

Assimilation of surface-sensitive SEVIRI radiances over land in meso-scale models

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CNRM/GAME



SEVIRI radiances

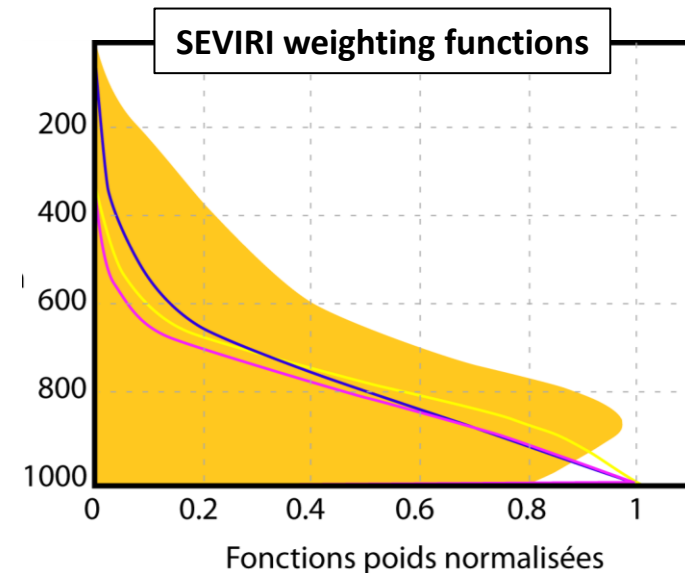
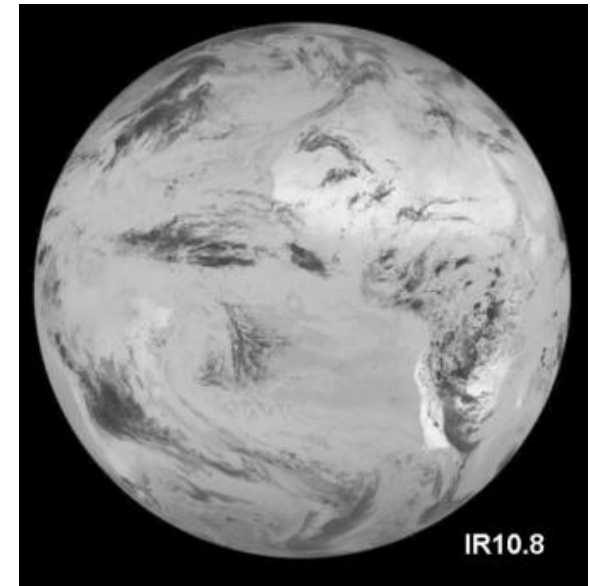
IR Radiometer onboard METEOSAT-8/-9 (geostationary)
Measures « top-of-atmosphere » radiances in 12 channels
Resolution : 1 image/15 min and 3 km at nadir

Informations from IR SEVIRI surface-sensitive channels :
tropospheric and low-level Temperature & humidity

⇒ Observations are NOT used over land in NWP systems ...

However, it has been shown that MO surface-sensitive channels can be assimilated over land with an adequately described surface (Karbou et al., 2006)

Can we use a similar approach for IR observations?



Motivation & outline

Objective: Improve Land Surface Temperature and Emissivity in NWP models to improve SEVIRI Bt assimilation over land in the AROME forecast system

- 1. Land Surface Temperature retrieved at SEVIRI channel IR10.8**
- 2. Assimilation experiments of surface-sensitive IR SEVIRI observations over land**

Method

Inversion of the radiative transfer equation using as input to RTTOV :

- SEVIRI Observations
- Short-range forecast of atmospheric profiles from AROME/France
- Monthly Emissivity atlas from the EUMETSAT LSA-SAF (Trigo et al., 2008)

