

Observation usage in Météo-France data assimilation systems :

Current status and planned evolutions

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GMAP/OBS

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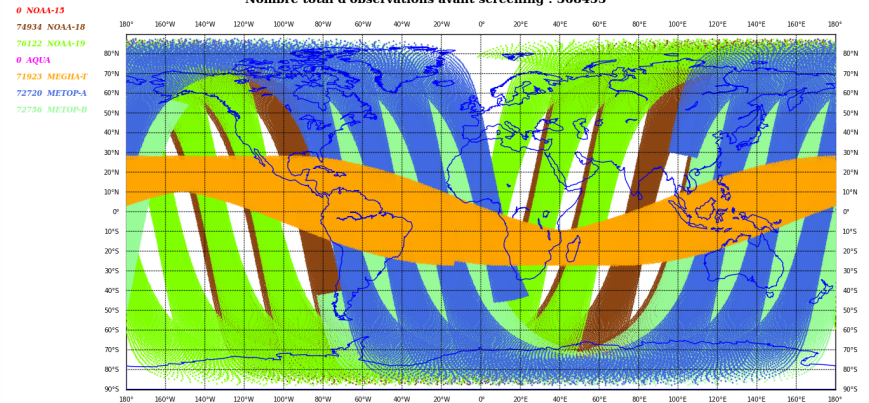
Outline

- Current status of observations in ARPEGE, AROME and ALADIN models (CY40_op2 – 13 April 2015)
- Short term planned evolutions
- Ongoing studies for longer term evolutions

Scientific changes

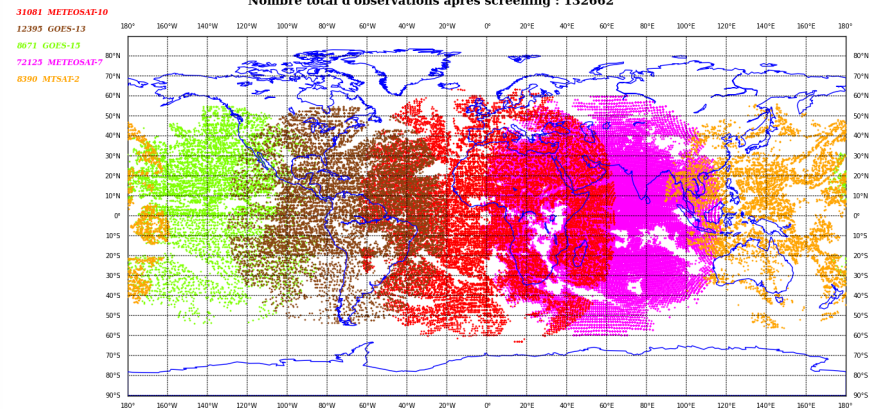
- ARPEGE 4D-Var assimilation : 6-h assimilation window with 30 minute time-slots (instead of 1 hour) => more observations for IASI, AMSU-A, AMSU-B/MHS, profilers, surface, ground based GPS
- Satellite observations (ARPEGE / ALADINs)
 - New instruments :
 - **SAPHIR**: microwave humidity sounder (AMSU-B/MHS like instrument with 6 channels) on board MEGHA-TROPIQUES (CNES/ISRO)
 - **Tandem-X**: GPS-RO instrument (similar to TerraSar-X)
 - Clear-sky radiances (1 WV channel) from geostationary satellites : **METEOSAT-7**, **MTSAT-2**

METEO-FRANCE couverture de donnees - ATOVS AMSU-B - 2015/04/05 00H UTC cut-off long
Nombre total d'observations avant screening : 368455



ARPEGE dbi

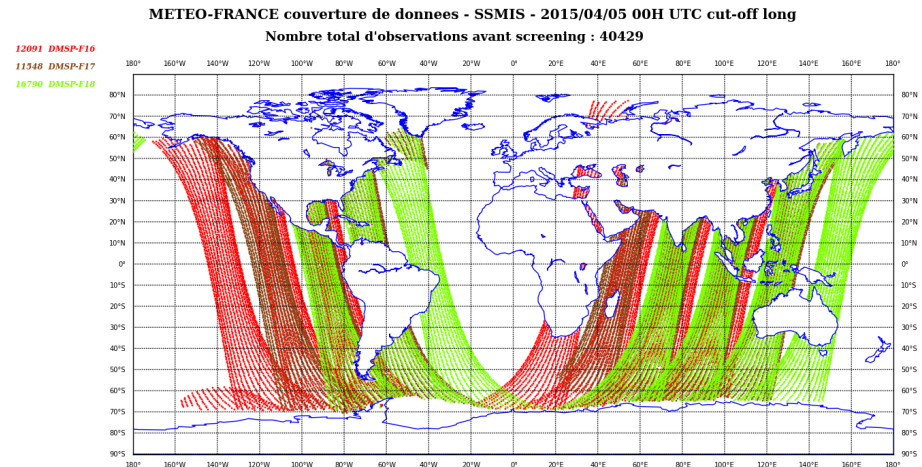
METEO-FRANCE couverture de donnees - CSR - 2015/04/05 00H UTC cut-off long
Nombre total d'observations apres screening : 132662



