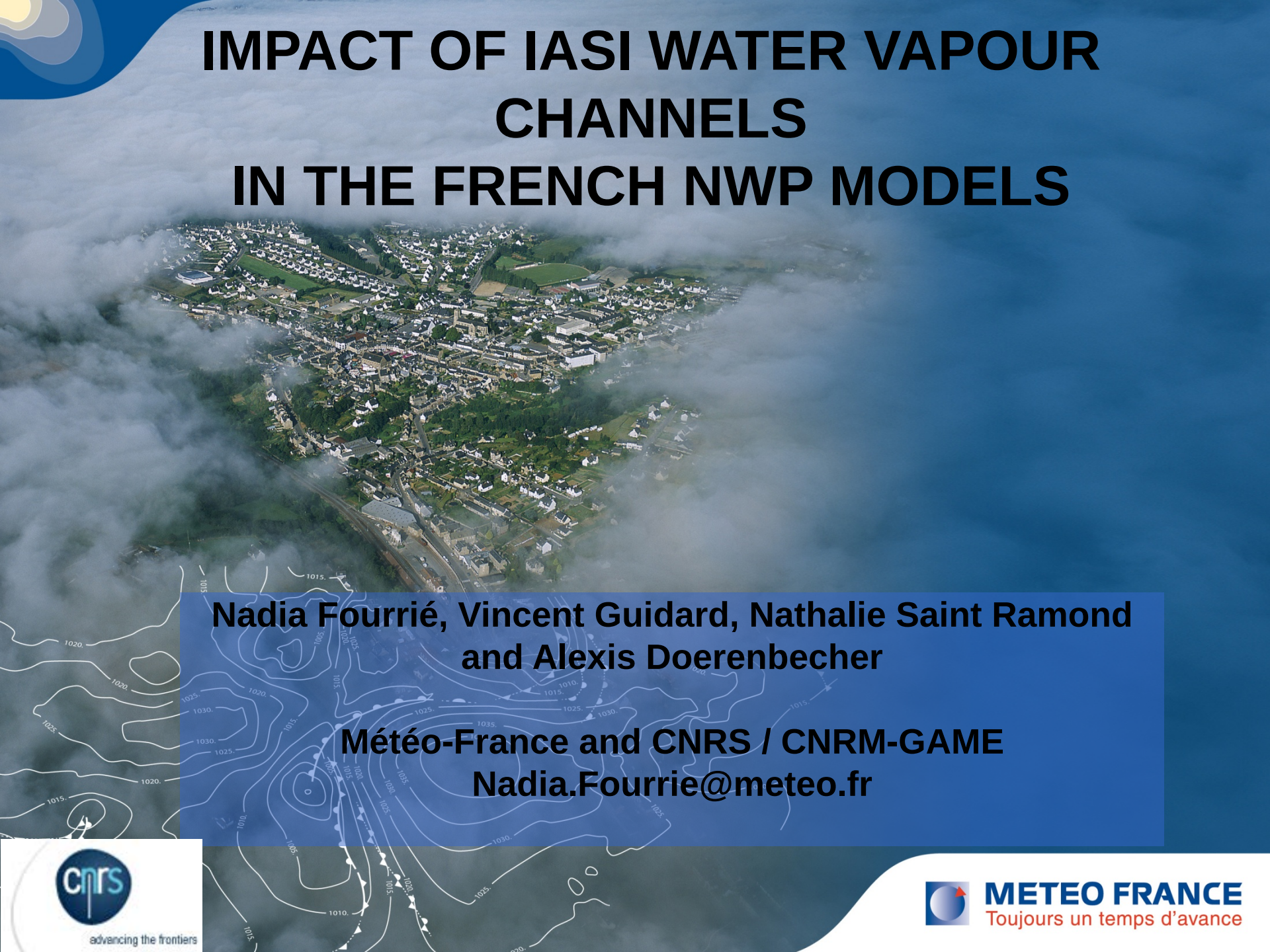
IMPACT OF IASI WATER VAPOUR CHANNELS IN THE FRENCH NWP MODELS



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advancing the frontiers

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Content

Water vapour channels for assimilation

Impact in the global model forecast

- Forecast score
- Observation impact

Impact in the mesoscale AROME model

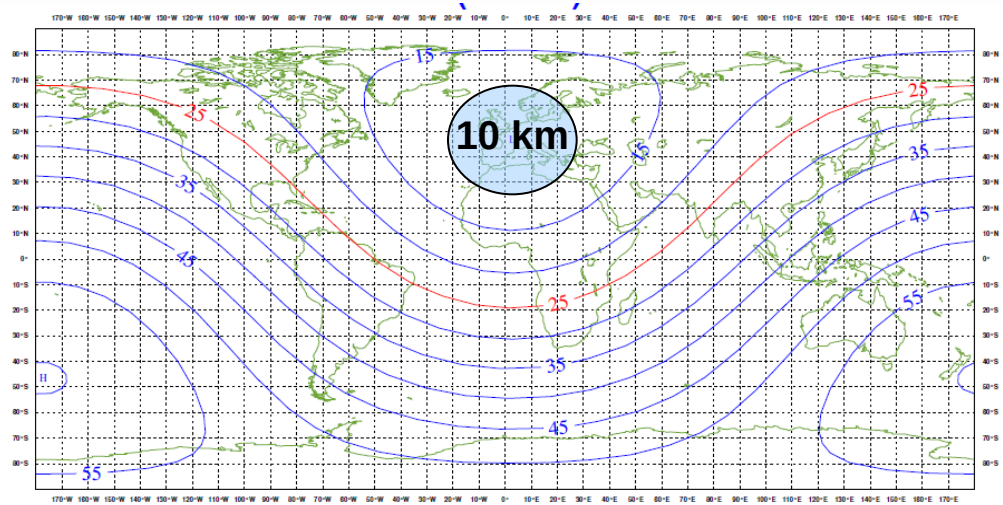
– Impact on the rain rate forecast

Conclusions and prospects

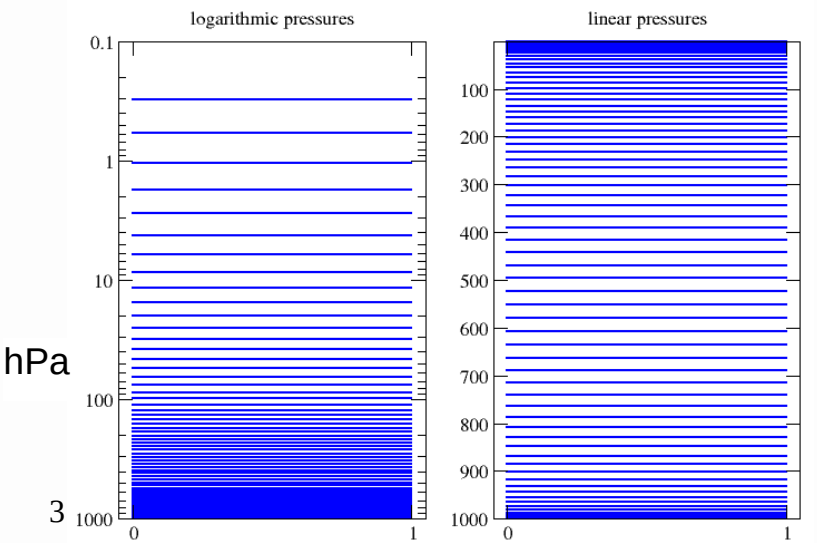
Description of the NWP global model at Météo-France

