



# Toward a better retrieval of fine water vapor atmospheric structures using IASI

**Lydie Lavanant. Météo-France/CMS/R&D**



## Motivation behind this study

- The first results of humidity profile retrievals in low troposphere with IASI were disappointing: accuracy less good than expected from simulations done before the launch of IASI.
- Problems:
  - channels with WV sensitivity in low troposphere are mainly in CO<sub>2</sub> band with high sensitivity to Temperature
  - Bg covariance matrices often don't take into account all local structures
  - temperature and humidity retrievals compensate and add incorrect structures elsewhere
  - large Observation covariance matrices do not allow to leave the initialization
- Question: is it possible to retrieve fine atmospheric structures from IASI data which are not present in the initialization profile?
- This study, test of :
  - dynamic selection of channels at each new processed data
  - reduction of T,q retrieval compensations



## Dynamic selection of channels

### Method:

- 1DVar Levenberg-Marquardt method.
- Guess: ECMWF 12h and 18h forecasts. 0.5x0.5 resolution
- ECMWF Background covariance matrix. Global.

### Experiments:

1. Standard run : 178 pre-selected channels (used for ECMWF oper runs)  
Rmat= constant values @280K ( 1K LW, 0.4K, 2K water vapor, 0.6K SWIR)
2. 178 channels  
Rmat=CNES NeDt (apodized level 1c) band matrix + RTTOV noise
3. In-line selection of channels:  
Rodgers method weighted by  $\Delta tb$  (forecast -Obs) ->150 channels in 366 ECMWF sub-set.
4. Same as 3) but in a sub-set of 1700 channels in bands1,2 sensitive to T,q

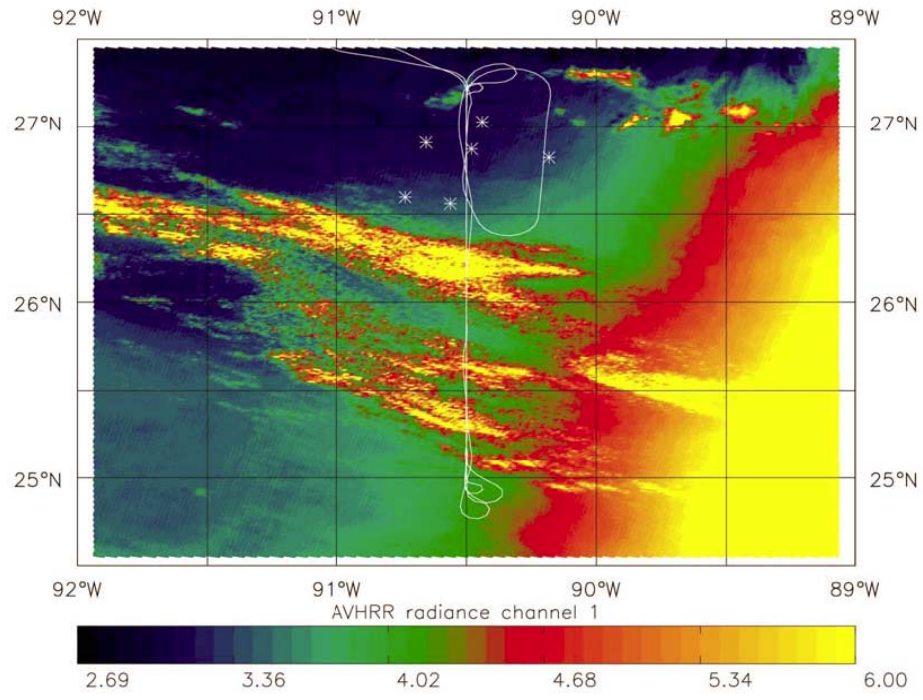
### Data:

- Jaivex campaign clear-sky and marine situations
- IASI / Radiosonde CMS matchup file

