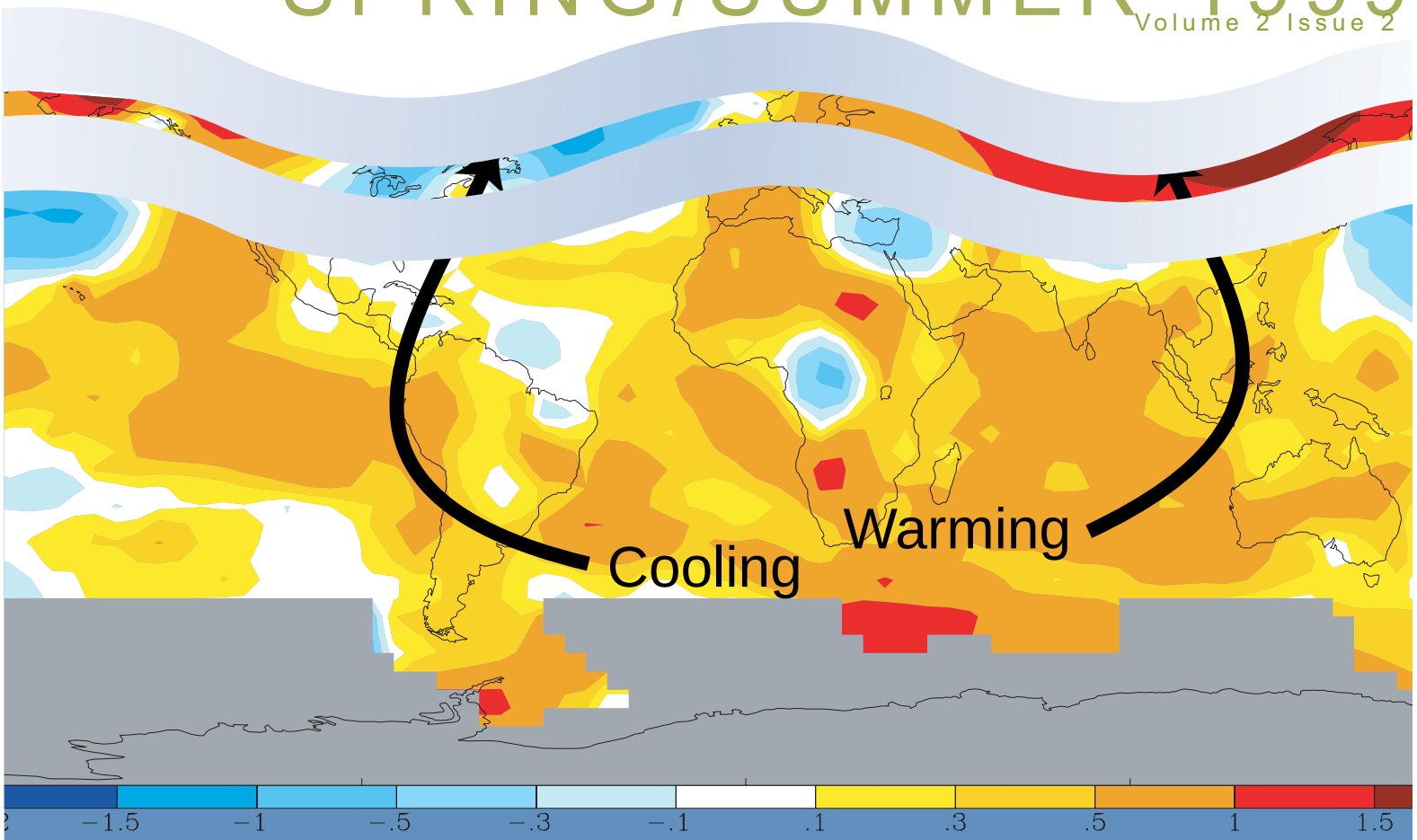
ICP Newsletter

SPRING/SUMMER 1999

Volume 2 Issue 2



featuring. . .

The Institute on Climate and Planets is a Research, Science Education, and Minority Outreach Program at the NASA Goddard Institute for Space Studies.

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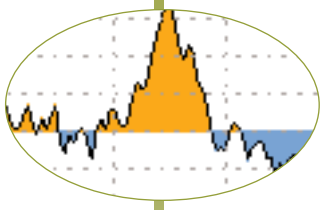
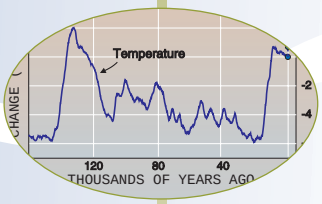
InThisIssue





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Research Update

THIS SPRING FIFTEEN HIGH SCHOOL AND COLLEGE STUDENTS WERE SELECTED AS ICP STUDENT RESEARCH INTERNS AT NASA GISS.

These students are continuing their climate research one to two days per week during the school year under the mentorship of GISS scientists and ICP faculty. Three new schools were selected as ICP Partner Schools and will receive a seed grant of $5000 each to support the development of a school-based ICP research and education program: Dewitt Clinton High School (Bronx), High School for Environmental Studies (Manhattan), and New Rochelle High School (New Rochelle).

ICP research projects are an outgrowth of priority GISS research areas that contribute to the broad study of climate variability. This year ICP teams are pooling the collective knowledge gained in their individual research projects to understand the contributions of various climate forcings, natural variability and global climate change to New York's climate. Each project is responding to unique science questions that aim to explain how humans and natural phenomena influence Earth's energy, water, and biogeochemical cycles, and atmospheric and ocean circulation. By applying the understandings gained about these climate processes and climate change, research teams will offer explanations of predictions for future climate.

A complementary effort is also underway in the ICP to connect our research objectives with national and state science standards. These standards call for students to develop problem-solving abilities they can apply in the workforce, understand science from an interdisciplinary perspective so they can make informed decisions as citizens, attain in-depth learning of science concepts in order to appreciate Earth as a system of physical, biological, chemical and social processes.

SPRING 1999 ICP STUDENT RESEARCH INTERNSHIPS AND PARTNER SCHOOL AWARDS

OCEANS

RAYSA RODRIGUEZ and DOROTHY LOUIS from Bronx High School of Science are continuing their summer '98 research investigating the question "What is the observed relation between ENSO and mid-latitude climate and is this simulated by the GISS coupled ocean/atmosphere model?" Under the mentorship of GISS scientist Ron Miller and ICP Bronx Science teacher Mitch Fox, these students are studying climate forcing by ENSO and how it effects regions throughout the globe.

Last summer, the ICP Oceans team found that the GCM was able to approximate the deflection of storm tracks over North America by ENSO. However, modest errors in the modeled deflection caused errors in the predicted temperature anomalies over the US. Research products include a GISS model ENSO index for comparison to observations along with observed and modeled anomalies of geopotential height, sea surface temperature and surface temperature during ENSO events.

The question guiding Dorothy and Raysa's current research is whether there is a consistent response to ENSO from event to event. They believe their research will allow people to assess the certainty of a forecast of the effects of El Niño and prepare in regions particularly affected, like California and Peru.

IMPACTS

CYNTHIA GIANNETTI of George Washington High School and CARYLE ANN FRANCIS from School of the Future are studying "How Does Water Stress Affect Crop Yields?" GISS scientist Jennifer Phillips and ICP faculty member Leila Woolley from High School for Environmental Studies are advising on this project that aims to estimate the sensitivity of corn yield to temperature, precipitation and water balance. The first phase of their research is concerned with the relationship between climate variability and water balance in two New York State regional climate divisions from 1972 to the present.

Caryle Ann and Cynthia will calculate an estimate of monthly potential evapotranspiration, which will then be used with monthly records of precipitation to calculate a seasonal water balance. Their analysis of precipitation, temperature and water balance records will identify

periods of drought when crop water stress may have limited crop yield. The second phase of their research will focus on crop yields for the same period as phase one in order to study the sensitivity of yields with climate variability and water balance.

Their final research product is the development of a simple model of the impacts of climate on corn yields which the ICP Impacts team plans to use two estimate changes in corn yields under future climate change scenarios for New York State. During the Summer Institute 1999, the team will use output from the GISS GCM to design these scenarios, depicting both potential climate change and influence of the North Atlantic Oscillation in New York State. Cynthia and Caryle Ann are excited about their research and its possible contribution to farming and dairy industries in the region where they live.

AEROSOLS

Queens College student MARICELA REYES and Bronx Science student ANDRE CASSELL are "Investigating the Spatial Distribution of Aerosols in New York City by Holding an Intensive Observation Period (IOP)." Working with their GISS advisors, Barbara Carlson and Brian Cairns, and faculty advisors Brendan Curran from Townsend Harris High School (Queens) and Robert Gandolfo and Kevin Finnerty from DeWitt Clinton High School (Bronx), they plan to field-test the 1998 sunphotometer design. The overall goal of the ICP Sunphotometer team is to obtain a better understanding of the nature and distribution of aerosols leading to an improved determination of aerosol radiative forcing on the earth's climate.

The students' study of aerosol in New York City will complement and contribute to the GISS investigation of aerosol properties retrieved from a network of Multi-Filter Rotating Shadowband Radiometers (MFRSR), measuring the intensity of sunlight in six channels or wavelengths. Last year, the Sunphotometer team conducted two IOPs with students from all five New York City boroughs. The data collected suggested seasonal variations in aerosol properties, analysis of the data also revealed that measurements made at a given school were as variable as measurements made at different schools. This prompted students to modify the hand-held circuits to decrease the instrument noise and increase instrument reliability.

This year's IOP focuses on assessing the reproducibility of the measurements by having more students at fewer schools make side-by-side measurements for comparison. Schools participating in the one-week IOP are LaGuardia Community College (Queens), Medgar Evers College (Brooklyn), Townsend Harris High School (Queens), Bronx Science and DeWitt Clinton High School (Bronx). IOP participants will log their data along with weather data (pressure, wind direction, wind speed, temperature and humidity) obtained from school-based weather stations on the database accessed from the GISS web site.

Andre and Maricela will produce a local analysis of aerosol optical thickness over each participating school site. In addition to testing their new sunphotometer design, this IOP will also include two hand-held sunphotometers developed for use in the GLOBE program, an initiative sponsored by Vice President Gore to engage students in climate measurements throughout the world. The students will calibrate the GLOBE instruments using Langley Regression and compare the GLOBE sunphotometer measurements to their own sunphotometer measurements and the measurements made by the GISS MFRSR.

CLOUDS/STORMS

For her ICP Student Research Internship, A. Philip Randolph High School student SHARIKA DE LA OZ will study "Do Stronger Storms Mean More Rain Clouds?" George Tselioudis is her GISS science advi-

sor, and Robert Kruckeberg from A. Philip Randolph is her faculty advisor. The project is designed to contribute to the ICP Cloud team study of Cloud Structure in Storm Lifecycles. This is a continuation of Sharika's Summer Institute 1998 research in which she related cloud properties derived from satellite observations to the dynamical properties of storms. During this school year she plans to increase the number of storms she is analyzing in order to improve our understanding of cloud formation in real world storms.

In addition, Sharika's research is a component of GISS work on the problem of how clouds affect climate and whether the current global warming trend will increase the frequency of extreme climate events such as droughts and floods. Her study focuses on storms in the mid-latitudes and the hypothesis that there is a strong correlation between storm strength and the amount of rain clouds. A new dimension of her research is comparison between storm clouds observed by satellites and cloud formation in GCM storms, that she hopes will contribute to the GISS model improvement effort.

■ A. Philip Randolph students, ANDREW AUDRY and HEBERTHE DELY, are studying "How Will the Change in Temperatures at the Poles Affect Storms in the Mid-Latitudes". Under the mentorship of GISS scientist George Tselioudis and their A. Philip Randolph faculty advisor Chris Petersen, Andrew and Heberthe's research attempts to better predict how changes in the Meridional Temperature Gradient (MTG) may change the strength of storms in the mid-latitudes. A measure of the difference between Earth's warm equatorial and cooler polar regions, the MTG is an important factor contributing to energy balance. If the temperature differences between these regions decrease, less energy will be globally distributed and this could possibly lead to fewer or weaker storms.

Andrew and Heberthe will study the relationship between sea level pressure anomaly distributions and the MTG, as well as analyze the strength and number of storms. They focus on the period 1979 to 1996, analyzing real world storms under different MTG conditions. The ICP Cloud team researches issues concerning how storm clouds may change in a warmer climate and hopes to contribute to the GISS modeling of clouds in the GCM.

FORCINGS/CHAOS

SONJAE WALLACE, a student at York College is investigating the question: *How Well is the GISS GCM Representing Incident Short Wave Solar Radiation at the Surface in Germany?* under the mentorship of GISS scientist Jim Hansen and York College faculty member, Sam Borenstein. This project will contribute to the Forcings and Chaos team study and assessment of the GISS GCM's predictive capabilities.

A comparison of incident short wave solar observations at the surface in Germany with the model's output for the same variable and dimension will be done by creating overlaying graphical line-plots. Dr. Martin Wild, a scientist in Zurich, Switzerland, inspired this investigation.

In a similar study with other models, Dr. Wild concluded that improper algorithmic computer coding is causing GCMs from various institutions to over estimate the amount of short wave radiation at the surface by about 10 Watts per square meter. If the GISS GCM has a similar discrepancy in shortwave radiation hitting the surface, it would have a deleterious effect on the model's ability to accurately simulate climate change and would need to be addressed in further model development. The results of this research will serve to emphasize how well many atmospheric variables that depend upon solar influx, are being expressed in the GISS GCM.

■ ROSA ANDUJAR and JOHANNA PINO from High School for Environmental Studies are ICP Student Research

Interns on a new Forcings and Chaos team project: "Global Warming and the Urban Heating Effect." Their GISS advisor is Jim Hansen and their faculty advisors are Sam Borenstein, from York College, and Umit Kenis, a teacher at their school. Their research interest "whether local climate change seen by the person in the street is the result of urban heating, a real global climate change, or just the climate is varying naturally".

A person's perception of climate change is influenced by what he or she experiences as the norm in a particular geographic area. Rosa and Johanna will study several cities that represent different US regions and geographic settings. The preliminary group of cities selected includes: Boston (coastal), Denver (high altitude) and Phoenix (desert). Using data from the GISS Common Sense Climate Index, they will study the effect of urban heating resulting from the development in large cities.

