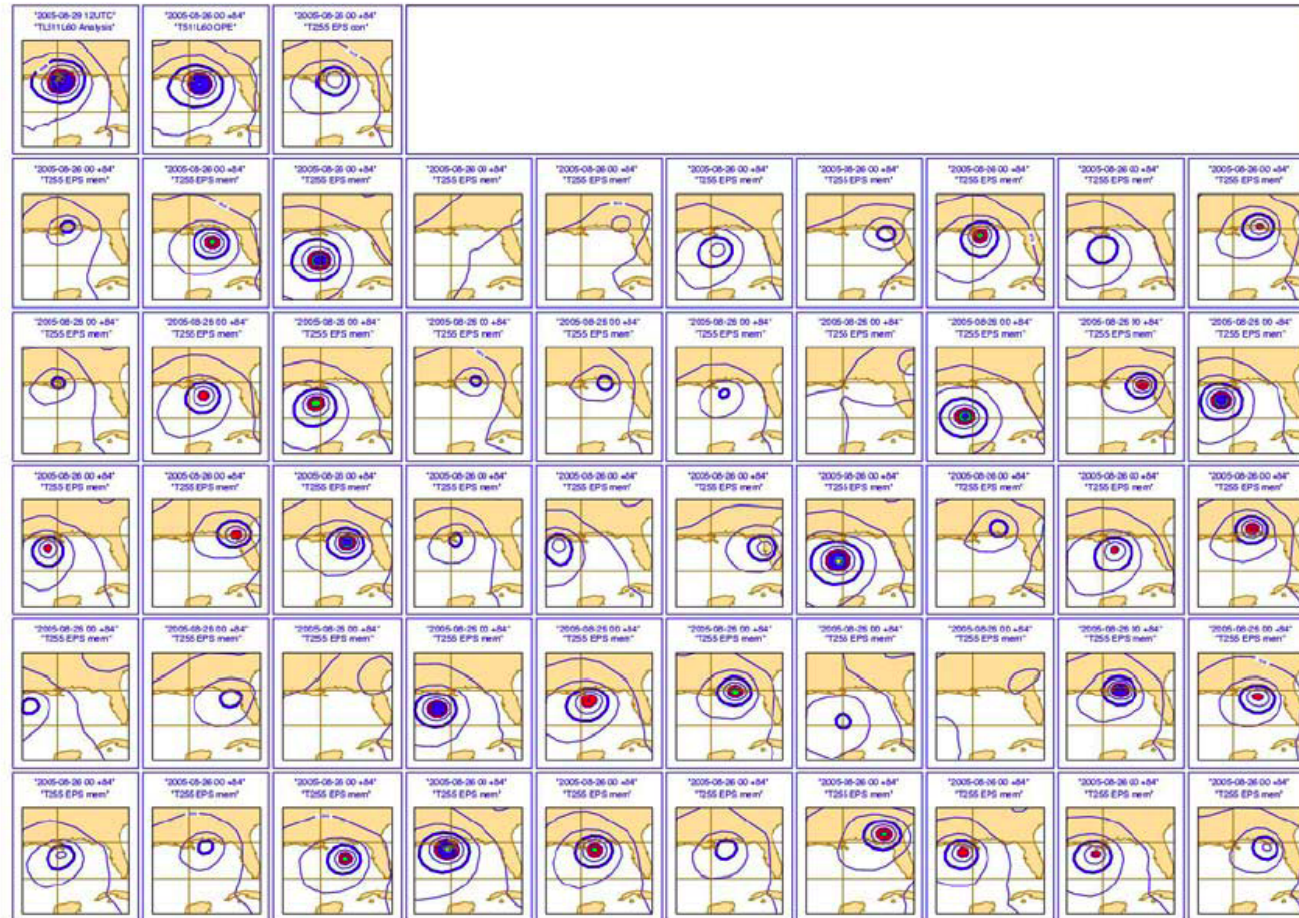


Figure 6 Hurricane Katrina mean-sea-level-pressure (MSLP) analysis for 12 UTC of 29 August 2005 and $t+84h$ high-resolution and EPS forecasts started at 00 UTC of 26 August:

- 1st row: 1st panel: MSLP analysis for 12 UTC of 29 Aug
 2nd panel: MSLP $t+84h$ T₁₅₁₁L60 forecast started at 00 UTC of 26 Aug
 3rd panel: MSLP $t+84h$ EPS-control T₂₅₅L40 forecast started at 00 UTC of 26 Aug
 Other rows: 50 EPS-perturbed T₁₂₅₅L40 forecast started at 00 UTC of 26 Aug.

The contour interval is 5 hPa, with shading patterns for MSLP values lower than 990 hPa.

Pourquoi les météorologistes ont-ils tant de peine à prédire le temps avec quelque certitude ?

Pourquoi les chutes de pluie, les tempêtes elles-mêmes nous semblent-elles arriver au hasard, de sorte que bien des gens trouvent tout naturel de prier pour avoir la pluie ou le beau temps, alors qu'ils jugeraient ridicule de demander une éclipse par une prière ?[...] un dixième de degré en plus ou en moins en un point quelconque, le cyclone éclate ici et non pas là, et il étend ses ravages sur des contrées qu'il aurait épargnées. Si on avait connu ce dixième de degré, on aurait pu le savoir d'avance, mais les observations n'étaient ni assez serrées, ni assez précises, et c'est pour cela que tout semble dû à l'intervention du hasard.

Centre Européen pour les Prévisions Météorologiques à Moyen Terme (CEPMMT, Reading, GB)

(European Centre for Medium-range Weather Forecasts, ECMWF)

Depuis le 26 Janvier 2010

Troncature triangulaire T1279 (résolution horizontale \approx 16
kilomètres)

91 niveaux dans la direction verticale (0 - 80 km)

Dimension du vecteur d'état correspondant $\approx 1,5 \cdot 10^9$

Pas de discrétisation temporelle : 10 minutes

Résultats extraits de

Richardson *et al.*, 2009, *Verification statistics and evaluations of ECMWF forecasts in 2008-2009*, Memorandum Technique 606 CEPMMT, Reading, GB.

Disponible à l'adresse

http://www.ecmwf.int/publications/library/ecpublications/_pdf/tm/601-700/tm606.pdf

ECMWF FORECAST VERIFICATION 12UTC

500hPa GEOPOTENTIAL

POS. ORIENTATED SKILL SCORE - RMS NORMALISED BY PERSISTENCE
 N.HEM LAT 20.000 TO 90.000 LON -180.000 TO 180.000

- T+ 24 MA
- T+ 48 MA
- T+ 72 MA
- T+ 96 MA
- T+120 MA
- T+144 MA
- T+168 MA
- T+192 MA

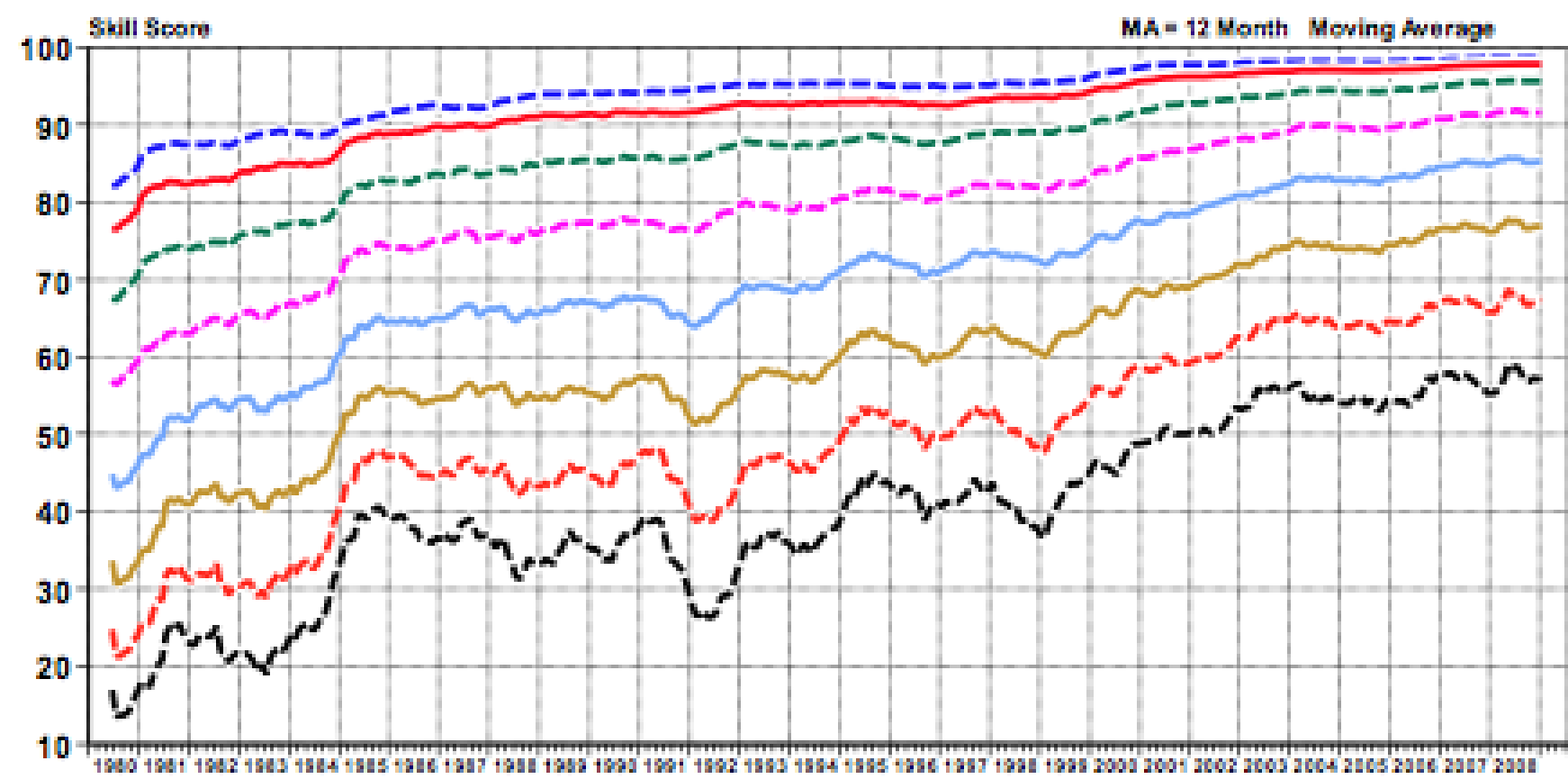


Figure 1: 500 hPa height skill score for Europe (top) and the northern hemisphere extra-tropics (bottom), 12-month moving averages, forecast ranges from 24 to 192 hours. The last point on each curve is for the 12-month period August 2008 - July 2009.

