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The radiative impact of TTL cirrus clouds on troposphere-to-stratosphere transport

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Radiative heating associated with cirrus clouds in the tropical tropopause layer (TTL) can significantly impact the mass transport rate from the troposphere to the stratosphere. However, quantification of the TTL cirrus radiative impact in 3-dimensional perspective and its seasonal variation were largely hindered by the lack of accurate global observations of thin cirrus clouds. The newly available cloud observations from CloudSat and CALIPSO, as well as from Aura MLS and other A-train satellites provide unprecedented opportunities to study the radiative impact of cirrus clouds on troposphere-to-stratosphere transport (TST). We synergistically combine cloud observations from CloudSat, CALIPSO and Aura MLS to compute the cloud radiative forcing and cloud-induced heating rates, with focus on the cirrus impact in the TTL and lower stratosphere. The preliminary results suggest that cirrus clouds induce large radiative heating in the TTL and can contribute to faster mass transport from the troposphere to the stratosphere. In the lower stratosphere, cloud-induced radiative cooling may partly contribute to the diabatic descent over the maritime continent. We have also performed back-trajectory calculations and found air parcels passing through clouds experience faster ascending across the TTL on average than parcels staying in clear-sky.