⇒ LST is retrieved at SEVIRI window channels every 3 hours over Europe

1. Land Surface Temperature retrieved at SEVIRI channel IR10.8

Period : 1st January – 20th January 2011

Method

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Evaluation

LST retrievals at SEVIRI channel IR10.8

vs

LST-SAF

(split window method)

or

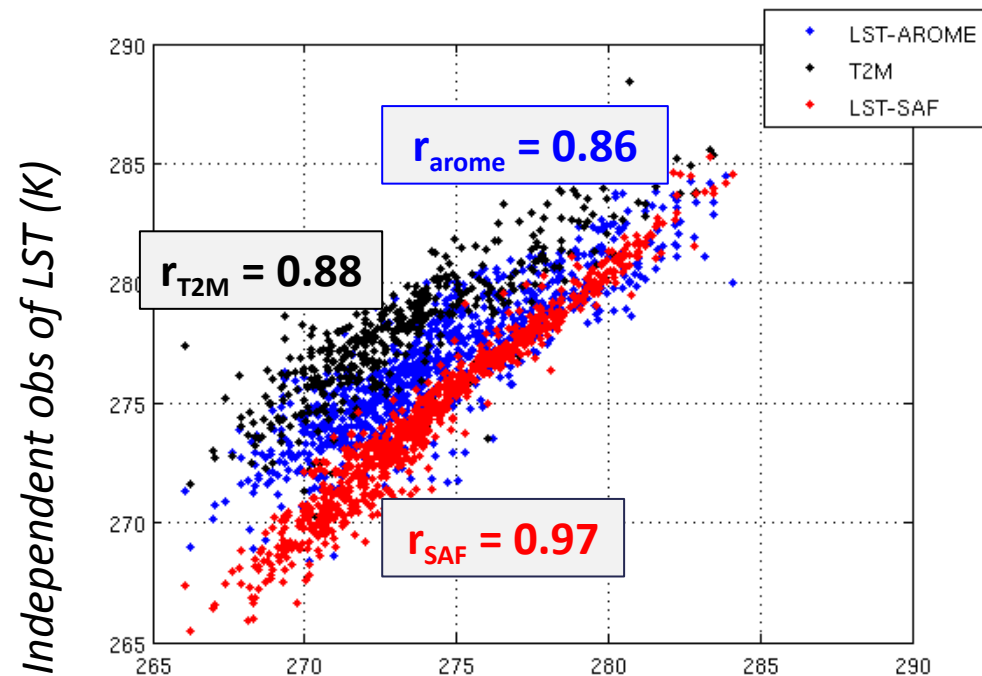
LST-AROME

(land surface analyse)

or

T2M

(synoptic stations)

