Florida Hurricane Alliance
PERFORMANCE PROGRESS REPORT

		Page 1	of Pages 38
1.Federal Agency and Organization Element to Which Report is Submitted **Daniel Meléndez, Program Officer** **NOAA NWS OST12**	2. Federal Grant or Other Identifying Number Assigned by Federal Agency **NA04NWS4680010**	3a. DUNS Number **07-129-8814**	3b. EIN **65-0177616**
4. Recipient Organization (Name and complete address including zip code) **Florida International University** **University Park** **11200 SW 8th Street** **Miami, Florida 33199**		5. Recipient Identifying Number or Account Number **120-000-586**	
6. Project/Grant Period Start Date: *(Month, Day, Year)* **June 01 2004** End Date: *(Month, Day, Year)* **May 31, 2009**	7. Reporting Period End Date *(Month, Day, Year)* **December 31, 2005**	8. Final Report? ☐ Yes √ No 9. Report Term or Frequency √ *annual* ☐ ***semi-annual*** ☐ *quarterly* ☐ *other* *(If other, describe: _____)*	

10. Performance Measures *(complete information on attached page as instructed by Federal Awarding Agency)*

11. Project/Grant Management *(complete information on attached page as instructed by Federal Awarding Agency)*

12. Sub-award Management *(complete information on attached page as instructed by Federal Awarding Agency)*

13. Activity Based Budget *(complete information on attached page as instructed by Federal Awarding Agency)*

14. Additional Narrative *(attach performance narrative as needed)*

15. Other Attachments *(attach other documents as needed or as instructed by Federal Awarding Agency)*
NOAA R&D priorities previously submitted to HMA

16. Certification: I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.

16a. Typed or Printed Name and Title of Authorized Certifying Official Stephen Leatherman, Director	16c. Telephone *(area code, number and extension)* (305) 348-1607
	16d. Email Address leatherm@fiu.edu
16b. Signature of Authorized Certifying Official	16e. Date Report Submitted *(Month, Day, Year)* January 31, 2006
	17. Agency use only

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10. Performance Measures

a. Label	b. Task/Objective/Goal Description	c. PI, Institution	d. % Task Complete to Date	e. NOAA Priorities Served (see attached list, item 15)	f. Accomplishments and Explanation i. Publications, ii. Technology Transferred, iii. Outreach Actions, iv. Other Results	g. Problems /Issues	
10-01	**Cost of Hurricane Warnings**	**FIU**	See Attachment A				
10-02	**Cost of Hurricane Warnings**	**FAMU**	See Attachment A				
10-03	**Weather Networks**	**UNF**	See Attachment A				
10-04	**Weather Networks**	**FAMU**	See Attachment A				
10-05	**Coastal Vulnerability**	**FIU**	See Attachment A				
10-06	**Coastal Vulnerability**	**FAU**	See Attachment A				
10-07	**Storm Surge**	**FIU**	See Attachment A				
10-08	**Airborne Lidar**	**FIU**	See Attachment A				
10-09	**Airborne Lidar**	**UF**	See Attachment A				

10-10	**Simulation and Visualization**	**UCF**	See Attachment A	
10-11	**Simulation and Visualization**	**FIU**	See Attachment A	
10-12	**Surface Wind Measurements**	**FIU** **UF**	See Attachment A	
10-13	**Hurricane Structure and Prediction**	**FSU**	See Attachment A	
10-14	**Ecological Impacts**	**USF**	See Attachment A	

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11. Program/Project Management

	Question	Yes / No/ Not Applicable?	Explanation
11a.	Do you collect credible performance information, including information from key program partners or sub-awardees, and use it to manage the program/project and improve performance?	**YES**	Individual quarterly reports are submitted October, January, April and July. Reports are reviewed by the FIY project management team and posted on the Florida Hurricane Alliance website: www.ihrc.fiu.edu/fha . Two-day working meetings with all researchers are held annually to discuss progress and findings. The FIU project management team visits participating universities and/or establishes conference calls with researchers to examine progress and offer advise where needed.
11b.	Are the award funds obligated in a timely manner and spent for intended purposes?	**YES**	FIU works with NOAA and all participating SUS universities to ensure that funds are dispersed in a timely manner.
11c.	Do you link your budgets to program/project activities and make adjustments to achieve cost-efficiencies?	**YES**	Florida Hurricane Alliance budgets are linked to NOAA National Weather Service priority areas.
11d.	Do you collaborate and coordinate effectively with related programs/projects (if applicable)?	**YES**	Through meetings and e-mail exchanges Florida Hurricane Alliance researchers are in communication with each other ensuring effective coordination and collaboration related to funded projects.
11e.	Have you identified any management deficiencies? If so, provide explanation of deficiencies identified.	**YES**	FIU and NOAA will make a better effort during future Florida Hurricane Alliance Rounds to establish effective and manageable project timelines (i.e proposal feedback, established priorities, proposal submittal, funding dispersal).
11f.	Have you taken meaningful steps to address management deficiencies (if applicable)?	**NO**	NOAA and FIU are still in discussion about timeframe for phase 3 funding (forthcoming).
11g.	Did you achieve all your performance targets in this reporting period?	**YES**	All Florida Hurricane Alliance projects are proceeding on schedule and meeting established performance targets.
11h.	Are you on target to achieve your long- term objectives?	**YES**	The Florida Hurricane Alliance is on target to achieve established long-term objectives.
12. Sub-award Management *(applicable if sub-grants or sub-contracts are awarded)*			
12a.	Are the award partners (including sub-awardees and contractors) held accountable for cost, schedule, and performance results (If applicable)?	**YES**	Award partners submit quarterly reports in October, January, April and July. Reports are reviewed and posted on the Florida Hurricane Alliance website: www.ihrc.fiu.edu/fha . Award partners are required to attend annual working meetings. If deficiencies are detected they will be immediately addressed by the FIU project management team (no deficiencies have been detected to date)
12b.	Are sub-awards and contracts awarded based on a clear competitive process that includes a qualified assessment of merit?	**YES**	FIU seeks the most qualified hurricane researchers at participating universities within the State University System (FIU, FAMU, UNF, FAU, UF, UCF, FSU, USF, UWF).

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13. Activity Based Budget

a. Activity Number or Label	b. Activity Description	c. Total Estimated Budget	d. Funding Expended
13-01	**Cost of Hurricane Warnings/FIU** (Round 1: $100,590 ; Round 2: $180,995)	$281,585	$3,362
13-02	**Cost of Hurricane Warnings/FAMU** (Round 1: $100,000* ; Round 2: $141,639)	$241,639	$1,323
13-03	**Weather Networks/UNF** (Round 1: $350,000* ; Round 2: $158,805)	$508,805	$184,160
13-04	**Weather Networks/FAMU** (Round 1: $100,000* ; Round 2: $20,000 – R2 funds given to new PI)	$120,000	$13,608
13-05	**Coastal Vulnerability/FIU** (Round 1: $446,875 ; Round 2: $402,084)	$848,959	$133,278
13-06	**Coastal Vulnerability/FAU** (Round 1: $150,000* ; Round 2: $121,745)	$271,745	$123,842
13-07	**Storm Surge/FIU** (Round 1: $337,235 ; Round 2: $191,651)	$528,886	$198,520
13-08	**Airborne Lidar/FIU** (Round 1: $315,786 ; Round 2: $0)	$315,786	$175,308
13-09	**Airborne Lidar/UF** (Round 1: $200,000 ; Round 2: $137,283)	$337,283	$88,155
13-10	**Simulation and Visualization/UCF** (Round 1: $195,646* ; Round 2: $158,171)	$353,817	$39,741
13-11	**Simulation and Visualization/FIU** (Round 1: $168,026; Round 2: $185,026)	$353,052	$64,195
13-12	**Surface Wind Measurements/UF&FIU** (UF Round 1: $150,041* ; Round 2: $194,062) (FIU Round 1: $98,870 ; Round 2: $142,333)	$585,306	$144,979 (UF) $44,398 (FIU)
13-13	**Hurricane Structure and Prediction/FSU** (Round 1: $650,000; Round 2: $480,844)	$1,130,844	$80,500
13-14	**Ecological Impacts/USF** (Round 1: $200,000 ; Round 2: $162,645)	$362,645	$31,260
13-15	**Project Management/FIU** (Round 1: $137,347 ; Round 2: $130,414)	$267,761	$137,348
13-16	**Meteorology/FIU** (Round 1: $0 ; Round 2: $241,625)	$241,625	$0
TOTAL		$6,749,738	$1,463,977

*Amount includes 40.5% on first $25,000 for each participating university removed as indirect charges to Florida International University.

14. Additional Narrative

Hurricanes are the most devastating and damaging natural hazards impacting the United States and its territories in the Caribbean and Pacific basins. The unavoidable seasonality of hurricanes and the damage they cause underscore our vulnerability to this awesome force of nature. Hurricanes now cause an average of 14 deaths and $5 billion in property damage per year in the United States. Industry data show that 65% of insured losses from natural hazards in the U.S. over the past half century are due to the impact of hurricanes

Extreme hurricane events in recent years have, with an increasing sense of urgency, reinforced the proposition that the nation must continue to work on, but also move beyond weather prediction and evacuation to achieve significant damage reduction. Against this background, increasing population and urban development in coastal areas highlight the dynamic nature of our vulnerability to hurricanes and the urgency of the problem. According to the 2000 census, population in the most hurricane vulnerable states has increased by 20% (11.7 million people) in the last ten years, and this trend is predicted to continue.

Mitigation offers the best alternative for reducing potential damages from hurricanes. Merely being prepared to respond to the inevitable damage that will occur from storms does nothing to reduce the ultimate cost of these dangerous events. Effective mitigation can only be achieved through increased research, vulnerability assessments, education and outreach to build a solid foundation for policy-making and building practices. Hurricane mitigation must continue to evolve by including not only a wide range of damage reduction tools such as improved building design and structural engineering methods, new construction technologies and materials, land use strategies, and building codes, but also new methods of data collection, continued social and behavioral research as well as improved communication technology, computer modeling, simulation and visualization.

