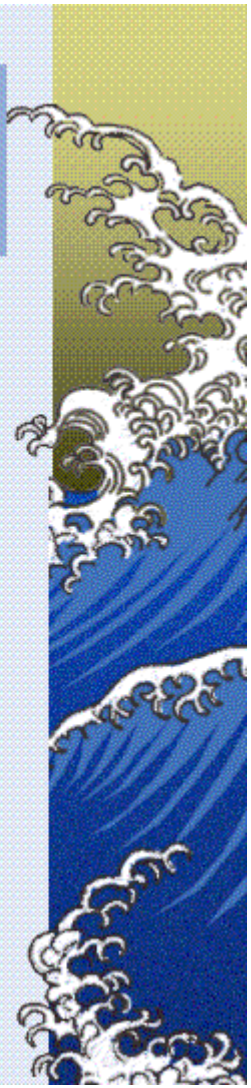
SCREENING OF OBSERVATIONS
Plan of the lecture

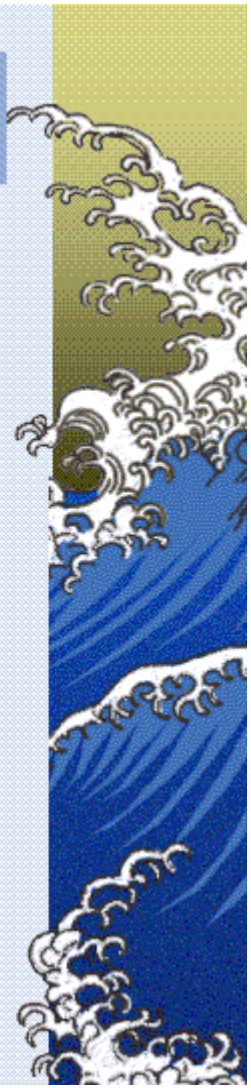
- Problematic
- Screening of conventional observations
- Screening of satellite observations
- Examples for some observation types



THE OBSERVATION SCREENING

Problematic

- The screening is the last step of the pre-treatment of the data used in the Arpege analysis
- We want to remove the wrong data and the make the final choice inside the set of data which are said to be potentially acceptable by the control and the monitoring
- We need to control them against the background, to verify their vertical consistency and to thin them when their space resolutions are too high

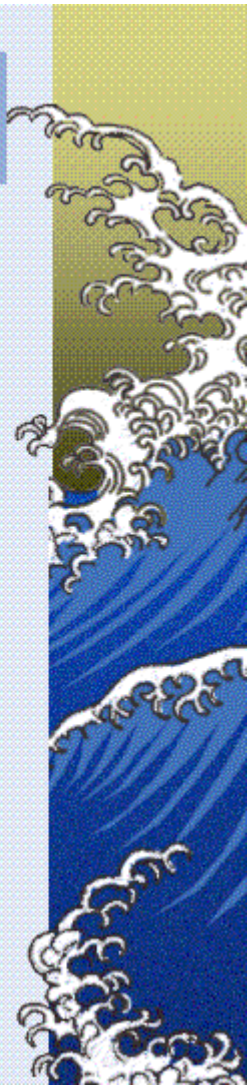


THE OBSERVATION SCREENING

- Arpege 3D/4D-Var assimilation system makes use of an incremental minimization scheme to reduce the computational cost
- The screening is done inside the Arpege code, not outside like the monitoring or the various pre-treatments of the observations
- The variational data analysis starts with the first high-resolution trajectory run

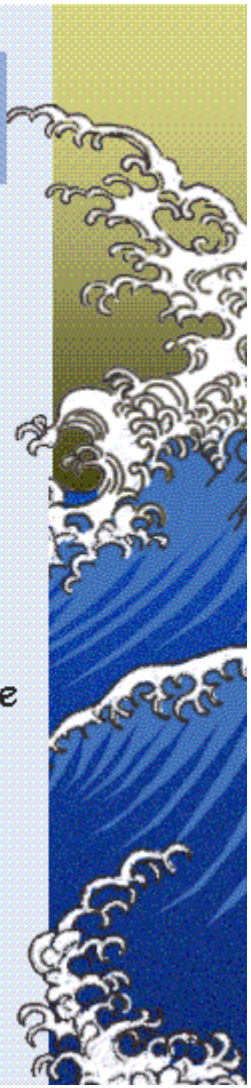
THE OBSERVATION SCREENING

- The model counterparts for all observations are calculated during that high resolution run
- As soon as these background departures are available, the screening can be performed
- 3D-screening time window extends over the whole assimilation time window
- In the 4D-screening, the assimilation time window is partitioned into one-hour time slots.