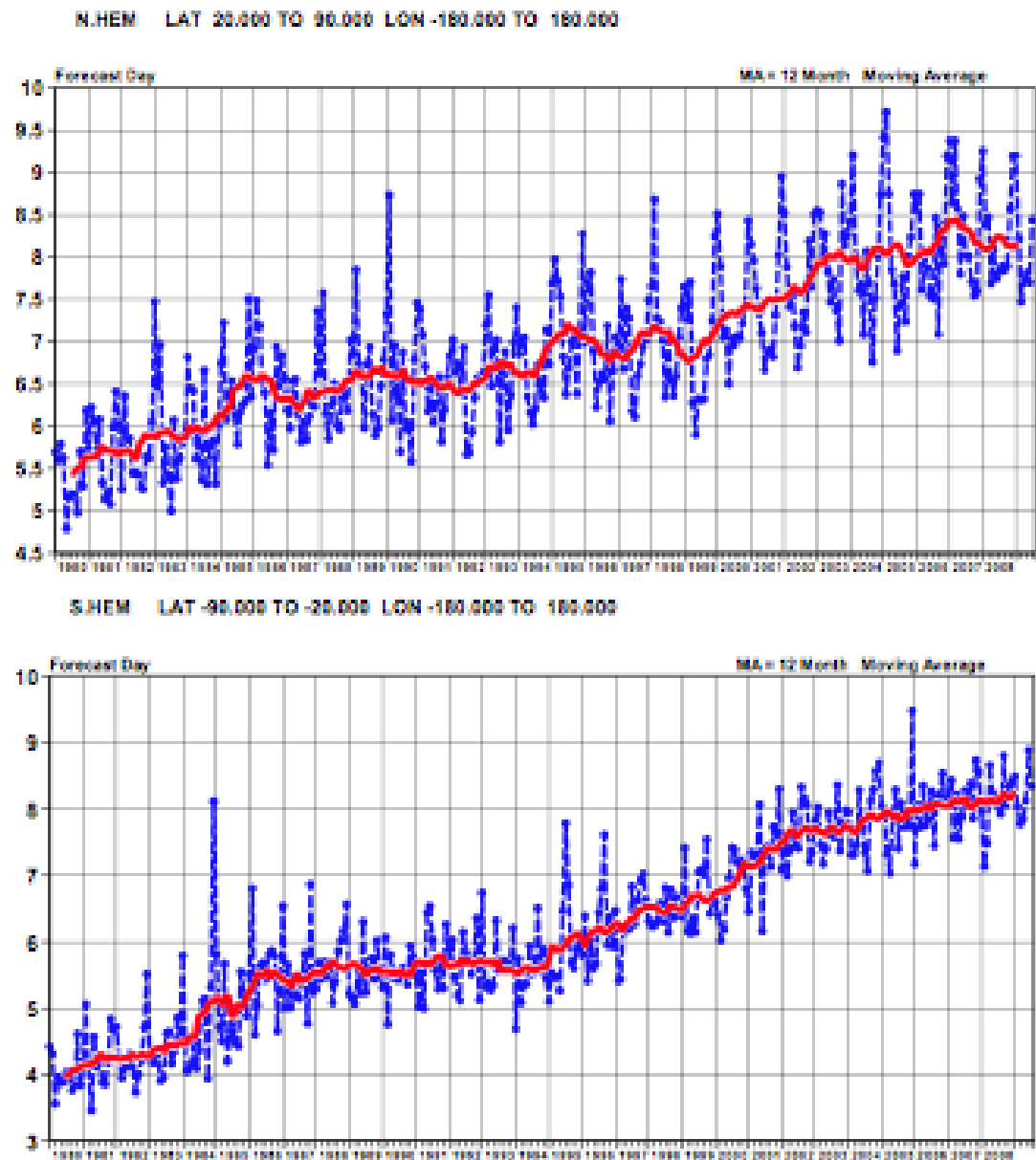


Figure 2: Evolution with time of the 500 hPa height forecast performance – each point on the blue curves is the forecast range at which the monthly average of the forecast anomaly correlation with the verifying analysis falls below 60% for Europe, northern and southern extratropics (the red curve is the 12-month moving average).

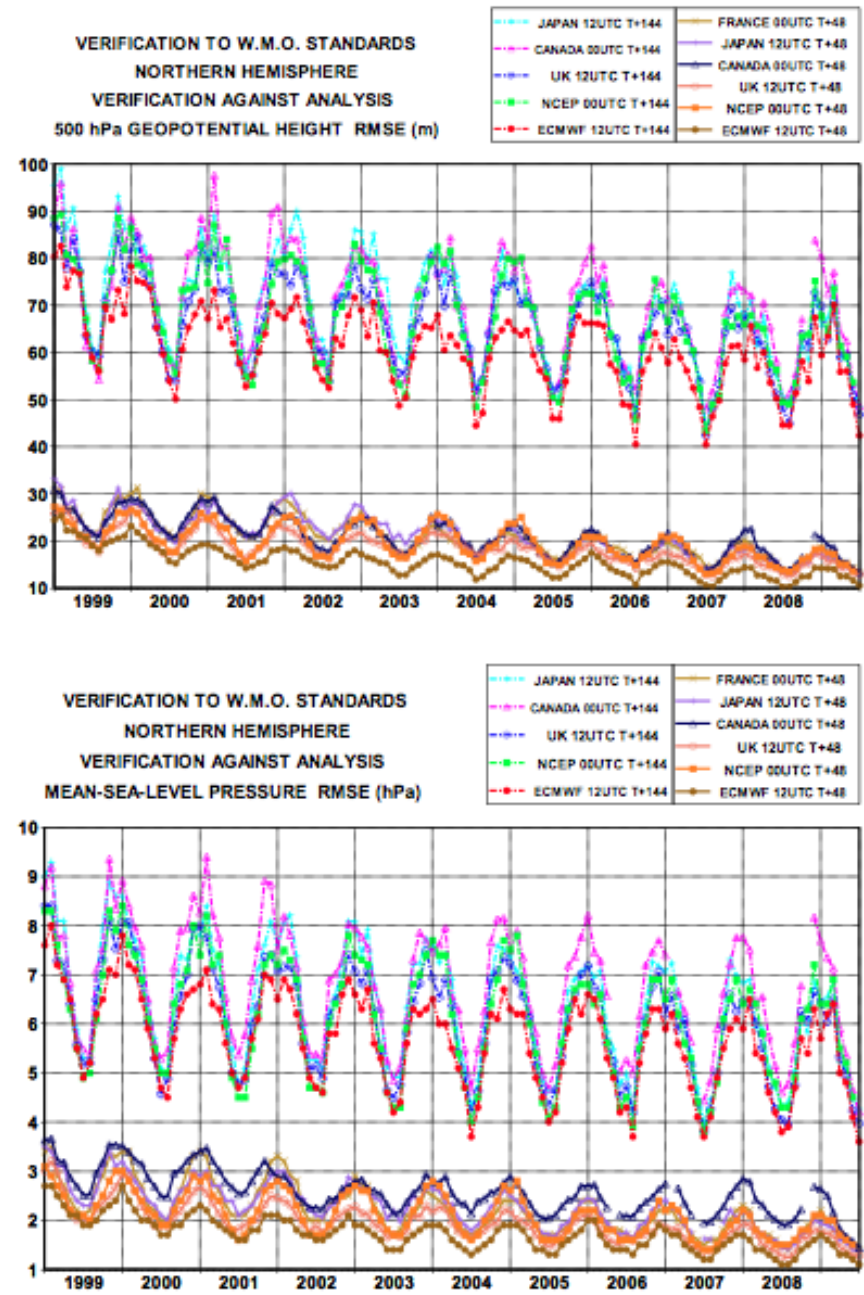


Figure 11: WMO/CBS exchanged scores (RMS error over northern extratropics, 500 hPa geopotential height and MSLP for 2-day and 6-day forecasts).

