

Beyond Book Spines

Visualizing Library Complexity

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Core Integration
Cornell University

NSDL Challenges

- Broad audience
 - Targeting for our vital constituents is difficult
- Large Volume
 - Resources
 - Users
- Broad content
 - Types of resources
 - Topics
 - Collection of collections
- Metadata Quality
 - Wildly inconsistent (what fields are used, what info is present)
 - Missing information
 - Inconsistent use of controlled vocabularies
- Disparate Quantities (by subject, by collection): 7 vs. 600,000 items
- Virtual Communities
 - Within communities, no agreement on needs
- Reduce human effort to keep costs down

Why Information Visualization?

- It's about the *USERS*
- GOAL: improve user satisfaction with digital library services and resources
- Narrower goal: improve online browsing

Search and Browse

- False dichotomy!
- Many different user tasks
- Multiple ways to present results to users
 - Should the presentation vary with quantity and/or context of results?
 - e.g, "browse" may be a certain presentation of subject search results

A Short List of User Tasks

- “Known Item Search”
 - Single Item Search
 - Answer to a Question
 - x “Best” Resources
 - Most informative? Easiest to access? Most appropriate to 8th graders?
 - *All* Germane Resources
 - Sense of the Information Space
 - Serendipitous Finds
- } Inputs may be fuzzy

... still looking for user needs and tasks analysis for information discovery ...

Problem Narrowed Further

- Improve evaluation of resource relevance without having to “go there”
 - “See and Go Manifesto” Ramana Rao
 - Allow users to manipulate result presentation
- What do we miss when we can’t walk through the stacks?
 - Sense of information space
 - Serendipitous finds

Information Organization

- Books, Bookcases, Book Spines, Catalogs all evolved over time
 - library staff/user needs
 - bookstore staff/customer needs
 - organized by **subject**
- We are taught how to use libraries
 - how resources are organized
 - how to use tools (card catalog, OPAC)

A Brief, Recent History of Information Discovery

- Card catalog (the world begins here)
- OPAC w/o keyword
- OPAC w/ keyword
- Internet, before WWW
- WWW before any cataloging
- Yahoo, Alta Vista, etc.
- Google



Open vs.
Closed
Stacks

More Information Organization

- “binned” then
- (possibly) sub-binned then
- sorted (alphabetical, size, format ...)
 - Note tension between linear ordering and hierarchical classification
- **Location** and **Book Spine**

Book Spines

- Aid information discovery while allowing efficient book storage
- Surrogate for book
 - surrogate closely related to resource
- Visual (color, size, shape ...)
- Aimed at multiple audiences
 - Bookstore staff
 - Potential users
- NISO standard

Can We Improve Reality?

- A resource *can* be in multiple places at once
- 2 or 3 dimensional organization instead of linear
- Organization can be dynamic
 - User manipulable
 - Can use **proximity** to indicate relationships
- Can we make visual surrogate richer?
- Semantic zoom for resource?
 - Different users have different needs
 - Visual surrogate ... user selected?
- Staff can alter organization of stored resources without affecting users' views
- Flexibility: organizing a very large collection has different constraints than organizing a small collection

The Big Questions

- How do we present shelves of book spine information to our users within a monitor screen?
- What should a virtual spine look like?

Design Notes

- Tension
 - intuitive, familiar \leftrightarrow new capabilities, change
- Semantic zoom
 - spec (partial bookspine info: color, position) \rightarrow
 - bookspine info \rightarrow
 - full metadata \rightarrow
 - resource itself
- User manipulability
- Text issues
 - horizontal, not vertical
 - Most materials in English
 - default sort is alphabetical

Browse by Subject

- Prototype
 - Semantic zoom: spec (partial bookspine info: color, position) → bookspine info → full metadata → resource itself
- (demo)

Prototype Next Steps

- Click through for resource
- API
 - Any fielded data
 - Search results? Colored by rank?
 - Any tree structure for any fielded data
- Multiple field values
- Jitter
- Scaling
 - When too much, scroll it (a la spotfire)?
- Table view (sortable, selectable, searchable, like spotfire)

The Metadata Frontier

- Missing information
 - Automatically generated (full text, iVia, kth nearest neighbor, support vector ... based on training set)
 - Supplied by community (ENC?)
- Controlled vocabularies
 - Automatic translation ?
- Data mining?

- Value-added services to motivate providers

Content viz, continued

- Subject as graph (inherent relationships) – tree?
- Vastly uneven leaf levels
- Sparsely populated nodes in tree?
- To explore: items pertaining to multiple subjects at multiple levels in hierarchy – explore “interdisciplinary” items and topics (“see also”) ... what do they tell us?

Information Visualization of Complex Data

John C. Huffman

Reciprocal Net Distributed Molecular
Database

(NSF Award - #0121699)

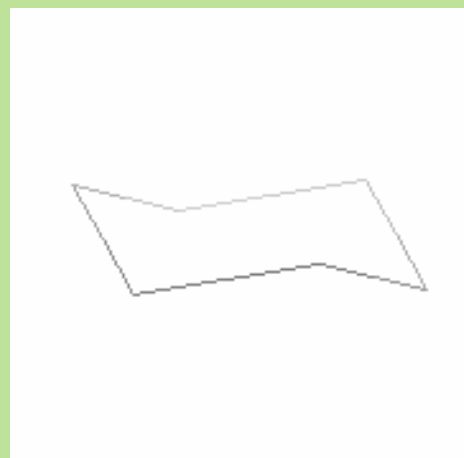
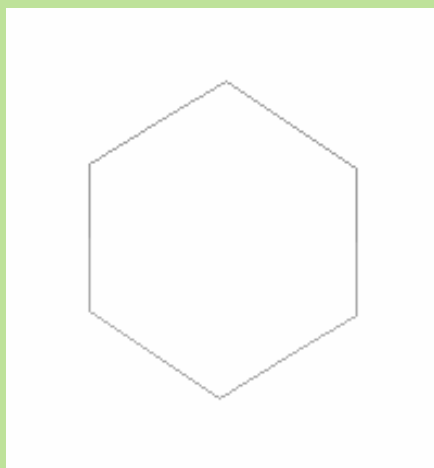


The Problem

C(1)	0.00000	0.00000	0.00000
C(2)	-1.47100	0.40500	0.17200
C(3)	-2.39200	-0.52700	-0.62900
C(4)	-1.99900	-0.54400	-2.11300
C(5)	-0.52700	-0.94800	-2.28500
C(6)	0.39400	-0.01600	-1.48400



The Problem



Solutions

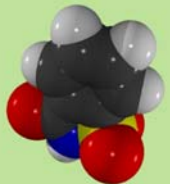
Depth queuing

Shadows

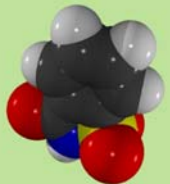
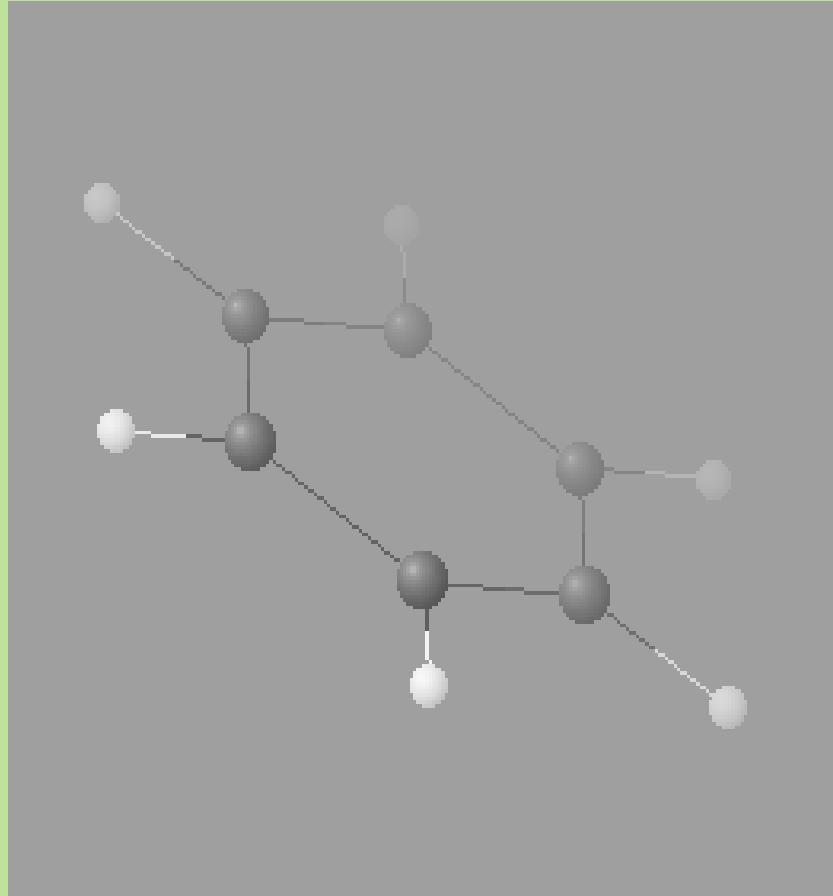
Perspective

