"*Science is as science does: Authentic learning by engaging students in research*"

Richard Clark

Unidata 2009 Summer Users Workshop

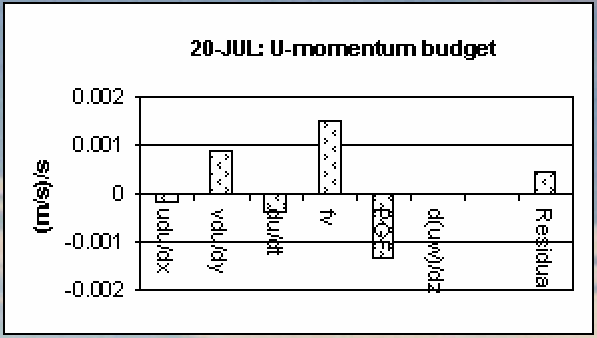
8-12 June 2009

Airborne studies of mesoscale horizontal pressure gradients

"Dynamic Forcing of the Great Plains Low-Level Jet Using Instrumented Aircraft"

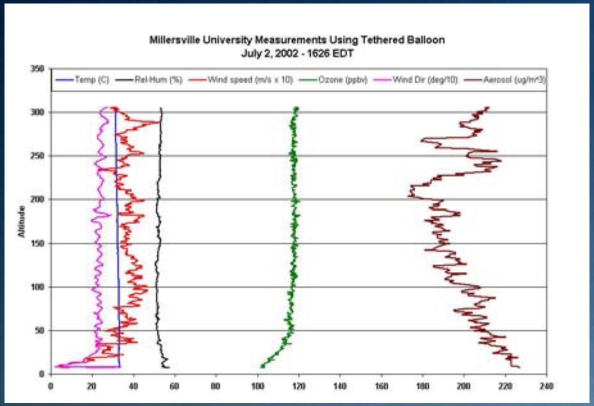
$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -\frac{g}{f}\frac{\partial z}{\partial x} + fv - \frac{\partial \overline{u'w'}}{\partial z}$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} = -\frac{g}{f}\frac{\partial z}{\partial y} - fu - \frac{\partial \overline{v'w'}}{\partial z}$$



Urban Boundary Layer and Air Chemistry Studies using Tethered Balloons

"Northeast Oxidant and Particle Study (NE-OPS)"



EPA STAR Grant

Acid Rain and Mercury Deposition Monitoring

Multivariate linear regression analysis to assess atmospheric ion deposition at PA47

PA Department of Environmental Protection

pH = 5.405 + 0.0704(Rainfall) + 0.0672(Wind Speed) -0.0002(Wind Direction) **– 0.00822(Temperature)** - 0.019(Relative Humidity) + 0.030(Pressure) + ε.

[SO4] = -0.7707 - **0.517(Rainfall) - 0.43337(Wind Speed)** – 0.0003(Wind Direction) **+ 0.01575(Temperature)** + 0.0039(Relative Humidity) + 0.10396(Pressure) + ε.

[Cl] = 0.1225 - 0.0412(Rainfall) + 0.01299(Wind Speed) **– 0.00077(Wind Direction)** - 0.00123(Temperature) - 0.00057(Relative Humidity) + 0.0139(Pressure) + ε.

[NO3] = -4.450 **– 0.5759(Rainfall)** – 0.1529(Wind Speed) + 0.0007(Wind Direction) + 0.0069(Temperature) + 0.0051(Relative Humidity) + 0.1980(Pressure) + ε.

[NH4] = 1.1135 **– 0.2503(Rainfall) – 0.1408(Wind Speed)** –0.0006(Wind Direction) + 0.0012(Temperature) - 0.0047(Relative Humidity) + 0.0162(Pressure) + ε.

[Na] = 0.1125 – 0.0111(Rainfall) + 0.0101(Wind Speed) **– 0.00052(Wind Direction)** – 0.00073(Temperature) – 0.00042(Relative Humidity) + 0.0056(Pressure) + ε.