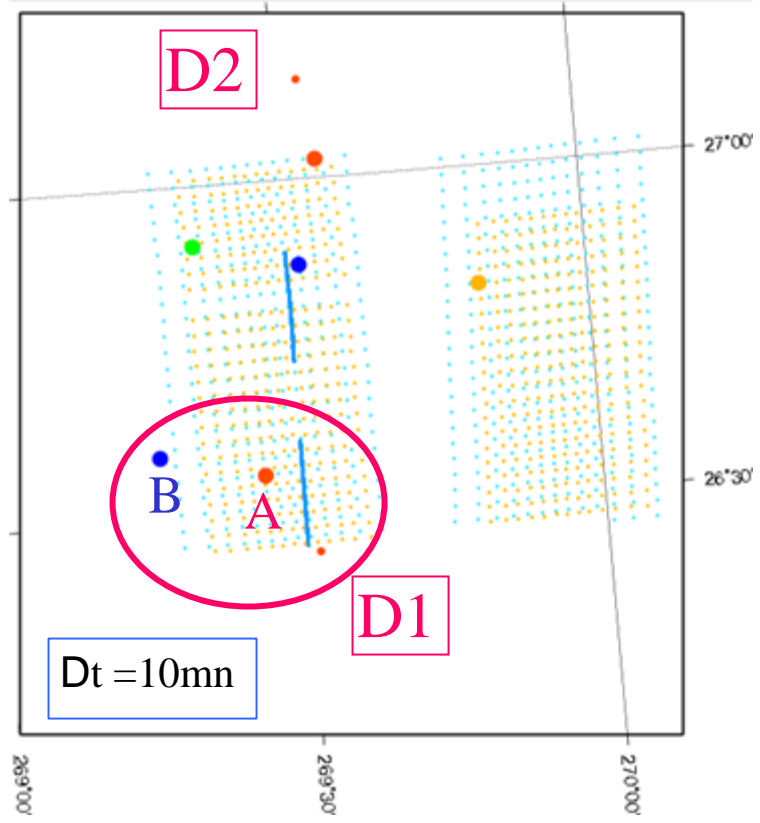
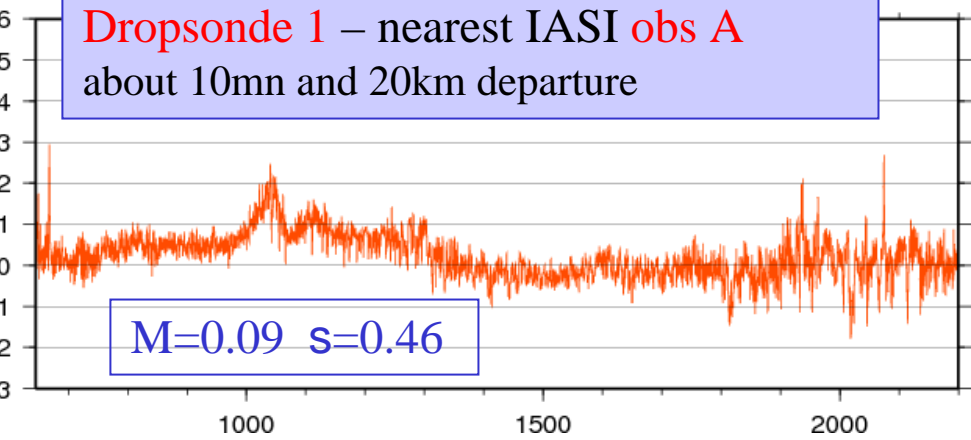