3D techniques

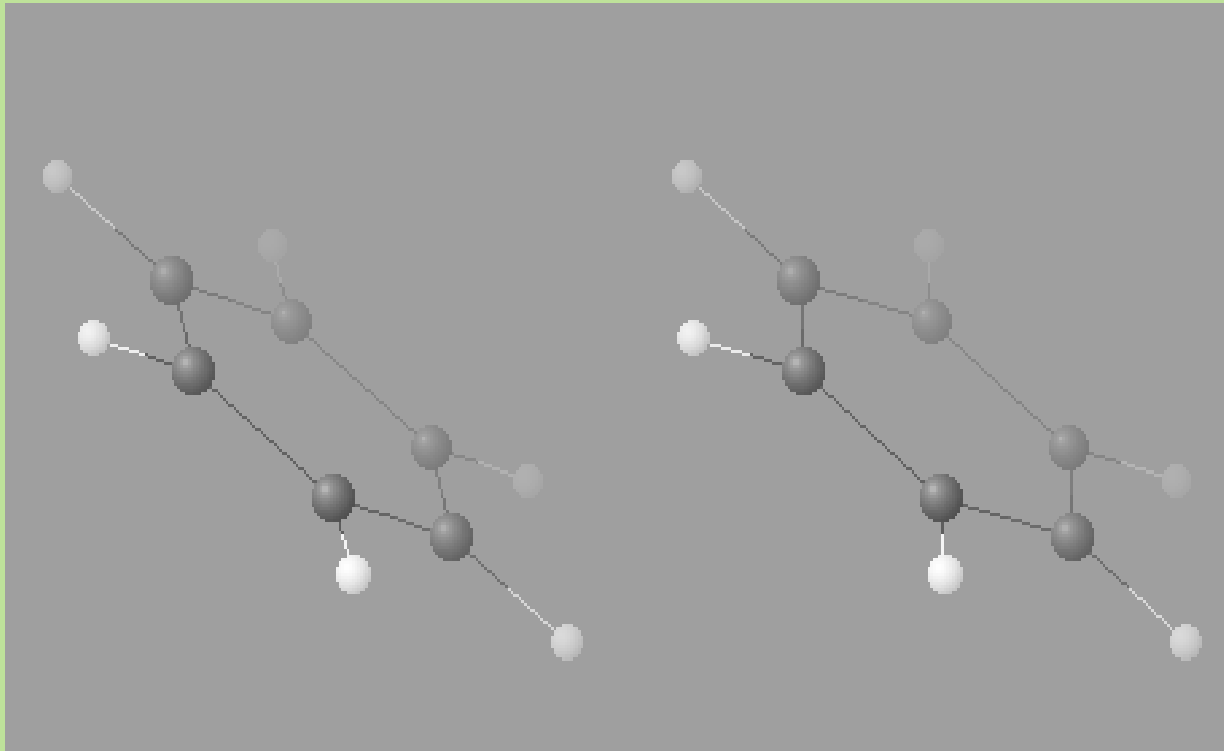
User manipulation



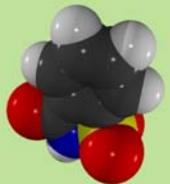
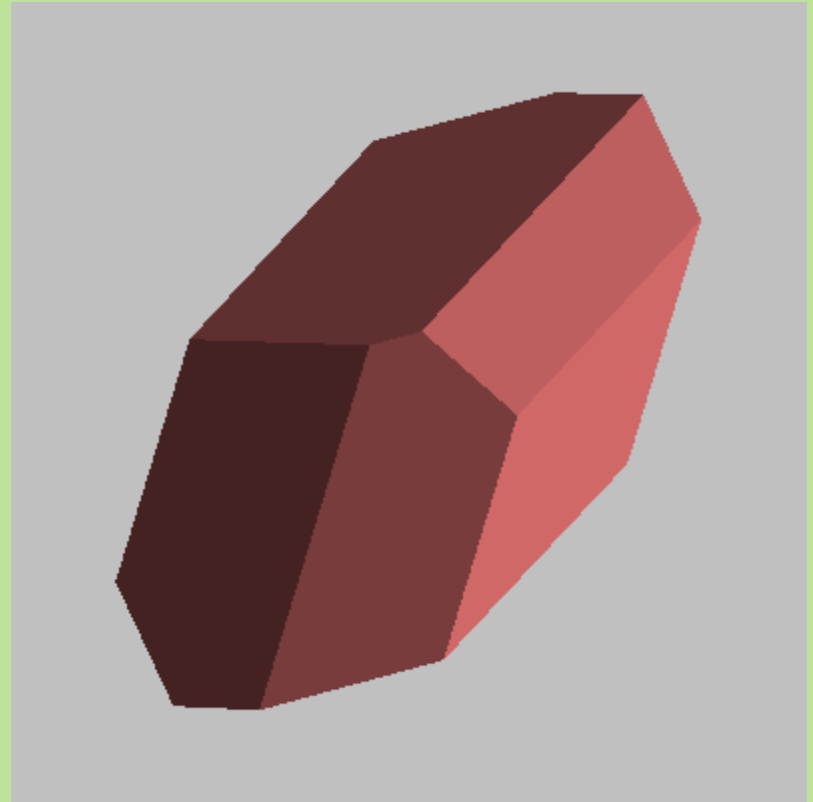
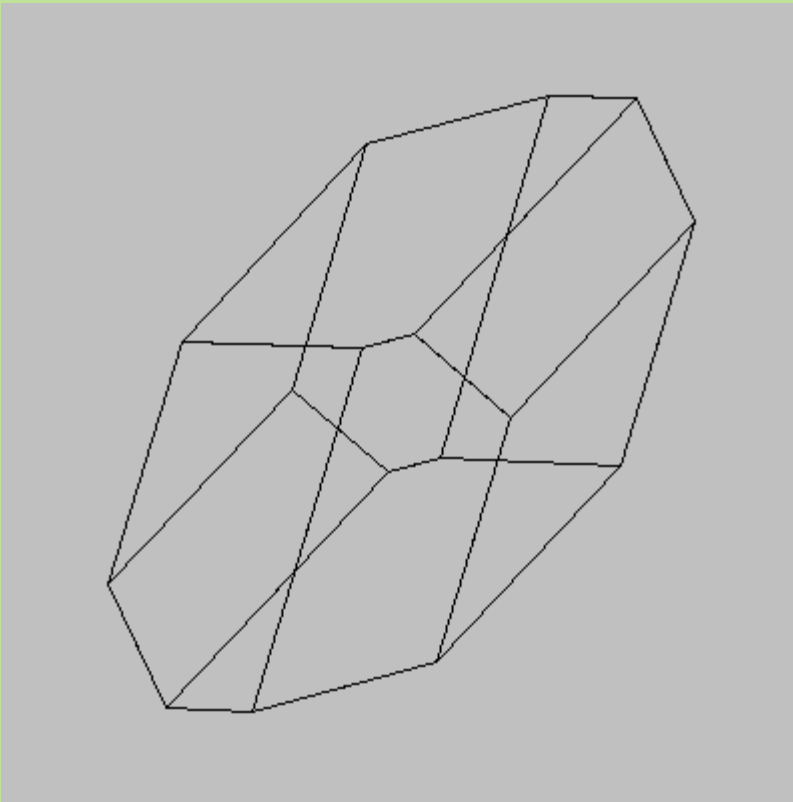
Solutions – Depth Queuing



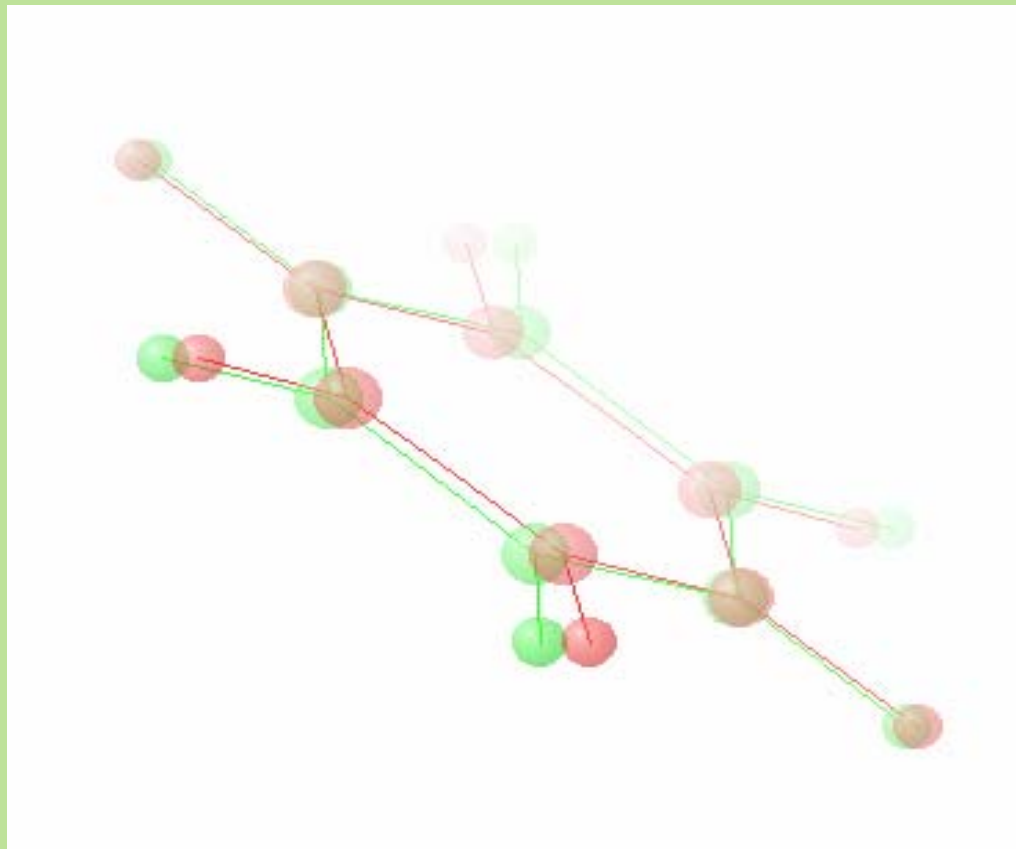
Solutions – 3D



Solutions – Shading



Solutions – 3D



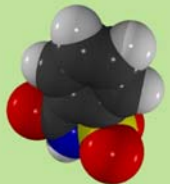
Other Solutions

VRML

CHIME

RASMOL

JMOL



Reciprocal Net

Bacteriopheophytin A - Reciprocal Net Common Molecules - Mozilla Firefox

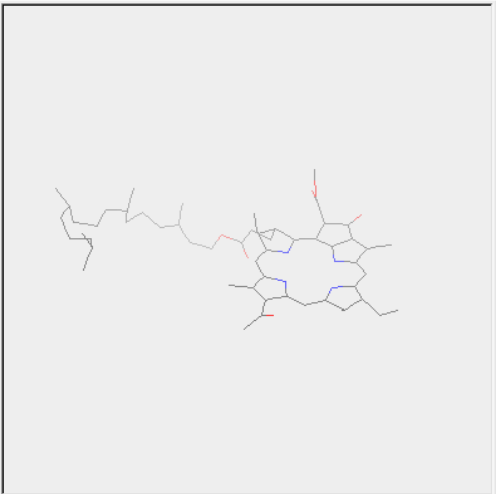
http://www.reciprocalnet.org/recipnet/showsample.jsp?sampleId=27344360

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Reciprocalnet.org
site network master server

Site Info | Search sample # (local search) Go

Bacteriopheophytin A - Reciprocal Net Common Molecule [Log in](#)



Bacteriopheophytin A

Pheophytin is a chlorophyll derivative involved in photosynthesis.

Chemical Formula: $C_{55}H_{76}N_4O_6$

Explanation: Pheophytin is essentially a chlorophyll molecule with two hydrogen atoms replacing the magnesium center. It can be synthesized through the acidification of chlorophyll, where the magnesium is pulled from the porphyrin ring and H^+ ions attach to the open binding sites. The structure of pheophytin is much more stable than that of the chlorophyll due to this hydrogen ion interaction. As a result, pheophytin is a problem in laboratory situations because the chlorophyll will spontaneously transform into pheophytin in any acidic environment. The function of pheophytin is to carry excited electrons from photosystem II and dump them off at the plastoquinone Q_a during photosynthesis. The pheophytin/chlorophyll interactions provide a source for a wide range of research in the areas of botany, biology, and plant physiology. Recently studies demonstrated that Pheophytin together with Caratenoid can be used on semiconductor surface to leads an efficient reductive quenching of the pheophytin moiety. The chemical structure is $C_{55}H_{76}N_4O_6$.


Keywords: chlorophyll, porphyrin, semiconductor surface

[Crystallographic details...](#)
[More visualization options...](#)
[See other versions...](#)

TIP ► Click and drag your mouse inside the applet above to rotate the molecule in 3-D. [Applet instructions...](#)

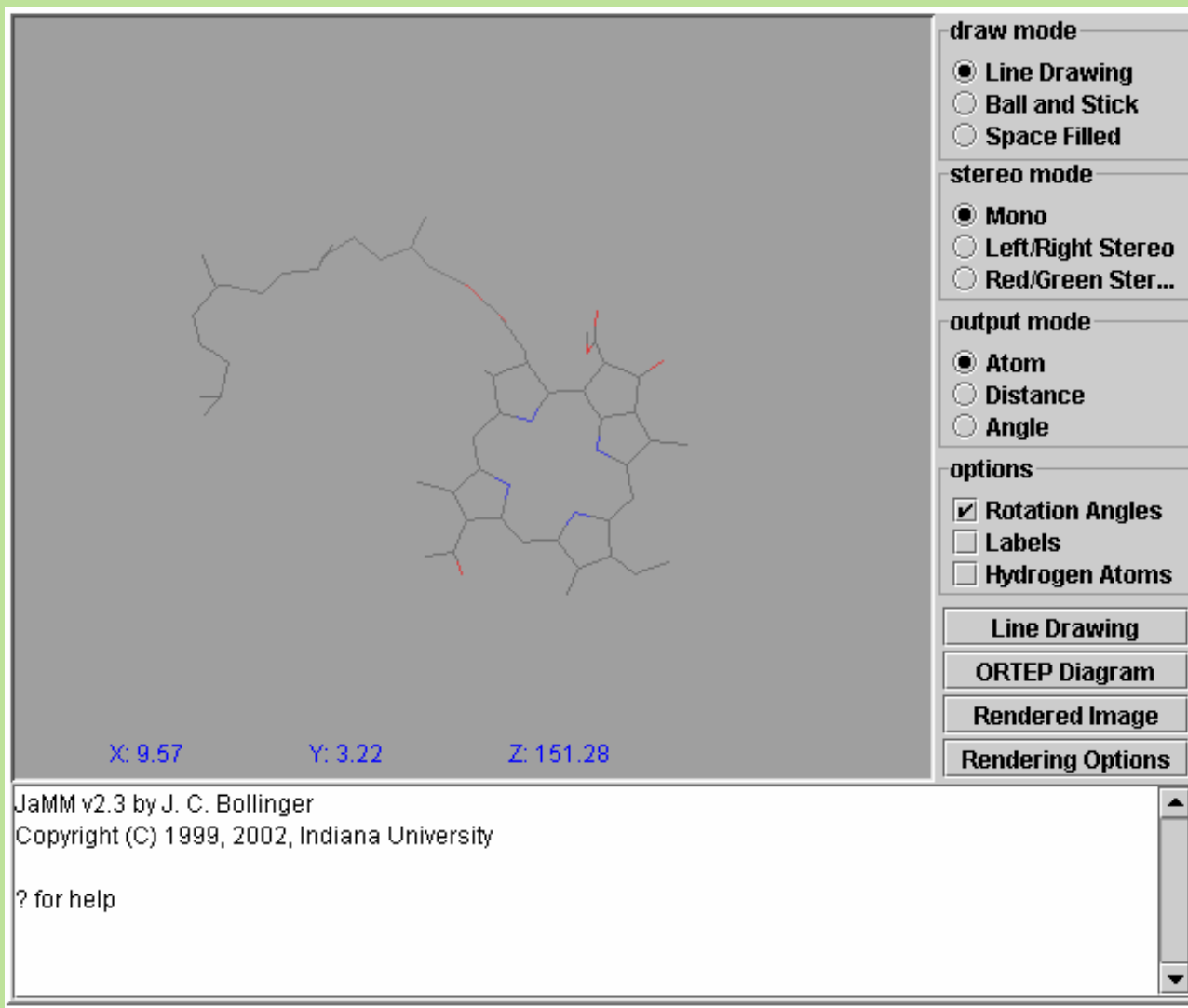
Switch to another visualization applet:

- [miniJaMM](#) [open in new window...](#)
- [JaMM 1](#)
- [JaMM 2](#)

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Reciprocal Net



The screenshot displays the JaMM v2.3 software interface. The main window shows a reciprocal net visualization with a complex, interconnected network of lines and nodes. The nodes are colored in shades of blue, red, and black. The lines are thin and connect the nodes in a non-linear fashion. The background is a light gray.

At the bottom of the main window, the coordinates are displayed: X: 9.57, Y: 3.22, Z: 151.28.

The control panel on the right side of the window contains the following options:

- draw mode**
 - Line Drawing
 - Ball and Stick
 - Space Filled
- stereo mode**
 - Mono
 - Left/Right Stereo
 - Red/Green Ster...
- output mode**
 - Atom
 - Distance
 - Angle
- options**
 - Rotation Angles
 - Labels
 - Hydrogen Atoms

Below the control panel, there are four buttons: Line Drawing, ORTEP Diagram, Rendered Image, and Rendering Options.

At the bottom of the window, the text reads: JaMM v2.3 by J. C. Bollinger, Copyright (C) 1999, 2002, Indiana University. Below this, there is a help icon and the text "? for help".



