IASI at high spatial resolution in Météo-France regional models

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CNRM, Météo-France and CNRS

- Convective scale AROME model
- Impact of the increase of the IASI density in the overseas ALADIN model.
- Conclusions and future works

The regional model AROME

In operations since 2008, dedicated to the forecast of high impact weather : heavy precipitation, thunderstorm and fog.

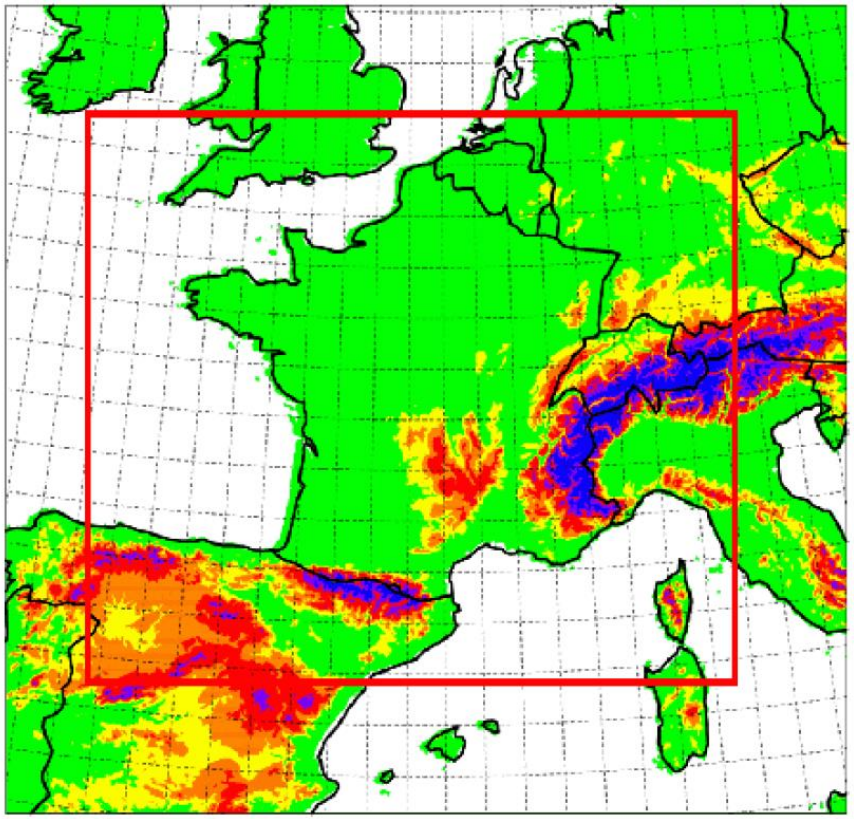
Forecast for the next day.
Coupling files : hourly ARPEGE forecasts

Spectral limited area non-hydrostatic model with explicit convection :
- Originallly 60 levels from 17m to 0.05 hPa, horizontal resolution 2.5 km

3D-Var assimilation (3h window)
- initialisation of convective clouds (low-level forcing + 3D humidity fields)

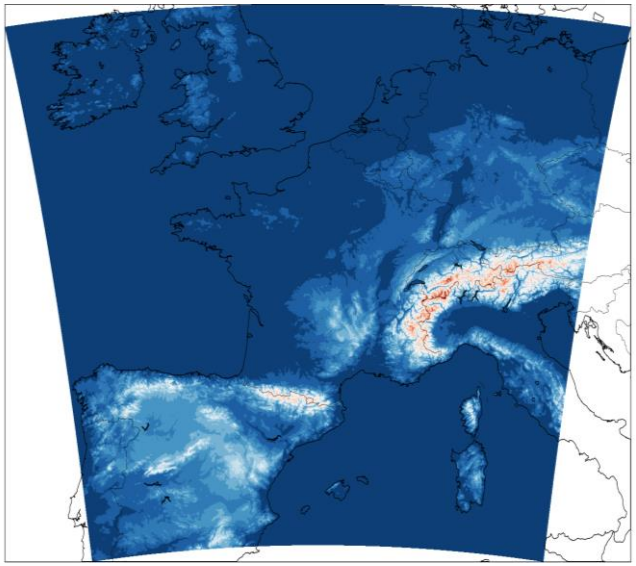
Same assimilated data as global model plus radar radial winds and reflectivities (French network : 24 radars)

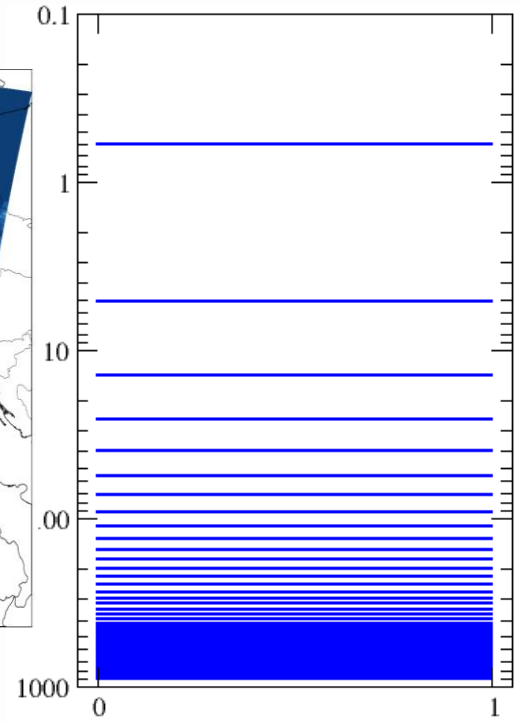
Seity et al 2011, MWR.

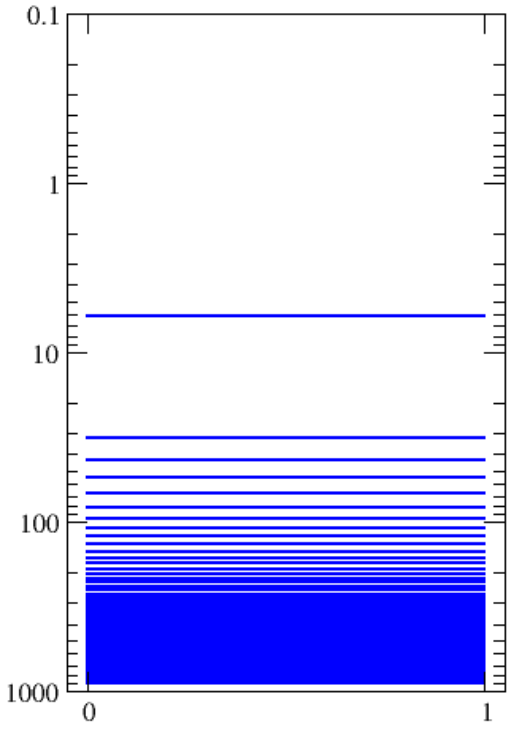


New configuration of Arome

	Old	Current (since 13th April 2015)
AROME *Deterministic*	2.5km L60 (750 x 720 pts) 0.05hPa 3DVar (3h cycle) 5 forecasts per day up to 36h	**1.3km L90 (1536 x 1440 pts)** **10hPa** 3DVar (**1h cycle**) 5 forecasts per day **up to 42h**