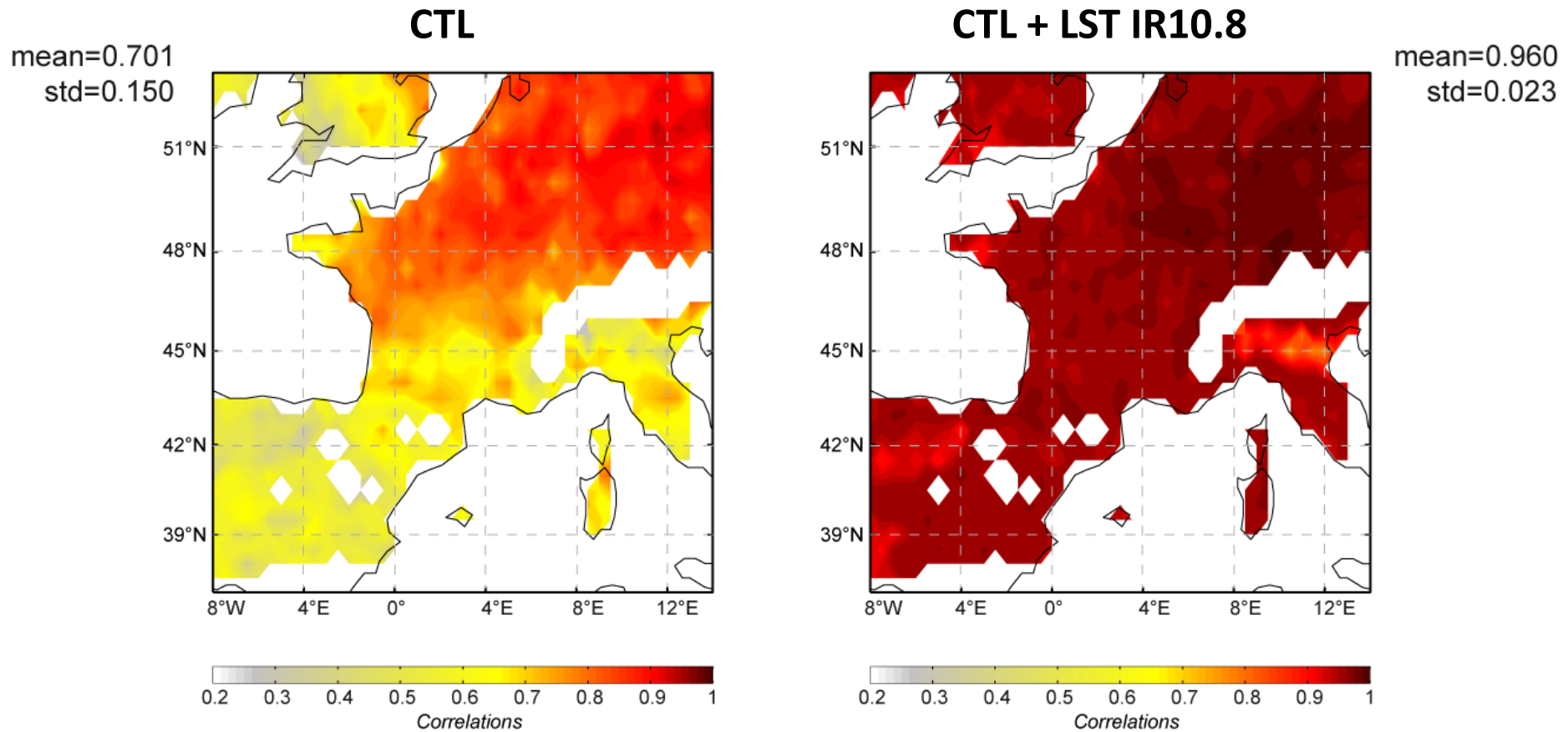


LST retrievals at SEVIRI channel IR10.8 (K)

Period : 1st January – 20th January 2011

RTTOV simulations

Correlation between Tb observations and Tb simulations (SEVIRI channel IR13.4)



Performance of the new land surface modelisation :

- Realistic retrievals of LST are obtained with regard to independent LSTs
- Significant improvement of SEVIRI Bt simulations when $LST_{IR10.8}$ is used as input

Now we are ready to assimilate SEVIRI surface-sensitive channels over land ...

