A RESEARCH PROPOSAL SUBMITTED
TO THE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION (NOAA)

FY 13 Joint Hurricane Testbed (JHT) program:
NOAA-OAR-OWAQ-2013-2003469

For the
Florida International University
11200 SW 8th Street
Miami, FL 33199

TITLE: Improvement to the Satellite-based 37 GHz Ring Rapid Intensification Index

PRINCIPAL INVESTIGATOR: Haiyan Jiang, Department of Earth & Environment, Florida International University

PERFORMANCE PERIOD:	September 1, 2013 – August 31, 2015
AMOUNT REQUESTED:	Year 1: $ 69,980 Year 2: $ 71,923 Total: $141,903
SUBMITTING DATE:	December 7, 2012

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A proposal in response to NOAA Research Announcement
FY 13 Joint Hurricane Testbed (JHT): NOAA-OAR-OWAQ-2013-2003469

TITLE: Improvement to the Satellite-based 37 GHz Ring Rapid Intensification Index

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ABSTRACT

Many tropical cyclones (TCs) experience one or more rapid intensification (RI) events during their life time. The physical processes associated with these events remain unsolved. Predicting these events is one of the most challenging aspects for TC forecasters. Recently, a distinctive ring pattern around the TC center has been found in the 37 GHz microwave images to be associated with RI. Margie Kieper (a PhD student of the PI) initiated a subjective forecast method using the 37 GHz color product developed by the Naval Research Laboratory to predict the onset of RI. Real-time testing and statistical evaluations show that the method is very promising. The primary goal of the PI's previous FY-11 JHT project is to translate the subjective forecast method into an objective one. After several months of real-time testing, the automatic 37 GHz ring pattern identification algorithm works well, especially for 37 GHz images from high-resolution sensors such as Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) and WindSat. However, the major product of our FY-11 JHT project is a "yes" and "no" type of RI forecast only for 30 kt/24 hr intensity increase, by following Kieper's original method. Upon discussions with our NHC points of contact, it is realized that the optimal approach for RI prediction is to produce a probability type of RI forecast, not only for 30 kt intensity increase for 24 hours, but also for 25 and 35 kt/24 hr increases.

Using 11 years of TRMM TMI data, a set of inner core rainfall and convective parameters has been compared between RI and non-RI storms. It is found that statistically RI storms always have larger raining area and volumetric rain than non-RI storms. According to the results, the best predictors additional to the 37 GHz ring are the inner core area with 85 GHz PCT < 275, 250, and 225 K. The probability of RI is almost doubled from the climatological mean if using one of these predictors alone. By adding these additional predictors, improvement of the 37 GHz ring RI index is possible.

Therefore for this two-year project, we propose to upgrade the "yes" & "no" based 37 GHz ring RI index into a probability-based RI forecast method for 25, 30, and 35 kt/24 hr increases for the Atlantic (ATL) and Eastern Pacific (EPA) basins.. Similar to our FY-11 JHT product, the probability-based 37 GHz ring RI index will be generated on top of SHIPS RI index by using the above mentioned additional predictors from 85 GHz observations. The final output will be probabilities of RI at 25, 30, and 35 kt/ 24 hr intensification rate. Both 37 GHz and 85 GHz data will be used as input. *The first objective* is to test the probability-based 37-GHz ring RI index in quasi-operational environment for ATL and EPA basins during year-1 of the project. *The second objective* is to refine the probability-based 37-GHz ring RI index by using the first-year's testing results and more data from microwave sensors besides TMI. Real-time testing will also be done during the Atlantic hurricane season in the second year of the project at NHC. This proposed research fits into the following JHT program priorities: *1). NHC-1/JTWC-1. Guidance for tropical cyclone intensity change, especially for the onset, duration, and magnitude of rapid intensification events, as well as for over-water rapid weakening events. 2). NHC-13/JTWC-8. Techniques to improve the utility of microwave satellite and radar data for tropical cyclone intensity and location analysis.*

