Topographic effects on ice clouds evaluated by CloudSat and CALIPSO satellite observations and a high-resolution global non-hydrostatic model

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Cirriform clouds in the upper troposphere are expected to be influenced by orographic gravity wave above steep mountain regions. In addition, convective clouds can also be triggered above such mountain regions when vertical velocity induced by gradient of topography lifts up an air parcel above the lifting condensation level. Since these clouds have meso-scale or more finer dynamic structures, GCM community have not paid attention to such phenomena. Higher-resolution GCMs are expected to better simulate the atmospheric disturbances by resolving such finer mountain structures. Thus, this study first evaluated topographic effects on ice clouds over mountain regions by using CloudSat and CALIPSO satellite observations (EarthCARE Research A-Train Product [Hagihara et al., 2010; Okamoto et al., 2010; Yoshida et al., 2010]). Cirriform clouds were defined by ice clouds with cloud bottom temperature colder than 253 K and convective clouds are defined by cloud top temperature colder than 273 K and cloud bottom temperature warmer than 273 K. We illustrated the characteristics of vertical profiles of ice cloud microphysical properties (ice water content and effective radii) and cloud size among ocean, land, and mountain regions.

In addition, we aimed at representing the topographic effects using a high-resolution global non-hydrostatic model NICAM [Tomita and Satoh, 2005; Satoh et al., 2008; 2014] with a double-moment bulk cloud microphysics scheme [Seiki and Nakajima, 2014; Seiki et al., 2014; 2015]. The simulated results were processed by the Joint Simulator for Satellite Sensors package [Hashino et al., 2013; Satoh et al., 2016]. We found that a choice of topographical data has significant impact on formation of ice clouds over mountain regions. In particular, we found that climatology of simulated ice cloud distribution improves by using horizontal resolution finer than 10 km.

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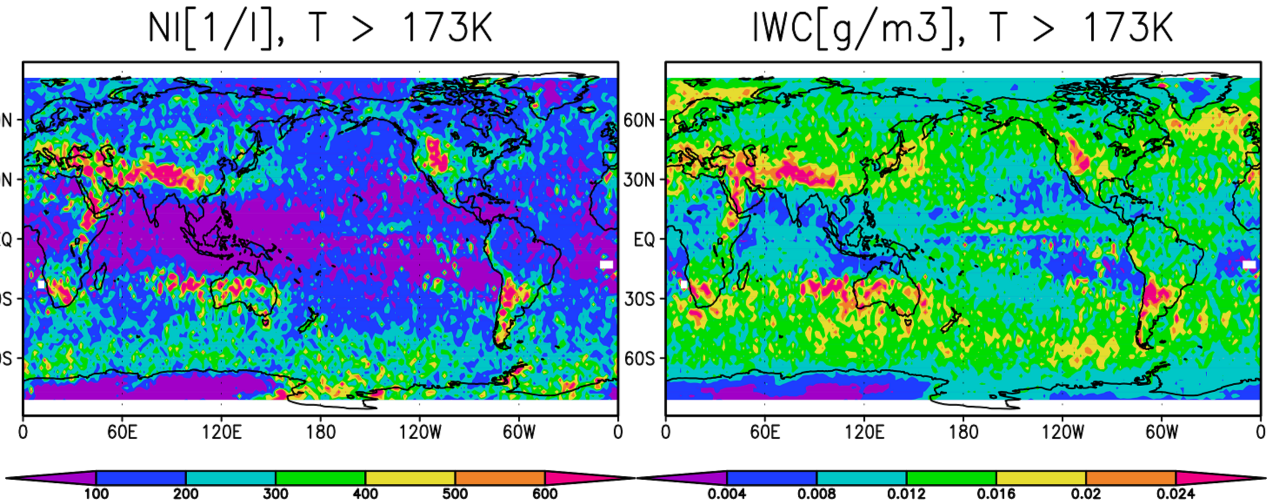
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