THE OBSERVATION SCREENING

- A - PRELIMINARY CHECK OF OBSERVATIONS.
  - Check of completeness of the reports.
  - Check of the reporting practice for SYNOP & TEMP mass observations [Ps & Φ]
  - Scanning for blacklisting :
    - A monitoring blacklist is applied for discarding the excessively noisy or biased observations.
    - A selection of variables for assimilation is done using the data selection part of the blacklist file and the informations hard-coded in ARPEGE (orographic rejection limit, land-sea rejection…).

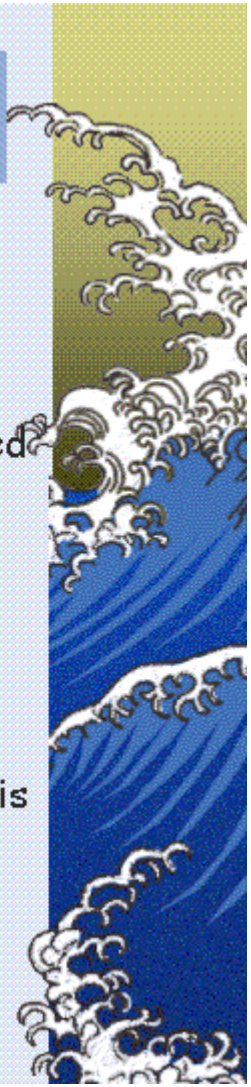


THE OBSERVATION SCREENING

- B - BACKGROUND QUALITY CONTROL.
  - It is performed for all the variables to be used in the assimilation.
  - The variance of the background departure is estimated by : $\langle y - H(x_b), y - H(x_b) \rangle \sim \sigma_o^2 + \sigma_b^2$
  - The estimate of variance for the normalized departure is given by : $(1 + \frac{\sigma_o^2}{\sigma_b^2}) = \lambda$
  - If $\left(\frac{y - H(xb)}{\sigma b} \right)^2 > n * \lambda$ then y is suspect.

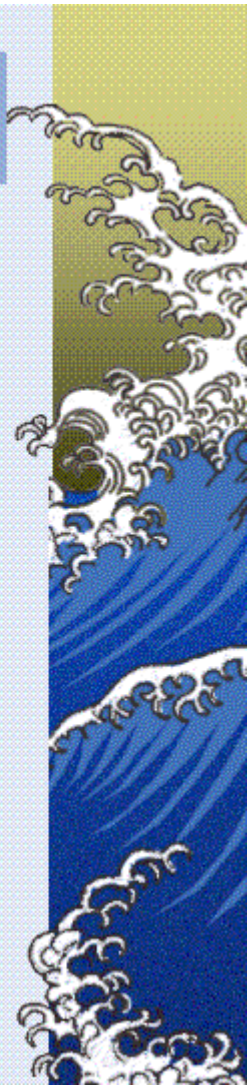
THE OBSERVATION SCREENING

- C - VERTICAL CONSISTENCY OF MULTILEVEL REPORTS.
  - The duplicated levels, in multi-level reports, are removed from the reports.
  - If 4 consecutive layers are found to be of suspicious quality then these layers are rejected.
- D - REMOVAL OF DUPLICATED REPORTS.
  - In case of co-located reports of the same observation types, some or all of the content of one of the reports is rejected (example : 2 Airep with same location, same content, but slightly different station identifier).



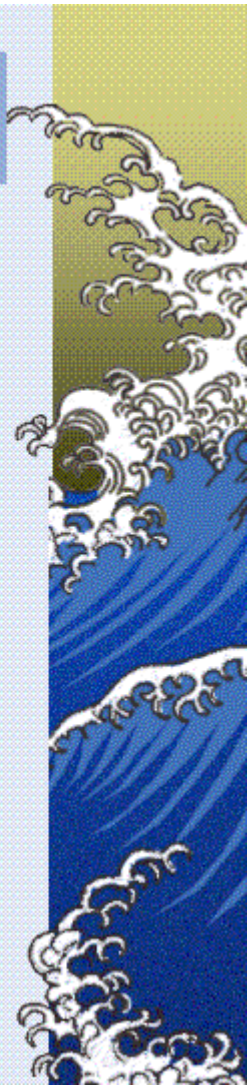
THE OBSERVATION SCREENING

- E - REDUNDANCY CHECK.
  - It is performed for the active reports that are co-located and originate from the same station.
  - For land Synop, the report closest to the centre of the screening time window with most active data is retained.
  - The ship Synop are redundant if the moving platforms are within a circle of 1 degree radius.
  - Temp and Pilot from same station are considered at the same time in the redundancy check.
  - A Synop mass observation is redundant if there are any Temp geopotential height observations (made in the same time and the same station) that are no more than 50hPa above the Synop mass observation.



