IASI is turning ten!

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ABSTRACT

The IASI mission is a versatile mission that fulfills the needs of three different communities: numerical weather prediction, climate research and atmospheric composition monitoring. In order to converge on the design of such an instrument all three communities had to make "reasonable accommodations" 20 years ago, and it turns out that this mission is now recognized as essential for weather forecasting, and for tracking pollutants/greenhouse gases from space. With the launch of MetOp-B and -C and the continuity and new challenges offered by IASI-NG, an exceptional data record will be available in the next few years.

The presentation (movie) illustrates some of the major findings related to atmospheric composition changes as monitored by IASI during the last 10 years. It relies on accurate data available in near real time along with an excellent horizontal coverage. We will show the global scale mapping of gases, along with the detection of dust and ash particles, as well as the potential of the mission to catch special events such as volcanic eruptions, large fires and pollution peaks.

Tropospheric Ozone Variability during the East Asian Summer Monsoon as Observed by Satellite (IASI), Aircraft (MOZAIC) and Ground Stations

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Abstract

Satellite measurements from the thermal Infrared Atmospheric Sounding Interferometer (IASI), the Measurements of OZone and water vapor by in-service AIrbus airCraft (MOZAIC), as well as observations from ground based stations, are used to assess the tropospheric ozone (O_3) variability during the East Asian Summer Monsoon (EASM). Six years [2008-2013] of IASI data analysis reveals the ability of the instrument to detect the onset and the progression of the monsoon reflected by a decrease in the tropospheric [0-6] km O_3 column due to the EASM, and to reproduce this decrease from one year to the other. Focusing on the period of May-August 2011, taken as an example year, IASI data show clear inverse relationship between tropospheric [0-6] km O_3 on one hand and meteorological parameters such as cloud cover, relative humidity and wind speed, on the other hand. Aircraft data from the MOZAIC project at Hyderabad, Nanjing and Guangzhou are used to validate the IASI data and to assess the effect of the monsoon on the vertical distribution of the tropospheric O_3 at different locations. Results show good agreement with a correlation coefficient of 0.74 between the [0-6] km O_3 column derived from IASI and MOZAIC. The aircraft data show a decrease in the tropospheric O_3 that is more important in the free troposphere than in the boundary layer and at Hyderabad than at the other two Chinese cities. Ground station data at different locations in India and China show a spatiotemporal dependence on meteorology during the monsoon, with decrease up to 22 ppbv in Hyderabad, and up to 5 ppbv in the North China Plain.

Towards a 10 years reanalysis of tropospheric and lower-stratospheric ozone with assimilation of IASI and MLS observations.

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ABSTRACT

Tropospheric ozone is a trace gas involved in the global greenhouse effect. During the last ten years, the tropospheric ozone increase has stopped in North mid-latitudes. Ozone variability in the troposphere is largely driven by stratosphere to troposphere exchanges (STE). An accurate determination of tropospheric and lower stratospheric ozone is necessary to quantify accurately the ozone dynamics.

The aim of this study is to understand and to assess STE and the variability of tropospheric ozone during the available years (2008-2013) of IASI observations from satellite Metop-A. IASI instrument allows global coverage with very high spatial resolution and its measurements are promising for long term ozone monitoring.

The global chemical transport model MOCAGE (MOdèle de Chimie Atmosphérique à Grande Echelle) has been used with a linear ozone chemistry scheme and meteorological forcing fields from ERA-Interim (ECMWF global reanalysis) to assimilate Microwave Limb Sounder (MLS) and IASI data. The 2°x2° global version of MOCAGE, with 60 sigma-hybrid vertical levels has been used. MLS observations and IASI-SOFRID O3 retrievals have been assimilated with a 4D-VAR variational algorithm to constrain stratospheric and tropospheric ozone respectively.

