格子間隔10数kmから1km未満の全球大気実験における湿潤対流の解像度依存性

Resolution dependence of deep convections in a global simulation from over 10-kilometer to sub-kilometer grid spacing

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The success of sub-kilometer global atmospheric simulation opens the door for resolving deep convections, which are essential elements of cloudy disturbances that drive global circulation. Previous study, Miyamoto et al. (2013), found that the essential change in simulated convection properties occurred at a grid spacing of about 2 km as a global mean. In grid-refinement experiments (14 km - 0.8 km) with a constant vertical resolution by using NICAM (Satoh et al., 2014), we conducted further comprehensive analysis of the global-mean state and the characteristics of deep convection, to clarify the difference of the essential change by location and environment. We found that the essential change in convection properties was different in location and environment for each cloudy disturbance. The convections over the tropics show larger resolution dependence than convections over mid-latitudes, whereas no significant difference was found in convection over land or ocean. Furthermore, convections over cloudy disturbances [(i.e., Madden Julian Oscillation (MJO), tropical cyclones (TC)] show essential change of convection properties at about 1-km grid spacing, suggesting resolution dependence. As a result, convections not categorized as cloudy disturbances make a large contribution to the global-mean convection properties. This implies that convections in disturbances largely affect organization processes, and hence have more horizontal resolution dependence. In contrast, other categorized convections that are not involved in major cloudy disturbances show the essential change at about 2-km grid spacing. This affects the latitude difference of the resolution dependence of convection properties, and hence the zonal mean outgoing long-range radiation (OLR). Despite the diversity of convection properties, most convection is resolved at less than 1-km grid spacing. In the future, longer integration of global atmosphere, to 0.87-km grid spacing, will stimulate significant discussion about the interaction between the convections and cloudy disturbances.

キーワード：湿潤対流、高解像度、全球大気実験、解像度依存性
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