UNIVERSITY OF
Rhode Island

PROPOSAL

PROJECT TITLE: Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCEP and Navy/FNMOC

DATE: December 6, 2012

AGENCY: NOAA, OAR, Department of Commerce

Submitted by
The University of Rhode Island

Total Amount Requested: $247,000.00

YR1: $122,000
YR2: $125,000

Proposed Starting Date: August 1, 2013

Duration of Project: 24 mos

Principal Investigator:

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Department: Graduate School of Oceanography

Telephone: 401-874-6484 iginis@mail.uri.edu

Authorized University Representative:

Name: M. JULIA IACONO SPECIALIST II, GRANTS & CONTRACTS Signature:

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A PROPOSAL FOR TRANSITION OF RESEARCH TO OPERATIONS
SUBMITTED TO THE:

NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION (NOAA)
Joint Hurricane Testbed (JHT) Program

FROM:
Geophysical Fluid Dynamics Laboratory
P.O. Box 308, Forrestal Campus
Princeton, NJ, 08542

TITLE: Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCEP and Navy/FNMOC

PRINCIPAL INVESTIGATOR: Morris Bender (GFDL/NOAA)

AMOUNT REQUESTED:
Year 1: $ 40, 000
Year 2: $ 40, 000

Date of Submission: December 7th , 2012

Endorsements:

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Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCEP and Navy/FNMOC

A proposal submitted to the USWRP Joint Hurricane Testbed
Transitions planned for FY13-FY15

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December 7, 2012

Total cost: URI - $247,000; GFDL - $80,000 Duration: August 1, 2013 – July 31, 2015

Abstract

The forecast operations of both NOAA's National Hurricane Center and the U.S. Navy's Joint Typhoon Warning Center require more accurate GFDL and GFDN models for improved model guidance and as integral parts of ongoing multi-model ensemble forecast efforts. We are requesting support, under the auspices of the USWRP Joint Hurricane Testbed (JHT) Program, to (1) further improve the performance of both the operational GFDL model at NOAA's National Centers for Environmental Prediction (NCEP) and the operational GFDN model at the U.S. Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) and (2) provide assistance to NCEP and FNMOC in transitioning the model upgrades to operations. We propose to undertake the following major tasks under JHT funding:

1. *Upgrade the GFDL and GFDN atmospheric model resolution and physics*
2. *Upgrade the GFDL and GFDN ocean model resolution, physics, domain configuration, and initializaion using URI's newly-developed MPIPOM-TC ocean model*
3. *Upgrade the GFDL and GFDN air-sea exchange parameterization*

This work will be conducted at URI and GFDL in close collaboration with our NCEP/EMC and FNMOC colleagues, building directly upon the successes of our previous work to improve and operationally implement GFDL and GFDN model upgrades. We will also continue to collaborate with scientists at ESRL towards the implementation of the ESRL sea-spray parameterization. All data and results obtained will be shared fully with NOAA and the Navy.

Statement of Work

1. Proposed duration of the project: August 1, 2013 – July 31, 2015 (two years)

2. Brief description of the project, with prior results from currently funded projects

Our program is designed to take advantage of our extensive experience in building and improving the operational GFDL, GFDN, and HWRF coupled models. Current funding from JHT supports continued improvements to the operational GFDL and GFDN models, while current funding from HFIP supports continued improvements to the operational HWRF model as well as development and validation of experimental components of the coupled HWRF system that can also be transitioned to the operational GFDL and/or GFDN models. Note that some tasks originally designated as JHT tasks, such as HWRF-specific tasks, were completed under HFIP funding when additional JHT-specific tasks, such as unexpected bug fixes in the operational GFDL and GFDN, were required. Supplemental funding from the Navy supports 1) working directly with FNMOC staff on making changes to the operational GFDN code, and 2) evaluation of GFDN model runs completed at FNMOC, because unlike the GFDL model, the PIs do not have direct access to the Navy's operational GFDN code.

Here, we propose to undertake the following major tasks under new JHT funding that builds upon the tasks in progress under current funding in an effort to further improve the track and intensity forecasts in the operational GFDL and GFDN models. We fully expect that additional unanticipated tasks may again arise based on changing operational needs that may require pooling of resources from other funding sources to complete the highest-priority tasks as efficiently as possible.

Task 1. Upgrade the GFDL and GFDN atmospheric model resolution and physics
Task 2. Upgrade the GFDL and GFDN ocean model resolution, physics, domain configuration, and initializaion using URI's newly-developed MPIPOM-TC ocean model
Task 3. Upgrade the GFDL and GFDN air-sea exchange parameterization

A detailed description of each task will be included in section 3: "Proposed work plan."

Below is a list of key results from currently and recently funded projects related to this proposal at URI and GFDL. The primary funding source for each task is included in parentheses, and a detailed description of each task and the associated results are available in the periodic progress reports sent to the funding source indicated. Specific references to existing documentation related to the tasks proposed are included in section 3.

a) GFDL and GFDN atmospheric model component upgrades
    1. New GFS SAS deep convection scheme implemented for 2011 (JHT)
    2. GFDN Optimum Interpolation routine bug found and fixed for 2011 (JHT)
    3. SAS deep convection scheme bug fixed for 2012 (JHT)
    4. GFS shallow convection scheme implemented for 2012 (JHT)

5. Communication of detrained convective microphysics species from SAS convection scheme to Ferrier microphysics scheme implemented for 2012 (JHT)
6. PBL scheme bug from 2003 implementation fixed for 2012 (JHT)
7. PBL scheme improvement via reduction of critical Richardson number and vertical mixing implemented for 2012 (JHT)
8. GFS PBL scheme rejected for 2012 due to degraded track performance (JHT)
9. Storm size reduced and asymmetries removed for 2012 vortex initialization (JHT)
10. Retuned momentum mixing implemented for 2012 (JHT)
11. Improved momentum and enthalpy surface exchange coefficients implemented for 2012 (JHT)
12. Modified dissipative heating implemented for 2012 (JHT)

b) GFDL, GFDN, and HWRF ocean model component upgrades
   1. GFDL/N East Atlantic ocean model domain expanded westward for 2011 (JHT)
      i. Prevents loss of ocean coupling when storm originates east of 50^{o}W longitude and propagates quickly westward during 5-day model forecast
   2. GFDN 3D coupling in North Indian, South Indian, South Pacific Oceans implemented for 2011 (JHT, Navy)
      i. Provides more realistic SST cooling than 1D ocean during model forecast
      ii. Uses NCODA daily initialization rather than Levitus monthly climatology
   3. Loop Current/Eddy ocean initialization methodology at NHC modified for 2012 to use alternative data sources after decommissioning of operational altimetry-based maps at NHC in 2011 (JHT, HFIP)
   4. Additional feature-based ocean initialization improvements underway (JHT)
   5. HWRF 1D coupling in East Pacific implemented for 2012 (HFIP, NCEP/IMSG)
      i. Replaces uncoupled HWRF in East Pacific prior to 2012
   6. Evaluation of operational configuration of POM-TC in HWRF ongoing (HFIP)
   7. Optimal ocean model grid spacing for HWRF coupling determined: 1/12° (HFIP)
   8. New high-resolution transatlantic MPIPOM-TC ocean model coupling with flexible initialization options under development (HFIP)
   9. Evaluation of different ocean initialization options (e.g. feature-based, Global HYCOM, Global RTOFS, NCODA) using in situ data ongoing (HFIP)
   10. DTC's HWRF scientific and technical documentation revised annually (HFIP)
   11. HWRF repository contributions made regularly (HFIP)