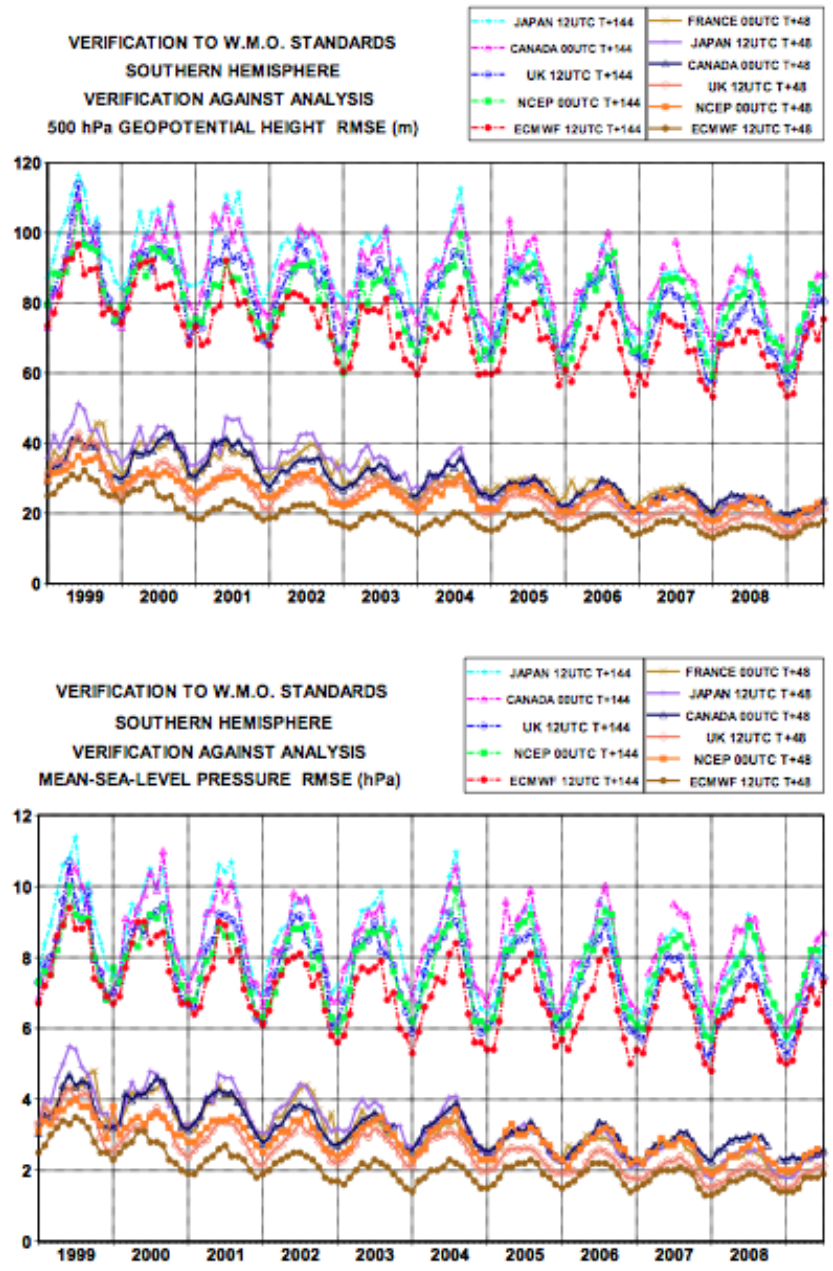


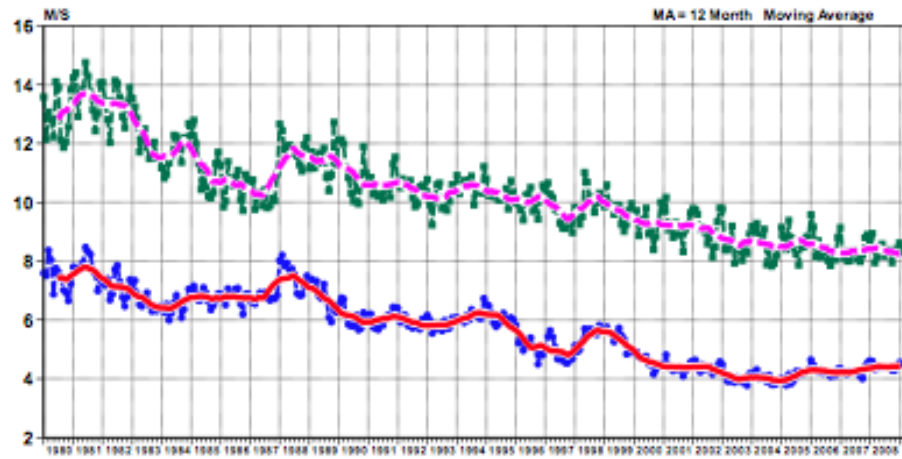
Figure 12: WMO/CBS exchanged scores (RMS error over southern extratropics, 500 hPa geopotential height and MSLP for 2-day and 6-day forecasts).

ECMWF FORECAST VERIFICATION 12UTC

200hPa VECTOR WIND

ROOT MEAN SQUARE ERROR FORECAST
TROPICS LAT -20.000 TO 20.000 LON -180.000 TO 180.000

-- T+24
— T+24 MA
-- T+120
— T+120 MA



ECMWF FORECAST VERIFICATION 12UTC

850hPa VECTOR WIND

ROOT MEAN SQUARE ERROR FORECAST
TROPICS LAT -20.000 TO 20.000 LON -180.000 TO 180.000

-- T+24
— T+24 MA
-- T+120
— T+120 MA

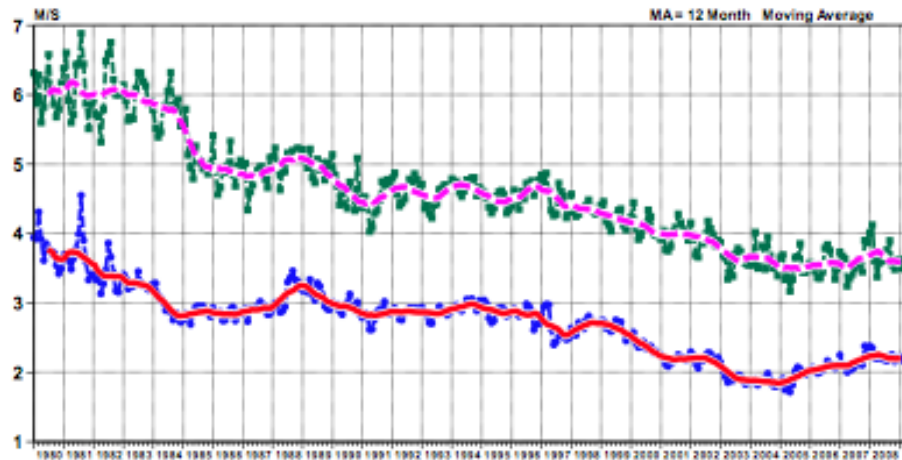


Figure 10: Model scores in the tropics (root mean square vector wind errors at 200 hPa and 850 hPa for 1-day and 5-day forecasts). Monthly mean and 12-month running mean.

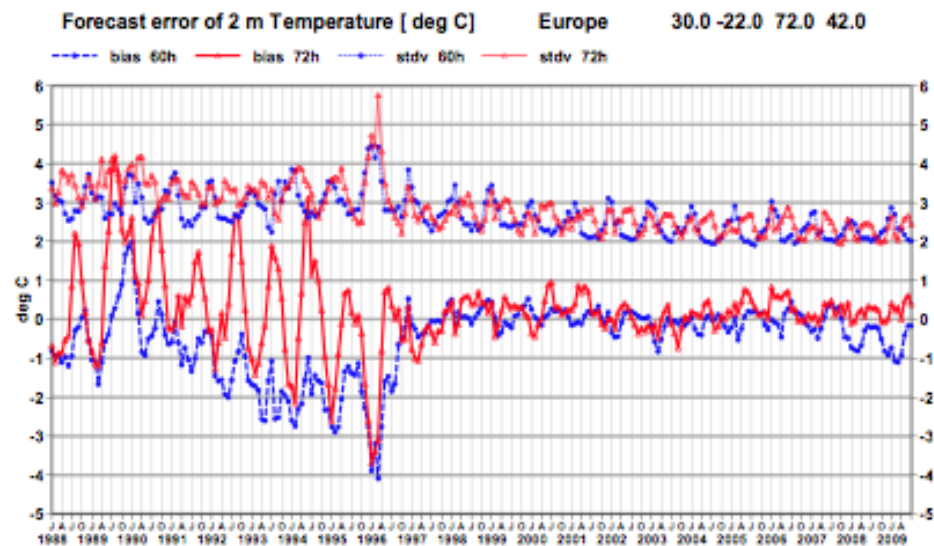


Figure 15: Verification of 2 metre temperature forecasts against European SYNOP data on the GTS for 60-hour (night-time) and 72-hour (daytime) forecasts. Lower pair of curves are bias, upper curves are standard deviation of error.

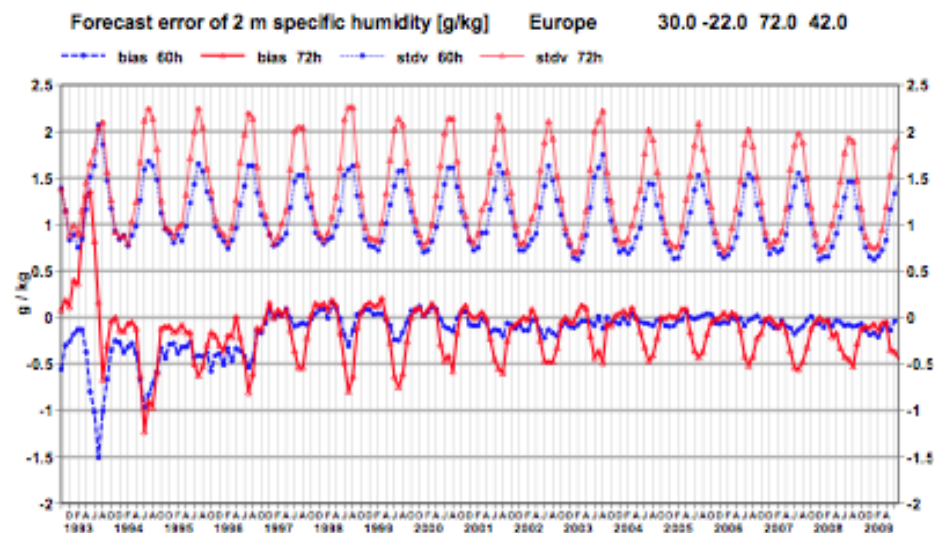
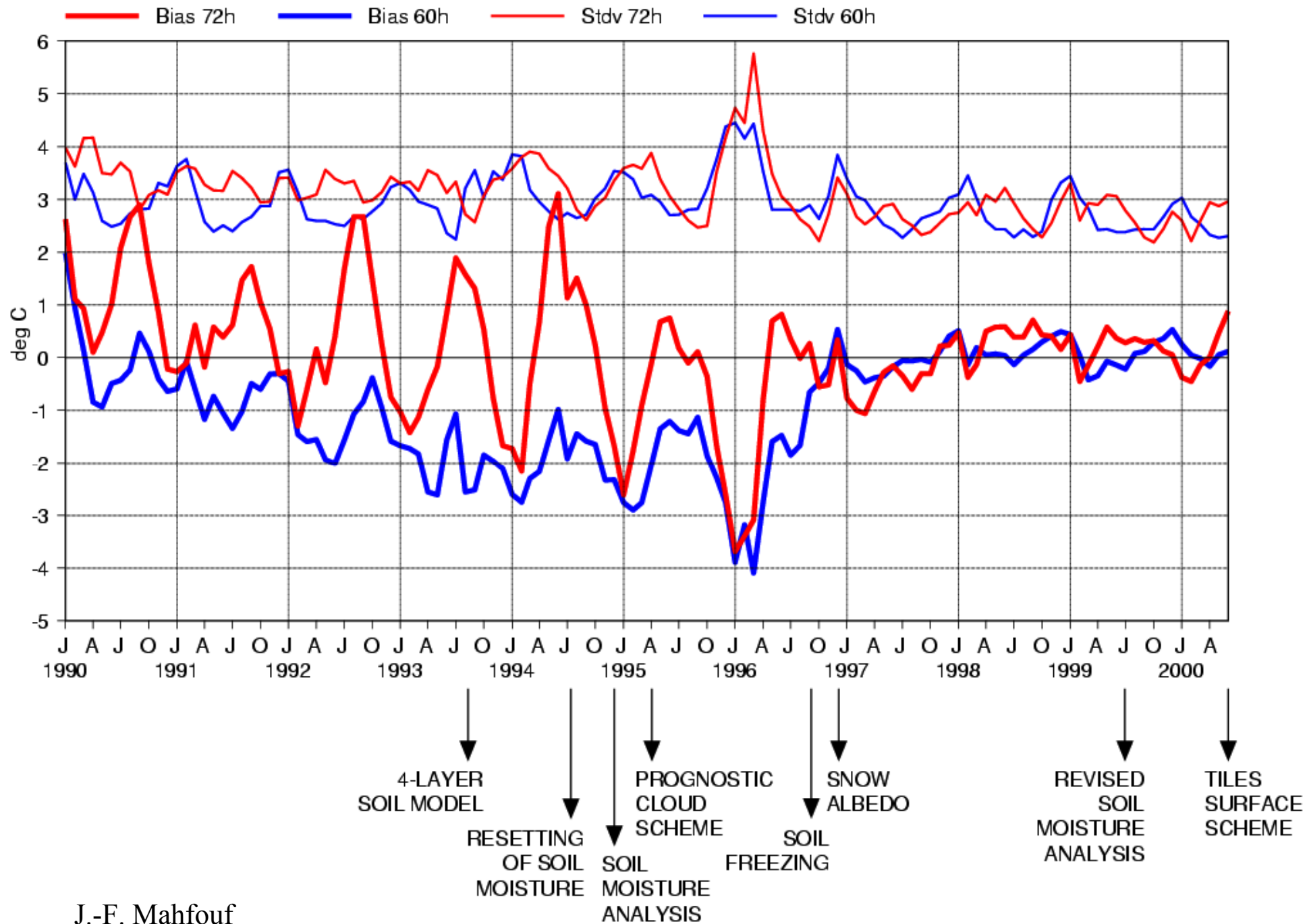


Figure 16: Verification of 2 metre specific humidity forecasts against European SYNOP data on the GTS for 60-hour (night-time) and 72-hour (daytime) forecasts. Lower pair of curves is bias, upper curves are standard deviation of error.



