

Advances in multi-instrument thermodynamic profile retrievals

The Integrated Profiling Technique (IPT) simultaneously determines temperature and humidity profiles in the lower troposphere together with macro- and micro-physical properties of boundary layer clouds. The IPT has recently been extended to include data from the infrared part of the electromagnetic spectrum. Principally the method is suited for combining in an optimal way all on-site sensors bearing significant information content on the desired quantity, such as passive spectrally resolved microwave and infrared radiances, active remote sensing observations cloud radar and lidar, and in situ observations. The IPT is an optimal estimation technique, and thus propagates the uncertainty in the observations and the sensitivity of the forward model to provide uncertainties in the retrieved properties.

The latest IPT improvement includes the combination of passive microwave with high-spectral-resolution infrared observations. A cloudy-sky retrieval procedure is presented that utilizes measurements from a standard microwave profiler (HATPRO) and an infrared spectrometer (AERI). The IPT is applied to each instrument separately, and the IPT has also been run incorporating measurements from both the AERI and HATPRO simultaneously. Retrieval accuracies and information content in clear and cloudy sky scenes are investigated and anticipated benefits from the multi-instrument IPT retrievals in cloudy scenes will be discussed. We will also discuss the synergy of using both active and passive measurements within the IPT during cloudy scenes, with a focus on cases where the clouds are composed entirely of liquid. Together with the retrieved profiles of temperature, humidity, cloud optical depth and cloud effective radius, IPT also yields corresponding accuracy estimates and covariance matrices. We are using a sophisticated target classification scheme prior to algorithm application to correctly discriminate cloud type and phase, thereby leading to a consistent retrieval.