Improving Diversity in the Atmospheric Sciences

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Diversity
What is it and why is it important?

• Race/Ethnicity, Age, Gender, Ability/Disability, etc…

• Globalization

• Innovation

• Morally the right thing to do.
Programs to increase Diversity

• SOARS
  Significant Opportunities in Atmospheric Research and Science – UCAR

• IGERT
  Integrative Graduate Education and Research Traineeship - NSF

• REU
  Research Experiences for Undergraduates - NSF

• EPP
  Educational Partnership Program – NOAA

And many, many, many others …
Ph.D.s Awarded in Atmospheric Science and Meteorology over 31 years (1973 – 2004)

- 3,166 Total in Atm. Sci. and Meteorology
- 2,140 Total earned by US Citizens
- 21 Total awarded to African Americans
- 30 Total awarded to Hispanic Americans

Clearly, something radical and disruptive is needed.

Source: Roman Czujko, AIP Statistical Research Center
The Path to Diversity

K-12

B.S. Earth, Atmospheric and Ocean Sciences

Workforce Diversity

M.S. Ph.D.
A Plan for Eliminating the Lack of Diversity in the Atmospheric Sciences
Can we quantify Diversity?

2005 U.S. Census Estimate

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>% of Population</th>
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</thead>
<tbody>
<tr>
<td>Total:</td>
<td>288,378,137</td>
<td></td>
</tr>
<tr>
<td>White alone</td>
<td>215,333,394</td>
<td>74.7%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>41,870,703</td>
<td>14.5%</td>
</tr>
<tr>
<td>Black or African American alone</td>
<td>34,962,569</td>
<td>12.1%</td>
</tr>
<tr>
<td>American Indian and Alaska Native alone</td>
<td>2,357,544</td>
<td>0.8%</td>
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For this plan, we’ll let Diversity be a synonymous word for Underrepresented Minorities.

Data Source: U.S. Census Bureau, 2005 American Community Survey
Ph.D.s needed to achieve parity

- Growth rate of Ph.D.s in the atmospheric sciences is 0.6%.
- In 20 years, the average annual number of Ph.D.s produced will be 145.9.
- To achieve parity in diversity, the average number of Ph.D.s needed annually from URMs are:
  - 17.7 African American
  - 21.1 Hispanic American
  - 1.2 American Indians/Alaskan Natives
Pilot Program

- Jackson State University Meteorology Program
  - Started with help from NOAA and NWS in 1975
- The only HBCU offering a B.S. degree in Meteorology
- JSU produces about 1 out of every 4 B.S. degrees awarded in meteorology to African Americans
- Program can be viewed as a robust system
  - Located in the very harsh Mississippi financial and educational environment
Environment

85.3% of the total JSU student body receives federal financial aid.

The per capita personal income in Mississippi was $25,318 in 2005 (MS was ranked 49 out of the 50 states).

2005 National Assessment of Educational Progress (NAEP) tests for public schools reveal that among 8th graders:

- **Mathematics** - Mississippi had the lowest average score with the highest percentage of students (48%) scoring below the Basic achievement level.

- **Science** - Mississippi had the lowest average score with the highest percentage of students (60%) scoring below the Basic achievement level.

- **Reading** - Mississippi was among the lowest performing states with 40% of the students scoring below the Basic achievement level.

>80% of the current meteorology majors enrolled are from MS.

100% of the students in the meteorology program are products of public schools.

The mean ACT score of entering freshmen at JSU is 18.1. In 2006, the state average composite ACT score was 18.8 with the national average at 21.1 out of a maximum of 36.

JSU has no graduate program in atmospheric science.
JSU Meteorology Program
“System Performance”

| First time entering meteorology majors:       | 7.3 |
| B.S. degrees produced annually:              | 2.7 |
| Graduates entering graduate programs in the  | 1.3 |
| atmospheric sciences:                         |     |

Average values taken over the last 3 academic years (2004-2006).
Profile
JSU Meteorology Program