It is in the national interest, indeed the interest of the Federal government, to support the development and implementation of a rational research strategy, focusing on the reduction of potential hurricane damage. Building upon current programs and other initiatives with shared objectives, this strategy will involve leading researchers in the State of Florida with the single focused goal of reducing the cost of hurricanes to the federal, state, and local governments, as well as to businesses and households.

To contribute to the development and implementation of a strong, coherent and united research agenda focusing on hurricane loss reduction, the International Hurricane Research Center [IHRC] at Florida International University [FIU] brings together the wealth of existing capabilities and evolving expertise of the public universities in Florida into an integrated multi-year, multidisciplinary cooperative research effort – ***the Florida Hurricane Alliance***. This IHRC led effort will develop a program of research, education and outreach to support the priorities of the National Oceanic and Atmospheric Administration (NOAA), as stated in its Strategic Plan for FY 2003-FY 2008 and beyond – *New Priorities for the 21st Century*, to meet the challenges of intensifying national needs related to the economy, the environment, and public safety.

The Alliance, whose single focus is to reduce the cost of hurricanes to federal, state, and local governments, and to businesses and households, brings together the multidisciplinary capabilities of nine of the 11 public universities in Florida **(FIU, FAMU, FAU, FSU, UCF, UF, UNF, USF and UWF)**.

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15. NOAA Tropical Cyclone Research and Development Priorities Submitted Earlier

1. Research on model superensembles for hurricane forecast guidance to five days, four times daily. The Government is interested in receiving real time guidance products produced in the natural course of this research.

2. Research on the economic benefits of hurricane forecasts and the improvements in these forecasts. For example, a quantitative assessment of the impact of extending hurricane warnings beyond 24 hours.

3. Research on the viability of using high resolution Lidar data for mapping coastal features for use in hurricane storm surge forecasting. Of particular interest, are the identification of small features and barriers and shallow-water bathymetry. NOAA is interested in data collected as part of the planned research provided the data can be referenced to a standard datum, be demonstrated to be accurate, and provided in a format that can be readily ingested by the NOAA storm surge model without extensive reprocessing and reformatting.

4. Research for a better understanding of the meteorology of tropical cyclones at landfall, especially the evolution of the surface wind field from the open water across the coastline to inland areas. NOAA is particularly interested in information on surface roughness at the coastline.

5. Research into the skill of storm surge models (e.g. Alliance member model(s), the North Carolina hurricane storm surge model,…..), and research on methodologies in which to perform meaningful comparisons among surge models in general.

6. Research on how and what types of government (local, state, federal) long-term (10-50 years) policies might reduce the large ($billions) and growing damages and loss of life that coastal communities could sustain from a direct hurricane strike regardless of the accuracy and lead-time of NOAA environmental forecasts.

7. Research on high resolution temporal and spatial data networks. NOAA is interested in receiving in real time, data from such mesonetworks.

8. Research on advanced data and forecast/warning visualization techniques that might aid NHC/TPC in providing media briefings during hurricanes and for training and outreach.

9. Research on instrumentation and networks for water level data along coasts. NOAA is interested in receiving in real time, high quality data from such networks.

10. Research quantifying the impacts (ecological and economic) of tropical cyclone (winds, rain, and surge on the marine environment (e.g. coastal water quality, coral reefs.....).

ATTACHMENT A

SECTION 10 – PERFORMANCE MEASURES

Florida Hurricane Alliance

Project Progress Reports

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-01

PROJECT TITLE: **Cost of Hurricane Warnings**
CONTRIBUTORS: Hugh Willoughby, Florida International University
PERFORMANCE PERIOD: 2005 calendar year

Percentage of Work Completed: 25%

Project Proceeding on Schedule: [X] Yes [ ] No

Cost Status: [X] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
Priority 2: Research on the economic benefits of hurricane forecasts and the improvements in these forecasts.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):

- Hugh Willoughby, along with the Deputy Director of NHC and the Director of HRD wrote a white paper on hurricane forecasting for NOAA's Hurricane Forecast Socioeconomic Working Group (HFSEWG).

  Willoughby, H. E., E. N. Rappaport, and F. D. Marks, 2005: Hurricane forecasting, the state of the art, 9 pp, in Hurricane *Social Science Research Workshop: Background Materials*.

- Hugh Willoughby attended the HFSEWG meeting in Pamona, CA, 16-18 February 2005.

- Hugh Willoughby attended the annual Natural Hazards Workshop in Boulder, CO, 10-13 July 2005.

- Recruitment of a tenured, full professor resource economist with a joint appointment between the International Hurricane Research Center and FIU's department of Environmental Studies is on-going. This faculty member will become the PI for this grant when he/she is on board.

- A newly hired Ph.D. candidate is in the early stages of a study to determine the relation between forecast lead times and the extent of warning areas as a function of damage prevented, costs of preparation, and forecast accuracy.

- Hugh Willoughby carried out an analysis of hurricane damage and mortality since 1900. Results include representation of the data as a ratio of actual impacts to the time varying geometric mean, bimodal statistical distribution of seasonal damage, and log-normal distribution of the number of deaths.

- The Hugh Willoughby submitted a paper on the variation of hurricane winds as a function of distance from the cyclone center, cyclone intensity, position, and other factors. This paper was accepted at *Monthly Weather Review*, subject to minor revisions, which the editors and reviewers are currently considering. It is Part II of a series of papers that began with Willoughby & Rahn (2004). This work, which has applications to modeling windstorm underwriting risk, is also reported under Meteorological Research.

  Willoughby, H.E., R.W.R. Darling and M.E. Rahn, 2005: Parametric representation of the primary hurricane vortex. Part II: A new family of sectionally continuous profiles. *Mon. Wea. Rev.* (accepted).

Provide a schedule for the remainder of work to project completion:

- Hiring of FIU's new resource economist, Summer 2006.
- Publication of the forecasting White Paper in *Natural Hazards Review*, 2006
- Writing of a paper on optimum forecast lead times and warning areas for hurricane landfall forecasts, 2006.
- Conduct preliminary research on more elaborate models of hurricane wind profiles that include representation of outer wind maxima, inclusion of observations obtained since the 2000 season, and

constraints to require a consistent pressure-wind relation on a storm-by-storm basis rather than for the aggregated data. Spring 2006.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

- Finalizing the recruitment of the resource economist who will lead this project is essential for the long-term research agenda.

Additional Comments/Elaboration: NONE

FLORIDA HURRICANE ALLIANCE
PROGRESS REPORT
PROJECT 10-02

PROJECT TITLE: **The Economic Value of Improving Hurricane Warnings**
CONTRIBUTORS: Michael Thomas, Florida A&M University
David Letson, University of Miami
Edward Mahoney, Michigan State University
PERFORMANCE PERIOD: entire project to date

Percentage of Work Completed: 25%

Project Proceeding on Schedule: [X] Yes [ ] No

Cost Status: [X] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served (see attachment)
This project will address the second NOAA priority (as listed on the attachment) by directly estimating the marginal value of incrementally improved hurricane forecasts. Additionally, the project will contribute to a better understanding of how human behavior changes with the phases of a hurricane's development (storm birth, growth and death). This information should help NOAA managers better select forecast attributes and level of precision during the course of a hurricane's life.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):

- The initial phase of research focused on better defining the economic explanation of the public's misinterpreting hurricane forecasts. In economic terms, this can be considered a cost of making one of two possible mistakes; the mistakes of "false alarm" or "false assurance." In both cases, the user of hurricane forecasts is dissatisfied with role these forecasts played in their decision making. In the former, they over react to the forecast, taking more evasive/mitigating actions than necessary and in the later, they under react to the forecast, not taking enough evasive/mitigating actions to properly prepare themselves for the storm. This dichotomy of forecast costs will permit us to better identify the relative importance of forecast attributes by type of mistake and assign economic benefits of marginal improvements in forecasting. Additionally, the econometric approach of choice has been identified as a blend of conjoint analysis and dichotomous choice models.
- The draft economic survey instrument has been completed and is being readied for a Web-based application. This prototype survey is initially designed to focus on a small area of Miami and look at the experiences of the 2005 hurricane season. Respondents will be asked about their actions during these series of storms, including mitigation and evacuation behavior, economic expenditures related to their actions and their attitudes about hurricane forecasting and its impact on their actual decision making. The information gathered with this survey will be used for further refinements necessary for the conjoint analysis.
- Additional Round 2 funding has made it possible to expand the sample frame for the Web-based survey to include both the Florida Panhandle (Tallahassee area) and the Florida Southeast coast (greater Miami area). Respondents will be asked about their reactions and attitudes to all historic hurricanes and then ask to join a 12 month panel for a series of follow-up questioning. This panel approach will allow one to follow the changing attitudes, mitigation and reactions to hurricanes in real time, as the storms develop and expire, over the course of the 2006 hurricane season. Pre and post storm comparisons of respondent behavior will contrast the importance of different hurricane forecast attributes across the time line of a storm's life.

Provide a schedule for the remainder of work to project completion:

- Web-based survey instrument completed at tested, January – June, 2006.
- Sample recruited and survey administered in Miami and Tallahassee regions of Florida, June – November, 2006.

- Data analyzed and used to develop survey instrument for conjoint analysis (used to test the marginal value of forecast attributes), December, 2006 – March, 2007.
- Administer conjoint survey May – June, 2007.
- Complete the hurricane forecast attribute valuation analysis, June – August, 2007

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:
NA

Additional Comments/Elaboration:

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-03

PROJECT TITLE: **Development of a Florida Mesoscale Weather Station Network - Phase I: Design, Data Assimilation and Research Models**
CONTRIBUTORS: J. David Lambert Ph.D., and Patrick T. Welsh, Ph.D., Co-Principal Investigators
PERFORMANCE PERIOD: August 1, 2004 through December 31, 2005

Percentage of Work Completed: 65%

Project Proceeding on Schedule: [X] Yes [ ] No

Cost Status: [X] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
Priority #7 . Research on high resolution temporal and spatial data networks. NOAA is interested in receiving in real time, data from such mesonetworks.

