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# STATE CLIMATE OFFICE OF NORTH CAROLINA

*2008-2009 Annual Report*

**The State Climate Office of North Carolina (SCO) serves as the primary scientific extension resource for weather and climate science focused on North Carolina. Following the mission as chartered by the UNC Board of Governors in 1998, the SCO focuses on service to public and private sectors of North Carolina through climate science extension, research, and education.**

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*Hiroshi Suda, Undergraduate Assistant*

*Jeremy Gilchrist, Undergraduate Assistant*

*David Church, Undergraduate Assistant*

*Corey Davis, Undergraduate Assistant*

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# Executive Summary

In the Academic Year 2008-2009, the State Climate Office continued its efforts to deliver climate information, climate data, and climate services to the state of North Carolina.

Extension efforts were focused on delivery of services through direct interaction and communication with clients, partnerships with state agencies, and collaboration with extension specialists and scientists at NC State University. Significant extension activities in 2008-2009 included the development of several new climate information tools, deployment of five new ECONet monitoring stations, initiation of new projects in collaboration with agricultural scientists, active monitoring and response to drought conditions in NC, development of climate database and information tools for the NOAA Southeastern Regional Climate Center, and membership in the Southeast Climate Consortium.

Research efforts in the past year focused on study North Carolina's climate and its interaction with the environment, and investigations into the effects of climatic variations on agriculture and natural resources to assist in resource management. Highlights of our applied research efforts include evaluation of new models and precipitation estimation tools, winter and tropical storm climatologies, a new climatology for recreational activities in NC, and advancements in short-term and seasonal agricultural forecasts.

Educational outreach activities in the State Climate Office are designed so that climate scientists interact with K-12, community colleges teachers and students, and with other community organizations on different aspects of NC climate and environment. There continues to be overwhelming demand from the public for education on climate variability and climate change, as well as severe events. Activities in the past year include dozens of invited presentations, development of severe weather training programs for Emergency Managers, participation in the FIRST Lego League Challenge and NC Science Olympiad, and a start of new climate education tools in partnership with the Science House.

# Extension

*Extension efforts were focused on delivery of services through direct interaction and communication with clients, partnerships with state agencies, and collaboration with extension specialists and scientists at NC State University. Significant extension activities in 2008-2009 included the development of several new climate information tools, deployment of five new ECONet monitoring stations, initiation of new projects in collaboration with agricultural scientists, active monitoring and response to drought conditions in NC, development of climate database and information tools for the NOAA Southeastern Regional Climate Center, and membership in the Southeast Climate Consortium.*

### Climate Information Services

The primary service of the State Climate Office is to provide scientific and data expertise to clients who request information. Climate Services is a broad concept, but fundamentally involves interaction between a client who needs climate information and SCO scientists who are experts in climate data and climate science. Most users are not sure what data or information is best for their needs, and many need guidance on how to properly use and interpret climate information. SCO staff and students interact directly with users to ensure responsive and reliable climate information services.

- **Requests for Services**: 2% increase in time spent directly responding to requests for services from clients. Clients request services via email, phone, and through the Climate Office website. An increasing percentage of time is devoted to supporting requests from faculty, staff, and student at Universities. 46% of time for requested services was in response to Universities, with 37% of all time supporting requests from within the UNC system. A more detailed breakdown of request-driven climate services is provided in Appendix A.
- **Monthly climate summaries**: Climate summary reports are prepared each month to highlight climate patterns and impact to agriculture and water resources in NC. These are distributed via a monthly online newsletter, reports to NOAA through the Southeast Regional Climate Center (SERCC), and reports to the American Association of State Climatologists (AASC). The SCO uses the newsletters to also inform users about new products and services. The AASC is providing $2500 for these services.
- **NCDA Monitoring**: NC Department of Agriculture now receives a feed of climate data from the SCO to develop their weekly weather and crop status reports. Weekly temperature, precipitation, and degree day accumulations are provided for dozens of sites across the state. A map of precipitation accumulation based from radar estimates is also provided.
- *Team: All students, Ashley Frazier, John McGuire, Mark Brooks, Ryan Boyles*

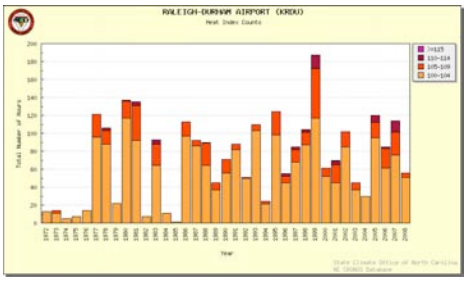
A sample of what some clients have said during the past year:

> *"I completed a request form … in less than one hour I had the data." – Robert N.*
>
> *"Excellent service....very responsive and exactly the information I needed to do my job." – Landon D.*
>
> *"Thanks for your prompt response. The data you have provided will help me get part of my research done. I do appreciate your help so so much." – Naser A.*
>
> *"Thanks so much...you guys are an excellent resource!" – David J.*
>
> *"Thanks very much for the rainfall info you sent to me. It has helped greatly in pinpointing the amounts of rain required to trigger the leak in the property." – Jason M.*
>
> *"Thank you for the prompt response and information, it has been very helpful for my Viticulture report." – Renee S.*
>
> *"Thank you for making my job more productive and helping me provide accurate information to our clients." – Mary T.*

