Statistical Analysis and Modeling of Hurricanes

FY 2013 Joint Hurricane Testbed (NOAA-OAR-OWAQ-2013-2003469)

Rebecca D. Wooten, Ph. D., Principal Investigator

Principal Investigator
Rebecca D. Wooten, Ph. D.
Assistant Professor
Department of Mathematics and Statistics
University of South Florida
4202 East Fowler Avenue CMC 319
Tampa, FL 33620
Phone: (813) 679-9318
Email: rwooten@usf.edu

Christos P. Tsokos, Ph. D., Co-Principal Investigator

Co - Principal Investigator
Christos P. Tsokos, Ph. D.
Distinguished University Professor
Department of Mathematics and Statistics
University of South Florida
4202 East Fowler Avenue CMC 366
Tampa, Fl 33620
Phone: (813)974-9734
Email: ctsokos@usf.edu

Rebecca Puig, Director

Keith Anderson, CRA
Associate Director, Division of Sponsored Research
Rebecca Puig, Director
Authorized Representative
University of South Florida
3702 Spectrum Blvd., Suite 165
Tampa, Fl 33612-9445
Phone: (813)974-5465
Email: rpuig@usf.edu

2. Abstract

The objective of this proposal for the FY 2013 Joint Hurricane Testbed (NOAA-OAR-OWAQ-2013-2003469) is to study several aspects of hurricanes in the Atlantic Basin through the use of modern statistical analysis. This research is relevant to many aspects of hurricane analysis: formation, intensity, and tracking. The anticipated results are to improve the analysis and forecast of hurricanes along with developing an improved real time operational model. Many aspects of the weather generator (simulator) need to be addressed. Namely, directionality using bivariate probability distributions as well as Markovian analysis of movement, non-response analysis of the relationship between wind speed, pressure and temperature, and how all the developed models with interact to better predict where a hurricane will form, where it will go, how long it will take to get there and the expected intensity of the storm. This may also include the limitation of hurricanes intensity due to position (latitude/longitude) and the bathymetry of the Gulf of Mexico in conjunction with pressure and temperature (air, water and dew point). The methods that will be used include **Parametric Analysis**, **Markovian Analysis**, **Regression Analysis** and **Non-response Analysis**. This research will improve analysis and forecast potential in reference with onset, duration, and magnitude of intensity changes along with model initialization. This research will use modern statistics in determining track and intensity forecasts while optimizing forecaster efficiency and ease in regards to analysis and forecast.

3. Statement of Work

There is strong evidence to support the fact that temperature and temperature differentials play a significant role in hurricane intensity; this relationship must be better understood in order to enhance prediction capabilities and improve efficiency of developed statistical models. To this end, data sets containing temperatures as well as pressure and wind speed need to be constructed and statistically analyzed. This research is important as it uses modern research methods to develop real-time operational models to predict tropical cyclones. It is relevant to many aspects of hurricane analysis: formation, intensity, and tracking. Current research shows that hurricane tracking may be accurately determined using the previously known conditions and the Coriolis Effect over time. This type of computer simulation is extremely efficient and can be run on desk top computers with minimum readily obtained data.

3.1. Duration

In this first phase of research, the individual relationships will be analyzed creating probabilistic models and predictive models using newly developed statistical methods. Upon completion of this first phase of research we will be in a position to couple these underlying models together to create a stochastic weather generator. The duration of this project is for a 2 year period of time.

3.2. Brief Description

Our goal is to take the developed sub-models and create a weather generator which better predicts the formation of a tropical storm, more accurately predict the intensity of tropical cyclones by improving the understanding of the underlying processes that exist with a storm including the internal storm dynamic and interactions between the atmosphere and the ocean's surface, but also predicts the tropical cyclones track with minimal field observations. This research would also increase our ability to predict tropical cyclone frequency.

These goals will be accomplished by helping designing and conducting research experiments in the hurricane to collect and provide data for research and applications; analyzing these data sets and publishing the research in the refereed journals; developing new statistical methods, implementing technology and applications based on this research to improve prediction models; and providing outreach to the public through the Internet, conferences, presentations, and other means.

PAST RESEARCH

In the paper ***Statistical Analysis and Modeling of Lightning***, we have use parametric analysis to identify the most appropriate probability distribution that characterizes the behavior of the **number of lightning** that occurs in the State of Florida, obtaining confidence limits on the true number of lightning in a given

month. Using historical data collected by the **National Lightning Detection Network** (**NLDN**) in conjunction with other meteorological phenomenon to determine the true number of cloud-to-ground lightning over the state of Florida. Identifying and ranking the contributing entities or explanatory variables (independent variables) which cause lightning strikes to occur; entities such as **temperatures**, **relative humidity**, and **precipitation**; others include the **Bermuda highs**, **tornadoes**, **waterspouts** and **hail**. This research is useful in that estimating or predicting the number of lightning strikes can reduce the number of fatalities by developing strategist for safety and would allow electric companies to better prepare for power outages caused by lightning by appropriately allocating resources.

In the paper ***A Markovian Analysis of Hurricane Transitions***, addresses the transitional states of hurricanes from the initial formulations, tropical storms to a level five hurricane, using conditional Markov chains and Monte Carlo simulation to predict hurricane intensity. Creating conditional transitional probabilities based on the recorded pressures, we can see the random nature of a storm; once a storm is in fruition, it will intensify and then weaken independent of the time of the transition; that is, is it before or after the storms hits its peak wind speed, the probability of transition are comparable showing that hurricane transition is not as dependent on pressures but rather is a random progression. Using unconditional Markov chains is only slightly less accurate, but allows predictions to be made with a single transformation matrix.

In the paper ***A Proposed New Scale to Identify the Category of a Hurricane's Status***, a new more stable index is introduced for categorizing **hurricane force winds** using parametric and non-parametric analysis coupled with molecular physics. Comparisons of categorical wind speeds between the proposed scale and the scale presently used show that the proposed scale has a much more balanced distribution in most measures: **count**, **total variance**, and individual **ranges** in terms of both **pressure** and **wind speed**. This index also clearly defines **pressure** ranges associated with **Tropical Storms** and **Tropical Depressions**.