3D-Var assimilation experiments

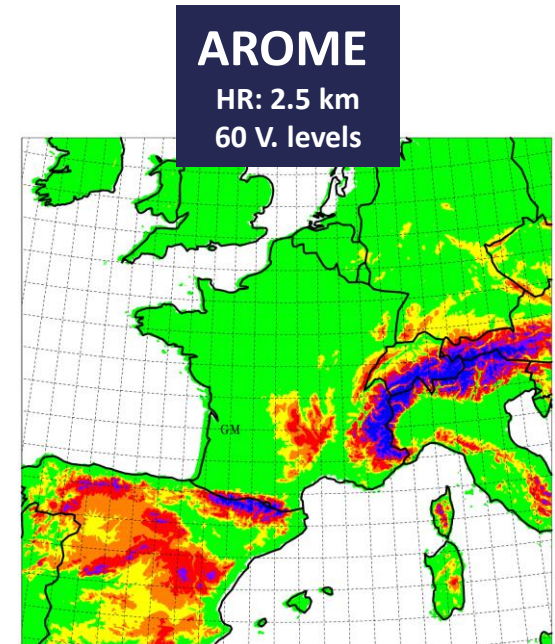
3 months period : May – July 2011

2 configurations

CTL : Operational AROME/France forecast system

EXP : CTL + 4 surface-sensitive channels over land

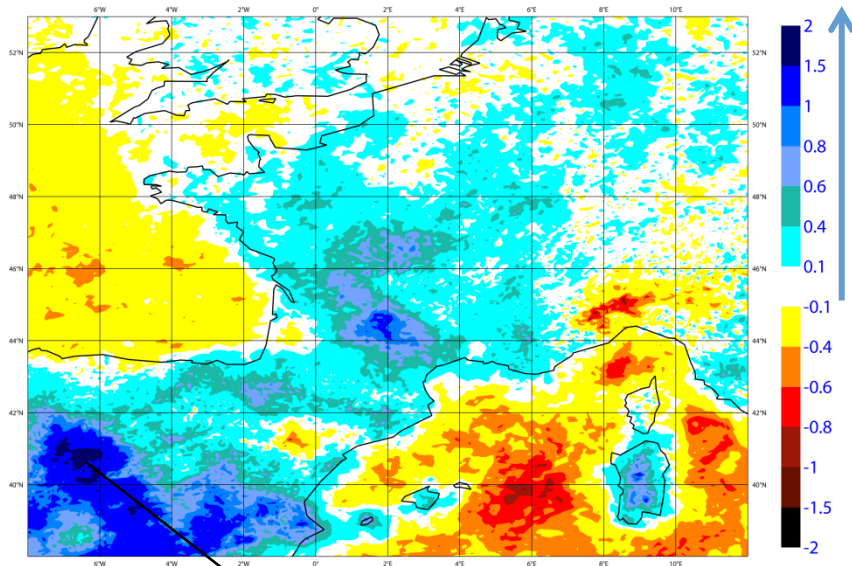
⇒ Using the new land surface scheme



Period : May – July 2011

Impacts on analyses of humidity

Mean analysis difference in TCWV at 12h
(EXP-CTL)



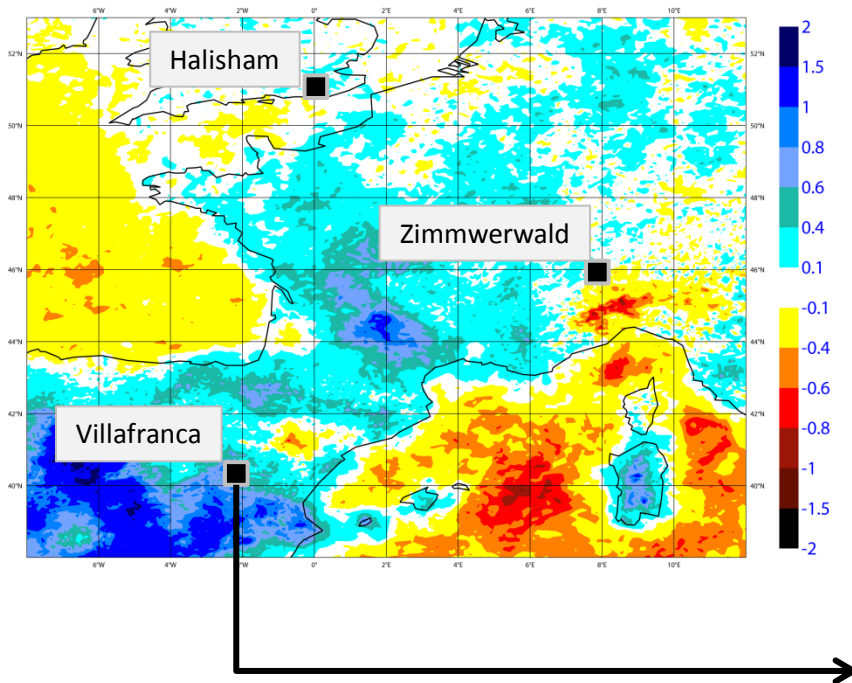
⇒ **Most changes in the analysis under 40°N:**
High density of clear sky situations