The MLS analysis, computed for the period 2004 to 2014, is validated against ozonesonde measurements and, for instance, shows episodes of ozone transport between stratosphere and troposphere. This validation confirms the effectiveness of MLS profiles assimilation in the stratosphere. Comparisons between MLS analysis and IASI-SOFRID O3 tropospheric column show a good consistency. This comparison shows that ozone transport from the upper-troposphere / lower-stratosphere (UTLS) detected by IASI-SOFRID data is consistent with the MLS analysis. As some previous research studies showed, biases between IASI-SOFRID and model (as high as 30%) in high latitudes are present but the ozone variability has been improved by the assimilation (standard deviation in the range of 15%). Overall the assimilation of IASI-SOFRID ozone retrievals improves the model ozone columns in the free troposphere and in the UTLS.

Global tropospheric budget using such long term reanalysis will be discussed. In the future, similar studies could be performed with the IASI-NG instruments with a first launch scheduled in 2018. The objective will be to extend the studied period to several decades.

Ozone and CO upper-tropospheric budget and variability during the Asian Summer Monsoon for 2008-2015: IASI and IAGOS observations and GEOS-Chem simulations.

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Topic 2 : Science and application
Atmospheric composition

Oral presentation

Abstract :
During the Asian Summer Monsoon (ASM), primary pollutants (CO, HCN, aerosols) accumulate into the large scale Asian Monsoon Anticyclone (AMA) that extends from the upper troposphere to the lower stratosphere. This accumulation is mostly due to South and East Asian pollution uplifted by monsoon convection. This lower tropospheric air uplift has a potentially strong impact upon the UTLS O_3, aerosols and water vapour budget and therefore also on the surface radiative forcing. Boundary layer precursors (NOx, COV's) uplifted from the densely populated regions of Asia are responsible for the photochemical production of O_3. Other sources have a potentially large impact on UT O_3 enhancement such as the production of NOx by lightning's and stratospheric intrusions from the subtropical jet.
The first objective of our study is to quantify the relative impact of these different sources on the Asian UT composition during the pre- to post-monsoon period. We have therefore performed a reference simulation with the GEOS-Chem global chemistry transport model for the 2008-2013 period. Distributions of CO and O_3 in the Asian troposphere are evaluated versus IAGOS observations from flights between Asia and Europe or the Middle-East and versus IASI-SOFRID retrievals. For chemical budget assessment we have performed sensitivity simulations with CO and NOx emissions from different types and regions impacting the AMA switched off. Our second objective is to characterize the intra-seasonal and interannual variabilities of the AMA composition. We will therefore present the departures of the CO and O_3 distributions from their climatological means for the 2008-2015 period. The analyses of these departures in light of different climate indices, meteorological parameters and sensitivity simulations will help to understand the dynamical and chemical factors controlling them.

CO monitoring with IASI: global and local variability

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ABSTRACT

Carbon monoxide (CO) is an important trace gas for understanding air quality and atmospheric composition. It is a good tracer of pollution plumes and atmospheric dynamics. Since the launch of the MetOp satellite, IASI CO concentrations are retrieved on a daily base and in near real time from the radiance data, using the Fast Operational/Optimal Retrievals on Layers for IASI (FORLI) algorithm. These products are now generated and operationally distributed by EUMETCAST under the O3MSAF auspices.

Global scale CO distributions will be shown, and the seasonal/annual variabilities over 8 years will be analyzed. A special focus will be put on the record concentrations observed over the islands of Borneo and Sumatra in the fall 2015, due to the worst forest fires in nearly two decades. This pollution excess is associated with the predictable impacts of the strong El Niño currently underway. We will provide estimates of the carbon emissions using a data-assimilation system that derives CO emissions from IASI data. Finally, we will show how this event is taken into account by the Copernicus Atmospheric Monitoring Service, and the usefulness of the IASI data in this context.