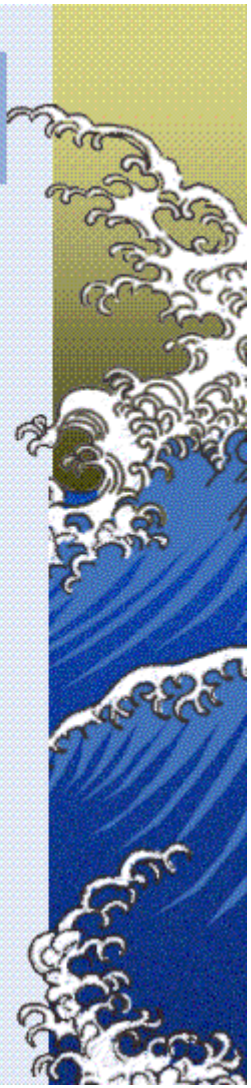
THE OBSERVATION SCREENING

- F - THINNING.
  - The horizontal and vertical résolutions of several types of observations are too high to allow to use all of them in Arpege analysis (knowing that no horizontal correlation of observation errors is supported)
  - A horizontal thinning is performed for the Airep, the Satob and the TOVS reports.
  - A vertical thinning is also performed for the Airep and the Satob reports.
  - A predefined minimum horizontal distance between the nearby reports from the same platform is enforced.



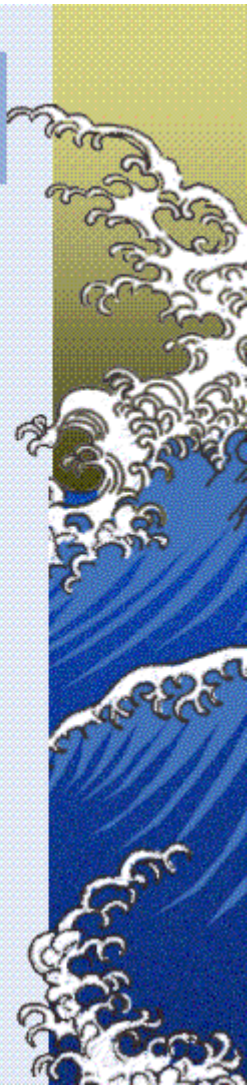
THE OBSERVATION SCREENING

- Thinning of Airep reports is done following the procedure :
  - A minimum distance of ~170 km is enforced.
  - We want to keep only one obs per box defined horizontally by the minimum distance and vertically by the standard levels
  - The obs will be chosen following these criteria :
    - Number of active data in the report
    - Closeness to the time of the center of the screening time window



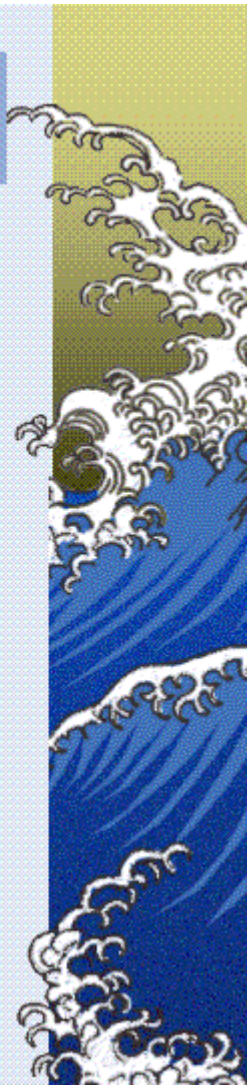
THE OBSERVATION SCREENING

- Thinning of Satob reports is done by the following procedure :
  - First a minimum distance of ~70 km is enforced
  - Then a repeated scan is performed to achieve the final separation of ~250 km.
  - We want to keep only one obs per box defined horizontally by the minimum distance and vertically by the standard levels
  - The obs will be chosen following these criteria :
    - Number of active data in the report
    - Closeness to the time of the center of the screening time window