The Forcings and Chaos team will compare weather station data of urban temperatures with nearby smaller rural locations. Their aim is to see if the larger city depicts a different temperature trend than the smaller rural locations.

The analysis will also be compared to global mean temperature trends. Rosa and Johanna's project investigates the significance of several natural and human factors that influence local climate, including a region's latitude, population, geography, and urban development.

PARTNER SCHOOL AWARDS

■ An ICP Partner School Grant was awarded to NEW ROCHELLE HIGH SCHOOL in New Rochelle, New York. PATRICK CUSHING is the principal investigator of this school proposal contributing to the Climate Impacts team research on "The Effect of Water Stress on Crop Yields". GISS scientist Jennifer Phillips is the research advisor for this new school based initiative to enhance the relevance of science in the lives of high school students. The project also aims to provide students with the opportunity to develop skills for using technology in a meaningful way in the process of doing science.

Mr. Cushing is integrating the Impacts team research into two "Living Environment" classes that each enrolls 25 students, by having students conduct growth experiments with bean plants, before doing analysis on real crop yield data. These classes are being designed to help develop the skills of students who have difficulty obtaining regents diplomas. They encourage projects like the ICP that integrate research experiences into students' science learning, building a bridge between what happens in the science classroom and in the real world.

Both Mr. Cushing and Dr. Phillips support the educational approach that students gain a hands-on experience concerning the science concepts related to their research, prior to working with Internet-accessed data. Toward this end, students will design and conduct experiments to determine how the amount and frequency of watering will effect the growth of bean plants. These experiments will provide some of the science foundation needed for students to contribute to Climate Impacts team study.

Student experience gained conducting the growth experiments and the Impacts research project will begin to give them an understanding of the concept of modeling physical processes and thinking about the Earth as a system. This aspect of Mr. Cushing's education strategy, as well as the emphasis on students participating in real world inquiry-based cooperative learning concerning the hydrological cycle, addresses key process and content skills in New York State Science Standards.

■ DEWITT CLINTON HIGH SCHOOL has received an ICP Partner School Grant award of seed funding to establish a school-based program to integrate the ICP sunphotometer aerosol research into their science program.

The principal investigators are

KEVIN FINNERTY and ROBERT GANDOLFO who are collaborating with GISS scientists Barbara Carlson and Brian Cairns. Mr. Finnerty and Mr. Gandolfo are committed to this project because students will have an opportunity to learn, reinforce, and supplement science concepts that are already part of the curriculum while improving their technological skills with computers and scientific instruments through their participation in a real science investigation. The school administration is supportive of this new initiative that addresses topics and skills in the New York Regents Earth Science and Physics.

This project offers students real world applications to concepts such as the electromagnetic spectrum, the behavior of light, planetary motion, atmospheric composition, meteorology and climate. The educational approach is to begin with concepts that are familiar to the students and expand their understanding via hands-on activities. The faculty plans to introduce the project with a series of student activities using the ICP GEEBITT spreadsheet-based climate model.

Unlike most other ICP projects, students involved in the Sunphotometer project build and test a scientific instrument as well as collect and validate the data that they use in their research projects. This gives the students ownership and builds confidence through seeing their design ideas implemented and contributing to the protocols for data collection. This school has dedicated a room for this research project that aims to have high school students study the role of aerosol in local climate variability.

■ HIGH SCHOOL FOR ENVIRONMENTAL STUDIES (HSES) received an ICP Partner School Grant to support school-based research and education activities lead by three faculty members on ICP research teams: LEILA WOOLLEY (Climate Impacts), UMIT KENIS (Forcings and Chaos) and SUSANE COLASANTI (Sunphotometer/Aerosols).

All projects are concerned with engaging students in studies that improve our understanding of climate in the northeastern region of the US where we live. Their investigations deal with important factors (forcings) that can produce climate change—water resources, atmospheric gases, urban heating and natural variability.

Impacts, and forcings/chaos research has been described previous ly. The Aerosol project aims to contribute to the sunphotometer study. The research team will use emissions and weather data to study the relationship between aerosol type and load with climate change. In this first phase of the school-based implementation, HSES faculty decided to introduce the program as an after-school research opportunity for 5–8 students. Like the DeWitt program, the HSES principal has dedicated a room for the NASA research.

In addition to leading student research, HSES faculty will prepare lessons motivated by their research that contribute to a range of Regents Earth Science topics. For example, the content areas they plan to impact include: The Water Cycle and Climates, Earth Dimensions, Surface Processes and Landscapes, Latent Heat and Atmospheric Energy and Meteorology.

The research skills emphasized in the HSES project are engaging students in formulating original hypotheses and problem statements, collecting and displaying data, analyzing data, and communicating results. *— CH*

Contributors: Sam Borenstein,Brian Cairns, Barbara Carlson, James Hansen, Ron Miller, Jennifer Phillips, & George Tselioudis

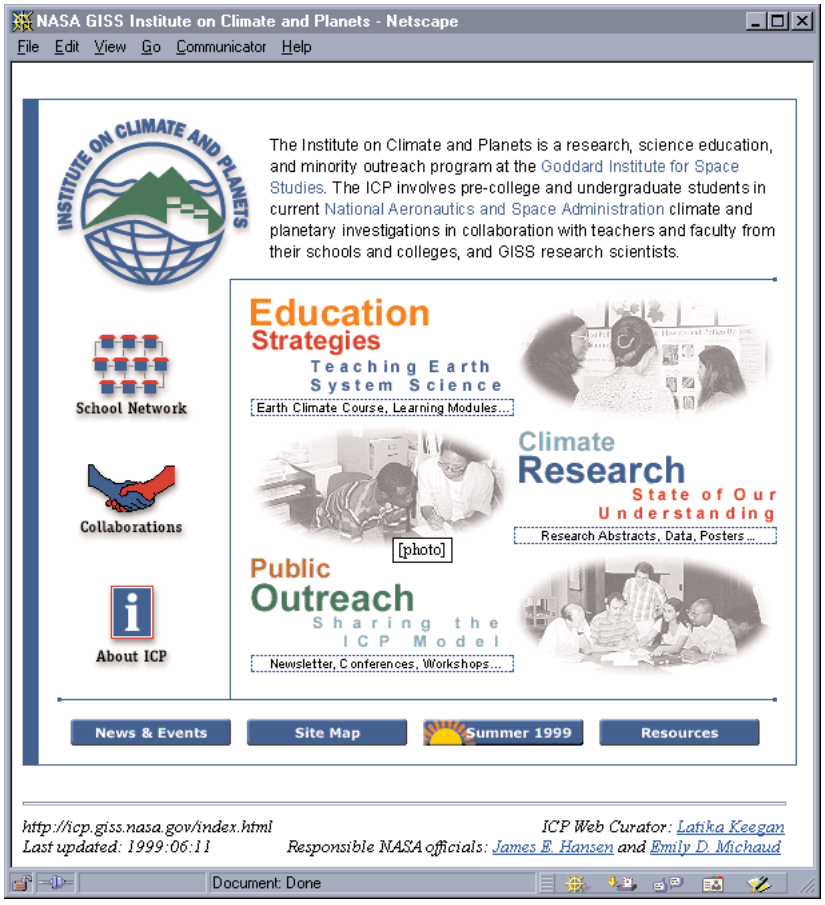
ICP WEB Highlight

http://icp.giss.nasa.gov/

New Design—Site Aligned with ICP Goals—Climate Research, Science Education, and Public Outreach

The newly redesigned web site for the GISS Institute on Climate and Planets was launched in February this year. The focus of the site is to take the program's model and offer opportunities via the Internet to reach beyond our existing network.

This expands the growing ICP community of students, teachers, and scientists who engage in NASA research related to understanding earth's climate, teaching earth system science, and sharing what we learn with the public. ICP web provides educators and students with resources for teaching and learning science and investigating climate research problems via three main categories: Education Strategies, Climate Research, and Public Outreach. Descriptions of each section and our future outlook follow.



ICP web home page.

EDUCATION STRATEGIES: Teaching Earth System Science

This section offers learning modules, (for example, an activity to study the Effect of the Sun's Energy on the Ocean and Atmosphere), educational tools (such as GEEBITT, a spreadsheet-based model), and the ICP Earth Climate Teacher Education Course currently being developed. These education products aim to prepare students with basic skills and understandings needed to participate in climate research. Many of the products are designed as examples for addressing state and national science standards to enhance current teaching practices. Studying problems linked to NASA's Earth Science Enterprise, they are designed to complement instruction by providing a means to reinforce and assess science learning. Teachers and students involved in school-based research projects are invited to make use of these materials and send their evaluations to ICP.

The Education Strategies section will also serve as a repository for upcoming curriculum, resources for student evaluation, and documentation of ICP's educational approach and benchmarks. An expected outcome of this year's Summer Institute is to produce lessons and assessments motivated by climate research problems and based on the NY State Science Standards. We are aiming to prepare these materials for classroom field-testing in the fall and gradually integrate them into the web site.

CLIMATE RESEARCH: State of Our Understanding

The "state of our understanding" of Earth's climate is reported by sharing progress on research done by our students and teachers in collaboration

with GISS scientists. The Climate Research section contains updates on current ICP projects, research results, abstracts, and posters. Topical papers written by students and teachers during the intensive summer program provide knowledge-building resources.

These materials are essential preparation for ICP projects as they present the science questions and issues that each team deals with in their research. Students and teachers looking to do climate research at their school or college campuses should begin by reading these topical papers.

We hope to facilitate student and faculty research by providing users access to a range of projects and products as more topical papers and posters come online. A future goal is to provide the next generation ICP projects in the form of mini research activities that students and teachers can carry out in their classrooms, including evaluation and reporting materials. Ultimately, this leads to online research guides with links to data and model, and a group of student-written papers that enable students to cite each other's research as they add to the collection.

PUBLIC OUTREACH: Sharing the ICP Model

Sharing our research and education activities with the public is an important responsibility for the GISS ICP community. The Public Outreach section carries ICP Newsletter issues, materials from the ICP youth service initiative Space Quest (a Saturday science program for elementary and junior high school students), and updates on outreach activities such as local staff development and special programs for visitors. Sharing the ICP model provides resources to improve public understanding of climate research and science.

THERE'S MORE…

Other sections of the website include a News & Events page that reports on participation of ICP students, teachers, and staff in conferences, workshops, competitions, and other events. Also included are links to parts of the Education Strategies, Climate Research, and Public Outreach sections for detailed papers, modules, or articles when relevant.

Since 1994, ICP has contributed to several project proposals that have been successful in receiving funding. Brief explanations of these Collaborations are provided, including the NASA MU-SPIN Network Resource and Training Site at the City College of New York (CCNY), the Solar Irradiance Research Network, and PAIR—NASA Partnership Awards at CCNY and Medgar Evers College.

The ICP Research and Education School Network provides a list of participating and represented schools currently in the program. The section entitled, About ICP, provides an overview of the program, a list of current participants by research team, links to schools, and a discussion forum used for planning purposes. For example, the Bulletin Board is being used in April-May to plan the schedule and activities for Summer Institute 1999.

Additional Resources at the site include a Science Glossary and ICP's PosterApplet, a downloadable package used for displaying science posters or papers online *(see following page).*

LOOKING AHEAD: Next Steps

Our long-term vision for ICP web is to continue providing meaningful science resources for the study and understanding of climate. Building a community via the web is not an easy task, and what we have undertaken is a challenge for the limited staff and resources at ICP.

Lessons that enhance classroom learning and research projects to apply one's skills and knowledge are to be placed online as ICP continues its quest for excellence and quality in science education and student research. This is done with the help of the students, teachers, faculty, staff, and GISS scientists, who have collaborated since the inception of the program in 1994, sharing in the responsibility of providing our young people with the highest quality science, mathematics, and technical education.

— LK

PosterApplet is a mini-

Featured Product: Electronic Science Poster Maker

application for displaying multi-section posters or papers online.

Written in the Java programming language, PosterApplet is platform-independent: it is able run on UNIX, Windows, and Macintosh operating systems. This resource is freely downloadable from the ICP web site at

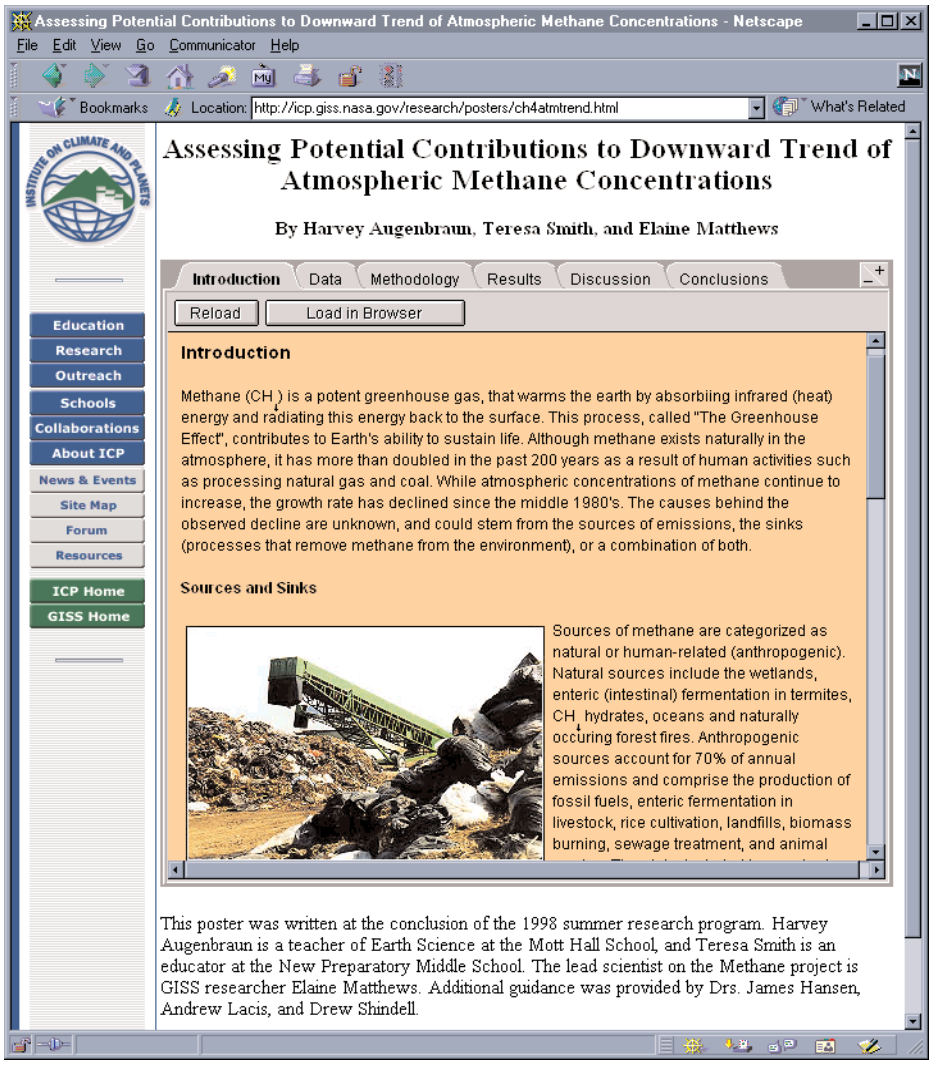
http://icp.giss.nasa.gov/resources/posterapplet/

Through the use of "tabbed" sections, PosterApplet provides an interface for displaying and viewing science posters using a Java-enabled web browser, a collection of documents can be presented in a cohesive and intuitive way for viewers to peruse. Students and teachers are encouraged to obtain and use the applet to share their campus-based research results by placing them on their school/college web sites.

