A Spatiotemporal Graph Model for Rainstorm Identification and Representation

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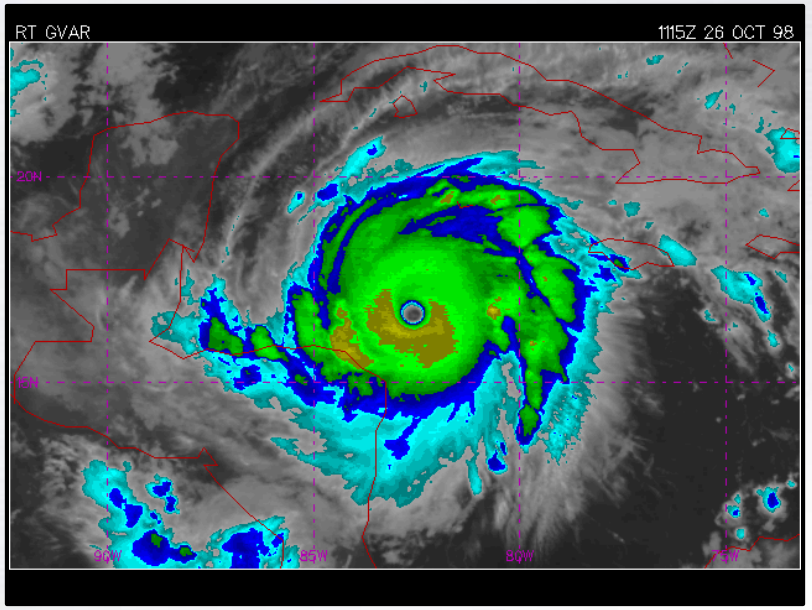
Introduction



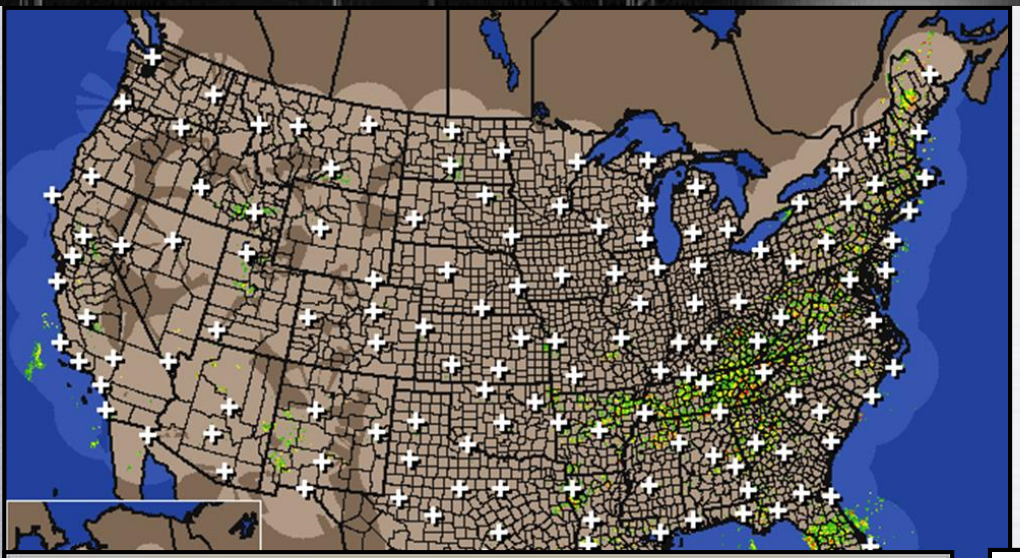
Geographic phenomena evolve in space and time:

- The development of a hurricane
- The evolution of a storm
- The spread of a wildfire
- Other dynamic geographic phenomena from time series of snapshot datasets