THE OBSERVATION SCREENING

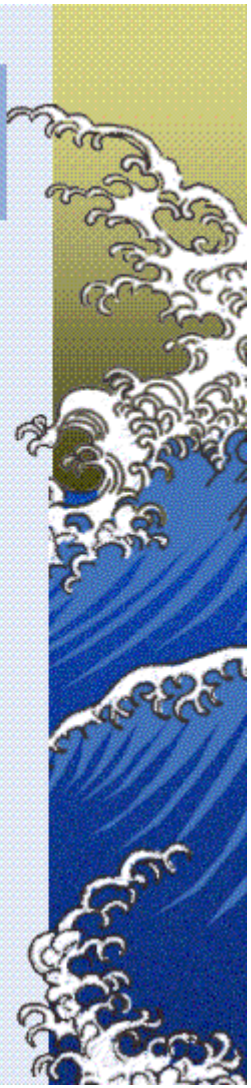
- Thinning of TOVS reports is done is done following the procedure :
  - First a minimum distance of ~70 km is enforced.
  - Then a repeated scan is performed to achieve the final separation of ~250 km
  - We want to keep only one obs per box defined horizontally by the minimum distance and vertically by the standard levels
  - The obs will be chosen following these criteria :
    - A sea sounding is preferred over a land one.
    - A clear sounding is preferred over a cloudy one.
    - The closeness of observation time to centre of the screening time window is preferred.



OBSERVATION SCREENING
Screening of satellite radiances

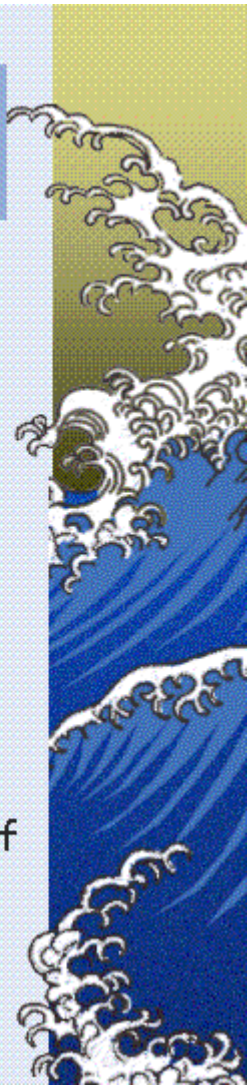
- For each analysis cycle, there are typically 20.000 TOVS observations in total for a dual polar orbiter system.

- A - INPUT
  - Necessity of an input profile from 1000 to 0.1 hpa for the radiative transfer model
  - But in the current 31 model levels, the background profiles are only available up to 1 hpa.
    - Extrapolation .
    - Climatological mean profiles (water vapour & ozone).
  - 1D-Var model is called to compute background radiances.



OBSERVATION SCREENING
Screening of satellite radiances

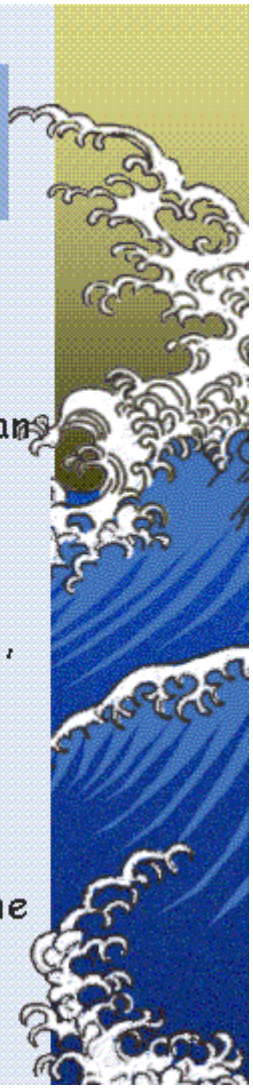
- B - QUALITY CONTROL.
  - Check that the background profile is within realistic limits
  - Check that the measured and background brightness temperature are present for all required channels and within the range 150-350 K.
  - Check that measured radiances departures from the background are less than 20K (gross errors checking)
  - The background temperature, specific humidity and ozone profiles are checked to be close to at least one of the profile contained in the dataset for which the radiative transfer equation is valid



