Impact of IASI data density in the assimilation of a convective-scale model

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Overview

1. IASI in operational NWP models

1.a- Data selection

1.b- Data usage

1.c- Impact on forecasts

2. Increasing IASI density: what impact ?

2.a- Analysis increments

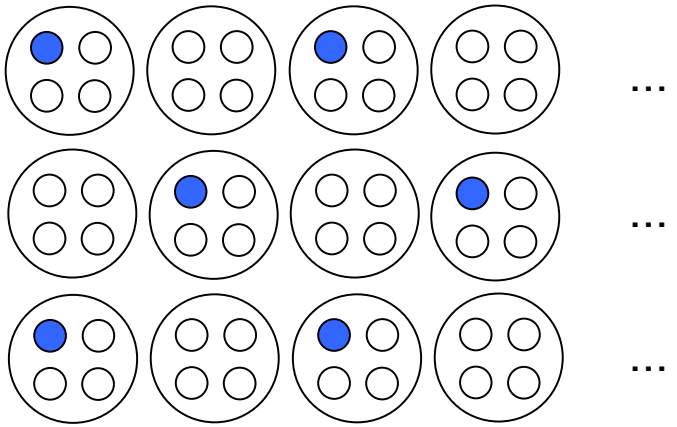
2.b- Observation errors

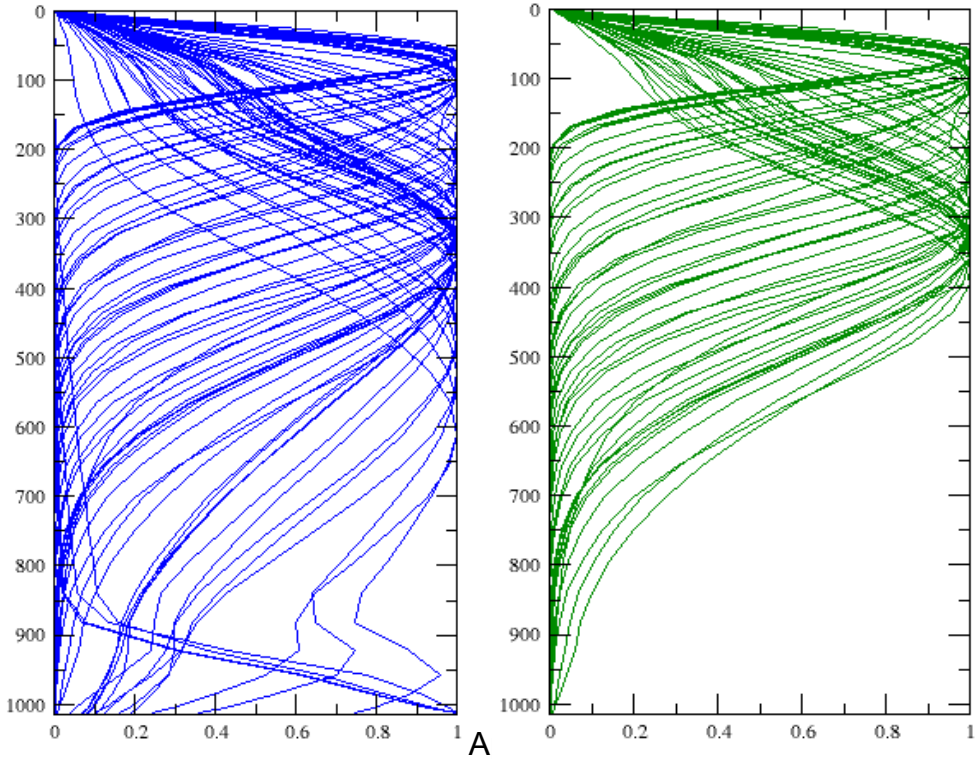
2.c- Impact on forecasts

Conclusion

1.a- IASI in operational NWP models: data selection

- Pre-selection:
  - Only data from detector #1
  - Pattern depending on scanline→
- Geographical thinning: 1 prof. / 125km



