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Ice cloud retrieval from high spectral resolution measurements in the thermal infrared : Application to IASI and IASI-NG

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Besides their strong contribution to weather forecast improvement through data assimilation in clear-sky conditions, thermal infrared sounders on board polar orbiting platforms are now playing a key role in monitoring changes in atmospheric composition. However, it is known that clear sky observations are only a small part of the entire set of measurements, the remaining part is only slightly used as they are contaminated by either aerosols and/or clouds. Moreover, ice or liquid cloud retrieval of column and profile properties from passive and active measurements respectively help us in reaching a better understanding of climate processes. If the information provided by the latter has allowed a significant advance in our knowledge of the vertical distribution of condensed water, it suffers from spatial coverage compared to passive measurements. It is therefore fundamental to better characterize cloud properties from passive measurements by using, for example, high spectral resolution instruments such as IASI and the future IASI-NG.

An information content analysis based on Shannon's formalism has been used to determine the level and the spectral repartition of the information about the ice cloud properties in the IASI and IASI-NG spectra. Based on this analysis, we have developped and tested an algorithm which allows to retrieve from an optimal estimation approach the cloud integrated ice water content together with the cloud layer altitude. We have taken into account the Signal-to-Noise ratio of each specific instrument and the uncertainties due to the non-retrieved atmospheric and surface parameters. The forward model is the fast radiative transfer model RTTOV which has been developped for satellite data assimilation in Numerical Weather Prediction (NWP) models. The ice cloud microphysical model is based on the ensemble model of Baran and Labonnote (2007), where the bulk ice optical properties have been parametrized as a function of the ice water content (expressed in g/m³) and in cloud temperature.

The present study aims to quantify the potential and limits of thermal infrared sounders such as IASI or IASI-NG to retrieve ice cloud properties by using a representative dataset from the global

operational short range forecast of the european center of medium-range weather forecast.