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Longwave Angular Distribution Models for Nighttime Permanent Snow Scenes from the CERES Instrument on the Terra and Aqua Satellites

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The Clouds and the Earth's Radiant Energy System (CERES) instrument is a scanning broadband radiometer that measures top-of-atmosphere (TOA) reflected solar and emitted terrestrial window and longwave radiances. In order to estimate the TOA radiative fluxes from the radiances, the angular distribution of the earth's radiation field is captured in empirical angular distribution models (ADMs). In this presentation, we focus on longwave ADMs over permanent snow surfaces at night. The polar night over the ice caps of Antarctica and Greenland is characterized by extremely cold temperatures, low amounts of water vapor, and strong surface-based inversions. Clouds are relatively common in the polar night, but are challenging to detect with passive sensors, and a large difference in the cloud fraction over Antarctica exists between the Edition 2 CERES-*Terra* and CERES-*Aqua* retrievals. Current nighttime permanent snow ADMs have 24 scene types: two surface-cloud top temperature difference categories, two surface skin temperature (T_s) categories, and six cloud fraction categories (including clear and overcast conditions). Permanent snow ADMs were developed separately for CERES-*Terra* and CERES-*Aqua*. We examine the sensitivity of TOA longwave flux to ADMs by applying the *Terra* ADMs to *Aqua* radiances and note that fluxes change by a magnitude of up to 5 W m^{-2} in some regions of Antarctica. There are also large differences in the anisotropy of clear scenes between the two T_s categories, leading to errors (up to 5 W m^{-2}) in retrieved fluxes for scenes that have surface skin temperatures near the boundary (T_s = 240 K) between the two categories. When two more T_s categories are added, these discretization errors are reduced by approximately 50%.