Optimal assimilation of retrievals from hyperspectral infra-red satellite sounders

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Even in the ideal case that assumes we have access to a perfect model of the different components of the Earth system, weather forecasts would still be affected by error. This is in great part due to the fact that initial conditions for prediction are inevitably affected by uncertainty associated to the observations that are used to determine the best estimate of the state of the Earth system at a given time. It follows that to increase the accuracy of the forecasts it is crucial to make the best use of all the observations that are available at different locations and times. In particular, the most important observation category, as established by a number of dedicated observation impact studies, is given by measurements from satellite instruments.

The central relevance of these observations was established with the advent of data assimilation techniques that made it possible to assimilate observations in the form of radiance data, with a straightforward error characterisation. A drawback is that a relatively complicated radiative transfer model needs to be used to represent the observations with model data, resulting in an increased use of computational resources, especially in the case of high-spectral-resolution satellite instruments.

A number of recent studies have paved the way to a viable alternative to radiance assimilation, which consists in splitting the satellite data assimilation process into two complementary parts. First, the data are used to produce an estimate of given components of the state of the Earth system, which is subsequently transformed in order to subtract from it any additional information that is used to constrain the initial estimate. The transformed measurements are then ingested into the data assimilation system.

In order for this alternative method to achieve results that are equivalent to radiance assimilation, specific conditions have to be met. In this project, a study of the conditions to achieve this equivalence will be performed, which focuses on measurements that are sensitive to atmospheric temperature and water vapour, from the Infrared Atmospheric Sounding Interferometer (IASI) on board of the MetOp platform. Assimilation experiments using the Met Office data assimilation system, to compare results with radiance data and transformed measurements will also be carried out.

Student profile:

This project would be suitable for students with a degree in mathematics, physics or a closely related physical or environmental science. Familiarity with a scientific programming language is desirable.

Funding particulars:

CASE support for this project has been agreed from the UK Met Office.

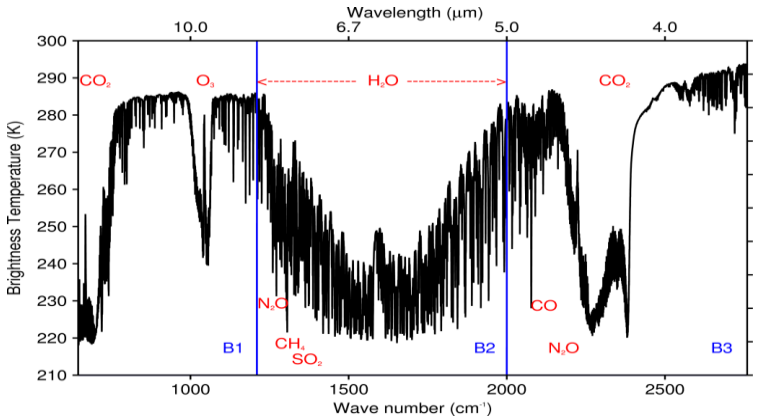

Figure 1 Radiation emerging from the atmosphere measured by the IASI instrument.