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Feature Mask determination using EarthCARE ATLID data

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The Earth Clouds Aerosol and Radiation Explorer (EarthCARE) mission is a combined ESA/JAXA mission to launch in early 2020 and has been designed with sensor-synergy playing a key role. EarthCARE will study the spatial (3D) distribution of clouds and aerosols and their impact on the Earth's radiative balance. To do this, the EarthCARE platform will carry a combination of active and passive sensors, with one of them the High Spectral Resolution Lidar (HSRL) ATLID operating in the UV at 355nm. An HSRL system can separate the backscatter signals from particles (Mie channel) and molecular return (Rayleigh channel) enabling the retrieval of extinction, backscatter and linear depolarization ratio directly.

The design of the ATLID (L2a) retrieval chain is driven by the expected signal-to-noise ratio of the ATLID instrument and the EarthCARE requirements. Three separate (but interdependent) processors have been created in order to retrieve the atmospheric state. As a first step, a feature mask algorithm (A-FM) has been created to separate regions with particle return from molecular backscatter regions only. The feature mask identifies 'significant returns' in the lidar signal, exceeding the ATLID noise, indicating the presence of either aerosols or cloud particles within the beam. It does not specify the nature of the feature but is used to determine different smoothing tactics in the microphysical retrieval schemes. The classification (e.g. aerosol type, cloud phase) occurs later in the processing chain.

In order to be able to derive reliable extinction and backscatter profiles, as well as a target classification an accurate feature mask is essential. The A-FM algorithm defines the feature mask based on the correlation of the data without relying on a number of hard coded or input dependent thresholds. As the signal strength of aerosol or very optically thin ice clouds on the single shot grid can be comparable to the instrument noise levels it was chosen to rely on image reconstruction techniques and not on signal to noise ratios and thresholds. The main reason why an image reconstruction technique can be so effective for the EarthCARE lidar data is that, in principle the Mie signals contain only particle backscatter, background noise and noise due to the Mie-Rayleigh cross-talk. It also ensures the derivation of a feature mask on the single shot resolution instead of directly going to a lower horizontal resolution of 1 or 10 km. This enables both the use of variable masks, e.g. use only those profiles which are sure to have no clouds to derive the mean aerosol signals and calculation of feature fractions which can result in a better determination of higher order products.

In this presentation the algorithm and results for a number of different scenes including ice clouds, liquid clouds and aerosols will be presented using simulated signals generated using the EarthCARE simulator corresponding to a number detailed frame-sized (6000km) scenes. The work described in this presentation was conducted as part of ESA/ESTEC contract No. 4000112018/14/NL/CT