IASI 2016 Abstract

Assessing the Impacts of Assimilating IASI and MOPITT CO Retrievals using CESM-CAM-chem and DART

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ABSTRACT

We show the results and evaluation with independent measurements from assimilating both MOPITT (Measurements Of Pollution In The Troposphere) and IASI (Infrared Atmospheric Sounding Interferometer) retrieved profiles into the Community Earth System Model (CESM). We used the Data Assimilation Research Testbed ensemble Kalman filter technique, with the full atmospheric chemistry CESM component Community Atmospheric Model with Chemistry. We first discuss the methodology and evaluation of the current data assimilation system with coupled meteorology and chemistry data assimilation. The different capabilities of MOPITT and IASI retrievals are highlighted, with particular attention to instrument vertical sensitivity and coverage and how these impact the analyses. MOPITT and IASI CO retrievals mostly constrain the CO fields close to the main anthropogenic, biogenic, and biomass burning CO sources. In the case of IASI CO assimilation, we also observe constraints on CO far from the sources. During the simulation time period (June and July 2008), CO assimilation of both instruments strongly improves the atmospheric CO state as compared to independent observations, with the higher spatial coverage of IASI providing better results on the global scale. However, the enhanced sensitivity of multispectral MOPITT observations to near surface CO over the main source regions provides synergistic effects at regional scales.

Spatio-temporal variability of three anthropogenic greenhouse gases CO_2, CH_4 and N_2O in the mid-troposphere as seen from IASI onboard Metop-A and Metop-B

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ABSTRACT

Thanks to its continuous spectral coverage of the whole thermal infrared domain, the IASI instrument offers the possibility to retrieve mid-tropospheric columns of the 3 major greenhouse gases influenced by human activities. These are: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The very small seasonal variability of these gases compared to their background values, combined to the strong dependence of IR radiances to atmospheric temperature and the simultaneous sensitivity of the channels to several gases, makes their retrieval challenging.

The non-linear inference scheme developed at LMD delivers mid-tropospheric columns of the 3 gases for both day and night condition, over land and over sea. It strongly relies on careful validation of level1c spectra, characterization of systematic radiative biases and severe cloud and aerosol screening. Almost 9 years of observations from Metop-A and 2 years from Metop-B have now been processed. CH_4 and CO_2 atmospheric columns are delivered on "near real time" (D-1) basis to the Copernicus-Atmosphere Service. Owing to its 20 year-program, IASI also participates to the establishment of long time series in the ESA-Climate Change Initiative-GHG. The retrievals are thus used for a variety of purpose: assimilation to produce CH_4/CO_2 profile forecasts; estimation of surface fluxes using "top-down" atmospheric inversions; characterization of specific emissions such as biomass burnings.

In this talk we will present the latest development of the retrievals of these 3 gases. In particular, recent achievements include: (i) extension of the spatial coverage of methane from the tropical region to mid and high latitudes; (ii) improvement of CO_2 retrieval in the tropical region by a combination of hundreds of 15µm channels; (iii) processing of Metop-B; (iv) characterization of the retrieval uncertainty based on the ARSA database; (v) near-real-time delivery of the retrievals (D-1). We will conclude by presenting the first results on spatio-temporal distribution of N_2O obtained from IASI observation.

Global monitoring of atmospheric CO_2 and CH_4 through the assimilation of level 2 IASI data within the Copernicus Atmosphere Monitoring Service

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ABSTRACT

As part of a delegation agreement with the European Union, the European Centre for Medium-Range Weather Forecasts (ECMWF) is managing the Copernicus Atmosphere Monitoring Service (CAMS: http://atmosphere.copernicus.eu/). CAMS provides daily near-real-time analyses and forecasts of global atmospheric composition including greenhouse gases (GHGs), reactive gases, and aerosols. We will focus the presentation on the analysis and forecast of carbon dioxide (CO_2) and methane (CH_4), two of the key greenhouse gases that are currently available in the CAMS system.

The present GHG analysis relies on the assimilation of the column-average dry-air mole fractions of CO_2 and CH_4 from the Greenhouse gases Observing Satellite (GOSAT). The assimilated GOSAT retrievals have a high near-surface sensitivity. They are, nevertheless, limited to daytime observations and sufficiently cloud-free conditions are also needed for accurate retrievals. These limitations combined with the design of the instrument reduce the number of available observations to only a few within the 12 hour assimilation window of the CAMS system.

