

# Communicating Hurricane Information

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# Our role as technical collaborators

- Working with Mike Lindell and Carla Prater at Texas A&M
- Development of *Dyna Search*
  - Automating time/event based information search tasks
- Exploring enhanced display technologies
  - A study of new ways to present predictive information containing high levels of uncertainty

*Dyna Search*

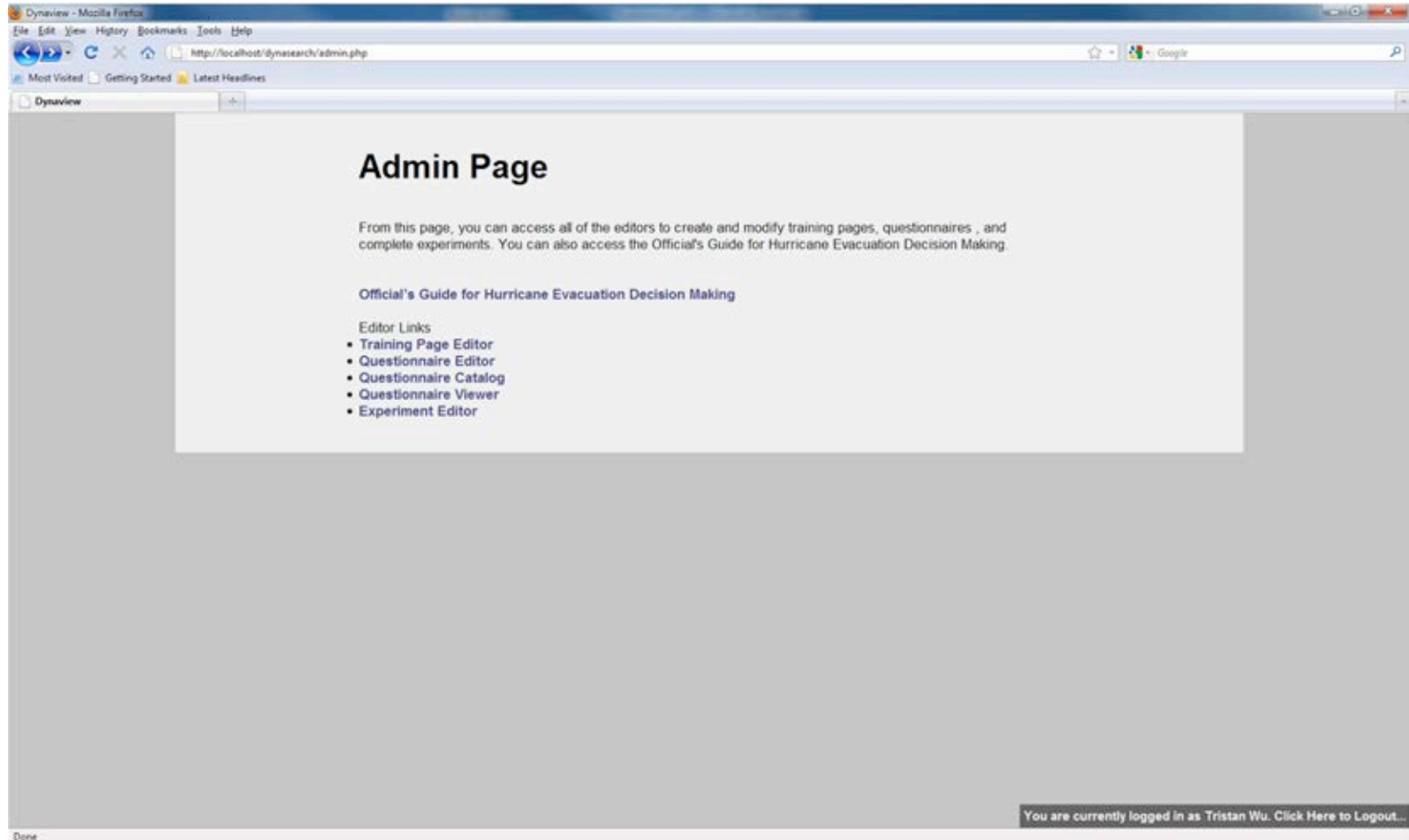
# *Dyna Search*

- System for developing and administering time/event-based information search tasks
- Web based
- Facilities for automating
  - Instrument construction,
  - experiment administration,
  - data collection.

