THE USE OF MONITORING STATISTICS TO PRODUCE BLACKLIST AND TO CONTROL ARPEGE ASSIMILATION CYCLE

Bruno Lacroix

Météo-France

Toulouse, France

Summary: The verification of ARPEGE assimilation is using the same tools as the monitoring of the observations, based on departures from background field. The general rules used in operations are listed here, with a few annexes giving the detailled values applied.

1. THE ASSESSMENT OF ARPEGE ANALYSIS (ANNEXE1):

The first and main step to control the ARPEGE model performances is to get, on average, a knowledge of the assimilation cycle quality. The simpliest way to perform that is to compute statistics of the differences of first guess minus observation, for all analysed parameters (geopotential, temperature, humidity and wind) at the surface and all standard levels, where observations are the SYNOP, SHIP, DRIFTER, TEMP, PILOT, SATEM available (annexe2).

For each analysis, statistics are computed on 3 areas (North20, Tropics, South 20). The total numbers of observations, the rejected and gross errors ones, and these statisitcs (bias and standard deviation) are plotted on graphs for the last 2 months, updated each main observation hour.

In practice, the statistics are very stable in time, except the daily osciallation due to the number of TEMP observations available.

After a few years, the seasonal variational, the changes in ARPEGE model (analysis, initializatio, geometry, ...), the variations in observations numbers and quality give a measure of what may happen and what is serious or not.

For each analysis, a test against a minimum number of observations available is done (annexe 2), and a mail sent to a mailing list in order to warn people of any anormal number of data.

Maps of data availability, per 5 degrees square boxes, are plotted in order to see where the observations are. Maps with quality flags, obs-guess, analysis increment on a selection field / levels are also produced. The control of surface parametrisation is done with a plot of curves for 12 regions of dayly soil wetness index.

Each month, but updated each day, for all data, a listing with number of observations, number of rejected data, number of gross errors , bias and standard

deviation for obs value, observation-guess and analysis averaged on North 20, Tropics, and South 20, is produced.
A plot of vertical profiles on model levels for vorticity , divergence, temperature, humidity and kinetic energy for bias analysis -guess is occasionnaly done to supplement the previous diagnostics.

2. THE VALIDATION OF NEW VERSION

The general rule to accept a new version is: "A good analysis is the one giving a good forecast". So a new analysis version is tested by the quality of the forecasts produced.
In order to obtain a smooth change in the operational suite, an e-suite is performed, to be switched operational if accepted. This parallel suite is running at the same speed as the operationnal, with a 96H forecast each day on 00UTC analysis, with its own assimilation cycle, based on the same observations.
All the tools used on the operationnal suite are also applied on the experimental one.
The objective verification consists in the valuation of thousands of scores on forecasts with respect to analysis , ECMWF analysis, TEMP/PILOT and SYNOP.
Occasionnaly, a human verification is also performed, using SYNERGIE and metview software.

3. BLACKLISTING OBSERVATIONS

The basic idea is that the quality of forecast depends upon the quality of the observations taken into account by the analysis, keeping in mind the following rules. First, le observations are a relatively weak constraints, due to their number, about 10^5, compared to the model degrees of freedom, about 10^7. The automatic quality control suppress some of them which are to far from the model. Next, the initialization is able to erase large and unbalanced departures. Finally, the impact on forecast is linked to the model sensitivity on the observation location, which is very variable.
Once the mean observations minus first guess behavior known, it is usefull to define thresholds in order to detect observations which are atypics, with a monthly average point of view. These thresholds are chosen in order to obtain a small number of platforms, which are assessed case by case. This operation gives a list of stations which are either good but non representative of the model scale, either suspect or of poor quality. Nothing can be conclude on observation where the model (first guess) is too bad on average.
This list is used as a first guess, to be confirmed, and a sensor in a platform is balcklisted if necessary after taking into account the stability in time of the

errors in the past months, the other observations available around, and the ECMWF blacklist and other monthly monitoring reports.
Of course, an observation is suppressed from the the blacklist once becoming better, the blacklist being updated each month.