Retrievals of CO_2 and CH_4 from the Infrared Atmospheric Sounding Interferometer (IASI) have a much better spatial and temporal coverage, with availability during daytime and nighttime, but with limited sensitivity to the lower troposphere due to the low thermal contrast between the Earth's surface and the air masses above. However, the IASI measurements have higher sensitivity to the mid-troposphere and retrieved GHG products from IASI are highly complementary to the GOSAT products.

We have already demonstrated the positive impact of the assimilation of IASI CH_4 retrievals on the analysis when we limited the data to the tropics. We will demonstrate the impact of the assimilation of IASI CO_2 retrievals and the assimilation of extra-tropical IASI data on the analysis. To assess this, we will use independent measurements such as in situ profiles from HIAPER Pole-to-Pole Observations (HIPPO) and from Comprehensive Observation Network for TRace gases by AIRLiner (CONTRAIL) or column-average remote sensing measurements from the Total Carbon Column Observing Network (TCCON).

O_3 variability in the troposphere and the stratosphere from IASI observations in 2008-2015

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In this study, we present geographical patterns of ozone (O_3) variability in the troposphere and the stratosphere derived from 8 years of IASI observations (2008-2015). The instrument provides a unique dataset of global vertically-resolved O_3 profiles with a high temporal sampling and a fairly good vertical resolution in the troposphere and the stratosphere allowing us to monitor the year-to-year variability in these layers. The retrievals are performed using the FORLI software, a fast radiative transfer model based on the optimal estimation method, set up for near real time and large scale processing of IASI data.

Multivariate regressions which include important geophysical drivers of O_3 variation (e.g. solar flux - SF, quasi biennial oscillations – QBO, El Niño/Southern Oscillation – ENSO) and a linear trend term have been performed on time series of spatially averaged O_3 on spatial grids. The resulting covariates and trend spatial structures are analyzed. In particular, we focus on O_3 variation and trends in the troposphere over and downwind anthropogenic polluted areas characterized either by increased (e.g. over Asia) or decreased (e.g. over Europe and the US) O_3 precursor emissions. Direct effects of positive (or negatives) ENSO indexes measured during moderate to intense El Niño (or La Niña) episodes in 2009 and 2014 (or 2010) observed in the ozone columns in the tropics will be also discussed.

Unaccounted variability in NH_3 agricultural sources detected by IASI contributing to European spring haze episode

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ABSTRACT

Ammonia (NH_3), whose main source is agriculture, is an important gaseous precursor of atmospheric particulate matter (PM). For the first time, we derived daily ammonia emissions using NH_3 total columns from the Infrared Atmospheric Sounding Interferometer (IASI) onboard Metop-A, at a relatively high spatial resolution (grid-cell of 0.5° x 0.5°). During the European spring haze episode of March 2014 8th to 15th, IASI reveals NH_3 total column magnitudes highlighting higher NH_3 emissions over Central Europe (especially over Germany, Czech Republic and eastern France) from the ones provided by the European reference EMEP inventory. These ammonia emissions exhibit in addition a large day-to-day variability, certainly due to spreading practices.

The increase of NH_3 emissions in the model, that reaches +300% locally, leads to an increase of both NH_3 and PM_{10} surface concentrations and allows for a better comparison with independent measurements (in terms of bias, root mean square error and correlation). This preliminary study suggest that there are good promises for better quantifying NH_3 emissions by atmospheric inversions.

Ozone pollution outbreaks analysed by synergism of novel IASI+GOME2 multispectral satellite observations, chemistry-transport models and in situ measurements

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ABSTRACT

Ozone pollution is a major worldwide-shared concern, which poses great threats to human health and ecosystems. Assessment of the origin of low-level ozone is complex, due to a great diversity of sources (local photochemical production, transboundary transport and exchanges with the stratosphere) and transport mechanisms determining its three-dimensional distribution. Satellite observations play a key role to monitor tropospheric ozone from regional to global scales and daily basis. Particularly, the capacity to observe ozone pollution has been recently enhanced by the novel multispectral synergism so-called IASI+GOME2 of IASI and GOME-2 measurements (in the IR and UV respectively) that has enabled the first spaceborne observation of ozone plumes in the lowermost troposphere (below 3 km of altitude). However, one needs to combine these observations with chemistry-transport models in order to describe the hourly evolution and fine vertical distribution of ozone pollution down to the surface. Moreover, such combination of satellite observations and models is a powerful approach for their inter-validation and for correcting the model by data assimilation.

