Directorate for Geosciences

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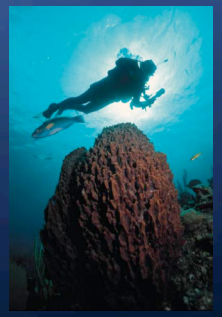
Long Science Plan for Seismology Workshop,
September 18, 2008

Advancing scientific knowledge of
Earth's environment

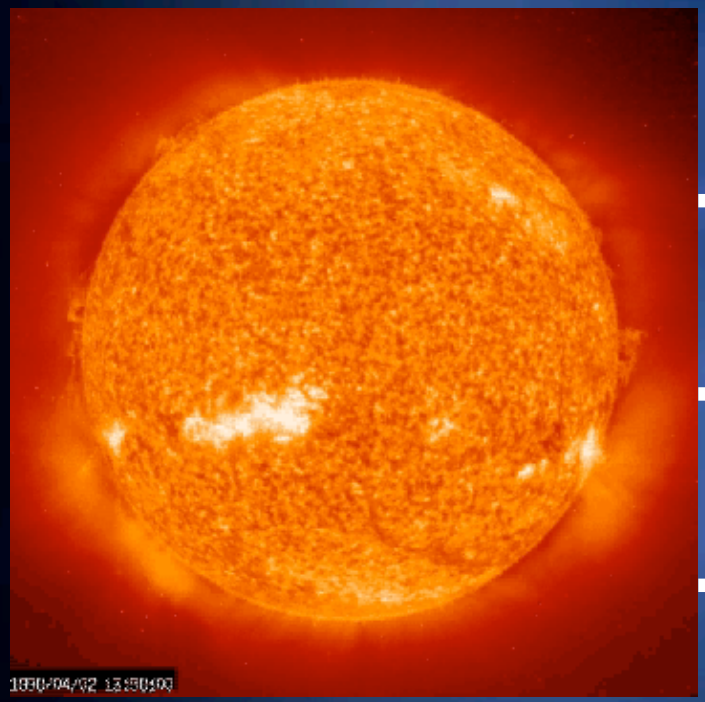
The Mission of the Directorate for Geosciences

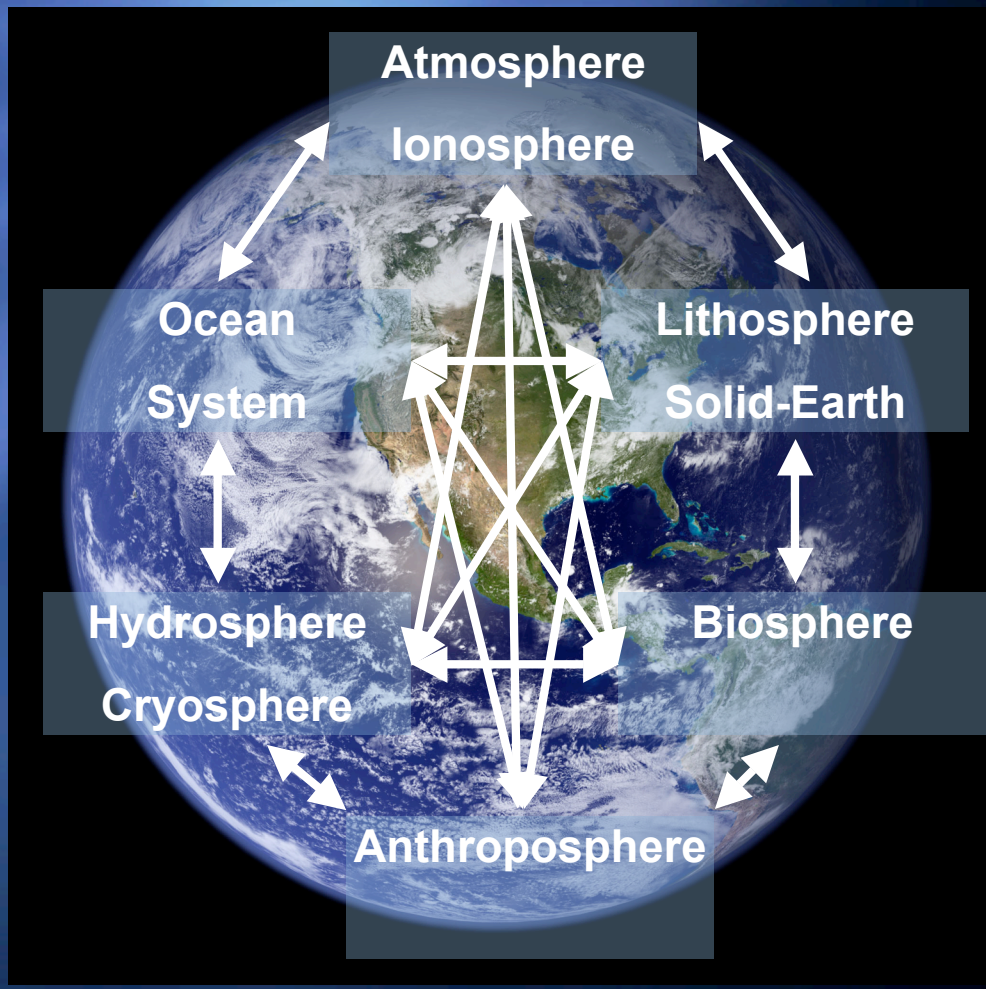
- Support research in the atmospheric, earth, and ocean sciences
- Address the nation's need to understand, predict, and respond to environmental events and changes in order to use the Earth's resources wisely