This utility is currently being used on our web site to display ICP research posters in a Science Poster Gallery

http://icp.giss.nasa.gov/research/posters/

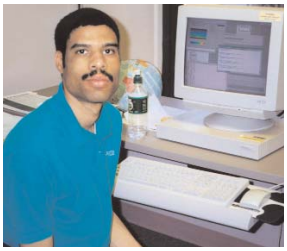
Users can browse through results of research done by teams of students, faculty, and scientists at GISS. A view of a poster entitled, *Assessing Potential Contributions to Downward Trend of Atmospheric Methane Concentrations,* written by Harvey Augenbraun (teacher at Mott Hall School), Teresa Smith (educator at Jr. HS #8), and Elaine Matthews (GISS Scientist), at the conclusion of the summer 1998 research program, is presented above.



PosterApplet displaying a Methane project poster
http://icp.giss.nasa.gov/research/posters/ch4atmtrend.html

About The Author

Jose Alburquerque, a student researcher on the ICP Clouds team, developed PosterApplet for the Institute on Climate and Planets. A graduate of the High School of Graphic Communication Arts, ranked 4th of a class of 150, he received his Regents Diploma in June 1987. He is currently pursuing a Bachelor of Science in Computer Science at the City College of New York. Jose programs primarily in Java and C/C++ and has written several applets for data visualization during his three-year participation in ICP. A skilled programmer, he enjoys learning and experimenting with new code and building software packages. Keep a lookout for upcoming visualization tools in the Research/Data section of ICP web.



Comments and questions on PosterApplet can be sent to the ICP Webmaster, Latika Keegan, at lkeegan@giss.nasa.gov

Earth Climate Education

THE NEW SCIENCE STANDARDS: IS THE DEBATE OVER CONTENT VERSUS PROCESS COMING TO AN END?

For centuries people have debated the goals of education and the priority placed on developing what students know, how they learn and how they think. In ancient Greece two characters in Aristophanes' comedy, The Clouds, pose the classic positions for this debate over students learning content versus process. On one side of the debate is a conservative, elderly soldier who favors traditional education where discipline and memorization are key to learning content. On the other is Socrates, depicted as a crafty debater with little respect for authority who believes education should develop skills to construct reasoned arguments and questions *(Nussbaum, 1997 p1).*

As in most debates, one position seeks to be declared the "winner," creating an environment where it is unlikely to provide students with the logical balance among goals to develop what they know, how they learn and how they think. Yet, the current wave of American education reform establishing new state and national science education standards raises the questions: Is the debate over content versus process coming to an end? Are we entering an era where teachers will be seeking new approaches that balance these learning goals?

The last ten years of U.S. education reform focused attention on new mathematics, science and technology standards to prepare students with fundamental understandings of the world while developing their abilities and technical skill to reason logically about the world *(Project 2061, 1990).* These new reforms represent a shift in thinking about education goals away from learning environments that emphasize the basic skills to read, write and do arithmetic and where analytical skills are only ideals, not stated aims of learning *(Ravitch, 1995 p102).* In order to help students meet the new science standards, providing them with a basic level of literacy will no longer be a sufficient education goal, distinct from developing their abilities to reason and make inferences. Ensuring in-depth learning of basic science content, beyond the lifetime of a multiple-choice test, is now viewed as requiring opportunities for students think critically about the knowledge they acquire in the contexts of problems that integrate themes in the nature of science inquiry and that relate other disciplines.

In New York State (NYS), the Lead Science Assistant Principal for Manhattan, Barbara Poseluzny, recently said the "State Education Department (SED) is now developing assessments and looking for model programs that emulate NYS' seven Mathematics, Science and Technology Standards (MST), based on national standards. The NASA GISS Institute on Climate and Planets (ICP) can contribute to these MST Standards by sharing existing lessons, courseware, data and web products and student research projects, as well as the ones planned for development during the ICP Summer Institute 1999."

A driving idea behind the GISS ICP education model is to devise practical ways to use the interdisciplinary study of Earth's climate as a context for developing students' science inquiry skills. The foundation of the ICP model is integrating students and educators into the GISS science community and creating contributing roles for them in NASA Earth Science Enterprise climate research projects. When asked about the potential long-term benefits of the ICP model, Jim Hansen, the Head of NASA GISS offered the following response. "A principal reason that NASA scientists are choosing to work with educators is the realization that all citizens need to be familiar with scientific and technical issues to participate effectively in both private and public decision making. If nonscientists have some familiarity with the research process, it helps in assessing the public discussion of issues such as global warming, air pollution, or genetic modification of plants and animals —the myriad of technical issues that will only increase in the future—issues that must ultimately be evaluated and acted on by the public and their representatives. Students who have participated in research projects are more likely to have some understanding of the research process and thus as citizens be better able to assess the conflicting arguments of special interest groups."

Dr. Hansen's views, as well as those shared by ICP faculty, students, scientists and staff in this article, provide insights into the benefits of our research and education collaboration and the common themes in climate research related to the new MST Standards. Faculty perspectives are also included on what is needed to successfully address these new standards and potential classroom impact.

Common Themes. ICP faculty is attempting to apply the following common themes drawn from their research experiences and related MST Standards in science instruction and materials. **1)** Climate is viewed as an unsolved puzzle with opportunities for students to apply science, mathematics and technology to real problems. **2)** Influenced by humans and natural phenomena, climate problems provide a learning context where students can use evidence to explain physical, chemical and biological processes and reason about how changing conditions affects vari-

ability in the climate system. **3)** Current scientific understandings are used to model the Earth system and make future predictions. **4)** Highly valued skills are the ability to look at problems from different perspectives (temporal, spatial), develop and test hypotheses, and explain relationships and patterns. **5)** The complexity of the climate system and reliance on measurements and models make uncertainty, probability and predictability important concepts. **6)** Science is a dynamic process, so reading about the history of the development of scientific ideas and communicating research (orally and in writing) are integral components of research and science learning.

Science for All Americans, a national standards initiative of the American Association for the Advancement of Science (AAAS) supports teaching grounded in similar themes. Integrated into instruction, these themes will expose students to the nature of science inquiry and lead to more indepth content understandings *(Project 2061, 1990).* Likewise, the NYS MST Standards, primarily based on the AAAS's Project 2061, advocates greater emphasis be given to science inquiry. Four out of the seven new standards focus on developing students' "science process skills" associated with the nature of science inquiry. Standard Four, most closely related to ICP student research, deals with the content area for the *Physical Setting/Earth Science Core Curriculum*. It provides a set of learning guidelines (not a curriculum, per se) for incorporating science process skills into studying the Earth and our solar system.

In their reviews of Physical Setting, many ICP faculty say that the "major understandings" (content) for students to learn are valid. The greater integration of science topics and process is an improvement over the current Earth Science curriculum for ICP teachers, like Susane Colasanti of High School for Environmental Studies, because it has the potential to give students a more indepth understanding. Teachers who give students experiences to reason about beliefs, justify claims, and critically examine theories (including their own) are connecting their classroom to the science community.

However, balancing student learning of science content and cognitive skills will require altering our conceptions of curriculum. Several ICP faculty state that in order to meet the standards more time should be given to labs and cooperative and problem-based learning. A new ICP teacher from New Rochelle High School, Ceasar Irby, raised the question, "With all the science content in the Physical Setting, can a teacher really spend the time developing process skills" since "working on problems that emphasize them [process skills] takes a lot of class time?" Addressing the new standards will require decisions to limit course content to what is essential for science literacy at the particular level of instruction *(Project 2061, 1990).* Umit Kenis and Leila Woolley, Earth Science teachers at High School for Environmental Studies, suggest an alternative is to deliver a two-year Physical Setting course.

New Rochelle High School biology teacher, Pat Cushing, is involving his students in a GISS/ICP climate impacts research project to study the influence of water stress on agriculture in New York. Students in his class conduct plant growth experiments, use the Internet to acquire precipitation and corn yield data, input and manipulate data in spreadsheets, calculate and graph data correlations, discuss and reason about the contribution of their findings to the research problem, and present their results. He believes that climate research is an "ideal context to meet the new standards," yet his classroom experience shows that many teachers will face a common challenge "to offer this type of learning environment to 34 students". To achieve the kind of instruction called for in the MST Standards, changes in class setting are also required, such as smaller class sizes and longer class periods.

According to Mitch Fox, a Geoscience teacher at the Bronx High School of Science, the goal of Earth Science education in New York has traditionally been to develop student skills in the scientific method (process) and understanding of a range of topics (content). What is different about the current MST Standards? The Preface to Physical Setting states "It (the Standards) addresses the content and process skills as applied to the rigor and relevancy to be assessed by the Regents examination . . ." A new 3-hour Regents examination will require students to answer multiple choice questions or construct responses in order to assess their understanding of science concepts. The real change is two of the three examination parts will now focus on students' ability to apply this content knowledge in conjunction with science inquiry skills (e.g., hypothesize, predict, analyze, evaluate) to real world problems *(New York SED, 1999).* Education goals for instruction and curriculum will have stated aims for both science content and process in order for students to pass the NYS Regents examination.

Robert Gandolfo, an ICP faculty member teaching physics at DeWitt Clinton High School, recognizes that

the content and format of the Regents examination drives what is taught in the classroom. While he sees no real difference in the Physical Setting content, adding the new examination sections on science process skills presents a potentially significant change. Without seeing the test questions, Mr. Gandolfo believes, "it is unclear how rigorous" the test portions dealing with science process skills will be, "they can potentially be very easy or difficult." He and other ICP faculty would see evaluating the standards document in conjunction with test questions as a more valuable exercise.

The performance based standards adopted by NYS present ICP with an opportunity to address a stated need for new assessments that give students opportunities to demonstrate what they know and apply learning to a real situation. This summer ICP faculty is aiming to produce test questions to submit to the SED, using GISS/ICP climate research problems and related science data.

A final comment shared by ICP faculty about the MST Standards dealt with a perceived shortfall of qualified teachers to implement the Physical Setting. Recognizing the demand for teacher education, many ICP faculty and school administrators have agreed to lead school-based Teacher Institutes (short-courses) to help teachers address the new MST Standards, using ICP lessons, modules, courseware, web resources and other products. This type of contribution is consistent with two problem areas identified in state-held hearings reviewing the MST Standards to provide models to attain Standard 1 (lessons, research projects and assessments) and offer professional development based on these models.

Classroom Impact of MST Standards. In terms of the actual classroom impact the MST Standards will have, ICP faculty and scientists were asked to determine the connections between their climate research and "key ideas" and "major understandings" defined in the Physical Setting/Earth Science Core Curriculum, as well as the standards addressing science process. This feedback is the basis for the following examples of ways ICP research projects engage students in the kind of science learning defined in the standards.

NYS Standard 1: Analysis, Inquiry and Design — students will use mathematical analysis, scientific inquiry and engineering design, as appropriate, to pose questions, seek answers and develop solutions.

ICP climate research projects integrate math into research tasks as opposed to giving students a set of math problems "to do", offering them a chance to realize the value of math and reinforce what they are learning. For example, students seek understandings of the natural phenomena of El Niño by creating an index of sea surface temperature data. This helps them estimate the magnitude and scale of El Niño effects, a key idea to use abstraction and symbolic representation to communicate mathematically.

The Climate Impacts team studies the effects of water stress on New York corn yield where students design plant growth experiments and derive the correlation between potential evapotranspiration levels and crop yields. This is leading them to develop explanations for the effects of water balance on plant growth, thus addressing the key idea that the central purpose of science inquiry is to develop explanations of natural phenomena.

A research question for the Clouds team is "Do stronger storms mean more rain clouds and will the current global warming trend increase the frequency of intense storms?" By analyzing the frequency and intensity of storms and the relationship of cloud properties to storm strength and the percentage of rain clouds, students test proposed explanations involving the use of conventional techniques and procedures.

An additional way ICP addresses science inquiry process skills, "not explicitly stated in the standards, is by dealing with the ideas of natural variability and experimental and theoretical uncertainty" (ICP faculty, Sam Borenstein). Their omission in the current MST Standards document represents a gap between the nature of scientific inquiry and what students learn in the classroom.

NYS Standard 2: Information Systems — students will access, generate, process and transfer information using appropriate technologies.

Students use a range of meteorological data in climate research, conducting Internet searches for data and downloading data from places such as the National Climatic Data Center and NASA. A team studying New York's pollen signature, and a second, using hand-held sunphotometer instruments to obtain solar irradiance data for an aerosol study, collect urban climate measurements, input their data in databases and use a range of software programs to prepare data products and presentations. Another team developed a Storm Tracks Atlas, providing on-line access to monthly, seasonal and annual data products and utilities to study storm statistics.

NYS Standard 6: Interconnectedness: Common Themes — students will understand the relationships and common themes (systems thinking, models, magnitude and scale, equilibrium and stability, patterns of change, optimization) that connect mathematics, science and technology and apply the themes to these and other areas of learning.

The Oceans team studies patterns of change in Pacific Sea Surface Temperatures to understand the extent of their regional and global influence on temperature, precipitation, and storm tracks. Students plan to use their results to see how well the GISS climate model reproduces El Niño effects. Another team, Forcings and Chaos, is researching the urban heat island effect, analyzing the sensitivity of the climate system to changes in land surface and the implications of human development on earth's habitability.