This FHA project by the University of North Florida is to assist in development of the Florida Mesonet and its integration into the NERON. Two conferences have been held in the last year to widen the awareness of the NOAA Mesonet objectives and its convergence with the needs within the Florida data stakeholder community. The UNF team has worked with the WFOs on developing a plan for NERON integration in Florida while also implementing the USWRP coastal observation goals. The integration of the Florida Road Weather Information System into the Florida Mesonet and NOAA MADIS system has been accomplished, including iFlorida wind data from Hurricane Evacuation Bridges in North and Central Florida.

Presentations at the Intelligent Transportation System Florida (ITS Florida) annual meeting in December are changing the perception of the RWIS from that of a private transportation dataset to that of an important part of the Weather Enterprise with benefits for a wider group of stakeholders than just traffic management personnel. It was pointed out that the additional data made available through CLARUS will impact mesoscale models and should provide improved National mesoscale forecasts for all.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):
OCT 04 – DEC 04
1) Hired Senior Research Meteorologist (hereafter SRM).
2) SRM meeting with Florida Automated Weather Network (FAWN) at U of F.
3) Set up tentative dates for Florida Mesonet Conference meeting 6-7 April 2005.
4) SRM and CO-Investigator meeting with Florida DOT representatives for Northeast Florida (Region 2) on Road Weather Information System (RWIS) coordination and communications.
5) Assembled Florida GIS datasets for site distribution considerations.
6) Website development initiated.
7) Database design development initiated.
8) Contact established with FSL MADIS on data transfers to NOAA systems.
9) Contact established with local WFOs in Florida on Mesonet Project.
10) SRM input provided to NOAA NWS CO-OP Program staff on future Florida Mesonet planning.

JAN 05 - MAR 05
1) Continued planning and Coordination for 2ND Florida Mesonet Conference meeting 6-7 April 2005.
2) Continued Website, database, and GIS development work
3) Initial RWIS data feed established with WFO Jacksonville, Florida for NOAA FSL LAPS assimilation and ingest into locally run UCAR Weather Research and Forecast model (funded by NOAA Coastal Storms Initiative).

4) Set-up Florida Mesonet data monitoring and communications between NOAA FSL MADIS and UNF AWIS Laboratory.

APR 05 – JUN 05

1) 2ND Florida Mesonet Conference was held 6-7 April 2005 at the University of North Florida's University Center with participation from NWS HQ, Southern Region HQ, 5 Florida WFO's. All parties were brought up to date on National issues and NERON by Ken Crawford, Georgia Mesonet by Gerrit Hoogenboom, and UNF participation in Florida Mesonet under this grant. Presentations were made by Florida DEP, Florida DOT and Florida Water Management Districts. In addition, the Florida /NOAA FSL GPS-IPWV was briefed by Seth Gutman, Hurricane Winds were presented by Shirley Murillo, and the REALM network was presented by Paul Ruscher of FSU.
2) UNF personnel advised Florida DOT personnel on the proposed Florida RWIS specifications on weather instrumentation and siting following the NWS Guidelines as part of the Florida Mesonet on 19 April.
3) Field calibration of iFlorida Project barometric sensors in Central Florida with Dave Jacobs of NWS WFO Melbourne using the NWS DigiQuartz calibrating barometer. 21-22 April.
5) Meeting with Florida DOT representatives for Northeast Florida (Region 2) on RWIS data communications to Region 2 Traffic Management Center (TMC) as part of Florida Mesonet. Continuing work on the iFlorida and Florida RWIS projects as part of the Florida Mesonet.
5) Continued work on Florida Mesonet site GIS datasets for site distribution considerations.
6) Presentation at Florida Governor's Hurricane Conference on Mesonet Project and results of 2004 Hurricane season realtime WRF model rainfall products. 9- 12 May
7) Briefed Florida SEACOOS Caucus meeting on Florida Mesonet and RWIS coastal winds, UNF data and modeling capability. 7 June
8) Continued planning and preparation for the Second Florida Mesonet Mini-Conference

OCT 05 to DEC 05

1) GIS graphics were produced for the upcoming Florida Mesonet Conference giving state and federally owned data sites in Florida and meshed with the NWS NERON grid and the USWRP recommended spacing grids.. The combined and Florida regional grids were developed to be presented at the next Conference scheduled 26 October.
2) Continued work on Florida Mesonet site GIS datasets for site distribution considerations, including wireless communication range masking., two large scale map series were produced for North and South Florida.
3) The third Florida Mesonet Conference was coordinated with Embry-Riddle Aeronautical University and held on 26 October 2005 on their Daytona Beach campus. Unfortunately Hurricane Wilma passed through south Florida the preceding day and prevented many south and central Florida participants from making the conference. Only Dr. Forrest masters (FIU) was able to participate from South Florida as he had been collecting data on the northern landfall winds, and was meeting nearby the next day as well. Participants from the northern Florida NOAA NWS WFOs were able to make the event along with the St Johns River Water ManagemenDistrict and other participants. FAWN participants were unable to attend as well, though Florida Road Weather Information System participants attended.

   A) Detailed GIS maps of the Florida sub-regional existing data sites plotted on the NWS 20 mile grid (shapefile thanks to U of Oklahoma) and a USWRP coastal grid based on Dabberdt et al. 2005 (BAMS July 2005) was developed and incorporated into the GIS by the University of North Florida Advanced Weather Information Systems Laboratory staff.

   B). Liaison was conducted on National issues and NERON with Dr. Ken Crawford, and additional GIS issues were discussed with Oklahoma Climaological Survey. Continued GIS and other work was conducted with Florida DOT on the Road Weather Information System (RWIS).
4) UNF personnel provided further input to Florida DOT personnel on the proposed Florida RWIS specifications on weather instrumentation and siting following the NWS Guidelines. Dr. Welsh and Dr. Lambert worked with NCAR personnel to schedule the agenda and speakers for the 06 December "Weather Day" at the ITS Florida meeting in Orlando. Dr. Welsh and Dr. Lambert presented talks on Florida-centric RWIS development and roles of the RWIS in the Weather Enterprise. Dr. Welsh was also the Session Chair for the Future RWIS Developments Session.

Provide a schedule for the remainder of work to project completion:

A. Outreach to data stakeholders QTR 2 to QTR 7 (Continuing)
B. GIS application development QTR 4 to QTR 7 (Continuing)
C. Outreach to participants unable to attend 3RD Mesosnet Conference QTR6
D. Develop integrated coverage plan in coordination with state agencies, NOAA, NWS WFOs, DOD and other statewide stakeholders (FDOT, FDEP, EPA, WMD, Forestry, Emergency Management, and others such as Utilities, Ports, Railroads). QTR 6
E. Develop integrated data delivery plan coordinated with NOAA FSL MADIS for data delivery. QTR 6
F. Initiate data assimilation and Research Modeling. QTR 6
G. Publish website. QTR 6
H. Circulate draft document among stakeholders. QTR 6
I. Florida Mesonet development results at National Conferences. QTR 6 and QTR 7
J. Integrate responses from stakeholders into final plan and publish results. QTR 7

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:
Hurricane Wilma crossed the state the day before the 3RD Mesonet Conference, severely limiting attendance. This will require additional outreach to several WFO's, Florida organizations, and agencies. This will require reprogramming some funds for the additional travel required.

Additional Comments/Elaboration:
(NOAA Priority #1 and UNF Year #3 Alliance effort convergence.) Research on model superensembles for hurricane forecast guidance to five days, four times daily. The Government is interested in receiving real time guidance products produced in the natural course of this research.

Talks are underway with FSU and other Southeast modelers to develop a joint WRF ensemble for both routine mesoscale and hurricane forecasting. The UNF scope of work for Phase II was reduced due to funding decrement for FY 2006. Planned WRF mesoscale hurricane modeling for 2006 was deleted, other funding sources were sought, but this created a year hiatus in WRF modeling efforts. FY 2007 funding restoration for WRF modeling has been input into FHA plan by Dr. Leatherman, however overall funding reduction will still limit the effort.. There are serious issues of both initialization and Lateral Boundary Condition (LBC) dominance in any five day solution with a mesoscale model.

(NOAA priority #4) Research for a better understanding of the meteorology of tropical cyclones at landfall, especially the evolution of the surface wind field from the open water across the coastline to inland areas. NOAA is particularly interested in information on surface roughness at the coastline.

UNF is willing and has the expertise to work with other members of the Alliance (Dr. Masters, FIU in particular) and NOAA NHC and HRD in comparing the evolution of the wind field from the coastal RWIS sites along the Florida East Coast, with FIU and UF tower data, and also the coastal Florida ASOS/AWOS.
We would also like to assist with improved ASOS back-up power designs to improve ASOS real-time reporting and survivability in hurricane-force wind fields. Backup power systems similar in design to the RWIS site power backup would dramatically increase survivability. POTS communications with wireless backup could also improve real-time communications survival to adjacent WFOs.

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-04

PROJECT TITLE: **Development of a Florida Coastal Neural Network Model to Increase Water Level Data**
CONTRIBUTORS: Wenrui Huang, Ph.D., Principal Investigator, Florida A&M University
PERFORMANCE PERIOD: August 1, 2004 through January 25, 2006

Percentage of Work Completed: 70%

Project Proceeding on Schedule: [x] Yes [ ] No

Cost Status: [x] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
Priority 7: Research on high resolution temporal and spatial data networks. NOAA is interested in receiving in real time, data from such networks.