GEOVision 2008





The People

NSF GEO: Who We Are

NSF GEO Staff (FY 2008)
- Managerial Staff: 15
- Science Staff: 70
- Administrative Staff: 37
- Technical Staff: 5

GEO Budget (FY 2007)
- Total: $745.85
- ATM: $227.44
- EAR: $152.83
- OCE: $308.76
- GEO-wide: $56.8

GEO Budget (FY 2008)
Total (est.): $752.66

GEO External Community (FY 2007)
- Principal Investigators: 1,243
- Co-PI's: 709
- Post-doctorates: 265
- Graduate Students: 1,109
- Undergraduate Students: 647

Funding Profile (FY 2007)
- Competitive Proposals: 3,804
- Competitive Awards: 1,038
- Funding Rate: 27%

Earth Sciences

- Paleobiology, Sedimentary Geology
- Geophysics & Geochemistry
- Tectonics & Continental Dynamics
- Hydrologic Sciences & Geomorphology
- Geobiology
- EarthScope Program
- Major Facilities (COMPRESS, IRIS, etc.)

Atmospheric Sciences

- Meteorology
- Climate Dynamics and Paleoclimate
- Atmospheric Chemistry
- Aeronomy
- Magnetospheric Physics
- Solar-Terrestrial Physics
- Major Facilities (NCAR, Incoherent Scatter Radars, etc.)

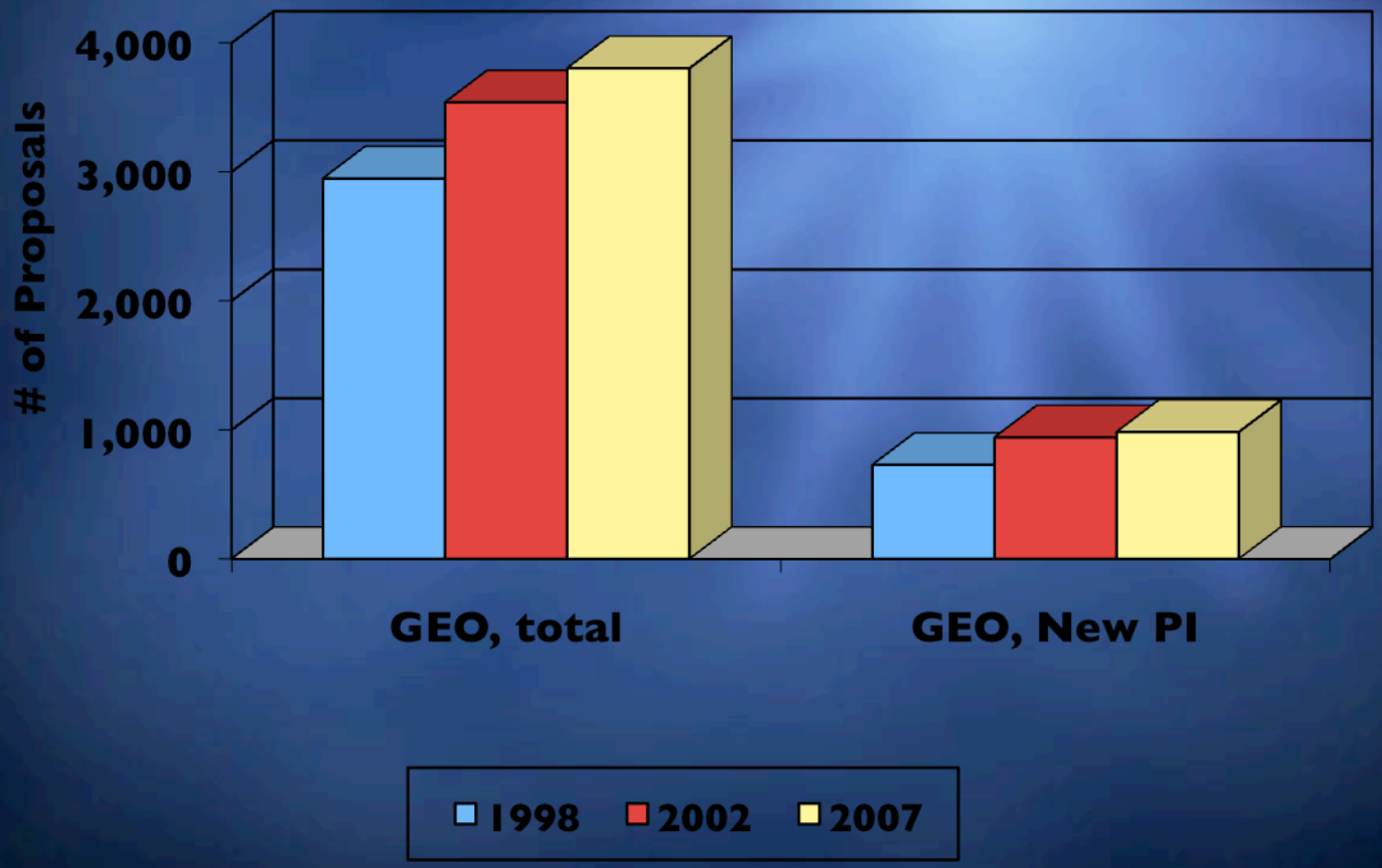
Ocean Sciences

- Physical Oceanography
- Biological Oceanography
- Chemical Oceanography
- Marine Geology and Geophysics
- Oceanographic Technology
- Ocean Drilling Program
- Major Facilities (Academic Fleet, etc.)

