Non-Convective High Wind Events:

Investigating the Cloud Features and Mesoscale Structure

of Non-Convective High Wind Events

by

NASA DEVELOP – Saint Louis University
Nicholas Elmer
Michelle Hogenmiller
Matthew Warbritton

205 O'Neil Hall
3642 Lindell Blvd
St. Louis, MO 63108

OPENING SHOT SHOWING TITLE SLIDE WITH PROJECT TITLE

MATT: Hello, my name is Matt Warbritton,

NICHOLAS: and this is Nicholas Elmer,

MATT: and we are members of the NASA DEVELOP National Program at Saint Louis University. Our Fall 2012 research project is titled: Investigating the Cloud Features and Mesoscale Structure of Non-Convective Wind Events.

SLU TEAM PICTURE SHOWN

MATT: The research team at Saint Louis University includes three Saint Louis University students: Nicholas, myself, and Michelle Hogenmiller. We work under the guidance of our science advisors, Dr. Emily Berndt and Dr. Timothy Eichler.

PHOTOS OF UK STORM DAMAGE

NICHOLAS: Localized wind damage, resulting from non-convective high wind events, is one of the most difficult aspects of weather to forecast. Our goal is to create a forecast tool that diagnoses the connection between stratospheric intrusions and near-surface non-convective winds, which can be assimilated into the new set of operational products under development by the GOES-R Proving Ground.

POWERPOINT SLIDE SHOWING PROJECT PARTNERS AND LOGOS

MATT: During this project, we worked with the GOES-R Proving Ground, which is a joint project of NOAA and NASA. The GOES-R Proving Ground creates simulated GOES-R products which can be tested and evaluated before the GOES-R satellite is launched. We are also working with NASA SPoRT, whose function is to transition observations and research capabilities to the operational weather community to improve regional short-term forecasts.

POWERPOINT SLIDE SHOWING MAPS OF STUDY AREA

NICHOLAS: We studied the mesoscale structure and cloud features of the October 26, 2010 cyclone which impacted the Midwest and Great Lakes regions of the U.S. We used RUC data to complete the mesoscale analysis and NASA MERRA Reanalysis data to investigate the cloud features, such as cloud-top temperature and liquid water mixing ratio.

MERRA OZONE AND WIND GUST IMAGES

NICHOLAS: Previously, we used MERRA reanalysis to link the presence of stratospheric intrusions to strong winds at the surface, which are within the clear dry slot and therefore unrelated to convection. MERRA also allowed us to more easily link the high concentrations of ozone to upper-level potential vorticity.
Our current study further investigated these high wind events by analyzing mesoscale parameters, such as convective symmetric instability, equivalent potential vorticity, and frontogenesis, to determine the possible presence of the sting jet in the Midwest United States case study. Additionally we determined whether MERRA Reanalysis data can adequately resolve and give additional information about cloud features linked to high surface winds.

MESOSCALE STRUCTURE: CROSS SECTION RESULTS

NICHOLAS: Cross sections were created in order to analyze the location of convective symmetric instability, abbreviated as CSI, equivalent potential vorticity, which is also called EPV, and frontogenesis with respect to the stratospheric intrusion and the strong surface wind gusts. We found that CSI and frontogenesis were only present along the cold front, circled in pink. The dry air is clearly present behind the front, as evidenced by the clear wedge of air with much lower relative humidity.
However, since the stratospheric intrusion was located just west of and at the same pressure level as the CSI and frontogenesis, it is possible that the downward components of these circulations enhanced the downward motion of the stratospheric air. The zero contour of the equivalent potential vorticity marks the boundary of the stratospheric air, since positive EPV values represent descending air and negative EPV values represent slantwise convection.

MESOSCALE STRUCTURE: SATELLITE OVERLAY RESULTS

NICHOLAS: EPV, frontogenesis, and omega were also overlaid on satellite imagery to assess their locations on a horizontal scale. The EPV and frontogenesis plots confirmed what we saw in the cross sections. Positive

values of the omega contours, which identify locations of downward moving air, are centered on the locations of the strongest surface wind gusts within the dry slot.

MERRA CLOUD FEATURE RESULTS

MATT: The cloud-top temperature plots and liquid water mixing ratio were compared to infrared and water vapor satellite imagery, respectively, to verify the accuracy of the MERRA Reanalysis. As shown in the comparison of the cloud-top temperatures and the infrared image, the general structure of the clouds is modeled accurately, particularly in the comma head, but the plots fail to capture the faster-moving clouds associated with the cold front.

CONCLUSIONS SLIDE

NICHOLAS: While the mesoscale structure of the cyclone supports concentrated areas of rapid downward motion, it is still difficult to confirm whether the sting jet occurred in this case. Future research will analyze downdraft CAPE in this storm, as well as complete an in-depth study of the mesoscale structure of storms in the United Kingdom with confirmed sting jets. Those results can then be compared to the results of this study to verify the existence of the sting jet.

MATT: The MERRA cloud feature analysis is in its initial stage and will be studied in more depth in the future. The MERRA results can also be jointly applied with the mesoscale analysis to other similar storms, especially the ones with confirmed sting jets, to gain further insight into these processes.

POWERPOINT SLIDE SHOWING ACKNOWLEDGEMENTS

NICHOLAS: We would like to thank Dr. Emily Berndt, Dr. Timothy Eichler, and Dr. Jack Fishman at Saint Louis University for advising us throughout this project. We would also like to thank Dr. Michael Folmer with GOES-R Proving Ground and John Knaff of NOAA/NESDIS/STAR for providing us with GOES-R RGB Air Mass imagery as well as the training to properly use the product. Lastly we wish to acknowledge the team at NASA SPoRT for their assistance.

CLOSING SLIDE WITH CREDITS

MATT: This concludes our Fall 2012 DEVELOP Project at Saint Louis University. Thanks for watching!

DEVELOP CLOSING