**Introduction to the IASI-NG principal component and L2 operational processor**

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The IASI-NG, EUMETSAT Polar System (Second Generation), will provide continuity of observations after EPS in the 2020-2040 time frame. It is Europe’s contribution to the future Joint Polar System (EPS), which is agreed to be established together with the National Oceanic and Atmospheric Administration (NOAA) of the United States, following on from the Initial Joint Polar System (IPS).

**The IASI-NG.** Infrared Atmospheric Sounding Interferometer - New Generation, is the successor instrument of the IASI instruments flown on the EPS/Metop satellites. It will provide hyper-spectral infrared soundings of tropospheric temperature, water vapour, and trace gases with a spectral resolution of 0.25 cm⁻¹ (twice the spectral resolution of IASI) within the spectral range from 645 to 2760 cm⁻¹. The noise figures of the IASI-NG are half the ones of IASI. As for IASI, the footprint at Nadir is about 12 km and the observations will be performed at an average spatial sampling distance of 25 km. Similarly as in EPS, IASI-NG will be accompanied by a microwave sounder (MWS) and a high spatial resolution radiometer (METEIR).

The IASI-NG L2 processor has a direct heritage from the operational IASI L2 v6 processor, including BRESCLA and FORLI retrieval functions to generate the EUMETSAT AC SAF products.

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**LID PCC**

IASI-NG measurements consist of signal and noise. The IASI-NG L2C measurements are represented as radiances at 16921 wave-numbers, which are spectrally highly correlated. This correlation comes from the signal itself as the noise is spectrally uncorrelated. This redundancy means that the effective rank of the subspace spanned by the signal within the measurements is much lower than the number of channels; or in other words, the number of independent pieces of information within the IASI measurements is much smaller than 16921. These are the principal components scores (PCS) computed with the leading eigenvectors representing the variance and covariance of the measurements. Reconstructed radiances can be computed from the PCS, effectively projecting the measurements onto the signal subspace with the result that the signal is preserved while a major part of the noise is suppressed. This is illustrated in the figure above. There can be more then one solution of the reconstruction. The residuals are used to compute reconstruction scores. If the reconstruction score for a given species is too high (i.e. exceeds a configurable threshold), then there is suspicion of some atmospheric signal which could not be represented by the selected leading principal components. An analysis of the noise residuals will be used to compute reconstruction scores.

**Prep**

The purpose of the input data preparation is to gather IASI-NG LID measurements and relevant collocated data in a common file, which serves as input for the further sub-functions. The collocated data includes IASI cloud radiance mean and standard deviations (already included in the IASI-NG L1C files). MWS, radiances, ECMWF forecasts data as well as land fraction and surface elevation mean and standard deviations within each IASI-NG field of view.

**PWLR**

All sky statistical retrieval of temperature, water vapour, ozone, emissivity and green-house gases profiles using IASI-NG with co-located MWS radiances.

PWLR is a fast, accurate and precise, all sky retrieval of temperature, water vapour, ozone, and surface pressure, which was developed for version 6 of EUMETSAT’s operational IASI L2 processor, using IASI as well as co-located AMSU and MHS radiances as inputs. The retrieval is based on linear regression, but in order to capture non-linear relationships between the inputs and the outputs, the input space is divided into several classes. For each of these classes a separate set of linear regression coefficients is computed from the corresponding subset of the training set, so that overall a piecewise linear function from the input space into the output space is obtained.

The training set consists of millions of real measurements paired with co-located ECMWF analysis profiles and the retrieval also computes estimates of the absolute retrieval error for each field of view, which are used as quality indicators.

**FORLI and BRESCLA**

Profiles of CO, HNO3 and O3 are retrieved by the FORLI library. The SO2 columnar amount is retrieved by the BRESCLA library. These two libraries are provided by the EUMETSAT AC SAF and take raw radiance from the L1C as input, rather than the reconstructed radiances from L1D and are built for IASI-NG spectra rather than IASI-GS spectra.

In order to invoke them it is therefore necessary to convert the IASI-NG spectra to IASI-Like spectra. After this transformation, the FORLI and BRESCLA libraries have to be applied. The input profiles of temperature and water vapour are taken from the optimal estimation retrieval (or PWLR).

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**References**

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2. EUMETSAT: Europäische Organisation für meteorologische Satelliten, Emmertaler Allee 1, 62699 Darmstadt. 
3. Spectrospatiale de l’Infrarouge, Service de Chimie Quantique et Photophysique, Université Libre de Bruxelles (ULB), Brussels, Belgium.