[K] = 0.1011 – 0.0054(Rainfall) + 0.0026(Wind Speed) – 0.00004(Wind Direction) + 0.0002(Temperature) - 0.00004(Relative Humidity) – 0.0026(Pressure) + ε.

[Mg] = -0.0024 **– 0.00595(Rainfall)** + 0.00008(Wind Speed) **– 0.00007(Wind Direction)** + 0.00012(Temperature) - 0.00005(Relative Humidity) + 0.0015(Pressure) + ε.

[Ca] = 0.1219 **– 0.04358(Rainfall)** – 0.0103(Wind Speed) – 0.00015(Wind Direction) **+ 0.00093(Temperature)** - 0.0010(Relative Humidity) + 0.00425(Pressure) + ε

University Corporation for Atmospheric Research

LINKED ENVIRONMENTS FOR ATMOSPHERIC DISCOVERY

UNC CHAPEL HILL

Colorado State University

UAH The University of Alabama in Huntsville

HOWARD UNIVERSITY

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NSF

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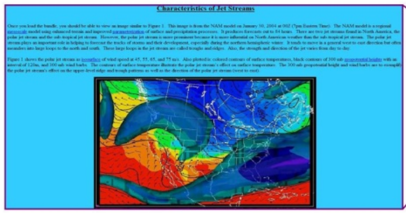
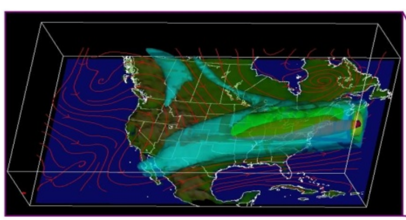
LEAD-to-LEARN:
An instructional pathway for meteorology education using a science gateway





LEAD-TO-LEARN MODULES

Undergraduate Curriculum

(Modules created by Millersville LEAD undergraduate students)

Exploring The Polar Jet Stream

Students interact with numerical model output from the North American Mesoscale (NAM) model to explore the components of the polar jet stream.

Exploring Lake Effect Snow

Students interact with numerical model output to explore the ingredients for generating lake effect snow. Students use a case study that covers the event that occurred in the Oswego, NY area on January 28-30, 2004.

Investigating the Parameters that Identify Fronts

Students explore the passage of a frontal boundary and associated events. Students use the IDV visualization tool to identify numerous aspects of the system that moved through the region.

From Observations to Models

Students learn about the different data sources used to initialize numerical weather prediction (NWP) models as well as complexity of the data assimilation process used in most models.

Exploring Land/Sea Breeze Circulations

Students interact with numerical model output from the Global Forecast System (GFS) to explore the land/sea breeze circulation. Students use a case study that covers the event that occurred in Florida on September 1, 2005.

Understanding the Skew-T Log P Diagram

Students interact with numerical model output from the North American Mesoscale (NAM) model to explore the concepts of a Skew-T log p diagram.

Investigating the Genesis and Maintenance of Squall Lines and Associated Bow Echoes

Students interact with model output and local observations to investigate the birth and propagation of a typical squall with an embedded bow echo. Students use a case study that covers the event that occurred on 11 March 2006 in Illinois .

Understanding the Q-G Omega Equation (in development)

Understanding the Q-G Height Tendency Equation

Pre-college Curriculum

(Modules created by Millersville LEAD undergraduate students)

- Exploring Temperature and Pressure Changes with Altitude DOC

Simulations

You must have the free QuickTime player installed on your system in order to view the simulation movies. Click below to download.