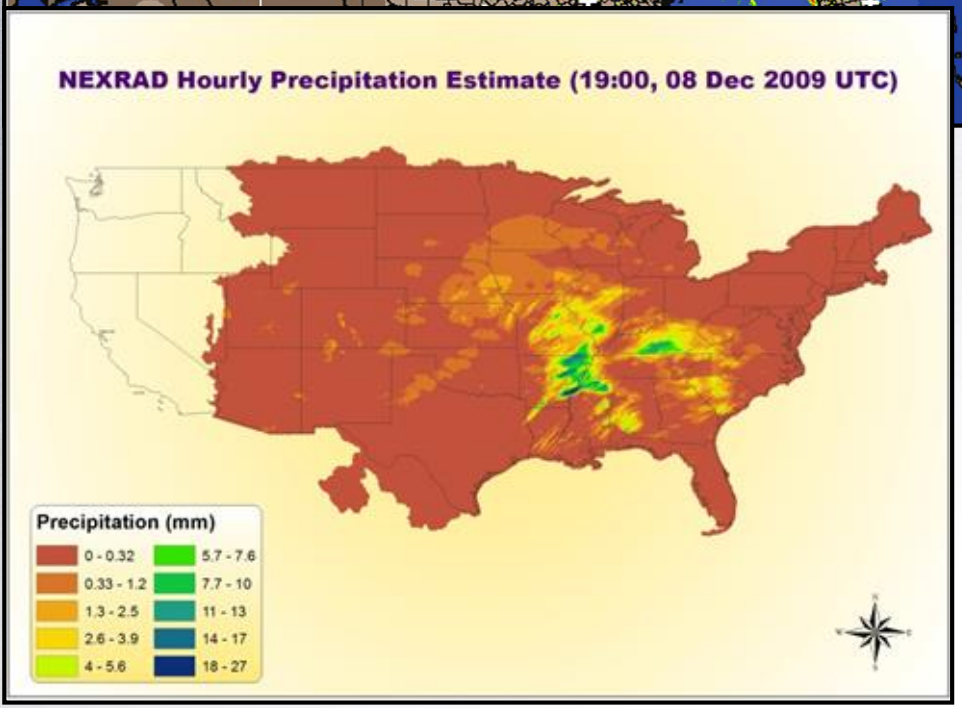
Research Objectives

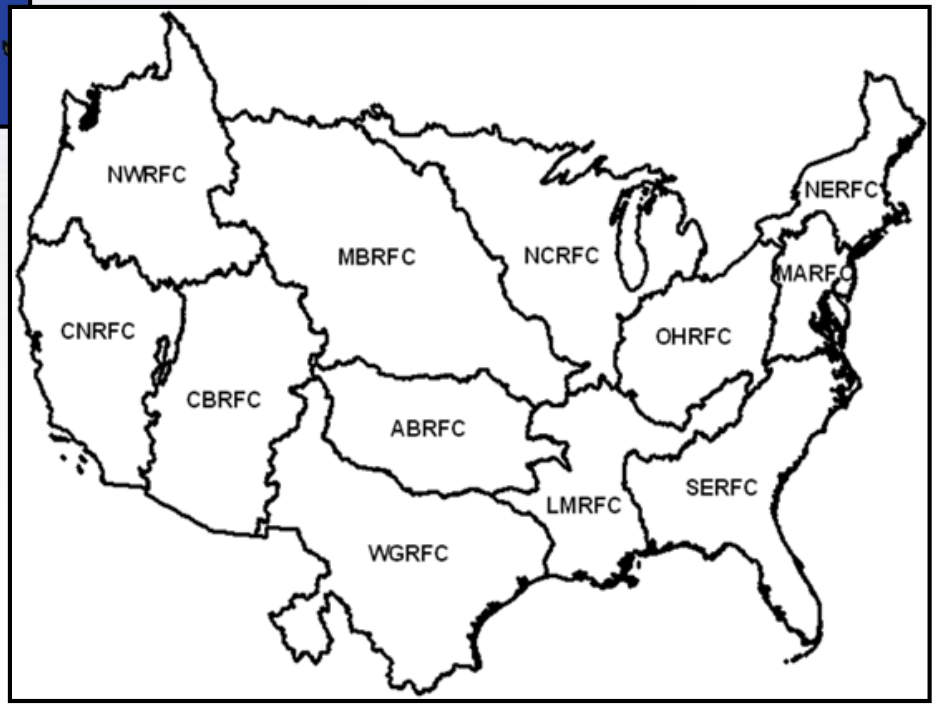
- Identify the whole lifecycle of rainstorms from time series of snapshot datasets;
- Represent and analyze the rainstorms based on a spatiotemporal graph model;
- Analyze the spatiotemporal characteristics of rainstorms.