In the paper (***Linear and Non-linear***) ***Statistical Modeling of Hurricane Force Winds***, regression is used to determine how maximum sustained winds relate to **pressure**, **location** and **linear velocity**. The developed model can be used to estimate, with a high degree of accuracy, the **wind speeds** expected in a given hurricane based on these few meteorological measurements and their interactions. This simplified statistical model is more efficient than more complex deterministic models currently in use today.

In the paper ***Statistical Analysis of the Relationship between Wind Speed, Pressure and Temperature***, we introduce a new statistical methodology referred to as **Non-Response Analysis** to better understand the co-dependent relationship between these various meteorological measurements. This new statistical methodology allows each variable to be expressed as a conditional function with

two solutions depending on factors such as the season and which can be extended to include two-way interaction between the three variables. This research shows that temperature is an important meteorological measure in the transitions of a tropical storm into a hurricane and possibly the formation of a storm.

CURRENT RESEARCH

Tropical Cyclogenesis (Storm Initiation):

Melena Frett, a graduate student working on her Master's thesis is working on a paper preliminary entitled ***Detecting the Formation of a Storm*** in which real world data from buoy in hurricane prone areas coupled with known hurricane information are used to analysis the relative rates of change and how the various meteorological measurements such as temperature and pressure interact days before a storm forms.

Hurricane Tracking:

Elizabeth Miller, a graduate student working on her Master's thesis is working on a paper preliminary entitled ***The Directionality of a Hurricane*** in which real world data from historical hurricanes are used to predict the position of a storm based on its previous location and the Coriolis Effect.

FUTURE RESEARCH

Image Analysis:

Using imaging analysis, we would like to measure the internal structure of the heat engine that is a hurricane. Using real world data including satellite images and radar coupled with rotational analysis (including standard regression and non-response analysis) to better understand the full force of hurricane, both span and intensity. To test the claim that hurricanes are about 300 miles in diameter and construct confidence limits on both the mean diameter of a hurricane as well as the variance (and standard deviation). To test the claim that the eye of a storm, the relatively calm clear area in the center of the storm is approximately 30 miles in diameter (usually stated to be between 20-40 miles across); to construct confidence limits on the diameter of the eye of the storm as well as on the number of rain bands produced and the distance between them.

Bathometry:

Using the bathometry, that is, the depth of the water, coupled with all the previous gathered measurements: wind speed, pressure, temperature, latitude and longitude; and using developed statistical procedures to determine the co-dependent relationship that exist among these contributing variables and create better forecasting models. Test the claim that in open water, hurricanes take the path of least resistance which is where the water is deepest.

Seasonal Probabilities:
Using real world data to test the claim of a Poisson probability distribution and extend the best fit probability distribution to include the contributing variables.

3.3. Work Plan

3.3.1 Hardware/Software Needs

Hardware needs include a data server used for data entry, storage, and computation. The software needs include Microsoft Office, Microsoft Excel, and Microsoft Word in addition to other statistical software such as R, SAS, and SPSS. Future operational software includes an interface program for transfer of incoming data into operational center.

3.3.2 Testing and Evaluation Approach

Data compilation into server and imported into Excel files. Statistical analysis of data using Markovian analysis, linear modeling, and non-linear modeling. In this first phase of research, the individual relationships will be analyzed creating probabilistic models and predictive models using newly developed statistical methods. Upon completion of this first phase of research we will be in a position to couple these underlying models together to create a stochastic weather generator.

Evaluation is based upon data gathering, data input, statistical analysis, model development, and new generator. Each section being of relatively equal importance, with a slight emphasis on model development.

3.3.3 Metrics for Success

3.3.3.1 Data gathering, compilation, and construction of temperatures, temperature differentials, pressure, and wind speed.

3.3.3.2 Statistical Analysis, creation, and development of probabilistic and predictive models.

3.3.3.3 Testing of new models with historical data and current data.

3.3.3.4 Creation of stochastic weather generator

3.3.3.5 Implementation of new model into operational centers.

3.3.4 Timeline with Key Milestones

Year 1 Project Timeline (Sept 2013 - August 2014)

Gather information and data: specifically data gathered from contacts made prior to the start of this project - this includes but is not limited to the following.

3.3.4.1 September (2013) / October (2013)

Data Set 1: Buoy data for **wind speed**, **pressure**, **air temperature**, **water temperature**, **humidity**, and **wind direction** starting with 2005 (**Time**). Projected Time: 2 months (a working in progress).

3.3.4.2 November (2013) / December (2013) / January (2014)

Data Set 2: Hurricane Information that is data on the **maximum sustained wind speed**, **minimum pressure**, **time** of Reading (From which **duration** of the storm can be determined), **latitude** and **longitude**. Projected Time: 2 months.

Data Set 2a: Note: In preliminary studies, temperature data within a storm is has not been found; therefore, it will take time to map the buoy data (namely temperature) to readily available Hurricane information. Projected Time: 2 months plus 1 month for **Stage 1 Analysis** determining the co-dependent relationship between the contributing variables combined (a working in progress).

3.3.4.3 February (2014)

Mid-year review report due

3.3.4.4 January (2014) - April (2014)

Data Set 3: Images from radar imaging needs to be gathered and analyzed to determine the **number of bands**, the **maximal** and **minimal band widths of bands**, the **maximal** and **minimal band widths of eye**. Projected Time: 4 months

3.3.4.5 April (2014)

Renewal proposal due

3.3.4.6 May (2014) / June (2014)

Data Set 3a: Note: It will take time to map the information gathered using image analysis to the main data set. Projected time: 2 months

3.3.4.7 July (2014) / August (2014)

Stage 2 Analysis incorporating the first three data sets and re-analyzing the co-dependent relationship between all contributing variables.

