

## The HSCaRS Summer Enrichment Program; Research Opportunities for Minority and Women Undergraduates in Global Change Science

Authors: Maurice G. Estes, Jr./IGCRE, Donald J. Perkey/IGCRE, T. L. Coleman/Alabama A&M University

### Background and Program Description

The Center for Hydrology, Soil Climatology, and Remote Sensing (HSCaRS) was established July 1, 1995, through a cooperative agreement between the National Aeronautics and Space Administration (NASA) and Alabama A&M University. One challenge in the Center was to develop an educational component that would increase participation by students in mainstream research and increase the production of underrepresented minorities who are U.S. citizens in NASA-related fields. This goal was strongly supported by a number of educational research publications. The Task Force on Women, Minorities, and the Handicapped in Science and Technology reported in the 1988 Interim Report entitled, *Changing America: The New Face of Science and Engineering*, that one of America's most urgent tasks is to strengthen the science and engineering workforce. The Task Force asserts that, "by the year 2000, 85 percent of new entrants to the Nation's work force will be members of minority groups and women". According to the Wall Street Journal, summer internships are flourishing with an emphasis on minorities. Bausch and Lomb Inc., and Chervon Corporation are increasing summer internship opportunities and are focusing recruiting efforts on minority candidates. The Aluminum Company of America is focusing internship opportunities on minorities and women with engineering and technical training. The challenge is clear, more women and minority scientists must be educated to meet the needs of America's technics] work force.

Based on this data, a summer research internship program with an emphasis on minority and women students was designed. Undergraduates were selected, as opposed to graduate students, for several reasons. First, we hope to recruit outstanding students in the physical sciences and mathematics and give them a positive research experience that will encourage them to attend graduate school and pursue research careers, Second, a survey of current NASA programs for students indicated that more opportunities were available for K-12 and graduate students than undergraduates.

The primary objective of the HSCaRS Summer Enrichment Program (SEP) is to make significant contributions to the NASA Mission to Planet Earth (MTPE) and the Alabama A&M University (AAMU) Center for Hydrology, Soil Climatology and Remote Sensing (HSCaRS) research missions by providing undergraduate student research internships with an emphasis on minority and women students. Additional objectives are to encourage more minority and women students to pursue advanced degrees in Earth system and global change science and to increase the participation of minority institutions in the U.S. Global Change Research Program. Also, the SEP strives to make students in the traditional science disciplines more aware of the opportunities in Earth System Science.

In designing the SEP, it was acknowledged that HSCaRS was a new research effort and Center. Consequently, students were not expected to immediately recognize the Center as one would older, more established research laboratories with national reputations, such as Los Alamos, Battelle, National Consortium for Atmospheric Research (NCAR), etc. Yet we still wanted to compete nationally for the best students. Therefore, we designed the program with a competitive financial package that includes a stipend of \$400 per week, round-trip transportation from home to the summer research site, and free campus housing and meal plans provided by Alabama A&M University. Students also received a modest living allowance of approximately \$25 per week. The internship program was 10 weeks in residence at Alabama A&M University or IGCRE, and gave students the opportunity to select from six general research areas: micro-meteorology, soil data analysis, soil moisture modeling, instrumentation, geographic information systems, and computer science. Student participants also enrolled in an introductory global change science course as part of the summer program (a copy of the course outline is in the appendix). The program included participation in a field program for approximately two weeks. All students were required to participate in the field program as a learning experience, regardless of the relationship of the field program to their majors or particular research project.

### Recruiting and Evaluation Methodology

In the inaugural year of the SEP, students were recruited by distributing posters throughout the university community. All the HBCU's, Other Minority Universities (OMU's), and a mixture of other types of institutions

were targeted for the distribution of program information. Other institutions included a mixture of large schools with established research programs and smaller institutions with a traditional emphasis on teaching as opposed to research. Students that would complete the sophomore year prior to the summer internship period were targeted in the recruiting process. A total of 102 students applied for the program, and 10 were selected. The applications included 81 from minority institutions, of which 57 were minority women. By class standing, applicants included 30 sophomores, 52 juniors, and 20 seniors.