This research work presents an analysis of ozone pollution combining IASI+GOME2 satellite observations, state-of-the-art chemistry transport models and in situ measurements over two key regions: East Asia and Europe. In both cases, ozone pollution outbreaks are analysed in term of their origin, their three-dimensional pathways and the impact on regional air quality. We also use pollution tracers such as CO co-located observations derived from IASI measurements and stratospheric air indicators such as potential vorticity fields derived from the ECMWF meteorological model. The analysis over East Asia focuses on the springtime of 2009 and that over Europe in July 2010. The following chemistry-transport simulations are used i) for East Asia: WRF-CHEM, WRF-CMAQ and CHASER, this last one having assimilated numerous satellite observations and ii) for Europe: CHIMERE and MOCAGE, with assimilation in this last case of IASI and surface datasets. Moreover, we study the contribution of the assimilation IASI+GOME2 observations into the MOCAGE and CHIMERE models, for better representing the 3D distribution of tropospheric ozone over Europe.

Atmospheric Trace Gas Anomaly Detection using IASI

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ABSTRACT

In order to provide near-real-time monitoring of atmospheric contaminants, fast and reliable methods are required to detect anomalies in the atmospheric state. Full optimal estimation retrievals are computationally expensive; therefore, faster methods are needed to identify such anomalous events. The Infrared Atmospheric Sounding Interferometer (IASI), on board both the MetOp-A and MetOp-B platforms, is a Fourier transform spectrometer covering the mid-infrared from 645-2760 cm^{-1} (3.62-15.5 μm) with a spectral resolution of 0.5 cm^{-1} (apodised) and a pixel diameter at nadir of 12km. These characteristics allow global coverage to be achieved twice daily for each instrument, making IASI a very useful tool for the observation and tracking of atmospheric pollutants, large aerosol particles (such as desert dust) and volcanic plumes. The method shown makes full use of the spectral information from hyperspectral sounders and allows the presence of the target species to be determined in near-real-time (NRT), if required.

The analysis algorithms developed at the University of Oxford are well established for the flagging of volcanic ash and SO_2. A linear retrieval is used to detect departures in the atmospheric state from a generalised background covariance matrix created from IASI data containing no enhancement. These procedures have been extended to detect enhancements in additional atmospheric species, such as NH3 and CO, which are important contaminants in pollution monitoring and forest fire detection. The data from the anomaly detection tests are available online via the IASI NRT website within 3 hours of measurement.

Ammonia emissions in biomass burning regions: Estimation from satellite-derived measurements and comparison with bottom-up inventories

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ABSTRACT

Vegetation fires emit large amounts of ammonia in the atmosphere (NH_3). Excess NH_3 can affect the environment in many ways: eutrophication of the ecosystem, soil acidification and loss of plant diversity. Despite the numerous studies achieved in the past decades to better quantify NH_3 emissions from biomass burning (mainly from bottom-up approaches), the uncertainties remain still large. NH_3 satellite measurements are now available for a few years and offer the possibility to better assess the NH_3 atmospheric budget, its spatial distribution and long-term trends.

In this presentation we first analyze monthly NH_3 total columns (molec cm^{-2}) from IASI on MetOp-A satellite over four large tropical regions known for their important seasonal fire activity. We next derive for these regions the monthly NH_3 emissions using a simplified box model and perform a top-down evaluation for NH_3 of the most widely used fire emission inventories (GFEDv3.1 and the GFASv1.2).

We then focus our attention on the NH_3 emissions from the intense fires which were devastating Indonesia in fall 2015. The region of Indonesia is characterized by peat soils, whose burning is thought to emit large amounts of NH_3. To assess the importance of NH_3 emissions from peat fires compared to other biomes, we derive NH_3 enhancement ratios (ERs) relative to CO and we compare them to ERs derived from other biomes in tropical biomass burning regions. We also compare these results to the ERs reported in the literature.

