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Libera's Split-shortwave Measurements and Their Application in Climate Research

Maria Hakuba[1], Peter Pilewskie[2,3], Graeme Stephens[1], and the Libera Science Team
[1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA USA;
[2]University of Colorado Boulder, Laboratory for Atmospheric and Space Physics, Boulder, CO USA
[3]University of Colorado Boulder, Department of Atmospheric and Oceanic Sciences, Boulder, CO USA

With a few exceptions, spaceborne measurements of Earth's top-of-atmosphere (TOA) outgoing reflected shortwave and emitted longwave radiation have been made over broad spectral bands covering the entirety of the solar spectral region, terrestrial infrared spectral region or the combination of both. Evidence suggests that separating the solar band into just two sub-bands, roughly equal in incoming solar irradiance levels but coincidently, where the atmosphere is nearly transparent to solar radiation in the visible (λ<700nm) and partially absorbing in the near-infrared sub-band (λ >700nm) primarily due to water vapor and clouds, provides great insight into the deposition of radiative energy in the atmosphere. Moreover, the two sub-bands also demarcate reflectance differences at the ground from different surface types such as vegetation, desert, ice and snow. Therefore, TOA reflected shortwave radiation in the two sub-bands are differently affected by changes in surface and atmospheric properties and support the characterization of processes relevant for shortwave absorption by the climate system, climate feedbacks, and Earth's albedo variability with added insight into hemispheric albedo symmetry given the hemispheric differences in ocean, continent and cloud distributions. A new NASA Earth Radiation Budget mission, Libera, will directly measure the two sub-bands. We use UKESM1 simulations, Fu-Liou RTM calculations, SCIAMACHY reflectance and CLARREO OSSE output as proxies for Libera's future data record to demonstrate applications of the shortwave sub-band knowledge in climate science.