

Research Issues in Uncertainty Visualization

CCC Uncertainty in Computation Workshop

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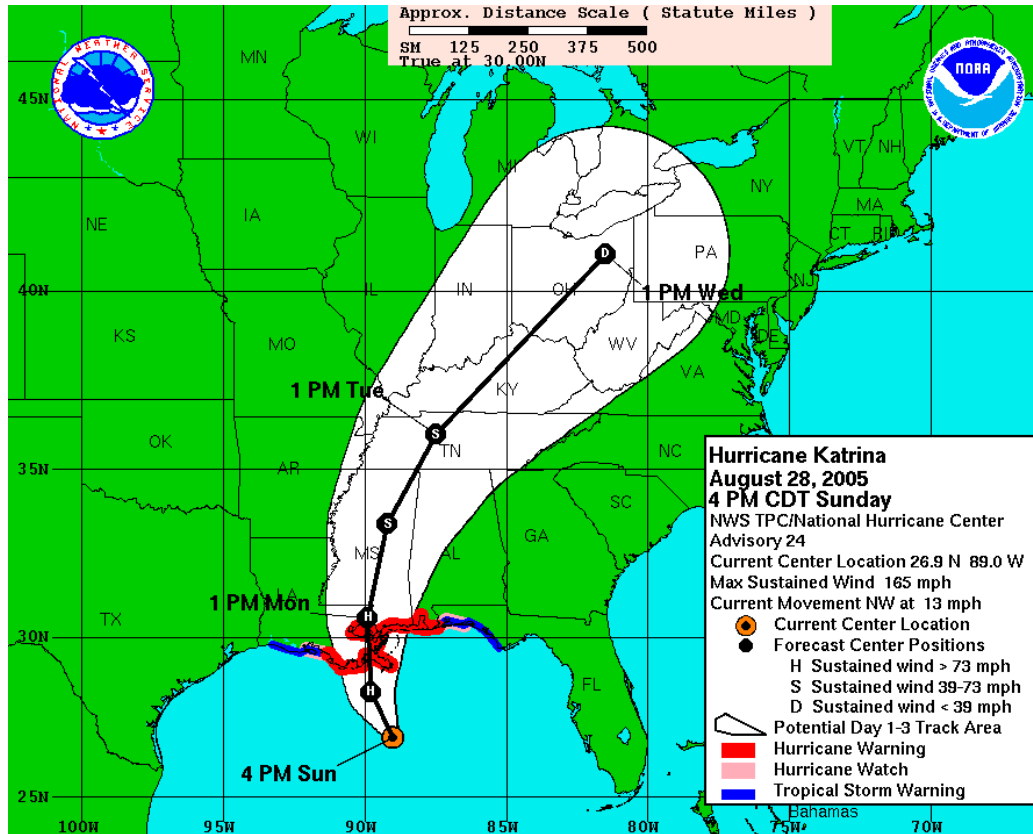
Uncertainty Representation

- Inconsistent data: multiple models, different responses from surveys or different observations, etc.
- Missing data: ignore, preset value, interpolated value
- Scalar quantity e.g. standard deviation
- Range
- Distribution

Quick Overview

- Previous works in statistical graphics and GIS
 - Tend to focus on data at discrete points or 2D spatial data with scalar uncertainty
- Previous works from visualization community
 - Focus on 2D and 3D fields, scalar and vector fields, but mostly scalar uncertainty
 - Only handful of uncertainty infovis techniques
- Current effort focus on ensemble fields
 - Most rely on normality assumption

My favorite uncertainty vis



but ...

Research Issue A:

- There is just as much, if not more, uncertainty in *relational data* than spatial data. Need more research in infovis/visual analytics dealing with uncertainty.
- E.g. edge or link predictions, node attribute uncertainties
- Relationship with big data push

Research Issue B:

- Novel and enhanced means of dealing with ***ensemble data*** sets that do not rely on assumptions about data distributions.
- Efficient ways of incorporating spatial correlations and multivariate correlations
- Extensions to vector and tensor ensemble fields.

Research Issue C:

- Data *analysis tools and techniques* that support ensemble data sets
- E.g. support for interpolation and integration methods that are distribution-aware
- E.g. support for high dimensional ensemble data sets

Research Issue D:

- Quantitative methods and interactive tools for ***accounting and tracking*** of uncertainty
- Identify different types of uncertainty, track how they propagate, and how they affect the final product.
- Imagine ability to turn on/off uncertainty at different stages, experiment with different types of propagation, and vary sensitivity parameters.

Research Issue E:

- Identify unique and common features across different application domains.
- Tools developed for one application may be used in another application, or improve our understanding of the underlying problem.
- What are the ***principles and strategies*** for uncertainty visualization that can span across applications?

Research Issue F:

- How *effective* are the uncertainty visualizations in helping the target audience understand the data and make better decisions?
- What design elements are more amenable for the general public?

What did I exclude?

- Interdisciplinary research
- Prioritization
- Parameter space analysis
- Looking forward to lively discussion later