Analyzing a Winter Cyclone with Snowbands During the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) Campaign

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1. Background & Goal

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) campaign is a research campaign that aims to study snow storms on the east coast. Specifically, IMPACTS aims to uncover the processes that might explain the precipitation variability (bands of concentrated snowfall) within these winter storms in order to help make the snowfall predictions of these winter cyclones more accurate.

Research Goal:

- Gain an understanding of the context and structure of a single storm that hit the Midwest on 17 February 2022
  - General atmospheric environment during the lifecycle of the storm
  - More detailed insight of its processes and structure

2. Methods & Data

- Focused on one specific storm In order to study the mechanisms of a snowstorm as in-depth as possible
- Used the European Centre for Medium-Range Weather Forecast reanalysis version 5 (ERA5) data to analyze the atmosphere during the lifecycle of the storm
- Used the National Oceanic and Atmospheric Administration's High-Resolution Rapid Refresh (HRRR) model analysis to investigate smaller scale synoptic features in greater detail

3. Surface Environment

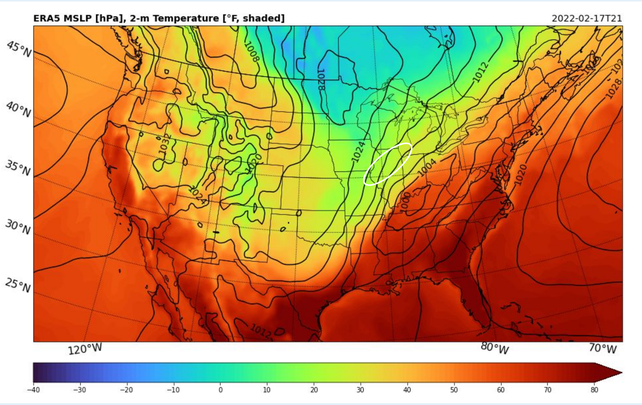


Fig. 1 Surface plot at 21 UTC 17 February 2022 from ERA5 data. White oval is general area of IMPACTS flight and snowband

- Temperatures are below freezing where snow is occuring
- Surface front is south of flight and snowband
  - cold air to produce snow

4. Upper-Level Environment & Dynamics

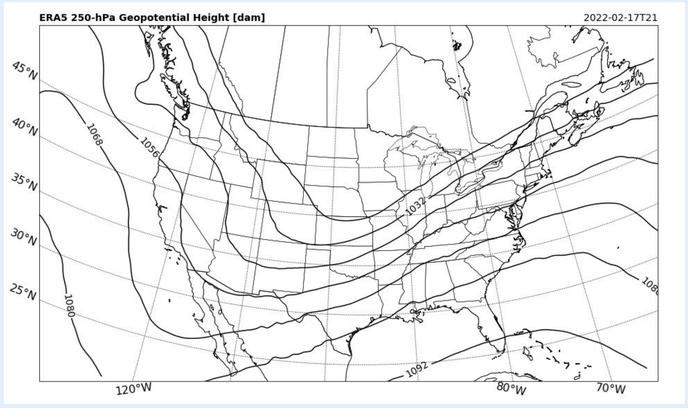


Fig. 2 Geopotential heights at the 250-hPa level at 21 UTC 17 February 2022 plotted from ERA5 data

- Shows the jetstream level trough at the time of the storm
- Westward tilt when compared to Fig. 3 (below) indicates a developing and strengthening storm system