Data



- NEXRAD (**Nex**t generation **Rad**ar)
- Hourly precipitation estimate
- Cover more than 2/3 of the nation





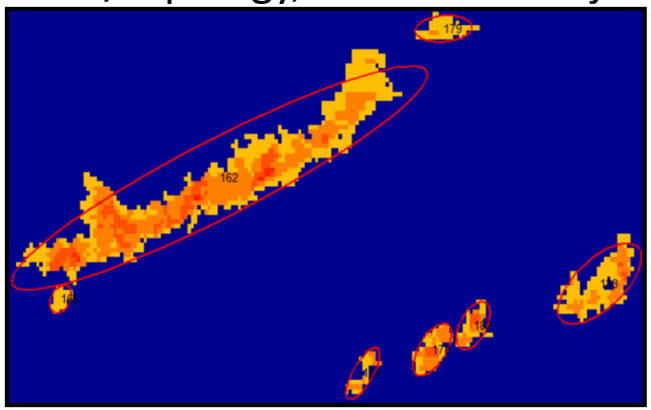
Extract rainstorms' lifecycle

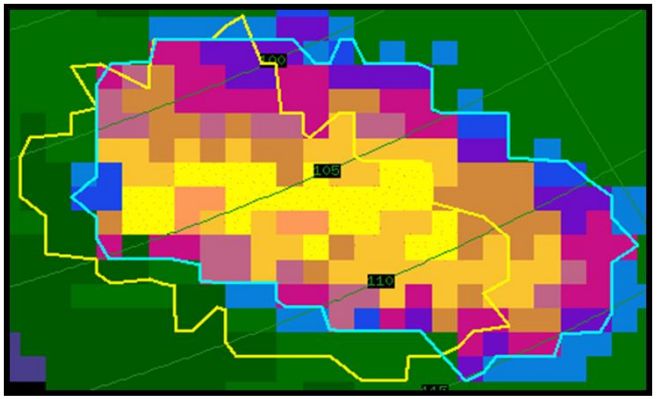
Delineate single rainstorm cell

- ✓ A rainstorm cell in a single snapshot image is defined as a contiguous region, where the precipitation and the area exceed a certain threshold.

