

HCI/Geol/CS 558 X

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**Introduction to the 3D
visualization of scientific
data**

Lecture 1 - 1/8/07

Today:

- What is 3D sci. vis.?
- Pretty 3D pictures (OpenDX)
- Review Syllabus + Schedule
- Class Survey
- Textbook ordering

What is visualization ? (scientific visualization)

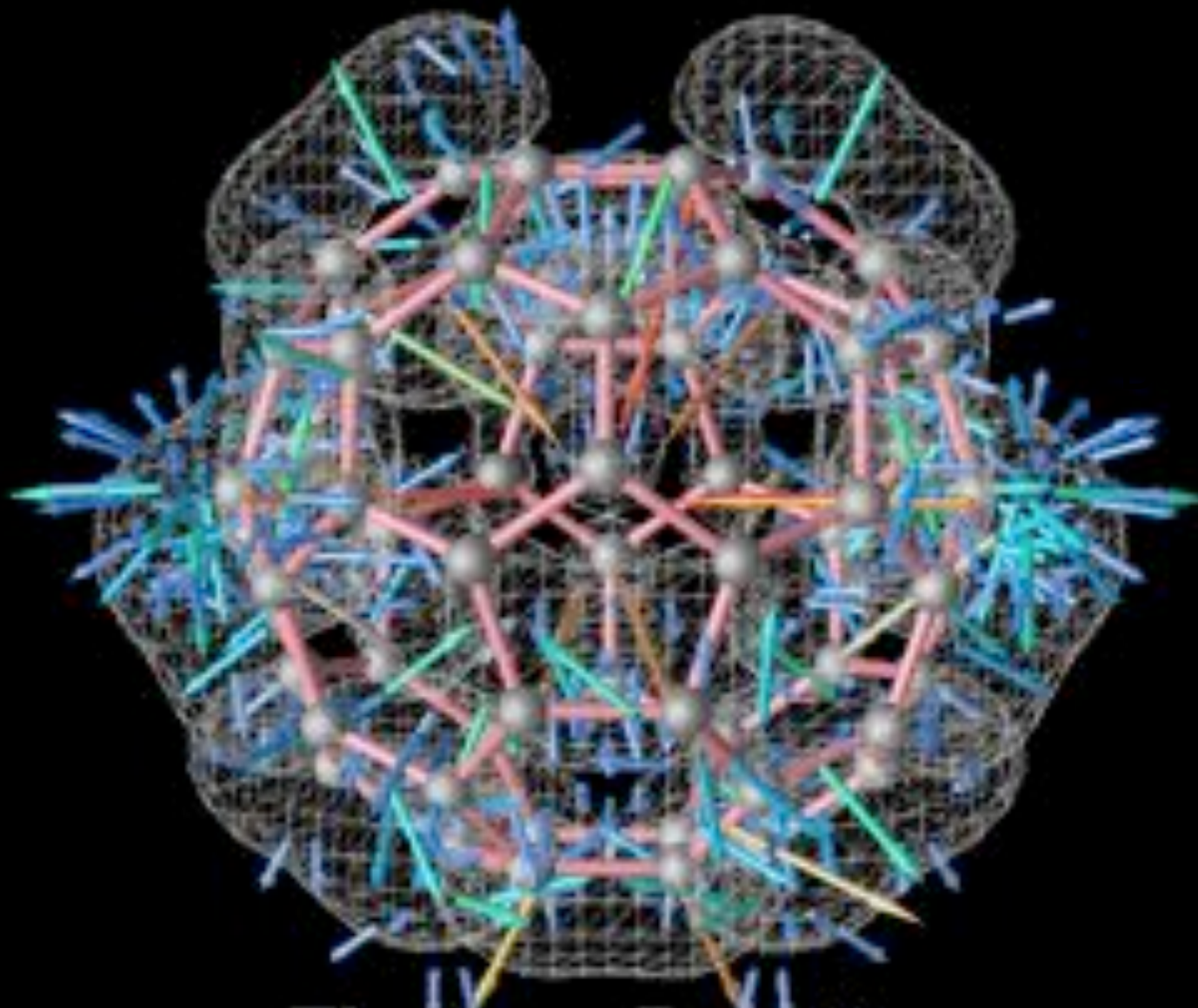
[B.H. McCormick, T.A. DeFanti, M.D. Brown, 1987 Computer Graphics]

- transforms the symbolic
(data, numbers, formulas, ...)
- into the geometric
(shape + color + ...)
- enables researchers to observe their
simulations and computations.

