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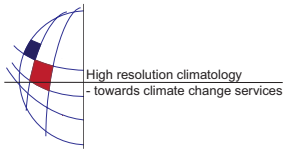

The impact of entrainment on trade-wind precipitation over Dominica

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This paper continues our investigation into the response of trade-wind cumuli to flow over Dominica, a small but mountainous island in the Carribean sea. Whereas our previous studies focused on the dynamical impact of orographic forcing on the impinging cloud field, here we focus on the roles of entrainment and cloud microphysics. To this end, we conduct large-eddy simulations of realistic trade-wind cloud fields impinging on an idealized ridge based on the shape of Dominica. Two different open-ocean cumulus realizations are considered, one a non-precipitating case and the other a lightly precipitating case. These two flows are based on observations from field programs over the eastern Carribean Sea close to Dominica (BOMEX and RICO, respectively). The simulated clouds that develop over the island are found to be significantly wider than those over the open ocean, which weakens the dilution from entrainment within the convective cores and helps to maintain their positive buoyancy. Along with a dynamical enhancement in cloud vigor associated with the bulk lifting, this effect helps the island clouds to penetrate deeper into the trade-wind inversion and convert more liquid water to precipitation. The reduction in evaporative cooling within the cloud shafts, also the result of diminished cloud dilution, greatly increases the accretion rate of precipitation over the island. These enhancements in precipitation production result in a ten-fold increase in area-averaged rain rate over the island.