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Title

View-angle dependent AIRS cloud radiances: Implication for tropical gravity waves and anvil structures

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Abstract

Tropical anvil clouds play important roles in redistributing energy, water in the troposphere. Interacting with dynamics at a wide range of spatial and temporal scales, they can become organized internally and form structured cells, transporting momentum vertically and laterally. To quantify small-scale structures inside cirrus and anvils, we study view-dependence of the cloud-induced radiance from Atmospheric Infrared Sounder (AIRS) using channels near CO_2 absorption line. The analysis of tropical eight-year (30°S–30°N, 2003–2010) data suggests that AIRS east-views observe 10% more anvil clouds than west-views during day (13:30 LST), whereas east-views and west-views observe equally amount of clouds at midnight (1:30 LST). For entire tropical averages, AIRS oblique views observe more anvils than the nadir views, while the opposite is true for deep convective clouds. The dominance of cloudiness in the east-view cannot be explained by AIRS sampling and cloud microphysical differences. Tilted and banded anvil structures from convective scale to mesoscale are likely the cause of the observed view-dependent cloudiness, and gravity wave-cloud interaction is a plausible explanation for the observed structures. Effects of the tilted and banded cloud features need to be further evaluated and taken into account potentially in large-scale model parameterizations because of the vertical momentum transport through cloud wave breaking.