OBSERVATION SCREENING
Screening of satellite radiances

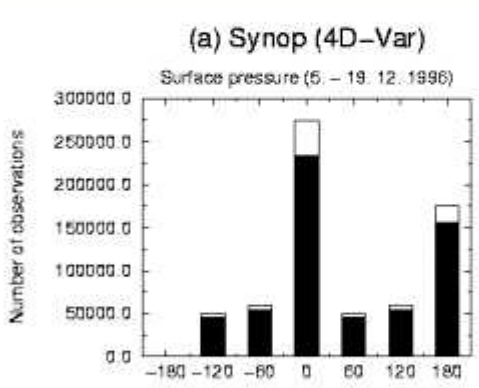
- A fine background check is done : the square of the radiance departures are flagged if they are greater than $16 \times (KBK^T + O + F)$
- Checking the radiance departure for HIRS channel is inside the range -4 to +8K
- Check that the bias correction coefficients, satellite id, and scan position are all valid.

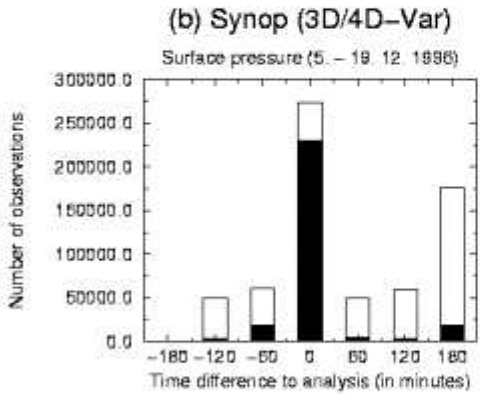
- C - Similar procedure for SSM/I radiances (water vapour, surface wind speed, cloud liquid water), but not used for the time being at Météo-France.



EFFECT OF THE OBS SCREENING ON Synop Ps observations

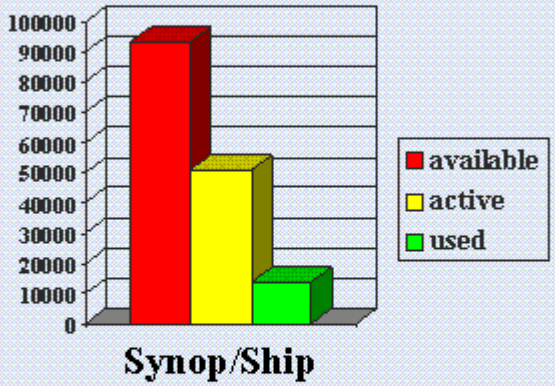
Comparison of the result of the screening done by a 3D-Var and a 4D-Var

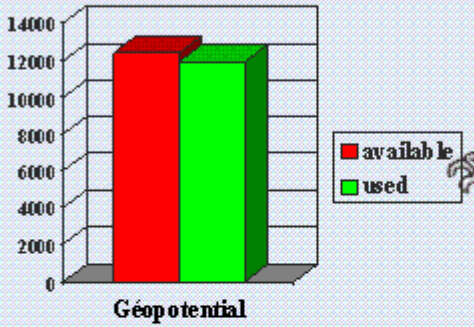




SCREENING OF OBSERVATIONS

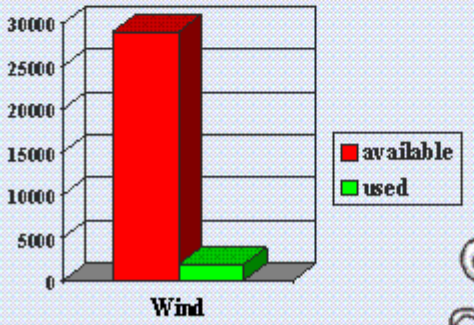
Synops/ships



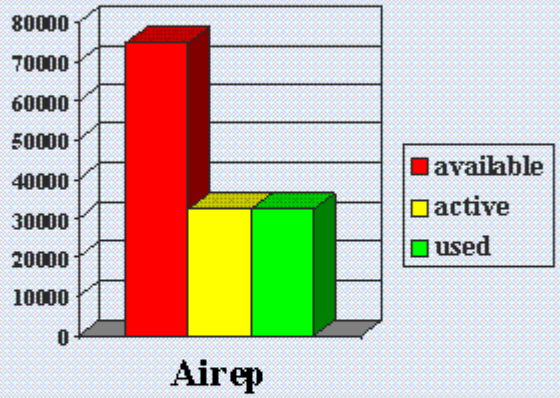


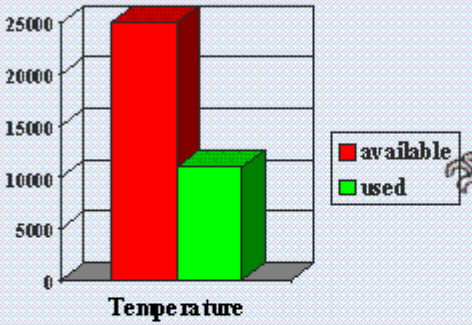
■ → ■ : rejection of precipitation, snow or cloudiness, blacklist

