Impact of cloud longwave scattering on radiative fluxes associated with the Madden-Julian Oscillation in the Indian Ocean and Maritime Continent

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Previous studies suggested that cloud longwave radiation contributes to the development and maintenance of the Madden-Julian Oscillation (MJO), and model-based convection is highly sensitive to the radiation scheme. However, currently used radiation schemes do not take cloud longwave scattering into account, resulting in an overestimation of the outgoing longwave radiation (OLR) and an underestimation of the downward longwave flux at the surface. We use combined active and passive satellite cloud property retrievals to quantify the one-layer cloud OLR and heating rate biases introduced by neglecting cloud longwave scattering in the Indian Ocean and Maritime Continent in the context of MJO, with a focus on its phases 3, 5, and 6. The results show that the satellite detected one-layer cloud area consists primarily of ice clouds, particularly during the boreal winter in the 4-year study period. An increased ice cloud area fraction of one-layer cloud groups is present up to 5 days before the onset of MJO events. If longwave scattering is neglected, the composite mean OLR overestimation over the one-layer ice cloud area from 5 days before to 4 days after the MJO passage is approximately 3.5 to 5.0 W m-2. Neglecting longwave scattering also leads to a heating rate (*HR*) underestimation at cloud base and an overestimation at cloud top, making the base-to-top heating gradient less sharp at the cloud-resolving scale.