Period : May – July 2011

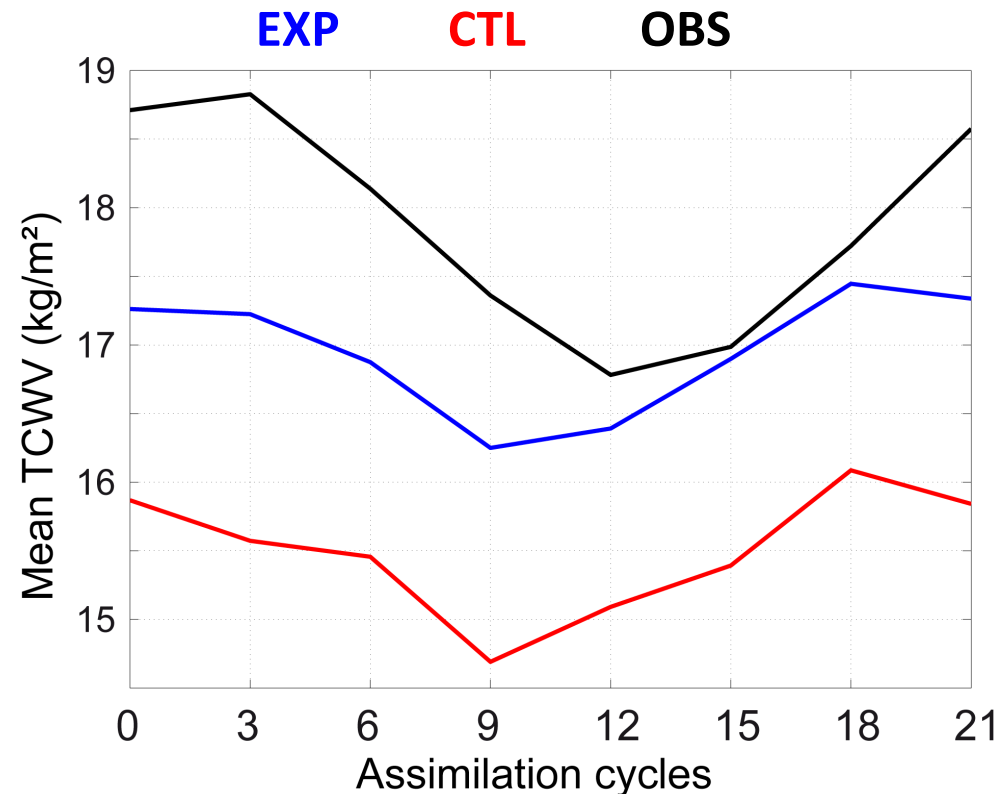
Impacts on analyses of humidity

Validity of this change ?

Mean analysis difference in TCWV at 12h
(EXP-CTL)