3.3.4.8 September (2014)

Annual report due

Year 2 Project Time line (Sept 2014 - August 2015)

3.3.4.9 September (2014) - November (2014)

Data Set 4: Bathometry data will then need to be gathered and mapped to the main data sets. Projected Time: 3 months

Data Set 4a: Note: It will take time to map the information gathered using image analysis to the main data set. Projected time: 2 months

3.3.4.10 December (2014) / January (2015)

Stage 3 Analysis. Projected time: 2 months.

3.3.4.11 February (2015)

Mid-year review report due

3.3.4.12 March (2015) - August (2015)

Analysis and interpreting the information: this includes but is not limited to: Descriptive Statistics, Parametric and Non-parametric Analysis, Regression, Non-response Analysis, Rotational Analysis.

3.3.4.13 March (2015) / April (2015)

Detailed Analysis 1: This will be an extension of Stage 1 Analysis which will (1) Determine the relationship between the frequency of occurrence and the contributing variables (2)

Determine the best fit probability distribution of the residuals and (3) Developing models to predict the number of hurricanes expected on a given day of the year given the surrounding environment and make predictions for the coming year. Projected Time: 2 months.

3.3.4.14 May (2015 / (June (2015)

Detailed Analysis 2: This will be extensions of Stage 2 and Stage 3 Analysis which will (1) develop non-functional models (conditional models) that allow for any contributing variable to be estimated in terms of the other now explanatory variables, (2) run simulations to determine the accuracy and the reliability of the developed models and (3) . Projected Time: 2 months.

3.3.4.15 July (2015) / August (2015)

Detailed Analysis 3: This will be the culmination of everything we have learned including address the question of tracking (solving for latitude and longitude in the previously developed equations), address the question of tropical cyclogenesis (using the relationship between temperature and pressure to predict the birth of a storm) and finally any additional questions that come up in the overall analysis of hurricanes. Projected Time: 2 months.

3.3.4.16 September (2015)

Final report due

3.3.5 Real time Operational Data Input

See section 3.3.4

3.3.6 Plan for Port to Operational Center

3.3.6.1 Collaborate with JHT personnel in adapting code for operational data systems with research data.

3.4. Timeline

3.4.1 Scientific and Technical Documentation

3.4.1.1 Data Sets

3.4.1.2 Data Analysis

3.4.1.3 Detailed Analysis and Interpretations

3.4.1.4 Provide research for transition to JHT personnel

3.4.1.5 Assist in testing and evaluating design implementation in conjunction with JHT personnel.

3.4.2 Training Materials

3.4.2.1 Provide research to JHT personnel

3.4.2.2 Provide case studies to JHT personnel

3.4.2.3 Create training material for operational forecast and support staff if implementation has been decided.

3.4.2.4 Travel to operational center for hands on training.

3.5. Travel Schedule

3.5.1 Annual Interdepartmental Hurricane Conference - 1 per year for 2014 and 2015.

3.5.2 Operational Center - 1 per quarter to Miami Operational Center.

3.6. JHT Staff Requirements

3.6.1 Help researcher with timing, resources and data evaluation

3.6.2 Code for operational data stream, hardware, and software

3.6.3 Collaborate with researcher in testing and evaluating data

3.6.4 Provides code with connectivity to NHC data streams and systems with pre-implementation operational testing.

3.6.5 Assist in training

4. Budget

4.1 Budget Summary

Budget Summary - 2 years

Salaries	*Amt. Requested*
Rebecca D. Wooten, Principle Investigator, University of South Florida	$23,710
Chris P. Tsokos, Co-PI, University of South Florida	$22,442
Direct Charges	*Amt. Requested*
Materials and Supplies	$1,000
Travel	*Amt. Requested*
IHC Conference	$9,820
NHC Operations Center	$2,400
Other Expenses	*Amt. Requested*
Database Server	$3,500
Indirect Costs	*Amt. Requested*
Facilities and Administrative Costs - on campus	$31,122

TOTAL AMOUNT REQUESTED	**$93,994**

4.2 Budget Justification

4.2.1 Salaries

4.2.1.1 Investigators

Rebecca D. Wooten is the principle investigator (PI) on this grant. She is requesting budget for time. She will be devoting 15% of her time and 15% of her salary is requested. She will be coordinating the various aspects of the grant proposal "Statistical Analysis and Modeling of Hurricanes FY 2013 Hurricane Test bed (NOAA-OAR-OWAQ-2013-2003469)" including grant writing, sub-model development, model testing, interpretation of the findings, writing and publishing journal articles. She will oversee and mentor multiple students working on this project with her. She will also oversee the computer analysts. Dr. Wooten has previous experience in statistics emphasizing environmental studies and has done research on lightning, flooding and rainfall, in addition to Global Warming, Volcanoes, and Red Tide. She will be responsible for the analysis of the results and publications of the resulting manuscripts.

Chris P. Tsokos is the Co- PI on this grant to which he will be devoting 8% of his time and 8% of his salary is requested. He will be an essential resource in all the various aspects of the project including sub-model development, model testing and interpretation of the findings. He will oversee the write ups, presentations and act as preliminary editor for all publications. Dr. Tsokos has extensive experience in statistics emphasizing environmental studies. He will be responsible for additional guidance and recommending edits for each publication. The remainder of his time will be spent in the other aspects of his duties as the program director.

4.2.2 Direct Charges

4.2.2.1 Materials and Supplies

The cost of necessary materials and supplies, charged at their actual price, that are to be used only for research in regards to FY 2013 Joint Hurricane Testbed (NOAA-OAR-OWAQ-2013-2003469).

4.2.2.2 Travel

Travel costs are the expenses for air travel, transportation, lodging, subsistence, and related items for 2 employees who are travelling in regards to FY 2013 Joint Hurricane Testbed (NOAA-OAR-OWAQ-2013-2003469).

IHC Conference - Travel costs associated for 2 employees to attend the annual ICH Conference

NHC Operations Center - Travel costs associated for 2 employees to travel to the NHC Operation Center 4 times per year.

4.2.2.3 Other Expenses

Database Server is a capital expenditure for special purpose which will be used for; data access, data entry, data storage, the generation of computational models and statistical analysis. It will be used only for research in regards to FY 2013 Joint Hurricane Testbed (NOAA-OAR-OWAQ-2013-2003469).