c) GFDL, GFDN, and HWRF air-sea interface (i.e. wave/spray) experimental upgrades
   1. URI air-sea interface module with explicit wave coupling implemented in GFDL/N model (JHT); HWRF implementation in progress (HFIP, NCEP/IMSG)
   2. Two new sea-state dependent wind stress parameterizations implemented based on a) updated URI scheme and b) University of Miami scheme into GFDL (JHT) and HWRF (HFIP, NCEP/IMSG)
   3. New WAVEWATCH 4.04 evaluated, including both the ST2 and ST4 physics packages, and URI momentum flux implemented for hurricane conditions (NCEP/IMSG)
   4. New ESRL sea spray scheme implemented (JHT, HFIP, NOPP)

3. Proposed work plan

Task 1. Upgrade the GFDL and GFDN atmospheric model resolution and physics

Scientists at GFDL and URI are developing a high-resolution version of the GFDL and GFDN models with upgraded physics. In the new model configuration, the area of the innermost nest with highest resolution remains the same as the present version, but with an increased horizontal resolution from 1/12° to 1/18° grid spacing. This 1/18° grid spacing is the highest resolution physically justified for the GFDL model because it is hydrostatic. In order for this high-resolution model to be operationally feasible, open MP computer software is being incorporated to improve efficiency. Also, several modifications to the model physics have been made to maximize the benefit of the increased resolution. A preliminary version of the model has been run for selected cases from the 2010, 2011, and 2012 Atlantic hurricane seasons. Results indicate a significantly improved storm structure for most storms, a reduced negative intensity bias for intense storms, and a neutral intensity impact for weak storms, probably because of the physics modifications being made. Finally, the track forecast skill has improved, as illustrated in the Hurricane Nadine (2012) comparisons in Fig. 1.

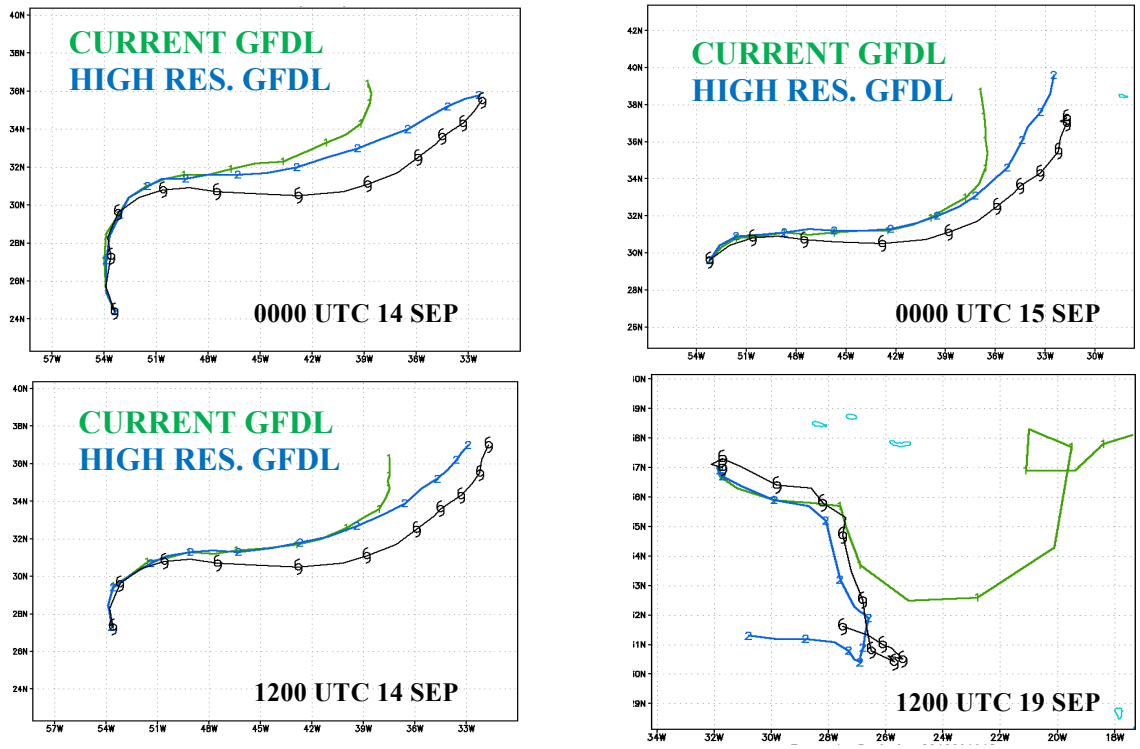

Figure 1. *GFDL simulated tracks for Hurricane Nadine (2012) at four initial times. Each panel includes current operational GFDL (green), high-resolution GFDL (blue), and observed (black).*

This model will serve as the benchmark model for evaluation of the following future improvements in physics. In the current implementation of the Ferrier microphysics in both the GFDL and HWRF hurricane models, the individual microphysics species (cloud water, rain water, and ice) are advected as a combined condensate, rather than advecting the individual

species. Preliminary tests suggest that when the individual species are advected, the forecasts of storm intensity in sheared situations are improved. This impact will continue to be evaluated for operational implementation. An improved version of the operational Simplified Arakawa-Schubert (SAS) convective scheme used in GFDL and HWRF, called "meso-SAS," has been developed by scientists at NCEP/EMC for use in high-resolution regional models (Pan 2012). This new convective parameterization will be extensively tested in the high resolution GFDL model with possible operational implementation if the results are positive. An effort is currently underway to upgrade the radiation code with some of the improved packages developed at GFDL over the past two decades, which will also require increasing the number of vertical levels. The benchmark and perhaps some of the additional physics improvements described above will be ready for testing in 2013 with possible operational implementation in 2014-15, while the rest of the physics improvements should be ready for testing in 2014 with possible implementation in 2015.

