A detailed statistics of cloud and precipitation processes in the trades from the RV M.S. Merian.

Shallow cumulus clouds always played an essential role in the uncertainties in climate predictions. The EUREC4A campaign was conceived to tackle the problem of how such clouds will respond to climate change. Recent studies showed that although the research outcomes of the EUREC4A campaign constrained their response to climate sensitivity, open questions remain on the importance of mesoscale processes and the role of precipitation in the cloud organization, both aspects not well represented in climate models.

The research vessel (RV) Maria S. Merian, during the campaign, continuously provided high-resolution observations of clouds, precipitation, and atmospheric boundary layer properties in a vast area of the Atlantic Ocean east and south of Barbados island. Here, we exploit such observations to statistically characterize clouds and precipitation properties and the surrounding environment in which they develop.

In agreement with the literature, we define shallow clouds with cloud tops within 600 m of lifting condensation level (LCL) and congestus clouds with cloud tops between 600 and 4000m. We characterize their cloud properties, rain rates, and raindrop size distributions. We investigate virga generated from shallow and congestus clouds and describe how humidity and temperature change with the different cloudy conditions. We also display the relation between the W-band radar reflectivity and the radar skewness, revealing insights into the precipitation onset for shallow and congestus clouds and characterizing their cloud lifetime. Finally, we connect the local boundary layer and cloud properties to configurations occurring at the mesoscale, providing additional characterizations of flower, fish, sugar, and gravel in terms of ship-based observations.