Statement of Work

1. Duration of project: Two years

2. Project description

2a. Introduction

Both environmental factors and storm inner core rainfall and convective properties are important for tropical cyclone (TC) rapid intensification (RI). As reported by Kieper and Jiang (2012), a distinctive satellite-derived ring pattern around the TC center was found to be related to RI. The ring pattern appears on the Naval Research Laboratory (NRL) 37 GHz passive microwave composite color product as a cyan color ring. It was seen from the simultaneous Tropical Rainfall Measuring Mission (TRMM) radar observations that the cyan color ring mainly contains shallow convection with warm rain process dominated. It was found that when combining the ring criterion with the Statistical Hurricane Prediction Scheme (SHIPS) RI Index (RII, Kaplan et al. 2010), the probability of RI almost doubled, indicating that both the ring (which indicates the inner core precipitation property) and SHIPS RII (which is derived from environmental factors) contain independent information for RI prediction. A subjective technique for predicting RI was proposed by Kieper and Jiang (2012) using both the 37 GHz ring and the SHIPS RII. Statistics based on 2003-2007 Atlantic RI events, which consist of a contiguous period where any 24-hour subset shows at least a 30 kt intensity increase, showed that the method captured 21 out of these 28 events and produced 2 false alarms, producing a probability of detection (POD) of 75% and a false alarm ratio (FAR) of 9%.

Our previous JHT-FY11 project was to translate the subjective 37 GHz ring RI index into an objective one. An automatic ring detection algorithm was developed using real-time 37 GHz microwave observations. After several months of real-time testing during 2012 hurricane season at NHC, the automatic algorithm works well, especially for 37 GHz images from high-resolution sensors such as TRMM Microwave Imager (TMI) and WindSat. However, the major product of our FY-11 JHT project was a “yes” and “no” type of RI forecast only for 30 kt/24 hr intensity increase. Upon discussions with our NHC points of contact, it is realized that the optimal approach for RI prediction is to produce a probability type of RI forecast. The RI threshold should be not only for 30 kt intensity increase for 24 hours, but also for 25 and 35 kt/24 hr increases. Therefore in this proposed research, a probability-based 37 GHz ring RI index is proposed by adding additional predictors from 85 GHz passive microwave observations.

2b.Previous JHT-FY11 Project

As planned in our previous JHT-FY11 proposal, the real-time testing of the automatic 37 GHz ring pattern RI index had been running smoothly during the 2012 Atlantic and East Pacific Hurricane season between May 15 and November 15, 2012. Access of the real-time microwave data has been successfully obtained. These data include the real-time TMI data from NASA Goddard, and real-time Special Sensor Microwave Imager (SSM/I), Special Sensor Microwave Imager/Sounder (SSMIS), and WindSat data from NOAA NESDIS. The new AMSR-2 data is expected to be available to us through NOAA NESDIS around January 2012, soon after the data is available to NOAA. Discussions with our NHC points of contact were made to better format our output to be better used at NHC. John Kaplan at NOAA HRD has provided the most recent version of real-time SHIPS RI forecasts as input of our automatic algorithm. Dr. Tie Yuan (Postdoc on this project) has been working on making and maintaining the real-time test code. It involves using multiple programming languages including IDL and scripts. The real-time automatic algorithm was running at Florida International University (FIU)

servers. Both text and figure outputs were put online at an ftp site (http://tcpf.fiu.edu/JHT/). NHC forecasters can check our ftp site anytime they want. We also sent an email alert to NHC whenever there was a positive RI forecast indicated by our automatic method. The Hurricane Carlotta case illustrated in Fig. 1 was considered as a successful RI forecast case, as confirmed by NHC hurricane specialist Jack Beven.