Reciprocal Net

Reciprocal Net home: <http://reciprocalnet.org>

MiniJaMM page:

<http://www.reciprocalnet.org/ recipnet/showsample.jsp?sampleId=27344380&sampleHistoryId=16086&level=8192&applet=jamm2&setApplet=1>

JaMM2:

<http://www.reciprocalnet.org/ recipnet/jamm.jsp?sampleId=27344380&sampleHistoryId=16086&jamm=JaMM2>

Morphology: <http://www.iumsc.indiana.edu/morphology/sucrose.html>

Morphology: <http://www.iumsc.indiana.edu/morphology/solids.html>

DoubleJaMM: <http://www.iumsc.indiana.edu/Symmetry/Octrahedral.html>



Reciprocal Net



The screenshot shows a Mozilla Firefox browser window displaying the Reciprocal Net website. The address bar shows the URL <http://www.reciprocalnet.org/recipnet/index.jsp>. The page header features the Reciprocal Net logo, a "Partner Site" badge, and a search bar with the text "sample # (local search)" and a "Go" button. Below the header, there are navigation links for "Site Info" and "Search", and a "Log in" link. The main content area is divided into two columns. The left column contains two sections: "What is Reciprocal Net?" and "How to use this site". The right column features a large 3D ball-and-stick molecular model of a complex organic structure, overlaid on a world map. The footer of the page contains copyright information for 2003, funding from the U.S. National Science Foundation, and the NSDL logo.

Reciprocal Net - Site information - Mozilla Firefox

http://www.reciprocalnet.org/recipnet/index.jsp

Reciprocal Net

Part of the Reciprocal Net Site Network

Reciprocalnet.org
site network master server

sample # (local search)

[Site Info](#) | [Search](#) [Log in](#)

What is Reciprocal Net?

The Reciprocal Net Site Network is a distributed database for crystallographic information, supported by the [National Science Digital Library](#), and is run by participating crystallography labs across the world. Each entry in the database generally describes a single crystal structure that was synthesized or isolated by a research chemist and was analyzed by means of X-ray crystallography.

How to use this site

You are visiting one of the many sites in the [Reciprocal Net Site Network](#). This site is operated by the [laboratory](#) noted in the upper-right corner of this page. Please use the menu bar above to navigate to samples in this site's database. Select samples are available to the general public without authentication. Authorized users, please [log in](#) first. You may jump to another site's database or visit the master server at [ReciprocalNet.org](#) for more information and [general help](#).

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Done



Reciprocal Net

Bacteriopheophytin A - Reciprocal Net Common Molecules - Mozilla Firefox

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Reciprocal Net

Reciprocal Net - JaMM Viewer - Mozilla Firefox

http://www.reciprocalnet.org/recipnet/jamm.jsp?sampleId=27344380&sampleHistoryId=16086

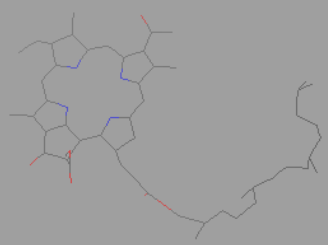
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JaMM Viewer [Log in](#)



draw mode

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stereo mode

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- Red/Green Ster...

output mode

- Atom
- Distance
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options

- Rotation Angles
- Labels
- Hydrogen Atoms

51005.crt

[Sample Information](#)

Line Drawing

ORTEP Diagram

Rendered Image


Rendering Options

X: -5.4 Y: -18.07 Z: -19.05

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? for help

[JaMM1](#) - works with any Java-capable browser
[JaMM2](#) - requires Sun Java plug-in 1.2 or higher (1.4 recommended)
[miniJaMM](#) - works with any Java-capable browser

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Applet.oro.recipnet.site.applet.iamm.iamm2.JaMM started



Reciprocal Net

Reciprocal Net - JaMM Viewer - Mozilla Firefox

http://www.reciprocalnet.org/recipnet/jamm.jsp?sampleId=27344380&sampleHistoryId=16086

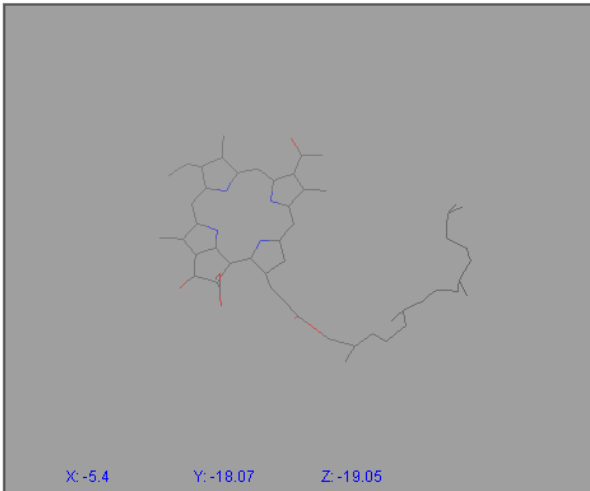
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Line Drawing

ORTEP Diagram

Rendered Image


Rendering Options

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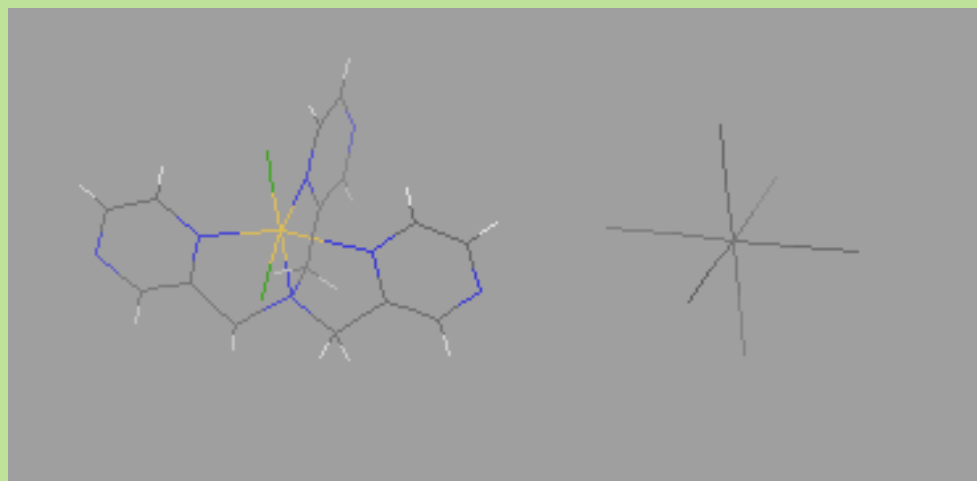
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Applet.oro.recipnet.site.applet.iamm.iamm2.JaMM started



Reciprocal Net



Reciprocal Net

For more information, contact

John C. Huffman

huffman@indiana.edu

<http://recipnet.org>

<http://reciprocalnet.org>

<http://www.iumsc.indiana.edu>





Digital Library for Earth System Education

www.dlese.org

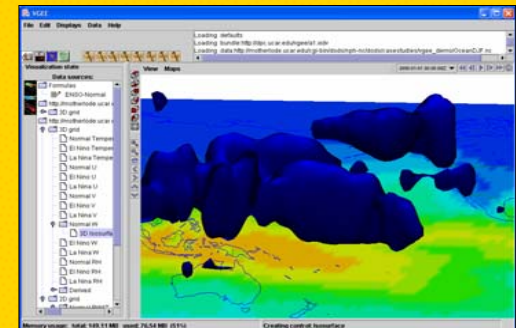
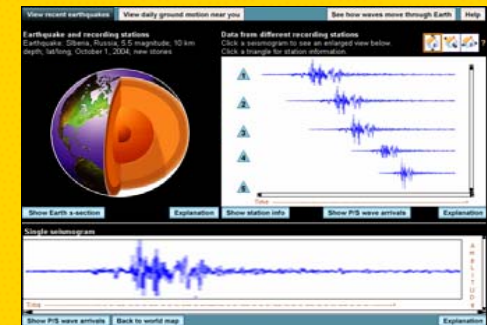
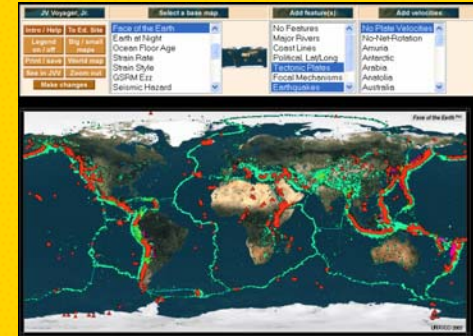


Creating data exploration programs for educational use

Marianne Weingroff
Instructional Designer, DLESE Program Center
<http://www.dlese.org>, support@dlese.org

Overview

- A model of levels of learning / understanding and the types of digital resources that can support them
- 3 visualization programs that support higher-order levels of learning
 - All are reworks of existing programs – done to make them more user friendly and educationally useful
- Tips for designing effective, educational, exploration environments



Tying learning goals to resource types

Level of learning (from basic to complex) *	You want students to be able to:	Types of resources to look for in digital libraries	Frequently used teaching approaches
<p>Knowledge (recall or recognize info, ideas, principles)</p>	<p>Gather facts about a topic, etc.</p> <p>Example: What are the different types of clouds and how are they formed?</p>	<ul style="list-style-type: none"> • Tutorials and modules • Presentations and demonstrations • Text materials: articles, etc. • Activities: classroom, computer, lab, and field • Visuals: graphics, illustrations, animations 	<p>For basic types of learning, the teacher typically organizes the learning, teaches the information and concepts (or points students to sources), and guides the activities</p>
<p>Comprehension (interpret or comprehend information)</p>	<p>Understand an Earth system process</p> <p>Example: How does wave strength influence erosion?</p>	<p>For comprehension, add:</p> <ul style="list-style-type: none"> • Case studies and simulations (basic) 	<p>Technology can be used to increase knowledge and comprehension</p> <p>Assessment is often straightforward (knowledge and comprehension questions)</p>

* Bloom, B.S., Engelhart, M.D., Furst, E.J., Hill, W.H., & Krathwohl, D.R. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain. New York: Longman.

Higher order thinking skills...

Level of learning (from basic to complex)	You want students to be able to:	Types of resources to look for in digital libraries	Frequently used teaching approaches
Application (select, transfer, and use data and principles to complete a problem with minimal direction)	<p>Apply the scientific process, etc.</p> <p>Example: How does the Gulf Stream affect biological productivity in the ocean?</p>	<ul style="list-style-type: none"> • Case studies • Simulations • Visualizations and data sets, particularly within exploration environments • Activities (classroom, computer, lab, field) • 'Ask an expert' services • Discussion forums 	<p>For increasingly complex types of learning, students play a more active role in the learning process</p> <p>Collaborative work can help students tackle problems and tasks</p>
Analysis (distinguish, classify, or relate assumptions, hypotheses, evidence)	<p>Analyze a problem</p> <p>Example: How is water quality determined and how does it affect biological (including human) communities?</p>	<p>Helpful keywords:</p> <ul style="list-style-type: none"> • Analyze, assess, choose, classify, compare, convince, decision, infer, measure, summarize 	<p>Teacher is more of a facilitator; scaffolds the amount of structured, didactic instruction and direction (provides less as students work more independently)</p> <p>Supports the philosophy that students construct their own knowledge</p>
Synthesis (originate, integrate, and combine ideas)	<p>Prepare for a discussion, role-play, or debate on an issue, etc.</p> <p>Example: Develop and defend a possible solution to global warming.</p>	<p>Helpful keywords:</p> <ul style="list-style-type: none"> • Synthesize, integrate 	<p>Learning is problem or inquiry based, contextual, and uses real data and problems when possible</p> <p>Encourages problem solving, creativity, and intellectual curiosity</p>

Examples of resources that support different levels of understanding

Level of learning (from basic to complex)	You want students to be able to:	Types of resources to look for in digital libraries	Frequently used teaching approaches
Knowledge (recall or recognize info, ideas, principles)	Gather facts about a topic, etc. Example: What are the different types of	<ul style="list-style-type: none"> • Tutorials and modules • Presentations and demonstrations • Text materials: articles, etc. 	For basic types of learning, the teacher typically organizes the learning, teaches the information and concepts

Comprehension (interpret or comprehend information)



Geologists came to the conclusion in the 1960's that the Earth's rigid outer layer (crust and outer, rigid layer of the mantle) was not a single piece, but was broken up into about 12 large pieces called plates. The red lines on the map of the world above indicate

1. *Convergent boundaries* - two plates collide to form mountains or a subduction zone.
2. *Divergent boundary* - two plates are moving in opposite directions as in a mid-ocean ridge.
3. *Transform boundary* - two plates are sliding past each other as in the San Andreas fault of California. A transform boundary is like a tear in the Earth's crust. These plates move very slowly across the surface of the Earth as though they were on a conveyor belt. The convection currents in the much hotter mantle continually move the plates about 1/2 to 4 inches per year.