J.-F. Mahfouf

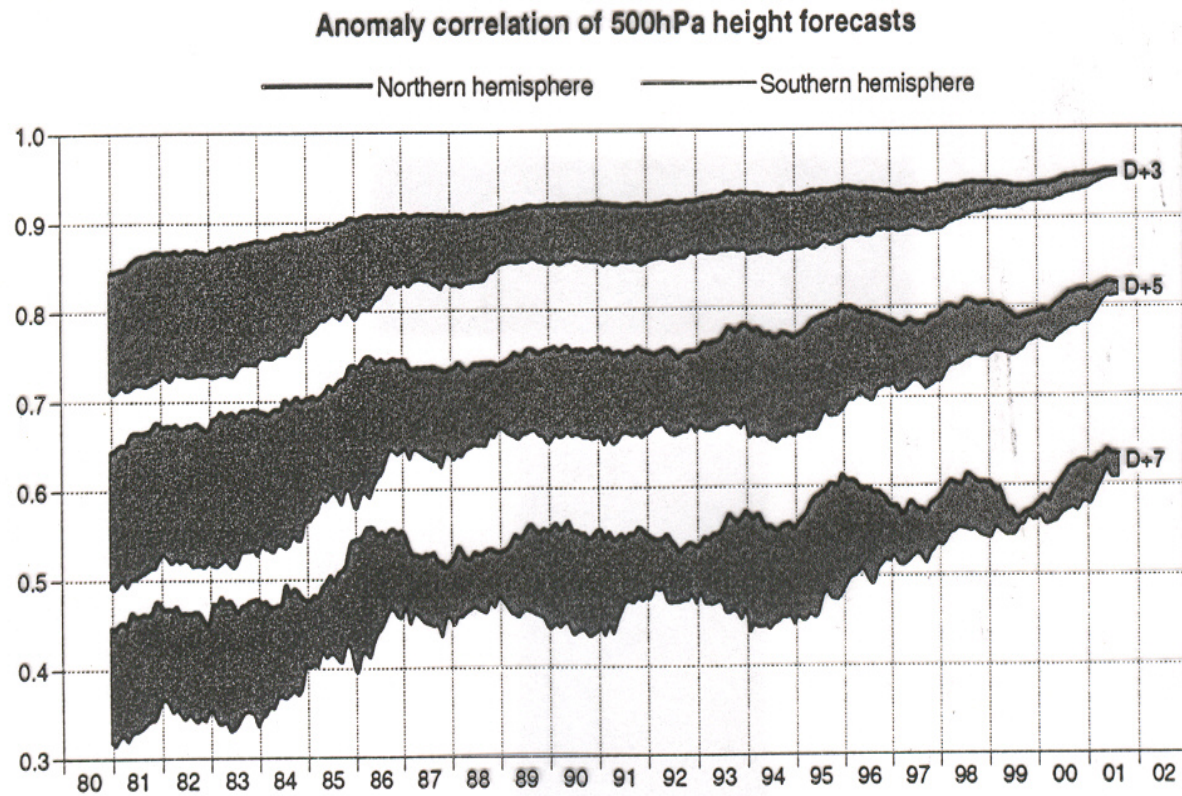


Fig 4. Anomaly correlation coefficients of 3-, 5- and 7-day ECMWF 500hPa height forecasts for the extratropical northern and southern hemispheres, plotted in the form of annual running means of archived monthly-mean scores for the period from January 1980 to August 2001. Values plotted for a particular month are averages over that month and the 11 preceding months. The shading shows the differences in scores between the two hemispheres at the forecast ranges indicated.

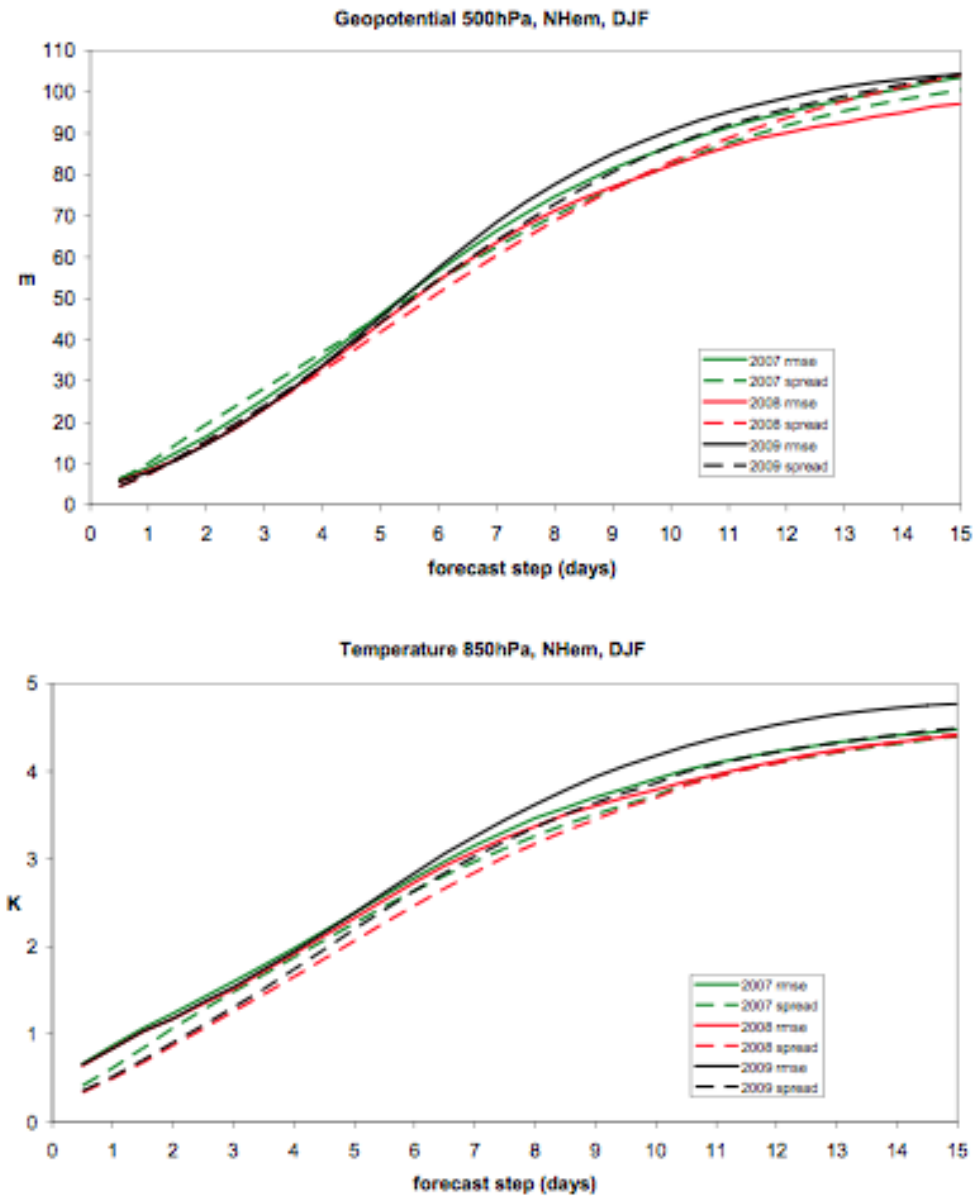


Figure 8: Ensemble spread (standard deviation, dashed lines) and root mean square error of ensemble-mean (solid lines) for 500 hPa geopotential (top) and 850 hPa temperature (bottom) for winter 2008-09 (black), 2007-08 (red) and 2006-07 (green) over the extra-tropical northern hemisphere.