Build filiation relations

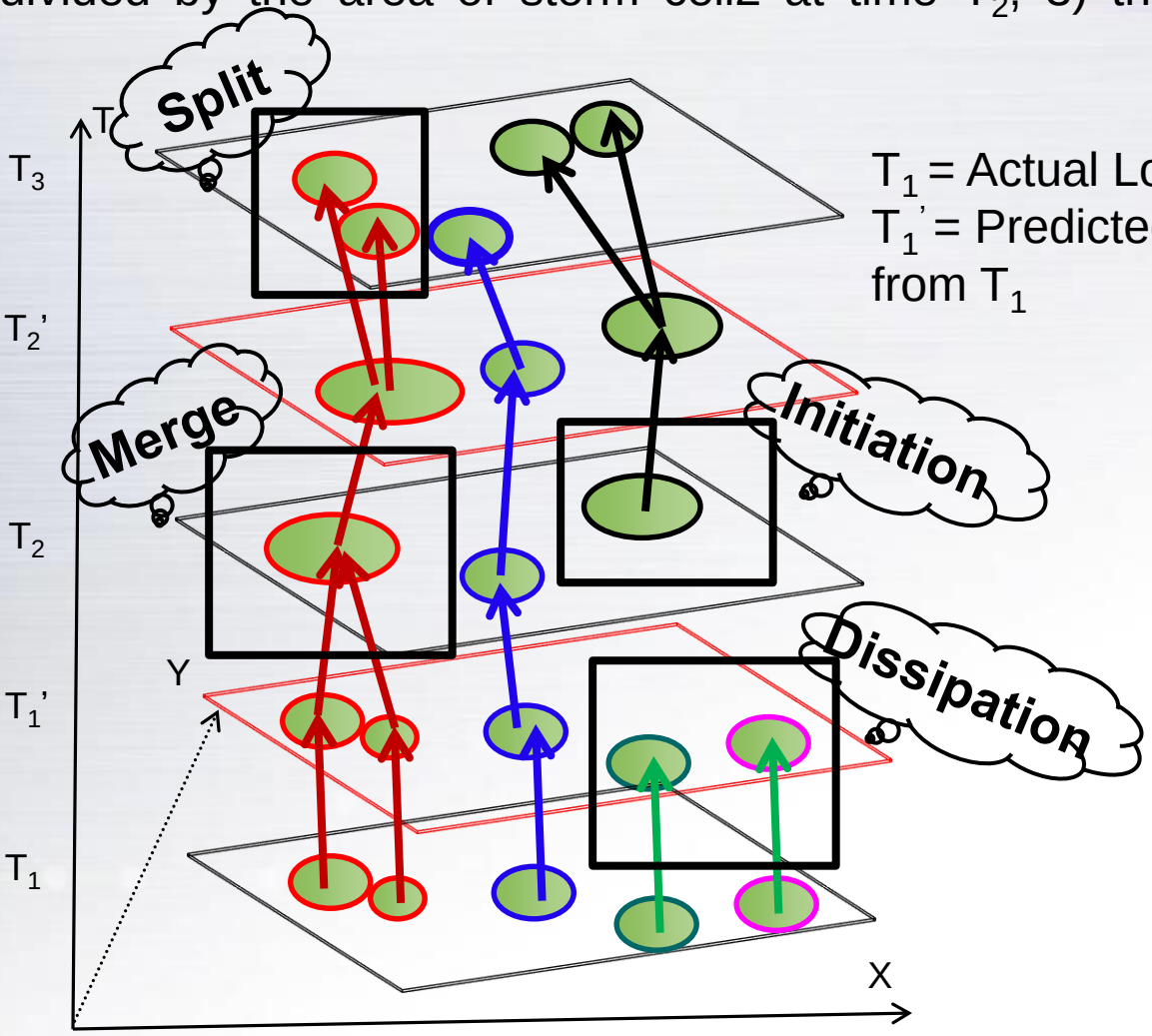
- ✓ Two major types of filiations: continuation and derivation;
- ✓ Location/topology, distance of objects.