4. THE PERFORMANCE OF SATELLITE SYSTEMS

Like for the analysis, we plot for each NOAA satellite, for thickness of the 7 layers for cloudy, semi-cloudy and cleared SATEM, and for each geostationnary satellite, for wind speed, on 3 layers for visible, infrared and water vapor channel, the number of observations, rejected data, gross errors, bias and standard deviation for observation minus guess and analysis.
Each month, maps are produced for all satellite and all layers, of number of observations, and bias and standard deviation of observation minus guess and analysis.
We use the ECMWF monitoring report to check the difference between SATEM retrievals and TEMP profiles, and SATOB and TEMP/PILOT/AIREP

5. CONCLUSION

Even if the direct benefit on model forecasts is not easy to measure, the tools developped to blacklist observations and to verify the assimilation cycle are usefull to get confidence on the model products.

annexe1

ARPEGE assimilation cycle configuration

The operationel version of ARPEGE has a T199C3.5L31 geometry with a quadratic grid, and an incremental 3DVAR analysis T127C1.0L31 with a semi linear grid (T105 160x320pts)
The delay for the short cut-off analyses is 1H50, and for the assimilation cycle, run with a six hour step:

	0000 UTC	0600 UTC	1200 UTC	1800 UTC
cut-off	1045 UTC	1115 UTC	2230 UTC	2315 UTC

The main steps of ARPEGE analysis are the followings:

Full-Pos: guess from T199C3.5L31 = Ghr to T127C1.0L31
Full-Pos: guess from T127C1.0L31 to T199C3.5L31 = Gbr/hr
CANARI: departure obs-guess + quality control
3DVAR: Minimisation
Full-Pos: analysis from T127C1.0L31 to T199C3.5L31 = Abr/hr
CANARI: incremental Ahr = Ghr + (Abr/hr - Gbr/hr)
CANARI: surface analysis

annexe 2

observations used and their thinning

SYNOP SHIP SYNOR		Z, u, v, T, SST, H ,Q
AIREP AMDAR ACARS	1/5 cruise level AMDAR/ACARS , no ascent nor descent phase	u, v, T
SATOB	1 / 4 for GOES	u,v
BUOY		Z, u, v, T, SST
BATHY TESAC		u, v, T, SST
TEMP TEMPSHIP TEMPMOBIL TEMPDROP		Z, u, v, T, SST, H, Q
PILOT PILOTMOBIL		u, v
SATEM		Thickness (14 -> 7 layers)

the general time window is [H - 2h59 , H + 3h00] , except for TEMPDROP, SYNOP, SHIP , SYNOR for which it is[H-0h30 , H+0h30] ([H-1h30 , H+1h30] for SYNOP of WMO region V).

annexe 3

minimum number of observations in the analyses

CYCLE	MODEL
SY_SH=3500	SY_SH=3200
AIREP=1000	AIREP=1000
SATOB=1500	SATOB=350
DRIFTER=150	DRIFTER=100
TEMP_PRINC=500,TEMP_SECOND=10	TEMP=400
PILOT=140, PILOT_18=100	PILOT=100
SATEM=500	SATEM=200

annexe 4

The general rules and threshold on monthly statisitcs of observation-guess, to declare suspect some observations, can be found in any monitoring reports. Here are the definition not exchanged in these reports.

Wind (SATOB): gross error = 40 m/s

Temperature (TEMP, SATEM): gross error = 20K, suspect TEMP if RMS >=10K

Humidity (TEMP): gross error = 0.5 , suspect if |bias| >= 0.5

rules in ARPEGE to report blacklist on parameters:

SYNOP: T2m => Hu2m ; Q, Hu2m => Q

TEMP: Z => Hu, T, Td, Q ; T => Hu, Q ; Hu => Q