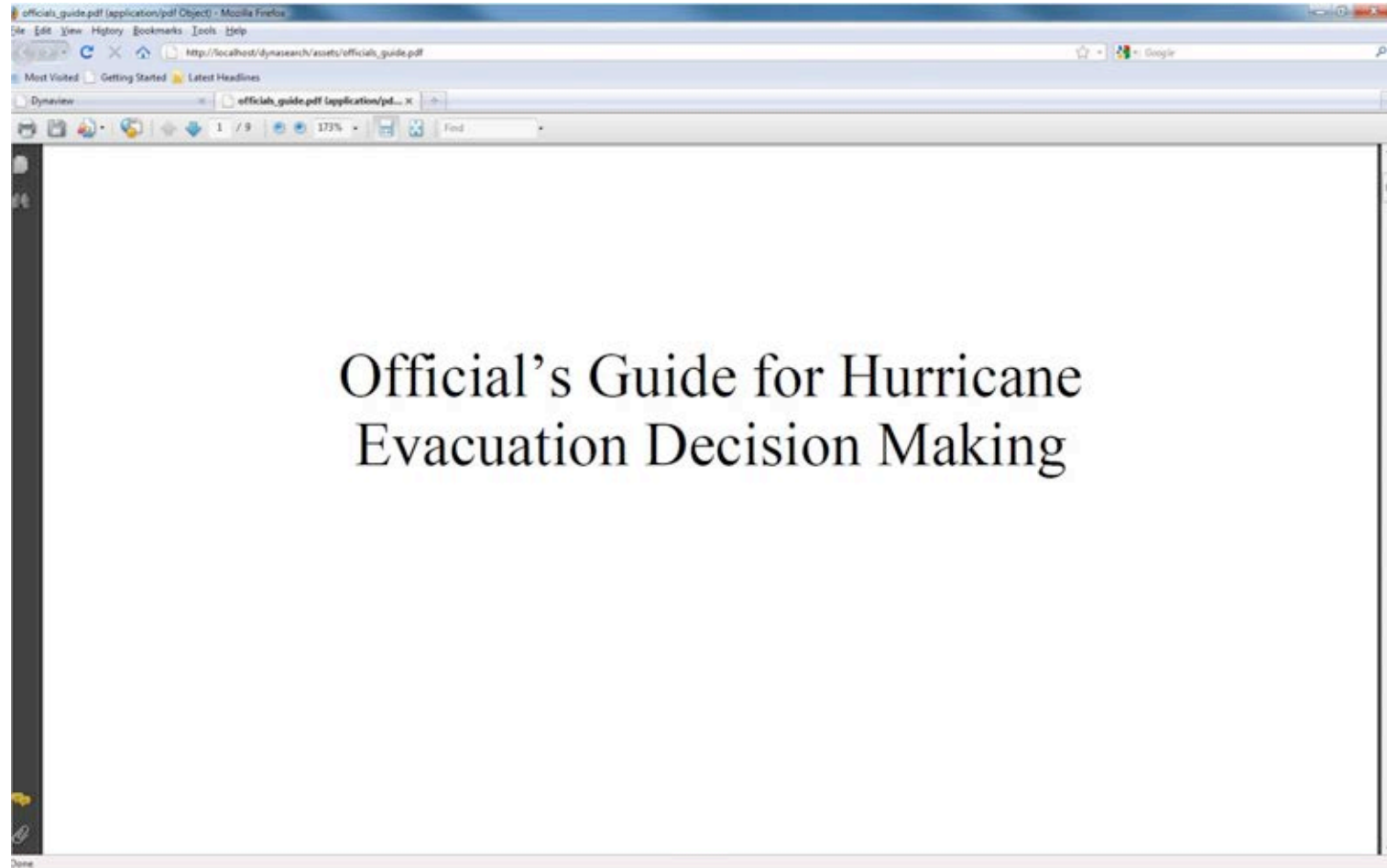
# Supported screen types

- Login for user identification and registration,
- Size registration,
- Instruction,
- Training (information search),
- Survey.

# Accessing the editor



# Example instruction screen



# Building a training screen





# Building a training screen

Editor - Mozilla Firefox

http://localhost/dynasearch/editor.php

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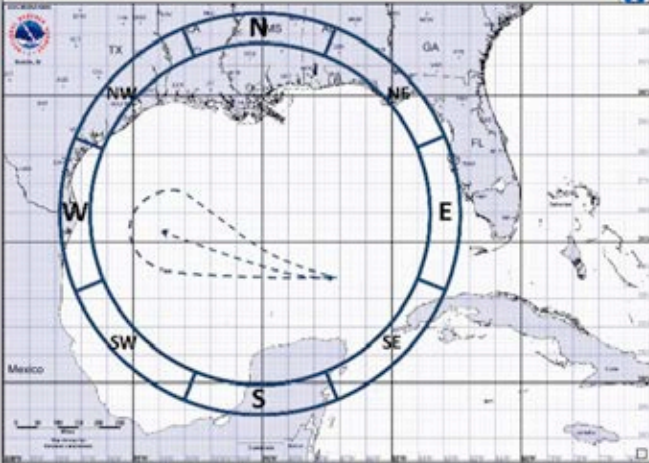
Editor

Do you want Firefox to remember the password for "bristan" on http://localhost?

Remember Never for This Site

**Dear Emergency Managers:**  
These are the hurricane map and hurricane information table. Please remember the information you need and click "next" for the Judgement Questions

**Map**



**Hurricane Information**

Name	Linda
Formed	Aug/1/2011
Predicted Landfall data	Aug/7/2011
Predicted Landfall time	3:00 AM
Category	1
Wind Speed	85 mph
Direction	West

**Legend**

	Current Location				
Past Track	1 Day	2 Day	3 Day	4 Day	5 Day
Forecast Track	1 Day	2 Day	3 Day	4 Day	5 Day
Uncertainty Cone	1 Day	2 Day	3 Day	4 Day	5 Day

**Toolbar**

Save Load

demo.bt

**Clock**

The page at http://localhost says:

Please enter the time limit for this

OK Cancel

# A text entry question

Questionnaire - Mozilla Firefox  
File Edit View History Bookmarks Tools Help  
http://localhost/dynascan/questEditor.php

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Questionnaire

What is the probability that the eye of the hurricane will "hit" each of the following Sectors

A. North

B. Northeast

C. East

D. South east

E. South

F. Southwest

G. West

H. Northwest

Please a title for the questionnaire:

Section 1

Save

Radio Button Question  
Text Question  
Line of Text

Next Save

You are currently logged in as Tristan Wu. Click Here to Logout...

# Steps in constructing a question

The screenshot shows a web browser window titled "Questionnaire - Mozilla Firefox" with the address bar displaying "http://localhost/dynasrch/randQuestEditor.php". The main content area features a header "DynaView" and a sub-header "Use this editor to create questions that will be used frequently. They can be added to questionnaires through the Questionnaire Editor." Below this, a "Question Constructor" panel is visible, containing the following elements:

- A label "Question Constructor" in a blue box.
- A text input field with the placeholder "Please enter the question text:" and the text "will hit your jurisdiction?" entered.
- A text input field with the placeholder "Please enter the number of buttons (integer value):" and the value "5" entered.
- A "Next" button.

At the bottom right of the browser window, a status bar indicates "You are currently logged in as Tristan Wu. Click Here to Logout...".

# Saving a finished question

The screenshot shows a web browser window titled "Questionnaire - Mozilla Firefox" with the address bar displaying "http://localhost/dynasearch/questionEditor.php". The main content area is titled "DynaView" and contains the following text: "From this screen you can create questionnaires that can be used in surveys created from the Experiment Editor." Below this, there are three sections marked with red dots:

