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An update on global atmospheric ice estimates from observations and reanalyses

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In light of the upcoming Ice Cloud Imager (ICI) on Metop-SG, the first operational satellite sensor designed for measuring atmospheric ice, this study assesses the global distribution of atmospheric ice mass from current state-of-the-art estimates and its variability on daily and seasonal timescales. Ice water path (IWP) retrievals from active and passive satellite platforms are analysed against reanalysis datasets. Specifically, these include DARDAR, Spare-ICE, GPM, and MODIS for satellite datasets, and the ERA5 and MERRA reanalyses.
Large discrepancies in IWP exist between the satellite datasets themselves, making validation of the model results problematic and indicating that progress towards a consensus on the distribution of atmospheric ice has been limited since Waliser et al. (2009). Zonal means of IWP exhibit similar shapes but differing magnitudes. Diurnal analysis centred on A-Train overpasses shows homologous structures in some regions, but the variability's degree and sign varies widely; the reanalyses exhibit noisier and higher amplitude diurnal variability than borne out by the satellite estimates. Spatial structures governed by the atmospheric general circulation are fairly consistent across the datasets – principal component analysis shows that the patterns of seasonal variability for atmospheric ice line up well spatially between the datasets while generally disagreeing on magnitudes. The vertical distribution of atmospheric ice is also assessed between DARDAR and the reanalyses.