Describe milestones achieved during this year:

1) Increasing the number and quality of water level data is very important to the hurricane and surge research. However, field data collections are expensive and often limited by available research budget. Only a few water level stations operated by NOAA provide long-term observations since 40's or 50s. In this project, a Florida Coastal Neural Network (FL_CNN) Model has been developed. Neural networks provide an effective alternative to increase the number of water level data by correlating short-term water levels at many local stations to the scatted distributed NOAA stations with long-term water levels in the region. Because many NOAA regional water level stations have been operated for several decades, missing historical data of water levels at many local stations over a long period can be supplemented through the hindcast modeling using FL_CNN model. Long-term water level data derived from the FL_CNN model can be used analyze historic hurricane surge hydrograph in Florida coast after removing tidal signals. The data can also be used as boundaries for modeling hurricane storm surges in bays, estuaries, and coastal waterways. FL_CNN model will resulted in considerable cost savings for NOAA and Florida Hurricane Alliance to increasing water level data.
2) The FL_CNN model has been satisfactorily tested using existing water level data given in NOS web site (Figure 1): http://140.90.121.76/coastline.shtml?region=fl. Model tests indicate that water levels at Virginia Key in south Florida can be predicted by those measured at remote station at Trident Pier (about 170 miles away) with very good accuracy as shown in Figure 2 (correlation coefficient of 0.96 and root-mean-square error of 0.06m). Even using data observed from a far way station at Fernandina Beach in north Florida (about 350 miles away), water levels at Virginia Key are predicted with a reasonable accuracy (correlation coefficient of 0.94 and root mean square error of 0.09 m). Model tests in other stations indicate that within a range of about 180-200 miles, the FL_CNN model provides very good accuracy with the correlation coefficient above 0.95 and the root-mean square error under 0.06m.
3) The Florida coast can be divided into five regions with the scale within 180-200 miles for the applications of the FL_CNN model as given in Figure 1. In the northwest region, there are long-term water level data in NOAA Pensacola Station since 1920s. Neural network model for Panama City Beach and Pensacola Stations have been developed. Using available data, model predictions of water levels in Panama City Beach compared well with observations. This indicates that we can derive water levels in Panama City Beach starting from 1920s from Pensacola Station using the neural network model. In the Northeast region from where three NOS stations (Fernandina Beach, Mayport, and St. Augustine Beach) are located. Mayport station was established in August 1995. St. Augustine Beach station was set up in May 1992. Fernandina Beach was established in May 1898 was used to hindcast long-term water levels in other stations. In the southeast Florida region, FL_CNN model has been used to correlate water levels at Virginia Key and Trident Pier. Ongoing research work is now conducted for southwest Florida coast.
4) Real-time water level predictions: The FL_CNN model is capable of prediction real-time water levels if real-time monitoring data are available in the coast region. In conjunctions with this study, a real-time water level

monitoring station is to be setup in the northeast region. Once the data are available, the FL_CNN model can provide quick real-time water level predictions in other locations in the northeast region. In the case of hurricane, real-time water level prediction can be used for hurricane mitigation.

Provide a schedule for the remainder of work to project completion:
1). Continue to improve the accuracy of the FL_CNN model.

2). Waiting for real-time monitoring water level measurement from North Florida University to test the model capability for real-time predictions

Additional Comments/Elaboration:
To provide quick real-time water level predictions along entire Florida coast using the FL_CNN model, five real-time water level stations are recommended to setup in five coastal regions in the Florida coastal water. Real-time observations of water levels at measurement stations and model predictions at other coastal locations will be posted in world-wide web.

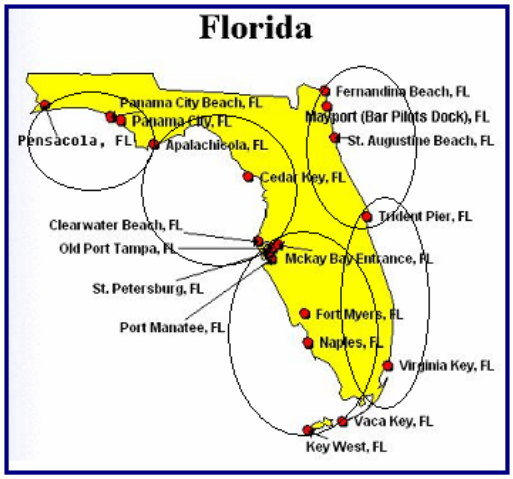

Figure 1. Within the region as shown, the FL_CNN model can provide very good predictions of water levels based on the observations at either a NOS station or real-time water level monitoring station.

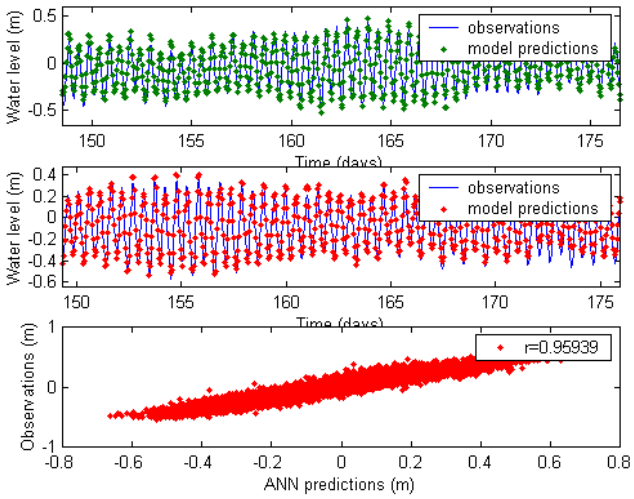

Figure 2. Comparisons of observed water levels at Virginia Key with model predictions using data at Trident Pier station (about 170 miles way). The root-mean-square is equal to 0.06 m.

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-05

PROJECT TITLE: **Coastal Vulnerability Characterization Through Erosion Rate Analysis and Volunteer Observations (STORM Project)**

CONTRIBUTORS: Stephen P. Leatherman, International Hurricane Research Center
William Robertson, International Hurricane Research Center
Patricia Houle, International Hurricane Research Center

PERFORMANCE PERIOD: October 1, 2004 through December 31, 2005

Percentage of Work Completed: 45%

Project Proceeding on Schedule: [√] Yes [ ] No

Cost Status: [√] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
3. Research on the viability of using high resolution Lidar data for mapping coastal features for use in hurricane storm surge forecasting. Of particular interest, are the identification of small features and barriers and shallow-water bathymetry. NOAA is interested in data collected as part of the planned research provided the data can be referenced to a standard datum, be demonstrated to be accurate, and provided in a format that can be readily ingested by the NOAA storm surge model without extensive reprocessing and reformatting.
10. Research quantifying the impacts (ecological and economic) of tropical cyclone (winds, rain, and surge on the marine environment (e.g. coastal water quality, coral reefs.....).

Describe milestones achieved (publications, technology transferred, outreach actions, other results):
Publications:

W. Robertson, K. Zhang, D. Whitman, S. Leatherman, 2005. Shoreline and beach volume change before and after the 2004 hurricane season, Palm Beach County, Florida. *Shore & Beach*, 73(2&3), 79-84.

Outreach:

W. Robertson, K. Zhang, D. Whitman, S. Leatherman, 2005. Beach recovery rates derived from airborne LIDAR following Hurricane Ivan. *Fall American Geophysical Union Meeting*, San Francisco, CA.

Dr. Leatherman made a keynote address at the annual meeting of the Florida Convention & Visitors' Bureaus to introduce them to the STORM & Tides project. The project has been well received, and we expect a partnership to be forthcoming.

Milestones:

- Obtained digital NOS T-Sheet and Florida DEP shoreline data
- Wrote and executed ESRI ARC scripts to extract and reformat shorelines into ESRI Shapefiles
- Attribute and projection information were assigned to ESRI Shapefiles representing shorelines
- IHRC Metric Mapping algorithms were rewritten to be compatible with ArcGIS software
- Acquired LIDAR data from University of Florida and US Army Corps of Engineers
- Florida Sea Grant Agent agree to train and assist STORM & Tides Beach Monitors (volunteers)
- Pat Houle was hired as STORM & Tides Research Coordinator
- STORM & Tides Beach Monitor's Guide prepared and in review

Provide a schedule for the remainder of work to project completion:
Winter/Spring 2006: Create State of Florida map showing coverage and temporal extent of shoreline data. Analyze historical shoreline change of Florida's beaches using IHRC Metric Mapping techniques.

Winter/Spring 2006: Complete STORM & Tides project plan and Beach Monitor's Guide. Prepare website and database.

Conduct training and workshop for Sea Grant Marine Agents. Begin recruitment of volunteers.

Summer 2006: Extend shoreline data sets with collected Florida beach LIDAR data by extracting shoreline positions.

Continue recruitment & training of STORM & Tides volunteers.

Fall/Winter 2007: Quantify shoreline change for Florida's beaches, identify coastal trends, and predict shoreline change.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

- DEP data for Collier County are not usable
- Rewriting of IHRC Metric Mapping software delayed historical shoreline change analysis with no foreseeable affect to the completion date

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-06

PROJECT TITLE: **Living on the Edge: a Study of the Treasure Coast Barrier Island's Coastal Hazards Vulnerability and Recommendations of Community Resiliency**
CONTRIBUTORS: Ana Puszkin-Chevlin & Jim Murley, CUES at FAU
PERFORMANCE PERIOD: entire project to date

Percentage of Work Completed: 99%

Project Proceeding on Schedule: [x] Yes [ ] No

Cost Status: [x] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
The ***Living on the Edge: Treasure Coast Barrier Island*** research project focused on advancing NOAA's research priority #6: Research on how and what types of government (local, state, federal) long-term (10-50 years) policies might reduce the large ($billions) and growing damages and loss of life that coastal communities could sustain from a direct hurricane strike regardless of the accuracy and lead-time of NOAA environmental forecasts.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):

September 2004 – September 2005 - The principal investigators provided technical support and guidance on hazard vulnerability and mitigation policy to the Committee for a Sustainable Treasure Coast, a regional task force organized by State Senator Pruitt in response to Governor Bush's Executive Order 04-61. The information was incorporated into the Committee's Special Hazard Report published in January 2005 and helped frame the development guidelines described in the Committee's final report published in September 2005.

April and May 2005 – Sarasota County invited CUES researchers to present their multilevel (federal, state and local) policy analysis framework to the County's Coastal Advisory Committee that is evaluating policy changes aimed at increasing coastal resiliency.