On the local level, the ICP Aerosols team is looking at NYC emissions trends in order to begin to develop a hypothesis about future warming or cooling. They also study the relationship among aerosol type, load, temperature, visibility and humidity, and the magnitude and scale of effects on urban climate. Another local study is

conducted by the Climate Impacts team where students are learning the concept of equilibrium by evaluating water balance conditions necessary for ideal crop yield, as well as gaining an appreciation for optimization in discussing crop yield applications to land use, pollution, global warming and natural resources.

NYS Standard 7: Interdisciplinary Problem-Solving — students will apply the knowledge and thinking skills of mathematics, science and technology to address real-life problems and make informed decisions.

While climate problems are naturally interdisciplinary, a goal for ICP is to give students further opportunities to connect scientific understandings and research results to decisions about real-life problems. These types of connections vary among the student projects since their investigations are designed as scientific studies. The Aerosols team is beginning to make this connection in studying potential relationships with asthma, a serious health problem in NYC. However, all teams have the task to communicate their research results in meaningful ways to the public in science talks, papers and education materials.

NYS Standard 4: Physical Setting/Earth Science: Key Idea 2 — many phenomena that we observe on Earth involve interactions among components of air, water and land.

ICP projects deal with cycles in the climate system — energy, water, and biogeochemical. More specifically than "interactions, among components of air, water and land," ICP research involves learning about phenomena in terms of principles and laws of physics and chemistry. How heat is transported in atmosphere and ocean and what creates weather patterns, regional climate and Earth's habitability are all relevant "major understandings." Existing projects introduce students to a range of data sources — radar, satellite, and weather maps, as well as strengths and limitations of these data. For example, students using NY weather station data from a small area realize the limitations in trying to draw conclusions about regional conditions.

Physical Setting does not emphasize atmospheric motion. "This (atmospheric motion) has important implications for climate and Earth's habitability because most emission to space occurs from the mid-troposphere due to the greenhouse effect, whereas most solar energy is absorbed at the surface" *(GISS Scientist, Ron Miller).* The importance of atmospheric dynamics is brought out in the Clouds team study where students analyze cloud properties (cloud top pressure, optical thickness) and weather variables (e.g., sea level pressure) to explain how clouds form, storms develop and implications for a warmer climate. In studying El Niño, students must apply dynamics to learn how changing wind and pressure patterns affect long-term weather systems. Atmospheric interactions with the land surface and atmosphere are equally important to the Methane team research dealing with the sources and sinks of this gas (natural and human). Methane (and other gases) changes state between the land surface and different levels in the atmosphere, influencing how gases absorb, reflect and scatter solar energy, contribute to unequal heating of Earth's surface and atmosphere, and climate variability.

Conclusion. Richard Feynman, a noted theoretical physicist and innovative physics educator, once said "there isn't any solution to this problem of education other than to realize that the best teaching can be done only when there is a direct individual relationship between a student and a good teacher — a situation in which the student discusses the ideas, thinks about the things, and talks about the things. It is impossible to learn very much by simply sitting in a lecture, or even by simply doing problems that are assigned." Feynman frames the premise for the current challenge in American education—"we have so many students to teach that we have to find some substitute for the ideal." *(Feynman, 1963 pg. xxix)*

Imbedded in this ideal that represents the "Holy Grail" of science education is the importance of science process and content. New state and national education standards outline the learning environment we want to provide every student, as well as raise many questions for teachers and others who have agreed to participate in education reform. Can a science classroom deliver traditional instruction and basic science literacy along with the ideals of Socratic argument where students search for the truth about problems in an objective way? Are there ways that teachers can involve students in science learning where their ideas are subject to change as are their explanations about the world? *(Project 2061, 1990)* If students face science problems in a broader context, will they be better able solve them? *(Nussbaum, 1997)*

These are questions that ICP faculty and scientists will deal with during the upcoming 1999 Summer Institute. The lessons and assessments that they produce over the summer will attempt to contribute to Feynman's "substitute ideal" education and provide teachers with examples for addressing the New York State Science Standards. *— CH*

References

Dewey, John. *Experience and Nature.* Dover Publications. New York, 1958.

Feynman, Richard P. *Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher.* Helix Books. Reading, Massachusetts. 1995

Holt, John. *How Children Learn,* revised edition. Addison-Wesley Publishing Company. Reading , MA, 1995.

New York State Education *Department. Physical Setting/Earth Science Core Curriculum* (Draft). The University of the State of New York. Albany, NY, December 1998.

Nussbaum, Martha C. *Cultivating Humanity: A Classical Defense of Reform in Liberal Education.* Harvard University Press. Cambridge, MA, 1997.

Project 2061: Science for All Americans. *American Association for the Advancement of Science.* Oxford University Press, 1990.

Ravitch, Diane. *National Standards in American Education: A Citizens Guide.* Brookings Institution. Washington, DC, 1995.

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Harvey Augenbraun, Sam Borenstein, Katherine Chance, Susane Colasanti, Patrick Cushing, Kevin Finnerty, Mitch Fox, Robert Gandolfo, William Gononsky, James Hansen, Ceasar Irby, Umit Kenis, Robert Kruckeberg, Ron Miller, Barbara Poseluzny, Theresa Rogers, Leila Woolley.

Partnerships

ICP Partners Form New Working Group to Leverage NASA and NSF Investments: Building A Continuum to Support Student Excellence in Science, Mathematics, and Technology.

On May 3rd, representatives from NASA GISS and CUNY colleges involved in the ICP gathered for the first meeting of the ICP Partner Working Group. By organizing this working group, we expect to clarify and evaluate the unique contributions of each partner to the research and education goals of our collaboration.

The initial task is to define each partner's contributions to develop and sustain an educational continuum for students to excel in science, mathematics, and technology. By leveraging the resources made possible through NASA and NSF investments in our institutions, we hope to support the a continuous pipeline for New York City students and teachers, involving them in a research and education community that promotes achievement, retention, and advancement in science.

This continuum provides:

- Student and faculty research;
- Scientist-faculty collaboration on education products and new courses that integrate climate research problems and address science standards;
- Teacher professional development and preparation, and
- Academic/professional mentoring.

In the future, working group objectives will include creating a forum to refine approaches to institutionalize research and education activities, apply "best practices," formulate plans for cost-sharing and dissemination of education materials.

At the meeting, each partner presented a project overview, including ICP-related activities. This was followed by a lunchtime working session to define shared objectives, roles, and a timeline. The primary outcome was a draft outline (presented below) of each partner's potential. Over the next few months, this outline will be reviewed and revised to produce an education model and memorandum of understanding (MOU) endorsed by all our partners. The ICP project director and/or administrator will make site visits to each partner to finalize the details of our MOU.

DRAFT OUTLINE: POTENTIAL PARTNER CONTRIBUTIONS

This model is being formulated with input from ICP's existing partners (NASA GISS, CUNY-AMP, Columbia University, and New York City Public Schools). Expanded partnerships are currently being developed or are planned for proposal within CUNY and Columbia University, as well as New York Urban Systemic Initiative and the New York State (NYS) Dept. of Education. This first conception of the partner contributions encompasses seven levels.

LEVEL I: Teacher preparation courses for graduate students and professional development courses for in-service teachers. The objectives of the courses will be to enhance science teaching and learning for students attending NYC public high schools, junior highs, and colleges. These enhancements provide instructional strategies, teaching materials, and learning assessments that address NYS and NYC science standards and introduce practical science problems into core science education. Each course will integrate and/or draw from the ICP Earth Climate Teacher Education Course modules and will be offered for credit. For example, MASTAP Summer Institute education course, ICP School-based Teacher Institutes.

LEVEL II: Teachers apply instructional strategies and materials from their

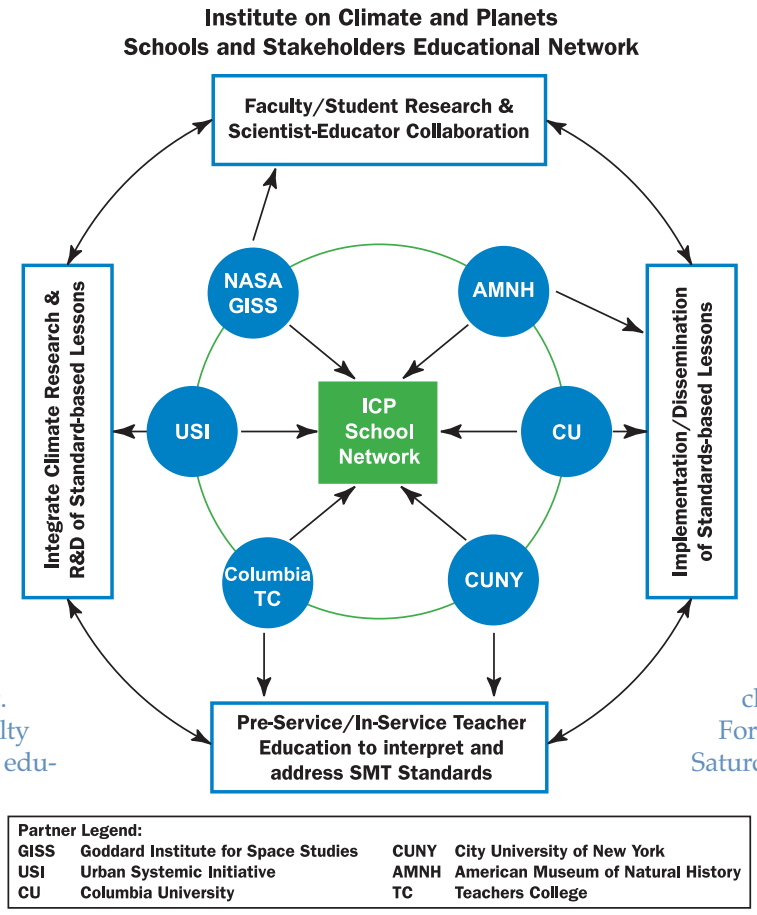
REPRESENTED AT THE WORKING GROUP MEETING ON MAY 3

ICP-CUNY Cooperative Grants

- NSF/CUNY New York City Alliance for Minority Participation (NYC AMP)
- NASA NYC Network Resource Training Site—Minority University Space Interdisciplinary Network (MUSPIN)
- NASA Partnership Award for Innovative and Unique Research and Education Projects (PAIR) at CCNY and MEC
- NASA Mathematics Science & Technology Awards for Teachers & Curriculum Enhancement Program (MASTAP)

ICP College Partners and GISS Research/ Education Projects

- CCNY-CUNY
- Columbia University
- GISS/ICP Earth Climate Teacher Education Course (NYC Public Schools)
- GISS/ICP Aerosol Projects
- GISS/ICP Climate Impacts-Water Resources Project
- Hunter College-CUNY
- LaGuardia Community College-CUNY
- Medgar Evers College-CUNY
- York College-CUNY



teacher prep and professional development in their science courses. Students engage in problem solving which complements learning with real connections to science research and process. Short- or long-term research projects are offered, producing student work—important for learning assessment. Research scientists and faculty collaborate with pre-college educators to develop educational products, student research projects, and new/restructured courses motivated by NASA's Earth Science Enterprise research and the NYS science standards. For example, instructional strategies and materials from ICP web and Earth Climate Course, NYC AMP Course Restructuring, PAIR Course R&D.

LEVEL III: Students local measurement network conducted at ICP partner schools contributing to local climate studies. Partners meet to determine and coordinate guiding research questions, protocols, analysis techniques, presentation guidelines, and teacher/student training. These measurement projects aim to develop students' fundamental research skills and scientific understandings about their local environment and how it compares with global climate and other regions. Potential projects: Sunphotometer, Polarimeter, Lidar projects, Pollen Signature Project, TEACH (air monitoring) Project/health study, CCNY Mobile Environmental Lab, MUSPIN/Weather Station School Network, Climate Impacts-Water Resources Project, Medgar Evers Environmental Lab-air and water quality.

LEVEL IV: Students/faculty provided with funded research opportunities (summers and academic year) with faculty and scientists at participating institutions (GISS, CUNY, Columbia U). Scientists and college faculty mentor students and high school teachers researching local, regional, and global climate. These studies make use of models and observations to contribute to understanding Earth's atmosphere and oceans, and the impacts of climate change. For example, ICP supports student interns and faculty fellows, NYC AMP recruits/supports faculty for targeted ICP research, Medgar Evers supports students/faculty for Environmental Lab research team.

LEVEL V: High school and college research interns conduct a community service science education program for elementary schools students and teachers, working with a science educator to prepare appropriate instruction and materials for involving younger students in hands-on climate and weather studies. For example, ICP's Space Quest Saturday program, Columbia Double Discovery Center, York College science education programs.

LEVEL VI: Recruit high school students from our network to pursue undergraduate degrees in science at CUNY colleges and Columbia University. For example, ICP disseminates recruitment materials and research/education opportunities, Columbia University and NYC AMP recruit students, provide scholarships and academic mentoring.

LEVEL VII: Recruit undergraduate students from CUNY colleges and Columbia University to pursue graduate degrees in education and enter the teaching profession in New York City public schools. For example, ICP disseminates recruitment materials and research/education opportunities, Columbia University and NYC AMP recruit students, provide scholarship support and academic mentoring.

— CH

Student Profiles

DOROTHY LOUIS is a junior at the Bronx High School of Science in New York. Last summer, she joined the ICP Oceans team led by Dr. Ron Miller. As a student researcher, Dorothy's project focused on the validity of GISS's Atmospheric General Circulation Model when compared to observed data in an El Niño and Southern Oscillation (ENSO) year. Her research this academic year is on the variability of ENSO and the affects of its response. Working at GISS has led her to become more interested in the research aspect of a medical career. She hopes to attend college at Columbia, Cornell, Duke, or Dartmouth to major in Anthropology or Genetics, eventually aiming to pursue a doctoral degree. Last spring, Dorothy presented at her school's Science Expo on "What is the Greatest El Niño?" She was also listed in Who's Who In High School Students? Her hobbies include reading and listening to different types of music. She is also keen on joining different clubs at her school.

