NSF REU SITE AT NCA&T

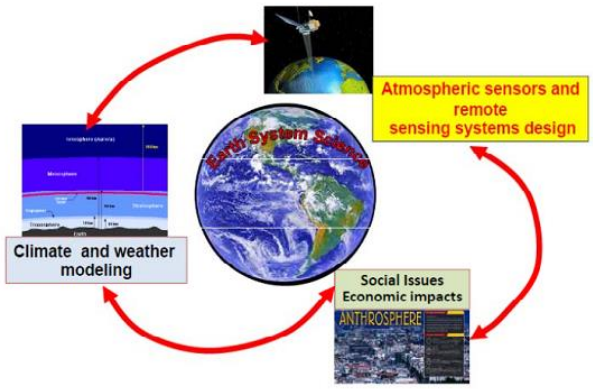
SUMMER AND ACADEMIC YEAR RESEARCH EXPERIENCE FOR UNDERGRADUATES (REU) -IN COLLABORATIVE EARTH SYSTEM SCIENCE RESEARCH- ATMOSPHERIC MODELING, SENSING AND SOCIETAL IMPACTS

OVERVIEW:

The North Carolina A&T State University will host six students in the summer of 2014. This REU provides opportunities for undergraduate students with **physical science, engineering, and social science backgrounds to** work in interdisciplinary groups on a problem that reflects a complex, real-world situation related to atmospheric modeling and the use of weather and climate models, sensor development and evaluation, remote sensing exploring the various issues involving the inherent tradeoffs between environmental protection and economic growth.

WHAT IS UNIQUE ABOUT THIS REU?

- Unlike traditional REU sites in which students work with only one faculty member on a specific topic, in this REU the design of projects will involve several faculty members (at least two from different disciplines) and expose students to interdisciplinary research approaches.
- A particular strength of the proposed REU model is the use of existing NOAA labs, NCAR and NIA, partnerships to provide cutting-edge research, educational, and professional development opportunities for undergraduate students.



Research topics under this REU are-

- Development of luminescence sensors for detecting volatile organic compounds
- MEMS sensors and systems to measure atmospheric variables
- Overtone induced dissociation of VOC's using cavity ring down spectroscopy
- Raman spectrometer in remote sensor module networks for water diagnosis
- Small satellite remote sensing system design
- Approximating a hurricane's path and position using simplified weather models
- Modeling of African easterly waves and hurricane formation
- The Caribbean low-level jet: Climatology and variability
- Societal Impacts

When

The 2014 program will run from **May 26 – July 31, 2014**. Students must be available for the entire 10 weeks in order to participate in the program.

Benefits

Students will be provided a $5000 stipend for the summer. Additionally, a travel allowance, housing on NCA&T campus (shared rooms), and a meal card will be provided.

Eligibility

Applicants should be full-time, undergraduate students with a GPA of 2.75 or better and majoring in science, technology, engineering, or mathematic (STEM) fields and social sciences. Students must be US citizens or permanent residents in order to be considered for this program. **Rising sophomores with prior research experience or strong in science and, women are encouraged to apply.**

To apply

To apply, fill out the application at the link http://www.ncat.edu/research/students/reu-earth-systems-landing-2014.html and send two letters of recommendation and unofficial transcripts to bililign@ncat.edu by **March 30, 2014**.

Location

The research facilities will be in different labs on the campus of North Carolina A&T State University located at 1601 E Market Street, Greensboro, NC 27411 and the Joint School of Nanoscience and Nanoengineering located at 2907 East Lee Street, Greensboro NC 27401

Additional information

Contact Dr. Solomon Bililign- Bililign@ncat.edu; Phone: 336-285-2328 or write to
NCA&T- REU **Collaborative Earth System Science Research** Program
Department of Physics and NOAA-ISET Center
North Carolina A&T State University
Greensboro, NC 27411

REU for Weather and Climate

- Director: Dr. Solomon Bililign (bililignsol@gmail.com)
- Faculty Advisors: Drs. Yuh-Lang Lin, Liping Liu, Ademe Mekonnen, Yevgenii Rastigejev, Jing Zhang
- Graduate Mentors: Galen Smith, Justin Riley, Jose Garcia, Gian Villamil-Otero, Nitza Santiago, Gokhan Sever

There are two parts involved in this part of the proposal.