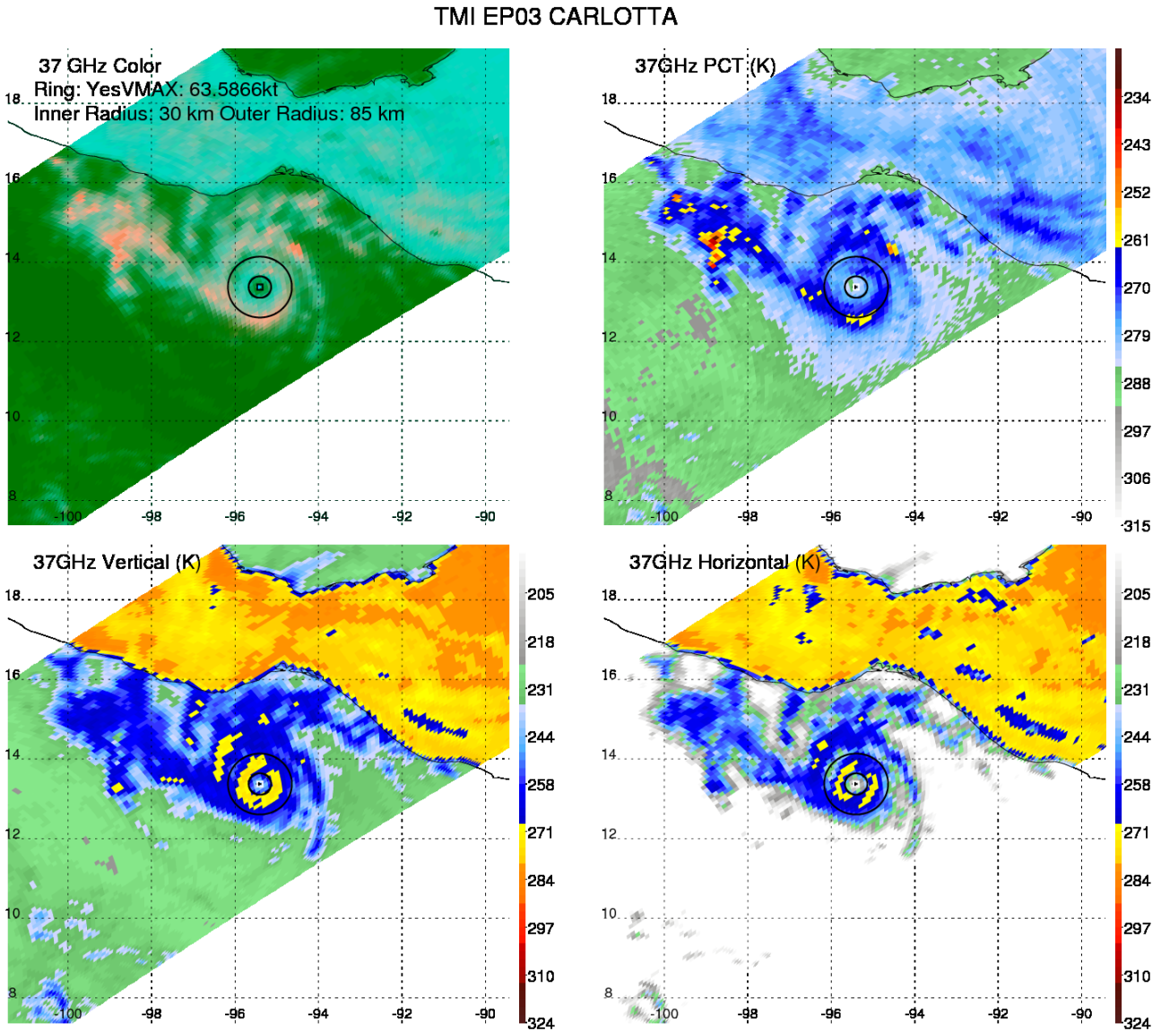

Figure 1. An example of real-time 37 GHz images for the TRMM overpass on 10:18Z June 15, 20112 for Hurricane Carlotta in the East Pacific basin. The file can be found online at http://tcpf.fiu.edu/JHT/Figures/1206151018EP03.TMI.1B11.2012-06-15T08-56-25Z.7.rt.png. The 37 GHz color (top left), Polarization Corrected brightness Temperature (PCT, top right), vertically polarized brightness temperature (bottom left), and horizontally polarized brightness temperature (bottom right) are shown. The storm center derived from 37 GHz observations is indicated as a small dot in each panel. Algorithm-detected inner and outer radii (30 and 85 km respectively) of the ring are indicated in the same panel.

Although a further detailed statistics is needed to summarize the total hit, miss, and false alarm

cases, a general impression is that the method tends to have low false alarms in the expenses to have some misses. The reasons for misses include 1) algorithm failure, 2) low SHIPS RII, or 3) microwave data latency. The algorithm did produce several false alarms. The main reason of false rings was the bad TC center fix, which is naturally a tough job for any automatic center detection algorithm, especially when the storm is below hurricane intensity. The improvement proposed in this research should help reduce misses and false alarms by adding additional objective predictors and by changing the "yes" & "no" type of RI index into a probability-based one.