When the plates move they collide or spread apart allowing the very hot molten material called lava to escape from the mantle. When collisions occur they produce mountains, deep underwater valleys called trenches, and volcanoes. As mountains and valleys are being formed natural disasters such as earthquakes and volcanic activity can occur

Targeting higher-order skills: Jules Verne Voyager

Exploring images and features of the Earth

JV Voyager, Jr.		Select a base map	Add feature(s)	Add velocities
Intro / Help	To Ed. Site	Face of the Earth	No Features	No Plate Velocities
Legend on / off	Big / small maps	Earth at Night	Major Rivers	No-Net-Rotation
Print / save	World map	Ocean Floor Age	Coast Lines	Amuria
See in JVV	Zoom out	Strain Rate	Political, Lat/Long	Antarctic
Make changes		Strain Style	Tectonic Plates	Arabia
		GSRM Ezz	Focal Mechanisms	Anatolia
		Seismic Hazard	Earthquakes	Australia

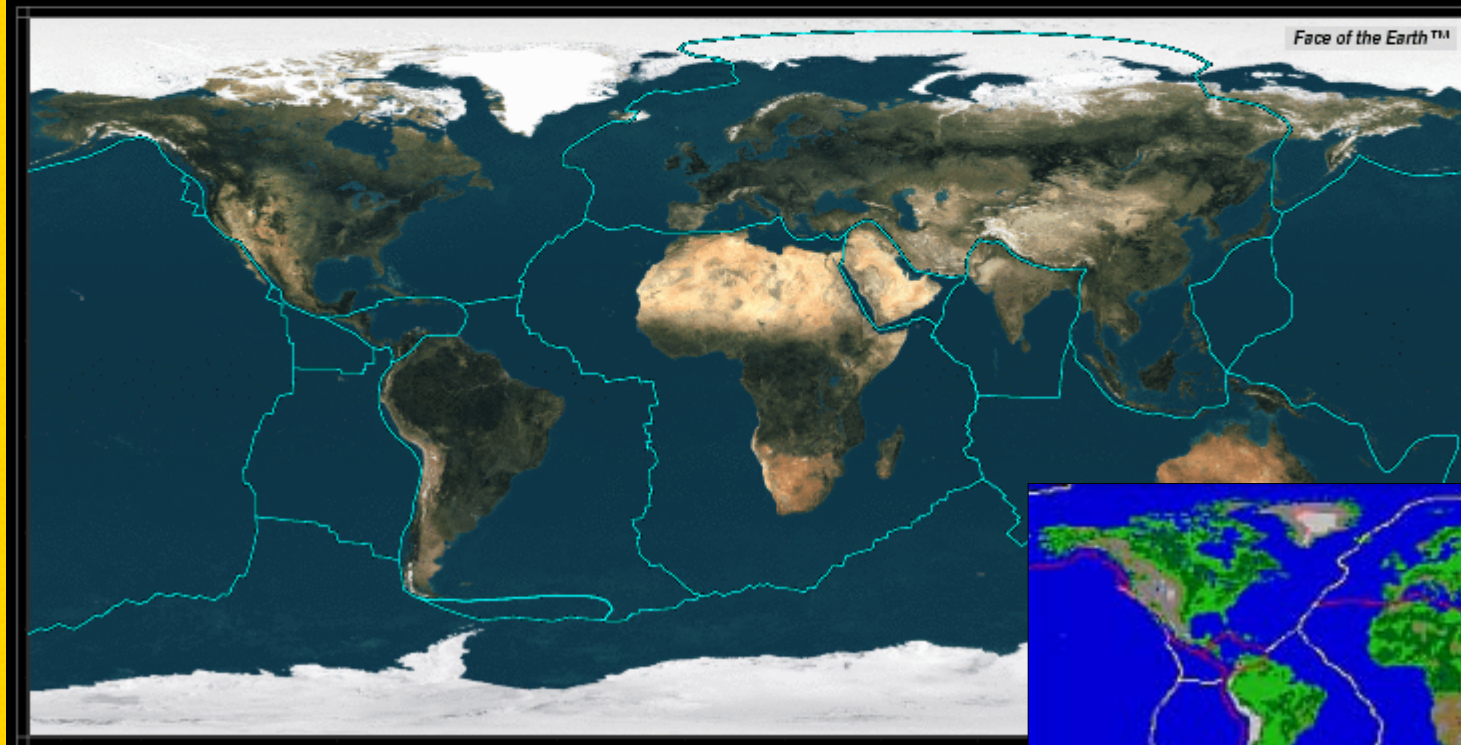
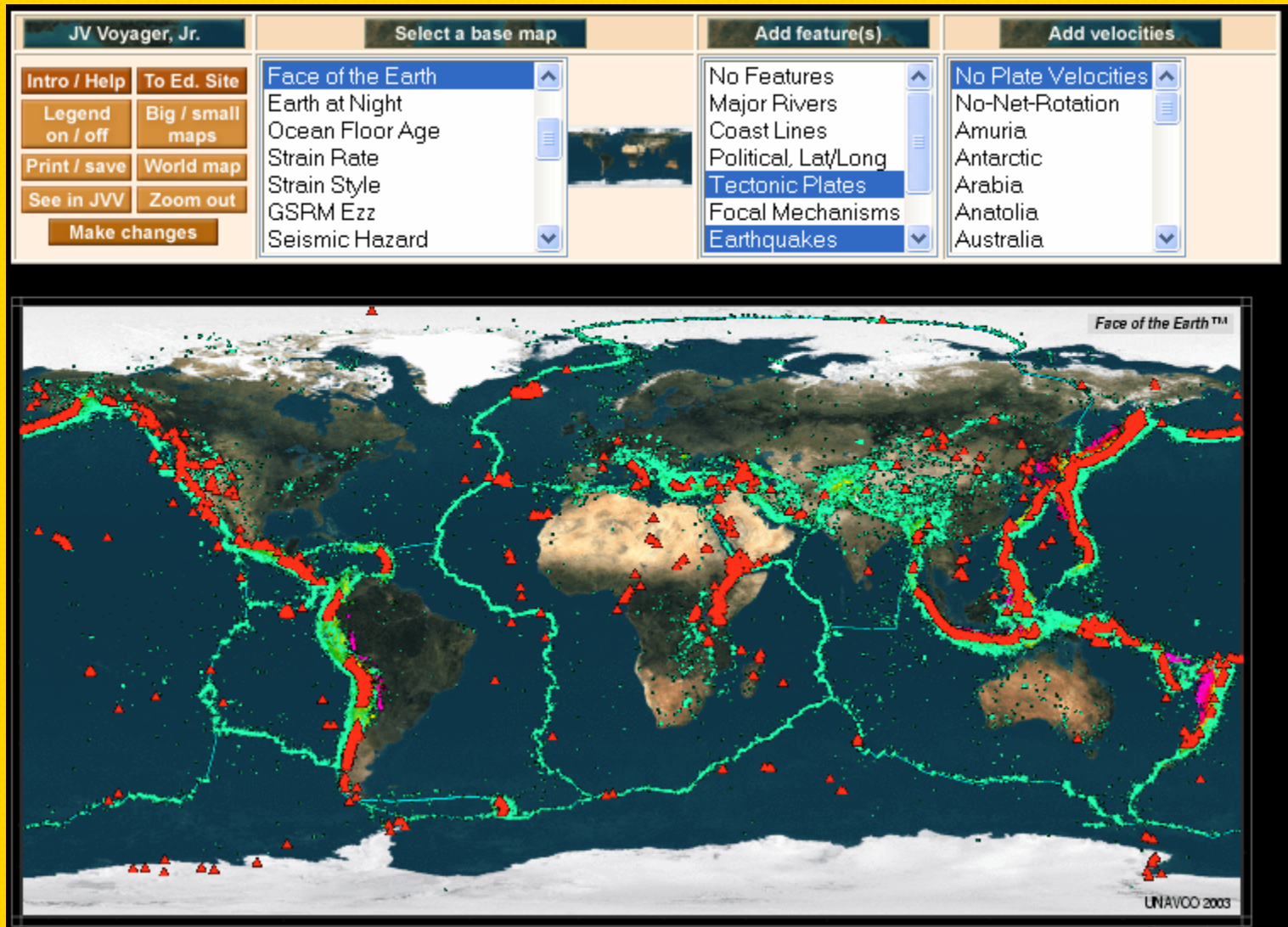
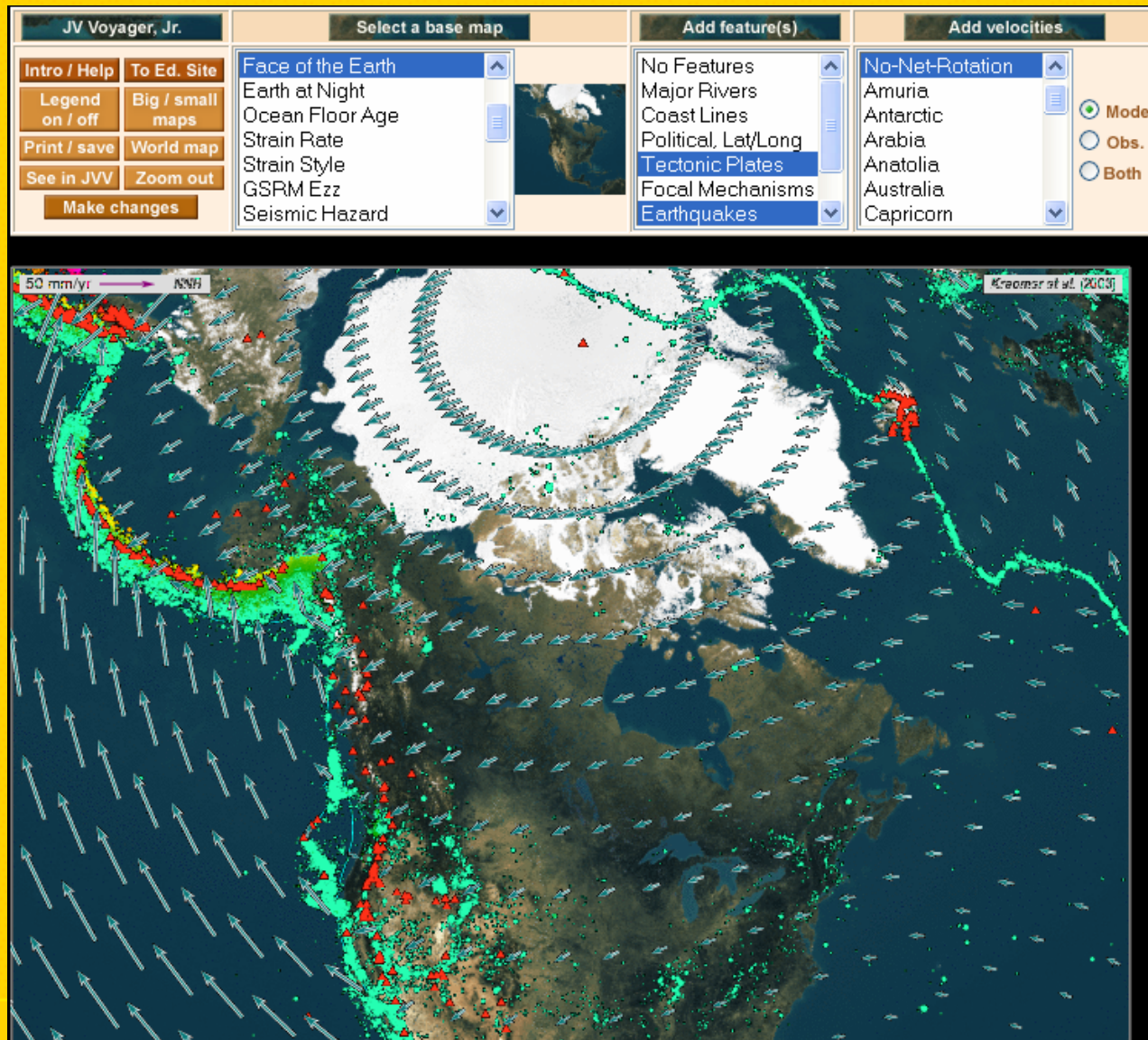


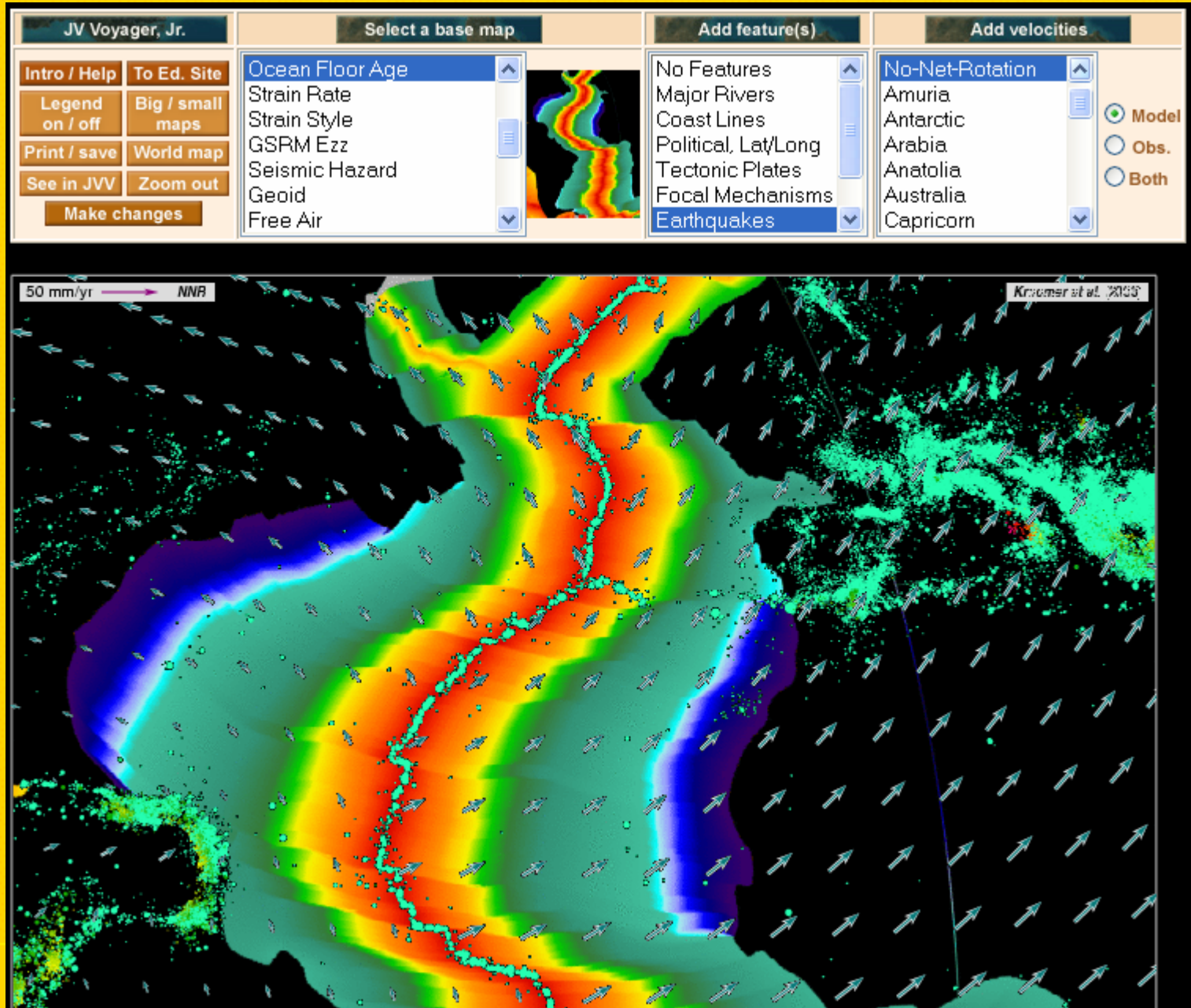
Plate boundaries, earthquakes, volcanoes – aha!