IASI 2016 Abstract

Detection of tropospheric ozone from IASI during exceptional events

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ABSTRACT

As an important greenhouse gas and air pollutant, tropospheric ozone (O_3) has become a significant environmental and climate concern. Both strong local photochemical production within the troposphere and transport from the stratosphere can lead to elevated tropospheric O_3 concentrations. These have increased globally over the last century due to enhanced anthropogenic precursor emissions. Monitoring of tropospheric O_3 is therefore essential to understand its impact on air quality, chemical composition and climate change.

Although quantifying tropospheric O_3 from space is difficult because of the abundance of ozone in the stratosphere, over the past decade satellite instruments have provided valuable information on its distribution and temporal evolution. Here, we use the IASI instrument to retrieve tropospheric O_3 from space and assess its ability to detect ozone in the lower troposphere during exceptional events, such as photochemical smogs. We use the WRF-Chem chemical transport model to interpret observations of tropospheric O_3 from IASI, and to assess the meteorological and dynamical processes involved in such extreme events.

Variability and short-term trends of lower and upper tropospheric ozone over the North China Plain from IASI observations.

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Important progresses in the field of atmospheric ozone sounding from space have been accomplished during the last decade. The lower troposphere is now available from IASI (Infrared Atmospheric Sounding Interferometer) with a maximum of sensitivity between 3 and 4 km. We use satellite observations from IASI on board the MetOp satellites to evaluate the short-term trends of tropospheric ozone over the North China Plain (NCP) for the period 2008-2015. The availability of two semi-independent columns of ozone from the surface up to 12 km allow ones to derive ozone trends for the lower (surface to 6 km a.s.l) and the upper troposphere (6 to 12 km a.s.l). Monthly variations show a maximum in late spring/early summer (May, June) in the lower troposphere. Short-term trends are calculated from deseasonalized monthly variations. Preliminary results show a negative trend of about -0.50%/yr in the lower troposphere whereas a positive trend (~ +0.7%/yr) is observed in the upper troposphere. If the negative trend appears to be significant in the lower troposphere, the positive trend in the upper troposphere remains poorly significant over such a short period and seems moderated by the stratosphere-troposphere exchanges. The consistency between the two in-flight IASI instruments aboard MetOp-A and MetOp-B is discussed. The IASI derived trends are compared to independent in situ observations provided by ozone sounding at different sites of East Asia for evaluation. The different processes driving the variability and short-term trends of lower tropospheric ozone during the 2008-2015 period are discussed.

Seasonal and interannual variabilities of tropospheric Ozone and CO over the Indian Ocean with IASI-SOFRID 2008-2013 data

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Topic 2 : Science and application
Atmospheric composition

Poster presentation

Abstract :
Tropospheric O3 over the Southern Indian Ocean is controlled by a number of sources such as Stratosphere to Troposphere Exchanges, LiNOx and Biomass Burning from Africa. From multi annual (2005-2009) observations from the TES space borne sensor, Zhang et al. (2012) recently highlighted an O3 maximum in May. This maximum was shown to be caused by the production of LiNOx from Africa. Important interranual variability was observed with larger maxima in 2006 and 2008 related to anomalous anti-cyclonic circulation over central Africa. Nevertheless, many aspects concerning the factors controlling the variability and evolution of O3 over the Southern Indian Ocean region remain unclear. In this study we use 6 years (2008-2013) of O3 and CO data retrieved from the Metop-A/IASI sensor with the SOftware for a Fast Retrievals of IASI Data (SOFRID) to document the seasonal and interannual variability of tropospheric O3 and CO over the Indian Ocean region. In order to understand the observed seasonal and interannual variabilities, we have performed simulations with the GEOS-Chem chemistry transport model. We present comparisons between the simulated and observed O3 and CO distributions and a preliminary discussion concerning the source regions and transport processes responsible for the observed variabilities.