Task 2. Upgrade the GFDL and GFDN ocean model resolution, physics, domain configuration, and initializaion using URI's newly-developed MPIPOM-TC ocean model

URI's version of the Princeton Ocean Model (POM-TC) has been the ocean component of the operational GFDL coupled model since 2001. Some significant improvements to POM-TC have been made since then, including implementation of a feature-based ocean initialization for ocean coupling in the western Atlantic in both GFDL and GFDN (Falkovich et al. 2005; Yablonsky and Ginis 2008) and an NCODA-based initialization worldwide outside of the Atlantic in GFDN. However, no upgrades have been made to the ocean model resolution, and none of the community-based upgrades to POM have been incorporated into POM-TC since 1994. Indeed, since POM-TC runs on only one processor, future upgrades to the ocean model resolution are not computationally feasible. Hence, URI is now in the process of finalizing a major new effort to develop a new version of POM-TC, which shall hereafter be known as MPIPOM-TC.

MPIPOM-TC incorporates all of the community-based upgrades to POM that have occurred between 1994 and 2012 by blending the community-based sbPOM (Jordi and Wang 2012) with the existing version of POM-TC (Yablonsky and Ginis 2008). Since it has MPI capabilities, MPIPOM-TC allows for higher spatial resolution and a larger domain size than POM-TC. In fact, one of the key improvements now included is the replacement of the two overlapping POM-TC domains in the Atlantic Ocean, each of which have ~1/6° horizontal grid spacing, with a single, new, transatlantic domain, which has ~1/12° horizontal grid spacing. MPIPOM-TC is also very computationally efficient and scalable.

Currently, POM-TC utilizes different initialization procedures in different ocean basins in the GFDL and GFDN coupled systems. URI has developed a new methodology to initialize MPIPOM-TC from different global real-time ocean products available at NOAA and the Navy. We are currently testing the initialization based on NCEP's Global HYCOM RTOFS and the Navy's Global HYCOM (Fig. 2). However, any other real-time ocean products, such as Navy's NCODA (as in the operational GFDN outside the Atlantic) and NCOM can be utilized as well, and in the Atlantic Ocean, the operational feature-based initialization can still be used (in the new transatlantic domain with 1/12° grid spacing) if none of the available real-time ocean products produce superior performance in the GFDL and/or GFDN models.

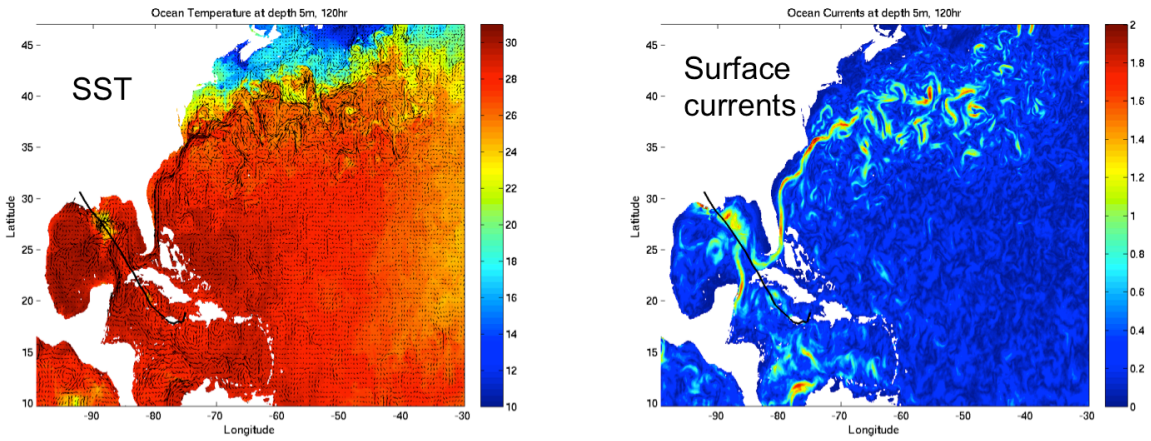

Figure 2. *Sea surface temperature (left) and surface currents (right) at the end of a 120-h integration of the new transatlantic MPIPOM-TC with Global HYCOM (not RTOFS) initial temperature, salinity, currents, and sea surface height and observed surface wind forcing from Hurricane Gustav, starting at 00 UTC on August 28, 2008.*

Here, we propose to incorporate the MPIPOM-TC with 1/12° grid spacing and flexible initialization options into the GFDN model worldwide, covering the Atlantic, East Pacific, West Pacific, North Indian, South Indian, and South Pacific Oceans (Fig. 3). While Fig. 3 shows the proposed configuration of the ocean domains, these domains can be modified based on input from our collaborators.

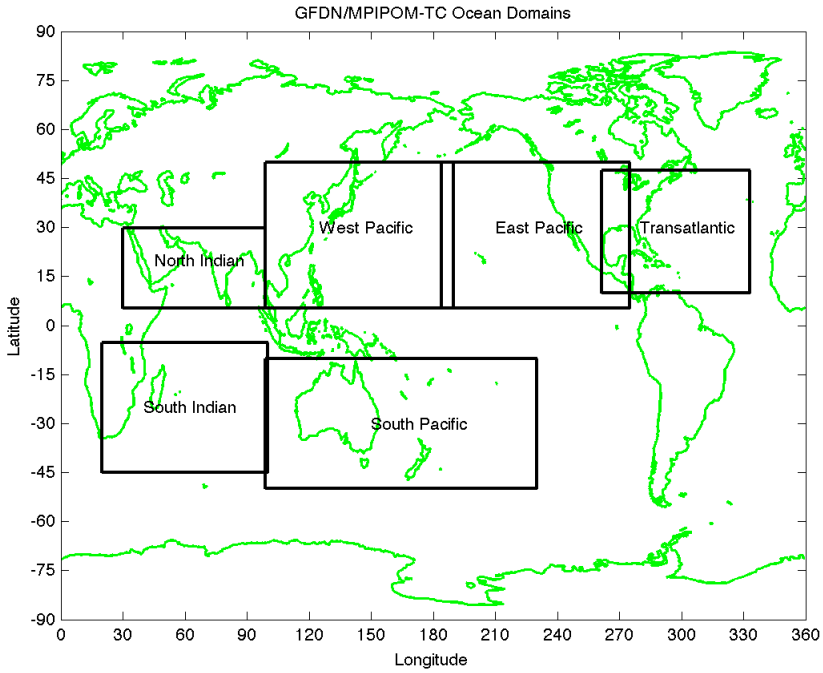

Figure 3. *Proposed GFDN/MPIPOM-TC worldwide ocean domains with 1/12° horizontal grid spacing and a flexible ocean initialization. The new transatlantic domain replaces the existing operational western Atlantic (i.e. United) and East Atlantic domains.*

The increased resolution is better able to capture the SST cooling under hurricane wind forcing (Kaufman et al. 2012). Testing and evaluation of the new MPIPOM-TC in the new 1/18° GFDL model in the Atlantic is already underway, and preliminary results are encouraging (Fig. 4). We propose to transition the finalized version of this new ocean system into the new high-resolution GFDL model for testing in 2013 for possible operational implementation in 2014-15.