# Tests on Jaivex campaign (1/5)

Example on the 29/04/2007 : marine clear sky case near a cloud layer



Dropsonde 1 – nearest IASI obs A about 10mn and 20km departure

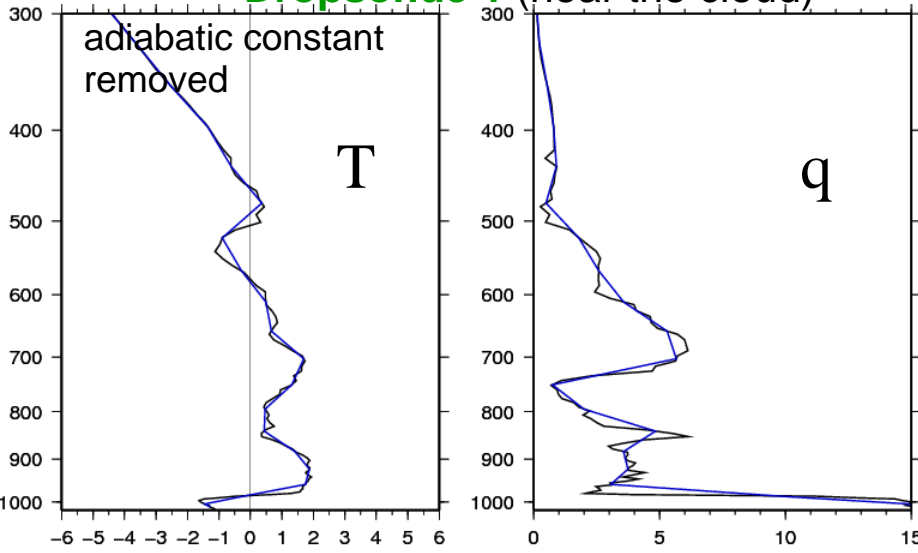




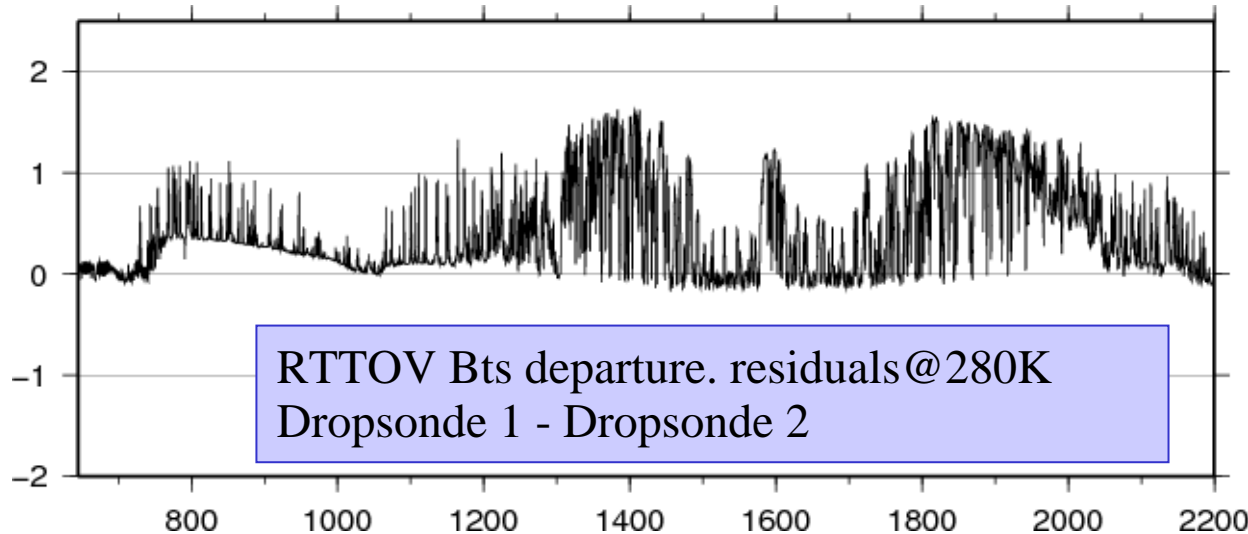
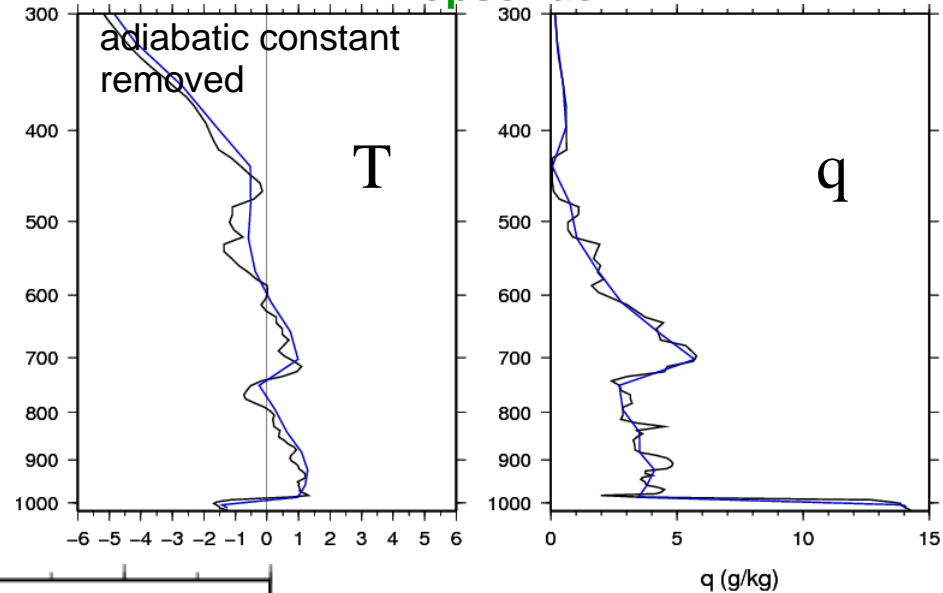
# Tests on Jaivex campaign (2/5)

