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Southeastern Australian heat waves from a trajectory viewpoint

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Although heat waves account for more premature deaths in the Australian region than any other natural disaster, an understanding of their dynamics is still incomplete. Based on 10-day backward trajectories, this study identifies the dynamical mechanisms responsible for heat waves in southeastern Australia. Prior to the formation of a heat wave, trajectories located over the South Indian Ocean and over Australia in the lower and middle troposphere ascend diabatically ahead of an upper-level trough and over a baroclinic zone to the south of the continent. These trajectories account for 44% of all trajectories forming the anticyclonic upper-level potential vorticity anomalies that characterise heat waves in the region. The remaining trajectories are transported adiabatically by the midlatitude jet from far upstream of Australia.

The near-surface air parcels that constitute southeastern Australian heat waves do not originate from the inner Australian continent, but instead from the midlatitudes. From there, they descend adiabatically and aggregate over the Tasman Sea. The adiabatic descent is accompanied by a strong warming, highlighting the importance of midlatitude dynamics in warming the air masses prior to the heat wave. A key finding is that the temperatures are raised further through diabatic heating in the boundary layer over eastern Australia but not over the inner Australian continent. From eastern Australia, the air parcels are advected southward as they become incorporated into the near-surface anticyclone that defines the heat wave.