K-12 Science and Math Trends

- At the fourth grade, U.S. students were above the international average in both science and mathematics.
- In the eighth grade, U.S. students scored above the international average in science and below the international average in mathematics.
- At the end of twelfth grade, U.S. performance was among the lowest in both science and mathematics, including among our most advanced students

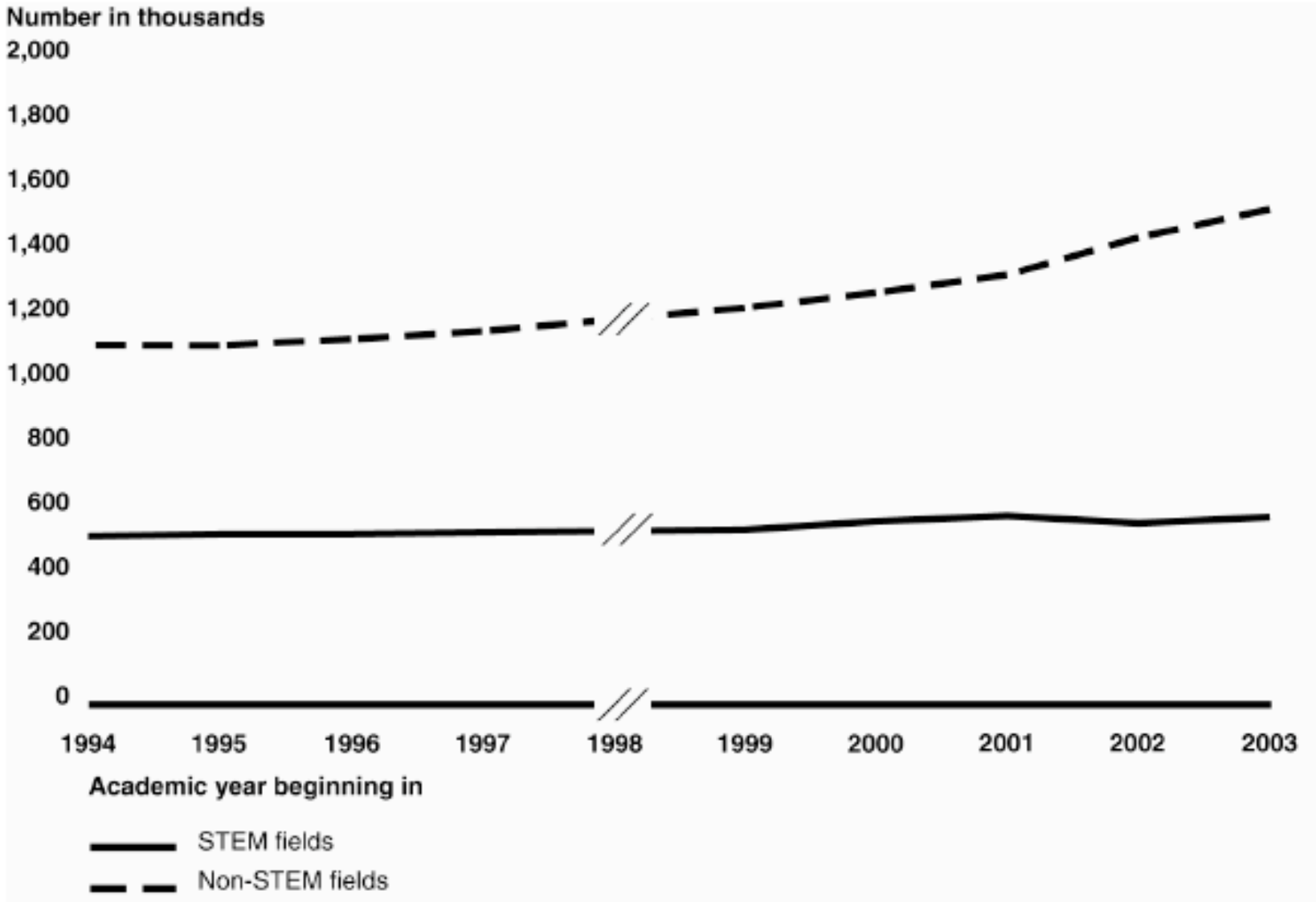
Source: Third International Mathematics and Science Study

Geosciences in K-12

- Elementary grades are dominated by literacy and numeracy
- In middle school, Earth Science is taught as a course
- In high school, most college-bound students don’t take Earth Science