Set plate velocities to see how plates move in relation to each other (reason for EQs + volcanoes)



Sea floor spreading – Mid-Atlantic Ridge

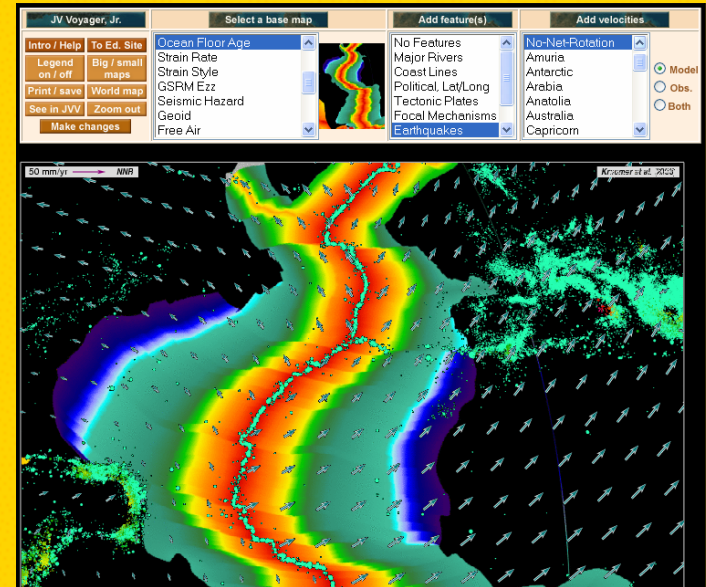


Types of educational supports

- Structured curriculum activities
- Questions to explore
 - Guide users in their exploration of the program
- ‘Did You Know’s
 - Info about particular locations and phenomena

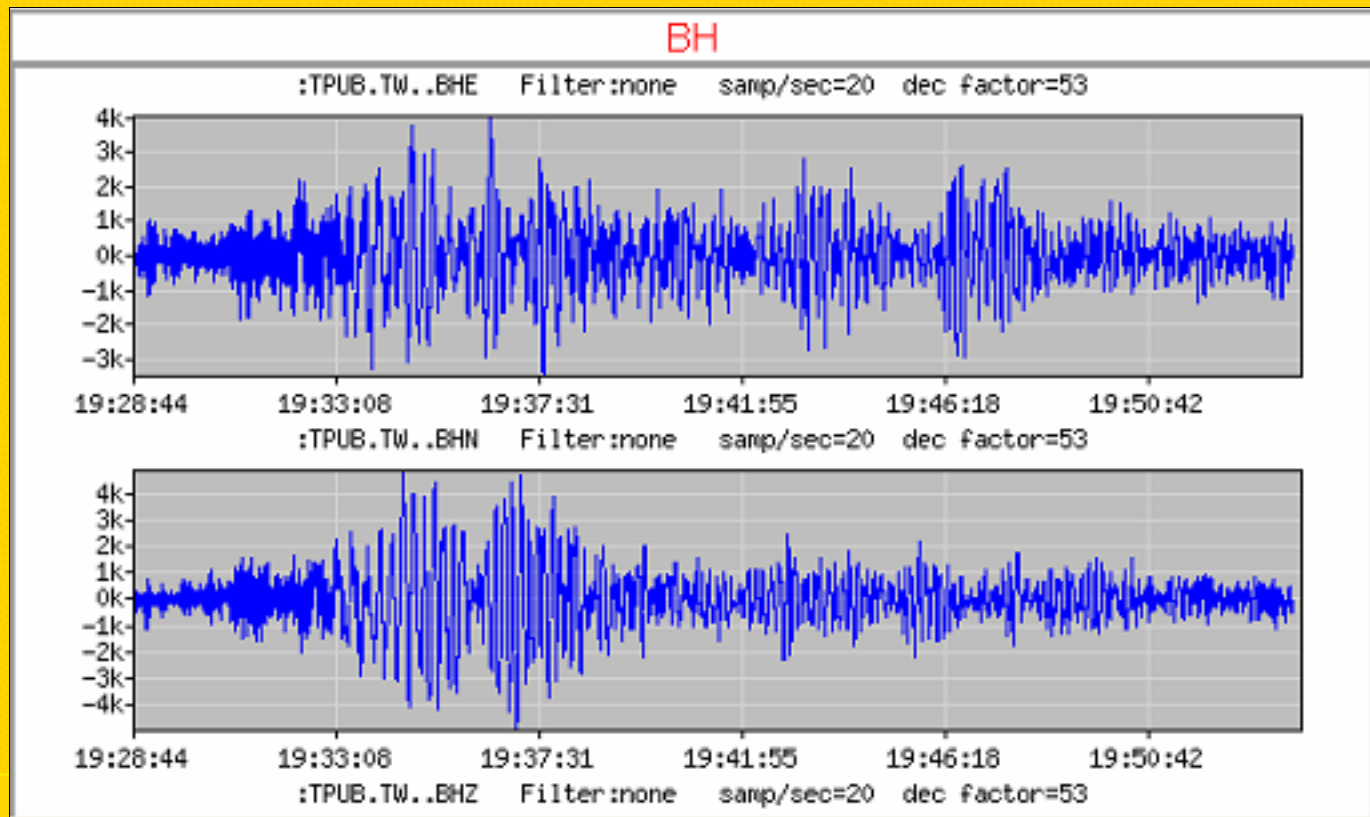
Help

- Technical information
 - Legends, how to interpret the maps, data sources
- Explanatory information
 - What the maps and overlays mean, putting them in context

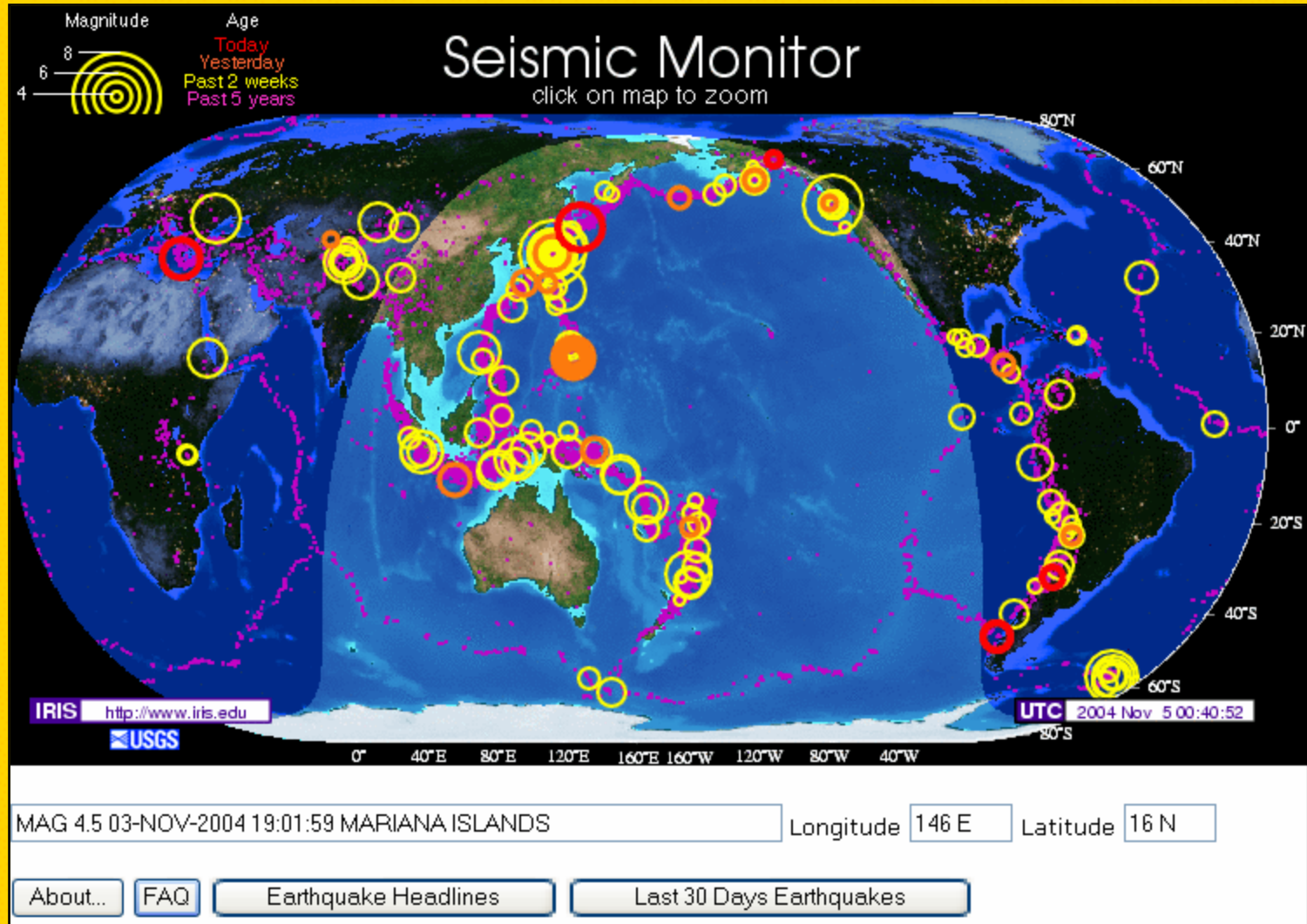


Seismograms (recordings of seismic activity)

- Various websites provide current earthquake information
- My concerns when asked to help rework one
 - How do users make sense of it, what it means
 - What are seismograms used for -> a major way of learning about Earth's structure



Major program for finding current EQ information



Getting to the data...

Up to 30 Recent Earthquakes

(within 10 degrees of LON=119.11, LAT=15.5682)

[Return to Zoom Map](#)
[Close & Return](#)

DATE links are into the IRIS WILBER system where you can see seismograms and request datasets.

DATE	LAT	LON	MAG	DEPTH	REGION
29-OCT-2004 19:28:59	15.57	119.11	5.6	40.2	LUZON, PHILIPPINE ISLANDS
26-OCT-2004 02:05:29	13.86	120.72	4.6	147.0	MINDORO, PHILIPPINE ISLANDS
22-OCT-2004 13:44:17	25.02	128.05	4.9	43.0	RYUKYU ISLANDS
21-OCT-2004 13:45:57	9.66	126.66	4.9	72.0	MINDANAO, PHILIPPINE ISLANDS
19-OCT-2004 03:51:16	20.75	122.06	4.8	171.0	PHILIPPINE ISLANDS REGION
15-OCT-2004 11:44:53	18.50	122.29	4.9	30.0	LUZON, PHILIPPINE ISLANDS
15-OCT-2004 04:08:50	24.52	122.67	6.6	94.4	TAIWAN REGION
14-OCT-2004 18:35:47	13.82	120.78	4.9	114.0	MINDORO, PHILIPPINE ISLANDS
13-OCT-2004 00:04:38	8.82	126.24	4.8	51.0	MINDANAO, PHILIPPINE ISLANDS
12-OCT-2004 09:40:44	13.76	120.81	4.6	129.0	MINDORO, PHILIPPINE ISLANDS
11-OCT-2004 08:58:50	15.58	119.55	5.1	17.0	LUZON, PHILIPPINE ISLANDS
09-OCT-2004 15:49:59	13.78	120.67	4.7	130.0	MINDORO, PHILIPPINE ISLANDS
08-OCT-2004 14:36:05	13.87	120.59	6.5	105.0	MINDORO, PHILIPPINE ISLANDS
05-OCT-2004 22:10:04	24.83	125.14	4.5	81.0	SOUTHWESTERN RYUKYU ISLANDS
05-OCT-2004 18:13:02	20.03	121.41	4.8	69.0	PHILIPPINE ISLANDS REGION

Here's the data. For non-scientists, what's it mean?