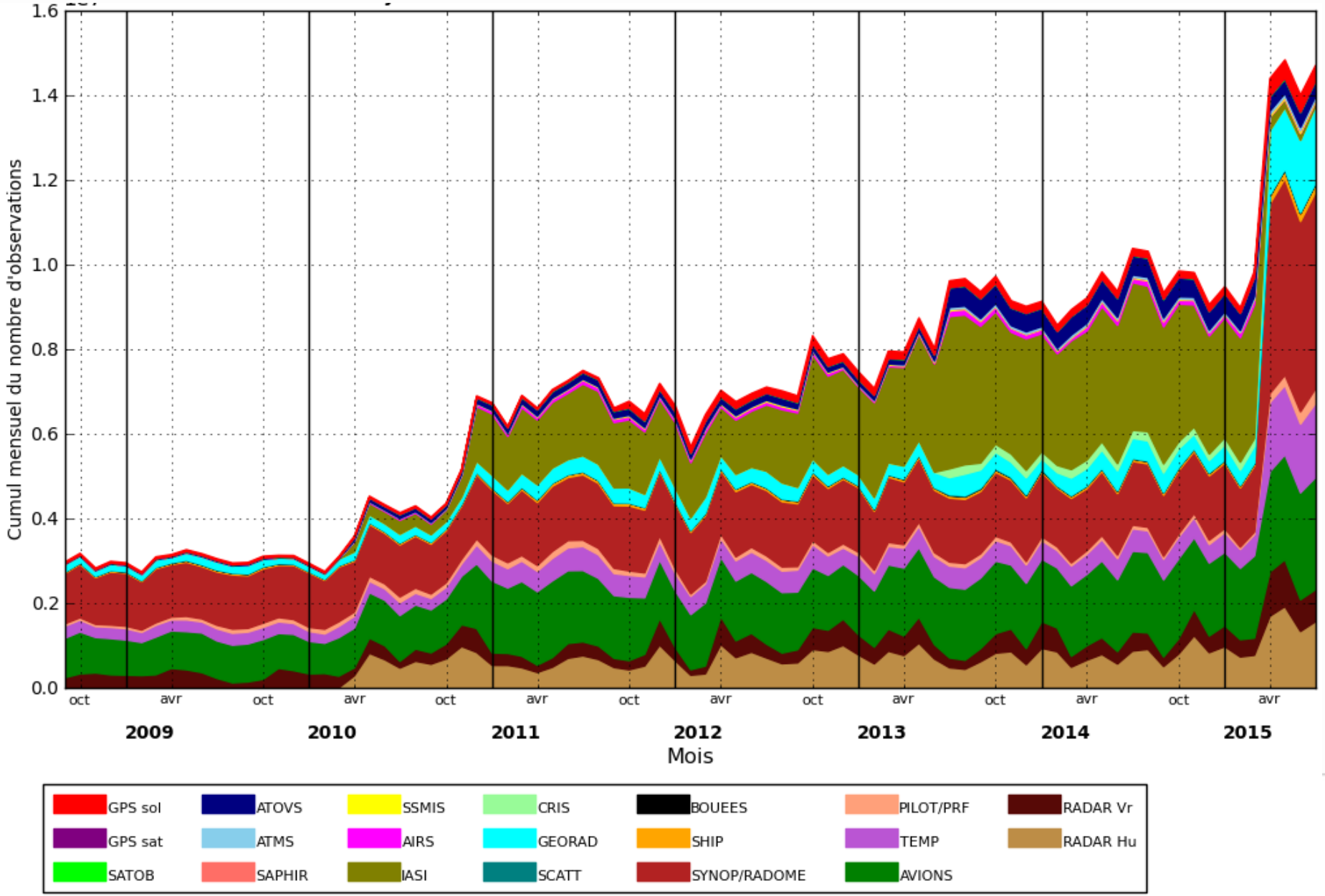






Assimilated data: conventional observations (80-90%) and satellite data

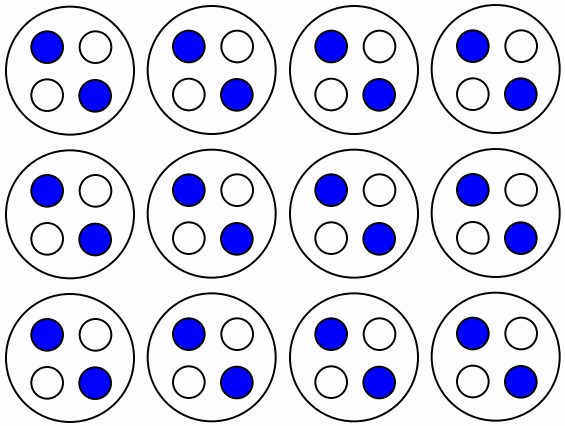
Monthly accumulated amount of assimilated observations in AROME since 2008



IASI data assimilation

Limited area model AROME : data selection and thinning.

Detectors #1 & #3, all FoR



1 pixel assimilated in a 80-km box

Iasi assimilation

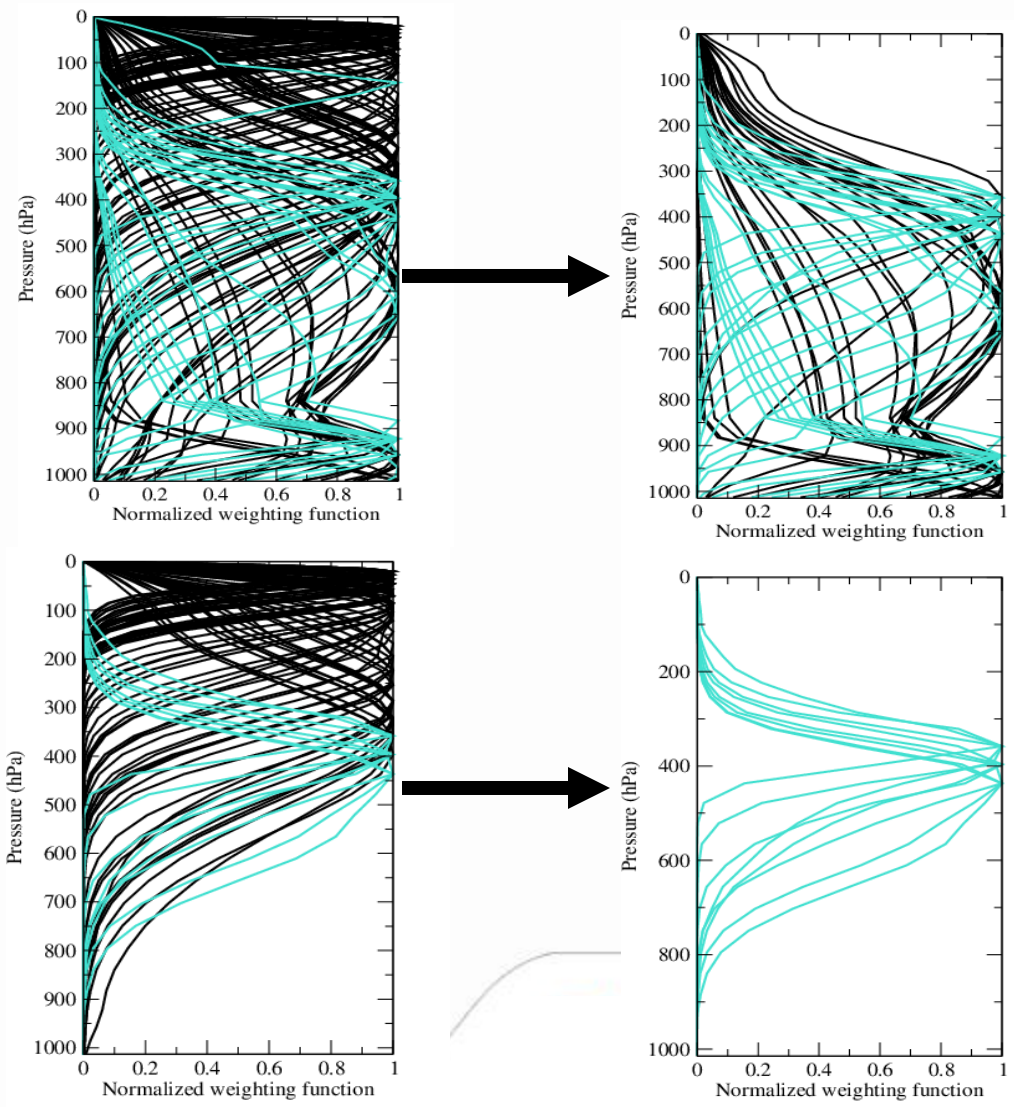
- Channel selection inheritated from ARPEGE but low level top model
- All « high peaking » channels discarded

	SeaARPEGE & Old AROME	New AROME
Sea	**103T+21 WV**	**24T+20 WV**
Land	**72T+8WV**	**8WV**