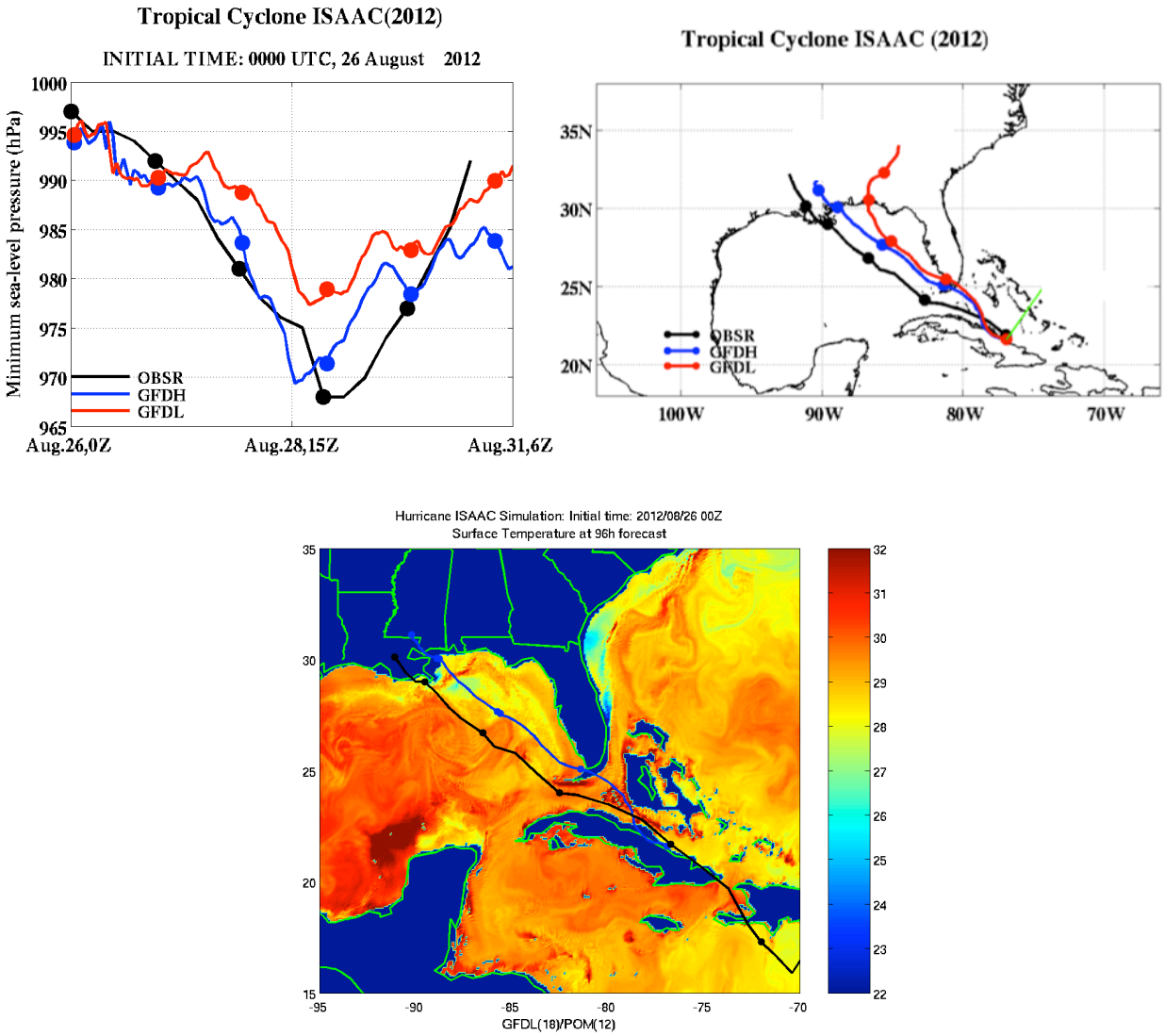

Figure 4. *GFDL intensity (upper left) and track (upper right) forecasts of Hurricane Isaac (2012), initialized at 00 UTC on August 26, 2012, using either the operational GFDL/POM system (GFDL, red) or the new high-res GFDL/MPIPOM-TC with Global HYCOM RTOFS ocean initialization (GFDH, blue), as compared to the observed intensity and track (OBSR, black). Sea surface temperature after 96-h of the GFDH simulation is shown in the lower panel.*

Task 3. Upgrade the GFDL and GFDN air-sea exchange parameterization

Under the currently funded JHT and HFIP projects, the URI group is in the process of completing the implementation of explicit wave coupling in the GFDL and HWRF systems, and

its near-real time testing will begin in 2013. This model development effort involves 1) improving physical parameterizations of the air-sea heat and momentum fluxes at and near the sea surface with fully coupled wind-wave-current interaction and sea spray effects and 2) forging a comprehensive, scientifically integrated atmosphere-wave-ocean framework that couples individual model components.

At the heart of the coupled framework developed under the NOPP funding is a computationally efficient, unified Air-Sea Interface Module (ASIM) that establishes a consistent, physically based representation of the air-sea interface. In the ASIM, the bottom boundary condition of the atmospheric model incorporates sea-state dependent air-sea fluxes of momentum, heat, and humidity, and it includes the effect of sea-spray. The wave model is forced by the sea-state dependent wind stress and includes the ocean surface current effect. The ocean model is forced by the sea-state dependent wind stress and includes the ocean surface wave effects (i.e. Coriolis-Stokes effect, wave growth/decay effect, and Langmuir turbulence effect).

A key requirement for the ASIM is that it supports both technical and scientific interoperability over a range of models, parameterizations, and data resources. As an example, we illustrate here two approaches to the sea-state dependent drag coefficient parameterizations implemented into ASIM. The first approach (URI) is an extension of the approach developed by Moon et al. (2004). It has been updated by improving the spectral tail parameterization (the unresolved high frequency part of the wave spectrum), based on recent observational and theoretical findings (Reichl et al. 2012). The second approach (Univ. of Miami) is developed by Donelan et al. (2012). The two approaches are different in the following two areas: (a) the growth rate is parameterized based on the wind stress in the URI approach but based on the wind speed in the UM approach and (b) inside the wave boundary layer, the mean wind profile is modified (i.e. it is not logarithmic and may rotate) in the URI approach but, it is logarithmic and does not rotate in the UM approach. Figure 5 compares different drag coefficient parameterizations implemented in ASIM with fetch dependent seas using the empirical wave spectrum of Elfouhaily et al. (1997).

