

**SCIENTIFIC COORDINATION OF ACTIVITIES FOR UNIVERSITY  
PARTICIPATION IN MISSION TO PLANET EARTH**

Contract Number:

NAS8-38782

Report Number: 13

**FINAL ACTIVITIES REPORT**

Reporting Period:

November 30, 1990 - February 28, 1994

Program Director:

Michael W. Kalb, Ph.D.

Submitted to:

**THE GEORGE C. MARSHALL SPACE FLIGHT CENTER  
MARSHALL SPACE FLIGHT CENTER  
ALABAMA 35812**

By:

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TO PLANET EARTH Final Report No.  
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## FINAL ACTIVITIES REPORT

### SCIENTIFIC COORDINATION OF ACTIVITIES FOR UNIVERSITY PARTICIPATION IN MISSION TO PLANET EARTH

NAS8-38782

November 30, 1990 - February 28, 1994

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#### OBJECTIVE

USRA provided management, clerical and organizational support to perform the following specific activities:

- Establish and administer (and serve as logistical interface for) a program supporting University Visiting Scientists at MSFC. The program involved Short-term Visiting Scientists, USRA Senior University Scientists, and Affiliated University Scientists;
- Establish and administer a program to increase the interaction, understanding and cooperation between MSFC earth scientists and the university earth science research community. This program included an education effort (to educate the university and NASA researchers as to the needs and goals of each other's activities), student fellowships and awards (to promote and stimulate student and faculty interest in NASA research) and production of a quarterly newsletter on behalf of the MSFC Earth Science and Applications Division (to keep MSFC affiliates and other interested scientists apprised of NASA/MSFC research programs and missions);
- Provide computer user consulting and assistance to university users to promote efficient usage and access to MSFC computers as part of approved research activities;
- Support, coordinate and provide oversight for scientific meetings and working groups required as part of MSFC's Mission to Planet Earth activities;
- Provide meeting logistical and information distribution support for scientific research, sensor development and science community interaction;
- Co-sponsor and serve as coordinator of annual MSFC scientific workshops in a topic of special interest and relevance to MSFC Earth science missions.

#### SPECIAL PROJECTS

**PROGRAM** - University-Based Cooperative Program in Earth Systems Science Education (ESSE)

**ELIGIBLE PARTICIPANTS** - The program targeted universities throughout the United States with a commitment to developing an interdisciplinary earth science program and curricula at their institution with an audience consisting of undergraduate students.

**PROGRAM DESCRIPTION** - Under this pilot program, selected universities participated cooperatively with other universities and NASA in two inter-related activities: curriculum development and scientific exchange. Each university was required to develop and offer an introductory survey course in earth systems science and senior-level interdisciplinary course. The

introductory course presents an overview of earth systems science to a broad segment of the student body, including both science and non-science majors. The purpose of the senior level course is to attract those undergraduate science majors with solid foundations in relevant sciences for future studies and work in earth systems science. The senior level course is taught jointly by faculty members from at least two academic departments with supplemental lectures from other in-house faculty, advanced graduate students, postdoctoral students, as well as visiting faculty and researchers from other universities or NASA laboratories. In addition to the curriculum development portion of the program, each university participated in an effort involving short-term visiting scientists from other participating universities and NASA Field Centers. These visitors provide additional technical insight and foster interdisciplinary education and research through their special expertise from a NASA Center which serves as a sponsor for their academic program. The NASA-sponsoring scientist may join in the identification and formulation of course work and relevant projects, facilitate access to NASA data, technical material, and other resources, and locate other NASA-based scientists to serve in a resource lecture pool from which universities may draw visiting lecturers.

Each participating university and its principal investigator were required to report on courses taught during the year and provide travel records for the visiting faculty. Previous reports outline the class participation, schedule, and topics. Tables that show participation and courses taught are attached at Appendix 1.

Curriculum development by universities is central to the ESSE program effort, especially in the areas of applying computer and visual aids technology to class room instruction in global change.