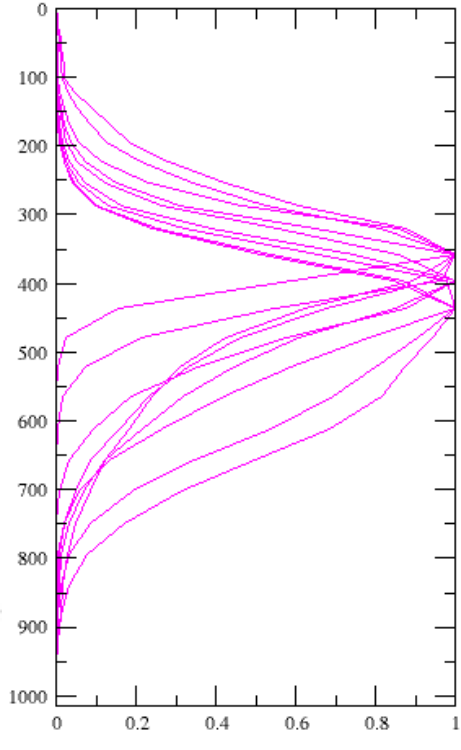


A

LW - T
68 over sea
50 over land

9 WV

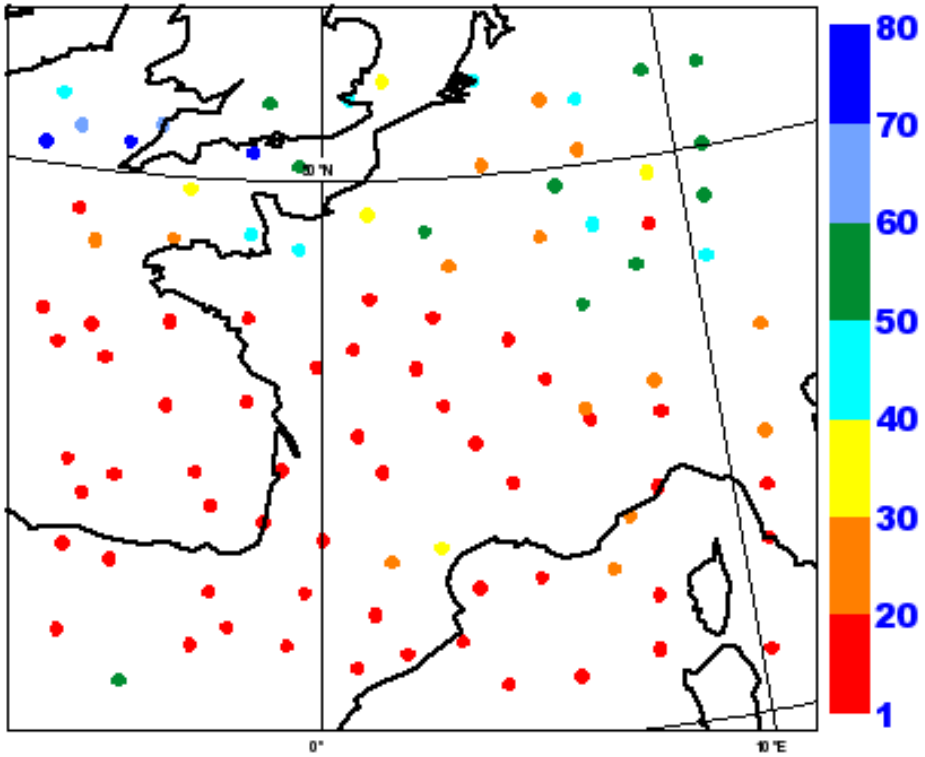
channels



1.b- IASI in NWP models: data usage in AROME

- Number of assimilated channels per profile
  for a typical 3-hour assimilation window

  example for 27th February 2010 @ 09 UTC assimilation time



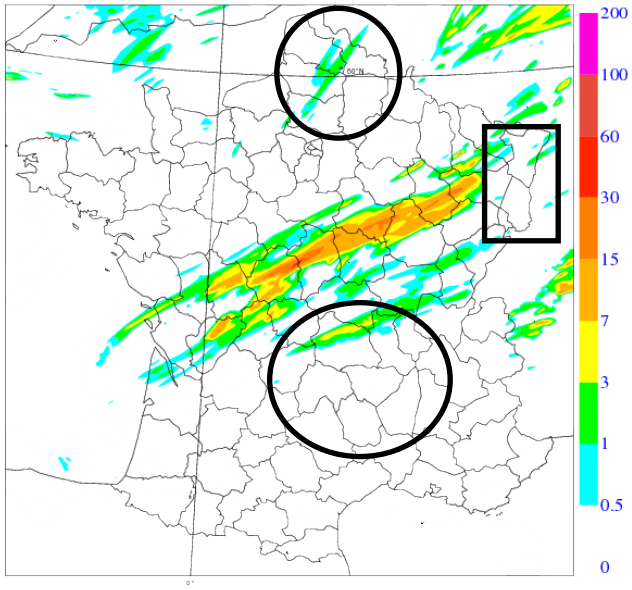
Such a coverage only twice a day

Cloud detection:
McNally & Watts (2003)