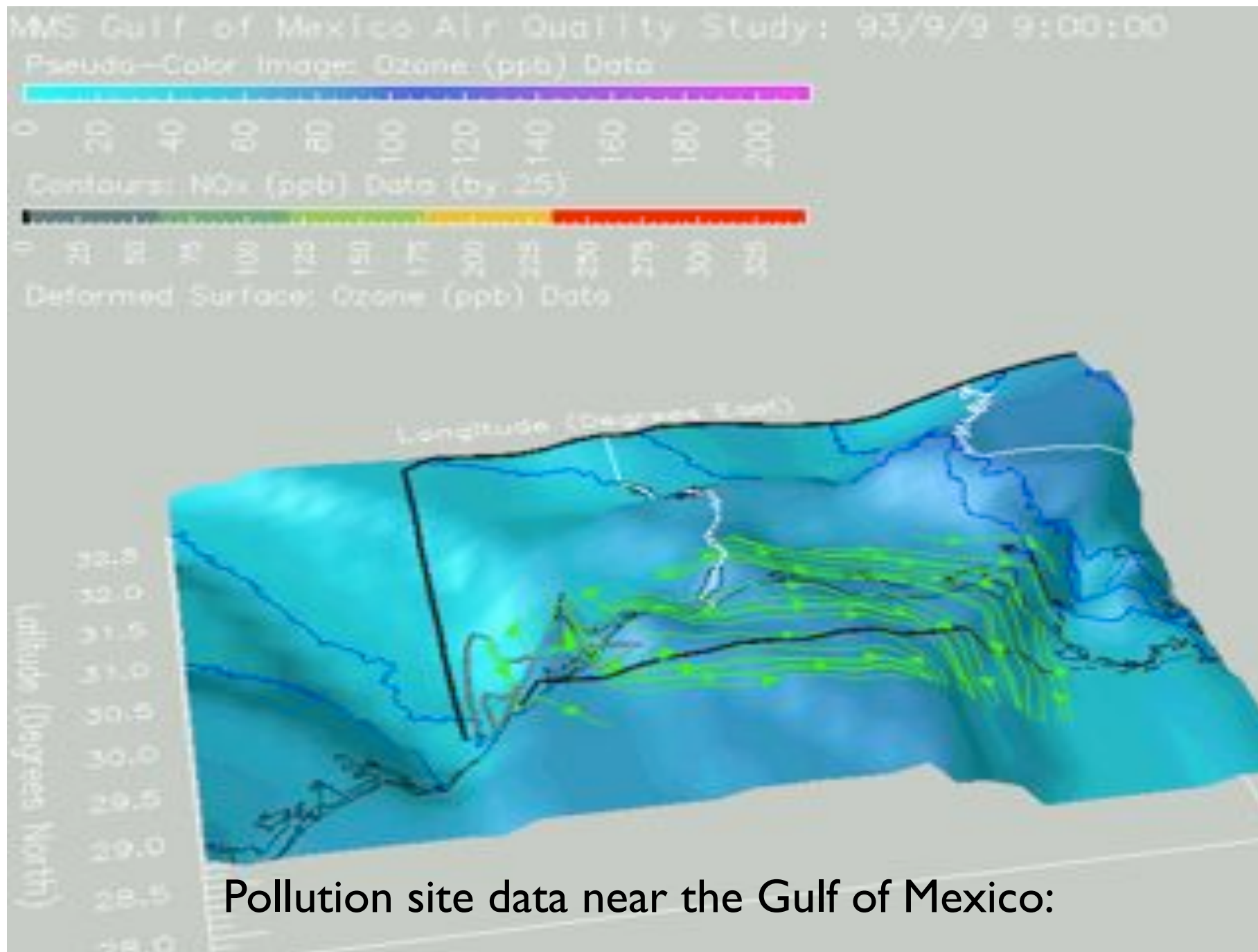
- a method for seeing the unseen
- empowers the process of scientific discovery (tools)
- may lead to profound and unexpected insights into data and processes

Why should I care?

