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Quantifying the interplay of clouds and their environment through an energetic lens during EUREC4A

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The trades form an important link in the atmospheric energy supply, transporting moisture and momentum to the deep tropics and influencing the global hydrological cycle. Trade-wind cumuli are the most ubiquitous cloud type over tropical oceans, yet models disagree in simulating their response to warming. Our study takes advantage of extensive in-situ soundings performed during the EUREC4A campaign, which took place in the downstream trades of the North Atlantic in winter 2020. We employ 1068 dropsondes made in a ca. 2deg x 2deg area to close the moisture and energy budgets of the subcloud layer and atmospheric column. Our motivation for closing moisture and energy budgets using EUREC4A data is two-fold. First, we try to understand which large-scale environmental factors control variability in subcloud layer moisture and moist static energy, given their influence on setting convective potential. Second, we quantify the interplay between clouds and their environment through an energetic lens. The cloud radiative effect emerges as a residual from the total column moist static energy budget, yielding an energetic estimate of clouds. We quantify how this cloud radiative effect compares with coincident satellite and geometric (i.e. cloud fraction) estimates of cloudiness, varies on different scales, and relates to large-scale environmental conditions.