## Water vapor fluctuations: Impact of dropsondes differences on IASI spectra

**Dropsonde 1** (near the cloud)



**Dropsonde 2**



RTTOV Bts departure. residuals@280K  
Dropsonde 1 - Dropsonde 2

About 10mn and 60-70km departure between dropsondes

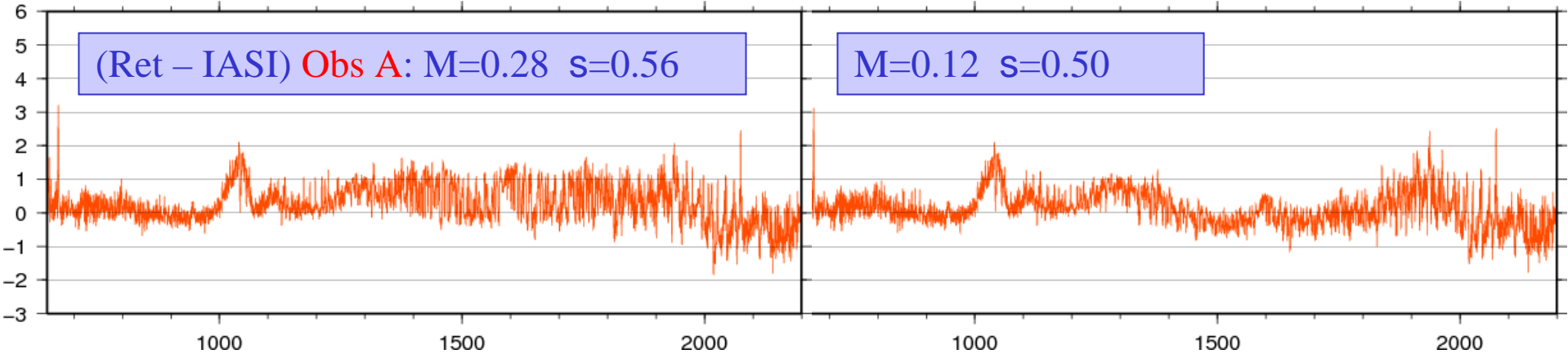
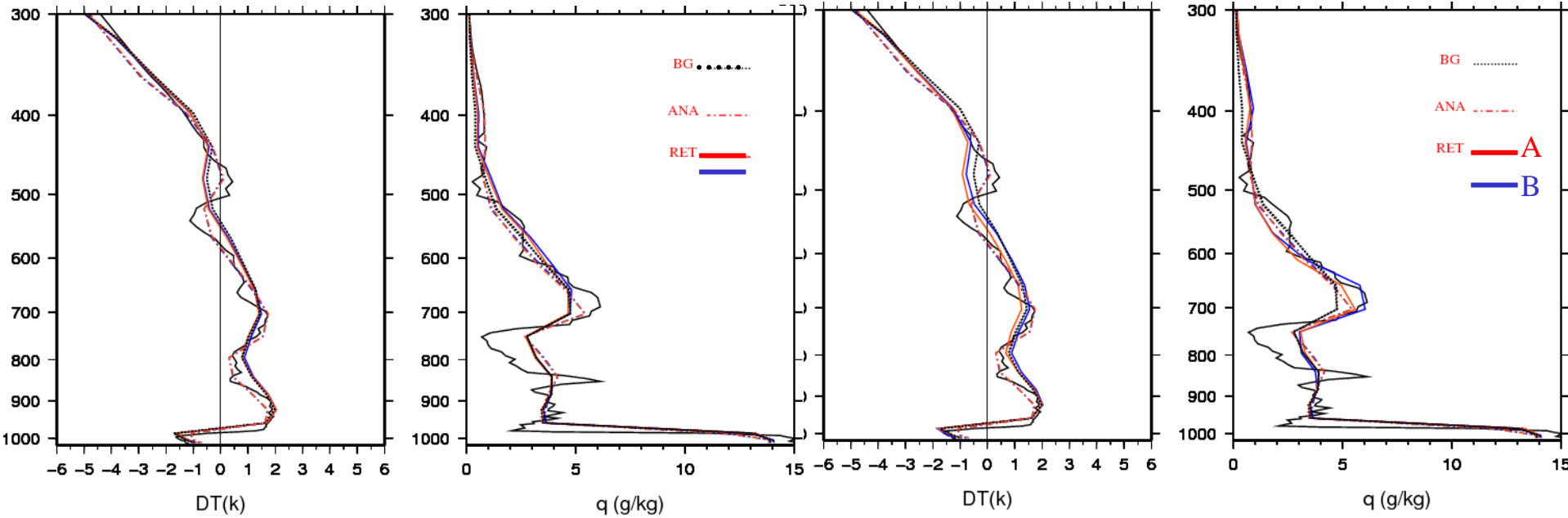
Black: dropsonde  
Blue: Plog interp. on 43 rttov levels