- Very multi-disciplinary:
Computer science (3D graphics), geology, biology, chemistry, physics, engineering, math, psychology, human-factors,
- Natural Scientists/ Engineers:
Preparation for your thesis work ?
- Computer Scientist:
Learn about your potential “client’s” work
- Your opportunity to get exposed to a rapidly evolving field and find out what parts you like to work with !

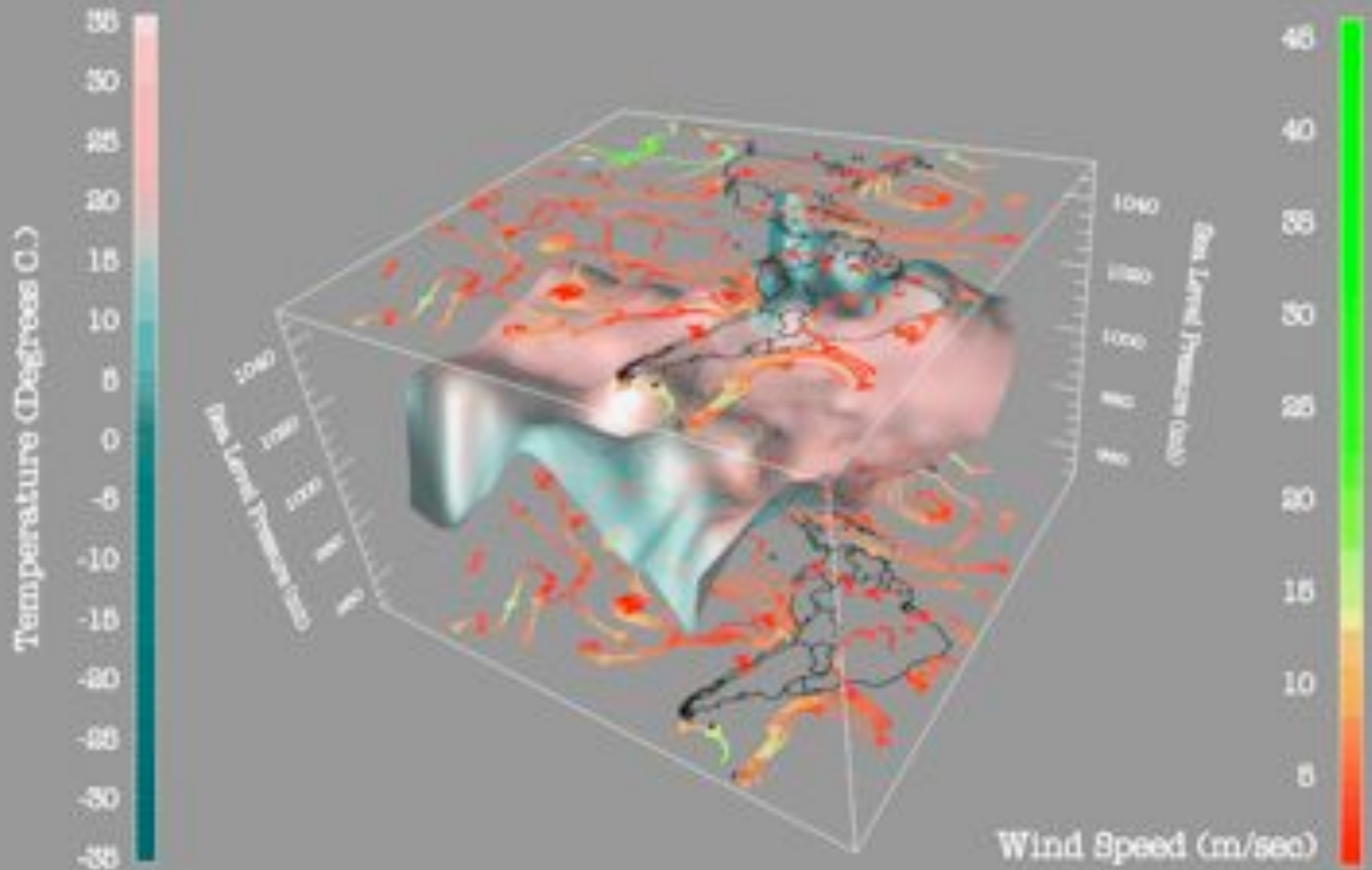


Electron Density
Gradient Magnitude and Direction

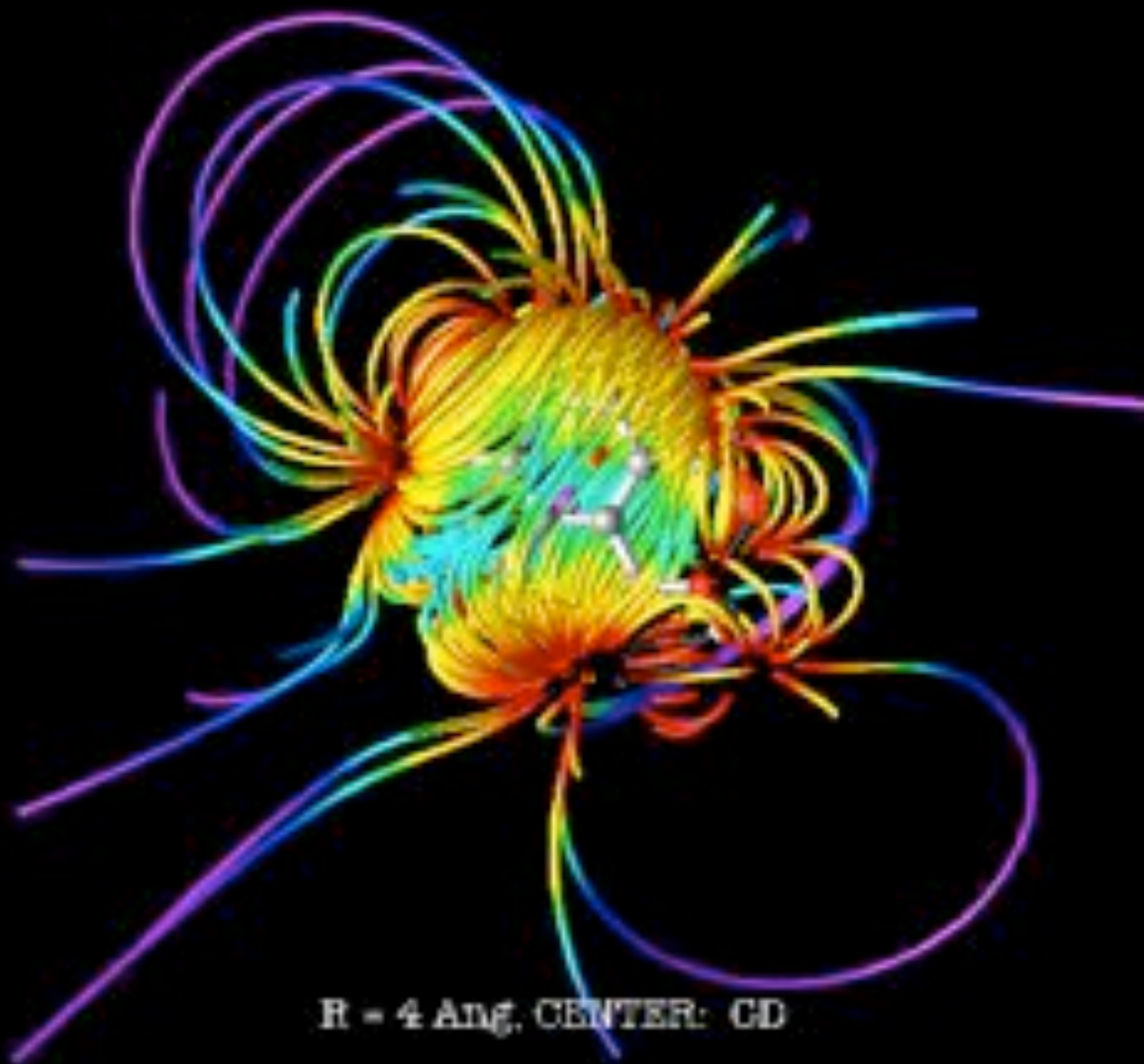


Pollution site data near the Gulf of Mexico:

Ocean Conditions on January 24, 1983



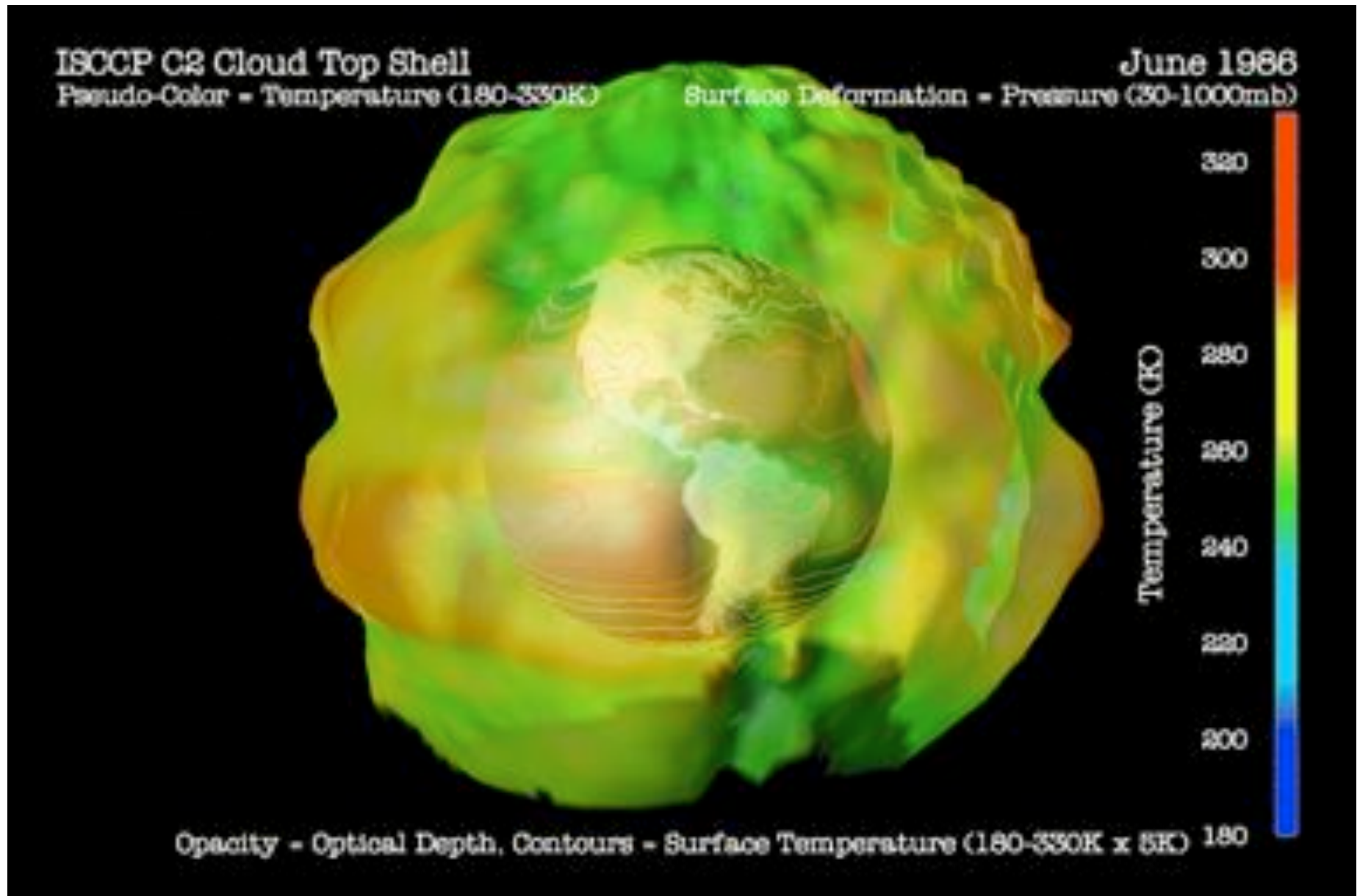
STO-3G Mulliken Field Lines



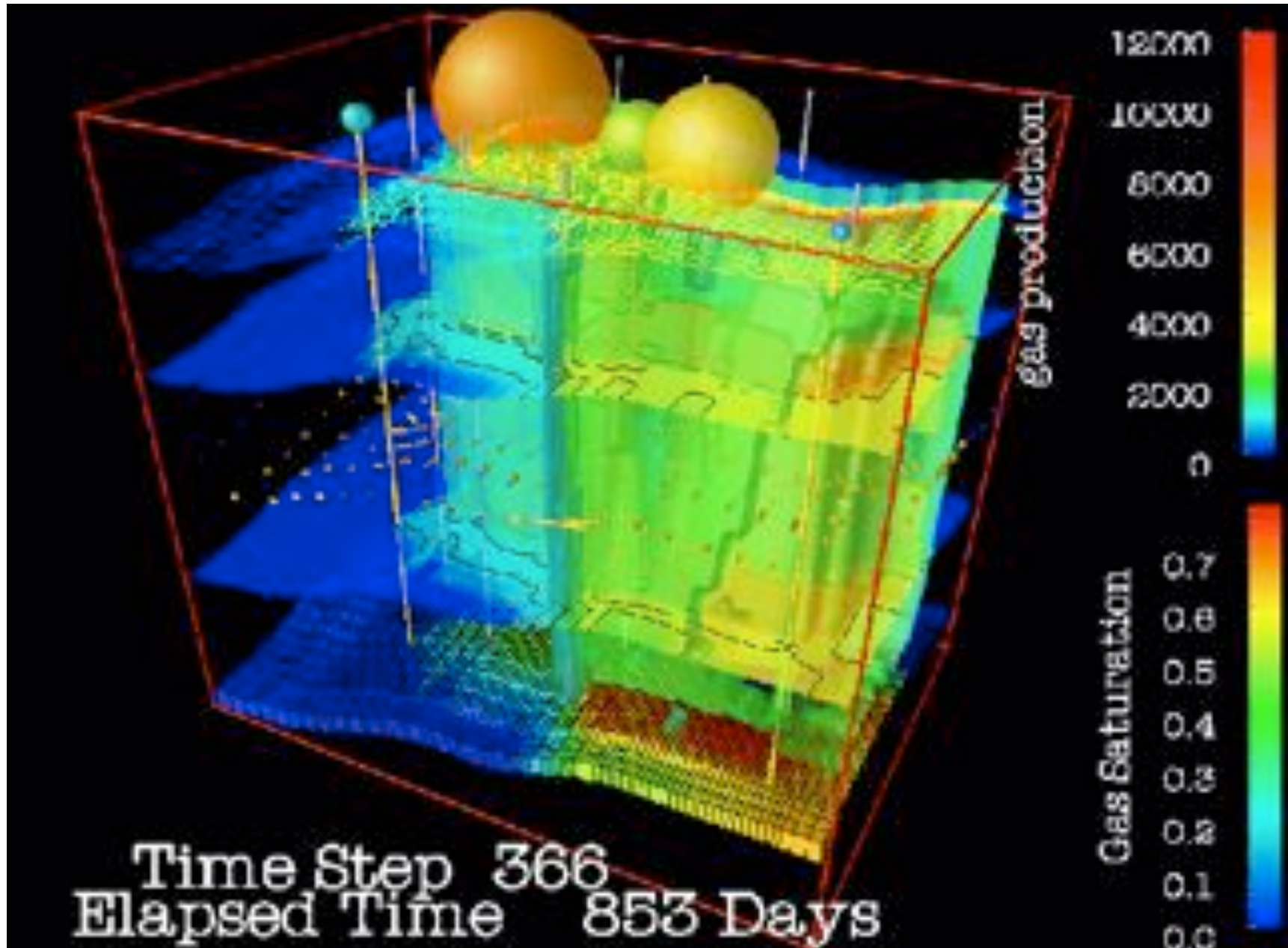
R = 4 Ang, CENTER: CD

Meta-
fluorobenzoic
Acid with
computed
electric field