4.2.3 Indirect Costs

4.2.3.1 Facilities and Administrative Costs - on campus

5. Curriculum Vita

5.1 Principal Investigator

Dr. Rebecca D. Wooten, University of South Florida

5.2 Co-Principal Investigator

Dr. Chris P. Tsokos, University of South Florida

Curriculum Vita

Rebecca D Wooten, Principal Investigator

Fall 2012

Department of Mathematics and Statistics
University of South Florida
Office: CMC 319
Phone: (813) 974-9559
E-mail: rwooten@usf.edu

RESEARCH INTEREST

Statistical Analysis (**Parametric** and **Non-parametric**), Statistical Modeling (**Univariate**, **Bivariate** and **Multivariate**), Time Series Analysis (**Stationary** and **Non-stationary**), Computerized Algorithms for Statistical Analysis, and Research emphasizing **Environmental Studies, Geo-Physics, Geo-Engineering**, **Health**, **Life Science**, and **Education**, studying such topics as **Hurricanes**, **Lightning**, **Rainfall**, **Floods**, **Red Tide**, and **Volcanoes**.

EDUCATION

University of South Florida, Tampa, FL
Post Doctoral
Graduated May 1996 with both a B.A. and a M.A in Mathematics
Graduated December 2006 with a Ph.D. in Statistics: Environmental Studies
Dissertation Title: "Statistical Environmental Models: Hurricanes, Lightning, Rainfall, Flooding, Red Tide and Volcanoes."
Specialization: Applied Statistics in Environmental Studies
Additional studies: Combinatorics, Graph Theory, Logic, Algebra, and Topology

Florida State University, Tallahassee, FL
Doctorial Student 1997-1998
Worked toward taking my preliminaries in Mathematics before returning to the University of South Florida

EMPLOYMENT

08/94 to 05/96 and 08/97 to Present
University of South Florida, Tampa, FL
Assistant Professor (as of August 2009)
Acting Course Coordinator for Introduction to Statistics I and teaching Applied Statistical Methods. Have also worked as an adjunct instructor, teaching Introduction to Statistics I; have also taught a number of courses including: College Trigonometry, College Algebra, Pre-calculus, Calculus (All levels), Finite Math, Number Theory, Technology Seminar, Basic Statistics and Introduction to Statistics (I and II).

07/98 to 07/09 and
The Pedagogue, Tampa, FL
Private Tutor/Webmaster
Work tutoring high school and college Mathematics and Statistics as well as acting as Webmaster of **Acceber** (http://www.acceber.net) and coordinator of the **Pedagogue** (http://www.acceber.net/Pedagogue).

01/02 to 12/02
Hillsborough Community College, Tampa, FL
Adjunct Instructor
Worked teaching Intermediate Algebra

08/00 to 01/01
Palmer Tennis Academy Tampa, FL
Mathematics Instructor
Worked teaching pre-calculus

06/96 to 06/97
Florida State University, Tallahassee, FL
Graduate Teaching Assistant

Worked as a teaching assistant

08/91 to 05/96
Project Thrust - U.S.F, Tampa, FL
Tutor
Worked tutoring all levels of mathematics including some computer languages such as FORTRAN and some engineering courses such as Linear Systems, also assisted in general office duties, data entry and statistical work.

SKILLS

Languages:	Formal training in **Basic** and **FORTRAN**; working knowledge of **Visual Basic**, **C/C++**, **HTML**, **EXCEL** and basic **Java**.
Programs:	Have working knowledge of **Norton**, **Works**, **WordPerfect**, **Microsoft Works**, **Word**, **Excel, Publisher**, **Power Point**, **Page Maker**, **Super Paint**, and **SAS Analyst**; working knowledge of linear and non-linear analysis as well as ANOVA both simple and factorial, both in Excel and SAS.
Operating Systems:	Have experience with **DOS**, **Windows** and **UNIX**.

PUBLICATIONS

1. *Statistical Analysis and Modeling of Lightning* with Dr. C. P. Tsokos

   Abstract: Florida is the lightning capital of the United States. Lightning strikes occur when electrostatic energy within storm conditions is unbalanced and ephemeral discharges of static electricity are set off to help the system find equilibrium. Lightning, meaning the number of lightning strikes per month is characterized by relative humidity, sea level pressure, sea surface temperature, rain, perceptible water and the outgoing long-wave radiation. In the present study we use real data to identify the probability distribution that characterizes the behavior of the number of lightning strikes, develop a statistical model that identifies that key attributable variables to the subject strikes along with attributing interactions and proceed to estimate the number of lightning strikes with an acceptable degree of confidence. The result of the present study can be effectively used for strategic protection planning, among others.

   Neural, Parallel & Scientific Computations, Volume 16, Number 1, March 2008, pages 125-147

2. *A Markovian Analysis of Hurricane Transitions* with Dr. C. P. Tsokos

   Abstract: Markov chains to predict hurricane transformation between indices as defined by the newly proposed scale.

   Neural, Parallel & Scientific Computations, Volume 16, Number 1, March 2008, pages 1-16

3. *A Proposed New Scale to Identify the Category of a Hurricane's Status*

   Abstract: The present study is concerned with the relationship between wind speeds in a hurricane and the pressure or depression. We propose a new index for categorizing hurricane force winds. Our method is developed utilizing statistical procedures and modeling with molecular physics. Our results are compared with the commonly used Saffir-Simpson scale.