LaVERNE DAVIS is a senior at Middle College High School, at the campus of Medgar Evers College in Brooklyn, New York. During the spring '99 semester, she has been a student intern at the ICP via the NYC BOE Executive Internship Program. She is assisting in program evaluation data analysis, under the guidance of the ICP Director, Carolyn Harris. LaVerne will be attending Embry Riddle Aeronautical University in Daytona Beach, Florida beginning this fall. She has been accepted into the Master's program in Applied Experimental Psychology and awarded the Embry Riddle Grant that covers 3/4 tuition for the entire 6-year period of study. Her career goal is to become a NASA Astronaut. Her extra-curricular activities include participation in the NYC Afro-Cultural Technological and Scientific Olympics, in Business, Dance, and Science categories (1996–98). This April, she participated in Earth Day, organized by Columbia Earth Institute. LaVerne's interests range from public speaking, reading, writing to singing, dancing, running, and swimming (she is a NYC lifeguard).

SONJAE WALLACE has been a student researcher on the ICP Forcings and Chaos team since fall 1997. A graduate of St. Georges High School in Jamaica, West Indies, he is currently a junior at York College majoring in Chemistry. Under the guidance of GISS director, Dr. James Hansen, his summer research focused on assessing the GISS General Circulation Model's ability to simulate observed winter and summer seasons from 1950 to 1998. This April, he presented a poster titled "How Well Does the GISS GCM Represent Incident Solar Radiation at the Surface?" at the NYC Alliance for Minority Participation's conference on The Urban University: Pathway to Careers in Science and Engineering for Minority Scientists and Engineers, held at City College. Sonjae says that his experience at GISS "*has introduced me to the raw aspects and demands of research which I might face in the future. This exposure has left me feeling more affirmed—better prepared—more confident, and less worried about my career choice.*" At York, he was on the Dean's List and Honor Roll. He wishes to achieve a doctoral degree attending graduate school at Polytechnic University in Brooklyn or at Rensselaer Polytechnic Institute in Troy, New York. His extra-curricular interests include soccer, reading, and electronic circuit design.

Faculty Profiles

SAMUEL R. BORENSTEIN is a professor of Physics at York College, CUNY. Now in his 32nd year teaching, his courses include College Physics, Advanced Physics Lab, and Meteorology. He holds a B.E. in Physics from McGill University, Montreal, and a Ph.D. in High Energy Physics from the Imperial College of Science and Technology, University of London. Since 1994, Sam has been a researcher on the ICP Forcings and Chaos team led by Dr. James Hansen. Last summer he conducted experiments studying the 12-layer version of the GISS GCM, successively introducing various forcings over a 50-year period, and comparing model results with observations. This year, he is focusing on absorbed solar radiation in selected regions.

His involvement at GISS has inspired him to develop courseware. He has designed and taught a course in meteorology at York. In Sam's words, "*The thing I am, perhaps, most proud of, is that together with John Knox, I published a paper which corrects an error in every elementary meteorology text book, as to the description of the approach to Geostrophic Equilibrium under the influence of the coriolis force. (Knox, J.A., and S.R. Borenstein. Unphysical Descriptions of the Approach to Geostrophic Equilibrium. Journal of Geoscience Education. 46 (2) March 1998).*" Sam has presented his work to the education community on several occasions, including a courseware exhibit at the national Science Teachers Association National convention this March. When not at work, he enjoys sports, opera, traveling, and reading.

KATHERINE CHANCE is in her second year teaching Biology to 9th and 10th grade students at George Washington High School in upper Manhattan. She completed her Bachelor's degree in Biology at Berea College in Berea, Kentucky in 1994. She is currently a Peace Corps Fellow and just received her Master's degree in Secondary Science Ed at Columbia Teachers College this May.

Since summer 1998, Kate has been a faculty researcher on the ICP Pollen team led by Drs. Dorothy Peteet and Margaret Kneller, working on linking pollen production with weather. She continues research after school with students, collecting and identifying pollen samples. As a new teacher, Kate provides insightful observations, "*…it has been an invaluable experience to meet and work with more experienced teachers at the ICP. Working on this project has helped me to define myself more as a teacher…. To choose to travel through life with an open heart and mind is the path of the true learner. Science is the same way—it is dynamic and is the unending search for knowledge through true experience. Student research can try to model this—and I saw some of this happening last summer at ICP—with the writing and editing of abstracts and presentations. I saw an evolution of ideas.*"

JOHN DaPONTE is a professor of Computer Science at Southern Connecticut State University in New Haven. In his 15th year, he is currently teaching *Introduction to Programming in C,* and a Senior Project Seminar. John graduated college from SUNY Stony Brook, obtained his Master's at Rochester Inst. of Technology, and his Ph.D. at the University of Connecticut. His collaboration with the ICP began in 1996 via a NASA Faculty Fellow Award by GSFC to work with GISS scientists, Bill Rossow and George Tselioudis. Last summer, John set up a campus-based ICP at SCSU involving a teacher and 7 students from Career Magnet HS. John has also developed independent studies based on his research on Image Processing and Pattern Recognition of Remote Sensed Images. He is proposing a new course that integrates science, technology, and policy. In February, John gave an invited presentation on Implementation and Comparison of the Backpropagation Algorithm in SAS to the Informs New York Metro Chapter. His publications with GISS co-authors include: *Parikh, JA, DaPonte, JS, and Tselioudis, G. Application of Evolutionary Techniques to Temporal Classification of Cloud Systems Using Satellite Imagery. Applications and Science of Computation Intelligence. Proceedings of SPIE Vol. 3390 April 13–16, 1998.*

School Research Network

City College of New York

OPTICAL REMOTE SENSING COURSE AT CCNY

One of the newly offered courses this spring at CCNY is Optical Remote Sensing (EE 5568), jointly taught by Dr. Moshary and GISS Scientist Dr. Brian Cairns. This advanced course covers remote sensing techniques and theory, requiring students to draw upon physics and mathematical understandings in real world applications. The course includes several laboratory projects carried out collaboratively by students who then submit individual reports. For example, this semester, students obtained information from the Internet to respond to the question : What are the technical methods used to calculate cloud height? They used their web research as the basis for a class discussion to evaluate the strengths and limitation of the methods. The project component of the course is conducted in a computer laboratory. Most of the projects use MATLAB software to analyze NASA data (e.g. Nimbus IRIS data) for retrievals of atmospheric properties (e.g. thermal structure of the atmosphere). Student projects are organized around science questions that engage them in analyses using the CCNY LIDAR, the GISS Sunphotometer, as well as other surface and ocean sensing data. NASA data are used as examples of different optical remote sensing techniques. These include data for atmospheric, surface and vegetation, and ocean color images.

The City College of New York (CCNY) School of Engineering has been an ICP partner school since the program's inception in 1994. One of the major objectives of the ICP is to develop research and education partnerships with our partner schools, all of who are recognized for delivering science, mathematics, engineering, and technology programs to large enrollments of minority students. An important outcome of these partnerships is to build campus-based institutional capabilities to successfully compete for NASA research and education grants that involve their faculty and students in the Agency's earth science research program.

CCNY is developing an effective model for a partner school. It is the only school of engineering in the City University of New York system and has one of the largest enrollments of minority students in New York State. Three faculty members in the School of Engineering are instrumental in developing the CCNY model, Drs. Shermane Austin (Computer Science), Reza Khanbilvardi (Civil Engineering) and Fred Moshary (Electrical Engineering).

Dr. Austin is the Principal Investigator for the CCNY Network Resource and Training Site (NRTS) funded by the NASA Minority University Space Interdisciplinary Network project. Under Dr. Austin's leadership this project has provided the network infrastructure and technical training for ICP partner schools. More recently, she created a spin-off project component, the NYC Metro Weather Network (METNET), installing Davis Weather Stations in 20 schools throughout the city (including ICP partner schools) to establish a student research program to monitor and study New York's climate.

Drs. Khanbilvardi and Moshary are Principal Investigators of the NASA Partnership Award for the Integration of Research into Mathematics, Science, Engineering, and Technology Undergraduate Education (PAIR), as well as NASA's Partnership Awards for Innovative and Unique Education and Research Projects. The aim of these projects is to expand research opportunities for undergraduate students and restructure SMET courses to integrate climate problems, data, and modeling. Focusing on two climate problems at the forefront of NASA's Earth Science Enterprise—atmospheric remote sensing and land use/land cover impacts—a focal point for the education and research activities is a new Remote Sensing Lab with LIDAR facility. In addition, the CCNY PAIR will provide a complementary air and water measurement component to the local student climate monitoring network initiated via the CCNY-NRTS METNET and the ICP Solar Irradiance Research Network (including hand-held sunphotometers and polarimeters) and pollen collection campaign. These field studies are designed to improve our understanding of climate forcings, feedbacks, and impacts related to changes in Earth's atmosphere, water, and soil.

CCNY's PAIR is significantly expanding ICP research opportunities for minority students in New York City through campus-based research at CCNY, as well as other participant PAIR grant schools: Medgar Evers College, LaGuardia Community College, and Hunter College. It also expands science course offerings that are motivated by real research problems and data.

TEACHEREducation

ICP Working with Teachers to Address the New York State Science Standards

ICP Faculty Fellows, Chris Petersen and Robert Kruckeberg, teachers at A. Philip Randolph High School, conducted three City-sponsored workshops this year to introduce educators and Science Assistant Principals to lessons under development for the ICP Earth Climate Teacher Education Course.

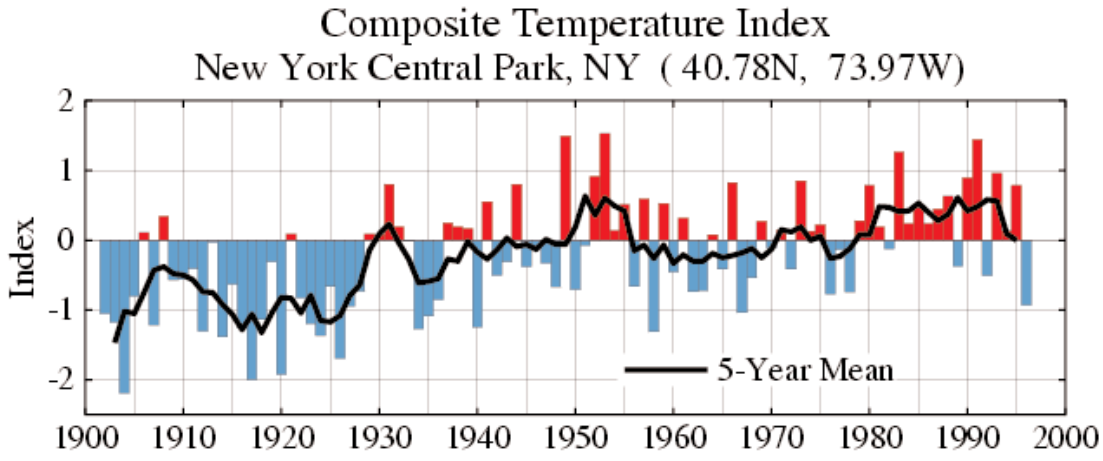
Chris Petersen (at left) with workshop attendees, estimating average planetary temperature from graphs.

In January, these faculty fellows were invited to present at the Chancellor's Office Staff Development Conference 'Science as Inquiry'. In February, the Board of Education invited them to convene a workshop organized for New York City Science Assistant Principals, and in April, the Science Council of New York City (SCONYC) requested that they conduct a session at the organization's annual conference—'Science Education: Building Blocks for the Future.'

The workshops focused on lessons from two of the Earth Climate Course modules "What Determines Global Climate?"and "What Determines Local Climate?" In both sessions, the aim was to interpret the New York State Science Standards relevant to the lessons presented and to actively engage educators in science problem-solving that they may adapt in their classroom instruction.

Teachers participating in "What Determines Global Climate?"compared atmospheric data from Venus, Earth and Mars, in a learning activity designed to develop understandings about how and why Earth's climate differs from nearby planets and an appreciation for the particular conditions that make Earth Habitable.

The presentation from the "What Determines Local Climate?"module offered teachers a way to introduce students to the concepts of anomaly and variability through a climate investigation. *Is the Earth's temperature increasing over time?* or *Is there scientific evidence that global warming is really happening?* are the questions guiding student learning. Students use daily temperature from the GISS Common



Sense Climate Index found on the GISS web site (http://www.giss.nasa.gov/data/update/csci/) to access temperature data to investigate these questions.

Teachers participating in the "What Determines Local Climate?"session were first asked to brainstorm about ways to study the guiding questions and what might serve as evidence for climate change. To develop analysis skills they worked with weather station data from selected US sites for the first 10 days of the month, graphing the data, and making interpretations of temperature for their location. In the next phase of the investigation they began to look at anomalies, calculating the mean, the variations from the mean and the standard deviation. Their analysis concluded with a discussion about their findings and the possible limitations of their 10 days of data to respond to the guiding question. This is where the GISS Climate Index plays a role, providing additional, long-term data to begin a study of monthly, seasonal, annual, and decadal trends. Teachers participating in the workshop engaged in a lively discussion about many possible student investigations that could be derived at this point in the module, including more critical consumers of accounts in the media about global warming.

Workshop Session: What Determine

Teachers began with an introduction to lessons that precede the workshop to conduct a comparative analysis of atmospheric data from Earth, Venus, and Mars. The learning activities leading up to the lesson presented have students creating concept maps of the factors that contribute to the temperature of a habitable planet.

Robert Kruckeberg (standing) in discussion with workshop attendees.

This technique (concept mapping) is used to elicit student understanding while emphasizing system-level relationships between concepts and ideas (Novak and Gowen, 1983). Hands-on investigations are also integrated that introduce students to controlled lab experiments designed for students to gain basic understanding of concepts such as temperature, heat, radiation, and atmospheric pressure. A theoretical calculation of the temperature of a body in space based on surface reflectivity and distance from the sun is either calculated by students or given to them as the

New York State Standards Addressed

Standard 1: ANALYSIS AND INQUIRY

1.3. The observations made while testing proposed explanation, when analyzed using conventional and invented methods, provide new insights into phenomenon. Students use various means of representing and organizing observations (e.g., diagrams, tables, charts, graphs, etc.) and insightfully interpret and organize data.