A two-phase process was used in the evaluation of the students' applications. The first phase was an evaluation by the SEP staff to identify the strongest applications by research group. This was done by considering the applicant's Grade Point Average (GPA), statement of interest in global change science, letters of recommendation, and resume. A grading scale was developed, that awarded two points for a GPA over 3.5, one point for a GPA between 3.0 and 3.5, and zero points for a GPA less than 3.0. An additional point or fraction of a point was awarded based on the staff's evaluation of the statement of interest in global change science, letters of recommendation, and resume. Consequently, these non-GPA evaluation factors provided the opportunity for student applicants to obtain three additional points. A maximum score of five points could be achieved.

This evaluation plan allowed us to consider all major relevant factors and was weighted toward students with the best grades. However, the plan did provide an opportunity for a student with a low GPA to still score high enough to be selected. This was considered important, since talented undergraduates sometimes do not achieve high grades early in college due to immaturity, changing interests, etc. Some of these students may still be very interested in research and have the talent to succeed in a research environment. The statement of interest in global change science offered insight into some outstanding candidates for our program that did not have high GPA's. Finally, relevant work experience as shown in the resume was considered to be of value.

Based on the phase one analysis, the students were ranked by score. Applicants scoring 3.5 or greater on the 5.0 scale, approximately forty percent of the total applicants, were considered further in the second evaluation phase. Phase two provided an opportunity for the potential mentoring scientists to rank in priority order the student applicants interested in the mentor's area of research. This data was used, with program goals in mind, to make final selections. The program goals that most prominently influenced the evaluation process related to the identification of students who would likely be able to make research contributions and who would be interested in graduate school.

## Results

Overall, the first year was very successful. The program objectives for the first year were as follow:

1. Recruit five outstanding undergraduate students to pursue NASA and AAMU research projects.
2. Recruit, as a part of the five undergraduate students, a minimum of two minority woman students.
3. Have a minimum of two students make significant research contributions and return for a second summer.
4. Recruit, as a part of the five undergraduate students, a minimum of two students from predominately minority institutions.

In regard to the recruiting objectives, we were able to select 10 outstanding students, with the following demographic makeup: nine females and one male. Seven of the students were African-Americans, and three Caucasians. The average GPA of the students selected was 3.73 on a 4.0 scale, and the range was from 3.33 to 4.00. Student majors included Physics, Chemistry, Computer Science, Geography, and Environmental Science. This clearly meets the first two objectives.

At the end of the summer term, each student was required to prepare a written paper on his/her research and present their results in a seminar setting. Based on this data and feedback from mentoring scientists, all of the students made contributions to the research effort. Four of the ten students have been invited back for a second summer in 1997. Three of the four students are resident at HBCU's. We anticipate all of them will accept our offer and continue their research projects in 1997 that will lead to publications. Of these four students, one is continuing to work on the HSCaRS research remotely and may have a co-authored publication with an Alabama A&M University mentor prior to next summer, and one is working toward enrollment in graduate school at Alabama A&M University. All SEP students have been encouraged to attend professional conferences and present HSCaRS

research results. In particular, students have been encouraged to present their HSCaRS research at the NASA University Research Centers (URC) Technical Conference and the National Conference on Undergraduate Research (NCUR). HSCaRS has committed to paying all travel expenses for those students attending these conferences. A listing of student research project titles is included in the appendix.