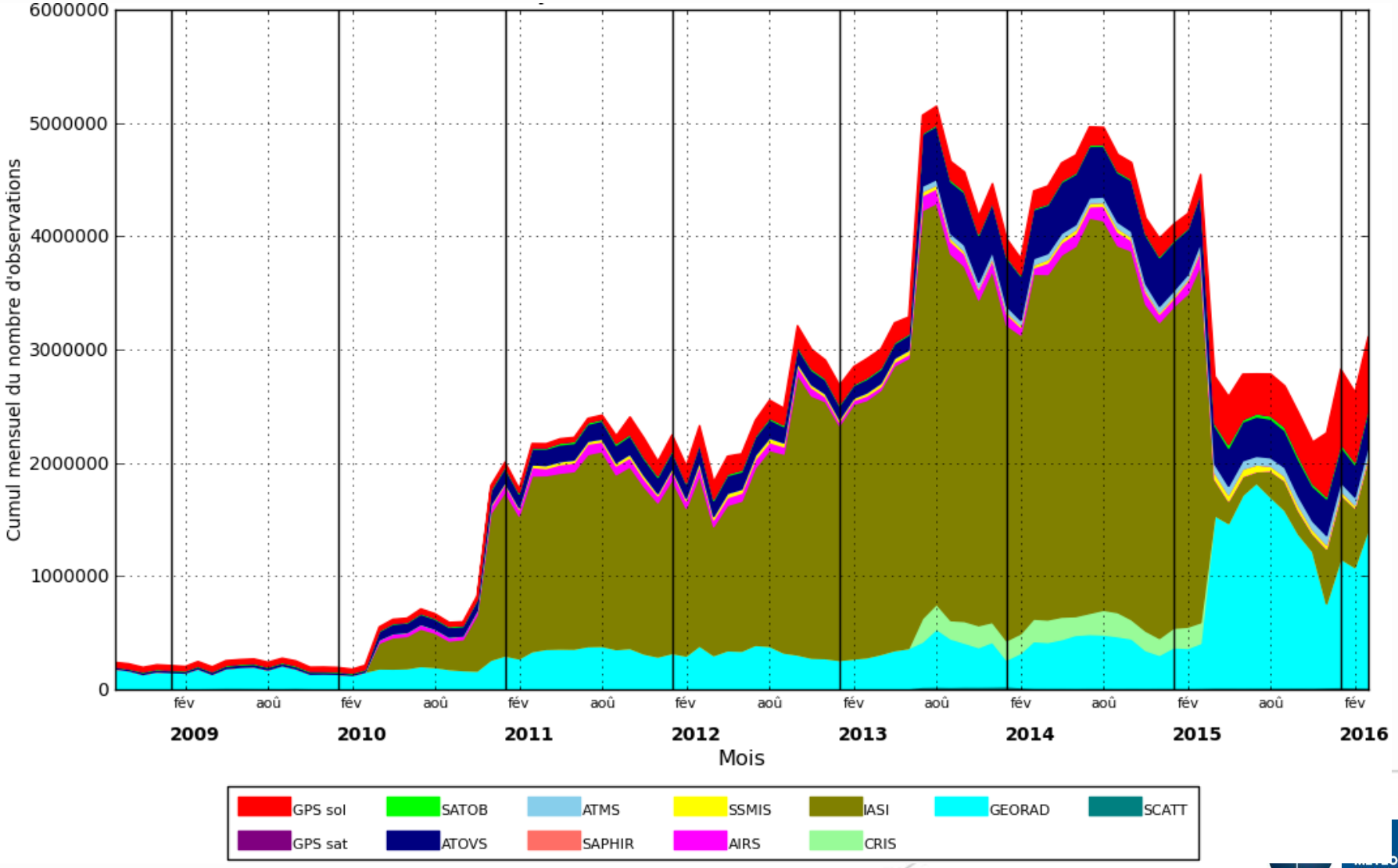
- Bias correction from ARPEGE
- Cloud detection

OLD

CURRENT



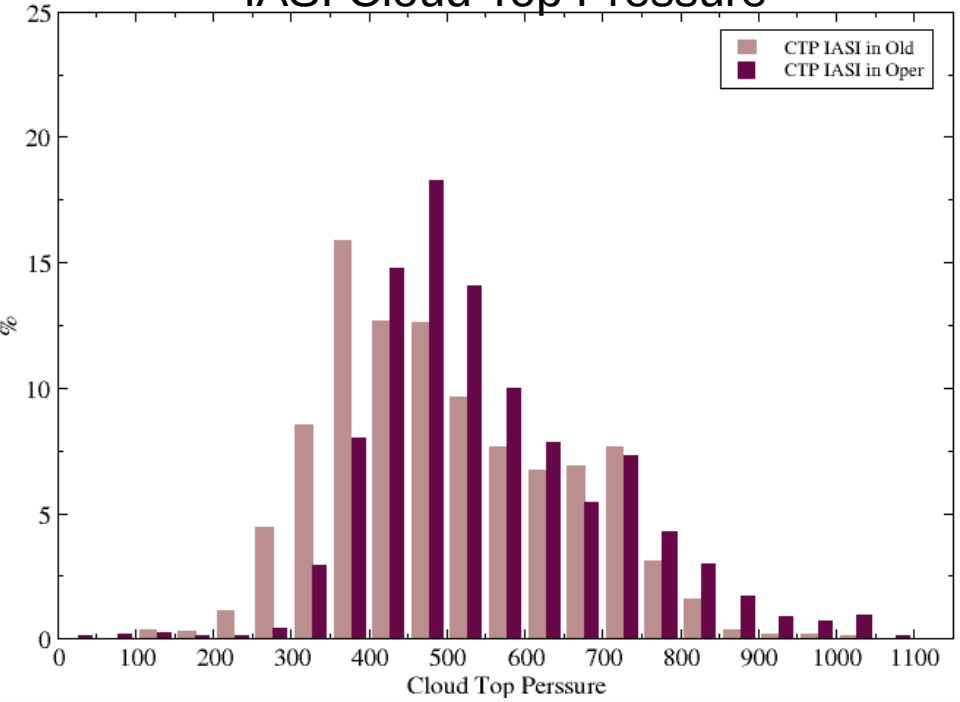
Evolution of the satellite observation number used in AROME since 2008



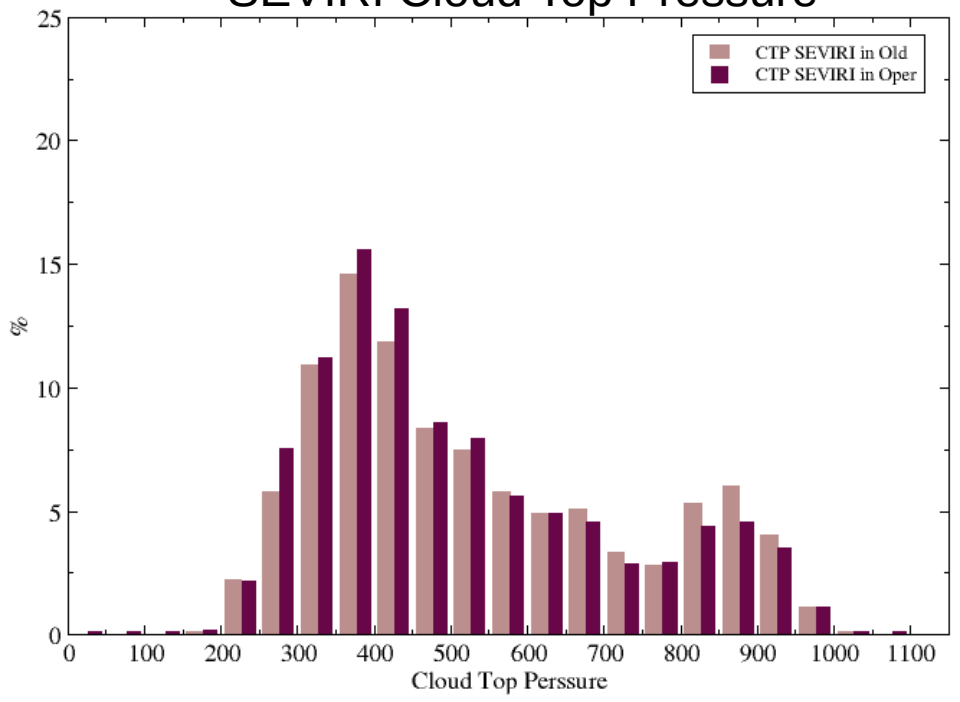
Impact on the cloud characterization

Over sea during night-time, evaluation with SEVIRI cloud top pressure, February 2015

IASI Cloud Top Pressure



SEVIRI Cloud Top Pressure

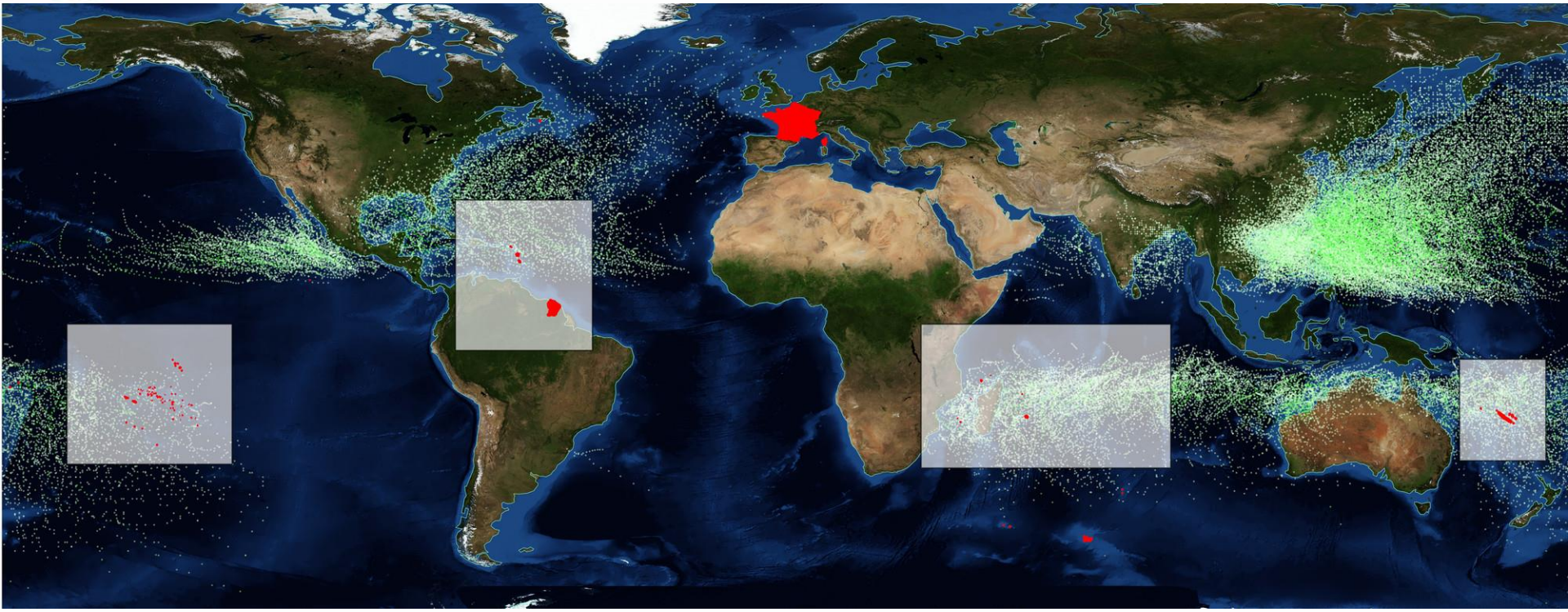


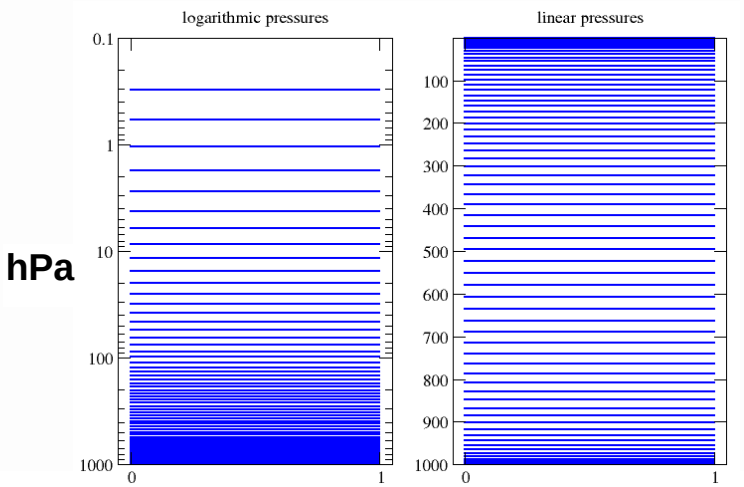
	OLD	OPER
Probability of detection	74.6	72.9
False alarm rate	10.3	12.2
Correlation	0.83	0.77

Verification scores degraded

See Poster S7-21, by Imane Farouk

Operational NWP oversea ALADIN models





4 regional models ALADIN for tropical cyclone forecast

Horizontal resolution: 7.5 km

70 vertical levels (0.1 hPa)

Operational since 2006

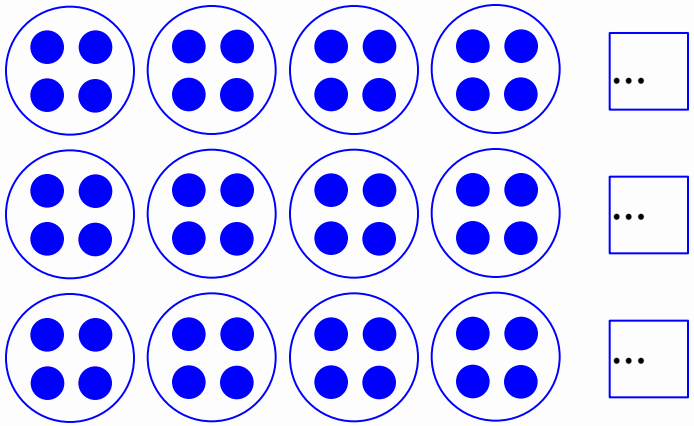
Boundary conditions provided by ARPEGE or IFS

IASI data assimilation in ALADIN model

3D-Var with a 6h window.

IASI data selection and thinning.

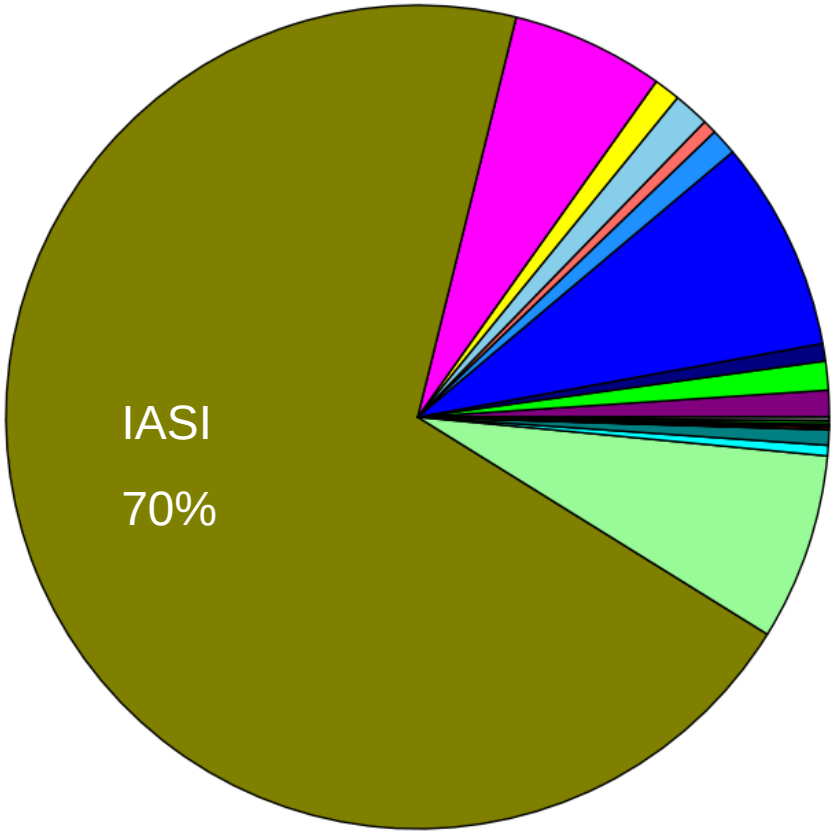
All detectors, all IASI FoR



1 pixel assimilated in a 70-km box

Bias correction from ARPEGE model

Distribution of assimilated observations in ALADIN LA reunion model

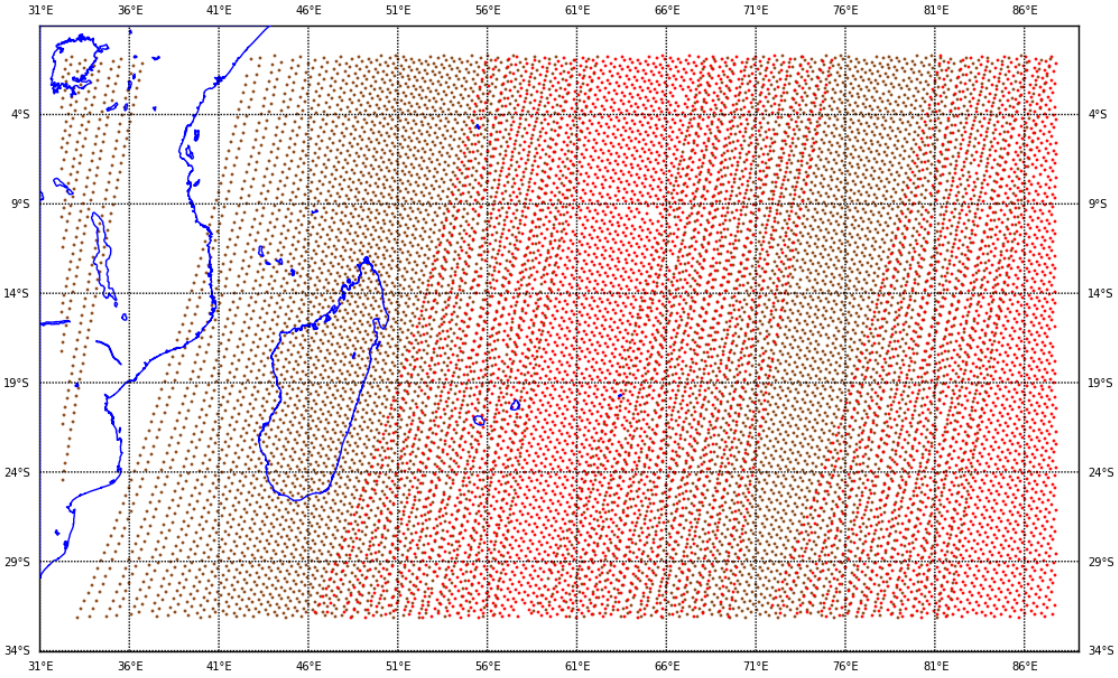


GPS ground	0.00%	SSMIS	1.04%	SYNOP/SYNOR/RADOME	0.10%
GPS sat	1.04%	GMI	0.00%	SHIP	0.01%
SATOB	1.13%	AIRS	5.99%	PILOT/PRF	0.00%
ATOVS HIRS	0.68%	IASI	70.01%	TEMP	0.08%
ATOVS AMSU-A	8.27%	CRIS	7.34%	AIRCRAFTS	0.14%
ATOVS AMSU-B	1.05%	GEORAD	0.41%	RADAR Vr	0.00%
SAPHIR	0.54%	SCATT	0.60%	RADAR Hur	0.00%
ATMS	1.40%	BUOY	0.02%	BOGUS	0.14%

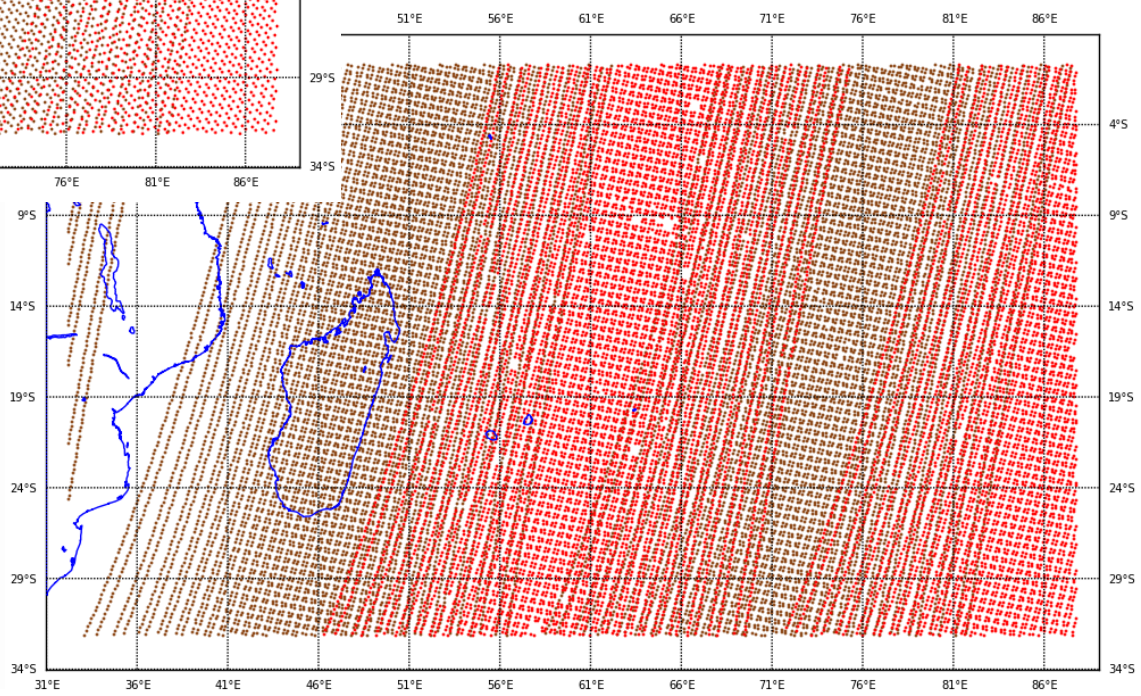
Input to the assimilation

detectors 1& 3

9 April 2015 around 6UTC **IASI-A** **IASI-B**



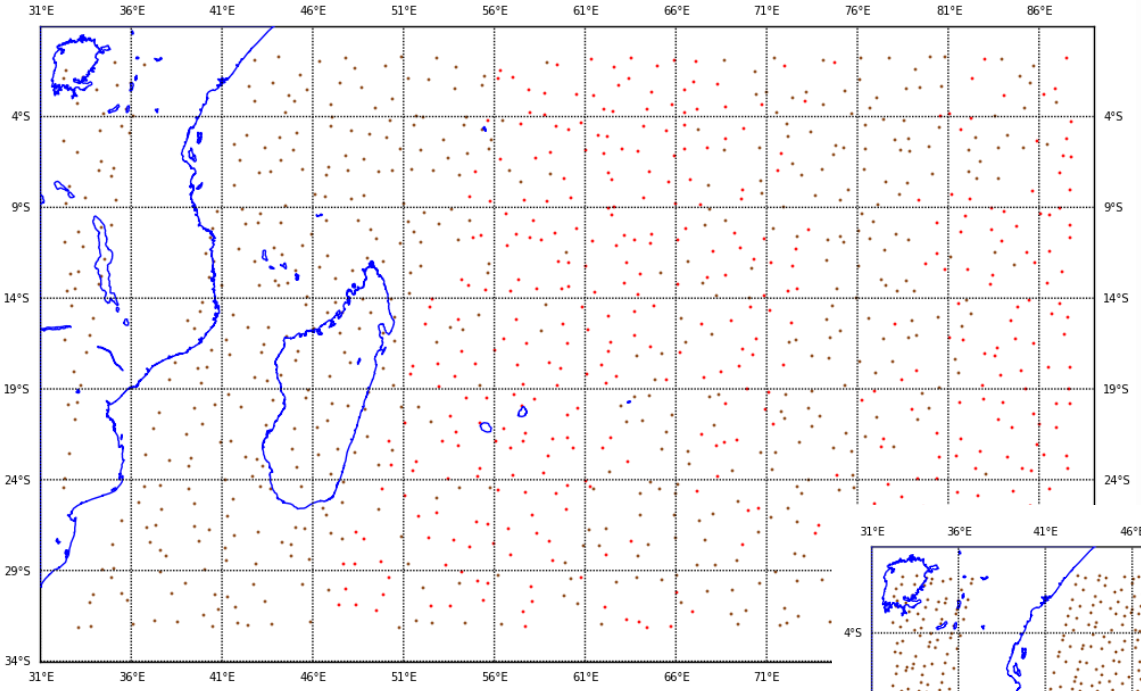
all detectors



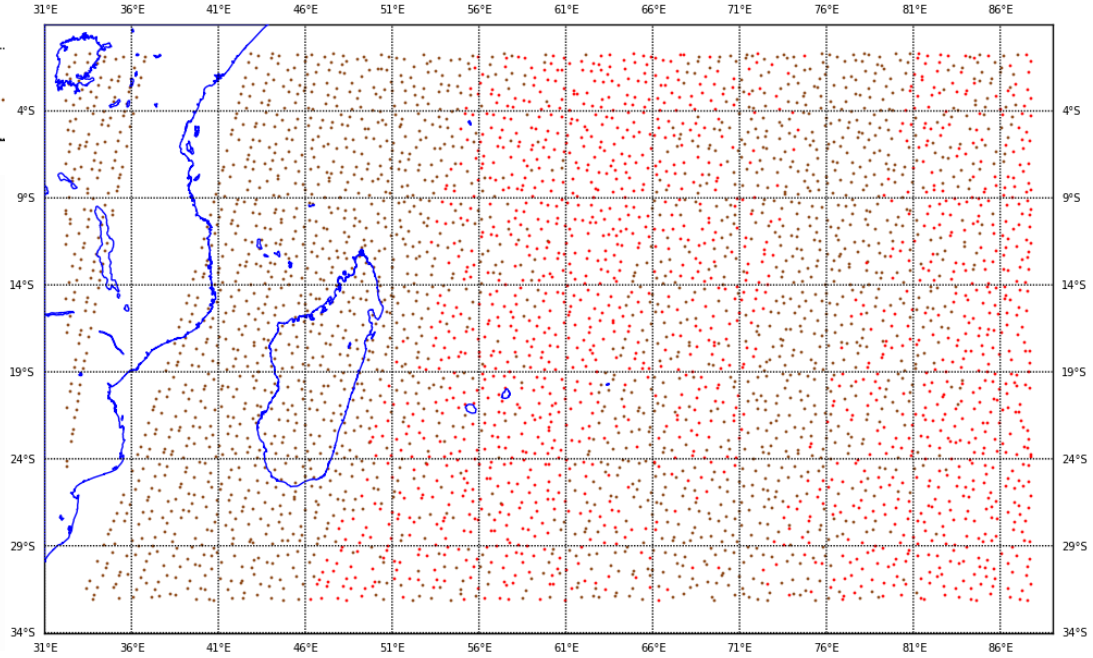
Used in the assimilation

125km box

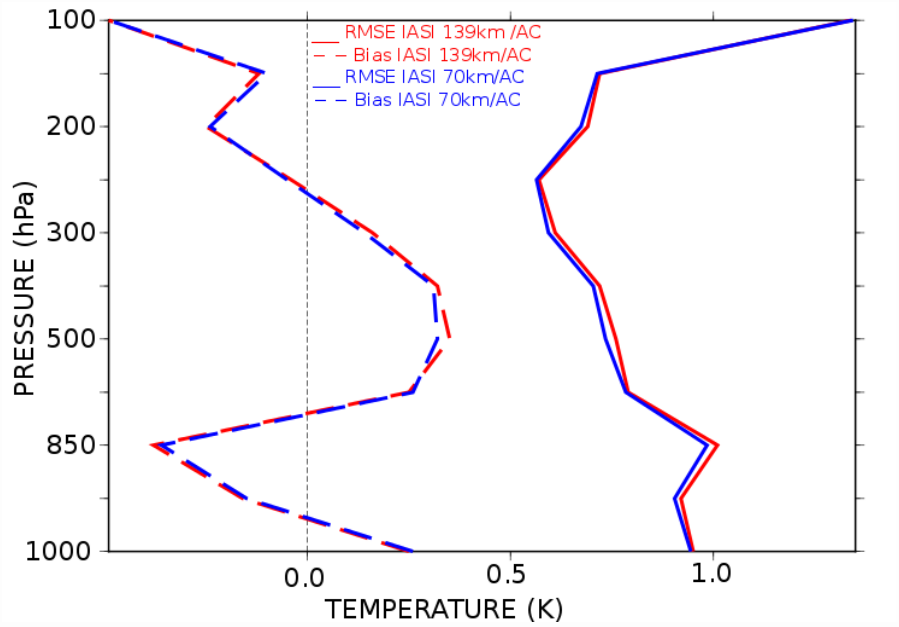
9 April 2015 around 6UTC **IASI-A** **IASI-B**

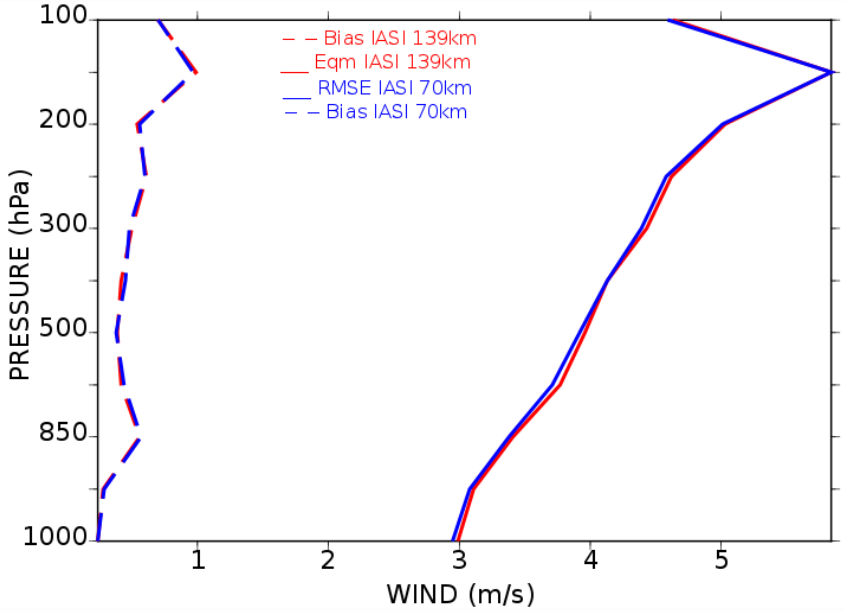


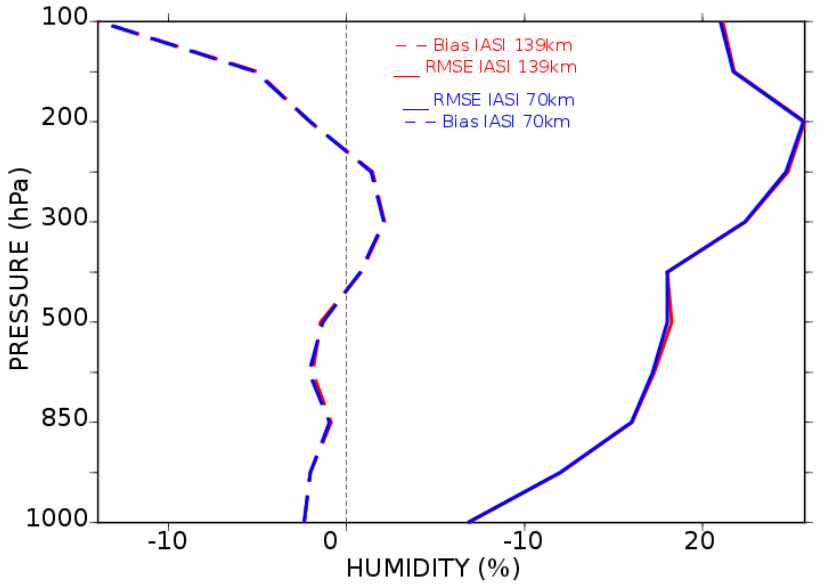
70km box



Scores wrt ECMWF Analysis (12h forecast)







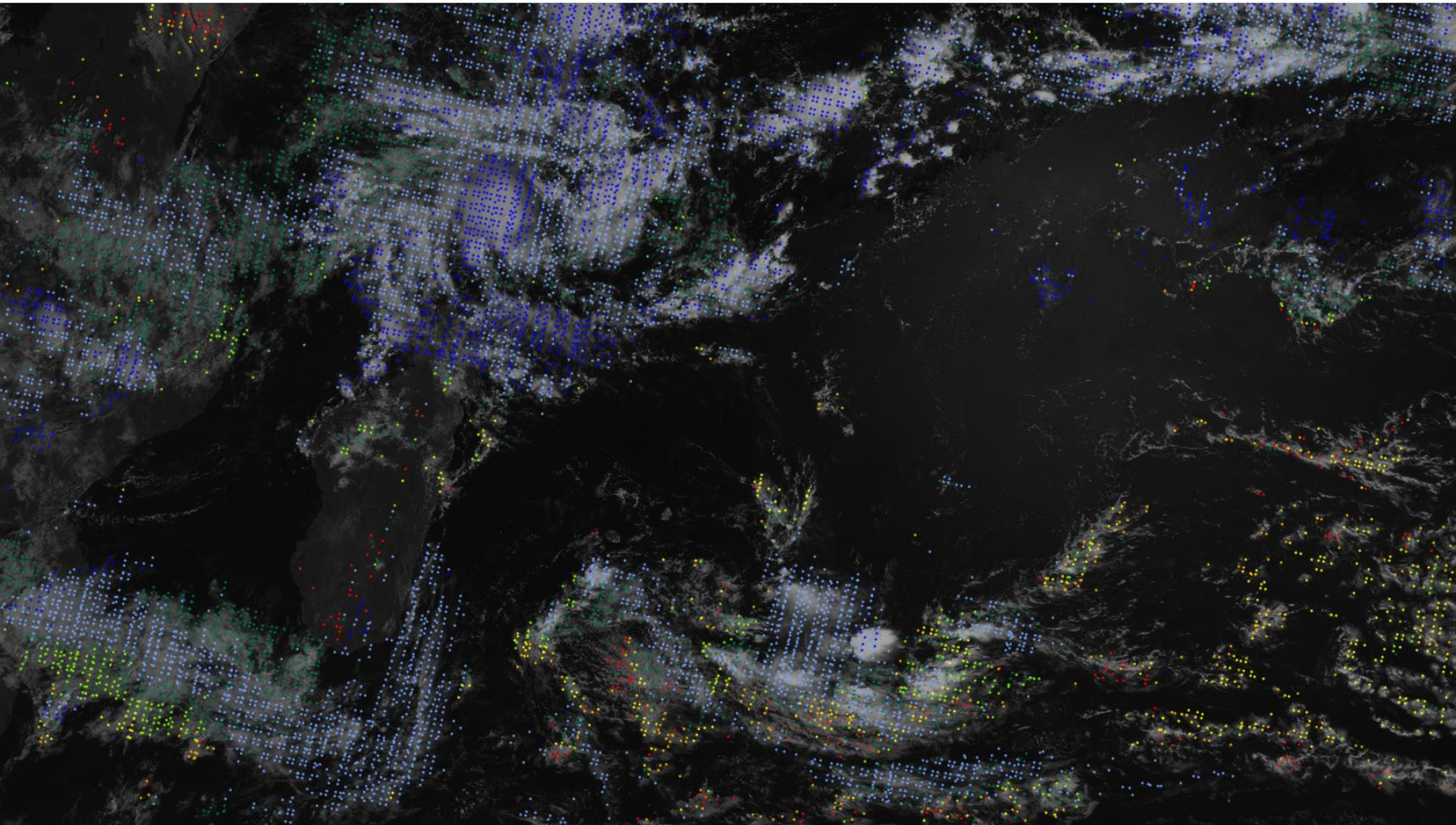
Evaluation wrt ECMWF analysis over a 36 day period

Impact on forecast statistically positive up to 12 h (T and wind)

Positive up to 48 hour forecast range.

Regional model over La Réunion and Indian Ocean
Hurricane Beijisa 28 December 2013

Cloud Top Pressure from IASI compared to Meteosat-7 IR channel



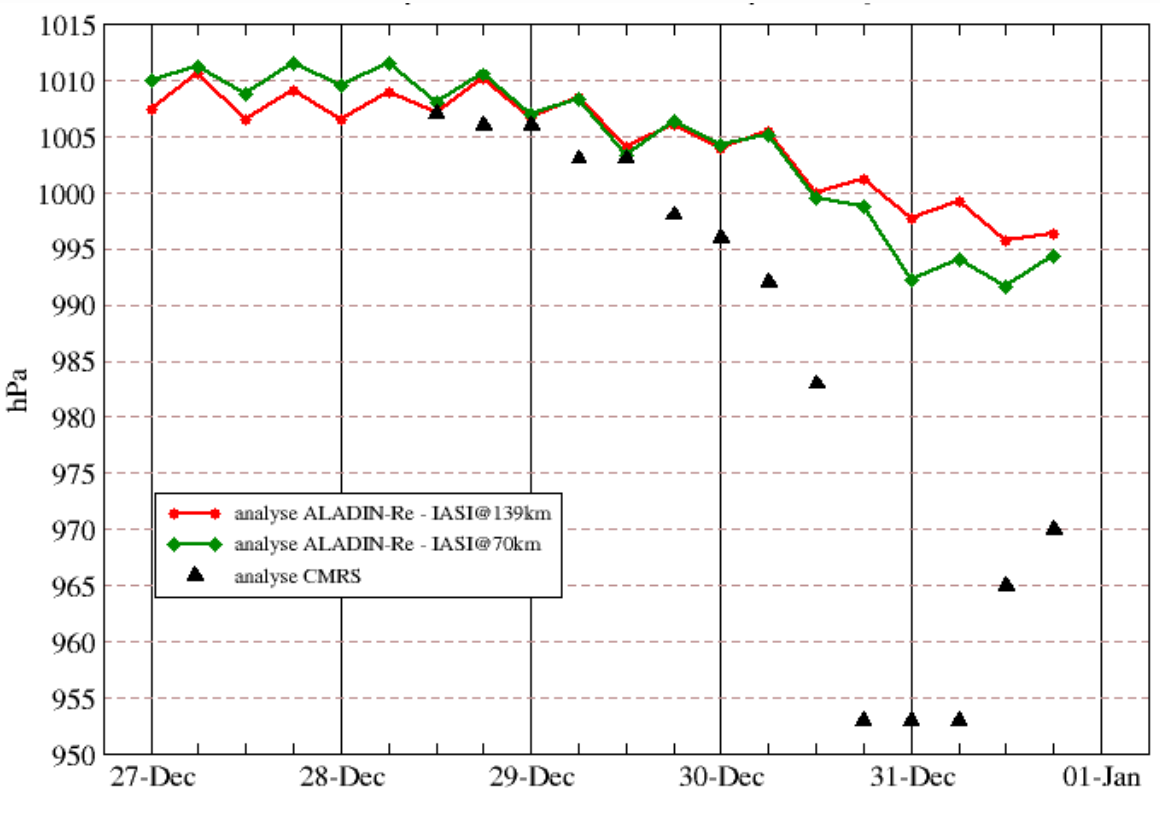
Hurricane Beijisa 28 December 2013

Minimum pressure analysis:

Verification

Analysis with IASI assimilated at **130km density**

Analysis with IASI assimilated at **70km density**



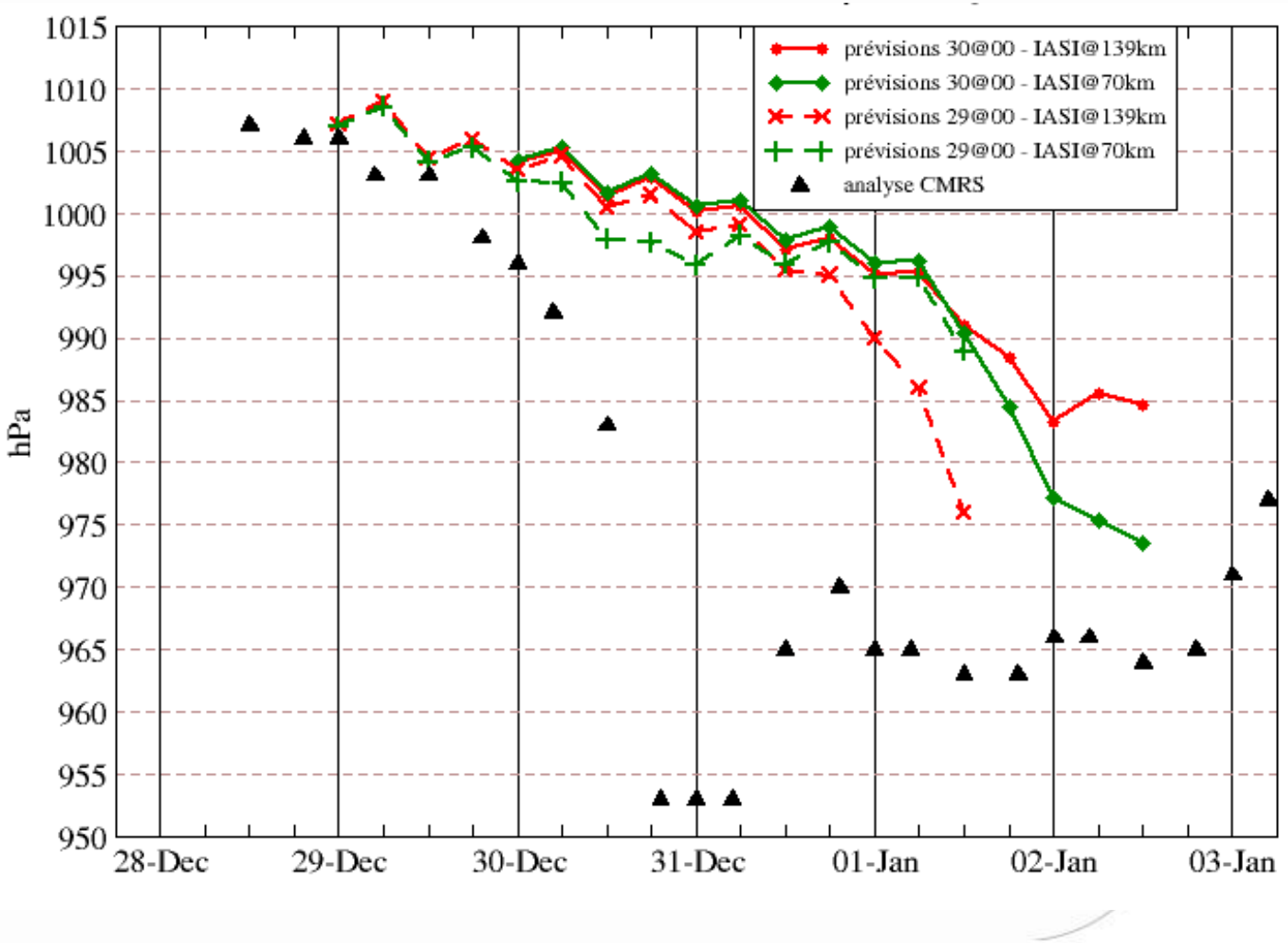
Hurricane Beijisa 28 December 2013

Minimum pressure forecasts:

Verification

Forecasts with IASI assimilated at **130km density**

Forecasts with IASI assimilated at **70km density**



Conclusions and future work (1/2)

AROME model:

- Many challenges for the IASI assimilation
- Need of a new channel selection to account for the top level modification
- Developement of the assimilation of surface sensitive channels over land (N. Boukachaba)
- Side benefit of a full R matrix or adapted IASI error for mesoscale model (in particular for WV sensitive channels).
- Bias correction (which is derived from ARPEGE), direct computation in AROME?
- How to have a realistic upper part of the atmosphere in the radiative transfer model simulations?

Conclusions and future work (2/2)

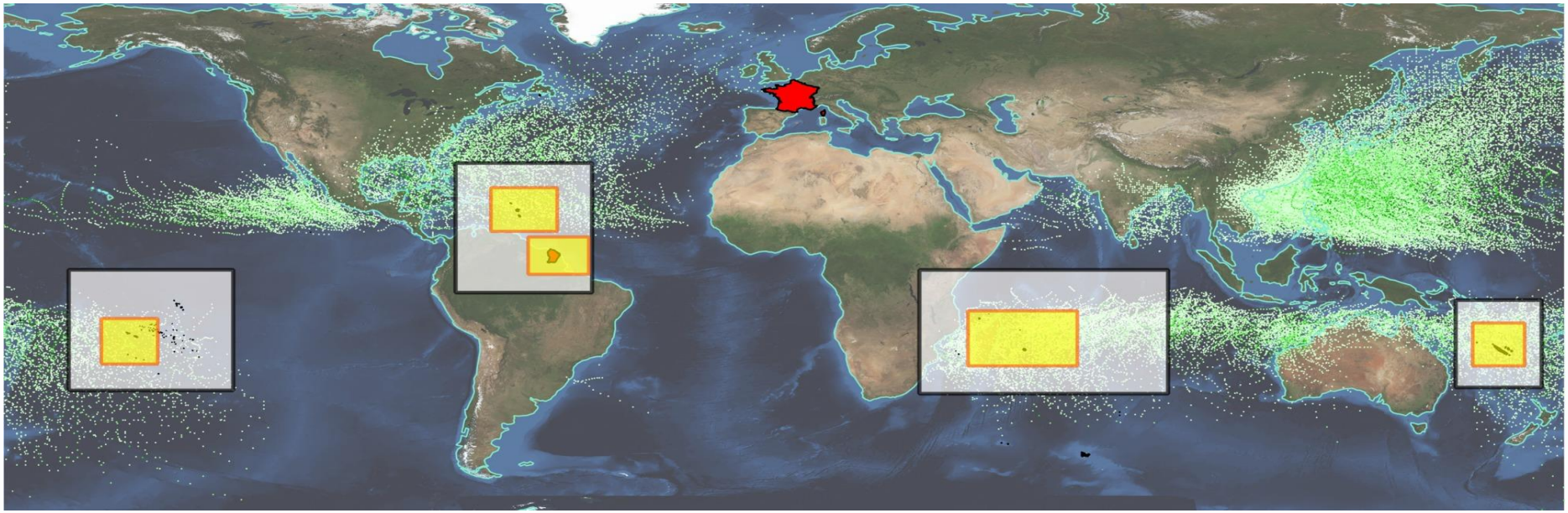
Positive impact of increasing the IASI density in ALADIN model

AROME overseas models:

5 domains spread all along the tropical belt,

Deployed in operations since 11th February 2016 (forecast only, 4/day)

2.5km resolution (instead of 8km) with 1D ocean mixing layer scheme, in dynamical adaptation coupled with IFS for upper air and with Arpege for surface.



AROME overseas domains (in yellow) and
current operational ALADIN domains (in white)

In the future: 3D-Var assimilation

Thank you!

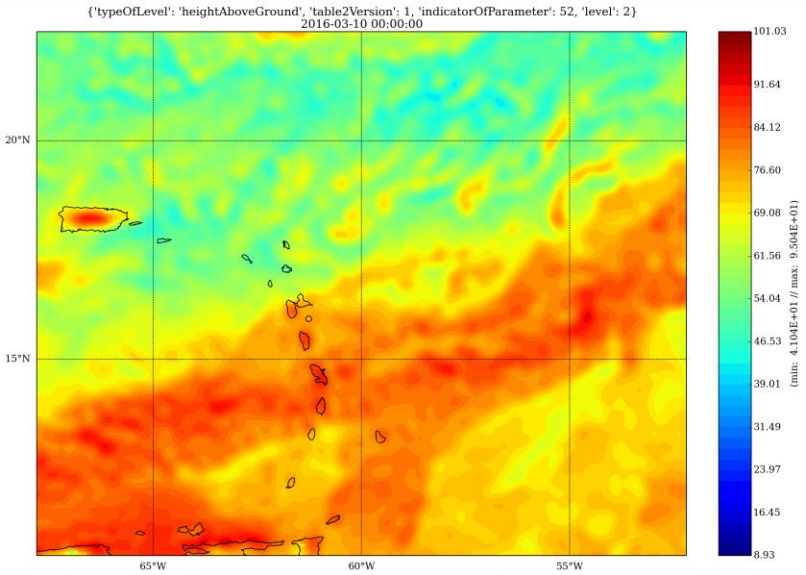
Conclusions and future work (3/3)

The future for AROME overseas models

1D ocean mixing layer scheme

First trial of 3D-Var

Without assimilation



with 3D-Var