Monitoring and forecast of atmospheric composition with IASI/MetOp

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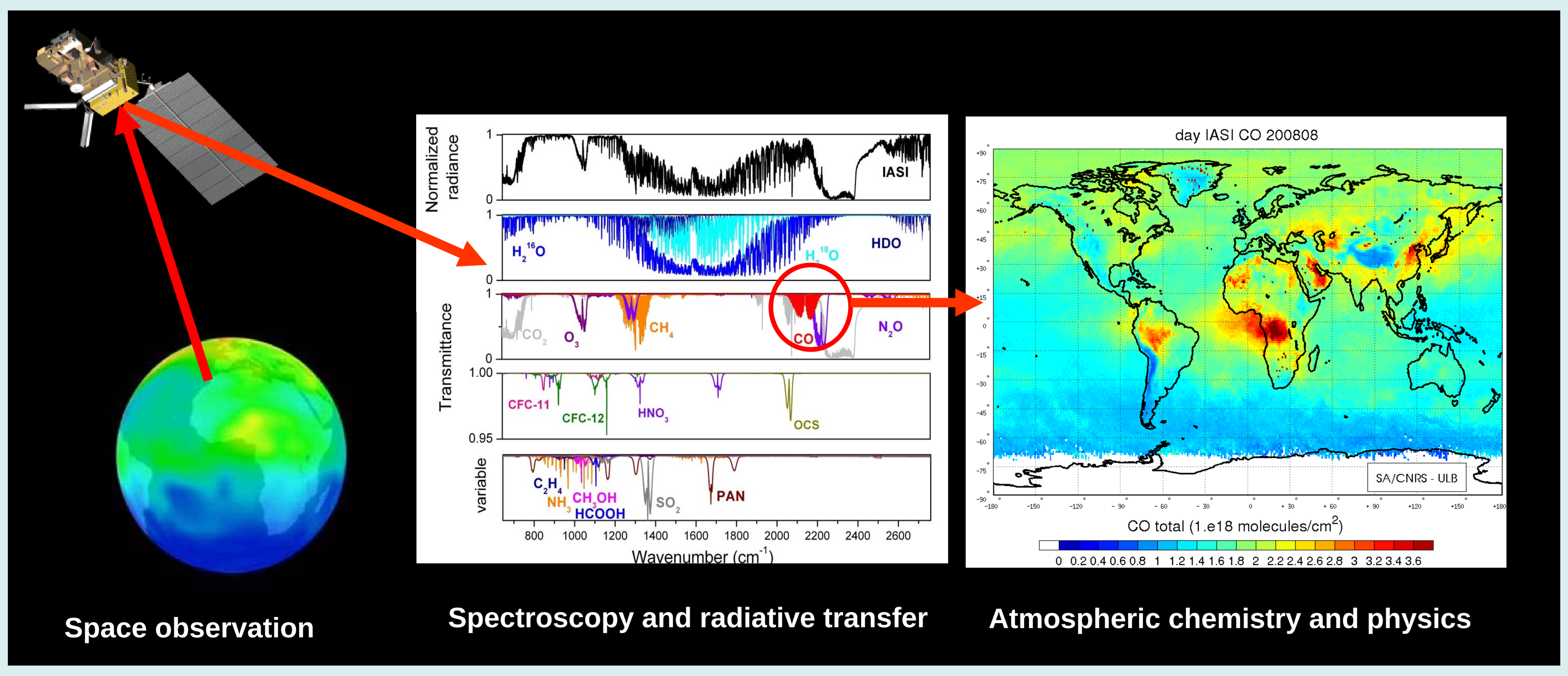
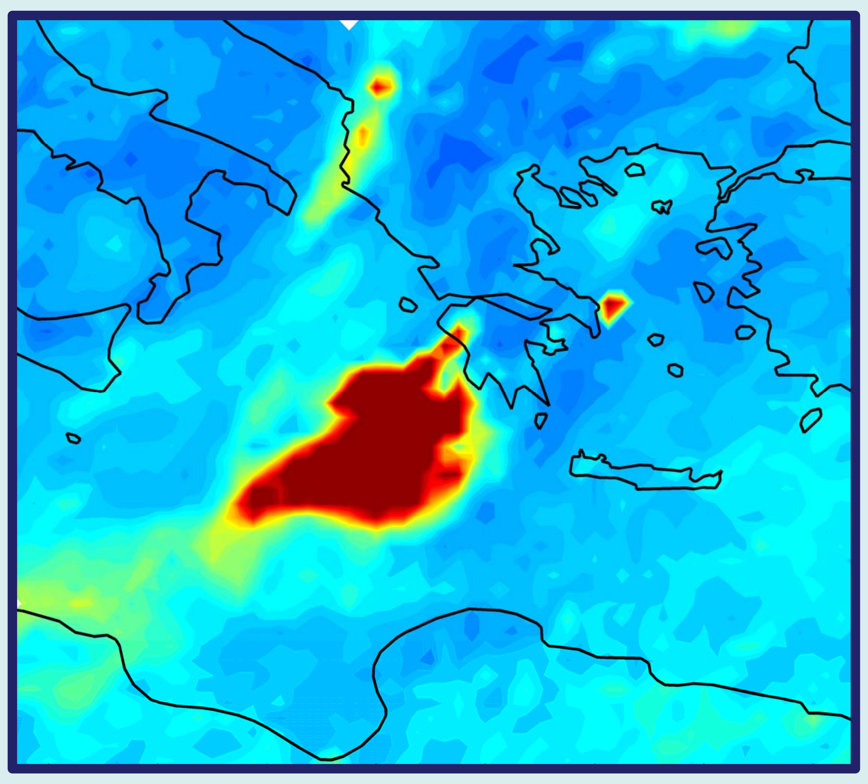
The IASI instrument developed by CNES and launched by Eumetsat onboard the MetOp satellites series is providing essential inputs for weather forecasting and pollution/climate monitoring. This mission based on a nadir looking thermal infrared Fourier transform spectrometer is measuring the atmospheric composition changes with an excellent horizontal resolution and coverage. Owing to the very good radiometric performance of the instrument a list of 24 climate and chemistry relevant species has been identified in the IASI spectra. As the data are available in near-real time, operational applications have been developed to exploit the global, regional and local distributions of trace gases that can be derived at cloud-free location two times per day.

