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

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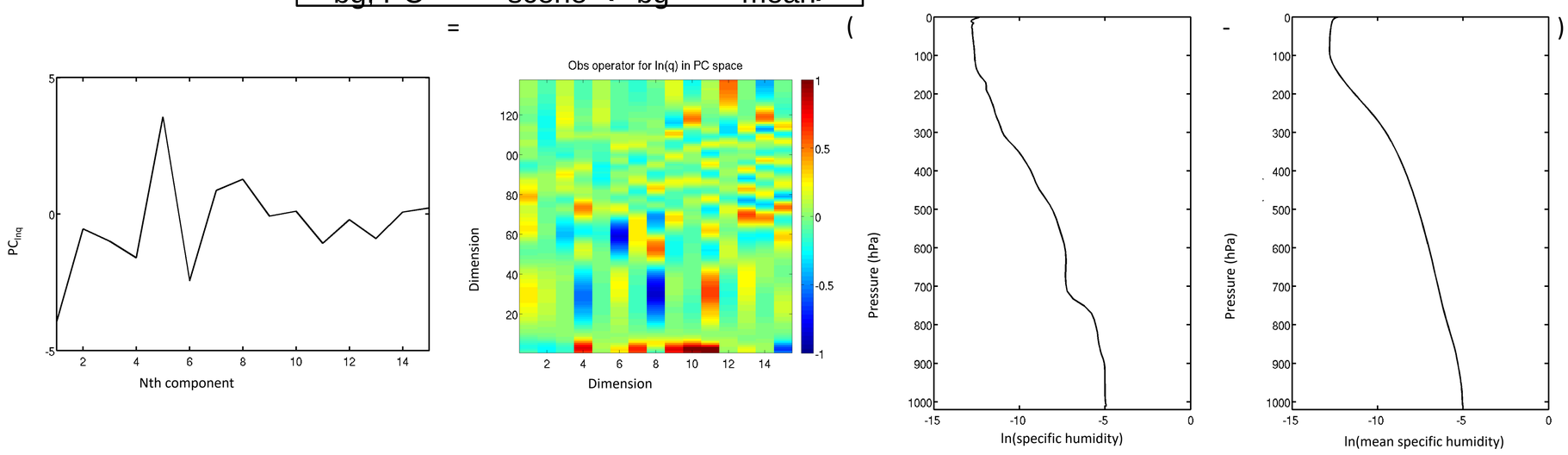
Introduction

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

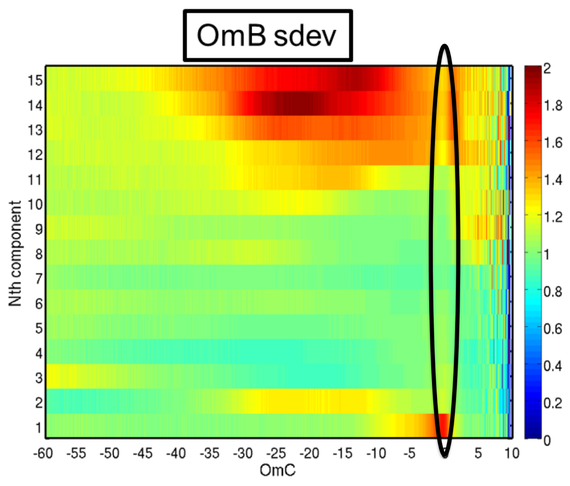
For each retrieval profile a scene dependent observation operator H_{scene} is provided. H_{scene} together with a mean profile x_{mean} , taken from a static data base, is used to transform the model T or ln(q) profiles, x_{bg}, on 137 pressure levels to the PC space with 15 components. The observation 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.

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



Quality control decisions

- The 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) sdev tor the temperature PC scores as seen in the figure.



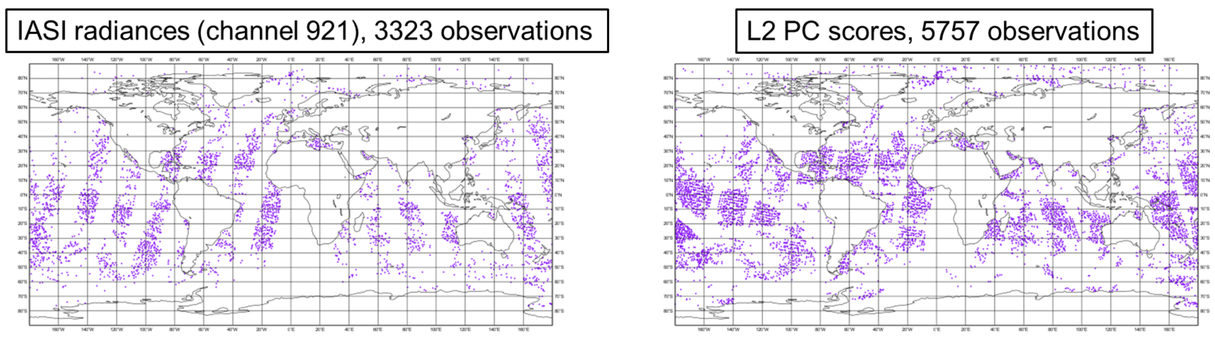
- In addition **criteria QI_T < 2 and QI_q < 0.5** are used for the provided quality indicators.
- The PC retrievals are normalised with their expected errors and the theoretical observation error is 1. However, the statistics indicate that slightly higher observation error should be considered for temperature. **In these experiments observation errors are 2 for T and 1 for ln(q) retrievals** (in PC space).

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. However, the impact of assimilating the radiances brings stronger improvements compared to assimilation of the retrievals.