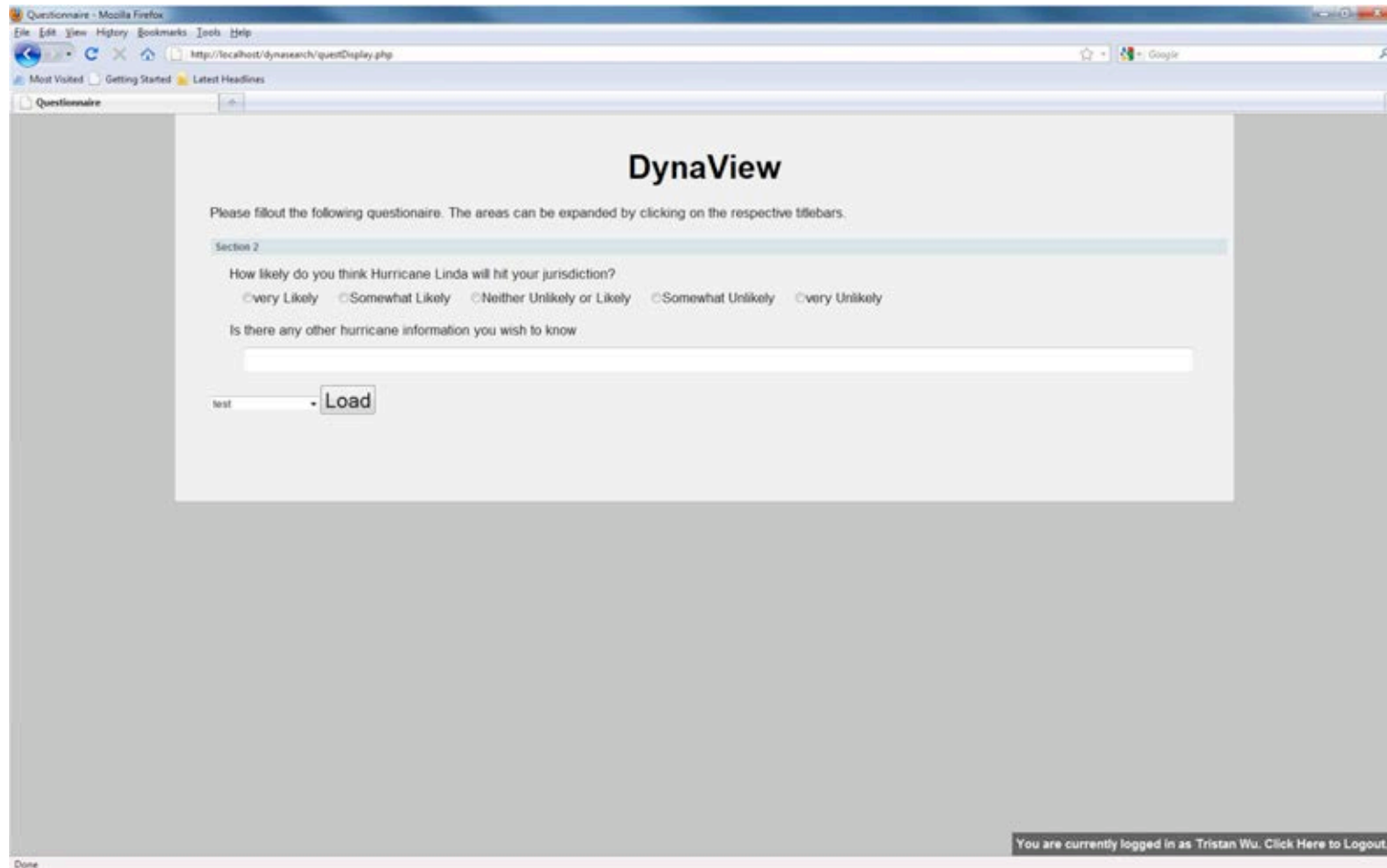
- Section 2**: "How likely do you think Hurricane Linda will hit your jurisdiction?" with radio button options: ☐ very Likely, ☐ Somewhat Likely, ☐ Neither Unlikely or Likely, ☐ Somewhat Unlikely, ☐ very Unlikely.
- Section 3**: "Is there any other hurricane information you wish to know" followed by a text input field.
- Section 4**: "Please a title for the questionnaire:" followed by a text input field containing "Section 2".

Below the title input field is a "Save" button and a dropdown menu showing "Q2".

A blue "Question Constructor" sidebar is on the right, containing the text "Please select the Item you would like to create." and four radio button options: ☐ Section, ☐ Radio Button Question, ☐ Text Question, and ☐ Line of Text. At the bottom of this sidebar are "Next" and "Save" buttons.

At the bottom right of the browser window, a status bar reads: "You are currently logged in as Tristan Wu. Click Here to Logout..."

# Loading question from a catalogue



The screenshot shows a web browser window with the title 'Questionnaire - Mozilla Firefox'. The address bar displays 'http://localhost/dynasrch/questDisplay.php'. The browser's toolbar includes buttons for 'File', 'Edit', 'View', 'History', 'Bookmarks', 'Tools', and 'Help'. Below the toolbar, there are links for 'Most Visited', 'Getting Started', and 'Latest Headlines'. The main content area is titled 'DynaView' and contains the following text: 'Please fillout the following questionnaire. The areas can be expanded by clicking on the respective titlebars.' Below this, there is a section titled 'Section 2' with the question 'How likely do you think Hurricane Linda will hit your jurisdiction?'. The response options are radio buttons labeled 'very Likely', 'Somewhat Likely', 'Neither Unlikely or Likely', 'Somewhat Unlikely', and 'very Unlikely'. Below the radio buttons is the text 'Is there any other hurricane information you wish to know' followed by a text input field. At the bottom left of the form, there is a 'test' label and a 'Load' button. In the bottom right corner of the browser window, a status bar reads 'You are currently logged in as Tristan Wu. Click Here to Logout...'. The browser's status bar at the very bottom shows 'Done'.

Questionnaire - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/dynasrch/questDisplay.php

Most Visited Getting Started Latest Headlines

Questionnaire

## DynaView

Please fillout the following questionnaire. The areas can be expanded by clicking on the respective titlebars.

Section 2

How likely do you think Hurricane Linda will hit your jurisdiction?

☐ very Likely ☐ Somewhat Likely ☐ Neither Unlikely or Likely ☐ Somewhat Unlikely ☐ very Unlikely

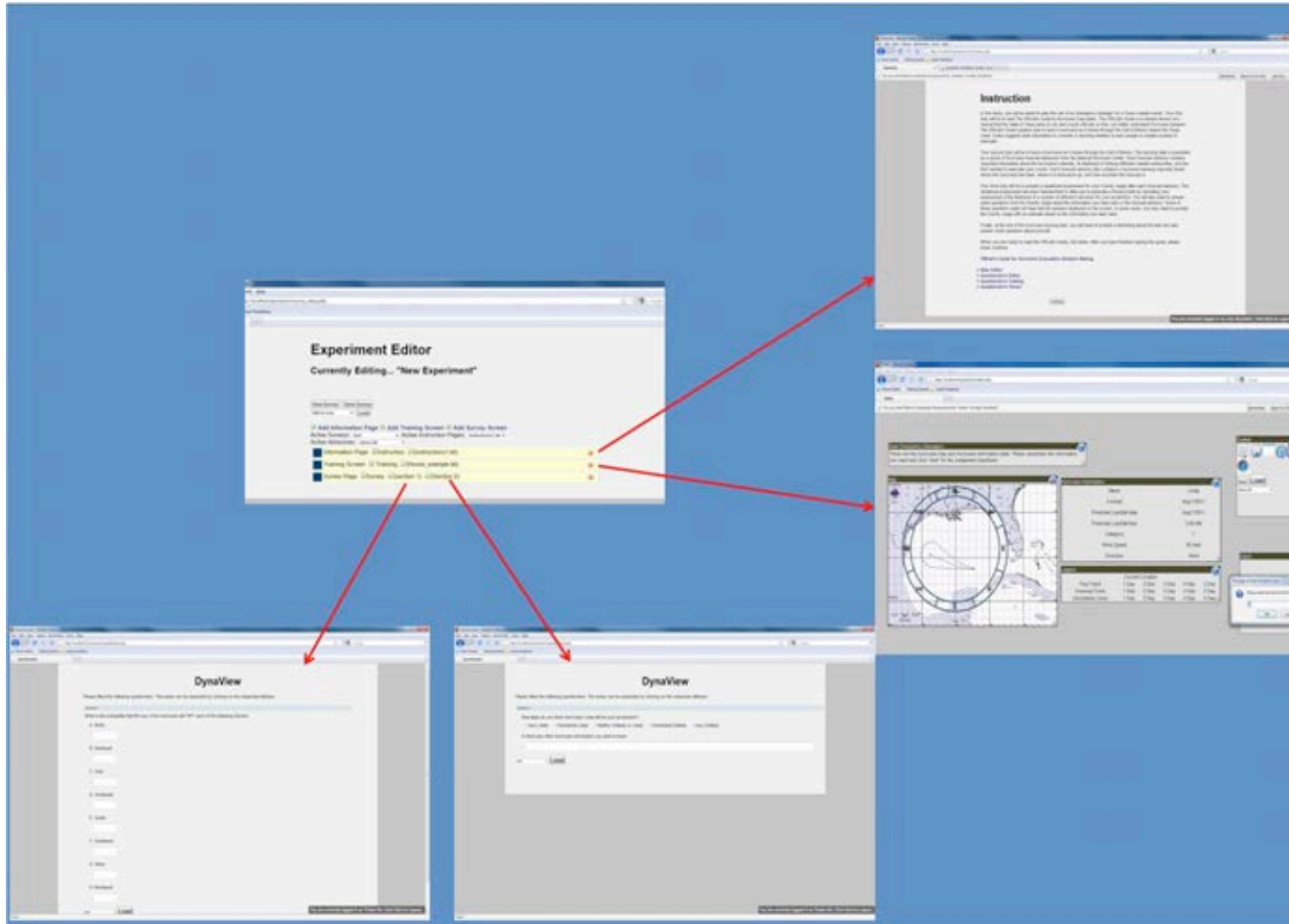
Is there any other hurricane information you wish to know

