National Aeronautics and Space Administration
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Warm Clouds based on A-Train and HadGEM3

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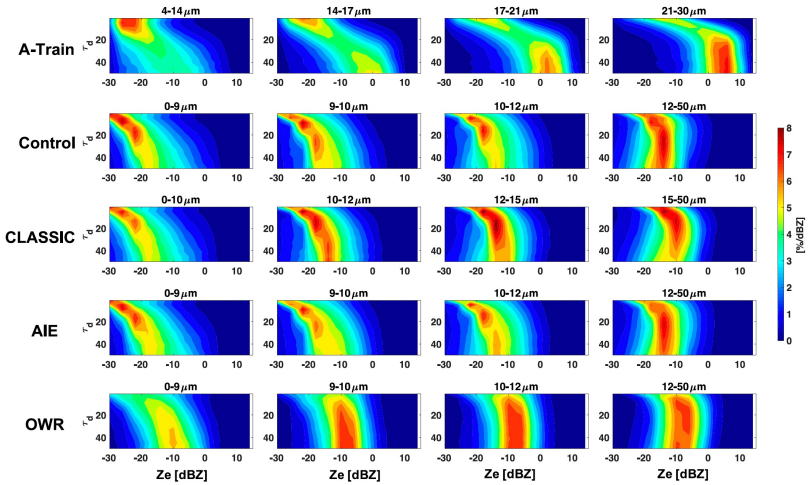

Figure 1: Quartile-based CFODDs over global ocean, classified according to four quartiles (0%–25%, 25%–50%, 50%–75%, and 75%–100%) of Re distributions based on the observations and different HadGEM3 runs.

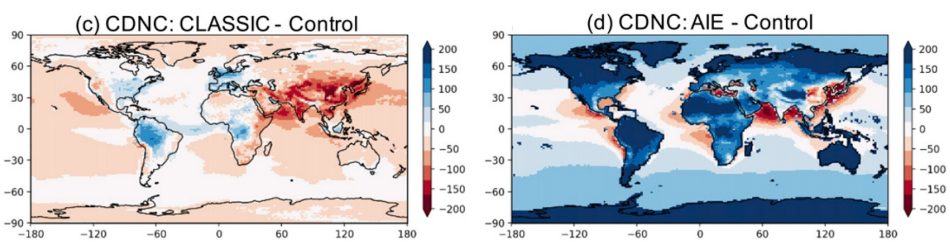

Figure 2: Warm cloud droplet number concentration annual climatology (2009–13) for (c) difference between CLASSIC and Control, and (d) difference between AIE and Control. Units are cm^{-3}.

Science Question: Is there any link between warm cloud evolution and precipitation in HadGEM3?

Data & Results: To track down the impacts of changes in warm rain formation processes between the latest two configurations of HadGEM3, the performance of the model with different configurations of cloud and aerosol parameterizations are evaluated against A-Train observations and it is found out that all experiments underestimate cloud-top effective radius (Re) compared to observations.

Significance: We introduce a new model evaluation tool, quartile-based contoured frequency by optical depth diagrams (CFODDs, Figure1). Results indicate that HadGEM3 has weak linkage between the size of particle radius and warm rain formation processes, and switching to the new warm rain microphysics scheme causes more difference in warm rain formation processes than switching to the new aerosol scheme through reducing overly produced drizzle mode in HadGEM3. Moreover, regions with large fractional changes in cloud droplet number concentration (CDNC) show a muted change in precipitation, arguably because large-scale constraints act to reduce the impact of such a big change in CDNC.

Takahashi, H., Bodas-Salcedo, A., & Stephens, G. (2021). Warm Cloud Evolution, Precipitation, and Their Weak Linkage in HadGEM3: New Process-Level Diagnostics using A-Train Observations. *Journal of the Atmospheric Sciences*, https://journals.ametsoc.org/view/journals/atsc/78/7/JAS-D-20-0321.1.xml

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