Standard 6: INTERCONNECTEDNESS AND COMMON THEMES

6.3. Magnitude and Scale. The grouping of magnitude of size, time, frequency, and pressure or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the

es Global Climate?

following values of planetary temperature: Earth: –20ºC, Mars: –60ºC, Venus: –29ºC.
Then, using the WeatherLabs Inc. web site, students sample a day of weather station data from around the world to estimate the Earth's surface temperature to be close to –15ºC. They must reconcile and build a consensus around theories that explain why the empirical evidence does not support the theoretical calculation.
This is the point where the teachers were actively engaged in the module lesson presented at the workshop. Divided into teams of "planetary specialists" to study each planet, three teacher working groups are provided temperature profiles. In addition, the Mars and Earth specialists receive probe data that reveals surface density while the Venus team only gets atmospheric pressure data. They must interpret the data from the graphs they are provided and estimate averages. Together, the teams enter their findings in a matrix, making inferences about the missing values and comparing temperature, pressure and density on the three planets to determine what accounts for the large differences in planetary temperatures. Due to time constraints, some of the important concepts that were not addressed include the limitations of planetary data and its impacts on the study findings. Probe data used in the exercise is taken at one location on the planet and the students are asked to estimate averages for the entire planet. Another idea deals with the significance of a difference if present. In the case of the lesson presented, students address this issue from the standpoint of the habitability of the planets investigated. Both these concepts relate to important expectations for students' science learning embedded in national and state standards.
This science inquiry, presented at the Chancellor's Staff Development Conference, is challenging for students because they are asked to make approximations of data and inferences about relationships among data variables. Yet, these goals for student learning are at the heart of new national and state science standards. In part, addressing this challenge requires creativity to relate such expectations for student learning to appropriate and motivational problem contexts in which they are used (Resnick, 1989).
Throughout the ICP Earth Climate Course development process and in our presentation of these education materials to teachers, we are reminded that the use of data is not the motivating factor for students, rather it is the nature of the problem that engages them in inquiry and data analysis. Thus, our approach has evolved into one that supports "learning as problem-solving" where the problem is more than a means to apply knowledge gained in an education activity and its organization provides a strategy for students learning (Bereiter and Scardamalia, 1989). This approach has students developing understanding and knowledge about climate problems by accomplishing very concrete or "novice" inquiry tasks (e.g., where they collect data themselves, observe phenomenon firsthand, or use simple conceptual models about a system they are observing) in the initial stages of a problem. More abstract "expert" tasks (e.g. using NASA data and more complex models) are introduced in the later problem stages that follow.

behavior and design of systems.
Students identify the largest and smallest values of a system when given information about its characteristics and behavior.

6.4. Patterns of Change. Identifying patterns of change is necessary for making predictions about future behavior and conditions.
Students use mathematical models, such as graphs and equations; [and] search for multiple trends when analyzing data patterns, and identifying data that do not fit the trends

OUTREACH

ICP Presents at NSTA '99 in Boston

On March 25th and 26th, ICP faculty demonstrated web-based educational courseware and learning modules at the National Science Teachers Association 47th National Convention in Boston, Massachusetts.

The presentation entitled, *Using NASA Climate Research in Your Classroom to Address Science Standards,* was a featured computer demonstration for teachers visiting the NASA Earth Science exhibit area. Representing the ICP and their schools at the convention were Harvey Augenbraun, Mitch Fox and Sam Borenstein, from Mott Hall School, Bronx High School of Science, and York College, respectively.

The main focus of the presentation was to introduce educators to lessons and modules accessible on the ICP web site. With *radiation* as theme, three computer demos provided educators with several strategies for using NASA data and climate research to motivate learning of science concepts.

Educational Courseware

http://icp.giss.nasa.gov/education/courseware/

Sam Borenstein focused his demos on educational courseware that he has been developing at ICP for the past four years. The courseware introduce students to the concept of modeling science phenomena and experimentation with simple models, a goal addressed in national and state science standards. Designed as a classroom resource, the courseware aims to develop student learning of science concepts related to climate. These interactive models give students a problem-solving resource where they can explore the systemic nature of physical processes such as the greenhouse effect, sea breezes, and cloud formation. They also include modeling experiments to illuminate and reinforce learning of Newton's and Kepler's Laws.

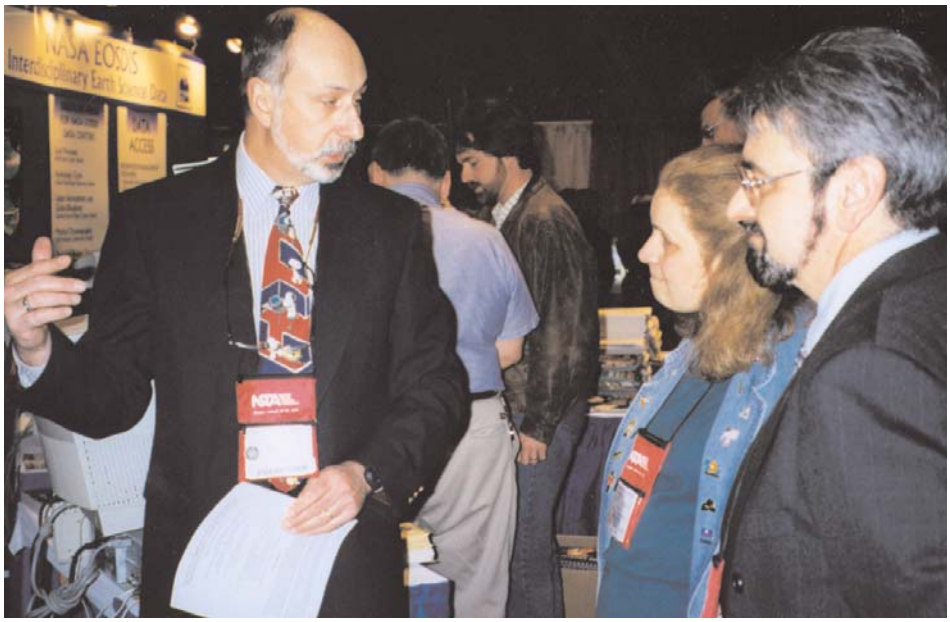
For example, the *Introduction to Meteorology* courseware provides a model to study the science concepts of ideal gas laws, isothermal adiabatic expansion, convection, and condensation. The experiments involve a study of the movement of air masses in the atmosphere and the formation of clouds, and how these processes conform to ideal gas laws. Students explore relationships between pressure, atmospheric height, and temperature, lifting an air mass from the planet's surface to vary height levels in the atmosphere.

Sam Borenstein (center) demonstrating courseware on the greenhouse effect and planetary habitability to convention attendees.

Radiative Balance

http://icp.giss.nasa.gov/education/radforce/

Mitch Fox presented a Radiative Balance learning module that he developed during the 1997 Summer Institute in collaboration with GISS



Harvey Augenbraun (left) and Mitch Fox (right) present a Methane project lesson and a Radiative Balance web activity at NSTA.

Scientist, Dr. Ron Miller. The module has been refined after classroom implementation and student feedback. The study explores the effect of the sun's energy on the ocean and atmosphere, a critical understanding linked to NASA's climate research. An interactive classroom activity, it addresses both science content and process skills called for in New York State Science Standards. For example, students learn that the earth receives energy from the sun and reflects, absorbs, scatters, and emits this energy.

Using satellite data, students explore this concept as they organize, graph, analyze, and interpret (science process skills) solar energy absorbed and emitted in particular region of the world. Students also develop hypotheses about regional differences in energy absorbed and emitted at the poles, in the tropics and mid-latitudes.

Data collected from the Earth Radiation Budget Experiment (ERBE) offers students a means to investigate whether the Earth is really in radiative balance. While studying this problem, students work in teams to learn science background about the energy budget and understand how their data was collected, its strengths and weaknesses.

The student research teams sample ERBE monthly data for their region of interest from the interactive web utility that allows them to produce an image. The class collectively analyzes their regional data and draws conclusions about the transport of energy between the poles and tropics necessary to maintain planetary energy balance.

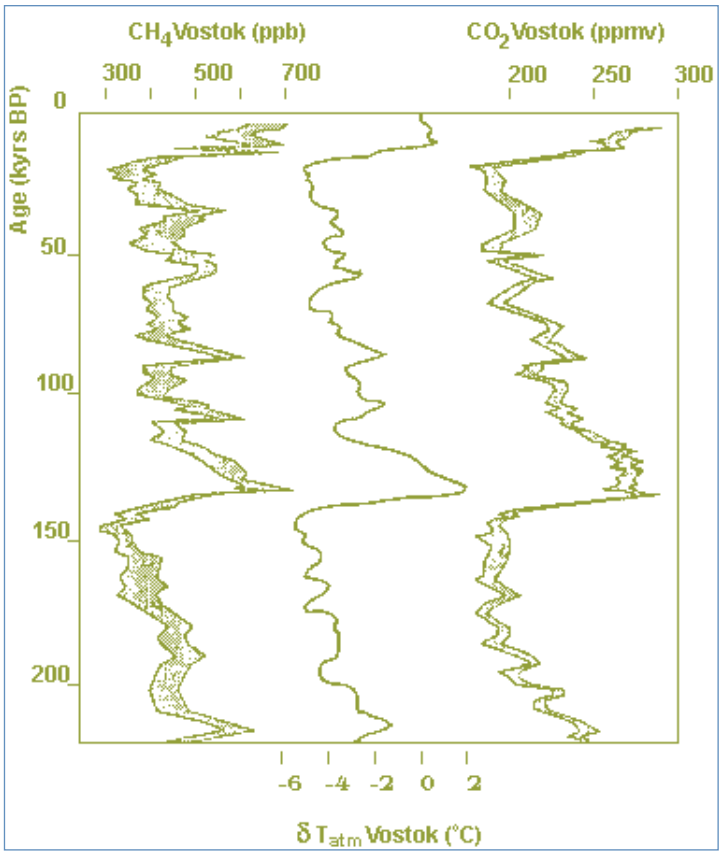
The Atmosphere, Greenhouse Effect, and Earth's Surface Temperature

http://icp.giss.nasa.gov/education/atmosgreen.pdf

Harvey Augenbraun presented a scenario-based lesson, adapting a radiative model (designed by Sam Borenstein) for the study of the Greenhouse Effect. Harvey introduced three experiments his students conduct in class to study this phenomenon. *Scenario One:* planet with no atmosphere, *Scenario Two:* planet with an atmosphere without greenhouse gases, and *Scenario Three:* planet with an atmosphere and greenhouse gases. Students compare the results of these model experiments, noting initial surface temperatures, units of energy absorbed and radiated, and resulting surface temperatures.

The second part of the lesson involves students in studying historical greenhouse gas data from the Vostok Ice Core records *(see graph, next page)* The y-axis shows the time in thousands of years before the present. The top x-axis shows the concentration of methane in parts per billion in a given volume *(curve at left)* and the concentration of carbon dioxide in parts per million *(curve at right)*. The bottom x-axis shows variations around the mean temperature *(curve at center)*.

Students complete a data table *(see next page)* to derive the levels of carbon dioxide and methane from this data set as inputs for a final paleoclimate model experiment. By running the model with past greenhouse gas



The climatic record obtained from the isotopic composition of the Vostok ice core compared to atmospheric CO_2 and CH_4 concentrations obtained from ice bubbles. Lorius, C. and H. Oeschger, *Paleo-perspectives: Reducing Uncertainties in Global Change?*, Ambio: A Journal of the Human Environment, 23(1), 30-36, 1994.

levels, students explore the effect that altering these concentrations has on Earth's surface temperature.

Next, students look at greenhouse gas data from the beginning of the Industrial Revolution to 1990 in order to develop their own explanations about the effect of natural and anthropogenic activities on greenhouse gas concentrations and their possible effects on earth's surface temperature. This explanation is at the heart of NASA's climate research, and it addresses two important New York State Science Standards. First, students are expected to be able to identify patterns of change in order to make predictions about future behavior and condition. Second, they are expected to understand interactions between air, land and water on weather and climate, and the influence on solar energy.

Educator Network

In addition to demonstrating educational lessons and software, ICP faculty introduced the newly designed ICP web site to 40–45 secondary school and college educators. We have begun building a nationwide network of educators who are interested in field-testing our education products, providing feedback, and integrating final versions into their science teaching. At the conclusion of the NSTA convention, 27 science teachers signed up to participate in this network. All of these teachers will receive an information package to identify their interest in specific ICP education products and to invite them to the Summer Institute '99 Final Conference in August.

— CH & LK

	CO_2	CH_4	Temperature
What is the maximum concentration of CO_2 and CH_4 and temperature 140,000 years ago? (this is our initial value)	pmv	ppbv	°C
What is the minimum concentration of CO_2 and CH_4 and temperature 20,000 years ago? (this is our final value)	pmv	ppbv	°C
What was the change in CO_2 and CH_4 and temperature for this period?	pmv	ppbv	°C
Did they increase or decrease?			
Calculate the percentage change for CO_2 and CH_4 % Change = Change/Initial Value			

EarthDay1999

By Eleni Palmos

NASA GISS staff, researchers, and ICP students joined in the celebration of Earth Day 1999 on April 22nd—a daylong festival open to the public, sponsored by the Earth Institute at Columbia University.

Eleni Palmos (seated at center) with Earth Day enthusi-

First organized in the 1970 by Senator Gaylord Nelson with the help of several environmental activists, Earth Day is now celebrated in towns and cities around the globe in order to promote responsible stewardship of our planet.

Located on the Columbia University campus, with many researchers having close ties to the University, GISS was invited to set up a booth at this celebration to share their Earth-related research with the public. The GISS booth coupled fun and science in order to try to better relate our science to the public. We provided public information on a range of NASA's climate research priorities and education programs. Staff members who serve in all different functions at GISS helped "work the booth" and were generally made available to the public. This included Dr. George Tselioudis, an expert in clouds and climate, Dr. Francesco Tubiello, who has worked on the Biosphere II project, graduate students Timothy Eichler and Max Kelley, and Emily Michaud, an administrative officer at GISS.

ICP students, LaVerne Davis and Cynthia Giannetti, were on hand to demonstrate newly developed classroom teaching modules available via the GISS ICP web site. They showcased student research and explained ICP's mission in training the researchers of tomorrow.

This year's Earth Day at Columbia University was truly a success with visitors from all walks of life including those involved in research themselves, those hoping to get involved in research, or people who were just passing by.