QuickTime

Isosurfaces of four cores of the jet stream from 45 m/s (in blue) to 75 m/s (in red), with 500 mb wind flow vectors in red, over topography

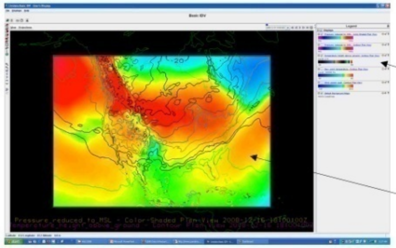
Isosurface of absolute vorticity at 1.7 x 10^-3 s^-1 over surface pressure

Undergraduate Meteorology students at Millersville University, working with computer science students at the National Center for Supercomputing Applications, under the supervision of LEAD project scientists and technical support personnel, developed a suite of learning modules for education; primarily for use as classroom supplements in undergraduate meteorology courses ranging from introductory survey courses to senior-level mathematically intensive courses. The modules are in the process of a major revision that will integrate scaffold instructional approaches so that students can follow a tiered, sequential pathway leading to self-discovery of key features and field variables that are relevant to a particular weather phenomenon. These new instructional approaches are described in the following sequence of slides.

After a student is presented with the lecture material and has proceeded through the demo and guided components of the learning module, they are ready to embark on an exercise of exploration. Using the key parameters presented earlier to discover for themselves where regions of frontal discontinuities occur using "live" data. This component can be completely open and flexible.

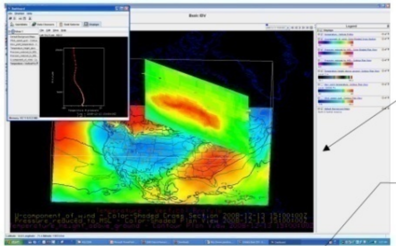
The student selects a temporal and spatial range for the data using a geoGUI within the LEAD portal

Rubber-banding capabilities allow for data subsetting.

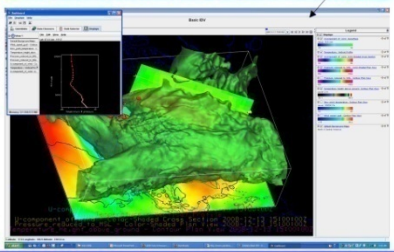


Once the data range is selected, Unidata IDV is invoked and displays a pre-selected set of key field variables, the same as in the demo and guided elements, to begin the exploration and analysis. IDV has 2-D and 3-D projections, and the student can toggle on/off each parameter to investigate them individually or to look for relationships.

The student is free to explore different types of displays and projections. To the left is an example of an analysis of the NAM initialization field for 12-13-2008 at 15:00 UTC.



Here the student is visualizing surface pressure reduced to MSL with an overlay of surface temperature (F), but has also added a vertical profiler and vertical cross-section display of temperature and u-wind component, respectively.



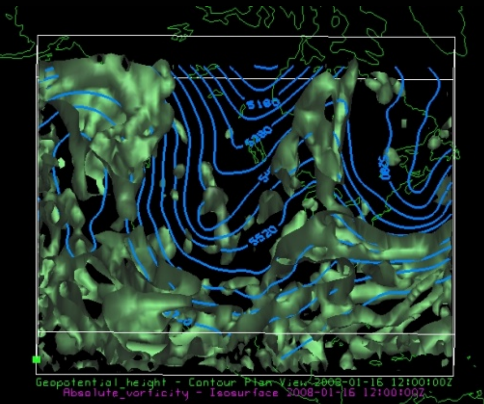
In the final example display below, the student selects an isosurface of u-wind component. IDV offers a particle point probe that can be used move through the data volume and display values of the selected parameters to the screen.

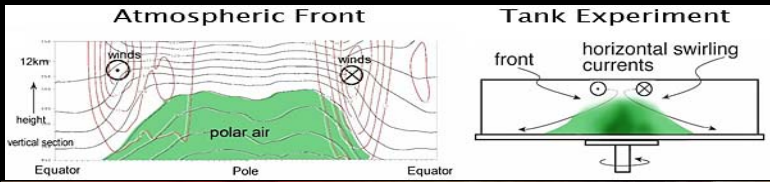
Once in IDV, the student's degrees of freedom for exploration are virtually endless. Students can incorporate information contained in other modules based on their interest and acumen. For instance, in the case of fronts, an upper level meteorology student may want to explore the modules on Q-G height tendency and omega equations.