Global model ARPEGE

Horizontal resolution: between 10 and 60 km

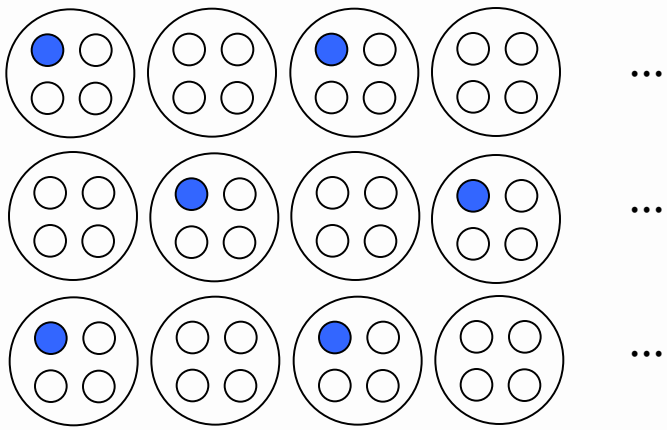


70 vertical levels



IASI pixels

Only detector #1, 1 FoR / 2

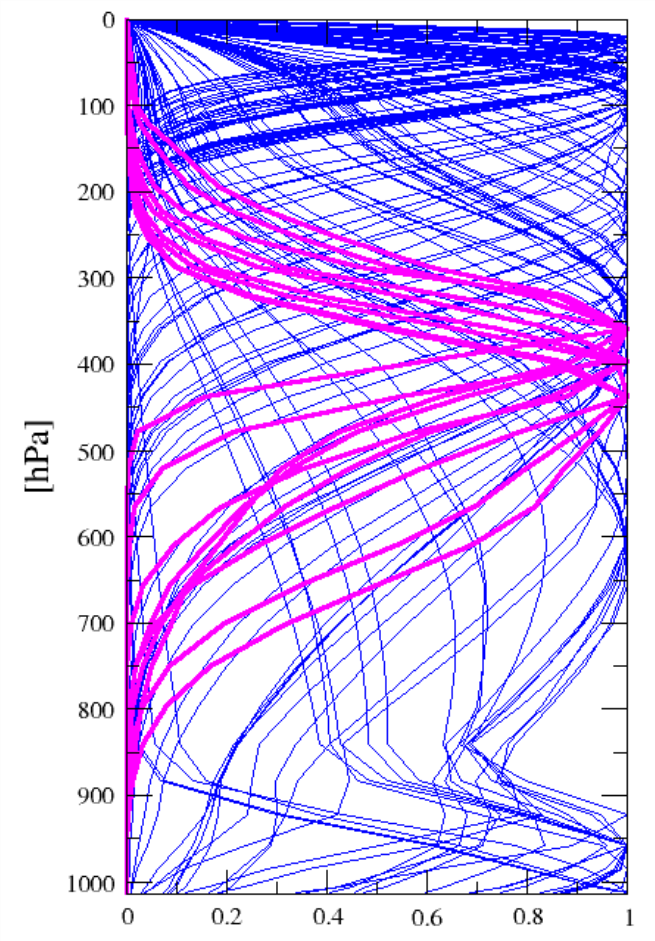


1 pixel in 125 km box in the assimilation

In operations (since 26 Sept. 2012)

Weighting function of assimilated IASI channels since 26 September 2012

101 T channels + 9 WV channels



Over land 78 T+ 9 WV channels

Over sea ice 60 T + 9 WV channels

Prescribed final observation error =3.6 K for the water vapour channels.