- Key words: Standards; No Child Left Behind

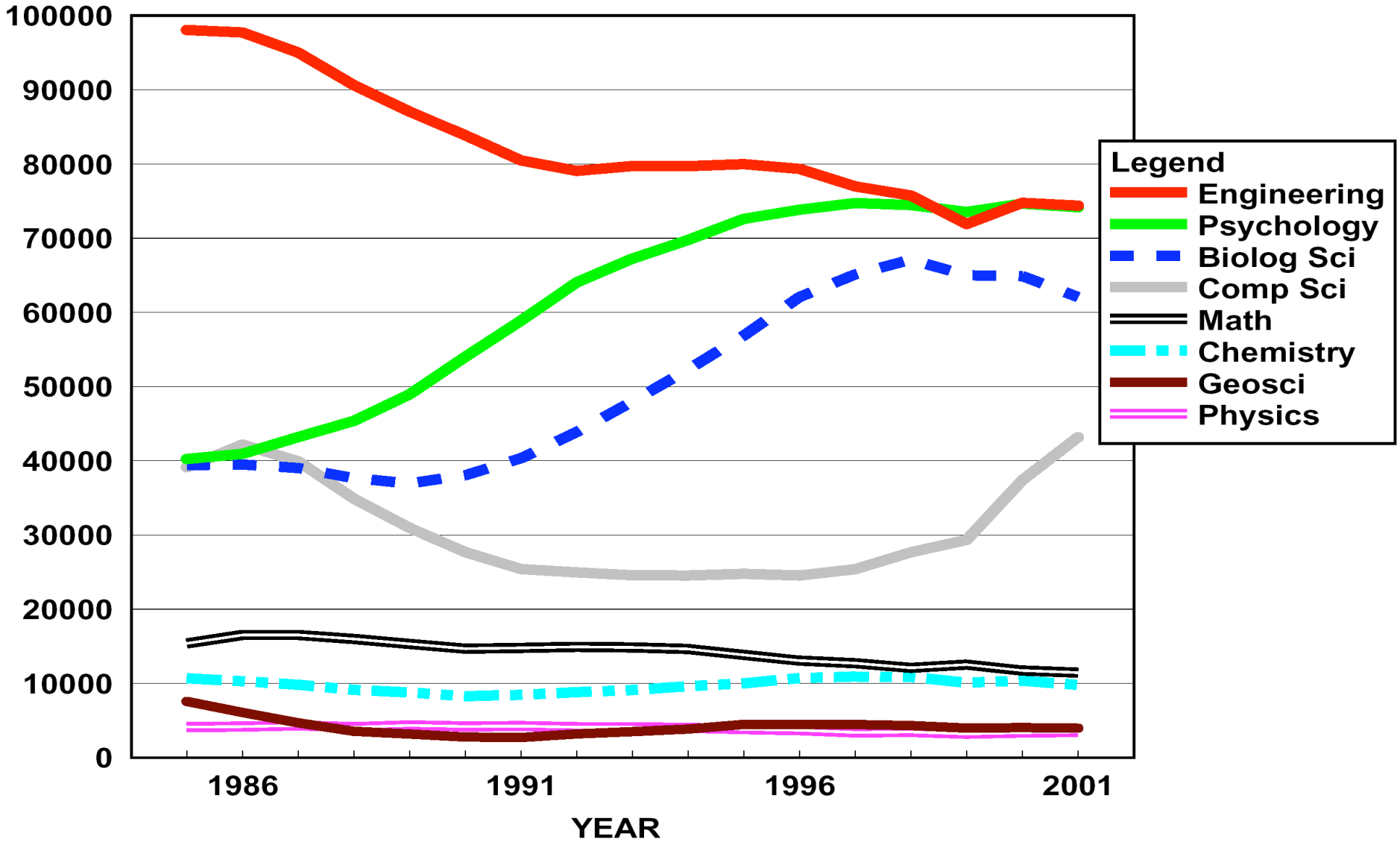
Figure 1: Number of Graduates in STEM and Non-STEM Fields, 1994–1995 through 2003–2004 Academic Years



Source: GAO calculations based upon Integrated Postsecondary Education Data System (IPEDS) data.

Note: Information for academic year 1998–1999 was not reported by IPEDS.

Total number of bachelor's degrees granted by discipline, 1985 to 2001



Source: AIP Statistical Research Center compiled data from NSF WebCASPAR Database System, February 2004

Broadening Participation in Climate Research: CMMAP Partnership with SOARS

Raj Pandya
SOARS Program
UCAR Office of Education and Outreach
Boulder CO

Overview

- Our science has an unprecedented opportunity to serve society
- An endeavor this important requires broad participation
- SOARS and CMMAP

