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Long-term Trend of Cloud Optical Thickness in East Asia and Its Impact on Radiation Budget

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The cloud feedback is very important for climate change. In this paper, the long-term variability of clouds in East Asia and their influence on the radiation budget are studied quantitatively by analyzing satellite observations, so as to determine the cloud feedback on regional warming. We firstly analysis the 18-year's (Mar.2000-Feb.2018) trend of cloud optical thickness (COT) over East Asia based on the retrievals of the Moderate Resolution Imaging Spectrometer (MODIS), and calculate the cloud radiative forcing of water cloud and ice cloud using BCC_RAD radiation transfer model based on the COTs, and then discuss the impact of COT's variation on the cloud radiative forcing. The water cloud COTw is found to increase in northeast China (∼0.05 per year) and east China sea (∼0.05 per year), and to decrease at south China (∼-0.07 per year) and south Japan (∼-0.05 per year). The ice cloud COTi is found to increase at northeast China (∼0.06 per year) and north Japan (∼0.08 per year), whereas decrease significantly at Tibetan plateau (∼-0.07 per year). The annual mean shortwave-, longwave- and net-radiative forcing caused by the water cloud in East Asia at the top of the atmosphere are -72.4 W m-2, 15.7 W m-2 and -56.7 W m-2, respectively; the corresponding forcing caused by ice cloud are -88.5 W m-2, 55.7 W m-2 and -32.7 W m-2 respectively. The effects of COTw and COTi variations on radiation in different regions are different remarkably. Both positive feedback (e.g. south China, 0∼0.4 W m-2 per year) and negative feedback (e.g. northeast China, -0.4∼0 W m-2 per year) occurs, which indicates that the cloud feedback to regional warming is significant and may be opposite at different areas.