6h-Averaged values of TCWV at Villafranca station,
3 months

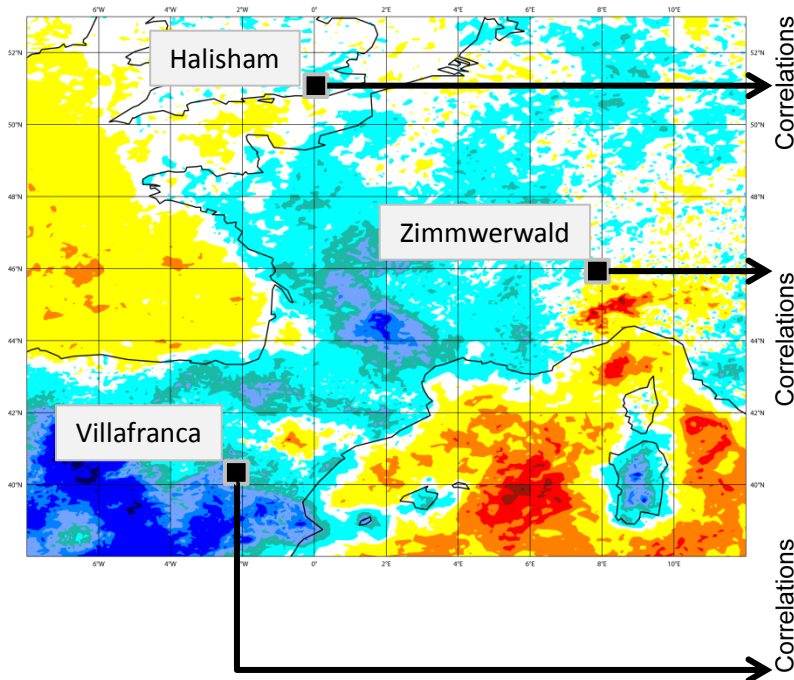


Period : May – July 2011

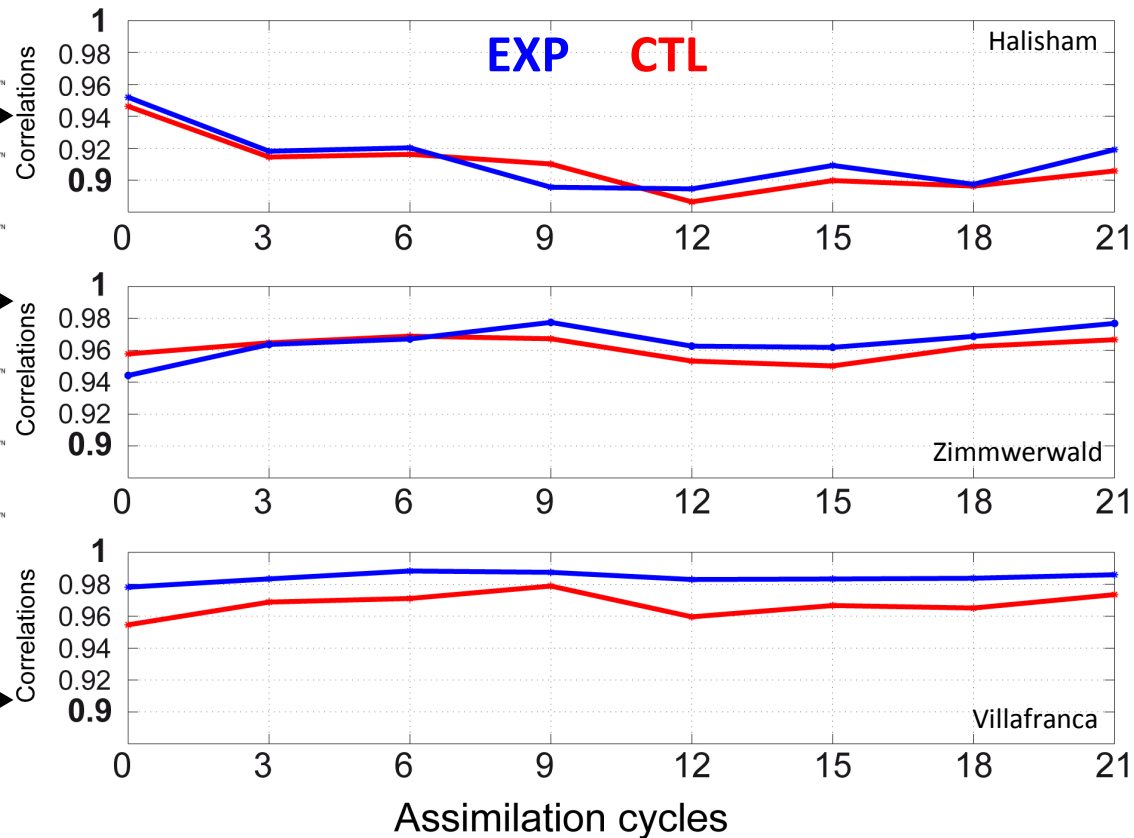