# Tests on Jaivex campaign (3/5)

**Test 1:** 178 channels. Rmat=Cst values

**Test 2:** 178 ECMWF channels.  
Rmat= CNES NeDt band matrix



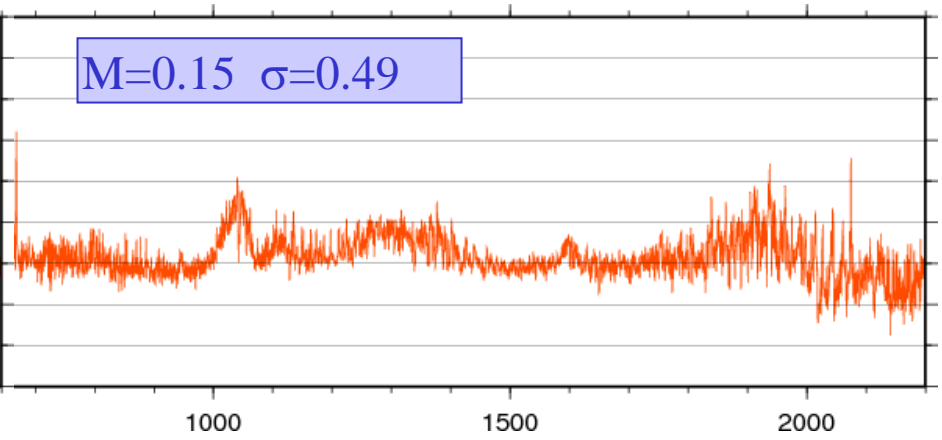
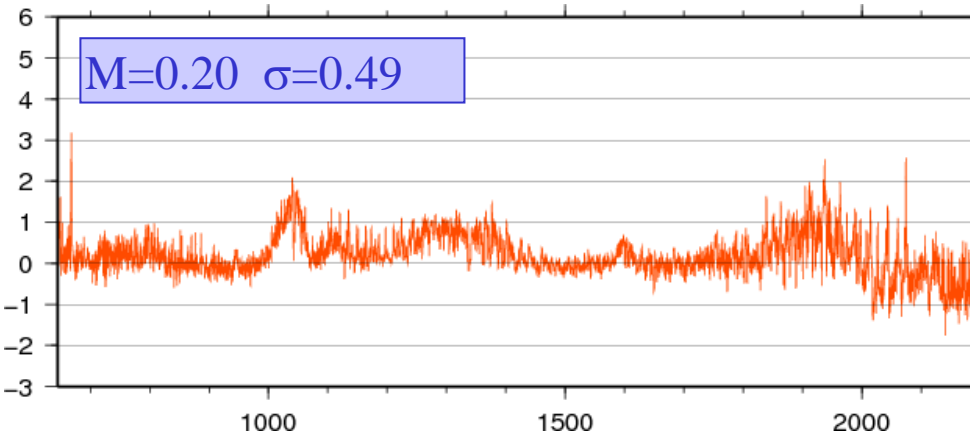
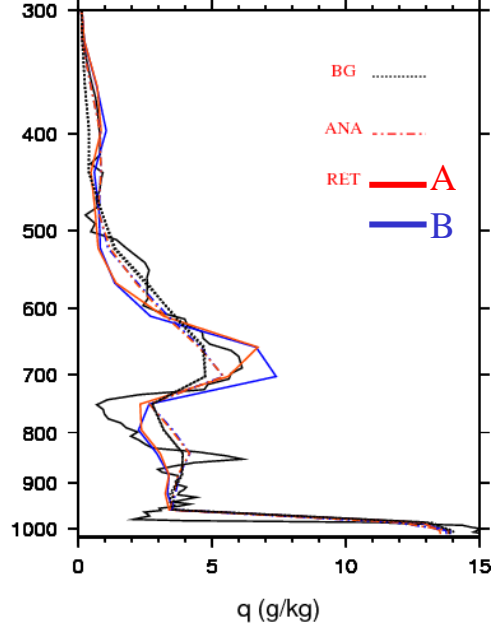
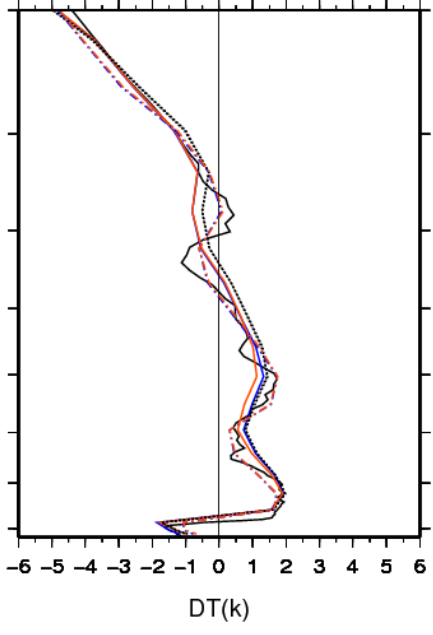
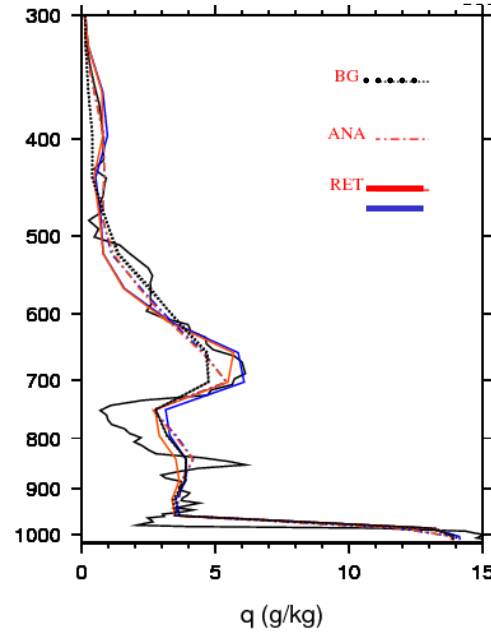
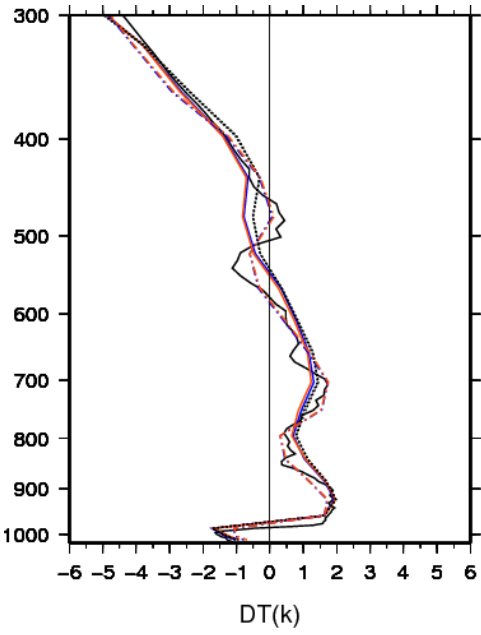