2c. Recent accomplishments

2c.1.Necessary conditions of RI in terms of inner core rainfall and convective properties

Kieper and Jiang (2012) demonstrated that a *precipitative* ring pattern around the TC center is a very good predictor of RI. This suggests that a particular condition that is necessary for RI is wide-spread precipitation with high total volumetric precipitation in the inner core. Moderate convective intensity might occur simultaneously under this condition. Using 11 years (1998-2008) of TRMM satellite data, Jiang and Ramirez (2012) quantitatively compared the TC inner core rainfall and convective properties as a function of four 24-h future intensity change categories: rapidly intensifying (RI), slowly intensifying (SI), neutral (N), and weakening (W). From Fig. 2, it is obvious that storms that will undergo RI always have larger raining area and total volumetric rain in the inner core region than storms that will slowly intensify, be neutral, or weaken.

Low values of 85 GHz Polarization Corrected brightness temperature (PCT, Spencer et al. 1989) tend to indicate strong ice scattering signatures, and low values of IR T_{B11} indicate higher cloud tops. Therefore, minimum 85 GHz PCT and minimum IR T_{B11} in the inner core is examined as convective proxies (Fig. 3). At stronger convective spectrum, no significant difference among different intensity change categories is seen in the distributions of these convective parameters. This indicates that RI storms do not necessarily have extremely intense convection in the inner core. However, it is interesting to observe from Fig. 3 that the maximum values (when the CDFs reach 100%) of the minimum 85 GHz PCT and IR T_{B11} for RI storms are much lower than those corresponding maximum values for storms in other intensity change categories. This indicates that a minimum threshold of convective intensity in the inner core has to be reached before a storm undergoes RI. This threshold can be deemed as necessary condition for RI. Therefore, the necessary conditions for RI derived from Fig. 3 are: 1) minimum 85 GHz PCT in the inner core is less than ~235 K (Fig. 3a), and 2) minimum IR T_{B11} in the inner core is less than ~220 K (Fig. 3b).

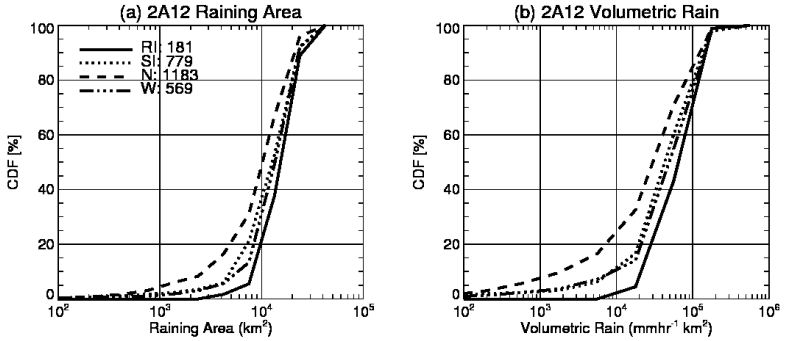

Figure 2. Cumulative distribution functions (CDFs) of TMI 2A12 (a) raining area and (b) volumetric rain in the inner core of TCs in different intensity change stages.

A threshold of 250 (275) K for the 85 GHz PCT is considered as an indicator of moderate (light) rain (Spencer et al. 1989), and 85 GHz PCT < 225 and 200 K has been used as a criterion of moderate convection. From Fig. 4, it is obvious that RI storms always have larger inner core area with 85 GHz PCT < 275, 250, and 225 K. Therefore, these parameters could be good predictors of RI.

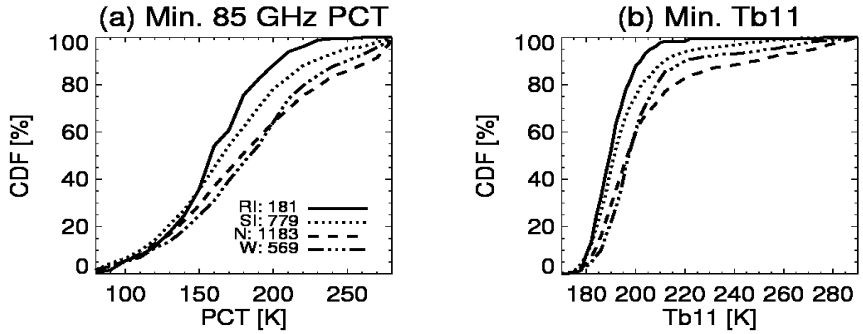

Figure 3. CDFs of (a) minimum 85 GHz PCT [K] and (b) minimum T_{B11} [K] in the inner core of TCs in different intensity change stages.