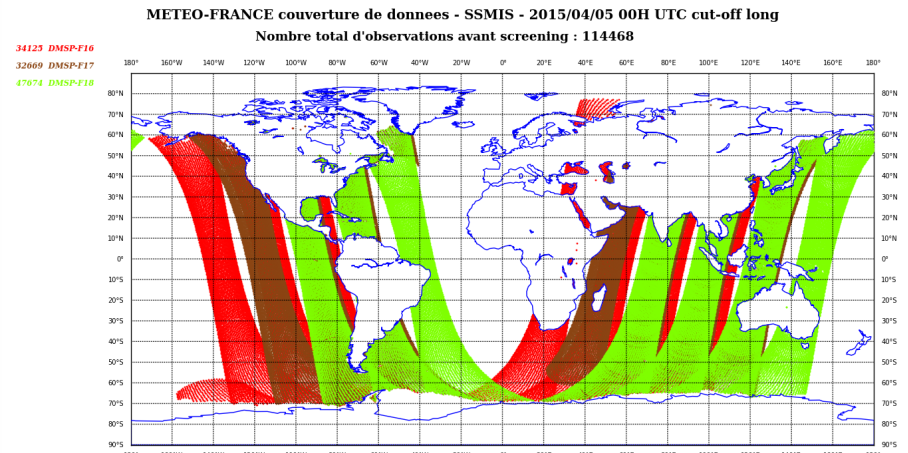
ARPEGE dbi

Scientific changes

- Satellite observations (ARPEGE / ALADINs) - Increased usage of existing instruments :
 - Input to the « screening » : radiances x 2 => 10 % more for assimilation
 - SSMI/S : data thinning at 125 km (instead of 175 km), sounding channels (55 and 183 GHz) from F17 and F18 (with a new predictor for VarBC)
 - Additional channels from IR hyperspectral sounders: CrIS/NPP (over sea and land, with revised σ_0) and IASI/METOP-A and B



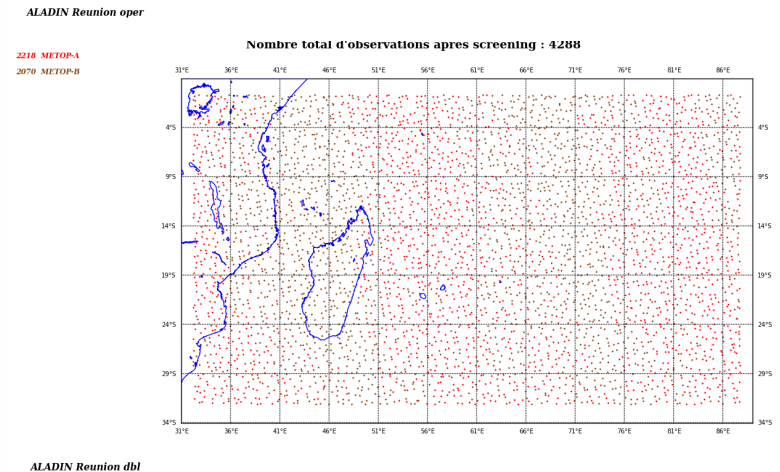
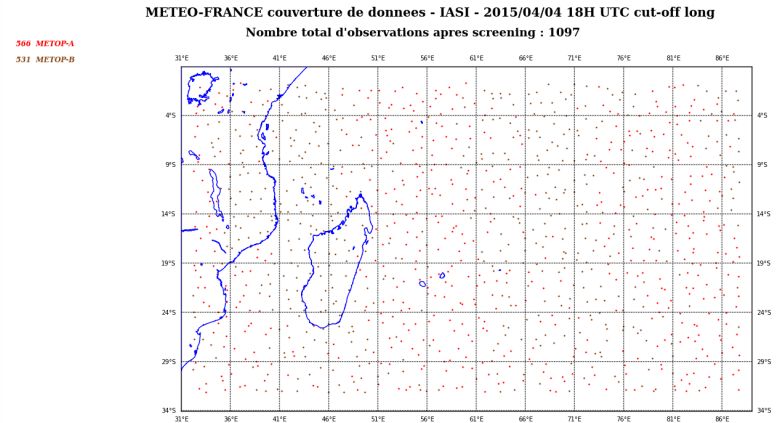
ARPEGE oper