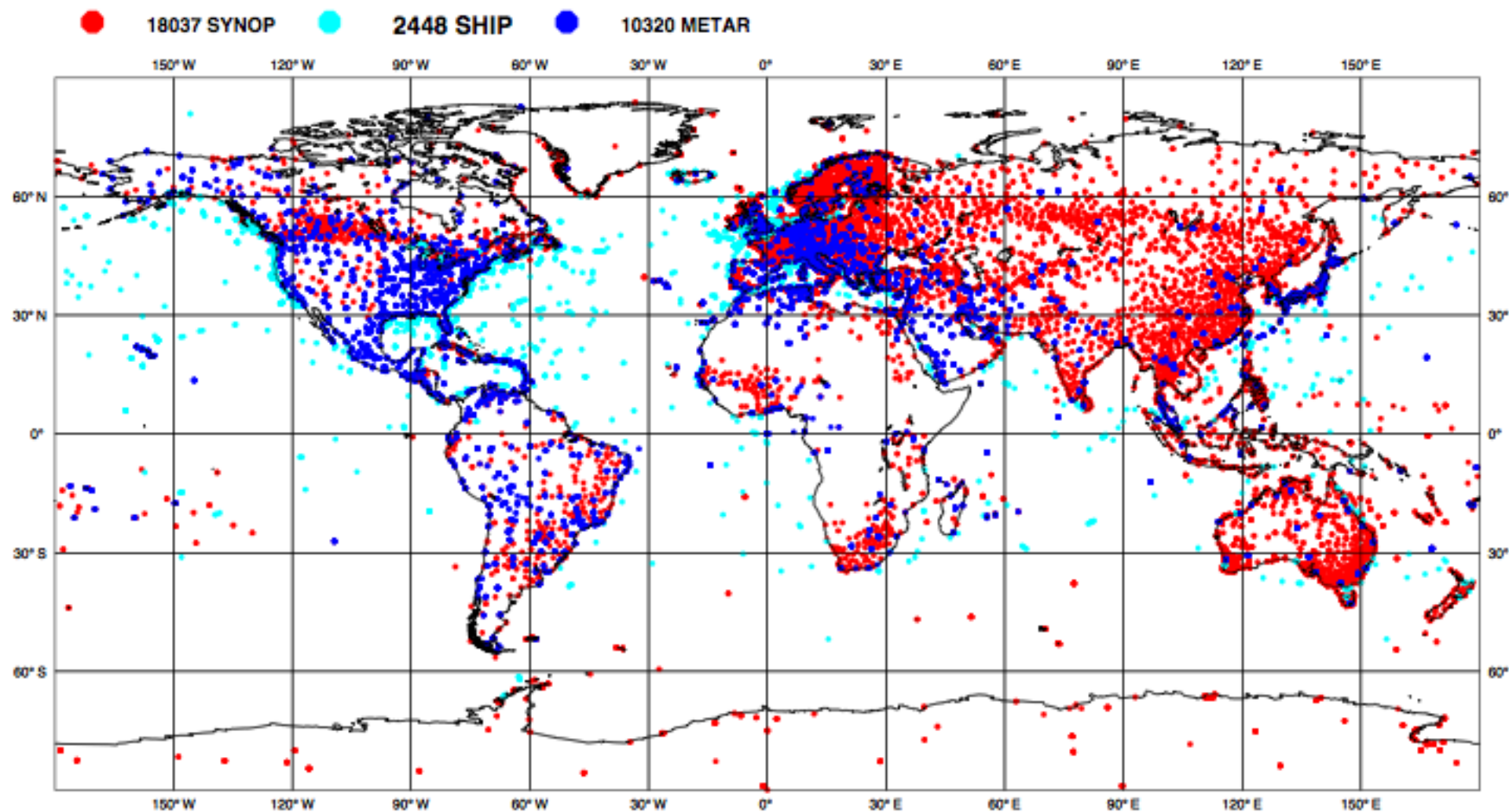
Problèmes restants

- Cycle de l'eau (évaporation, condensation, influence sur le rayonnement absorbé ou émis par l'atmosphère)
- Échanges avec l'océan ou la surface continentale (chaleur, eau, quantité de mouvement, ...)
- ...

