Monitoring of atmospheric composition with IASI/MetOp Sounders: ULB/LATMOS data in open access via Ether website

Juliette Hadji-Lazaro, Cathy Boonne, Cathy Clerbaux, Maya George, Lieven Clarisse, Martin van Damme, Simon Whitburn, Daniel Hurtmans, Pierre-François Coheur, Thomas August, et al.

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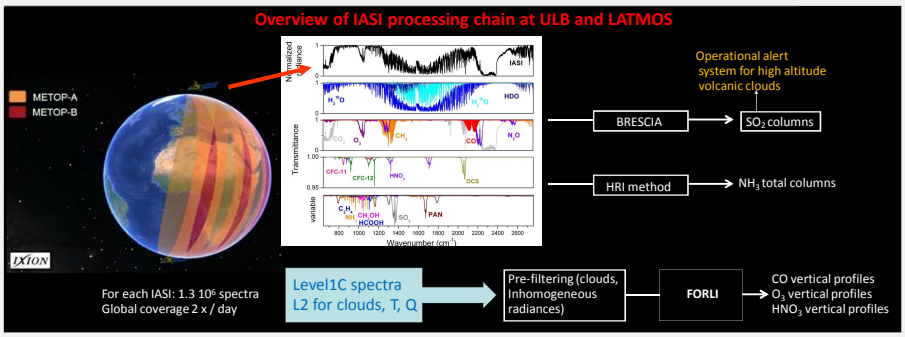
The IASI remote sensor flying onboard the MetOp-A and -B satellites has been providing twice daily observation of the atmospheric composition since the end of 2007.

Global distributions of several reactive species are retrieved from IASI radiance spectra both at ULB and LATMOS, using dedicated radiative transfer models and retrieval schemes. Among the different algorithms set up, the FORLI software series provides near-real-time (NRT) vertical profiles for CO, O_3, and HNO_3, while alternative methods using brightness temperature differences (Brescia) or so-called "hyperspectral range indices" (HRI) coupled with look-up tables or artificial neural networks allow retrievals of SO_2 and NH_3 columns.

The FORLI software package is now implemented in the Eumetsat operational processing chain, in the framework of the Ozone and Atmospheric Composition Satellite Application Facility (O3MSAF): CO products are now distributed by Eumetcast, and O_3 and HNO_3 should follow in 2017. SO_2 Brescia products will be distributed too in 2016.

In this presentation, we will review the methods and the products available from our processing chains. Global scale distributions of CO, O_3 profiles as well as SO_2 and NH_3 columns can be downloaded from the Ether (AERIS) website for further scientific analysis.

Overview of IASI processing chain at ULB and LATMOS

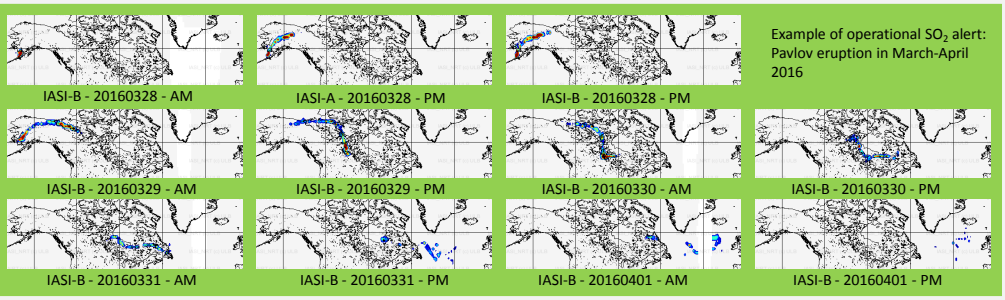


SO_2 Brescia retrieval algorithm

It consists in measuring the difference in brightness temperature between a small number of target sensitive and background channels to determine the presence of the target species. Background channels should respond similarly to H_2O and other atmospheric parameters than the channels sensitive to SO_2. SO_2 Brescia retrieval algorithm is fully described in Clarisse et al. (2012).

At ULB, NRT alerts on volcanic plumes are based on the same algorithm (web interface (http://cpm-ws4.ulb.ac.be/Alerts/) and e-mail alert system).

SO_2 Brescia products will be distributed in near-real-time by Eumetsat through the Eumetcast system distribution in the framework of the O3M SAF project in 2016.



Example of operational SO_2 alert: Pavlov eruption in March-April 2016

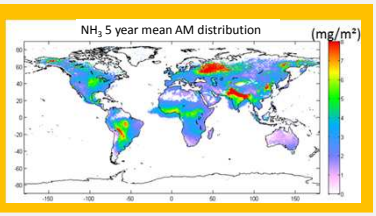
Hyperspectral Range Indices (HRI) method

This method was derived from the work of Walker et al. (2011) and Carboni et al. (2012). The aim of this method is to separate the contribution of the target from the spectral background without having to retrieve any of these other parameters directly. It uses a set of measured spectra where there is some confidence that the signal from the target species is below the noise under normal circumstances. From this set, a mean background spectrum and a total measurement error covariance are estimated.