test Load

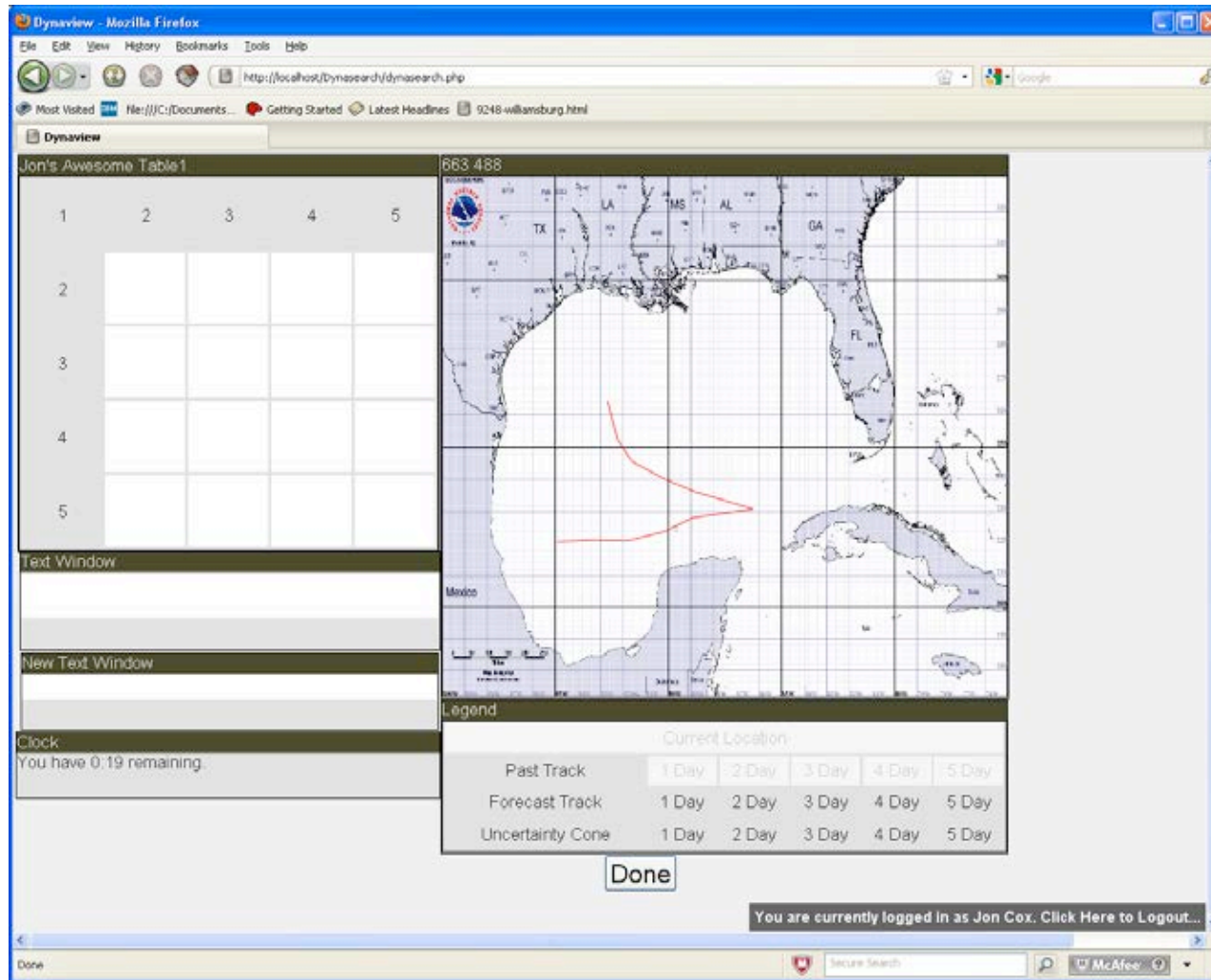
You are currently logged in as Tristan Wu. Click Here to Logout...

Done

# Overview of experiment editor



# Example user view



# Results saved to database

- Identifying information
- The identity and duration of the click/hold for each information element accessed.
- All questionnaire answers



# Conclusion

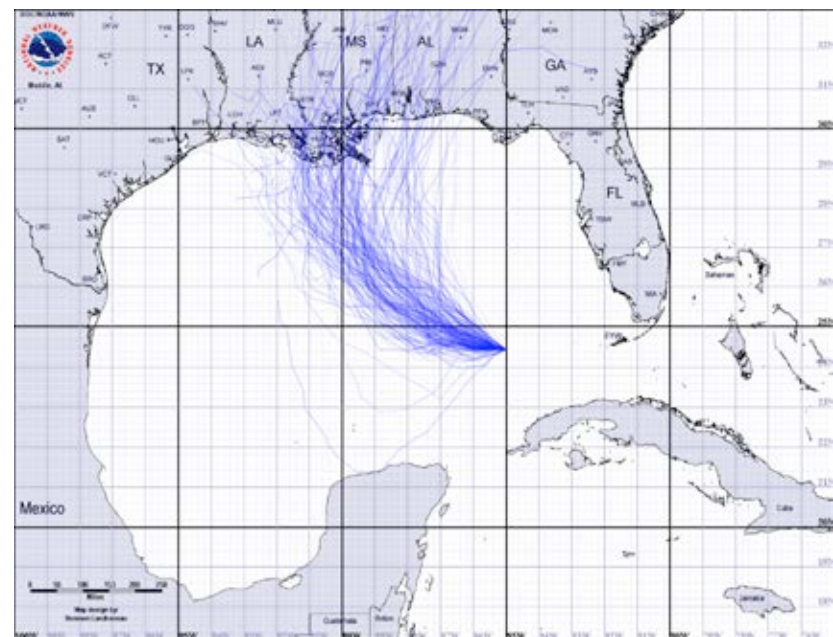
- *Dyna Search* will provide the framework for a series of experiments with large user populations.
- Web will allow administration across diverse subject pool.

