Geophysical Research Abstracts
Vol. 20, EGU2018-9165, 2018
EGU General Assembly 2018

Stratocumulus clouds - exploring sensitivities of vertical heating rate profiles constrained by active/passive satellite retrievals

Florian Tornow, René Preusker, Cintia Carbajal Henken, Sören Testorp, and Jürgen Fischer
Institute for Space Sciences, Freie Universität Berlin, Berlin, Germany (florian.tornow@wew.fu-berlin.de)

Clouds interact with solar and terrestrial radiation. Resulting heating rates govern thermodynamics in and around the cloud layer. In the special case of Stratocumulus clouds, enhanced boundary layer circulation often involves entrainment of warm and dry air from aloft inversion – with the potential to substantially alter a cloud's optical micro and macro-physical properties. To better understand vertical heating rate profiles in Stratocumulus clouds, this study explores sensitivities to vertical humidity and cloud extinction profiles, as well as cloud-topped aerosol. In order to seek out the variability of relevant atmospheric constituents, we collected data from both active and passive satellite instruments: through CloudSat/CALIOP we verified the (sub-)adiabatic assumption on vertical cloud extinction profiles; via MODIS we detected cloud-top optical micro & macro-physical properties; and with the help of POLDER we identified properties of cloud-topped aerosol. In addition, we used radiosonde data from St. Helena to obtain vertical temperature and humidity profiles.
We present broadband simulation results performed in two ways: 1) with the line-by-line and plane-parallel radiative transfer model MOMO (Hollstein and Fischer, 2012), using a non-correlated k-binning (Doppler et al., 2014) and Mie-calculated cloud and aerosol radiative properties; 2) with RRMTG. We show agreement between simulated TOA broadband fluxes and CERES-based estimates. Simulated heating rates reveal sensitivities to the presence of soot-mixed aerosols above clouds as well as to changes in the moisture profile, similar in magnitude to changes in cloud optical micro and macro-physics (at a steady cloud optical thickness of 10).