GEO-wide programs including

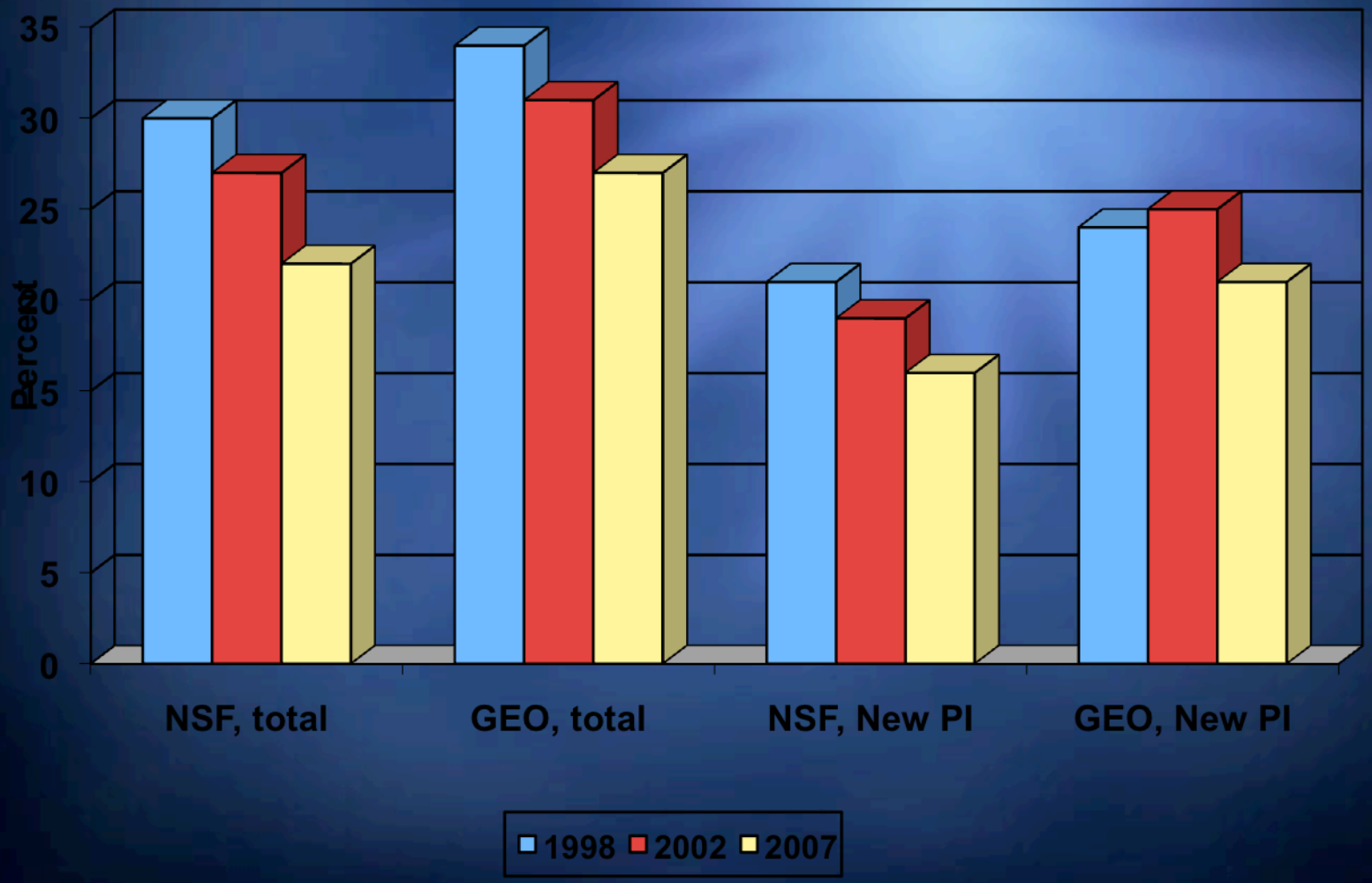
- GEO Education
- Opportunities for Enhancing Diversity in the Geosciences
- Emerging Topics
- Dynamics of Coupled Natural and Human Systems