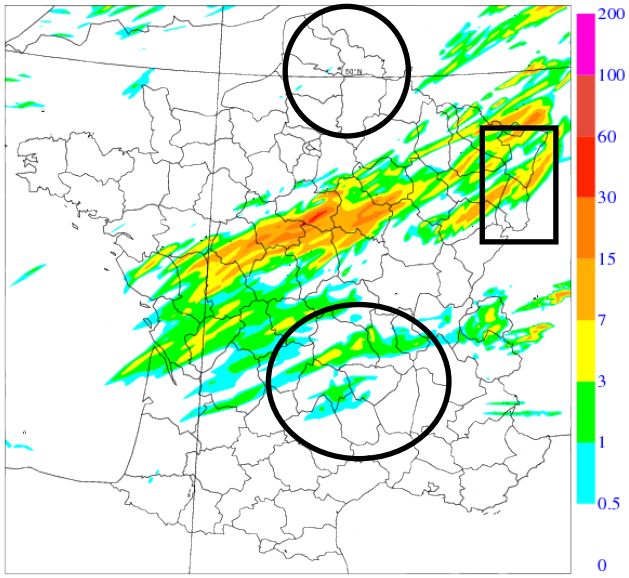
1.c- IASI impact in AROME

- **Impact on precipitation prediction**
  example of 12h precipitation between 00 and 12UTC on 21 May 2009