August 2005 - The principle investigators completed an interim report entitled *Living on the Edge: Building Post-Hurricane Resiliency through Community Assessment and Informed Rebuilding, Research Model.* The report outlines a comprehensive approach for Community Vulnerability Analysis (CVA) that incorporates parameters that describe demographic, economic, environmental and built conditions. The interim report provides a conceptual framework for CVA and offers specific examples of data sources and analysis techniques that can aid communities in assessing asset exposure to coastal hazards. The accompanying data CD shows the GIS layers developed for the research.

September 2005. CUES was able to leverage the *Living on the Edge* research to address an RFP for policy analysis that will be used by the Coastal High Hazard Area Taskforce Committee created by Governor Bush's Executive Order 05-178. Mr. Murley, an advisor to the taskforce, incorporated some of the research findings on barrier island assets for his presentation to the committee. He highlighted:

- That although Local Comprehensive Plans define a Coastal High Hazard Area (CHHA) for their communities, the restrictions of development and public investment varies among communities resulting in different levels of exposed assets.
- That the CHHA, which includes oceanfront and Intracoastal accessible parcels provides the greatest share of local property tax. In the Indian River and Martin County study area, barrier islands real estate represents 45%-48% of their counties' total assessed property values.
- The size of the political jurisdiction planning CHHA land-uses varies significantly and impacts asset exposure.

September 2005 – The Ana Puszkin-Chevlin and faculty from FAU's Department of Urban Planning establish a Hazard Mitigation Research study group to examine synergistic research possibilities and respond to funding opportunities. Already this group added a Disaster Mitigation Roundtable to the University's research symposium, participated in developing a multi-disciplinary proposal to the US Department of Homeland Security and began collaborating on research to be presented at the Annual Conference of the Urban Affairs Association (April 2006). Ms. Puszkin-Chevlin is also submitting an abstract for the Association of Collegiate Schools of Planning 2006 Conference in Ft. Worth, Texas. Data from the Florida Hurricane Alliance project is being in her doctoral dissertation.

November 2005 – Due to the hazard planning expertise Ms. Puszkin-Chevlin gained during the past year, she was asked to serve on Palm Beach County's Local Mitigation Strategy Ac Hoc Committee on Plan Revision. The group is charged with monitoring the Local Mitigation Strategy plan for FEMA compliance, assisting the Palm Beach County Division of Emergency Management with crosswalks and responding to FEMA feedback, improving the linkages between LMS and other local plans and supporting plan updates and revision.

December 2005 – A working draft of the Living on the Edge: Treasure Coast Barrier Island Study final report was completed. The research report identifies vulnerability factors, hurricane impacts and mitigation initiatives to coastal communities in Martin, St. Lucie and Indian River Counties. It provides detailed analysis of both the extent to which public and private assets are exposed to risk and of local and state planning policies and then offers 63 recommendations to improve resiliency. Select research findings include:

- That the barrier island residents accounted for only 5% of FEMA's Individual Assistance grant applications and received 8% of the grant monies, although they represent 9% of the population, and their properties reflect $26 billion in assessed taxable value. This illustrates how geographic vulnerability does not always correspond to social vulnerability.
- The barrier island study area received $37 million in FEMA public assistance grants, $19 million to repair and rebuild recreational facilities and beaches. Thus, despite policy to limit public asset exposure, the cost of achieving desired objectives, such as beach accessibility can be significant.
- The study areas hospitality sector, although badly impacted, is in the processes of recovery and rebuilding. There might be a net loss of 200 rooms and an unspecified number of jobs, but redeveloped proprieties will be more resilient.
- Land-use based hazard mitigation strategies are compromised by the amount of preexisting development, deference to state coastal setbacks regulations, high land costs, and competing environmental and economic objectives.
- The hazard mitigation policies and initiatives embodied in the Local Comprehensive Plans, Comprehensive Emergency Management Plan and Local Mitigation Strategy plan must be formally integrated horizontally and across jurisdictional boundaries.

Provide a schedule for the remainder of work to project completion:
The final report related with this phase of the research is currently being edited. It will be circulated for peer review the last week of January and layout and printing will be done in early February. We hope to begin the supplemental research of round II at that time.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:
As mentioned in the previous Quarterly Update, the report publication was delayed by approximately 6 weeks due to Hurricane Wilma recovery issues in South Florida. Regarding the scope, we regret that difficulties in joining and culling GIS data received from several counties and government agencies prevented us from experimenting with the LIDAR format. Our initial assessment of the ease of integration it revealed that it would require perhaps 100 or more hours of manual digitization, for which we had no staff, budget or time. Alternatively, we would have to hire a computer specialist to research more automated approach; again there was no budget for this work.

Additional Comments/Elaboration:
The first year of NOAA funding has been marked by several notable milestones detailed below. It has achieved its proposed objectives. Most importantly, in completing the Alliances' one of two social science-based research projects, the year's research has uniquely positioned CUES to advance NOAA's growing interest in social science research issues focused on hurricane forecast and warning systems. The highlighted achievements illustrate our ability to make scientific research relevant to public policy.

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-07

PROJECT TITLE: **Development of the Method and Geodatabase for Assessing Storm Surge Models**
CONTRIBUTORS: Keqi Zhang Chenyou Xiao, and Lixin Huang, International Hurricane Research Center
Heather Vollmer, Department of Environmental Studies
PERFORMANCE PERIOD: October 1, 2004 through December 31, 2005

Percentage of Work Completed: 45%

Project Proceeding on Schedule: [√] Yes [ ] No

Cost Status: [√] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
5. Assess the skill of storm surge models (e.g. Alliance member model(s), the North Carolina hurricane storm surge model,…). Provide a methodology in which to perform meaningful comparisons among surge models in general.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):
Publications:

Milestones:

- Developed a procedure to convert high water marks and debris lines in the paper maps into digital GIS format through scanning and georeferencing
- Collected reports and maps for historical storm surge measurements from various agencies including USGS, NOAA, and USACE
- Converted storm surge observations including high water marks and debris lines for Hurricanes Besty (1965), Camille (1969), Hugo (1989), Andrew (1992), Opal (1995), George (1998), Ivan (2004), and Katrina (2005) into GIS format
- Converted 17 storm surge related reports into digital PDF format

Provide a schedule for the remainder of work to project completion:

- Spring/Summer 2006: Create a geodatabase to store historical storm surge observations and populate the geodatabase
- Fall /Winter 2006:Collect wind field, topography, and bathymetry for historical hurricanes and develop GIS tools for comparing computed and field observations
- Spring /Summer 2007: Evaluate the storm models in terms of algorithms and theory
- Fall/Winter 2007:Run the storm surge models for selected historical hurricanes and evaluate the storm models by comparing the computed values with field observations

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

Additional Comments/Elaboration:

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-08

PROJECT TITLE: **Improving Storm Surge Simulation and Prediction Using High-resolution Airborne LIDAR Measurements**
CONTRIBUTORS: Keqi Zhang and Zheng Cui, International Hurricane Research Center
Jianhua Yan, School of Computer Science
PERFORMANCE PERIOD: October 1, 2004 through December 31, 2005

Percentage of Work Completed: 45%

Project Proceeding on Schedule: [√] Yes [ ] No

Cost Status: [√] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
3. Research on the viability of using high resolution Lidar data for mapping coastal features for use in hurricane storm surge forecasting. Of particular interest, are the identification of small features and barriers and shallow-water bathymetry. NOAA is interested in data collected as part of the planned research provided the data can be referenced to a standard datum, be demonstrated to be accurate, and provided in a format that can be readily ingested by the NOAA storm surge model without extensive reprocessing and reformatting.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):
Publications:

Outreach:

Zhang, K., 2005. Feature extraction from airborne laser scanning measurements. *American Geophysical Union Annual Meeting*, Abstract, San Francisco, CA.

Milestones:

- Improved Progressive Morphological Filter for classifying LIDAR measurements at flat coastal areas
- Developed algorithms to remove "blunders" caused by multipath laser reflections
- Designed a local polynomial fitting filter for classifying LIDAR measurements at mountainous coastal areas
- Developed a TIN based filtering algorithm for classifying LIDAR measurements
- Compared the performance of filters on the LIDAR data sets for different coastal topography

Provide a schedule for the remainder of work to project completion:

- Spring 2006: Examine the effects of LIDAR data on storm surge modeling
- Summer 2006: Develop algorithms to extract major geomorphological features in the coastal areas
- Fall 2006: Develop a GIS interface for storm surge models to ingest LIDAR data
- Winter 2006: Develop a GIS interface for storm surge model to ingest LIDAR data

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

Additional Comments/Elaboration:

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-09

PROJECT TITLE: **Improving Storm Surge Simulation and Prediction Using High-Resolution Airborne ALSM Measurements**

CONTRIBUTORS: William E. Carter[1] (PI) and Clint Slatton[1,2] (co-I)
[1]Department of Civil & Coastal Engineering; [2]Department of Electrical & Computer Engineering, University of Florida; Gainesville, FL

PERFORMANCE PERIOD: January 1, 2005 through December 31, 2005

Percentage of Work Completed: 100% (*for Round 1*)

Project Proceeding on Schedule: [X] Yes [ ] No

Cost Status: [X] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:

1) This work addresses the following NOAA Tropical Cyclone Research and Development Priorities.
   - #3. Research on the viability of using high resolution Lidar data for mapping coastal features for use in hurricane storm surge forecasting. Of particular interest, are the identification of small features and barriers and shallow water bathymetry. NOAA is interested in data collected as part of the planned research provided the data can be referenced to a standard datum, be demonstrated to be accurate, and provided in a format that can be readily ingested by the NOAA storm surge model without extensive reprocessing and reformatting.
   - # 7. Research on high resolution temporal and spatial data networks. NOAA is interested in receiving in real time, data from such mesonetworks.
   - #10. Research quantifying the impacts (ecological and economic) of tropical cyclone (winds, rain, and surge on the marine environment (e.g. coastal water quality, coral reefs.....).

