Introduction

During the late morning of 16 December 2015, an EF-2 tornado occurred 4 km southeast of Australia’s busiest airport—Sydney Airport. This tornado was notable in many ways:

- A relative abundance of observations was available, including the Kurnell C-band Doppler radar located less than 2 km from the tornado path.
- The parent supercell tracked over water just off the east Australian coastal during its life cycle, apart from when it briefly crossed the Kurnell peninsula when the tornado occurred.
- The tornado passed very close to an Automatic Weather Station (AWS) located on a jetty in Botany Bay at Kurnell which recorded a wind gust of 59.2 m s⁻¹ (213 km h⁻¹, 115 mph) at 10:53 am local time.
- The wind gust measured by the Kurnell AWS is an Australian record outside of a tropical cyclone.
- There were several RDF pulses and strong gate to gate velocity couplets associated with the parent storm prior to the tornado.
- Damage from the tornado was extensive with the Insurance Council of Australia estimating it to be the most costly disaster of the Australian 2015/2016 summer, costing insurance companies A$500m.
- The processes for the cap removal (figure 10) are unclear, but candidates are high.
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Kinematic assessment of Mesocyclone and Tornado Cyclone

- Dual Doppler winds were derived using Terry Hills (5-bands) Doppler radar (~36 km to the north of Kurnell) and the Kurnell radar (~7 km to the east of tornado track).
- The tornado parent cyclone appears as a zone of strong convergence / vorticity in the southeast corner of a ~7 km wide low-level mesocyclone—refer figure 6.
- Just prior to tornado formation the storm generated localized patches of enhanced 0.2-1 km storm-relative helicity (SRH) — refer figure 7.
- The key contributor to the overall SRH values appears to be a 'vortex sheet' within the storm inflow layer where the north-easterly inflow backs to north-westerly — refer figure 8.
- AMBAR holographs confirm very strong spatiotemporal variability in the SRH — refer figure 9.

Thermodynamic Assessment of Pre-storm Environment

- A firmly capped marine layer at 19 UTC experienced complete removal of the cap during the early morning hours (between 6 am and 10 am LT) — refer figure 10
- A wind gust of 59 m s⁻¹ was measured as the tornado moved offshore along the northern coastline of the Peninsula.
- Small patches of large low-level storm-relative helicity are evident along the eastern coastline of Australia just ahead of the storm and prior to the Kurnell tornado.
- In the vertical, these maxima in SRH are dominated by a sheet of large streamwise vorticity along the interface of north-easterly flow (below) and north-westerly flow (above).
- The processes for the cap removal (figure 10) are unclear, but candidates are high based on the pre-existing light showers raining into a very dry capping layer and an inland push of easterly flow at 900 hPa, potentially associated with a mesoscale low.

Summary and Points for Discussion

- An EF-2 tornado crossed a small Peninsula on 16 December 2015 just 4 km southeast of Sydney Airport.
- A wind gust of 59 m s⁻¹ was measured as the tornado moved offshore along the northern coastline of the Peninsula.
- Small patches of large low-level storm-relative helicity are evident along the eastern coastline of Australia just ahead of the storm and prior to the Kurnell tornado.
- In the vertical, these maxima in SRH are dominated by a sheet of large streamwise vorticity along the interface of north-easterly flow (below) and north-westerly flow (above).