National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Goddard Institute for Space Studies

An Improved Convective Ice Parameterization for the NASA GISS Global Climate Model and Impacts on Cloud Ice Simulation (Elsaesser et al. 2017)

Fig. 1

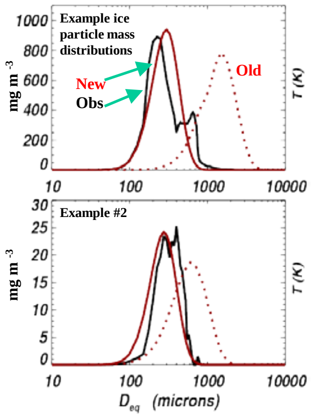
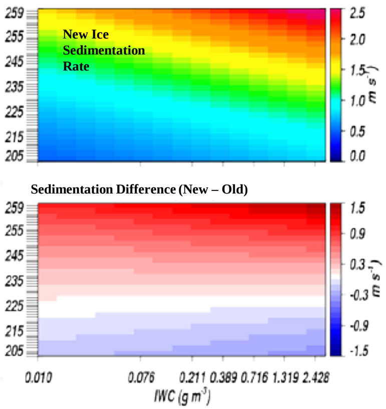
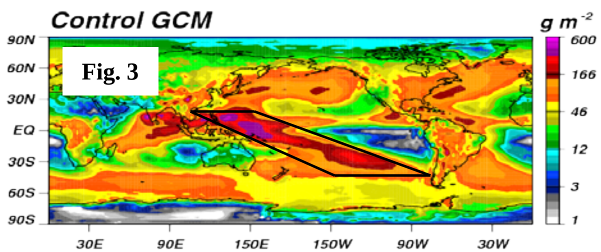
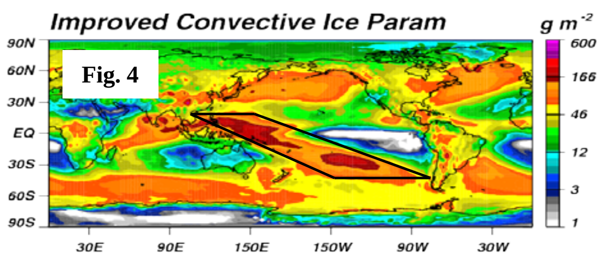
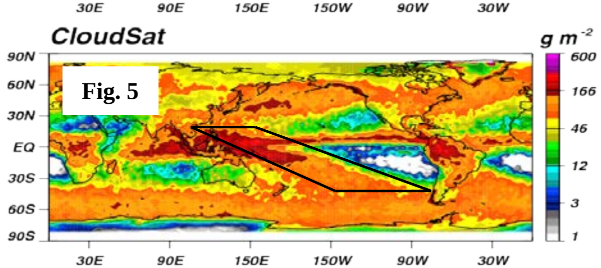


Fig. 2









Problem: The GISS Global Climate Model (GCM) produced too much cloud ice, especially in convective regions where deep, raining clouds are found (Fig. 3, *black highlighted region*). This can impact the model radiation and rainfall fields, which can affect the accuracy of climate projections.

Research: We use a number of NASA and DOE field campaign datasets to investigate the sizes and fall speeds of ice particles in deep convective clouds. We found that our model ice particles were too large relative to observations (Fig. 1). Averaged over many different temperature and ice water contents (IWC), these large particles fell too slowly relative to observations (Fig. 2). We have incorporated this new knowledge into our GCM convective ice parameterization.

Results: Because ice particles in deep clouds are smaller, but fall faster, we expect an overall decrease in cloud ice water content in deep convective regions. A 5-year prescribed sea surface temperature simulation confirms this expectation (Fig. 4, *30-50% decrease in black highlighted region*). The new cloud ice simulation is in better agreement with CloudSat retrievals (Fig. 5) .

Relevance to NASA: This study highlights the importance of using multiple NASA observations in GCM development, including the parameterization development step, and subsequent model evaluation step. More confidence in simulations is gained when observations are incorporated in such a manner.

Reference: Elsaesser, G., A. Del Genio, J. Jiang, and M. van Lier-Walqui, An Improved Convective Ice Parameterization for the NASA GISS Global Climate Model and Impacts on Cloud Ice Simulation, *J. Climate*, 30, 317-336,2017.

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