### VISITING SCIENTIST

Dr. Robert Thomas served as a Visiting Scientist at NASA Headquarters from January 1, 1991, through February 8, 1992, to manage the Polar Research Program in the Earth Science & Applications Division to act as coordinating investigator for ice-sheet research using data from ERS-1 and to serve as a team member for the EOS/GLRS instrument.

Dr. Thomas produced a review entitled, "Polar Research From Satellites," while working under this contract. The review is on file at the USRA Corporate Drive office in Huntsville, Alabama.

### WORKSHOPS AND CONSULTING

The following workshops/meetings were held during the course of this contract to promote Earth System Science and Education (ESSE):

- Planning Meeting in Washington, DC, October 1-3, 1991;
- Program Meeting in New Carrollton, MD, May 31, 1992, through June 2, 1992;
- Program Meeting in Stanford, CA, December 2-4, 1992;
- STELLA Workshop in Boulder, CO, June 5-13, 1992.

The following consultants were retained by USRA to develop Earth System Science courses and other ESSE related issues at their institution. The program had two inter-related objectives of (1) promoting ESS undergraduate curricula development and (2) encouraging interdisciplinary collaboration between scientists both within the same university and between universities. The participants and their institutions are listed below in alphabetical order.

Ms. Susan Alexander from the Stanford University;  
Dr. Raymond E. Arvidson from the Washington University;  
Dr. Eric Barron from the Pennsylvania State University;  
Dr. Patrick Bartlein from the University of Oregon;

Dr. Robert Bartlett from the Purdue University;  
Mr. Richard Becker from the Washington University;  
Mr. Ben Boyle Rice from the University Boulder;  
Dr. Francis Bretherton from the University of Wisconsin;  
Dr. Jim Buttle from the Trent University;  
Dr. Mark Chandler from the NASA/GISS;  
Mr. Peter Czepiel from the University of New Hampshire;  
Robert Dickerson from the University of Arizona;  
Dr. W. G. Ernst from the Stanford University;  
Mr. Bruce Fegley and Ms. Laura Griffith from the Washington University;  
Dr. Arthur Few from the Rice University;  
Dr. George W. Fisher from the Johns Hopkins University;  
Mr. Paul Forward from the Northwestern University;  
Mr. Steve Frolkong from the University of New Hampshire;  
Dr. Catherine Gautier from the University of California-Santa Barbara;  
Dr. Barbara Grandin from the Rutgers University;  
Dr. Lisa Graumlich from the University of Arizona;  
Ms. Laura Griffith from the Washington University;  
Mr. Jay Gulledge from the University of Alaska-Fairbanks;  
Dr. David Halpern from the Jet Propulsion Laboratory;  
Dr. Patrick Halpin from the University of Virginia;  
Dr. Paul Harcombe from the Rice University;  
Mr. David Harris from the Utah State University;  
Dr. Robert C. Harriss from the University of New Hampshire;  
Dr. Brian Haskell from the University of Minnesota;  
Dr. Harold Helgeson from the University of California-Berkeley;  
Dr. Katherine Hirschboeck from the University of Arizona;  
Dr. David Hodell from the University of Florida;  
Mr. Martin Hoffert from the New York University;  
Dr. Henry Horn from the Princeton University;  
Mr. John Jirikowic from the University of Arizona;  
Dr. Donald R. Johnson from the University of Wisconsin;  
Ms. Joyce Johnson from the University of Iowa;  
Dr. Kerry Kelts from the University Minnesota;  
Dr. Carol Kendall from the U. S. Geological Survey;  
Dr. Stan Kidder from the University of Alabama in Huntsville;  
Me. Paul J. Kinder, Jr. from the Romney, West Virginia;  
Dr. Lee Kump from the Penn State University;  
Ms. Lisa Leffler from the Northwestern University;  
Dr. James K. Luers from the University of Dayton;  
Dr. Jeffrey McDonnell from the Utah State University;  
Dr. Richard McNider from the University of Alabama in Huntsville;  
Dr. Gregory Mead from the University of Florida;  
Dr. Carlos Mechoso from the University of California-Los Angeles;  
Dr. James R. Miller from the Cook College, Rutgers University;  
Dr. Jon Nese from the Penn State Beaver Campus;  
Dr. Greg Norris from the University of New Hampshire;  
Dr. Bradley Opdyke from the University of Michigan;  
Dr. Daniel Orange from the Stanford University;  
Mr. Leigh Orf from the University of Wisconsin;  
Mr. Patrick Parker from the University of Arizona;  
Mr. Kurtis Paterson from the University of Iowa;  
Dr. Donald Perkey from the Drexel University;  
Dr. Mario Picazo from the University of California in Los Angeles;

