Recent progress on assimilation of microwave radiances at Météo-France

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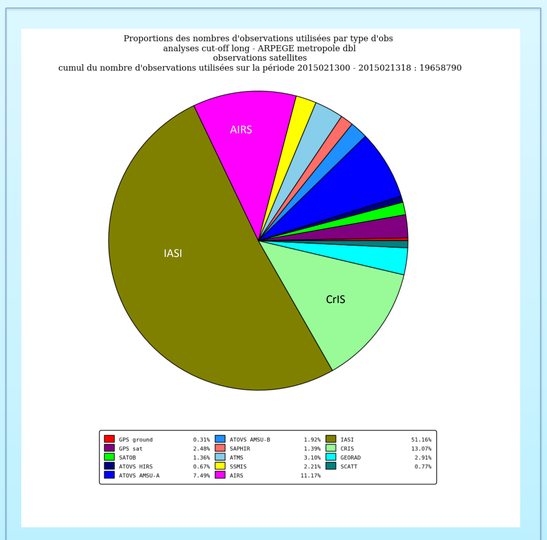
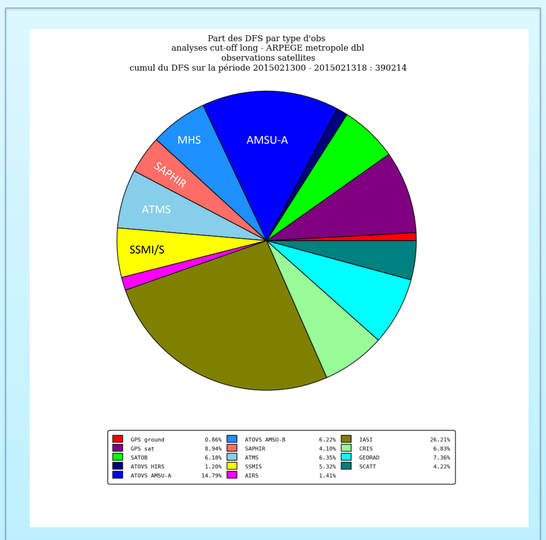
Satellite observations in the 4D-Var assimilation of the global model ARPEGE (since April 2015)



Percentage by observation type

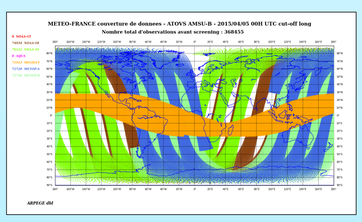


Information content : Degrees of Freedom for Signal

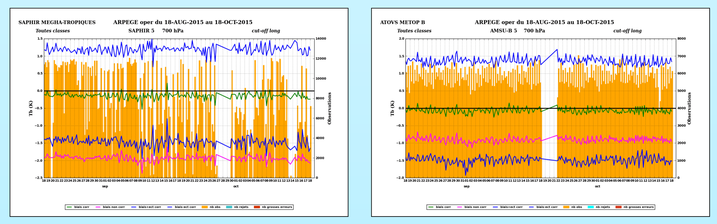
Microwave radiances : **16 %** of observations and **37 %** impact on analyses (DFS)

Microwave radiances Recent operational changes (04/2015)

- Assimilation of SAPHIR (Megha-Tropiques) radiances : 6 channels around 183.31 GHz (clear sky scenes over oceans and land). Use of FASTEM emissivity model over oceans and an emissivity atlas over land. Cloud detection method based on channel 183.31+/-11 GHz with a fixed bias correction
- Additional ATMS radiances at the edge of scan lines
- Use of direct broadcast ATMS radiances from Lannion for improved timeliness (models with short cut-offs)
- Revised thinning of SSMI/S radiances from 175 km to 125 km -> leading to an increase by 65 %
- Assimilation of SSMI/S F17 and F18 sounding channels at 60 GHz (3) and 183 GHz (3) but only assimilated over oceans for F18 (since 150 GHz – channel 8 is not nominal)



Spatial coverage of humidity microwave sounders in the ARPEGE model over a 6 hour period
The number of assimilated radiances is roughly doubled with SAPHIR with respect to AMSU-B/MHS

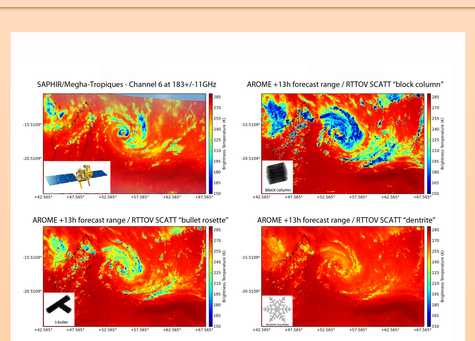


ARPEGE monitoring of innovations statistics (bias and standard deviation) for SAPHIR channel 5 (183+/-7 GHz) onboard Megha-Tropiques and MHS channel 5 (183 +/- 6.6 GHz) onboard METOP-B (2 month period from 09/2015 to 10/2015)

