**Progress Report:** Cooperative Institute for Climate Science Professional Development Summer Institute in Weather and Climate July 9-13, 2007

**Principal Investigator:** Steve Carson (Princeton Regional Middle School Chemistry Teacher)

**Other Participating Researchers:** 10 Participants

**Theme #1:** Earth System Studies/Climate Research

**NOAA’s Goal #2:** Understand Climate Variability and Change to Enhance Society’s Ability to Plan and Respond

**Objectives:** In support of the Cooperative Institute for Climate Science’s (CICS) intent to train the next generations to deal with the increasing complexity of understanding and predicting climate, the CICS collaborated with a Princeton University program called QUEST on a professional development institute for New Jersey teachers, July 9-13, 2007. QUEST is a long-standing summer program of Princeton University’s Teacher Preparation Program. The two-week Weather and Climate unit in which CICS was involved was for teachers in third through sixth grades and offered a wide range of inquiry-based experience through which the teachers could develop an understanding of atmospheric processes and learn methods to teach about weather and climate. The unit was developed and taught by Dr. Steven Carson who was formerly a scientist and Outreach Coordinator at the Geophysical Fluid Dynamics Laboratory (GFDL) of CICS and is currently a middle school science teacher in Princeton, New Jersey.

**Methods and Results/Accomplishments:**

The 2007 QUEST unit “Oceans and Climate” (O&C) was designed to highlight the roles of Earth’s oceans as recorders of past climates and as participants in climate and climate change. The O&C unit touched on aspects of three themes: (#1) Earth System Studies/Climate Research, (#2) Biogeochemistry, and (#4) Paleoclimate. The O&C unit also supported NOAA’s Goal #2: “Understand Climate Variability and Change to Enhance Society’s Ability to Plan and Respond”.

After an introduction to ocean sediments, participants examined samples of foraminifera from different depths in a core from the Atlantic Ocean with a focus on determining relative abundances of G. Menardii and how those relate to ocean surface temperatures. The depth distributions of G. Menardii were then related to data on depth distribution of δ18O in foram shells of the same core. Participants were introduced to the principles of oxygen isotope fractionation through evaporation and condensation by means of a hands-on activity. The data from cores were then related to patterns of glacial cycles. A post-doc from Princeton University provided further background on uses of isotopes in climate studies and gave a tour of the mass spectrometry labs. To connect Milankovitch cycles to glacial cycles, activities were done to illustrate the basis of seasons and how orbital parameters can change. The importance of temperature and salinity in the ocean were explored through demonstrations and examinations of maps and cross-sections. Principles of ocean currents were then introduced including wind driven currents, the Coriolis effect, and thermohaline currents with an emphasis on the Ocean Conveyor. All of these studies and activities culminated with a mid-week trip to the Core Laboratory of the Lamont Doherty Earth Observatory where the participants were given a tour of the facilities, processed and examined sediment samples from cores, and were provided background on the climate research carried out.

The remaining two days focused on ocean/climate interactions and potential future climate changes. An introduction to the greenhouse effect and basic modeling was done through a simple spreadsheet model of the Earth’s radiation balance in which participants could experiment with changes in parameters that affect the radiation balance. The basics of the greenhouse effect were
also demonstrated through a hands-on activity. To understand the impacts of thermal expansion of ocean water, participants measured the thermal expansion of water and related their measurements to potential rise in sea level. Effects of melting ice were also considered through a demonstration. Participants examined topographic maps of some regions of the East and Gulf Coasts of the U.S. to discover possible impacts of sea-level rise. On the last morning the group went to NOAA’s Geophysical Fluid Dynamics Laboratory and received a tour of the supercomputer facilities as well as presentations on hurricanes, climate modeling and possible impacts of global warming. The week ended with a presentation and activity on Stabilization Wedges for reducing greenhouse gas emissions that was developed at Princeton University.

Participating School Districts:
Montgomery, Burlington City, Hillsborough, Ewing and West Windsor-Plainsboro and one teacher from the Newgrange School for children with special education needs. Burlington City is a high poverty district and Ewing has similar demographics. The others are suburban districts/school.
Feedback from teachers:

• “Without a doubt, QUEST is the best professional development I’ve experienced as a science teacher because it challenges my own adult understanding of concepts and allows me to determine how I can best take this back and apply it to my classroom activities.”
• “It is an incredible experience. You get to meet and talk to the scientists doing the actual research. All QUEST staff help explain concepts in a way that we can understand it.”