Rainstorms' Lifecycle Identification

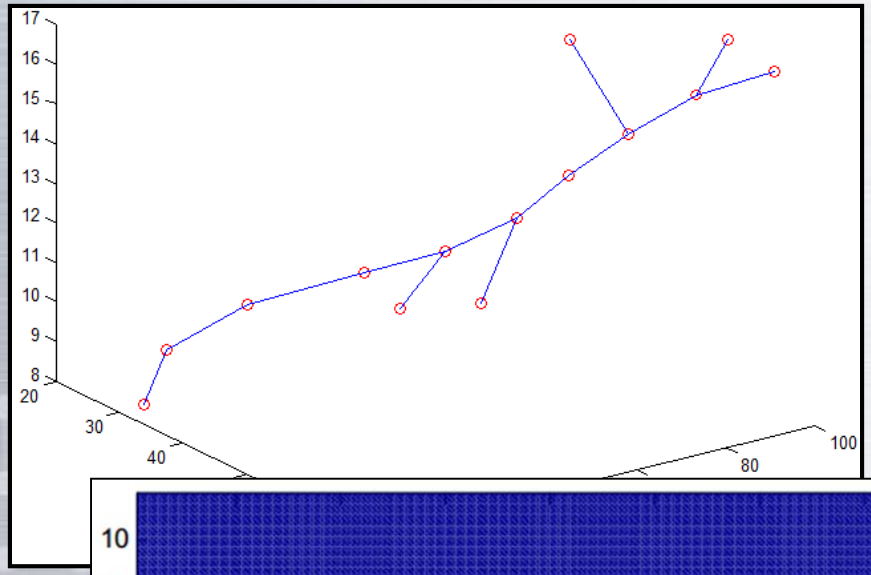
Associate the rainstorm cells between consecutive snapshots **(areal overlap and centroid distance)**: 1) the overlap area divided by the area of storm cell1 at time T_1; 2) the overlap area divided by the area of storm cell2 at time T_2; 3) the sum of two fractions.

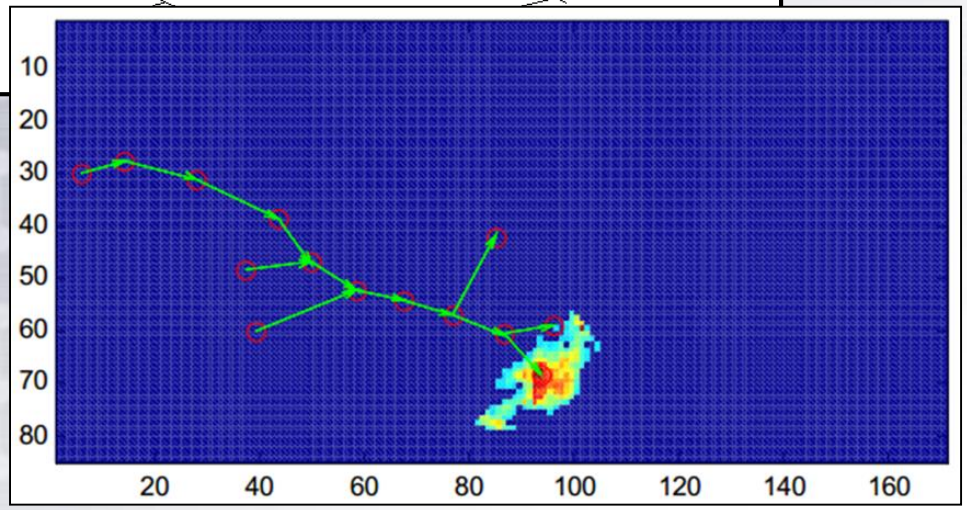


T_1 = Actual Location at T_1
T_1' = Predicted location at T_2 from T_1

Rainstorm Representation

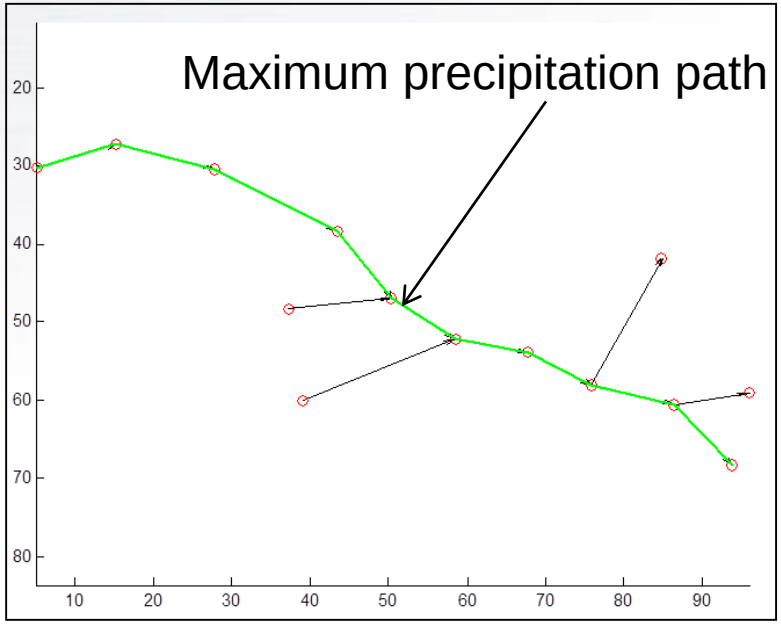
- The directed spatiotemporal graph is proposed in this research to represent a rainstorm.
- Nodes—Storm cells; Edges—Filiation relations between storm cells