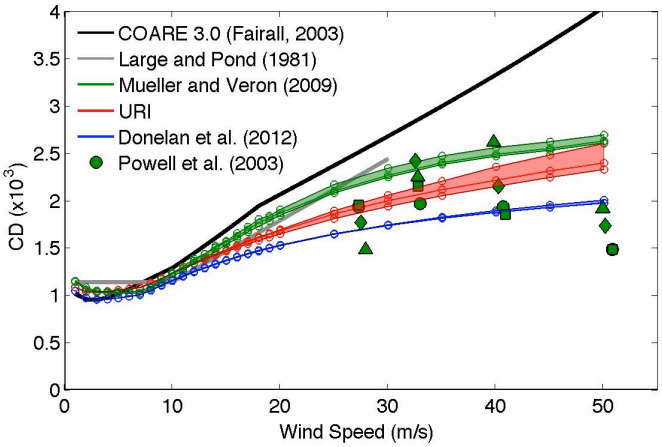

Figure 5. *Drag coefficient over fetch dependent (growing to fully developed) surface waves estimated using the URI (red) and UM (blue) approaches implemented into ASIM. The wave spectrum is based on Elfouhaily et al. (1997). With each method, the upper bound is for younger seas and the lower bound is for the fully developed seas. For reference, the modeling results of Mueller and Veron (2009) are also shown (green).*

Figure 6 illustrates the URI and UM approaches with surface wave spectra simulated by WAVEWATCH under tropical cyclone conditions. The drag coefficient values are quite similar and the sea state dependence is relatively weak in both approaches. The UM result shows a slight increase of the drag coefficient in the left rear quadrant, where the sea is less developed. A notable difference between the two approaches is the misalignment angle between the 10-meter wind speed and the wind stress. While the URI approach always predicts small misalignment less than 2 degrees, the misalignment angle may exceed 4 degrees by the UM approach, particularly inside the radius of maximum wind.

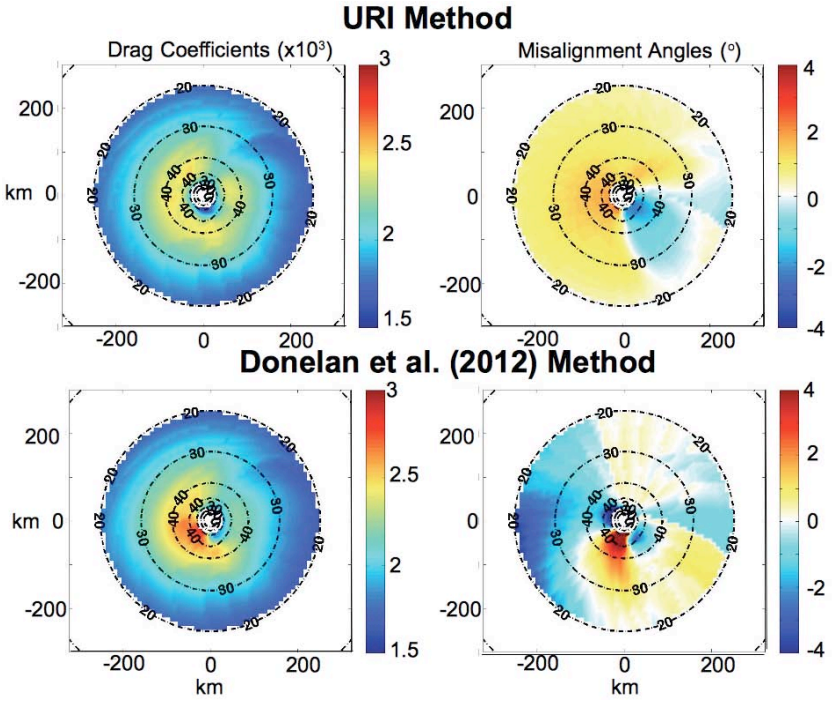

Figure 6. *The drag coefficient under a moving hurricane estimated by two different approaches. Maximum wind speed is 45 m/s, radius of maximum wind is 70 km, and translation speed (to the north) is 5 m/s. The right panels show misalignment angle between wind speed and wind stress.*

Timeline.

Year 1 (2013-2014)

1. Transition the 1/18° benchmark GFDL/N, perhaps with physics changes, to operations.
2. Transition open MP software in 1/18° GFDL/N, for improved efficiency, to operations.
3. Begin testing the radiation package with an increased number of vertical levels.
4. Continue to test the upgraded Ferrier microphysics in preparation for operations.
5. Transition the meso-SAS convective scheme to operations, pending positive results.
6. Transition GFDL/MPIPOM-TC to operations in the Atlantic, pending positive results.
7. Set up the worldwide MPIPOM-TC domains in GFDN and conduct initial testing.
8. Select the optimal set of air-sea interface physics packages and transition the hurricane-wave-ocean coupled system to operations in the Atlantic, pending positive results.

Year 2 (2014-2015)

1. Transition new open MP software-based changes to operations.
2. Transition new radiation package to operations, pending positive test results.
3. Transition upgraded Ferrier microphysics to operations, pending positive test results.
4. Evaluation of different initialization products in worldwide GFDN/MPIPOM-TC.
5. Transition hurricane-wave-ocean coupled system to operations in the East Pacific, pending positive results.
6. Transition GFDL/MPIPOM-TC to operations in the East Pacific, pending positive results.
7. Configure and test GFDN hurricane-wave-ocean system worldwide.

References.

Donelan, M. A., M. Curcic, S. S. Chen, and A. K. Magnusson, 2012: Modeling waves and wind stress. *J. Geophys. Res.,* **117,** C00J23, doi:10.1029/2011JC007787

Elfouhaily, T., B. Chapron, K. Katsaros, and D. Vandemark, 1997: A unified directional spectrum for long and short wind-driven waves. *J. Geophys. Res,* **102,** 15 781, doi:10.1029/97JC00467.

Falkovich, A., I. Ginis, and S. Lord, 2005: Ocean data assimilation and initialization procedure for the Coupled GFDL/URI Hurricane Prediction System. *J. Atmos. Oceanic Technol.,* **22,** 1918–1932.

Jordi, A., and D.-P. Wang, 2012: sbPOM: A parallel implementation of Princeton Ocean Model. *Environmental Modelling & Software*, **39,** 58-61. doi:10.1016/j.envsoft.2012.05.013

Kaufman, M., I. Ginis, and R. M. Yablonsky, 2012: Impact of an ocean model's horizontal resolution on the ocean response to a hurricane. *30th Conf. on Hurricanes and Tropical Meteorology,* Ponte Vedra Beach, FL, 15-20 April 2012, Amer. Meteor. Soc., 5D.6.

Moon, I.-J., I. Ginis, and T. Hara, 2004: Effect of waves on air-sea momentum exchange: II. Behavior of drag coefficient under tropical cyclones. *J. Atmos. Sci.,* **61,** 2334-2348.

Mueller, J. A., and F. Veron, 2009: Nonlinear formulation of the bulk surface stress over breaking waves: Feedback mechanisms from air-flow separation. *Bound.-Layer Meteor.*, **130**, 117–134.