The final year one objective was to recruit at least two students from minority institutions. This objective was achieved by recruiting seven students from Historically Black Colleges and Universities (HBCU's), as shown in the table below:

**Home Institutions for 1996 SEP Students**

<u>Institution</u>	<u>Location</u>	<u>Classification</u>	<u># Students</u>
Alabama A&M Univ.	Normal, AL	HBCU	2
Carleton College	Northfield, MN	Majority	1
Fayetteville State Univ.	Fayetteville, NC	HBCU	1
Jackson State University	Jackson, MS	HBCU	1
Miles College	Birmingham, AL	HBCU	1
Norfolk State University	Norfolk, VA	HBCU	1
Spelman College	Atlanta, GA	HBCU	1
University of Maryland	College Park, MD	Majority	1
University of Oklahoma	Norman, OK	Majority	1

Source: SEP Program Office Records

Plans for 1997

Our plan for year two is to follow the successful script from the first year, with changes integrated from lessons learned. Due to the first year's success, the program is on track to meet or exceed all of the originally proposed year two SEP milestones. The original SEP milestones for year two are as follow:

1. Assuming two students return to continue research projects from the first summer, recruit three more outstanding undergraduate students to pursue NASA and AAMU research projects.
2. Recruit as a part of the three undergraduate students, a minimum of one minority woman student.
3. Have two undergraduate students co-author papers with mentor scientists
4. Have two undergraduate students enroll in graduate programs relating to Earth system and global change science.
5. Recruit as a part of the three undergraduate students, a minimum of one undergraduate student from a predominately minority institution.

Given the outstanding response by students to last year's program advertisement, it is reasonable to assume that the program is on track to meeting all recruiting related objectives. Our plans are to recruit ten new students, plus to invite back for a second summer, four outstanding students from the SEP class of 1996. Also, of the four students invited back for a second summer, at least two student co-authored papers are likely. The enrollment of one SEP student from the class of 1996 in graduate school to study in the computer science area at Alabama A&M is expected. Overall, the program is in a good position to meet or exceed all year two milestones.

## Observations and Conclusions

First, it was exciting to see the overwhelming positive response to the 1996 SEP. The program was advertised primarily by posters that were distributed late in 1996 and early 1997 to several hundred institutions. Given the lateness and amount of the publicity, the receipt of over 100 applications and approximately twice that many inquiries about the program, is indicative of the interest in HSCaRS research and of the tremendous need for more undergraduate research opportunities.

The approach to the field program was that it would be beneficial to all the students to participate in this phase of the project to reinforce understanding that science is not done only in books. While the SEP program staff realized the field work would be more relevant to some student research projects than others, we did not communicate this effectively enough to the students. As a result, several students complained that there was not a direct connection between their research and the field program, and that this was time that could have been better spent on their respective research project. We will spend more time this year communicating program expectations and goals so similar frustrations will not occur.

About the midpoint of the summer term, we began to see a **correlation** between student performance in the introductory class in global change science and the students' background in Physics. Those students with at least one semester of Physics found the course to be much easier than the other students. As a result, we will emphasize the need for future student interns to take a course in Physics prior to beginning the summer internship. One anomaly to this conclusion was a Geography major who did very well in the course and with her research. Upon discussion of this issue, it was found that fundamental Physics Laws and basic theories had been integrated into other science courses as needed to fully explain and illustrate topics. Therefore, her Physics background was in fact sufficient. This is one illustration of why it is good to look beyond course titles and associated grade point average when evaluating students applicants. We think the evaluation methodology described above continues to give us the foundation needed to make the thorough analyses needed to ensure that we select the best possible applicants.

In regard to selection, global change science does encompass in some fashion a large number of courses of study. Consequently, one of our challenges was how much priority to give outstanding students in marginally related areas of study and interest in the evaluation process. We did have one example of a student who was mismatched in terms of project opportunities in HSCaRS and personal research interests. Nevertheless, this student was able to pursue a research project with some connection to HSCaRS research objectives, and overall had a productive summer. Conversely, the one student we recruited from the computer science area completed an excellent research project and as a result she is now planning to attend graduate school at AAMU.