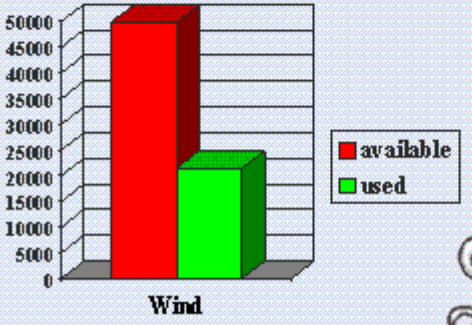
■ → ■ : no use of T2m, Hu2m, V10m over land, Geopotential over too high orography



SCREENING OF OBSERVATIONS
Airep/Amdar/Acar



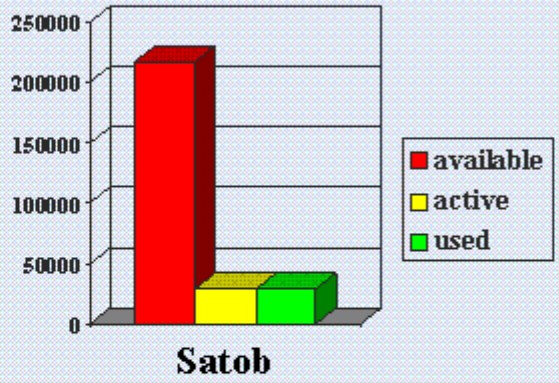




■ → ■ : thinning, blacklist

■ → ■ : nothing

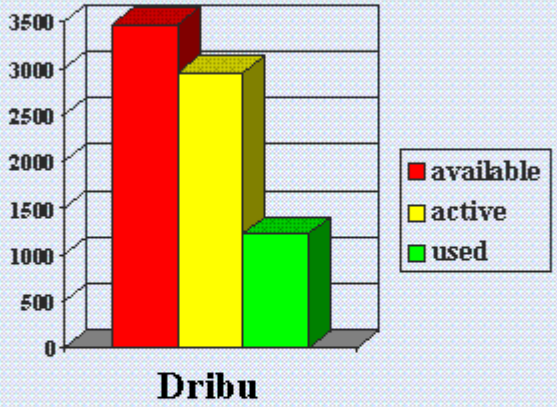
SCREENING OF OBSERVATIONS
Satob/Satgeo

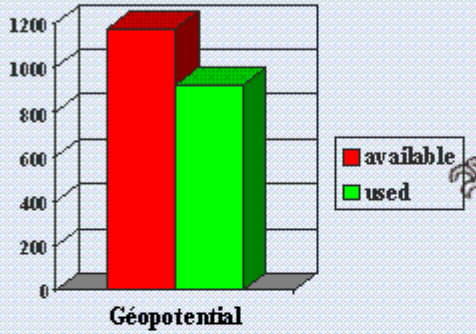


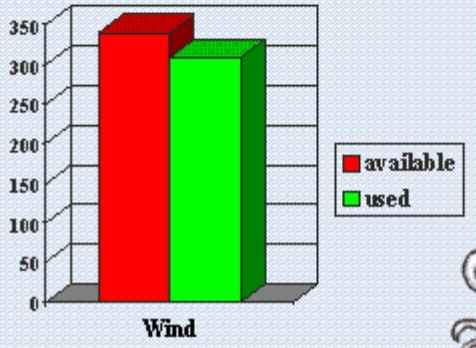
■ → ■ : thinning (essentially of GOES High Resolution Satob which is ≃ 10 times the resolution of Meteosat Satob and Satgeo), blacklist

