Abstract

THURMAN, JAMES ARNOLD. Numerical Studies of Synoptic and Mesoscale Environments Conducive to Heavy Rainfall in Tropical and Extratropical Systems. (Under the direction of Yuh-Lang Lin.)

The purpose of this research was to examine the environments conducive to heavy rainfall production, specifically a landfalling hurricane, Hurricane Floyd (September 1999) and an Alpine event, MAP IOP-2B (September 1999). In addition to studying the two events independently, a third study examined the link between Floyd's extratropical transition and IOP-2B given that the two events occurred a few days apart. Analysis of observations of both events led to the formation of the hypothesis that the coupling of transverse ageostrophic circulations over a preexisting low-level confluence zone was a key precursor to heavy rainfall production.

In both cases, a low-level confluence zone was found based on the observations and simulations. For Floyd, the confluence zone developed as warm easterly winds ahead of the hurricane became juxtaposed with cooler northeast winds just inland over North Carolina and Virginia. In IOP-2B, the confluence zone developed as southerly winds from the Mediterranean became juxtaposed with easterly and southeasterly winds from eastern Italy. These easterlies and southeasterlies developed as southeast winds from the Adriatic Sea impinged upon the eastern Alps, and turned west in the form of a barrier jet. Also, in both cases, upper-level diffluence, due to a split flow, became juxtaposed over the low-level confluence, enhancing the upward motion. MM5 simulations for both events revealed coupled thermally direct and thermally indirect circulations over the low-level confluence zone with their rising branches coupled over the zone, proving the hypothesis.

Simulations of Floyd's extratropical transition showed a link existed between Floyd and

IOP-2B. Parcels from Floyd's upper-level circulation reached Italy around the time the heavy rainfall developed in IOP-2B. Simulations with and without latent heat release demonstrated the importance of latent heat release in maintaining the upper-level jets and split flow which in turn, aided in the maintenance of convection. Latent heat release was also found to be important in maintaining the strength of the transverse ageostrophic circulations.

NUMERICAL STUDIES OF SYNOPTIC AND MESOSCALE ENVIRONMENTS CONDUCIVE TO HEAVY RAINFALL IN TROPICAL AND EXTRATROPICAL SYSTEMS

by

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Biography

James Thurman was born in Kinston, NC on December 22, 1973 (what a Christmas present for his sister!). Growing up in Kinston, he graduated from South Lenoir High School in 1992. In the fall of that year, he began his undergraduate studies in meteorology at N.C. State University in Raleigh. In the spring of 1996, he received his B.S. in meteorology and in the fall of the same year began his master's degree study under Jerry Davis. James received his M.S. in meteorology in the fall of 1998. In 1999, James began work on a Ph.D. under Yuh-Lang Lin, also at N.C. State where he remained a full time graduate student until May, 2001. On May 7, 2001 James began working for Dyntel (now part of Computer Science Corporation) as an assistant systems analysist/programmer. On September 8, 2001, he married Alison Hall of Kinston and the couple moved to Garner in the summer of 2002.

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the Codiac service of UCAR. IOP-2B observations and satellite imagery were obtained from the MAP Data Centre (www.map.ethz.ch). Distance calculations in Chapter 2 were based on an algorithm from the website of Andrew Gray (www.argray.org). Simulations were performed on an SGI Origin at the North Carolina Supercomputing Center.

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