Dr. Jorge Ramirez from the Colorado State University;  
 Dr. Michael Rampino from the New York University;  
 Mr. Ron Resmini from the Johns Hopkins University;  
 Mr. Dave Roberts from the Utah State University;  
 Dr. Jonathan Roughgarden from the Stanford University;  
 Dr. Nigel Roulet from the York University;  
 Dr. Jorge L. Sarmiento from the Princeton University;  
 Dr. Ron Sass from the Rice University;  
 Dr. Joshua Schimel from the University of Alaska Fairbanks;  
 Dr. Stephen H. Schneider from the Stanford University;  
 Dr. Jerald Schnoor from the University of Iowa;  
 Ms. Diane Schweizer from the University of California-Santa Barbara;  
 Dr. Douglas Sherman from the University of Southern California;  
 Dr. Everette Shock from the Washington University;  
 Dr. Raymond C. Smith from the University of California-Santa Barbara;  
 Dr. John Snow from the Purdue University;  
 Dr. Anne Spacie from the Purdue University;  
 Mr. Parvada Suntharalingam from the Princeton University;  
 Ms. Tracy Totten from the Rice University;  
 Dr. Lonnie Thompson from the Ohio State University;  
 Dr. Ellen Mosley-Thompson from the Ohio State University;  
 Dr. Richard P. Turco from the University of California-Los Angeles;  
 Mr. Daniel Vietor from the Purdue University;  
 Mr. Mitch Wagener from the University of Alaska-Fairbanks;  
 Dr. John Walther from the Northwestern University;  
 Dr. Paul Weiblen from the University of Minnesota;  
 Dr. Frank Weirich from the University of Iowa;  
 Dr. Ed Wright from the University of Arizona;

Detailed program descriptions and status reports for each institution were submitted in previous quarterly reports. They remain on file in the USRA Corporate Drive office.

### SUBCONTRACTS

USRA entered into a subcontract agreement with the University of Oklahoma effective August 15, 1991, for a period of twelve months to perform the research entitled, "Theory and Application of Remote Sensing to Understanding Land-Atmosphere Interactions and Surface Hydrology." The subcontract supported Dr. Claude Duchon, Professor of Meteorology, to use SSM/I data to provide estimates of precipitation, vegetation, land surface temperatures, and soil moisture and to determine the feasibility of employing SSM/I data as input to a hydrological model, for example SWRRB. The research directly supported the CaPE field program at Marshall Space Flight Center.

### FINANCIAL

Total Contract Value:	\$990,961
Total Cumulative Costs and Fee:	\$990,961
Estimated Residual:	\$0

The period of performance was extended through February 28, 1994, at no additional cost to the government to allow additional time for the participating institutions to invoice final billing.

