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The scientific basis for a satellite mission to retrieve CCN and its impacts on convective cloud

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The cloud -mediated radiative forcing is widely recognized as the main source of uncertainty in our knowledge of the anthropogenic climate forcing and in our understanding of climate sensitivity. Current outstanding challenges are (1) global measurements of cloud condensation nuclei (CCN) in the cloudy boundary layer from space, and, (2) disentangling the effects of aerosols from the thermodynamic and meteorological effects on the clouds. Here we present a new concept for a way to overcome these two challenges, using relatively simple passive satellite measurements in the visible and IR. The idea is to use the clouds themselves as natural CCN chambers by retrieving simultaneously the number of activated aerosols at cloud base, N_a, and the cloud base updraft speed. The N_a is obtained by analyzing the distribution of cloud drop effective radius in convective elements as a function distance above cloud base. The cloud base updraft velocities are estimated by double stereoscopic viewing and tracking of the evolution of cloud surface features just above cloud base. In order to resolve the vertical dimension of the clouds, the field of view will be 100 m for the microphysical retrievals, and 50 m for the stereoscopic measurements. The viewing geometry will be 30 degrees off nadir eastward, with the Sun in the back at 30 degrees off zenith westward, which requires a Sun synchronous orbit at 14 LST. Having measured simultaneously the thermodynamic environment, the vertical motions of the clouds, their microstructure and the CCN concentration will allow separating the dynamic from the CCN effects. This concept is being applied in the proposed satellite mission named Clouds, Hazards and Aerosols Survey for Earth Researchers (CHASER).