This can

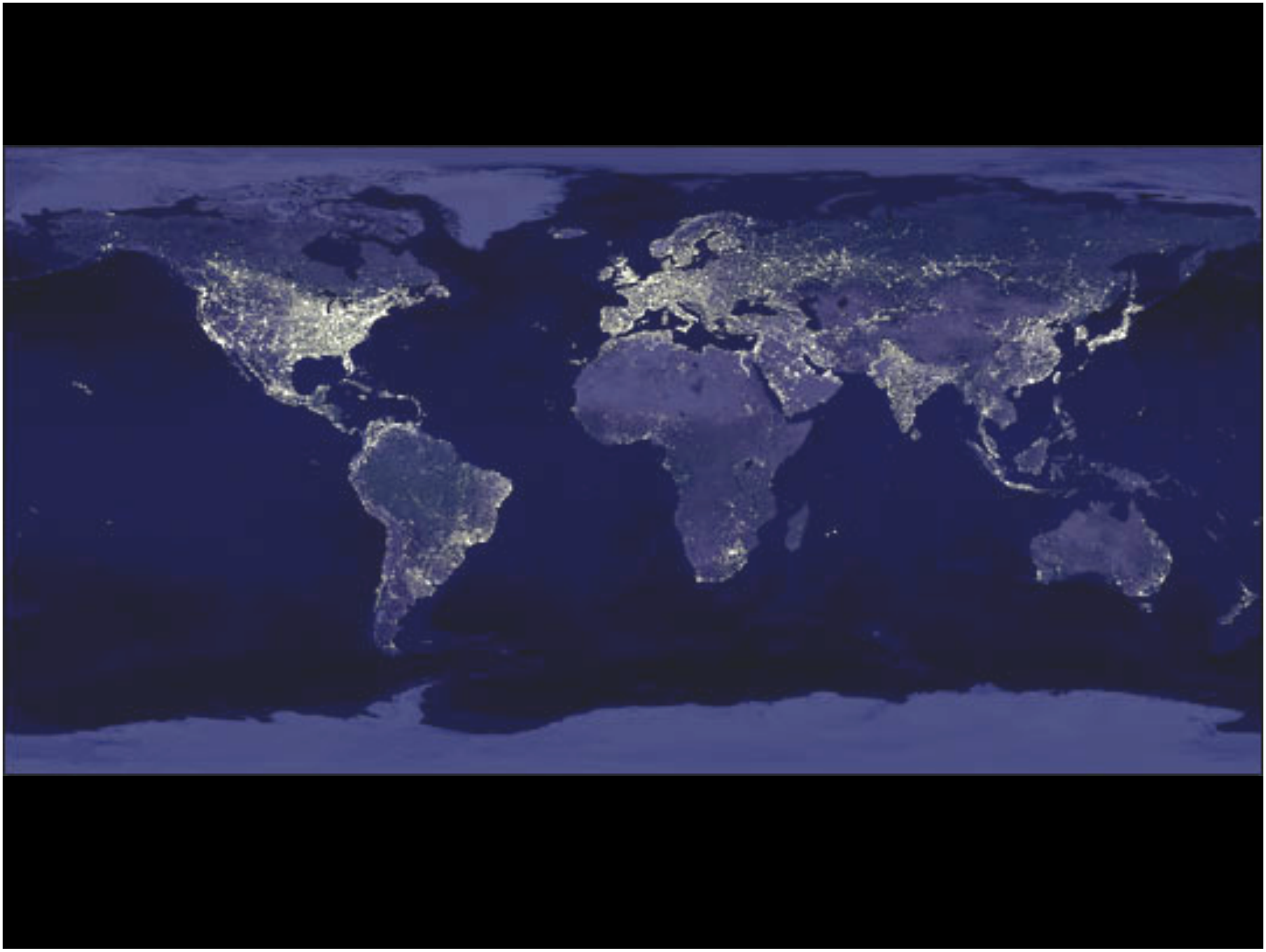
Describing the opportunity to benefit society can make our science more attractive, including to members of groups that are historically underrepresented

Disasters' Global Impact

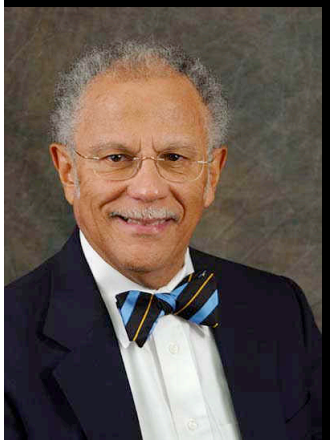
- 500-800 disasters per year in 90's
  - $600 billion lost
    - More than all losses from 1950-1990
    - 45% lost in Asia, 30% Europe, only 10% in USA
  - 2 billion people affected
    - More than 66% in Asia
  - Half million killed
    - Half of these deaths due to flooding