Atmospheric composition measurement



The processing chain consists of sophisticated radiative transfer models and retrieval procedures, such as the FORLI –Fast Operational/Optimal Retrievals on Layers for IASI– software (HNO_3, CO, O_3 columns and profiles), and a series of fast and robust methods for measuring local hotspots on the globe (NH_3, VOCs). We provide below three illustrations of the local to global distributions obtained for some of these species, emphasizing on the capabilities of the instrument to identify local pollution sources, to track the transport of the resulting plumes over long distances, and to capture major events.

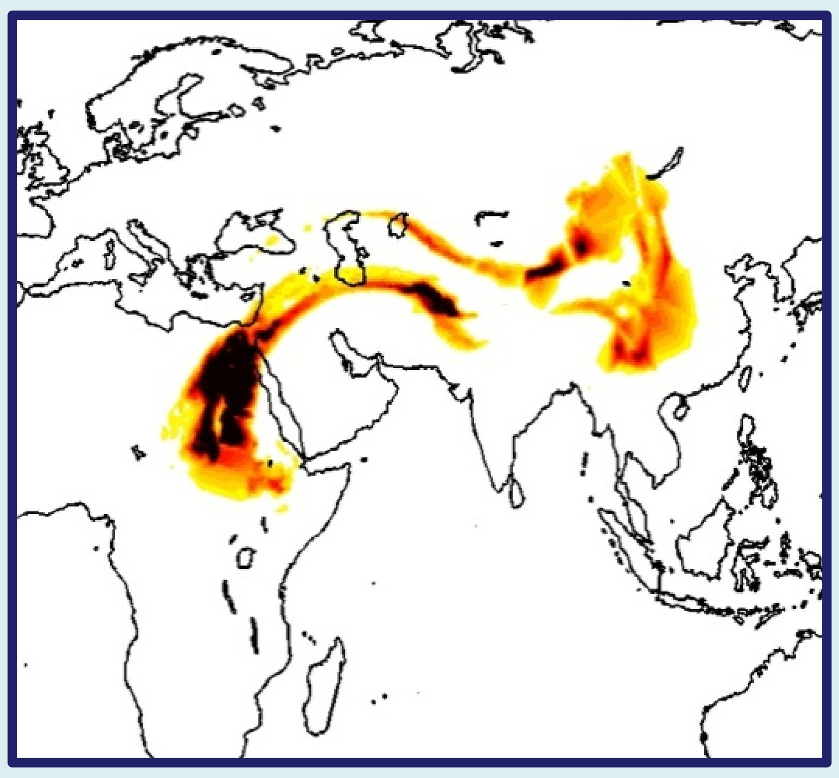
CO as a tracer of fire activity



Carbon monoxide is a primary pollutant produced from vegetation burning for agricultural purposes or from wildfires. Other emission sources include fossil fuel combustion (associated with car traffic, industry and domestic heating) as well as methane and non-methane hydrocarbon oxidation. Its primary sink is oxidation by the hydroxyl radical (OH), which in turn controls the removal of most of the atmospheric pollutants as it is usually the predominant atmospheric oxidant. The CO atmospheric lifetime ranges from a few weeks to a few months depending on location and season, making it particularly suitable as a tracer of pollutant emissions. As result of its relatively long lifetime, it undergoes long range transport from its sources and mixes both horizontally and vertically.

