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Cloud base height retrieval from multi-angle satellite observations and its application to assess cloud heights over the Southeast Pacific

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The representation of clouds in climate models is still subject to large uncertainties. In particular this holds true for marine boundary layer clouds. As the Earth's radiation budget is strongly influenced by clouds, these uncertainties introduce a wide spread among simulations of future temperature increase. Important parameters which affect the net radiative effect of clouds are cloud cover along with cloud top (CTH) and cloud base height (CBH). While the CTH is operationally retrieved with global coverage only a few methods have been proposed to determine CBH from satellite measurements with varying strengths and weaknesses.

This study presents a new approach to retrieve cloud base heights which uses the Multi-angle Imaging Spectro-Radiometer (MISR) on the Terra satellite. For a circular area with a radius of 20 km the CTH retrievals of MISR which are available at a 1.1 km horizontal resolution, are bundled and the CBH is retrieved by evaluating the distribution of the enclosed CTH retrievals. The method is validated against ceilometer data spanning one year over the continental United States of America.

Furthermore, an application of this new retrieval algorithm is presented with a focus on the Southeast Pacific which hosts the largest subtropical stratocumulus deck on Earth. The associated stratocumulus clouds represent a critical but poorly understood component of the coupled climate system of the region that is characterized by strong coastal upwelling and one of the driest regions on Earth land inwards, i.e. the Atacama desert. Within the German Science Foundation funded Collaborative Research Center "Earth at its dry limit" our overarching goal is to understand the moisture supply to the Atacama desert and its variability which is to a large degree affected by stratocumulus clouds moving inland. Cloud heights are retrieved with a horizontal resolution of $0.25°$x$0.25°$ over a time period of 16 years between 2001 and 2016. Regional and seasonal variabilities are investigated.