

Freezing Rain Analysis for the Great Lakes region Project Suite

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Project Background

Though freezing rain is an infrequent component of the Great Lakes winter precipitation regime, it can have major socioeconomic implications. In 2013, GLISA authored a report on the climatology of freezing rain events and future projections of freezing rain focused on Chicago. We would like to expand this work to include a synthesis of freezing rain throughout the Great Lakes region along with the updated climatology. This expanded focus on the wider Great Lakes region is important due to the differing patterns and mechanisms of freezing rain across the region. Existing data analysis contained in climatologies of freezing rain for the Great Lakes only extend through the 1990s. An updated climatology would be of value to many decision makers in the region, particularly in cities and within the transportation sector

Related Projects: Updating GLISA Climatologies

Estimated time (in semesters or hours) See individual project descriptions

Description of Work

Surface Observations:

Currently, GLISA is planning the examination of hourly climatological data from 1st order weather stations in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin to determine if sufficient data exists for an updated climatology. One major concern is a potential discontinuity in the data series associated with the switch from manual to automated observations (ASOS) of precipitation type during the 1990's. Previous climatologies explicitly exclude automated precipitation sensor data over concerns about detection of freezing rain. This project will compare data from automated precipitation type observations to manual observations to determine if sufficient data exists to create an updated climatology for the region. Analyzing hourly data for this project will have benefits to future projects that implement hourly observations.

Key skills: Observational Data Analysis, Programming, and Meteorological Knowledge

Estimate Time: 1-2 semesters (depending on hours per week, programming experience)

Upper Air Observations

Details atmospheric temperature, dew point, and wind profile before, after, and during freezing rain events. This will follow the climatology of surface observations.

Look for changes in nature of thermal stratification required for freezing rain events. Some characteristics of interest could be:

- Shallower, deeper, magnitude of inversions associated with freezing rain

- Possibly incorporate wind data
 - Look for cases of warm air advection
 - Inversion characteristics

Key skills: Programming, Meteorological Knowledge, and interest in atmospheric processes

Estimate Time: 1 semester

Use Atmospheric Reanalysis to examine physical aspects of freezing rain events

Use methods similar to *Cortinas 2000, Holle and Watson 1996* to examine the nature of vertical motion during freezing rain events.

- Quasigeostrophic adiabatic ascent/descent
 - Differential vorticity advection
 - Thermal advection
 - Justification: Reanalyses have improved since 2000

Could use reanalyses to establish the historical storm tracks for freezing rain events as well as a constructing a comparable climatology.

Key skills: Interest in Atmospheric Processes, Programming, and Synoptic Meteorology

Estimate Time: This could vary a lot depending on what we decide to do/the student's interest. 1 semester is a fair estimate.

Projections

Use CMIP5 model output under various emissions scenarios to evaluate potential changes in atmospheric processes important to freezing rain.

- Storm track
- Characteristics/Occurrences of inversions
- Modifications of synoptic-scale pressure fields/wind patterns

There is little research on the future of freezing rain events.

- Some of the reasons detailed in GLISA report on Freezing-Rain in the Great Lakes
 - http://www.glisacclimate.org/media/Freezing%20Rain%20in%20the%20Great%20Lakes%20%286.7.13%29_0.pdf

Key skills: Interest in Climate Projections, Data Analysis, and Programming

Estimate Time: 1-2 semesters, This may change as this portion of the project develops

Evaluation of Resources

Use a combination of NCDC Storm Event Data and other published available resources to look at the economic and social impacts of freezing rain events in the Great Lakes region. This project would largely be a search and synthesis of existing literature and resources on this subject.

Key skills: Synthesis of information from a variety of sources, Organizational skills, Interest in Human/Economic Impacts

Estimate Time: ½ to 1 semester