## APPENDIX 1

Table A

SCHOOLS TEACHING ACADEMIC YEAR 1992-93 WITH ESSE SUPPORT

SCHOOL NAME	TITLE - SURVEY COURSE	DATE OFFERED	ENROLL	TITLE - SENIOR COURSE	DATE OFFERED	ENROLL
Univ. of Alaska - Fairbanks	Humans in the Earth System	Spring '93	3	The Earth as a System	Spring '93	13
University of Arizona	Intro. to Global Change	Fall '92	37	Global Change	Spring '93	101
Univ. of CA - Santa Barbara	The Earth from Space	Winter '92 Spring '93	29	Earth System Science	Spring '93	10
University of Iowa	Intro. to Earth Sys. Science	Fall '92 Spring '93	200	Atmos. Chemistry & Physics	Fall '92	35
Johns Hopkins University	Environmental Earth Systems	Spring '93	47	Modelling Earth Systems	Spring '93	5
Univ. of New Hampshire	Global Environmental Change	Spring '93	132	Energy for a Sustainable Future	Fall '92	15
Ohio State University	Geology & the Environment Global Environmental Change	Spring '93 Winter '92 Spring '93	70 8	Integrated Earth Systems	Spring '93	15
Penn State University	Earth As A System	Fall '92 Spring '93	780	Numerous Earth Systems related Courses	Fall '92 Spring '93	280
Princeton University	Perspective on Env. Issues	'92/'93	10			

Table A Cont.

SCHOOLS TEACHING ACADEMIC YEAR 1992-93 WITH ESSE SUPPORT

SCHOOL NAME	TITLE - SURVEY COURSE	DATE OFFERED	ENROLL.	TITLE - SENIOR COURSE	DATE OFFERED	ENROLL.
Rice University	Atmosphere, Weather & Climate	Spring '93	117	Earth System Dynamics	Fall '92	13
Stanford University	Intro. to Earth Systems	Winter '93	61	Senior Sem. in Earth Systems	Spring '93	10
Utah State University	Intro. Earth System Science	Winter '93	25	Climate - Hydrologic Inter.	Winter '93	6
Washington University	Biochemistry	Spring '93	21	Hydrology	Spring '93	13
University of Wisconsin	Global Change: Atmospheric Issues and Problems	Fall '92	44	Earth System Modeling	Fall '92 Spring '93	9
<b>Totals</b>			<b>1584</b>			<b>525</b>

**SCHOOLS TO TEACH ACADEMIC YEAR 1993-94 WITH ESSE SUPPORT**

**Table B**

		(P) Projected Enrollment				
SCHOOL NAME	TITLE - SURVEY COURSE	DATE OFFERED	ENROLL	TITLE - SENIOR COURSE	DATE OFFERED	ENROLL
Univ. of Ala. - HSV						
Univ. of Alaska - Fairbanks	Humans In the Earth System	Spring '94	10P	The Earth as a System	Spring '94	13P
Univ. of CA - Los Angeles	The Earth: How It Works	Spring '94	50P	Environmental Chem. Lab.	Winter '93/'94	15P
University of Florida	The Earth As A System	Fall '93 Spring '94	55P	1) Global Biogeochem. Cycles 2) Modeling the New Earth Sys.	Fall '93 Spring '94	15P
University of Iowa	Intro. to Earth Sys. Science	Fall '93 Spring '94	200P	Atmos. Chemistry & Physics	Fall '93	35P
Johns Hopkins University	Environmental Earth Systems	Spring '94	47P	Modeling Earth Systems	Spring '94	5P
University of Minnesota						
New York University	Earth System Science	Summer '94	70P	Gala: The Earth As A System	Summer '93 Summer '94	35P
Northwestern University	Earth: A Changing Planet	Winter '93/'94	150P	Biogeochem. of the Earth Sys.	Spring '94	25P
Ohio State University	Geology & the Environment	Spring '94	70P	Integrated Earth Systems	Spring '94	15P
Penn State University	Earth As A System	Fall '93 Spring '94	780P	Numerous Earth Systems related Courses	Fall '93 Spring '94	280P
Princeton University	Perspectives on Env. Issues	'92/'93	90P	Biogeochemistry of	'92/'93	25P

SCHOOLS TO TEACH ACADEMIC YEAR 1993-94 WITH ESSE SUPPORT

Table B Cont.