Station: **TPUB - TA-PU**

Network: **TW - Broadband Array in Taiwan for Seismology**

Lat: 23.30 Lon: 120.63 Elev: 370.00

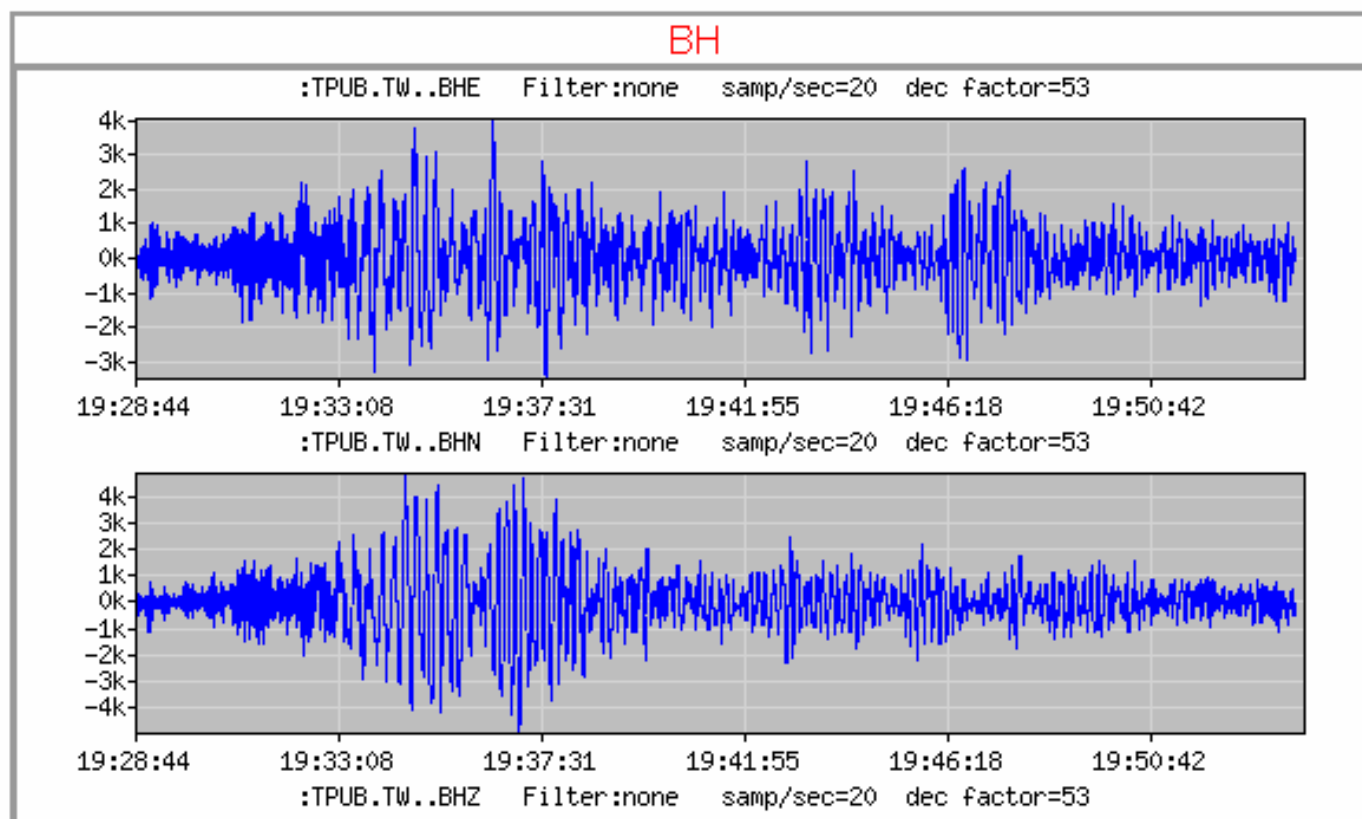
Event Name: **20041029_192859.3.spyder**

Available Channels: **BHE,BHN,BHZ,LHE,LHN,LHZ**

Available Locations:

Sample Seismograms

Close Window



Revised version: Adding context to the data

Seismograms are 1 – 2 map clicks away

Rapid Earthquake Viewer About Contact

View recent earthquakes View daily ground motion near you See how waves move through Earth Help

To select an earthquake, click a circle on the map or select one in the Recent Earthquakes list below.
If you click a clump of earthquakes on the map, you will go to a zoomed in map, where you can better select the EQ you want.

Age: Today
Yesterday
Past 2 wks
Past 5 yrs

Magnitude
8
6
4

UTC 80°S

0° 40°E 80°E 120°E 160°E 160°W 120°W 80°W 40°W

80°N
60°N
40°N
20°N
0°
20°S
40°S
60°S

www.dlcese.org

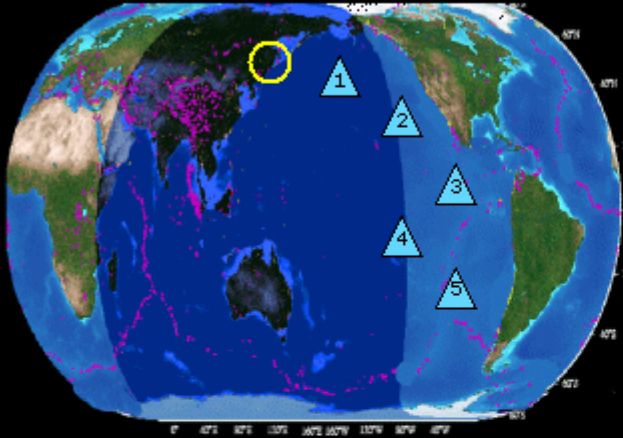
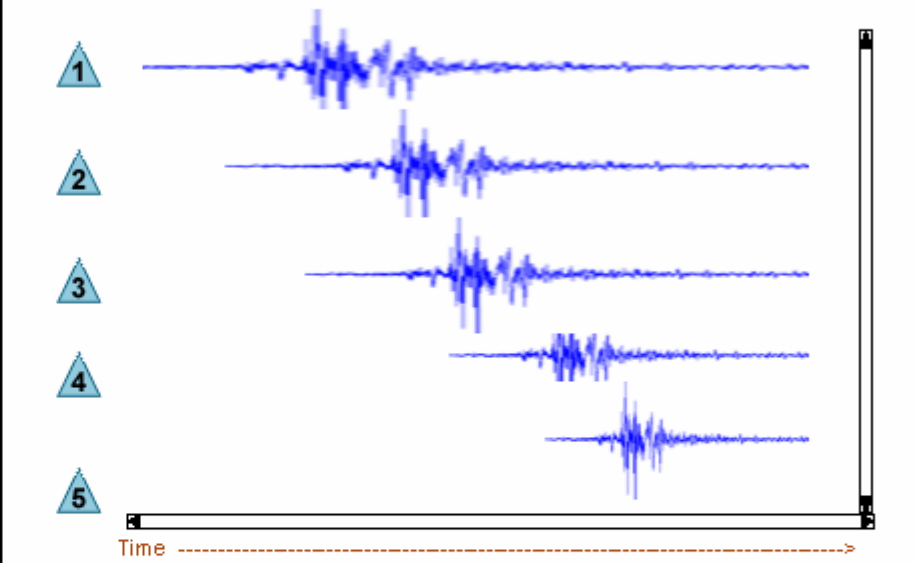
Show plate boundaries Select a recent earthquake Explanation

Location of EQ and stations, how waves move thru Earth, types of waves, explanations...

View recent earthquakes View daily ground motion near you See how waves move through Earth Help

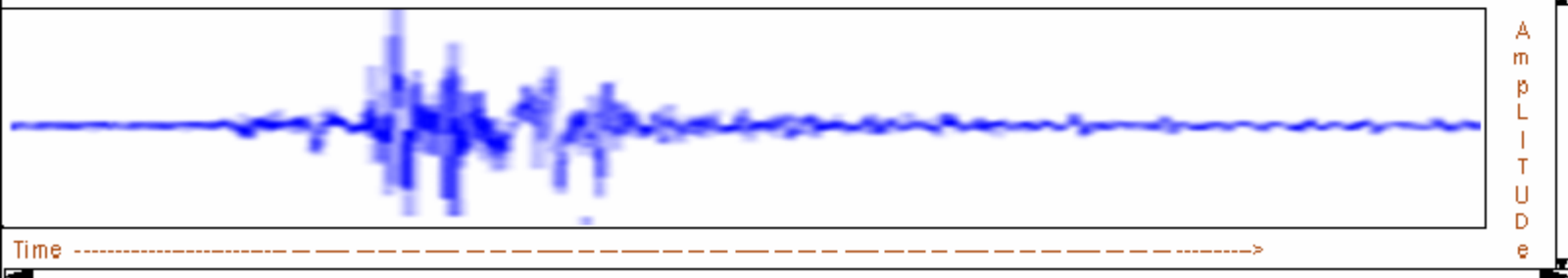
Earthquake and recording stations
 Earthquake: Siberia, Russia; 5.5 magnitude; 10 km depth; lat/long; October 1, 2004; new stories

Data from different recording stations
 Click a seismogram to see an enlarged view below.
 Click a triangle for station information.

Show Earth x-section Explanation Show station info Show P/S wave arrivals Explanation

Single seismogram



Show P/S wave arrivals Back to world map Explanation


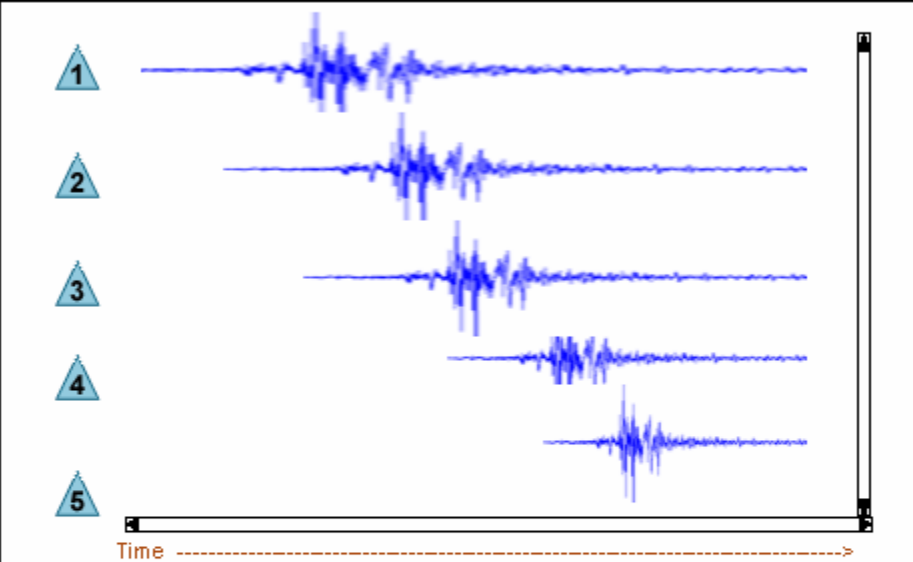
www.dlese.org

Cross-section will show waves moving thru Earth

View recent earthquakes | View daily ground motion near you | See how waves move through Earth | Help

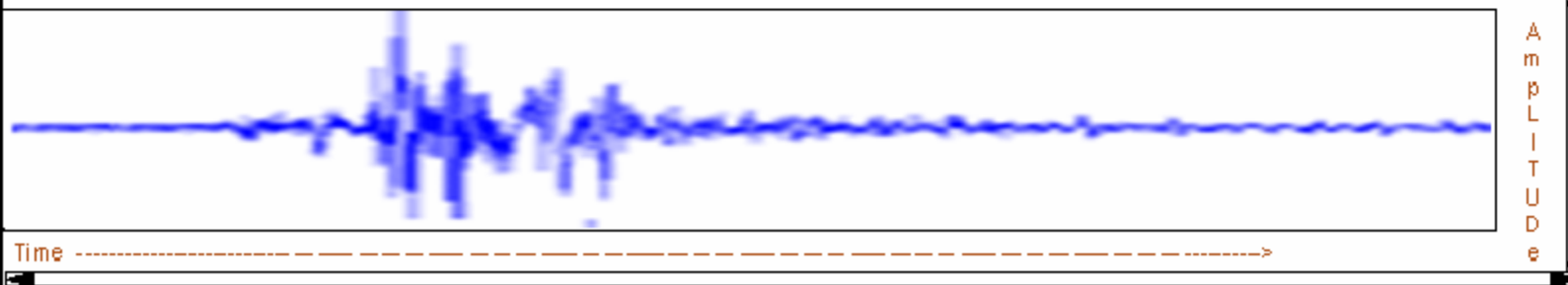
Earthquake and recording stations
 Earthquake: Siberia, Russia; 5.5 magnitude; 10 km depth; lat/long; October 1, 2004; new stories

Data from different recording stations
 Click a seismogram to see an enlarged view below.
 Click a triangle for station information.

