Applying **Immersive Visualization** techniques to analyze model outputs
...a case study of **Hurricane Lili**

Jibonananda Sanyal, Phil Amburn, Song Zhang
Patrick J Fitzpatrick and Robert Moorhead

{jibo, amburn, szhang, fitz, rjm}@gri.msstate.edu

Mississippi State UNIVERSITY

Why Hurricane Lili?

- Lili weakened from a Category 3 to a Category 1 hurricane in a period of just 13 hours

- A low lying mass of dry air from the south-west opened the eye wall

Our visualization goals...

- Recreate the events leading to Lili's dissipation

- Devise techniques to compare model outputs

- Have meteorologists evaluate our results

- Show how virtual environments could help such studies

Sources of data...

- Lili: Mesoscale Model 5 runs of Dr Fitzpatrick
    - With satellite data (SATC simulation run)
    - Without satellite data (BDAC simulation run)

- Isabel: Weather Research and Forecasting model simulation run

So, why Isabel?

To see whether we could repeat such visualization results with other datasets.

## Virtual Environment for Real-Time Exploration (VERTEX)

- Comprised of 3 back-projected walls and a front-projected floor, 10'x10'x7.5' enclosure

- 4 render nodes: 3.06 GHz Intel Xeon, NVIDIA Quadro FX3000G driving each wall at 1400x1250

- 16 compute nodes: 3.2 GHz Pentium IV

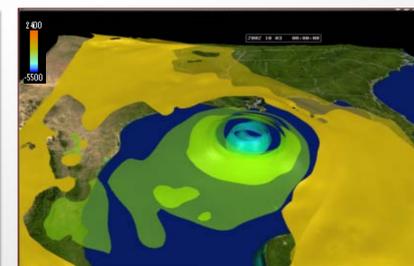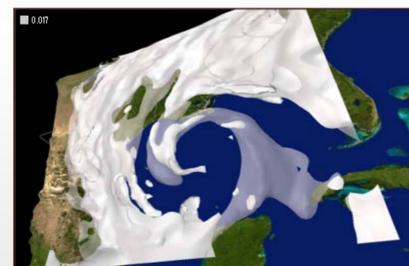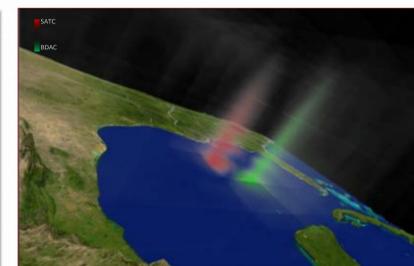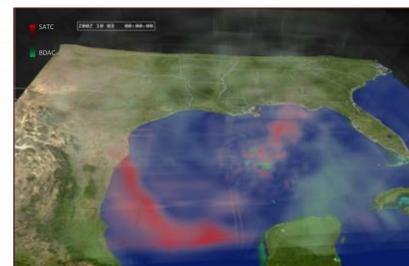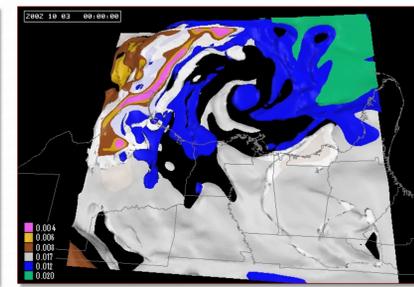- 6DOF acoustic tracker system
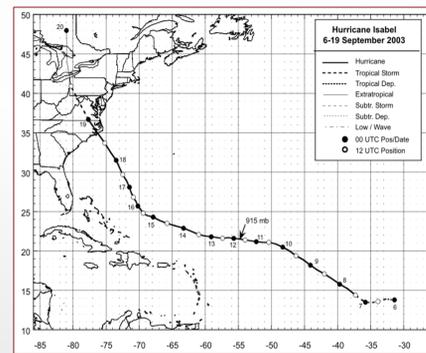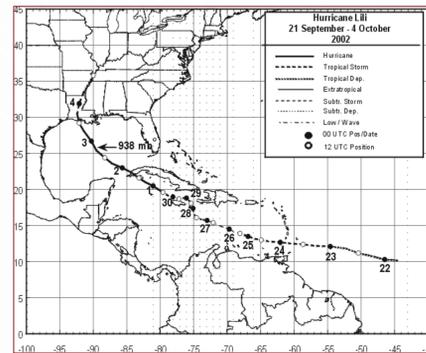
Best track positions of Lili (Top) and Isabel (Bottom) as provided by the National Hurricane Center
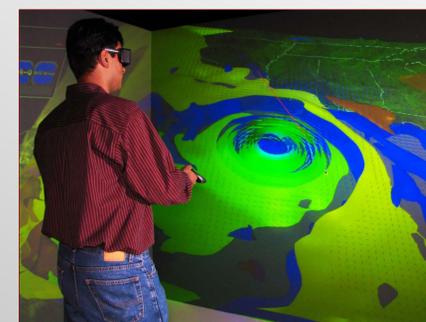