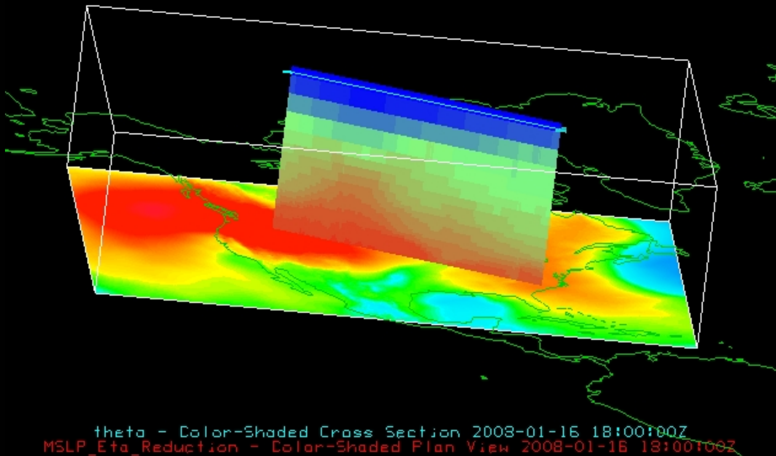
LEAD is a Large Information Technology Research (ITR) Grant funded by the National Science Foundation under the following Cooperative Agreements: ATM-0331594 (University of Oklahoma), ATM-0331591 (Colorado State University), ATM-0331574 (Millersville University), ATM-0331480 (Indiana University), ATM-0331579 (University of Alabama in Huntsville), ATM03-31586 (Howard University), ATM-0331587 (University Corporation for Atmospheric Research), and ATM-0331578 (University of Illinois at Urbana-Champaign, with a sub-contract to the University of North Carolina).