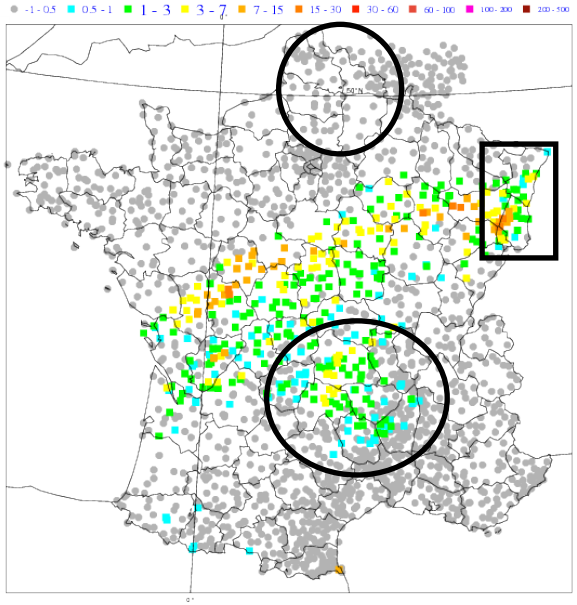
12h forecast range



Reference: no IASI



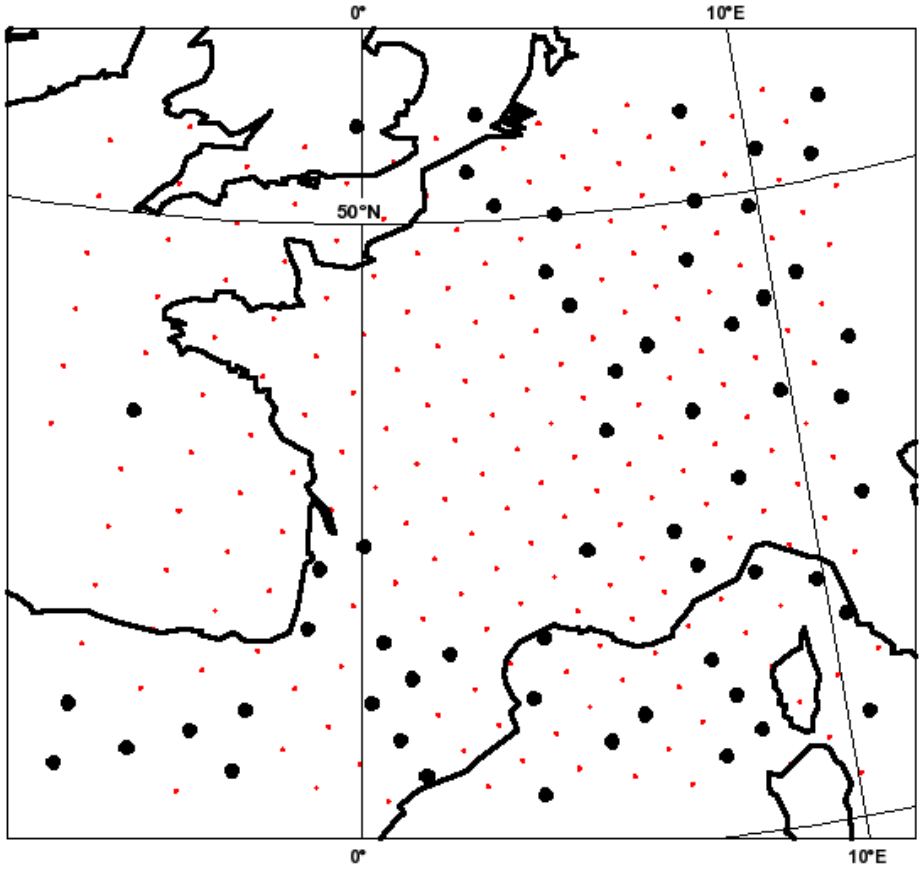
First step: IASI 125km



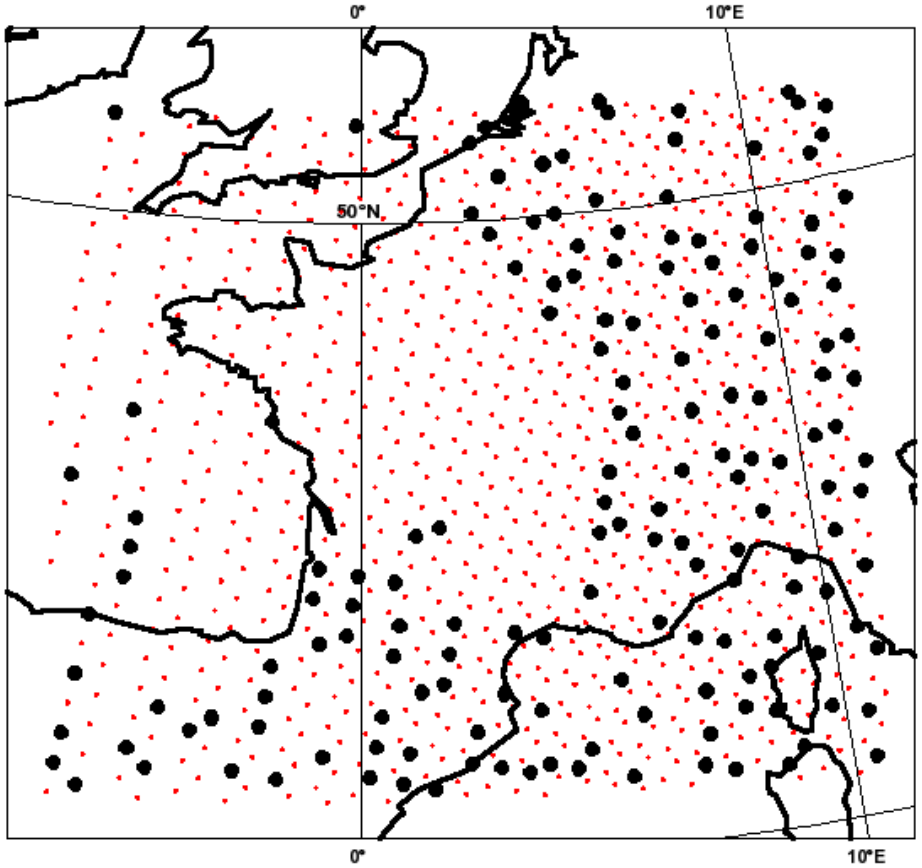
Verif.: Rain gauges

2.a- IASI 125km versus IASI 80km