# Tests on Jaivex campaign (4/5)

Test 3: In-line Selection of 150 channels in the ECMWF set of 366 channels

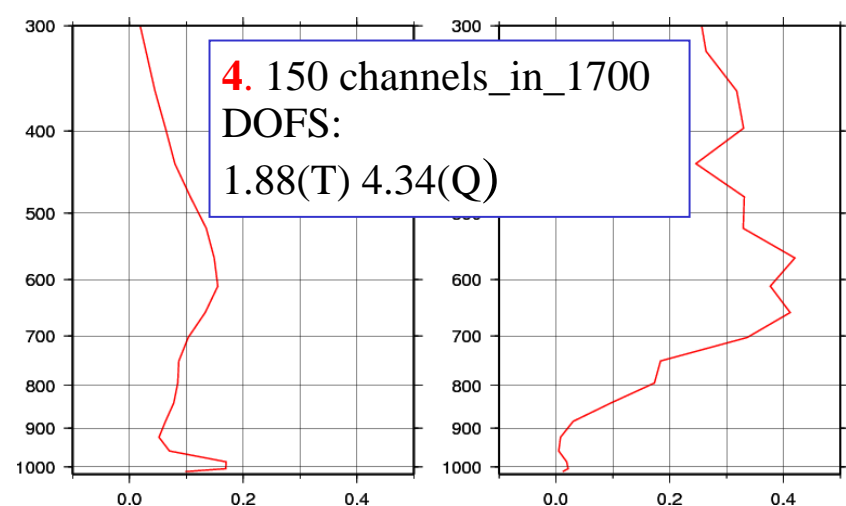
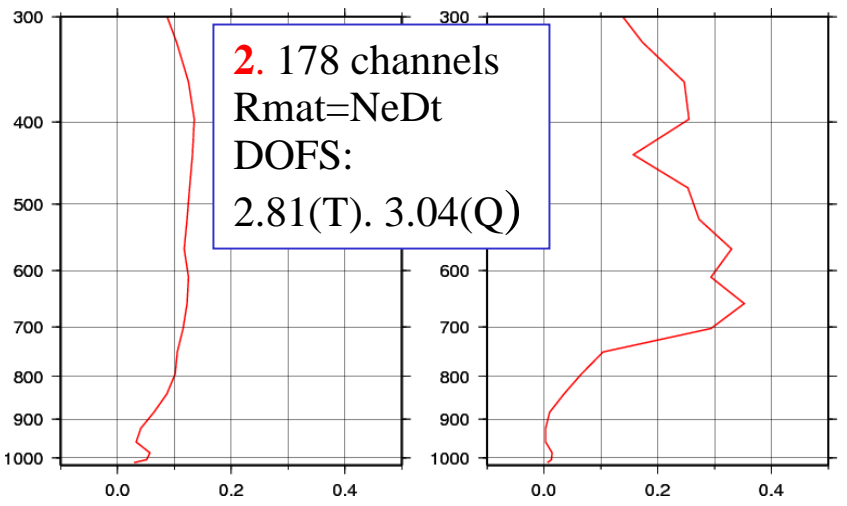
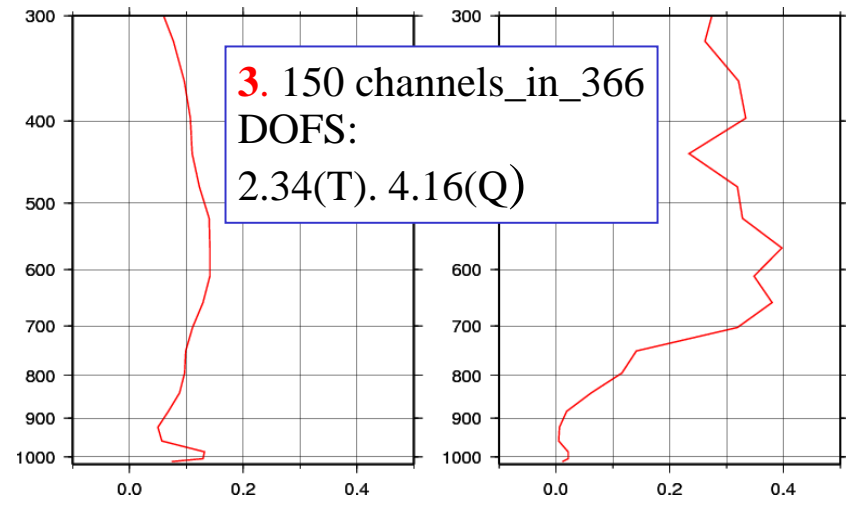
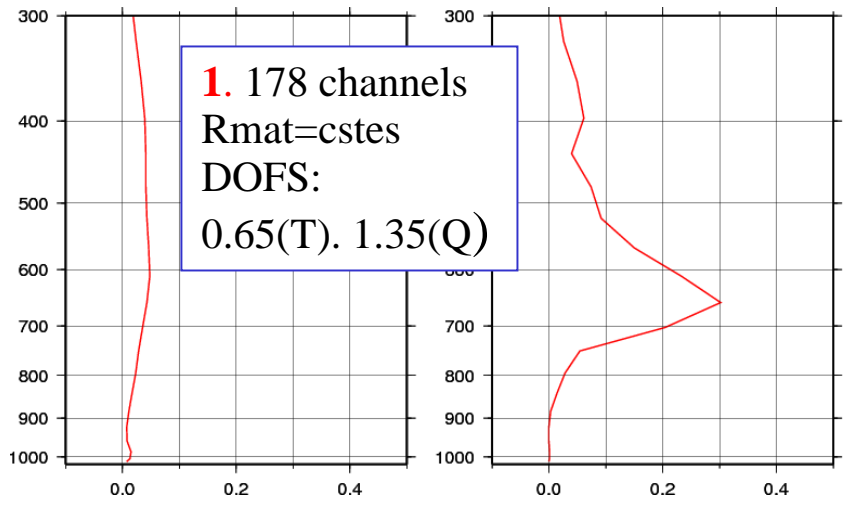
Test 4: Selection of 150 channels in a set of 1700 channels