lines

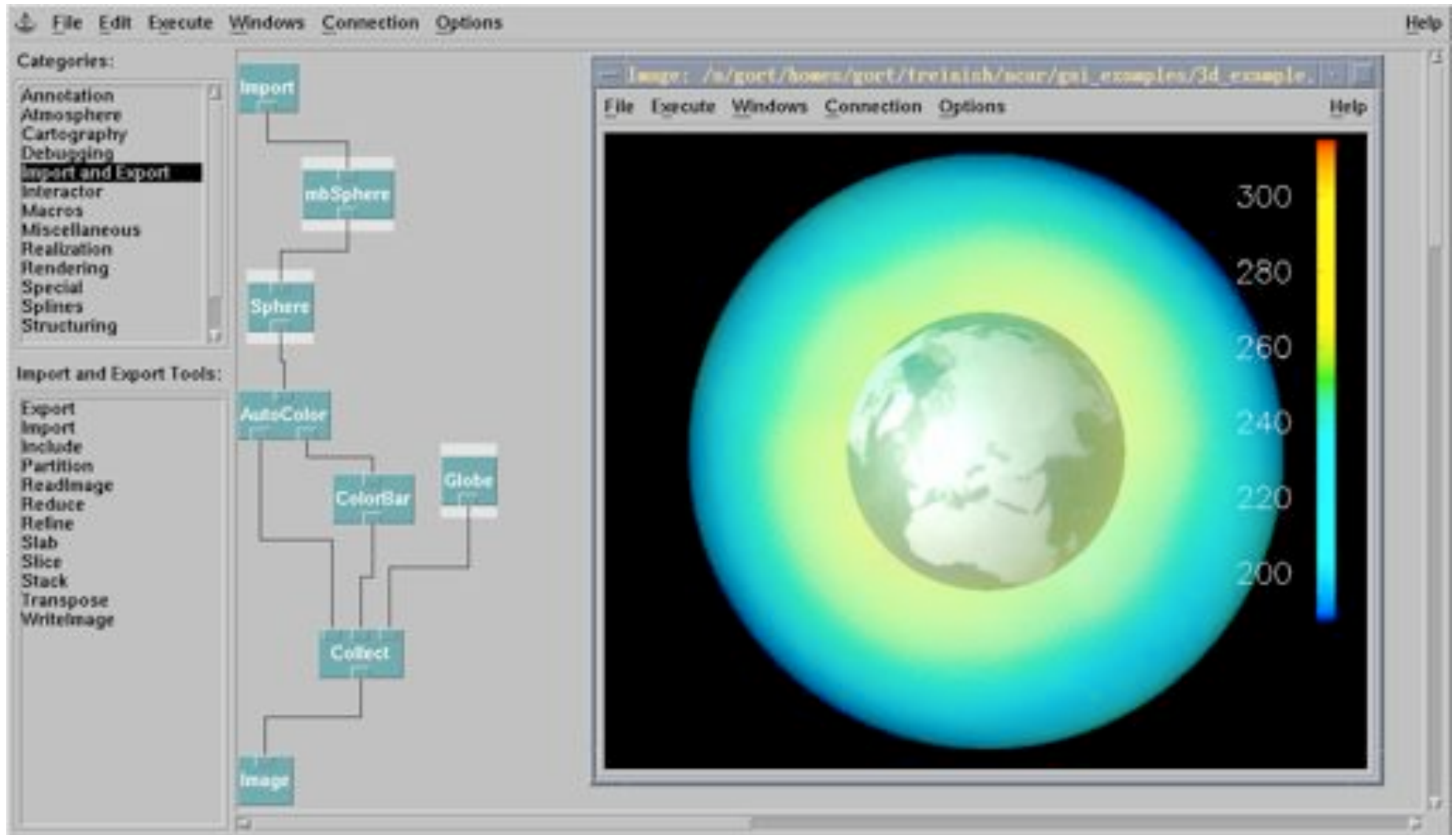
Monthly Cloud Climatology



Gas Reservoir



Open Data Explorer - Visual Programming Environment (VPE)



HCI 558 X - Syllabus

- Tuesday 9-11 (lecture + exercises)
- Thursdays 9-11 (lab)
- 2268 Hoover Hall (Linux Lab)
- Instructor: Chris Harding
charding@iastate.edu
www.vrac.iastate.edu/~charding/hci558
- Office Hours: by appointment, send email first!
- on WebCT (check later, if I enrolled you)

