

# Application of KLIMA algorithm to CO<sub>2</sub> retrieval from IASI/METOP-A observations and comparison with GOSAT/TANSO-FTS products

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**Abstract** — This project aims at the application of the KLIMA inversion algorithm, optimally suited for CO<sub>2</sub> retrieval and integrated into the ESA GPOD (Grid Processing On-Demand) operational environment, to processing Level-1 data acquired by the IASI instrument onboard the METOP-A satellite and at the retrieval of carbon dioxide columns for comparison and cross-validation with GOSAT TANSO-FTS Level-2 data. The activities included in this study are: the adaptation of the KLIMA algorithm for the retrieval of CO<sub>2</sub> column from IASI spectra; a sensitivity assessment and evaluation of the performances of the optimized KLIMA-IASI code for CO<sub>2</sub> retrieval; the integration of the KLIMA-IASI inversion code on the ESA GRID-based operational environment G-POD (Grid Processing On-Demand); the processing of IASI Level 1 data using the KLIMA-IASI/G-POD retrieval code and a final comparison and cross validation of KLIMA-IASI CO<sub>2</sub> products along with GOSAT/TANSO-FTS operational products. For the performance of the retrieval a target accuracy of 0.3% (1 ppmv out of 370 ppmv) on regional scales (1000 × 1000 km) at monthly intervals was assumed as reference value. The KLIMA-IASI retrieval code integration on G-POD has been completed and is now available for bulk processing of IASI data to be compared with TANSO-FTS measurement products for validation purposes. The consolidated version of the KLIMA-IASI code on G-POD will be then made available to all interested users.

**Keywords** — Carbon dioxide, G-POD, GOSAT, KLIMA, Remote sensing

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## 1 INTRODUCTION

This study has been carried out as part of the ESA project KLIMA-IASI, whose final goal is to retrieve CO<sub>2</sub> column values from IASI spectra using the KLIMA inversion algorithm developed by IFAC-CNR and to use this information (averaged over a monthly to seasonal time scale and over a spatial scale compatible with the requirements of a comparison with the CO<sub>2</sub> products of the TANSO-FTS and TANSO-CAI instruments) for GOSAT validation purposes.

## 2 THE KLIMA-IASI PROJECT

The research project “Application of KLIMA algorithm to CO<sub>2</sub> retrieval from IASI/METOP-A observations and comparison with GOSAT/TANSO-FTS products” aims at the application of the KLIMA inversion algorithm, optimally suited for CO<sub>2</sub> retrieval and integrated into the ESA GPOD (Grid

Processing On-Demand) operational environment, to processing Level-1 data acquired by the IASI instrument onboard the METOP-A satellite and at the retrieval of carbon dioxide columns for comparison and cross-validation with GOSAT TANSO-FTS Level-2 data.

The ESA G-POD is a generic GRID-based operational environment where specific data handling applications can be seamlessly plugged into system. The G-POD web portal is a flexible, secure, generic and distributed plat-form where the user can easily manage all its tasks.

## 3 THE KLIMA-IASI ALGORITHM

The KLIMA algorithm consists of two distinct modules, that can operate independently to produce simulated observations or be combined for inverse processing of real or synthetic data: the Forward Model (FM) and the Retrieval Model. The FM

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simulates wideband nadir radiances measured at the top of the atmosphere using line-by-line Radiative Transfer calculation. The code computes the radiance that reaches the instrument, and simulates the instrumental effects. The retrieval procedure is designed as a global-fit, multi-target retrieval, based on the constrained Non-linear Least-Square Fit approach. The retrieval algorithm enables us to fit the wideband spectrum to find more quantities simultaneously (multi-target retrieval) in order to best account for the errors due to the interfering unknowns.

#### 4 ACTIVITIES

The activities included in this study are the adaptation of the KLIMA algorithm into a non operational inversion code optimized for fast and accurate retrieval of CO<sub>2</sub> column from IASI spectra; a sensitivity assessment and evaluation of the performances of the optimized KLIMA-IASI code for CO<sub>2</sub> retrieval; the integration of the KLIMA-IASI inversion code on the ESA GRID-based operational environment G-POD (Grid Processing On-Demand); the processing of IASI Level 1 data using the KLIMA-IASI/G-POD retrieval code and a final comparison and cross validation of KLIMA-IASI CO<sub>2</sub> products along with GOSAT/TANSO-FTS operational products. Optimized versions of the KLIMA-IASI forward and inverse models have been investigated, aiming at developing a non-operation retrieval code with capabilities that meet the requirements of cross validation with GOSAT TANSO-FTS products and with adequate features for the integration on the G-POD system. For the performance of the retrieval a target accuracy of 0.3% (1 ppmv out of 370 ppmv) on regional scales (1000 x 1000 km) at monthly intervals, which is consistent with the requirements of the GOSAT mission for CO<sub>2</sub> products, was assumed as reference

value. The required maximum program size was set to 1 Gbyte and the running time was limited with the aim of processing 1 orbit of IASI data in 1 day when using G-POD computing resources.

Data in EPS (Eumetsat Polar System) format from July 2008 will be processed with the objective of determining whether Level 1B or Level 1C data give the best results.

#### 5 CONCLUSIONS

The KLIMA-IASI retrieval code integration on G-POD has been completed and is now available for bulk processing of IASI data to be compared with TANSO-FTS measurement products for validation purposes. The consolidated version of the KLIMA-IASI code on G-POD will be then made available to all interested users.

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