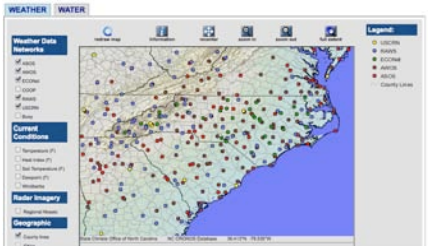
**Website**

The SCO website is often the first point of contact with clients who need climate information. Effort over the past several years has been focused on linking web products and tools to the climate observation database to provide products and services that are dynamically update.

- **Usage**: 19% increase in website activity as measured by the number of unique visitors. The SCO website averages nearly 14,000 unique visitors every month. Other measure of website activity such as bandwidth and hit counts are available but may be biased by the increase in the number of pages and content added to the site over the past year.
- **Holiday Climatology**: New tool to provide public and media with local climatologies for most holidays, including those that do not occur on the same calendar date each year (e.g. Thanksgiving, Easter, Labor Day). http://www.nc-climate.ncsu.edu/holiday_climatology.php
- **Heat Index Climatology**: New page that provides a historical climatology of heat events as measured by heat index thresholds. This product was developed in response to a request from the National Weather Service.
- *Team: Ashley Frazier, John McGuire, Bryan Aldridge, Mark Brooks, Ryan Boyles*



## CRONOS Database




CRONOS is the name given to the SCO's climate database, which includes data from surface observational networks, severe weather data, and every type of climate data that we can insert. The CRONOS database serves as the foundation for most SCO products and services.

- **Usage**: Average of 4400 queries per month to CRONOS, the SCO online climate database.
- **Soil Erosivity**: Collaboration with Dr. Manuel Reyes (NC A&T State University) to develop and launch database calculations of soil erosivity for monitoring stations that report data at 1-minute intervals. A technical paper on this effort is under development.
- **SCOUT Data availability tool**: A tool to visually explore database inventory. This tool will be helpful for both staff and the public, as they would be able to see if the data they want is available before submitting a data request.
- **COOP Data Updates**: Data from National Weather Service Cooperative Observers are now ingested into CRONOS each day via the Applied Climate Information System (ACIS). ACIS is maintained at the SCO under a contract with the NOAA Southeast Regional Climate Center. Previously, COOP data inserts were delayed by 3-6 months due to quality control processing at the National Climatic Data Center.
- **CRONOS API**: An application programming interface (API) is under development which will enable authorized users to access CRONOS data without going through the web interface. This API will facilitate internal and external data use, allowing staff, students, and collaborators access to data for research and product development without requiring SQL expertise. The API was launched in beta in early 2009 for testing by colleagues in the Southeast Climate Consortium (SECC).
- *Team: Hiroshi Suda, Ashley Frazier, John McGuire, Bryan Aldridge, Mark Brooks, Ryan Boyles*

## NC Environment and Climate Observing Network (ECONet )

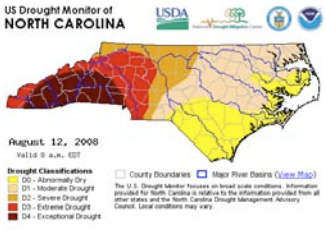
The ECONet is a network of real-time research-grade monitoring stations that provide observational data on atmospheric and soil conditions. Base funding for the ECONet is provided by NC Agricultural Research Service, which supports the maintenance of sensors at Ag Research Station. Additional support is provided by DENR Air Quality, RENCI, NC Electric Cooperatives, and individual partners. The ECONet is unique in North Carolina, and provides information that is not collected by any other sensors in the state.

- **New Installations**: Five new stations were installed at Burnsville (Yancey County), Mount Mitchell (Yancey County), Taylorsville (Alexander County), Wallace (Duplin County), and Durham (Durham County). Installation of two stations was funded through the Renaissance Computing Institute (RENCI). DENR Division of Air Quality supports the station at Mount Mitchell while the sensors at Williamsdale Field Laboratory near Wallace, NC is supported by NC Agriculture Research Service. Shown to the right is the Durham station.
- **Planned Installations**: A new station has been approved for installation at the Lonnie Poole Golf Course on Centennial Campus. New stations are planned for Ocracoke Island and Stanly County – both installations are supported by RENCI. With these installations, the ECONet will have 39 stations.
- **Sensor Upgrades**: Upgrades for the network are underway to provide new dataloggers, solar radiation sensors, sonic wind sensors, and impact precipitation sensors. These upgrades also provide data recorded every minute.
- **Radio Licenses**: The SCO has applied and been granted radio licenses for all ECONet stations by the FCC. The SCO is authorized to use two different VHF frequencies at each site, which are part of the NOAA spectrum. NWS-Raleigh provided support for the license applications. Over the next year, SCO will cooperate with the State Highway Patrol to test radio transmission and relay of the data through the Highway Patrol's network. Once successful, the transition of ECONet data communication will provide more robust services and largely eliminate the ongoing costs for telephone line connections in the field and long-distance phone services.
- *Team: Ashley Frazier, John McGuire, Bryan Aldridge, Mark Brooks, Sean Heuser, Aaron Sims, Ameenulla Syed, Ryan Boyles*

## Drought Monitoring and Response

- SCO is a key member of the NC Drought Management Advisory Committee, participating in weekly drought monitoring conference calls and providing public presentations on drought in NC. In the past year, drought conditions were widespread and persistent. In response, SCO staff frequently provided public presentations and media interviews.