● **Course Goals:**

- Introduction (!) to the major concepts used in 3D scientific visualization (sci vis)
- How do these visualization techniques relate to concepts in human visual perception ?
- Research into a single 3D sci vis topic (“report”)
- Learn fundamentals of 3D sci vis using the Open Data Explorer (Open DX) software
- Optional 3D visualization student project

Grading

- Reading and class presentation of visualization papers (choice of topic) (30%)
- Several 10 min. quizzes (2 out of 3 questions, handwritten answers, open book) (20%)
- Final Exam (multiple choice and practical, using Data Explorer, open book) (30%)
- Class participation (20%) !
- Optional: class project (using DX, other 3D Viz software or CG system) (+30%)

Books

Required Text:

- “OpenDX - Paths to Visualization”,
- 207 pages, hands-on introduction to Open DX.
- Available via VIS, Inc. (<http://www.vizsolutions.com/paths.html>)
- printed book: \$55.00 + shipping/handling,
- \$50, if we pool our order – sign up after lecture

Supplemental Text:

- “Information Visualization – Perception for Design” (2. Ed.)
Colin Ware, 486 pages, ISBN: 1-55860-819-2, \$65 (\$54 at Amazon)

Course structure

Tuesdays:

- 1 hour lecture: 3D scientific visualization, DX theory or relevant human perception background
- practical exercises depending on the lecture content (up to 1 hr).

Thursdays:

- 2 hr lab, work through the DX exercises in the textbook step by step.
- We will occasionally work on bigger DX exercises I have created.

- printout of the slides before the lecture
- the slides will also be on WebCT.
- lecture + lab: 2268 Hoover Hall
- also open at other times (see door)
- (unless there are other classes).

“Midterm”: Reading and class presentation (report)

- Find topic in visualization (visualization techniques, case studies, etc.)
- Conduct individual (literature) research on this topic (I’ll be available for advice!)
- Deliverables:
 - 3 – 5 page written report (due at midterm)
 - 10 minute powerpoint presentation

List of potential research topics :

- Scalar Field visualizations (isosurfaces)
- Volume rendering (direct, GPU based, transfer functions)
- Vector field vis. (flow, vortex)
- Geometric modeling (meshes, compression)
- Virtual Environments & Visualization
- Large-scale Data vis. (distributed systems, parallel, time varying)
- Medical vis. (volume rendering, segmentation, transfer functions)
- Engineering vis. (vector, streamlines, stress, tensors)
- Geoscience 3D vis. (3D GIS, subsurface, hydrology, geophysics)
- Meteorology 3D vis (time series, specific met vis applications)
- 3D visualizations at ISU
- Non-visual “visualization” (sonification, haptics)
- Color perception & rules for efficient use
- Non-realistic (artistic) rendering
- History of 3D visualization

Quizzes

- ~3 written quizzes during the semester
- 10 min. to answer 2 out of 3 questions
- not multiple-choice, open book
- written questions about the proceeding lectures
- Examples:
 - Write down the major steps in scientific visualization
 - show a graphic - explain what is going on.

Final Exam

- 15 min multiple-choice part
- 90 min practical part
- open book exam
- MC questions: material covered in the lecture-part during the entire semester
- The practical part: several small visualization tasks similar to the exercises in the text book

Optional class project (+ 30%)

- Practical use of 3D sci viz skills and acquired in the course. (Open DX, programming API, ...)
- A (limited) 3D visualization project with data from your domain (i.e.: beyond the sample data)
- Data import / massaging is not the main point!
- Topics: Open to your suggestions but need to know in March
- Results: 10 min presentation + report

About you:

- Name / Major ?
- Science/engineering background ?
- Computers in general (user) ? Linux OS ?
- Computer programming / coding (OS? languages?)
- 3D computer graphics ? Games?
- 3D Modeling software? CAD, 3D Studio, Maya?
- 3D sci vis software? VTK, AVS, Paraview, Amira ?
- Other scientific computing software ? Matlab?
- Reason for taking the course, expectations?

- Any questions?
- Textbook sign-up:
 - \$50
 - I'll order today
 - Should arrive before next Tuesday
 - You pay me later (cash only!)