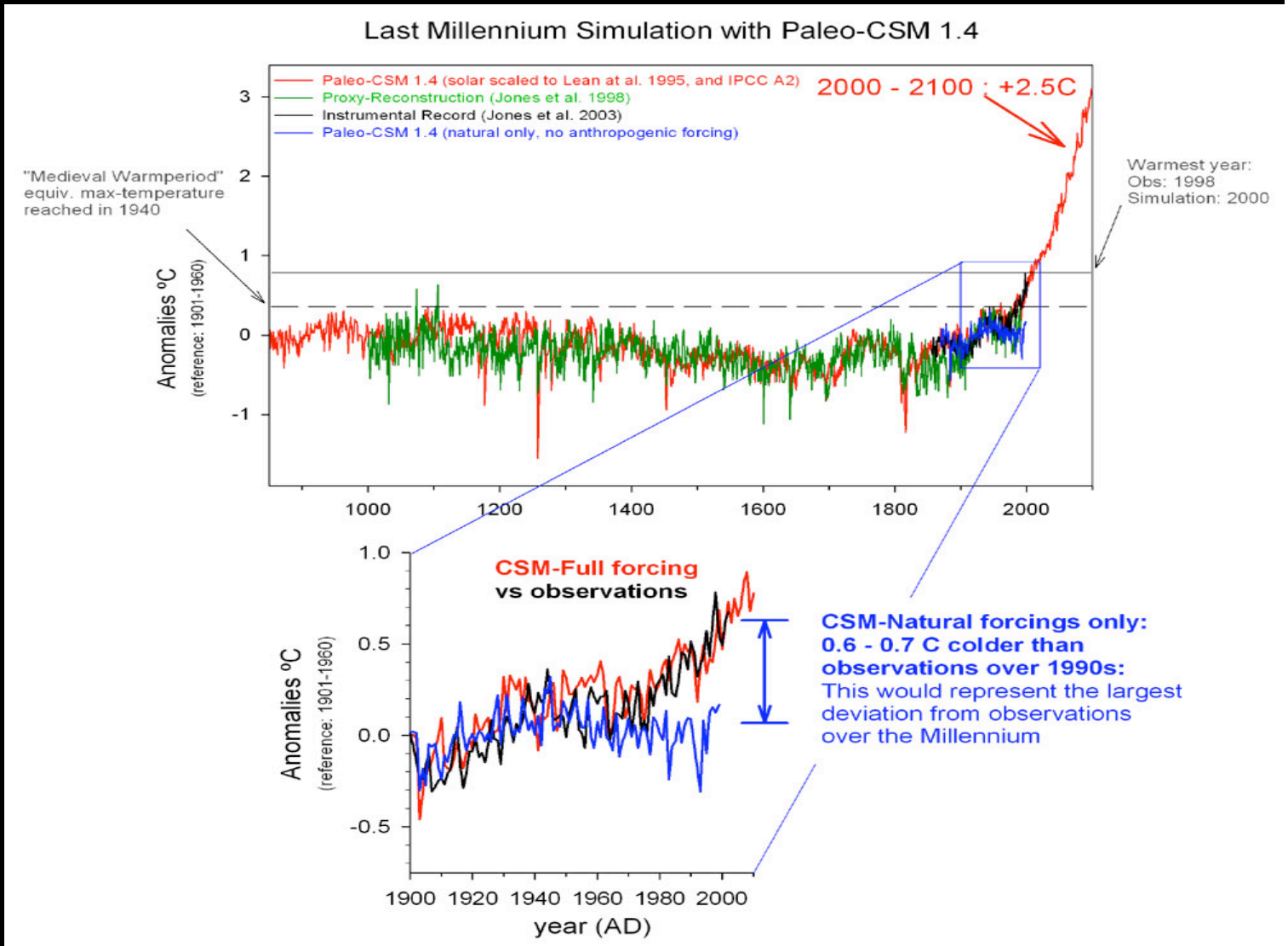
FEMA

Data from Rischard, J.F., 2002



And underlying it all…
A Changing Climate

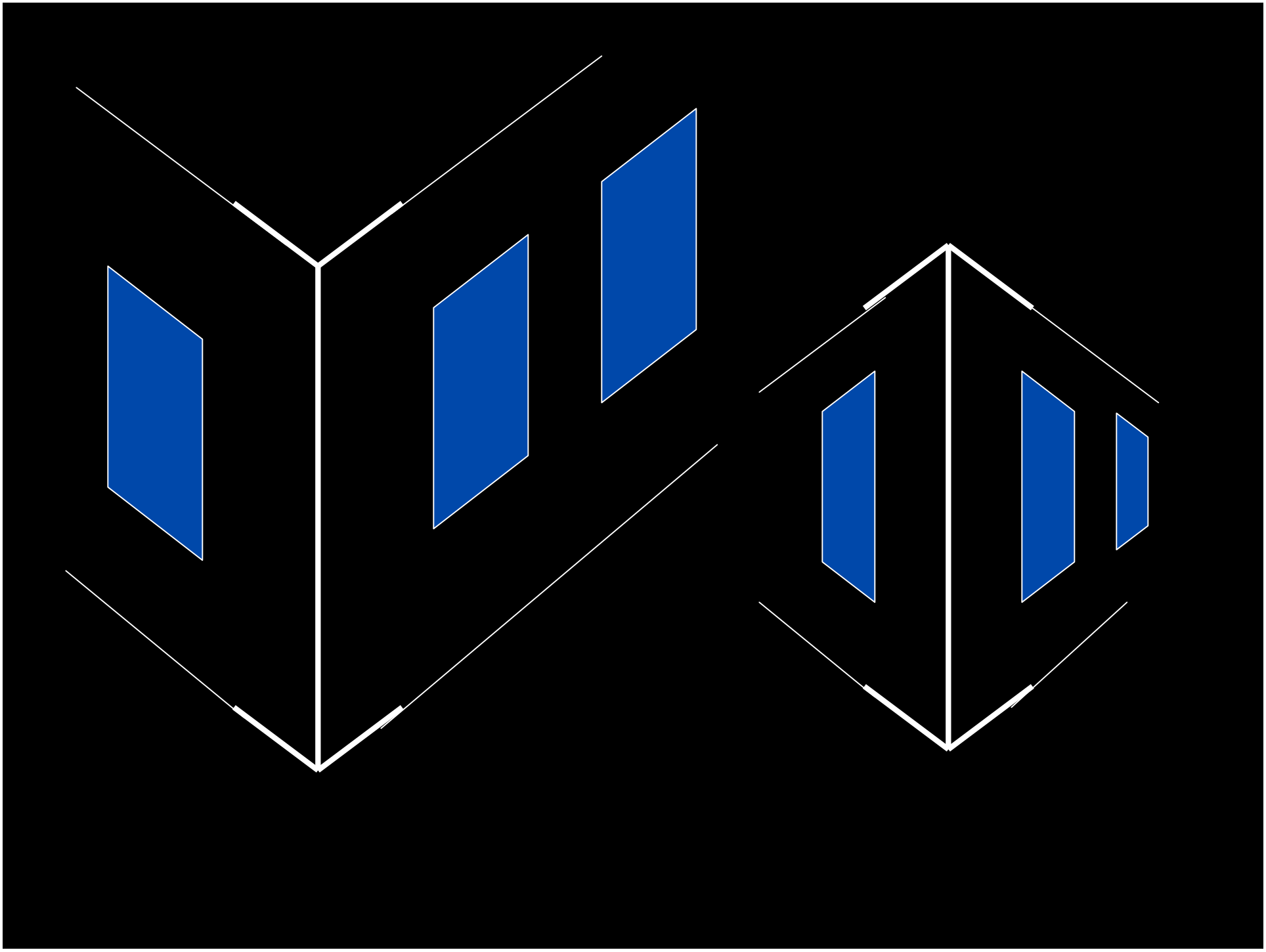




Science with and for all communities

- Broader perspectives improve science
  - Diverse teams are better learners and more creative
  - Doorways to Indigenous knowledge
- Scientific priorities should be set by all communities
  - Polar, Equatorial Climates change fastest
  - Urban air pollution, heat Islands
- A future workforce depends on broad participation
  - A majority-minority USA by 2050
- Diversity is *a compelling state interest*[1]

(1) Majority Opinion *(Grutter v. Bollinger et al.)* "participation by members of all racial and ethnic groups in the civic life of our Nation is essential"