SCHOOL NAME	TITLE - SURVEY COURSE	DATE OFFERED	ENROLL.	TITLE - SENIOR COURSE	DATE OFFERED	ENROLL.
Purdue University	Survey of Earth Sys. Sci.	Fall '93	50P	Global Change	Spring '94	25P
Rice University	Atmosphere, Weather & Climate	Spring '94	117P	Earth System Dynamics	Fall '93	13P
Stanford University	Intro. to Earth Systems	Winter '94	61P	Senior Sem. in Earth Systems	Spring '94	10P
Rutgers University	Perspectives in Agrl. & Environ.	Fall '93	500P	Seminar ESSE Colloquium	Spring '94	14P
Washington University	Biogeochemistry	Spring '94	21P	Hydrology	Spring '94	13P
University of Wisconsin	Global Change: Atmospheric Issues and Problems	Fall '93 Spring '94	44P	Earth System Modelling	Fall '93 Spring '94	9P 9P
Totals			2315			556

Table D Cont.

SENIOR COURSE FACULTY AND TEACHING ASSISTANTS '92 - '93

SCHOOL NAME	TITLE-SENIOR COURSE	PRINCIPAL TEACHING FACULTY	DEPARTMENT	TEACHING ASSISTANT
Ohio State	Integrated Earth Systems	Ellen Thompson Carolyn Merry	Geography & Polar Resources Civil Engineering	Paul Kinder
Penn State	Earth Systems	Brent Yarnal Nels Shirer Alistair Fraser, & Others	Geography Geosciences Meteorology	
Rice	Earth System Dynamics	Arthur Few Ron Sass Tamarz Ledley	Space Physics & Astronomy Ecol. & Evolutionary Biology Space Physics & Astronomy	
Stanford	Senior Seminar in Earth Sys.	Mark Johnsson	Earth Systems Program	Susan Alexander
Utah State	Climate-Hydrologic Inter.	Jeff McDonnell	Watershed Sciences/ Forest Resources	Dave Harriss
Washington	Hydrology	Ray Arvidson	Hydrology/Earth & Planet. Sci.	Jahander Ramezani
Wisconsin	Earth System Modeling	Francis Bretherton John Kutzbach	Atmos. & Ocean. Sci. Atmos. & Ocean. Sci. & Inst. Env. Studies	

Table D

SENIOR COURSE FACULTY AND TEACHING ASSISTANTS '92 - '93

SCHOOL NAME	TITLE - SENIOR COURSE	PRINCIPAL TEACHING FACULTY	DEPARTMENT	TEACHING ASSISTANT
Alaska - Fairbanks	The Earth as a System	Glenn Shaw Dave Musgrave	Physics Oceanography	Elise Pendall
Arizona	Global Change	Lisa Graumilch	Tree Ring Laboratory	Diane Schweizer
California - Santa Barbara	Earth System Science	Catherine Gautier Alice Aldredge John Melack F. Davis	Geography Biology Biology Geography	
Florida	1) Global Biochemical Cycles 2) Modelling the Earth System	Paul A. Mueller Katherine Ellins Guerry McClellan Claire Schelske	Geology Geology Geology Aquatic Science	Gregory A. Mead
Iowa	Atmospheric Chem. & Physics	Gregory Carmichael Frank Weirich Jerald Schnoor G. Edgar Folk Other members of the Ctr. Glob. & Reg. Env. Res.	Chemical & Biochemical Eng. Geography Civil & Environmental Eng. Physiology & Biophysics	Kurtis Paterson Kevin Crist
Johns Hopkins	Modelling Earth Systems	George Fisher Jack Salisbury	Earth & Planetary Sciences	Dolores Durant
New Hampshire	Energy for a Sustainable Future	Robert Harriss	Earth Science	Terry Bense Stuart Leiderman
New York	Gala: The Earth As A System	Michael R. Rampino	Applied Science	

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4-7

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