Pan, H.-L. and Q. Liu, 2012: New SAS convection scheme for high resolution models. *HFIP Regional Modeling Team Workshop,* College Park, MD, 17-18 Sept. 2012. (http://www.hfip.org/events/physics_workshop_9.12/presentations/meso-SAS.pdf)

Reichl B., T. Hara, and I. Ginis, 2012: Sea state dependent air-sea momentum flux under high and hurricane winds. In preparation.

Yablonsky, R. M., and I. Ginis, 2008: Improving the ocean initialization of coupled hurricane-ocean models using feature-based data assimilation. *Mon. Wea. Rev.,* **136,** 2592-2607.

4. Timeline for delivering documentation and training materials: Refer to earlier timeline.

5. Schedule of expected travel: Travel support is for PIs Isaac Ginis and Morris Bender to attend the 2014 and 2015 Interdepartmental Hurricane Conferences and to visit NCEP/EMC.

6. Estimate of JHT staff requirements and computational requirements: No time of JHT staff is requested. Existing computational resources available to URI and GFDL are sufficient.

Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCEP and Navy/FNMOC

A proposal submitted to the NOAA Joint Hurricane Testbed Program□

□PI: Isaac Ginis, URI
Co-PI: Morris Bender, NOAA/GFDL

December 6, 2012

Budget Justification

We are requesting funding for two years. The proposed budget will cover costs for salary, fringe, travel, supplies and indirect costs.

SALARY

Yr 1 Salary: $50,696
Yr 2 Salary: $52,217

The Principal Investigator, Isaac Ginis, has a 12-month state supported URI appointment and requests no salary support from NOAA.
Salary and fringe support for 4.20 months for year 1 and 4.20 months for year 2 is requested for two Marine Research Associates: Dr. Biju Thomas and Dr. Richard Yablonsky. Drs. Thomas and Yablonsky will be actively involved in all components of this project and will work with GFDL, NCEP, FNMOC scientists on the development, testing, and evaluation of upgrades to the operational tropical cyclone models, as described in the proposal. They will also be responsible for keeping the numerical codes updated and consistent with the NCEP and FNMOC operational requirements and aid NCEP and FNMOC in their transitioning to operations. Dr. Thomas and Yablonsky have active collaborations ongoing at NCEP and FNMOC; they are well known to our colleagues there.

FRINGE

Yr 1 Fringe: $26,382 - Fringe benefits are calculated at the University's required rates.
Yr 2 Fringe: $27,173 - Fringe benefits are calculated at the University's required rates

COMPUTER RESOURCES

The initial model development and testing will be done on the URI/GSO 128-CPU computer cluster and the GFDL supercomputer. The final testing before operational implementation will be performed on NCEP and NAVOCEANO supercomputers.

TRAVEL

Yr 1 Travel: $2,300
Yr 2 Travel: $2,000

Travel includes airfare, lodging, meals and other required travel costs, for PI to attend NCEP and IHC meetings each year. To also include travel that is explicitly associated with the tasks of this proposal.

SUPPLIES

Yr 1 Computer Supplies: $100
Yr 2 Computer Supplies: $ 43

Supplies necessary to operate and maintain research computers for this project. (i.e external hard drive for data storage, printer cartridges, software, workstation)

INDIRECT COSTS

Yr 1 Indirect Costs: $42,522
Yr 2 Indirect Costs: $43,566

Indirect costs are calculated at the University required rate of 53.5% on all direct costs

Request for Yr 1: $122,000
Request for Yr 2: $125,000

Total Request: $247,000

Morris Bender (Co-PI) 12/5/12
Joint Hurricane Testbed Proposal
"Improving HWRF and GFDN Coupled Models for Transition to Operations"

	FY2013	FY2014
	Year 1	Year 2
	0.17 FTE	0.17 FTE
Bender Salary	23,894	23,894
Benefits (16%)	3,823	3,823
Overheads (38.85%)	9,283	9,283
Travel	3,000	3,000
Total Funding Requested	**$40,000**	**$40,000**

Curriculum Vita

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e-mail: iginis@mail.uri.edu
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Professional Preparation:

Kabardino-Balkarian State University, Nalchik, Russia	Mathematics	M.S.	1977
Institute of Experimental Meteorology, Obninsk, Russia	Geophysics	Ph.D.	1986

Appointments:

2002-present	Professor of Oceanography, University of Rhode Island
2006 - Fall	Visiting Research Scholar, Princeton University/NOAA GFDL, Princeton, NJ
1998-2003	Associate Professor of Oceanography, University of Rhode Island
1993-1998	Associate Marine Research Scientist, Adjunct Professor of Oceanography University of Rhode Island
1990-1993	Visiting Research Scientist, Geophysical Fluid Dynamics Laboratory/NOAA Princeton University, Princeton, NJ
1977-1989	Research Scientist, Kabardino-Balkarian State University, Nalchik, Russia

Awards

National Oceanic and Atmospheric Administration 2001 Outstanding Scientific Paper Award
National Science Foundation Atmospheric Sciences Division 2001 Highlighted Research Project
National Oceanic and Atmospheric Administration 2002 Environmental Hero Award
National Oceanographic Partnership Program 2002 Excellence in Partnering Award

Journal Publications (last 3 years)

Yablonsky, R. M., and **I. Ginis**, 2012: Impact of a warm ocean eddy's circulation on hurricane-induced sea surface cooling with implications for hurricane intensity. Mon. Wea. Rev., 141, in press.

Gall, J. S., **I. Ginis**, S.-J. Lin, and T. P. Marchok, 2011: Experimental tropical cyclone prediction using the GFDL 25km resolution Global Atmospheric Model. Wea. Forecasting, 26, 10.1175/WAF-D-10-05015.1

Cotton, W. R., W. L. Woodley, **I. Ginis**, J. H. Golden, A. Khain, and D. Rosenfeld, 2011: The rise and fall of HAMP. *J. Wea. Modif.*, 43, 88-95.

Buckingham, C., T. Marchok, **I. Ginis**, L. Rothstein, and D. Rowe, 2010: Short- and medium-range prediction of tropical and transitioning cyclone tracks within the NCEP Global Ensemble Forecasting System. *Wea. Forecasting*, 25, 1736-1754.

Fan, Y., **I. Ginis,** and T. Hara, 2010: Momentum flux budget across air-sea interface under uniform and tropical cyclones winds. *J. Phys. Oceanogr.*, **40**, 2221–2242.

Fan, Y., **I. Ginis**, T. Hara, C. W. Wright, and E. Walsh, 2009: Numerical simulations and observations of surface wave fields under an extreme tropical cyclone. *J. Phys. Oceanogr.*, **39**, 2097-2116.

Fan Y., **I. Ginis**, T. Hara, 2009: The effect of wind-wave-current interaction on air-sea momentum fluxes and ocean response in tropical cyclones, *J. Phys. Oceanogr.,* **39***,* 1019-1034.

Yablonsky, R. M., and **I. Ginis**, 2009: Limitation of one-dimensional ocean models for coupled hurricane-ocean model forecasts. *Mon. Wea. Rev.,* **137**, 4410-4419.

