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The influence of terrain forcing on the initiation of deep convection over Mediterranean islands

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The influence of mountainous islands on the initiation of deep convection is investigated using the Consortium for Small-scale Modeling (COSMO) model. The study day is 26 August 2009 on which moist convection occurred over both the Corsica and Sardinia island in the Mediterranean Sea. Sensitivity runs with systematically modified topography are explored to evaluate the relative importance of the land-sea contrast and the terrain height for convection initiation. Whereas no island precipitation is simulated when the islands are completely removed, all simulations that represent these land surfaces develop convective precipitation. Although convection initiates progressively earlier in the day over taller islands, the precipitation rates and accumulations do not show a fixed relationship with terrain height. This is due to the competing effects of different physical processes. First, whereas the forcing for low-level ascent increases over taller islands, the boundary-layer moisture supply decreases, which diminishes the conditional instability and precipitable water. Second, whereas taller islands enhance the inland propagation speeds of sea-breeze fronts, they also mechanically block these fronts and prevent them from reaching the island interior. As a result, the island precipitation is rather insensitive to island terrain height except for one particular case in which the island precipitation increases considerably due to an optimal superposition of the sea breeze and upslope flow.

These results demonstrate the complexity of interactions between sea breezes and orography and reinforce that an adequate representation of detailed topographic features is necessary to account for thermally induced wind systems that initiate deep convection.