Number of Competitive Proposals Submitted to GEO: FY 1998, 2002, 2007



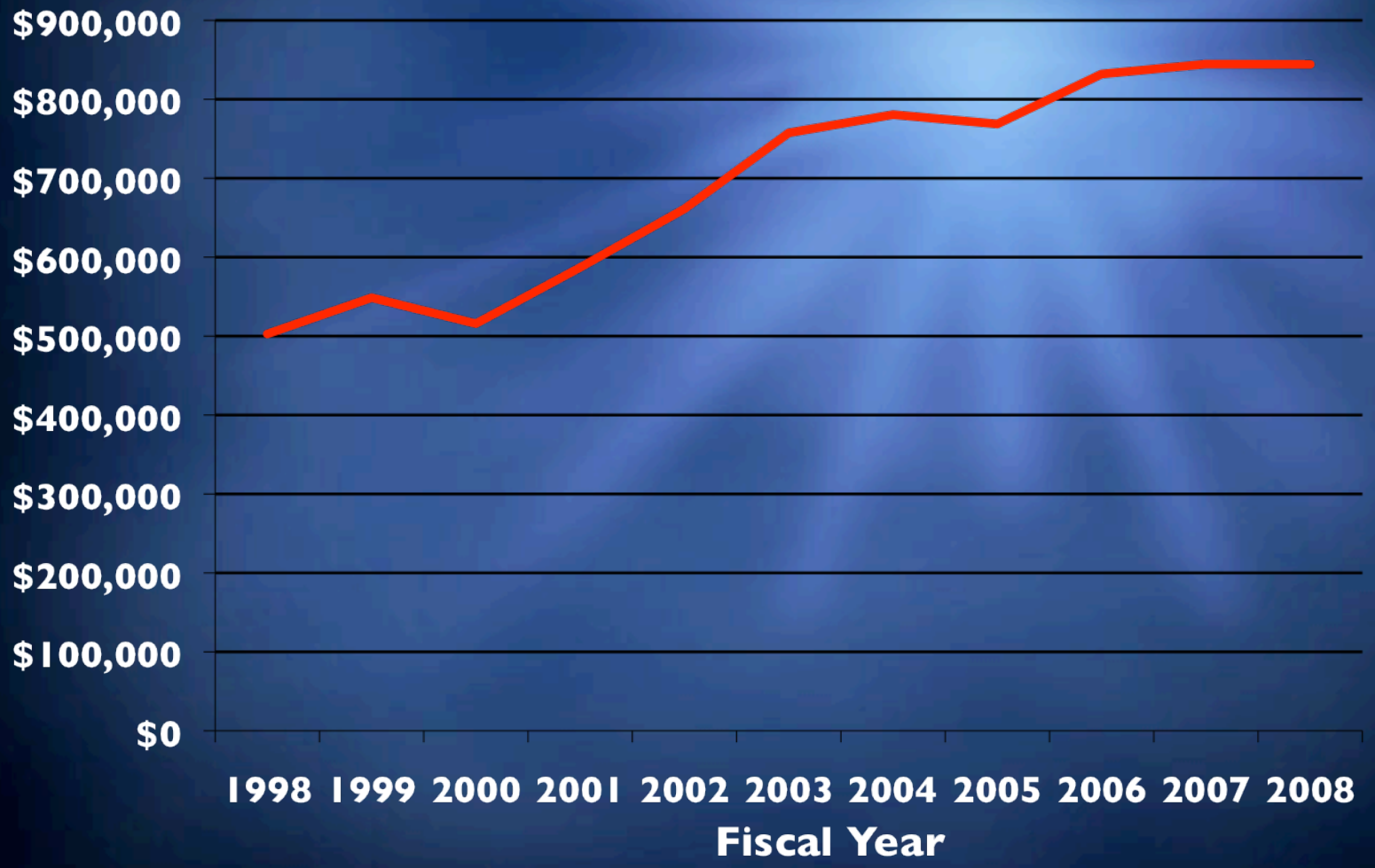
NOTE: The number of NSF proposals overall grew from 19,218 in FY 1998, to 25,241 in FY 2002, and to 33,870 in FY 2007.

Funding Rates for Competitive Awards: FY 1998, 2002, 2007



The Budget

GEO Operating Budget ($thousands): FY 1998-2008



Budget Request by GEO Division

2009 BUDGET REQUEST

Appropriations Account	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	Change Over FY 2008 Estimate Amount	Change Over FY 2008 Estimate Percent
Atmospheric Sciences	227.44	229.30	260.58	31.28	13.6%
Earth Science	152.83	156.08	177.73	21.65	13.9%
Innovative & Collaborative Education & Research	56.82	56.82	56.82	--	--
Ocean Sciences	308.76	310.46	353.54	43.08	13.9%
TOTAL, GEO	**$745.85**	**$752.66**	**$848.67**	**$96.01**	**12.8%**

Education and Outreach

Education Investments

2009 BUDGET REQUEST

GEO has built a robust portfolio of education and diversity investments. In FY 2009, support for these programs is maintained.

- Opportunities for Enhancement of Diversity in the Geosciences
  - $4.6 million
- Geoscience Education
  - $2.5 million including $1 million to foster linkages with LSAMPP
- GEO Teach
  - $3.0 million
- Global Learning and Observations to Benefit the Environment (GLOBE)
  - $1.1 million
- Centers for Ocean Science Education Excellence
  - $5.55 million

In addition, most facilities, centers, and many individual investigator awards include strong education and outreach programs.

Increasing GEO Diversity by "Degrees"

Bachelor's Degrees

	1995	2004
Sci & Eng	363,463	436,472
Women	171,106 (47%)	221,846 (51%)
Minorities	50,265 (14%)	74,834 (17%)
Earth, atmos, Ocean	4,405	3,853
Women	1,500 (34%)	1,622 (42%)
Minorities	174 (4%)	227 (6%)

Doctorates

	1995	2004
Sci & Eng	18,997	15,721
Women	6,914 (36%)	6,842 (44%)
Minorities	1,191 (6%)	1,522 (10%)
Earth, atmos, Ocean	526	426
Women	119 (23%)	166 (39%)
Minorities	11 (2%)	22 (5%)

Note: Data are for U.S. Citizens and Permanent Residents. Source: NSF, Division of Science Resources Statistics.