1 fov over 8
125km thinning



1 fov over 2
80km thinning



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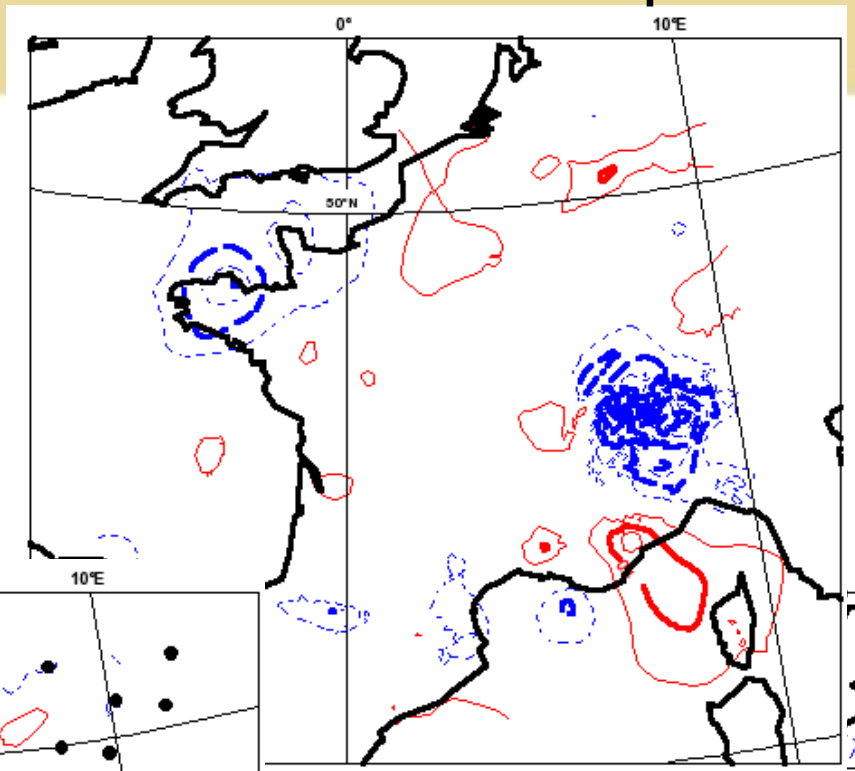
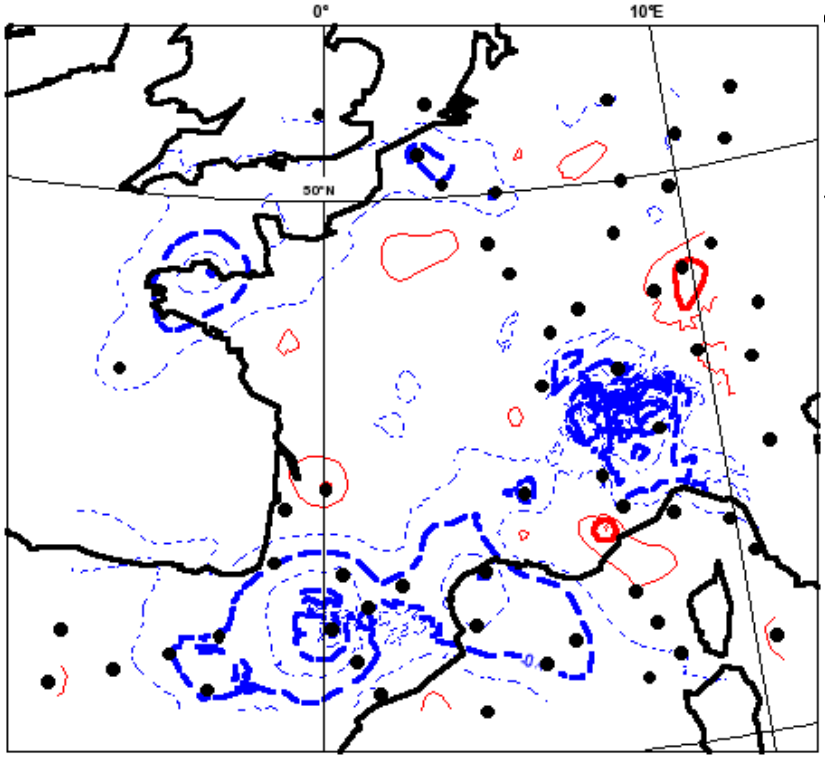
2.a- Analysis increments: temperature at 500 hPa