Then the retrieval consists in two steps. The first is the calculation of the hyperspectral range index (HRI), a dimensionless spectral index, from IASI Level 1C radiance and the mean background spectrum and the total measurement error covariance. In a second step this HRI is converted to a total column using look-up tables or artificial neural networks built from forward radiative transfer model simulations under various atmospheric conditions.

At ULB/LATMOS, this method is used to retrieve NH_3 columns in the spectral range between 800 and 1200 cm^{-1}.

Van Damme et al., 2014



Fast Operational/Optimal Retrievals on Layers for IASI (FORLI)

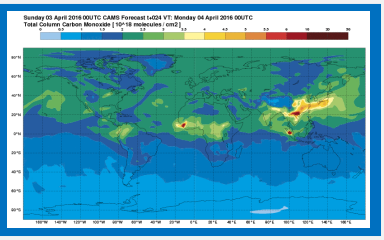
The aim of FORLI is near-real-time provision of global scale concentrations of trace gases from IASI observations, either integrated over the altitude (total columns for CO) or vertically resolved (profiles for O_3 and HNO_3). To decrease the radiative transfer model calculation time, FORLI uses precalculated tables of absorbances. For the inversion step, FORLI relies on a scheme based on the Optimal Estimation theory (Rodgers, 2000). FORLI software is fully described in Hurtmans et al. (2012).

FORLI-CO products are distributed in near-real-time by Eumetsat through Eumetcast system distribution in the framework of the O3M SAF project since September 24, 2015. FORLI-O_3 and -HNO_3 products should be distributed through the Eumetcast system distribution in 2017.

FORLI-CO in Copernicus project

FORLI-CO products (total column) are operationally assimilated in the ECMWF near-real time analysis to produce chemical forecasts of CO global distributions in the framework of the CAMS (Copernicus Atmospheric Monitoring Service) of Copernicus project.

http://www.gmes-atmosphere.eu/d/services/gac/nrt/nrt_fields/



Dissemination of IASI data through CDS-ESPRI/AERIS (former Ether) web portal

The **AERIS Data & Services** is an infrastructure designed to foster the use of atmospheric data by offering to scientific or public actors access to a broad range of data acquired from space, airborne, in-situ or balloon, ...

http://www.aeris-data.fr/

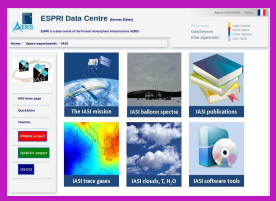
AERIS is built upon **4 existing French data & services centers** including **CDS-ESPRI** (former Ether) dedicated to atmospheric chemistry.

http://cds-espri.ipsl.fr

Click on IASI logo to access to IASI web pages

IASI Home Page

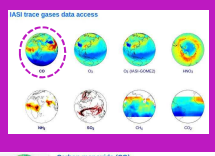
http://cds-espri.ipsl.fr/etherTypo/index.php?id=1577&L=1



The **IASI home page** permits users **to access** :

- Information on the IASI mission
- IASI publications
- various IASI (MetOp-A and MetOp-B) data :
  - research trace gases free data : **CO** (FORLI), **NH_3** (HRI), **SO_2** (Brescia)
  - *soon CH4 and dust (from LMD), O_3 (FORLI and from LISA)*
  - Eumetsat IASI free data (level 2) : T, H_2O, cloud, COX
  - balloon spectra
- Software tool : **OBR**, the application allows to read IASI level 1C and Eumetsat level 2 data. An user manual is available to give information on the different parameters that the application uses to extract the data.

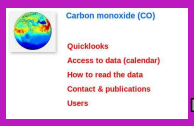
Research Data Access Web Pages (e.g. CO data pages)

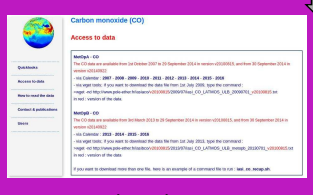


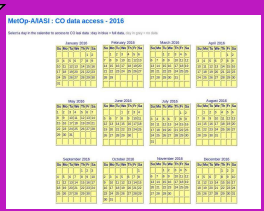
Trace gases pages presents the same five items.

Access to data :

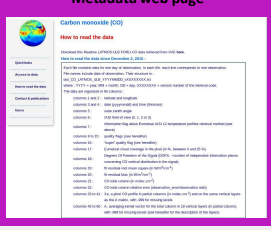
- Via calendar
- Via wget tools



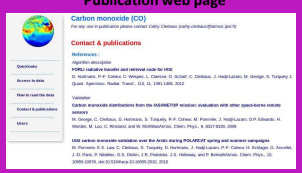




Metadata web page

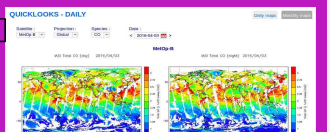


Publication web page

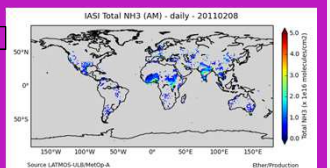


Quicklooks interface

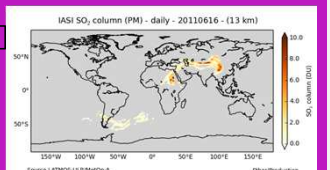
CO



NH_3



SO_2



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