Describe milestones achieved during this quarter:

I.) Coastal zone fusion of Lidar, NOAA bathymetry, and SRTM data

1) An invited paper was published in IEEE Geoscience and Remote Sensing Letters
   K. Clint Slatton, S. Cheung, and H. Jhee, "Reduced-Complexity Fusion of Multiscale Topography and Bathymetry Data over the Florida Coast", *IEEE Geoscience and Remote Sensing Letters*, (invited: special issue on surface mapping), vol. 2, no. 4, Oct, 2005, pp. 389 – 393.
2) A paper is being re-submitted to ASPRS Photogram. Engr. and Remote Sensing
   S. Cheung , H. Jhee, and K. C. Slatton, "Estimating landscape-dependent uncertainty in SRTM DTED-2 elevations via fusion with LIDAR data," *ASPRS Photogram. Engr. and Remote Sensing*, submitted.
3) A paper was presented at the SPIE Defense and Security Symposium in Orlando, FL in April 2005. It appears in the proceedings.
   K. Clint Slatton, Sweungwon Cheung, Hojin Jhee, "Reduced Memory Multiscale Fusion for Combined Topographic and Bathymetric Data," *Proc. SPIE Defense and Security Symposium*, vol. 5813, Mar. 2005, pp. 223-232.
4) Another paper was presented at the IEEE International Geoscience and Remote Sensing Symposium in Seoul, S. Korea in July 2005. It appears in the proceedings.
   H. Jhee, S. Cheung, and K. Clint Slatton, "Efficient Observational Updating for Fusion of Incomplete Image Data," *Proc. IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, (accepted), Jul., 2005.

5) We demonstrated computationally efficient fusion of NOAA NGDC, SRTM, bathymetric lidar, and topographic lidar data over the Miami-Dade coastline of Florida. See Figure 1.

II.) Photon-counting ALSM (PC-ALSM)

1) Subcontractors Fibertek, Inc. and Sigma Space, Inc. experienced delays throughout the year. PI Bill Carter visited both contractors multiple times during the year to facilitate and monitor their progress. At the end of the 4th quarter, final system integration was beginning at Sigma Space, Inc. All subsystems are functioning nominally.
2) UF graduate students Tristan Cossio and Kris Shrestha developed computer simulations of the PC-ALSM detection characteristics and the conversion of raw ranges and scanner readings into geo-located laser returns.
3) A paper was presented at the SPIE Defense and Security Symposium in Orlando, FL in April 2005. It appears in the proceedings.

   K. Clint Slatton, William Carter, and Ramesh Shrestha, "A Simulator for Airborne Laser Swath Mapping via Photon Counting," *Proc. SPIE Defense and Security Symposium*, vol. 5794, Mar. 2005, pp. 12-20.
4) Another paper was submitted for the 2006 SPIE Defense and Security Symposium. It has been accepted.

   William E. Carter, Kris Shrestha, Tristan Cossio, K. Clint Slatton, and Ramesh L. Shrestha, "System Integration for the Coastal Area Tactical-mapping System (CATS)," *2006 Proc. SPIE Defense and Security Symposium*, (accepted).

III.) St. Augustine lidar time series

1) Airborne lidar data were acquired over portions of the St. Augustine Beach area during April 2004, March 2005, May 2005, and October2005. The Mean Higher High Water (MHHW) tidal datum was used as a proxy for the shoreline. Initial findings (preliminary) suggest that the site experienced an average shoreline retreat of 30m between April 2004, and March 2005. This epoch includes the Hurricane season of 2004 and the 2004-2005 winter season. From March 2005 to October2005, the shoreline steadily built back so that for the epoch of April 2004 to October 2005, the net average shoreline retreat was 18m.
2) Beach sand volume changes are also being calculated, and small-scale erosion patterns are being investigated.

IV.) Miscellaneous

1) Ph.D. student Michael Starek submitted an abstract, which was accepted, to the American Geophysical Union (AGU) Fall Meeting in San Francisco, California. He presented his work, entitled "High-Resolution Measurement of Beach Morphological Response to Hurricane-Induced Wave Dynamics". He used a model based on linear wave theory to predict nearshore wave directions given offshore wave data from a NOAA buoy due to shoaling and refraction. The nearshore wave directions predicted by the model supported the pattern of erosion and deposition observed in the lidar data. See Figure 2.
2) PI Carter organized a lidar session for the AGU Fall Meeting entitled "Geodetic Laser Scanning: Space, Airborne, and Ground". It included an invited presentation by FIU student Quin Robertson.
3) Co-I Slatton organized another lidar session for the AGU Fall Meeting entitled "Advances in Airborne Laser Swath Mapping: Data Analysis and Discoveries in the Earth Sciences".
4) UF personnel raised the issue of using the UF/FIU ALSM system to map areas affected by Hurricanes Katrina and Rita with FIU and NOAA personnel. It was indicated that NOAA personnel and the Army Corps of Engineers were mapping the areas they desired and did not require any assistance.

Provide a schedule for the remainder of work to project completion:

Round 1 is now completed, and Round 2 has begun.

1) Investigate spatial patterns in the shoreline change. (Q1 2006)
2) Investigate the use of a more sophisticated wave model to predict the nearshore wave environment. It is a USGS model called SWAN (Simulating WAves Nearshore) and it is capable of predicting the non-steady propagation of short-crested waves.
3) Continue to monitor changes of the beaches in the St. Augustine study area, repeating the ALSM observations at approximately three-month intervals.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

1) No major problems were encountered. Some delays in the fabrication and integration of the photon-counting lidar occurred, but the work is now proceeding nominally.

Additional Comments/Elaboration:
Figures are located at the Florida Hurricane Alliance website: http://www.ihrc.fiu.edu/fha/research_topics.htm#lidar

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-10

PROJECT TITLE: **Hurricane Visualization**
CONTRIBUTORS: J. Peter Kincaid, Glenn Martin and Dezhi Liao, University of Central Florida
PERFORMANCE PERIOD: entire project to date (calendar year 2005)

Percentage of Work Completed: For Phase 1 – 90%. Some Phase II effort started early (see below).

Project Proceeding on Schedule: [] Yes* [ ] No

*Note: Project has been accelerated due to an unexpected opportunity which presented itself to collaborate with the Museum of Science and Industry in Tampa. This is a Phase 2 task- to provide an exhibit for their "Disasterville" exhibit scheduled for opening in Spring 2006.

Cost Status: [x] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
This project addresses NOAA Priority 8- research on advanced data and forecast/warning visualization techniques that might aid NHC/TPC in providing media briefings during hurricanes and for training and outreach.

Describe milestones achieved (publications, technology transferred, outreach actions, other results): See below for list of tasks scheduled and status. Of the seven tasks scheduled for Phase 1, all are on track and will be finished by the scheduled completion date of our Phase I effort.

Outreach. Through our sub-contract with Kinetics Research Corporation our project is partially responsible for the development of a hurricane visualization and forecast website. During the record setting 2005 hurricane season, the web site generated traffic from over 3 million users representing in excess of 50 countries. Users who spent more than 10 seconds on the site (25% of total users) spent an average of 2.5 minutes per visit viewing the site, and returned for multiple visits during hurricane landfalls. Press coverage was extensive and favorable. This is documented in a recent technical report: *Hurricane Damage Forecasting and Visualization Project: Report for 2005 Hurricane Season*, Charles E. Watson and Mark E. Johnson.

Dissertation. Dezhi Liao, a Ph.D. candidate in UCF's Modeling and Simulation Graduate Program has just started working on a dissertation directly related to this project, "Physically-based Modeling and Visualization of Hurricane Damage." Dr. Forest Masters, FIU Assistant Professor of Engineering and a prominent researcher in the Florida Hurricane Alliance, is a committee member which will help us coordinate our project with his work.

Museum Exhibit. We are in the process of negotiating an agreement with the Museum of Science and Industry in Tampa to provide a component of their large Disasterville exhibit schedule for opening in Spring 2006.

Provide a schedule for the remainder of work to project completion: For Phase 1 we still have to: (1) provide a visual simulation of hurricane impacts into our visualization. We should be able to complete simulations within the next 2-3 months.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost.
Some of the visualizations we are building into the tutorial will be appropriate for a NOAA priority for this program – aid in providing media briefings during hurricanes and for training and outreach.

Additional Comments/Elaboration: This is a relatively new project (now a little older than one year) and most of the effort during 2005 was in been in coming up to speed in some new technical areas and building an infrastructure to allow efficient and realistic visual renderings for various aspects of NOAA Priority 8. We anticipate producing publications and conference presentations during 2006, as well as a usable tutorial. A listing of project tasks and status can be found at the Florida Hurricane Alliance website:
http://www.ihrc.fiu.edu/fha/research_topics.htm#simulation_visualization

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-11

PROJECT TITLE: **An Interactive 3D Visualization and Animation System for Hurricane Impacts**

CONTRIBUTORS: Shu-Ching Chen, Associate Professor, School of Computing and Information Sciences, Florida International University
Keqi Zhang, Assistant Professor, International Hurricane Research Center
Peter Singh, School of Computing and Information Sciences, Florida International University
Khalid Saleem, School of Computing and Information Sciences, Florida International University
Malaka Walpola, School of Computing and Information Sciences, Florida International University
Kasun Wickramaratna, School of Computing and Information Sciences, Florida International University

PERFORMANCE PERIOD: December 31, 2004 to Dec 31, 2005

Percentage of Work Completed: 65%

Project Proceeding on Schedule: [X] Yes [ ] No

Cost Status: [X] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
The research and development work over the last year was carried out ensuring that our system is beneficial to NOAA and it collaborates and serves NOAA priorities. This project addresses NOAA Priority 8- research on advanced data and forecast/warning visualization techniques that might aid NHC/TPC in providing media briefings during hurricanes and for training and outreach.

