Geophysical Research Abstracts
Vol. 14, EGU2012-8180, 2012
EGU General Assembly 2012

Idealized simulations of sting jet cyclones

L. H. Baker (1), S. L. Gray (1), and P. A. Clark (2)

(1) Department of Meteorology, University of Reading, Reading, United Kingdom (s.l.gray@rdg.ac.uk), (2) Faculty of Engineering and Physical Sciences Mathematics/Civil, Chemical and Environment Engineering, University of Surrey, Guildford, United Kingdom

An idealized modeling study of sting-jet cyclones is presented. Sting jets are descending mesoscale jets that occur in some extratropical cyclones and produce localized regions of strong low-level winds in the frontal fracture region. Moist baroclinic lifecycle (LC1) simulations are performed with modifications to produce cyclones resembling observed sting-jet cyclones. Two jets exist in the control idealized cyclone that descend into the frontal fracture region and result in strong winds near to the top of the boundary layer; one of these satisfies the criteria for a sting jet, the other is associated with the warm front. Sensitivity experiments show that both these jets are robust features. The sting jet strength (measured by maximum low-level wind speed or descent rate) increases with the cyclone growth rate; growth rate increases with increasing basic-state zonal jet maximum or decreasing basic-state tropospheric static stability. The two cyclones with the weakest basic-state static stability have by far the strongest sting jets, with descent rates comparable to those observed. Evaporative cooling contributes up to 20% of the descent rate in these sting jets compared with up to 4% in the other sting jets. Conditional symmetric instability (CSI) release in the cloud head also contributes to the sting jet, although there is less extensive CSI than in observed cases. The robustness of the sting jets suggests that they could occur frequently in cyclones with frontal fracture; however, they are unlikely to be identified unless momentum transport through the boundary layer leads to strong surface wind gusts.