# Development of Enhanced Displays

# Building a model of a predicted hurricane event



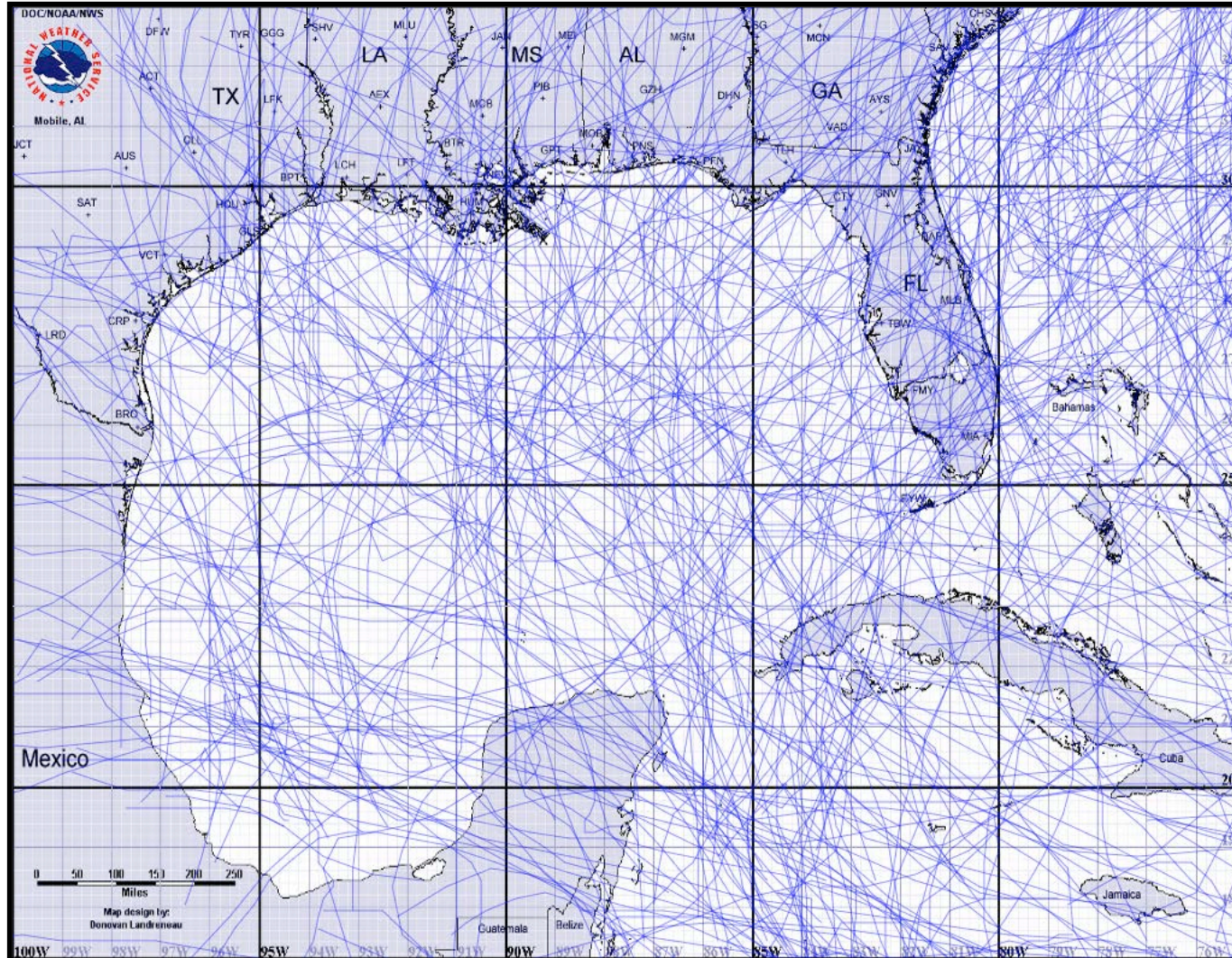
## NHC error cone



## Markov model track generation



# Historical track paths since 1945

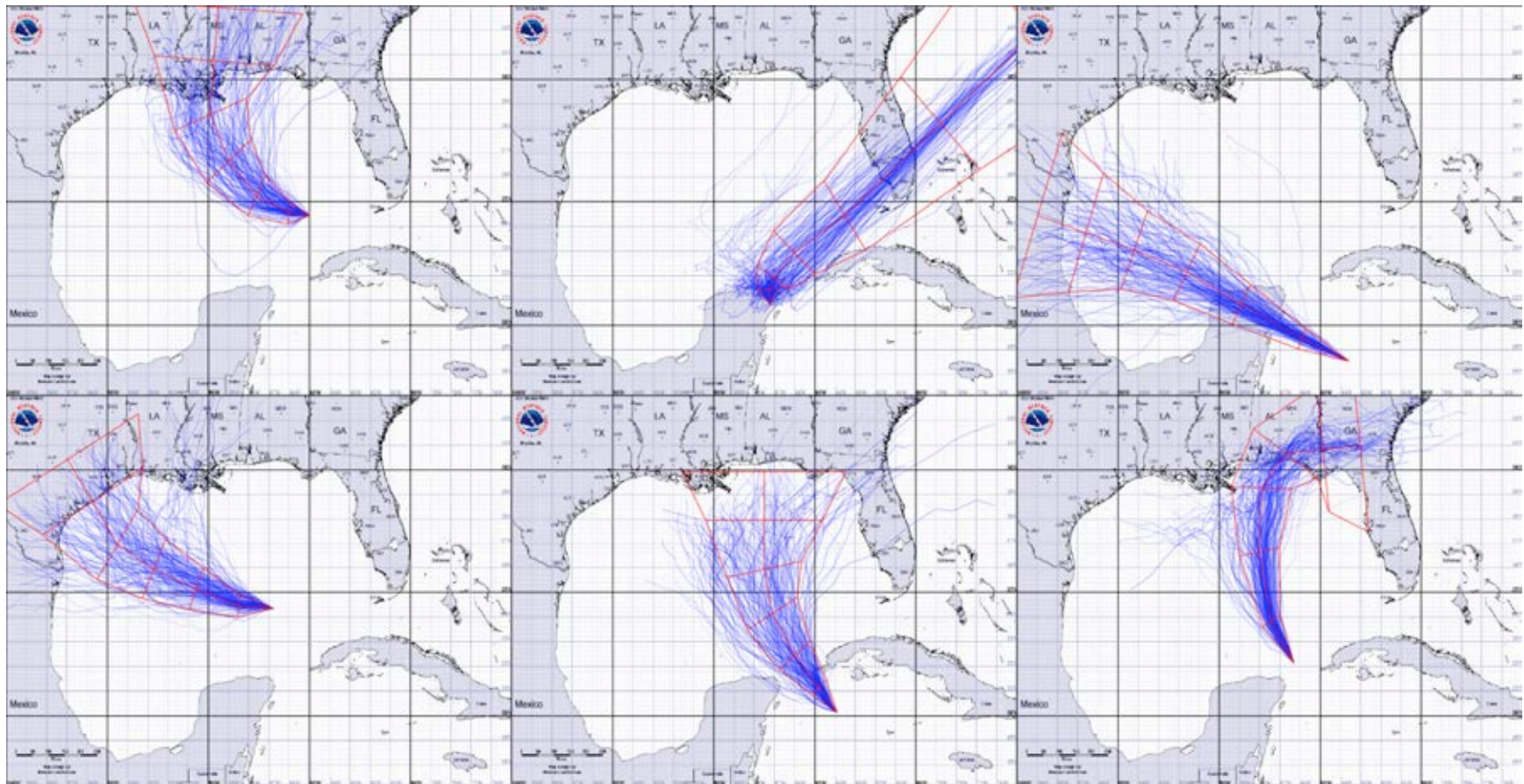


