A Climatology of Inverted Troughs over the Gulf of Maine and New England

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Inverted troughs (ITs) over the Gulf of Maine are cool season phenomena that are responsible for unexpected high-intensity snowfall over New England. An IT is a north and westward extension of relatively low atmospheric pressure that contains an easterly component of wind and cyclonic relative vorticity. These ITs have the ability to focus moisture into a low-tropospheric convergence zone, lift the air parcel into an unstable atmosphere, and produce high-intensity banded precipitation over a given region. This study creates an inceptive 25-year cool season (September–May) climatology of ITs over the Gulf of Maine from 1989 to 2013. The dynamical characteristics of the IT-influenced precipitation events are investigated via composite analyses of various dynamics parameters at the time of IT maximum amplification.

The temporal climatology suggests that IT manifestation is most common during relatively cool months of the year (i.e., December through April). A k-means clustering test indicated that there is no obvious clustering of IT location based on surface cyclone location alone, but when the

orientation of the IT axis is considered as well, there appears to be two possible clusters: (1) cyclones with ~NW-to-SE ITs, and (2) cyclones with ~W-to-E ITs.

Composite results suggest that (1) north and westward extensions of quasi-geostrophic forcing for upward vertical motion removed from the sea-level pressure minimum of a parent-low pressure system can result in the genesis of ITs, and (2) IT axes serve as low-tropospheric convergence zones and loci of frontogenesis resulting in characteristics of frontal boundaries. It is hypothesized that mesoscale responses to the synoptic-scale forcing are responsible for the enhanced regions of precipitation located within the bounds of the IT. A robust mesoscale analysis is not detailed in this presentation but will be the focus of future work. Operational forecasting techniques based upon the results of this study are proposed in order to improve the forecasts of IT-influenced precipitation.