- Through CRONOS, SCO provides state agencies with climate and weather data for drought monitoring and management planning. Drought monitoring products have been developed and are used each week for discussions on depictions of drought severity as part of communicated recommendations to the US Drought Monitor.




- *Team: Ashley Frazier, Mark Brooks, Aaron Sims, Ryan Boyles*

## ECONet Monitoring for DENR Division of Air Quality (DAQ)

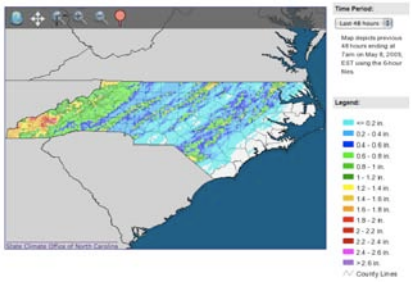
- A new ECONet station was installed at Mount Mitchell State Park to support the DAQ need for high elevation climate data. The sensors were installed near the ranger residences at an elevation of 6200 ft above sea level. This station is now the highest monitoring site in NC, and one of the highest in eastern North America.
- SCO contract with DAQ was extended through June 2009. A new proposal to maintain the seven ECONet stations supported by DAQ has been submitted and is under final review by DENR. This next contract will provide funds to support the seven DAQ stations through 2014.
- *Team: Sean Heuser, Ameenulla Syed, Ryan Boyles*

## Water Data Support for DENR Division of Water Resources (DWR)

- SCO contracted with DWR to provide ongoing climate and water data to support drought monitoring and water resource planning in North Carolina. As part of this effort, SCO developed new software to ingest, process, and integrate streamflow, groundwater, reservoir, and precipitation observations from several providers, including US Geological Survey, US Army Corps of Engineers, Duke Energy, National Weather Service, and DWR. This contract ends in May 2009, but ongoing maintenance funding from DWR is expected.
- As part of a separate contract with DWR, SCO developed a tool to provide multi-sensor precipitation estimates (MPE) via a simple URL and developed an interface that provides MPE-based comparisons with normal precipitation.
- http://www.nc-climate.ncsu.edu/cronosh2o/
- *Personnel Involved: Ashley Frazier, John McGuire, Bryan Aldridge, Mark Brooks, Aaron Sims, Ryan Boyles*

## Precipitation Monitoring and Alerts for DOT Stormwater Management

- SCO has a contract with DOT to provide precipitation monitoring and heavy rainfall alerts to support testing and evaluation of highway and construction stormwater controls. Over the past year, SCO provided operational maintenance and support for this tool. This 3-year contract ends in June 2009, but ongoing funding to support this service is expected. A proposal for funding support through 2012 is in development.



- http://www.nc-climate.ncsu.edu/dot/
- *Team: Ashley Frazier, John McGuire, Bryan Aldridge, Mark Brooks, Aaron Sims, Ryan Boyles*

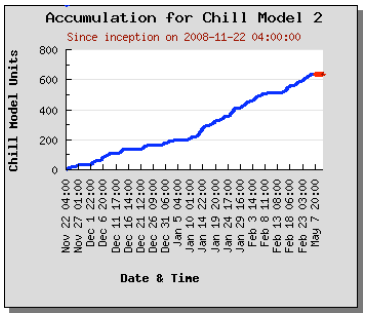
## Turfgrass Irrigation Management System (TIMS)

- SCO collaborated with partners in NCSU Crop Science to develop irrigation guidance tools for urban lawn maintenance, called TIMS. Phase 3 of this project was funded by the Center for Turfgrass Environmental Research and Education through June 2009. Phase 3 will add CoCoRaHS data and NWS forecasts to the TIMS website tool. Also included in the phase 3 proposal is an evaluation of the next generation of precipitation estimates, called Q2.
  - http://www.turffiles.ncsu.edu/TIMS/
- *Team: Heather Dinon, Adrienne Wootten, John McGuire, Mark Brooks, Ryan Boyles*

## Forecasting Ice Accumulation

- Working with Dr. Gary Lackmann (NCSU MEAS) and Richard Barnhill (ECU), SCO implement a technique to provide forecasts for ice accumulation based on numerical weather predictions. A prototype tools has been developed, which will be evaluated during future ice storms in NC.
- *Team: Aaron Sims*