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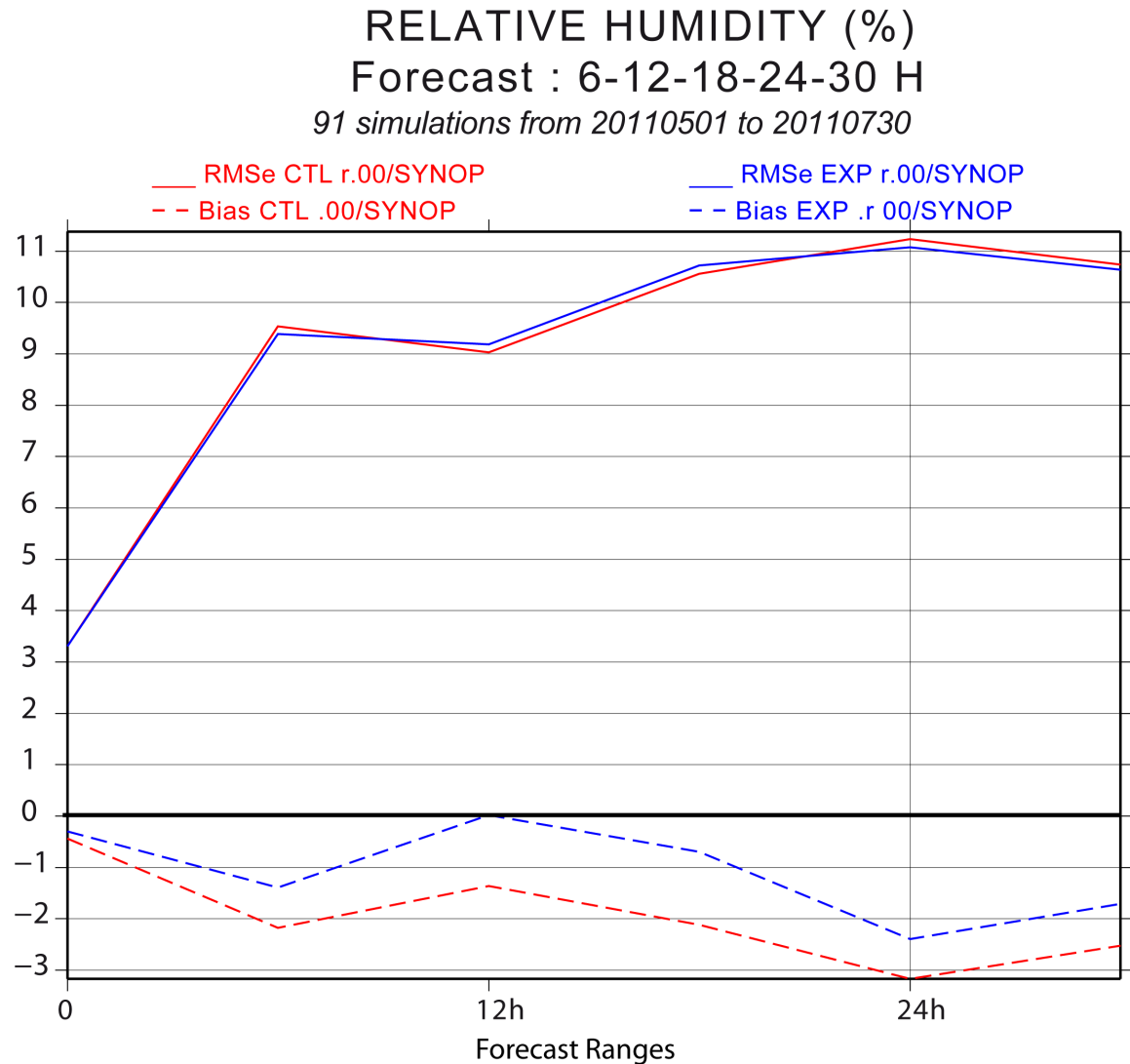
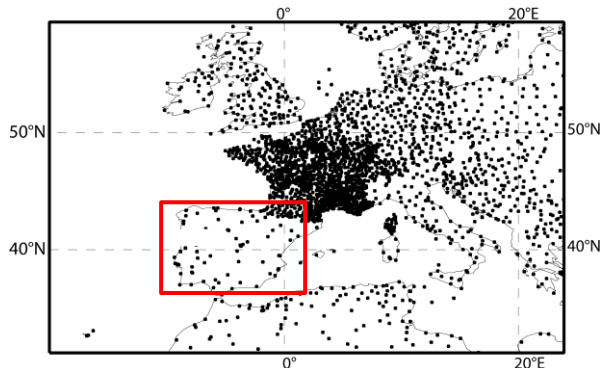