No IASI

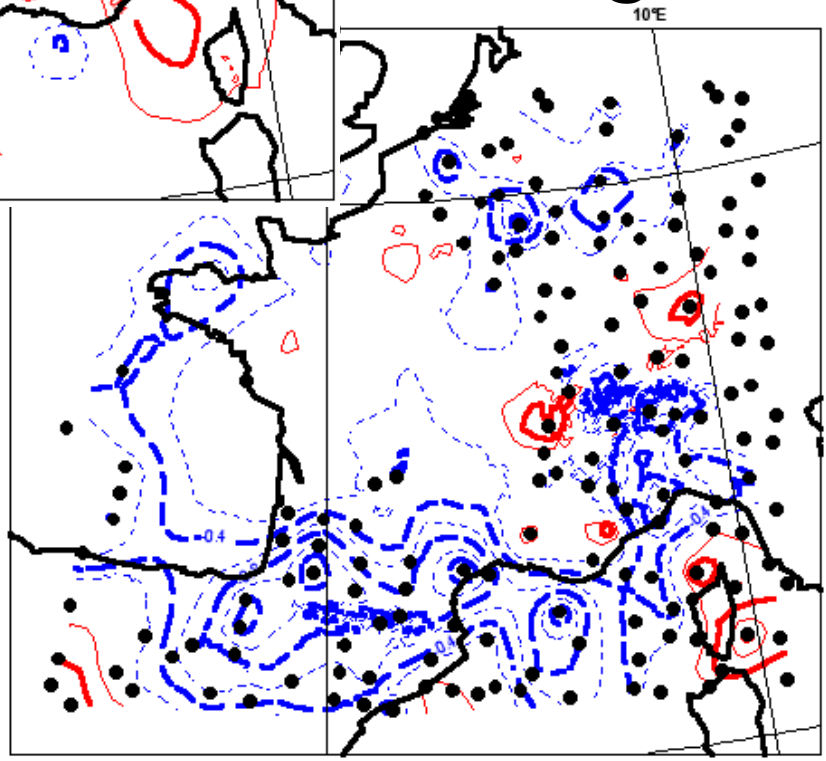


1 isoline every 0.2K

IASI @ 125km

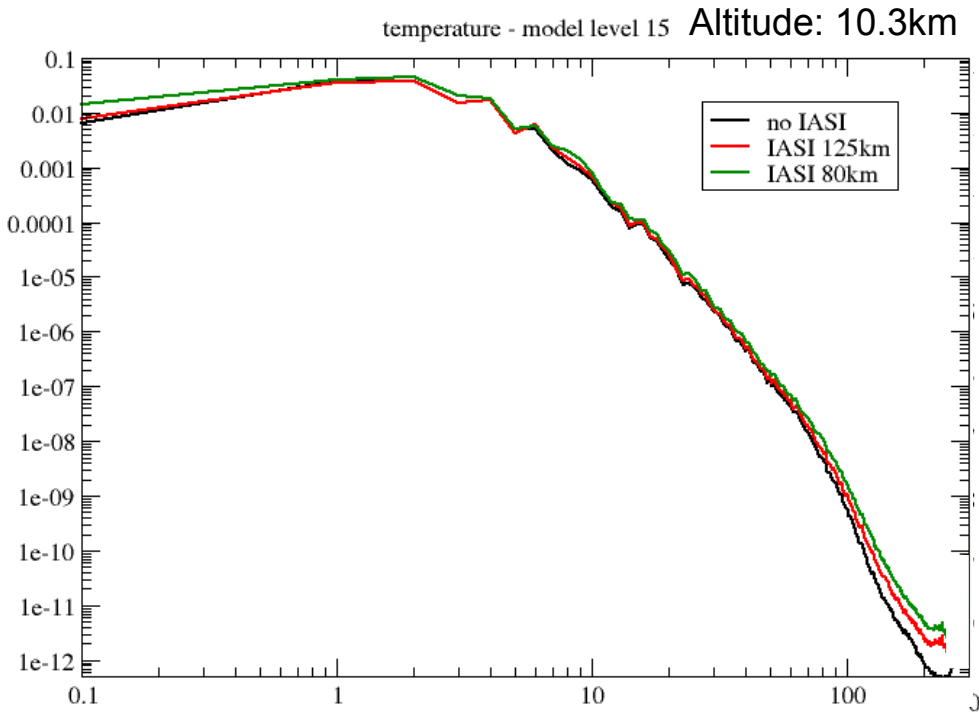


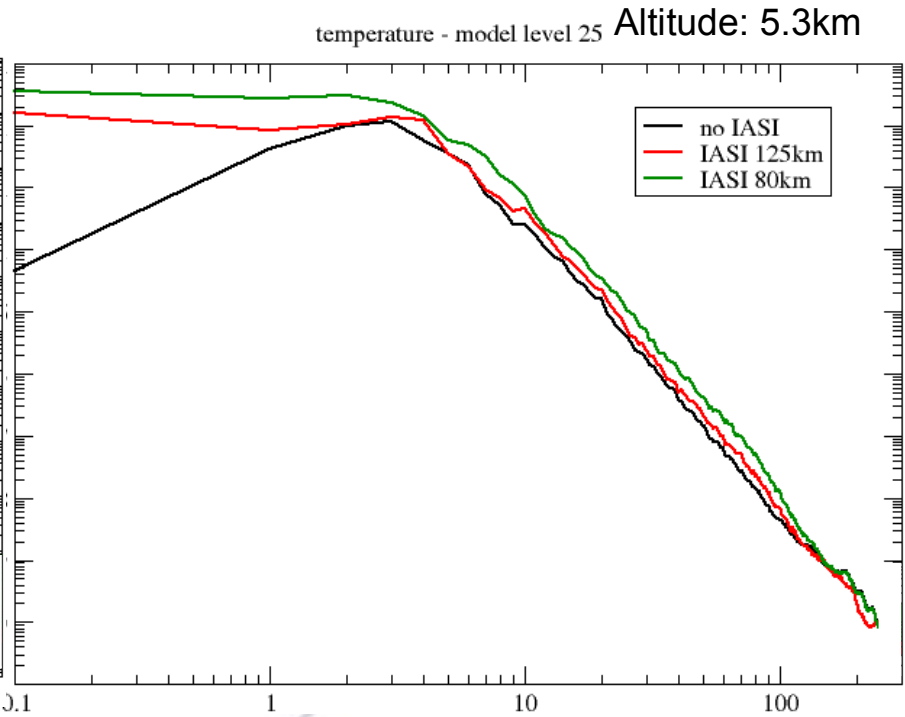
IASI @ 80km



2.a- Analysis increments: spectra for temperature

Assimilating IASI at a higher density leads to larger analysis increments at all wavelengthes