## Berry Chill and Heat Models




- Working with Dr. Gina Fernandez (NCSU Horticulture Science) and Dr. Bill Cline (NCSU Plant Pathology), SCO developed web-based climate monitoring tools to support blackberry and blueberry growers through heat and chill accumulation tools. SCO presented the blueberry tool at the annual Blueberry Open House.
- http://www.nc-climate.ncsu.edu/cronos/blackberry/
- http://www.nc-climate.ncsu.edu/cronos/blueberry/chill_model
- *Team: Ashley Frazier, Mark Brooks, Ryan Boyles*

## Peanut Disease Advisories

- Working Dr. Barbara Shew (NCSU Plant Pathology), SCO provided daily guidance for fungicide spraying to peanut growers in NC from June-October 2008. These advisories take advantage of research into the relationships between climate and the development of two peanut fungal diseases. In 2009, SCO will begin its 5$^{th}$ year of collaborating with Dr. Shew to provide these advisories.
- *Team: Ashley Frazier, John McGuire, Mark Brooks, Aaron Sims, Ryan Boyles*

**Strawberry Frost Guidance**

- Working with Dr. Barclay Poling (NCSU Horticulture Science), SCO is working to develop a weather-based decision support system for strawberry growers to evaluate their risk to frost and freeze events. Support for development and evaluation of this tool is provided from the University Office of Extension, Engagement and Economic Development seed grant the Southern Region Small Fruit Consortium.
- *Team: John McGuire, Mark Brooks*

**Climate Information for Thrips Risk Assessment**

- In collaboration with Drs. George Kennedy and Hannah Burrack (NCSU Entomology), SCO is working to develop an online, automated advisory system that evaluates the risk of thrips in tobacco. Work will begin in summer 2009 and a beta website will be launched by the end of 2009
- *Team: Mark Brooks*

**Water and Climate Data for Tennessee Valley Water Partnership**

- Based on work to support DENR Water Resources, SCO is working with partners in seven states that form the Tennessee Valley Water Partnership to expand the NC water resources database and monitoring tools to Kentucky, Virginia, Tennessee, Mississippi, Georgia, and Alabama. Over the past year, initial efforts have involved ingest of new climate and water data for the seven-state region. Ongoing funding to support this service is expected after the initial development phase.
- *Team: Ashley Frazier, Aaron Sims, Mark Brooks, Ryan Boyles*

**National Catalog of Climate Services**

- SCO is the lead state working with the American Association of State Climatologists to develop a catalog of climate products and services provided by the state climatologists and NOAA regional climate centers. SCO is collecting data from AASC members to showcase the economic benefit of these local products and services and contribute to the NOAA Economics website.
- Catalog will illustrate the value of state and regional expertise in the context of a National Climate Service and other NOAA initiatives. AASC is providing $5000 to support this effort.
- *Team: Mark Brooks, Ryan Boyles*

## Southeast Climate Consortium


- The Southeast Climate Consortium is a group of Universities in FL, AL, and GA working to develop climate risk research and decision support tools for agriculture in the southeastern US. Funding for the SECC is provided through USDA RMA, NOAA Climate Program Office, and a congressional earmark (primary funding source). NCSU was invited into this Consortium in 2008. This effort has research, education, and extension components.
- NC hosted two workshops for extension specialists and county extension agents to introduce them to AgroClimate.org and get their feedback. Workshops involved direct participation and presentations from collaborators in Georgia and Florida.
- Working with our SECC partners, tools for NC have been added to the SECC decision portal http://agroclimate.org/
- Collaborators are Dr. Gail Wilkerson (NCSU Crop Science), Dr. David Jordan (NCSU Crop Science), Bridget Lassiter (NCSU Crop Science), Dr. Jim Jones (U. Florida), Dr. Clyde Fraisse (U. Florida), Dr. Joe Paz (UGa), and Dr. Jim O'Brien (Florida St. U.)
- *Team: Heather Dinon, Ryan Boyles*

## Climate Information Support for the NOAA Southeast Regional Climate Center

- NCSU and UNC-Chapel Hill were awarded the NOAA Southeast Regional Climate Center (SERCC) in 2007. As part of that award, the SCO is responsible for supporting and maintaining the Applied Climate Information System (ACIS), which serves as the climate database for all six NOAA Regional Climate Centers. Additionally, SCO is responsible for developing and maintaining the SERCC web services and online climate tools.
- Over the past year, SCO has provided operational support for ACIS and the SERCC website. Additionally, SCO has enhanced server reliability and develop a new Climate Perspectives tool that places recent climate observations in geographical and historical context.
- Collaborators are Dr. Peter Robinson (UNC-CH), Dr. Chip Konrad (UNC-CH), William Schmitz (UNC-CH).
- http://www.sercc.com/perspectives/
- *Team: John McGuire, Bryan Aldridge, Ashley Frazier, Mark Brooks, Ryan Boyles*

