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Characterising reanalysis representation of winds at the interface between Antarctica and the Southern Ocean

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Low-level easterly winds encircle Antarctica, helping drive coastal currents which modify transport of circumpolar deep water to ice shelves as well as the formation and distribution of sea ice. Semi-permanent katabatic winds interact with a highly variable maritime component associated with synoptic forcing, both of which are influenced by the steep orography of the Antarctic margins. In this research, representation of the terrestrial and maritime components of the easterlies in three state-of-the-art reanalyses (ERA5, MERRA2 and JRA55) is evaluated. Variability on daily timescales is analysed using self-organising maps which objectively cluster coastal flow regimes into states with different synoptic and mesoscale influences. Correlation coefficients with station and sonde observations are highest in ERA5 overall but stronger terrestrial winds in MERRA2 and JRA55 reduce biases relative to ERA5 for many states. ERA5 is the least prone to overestimating low wind speeds. Performance is reduced for all reanalyses during states dominated by terrestrial katabatics and at stations near sloping terrain. Wind speeds are consistently underestimated when cyclone activity near the steep coastal orography drives a super-geostrophic low-level jet. These results demonstrate how a characterisation of coastal wind variability on short timescales could help diagnose errors in coarser models used for future projections.