Assimilation of IASI over Sea

Towards assimilating more WV channels

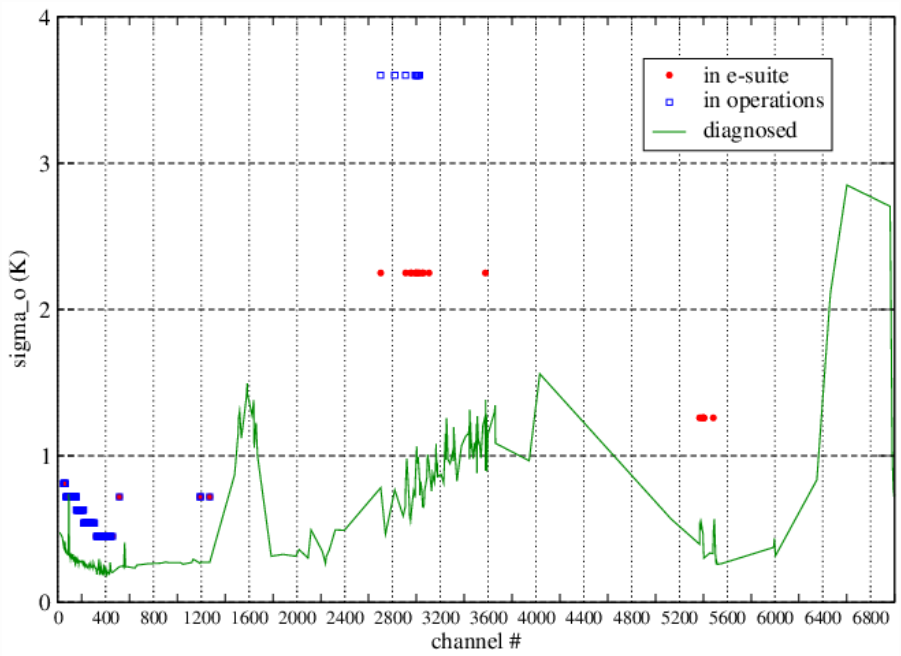
From 9 WV channels

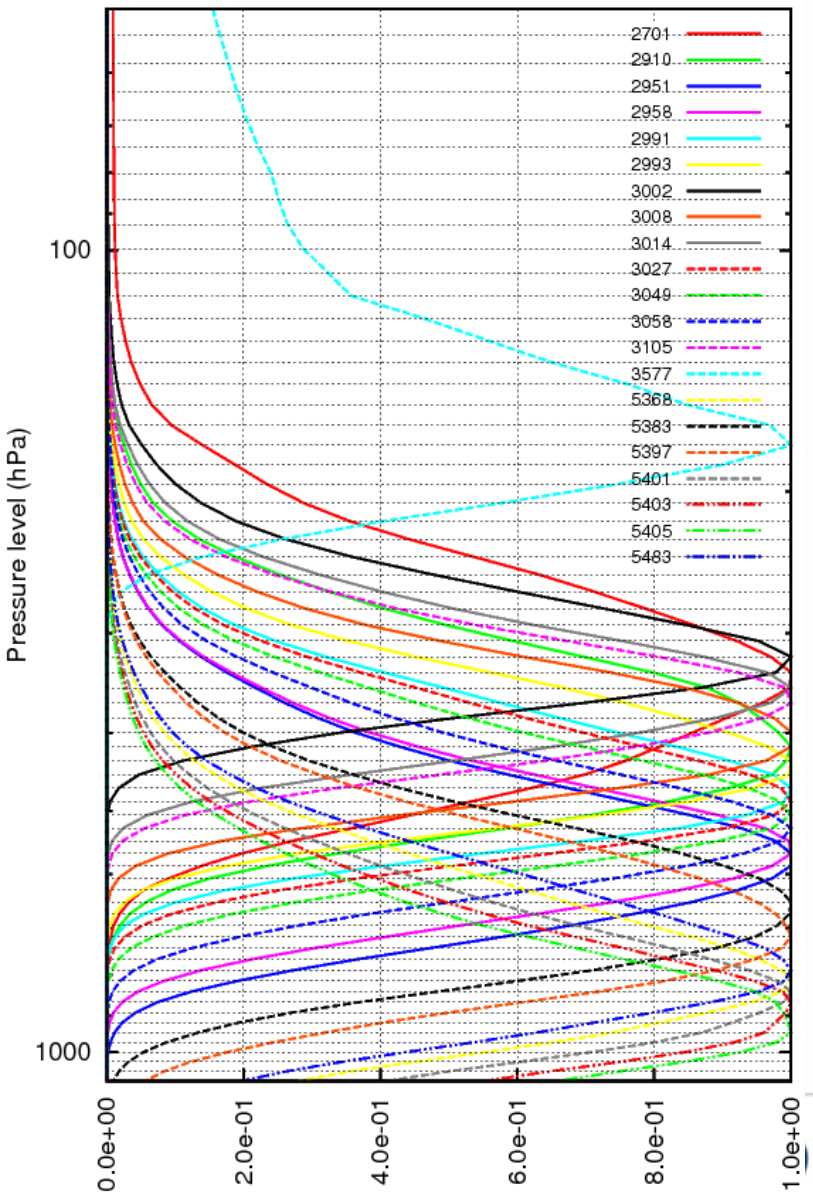
To 21 WV channels only over sea

No inter-channel error
correlation is prescribed