Improving Education and Increasing Diversity in the Geosciences: Unique Obstacles

- K-12 Education is limited and lacks rigor
- Undergraduate enrollments remain flat despite growing job demand
- All students and especially minority students are not exposed to the opportunities in geosciences at critical transition points
- “Earth” sciences not yet essential to general education

New Frontiers

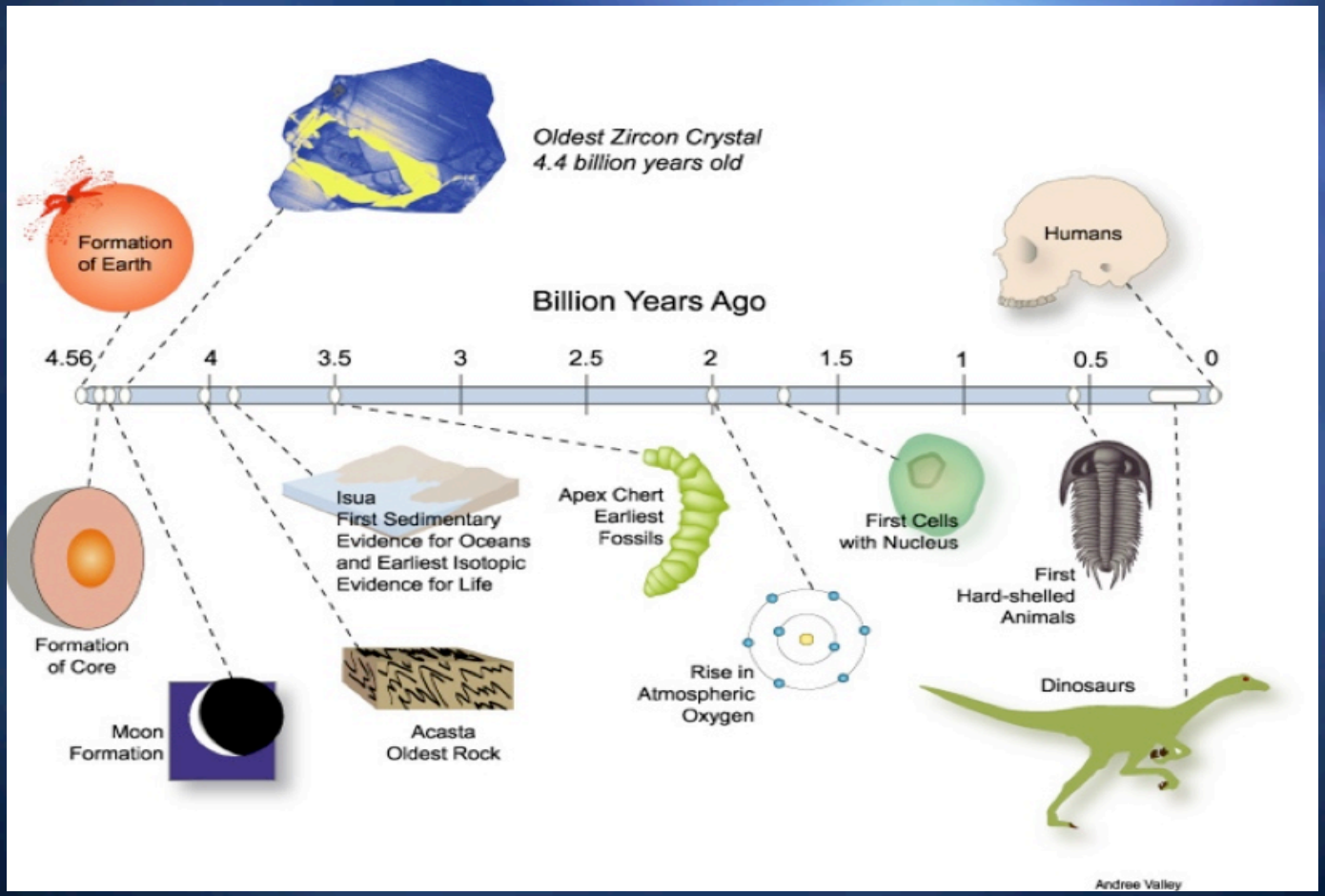
New GEO Research Activities

- Emerging Topics in Biogeochemical Cycles

- Paleo Perspectives on Climate Change

- Critical Zone Observatories

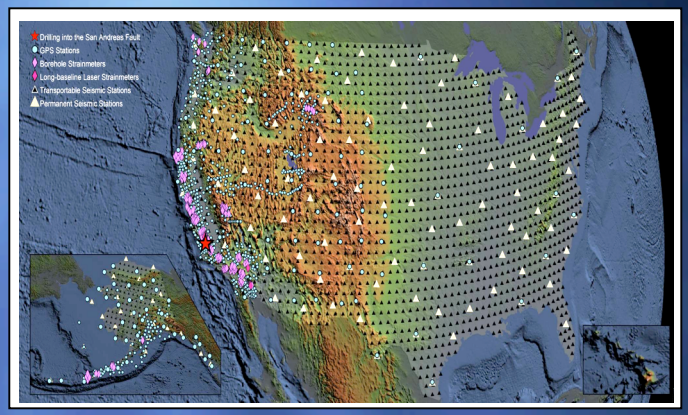
Geosciences helps investigate what changes we have seen in the Earth's past