More information about Earth Day may be obtained from the following sites:

http://www.epa.gov/earthday/

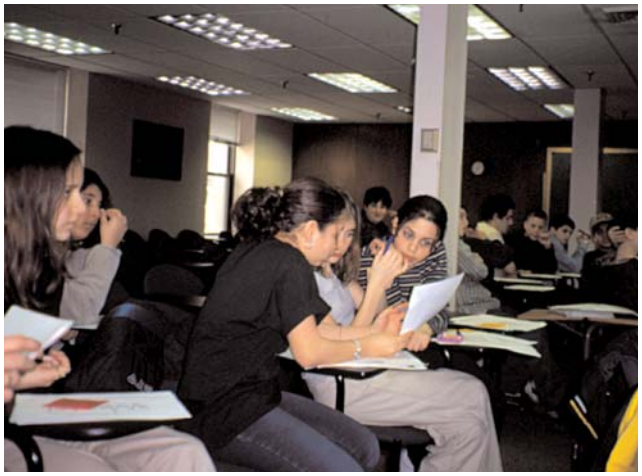
http://www.erl.noaa.gov/EarthDay/

http://www.earthday.net/

For those who do not have easy access to the Web, the Environmental Protection Agency (EPA) has an information desk on Earth Day that may be accessed at (202) 260-4955.

Cynthia Giannetti (at left), Emily Michaud (center), and LaVerne Davis (right) at Earth Day '99 celebrations at Columbia University's campus.

El Niño Investigation: Kinneret Day School Visit to NASA GISS



Students from Kinneret Day School participate in an El Niño workshop at GISS.

On March 19th, twenty-five students from a seventh grade science class at the Kinneret Day School in Bronx, New York, visited NASA GISS to participate in an El Niño investigation led by GISS/CCSR Senior Research Scientist Dr. Leonard Druyan and doctoral student Timothy Eichler.

Professor Steven Greenbaum, Director of the Solid State NMR/EPR Laboratory at Hunter College, coordinated the visit on behalf of Kinneret Day School. The class science teacher, Mrs. Rita Kahn, also accompanied the students. Mickey Krakowsky, the school's director for curriculum, said "the students came back full of enthusiasm for what they saw—they were able to appreciate how the food web is affected by climate phenomena and were impressed by the instruments used to track systems and to make forecasts."

During the investigation, students learned about El Niño and the conditions associated with this phenomenon. After a brief introduction to El Niño and questions to think about *(see program, following page)*, students sampled data images using a website of the National Oceanic and Atmospheric Administration. They applied the science background they learned to study the variability of El Niño. Using the time series plot below of Sea Surface Temperatures from the Niño 3 region index *(see figure 1 below)*, they attempted to discern the years when strong and weak El Niños occurred, whether we can infer if cycles (periodicities) exist, and brainstormed about the significance of research to improve El Niño forecasts.

This lesson, like other ICP education products, aims to address state and national science standards. One of the main focuses is to involve students in inquiry-based learning to develop understandings of science concepts. Students learned how ocean processes interact with the atmosphere, introducing the concept of convection and factors that influence the global circulation of winds. The workshop aimed to develop students' inquiry skills by providing a problem-solving activity: to brainstorm about the processes and impacts related to El Niño. Students were introduced to working with science data in order to search for patterns of regional and global physical processes associated with El Niño. The concluding activity asked students to apply their understanding of El Niño to infer connections to real world problems such as extreme weather impacts on agriculture. *— CH*

Contributors: Leonard Druyan & Timothy Eichler

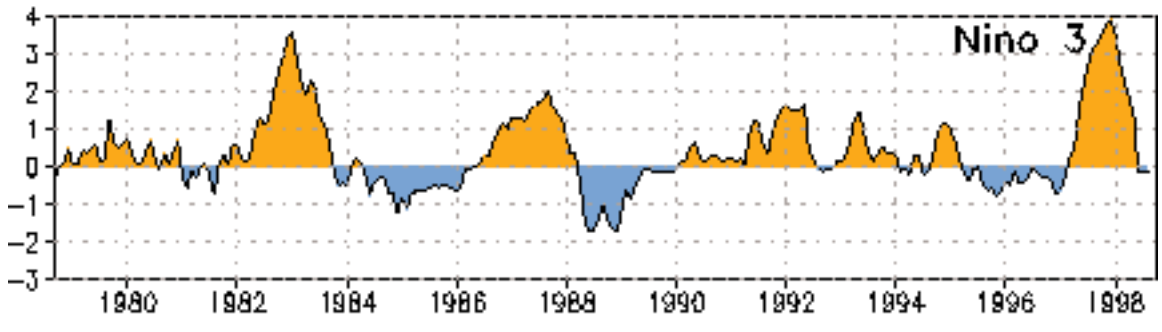


Figure 1: Niño 3 region index.

Kinneret Day School Visit to NASA's Goddard Institute for Space Studies

Thursday, March 19, 1999
El Niño: Searching for Patterns, Processes, and Impacts

A C T I V I T I E S

10:00 AM Welcome to NASA GISS
Carolyn Harris, Director, Institute on Climate and Planets

Presentation and group discussion:
Tim Eichler, GISS Researcher
Research question for Kinneret Day School students:
How would you justify investing $5 million dollars to improve El Niño forecasts?

Research Activity #1: Prepare a chart that summarizes the group's initial responses to the following questions? (20 minutes)
What is El Niño?
- In which geographic region is El Niño best detected?
- What atmospheric and ocean conditions are associated with El Niño?
- What are some of the social and economic impacts of El Niño around the globe?

10:30 AM Research Activity #2:
Using the web site listed below, teams of students enhance their knowledge about El Niño concerning the three questions above. (25 minutes)
http://www.pmel.noaa.gov/toga-tao/el-nino/home.html

Students report their findings to Dr. Druyan and Mr. Eichler. *Each team to add to the El Niño chart prepared at the beginning of the workshop. (15 minutes)

11:15 AM Research Activity #3:
How does El Niño change in time? (30 minutes)
Tim Eichler gave student teams several years of sea surface temperature data to analyze.

Additional Resource: Return to the El Niño web site to view the animation

Respond to the following questions (be prepared to defend all your answers):
- Which years are El Niño years?
- Which are the strongest and weakest El Niño years?
- Is there a year(s) when a La Nina occurred?
- Can you infer any cycles (periodicities) of El Niño?

11:45 AM Research Activity #4:
Teams report on their data analysis to Dr. Druyan.
Group discussion on justifications for investing in El Niño prediction (30 minutes)

12:15 PM Concluding Remarks and Questions:
Climate Models and Prediction
Dr. Leonard Druyan

Readings: El Niño (NOAA), El Niño Facts (NASA), Severe Weather Warning (New York Times)

THESUMMERINSTITUTI

On June 30th, Summer Institute 1999 (SI99) officially begins, involving a total of 56 students, teachers, and faculty, and 15 GISS scientists working on climate research projects at GISS or in campus-based programs. This summer, most of the students who have participated in ICP for 2–3 years are moving on to professional or other academic experiences. SI99 will provide younger students with an opportunity to assume the leadership roles previously held by these older students who mentored them last summer. Just as the first generation of ICP students, this next generation has their own spirit and character that is certain to shape the ICP environment and tradition.

Key Activities of the Summer Program

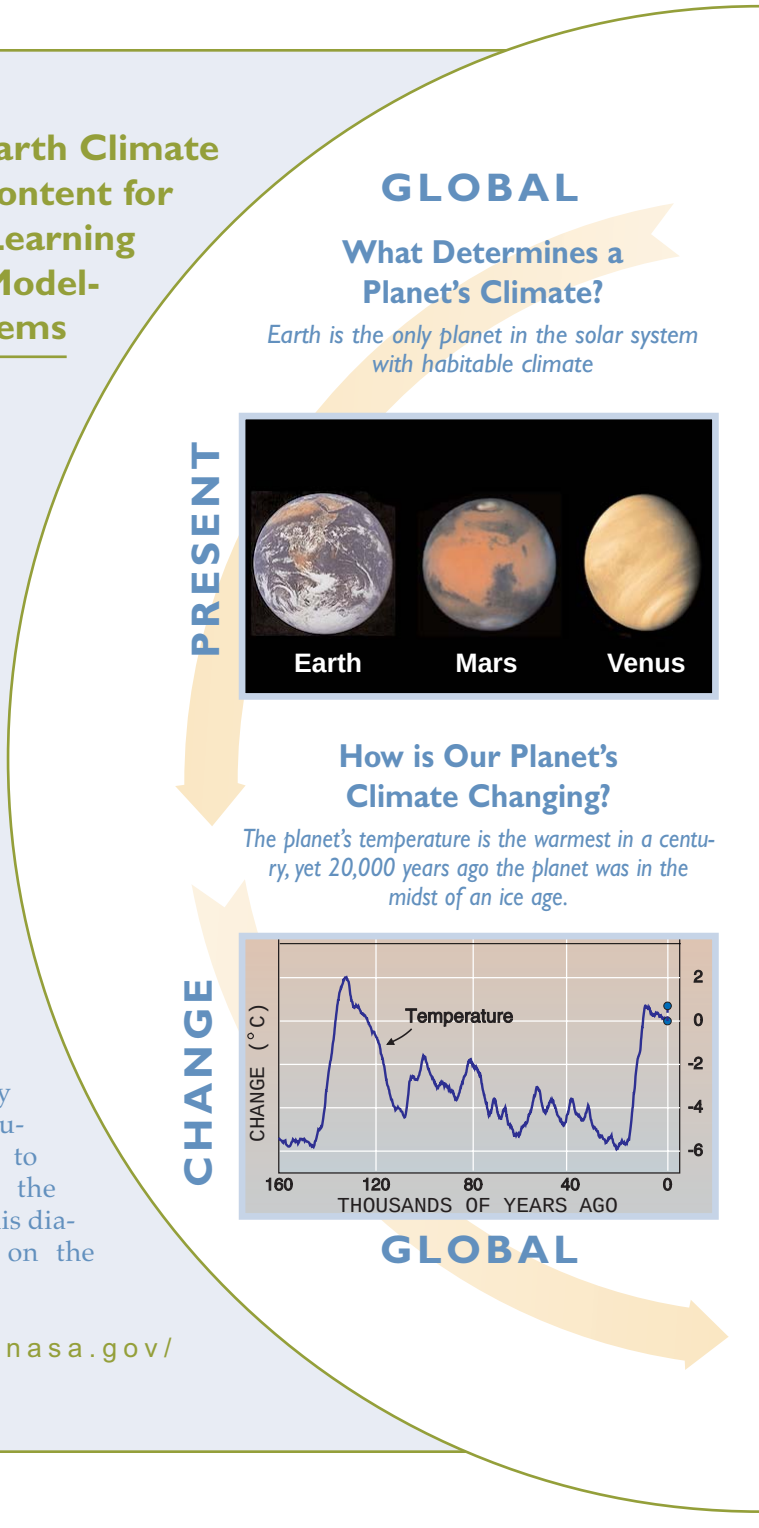
- Conducting team research projects that aim to improve our understanding of Earth's climate
- Writing workshops to develop science-writing skills and to prepare a science paper and oral research presentation
- Earth Climate Education Workshops for students to gain science background and for faculty to pilot the climate motivated and standards-based lessons they are developing
- Faculty-Scientist lunchtime discussions to critique and revise lessons presented in the Earth Climate Education Workshops

ICP Earth Climate Course - Content for 4 Modules: Learning Science by Modeling Systems

- Field investigation designed to learn about New York's environment
- Science and Society Seminar
- Final Conference team research presentations in the morning session and teacher workshops (using SI99 lessons developed) in the afternoon session

Currently a web dialogue is underway among educators, students, and scientists to assist in planning the summer program. This dialogue is accessible on the ICP web at:

http://icp.giss.nasa.gov/



E 1999OUTLOOK

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This tradition was started last year where a "strawman" for the summer program is posted on the web and Summer Institute participants have an opportunity to contribute their comments and suggestions. The collective input of participants is used to plan the final summer schedule.

Planned "Product" Outcomes of the SI99

- S t u d e n t r e s e a r c h papers, team conference presentations and a team "Popular Science Article"
- Lessons and student assessments prepared by faculty-scientist development teams motivated by the study of Earth's climate system and that addresses the New York State Science Standards

One of the linkages between the summer ICP research projects and the education lessons being developed is the perspective for studying climate change over time and space. The figure in the center shows an approach developed by a team of faculty and scientists for using Earth's climate as the context to develop educational materials and a teacher course. Lessons developed in the four modules use our vested interest in the environment we live in as the motivation for science learning while offering opportunities for problem-solving that address common attributes of research problems and themes of state and national science standards.

This context provides a framework for looking at a problem over varying geographic and time scales, identifying the magnitude and scale of changes, and appreciating the variability of climate and the relationship among system processes. The question of what determines local and global climate and change also fits well with problems (labs) that involve students in 1.) experimentation with physical models/instruments for collecting data, 2.) complementary applications with PC-based computer models, and 3.) activities with data used by the science community. This iteration between observations and models introduces the idea that there is uncertainty and unpredictability in climate problems, two concepts that are not easily addressed in science learning.

— *CH*

ONWARDANDUPWARD ICP ALUMNI SPECIAL REPORT

Kwajo Abeyie

Kirk Beckford

Errol Brown

This special report focuses on our student alumni, their academic, professional, community, and personal pursuits. Several students agreed to pass on words of wisdom, advice, and inspiration to the next generation of student researchers. After hearing back from them, there are many common threads to the lives of these young people. Most cite critical thinking, communication (oral and written), and teamwork as the skills they most use in life after ICP. Community and volunteer service is a part of most of their lives. They all are continuing in research, science, or engineering fields. There are too many alumni to cover in this one issue, so we plan to continue this special report in our next newsletter.

Kwajo Abeyie

joined the ICP while he was a student at A. Philip Randolph High School and upon graduation was the national Physics Finalist in the ACT-SO competition. He is now a sophomore at the State University of New York at Stony Brook. His declared major is biochemistry with an interest in pre-med. An elected Board Member of the Minorities in Medicine Club on campus, he is also the organization's representative to the Student National Medical Association. Most recently, Kwajo was awarded the Howard Hughes Medical Institute Undergraduate Biological Sciences Summer Program Fellowship. Last summer, he participated in the Pittsburgh University Pre-Medical Academic Enrichment Program and the SUNY School of Optometry Enrichment Program. During the school year, he is an undergraduate research assistant in Dr. Nicole Sampson's lab in the Chemistry Department, preparing to study the roles of active site amino acid asparagine 485 in cholesterol oxidase catalysis. Kwajo has also become the webmaster for the Biochemistry and Cell Biology Department. In his spare time, he plays competitive squash. While he does not like to admit it, he has been challenged this year to discover his limits with respect to his extra-curricular activities.