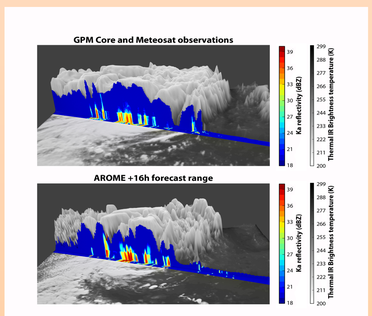
Ongoing activities: preparation of future instruments and improved usage of existing ones

- Improved description of surface emissivity over oceans (use of wave model outputs for foam fraction) and over sea-ice (specularity factor)
- Assimilation of clear-sky radiances from new instruments : GMI on GPM-Core, SSMI/S on DMSP-F19, MWTS-2 and MWHS-2 on FY-3C
- Assimilation of ATOVS radiances from South America RARS stations

- Towards the assimilation of all-sky radiances: simulation of cloudy radiances in limited area models with parameterized (ALADIN) and explicit (AROME) moist convection – use of 1D optimal estimation theory for inversion of profiles
- Simulation of radar reflectivities from the DPR on board GPM-Core with the AROME model (validation purposes and passive microwave calibration)
- ESA project 1: Information content of a future hyperspectral microwave sounder (300 channels between 6 and 900 GHz)
- ESA project 2: OSSEs with the AROME 3D-Var system (1-h hour cycling) of radiances from a future microwave sounder (SAPHIR like) onboard a geostationnary satellite



Observed and simulated SAPHIR brighness tempratures (Channel 6 : 183.31 +/- 11 GHz) with the AROME convective scale NWP model (2.5 km) and the RTTOV-SCATT radiative transfer model with various scattering properties of solid precipitation (tropical cyclone Bansi, January 2015)

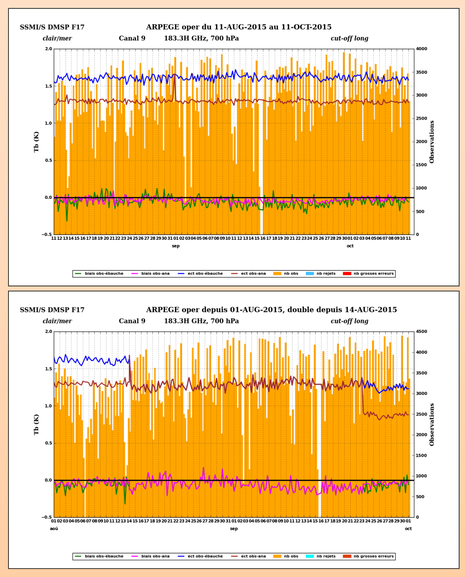


Courtesy of Ghislain Faure

Observed and simulated Ka reflectivity from the Dual frequency Precipitation Radar (DPR) onboard GPM-Core with the AROME convective scale NWP model (2.5 km) and the SDSU observation operator (Matsui et al., 2014) (Tropical cyclone Bansi)

Microwave radiances New operational changes (by end 2015)

- Use of version 11 of RTTOV with vertical internal interpolation (54 levels)
- Revised specification of observation errors for MHS humidity sounders (improved consistency with similar instruments and with innovation statistics)
- Spatial averaging of SSMI/S sounding and window channels (8 pixels) to reduce instrumental noise (similar to ATMS)
- Assimilation of 2 additional SSMI/S temperature sounding channels (6, 7)
- Monitoring of GMI sounding and window channels



Background and analysis departures for channel of SSMI/S on DMSP F17 in the current operational suite (top panel) and in the experimental suite (bottom panel)

Channel	Frequency	STD	Bias
1	10.6 V	1.7	0.2
2	10.6 H	3.0	4
3	18.7 V	1.60	0.2
4	18.7 H	3.5	2.5
5	23.8	2.2	0.3
6	36.5 V	1.7	0.0
7	36.5 H	2.5	-0.1
8	89 V	2.3	0.1
9	89 H	4.8	0.1
10	166 V	1.6	-0.2
11	166 H	2.0	0.0
12	183 +/-3	1.5	0.0
13	183 +/-7	1.3	-0.1

Monitoring of GMI radiances (clear sky over oceans) onboard GPM-Core
Innovations statistics from 6-h ARPEGE forecasts

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