- 3 tenure track faculty lines (Ph.D.s)
- 1 Weather Lab Coordinator (M.S. degree)
- 1 Operational Meteorologist (Military Ret.)
- 1 Technical Staff Member (M.S. degree)
- 1 Secretary
- Weather Lab (nerve center of program)
- Resources (computer workstations, “The Weather Channel”, modest library, math tutor)
- ~ 30 undergraduate meteorology majors
- Passive Recruitment
- Low attrition (~ 1 student/year)
The Diversity Plan

A 20 year long-term plan for eliminating the lack of diversity in the atmospheric sciences.
The Diversity Plan

• Phase I – Access Points
• Phase II – Undergraduate Degrees
• Phase III – Graduate Degrees
• Phase IV – Workforce Diversity

Each phase has a deliberate focus area and lasts for 5 years.
Phase I – Access Points

The number of access points for underrepresented minorities to enter into the field must be increased strategically.
Strategic Location of Programs

• Place programs geographically near underrepresented minority students to increase the probability of attracting majors.

• Where do African Americans, Hispanics, American Indians and Native Alaskans live?
Number of People, 2000
One Race:
Black or African American

Number of people indicating exactly one race, Black or African American, by state:
- Purple: 1,000,000 to 2,999,999
- Dark purple: 1,000,000 to 1,999,999
- Light purple: 100,000 to 999,999
- Dark gray: 20,000 to 99,999
- Light gray: 2,000 to 19,999
- White: 0 to 1,999

Data source: U.S. Census Bureau, Census 2000.

Percent of Black or African American Population Indicating One Race, 2000

People indicating one race, Black, as a percent of those indicating one or more races including Black by state:
- 65.2 to 66.2
- 75.0 to 65.1
- 60.6 to 74.9

This map is one of a series of 11 percent indicating one major race/total population categories for counties.

Races indicating the lowest categories date ancestry maps not groups sub into that against U.S. percent.

People indicating one race, Black or African American, as a percent of those indicating one or more races including Black or African American by county:
- 99.0 to 100.0
- 95.2 to 98.9
- 90.1 to 95.1
- 60.1 to 86.0
- 45.6 to 60.0
- 20.0 to 45.5
- 0.0 to 19.9


American Factfinder at factfinder.census.gov provides census data and mapping tools.
Number of People, 2000
One Race:
American Indian and Alaska Native

Number of people indicating one race, AIAN, by state

Data Source: U.S. Census Bureau, Census 2000
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For more information, contact the U.S. Census Bureau.

U.S. Census Bureau
Mapping Census 2000: The geography of U.S. diversity
Strategic Placement of Atmospheric Science Programs

Legend
- Black (15)
- Hispanic (15)
- American Indian/Alaskan Native (5)
Degree Programs

• The new meteorology degree programs will be modeled after the JSU Met program in terms of personnel and infrastructure.

• The individual selected to serve as the program catalyst is very important. Must have enthusiasm, commitment and the ability for leadership.

• Institutional leadership and support is a must.
Phase II – Undergraduate Degrees

The number of Ph.D.s awarded will never exceed the number of undergraduate degrees awarded. It is necessary to increase the number of undergraduate degrees in order to increase the number of Ph.D.s.
Retention and Intervention

- Risk Factor - Inadequate preparation in Mathematics.

- Math tutoring and resources are needed.

- Focus on our sphere of influence.

- Mentoring by faculty plays a significant role.
Success factors for undergraduates

- Mentoring.
- Exposure to professionals.
- Peer interaction.
- Faculty supervised undergraduate student research.
- Knowledge of the various programs, opportunities and career options that are available to them.
- Experience gained through summer internships.
- Practical work experience gained during the academic year.
Phase III – Graduate Degrees

Graduate schools must take bold and aggressive steps towards: admitting URMs, institutionalizing systems to increase the chances for success and reducing the lapse time for Ph.D. degree completion.
National Consortium for Diversity in the Atmospheric Sciences

• Membership consists of Ph.D. programs in the Atmospheric Sciences.
• The National Office provides 1st year funding to incoming atmospheric science doctoral students.
• Members of the consortium agree to provide support for students entering their programs from years 2 - 7.
Bridge Program

- A Summer Institute in Applied Mathematics.

- Specifically for B.S. recipients heading to graduate school.

- Four weeks during the summer in a centrally located neutral location (i.e. – NCAR).
Reduce the Time Lapse between baccalaureate and Ph.D.