ECMWF Data Coverage (All obs DA) - SYNOP/SHIP

14/APR/2010; 00 UTC

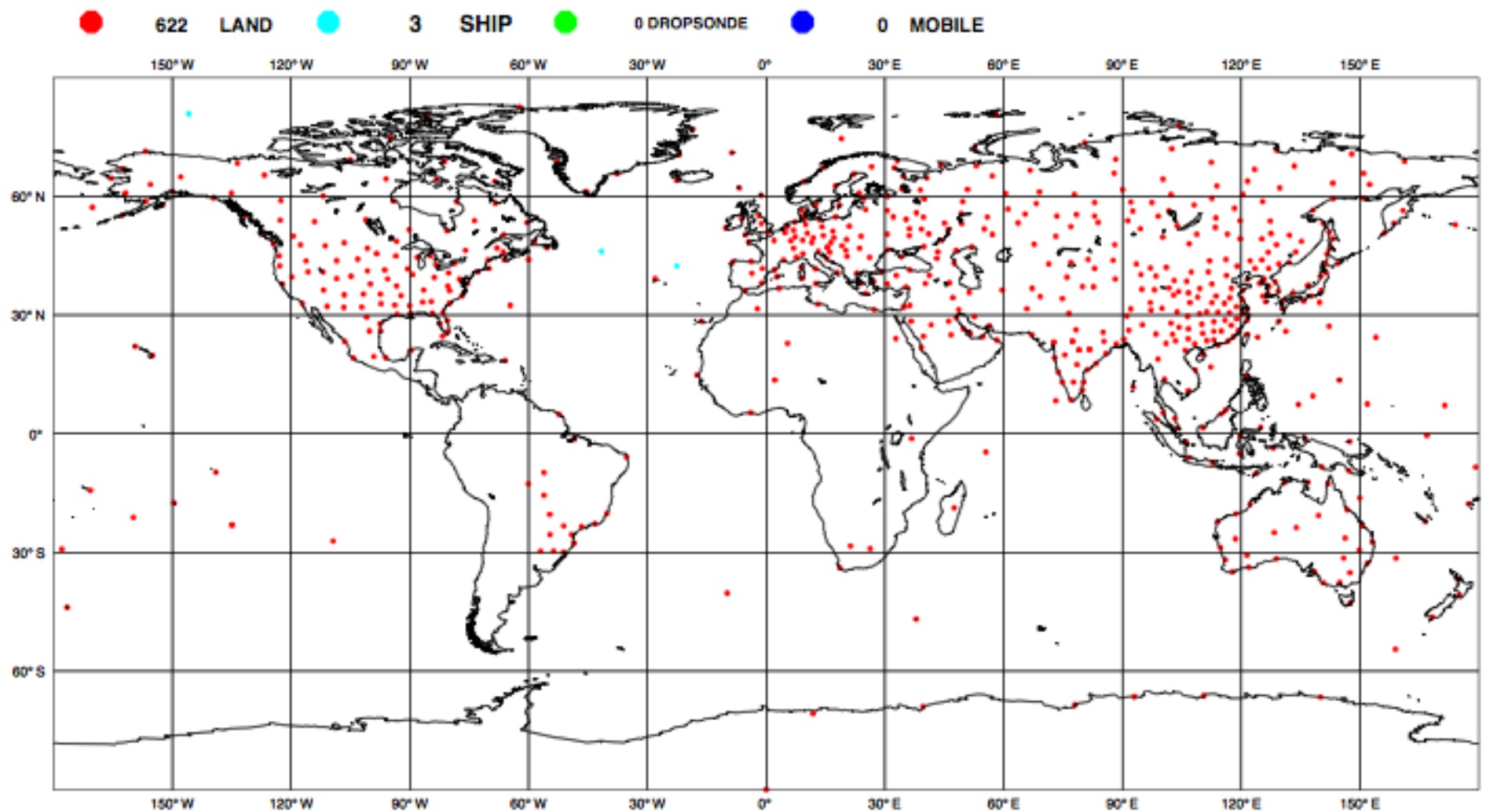
Total number of obs = 30805



ECMWF Data Coverage (All obs DA) - TEMP

14/APR/2010; 00 UTC

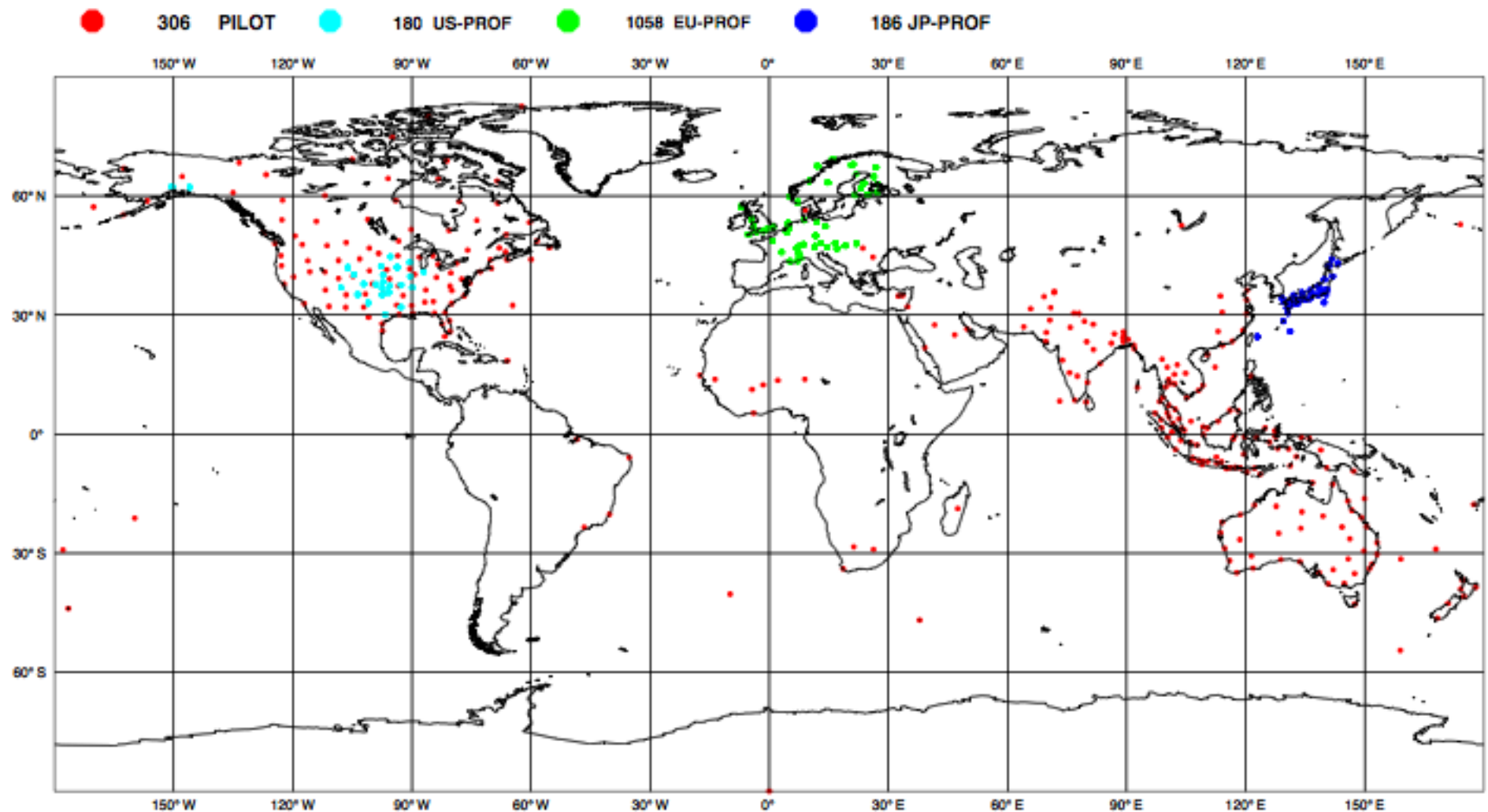
Total number of obs = 625



ECMWF Data Coverage (All obs DA) - PILOT/PROFILER

14/APR/2010; 00 UTC

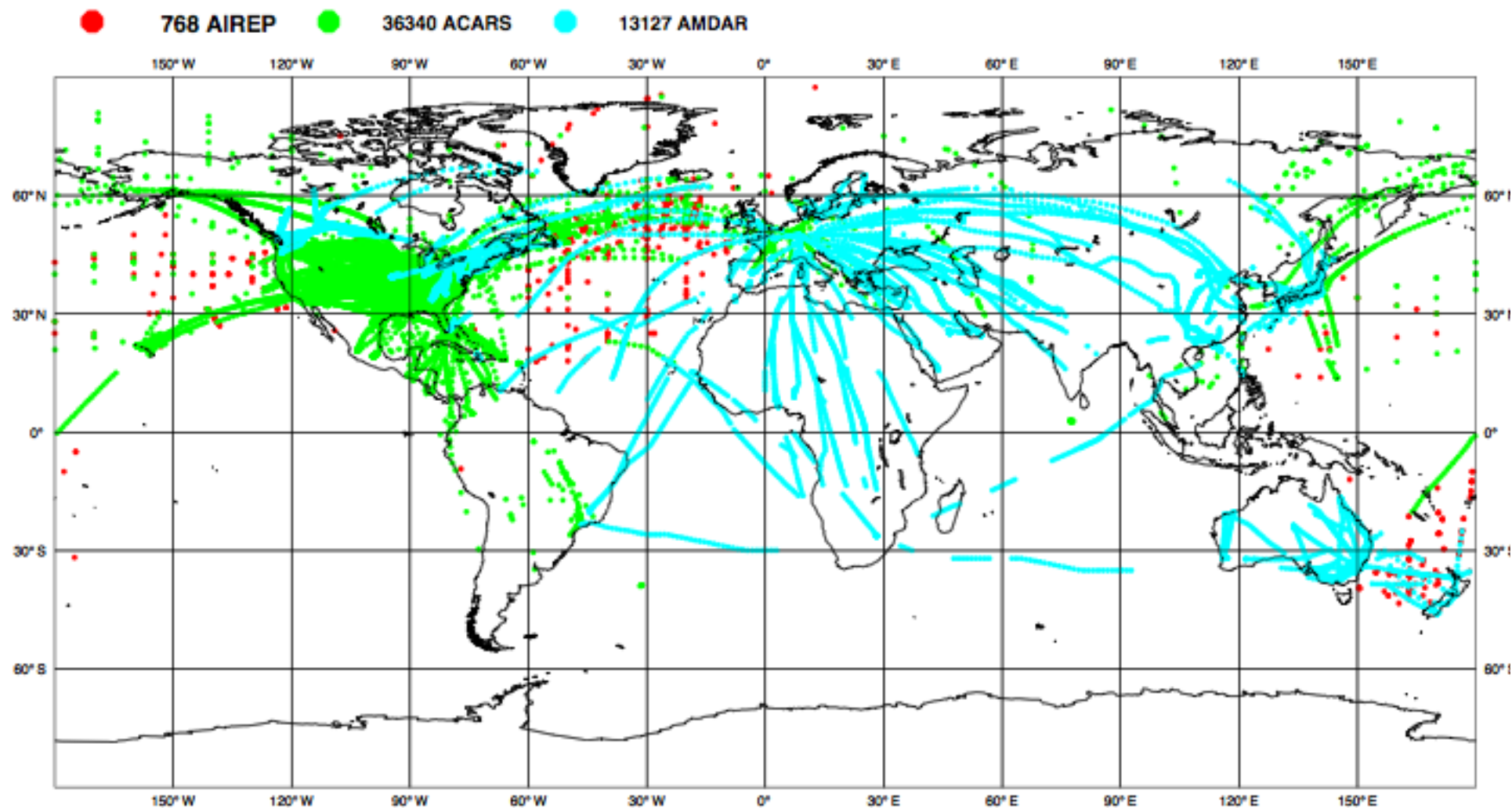
Total number of obs = 1730



ECMWF Data Coverage (All obs DA) - AIRCRAFT

14/APR/2010; 00 UTC

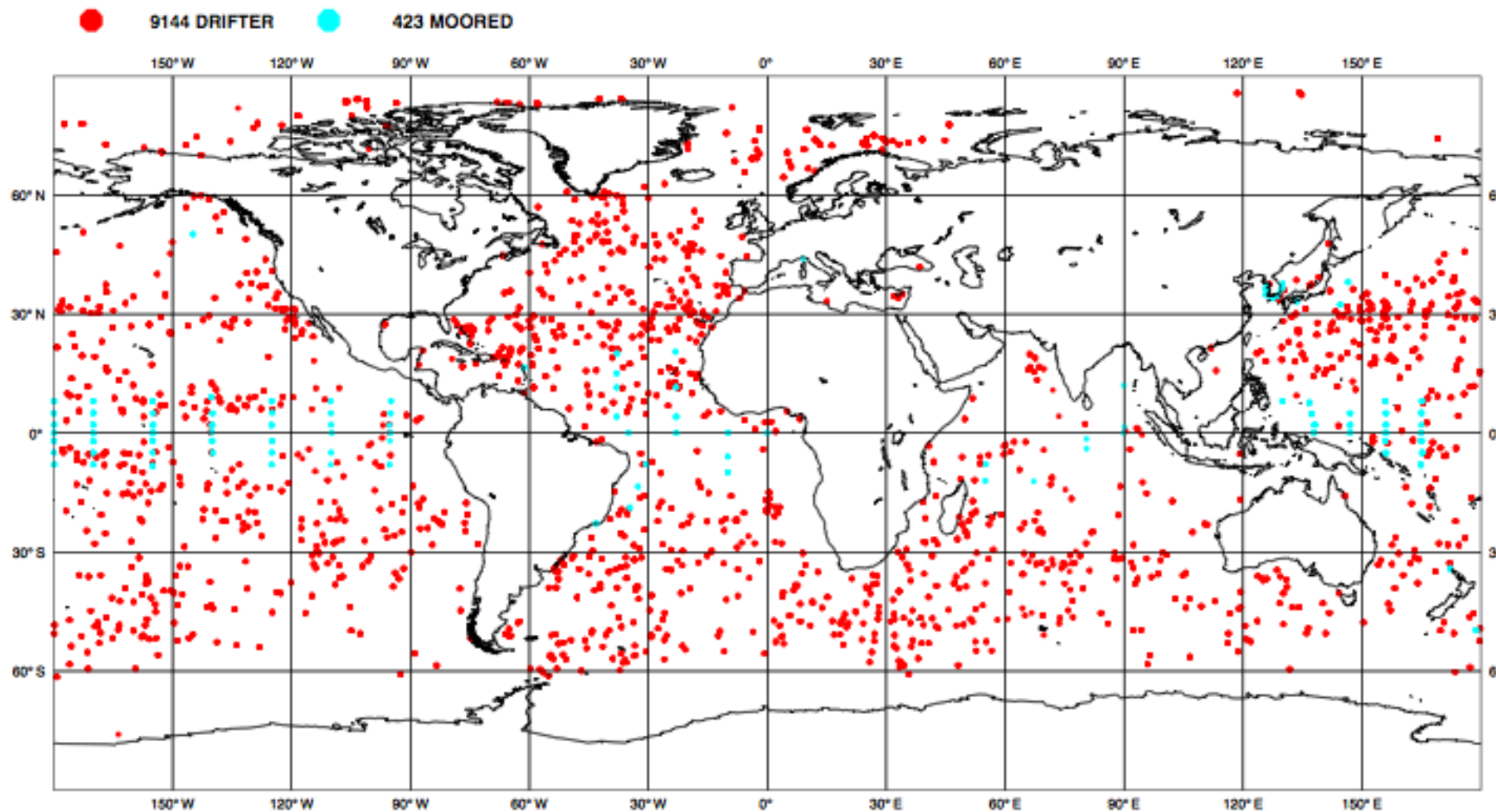