- Our project uses VTBuilder for rendering terrain level topography. VTBuilder allows the import of a variety of geospatial data formats including LIDAR data **.grd** formats. VTBuilder allows for accurate and precise terrain representation for coastal regions via our animation system, ensuring that the hurricane and storm surge flooding effects are realistic and helpful for immaculate estimation of the risks, threats and damages due to hurricanes and storm surge flooding. The precise terrain level animation further helps with storm surge forecasting as well.
- The 3D visualization and animation system allows the NHC and media advisories with a visualization environment that can provide realistic representation of the risks, threats and damages associated with the hurricane and storm surge flooding and help the advisories in effectively influencing the general public to undertake the necessary precautionary measures against an approaching hurricane or storm surge flooding. The traffic animation sequence across Rickenbacker Causeway under hurricane and storm surge flooding can also help the advisories in influencing the general public for executing timely and proper evacuations.

The above benefits comply with the NOAA priorities and can facilitate in achieving its goals and objectives.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):
The following research and development progress was made during the performance period.

- Implementation of traffic animation over Rickenbacker Causeway along with its interaction with storm surge flooding emphasizing upon the risks and threats involved with delayed evacuations
- Investigation and implementation of an **.xml** based file format facilitating the efficient plantation of vegetation instances across the animation environment
- Implementation of water wake effect reflecting vehicle movement through rain adding realism and detail to the animation environment

- Implementation of 3D tree animation based on wind speed and wind direction ensuring realistic tree movement under hurricane conditions
- Implementation of an **.xml** and **.obj** based file format for facilitating future automated generation of digital city models for on-demand faster and more efficient hurricane and storm surge impact animations
- Implementation of animated light posts representing power failure under hurricane and storm surge associated flooding conditions

In addition to the above research and development progress some enhancements were made to the current 3D Visualization and Animation environment. These enhancements are listed below.

- Addition of a **.3DS** Toll Plaza model based on digital images in the Key Biscayne Animation sequence enhancing the animation sequence's appeal and realism
- Addition of a **.3DS** bridge model across the Rickenbacker Causeway
- Enhancements to the current **.3DS** car models and addition of newer **.3DS** car models enhancing the current **.3DS** car models library and allowing for a diverse range of car models to use from in the animation sequences.

Moreover, based on our research and development progress made during the past year, we crafted two research papers that were published by well renowned conference and magazine journals. The research papers along with a summary of the work published, are listed below

- Peter A. Singh, Na Zhao, Shu-Ching Chen, and Keqi Zhang, "Tree Animation for a 3D Interactive Visualization System for Hurricane Impacts," Proceedings of the IEEE International Conference on Multimedia & Expo (ICME), pp. 598-601, July 6-8, 2005, Amsterdam, The Netherlands. The paper described and elaborated upon the vertex weighting based technique for 3D tree animation based on wind speed and direction used in our animation environment.
- K. Zhang, S. Chen, P. Singh, K. Saleem and N. Zhao, "A 3D Visualization System for Hurricane Storm- Surge Flooding," IEEE Computer Graphics and Applications Magazine, pp. 18-25, Jan-Feb 2006. The paper described the use of LIDAR for a geospatially accurate and realistic animation for our visualization for our animation system. The paper further elaborates on the methodologies and approaches used for the ocean water, wind, traffic, debris, rain and lightning animations engines used in our animation system.

Provide a schedule for the remainder of work to project completion:

We plan to focus on the following tasks in the next development period.

- Continue working on the automated Digital City Model Generation using **.mtl** and **.obj** files
- Research, collection, and possible implementation of LIDAR based elevation grids for additional coastal locations across south eastern Florida
- Adding .3DS models for School Buses and Police Cars used in emergency situations
- Filtering of the terrain level elevation data for the removal of elevation bumps
- Implementing 3D Sound for the animation environment
- Research for animating shallow ocean water caused by bathymetry

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

None

Additional Comments/Elaboration:

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-12

PROJECT TITLE: **Ground Level Hurricane Wind Characteristics in Real Time**
CONTRIBUTORS: Kurt Gurley, University of Florida
Forrest Masters, Florida International University
PERFORMANCE PERIOD: January 1, 2005 through December 31, 2005

Percentage of Work Completed: 90 % - remaining work to be completed in Year Two

Project Proceeding on Schedule: [x] Yes [ ] No

Cost Status: [x] Cost Unchanged [ ] Under Budget [ ] Over Budget

NOAA Priorities addressed in Year One of this continuing research program:
4. Research for a better understanding of the meteorology of tropical cyclones at landfall, especially the evolution of the surface wind field from the open water across the coastline to inland areas, and information on coastline surface roughness.
7. Research on high resolution temporal and spatial data networks transmitting real-time data.

Describe milestones achieved during this quarter:
Completed tasks in Year One:

- Procured all hardware units needed to upgrade the real-time system to include NOAA GEOS satellite communication. Each tower will report real-time data using both cellular and satellite communication in 2006
- Completed upgrades to customized data collection software to accommodate satellite communication system.
- Completed the construction of one additional tower, bringing the working fleet up to five.
- Deployed for each U.S. landfalling storm in 2005.
    - Dennis (Florida Panhandle)
    - Katrina (South Florida, Gulf Coast)
    - Rita (Texas)
    - Wilma (South Florida)
- Maintained and upgraded the deployment equipment as needed to improve reliability and safety.
    - Routine tow vehicle and tower maintenance
    - Upgraded power supply for each tower with a new diesel generator with customized reserve fuel, giving each tower an autonomous data collection window of at least 48 hours.
    - Installed 100 gallon diesel reservoir in each tow vehicle, providing greatly improved range of operation with reduced risk of fuel shortage difficulties. Katrina deployment would not have been possible without this upgrade.

Ongoing tasks continuing into Year Two:

- Nearing completion of one additional tower, bringing the tower fleet to six for 2006 season.
- Continuing work on FIU-based GIS repository for ground level hurricane data from this and other in-field research programs. Prototype to be operational for the 2006 season.
- Continued collection and analysis of data to describe the evolution of the surface wind field from the open water across the coastline to inland areas, and to provide measurements of coastal surface roughness.

Provide a schedule for the remainder of work to project completion:

Round One contract expired December 31, 2005.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

No critical problems

Additional Comments/Elaboration:

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-13

PROJECT TITLE: **Understanding the Structure and Improved Prediction of Hurricanes**
CONTRIBUTORS: R. G. Ellingson, T. N. Krishnamurti and X. Zou Florida State University

PERFORMANCE PERIOD: entire project to date

Percentage of Work Completed: About 80% of round 1 research has been completed (100% of portions proposed by Krishnamurti and Zou, about 20% of radar activity as described below)

Project Proceeding on Schedule: [x] Yes [ ] No (with exception of radar activity described below)

Cost Status: [X] Cost Unchanged [ ] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:

Our research to date has primarily focused on NOAA Priority 1 as described below and on 4 to some degree.

1. Research on model superensembles for hurricane forecast guidance to five days, four times daily. The Government is interested in receiving real time guidance products produced in the natural course of this research.

4. Research for a better understanding of the meteorology of tropical cyclones at landfall, especially the evolution of the surface wind field from the open water across the coastline to inland areas. NOAA is particularly interested in information on surface roughness at the coastline.

Describe milestones achieved (publications, technology transferred, outreach actions, other results):

Research by Prof. T. N. Krishnamurti

- We successfully provided 6 hourly forecasts on hurricane tracks and intensity to the NHC for the entire season of 2005.
- During the year 2004 when Florida was impacted by many hurricanes the skills of the FSU superensemble was clearly higher than those of all participitating models for the track and intensity. We provided some of the best guidance to NHC (National Hurricane Center) on real time in 2005 as well. Our results through day 3 of forecasts are provided here. Here we see the superior performance of the FSU superensemble for tracks and intensity compared to nearly all the participating member models. Fig. 2 (a and b) show the track and intensity errors respectively.
- We were able to include a further refinement the superensemble methodology towards the reduction of timing errors. This also impacts the position errors since it works separately on the X and Y coordinate. Those results on the reduction of position errors are shown in Fig. 3. Further details are provided in appendix I.
- We have developed a downscaled precipitation forecast superensemble that goes out to 5 days. It has the capability to provide real-time products at 25 km resolution and at intervals of every 6 hours. This product would be useful for the monitoring of floods related to hurricane landfall. This was also strongly recommended by the NOAA management.
- We have been working on various aspects of hurricane Katrina. The superensemble forecasts of tracks and intensity during the three days prior to landfall were very close to the observed official estimates. The second major component of our study was a mesoscale forecast of hurricane Katrina between 03UTC August 28th to 03UTC August 30th. This was a most important landfall point of the storm. The total precipitation during the passage of the storm Katrina was an important feature. The model shows features that were quite similar to

what was seen for high-resolution imagery. This was a successful aspect on the details the model forecast for Katrina. Details are available upon request.

- Mr. Mark Rickman Jordan II completed an M.S. thesis with project support, the title being "Using the Superensemble Method to Improve Eastern Pacific Tropical Cyclone Forecasting." Details are available upon request.

Publications

Halverson, J., P. L. Azofeifa, M. Black, S. Braun, D. Cecil, M. Goodman, A. Heymsfield, G. Heymsfield, R. Hood, T. N. Krishnamurti, J. Molinari, R. Rogers, J. Turk, C. Velden, D.-L. Zhang, E. Zipser, and R. Kakar, 2006: NASA's Tropical Cloud Systems and Processes (TCSP) Experiment: Investigating Tropical Cyclogenesis and Hurricane Intensity Change. Manuscript submitted for publication in *Bulletin of American Meteorological Society.*

Krishnamurti, T.N., A. Chakraborty, Brian P. Mackey, M.K. Biswas, A.K. Mishra, T.S.V. Vijaya Kumar, Paul H. Ruscher and Robert G. Ellingson, 2006: The FSU Superensemble for Weather and Climate Forecasts. Manuscript submitted for publication in *Bulletin of American Meteorological Society*

Cartwright. T. J. and T.N. Krishnamurti, 2005: Warm Season Mesoscale Superensemble Precipitation Forecasts. *Monthly Weather Review*,, submitted for review.

