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Do Sting Jets Form in Mediterranean Cyclones?

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One of potential hazards that extratropical cyclones produce is strong winds. One region where such intense winds occur is in association with the bent-back front of a cyclone and with the so-called cold conveyor belt (the air that encircles the cyclone) and/or the sting jet (a descending airstream of rapidly accelerating winds in cyclones that undergo an evolution consistent with the Shapiro-Keyser model of cyclone evolution). These features have been observed in cyclones over the North Atlantic Ocean, which have been studied over the last decades because of their frequency, intensity and potential for large damages in Europe.
In contrast, Mediterranean cyclones are much less frequent, but can still produce damage in southern Europe. In some situations, Mediterranean cyclones can evolve as a Shapiro-Keyser cyclone and develop a bent-back front with hurricane-force winds. Although previous studies have examined the winds in intense Mediterranean cyclones, cyclones that develop a ben-back front were less studied and an examination of the origin of these wind fields in the context of the cold conveyor belt and sting jet have not yet been performed.
To better understand such windstorms, a case of explosive Mediterranean cyclogenesis that affected the Black Sea area during 2-3 December 2012 is analyzed. The cyclone developed a bent-back front and strong winds in the southern part of the low center (up to 137 km h-1), suggesting that the cold conveyor belt and/or sting jet could be the cause. A mesoscale model simulation using the Weather Research and Forecasting model (WRF) is used to investigate the synoptic and mesoscale dynamics that are responsible for the strong winds, the relative importance of the stability of the boundary layer, and the causes of acceleration leading to the high-winds areas. Our results indicate that the strongest winds occur at the end of the bent-back front where the front is weakened by frontolysis and that these winds accelerate as they descend from the midtroposphere and through the boundary layer, aided by near-neutral static stability near the surface.