# Our first model

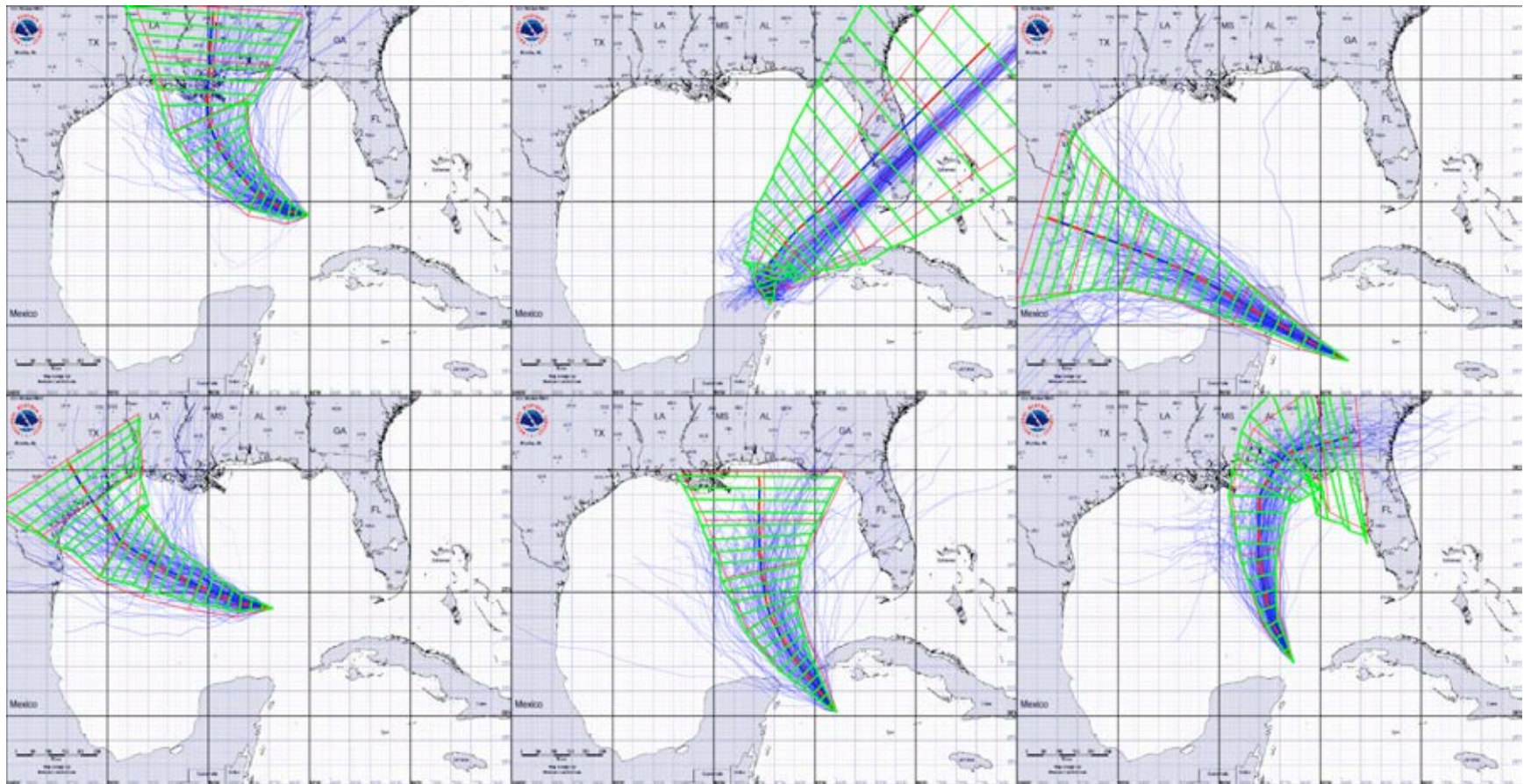
- Paths grown in 3 hour time steps
- Retrieve a collection of nearby historical hurricanes at each step
- Probabilistically choose new speed and bearing from this collection
- Refine ensemble statistics with control system that modifies speed and bearing