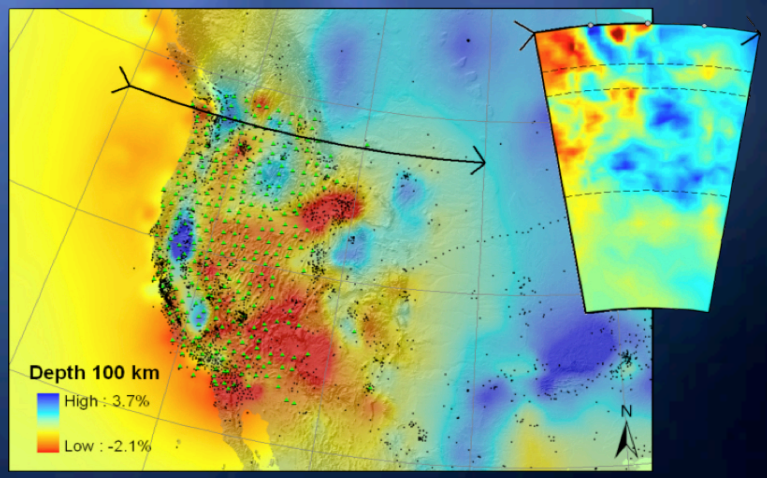


EarthScope – Our Downward Looking Telescope

The EarthScope Facility is a distributed, multi-purpose geophysical instrument array of geodetic, seismic, magnetotelluric, and strain instrumentation.

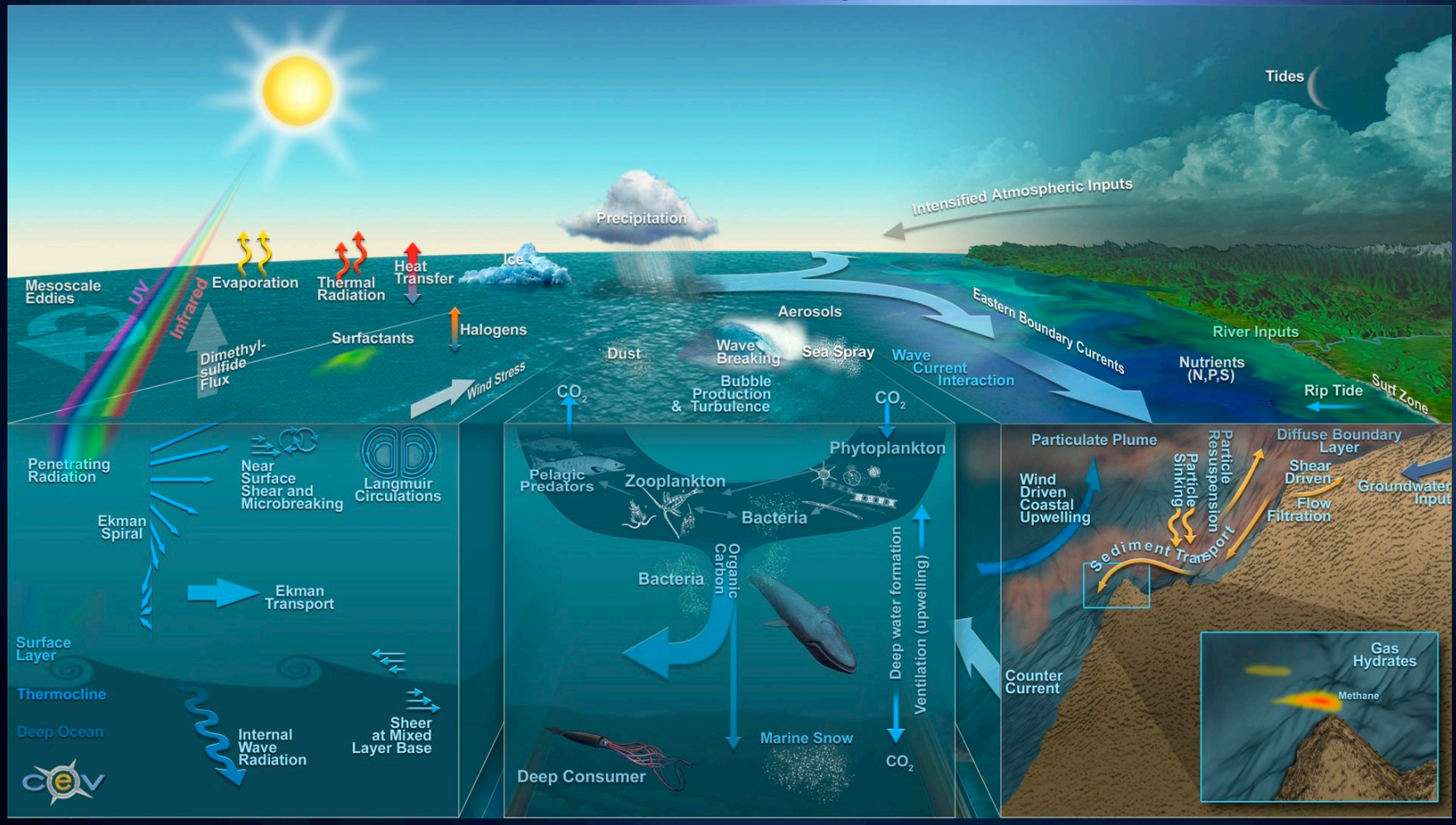
- Plate Boundary Observatory (PBO) – GPS receivers & strainmeters
- San Andreas Fault Observatory at Depth (SAFOD) – deep borehole into the SA fault
- USArray – network of fixed and transportable seismic stations
- Earthquakes & seismic hazards, magmatic systems & volcanic hazards, lithospheric dynamics, regional tectonics, and fluids in the crust.





