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Outline

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Introduction

- Saharan Air Layer (SAL)
  - Intensely dry, warm and sometimes dust-laden layer of the atmosphere
  - Offshore, base at ~900-1800 m and the top is usually below 5500 m (Diaz et al. 1976)
- SAL has negative impact in TC development (Dunion and Velden 2004)
  - Enhancement of trade winds inversion (more stable atmosphere)
  - Enhancement of the local vertical shear due to the African Easterly Jet (AEJ)
  - Intrusion of dry air by the SAL
- Positive impact of the SAL on the microphysical level (Jenkins et al. 2008)
  - Cloud Condensation Nuclei (CCN) source, invigorating rain bands.
- Braun (2010a) found SAL to be a integral part of the environment at the TC formation
Objectives

- Better understanding of the SAL in terms of the microphysics of tropical cyclones formation.
- Find a correlation of AOD, lightning, and wind shear at the genesis stage.
Research Methods

• Comparative Analysis
  • Two study cases: Helene (2006) and Julia (2010)
  • Field Campaigns data:
    • NASA African Monsoon Multidisciplinary Analyses (NAMMA) 2006
      (http://airbornescience.nsstc.nasa.gov/namma/)
    • Genesis and Rapid Intensification Processes (GRIP) 2010
      (http://airbornescience.nsstc.nasa.gov/grip/)
    • METEOSAT-8, MODIS, and UK Met Office’s lightning Arrival Time Difference (ATD)
Case Descriptions

• **Helene (2006)**
  - Tropical Depression (TD) #8 on September 12, 2006 at 1200 UTC
    - Location: 11.9°N, 22°W
    - Pressure: 1007 hPa
    - Sustained winds: 12.9 ms\(^{-1}\)

• **Julia (2010)**
  - TD #12 on September 12, 2010 at 0600 UTC
    - Location: 12.9°N, 20.5°W
    - Pressure: 1007 hPa
    - Sustained winds: 14.9 ms\(^{-1}\)
NCEP Reanalysis

Higher Precipitation

Stronger AEJ
CALIPSO aerosol backscatter

- “Secondary” SAL layer seen in 2010
Radiosonde Analysis: Mixing Ratio and RH

- Drier conditions at lower elevations in 2006
- “Secondary” SAL layer induces drier conditions in 2010
- Higher vertical development in 2010
Lower values of Aerosol Optical Depth on 2010 in comparison with 2006 over the selected days.
MODIS AOD vs. ATD
## Radiosonde Analysis: Wind Shear and RH

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Prior: Wind shear of 5.8 m s\(^{-1}\)
During: ~ 11.7 m s\(^{-1}\)
After: ~ 3.5 m s\(^{-1}\)

Prior: Wind shear of 0.4 m s\(^{-1}\)
During: ~ 1.7 m s\(^{-1}\)
After: ~ 2.5 m s\(^{-1}\)
Summary

• Both systems develop under either stronger or weaker dust conditions.

• AOD and lightning data suggest that higher amounts of dust particles in the background environment could increase CCN that help the development of the system.

• Lower vertical wind shear (< ~ 2.6 m s\(^{-1}\)) and lighter dust covered conditions in 2010 contribute to the vertical development of Julia.

• Data analyzed may not be able to establish a correlation between AOD, lightning, and wind shear.

• Overall the results in this study suggest that dust is a contributor but may not be a key factor to affect the formation.
Future Work

- Analyze a non-develop system under strong outbreak and weak outbreak conditions.

- The Weather Research and Forecast (WRF) chemistry model (WFR-CHEM)
Acknowledgements

• We acknowledge the suppliers of datasets employed in this research.

• Suggestions from J. Dunion and G. Jenkins were much appreciated.

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Questions?

Thank you!
