The validation of oceanic precipitation using the ship-based OceanRAIN dataset

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The naturally high small-scale variability and intermittency of precipitation mainly complicate global climate projections as well as global observations of precipitation. Whereas precipitation observations over land primarily rely on networks of rain gauges and surface-based weather radars, most oceanic precipitation observations are satellite sensor-retrieved estimates. Typically, passive microwave (PMW) satellite sensors, partly calibrated with ground- and space-based active microwave sensors, serve to derive global precipitation estimates. Owing to their wide swaths, PMW sensors reach a relatively high revisit time of twice a day, yet their spatial pixel resolution remains low. These large PMW satellite pixels introduce the point-to-area problem when being validated against direct surface-based point measurements of precipitation. Accurate global precipitation monitoring using satellite sensors therefore strongly requires validating these satellite precipitation estimates with surface-based precipitation observations. For a long time, systematic surface-based oceanic precipitation observations were limited to low quality gauges on buoy arrays and qualitative precipitation reports by human observers onboard ships. Since 2010, the "Ocean Rainfall And Ice-phase precipitation measurement Network" (OceanRAIN) represents the first systematic ship-board long-term data collection effort over the ocean. OceanRAIN samples precipitation from particle size distributions (PSDs) from optical disdrometers developed for and deployed on research vessels. OceanRAIN discriminates rain, snow and mixed-phase precipitation. As an all-weather instrument, the used optical disdrometer ODM470 was developed to measure under high wind speed and sea state. Valuable meteorological ancillary data and present weather observations add to OceanRAIN precipitation measurements and are used to calculate the evaporation to derive the along-track freshwater flux.

In this presentation, we aim to outline the chances and challenges of the unique OceanRAIN ship-based precipitation dataset and its implications for global observations as well as climate model validation. Depending on the desired application, we address different issues with respect to precipitation validation. First, the representativeness error is discussed that arises from different spatial resolutions as well as seasonal biases, and statistical point-to-area adjustments are introduced. Second, instrument sensitivity is key to reproduce a realistic probability distribution of precipitation. Third, precipitation phase changes can increase the uncertainty associated with the precipitation rate. Finally, we provide an outlook on future OceanRAIN developments, potential changes and applications at which we would welcome user input.