ARPEGE dbI

Scientific changes

- Satellite observations (ARPEGE / ALADINs) - Increased usage of existing instruments :
 - Use of GPS-RO bending angles up to 50 km (instead of 46 km) with revised σ_0
 - Additional ATMS radiances at the edge of scan lines
 - Thinning of IASI radiances at 70 km in ALADIN models (instead of 125 km)
 - Early delivery data : ATMS and CriS from Lannion, EARS ASCAT from METOP-B, RARS ATOVS from METOP-B (important for AROME nowcasting with 10 min cut-off)
- Monitoring of new observations : Dual METOP winds + AMVs from METOP-B
- Ground based GPS : additional stations and processing centres (NOAA, METG, IGE2)



Scientific changes

- 3D-Var AROME assimilation with 1 h cycle (instead of 3h) => beneficial to the following observations :
 - Surface automatic weather stations
 - Ground based GPS
 - Aircrafts (improved temporal match)
 - Weather radars
 - MSG SEVIRI radiances
 - Wind profilers
- AROME model with 90 levels and a top at 10 hPa : detrimental to high peaking channels from IR hyperspectral instruments (IASI, AIRS, CrIS), revised observation operator for ZTD

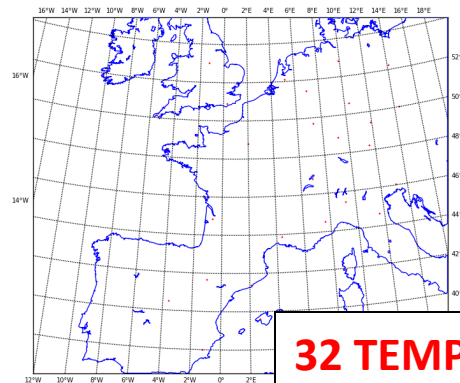
Technical changes

- WMO recommendations : TAC-> BUFR
- Use of SYNOP Land data in BUFR format since 04/11/2014 in all operational DA systems
- Use of aircraft data in BUFR format to accommodate the E-AMDAR changes in Nov. 2014 (New BUFR WIGOS template)
- Preparation to the use of radiosoundings in BUFR format:
 - Additional information: space and time location of the measurement during the ascent, more measurement points (up to 4000) – thinning at $\Delta z=75$ m
 - Difficulty : need to accommodate the diversity of messages (TEMP ASCII, BUFR LR, BUFR HR) => possible duplications.

METEO-FRANCE couverture de donnees - TEMP - 2015/04/05 00H UTC
Nombre total d'observations avant screening : 32

32 TEMP
0 TEMP-SHIP
0 TEMP-DROP
0 TEMP-MOBI

10h30-13h30

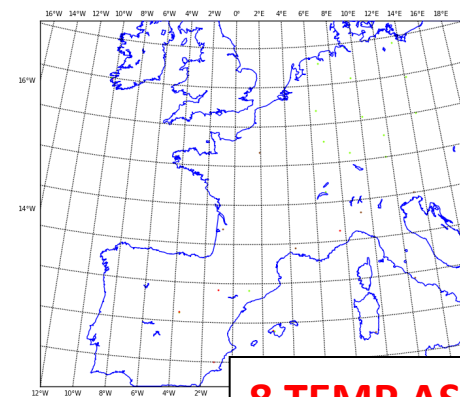


3D-Var
3h

AROME France oper

8 TEMP
9 TEMP/BUFR-LR
19 TEMP/BUFR-HR
0 TEMP-SHIP
0 TEMP-SHIP/BUFR-LR
0 TEMP-SHIP/BUFR-HR
0 TEMP-DROP
0 TEMP-DROP/BUFR-LR
0 TEMP-DROP/BUFR-HR
0 TEMP-MOBI
0 TEMP-MOBI/BUFR-LR
0 TEMP-MOBI/BUFR-HR

