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Cold pools observed during EUREC4A: detection and characterization from atmospheric soundings

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A new method is developed to detect cold pools from atmospheric soundings over tropical oceans and applied to sounding data from the EUREC4A field campaign, which took place south and east of Barbados in January-February 2020. The proposed method uses soundings to discriminate cold pools from their surroundings: cold pools are defined as regions where the mixed-layer height is smaller than 400 m. The method is first tested against 2D surface temperature and precipitation fields in a realistic high-resolution simulation over the western tropical Atlantic. Then, the method is applied to a data set of 1068 atmospheric profiles from dropsondes (launched from two aircrafts) and 1105 from radiosondes (launched from an array of four ships and the Barbados Cloud Observatory). We show that 7 % of the EUREC4A soundings fell into cold pools. Cold pools soundings coincide with i) mesoscale cloud arcs, ii) temperature drops of about 1 K compared to the environment and moisture increases of about 1 g kg -1. Furthermore, cold pool moisture profiles exhibit a "moist layer" close to the surface, topped by a "dry layer" until the cloud base level, and followed by another moist layer in the cloud layer. In the presence of wind shear, the spreading of cold pools is favored downshear, suggesting downward momentum transport by unsaturated downdrafts. The results support the robustness of our detection method in diverse environmental conditions and its simplicity makes the method a promising tool for the characterization of cold pools, including their vertical structure. The applicability of the method to other regions and convective regimes is discussed.