

# Assimilation of IASI L2 in the ECMWF model with scene dependent observation operators

Kirsti Salonen<sup>1</sup>, Thomas August<sup>2</sup>, Tim Hultberg<sup>2</sup> and Anthony McNally<sup>1</sup>

<sup>1</sup> ECMWF, Reading, United Kingdom, [kirsti.salonen@ecmwf.int](mailto:kirsti.salonen@ecmwf.int)

<sup>2</sup> EUMETSAT, Darmstadt, Germany, [thomas.august@eumetsat.int](mailto:thomas.august@eumetsat.int)



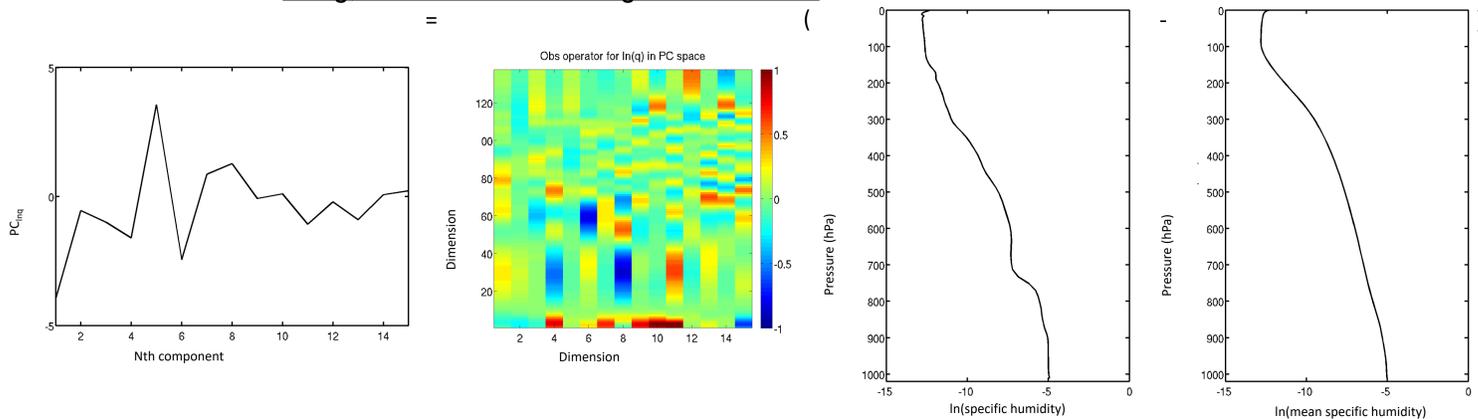
## Introduction

EUMETSAT is producing forecast independent statistical retrievals of atmospheric temperature (T) and humidity (q) from IASI hyperspectral infrared radiances. This is done in preparation for the future product generation from MTG-IRS. Novelty of the product, provided in PC space, is to include scene dependent observation operators characterizing the vertical resolution of the retrieval information. The quality of the retrievals has been investigated and an impact assessment of the clear sky retrievals over sea has been performed in the ECMWF system.

## Scene dependent observation operator

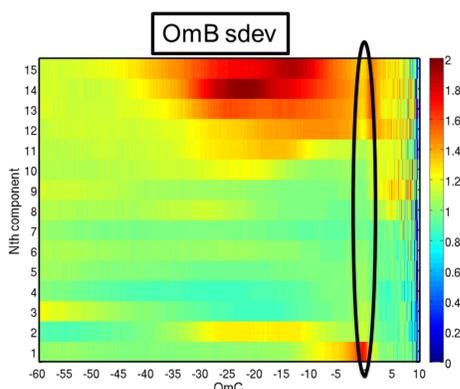
For each retrieval profile a scene dependent observation operator  $H_{\text{scene}}$  is provided.  $H_{\text{scene}}$  together with a mean profile  $x_{\text{mean}}$ , taken from a static data base, is used to transform the model T or  $\ln(q)$  profiles,  $x_{\text{bg}}$ , on 137 pressure levels to the PC space with 15 components. The observation operators take into account the smoothness of the retrieval profiles in the assimilation. Ignoring this has been problematic in the previous assimilation studies especially when assimilating the temperature retrievals.

$$X_{\text{bg, PC}} = H_{\text{scene}} (x_{\text{bg}} - x_{\text{mean}})$$



## Quality control decisions

- The retrieval quality is overall good and homogeneous over sea. Thus, the **focus in this study is on retrievals over sea only**.
- The retrievals are provided with quality information and with information of the cloudiness of the scene, OmC.
- Most effective quality measure is the OmC and criteria **|OmC| < 1 is used to select the clear scenes**. There is a clear increase in the magnitude of observation – background (OmB) standard deviation for the temperature PC scores in cloud affected scenes as seen in the figure.



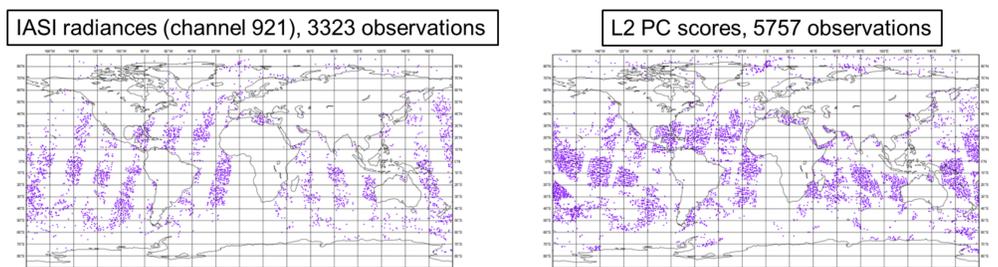
- In addition **criteria  $QI_T < 2$  and  $QI_q < 0.5$**  are used for the provided quality indicators.
- The PC representation is normalised by the retrieval errors and thus, the theoretical observation error is 1. The statistics indicate that slightly higher observation error should be considered for T. **In these experiments observation errors are 2 for T and 1 for  $\ln(q)$  retrievals**. Currently possible error correlations are not taken into account, resulting possibly to sub-optimal use of the data.

## Data assimilation experiments

The experiments shown here are performed in depleted observing system. This is a commonly used methodology to emphasise the impact of adding single instrument or channel into the system. The experimentation covers 3 months, 1.12.2019-28.2.2020.

- Baseline:** conventional observations + AMSU-A (**100% line**)
- Radiance:** Baseline + Metop-C IASI radiances used over sea (**blue line**)
- L2:** Baseline + T and q retrievals from Metop-C IASI over sea (**black line**)

The data selection is designed to be as similar as possible for the retrievals and IASI radiances. Overall impression from the 12-hour sample coverage is that the number of active data is higher for the retrievals but the cloud detection is acting roughly in the same areas.



Figures below show the first guess departure standard deviations normalized by the baseline experiment for radiosonde temperature, humidity and wind, indicating the short range forecast impact. The L2 experiment bring clear improvements to the baseline. The impact on temperature is neutral to slightly positive and the impact on humidity and wind clearly positive. Assimilation of radiances still yield better forecasts at this stage. Further work is ongoing to understand and optimize further the exploitation of the information in the L2 products.