Research by Prof. Xiaolei Zou

- As the first step of applying QuikSCAT surface wind observations to initialization of tropical cyclones (TC), QuikSCAT Level-3 surface wind fields were analyzed for 230 cases in the North Atlantic TC basin for the years 1999-2004, and values of wind-related parameters issued by the TPC were compared with those derived from the QuikSCAT wind vectors. Overall, the wind vectors are quite accurate, with only one major issue related to the method of rain-contaminated wind vector cell (WVC) removal. It was found that a major limitation with the current rain-contaminated WVC removal algorithm, the multi-dimension histogram (MUDH) algorithm, is the high false-alarm rates (e.g., good-quality data is removed when rain-contaminated data are removed). It was also found that the maximum wind speed (Vmax) calculated from QuikSCAT is most correlated with NHC values of Vmax, while significant correlations for the radius of 34kt wind and radius of maximum wind (Rmax) between NHC and QuikSCAT were found only in certain regions. The correlations between QuikSCAT and NHC for all the wind-related TPC parameters in the northwestern Atlantic are in general higher than those in the eastern Atlantic, the western Caribbean/the Gulf of Mexico, and the eastern Caribbean/western Atlantic. Such results seem to be related to less severe rain contamination with the QuikSCAT data as well as the lower convective rain rates within TCs at higher latitudes.

- In order to incorporate TOMS ozone in a hurricane environment into a hurricane forecast model, two regime-dependent linear regression models were developed. This research applied these two regime-dependent linear regression models in the actual assimilation of TOMS ozone data. A case study was carried out to compare the track forecasts for Hurricane Erin (2001), initialized at 15 UTC September 8, 2001, with and without TOMS ozone data. TOMS ozone data are assimilated at 45-km resolution and a 4D-Var bogus data assimilation was conducted at 15-km resolution. The model forecasts (3 days) were made from the nested run with 45-15 km resolutions. The control forecast used the NCEP large-scale analysis on the 45-km domain without incorporating TOMS ozone data. The track error of the control forecast without TOMS ozone is below 150 km during the entire 3-day forecast periods, close to the official track error during the first 40 hours, and much smaller than the official track error between 42-72 hours. Assimilation of TOMS ozone data produced a model forecast whose track error is smaller than that of the control experiment after 18 hours of model forecast. The mean track error was reduced by half due to TOMS ozone data. The improvements in the model track forecast after assimilating TOMS ozone into MM5 model were found to be related to both the steering flow and the temperature distribution near the hurricane.

- We (i) compared Global Positioning System (GPS) radio occultation (RO) data with NCEP large-scale analysis and dropsonde data over the globe and within TC environments and examine detailed vertical structures of the atmosphere within TCs, and (ii) conducted two more hurricane initialization case studies using TOMS ozone data. The main conclusions are: (i) GPS RO profiles deviate from NCEP more near the center of Tcs; (ii) the GPS RO observed bending angle and refractivity tend to be smaller (larger) than the NCEP analysis below about 2.5 km MSL altitude (between 2.5 and 6 km); (iii) GPS RO profiles can resolve the same thermodynamic

structures as dropsondes, such as temperature inversions, steep lapse rates, moist and dry layers, illustrating a beneficial addition to HRD dropsondes, and (iv) improvements in the hurricane track forecast are observed in all three experiments due to the use of TOMS ozone. Details are available in previous quarterly reports and/or by contact.

- Completed a journal paper entitled "Improving hurricane track prediction using TOMS ozone observations", the abstract for which is included in Appendix III
- Combined QuikSCAT surface wind with atmospheric motion vectors (AMV) for an improved hurricane initialization and prediction

Research by Prof. Ellingson

- The FSU Doppler radar was taken to the Chill Radar Facility at Colorado State University, Fort Collins, CO for in the spring for characterization and calibration. The radar returned to FSU on June 19, 2005. Based upon the findings at CHIL, additional equipment was added to the facility to make it ready for deployment to study tropical cyclones.
- The FSU Doppler radar was deployed to Panama City, FL on Sunday, 10 July 2005 to obtain wind and precipitation data preceding, during and following the landfall of hurricane Dennis. The radar was set up in a parking lot adjacent to the Gulf of Mexico on the western side of Panama City which afforded a clear view to the south and west, thereby enabling easy tracking of the system as it skirted the coastline prior to making landfall between Panama City and Pensacola. Shortly after setting up for operations, the power supply for the radar failed, and this negated our attempts to collect data from this storm.
- During the examination of the radar to determine the cause of the failure of the radar power supply, the radar truck mounted pedestal incurred substantial damage in an accident when the truck was being repositioned to allow better access to its electronics. A new radar pedestal was sent to the Chill Radar Facility for rewiring, and it will be shipped to FSU on 3 February for mounting on the radar.

Provide a schedule for the remainder of work to project completion:

Prof. Krishnamurti

- We are preparing for the real time hurricane forecasts for the 2006 season at two fronts. The operational model based multimodel superensemble will include a space/time algorithm that will require testing for its real time application for the coming season. This takes a roughly 3 to 4 months of testing and preparation. This would be carried out during the months January through April of 2006. The mesoscale multimodel superensemble (Fig 1) is being designed as a future milestone for improved intensity forecasts for hurricanes. Roughly 40% of that work has been completed. The remaining developmental work is expected to take roughly another 12 months. Thereafter tests for its real time applications are expected.

Prof. Zou

- Our project research follows very closely that outlined in the proposal for year 2. In particular, for the next quarter we expect to:
    a. Refine the journal paper on the assimilation of TOMS ozone data for hurricane track forecasts and submit it to a refereed journal. Expected completion date: February 28.
    b. Complete a journal paper on the assimilation of QuikSCAT surface wind and atmospheric motion vectors (AMV) for 2005 hurricanes Katrina, Ophelia, and Rita. Expected completion date: March 31.

Dr. Ellingson

- The radar will be repaired over the next few months after which it will be deployed to obtain data from convective and prefrontal systems and prepare for more substantial operations during 2006 hurricane season. Otherwise, our plans are to follow the plans provided in our Round 2 proposal

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:

Dr. Krishnamurti

- We are closely working with the EMC's HWRF hurricane model. We are also working with the WRF model of NCAR. These are two of the mesoscale models of our suite. We have noted that these codes require

development of a rain rate initialization algorithm (Appendix II). That is a sizable task for the mesoscale model suite and may require some additional manpower (one additional full time post doc and related funds around 70k/year). This is a very important project from the current national interests and needs for high resolution real time intensity forecasts

Dr. Ellingson

- The radar activities are continuing using funding from round 1 that have rolled over into round 2 beginning 1 January 2006. That is, the radar activities for year 1 were under budget because there were not as many deployments as planned due to operational problems. Nonetheless, we due plan to use those funds during the next period along with the new funding, thereby allowing us to devote more attention and time to obtaining radar data during 2006 landfalling tropical systems.

Additional Comments/Elaboration:
Progress Report Appendices can viewed at the Florida Hurricane Alliance website:
http://www.ihrc.fiu.edu/fha/research_topics.htm#hurricane_structure_prediction

FLORIDA HURRICANE ALLIANCE
ANNUAL PROGRESS REPORT
PROJECT 10-14

PROJECT TITLE: **Quantifying Ecological and Economic Impacts of Tropical Cyclones on Coral Reefs and Coastal Water Quality in South Florida**
CONTRIBUTORS: Thomas J. Mason, Global Center for Disaster Management and Humanitarian Action, College of Public Health, University of South Florida and Pamela Hallock Muller, College of Marine Science, University of South Florida
PERFORMANCE PERIOD: Year 1 - 2005 (project to date)

Percentage of Work Completed: 50% (100% of Year 1)

Project Proceeding on Schedule: [X] Yes [ ] No

Cost Status: [X] Cost Unchanged [] Under Budget [ ] Over Budget

Project Benefits to NOAA including priorities served:
10. Research quantifying the impacts (ecological and economic) of tropical cyclone (winds, rain, and surge on the marine environment (e.g. coastal water quality, coral reefs.....).

Describe milestones achieved (publications, technology transferred, outreach actions, other results):
Website created for the Hurricane Alliance http://www.marine.usf.edu/reefslab/pages/hurricane_alliance.html
The following products have been or very soon will be posted on the webpage:

- Observations of 2005 Hurricane Season in South Florida (powerpoint)
- Longevity and Extent of Tropical Storm-Induced Plumes Detected from Satellite Data (report)
- Annotated Bibliography initiated for the following topics…
  - Hurricane Impacts on Benthic Resources
  - Historic contaminant studies in Biscayne Bay, Florida
  - Biscayne Bay water transport
  - Environmental factors influencing benthic resources in a subtropical estuary
  - Tools for managing and evaluating estuarine health
  - Pollutant effects on benthic resources

Manuscript submitted for publication:

Carnahan, E.A., A.M. Hoare, P. Hallock, B.H. Lidz, C.D. Reich. Distributions of Heavy Metals and Foraminiferal Assemblages in Sediments in Biscayne Bay, Florida, USA. Marine Pollution Bulletin. Submitted January 2006.

Provide a schedule for the remainder of work to project completion:

1. Characterize categories and aerial extent of benthic resources in BB/BNP that can be influenced by hurricanes using satellite and LIDAR products, augmented by fieldwork to ascertain habitat types. Draft report completed by June 1, 2006; report on website by September 1, 2006.
2. Continue to build the bibliography on potential pollutants in storm plumes generated by South Florida hurricanes, based upon land use in the watershed and data from point and non-point sources to Biscayne Bay, with emphasis on agricultural and urban pollutants. Bibliographies on website will be updated quarterly.
3. Refine targeted sampling to determine presence and concentrations of suspected pollutants, and utilize bioindicators to characterize potential resource responses. Sampling will take place in May/June and September 2006.

4. Develop a GIS-based model to map locations where impacts are likely to occur based on characteristics of the tropical storm. Draft report completed by September 30, 2006; final report on website by December 31, 2006.

Describe problems or circumstances affecting completion date, milestones, scope of work, and cost:
The 2005 hurricane season repeatedly "impacted" planned field activities; additional field sampling will be conduced in 2006.

Additional Comments/Elaboration: