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Contribution of the MTG/IRS radiance assimilation in the characterization of the atmospheric chemical composition

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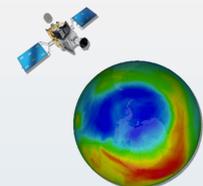
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I. Introduction

Air quality can deeply affect population health and environment. This is associated with atmospheric composition near the surface. It is influenced by local contributions (emissions), chemistry and small-scale and large-scale transport. Its modelling is complex because it involves several physical and chemical processes. Weather conditions, and especially winds, play an important role in dispersion or accumulation of chemical compounds and fine particles.

The observation system of the atmospheric chemical composition is mainly based on "in situ" measurements and observations from polar orbiting satellites. However, in situ measurements are few and very localized. Measurements from polar satellites, on the other hand, although nowadays very valid, are limited by the scanning of the satellite footprint. This often limits the study of the transport of a specific species. For this reason, having exploitable data from sounders based on geostationary satellites would represent an interesting improvement.

II. Modèle de Chimie Atmosphérique à Grande Echelle (MOCAGE)

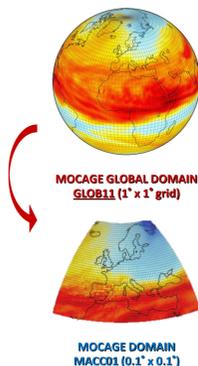
Météo-France takes part to the operational air quality forecasting system with the MOCAGE chemistry-transport model (developed since 2000).

Three-dimensional model that covers the global scale (GLOB11), down to a smaller scales (e.g. MACC01), using two-way nested grids.

Non-uniform vertical resolution: 47 vertical altitude-pressure levels from the surface up to 5 hPa. A 60 hybrid levels version is actually used in research mode: from surface, up to 0.1 hPa.

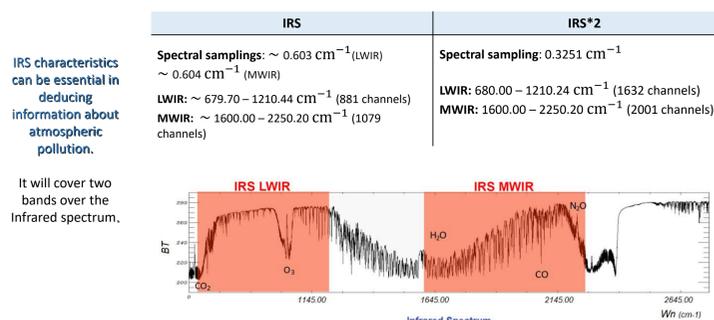
MOCAGE simulates gases, primary aerosols and secondary inorganic aerosols.

Meteorological forecasts (wind, pressure, temperature, specific humidity, precipitation) are used as input (e.g. ARPEGE or ECMWF meteorological forecast from IFS).



III. Meteosat Third Generation (MTG) – Infrared Sounder (IRS)

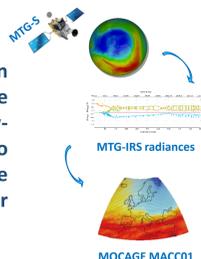
The Infrared Sounder (IRS), which will be launched in 2023 on board the Meteosat Third Generation (MTG) geostationary series, will be able to provide ~6 km resolution data (over Europe), with a temporal sample of less than one hour.



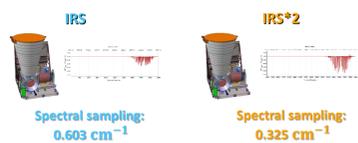
While the IRS is being build, a new version with increased spectral resolution is already being considered.

IV. GOALS

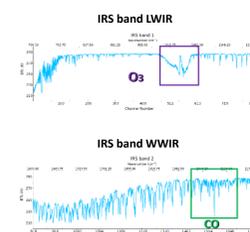
Evaluating the contribution of MTG/IRS radiance assimilation in a chemistry-transport model in order to characterize the atmospheric pollution over Europe