Researchers in the VETEX facility
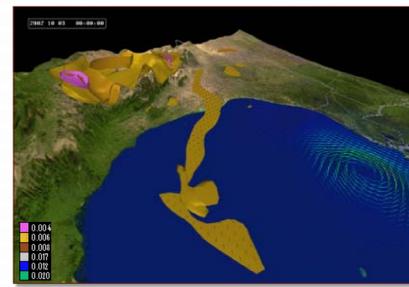
(Left) SATC simulation showing shaft of dry air originating in the Sierra Madre Mountains of Mexico, visualized with wind vectors and (right) underside view of Lili


(Top) Difference volume between SATC and BDAC for cloud-water mixing ratio where red region indicates dry air, and (bottom) using transparency for BDAC

(Top) Difference volume between SATC and BDAC for pressure perturbation, and (bottom) using transparency for BDAC
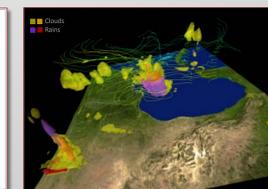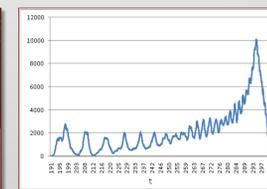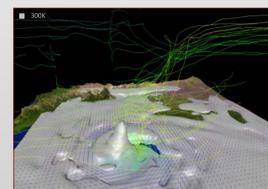
SATC run: (Left) Hot-tower or a simulation artifact, with particle tracks, (center) temperature histogram, (right) clouds and rainfall with particle advection tracks
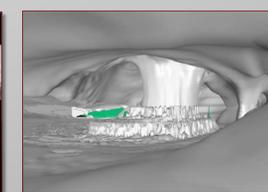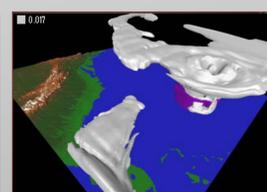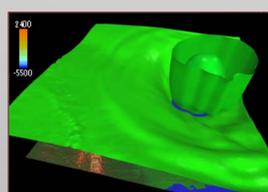
Isabel: (Left) Pressure isosurfaces, (center) cloud-water mixing ratio, (right) inside structure of cloud-water mixing ratio

What meteorologists think...

Dr Fitzpatrick's comments

- Found VE useful for comparing models

- Multiple 2D colorslices with 3D isosurfaces with animation quite useful

- Found difference volume quite effective

Dr Dyer's comments

- Interested in looking at what level the dry air gets pulled into the system and how high it goes before it changes to the next isolevel

- Found the VE provided context between synoptic scale (hurricane) and mesoscale (individual storms) phenomena to see cause and effects

- "better than isomaps"

- "put me in the NNW, looking over the Gulf of Mexico"

- Particle advection: "extremely useful"

- Motion tracking useful to study structures

- Revealed to him a general tilt in the upward propagation of updrafts which made thermodynamic sense

Acknowledgement