Using IASI to characterise CO and other volatile organic compound emissions

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ABSTRACT

It is well established that terrestrial vegetation emits a diverse range of volatile organic compounds (VOCs) into the atmosphere either through direct emission or as a consequence of burning through fire events. VOCs serve important roles in the biosphere and influence global atmospheric chemistry and affect climate. Photochemical reactions of VOCs influence the oxidation capacity of the atmosphere and, as a direct consequence, the lifetimes and distributions of other key climatic gases, such as methane (CH4) and carbon monoxide (CO)

The University of Leicester IASI Retrieval Scheme (ULIRS) is an algorithm which has been developed to retrieve CO and VOC concentrations from IASI measured top of atmosphere radiances on a local scale, using an Optimal Estimation Method. The scheme was developed to incorporate a line-by-line forward model and the calculation of the extinction coefficient is one of the most time-consuming steps of the ULIRS. We investigate the use of pre-calculated look-up tables for CO retrievals and discuss the effects on retrieval accuracy and significantly reduced computation times which allow the scheme to be used for near-real time applications.

The CO and VOC signatures in IASI spectra in the immediate vicinity of fires and within (boreal) biomass plumes, has been examined. For example, HCOOH contributes significantly to acidity of precipitation and it is shown that a state-of-the-art chemical transport model significantly underestimates the enhancement ratios for ΔHCOOH/ΔCO from fires over North America implying that the model lacks important primary and secondary sources of atmospheric HCOOH.

Emissions from tropical forest vegetation is an area where remotely-sensed products from satellite measurements are helping us to better understand local chemical processes and complement the sporadic aircraft campaign measurements and sparse observing networks over these regions. We show successful detection of very short-lived, weakly absorbing, biogenic VOCS (BVOCs) over the Amazon by using co-addition of IASI spectra to reduce the spectral noise and enhance the absorption signal. Although some information is lost by spatially averaging data, the large number of IASI measurements each day means that this method still provides valuable information to determine regional emissions on weekly to monthly scales. Regional positive correlations of up to 0.5 are found between IASI BVOCs and GEOS-Chem model data. Seasonal comparisons show some significant temporal differences between the maxima in the datasets, peaking around one or two months later in the satellite data over the Amazon region, for example.

Main results of Carbon Dioxide comparison between IASI, TANSO-FTS and HIPPO products.

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ABSTRACT

A great effort is undertaken by the scientific community to investigate carbon dioxide amounts and vertical distribution and to characterize its sources and sinks. In this background, the development of CO_2 retrieval models in the Thermal InfraRed (TIR) spectral range is extremely important for the characterization of the CO_2 distribution in the mid-to-upper troposphere with a high accuracy level. The research project "Application of KLIMA Algorithm to CO_2 Retrieval from IASI/METOP-A Observations and Comparison with TANSO-FTS/GOSAT Products" had the main purpose to investigate the performances of KLIMA algorithm applied to the Infrared Atmospheric Sounding Interferometer (IASI) observations. The Thermal And Near infrared Sensor for carbon Observation (TANSO)-FTS on board of the Greenhouse gases Observing SATellite (GOSAT) can measure CO_2 column amounts from the ShortWave InfraRed band (SWIR) and CO_2 profiles from the TIR band, simultaneously. SWIR observations are more sensitive to CO_2 near the surface, but less sensitive to the vertical profiles than TIR observations. Thus, the use of the SWIR and TIR combined data provide the possibility to estimate the amounts of CO_2 in the boundary layer accurately and consequently may produce a useful dataset for the study of CO_2 sources and sinks. The main goal of the HIAPER Pole-to-Pole Observations (HIPPO) project is to provide the first high-resolution vertically resolved global survey of trace gases and aerosol investigating the Carbon Cycle and greenhouse gases annual cycle throughout various altitudes of the western hemisphere. In order to provide additional evidence to the ongoing discussion on the measurement of carbon dioxide from space, we performed a comparison between temporally reduced dataset of collocated IASI, GOSAT TIR and HIPPO data. In this work, we present the main results from this activity, developed as part of the collaboration between IFAC-CNR and the GOSAT team.