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Cloud detection from IASI radiance for climate analysis purposes

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Clouds are an essential component in our Earth system because of their importance for the weather, the water cycle and the Earth radiation budget. To better understand the climate, its past and future evolution, the development of long coherent time series of cloud properties is needed. In addition, as the clouds strongly impact the radiance at the top of the atmosphere, the detection of clear-sky scenes is a major preprocessing step for most climate and atmospheric satellite applications, such as trace gas retrieval or to derive the Earth Outgoing Longwave Radiation.

The Infrared Atmospheric Sounding Interferometer (IASI), flying on board the suite of Metop satellites for more than 15 years, has shown an excellent stability over its entire lifespan and a very good consistency between the three instruments (on board Metop-A, -B and -C). This makes the IASI dataset an excellent climate data record. For the detection and the characterization of clouds, the current IASI operational Level 2 product is highly performant. However, since it was first released in 2007, the L2 cloud data have undergone a series of updates which have not yet been reprocessed back in time. This leads to discontinuities in the data record which makes it very difficult for use in long-term studies. Even in the event of a complete reprocessing of the L2, there would also be no guarantee on the homogeneity of the futures versions. Other cloud products exist (e.g. the AVHRR-L1C, the cloud_cci, the CIRS-LMD) but those are usually either less accurate or sensitive to cloud detection or are not available in near-real-time. These limitations in the existing products triggered the development of a sensitive and coherent IASI cloud detection dataset.

Here we present a new cloud detection algorithm for the IASI measurements based on a Neural Network (NN). The input data consists of a set of 45 IASI channels. Those were selected outside the regions affected by CO_2, CFC-11 and CFC-12 absorptions to avoid any long-term bias in the detection as their concentrations are evolving over time in the atmosphere. As a reference dataset, we use the current version (v6.6) of the IASI L2 cloud product. The IASI-derived NN cloud product appears to be both accurate in the cloud detection and coherent over the whole IASI period and between the three versions of the instrument. To illustrate this, we show global distributions and time series of the cloud fractions and we assess the quality of the cloud mask by comparing the NN product against several other cloud products. We also evaluate the capabilities of our NN cloud detection product to correctly distinguish cloud from dust plumes.