5 other significant publications

Bender, M.A., **I. Ginis**, R. Tuleya, B. Thomas, T. Marchok, 2007: The operational GFDL coupled hurricane-ocean prediction system and a summary of its performance. *Mon. Wea. Rev*. **135**, 3965-3989.

Ginis, I., A.P. Khain, E. Morozovsky, 2004: Effects of large eddies on the structure of the marine boundary layer under strong wind conditions, *J. Atmos. Sci.*, **61**. 3049-3064.

Moon, I.-J., **I. Ginis**, and T. Hara, 2004: Effect of surface waves on air-sea momentum exchange. Part II: Behavior of drag coefficient under tropical cyclones, *J. Atmos. Sci.*, **61**, 2334– 2348.

Moon I.J., **I. Ginis,** T. Hara, E. J. Walsh, and H. L. Tolman, 2004: Numerical modeling of sea surface directional wave spectra under hurricane wind forcing, *J. Phys. Oceanogr*., **33**, 1680–1706.

Ginis I., 2002: Tropical cyclone-ocean interactions. Chapter 3. In Atmosphere-Ocean Interactions, Edited by W. Perrie, WIT Press, Advances in Fluid Mechanics Series, **33**, p. 83 – 114.

Synergistic Activities

I've been leading the effort toward improvements of the operational GFDL/GFDN and HWRF coupled tropical cyclone models related to the ocean and wave coupling. This work involves close collaboration between my research group at URI and scientists at the NOAA's National Centers for Environmental Prediction (NCEP), Geophysical Fluid Dynamics Laboratory (GFDL). Through ongoing collaboration with GFDL, Navy's Fleet Numerical Meteorology Center (FNMOC) and Joint Typhoon Warning Center (JTWC) we have transitioned a new version of the GFDL/URI hurricane model to operations at FNMOC for global tropical cyclone forecasting. We also collaborate with scientists at the Korean Oceanography and Development Institute in developing a coupled tropical cyclone-ocean model for the western Pacific.

I've been one of the lead developers and science advisors of the most comprehensive educational internet resources on hurricanes, ***Hurricanes: Science and Society (hurricanescience.org)*** funded by the U.S. National Science Foundation. The HSS website provides information on the science of hurricanes, methods of observing hurricanes, modeling and forecasting of hurricanes, how hurricanes impact society, and how people and communities can prepare for and mitigate the impacts of hurricanes.

I advise graduate students and postdoctoral scientists, contributing to training a new generation of scientists with expertise in numerical modeling and forecasting of the atmosphere and oceans. Another most important contribution is teaching graduate and undergraduate courses that cover various numerical methods applied for solving the fundamental equations governing atmospheric and oceanic motions, marine geophysics and biophysics. I also provide informal advice to URI students who use numerical methods for computer modeling in their research.

Research Collaborators within Last 48 Months

M. Bender, T. Marchok, S-J Lin (GFDL/NOAA), A. Khain (HIUJ), G. Sutyrin, T. Hara (URI), Il-Ju Moon (JU, Korea), H. Tolman, V. Tallapragada (NCEP/NOAA), J-W Bao, Chris Fairall (ESRL/NOAA), Sok Kuh Kang (KORDI).

Graduate Students Advised/Sponsored

Sergey Frolov (PhD, 2001), Evan Robertson (MS, 2002), Minoru Kadota (MS, 2002), Yalin Fan (PhD, 2007), Richard Yablonsky (PhD, 2009), Zhitao Yu (PhD, 2010), Lou Licate (MS, 2010), Seunghoun Lee (PhD, 2011), Michael Bueti (PhD- present), Kun Gao (PhD-present), Brandon Reichl (PhD-present), Melissa Kaufmann (MS – present), Colin Hughes (MS-present).

Postdoctoral Fellows Advised/Sponsored

Dr. Clark Rowley, Dr. Weixing Shen, Dr. Ray Richardson, Dr. Il-Ju Moon, Dr. Yalin Fan, Dr. Geoffrey Gall, Dr. Biju Thomas (present), Dr. Richard Yablonsky (present)

CURRICULUM VITA FOR MORRIS A. BENDER

EDUCATION
B. S. in Mathematics, Ohio State University, 1974
M. S. in Meteorology, Pennsylvania State University, 1976

EMPLOYMENT

GEOPHYSICAL FLUID DYNAMICS LABORATORY/NOAA
Research Associate 1976-1985
Research Meteorologist 1985-present
Present Grade: GS-14

PENNSYLVANIA STATE UNIVERSITY
Department of Meteorology
Graduate Assistant 1974-1976

MEMBERSHIPS IN PROFESSIONAL SOCIETIES & COMMITTEES:

American Meteorological Society 1980-present
AMS Committee on Hurricanes and Tropical Meteorology 1997-1999
WRF Scientific Advisory Board 1999-2002

RESEARCH INTERESTS

Tropical cyclone modeling
Operational Hurricane modeling
Coupled hurricane/ocean models

AWARDS:

OAR 1993 EMPLOYEE of the Year award
ERL/NOAA Outstanding paper award 1993
US Dept. of Commerce Gold Medal 1996
American Meteorological Society's 1998 Banner I. Miller Award
ERL/NOAA Outstanding paper award 2001
US Dept. of Commerce Bronze Medal 2005
US Dept. of Commerce Gold Medal 2006

RECENT PUBLICATIONS (2010-2007):

Bender, Morris A., Thomas R Knutson, Robert E Tuleya, Joseph J Sirutis, Gabriel A Vecchi, Stephen T Garner, and Isaac Held, 2010: Modeled impact of anthropogenic warming on the frequency of intense Atlantic hurricanes. *Science*, 327(5964), doi:10.1126/science.1180568.

Bender, M.A., I. Ginis, Robert Tuleya, Biju Thomas and Timothy Marchok, 2007: The operational GFDL coupled hurricane-ocean prediction system and summary of its performance. *Monthly Weather Review*, 135 (12), 3965-3989.

OTHER RELEVANT PUBLICATIONS

Bender, M. A., and I. Ginis, 2000: Real-case simulations of hurricane-ocean interaction using a high-resolution coupled model: effects on hurricane intensity. *Monthly Weather Review*, 128(4),917-946.

Wu, C-C., M. A. Bender, and Y. Kurihara, 2000: Typhoon forecast with the GFDL Hurricane Model: Forecast skill and comparison of predictions using AVN and NOGAPS global analyses. *Journal of the Meteorological Society of Japan*, 78(6), 777-788.

Kurihara, Y., R. E. Tuleya, and M.A. Bender, 1998: The GFDL Hurricane Prediction System and its performance in the 1995 hurricane season. *Monthly Weather Review*, 126(5), 1306-1322.

Bender, M. A., 1997: The effect of relative flow on the asymmetric structure in the interior of hurricanes. *Journal of the Atmospheric Sciences*, 54(6), 703-724.

