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Cloud geometry from high-resolution airborne solar spectral imagery

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The spatial distribution of clouds is the most fundamental cloud characteristic.
Before successive methods can provide any additional microphysical insight, the cloud geometry has to be identified. The cloud spatial distribution itself has an important effect on the radiation budget and its variability over a cloudy scene and can this way feed back on cloud dynamics. In addition to the impact on the cloud radiative effect, orientation of the cloud surface has an decisive effect on remote sensing of microphysical parameters of inhomogeneous clouds with passive sensors. It is found that knowledge of cloud geometry significantly reduces retrieval uncertainties.

With the latter motivation in mind, we will present the derivation of cloud geometry from passive observations of solar radiation reflected by clouds. observations collected during the German HALO aircraft campaigns ACRIDICON in Brazil 2014 for cloud sides as well as nadir observations during the North Atlantic NARVAL-2 and NAWDEX 2016 campaigns are used. Measurements of spectral radiation around the oxygen-A band from the hyperspectral imager specMACS as well as stereographic data collected by a video camera are used. In the spectral method distance between sensor and cloud is derived using the fact that an increase in absorption path length is reflected by a deepening of the oxygen absorption band around 762 nm. Sensitivity of the depth of this absorption band to other parameters like the surface albedo, aerosol content or cloud density (LWC or extinction) is investigated and the related uncertainty is quantified.
For validation, results of the spectral method are compared to results from stereographic methods based on visible imagery collected at the same time.