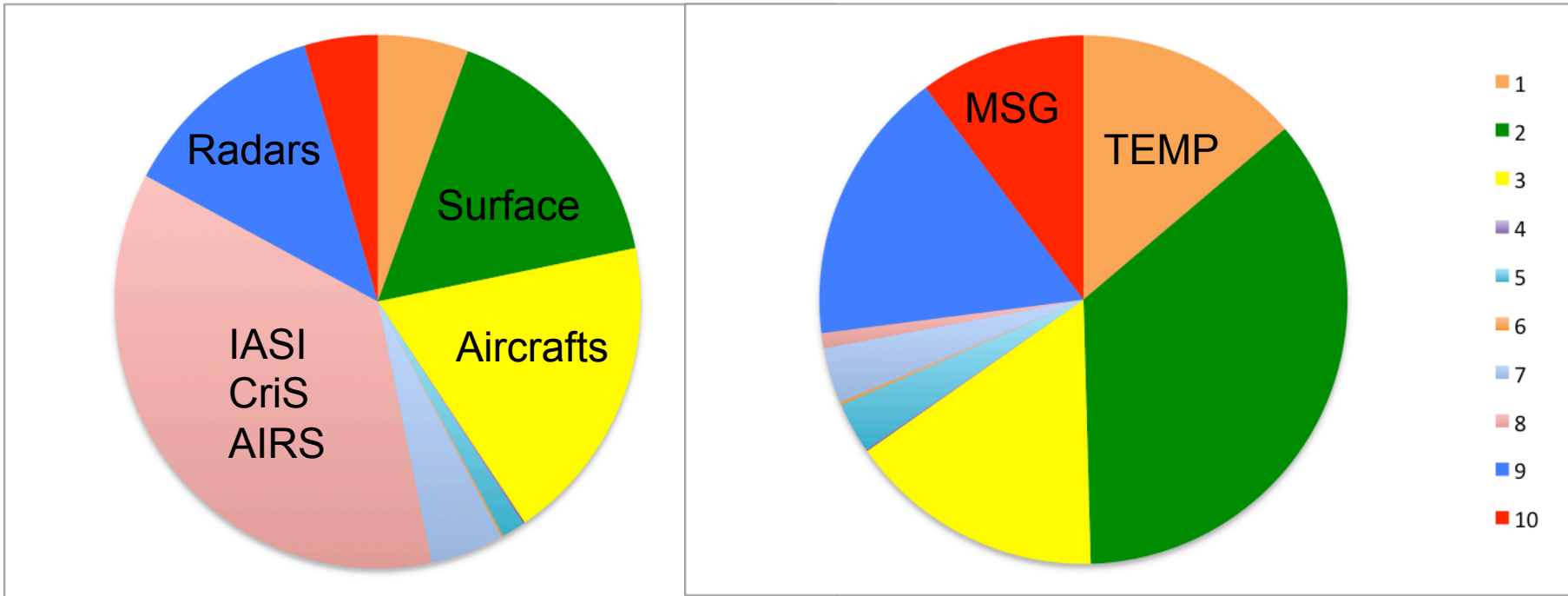
11h30-12h30



3D-Var
1h

AROME France dbi

Recent evolution of observations in AROME



OPER (2013->2015)

OPER (April 2015)