   Proceedings of the *Fifth World Congress of IFNA*, (R) Orlando, FL 2008,

   Citation: R.D. Wooten, C.P. Tsokos, A proposed new scale to identify the category of a Hurricane's status, Nonlinear Analysis (2009), doi:10.1016/j.na.2009.06.088

   Nonlinear Analysis: Theory, Methods & Applications, Vol. 71, 15 December 2009, Pgs. e2824-e2832

4. *Parametric Analysis of Carbon Dioxide in the Atmosphere*

   Abstract: Two important entities that constitute **Global Warming** are **atmospheric temperature** and **carbon dioxide** (CO_2). The present study is to use actual CO_2 data from the various locations including Hawaii and Alaska and identify the actual probability distribution functions (pdf) that probabilistically characterize its behavior. Having such a pdf of CO_2 we can proceed to perform parametric statistical analysis and obtain needed useful information. Presently, scientists working on the subject matter of CO_2 characterize the pdf as the classical and popular Gaussian pdf. We have found that the three parameter Weibull pdf gives a much better fit to CO_2 and the Gaussian is statistically rejected. In addition, we perform trend analysis and identify that the behavior of CO_2 as a function of time is quadratic. We proceed to filter the data accordingly to be independent of time and the subject data follows a general logistic pdf. Utilizing this finding we proceed to obtain ten and twenty year projections of CO_2 in the atmosphere along with appropriate degrees of confidence.

   Journal of Applied Sciences Vol. 10 (March 15, 2010), no. 6, 440-450

5. *Linear and Non-Linear Statistical Modeling of Hurricane Force Winds*

   Abstract: In the present study, the primary aim concentrates on the modeling of hurricane force winds; that is, maximum sustained winds related to pressure, location and linear velocity. We were successful in modeling the wind speed within storm as a function of the contributing entities. In this study, we were able to re-evaluate the association between wind speed and pressure within storms and know this will lead to historical breakthroughs in how we see hurricanes and predict hurricanes. This paper is the first paper of a series, and its analysis of wind speed versus pressure indicates that further analysis of the Saffir-Simpson Scale is necessary, as well as determining if pressure is an indicator or a consequence of a hurricane force wind speed.

   International IFNA-ANS Scientific Journal "Problems of nonlinear analysis in engineering systems", ISSN 1727-687X 2(36), v.17, 2011, 32-38 (in English), 39-45 (in Russian), 2011

6. *Failure mode classification for tumor Endoprostheses: retrospective review of five institutions and a literature review*. **Henderson ER,** Groundland J, Pala E, Dennis J, Wooten R, Cheong D, Mercuri M, Kotz R, Windhager R, Funovics P, Hornicek FJ, Temple HT, Ruggieri P, Letson GD.

   Abstract: http://www.ncbi.nlm.nih.gov/pubmed/21368074

   The Journal of Bone and Joint Surgery, 2011, Mar 2; Volume 93 Issue 5, Pages: 418-29.

7. *Statistical Analysis and Modeling of Red Tide Blooms*

Abstract: The present study considers the random phenomenon that is Red Tide as found around the State of Florida. Among the many organism that make up Red Tide, ***Karenia Brevis*** is the organism commonly associated with an outbreak, the probability distribution which best describes the behavior of ***Karenia Brevis*** is the Weibull probability distribution. There are regional differences as well as regional relationships including delay effects. Recursion rates indicate a logistic growth model; however, additional information is needed before research can determine the effects of runoff on Red Tide blooms.

Journal of Nonlinear Studies, Vol. 18, No. 4, pp. 649-666, 2011

8. *Statistical Analysis of the Relationship between Wind Speed, Pressure and Temperature.*

Abstract: There are two common entities that meteorologists consider contributing factors within a storm; namely, pressure and wind speed. The present study uses actual readings from a buoy in the Gulf near Florida and a reading estimated using Doppler within a hurricane and identifies the relationship between wind speed and pressure using both regression analysis and non-response analysis to detect interaction and higher order terms. Then proceed to perform non-response analysis to obtain useful information about the relationship between pressure, wind speed and temperature. I found that non-response analysis can be used as an alternative to regression analysis and can be further extended to detect relationship among co-dependent variables. Utilizing this findings, I obtained solutions to the developed model that estimated one variable as a function of the remaining two with two solutions depending on the season; that is, pressure as it relates to wind speed and temperature, temperature as it relates to wind speed and pressure and wind speed as it relates to both pressure and temperature.

Journal of Applied Sciences (June 2011), ISSN 1812-5654 / DOI: 103923/jas.2011. (c) 2011 Asian Network for Scientific Information

9. *Mathematical and Statistical Analysis of Tephra Fallout*

Abstract: In this study, the bivariate probability distributions of volcanic explosivity index as well as the tephra fallout as measured at Cerro Negro are considered and the skewness of the distribution is considered empirically and the non-skewed bivariate Gaussian probability distribution is compared to the skewed Gaussian distribution.

To appear in *International IFNA-ANS Scientific Journal* "Problems of nonlinear analysis in engineering systems", 2012

JOURNALS & PUBLISHING HOUSE

On the editorial board for **Nonlinear Studies** and the **International Journal of Environmental Sciences**.

A book review for **Atlantis Press/Springer Publishing Co.**

GRADUATE STUDENTS & HONORS THESIS

Doctorial Candidates

Yong Xu	Fall 2010	Committee Member	Radford University
Chunling Cong	Fall 2010	Committee Member	Senior Consultant at Travelers, Harford, CT
Dimitrios Vovoras	Fall 2011	Committee Member	
Carlos Molinares	Fall 2011	Committee Member	
Keith Hackett	Fall 2011	Committee Member	
Prony Bonnaire Fils	Spring 2011	Committee Member	
Bong-jin Choi	Work in Progress	Committee Member	
Zahra Kottabi	Work in Progress	Committee Member	
Ram Kafle	Work in Progress	Committee Member	
Sherlene Enriquez-Savery	Work in Progress	Committee Member	

Honors Thesis

Undergraduate Honor Thesis Advisor Committee for **Michael Kotarinos**, Director: Dr. C. P. Tsokos
Undergraduate Honor Thesis Advisor Committee for **Aimee Binder**, Director: Dr. Kelly Leach
Undergraduate Honor Thesis Advisor Committee for **Michael Uanino**, Director:
Undergraduate Honor Thesis Advisor Committee for **Jillian Donohue**, Director:

PRESENTATIONS

1. Title: *Parametric Analysis of Tornado Activity in the United States*
   Session: Sixth World Congress of Nonlinear Analyst
   Dates: June 25-July 1, 2012
   Location: Athens, Greece
   Audience: IFNA

