A Novel Partnership for Addressing the Impacts of Climate Change in Western North Carolina

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1. Introduction

The National Environmental Modeling and Analysis Center (NEMAC) located at the University of North Carolina - Asheville (UNC-Asheville) develops partnerships between academic, private-sector, government, and non-profit organizations working closely together to utilize the vast amount of environmental data archived at the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC). Through research that is lead by NEMAC and conducted by the Center and its partners, NEMAC is working to address issues that are too large and complex for any one of the partner organizations to effectively analyze alone.

2. NEMAC – The Center

The Center conducts basic and applied environmental modeling research and technology development. Through collaborations with academic, governmental, commercial, and non-profit organizations, the Center provides multi-factor analytical, visualization, and prediction capabilities to advance public education, health, welfare, and the economy. NEMAC was established in Western North Carolina in an effort to enhance the region's environmental sciences research community and to build upon the area's unique resources, including NOAA's National Climatic Data Center and UNC-Asheville. Several departments within UNC-Asheville, including Atmospheric Sciences, Computer Science, Management, Mathematics, and Biology, are actively involved in the day-to-day operations of NEMAC as well as in the Center's ongoing research projects.

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3. NEMAC – The Projects

The Center pursues projects that help to enhance research and educational opportunities for the academic partners. In addition, NEMAC strives to bring projects to the collaboration that utilize the resources of the NCDC and enhance the economic development of the region.

3.1. Database Development

As the world's largest archive of weather data, the NCDC has numerous data sets. However, due to the size and complexity of many of these data sets, significant data storage capacity and computational power is needed to effectively process and mine the data. NEMAC is currently working with several partners to develop databases that are easily queried through an interactive data processing system in order to produce valuable processed data and products based on historical weather data sets.

One example is the Time Integrated Random Access NEXRAD Database (TIRAND)
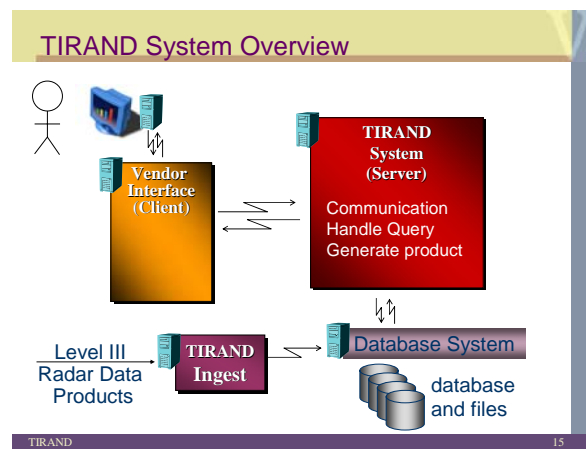

Figure 1 TIRAND System

3.2. Numerical Modeling

NEMAC and its partners have significant interest in a variety of environmental modeling activities including land-surface hydrology modeling, numerical weather prediction, air quality and visibility modeling, climate change, and scientific visualization of model output.

3.2.1. Land-Surface Hydrology

Western North Carolina has experienced significant and deadly flooding from the remnants of three tropical systems during the 2004 Hurricane Season. These major events have increased the awareness and need for timely and accurate hydrology models, especially in mountainous regions. NEMAC and its partners are working to provide better modeling of water levels in specific waterways to anticipate flash-flooding and provide better tools for organizations that manage the flow of water through rivers.
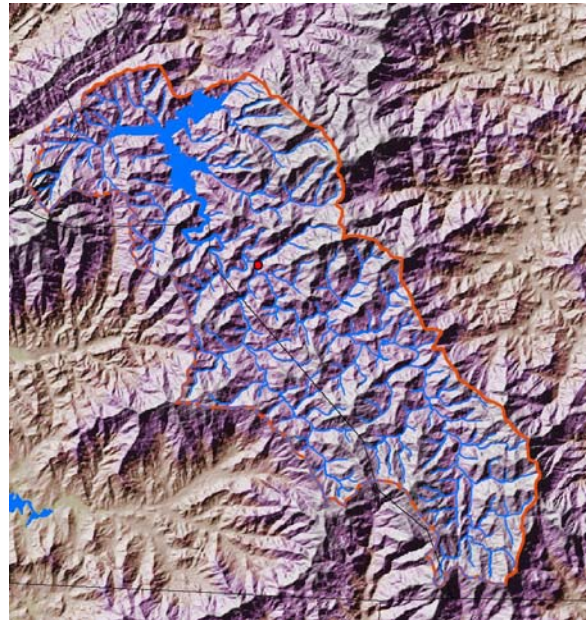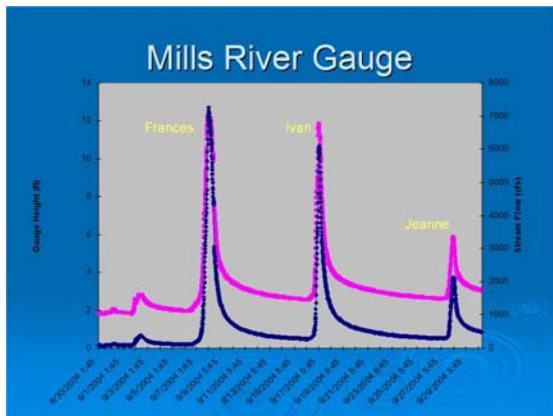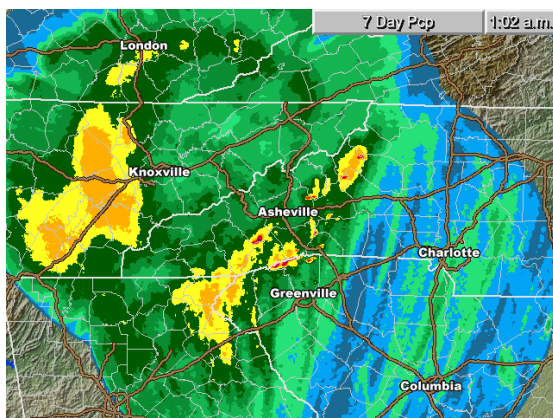

Figure 2 - Mills River Gauge 2004 Hurricane Season

Figure 3 - Radar Estimated Precipitation over 7 days due to Hurricane Ivan from NWS GSP radar *(BAMS)*

Figure 4 Nantahala Basin, Western NC

3.2.2. Numerical Weather Prediction

In order to advance the study of local weather and to improve weather forecasts in general, NEMAC is currently conducting research on high resolution numerical weather prediction forecasts, especially as they relate to and perform in areas with significant terrain variation.
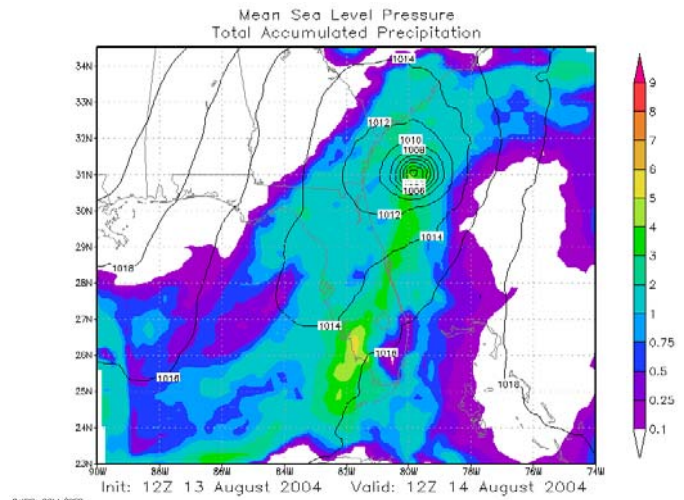

Figure 5 - WRF simulation of Hurricane Charley using the Kain-Fritsch convective parameterization scheme (CPS)
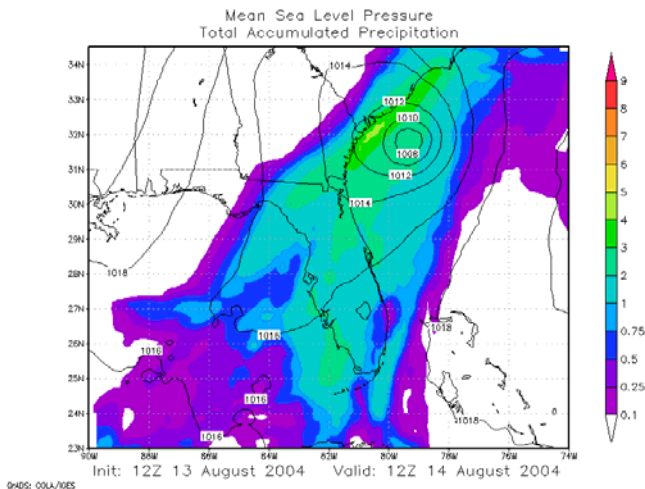
Figure 6 - WRF simulation of Hurricane Charley using the NCEP Eta version of the Betts-Miller CPS

NEMAC research includes comparison of models runs during significant events and post-event analysis.

3.2.3. Air Quality and Visibility

Working with its partners, NEMAC is conducting research that utilizes NCDC's data sets in combination with advanced atmospheric chemistry modeling. The goal is to produce assessments of the air quality benefits of increased use of energy efficient and renewable energy technologies. Additionally, the Center is working on projects that will produce computer visualizations of visibility and haze forecasts.

4. NEMAC – The Partners

A novel partnership, NEMAC is able to address a number of issues related to climate variability and climate change, in addition to its work in other areas of environmental modeling. The Center is always seeking new partnerships and new research opportunities that will serve to enhance the Center's mission. Current NEMAC partners include:

4.1. Academic
University of North Carolina - Asheville
University of North Carolina – Charlotte
North Carolina State University
Asheville-Buncombe Technical College

4.2. Government
NOAA's National Climatic Data Center
Department of Energy – Oak Ridge National Lab
US Forest Service
North Carolina Department of Agriculture and Consumer Services
North Carolina Center for Geographic Information & Analysis

4.3. Private-Sector
Baron Advanced Meteorological Systems

4.4. Non-Profit
Education and Research Consortium of the Western Carolinas (ERCWC)
Education and Research Services

5. NEMAC – Goals

The partnerships that initiated the development of NEMAC have agreed to a set of common goals that help define the Center's mission and guide future research:

5.1. To become the preeminent working model of university, government, and private sector collaborative research

5.2. To promote faculty and undergraduate research and scholarship

5.3. To stimulate economic development activities in the Western Carolina region

5.4. To remain financially self-sufficient and contribute to the financial and scholastic welfare of UNC Asheville and the UNC system

5.5. To contribute to the well-being of the environment and society in general.

6. Acknowledgements