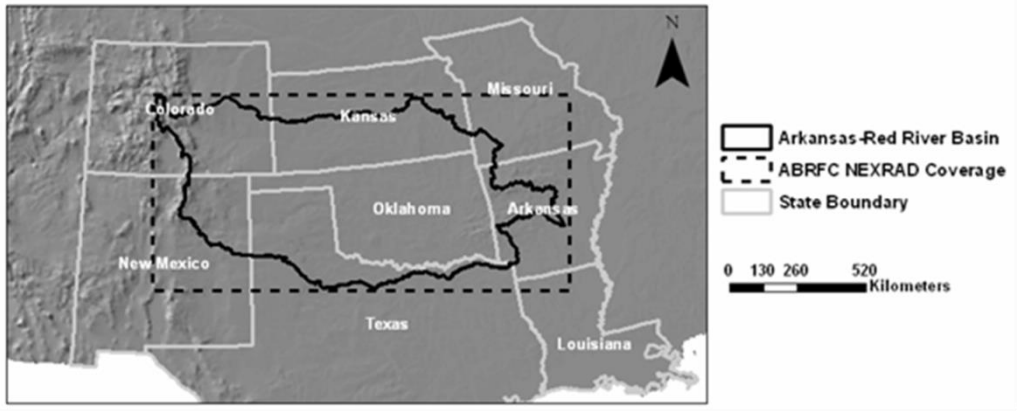


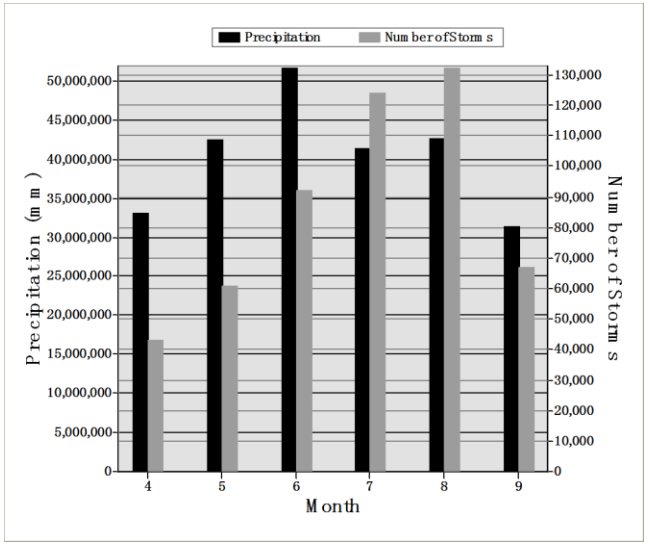
Analyses based on graph model

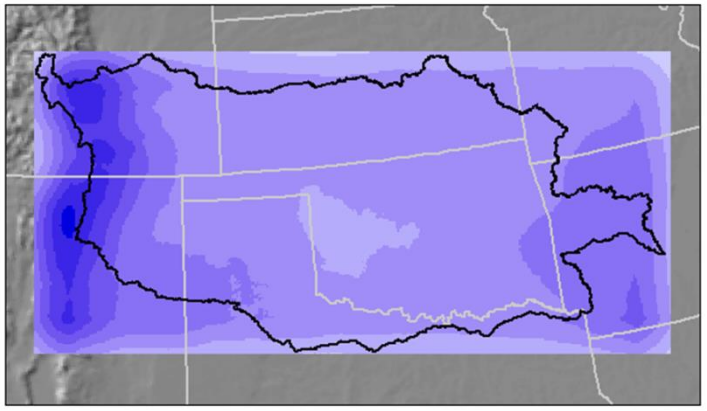
- Maximum precipitation/coverage path