## Acknowledgments

Many thanks to the Center for Hydrology, Soil Climatology, and Remote Sensing (HSCaRS) mentor scientists, Phyllis Campbell, and Kate Hinke for assistance with this project. Contribution from HSCaRS, Department of Plant, Soil, and Animal Sciences, and the Agricultural Experiment Station, Alabama A&M University, Normal, AL 35762. Journal No. 344. This work was supported by Grant No. NCCW-0084 from the National Aeronautics and Space Administration (NASA), Washington, DC. Any use of trade, product or firm names is for descriptive purposes only and does not imply endorsement by the U.S. government.

## References

The Task Force on Women, Minority, and the Handicapped in Science and Technology, "Changing America: The New Face of Science and Engineering", Interim Report, Washington D. C., September 1988, p. 3.

Feinstein, Selwyn, "Summer Internships Flourish, with Emphasis on Minorities", *The Wall Street Journal*, April 24, 1990, front page,

Office of Space Science and Applications in Partnership with the Educational Affairs Division, "Looking to the Future: 1991 Catalog of Educational Programs and Activities", National Aeronautics and Space Administration, Washington, D. C., 1991.

Discussions with 1996 SEP Students and HSCaRS scientists.

Appendix

1996 SEP Student Research Project Titles

**Determining Iron and Manganese Concentrations in Soil Using Radiometric Reflectance Readings**

Student: Carrie Kienenberger      Mentor: Dr. Ahmed Fahsi/AAMU

**Physical and Chemical Characterization of the Research Test Bed at the Winfred Thomas Agricultural Research Station**

Student: Tomeka Prioleau      Mentor: Dr. Andrew Manu/AAMU

**Assessing Rooting Traits in the Loblolly Pine and the Slash Pine to Compare Genetic Variations**

Student: Latousha Parker      Mentor: Dr. Ahmed Fahsi/AAMU

**Using Ultrasonic Techniques to Measure Soil Moisture**

Student: Kimberly Williams      Mentor: Dr. Mohan Aggarwal/AAMU

**Optical Sensing of Soil Moisture**

Student: Mario Thomas      Mentor: Dr. B. R. Reddy/AAMU

**Creating a Cheap Model of the Relationship Between Soil and Hydrological Processes**

Student: Barbara Cosgriff      Mentor: Dr. Jason Kinser/AAMU

**The Role of Topography in Water Movement and Energy Exchange at the Land Surface**

Student: Ann Zawistoski      Mentor: Dr. William Crosson/IGCRE

### **Simulation of Drainage, Water Content and Runoff of Four Varied Soil Types Using SHEELS**

Student: Lucretia Jones

Mentor: Dr. William Crosson/IGCRE

### **Patterns of the Radiation Balance as Influenced by Soil Moisture, Vegetation Cover and Meteorological Factors**

Student: Malinda Taylor

Mentor: Dr. Charles Laymen/IGCRE

### **Application of Modular Modeling System to Predict Evaporation, Infiltration, Air Temperature and Soil Moisture for Two Bare Plots**

Student: Latrica Birgan

Mentor: Dr. Teferi Tsegaye/AAMU

---

## **SPS 366- Climate and Global Change**

4 Semester Credits

Lecture -3 hours weekly

Laboratory - SEP Research Project

Introduction to climate and global change including: the relationships between the Sun and the Earth that drive the climate system; the global structure and variations of the atmosphere and oceans, and the influence of humans and natural processes on the climate system and its variability. Additional topics include: the greenhouse effect; ozone depletion; air pollution; acid rain; biodiversity; paleoclimatology, and volcanism,

---

### **Topics**

---

*Introduction to Climate and Global Change*  
*Atmospheric Variables and Measurements*  
*Surface Variables and Measurements*  
*The Earth's Radiation and Energy Budget*  
*Remote Sensing Measurements*  
*Atmospheric Motion and Global Circulations*  
*Climate and Ocean Currents*  
*The Earth's Hydrologic Cycle*  
*Climate and Global Change*  
*The Earth's Carbon Cycle*  
*Interactions and System Dynamics*  
*'Climate and Global Change*

Source: Dr. Donald J. Perkey, Instructor