✪ ADVICE to ICPers:

Continue to exist and endure throughout all your obstacles and let a good education be your foundation for a lifetime.

Kirk Beckford

became an ICP researcher in 1996 as a York College student where he will finish his bachelor's degree in mathematics this fall. He recently joined PaineWebber where he is a Senior Associate and interim Supervisor of the company's Data Analysis/Associates in the Distributed Systems and Management Department.

Errol Brown

was a junior at the Bronx High School of Science when he joined the ICP in 1994. At Bronx Science his ICP research gained him recognition as a Westinghouse Semi-Finalist and an American Meteorological Society Scholarship to the University of Miami where he is currently enrolled. His expected graduate date is May 2000 with a degree in Marine Science. While at school, he and some friends have started a business that provides clients with a range of web services, including hosting, design, and animation. Errol says his ICP experience is helpful in this new venture, as the company requires sharing of skills and knowledge among the business team partners. This is important as the partners who reside in different geographic regions—California, New York, Chile, Armenia, Miami, Virginia and Connecticut—must be able to conduct business from their home base. Once Errol receives his undergraduate degree, his prospects for graduate school are the University of Miami, Boston University, or University of Hawaii.

Danielle Deane

Jeantel DeGazon

Donna Hope

Danielle Deane

came to the ICP as a rising senior at Williams College. She based her senior thesis on her climate impacts research with GISS scientist Jennifer Phillips as thesis advisor. Dr. Phillips and Danielle are currently working on a science publication based on this work. Danielle is a Financial Analyst with Guy Carpenter & Company, the world's largest reinsurance intermediary. In her busy schedule, she finds time for volunteer work at the Trinidad and Tobago Consulate in New York City. Her other extra-curricular activities include being a Board Member of the political action committee Campaign Funds for Young Candidates, Inc., and a marketing committee member of Pampeleh Productions to promote a Caribbean film network.

✪ ADVICE to ICPers:

Give this experience everything you've got because it will give back to you many times over. The skills you develop or fine tune at the ICP, from critical thinking to teamwork, are foundations that will get you to wherever you want to go personally and professionally.

Jeantel DeGazon

came to the ICP from A. Philip Randolph in 1994. She continued to participate after she graduated and entered Williams College. Now a junior, she received a fellowship in the Mellon Minority Undergraduate Program to research various leadership roles of black American women after emancipation. She plans to continue as a Mellon researcher until graduation. She says her participation in the ICP was preparation for her current research environment.

✪ ADVICE to ICPers:

The most valuable perspective gained in ICP was the desire and commitment gained to continually ask questions, always keeping in mind that all ICP participants—faculty, students and scientists—are part of the learning process.

Donna Hope

was a student at Spelman College when she entered the ICP. She has since transferred to Rensselaer Polytechnic Institute (RPI) and is working towards a BS in Civil Engineering with an environmental concentration. The summer '99 job she has lined up is with the Environmental Protection Agency (EPA) in Edison, NJ. She'll be doing macroinvertebrate sampling and aerial surveillance (from a helicopter!) of the New York/New Jersey Harbor complex. During the semester, she continues her research with an RPI professor on the modeling of solute transport in rivers and streams. She participated in the "Action for Earth" environmental leadership conference at Vassar College this March and is a member of EcoLogic, RPI's environmental group. Donna loves to travel and spent her Spring Break in Cairo, Egypt.

✪ ADVICE to ICPers:

Donna hopes the "ICP Impacts team continues to be the best one!" Students should realize that they have quite a bit of resources available to them through the ICP program. Seek the knowledge from scientists, teachers, and mentors. ICP was a wonderful way for her to learn teamwork, computer skills, and develop the ability to make a professional presentation.

Anthony Luckett

entered the ICP as a sophomore at the Bronx High School of Science and continued into his second year at Dartmouth College where he is majoring in engineering. He has a wide range of academic and social activities at school. Currently, he is involved in a dance group on campus called SHEBA and is the newest member of the Alpha Phi Alpha Fraternity where he is the programming chair.

✪ ADVICE to ICPers:

Embrace the experience and promise yourself that you'll do the same for those next in line.

Karimi Mailutha

started in the 1995 ICP as a student at Columbia University. She is now a graduate about to graduate, with a degree in Biology. At Columbia, Karimi was a Resident Assistant in one of the college dorms and has been actively involved in an African Dance troupe. She has made community service a part of her life, both through ICP and Columbia organizations, primari-

Anthony Luckett

Karimi Mailutha

Lisa Sarma

ly in education programs for elementary school students. Karimi also continued to gain research experiences after the ICP in medical-related studies conducted at Columbia Presbyterian Hospital and St. Luke's Hospital. Karimi will attend Harvard Medical College but plans to defer for year to work in a community service project, hopefully serving as an International Intern with the Presbyterian Church either in Argentina, Ghana, or the Philippines.

✪ ADVICE to ICPers:

ICP is not only an opportunity to engage in challenging research, but also a wonderful time to foster friendships, learn about science, and expand your analytical skills. In order for any entering student to get the most out of their ICP experience, it takes continuous initiative, enthusiasm, and dedication. To all young ICP students Karimi says, "enjoy the summer at ICP, it's a great program."

Lisa Sarma

was a student at Columbia University when she came to the ICP in 1996 as a student researcher. She continued to contribute to ICP's Space Quest community service program for city children. She has held positions at school as the Activities Coordinator for University Residence Halls, as well as Coordinator of Volunteer Activities at the Columbia University Double Discovery Center. After her experience at ICP, she spent the next summers conducting seismology research at Lamont-Doherty Earth Observatory and California Institute of Technology. She presented her research at the Southern California Earthquake Center Annual Conference and the Earthquake Engineering Research Center Annual Meeting. During her senior year, she and two other Columbia students were finalists in the American Society of Civil Engineers/Parsons Brinkerhoff Water Resources Design Competition. She recently graduated with a BS, majoring in Civil Engineering with a minor in Earth and Environmental Engineering. This coming fall, Lisa will enter a Ph.D. program at Stanford University in Environmental Fluid Mechanics and Hydrology Program within the Department of Civil and Environmental Engineering.

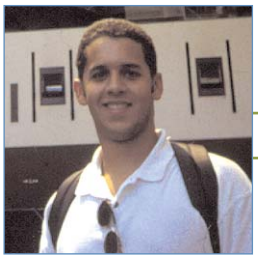
✪ ADVICE to ICPers:

One of the most important parts of the ICP is the opportunity to play different roles in the same setting. Students are asked to be teachers, students, and peers, and to learn to relate to those in and out of the science arena. It is important to realize the process that you are undergoing as a future scientist — recognize your way of thinking, rather than focusing on WHAT you are thinking about. You are being given a tremendous opportunity…make the best of it and GOOD LUCK!

David Vargas

started in the 1994 ICP as a student at Queensborough Community College and then transferred to Polytechnic University. During this time, the NSF Alliance awarded him national recognition for Minority Participation Conference for his Storm Tracks research. After graduating with a degree in mechanical engineering, he joined Exxon Chemical Company in Houston, Texas. His first assignment was as an engineering consultant on four of the company's manufacturing units, one of which produced the raw material that goes into making soda bottles. More recently, he organized a work review and prioritization procedure for a plant shutdown, which resulted in new company procedures to be implemented in Chemical plants worldwide.

In a few weeks, David is going to make a presentation to the Exxon Worldwide Engineering Services manager. Dave said that all the ICP presentations and technical writing in the ICP has been invaluable to him in his professional life. These skills are some of the most helpful skills that ICP students can develop. Shortly, David will begin work on an exciting new project, as a Robber Plant Finishing Area Contact Engineer. This division is the largest producer of synthetic rubber in the world, with such clients as Goodyear and Firestone. David does find time for such extra-curricular activities, as being chairman of the Exxon Hispanic Professional Network. A leader in ICP's Space Quest community service education program, it is no surprise that Dave continues this work in his role of chairman of this organization. He and other members are mentoring students, raising college scholarship funds, building houses as part of Habitat for Humanity,



David Vargas

Abdon Whitelocke

Joshua Wilder

and providing professional development and mentoring to Hispanic professionals at Exxon.

Abdon Whitelocke

started in the ICP in 1994 as a student at Queensborough Community College and continued through his junior year at Polytechnic University where he earned a BS degree. His work experiences include IBM and Telcordia Technologies, formerly known as Bellcore. While a full-time employee at Telcordia where he tests leading edge technologies, Abdon is pursuing an MS degree in electrical engineering at Columbia University. Despite his busy work and school schedule, Abdon intends to contribute some time to a volunteer organization in his community. He also has time to "stop and smell the roses" by traveling to other states and at least one Caribbean country.

✪ ADVICE to ICPers:

I strongly implore you to be the best at what you do, irrespective of its nature. You have your fingertip on some of the best scientists and leaders around, and I ask you to make use of every opportunity to learn from them. Throughout your involvement in the ICP you may visit places and meet new people, mingle with them, learn about obstacles they encountered and how they overcame them. I know everyone of you want to be successful, but to do so you must conquer the art of communication—both oral and written. Please use the reports and talks you give in the ICP to prepare you with these skills.

Joshua Wilder

began his participation in the ICP in 1994 as a student at the Bronx High School of Science and continued into college at Polytechnic University. In spring 2000, Josh will graduate with a joint degree in electrical engineering and computer science. He recently joined PaineWebber where he is a Junior Administrator in the Distributed Systems and Management Department. The biggest project Josh works on deals with maintaining system integrity of the company's new Data Center. In addition, he troubleshoots problems that occur in the Japan, London, and Mexico offices. Josh says his work at PaineWebber is important and stressful and in high demand, but in no way does it compare with [his] GISS experience. He plans to work for a while and then come back to GISS?! He plans on attending graduate school studying Computer Science and Education. As for community involvement, Josh has been a long-time volunteer at the Boys Harbor that provides a comprehensive program of education and social services to urban youth. This year, Josh was invited to join the Harbor's Advisory Board, which is comprised of some of New York's most influential public and private sector leaders.

✪ ADVICE to ICPers:

Challenge the environment and yourself! Teachers know that students regardless of ability or skill will perform only to the expectation of the environment. Scientists are aware that by creating a challenging environment the community overall is enhanced and progress is made. New students should challenge themselves to learn as much as they possibly can and redefine the expectation of themselves and what they expect of the environment. You truly get out what you put in. Be creative and explore. Albert Einstein once said, "knowledge is nothing without creativity." If you observe the most notable ICPers: Corey, Errol, Sam, etc., it becomes clear that working hard and seriously, while having fun and being creative are essential ingredients to success in the ICP.

Current ICP Students

CYNTHIA GIANNETTI, a senior at George Washington High School, will be attending Penn State University or Mount Saint Vincent College where she plans to major in Biology. She is the recipient of the George Washington High School Alumni College Scholarship for Academic Excellence.

SHARIKA DE LA OZ, a senior at A. Philip Randolph High School, will be attending Columbia University.

ROSA ANDUJAR, a senior at High School for Environmental Studies plans to attend Wellesley College, possibly majoring in mathematics. Once at school she plans to apply for the Wellesley-MIT Double Degree program and graduate in five years with a BA from Wellesley and BS from MIT.

CARYLE ANN FRANCIS, a senior at School of the Future, plans to attend either SUNY at Stony Brook or Spelman College.

SPRING 1999 CONFERENCE:

Local, Regional, and Global Climate Change

Monday, June 7 1999

NASA GISS, 2880 Broadway at 112th Street, New York, NY 10025

NASA Goddard Institute for Space Studies

Institute on Climate and Planets

A partnership with NASA Equal Opportunity, Education, Earth Science, CUNY–AMP, Columbia University, New York City Public Schools, MU–SPIN CCNY NRTS, and SSAI

A G E N D A

* Events take place in the 3rd floor conference room unless noted otherwise.

3:30pm	Registration
3:45	Welcome: Carolyn Harris, Director, ICP
4:00–5:20	ICP NYC Climate Measurement Projects

Session Facilitator: Dr. Brian Cairns, NASA GISS

- School Weather Station Network: *NYC's Climate*
- New York's Pollen Signature
- Aerosol Measurement Campaigns: *Sunphotometer/Polarimeter*

5:30–6:30 Local, Regional, and Global Climate Studies Using Models and Observations

Breakout Session A
Session Facilitator: Dr. Gavin Schmidt, NASA GISS

- ENSO Teleconnection Patterns
- Global Warming and the Urban Heat Island Effect
- Clouds, Storms, and Climate Change
- GCM Validation Study

Breakout Session B 7th Floor Conference Room
Session Facilitator: Dr. Jennifer Phillips, NASA GISS

- Climate Impacts: Effects of Water Stress on Crop Yields
- Global Methane Inventory

6:30 Reception

Throughout the New York City metropolitan area, students, faculty, and scientists participating in the NASA GISS Institute on Climate and Planets (ICP) are engaged in the broad study of Earth's climate. Their research captures many views of Planet Earth, encompassing global, regional, and local dimensions of science problems that aim to improve our understanding of the climate system - its variability, changes, and potential impact on our lives. Time dimensions are equally important to their research as they look to past climates to understand the present-day climate and apply current state of knowledge about the climate to predict the future.

The 1999 ICP Spring Conference focuses on the importance of studying climate from various time and geographic scales, from the perspective of a scientific endeavor and its relevance to decision-makers. Looking at Earth from two dimensions of time and space creates interesting and complex scientific problems that require researchers to explore patterns of change, explain causes and effects, quantify significance, and estimate the probability for future change.

To tackle a range of climate problems dealing with Earth's atmosphere and oceans, student and faculty researchers at NASA GISS and in the ICP School Network work with satellite and ground-based observations, climate models, and data collected from New York student measurement campaigns. Their reliance on measurements and models to study the climate introduces uncertainty in these science problems, providing a flavor of how research works.

Dealing in uncertainties and probabilities makes one of the greatest challenges climate researchers face in communicating research results in ways that are useful to the public and decision-makers. Students, faculty, and scientists presenting at this year's ICP Spring Conference are encouraged to address this challenge and define the real connections that exists between their climate research and issues that affect our everyday lives - globally, regionally, and locally.