Show Earth x-section | Explanation | Show station info | Show P/S wave arrivals | Explanation

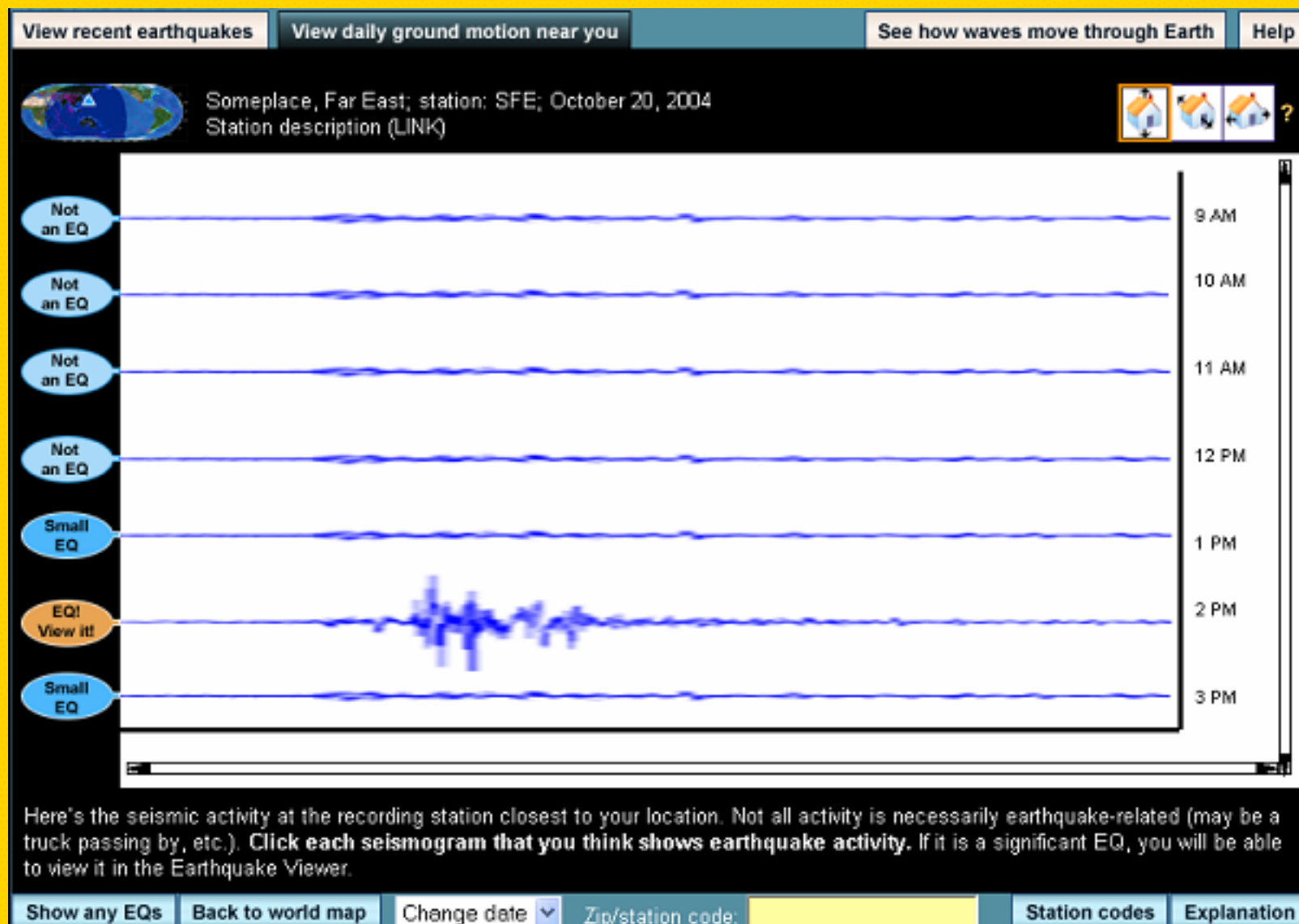
Single seismogram



Show P/S wave arrivals | Back to world map | Explanation

www.dlese.org

24-hr data at one location (are there any EQs?)



Challenges in teaching meteorology

Classroom challenges identified by professor

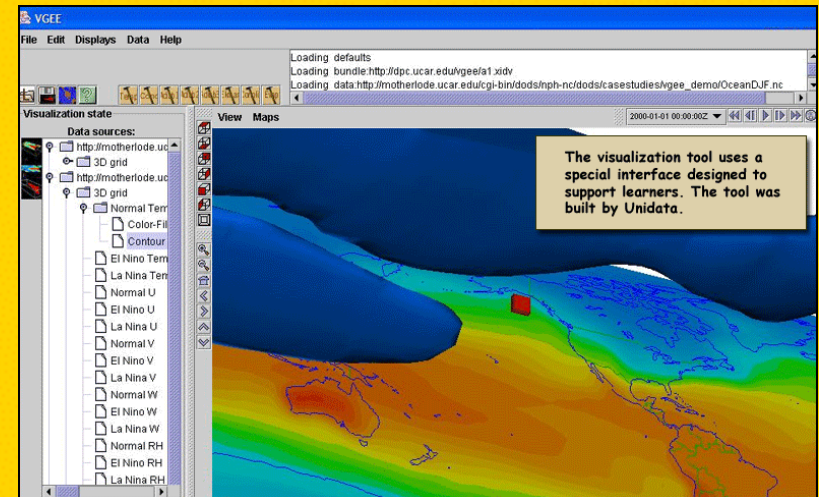
- Even after studying a phenomena in class, students often had a fragile and incomplete understanding of the underlying physical processes
- Students had difficulty using scientific tools and data, especially in inquiry environments
- Professors encountered real practical and technological hurdles when using data

Data challenges

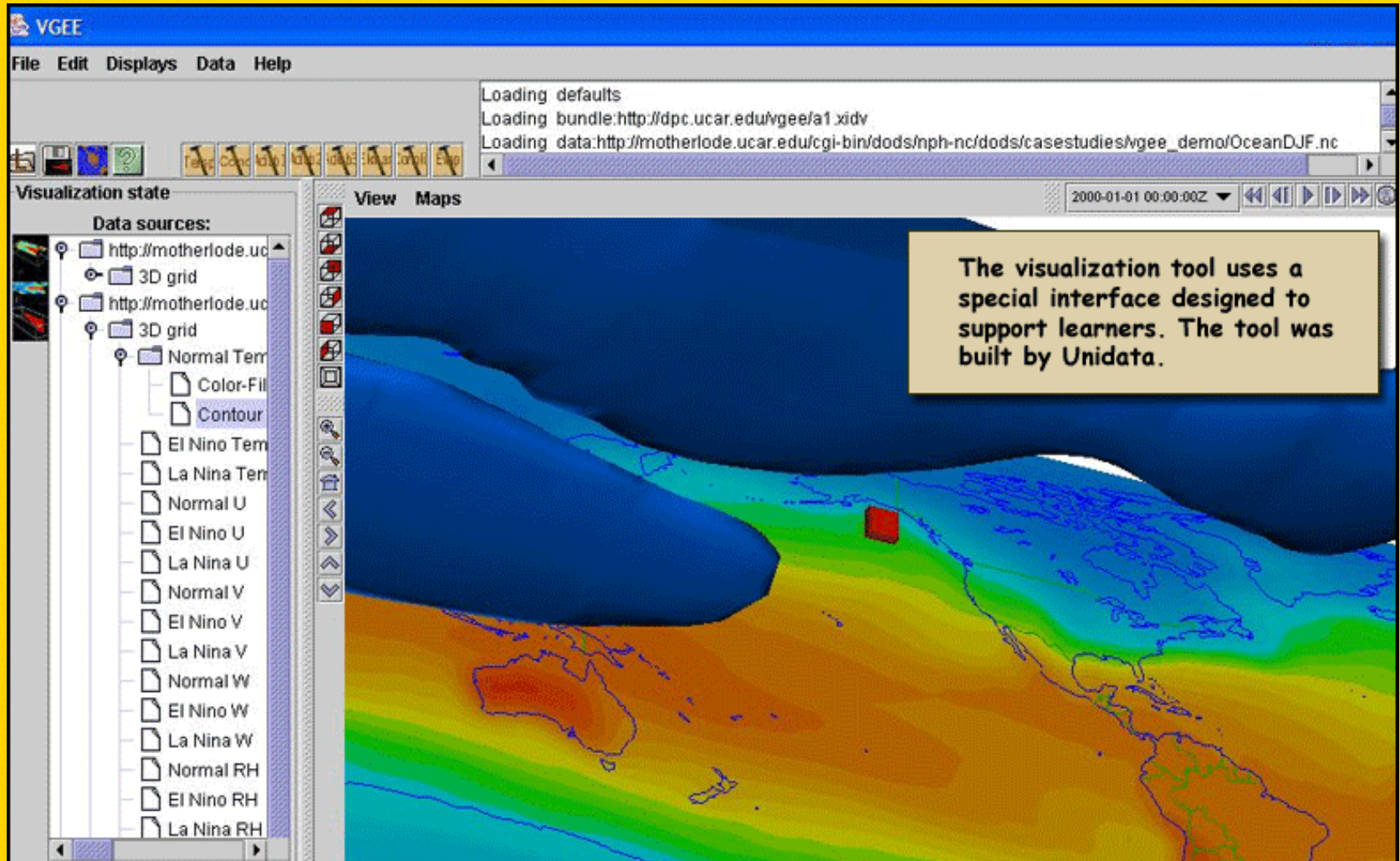
- Data access needed to be linked to appropriate tools and guided by relevant educational context

Visual Geophysical Exploration Environment (VGEE)

- Inquiry-based curriculum to guide student exploration
- Learner-centered interface to a scientific visualization tool
- Concept models to help students understand scientific principles and their role in data
- A suite of El Niño-related data sets adapted for student use (and connections to real-time data)



A scientific visualization tool (Integrated Data Viewer) customized for educational use





Introduction

- Using the VGEE
- Background Info
- ▣ VGEE Philosophy
- Bib. & References
- Project Credits
- Presentations & Pubs.

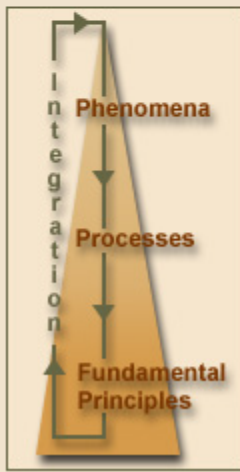
Tools

- ▼ El Niño Learner Guide
- El Niño Teacher Guide
- ▼ Encyclopedia
- Email Us

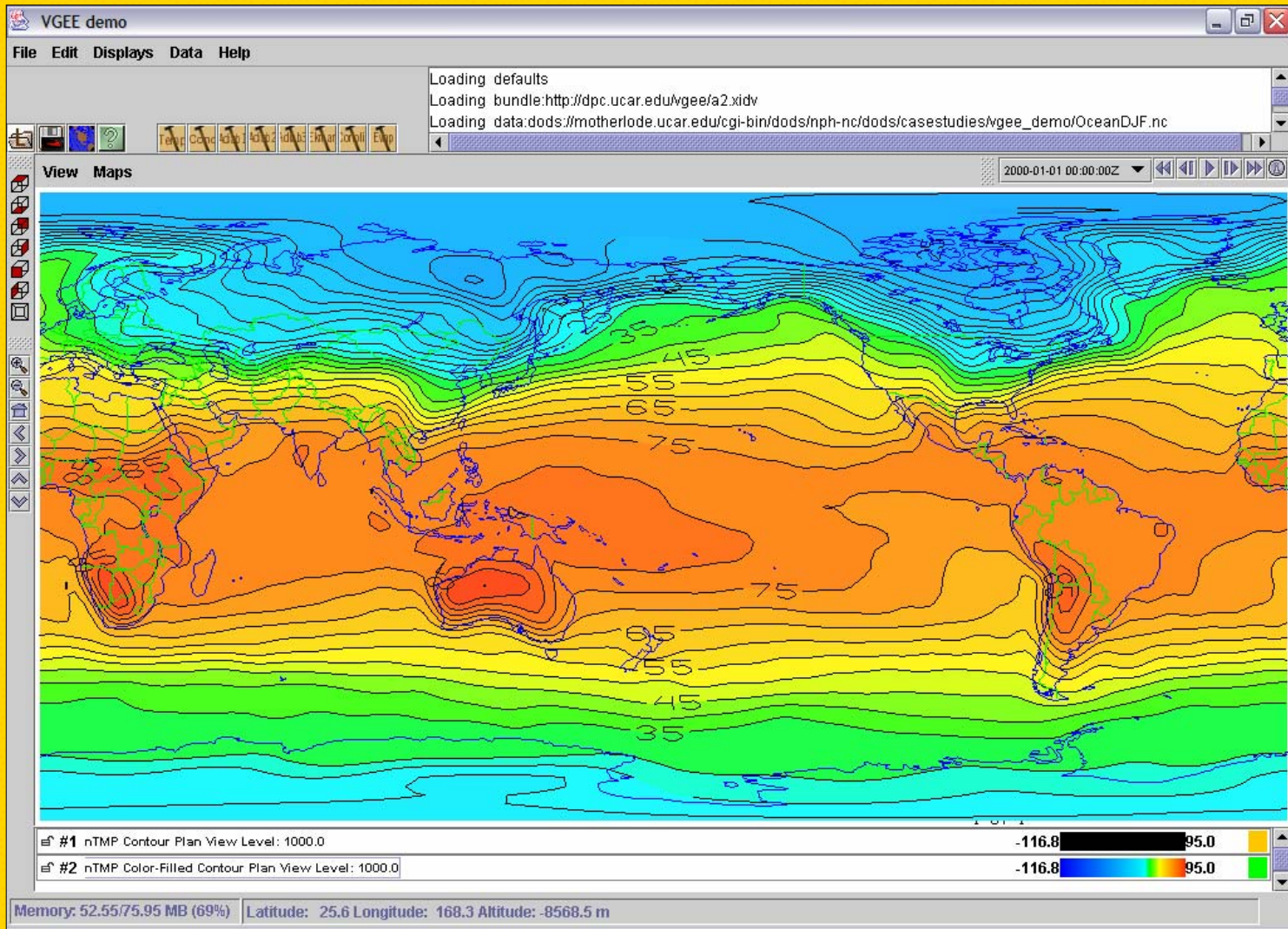
VGEE Philosophy & Approach

TOOLS FOR LEARNING

In the phenomenon level of the pyramid, learners construct visualizations using geophysical datasets in the Visualization Environment and use the visualizations to discover underlying processes. They then explore fundamental principles using concept models (probes in idealized environments). Finally, they return to the Visualization Environment and use probes to investigate the visualizations and integrate the fundamental principles with the phenomena.

