New Opportunity to Evaluate the Warm Rain Formation Process in Global Climate Models with A-Train Observations

*Hanii Takahashi[1,2], Kentaroh Suzuki[3], Graeme Stephens[1,4], Alejandro Bodas-Salcedo[5]

1. NASA Jet Propulsion Laboratory, 2. Joint Institute for Regional Earth System Science and Engineering, University of California, Los Angeles, CA, USA, 3. Atmosphere and Ocean Research Institute, The University of Tokyo, Chiba, Japan, 4. Department of Meteorology, University of Reading, UK, 5. Met Office Hadley Centre's climate model, UK

This study demonstrates a new way of evaluating model performances in GCMs by investigating the land-ocean differences in warm rain formation processes. In our recent study (Takahashi et al., 2017), A-Train observations show that oceanic clouds have a higher fraction of drizzle droplets than their land-based counterparts, and a methodology called the Contoured Frequency by Optical Depth Diagram (CFODD) is applied to explain why clouds over the ocean are more “drizzly” than clouds over the land. Updrafts over land are generally stronger than over ocean, and these stronger updrafts push the drizzle droplets higher, resulting in thicker clouds. Therefore, raindrops over land tend to be much bigger than those over ocean because they fall further and so experience greater growth via coalescence. Knowing that a land-ocean difference in warm rain formation processes appears in observations can help to evaluate model performance from a different angle. For example, it is known that HadGEM2 produces too much rain at all stages, a common problem in some GCMs. However, warm oceanic clouds tend to be more “drizzly” than warm continental clouds in HadGEM2, which is consistent with the A-Train observations. On the other hand, this land-ocean difference cannot be seen in HadGEM3. This study introduces a new model diagnostic tool, which helps to identify the sources of model biases and to improve model performance in GCMs.

Keywords: Warm rain formation processes, The land-ocean differences , GCMs, A-Train Observations