# Early track predictions for 6 hurricanes



# Early attempts to match with NHC prediction



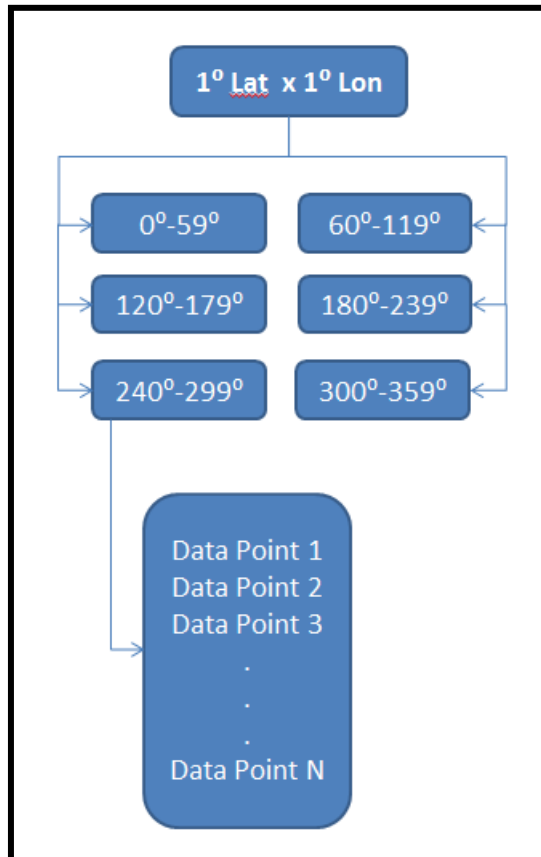


# Our new model

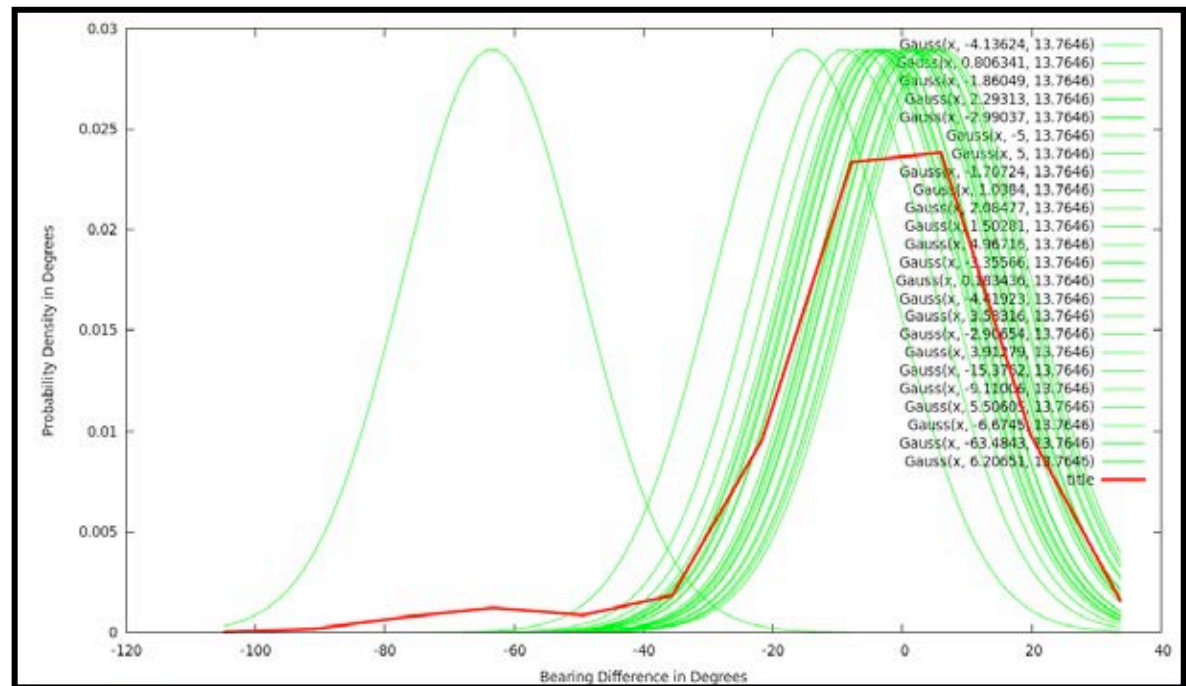
- Build Markov random field over spatial grid
- Each cell provides PDF of exit speed and bearing given entry speed and bearing
- PDF's refined at each cell into 60 degree subcells
- New speed and bearing drawn from the local PDF weighted by predicted path



# PDF estimation per $1^\circ \times 1^\circ$ grid cell



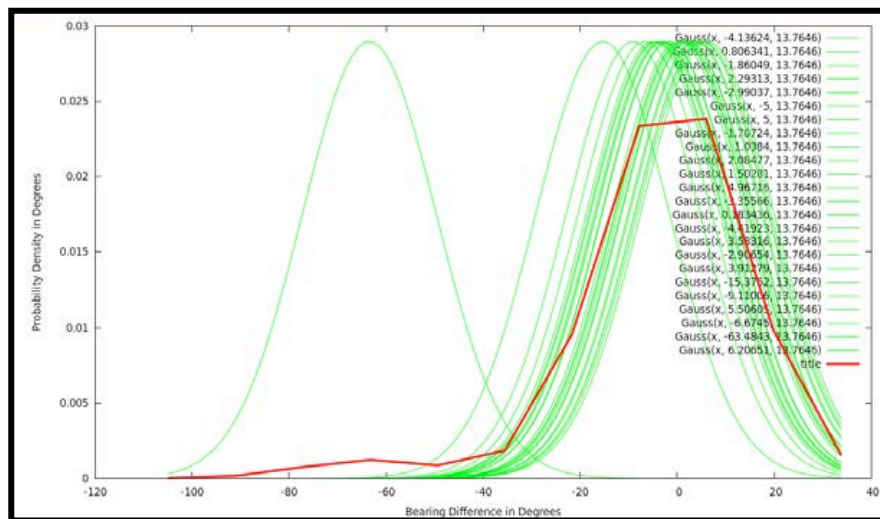
Data structure per cell



Kernel density estimator base on paths through cell

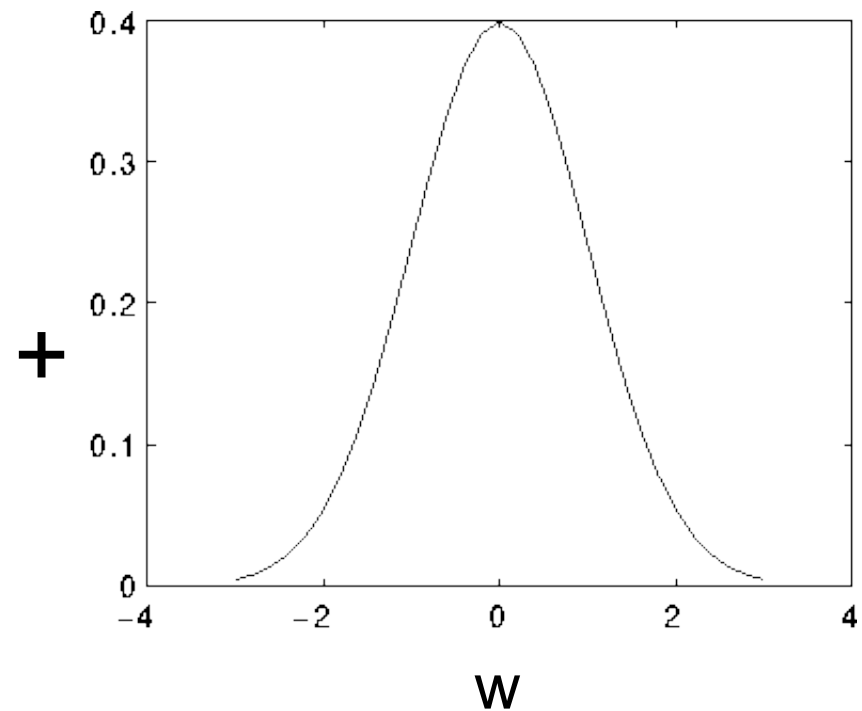
# Predicted and historical PDF's combined

