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Drivers of Lagrangian evolution of mesoscale cellular convection in eastern subtropical oceans

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In order to study the Lagrangian transition of mesoscale cloud morphologies in four eastern subtropical ocean basins, over 160,000 96-hour boundary layer trajectories are produced from ERA5 winds in these regions. Mesoscale cellular convection (MCC) classifications are generated from a supervised neural network algorithm applied to MODIS daytime liquid water path (LWP) data. This algorithm classifies cloud scenes as closed cell, open cell, or disorganized MCC. The MCC classifications of cloud scenes are sampled every 24 hours along trajectories, allowing for a comprehensive study of environmental precursors to transitions from closed cells to open cells or disorganized cells.

Early results show strong differences between cloud scenes that transition from closed to open cell MCC compared to scenes that stay closed or transition to disorganized MCC. The closed to open cell transition is preceded by anomalously strong surface winds, increased precipitation, and low cloud droplet concentration. A mechanism is proposed where strong winds drive increased latent heating, water vapor flux, and humidity in boundary layers with closed cell MCC. The increased moisture and heat leads to increased precipitation and declining cloud droplet concentrations, which drive the transition from closed to open MCC. This contrasts with the closed to disorganized MCC transition, which is associated with a drying and deepening boundary layer driven by declines in overlying subsidence and humidity, a weaker inversion, and a warming sea surface. These results highlight the importance of studying cloud changes while taking morphology into account since changes in cloud properties can be driven by different mechanisms depending on their morphology.

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