

The forgotten clouds of the tropical middle troposphere

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Clouds are the predominant atmospheric component that determines the amount of solar radiation that reaches the Earth surface. Great attention has been paid to low-level stratiform and convective clouds for their significant role on weather and climate, and to some extent to high clouds (mainly cirrus) that have – in contrast with previous clouds – a warming impact on climate. However, very few studies mentioned thin mid-level clouds (TMLCs), hardly detectable by remote sensing techniques, squeezed between low- and high-level clouds. Here we use CALIOP satellite observations to show that TMLCs are ubiquitous in the tropics. Supported by high-resolution regional model simulations, we argue that the TMLCs are mostly liquid clouds formed by detrainment of convective clouds near the zero-degree isotherm. These clouds are not found in reanalysis data nor in general circulation models. Calculations using a radiative transfer model indicate that the TMLCs in the tropics have a cooling effect of similar magnitude (but opposite sign) as cirrus but that their radiative properties are highly sensitive to the surface albedo and temperature below them. By highlighting the potential radiative effect of TMLCs and its sensitivity, our results suggest that the TMLCs should not be forgotten any longer, better understood, and implemented in global models in order to reduce uncertainties of their radiative effect.