# Tests on Jaivex campaign (5/5)

## Impact on Averaging kernels area for IASI Obs A







## IASI / RS matchup file(1/2)

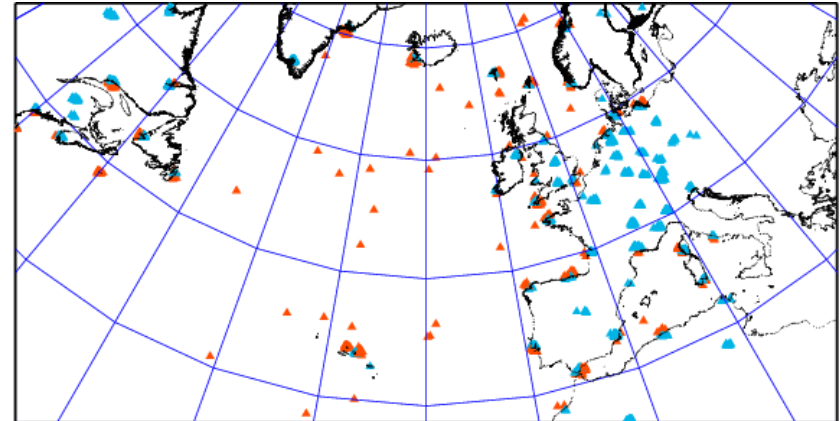
Colocation dataset of radiosonde and nearest IASI Observation with

Distance <50km, time difference < 1h.