- In Earth and Space Science, it is 9.8 years. The longest time among all Science & Engineering fields!

- Needs to be reduced to 7 years.

- Graduate advisors must work diligently to achieve this goal.
Phase IV – Workforce Diversity

Underrepresented minorities must be hired into professional positions and should hold high visibility positions where they will serve as role models while also sensitizing the geoscience workforce.
Workforce Diversity

• In 2001, 8,910 Ph.D.s in Earth, Atmospheric and Ocean Sciences were employed.
  – 60 (0.6%) African Americans
  – 230 (2.6%) Hispanics
  – N/A American Indians (fewer than 50)

• Employment is really the ultimate goal.

• The self-interests of the various employment sectors must be taken care of to influence hiring practices.
# Self-Interests of Employment Sectors

<table>
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<tr>
<th>Employment Sector</th>
<th>Self-interests</th>
<th>Recommendations of ways to address the self-interests</th>
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<tbody>
<tr>
<td><strong>Industry</strong></td>
<td></td>
<td>Make government grants and contracts involving geoscience work more accessible to those companies that meet or exceed the diversity criteria among the professional geoscientists on staff. Provide tax incentives for diverse organizations.</td>
</tr>
<tr>
<td><strong>Academia</strong></td>
<td>Grants, Prestige</td>
<td>Provide diversity grants for research and education to those entering the professoriate. Establish a prestigious White House recognition to be awarded to institutions that exemplify diversity through the hiring of URM faculty.</td>
</tr>
<tr>
<td><strong>Federally Funded Agencies</strong></td>
<td>Funding, Prestige</td>
<td>Link budget allocations to diversity at the professional level. Establish a prestigious White House recognition to be awarded to institutions that exemplify diversity through the hiring of URM faculty.</td>
</tr>
<tr>
<td><strong>Military</strong></td>
<td>Specialized knowledge, Military Personnel</td>
<td>Establish accession programs at the undergraduate level with the Navy and Air Force. Expose URM to the opportunity of working as civilians with the military in geoscience occupations.</td>
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</tbody>
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The Diversity Model

A spreadsheet model for predicting:
  The expected outcome
  The cost of implementation
Primary assumptions for the model

- The JSU meteorology degree program format can be replicated.
- Each program behaves as a statistically stable system and its productivity output accounts for yearly fluctuations.
- The strategically selected universities for the undergraduate degree programs will fund the faculty and staff positions after year five.
- Graduate student support is provided in the first year by the Geoscience Consortium.
- The lapse time from the baccalaureate to the doctoral degree is 7 years.
CASE I

B.S. graduation rate: 39%

Graduates continuing to Grad School: 48%

Percent of grad students receiving the Ph.D.: 77%

Strategic Sites
Black: 13
Hispanic: 15
American Indian: 1

Cost: $1.16B

Time: 20 years

Cumulative #PhDs: 293
CASE II

B.S. graduation rate: 50%

Graduates continuing to Grad School: 75%

Percent of grad students receiving the Ph.D.: 80%

Strategic Sites
- Black: 6
- Hispanic: 7
- American Indian: 1

Cost: $586M

Time: 20 years

Cumulative #PhDs: 420
CASE III

B.S. graduation rate: 80%

Graduates continuing to Grad School: 80%

Percent of grad students receiving the Ph.D.: 80%

Strategic Sites
- Black: 3
- Hispanic: 4
- American Indian: 1

Cost: $367M

Time: 20 years

Cumulative #PhDs: 492
Conclusions

• A long-term plan for eliminating the lack of diversity in the atmospheric sciences has been presented.

• A spreadsheet model of the diversity plan indicates that with 8 strategically placed undergraduate programs, parity in diversity can be achieved in 20 years under the right conditions.

• Model results show that it is possible to solve the diversity problem in 20 years for less than $370M.
Now What?

- Get Organized – AMS, AGU, AGI, UCAR Diversity Committees are encouraged to consider this type of approach.

- Develop a PLAN that the community supports.

- Engage the Federal Funding Agencies and Washington D.C. to get funding commitments.
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  - Faculty: R. S. Reddy, L. White, H. Liu
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- UCAR
  - R. Pandya et al.

- NOAA

- NSF

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