Green Roof Project

Geophysical Fluids: Weather in a Tank

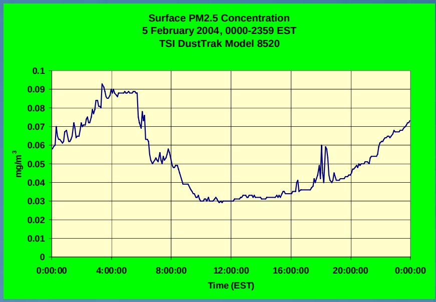


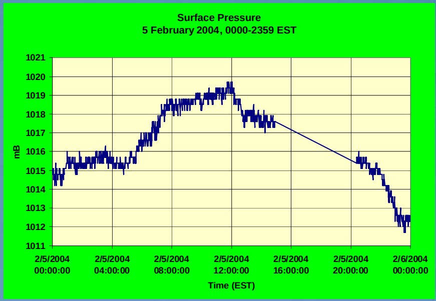


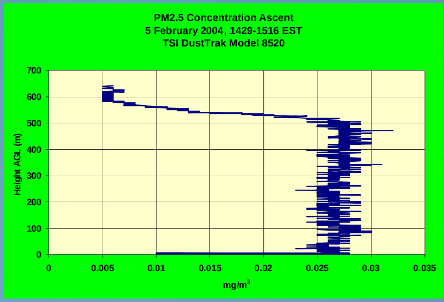


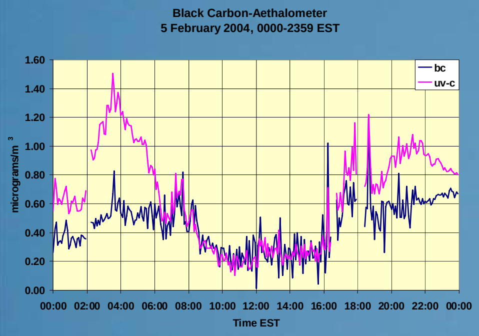
Wind Energy

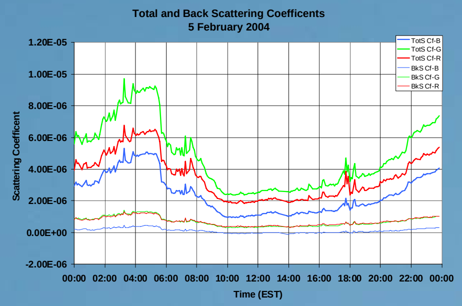
Winter Aerosol Studies

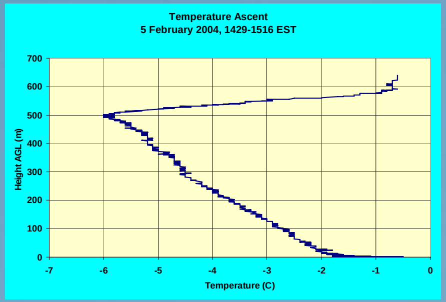




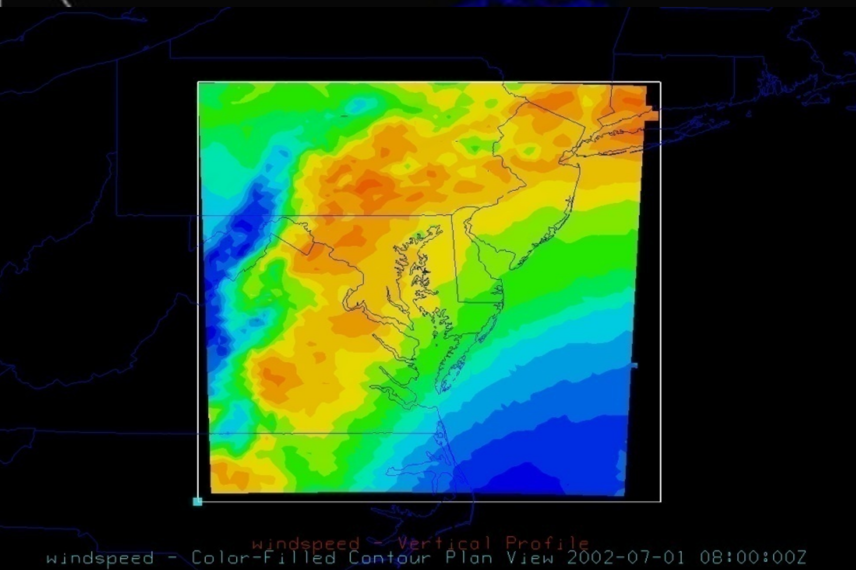






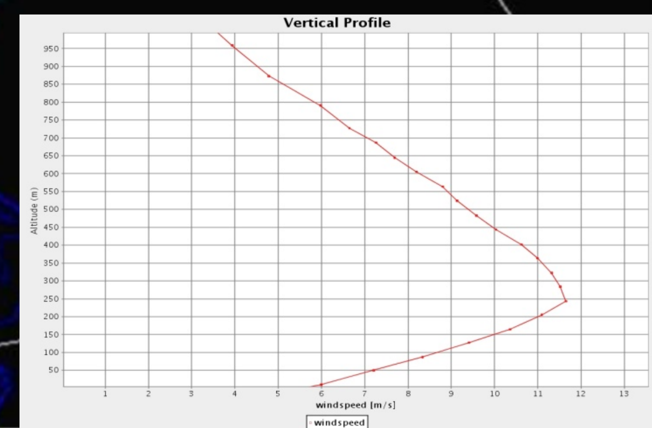


Numerical Study of the Mid-Atlantic Low-Level Jet Using the Weather Research and Forecasting Modeling System (WRF)