Total number of obs = 50235



ECMWF Data Coverage (All obs DA) - BUOY

14/APR/2010; 00 UTC

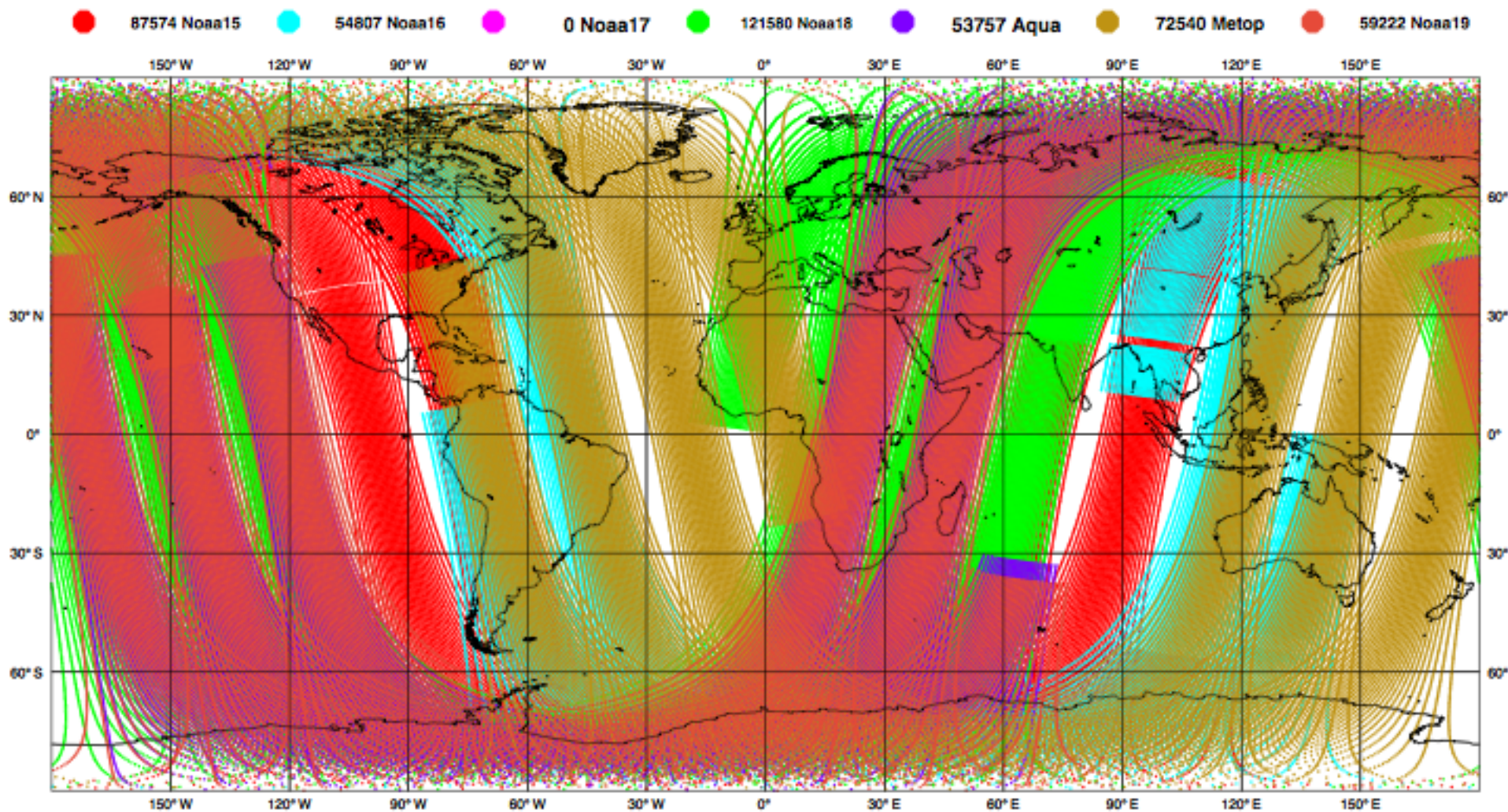
Total number of obs = 9567



ECMWF Data Coverage (All obs DA) - AMSU-A

14/APR/2010; 00 UTC

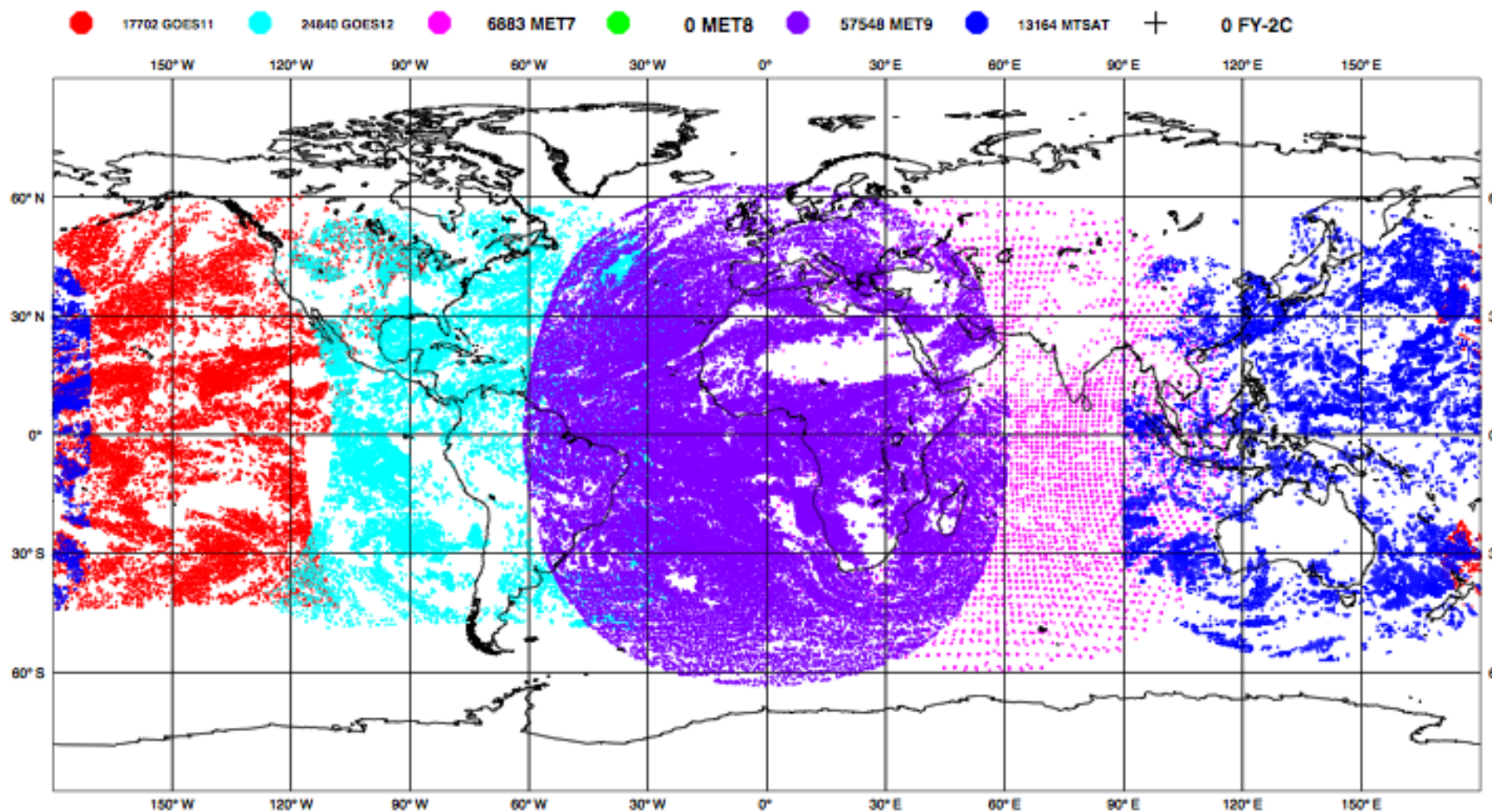
Total number of obs = 449480



ECMWF Data Coverage (All obs DA) - AMV IR

14/APR/2010; 00 UTC

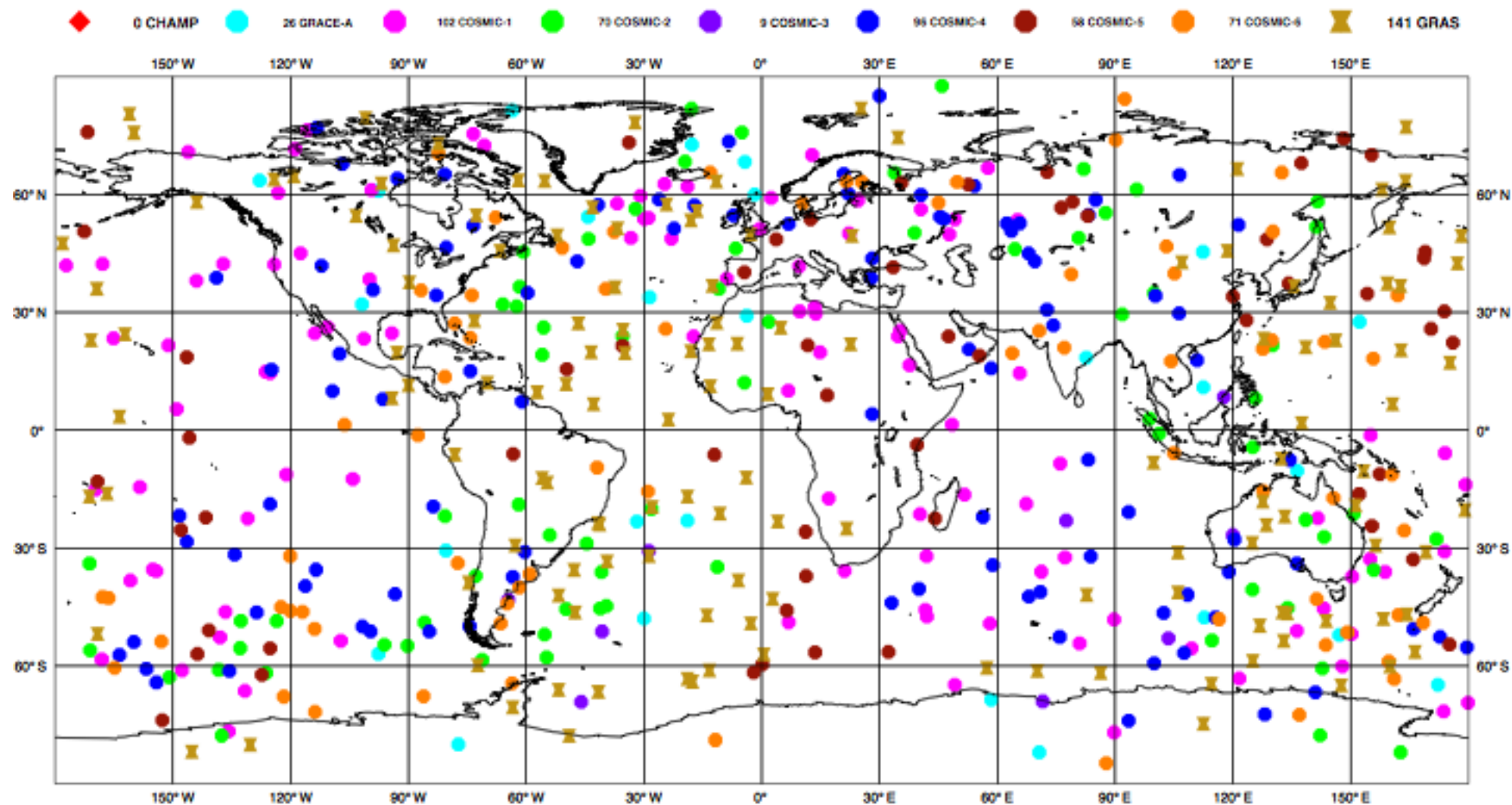
Total number of obs = 120137



ECMWF Data Coverage (All obs DA) - GPSRO

14/APR/2010; 00 UTC

