Fast spectral retrieval of Outgoing Longwave Radiation and heating rate from infrared sounders applied to the long time series obtained with IASI A,B and C observations

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The study of the imbalance in the Earth Radiation Budget between the net shortwave incoming solar radiation and the outgoing longwave radiation (OLR) from the Earth and its atmosphere can give important indications of the global evolution of the Earth climate. These Essential Climate Variables (ECVs) that can only be measured from space are being measured by spaceborne radiometers such as ERBE, CERES or ScaRaB since the years 1970s. With the advent of spatial infrared hyperspectral sounders in the years 2000s, it is now possible to have the spectral repartition of these ECVs and to link their variation to other ECVs such as surface temperature and greenhouse gas concentrations.

In this talk, we will present a machine learning method to estimate and study the OLR and corresponding heating rate from hyperspectral infrared sounders, such as IASI, IASI-NG and FORUM. The retrieval scheme is based on a MultiLayer Perceptron (MLP) implementation based on the forward model 4A-Flux, which is the flux and heating rate computation module into the reference line-by-line radiative transfer code 4A/OP validated during the RFMIP experiment.

We will show that the resulting OLR reproduces direct computation with a very small bias of 0.52 ± 0.31 W.m-2 (0.19% ± 0.11%) over the tropical oceans and with a computation time 10’000 times faster than the 4A-Flux computation. The same precision has been obtained with Retrieved IASI OLR collocated with ScaRaB onboard Megha-Tropiques and CERES onboard Terra.

After showing an application of the retrieval scheme on more than 17 years of observations from the IASI instruments that has been launched on Metop-A (2006), Metop-B (2012) and Metop-C (2018), we will present an analysis of the complete OLR and heating rate IASI time-series with regards to main climate patterns.