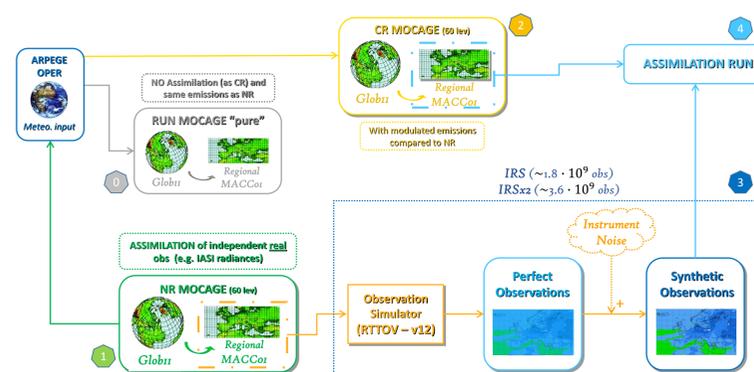
Studying the atmospheric pollution analysis quality as a function of the IRS spectral resolution: an IRS with increased resolution compared to the one at present under construction will be examined



Main focus on Ozone and Carbon Monoxide



V. Observing System Simulation Experiments (OSSEs)



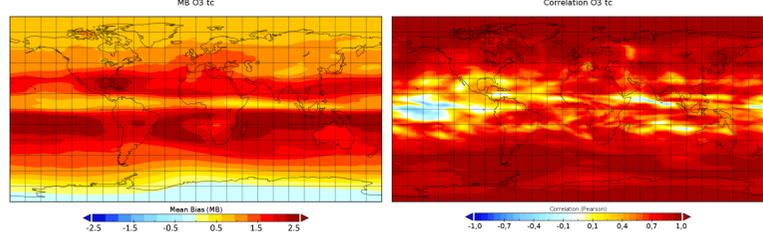
VI. IASI L1C Ozone assimilation in MOCAGE (60 lev)

Run over the period June-July 2019 with settings:

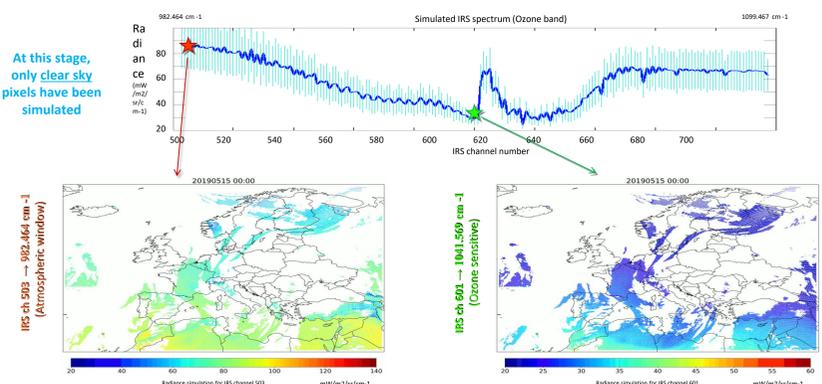
- Assimilation of 34 IASI channels in Ozone sensitive band (selected during another project)
- Bias correction + full R matrix diagnosed through Desroziers method

$$\text{Mean Bias} = \frac{1}{N_{\text{days}}} \sum (NR_i - RUN0_i)$$

$$\text{Corr} = \frac{1}{N_{\text{days}}} \frac{\sum (NR_i - \bar{NR})(RUN0_i - \bar{RUN0})}{\sigma_{NR} \sigma_{RUN0}}$$



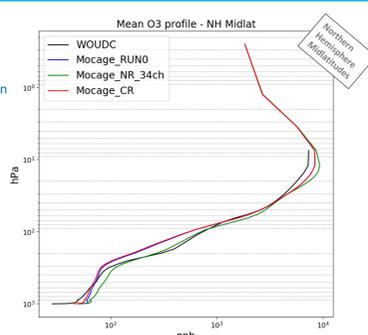
VII. IRS observation simulations



VIII. Validation through Ozone Sondes

World Ozone and Ultraviolet Radiation Data Centre (WOUDC) location

It is possible to validate results of the different runs through many real obs. Here a first comparison is performed using the WOUDC Ozone Sondes observations.



IX. Next steps

- Completing **Nature Run** in the present configuration + evaluating other configurations (amount of IASI channels to assimilate, error matrices, etc). NR1, NR2, NR3 choice
- Finalizing the evaluation of the **Control Run**
- Completing the **IRS** and **IRS*2 observation simulations**
- Assimilation Run**
- Evaluation of the IRS and IRS*2 Assimilation in MOCAGE**

Acknowledgements

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