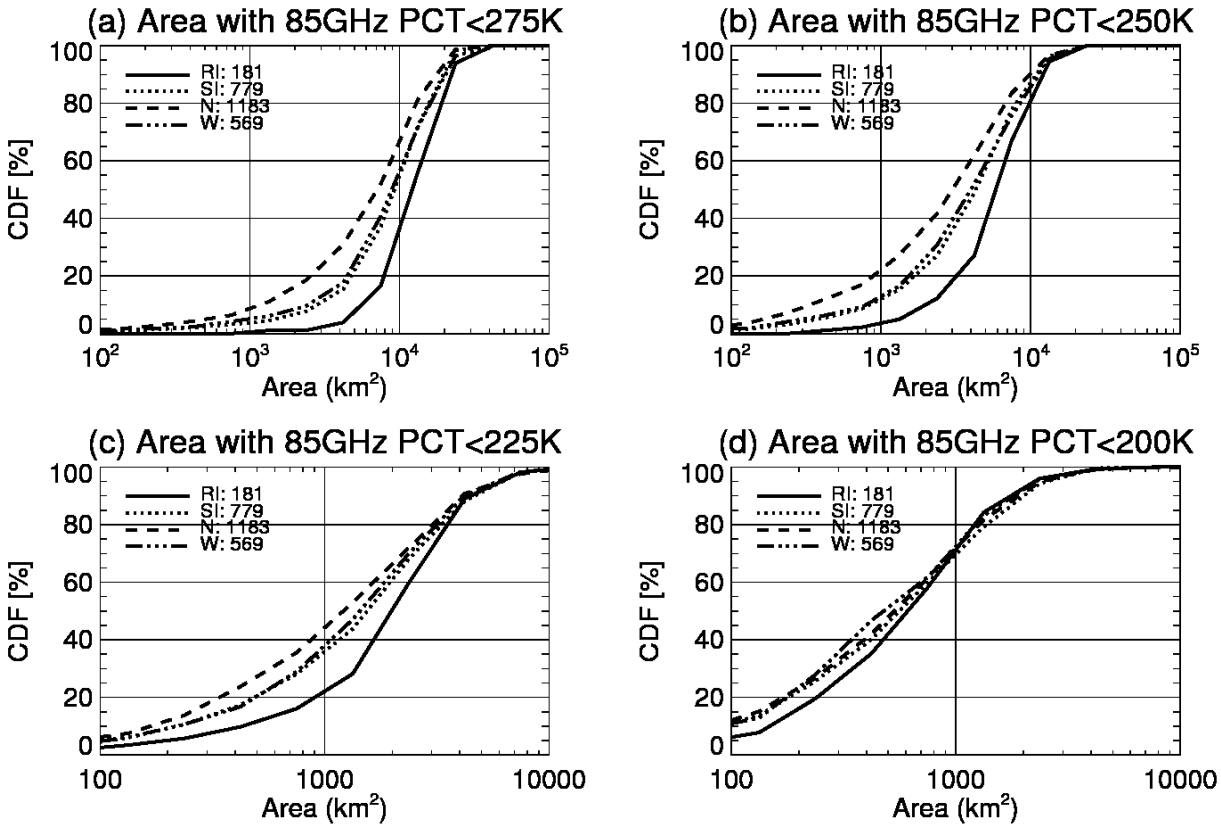

Figure 4. CDFs of inner core area with 85 GHz PCT < 275 K (a), 250 K (b), 225 K (c), and 200 K (d) of TCs in different intensity change stages.