- Degrees of the nodes

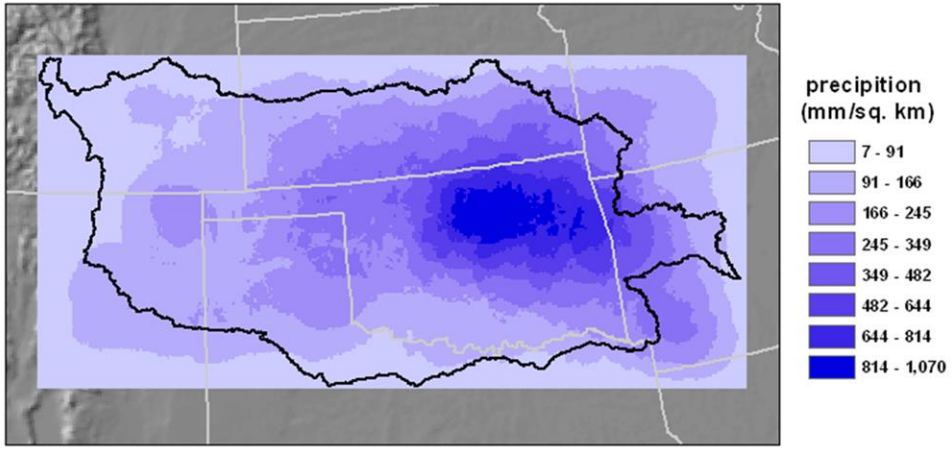


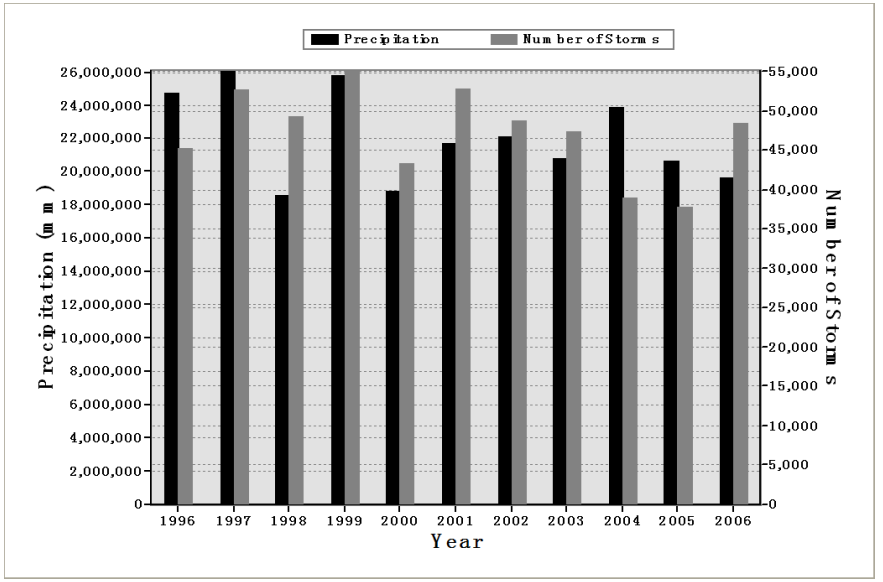
Spatiotemporal Characteristics of Storms in Arkansas-Red River Forecast Center











Thanks!