Scale: ~650km ⟶ Scale: ~6.5km

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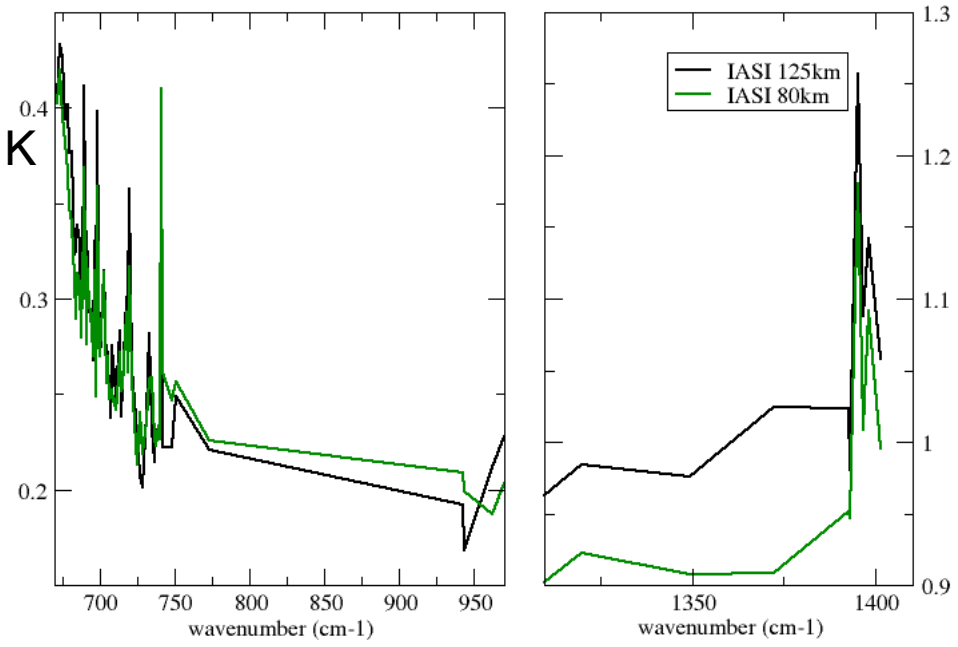
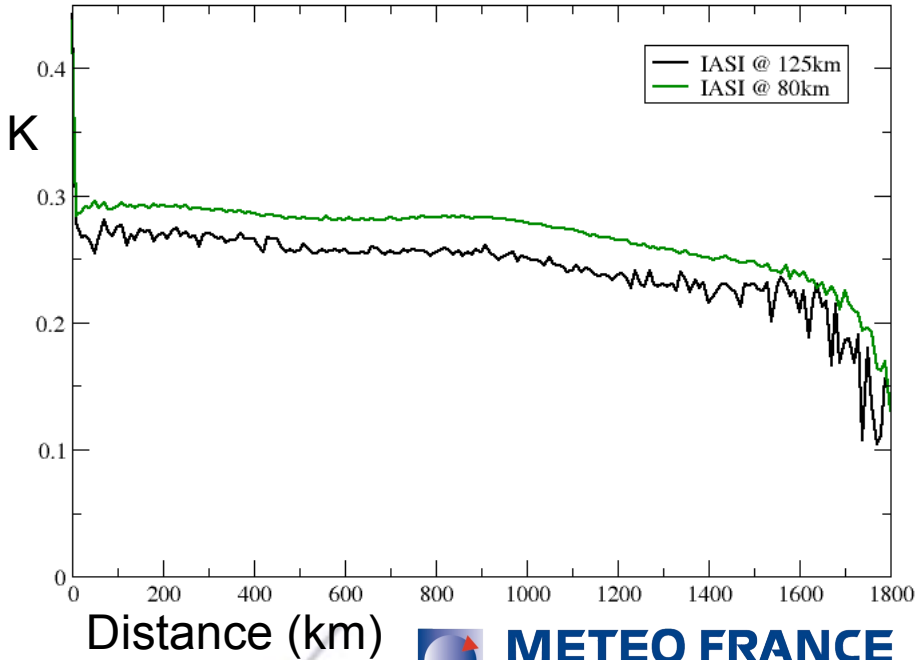
2.b- Observation error estimation

Signal of horizontal observation error correlation for IASI @ 80km ?

