Representation of the Sierra Barrier Jet in 11 years of a high-resolution dynamical reanalysis downscaling

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We investigate the representation of the Sierra Barrier Jet (SBJ) in four numerical models at different resolutions, primarily documenting its representation within a high-resolution (6 km), 11-year WRF reanalysis downscaling (WRF-RD). A comprehensive validation of this dynamical downscaling is undertaken during 11 cool seasons (water years 2001-2011, October to March) using available wind profiler data at Chico, CA (CCO). Using an SBJ objective identification tool, we identify SBJ cases in the observed CCO wind profiler data, as well as in WRF-RD at the gridpoint nearest this site. WRF-RD's representation of the SBJ is compared with that of other reanalysis products with different horizontal resolutions (i.e., the North American Regional Reanalysis, the California Reanalysis downscaling at 10 km, and the NCEP/NCAR Reanalysis Product) to assess the spatial resolution necessary to correctly capture this topographically-induced low-level jet. More detailed comparisons between WRF-RD and NARR further justify downscaling from NARR's 32-km resolution to represent SBJ conditions. A catalog of modeled SBJ events that have significant timing overlap with the observations is created and used to further assess WRF's representation of the winds during SBJ events. In addition, observation-model comparisons of other meteorologically important variables (e.g., radar brightband height of precipitation melting level, profiles of winds, temperature, and relative humidity, and boundary layer temperature) during wintertime storms that impact California are performed in order to evaluate WRF's ability to capture the dynamical evolution of the SBJ. We find WRF-RD reasonably represents 56 percent of the observed SBJ cases occurring during the 11 cool seasons, albeit with a weak wind bias that increases with the strength of the jet maximum wind.

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