2. Title: *Statistical Analysis of the Relationship between Wind Speed, Pressure and Temperature*
   Session: Sixth International Conference on Dynamic Systems and Applications
   Dates: May 25-28, 2011
   Location: Morehouse College, Atlanta GA
   Audience: MAA

3. Title: *Probability Distribution of Carbon Dioxide independent of Time*
   Session: MAA Suncoast Regional Meeting XXXV
   Dates: December 10, 2010
   Location: Tampa University, FL
   Audience: MAA

4. Title: *Statistical Modeling in Meteorology*
   Session: Mathematical and Statistical Modeling of Environmental Problems
   Dates: April 11 -14, 2010
   Location: Atlanta, GA
   Audience: ICNPSC4

5. Title: *Statistical Analysis and Modeling of Carbon Dioxide in the Atmosphere*
   Date: Saturday, February 27, 2010 Time: 3:30PM
   Location: PHY 130
   Audience: GCCPS 2010

6. Title: *Markov Chains and Differential Equations in Hurricane Analysis*
   Date: Friday, April 10, 2009 Time: 12:10PM
   Location: ENB 109

7. Title: *Red Tide and its Biological Effects*
   Date: Friday, February 20, 2009 Time: 3:00PM
   Location: ENB 109

8. Title**:** *Linear and Non-linear analysis of Hurricanes Force Winds*
   Date: Friday, July 4, 2008 Time: 2:00PM
   Location: World Congress of Nonlinear Analyst
   Audience: International Federation of Nonlinear Analyst

9. Title 1: *Statistical Environmental Modeling: Lightning*
Title 2: *Statistical Environmental Modeling: Hurricanes*
Date: June 2008 Time:
Location: University of South Florida
Audience: Students and Faculty, PROGRESS ENERGY

10. Title: *Carbon Dioxide in the Atmosphere: CO2*
Date: Spring 2008 Time:
Location: University of South Florida
Audience: Students and Faculty, T.J. Blasing for Oak Ridge Lab

11. Title: *Looking at Red Tide from and Statistical Perspective*
Date: December 2007 Time:
Location: Florida Institute for Game and Wildlife
Audience: Students and Faculty

12. Title: *Statistical Analysis and Modeling of Lightning*
Date: Thursday, April 11, 2007 Time: 3:00-4:00 pm
Location: Florida Southern College
Audience: Students and Faculty

13. Title: *Statistical Analysis and Modeling of Hurricanes: Birth of a storm and analysis of the Saffir-Simpson Scale*
Date: Friday, October 6, 2006 Time: 3:00-4:00 pm
Location: University of South Florida
Audience: Students and Faculty

14. Title: *Statistical Analysis of Lightning Data*
Date: Friday, March 31, 2006 Time: 3:00-4:00
Location: University of South Florida
Audience: Students and Faculty

15. Title: *On Hastings-Metropolis Algorithm*
Date: Friday, September 16, 2005 Time: 3:00-4:00
Location: University of South Florida
Audience: Students and Faculty

16. Title: *An Analysis of the Effects of Grading with the Plus/Minus system versus the Standard Four Point System*
Date: Friday, October 29, 2004 Time: 3:00-4:00
Location: University of South Florida
Audience: Students and Faculty

COLLOQUIUMS, WORKSHOPS AND CONFERENCES

1. **MAA Suncoast Regional Meeting XXXV**

Dates: December 10, 2010
Location: Tampa, FL

Session Hosts: University of Tampa and the Mathematical Association of America

2. **Early Childhood Literacy Information Session**

Dates: November 30, 2010
Location: Tampa, FL

Session Hosts: Hillsborough Education Foundation

3. **Fourth International Conference on Neural, Parallel and Scientific Computations**

Dates: April 11 -14, 2010
Location: Atlanta, GA

Session Hosts: Dr. G.S. Ladde
Dr. C.P. Tsokos
Dr. R.D. Wooten Mathematical and Statistical Modeling of Environmental Problems
Dr. G.R. Aryal Theory and Application of Probability Distributions

4. **Gulf Coast Conference on Probability and Statistics**

Date: Saturday, February 27, 2010 Time:
Location: PHY 130 8:30AM to 6:15PM

Organizing Committee: Dr. G.S. Ladde
Dr. C.P. Tsokos
Dr. K.M. Ramachandran
Dr. W. Kim
Dr. R.D. Wooten

For more information, go to http://shell.cas.usf.edu/gccps2010.

5. **Interdisciplinary Workshop:** ***Cancer Research***

Date: Thursday/Friday, January 14-14, 2010 Time:
Location: ENB 209 9:30AM to 12:40PM and
1:40PM to 4:40PM

Distinguished Guests: Dr. Robert Smith
Dr. James Kepner

USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. Frank Vironis
Dr. R.D. Wooten

6. **Interdisciplinary Workshop**: ***Cancer and Hybrid Dynamic Systems***

Date: Friday, October 30, 2009 Time: 9:30AM to 12:40PM and
Location: CIS 1016 1:40PM to 4:40PM

Distinguished Guests: Dr. Sara Sambandham
Dr. Bonita A. Lawrence
Dr. M. Sambandham

USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. R.D. Wooten

7. **Interdisciplinary Workshop:** ***The Frontiers of Theories and applications of stochastic dynamic hybride systems***

Date: Friday, April 10, 2009 Time: 9:30AM to 12:40PM and
Location: ENB 109 1:40PM to 4:40PM

Distinguished Guest: Dr. V. Lakshmikantham
Founder of IFNA and the GVP-V. Lakshmikantham Institute of Advanced Studies, India

USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. R. Ramachandran
Dr. W. Kim
Dr. R.D. Wooten

8. **Interdisciplinary Workshop:** ***Statistics/USF and American Cancer Society***

Date: Friday, February 20, 2009 Time: 10:0AM to 12:00Noon
Location ENB 109

Distinguished Guest: Dr. James Kepner
Vice President, American Cancer Society

USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. R.D. Wooten

9. **Interdisciplinary Workshop:** ***Growth Mixture Modeling as an Exploratory Tool in Longitudinal QTI L Analysis***