Ocean Observatories Initiative

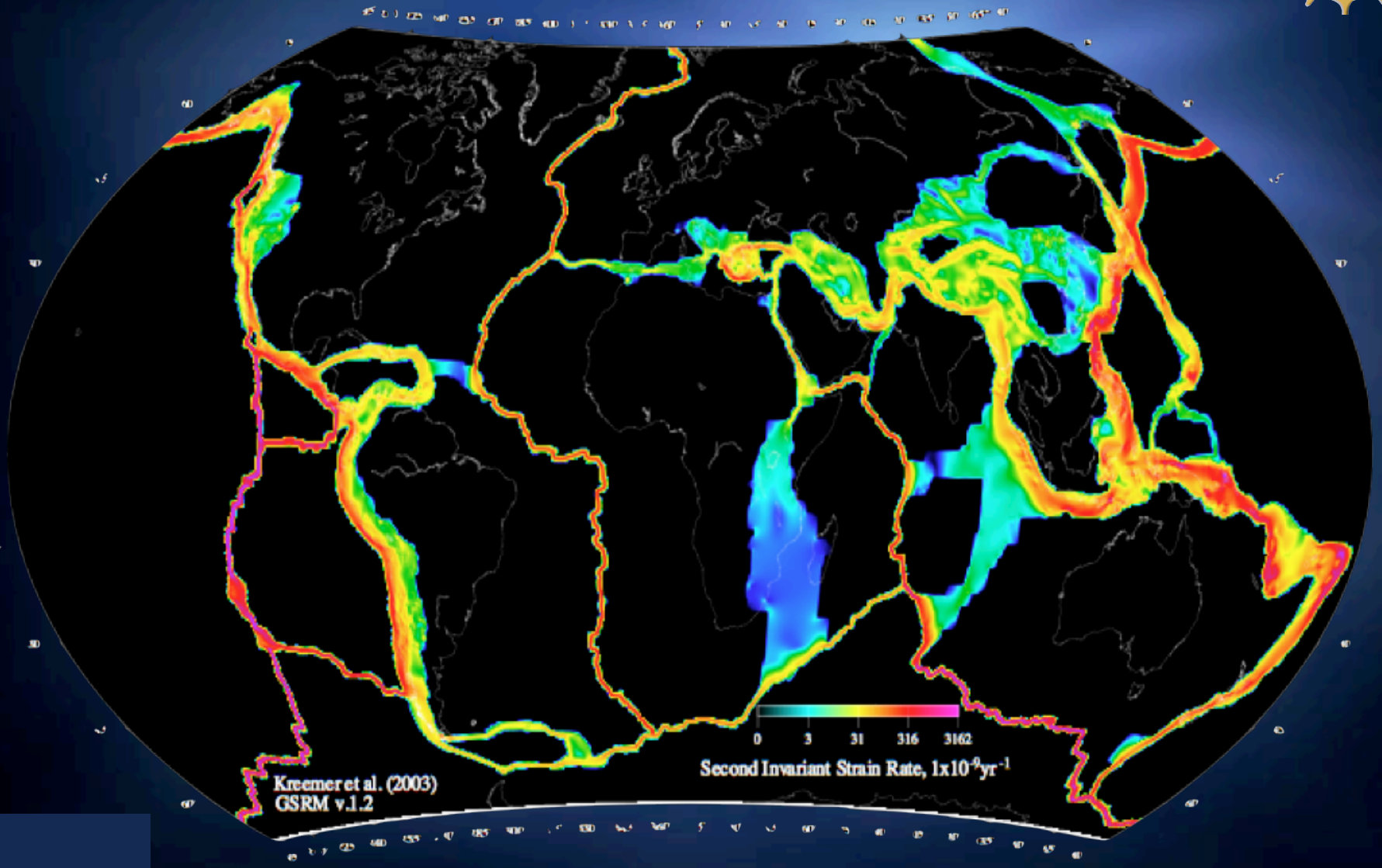
The Vision: To launch a new era of scientific discovery within the ocean basins using widely accessible, interactive, remote human telepresence