(A) Research projects

1. **Hurricane research (Drs. Lin, Rastigejev, Liu, Mekonnen)**
   a. African Easterly Waves
   b. Effects of Ocean Spray, SST, and Orography on TC Intensity
   c. Rapid Intensification of Hurricanes
   d. Orographic Effects on Tropical Cyclone Tracks and Precipitation
2. **Severe Local Storm research (Dr. Liu, Lin)**
   a. Recent Tornado Outbreaks
   b. Data Assimilation for Severe Storm Initiation
   c. Effects of aerosols on tornado genesis
   d. Orographic Effects on Tornado Outbreaks
   e. Hurricane-Induced Tornado Outbreaks
   f. Effects of Climate Change on Severe Local Storms
3. **Tropical Meteorology and Climatology research (Dr. Mekonnen)**
4. **Arctic and Polar Meteorology (Dr. Zhang)**

(B) Hands-on research experience for NCAT and visiting REU students

1. Shallow water tank modeling
2. Modeling of airflow over mountains
3. Modeling of cloud convection
4. Modeling of hurricanes and hurricane trajectory

Research Ideas: Gets hands on experience in numerical modeling and understand the atmospheric and fluid dynamics behind the modeled phenomena.

Research Activities on Hurricane and Storm Modeling at NC A&T:

(1) Mesolab and AMCA webs will lead you to most of the modeling activities you need:

(a) NOAA ISET Center
(b) NCAT Real-Time Weather Forecasting System
(c) Modeling Activities
(d) Theoretical & Computational Fluid Dynamics (AMCA)

(2) Check with Dr. Zhang (Jingnc@gmail.com) regarding research activities of polar and arctic meteorology

Descriptions of research projects:
Some examples of detailed descriptions are given below.

Project 1: Educational Module I of Shallow Water Tank Model

This module will be developed under the currently NSF funded NSF HBCU/RISE Center Advanced Multi-scale Computational Algorithms (AMCA) (PIs: Rastigejev, Tang, and Lin), according to the following plan:

(i) One-dimensional Advection Model.
- a) Develop a numerical code for the Burgers Equation that uses higher-order time and spatial discretization schemes.
- b) Test the code for different initial and boundary conditions for nonlinear and linear flows.
- c) Document the one-dimensional Advection Model

(ii) One-dimensional Shallow-Water Tank Model.
- (a) Extend the one-dimensional Advection Model numerical code described above for numerical calculation of one-dimensional Shallow-Water Tank Model.
- (b) Test the Shallow-Water Tank Model with different initial and boundary conditions.
- (c) Document the Shallow-Water Tank Model.

(iii) Two-dimensional Shallow-Water Tank Model
- (a) Extend the one-dimensional Shallow-Water Tank Model to two-dimensional Tank Model.
- (b) Test various initial and boundary conditions, and perform calculation for different linear/nonlinear flows.
- (c) Extend the plotting subroutines to allow contour plotting of the water surface.
- (d) Document the two-dimensional Tank Model.

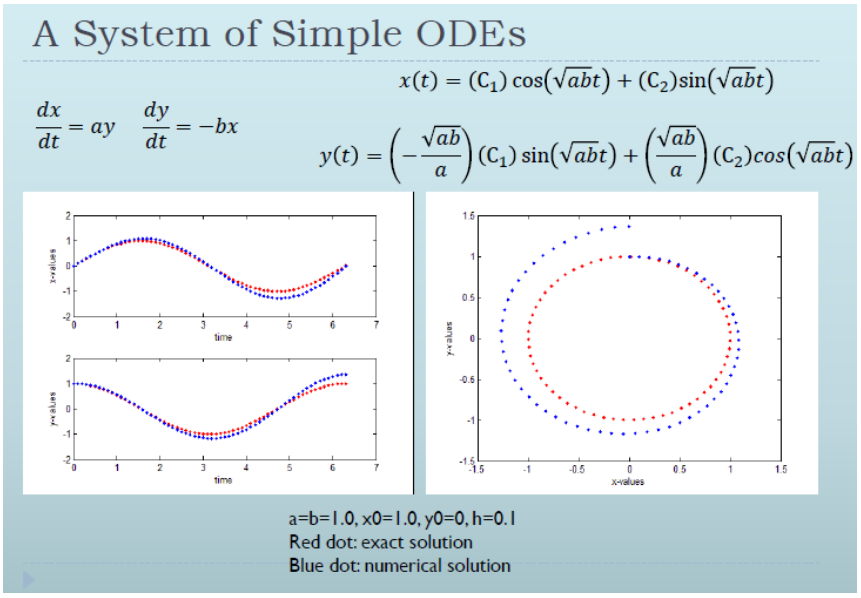
(iv) Two-dimensional Shallow Water Tank Model with bottom topography
- (a) Modify the lower boundary condition of the two-dimensional Tank Model to include the bottom topography.
- (b) Test different bottom topographies against the shallow-water theory explained in the NWP class.
- (c) Test different numerical schemes explained in the NWP class and in the course textbook (Lin, 2007).
- (d) Add the earth rotation effect (i.e., the Coriolis parameter) to the Shallow Water Tank Model and test the effects with large-scale flow.
- (e) Document the two-dimensional Shallow Water Tank Model with bottom topography.