Date: Friday, December 4, 2008 Time: 10:00AM to 5:00PM
Location PHY 118

Distinguished Guest: Dr. Stephen J. Finch
State University of New York, Stony Brook

USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. W. Kim
Dr. R.D. Wooten

10. **Interdisciplinary Workshop:** ***Stochastic Dynamic Systems with Application***

Date: Friday, November 14, 2008 Time: 11:00AM to 4:30PM
Location: SCA 202

Guest Speaker: Dr. A. Korzenlowski
Department of Mathematics, University of Texas, Arlington, TX

USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. R.D. Wooten

11. **Interdisciplinary Workshop:** ***Statistics/USF and TECO Scientific Workshop***

Date: Thursday, April 3, 2008 Time: 1:30PM to 4:00PM
Location: ENB 109

TECO Representative: Scott Smith, Manager for System Reliability
USF Representatives: Dr. Chris P. Tsokos
Distinguished University Professor
Dr. G. Ladde
Professor Mathematics and Statistics

12. **Interdisciplinary Workshop:** ***Optimal Delayed Control of Stochastic Systems with Memory***

Date: Friday, February 15, 2008 Time: 1:00PM to 2:00PM
Location: University of South Florida

Guest Speaker: Dr. Mou-Hsiung Chang
Manager of the Probability and Statistics Program in Mathematical Sciences Division, US Army Research Office

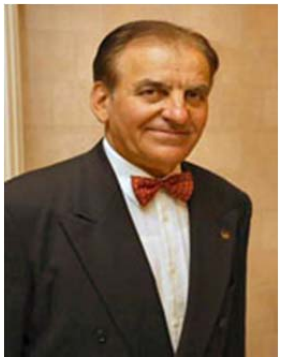
USF Representatives: Dr. Chris P. Tsokos
Dr. G. Ladde
Dr. R.D. Wooten

ORGANIZATIONS

1993	*Pi Mu Epsilon*
1992	*Mathematics Association of America*
2004	*American Statistical Association*
2005	*Urban Scholars Outreach Program* (**USOP**) Academic Coordinator, January 2007 to Present http://math.usf.edu/outreach/scholars/ Winner of the *Education Excellence Award* from the University Area Community Development Corporations, Inc. in 2012 http://www.uacdc.org/index.php/events/awards-banquet-gallery-pro
2005	*Geological Society of America*
2006	*National Honor Society*
2007	*Dr. A.N.V. Rao Gurukulam Program* (**RGP**) Co-Founder and Academic Coordinator, August 2007 to Present www.acceber.net/RGP
2008	*International Federation of Nonlinear Analyst* (IFNA) Board of Directors, July 2008 to Present, Secretary of IFNA thru summer 2010 Promoted to the position of Vice President and Treasure, fall 2010
2009	*Statistics Club at USF*, Co-advisor

GRANTS

Bright House	Spring 2009, $250 for supplies for **RGP**
Children's Board	Spring 2008, $5000 for supplies and brochures as well as a copier/printer/scanner for the **USOP** office



Chris P. Tsokos (Co-Principal Investigator) is a Distinguished University Professor of Mathematics and Statistics and Director of the Graduate Program in Statistics at the University of South Florida. Dr. Tsokos received his B.S. in Engineering Sciences/Mathematics and his M.A. in Mathematics from the University of Rhode Island and was recognized with the Distinguished Alumni Excellence Award in Science and Technology. He received his Ph.D. in Statistics and Probability from the University of Connecticut and was recognized with the Distinguished Alumni Award along with the recognition of the State of Connecticut General Assembly Award for outstanding public and philanthropic service to our country. Professor Tsokos has also served on the faculties at Virginia Polytechnic Institute and State University and the University of Rhode Island.

Dr. Tsokos' research has extended into a variety of areas in the mathematical sciences, including stochastic systems, statistical models, reliability analysis, ecological systems, operations research, time series, Bayesian analysis, mathematical and statistical modeling of global warming, and both parametric and nonparametric survival analysis, among others. He is the author of more than 350 research publications in these areas.

Professor Tsokos is the author of more than 20 research monographs and books in mathematical and engineering sciences. He has been invited to lecture in several countries around the globe – Russia, People's Republic of China, India, Turkey and most EU countries, among others. Dr. Tsokos has directed the doctoral research of more than 45 doctoral students that are presently working at our universities and private and government research institutes.

For the past five years, Professor Tsokos' research efforts have been focused on developing probabilistic analysis, parametric and nonparametric statistical models for breast, lung, brain, colon and prostate cancer. His research aims are data-driven and are oriented toward understanding these types of cancers and, most importantly, in statistically identifying the attributable variables and interactions that cause such cancers.

Professor Tsokos has served as an advisor, consultant and lecturer for the U.S. Army, U.S. Environmental Protection Agency, the U.S. Air Force Office of Scientific Research, the U.S. Navy, NASA, Bureau of Land Management and the American Cancer Society. He also has performed similar services for several public Fortune 500 companies.

Dr. Tsokos is the co-founder of the award-winning Urban Scholars Outreach Program (USOP) at USF, whose objective is to offer free educational assistance to disadvantaged African-American and Hispanic students. USOP started in 1998 and has helped hundreds of students to enter the university.

Professor Tsokos is the president of the International Federation of Nonlinear Analysts (IFNA), a not-for-profit global educational research organization with more than 125 participating countries. IFNA is, globally, an interdisciplinary professional organization promoting the understanding of related complex nonlinear problems and approaches to solutions from all

disciplines. Our motto is: “Understanding Through Global Diversity, Cooperation and Collaboration”.

Professor Tsokos is a member of several academic and professional societies. He is serving as Honorary Editor, Chief-Editor, Editor or Associate Editor of more than 12 international academic research journals. Dr. Tsokos is the recipient of many distinguished awards and honors, including Fellow of the American Statistical Association, the International Statistical Institute, USF Distinguished Scholar Award, Sigma Xi Outstanding Research Award, USF Outstanding Undergraduate Teaching Award, USF Professional Excellence Award, Pi Mu Epsilon, Sigma Pi Sigma, USF Teaching Incentive Program award, Education Excellence Award of the University Area Community Development Corporation and the Time Warner Spirit of Humanity Award, among others.