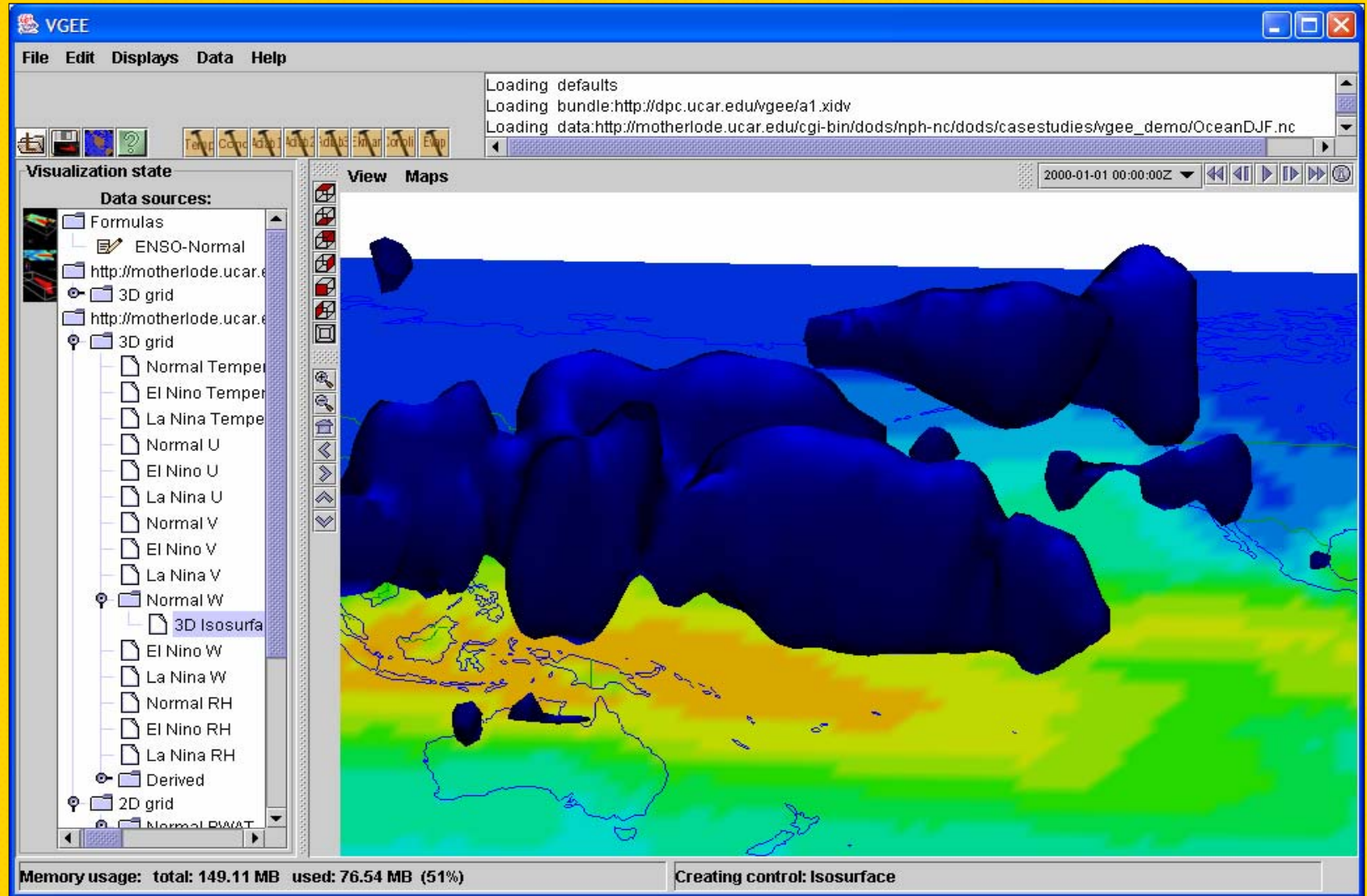
Pyramid levels	Tools	Topics
 Phenomena	Visualization Environment	1
Discover underlying processes	Visualization Environment	2, 3, 4
Explore fundamental principles	Concept models	2, 3, 4
Integrate fundamental principles and phenomena	Probes in the Visualization Environment	5 & 6

Step 1: Identify phenomena and patterns



Students notice that the Western Pacific is considerably warmer than the East

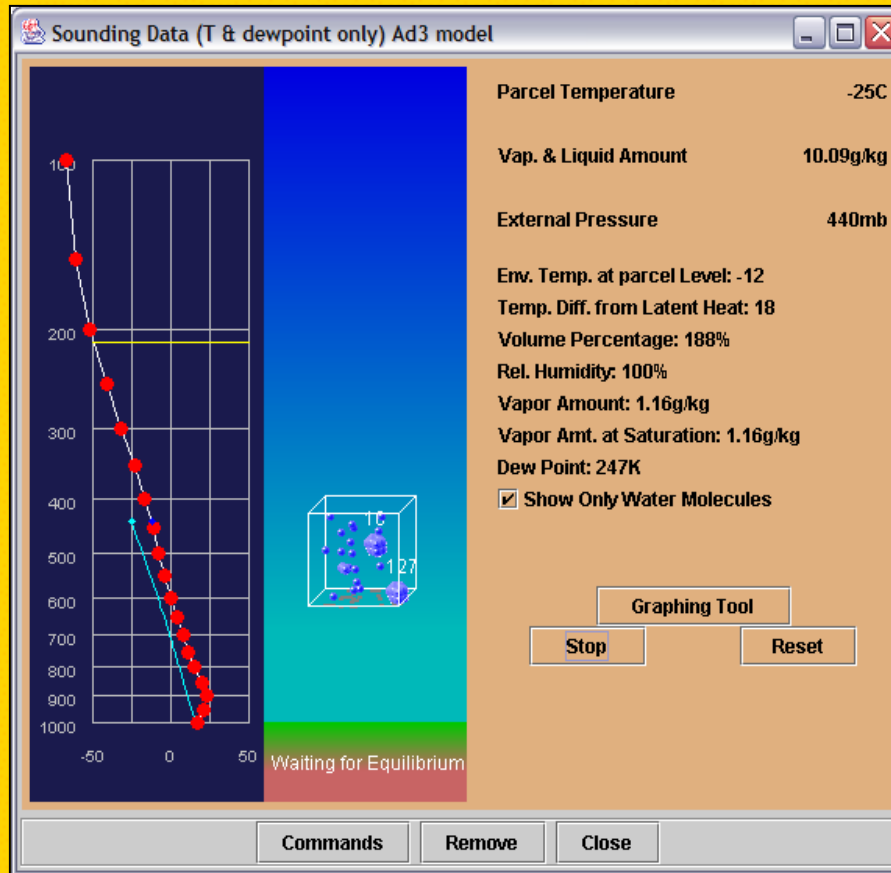
Step 2: Relate patterns



Learners explore relationships (in this case, that upward motion, above average precipitation, and warm SST all occur together)

Step 3: Explain patterns

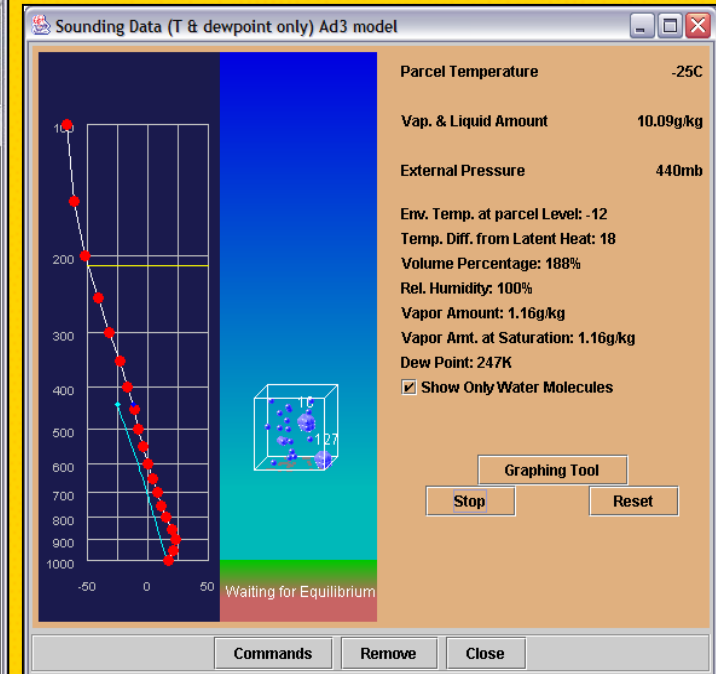
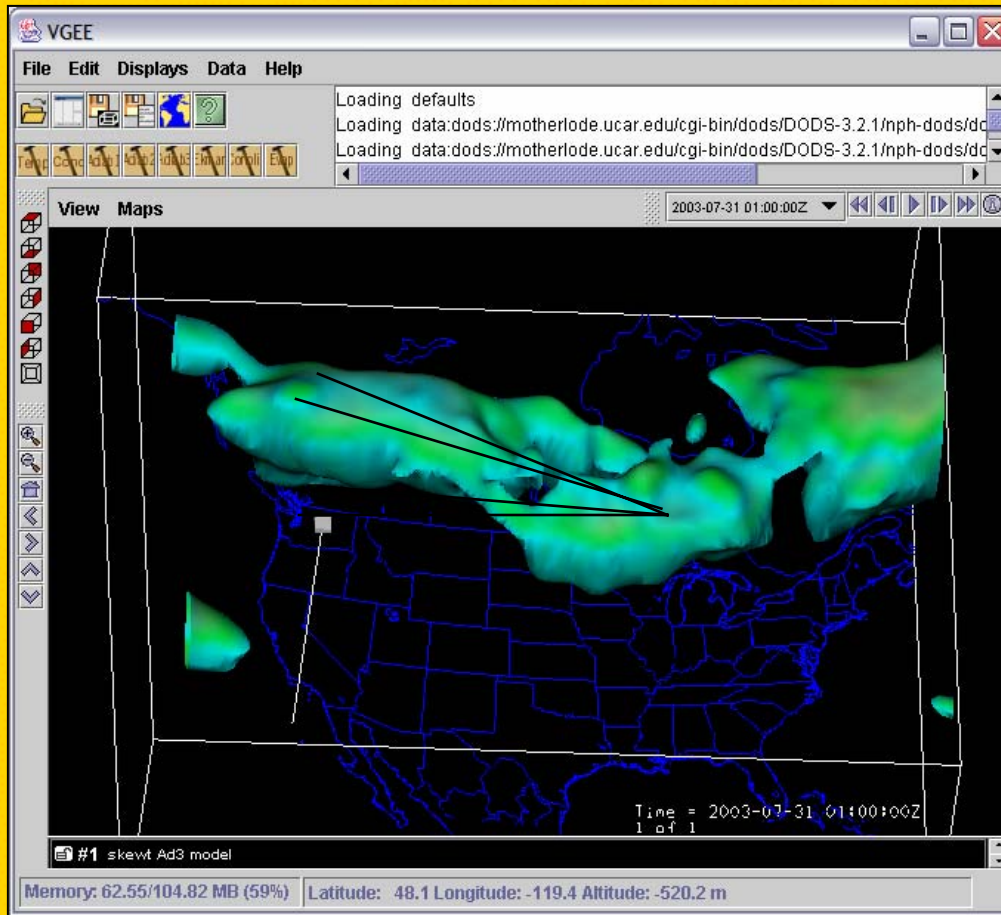
Concept models are used to explore and explain relations in an idealized context



Atmospheric sounding:
Vertical profile of atmospheric temperature and moisture

Step 4: Integrate understanding

Concept models are used to probe the data. Helps students apply basic physics toward understanding geoscience data



Creating educationally useful visualization and data exploration environments

Impetus:

- Funding sources increasingly want scientific organizations and research grants to have an educational component
- Scientists may want to take existing research programs and convert them for educational use

Problems:

- Can be hard to redesign programs for use by non-experts
- Programs may have obscure features and options
- Designs may be too complex and hard to understand
- May be insufficient help and educational supports

Suggestions for creating effective programs

Follow a design process

- Define your audience
 - May be able to address a broader audience than you think by making adaptations to your program
- Define your goals
 - What you want users to be able to do & learn
 - **Use that info to define your features/capabilities**
- Create your design (on paper, PPT...). Test it!!!!!!!!!!!!
- Plan your educational materials and supports; test them; start development
- Create the interface pieces – graphical elements, navigational system
- Do the programming and assemble the pieces
- Test, revise, retest...

Design tips

- If you want a broad audience, consider having basic vs. advanced features and functions
- Avoid ‘feature creep’ – just because you can do something doesn’t mean you should put it in your program (stay focused on your audience and goals!)
- Writing issues:
 - Be concise (users tend not to read lots of text)
 - Write clearly – informal, active voice (very different from writing an article)

Educational activities

- Provide a range of educational activities
 - **Structured curriculum for teachers to use**
 - Particularly useful for new teachers and those teaching out of discipline
 - Also useful when programs, concepts, and data are difficult to understand
 - For K-12 levels, tie your curriculum to educational standards - you'll get FAR more use!
 - **Open-ended questions that help users explore and work with the program**
 - Provide ideas and suggestions for what to explore – makes users feel more comfortable, gives them a sense of the kinds of things they can explore

User interface

- Have a well-designed interface (easy to use)
 - Create standards for how things work and where things go
 - Keep menu items and buttons in same place...
 - If users have trouble, consider if it's a design problem (things aren't clear enough or users don't know where to go or what to do next...)

User interface and TESTING!

- Keep technical terms to a minimum (unless they're necessary for technical or educational reasons, in which case provide an explanation/common term)
- Always provide legends – and make them easy to understand and use
- TEST, TEST, TEST throughout the development process. You'll be amazed at what you find!
It's MUCH easier to catch and fix things at the beginning than later on!!!!!!!!!!!!!!!

Data Knowledge:
What data is available?

Data Knowledge:
What does this
data represent

Tool Knowledge:
What are the
appropriate tools for
the data?

Technical Expertise:
How can I get the data into the
right format for the tools I need?

Pedagogical Knowledge:
What are the
important concepts to learn?

Pedagogical Knowledge:
What is the best way
to help students learn
from this data?

Tool Knowledge:
What are the appropriate
tools for students?

Technical Expertise:
How can I modify the
tools to support students?

Evaluation Expertise:
How can I tell if it was
worth the work?