Compilation since the 1th of June 2009

### Standard retrieval:

- 114 channels in 366 ECMWF sub-set
- ECMWF global Bmat



### Test:

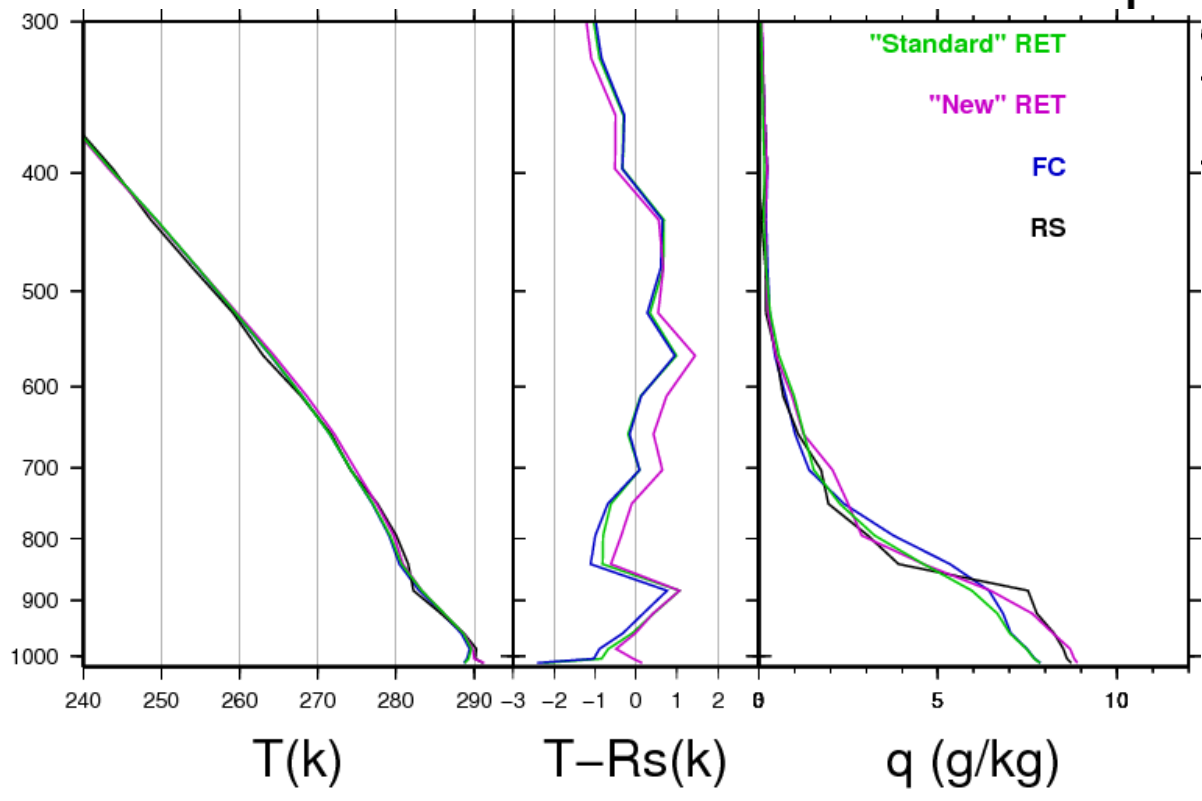
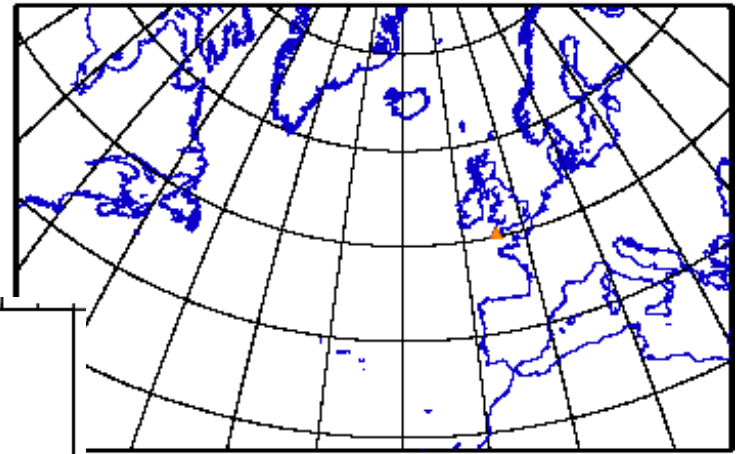
- In line channels selection in the 366 ECMWF sub-set.
- 2 steps with modified Bmat
  1. Temperature profile + Ts only. 50 channels.  
Increased Bmat values near surface + correlation Ts / Ta near surface  
**Purpose: to fix the T profile to reduce compensations of T and q retrievals**
  2. T, q profiles. 100 channels .  
Increased Bmat values near surface for q  
Reduced Bmat values near surface for T



# IASI / RS matchup file(2/2)

IASI: 20090601 / 10:32 - dt\_Rs <1h

Preliminary results: example on the dataset first situation



## Conclusions

- Water vapor fluctuations can change quickly in small distances with:
  - impact on the spectrum could be much larger than noise for distances <50km
  - necessity of doing the WV retrieval at the IASI ifov
- A dynamic in-line selection of channels weighted by  $\Delta B_t(\text{guess-Obs})$  helps retrieving WV fluctuations
- Due to
  - T and Q profile retrieval compensations
  - local structures in Bmat not in global matrix
  - small sensitivity of IASI spectrum to low level humidity profilepreliminary tests indicate that a first “temperature alone” retrieval helps retrieving WV fluctuations

This work will be pursued on RS/IASI co registrations