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A Dynamical Analysis of Sea Breeze Hodograph Rotation on Sardinia

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We investigate the dynamics of diurnal sea-breeze rotation over coastal Sardinia using realistic and idealized model runs and historical observations. Earlier research on sea-breezes in Sardinia shows that the onshore winds around various coasts of the island exhibit both the theoretically predicted clockwise rotation as well as seemingly anomalous anticlockwise rotation. A non-hydrostatic fully compressible numerical model (WRF) is used to simulate wind fields on and around the island on previously-studied sea-breeze days. WRF accurately captures the sea breeze circulation on all coasts, as depicted in station data. Diurnal rotation of wind is examined and patterns of clockwise and anti-clockwise rotation are identified. A dynamical analysis is performed by extracting individual forcing terms from the horizontal momentum equations. Analysis of several regions around the island shows that the direction of rotation is a result of a complex interaction between near-surface and synoptic pressure gradient, Coriolis and advection forcings. An idealized simulation is performed over an artificial island of similar dimensions and latitude to Sardinia, but with dramatically simplified topography. Dynamical analysis of the idealized runs reveals a rather different pattern of hodograph rotation to the real Sardinia, yet similar underlying dynamics. The research provides new insights into the dynamics underlying sea-breeze hodograph rotation, especially in coastal zones with complex topography and/or coastline.