EMS Annual Meeting Abstracts
Vol. 14, EMS2017-623, 2017

Developing a Forward Model for Ice Cloud Attenuated Backscatter

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Ice clouds play an important role in the Earth's climate and weather by their influence on the radiation budget, formation of precipitation and dynamical impacts due to latent heating/cooling. The effect of the ice cloud is dependent on the cloud height and thickness, and on the optical and microphysical properties. Observations of these properties are vital in improving our understanding and representation of ice clouds in numerical models. The Met Office has a large network of ceilometers which run continuously, providing an extensive and untapped source of data to evaluate numerical model predictions.

A forward model has been developed that uses the ice water content (IWC) from the Met Office 1.5 km variable resolution model over the UK and predicts the observed attenuated backscatter through the cloud which can then be compared directly with the ceilometer measurements. A lidar ratio of ice cloud is determined by integrating the attenuated backscatter of optically thick, attenuating ice clouds observed by the Met Office ceilometer network and the statistics of various cases are examined. The forward model then uses this lidar ratio derived from the ceilometer observations, and extinction derived from model profiles of IWC based on the same parameterisations used in the Met Office Unified Model microphysics scheme. A correction is applied to account for multiple scattering effects.

By comparing the forward modelled attenuated backscatter with that from the ceilometer network, we characterise the systematic errors of the forward model and begin to assess the value of assimilating the ceilometer data.