Open problem: Dynamic Relational Models for Improved Hazardous Weather Prediction

Amy McGovern, Adrianna Kruger, Derek Rosendahl, Kelvin Droegemeier School of Computer Science and School of Meteorology University of Oklahoma

Severe storm damage

 Severe (tornados, hail, thunderstorms, floods, etc) weather causes:

– Loss of life

– More than \$13 Billion in damage annually!





NWS Operational Performance



NWS GOAL: Reduce the national average tornado warning false alarm rate from 0.80 (1998) to 0.69 or lower and increase the probability of detection from 0.64 (1998) to 0.73 or higher and the lead time from 11 minutes (1998) to 13 minutes (2005).

Source: NWS Office of Science and Technology

Our goals

- Improve understanding of tornadogenesis through knowledge discovery
 - Many simulated storms (instead of single storms)
- Reduce the false alarm rate
- Increase warning lead time
- Save lives!

Raw data

Wind velocity

Reflectivity

May 29, 2004 OKC tornado

Assimilated Data

Reflectivity

- 4-dimensional large dynamic data
- Can obtain meteorological variables not observed by radar
- Data & algorithms not tied to radar hardware

Pressure

Temperature

Algorithms Applied to Assimilated Data

NEXRAD, TDWR, FAA, NETRAD Radars

Other Observations

Forecast Model Output

Data Assimilation System

High-Resolution, Physically Consistent Gridded Fields of all Meteorological Variables

Detection Algorithms Applied to Gridded Fields

Features and Relationships

A New Way of Thinking...

Mid-Level

Just Above Ground

- No simple solutions to detecting these features!
- NEXRAD concepts likely won't work!!
- May need advanced data mining, image processing and pattern recognition techniques

Current Approach

View the data propositionally (Ack!)

Relational Challenges

© 1993 Oxford University Press -- From: Bluestein, *Synoptic-Dynamic Meteorology -- Volume II: Observations and Theory of Weather Systems*

Future Work

Relational approach (hooray!)
Develop new PRMs for this data

Large, dynamic data

Applications to other severe weather

Flash flooding
Many more possible!

Input welcomed!

Come see our posters!

Dynamic Relational Models for Improved Hazardous Weather Prediction and The Thing That we Tried That Worked: Utile Distinctions for Relational

Reinforcement Learning