Bender, M. A., R. J. Ross, R. E. Tuleya, and Y. Kurihara, 1993: Improvements in tropical cyclone track and intensity forecasts using the GFDL initialization system. *Monthly Weather Review*, 121(7), 2046-2061.

Current and Pending Support

Investigator: Isaac Ginis

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: GFDN Model Upgrade
URI Project: 3442

Source of Support: Navy
Total Award Amount: $51,000 Total Award Period Covered: 09/10/12 – 03/10/2013
Location of Project: University of Rhode Island/GSO
Person-Months Per Year Committed to the Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: CI: Improving Super-parameterization of Boundary Layer Roll Vortices in Tropical Cyclone
URI Project: 3206

Source of Support: ONR
Total Award Amount: $ 367,858 Total Award Period Covered: 03/01/2012 – 02/28/2015
Location of Project: University of Rhode Island/GSO
Person-Months Per Year Committed to the Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Advancing the NOAA's HWRF Prediction System through New and Enhanced Physic of the air-sea-wave
CO-PI: R. Yablonsky
URI Project: 3133
Source of Support: NOAA
Total Award Amount: $ 234,176 Total Award Period Covered: 08/01/11 – 07/31/2013
Location of Project: University of Rhode Island/GSO
Person-Months Per Year Committed to the Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Geophysical Fluid Dynamics Lab (GFDN)-Navy Model Maintenance Support
URI Project: 2992
CO-PI:
Source of Support: NAVY
Total Award Amount: $ 94,342 Total Award Period Covered: 06/01/2011 – 05/13/2014
Location of Project: University of Rhode Island/GSO
Person-Months Per Year Committed to the Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Collaborative Research: Langmuir Turbulence under Tropical Cyclones
CO-PI: 3046
URI Project:
Source of Support: NSF
Total Award Amount: $376,220 Total Award Period Covered: 09/01/2011 – 08/31/2014
Location of Project: University of Rhode Island/GSO
Person-Months Per Year Committed to the Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future Support:
Project/Proposal Title: Improving the Operational Cyclone Models at NOAA/NCEP and Navy/FNMOC
URI Project: 3061
CO-PI:
Source of Support: NOAA / NCEP
Total Award Amount: $247,559 Total Award Period Covered: 8/01/11 – 7/31/13
Location of Project: University of Rhode Island/GSO
Person-Months Per Year Committed to the Cal: Person-Months Per Year

Current and Pending Support

Investigator: I Ginis

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCE and Navy/FNMOC

CO – PI:

URI Project:

Source of Support: NSF

Total Award Amount: $247,000 Total Award Period Covered: 01/01/2013 – 12/31/2014

Location of Project: University of Rhode Island/GSO

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

CO-PI:

URI Project:

Source of Support:

Total Award Amount: Total Award Period Covered:

Location of Project: University of Rhode Island/GSO

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

URI Project:

Source of Support:

Total Award Amount: Total Award Period Covered:

Location of Project: University of Rhode Island/GSO

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: Total Award Period Covered:

Location of Project: University of Rhode Island/GSO

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project: University of Rhode Island/GSO

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Federal Support: Morris Bender

Project/Proposal Title: Improving HWRF-GFDN Coupled Models for Transition to Operations Source of Support: NOAA/JHT Total Award Amount: $80,000 Total Award Period Covered: 8/01/2011-7/31/2013

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:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: University of Rhode Island

* b. Employer/Taxpayer Identification Number (EIN/TIN): 223011455

* c. Organizational DUNS: 144017188

d. Address:

* Street1: Division of Research and Economic Development
Street2: 70 Lower College Road
* City: Kingston
County/Parish: Washington
* State: RI: Rhode Island
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 02881-1967

e. Organizational Unit:

Department Name: Sponsored Programs

Division Name: Research and Economic Develop

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

Prefix:
* First Name: Franca
Middle Name:
* Last Name: Cirelli
Suffix:

Title: Assistant Director, Sponsored Projects

Organizational Affiliation:

* Telephone Number: 401-874-5891
Fax Number: 401-874-4272

* Email: franca@uri.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:

Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCEP and Navy/FNMOC

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

Add Attachment | Delete Attachment | View Attachment

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

Improving the GFDL/GFDN Operational Tropical Cyclone Models at NOAA/NCEP and Navy/FNMOC

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: RI-002 | b. Program/Project: RI-002

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

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 08/01/2013 | * b. End Date: 07/31/2015

18. Estimated Funding ($):

* a. Federal	247,000.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	247,000.00

*** 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: Franca

Middle Name:

* Last Name: Cirelli

Suffix:

* Title: Assistant Director, Sponsored Projects

* Telephone Number: 401-874-5891 | Fax Number: 401-874-4272

* Email: franca@uri.edu

* Signature of Authorized Representative: Franca Cirelli | * 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-OAR-OWAQ-2013-2003469	11.459	$	$	$ 122,000.00	$	$ 122,000.00
2.						
3.						
4.						
5. Totals		$	$	$ 122,000.00	$	$ 122,000.00

Standard Form 424A (Rev. 7- 97)
Prescribed by OMB (Circular A -102) Page 1

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1) NOAA-OAR-OWAQ-2013-2003469	(2)	(3)	(4)	Total (5)
a. Personnel	$ 50,696.00	$	$	$	$ 50,696.00
b. Fringe Benefits	26,382.00				26,382.00
c. Travel	2,300.00				2,300.00
d. Equipment	0.00				
e. Supplies	100.00				100.00
f. Contractual	0.00				
g. Construction	0.00				
h. Other	0.00				
i. Total Direct Charges (sum of 6a-6h)	79,478.00				$ 79,478.00
j. Indirect Charges	42,522.00				$ 42,522.00
k. TOTALS (sum of 6i and 6j)	$ 122,000.00	$	$	$	$ 122,000.00
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.	$	$	$	$
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	$ 122,000.00	$ 30,500.00	$ 30,500.00	$ 30,500.00	$ 30,500.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 122,000.00	$ 30,500.00	$ 30,500.00	$ 30,500.00	$ 30,500.00

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-OAR-OWAQ-2013-2003469	$ 125,000.00	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 125,000.00	$	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: 81,434

22. Indirect Charges: 43,566

23. Remarks: Indirect Rate is 53.5%

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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
Franca Cirelli	Assistant Director, Sponsored Projects
* APPLICANT ORGANIZATION	* DATE SUBMITTED
University of Rhode Island	12/07/2012

Standard Form 424B (Rev. 7-97) Back

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 Rhode Island

* AWARD NUMBER

* PROJECT NAME

Improving the GFDL/GFDN Operational Tropical Cyclone Models

Prefix:

* First Name: Franca

Middle Name:

* Last Name: Cirelli

Suffix:

* Title: Assistant Director, Sponsored Projects

* SIGNATURE: Franca Cirelli

* DATE: 12/07/2012