Total number of obs = 573

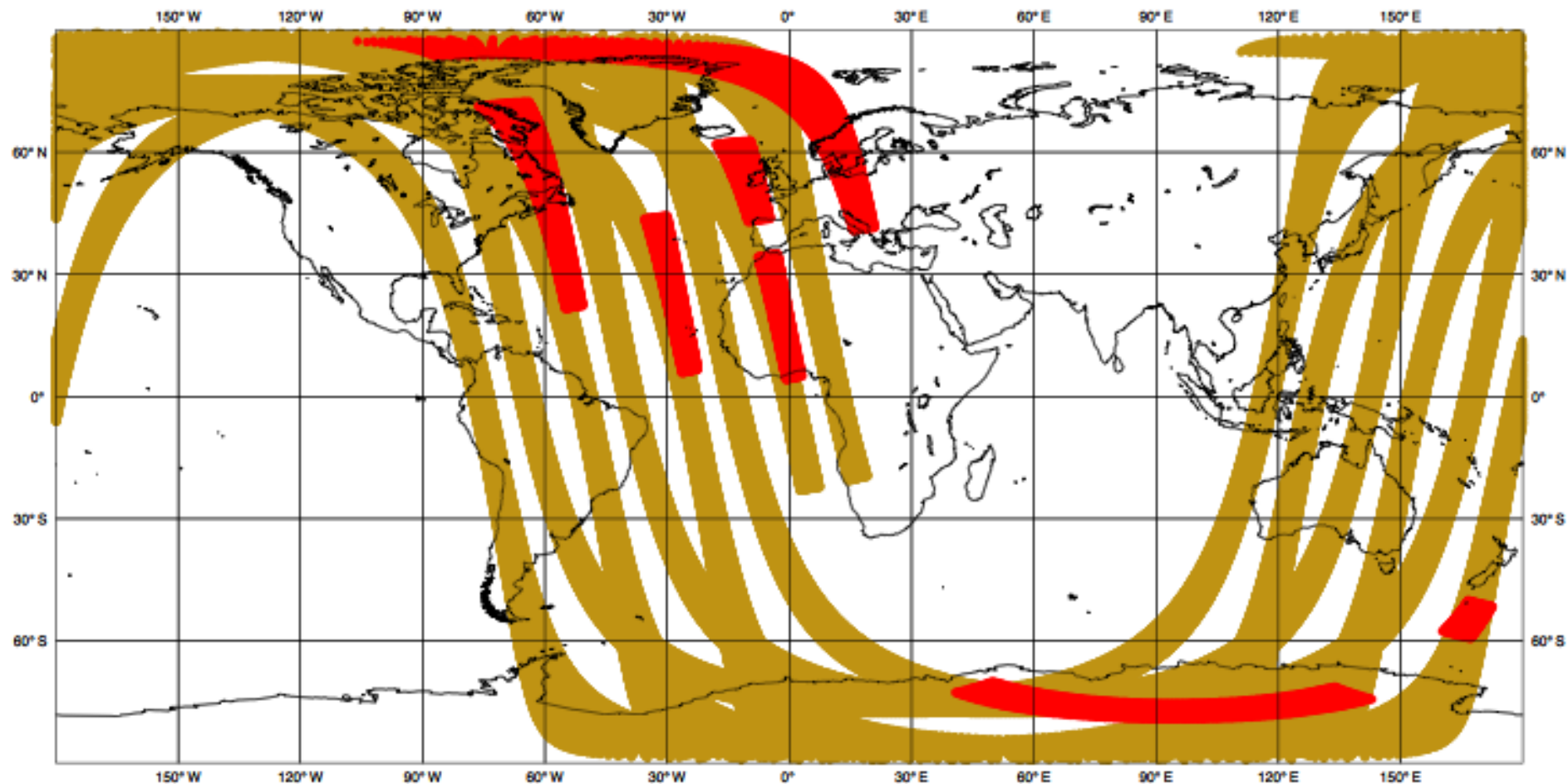


ECMWF Data Coverage (All obs DA) - SCAT

14/APR/2010; 00 UTC

Total number of obs = 514632

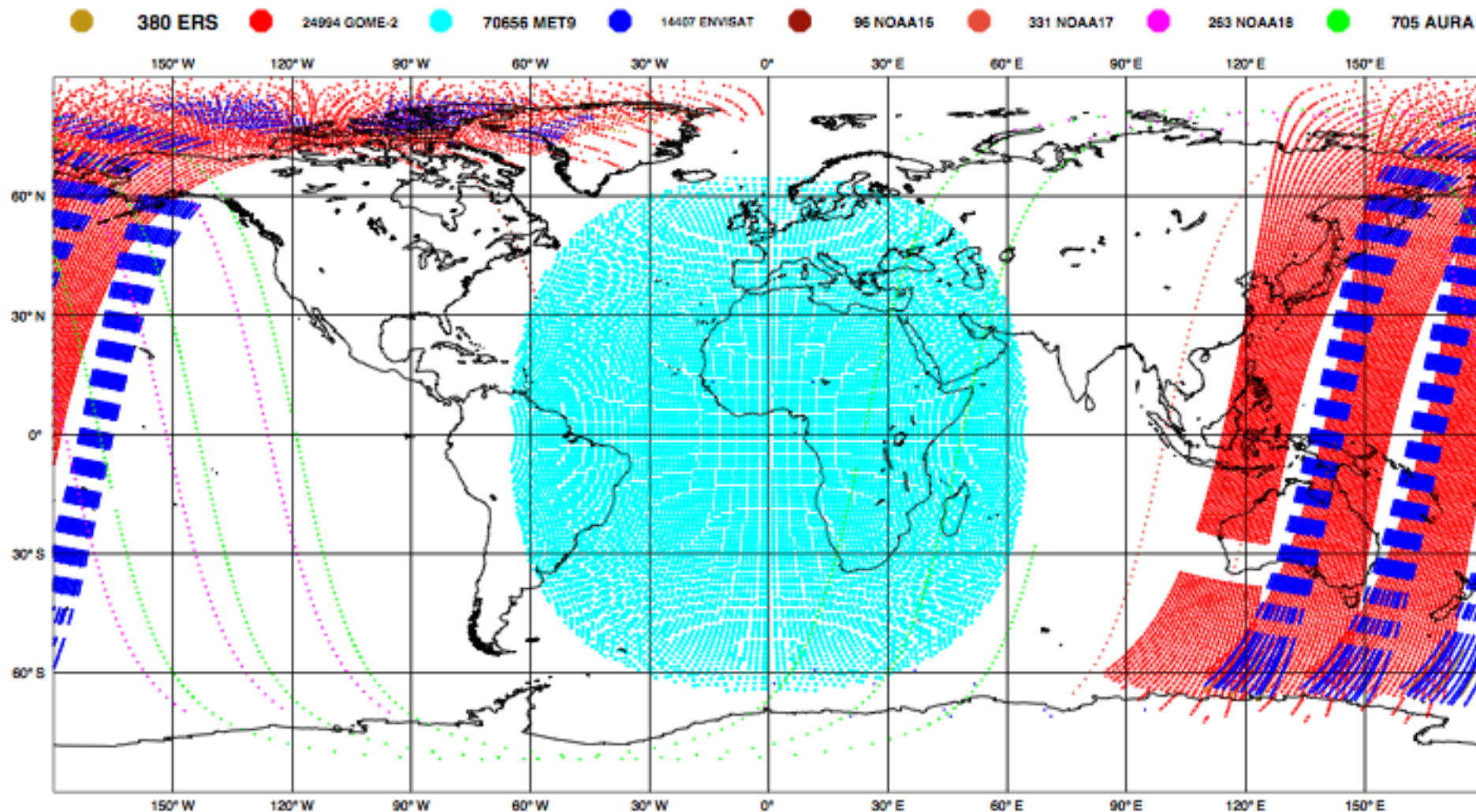
● 0 Qscat ● 495138 Ascats ● 19494 Ers-2



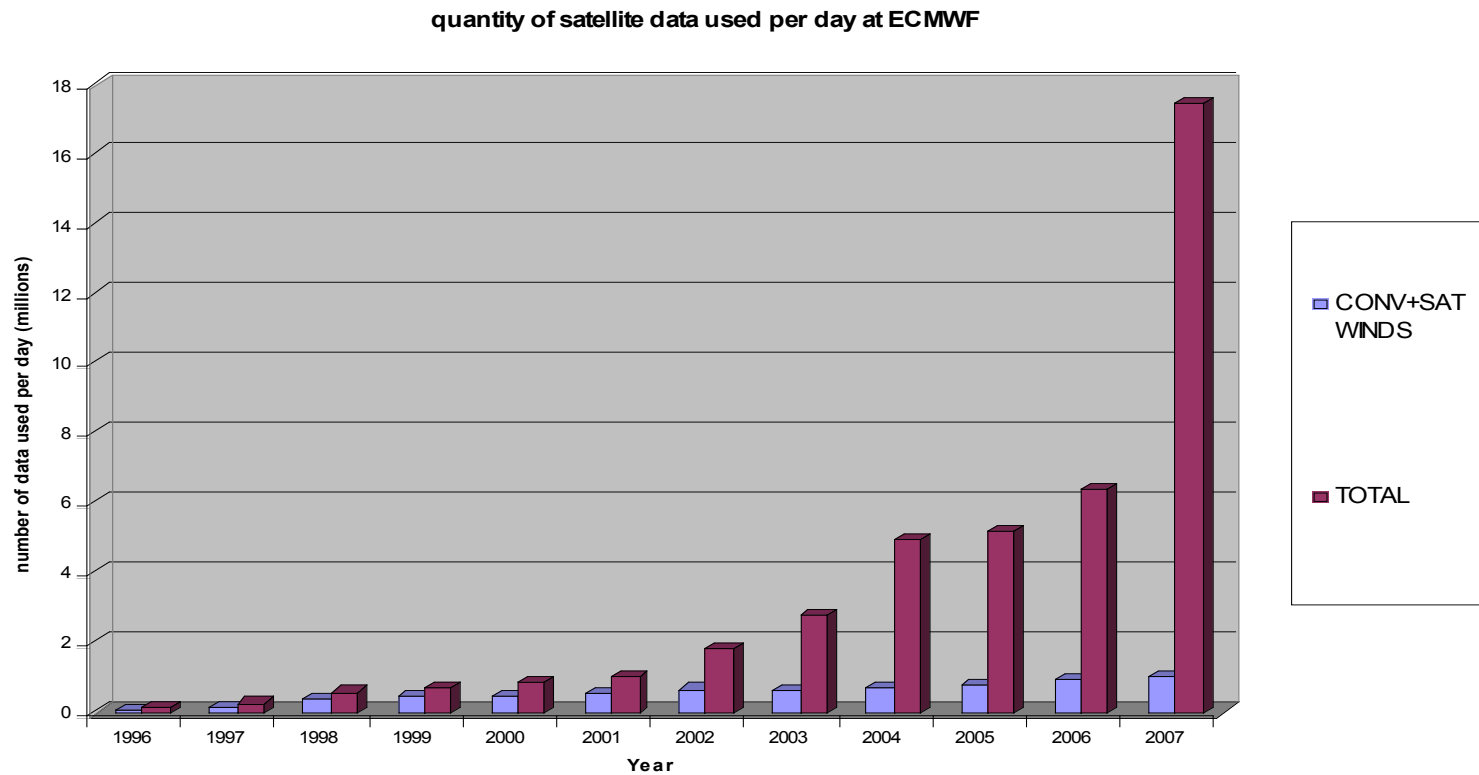
ECMWF Data Coverage (All obs DA) - OZONE

14/APR/2010; 00 UTC

Total number of obs = 111832



December 2007: Satellite data volumes used: around 18 millions per day



Value as of March 2010 : 25 millions per day