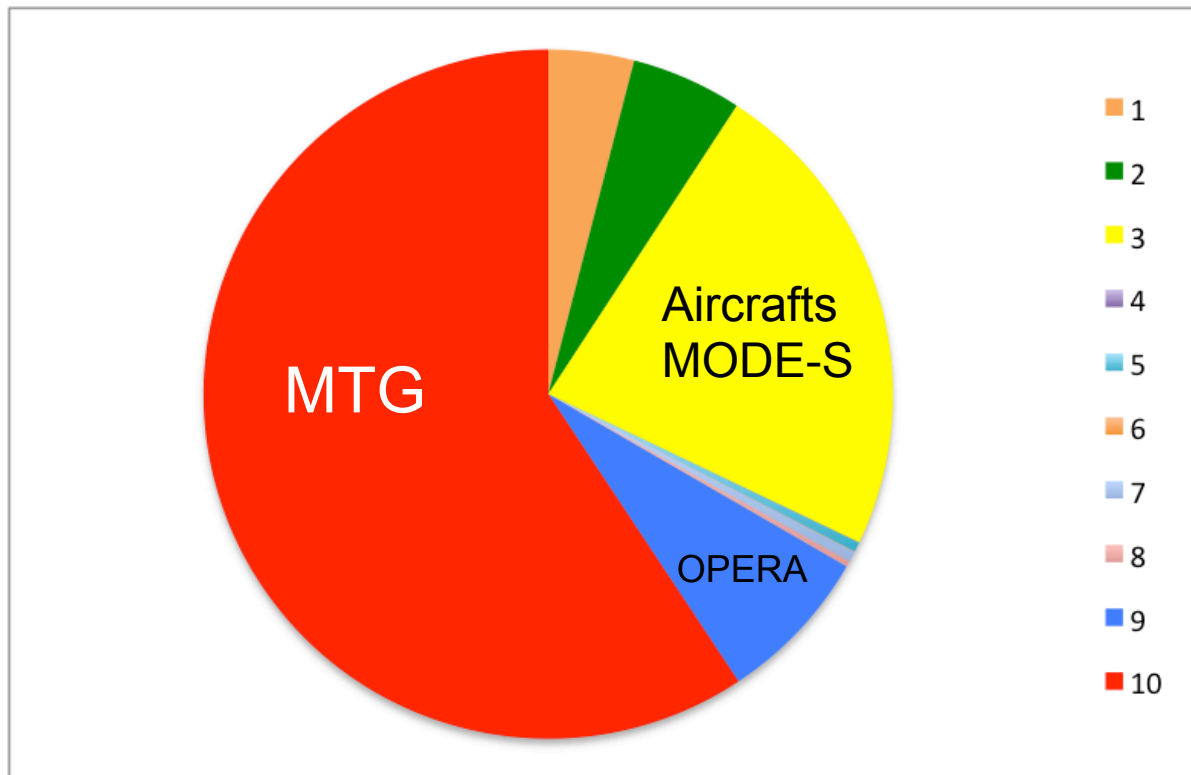
Short-term evolutions

- Increased thinning of radar data in AROME : 8 km (instead of 15 km) with revised tuning of the Bayesian inversion
- Use of a VarBC scheme for ZTD observations (cst + TCWV + $\Delta Z(1000-300\text{hPa})$)
- Use of RTTOV-11 with internal interpolation (54/101 levels)
- Increased thinning of GEORAD : 250 km -> 100 km (for ARPEGE and ALADINs) ; 50 -> 25 km (for AROME)
- Assimilation of ocean surface winds from RapidScat/ISS (Ku band scatterometer)
- Use of oceanic observations in BUFR format (BUOY, BATHY, TESAC)

Longer term evolutions

- Preparation to the use of radar data from OPERA : use of CONRAD to read ODIM/HDF5 and ODIM/BUFR – Doppler winds are becoming available but still issue to get raw reflectivities from data producers
- Assimilation of MODE-S data in AROME (-> real-time availability on GTS ?)
- New instruments: MWTS/MWHS on FY-3C, GMI and DPR on GMP Core, Ku band scatterometer on HY-2A
- Use of VarBC for aircraft measurements
- Preparation to the use new hyperspectral IR instruments (MTG/IRS and IAS-NG/EPS-SG) : radiances in principal components and inter-channel error correlations
- IR radiances over land and IR/MW cloudy radiances

What about AROME in 2022 ?



MTG : 50 channels at 25 km resolution every 30 min
European radars from OPERA : x 6
Aircraft data from MODE-S reports : x 20
High density radiosoundings : x 4
Polar orbiting satellites at higher density : x 4

References to recent papers

- **Assimilation of radar data in AROME** : Wattrelot E., O. Caumont, and J.-F. Mahfouf, 2014: Operational implementation of the 1D+3D-Var assimilation method of radar reflectivity data in the AROME Model. *Mon. Wea. Rev.*, **142**, 1852–1873.
- **Assimilation of SAPHIR data in ARPEGE** : P. Chambon, L.-F. Meunier, F. Guillaume, J.-M. Piriou, R. Roca and J.-F. Mahfouf (2014) : Investigating the impact of the water-vapour sounding observations from SAPHIR on board Megha-Tropiques for the ARPEGE global model, *Quart. J. Roy. Meteor. Soc.*, DOI: 10.1002/qj.2478
- **FSO impact study during CONCORDIASI** : N. Boullot, F. Rabier, R. Langland, R. Gelaro, C. Cardinali, V. Guidard, P. Bauer and A. Doerenbecher, 2014: Observation impact over the southern polar area during the Concordiasi field campaign. *Quart. J. Roy. Meteor. Soc.*, DOI: 10.1002/qj.2470
- **Impact study on assimilation of GPS ZTD in AROME**: Mahfouf, J.-F., F. Ahmed, P Moll and N.F. Terfele, 2015: Assimilation of zenith total delays in the AROME France convective scale model: a recent assessment. *Tellus A*, **67**, DOI: 10.3402/tellusa.v67.21016
- **Description of the near-real time 3D-Var AROME-WMED system during HYMEX** : Fourrié, N., Bresson, É., Nuret, M., Jany, C., Brousseau, P., Doerenbecher, A., Kreitz, M., Nuissier, O., Sevault, E., Bénichou, H., Amodei, M., and Pouponneau, F.: AROME-WMED, a real-time mesoscale model designed for the HyMeX Special Observation Periods, *Geosci. Model Dev. Discuss.*, **8**, 1801-1856, doi: 10.5194/gmdd-8-1801-2015, 2015.

Thank you for your attention !