7. Current and Pending Support

None at this time.

OMB Number: 4040-0004
Expiration Date: 03/31/2012

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 12/07/2012

4. Applicant Identifier:

5a. Federal Entity Identifier: 593102112

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: University of South Florida

* b. Employer/Taxpayer Identification Number (EIN/TIN): 593102112-F5

* c. Organizational DUNS: 0696872420000

d. Address:

* Street1: 4202 E. Fowler Ave
Street2: cmc 319
* City: Tampa
County/Parish: Hillsborough
* State: FL: Florida
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 33612-9220

e. Organizational Unit:

Department Name: Mathematics and Statistics

Division Name: College of Arts and Sciences

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:
* First Name: Heather
Middle Name:
* Last Name: Morr
Suffix:

Title: Sponsored Research Administrator

Organizational Affiliation: University of South Florida

* Telephone Number: 813-974-3562
Fax Number: 813-974-4962

* Email: hmorr@usf.edu

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Department of Commerce

11. Catalog of Federal Domestic Assistance Number:

11.459

CFDA Title:

Weather and Air Quality Research

*** 12. Funding Opportunity Number:**

NOAA-OAR-OWAQ-2013-2003469

* Title:

FY 2013 Joint Hurricane Testbed

13. Competition Identification Number:

2297052

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Statistical Analysis and Modeling of Hurricanes FY 2013 Joint Hurricane Testbed (NOAA-OAR-OWAQ-2013-2003469)

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: FL-011 | b. Program/Project: FL-011

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 09/01/2013 | * b. End Date: 08/31/2015

18. Estimated Funding ($):

* a. Federal	93,994.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	93,994.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: | * First Name: Heather

Middle Name:

* Last Name: Morr

Suffix:

* Title: Sponsored Research Administrator

* Telephone Number: 813-974-3526 | Fax Number: 813-974-4962

* Email: hmorr@usf.edu

* Signature of Authorized Representative: Heather Morr | * Date Signed: 12/07/2012

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 06/30/2014

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. NOAA CSC	11.459	$	$	$ 93,994.00	$	$ 93,994.00
2.						
3.						
4.						
5. Totals		$	$	$ 93,994.00	$	$ 93,994.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1) NOAA CSC	(2) N/A	(3)	(4)	Total (5)
a. Personnel	$ 19,669.00	$ 20,259.00	$	$	$ 39,928.00
b. Fringe Benefits	3,066.00	3,159.00			6,225.00
c. Travel	6,110.00	6,110.00			12,220.00
d. Equipment					
e. Supplies	500.00	500.00			1,000.00
f. Contractual					
g. Construction					
h. Other	3,500.00				3,500.00
i. Total Direct Charges (sum of 6a-6h)	32,845.00	30,028.00			$ 62,873.00
j. Indirect Charges	16,258.00	14,863.00			$ 31,121.00
k. TOTALS (sum of 6i and 6j)	$ 49,103.00	$ 44,891.00	$	$	$ 93,994.00
7. Program Income	$	$	$	$	$

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SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. NOAA CSC	$ 0.00	$ 0.00	$ 0.00	$ 0.00
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 49,103.00	$ 12,276.00	$ 12,276.00	$ 12,276.00	$ 12,275.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 49,103.00	$ 12,276.00	$ 12,276.00	$ 12,276.00	$ 12,275.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. NOAA CSC	$ 44,891.00	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 44,891.00	$	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: $62,873

22. Indirect Charges: MTDC 49.5% applied to $62873 (indirect of $31,122)

23. Remarks:

OMB Number: 4040-0007
Expiration Date: 06/30/2014

ASSURANCES - NON-CONSTRUCTION PROGRAMS

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C.§§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U. S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee- 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

19. Will comply with the requirements of Section 106(g) of the Trafficking Victims Protection Act (TVPA) of 2000, as amended (22 U.S.C. 7104) which prohibits grant award recipients or a sub-recipient from (1) Engaging in severe forms of trafficking in persons during the period of time that the award is in effect (2) Procuring a commercial sex act during the period of time that the award is in effect or (3) Using forced labor in the performance of the award or subawards under the award.

* SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	* TITLE
Heather Morr	Sponsored Research Administrator
* APPLICANT ORGANIZATION	* DATE SUBMITTED
University of South Florida	12/07/2012

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FORM **CD-511**
(REV 1-05)

U.S. DEPARTMENT OF COMMERCE

CERTIFICATION REGARDING LOBBYING

Applicants should also review the instructions for certification included in the regulations before completing this form. Signature on this form provides for compliance with certification requirements under 15 CFR Part 28, 'New Restrictions on Lobbying.' The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of Commerce determines to award the covered transaction, grant, or cooperative agreement.

LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 15 CFR Part 28, for persons entering into a grant, cooperative agreement or contract over $100,000 or a loan or loan guarantee over $150,000 as defined at 15 CFR Part 28, Sections 28.105 and 28.110, the applicant certifies that to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, 'Disclosure Form to Report Lobbying.' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure occurring on or before October 23, 1996, and of not less than $11,000 and not more than $110,000 for each such failure occurring after October 23, 1996.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

In any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, 'Disclosure Form to Report Lobbying,' in accordance with its instructions.

Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure occurring on or before October 23, 1996, and of not less than $11,000 and not more than $110,000 for each such failure occurring after October 23, 1996.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above applicable certification.

* NAME OF APPLICANT

University of South Florida

* AWARD NUMBER

NOAA-OAR-OWAQ-2013-200346

* PROJECT NAME

Statistical Analysis and Modeling of Hurricanes

Prefix:

* First Name: Heather

Middle Name:

* Last Name: Morr

Suffix:

* Title: Sponsored Research Administrator

* SIGNATURE: Heather Morr

* DATE: 12/07/2012