But observation error decreased

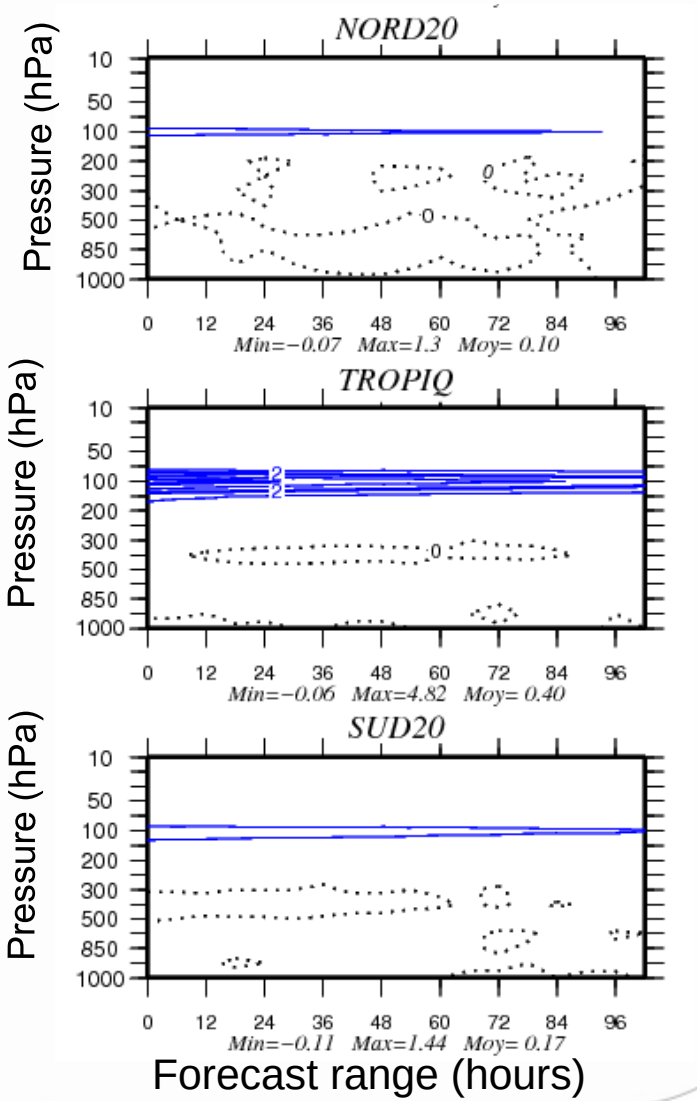
From 3.6 K to 2.25 K or 1.26 K





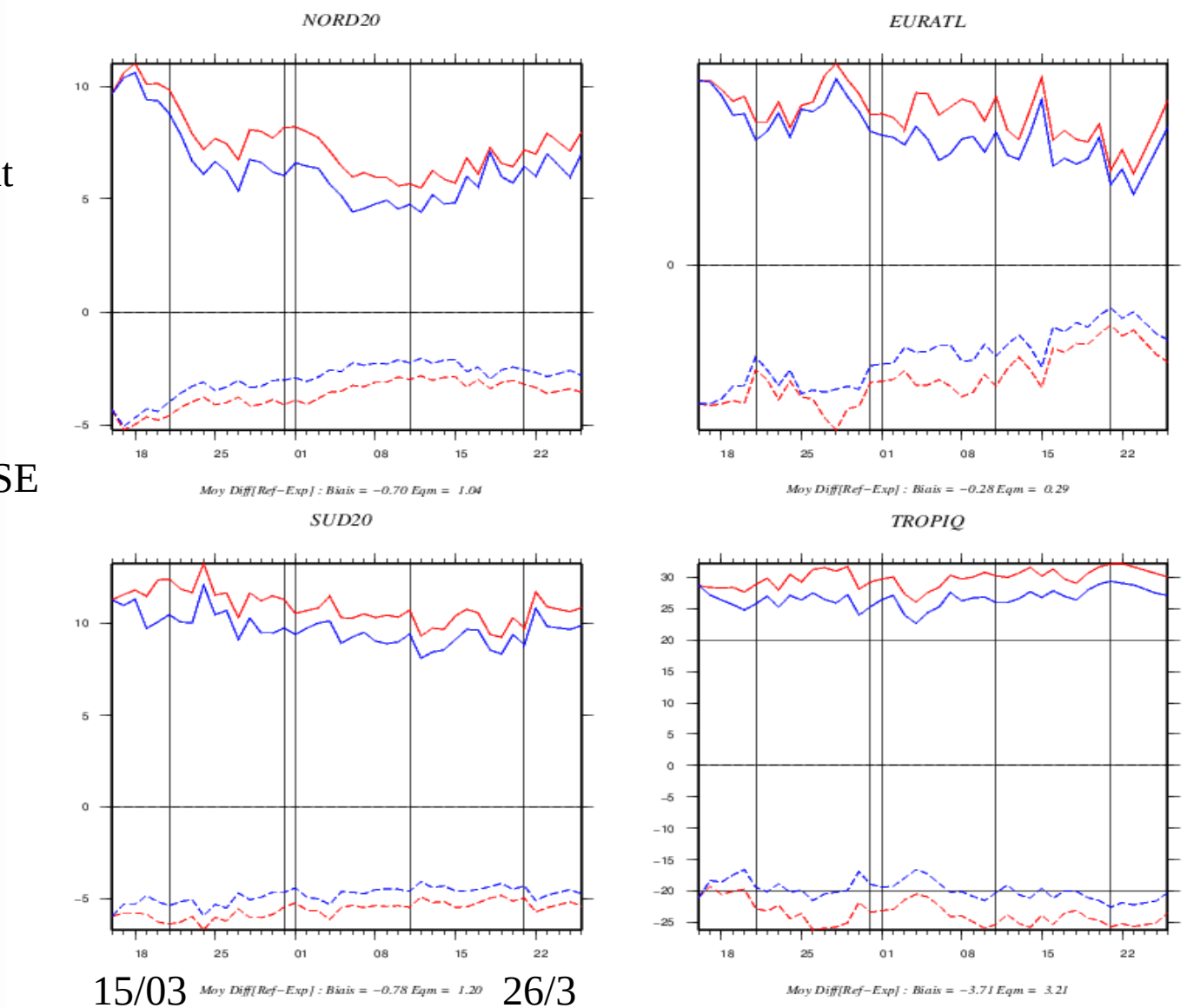
Towards assimilating more WV channels

Impact on forecats – 41 cases (13/03/2012-23/04/2012)
Relative humidity wrt ECMWF analyses



Improvement of the forecast

RMSE of the humidity at 100 hPa at the 3 day forecast range



——————— RMSE

- Bias

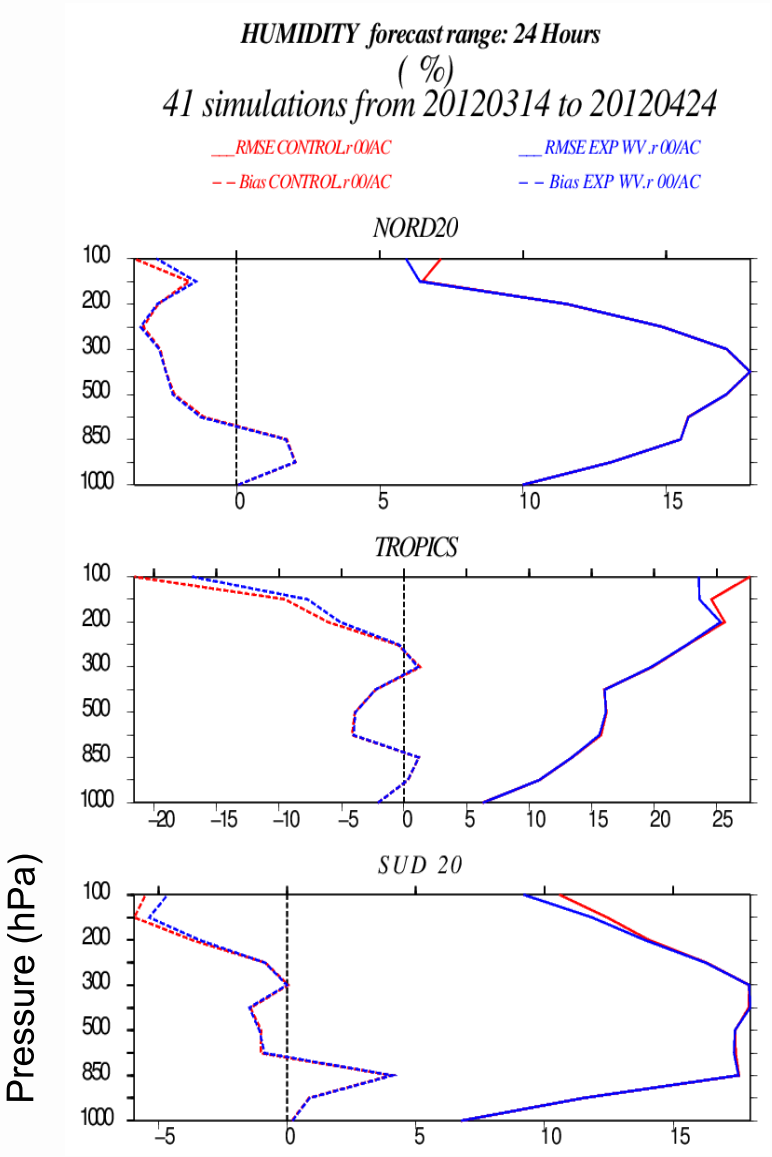
CONTROL

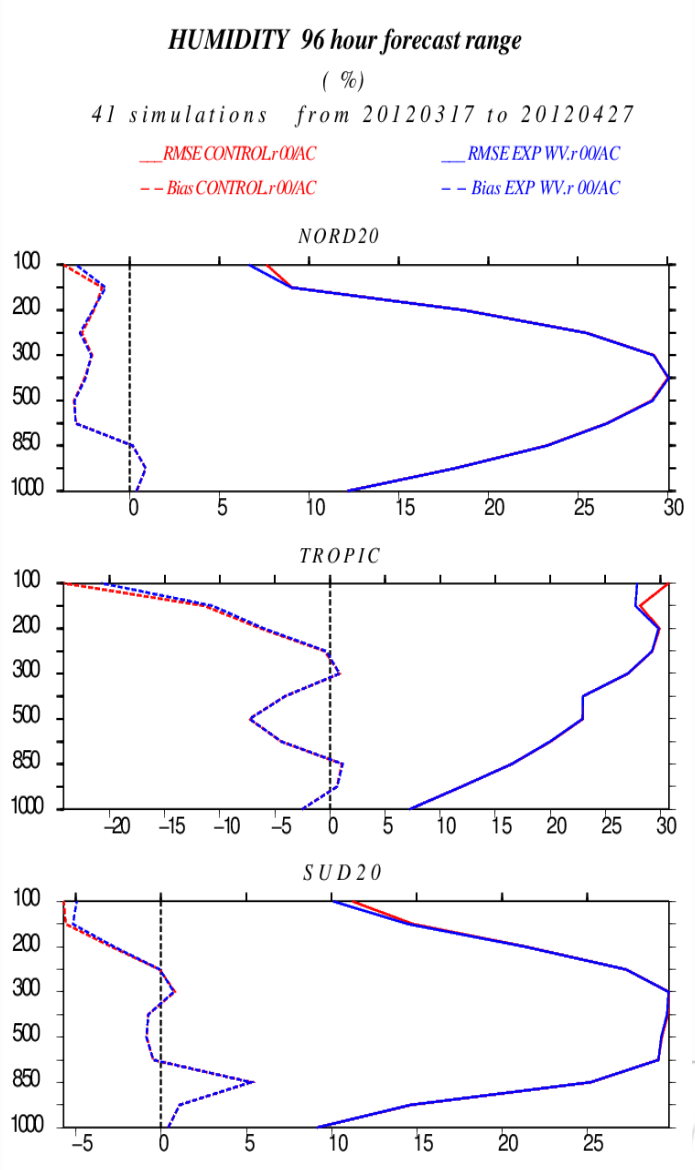
WV EXP

15/03 26/3

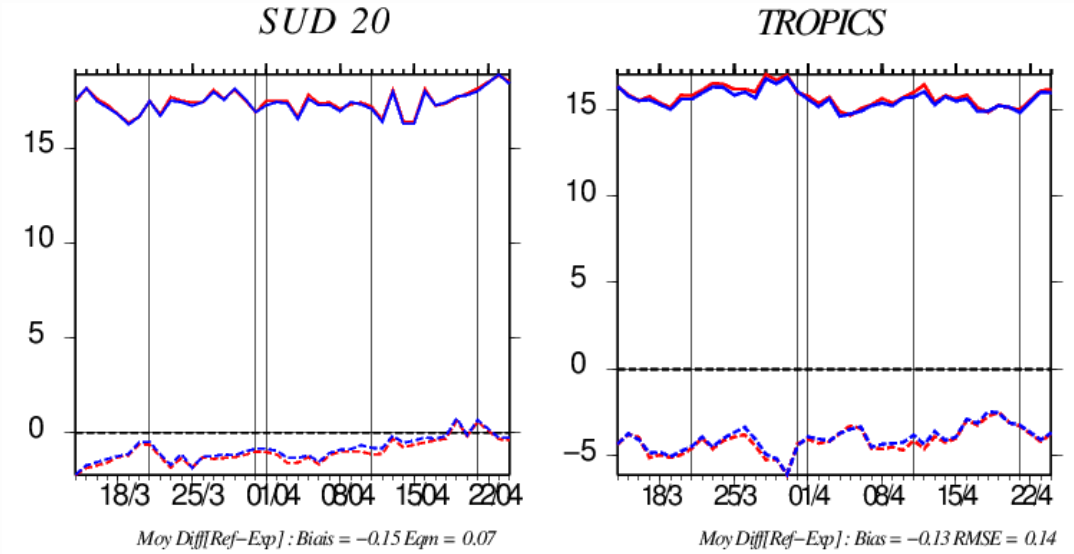
Time period

RMSE of Humidity at 24 and 96 hours





Humidity at 700hPa for the 24 hour forecast range wrt time



Smaller impact but still statistically significant

Information brought by microwave sounders

Bootstrap Statistical test

Paramètre HU ; 41 cas

Domain	SUD20																	TROPIQ																	NORD20																
Range	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
10	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
20	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
30	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
50	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
100	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
150	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	+	+	++	++	+	++	+				+	+					
200	++	++	++	++	++	++	++	++	++	++	++	++	++					++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	+	++																
250				++						++										+	+	+	++	++	+			+																						
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400	--	--	--	--	--																+																															
500																		++	+	++	+																															
700	++	++	++	++	++	++	++											++	++	++	++	++	++	++	++	++	++	++	++	+																						
850	++		+															++																																		
925																																																					
1000		+	++	++	++	+												-																																		

Pressure (hPa)

++ significant at 95% level

Error reduction from the observations: Introduction

Computation of the forecast sensitivity

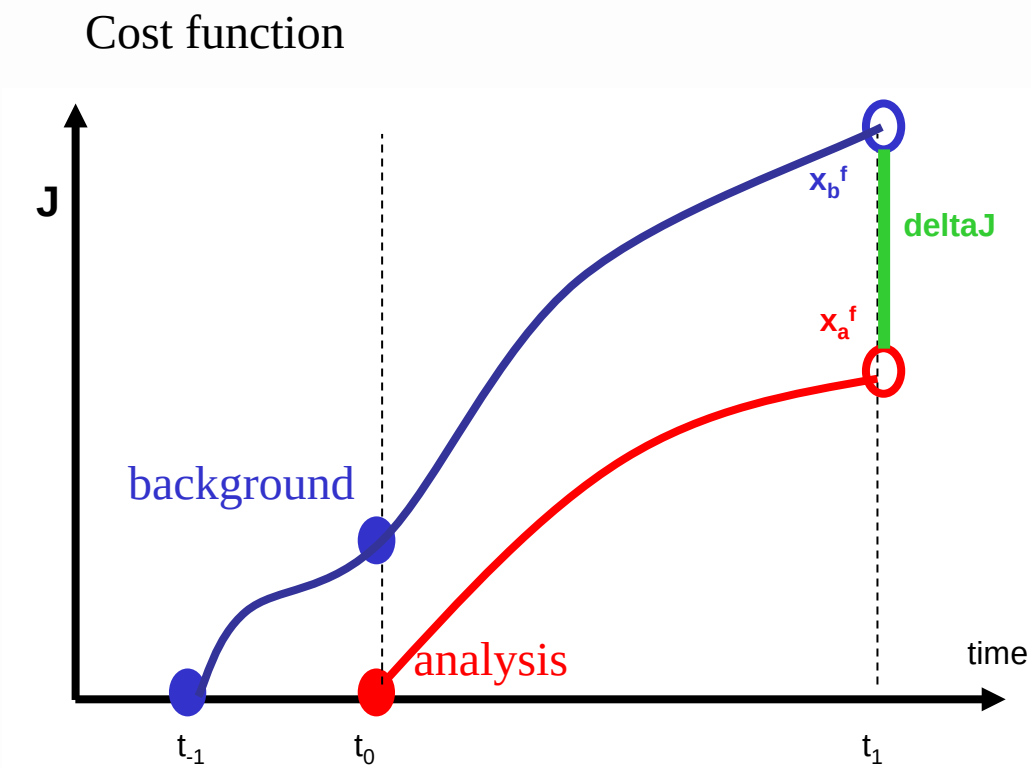
Implemented in IFS (ECMWF) by C. Cardinali.