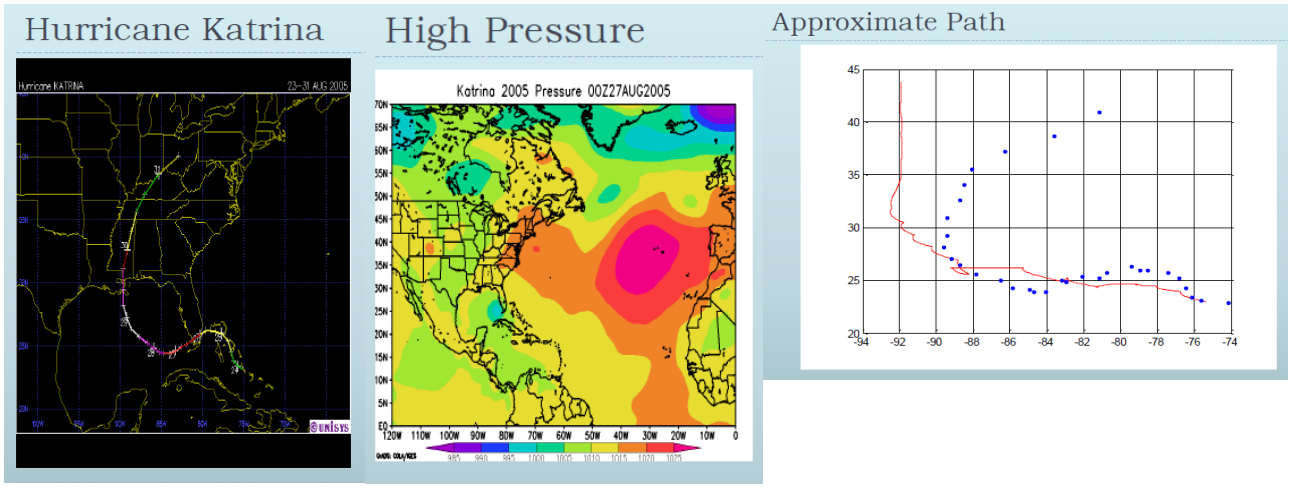
HBCU RISE doctoral student R. Islam who will be taking EES 735 will develop and document the "Shallow Water Tank" module. The educational model will allow future undergraduate students to learn and master more efficiently numerical techniques used for numerical simulations of atmospheric flows. This module is applicable to both atmospheric and oceanic flows.

Project 2 & 3: These two educational modules will be packaged for Windows machines based on the idealized modules of the NCAR Advanced Weather Research and Forecast model.

Project 4: Approximating a Hurricane's Path and Position Using Simplified Weather Models

This module is developed by Guy Oldaker IV, an undergraduate student in the Department of Mathematics, advised by Drs. Liu and Lin by applying the idea of that Atlantic hurricanes are mainly driven by the Bermuda High under the NASA INSTRUCT project. For example, the track of Hurricane Katrina (2005) may be forecasted by this simple model as follows.





The REU students supported by this proposal will be able to gain hands on experiment of this model by varying the strength and location of the idealized or real-case high pressure.

Project 5: Idealized or real-case hurricane modeling will be developed to provide REU students hands-on experience on hurricane modeling. These modules will be constructed based on the current modeling simulations using NCAR ARW model.