Correlations with GPS measurements, 3 months



Impacts on humidity forecast (near the surface)

Relative Humidity scores for
different forecast ranges
VS
Spanish Synoptic stations
(≈ 60 stations)



Conclusion

The aim of this work was to assimilate as many IR SEVIRI observations over land as possible by reducing the uncertainties about the surface

LST has been retrieved at SEVIRI IR10.8 window channel and has been successfully evaluated

Results from 2 assimilation experiments (3 months):

- ⇒ Positive impacts were found over humidity analyses/forecast (GPS, surface stations ...).
- ⇒ Other parameters : neutral to positive forecast scores (not shown)
- ⇒ Similar scores were obtained using the ALADIN/France model

Operational implementation of these developments are underway for the next cycle ...

Conclusion & future plans

2 models, 2 conclusions :

The assimilation of IR surface-sensitive SEVIRI channels provides more moisture in AROME
Whereas, same the experiments in ALADIN/France shown a significant decrease (2010).

The use of this method to improve radiances assimilation from hyperspectral sounders (IASI, MTG-IRS...) => presentation of Anaïs Vincensini

Estimation & Specification of observation error correlation in R for meso-scale models

Thank You

Guedj S., F. Karbou and F. Rabier, 2011, Land surface temperature estimation to improve the assimilation of SEVIRI radiances over land, **Journal of Geophysical Research**, vol 116, D14107

Guedj S., F. Karbou and F. Rabier, V. Guidard, T. Montmerle, Improved assimilation of SEVIRI radiances over land, **Monthly Weather Review**, submitted

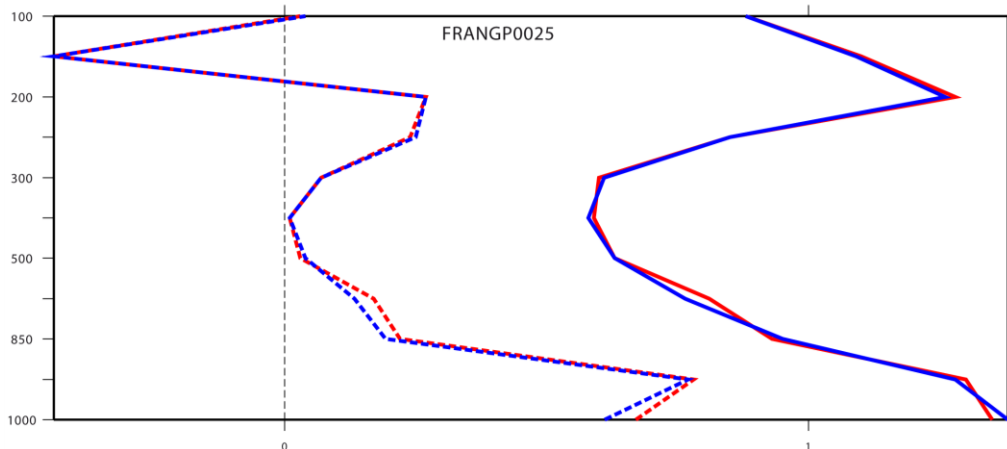
Forecast error vs radiosondes

Period : May – July 2011
91 simulations

___ RMSe CTL r.00/Radiosondes
-- Bias CTL .00/Radiosondes

___ RMSe EXP r.00/Radiosondes
-- Bias EXP .r 00/Radiosondes

TEMPERATURE
Forecast : 12H



WIND SPEED (m/s)
Forecast : 12H