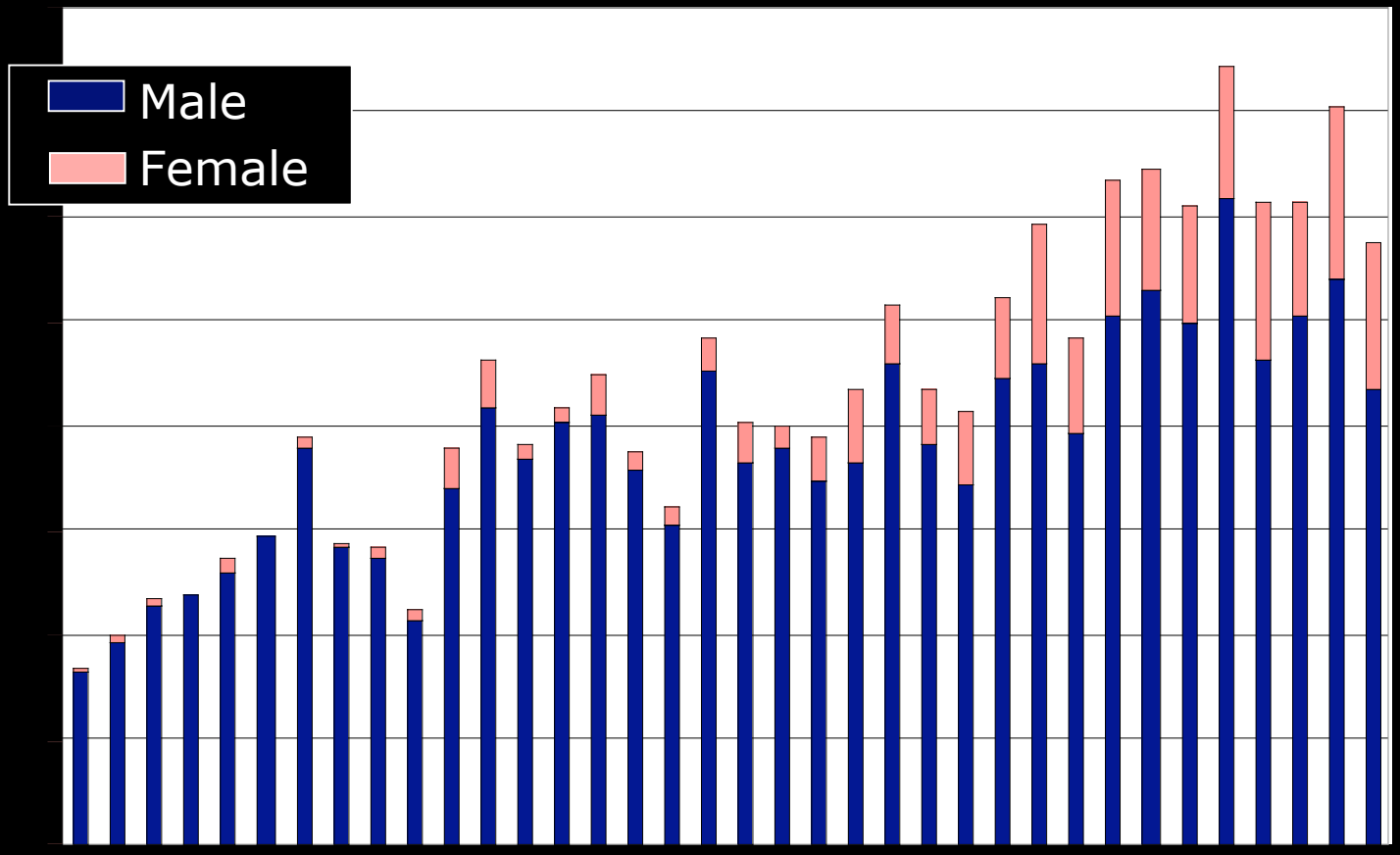


U.S. Atmospheric Science PhDs (1973 to 2002)

- 1,991 Total PhDs
- 30 Hispanic American PhDs (1.5%)
- 17 African American PhDs (.85%)

Data from Roman Czujko, AIP Statistical Research Center, with support from the Packard Foundation

Atmospheric Science PhDs by Sex



1966 2001

Tabulated by National Science Foundation/Division of Science Resources Statistics; data from Department of Education/National Center for Education Statistics: Integrated Postsecondary Education Data System Completions Survey; and NSF/SRS: Survey of Earned Doctorates

SOARS Mission

- Broaden participation in the geosciences by increasing the number of Black or African-American, American Indian or Alaska Native, Hispanic or Latino, female, and first-generation college students who enroll and succeed in graduate school in the atmospheric and related sciences.

- Contribute to “a diverse, internationally competitive, and globally engaged workforce of scientists, and engineers.”

  - National Science Foundation Strategic Plan

- Create the next generation of leaders in the atmospheric and related sciences by helping students develop investigative expertise complemented by leadership and communication skills