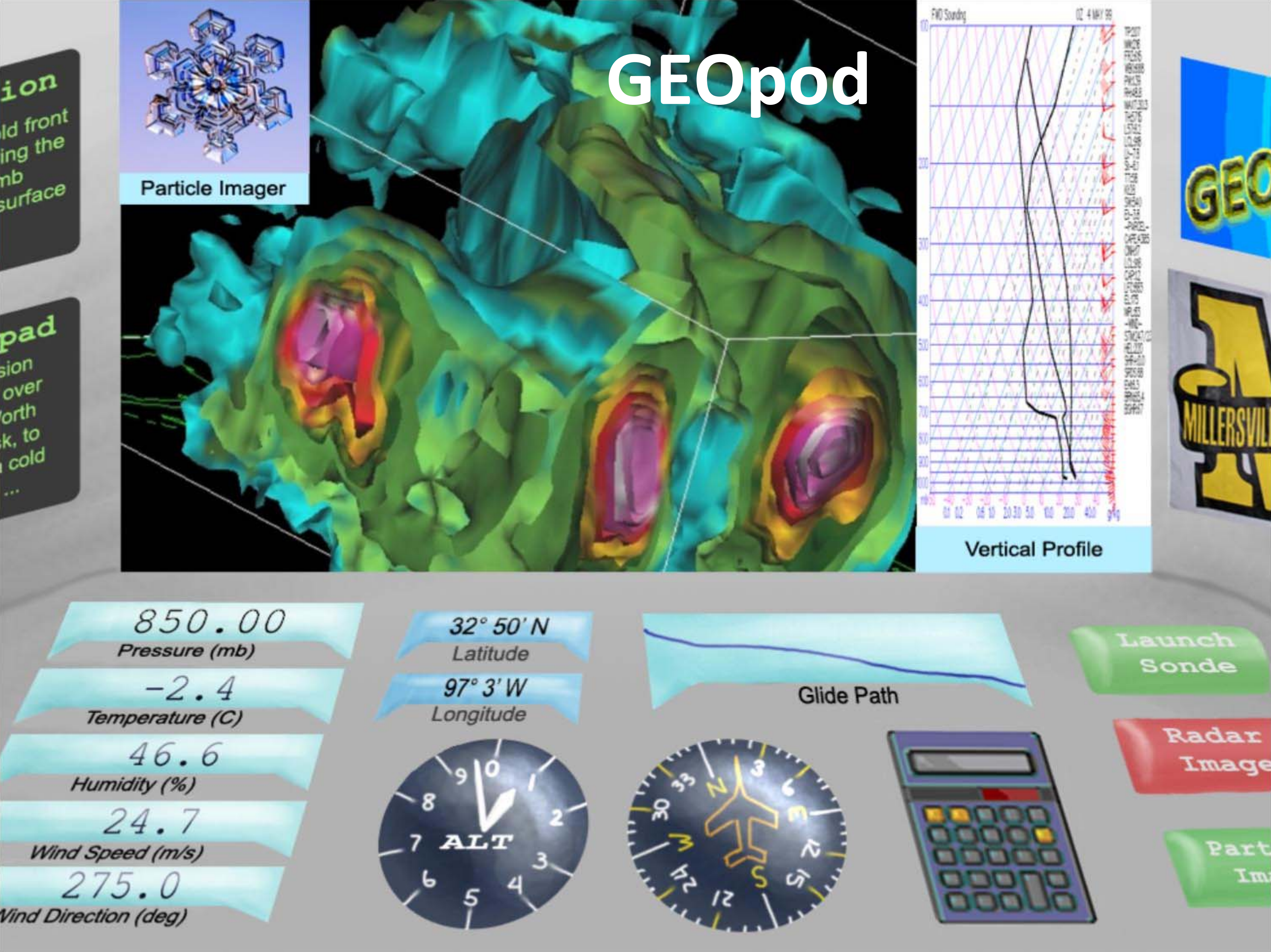


Convective Initiation over the Chesapeake Bay

Observational and Numerical Study of Lake-Effect Snow Events



Higher gas prices, greater conservation, 79 billion fewer miles driven in 2008. We're looking for at ozone and PM for a signature using observations, U.S. DOT data, and WRF-Chem


GEOpod
Particle Imager
Vertical Profile
850.00
Pressure (mb)
-2.4
Temperature (C)
46.6
Humidity (%)
24.7
Wind Speed (m/s)
275.0
32° 50' N
Latitude
97° 3' W
Longitude
Glide Path
ALT
Launch Sonde