# Applied Research

*Research efforts in the past year focused on study North Carolina's climate and its interaction with the environment, and investigations into the effects of climatic variations on agriculture and natural resources to assist in resource management. Highlights of our applied research efforts include evaluation of new models and precipitation estimation tools, winter and tropical storm climatologies, a new climatology for recreational activities in NC, and advancements in short-term and seasonal agricultural forecasts.*

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### Integrated Air Quality and Climate Data

- Under a contract with US Environmental Protection Agency, SCO processed historical air quality observations and created a serially complete data set that combined the air quality data with available climate observations for all air quality monitoring sites in NC. This pilot project is part of a larger effort to design and develop a tool for state and regional air quality planners to assess local sensitivities of air quality to climate change projections.
- Collaborators on this project are Dr. Brooke Hemming (US EPA) and Dr. Fred Semazzi (NCSU MEAS).
- *Team: Kristen Gore, Mark Brooks, Ryan Boyles*

### Winter Storm Impacts Climatology

- SCO is working to develop a comprehensive winter weather climatology that linked the observational snow and ice data to impact data as provided through the NWS Local Storm Reports and NOAA Storm Data publications. Research is underway to identify relationships with known climate oscillations and offer seasonal guidance on winter storm frequency and intensity. A preliminary website is expected by August 2009.
- *Team: Bradley McLamb, Elizabeth Wilson, Ashley Frazier, Mark Brooks, Ryan Boyles*

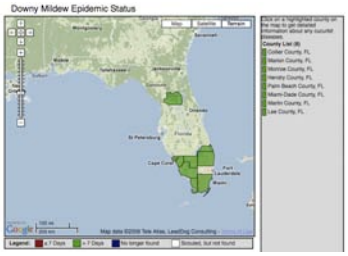
### Updated Tropical Storm Climatology

- SCO is working to build an updated tropical storm climatology web page that allows users to directly interrogate the database of storm tracks and link tropical storm tracks to the observational climate data (e.g. wind, precipitation). A preliminary website is expected by August 2009.
- *Team: David Church, Ashley Frazier, Mark Brooks, Ryan Boyles*

## Recreation and Tourism Climatology

- Based on media interest and discussions with colleagues at the ECU Center for Sustainable Tourism, SCO is researching the variability of climate conditions favorable for a range of recreational activities. A preliminary report is expected in summer 2009, with a web page planned for development over the next year.
- *Team: Corey Davis, Ashley Frazier, Mark Brooks, Ryan Boyles*

## USDA/RMA Cucurbit Downy Mildew Forecasts




- NCSU was awarded a 3-year grant from USDA Risk Management Agency to develop national operational integrated pest management (IPM) forecasts for Downy Mildew that affects cucurbits (cucumbers, melons, squash). As part of this project (known as ipmPIPE), SCO is responsible for providing weather information, technology support, and dispersion forecast guidance.
- Over the past year, SCO has developed online tools for partners to input mildew monitoring and maps for cucurbits yields. A new website to provide all forecasts and monitoring products has been developed and is being tested, including maps that dynamically link to online monitoring inputs.
- SCO has expanded the domain for numerical weather prediction tools based on the Weather Research and Forecast (WRF) model to support the forecast development.
- Working with a partner at Lawrence Livermore National Lab, SCO has linked the FLEXPART dispersion model to WRF output. FLEXPART is being tested as a primary tool to support the operational mildew transport and risk forecasts.
- Collaborators at NCSU are Dr. Peter Ojiambo (PI), Wendy Britton, and Thomas Keever in the Department of Plant Pathology. Dr. Gerald Holmes, who originally developed the proposal, served as PI until December 2008 when he left NCSU.
- http://cdm.ipmpipe.org/
- *Team: Lara Pagano, John McGuire, Bryan Aldridge, Ashley Frazier, Mark Brooks, Aaron Sims, Ryan Boyles*

## Microsoft Sensor DataBus

- SCO is collaborating with the Renaissance Computing Institute (RENCI) under a grant from Microsoft Corporation to research a next-generation environmental data server. SCO is working with RENCI partners to feed CRONOS data into a new data server and evaluate the development process for creating software that drives new products and tools.
- Collaborators at RENCI are John McGee and Ken Galluppi.
- *Team: John McGuire, Bryan Aldridge, Mark Brooks, Aaron Sims, Ryan Boyles*

**Evaluation of RENCI Operational Model Forecasts**

- RENCI is supporting the SCO to develop automated tools that provide qualitative and quantitative evaluation of RENCI operational model forecasts. RENCI model output is compared with observations and other models to determine the value of high-resolution forecasts for severe weather.
- Over the past year, SCO completed tools for qualitative evaluations (graphical comparisons of model output) and is expected to complete the tools for quantitative (statistical) evaluation.
- *Team: Monica Laureano, Heather Russett, Jennifer Marik, Eliott Foust, John McGuire, Aaron Sims*

**Data Assimilation for Improved Model Forecasts**

- RENCI is supporting SCO to develop improved forecasts through the implementation of 3-dimensional variational data assimilation (3D-VAR) into the Weather and Research Forecast (WRF) model. Previous studies have shown that data assimilation can dramatically improve model forecasts of wind and precipitation during severe events.
- *Team: John McGuire, Bryan Aldridge, Aaron Sims*