SOARS Values

Authentic research experience

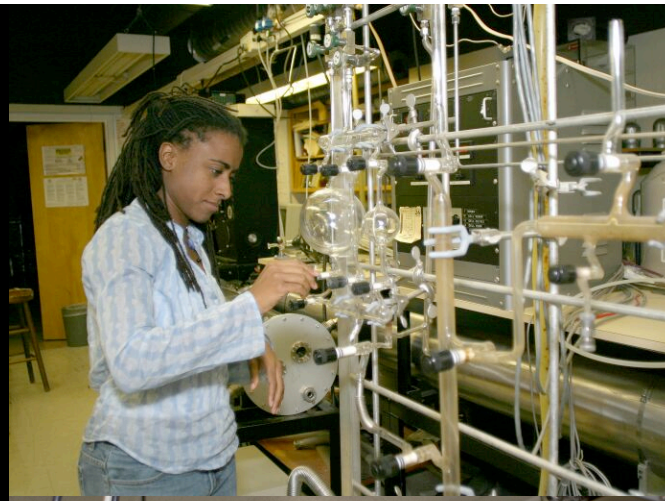
Multidimensional mentoring

Supportive community

Professional development

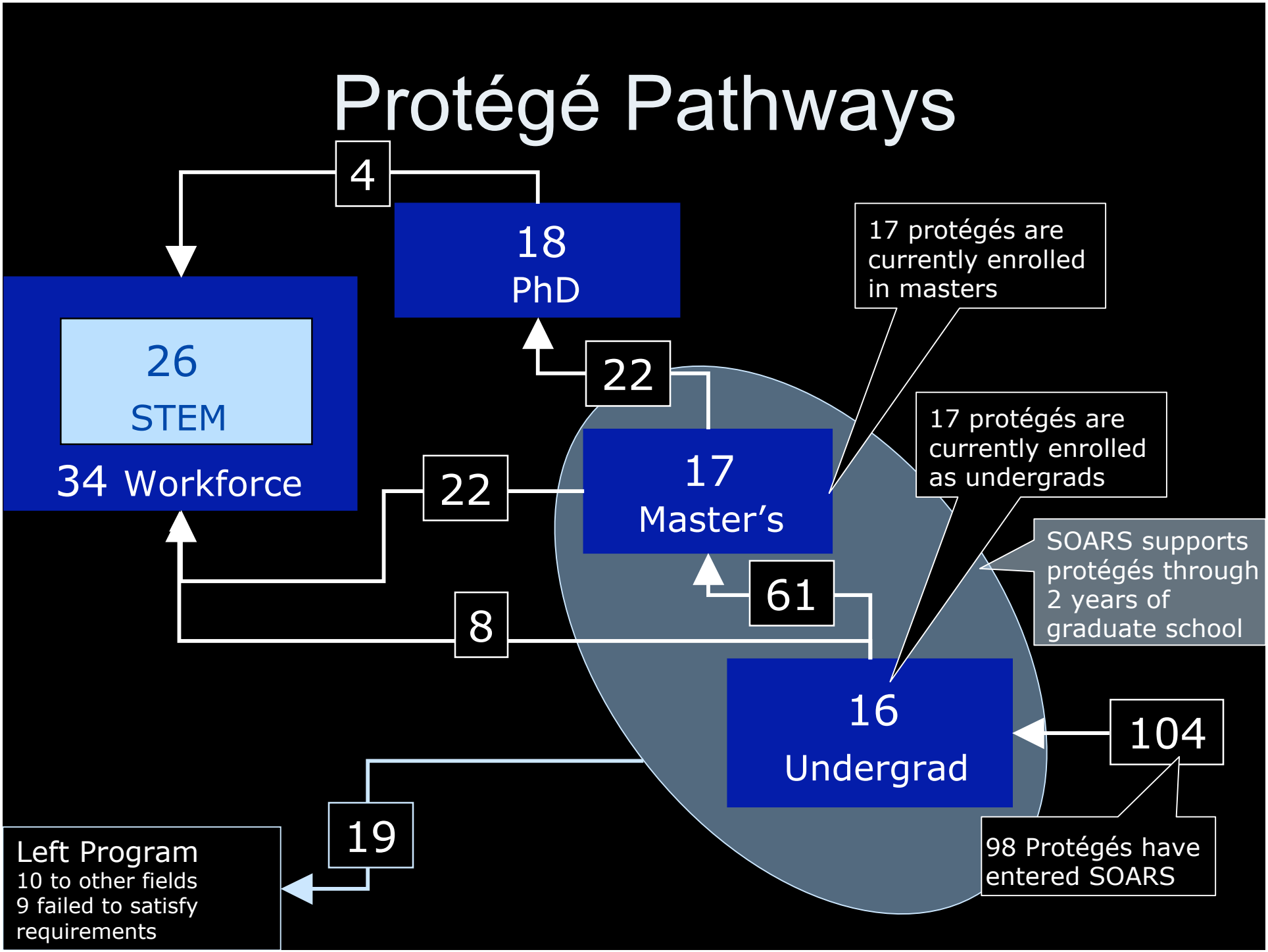
Comprehensive financial support

Multi-year experiences



Ethnicity and Gender of SOARS Protégés, 1996-2006

Ethnicity and gender	Number of protégés	Percent of protégé population	18-24 Year Olds in 2000 US Census	In Atmospheric Science graduate programs, 1994-2000
African American or Black	43	41%	14%	1.8%
Hispanic or Latino	36	35%	17%	1.6%
American Indian, Alaskan Native, or Native Hawaiian	13	12.5%	0.9%	0.4%
Asian American	6	5.8%	4.3%	7.1%
White	6	5.8%	62%	85%
Female	63	61%	48.8%	33.6%
Male	41	39%	51.2%	66.4%


Protégé Pathways
4
18
PhD
17 protégés are currently enrolled in masters
26
STEM
34 Workforce
22
22
17
Master's
17 protégés are currently enrolled as undergrads
SOARS supports protégés through 2 years of graduate school
61
8
16
Undergrad
104
19
Left Program
10 to other fields
9 failed to satisfy requirements
98 Protégés have entered SOARS

Other SOARS Success

- 12 refereed, protégé co-authored papers from summer research
- 3 AMS graduate fellows
- 3 NSF graduate fellows
- 4 NASA pre-doctoral fellowships
- 65 oral presentations by protégés at national or regional conferences
- 113 posters presented by protégés at national or regional conferences
- SOARS received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring in 2001