Desroziers et al (2005):
Using obs *minus* guess and obs *minus* analysis, provides full R
in particular, sigma_o

Hollingsworth-Lonnberg:
obs *minus* guess for channel 0109 averaged in function of distance
provides R + HBH^T





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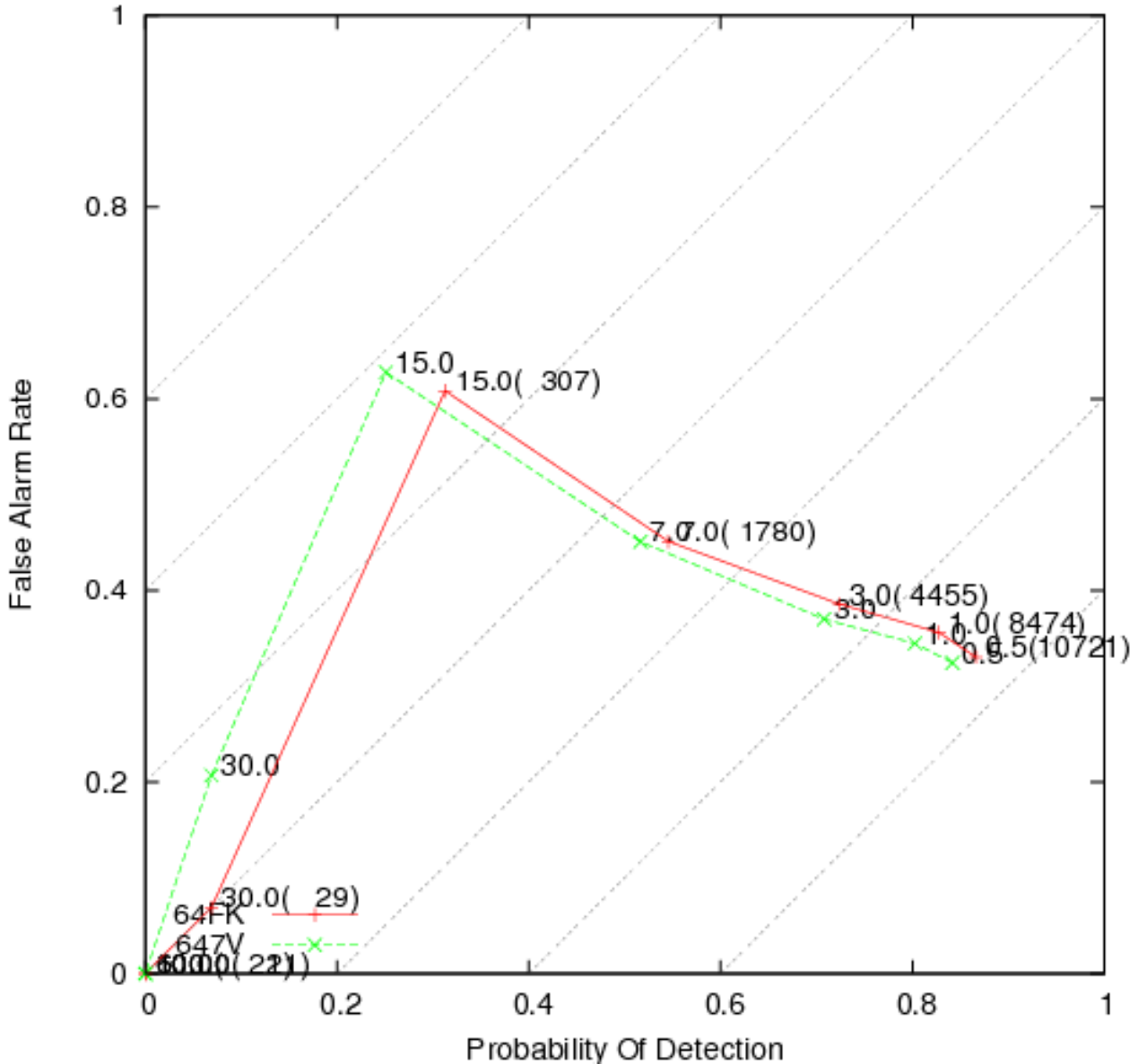
2.c- Impact on rainfall forecasts

- FAR vs. POD
  green = IASI @125 km
  red = IASI @80 km
  stats over 3 weeks
  in December 2009

- POD is better
  @ 80 km

- FAR is =



Conclusion

- IASI has a positive impact both in global and convective-scale NWP
- More data will be used
  - More channels, especially in the water vapour band
  - Cloud affected radiances (eg. Nadia Fourrié's talk)
  - At a higher horizontal resolution
- Tuning observation error statistics may be needed
  - Inter-channel correlation (see Vincent Guidard's poster)
  - Take into account horizontal correlations or find the optimal separation distance
- LAM specific issue in bi-Fourier space:
  if information only on one part of the domain, increments may look bad (-->).
  An additional constraint coming from the coupling model may be introduced in the cost function (Guidard & Fischer, 2008)