**Evaluation of Peanut Disease Forecasts**

- Research into the effectiveness of using numerical weather models (MM5, NAM, NDFD) to predict the growth of sclerotinia and peanut leaf spot diseases.
- Collaborator is Dr. Barbara Shew (NCSU Plant Pathology)
- *Team: John McGuire, Mark Brooks, Aaron Sims*

**Evaluation of Multi-Sensor Precipitation Estimates (MPE)**

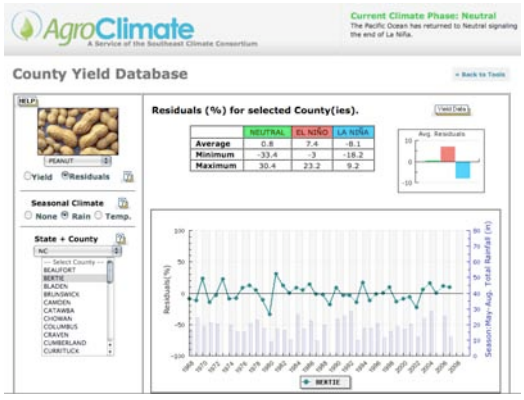
- SCO uses MPE products provided by NWS River Forecast Centers and the National Center for Environmental Prediction in several products and tools used by DOT, DWR, TVA, and others. As part of the ongoing use of the data, SCO is revisiting an evaluation from 2006 to incorporate data from recent years and compare with next-generation precipitation estimates under development at the National Severe Storms Lab.
- Collaborator is Dr. Suzanne VanCooten (NSSL)
- *Team: Adrienne Wootten, Mark Brooks, Aaron Sims, Ryan Boyles*

## Evaluation of Global Climate Model Forecasts

- Working with Dr. Fred Semazzi (NCSU MEAS), SCO has been evaluating the performance of global climate models used in IPCC assessments to forecast seasonal temperature and precipitation over the Southeastern United States. This research is driven by questions from clients on which models are best and how much confidence there is with regard to climate change scenarios in the Southeast. A manuscript based on this research is in development.
- *Team: Sean Heuser, Ryan Boyles*

## Southeast Climate Consortium (SECC)

- The Southeast Climate Consortium is a group of Universities in FL, AL, and GA working to develop climate risk research and decision support tools for agriculture in the southeastern US. Funding for the SECC is provided through USDA RMA, NOAA Climate Program Office, and a congressional earmark (primary funding source). NCSU was invited into this Consortium in 2008. This effort has research, education, and extension components.
- As part of our SECC contract with USDA Risk Management Agency, SCO is researching the historical relationships between crop yield and climate. In particular, attention is focused on the relationship between yield of peanuts, cotton, and corn with the phase of the El Niño – Southern Oscillation (ENSO). Research is also underway to develop improved understanding of evaporation and solar radiation variability.




- A survey was developed and distributed to extension agents to establish a baseline reference on the understanding and value of climate forecasts for agriculture applications.
- Additional funds are expected for the 2009-2011 period depending on congressional markup amounts.
- Collaborators are Dr. Gail Wilkerson (NCSU Crop Science), Dr. David Jordan (NCSU Crop Science), Bridget Lassiter (NCSU Crop Science), Dr. Jim Jones (U. Florida), Dr. Clyde Fraisse (U. Florida), Dr. Joe Paz (UGa), and Dr. Jim O'Brien (Florida St. U.)
- *Team: Heather Dinon, Ashley Frazier, Ryan Boyles*

# Educational Outreach

*Educational outreach activities in the State Climate Office are designed so that climate scientists interact with K-12, community colleges teachers and students, and with other community organizations on different aspects of NC climate and environment. There continues to be overwhelming demand from the public for education on climate variability and climate change, as well as severe events. Activities in the past year include dozens of invited presentations, development of severe weather training programs for Emergency Managers, participation in the FIRST Lego League Challenge and NC Science Olympiad, and a start of new climate education tools in partnership with the Science House.*

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### Undergraduate Training

- SCO supported 11 undergraduate and 3 graduate students over the past year
- 12 undergraduate students will be supported during the summer of 2009

### Invited Presentations and Visitor Programs

- SCO staff provided 28 presentations by invitation
- SCO provided tours and programs for 11 visitor groups
- Most invited presentations requested programs that addressed two primary climate themes as related to NC: drought and climate change
- Total Direct Educational Outreach Contact Hours: 224

### NC-FIRST Severe Weather Training

- With funding and coordination support from RENCI, SCO developed an advanced severe weather education curriculum for the NC Emergency Management community. The curriculum, including presentation material and reference manuals, is currently under review by FEMA for formal accreditation. Once approved, training workshops will offered annually for emergency managers and first responders. In additional to training, SCO is supporting RENCI's NC-FIRST weather portal, which provides a comprehensive tool for severe weather forecasts and monitoring.
- Collaborators are Jessica Proud (RENCI) and Ken Galluppi (RENCI)
- *Team: David Church, Corey Davis, Bradley McLamb, Jeremy Gilchrist, Ryan Boyles*

**NC Weather Photo Contest**

- SCO invited K-12 students to submit their best weather-themed photograph and a brief statement on the photo and weather involved. Three winners were selected to receive NCSU prize packs and recognition of their photos in the PAMS Scope Magazine. The Photo Contest for 2009 is currently underway.
- *Team: Shannon Futrell, Ashley Frazier, Mark Brooks*
- *Shown to the right is last year's winning photo.*

**Centennial Campus Middle School Internship**

- SCO hosted three 7th grade student interns from Centennial Campus Middle School for the period October 2008 through April 2009. This is the 6th year of this internship program, where students spend an afternoon every week in the SCO to learn about NC climate and develop their own research projects.
- *Team: Heather Dinon, Ashley Frazier*

**FIRST Lego League Forum**

- SCO hosted a web-based forum for coaches and students involved in the 2008 FIRST Lego League competition that involved K-12 student teams using science and technology. The theme for the 2008 competition was climate and climate change.
- *Team: Ashley Frazier, Ryan Boyles*

**Groundhog Day at Museum of Natural Sciences**

- SCO hosted an educational session at the NC Museum of Natural Sciences as part of the annual Groundhog Day celebrations on February 2, 2009. The SCO also developed a Groundhog Day climatology and information page for students to learn about animal and weather folklore.
- http://www.nc-climate.ncsu.edu/climate/groundhog/
- *Team: Heather Dinon, Ashley Frazier*

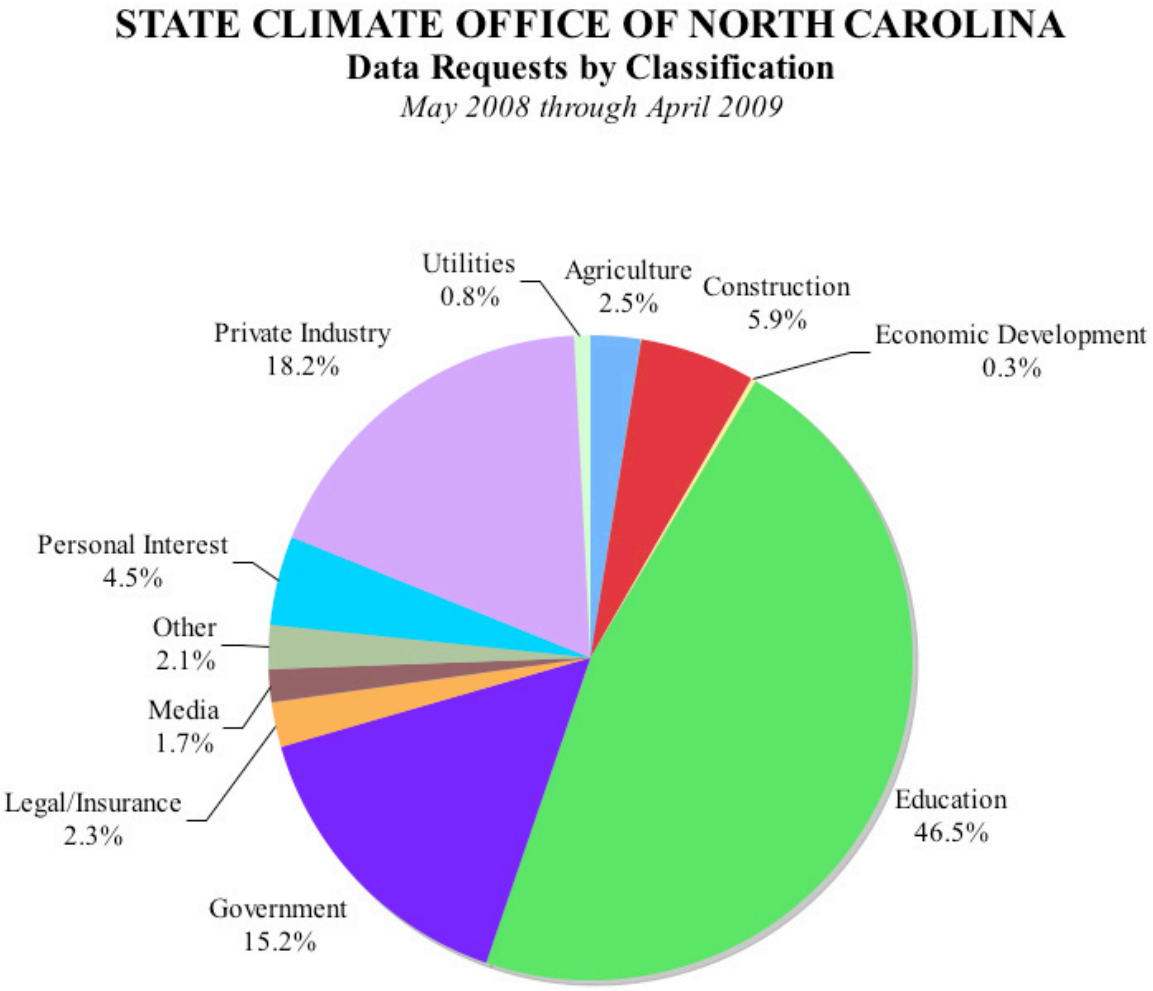
**NC Science Olympiad (NCSO)**

- The Science Olympiad is an annual science contest for middle and high school students. The theme for the state contest in 2009 was climate, and the SCO worked extensively with NCSO to host a workshop for team coaches and implement a climate test event for the Olympiad.
- *Team: Heather Dinon, Ashley Frazier*

**Southeastern Climate Consortium**

- A series of climate education modules for agricultural clients is in development to improve basic understanding of climate science, including climate variability and climate change, among growers in NC and the southeast.
- Collaborators are Dr. Sharon Schulze (NCSU Science House), Dr. Anantha Aiyyer (NCSU MEAS), Dr. Gail Wilkerson (NCSU Crop Science), Bridget Lassiter (NCSU Crop Science)
- *Team: Amy Lee, Dan McKemy, Megan Embrey, Corey Davis, Heather Dinon, Ryan Boyles*

## Appendix A: Climate Services by Client Classification



**Climate Services by Classification - Details**

*May 1, 2008 – April 30, 2009*

| Classification | Number of Requests | Hours Worked |
|---|---|---|
| **Agriculture** | 15 | **16** |
| **Construction** | 36 | **36** |
| **Economic Development** | 2 | **2** |
| **Education: K-12** | 13 | **15** |
| **Education: NCSU/UNC** | 214 | **243** |
| **Education: Other Colleges** | 55 | **62** |
| **Government: Federal** | 31 | **33** |
| **Government: Local** | 20 | **22** |
| **Government: State** | 41 | **44** |
| **Library** | 0 | **0** |
| **Legal / Insurance** | 14 | **15** |
| **Media** | 10 | **10** |
| **Other** | 13 | **14** |
| **Personal Interest** | 27 | **29** |
| **Private Industry** | 110 | **112** |
| **Utilities** | 5 | **9** |
| **Total** | **606** | **662** |
| ***Percent change* *** | ***-1.8%*** | ***+2.6%*** |

* Compared with May 1, 2007 – April 30, 2008.

Note an increase in hours worked but a decrease in the number of data. This is due to the growing complexity in the type of requests for data that require more time.

# Appendix B: 2008-2009 Budget Summary

| Source | Salaries | Operating Expenses | Total | Percent |
|---|---|---|---|---|
| College of Physical & Mathematical Sciences | $277,986 | $30,000 | $307,986 | 30 |
| NC Agriculture Research Service | $136,808 | $58,000 | $194,808 | 19 |
| External Contracts & Grants | $458,760 | $50,000 | $508,760 | 50 |
| Service Center | | $6,500 | $6,500 | 1 |
| **Total** | **$873,553** | **$144,500** | **$1,018,053** | |

# Appendix C: SCO Impact Statement

## State Climate Office of North Carolina
## NC State University

### The Need

North Carolina has a complex climate due to its three distinct regions: the mountains, the piedmont, and the coastal plain. Climate affects many aspects of our daily lives - agriculture, environment, transportation, tourism, and natural disasters to name a few. Nearly one-third of our nation's economic activity is estimated to be sensitive to weather and climate. Scientific discovery and understanding of weather and climate begins with environmental data collection, research and education.

### Serving the Need

The State Climate Office (SCO) is a public-service center for climate-environment interactions in North Carolina and chartered by the UNC Board of Governors. The SCO is housed at NC State University in the College of Physical and Mathematical Sciences with support from the NC Agricultural Research Service. It was acknowledged by the American Association of State Climatologists as one of the first officially recognized State Climate Offices. The SCO is the primary source for North Carolina weather and climate information and is involved in all aspects of climate research, education, and extension services. Activities include:

- Operate and collect high-resolution weather data from a growing network of over 30 research quality weather stations called the Environment and Climate Observing Network (ECONet).
- Disseminate climate information to the citizens and businesses of North Carolina through the CRONOS database, an intuitive website making climate data available from over 6,000 surface weather and water resource stations in and around North Carolina.
- Assist state government agencies in climate-related challenges and decision support tools that reduce costs and conserve resources.
- Collaborate with extension scientists to provide agricultural guidance to growers for disease management and irrigation, which lead to crop loss mitigation and better production decisions. An estimated $2.2 million in peanut crop savings result from this work.
- Drought monitoring and management at community, statewide, and national scales.
- Study climate variations and impacts on North Carolina, including sensor and model evaluation, severe weather patterns, drought and water resource management, and economic impacts.
- Numerous community presentations, science fairs, and other interactions with K-12, college students and teachers.

### Impact beyond North Carolina

Undergraduate and graduate students working at the SCO gain a genuinely multi-disciplinary experience that contributes to career growth and lifelong learning. Many successes of the SCO are often heralded as a model for other states' climate offices.