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### **Southern Ocean Precipitation: New Insights from Recent Ship-based Field Campaigns**

#### **Abstract:**

Large differences continue to exist between current precipitation products over the Southern Ocean (SO). This limits our ability to close the hydrological cycle over the SO and Antarctica, as well as limiting our understanding of a range of climatological and meteorological processes. This uncertainty arises from the absence of high-quality surface precipitation observations suitable for evaluation across a range of spatiotemporal scales.

The presented research capitalises on six recent cruises undertaken by the RV Investigator, where comprehensive ship-based in-situ and remote-sensing precipitation observations were collected from the Australian sector of the SO from 2016 onwards. In particular, observations from the Ocean Rainfall And Ice-phase precipitation measurement Network (OceanRAIN) disdrometer and the first-ever dual-polarization C-band weather radar (OceanPOL) are used jointly to quantify the amount of precipitation (including the frequency, intensity and thermodynamic phase) under various synoptic and thermodynamic conditions. The analysis is then extended to examine precipitation regimes and associated macro- and microstructure. These observations are further employed to directly evaluate a couple of widely used satellite-based and reanalysis precipitation products over this region. Using an array of verification techniques, systematic errors in the evaluated products will be assessed and quantified. New insights derived from the OceanPOL radar datasets will also be discussed.