2c.2.Estimating the probability of RI for a series of inner core rainfall and convective parameters

Results in section 2c.1 indicate that all the examined inner core rainfall and convective parameters could be a predictor of RI. Significant tests have shown that the differences for each parameter between RI and non-RI storms are significant at the 95% level. In this section, estimates of

the probability of RI are obtained for each of the following 8 predictors in the inner core: TMI 2A12 raining area (rainarea), TMI 2A12 volumetric rain (volrain), minimum 85 GHz PCT (min85pct), minimum IR T_{B11} (minir), area with 85 GHz PCT < 275 (area275), area with 85 GHz PCT < 250 (area250), area with 85 GHz PCT < 225 (area225), and area with 85 GHz PCT < 200 (area200). The dataset used here is the 11 years (1998-2008) of TRMM TC data as used above. The inner core region was manually separated from inner rainband and outer rainband regions for all the TRMM TC overpasses used in this study. We consider three RI categories: 25, 30, and 35 kt intensity increase per 24 hours. Table 1 shows the mean value of each predictor in the inner core for each RI category.

Probabilities are calculated by comparing each of the parameters of the 2712 cases that composed the study sample to the corresponding RI threshold. The methodology used here is the same as that used in Kaplan and DeMaria (2003). The RI threshold for each parameter is defined as the RI sample mean as shown in table 1. A threshold is said to be satisfied if a value is either $\leq$ or $\geq$ the specific RI threshold. For example, the 25-kt RI sample has a mean area275 of 16,545 km^2. Thus, area275 RI threshold for 25 kt RI category is satisfied when area275 is $\geq$ 16,545 km^2.

Table 1: Mean value of different predictors in the inner core for different RI categories.

	area275 (km^2)	area250 (km^2)	area225 (km^2)	volrain (mm h^{-1} km^2)	minir (K)	rainarea (km^2)	area200 (km^2)	min85pct (K)
25-kt RI	16,545	8,299	2,987	119,855	193	2,0721	957	165
30 kt RI	17,214	8,561	2,967	122,933	192	21,362	912	164
35 kt RI	18,008	9,297	3,310	133,615	190	21,698	961	162

Fig. 5 shows the probability of RI for each of the 8 parameters for the 30-kt RI category only. These probabilities are obtained by dividing the number of RI cases that satisfied a given threshold by the number of cases in the entire sample that satisfied that same threshold. The figure shows that the probability of RI ranges from 9.14% when the threshold for min85pct is satisfied to 12.07% when the threshold for area275 is satisfied. For comparison, the sample mean probability of RI is 6.67% (181 RI cases/2712 total cases). Thus, the probability of RI when an RI threshold is satisfied exceeds the probability of RI when an RI threshold is not satisfied for each of the 8 predictors by about a factor of 2 (Fig. 5). Also, these RI probabilities are all larger than the sample mean probability of RI. This suggests that these parameters do provide additional information over that which is provided by climatology. Specifically, the area275, area 250, and area225 predictors are among the best, indicating that area of total rainfall and moderate convection in the inner core is more important for RI than those convective intensity parameters such as min85pct and minir.

2c.3. Development of the probability-based 37-GHz ring RI index

Since the probability of RI for any individual predictor shown in Fig. 5 is not particularly higher than others, various sets of predictors were combined in an attempt to provide improved probability of RI estimates. However, since these predictors are highly dependent on each other, no combinations give substantially improved results. Since rainfall retrievals are usually not available in real-time, it is decided to select the first 3 predictors with the highest probability of RI to be added as additional predictors into the existing objective 37 GHz ring RI index. These 3 predictors are area275, area250, and area225. All of these predictors are from the 85 GHz observations, which are available from all the sensors that were used in the existing objective 37 GHz ring RI index. As found by Kieper and Jiang (2012), the SHIPS RII contains environmental predictors that are highly independent on the inner core

rainfall and convective parameters. Therefore, similar to what we did in our previous JHT-FY11 project, here we'll add SHIPS RII on top of each 85 GHz predictor.