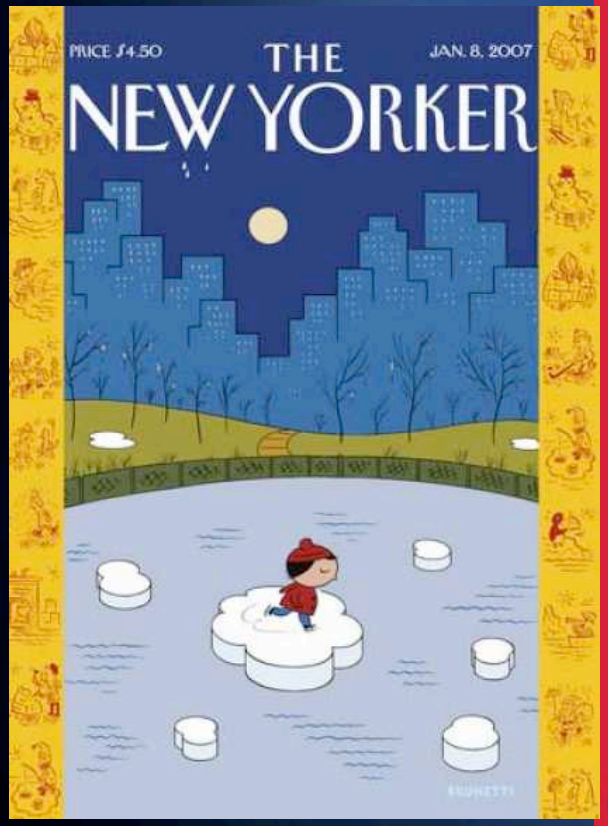
Deep Earth Processes

- What happened in the earliest part of the Earth's planetary history?
- What drives and defines Earth's deformation?
- What are the characteristics of the Earth's deep interior?
- How does Earth's inner activity influence natural hazards?

Deformation of the Earth
moving beyond plate tectonics



Society demands reliable projections of coming changes…



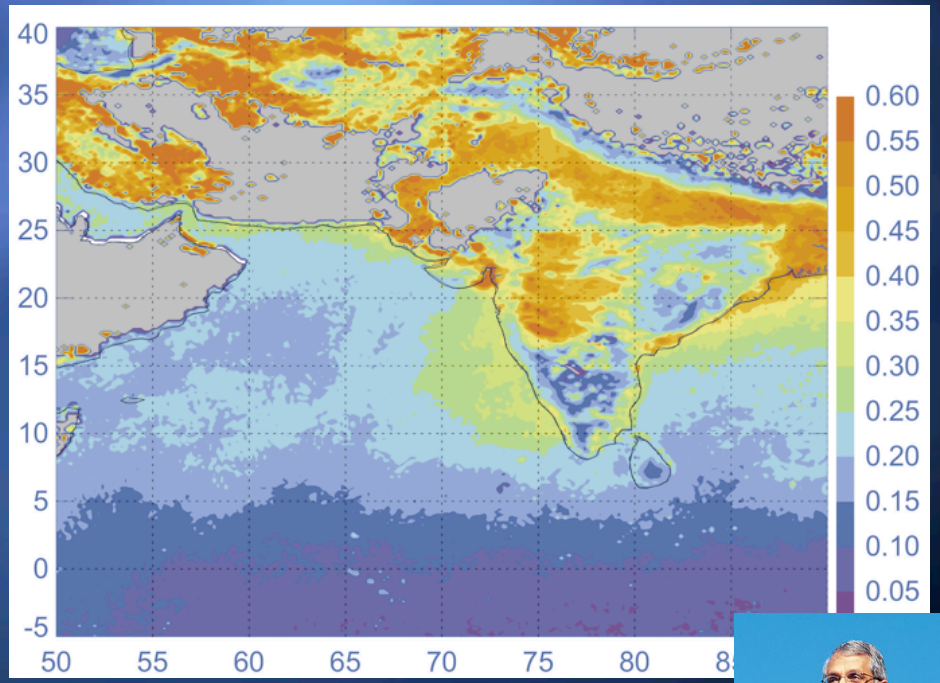
…yet the forecast is challenging.
Earth's future has no analogs in its recent past.

- Range of atmospheric [CO_2] over last million years (from ice cores): 190-280 ppmv
- [CO_2] at Mauna Loa in February: 387 ppmv
- Current rate of increase, 150 ppmv/century, far exceeds any in recent geologic record

Humans influence the monsoon – the Atmospheric Brown Cloud (ABC)

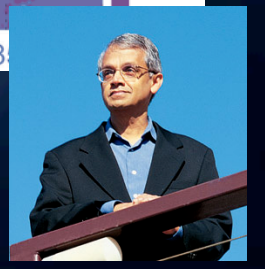
Monsoon rains provide water for drinking and food production to more than half Earth's people

Aerosol Optical Depth over India and the Arabian Sea: winter 2001-2



East longitude

Ramanathan *et al. GRL* 2004



Some Current Challenges in Geosciences

- Regional and Decadal Climate Change
- Ocean Acidification
- Deep Earth Processes
- Hazards: Prediction and Mitigation
- Water Dynamics in the Environment
- Sub-Seafloor Biosphere
- Geo-Cyber-Infrastructure

Why do we scientists and engineers do this?

"Nature intended me for the tranquil pursuits of science, by rendering them my supreme delight. But the enormities of the times in which I have lived have forced me to commit myself on the boisterous ocean of political passions."

-Thomas Jefferson

My first impressions…

- Great people
- Grand intellectual challenges *and* societal needs
- New "Geovision" document: truly integrative and visionary - but not quite ready
- Near-term opportunities with partnerships
- Human capital challenges and opportunities
- Wonderful facilities in place and planned (thanks!)
- Project performance and active management
- Budget (M&O) stresses, preserve balance
- Poised for new, transformative science: a "naissance"

Where are we going?

- Integrative Sun-Earth science
- Towards Sun-Earth-Human Systems Science
- Climate change: probabilistic prediction across scales
- Adaptation science; societal impacts
- GEO partnerships (OPP,BIO,EHR,SBE,ENG,MPS…)
- Integrating education and research, transforming educational practice, creating a needed workforce
- Meeting national and societal needs
- Cyber-infrastructure, telepresence