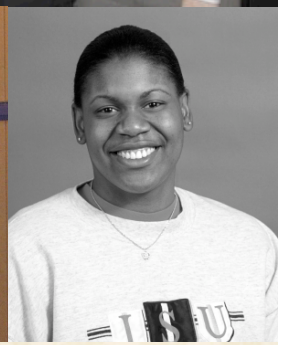
As of January, 2006

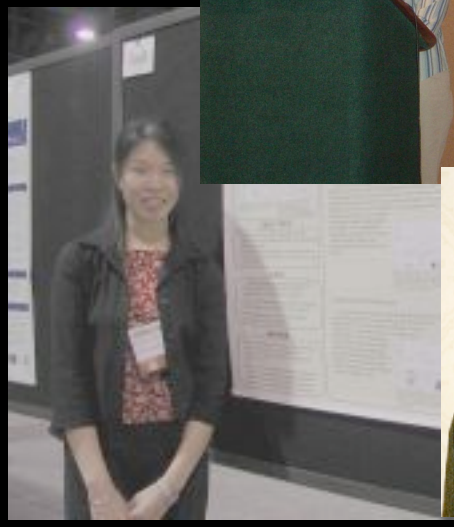
Independent Evaluation

- Conducted by the University of Colorado Ethnography and Evaluation Group
- Over 200 interviews with protégés, mentors, and program staff and 100 hours of observation
- “SOARS is a successful program as measured by a number of different metrics.”

CMMAP & SOARS

- A history of collaboration
  - 2 recent PhDs
  - 2 students continuing after their MS
  - 2 entering the workforce after MS
  - 2 new graduate students





Chris Castro, PhD

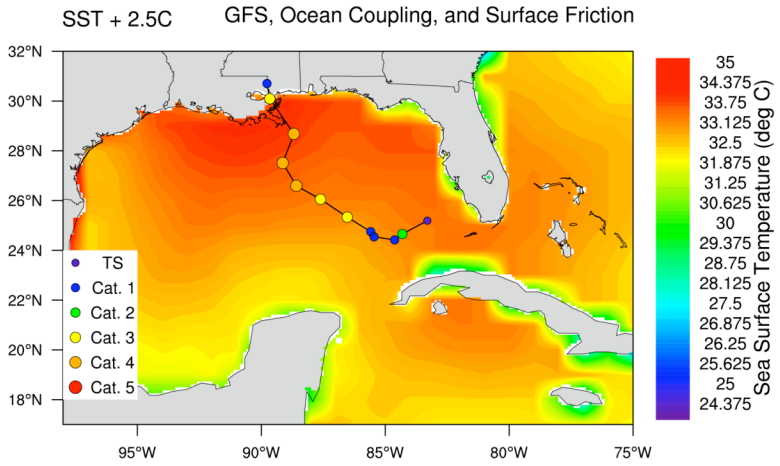
"SOARS taught me that it is very important that different cultural perspectives should be appreciated and add scientific value. A good example for myself has been participation in North American monsoon research, which requires collaboration with both Mexican scientists and the Mexican public … I will likely use my position to help train Hispanic students (from both the U.S. and Latin America) so they may transfer this knowledge

CMMAP and SOARS

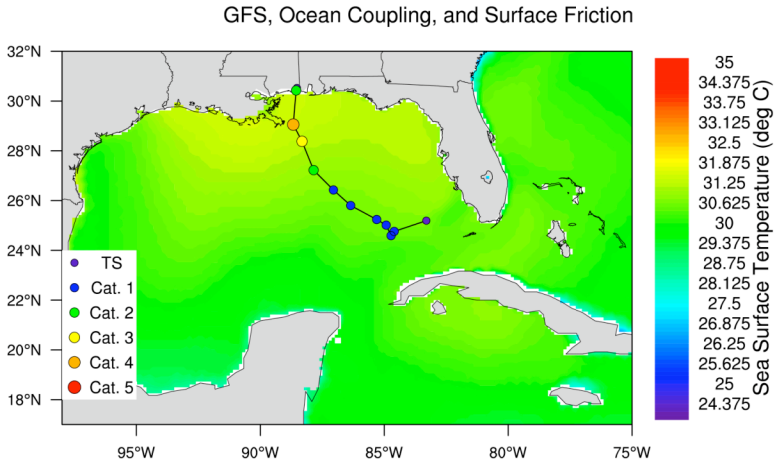
- MMAP will support 1 or 2 undergraduate SOARS protégés in MMAP-related research
- MMAP will support two SOARS graduate students (at CSU)
- MMAP and SOARS will co-recruit

Effect of the Gulf of Mexico's Mixed Layer Depth on Hurricane Intensity in the Warming Environment

ARW Simulation of Hurricane (2100)



ARW Simulation of Hurricane Katrina (2005)



Mary Haley and Kimberly Trent

Kimberly Trent, from Yale, the first MMAP-SOARS protégé.

Extending SOARS

- RESESS: Research Experience in Solid Earth Science for Students
  - Extending SOARS into solid Earth
  - Three students so far, all undergraduates

2006 SOARS Protégés

SOARS Sponsors and Partners

- National Science Foundation, ATM Division of the GEO Directorate
- Cooperative Institute for Research in the Environmental Sciences
- NOAA, Climate Program Office
- NOAA, Oceans and Human Health Inititative
- CSU
- NCAR Earth Observing Laboratory
- NCAR Biogeosciences Initiative