Grid cell PDF

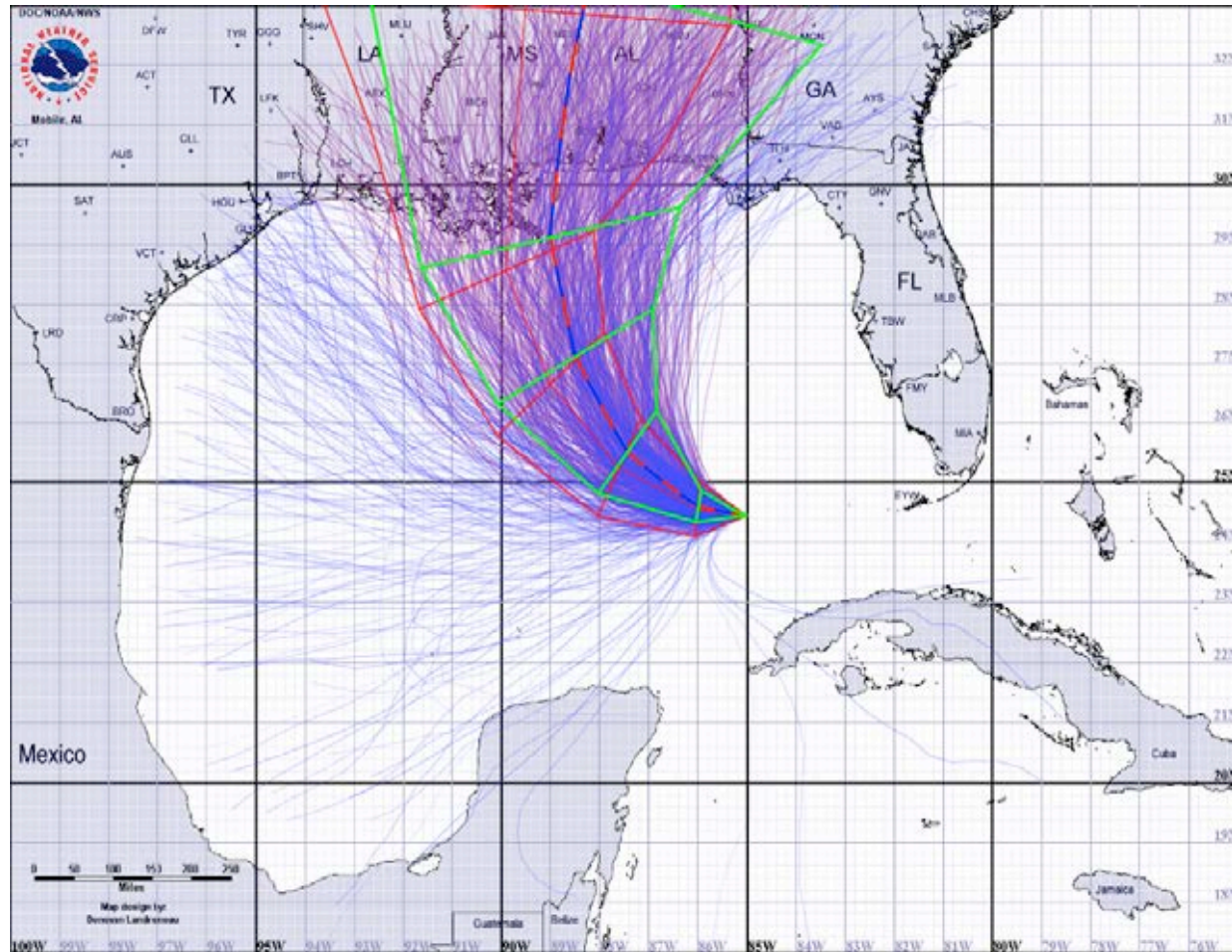


$(1 - w)$

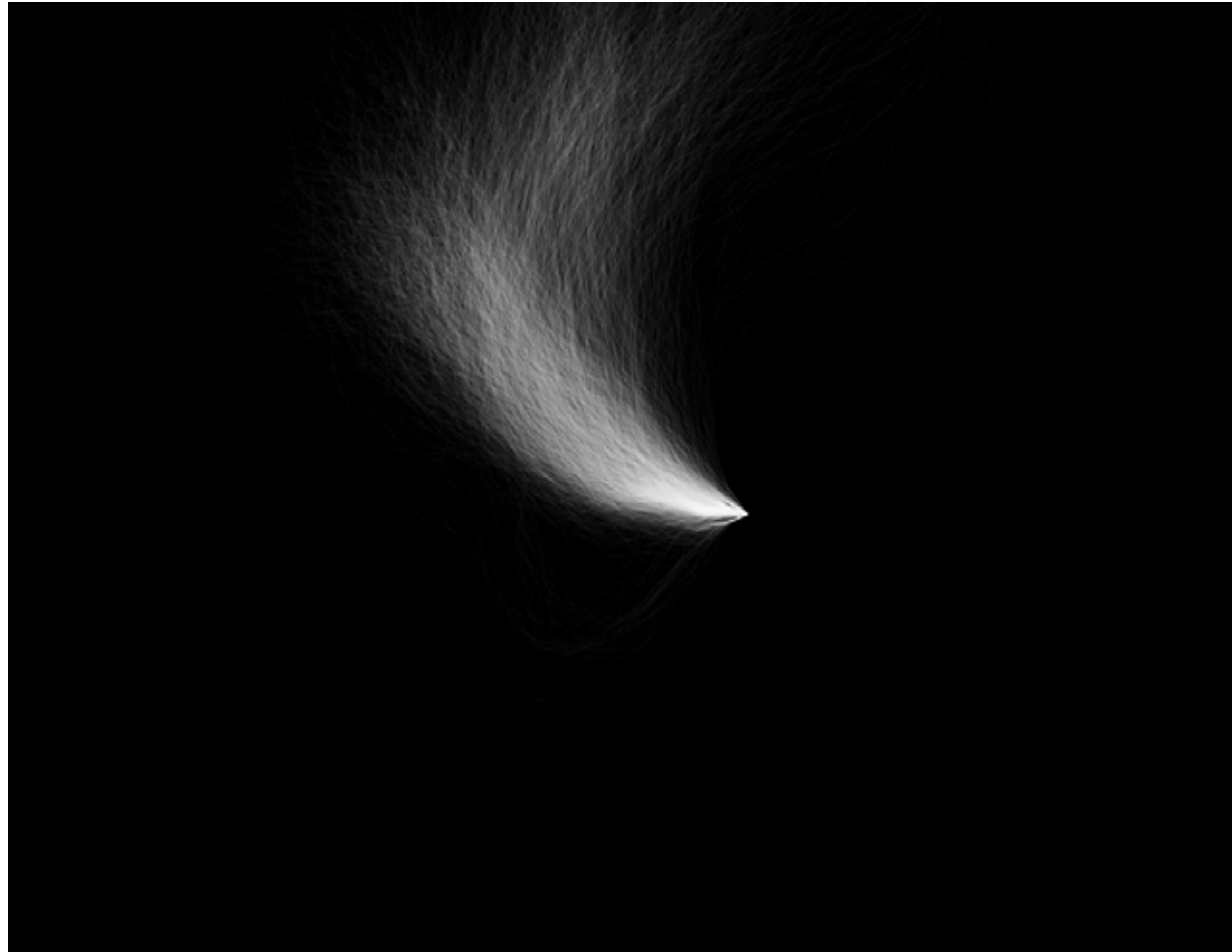
NHC prediction



# New prediction model



An underlying probability field  
shown as a heat map



# HurVis Demo

# Conclusion

- We are close to having a sound model for generating predicted path ensembles.
- Ensembles reflect both historical data and NHC prediction.
- Should provide a sound basis for a number of specialized visualization tools.