■ → ■ : nothing

SCREENING OF OBSERVATIONS
Dribu



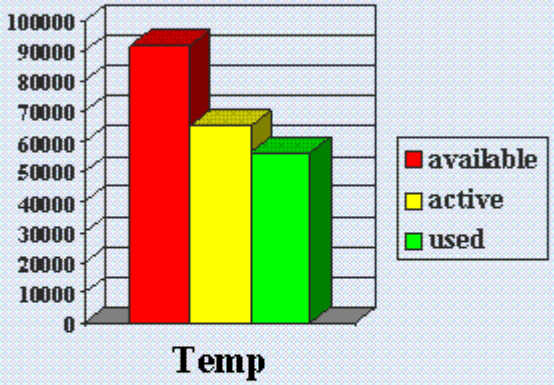


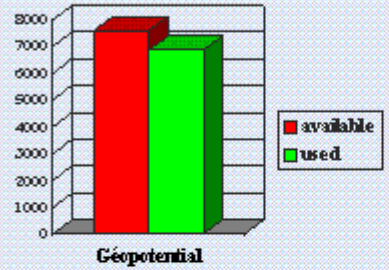


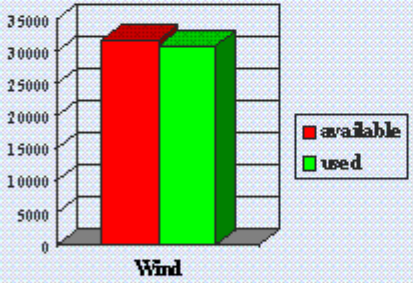
■ → ■ : time thinning, blacklist

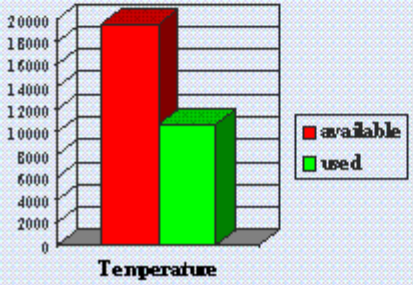
■ → ■ : no use of T2m, Hu2m, SST

SCREENING OF OBSERVATIONS
Radiosondes





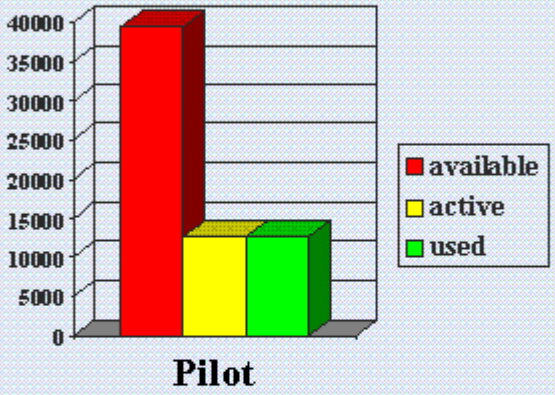


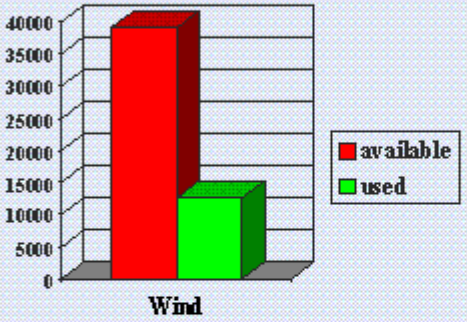


■ → ■ : rejection of Hu (redundant with Q), blacklist

■ → ■ : no use of the characteristic levels of geopotential and of the standard levels of temperature

SCREENING OF OBSERVATIONS
Pilot

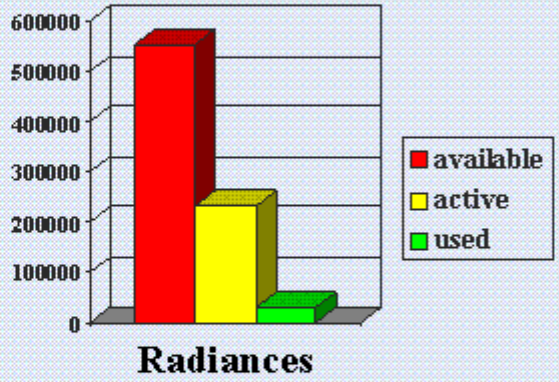




■ → ■ : rejection of profiler and europrofile data, blacklist

■ → ■ : nothing

SCREENING OF OBSERVATIONS
Radiances



■ → ■ : geographical thinning (more than a half), blacklist

■ → ■ : channels selection