Use of the forecast model adjoint and of the assimilation system adjoint

J : 3D dry total energy of the difference between the 24 h forecast and a reference (the analysis)

Observation impact:

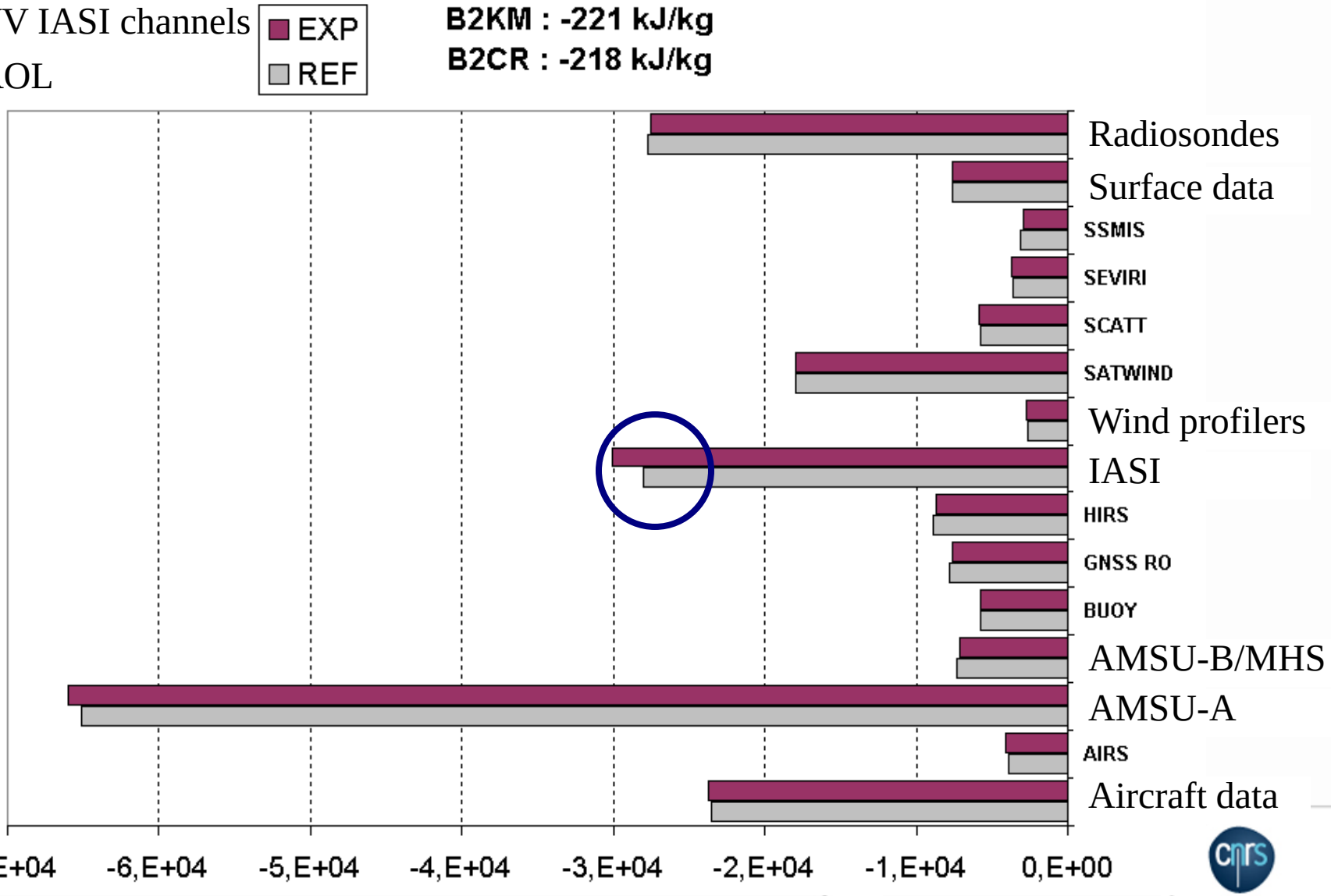
$$deltaJ = \sum \left(\frac{dJ}{dy_i} \right) \times dy_i$$



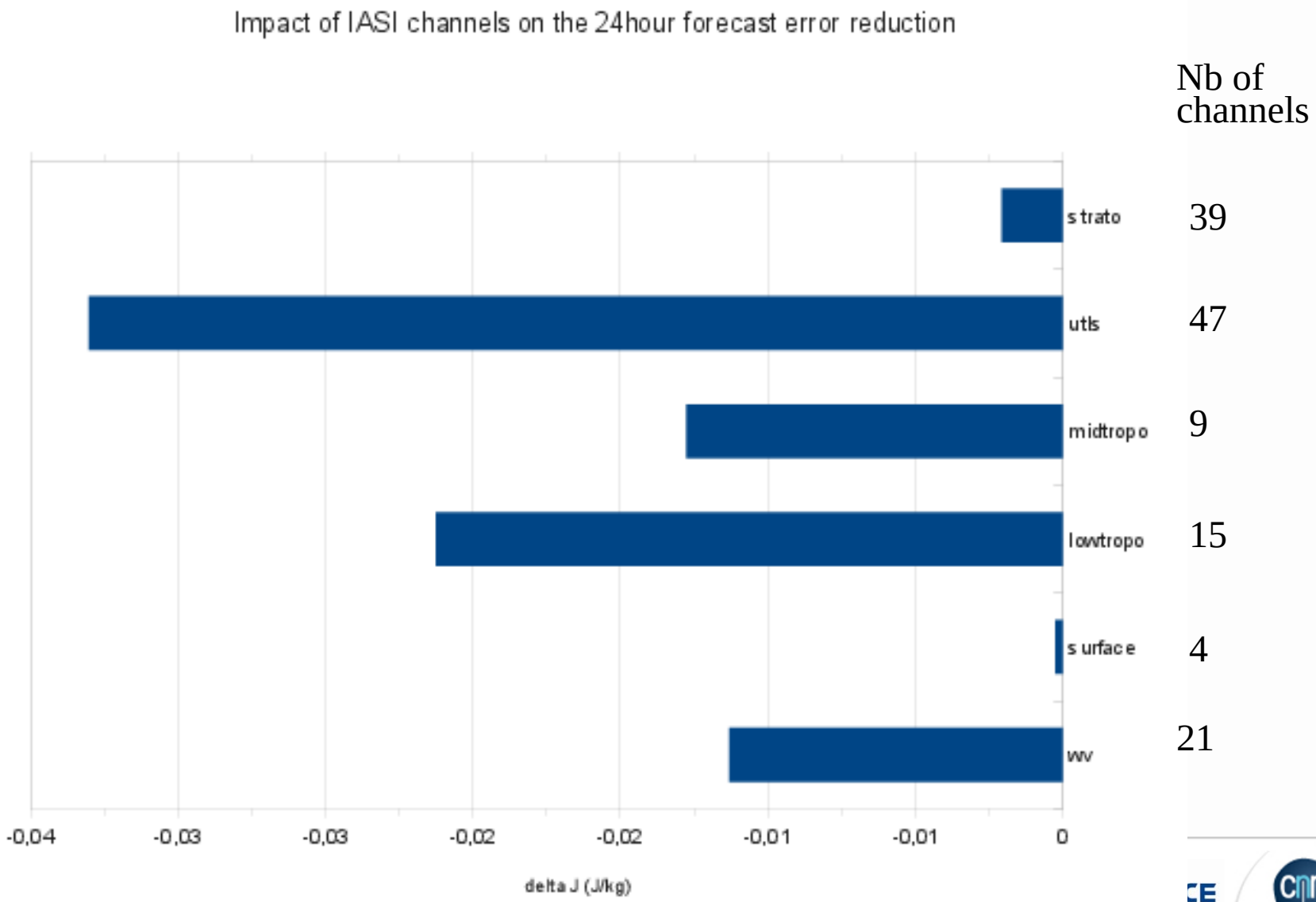
Error reduction from observations computed over a 3 week period

More WV IASI channels

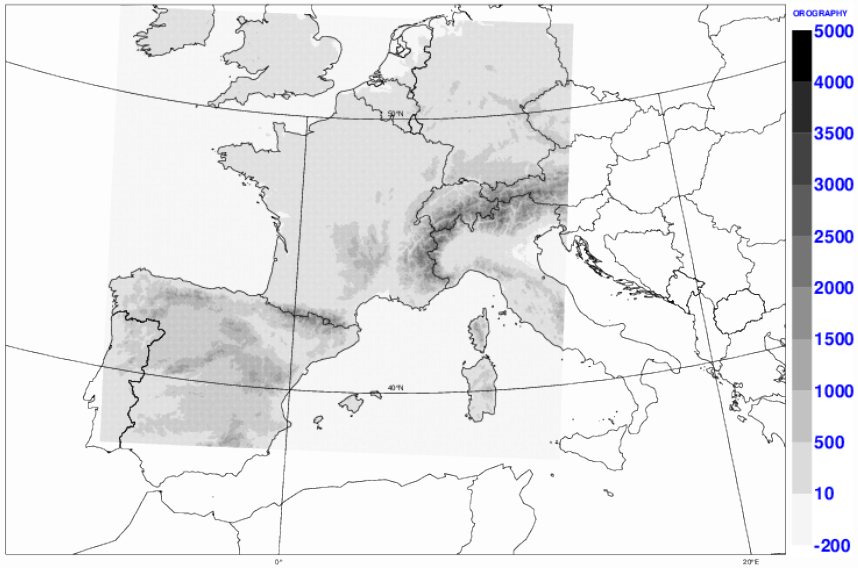
CONTROL



Error reduction from IASI observations computed over a 3 week period

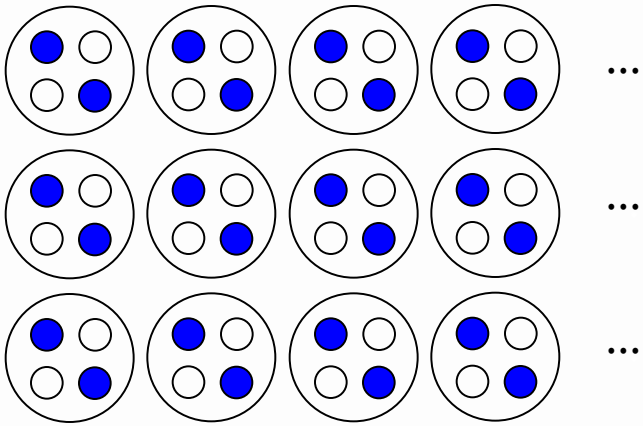


Assimilation of IASI in the convective scale AROME



Limited area model AROME

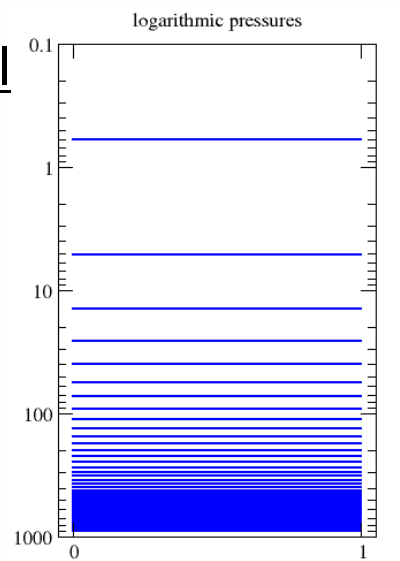
Detectors #1 & #3, all FoR



<u>Limited area model AROME</u>

2.5 km horizontal mesh

60 vertical levels

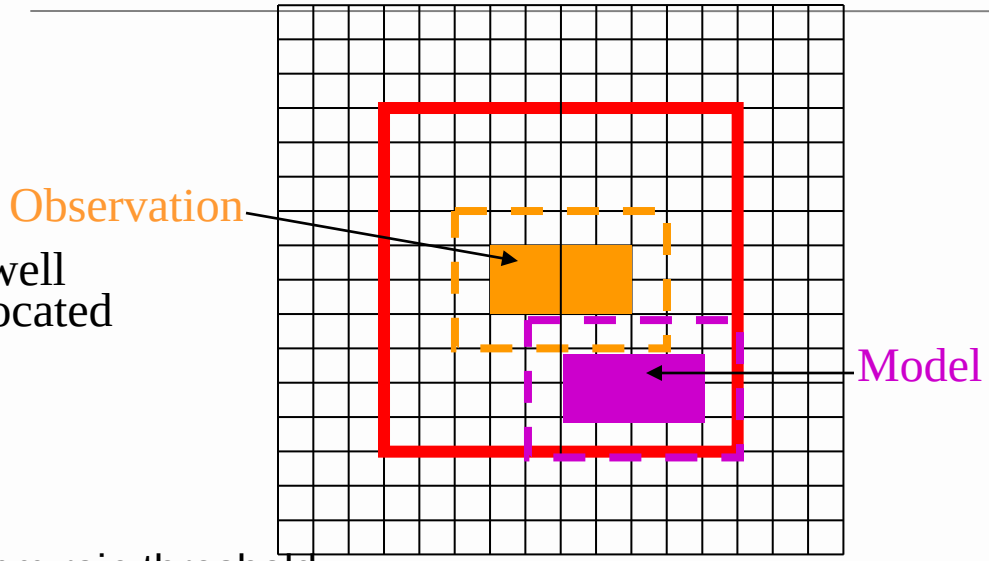


1 pixel in 80 km box

Similar channel selection than ARPEGE

Brier Skill Score
(with neighbouring distance)

Rain rate amount well predicted but mislocated



Example for a 10 mm rain threshold

$$BS\_NO = \frac{1}{Nj}\sum_{j=1}^{Nj}\frac{1}{N_{obs}}\sum_{p=1}^{N_{obs}}\left(\nu_{prev}(rr>10mm)-\nu_{obs}(rr>10mm)\right)^2$$

The Brier Score measures the quadratic difference between the predicted frequency and the observed frequency over a « neighbouring » area

$$BSS\_NO = 1-\frac{BS\_NO}{BS\_NO_{pers}}$$

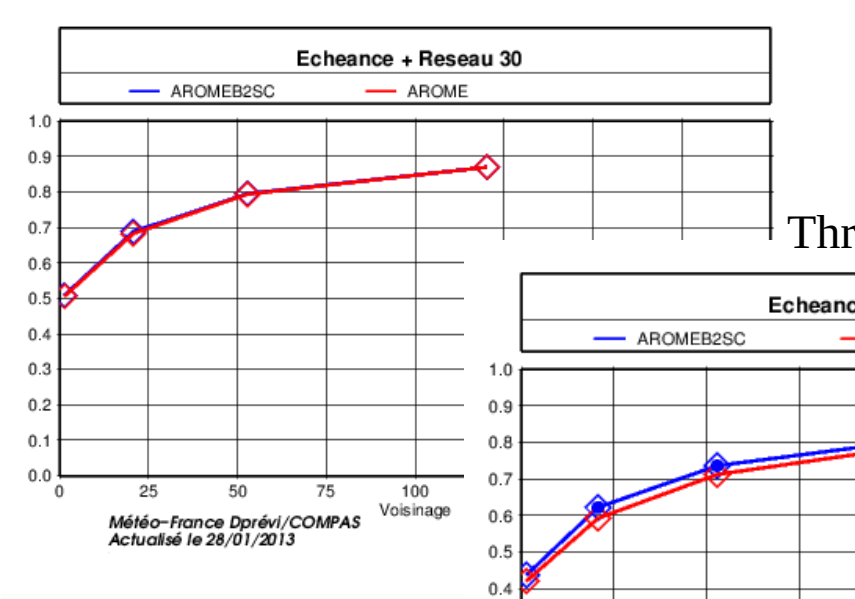
Normalization with the persistance score => The inter-annual variability is taken into account

Impact on the 24h rain rate forecast
Brier skill score

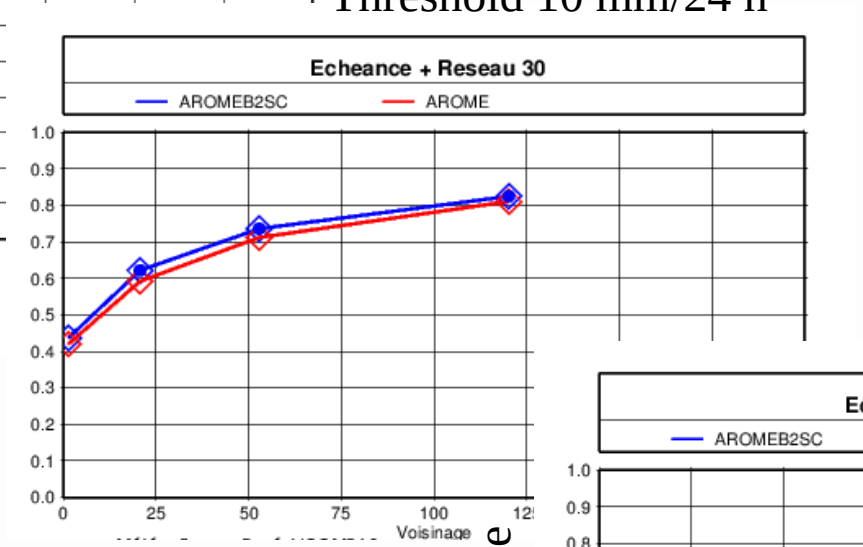
Threshold 5 mm/24 h

AROME WV

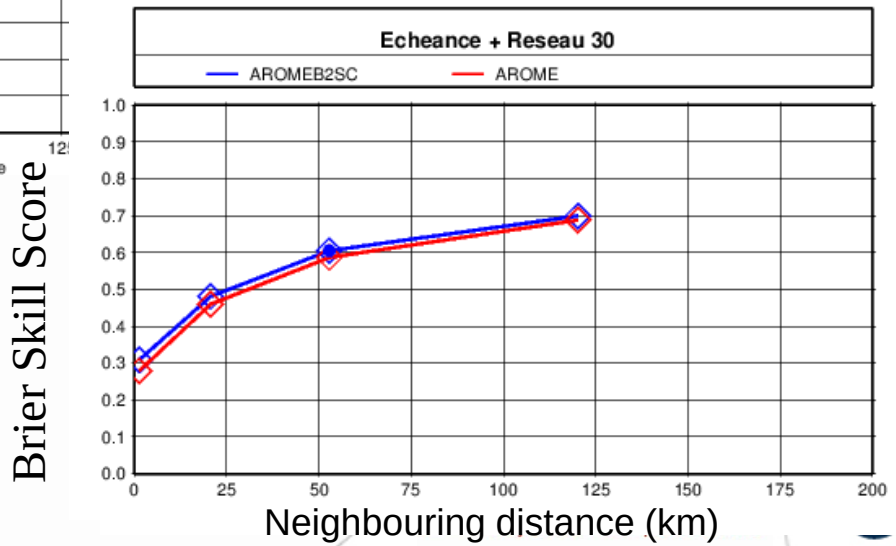
CONTROL



Threshold 10 mm/24 h



Threshold 20 mm/24 h



Conclusions and further work

- Increase of number of assimilated WV IASI channels in the NWP models ARPEGE and AROME
- Large positive impact from a upper troposphere-lower stratosphere channel

- Positive impact of the IASI water vapour channels
  - In the global model up to 96 hour forecast range
  - Improvement of the humidity, temperature and geopotential height at around 100 hPa
  - Small positive impact at 700 hPa
  - In the convective scale model, positive impact in the rain rate forecast.

  - In the next e-suite

Study of the assimilation of the UTLS WV channel over land.

Humidity analysis increment cut at 100 hPa, to be further evaluated with information brought by IASI and other satellite sounders.

Thank you for listening !

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