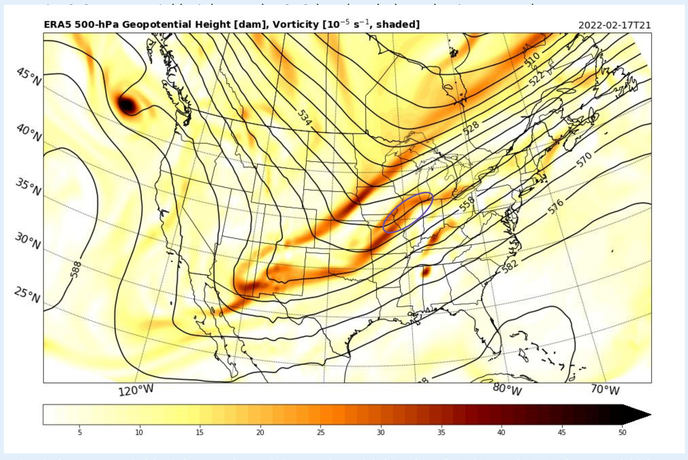
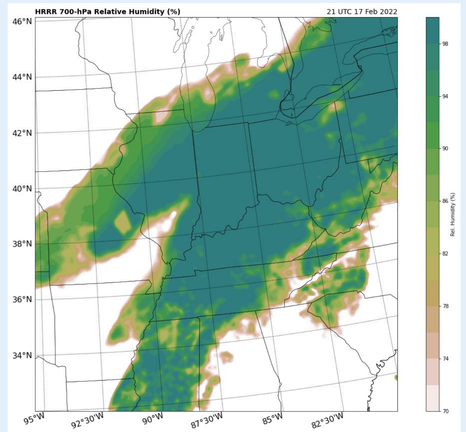


Fig. 3 Geopotential heights and vorticity at the 500-hPa level at 21 UTC 17 February 2022, plotted using ERA5 data. Purple oval is general area of IMPACTS flight and snowband

- Trough to the west of Illinois with a strong vorticity center in the middle
  - There is upper level support
  - Storm system is developing

5. Mid-Level Dynamics & Moisture

Fig. 4 (below) Relative Humidity at the 700-hPa level at 21 UTC 17 February 2022, plotted using HRRR data



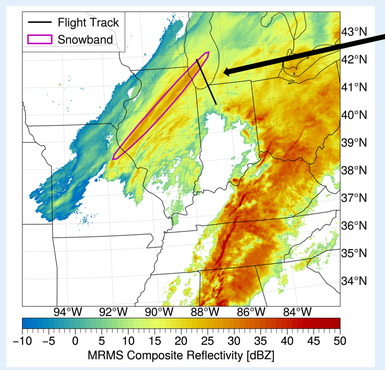


Fig. 5 (above) Radar reflectivity from the Multi-Radar/Multi-Sensor System (MRMS) at 2230 UTC 17 February 2022. Black line is the flight track and magenta oval is an identified snowband

- Reveals the atmospheric moisture, and therefore the potential for precipitation
- Drier air coming in from southern Illinois
  - A complicating development during the IMPACTS flight

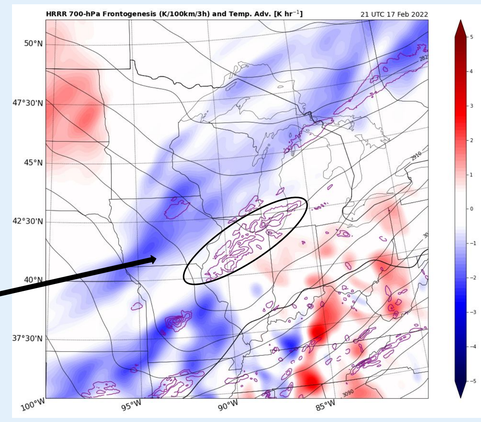


Fig. 6 (above) Frontogenesis and Temperature Advection at the 700-hPa level at 21 UTC 17 February 2022 plotted using HRRR data. Black oval is general area of IMPACTS flight and snowband

- Colder air was rushing in from Iowa and Wisconsin
- Frontogenesis (production of fronts) aligns with snowband
  - May be one of the forcing mechanisms for the lift necessary for making the snowband

6. Summary & Future Work

- The storm that occurred on 17 February 2022 was a developing storm with strong large scale forcing. Additionally, mid level frontogenesis was associated with the banded area that saw the heaviest snowfall
- In the future, this research will be utilized as a background to study the mesoscale and microscale processes within and outside of the snowband using the IMPACTS datasets such as radar reflectivity from aircraft and cloud particle measurements within the clouds.

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Data available at the NASA Global Hydrology Resource Center DAAC: http://dx.doi.org/10.5067/IMPACTS/DATA101

Questions?

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