The CO tropospheric column is measured by IASI with around 10 % accuracy, and with a maximum of 2 independent pieces of information on the vertical. The data are available for further scientific use at **http://ether.ipsl.jussieu.fr/** and are operationally assimilated in the MACC ECMWF near-real time analysis to produce chemical forecasts of CO global distributions. The EU-funded MACC (Monitoring Atmospheric Composition and Climate) project (component of the GMES initiative) operates and improves data-analysis and modeling systems for a range of atmospheric constituents (**http://www.gmes-atmosphere.eu/**).

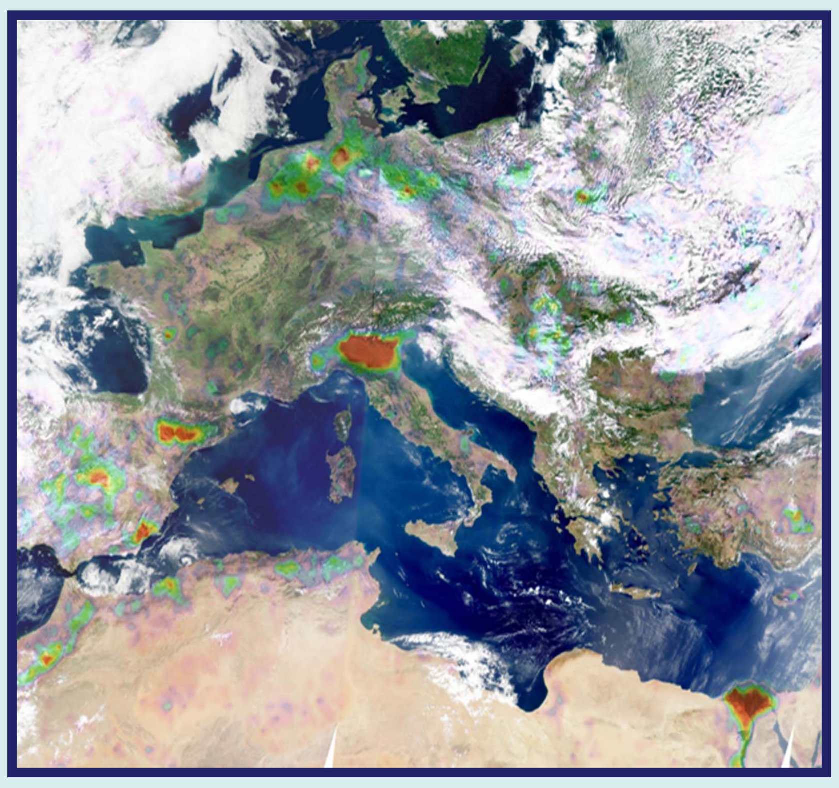
Early detection of SO_2 from volcanic plumes for aviation hazard mitigation



Volcanoes are an important source of **sulfur dioxide** and **ash** particles. Eruptive events emit, in addition to large amounts of ash, a gaseous plume high into the troposphere or even the stratosphere. Volcanic emissions pose a risk for populations living close to volcanically active regions and for air traffic as aircraft engines can be damaged by both ash and sulphuric acid. Therefore, rapid detection of volcanic emissions and prediction of their transport pathways is of high interest.

Based on the IASI SO_2 retrieval system ULB is running in near-real time an SO_2 alert system since November 2008. The alerts are sent out by email and complemented by images directly available on the web (**http://cpm-ws4.ulb.ac.be/Alerts/index.php**). As the retrieval technique is negligibly affected by SO_2 in the boundary layer (e.g. pollution or passive degassing of volcanoes) it is an ideal tool to be used for aviation hazard mitigation.

Ammonia hotspots for a better forecast of PM



Global **ammonia** emissions have more than doubled since pre-industrial times, largely owing to agricultural intensification and widespread fertilizer use. In the atmosphere, ammonia accelerates particulate matter formation, thereby reducing air quality. Despite its ecological significance, there are large uncertainties in the magnitude of ammonia emissions, mainly owing to a paucity of ground-based observations and a virtual absence of atmospheric measurements.

The infrared spectra obtained by IASI were used to map global ammonia concentrations from space. We identified several ammonia hotspots in middle–low latitudes across the globe. In general, we found a good qualitative agreement between the satellite measurements and simulations made using a global atmospheric chemistry transport model. However, the satellite data reveal substantially higher concentrations of ammonia north of 30° N, compared with model projections.

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