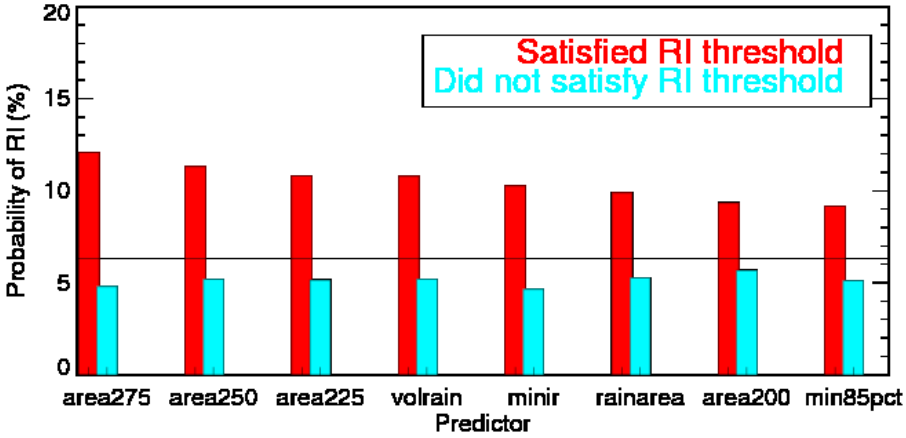

Figure 5. Probability of RI (only for 30-kt RI category) for predictors satisfying and not satisfying RI thresholds. The climatological probability of RI is indicated by the solid line at the 6.67% level.

To estimate the probability of RI in the Atlantic (ATL) and Eastern Pacific (EPA) basins where the SHIPS RII is available, a database is built that consists of all the TMI observations of tropical and subtropical cyclones in the ATL and EPA basins that developed from 1998 to 2008. At the TMI observation time, the storm must be over water, and will be over water in the following 24 hours. The initial storm intensity has to be between 35 and 100 kt according to Kieper's original RI forecast method. The dependent SHIPS RII estimates (John Kaplan, personal communication) have to be available within 6 hours before or after the TMI observation time. Table 2 gives the number of RI and non-RI cases for each RI threshold in each basin.

Table 2: The number of RI and non-RI cases for each set of RI category for ATL and EPA basins.

	RI categories for 24-h intensity change		
	25 kt	30 kt	35 kt
ATL	85 RI/889 non-RI	55 RI/ 919 non-RI	38 RI/936 non RI
EPA	55 RI/486 non-RI	39 RI/502 non-RI	27 RI/514 non RI

Probabilities of RI for all samples (climatological mean) and for samples that satisfy area275, area275+SHIPS (SHIPS RII>=20%), area250, area250+SHIPS, area225, area225+SHIPS, 37 GHz ring, ring+SHIPS criteria are shown in table 3. For both ATL and EPA, we can see that the probability of RI for cases that satisfied the microwave predictor+SHIPS criterion is always higher than for cases that satisfied the microwave predictor criterion alone. The increase is at least 50% and sometime even reaches a factor of 3 to 4. For example, for the EPA basin, the probability of RI for 30-kt intensity change in 24-h is 11% when the inner core area with 85 GHz PCT < 275 K is larger than the RI threshold, and is 46% when the area275 criterion is met and the environmental condition is favorable as indicated by SHIPS RII greater than 20%. Again, this indicates that the inner core precipitation based parameters are largely independent to the SHIPS environmental RII index. Also as seen from table 3, the probability of RI decreases as the RI threshold increases. For EPA, overall RI probability is higher than that for ATL storms. For example, the probability of RI for 25-kt intensity change in 24-h for ring+SHIPS cases is 64% in ATL, but 90% in EPA.

The newly developed probability-based 37 GHz Ring RI Index will be implemented by following 4 steps: 1) for each RI category (25, 30, or 35 kt/24 hr intensity increase), check the 8 criteria listed in table 3 respectively; 2) if only one criterion is satisfied, then the predicted RI probability will be the RI probability listed in the table correspondingly; 3) if multiple criteria are satisfied, select the highest RI probability listed in table 3; 4) if no criterion is satisfied, forecast RI probability = 0. When doing the real-time forecast, we'll need to define the inner core radius first for each satellite overpass. Currently, we plan to use 100-km fixed radius as the outer boundary of inner core.

Table 3: The probabilities of RI for all samples (climatological mean) and for samples that satisfy area275, area275+SHIPS, area250, area250+SHIPS, area225, area225+SHIPS, 37 GHz ring, ring+SHIPS criteria for ATL and EPA basins for the 25-, 30-, and 35-kt RI categories, respectively.

	ATL RI categories for 24-h intensity change			EPA RI categories for 24-h intensity change		
%	25-kt	30-kt	35kt	25-kt	30-kt	35kt
Area275	25.0	16.7	13.3	22.6	11.1	6.0
Area275+SHIPS	46.7	28.6	16.7	53.3	46.2	23.1
Area250	30.0	17.9	17.4	24.1	14.3	13.5
Area250+SHIPS	46.2	25.0	22.2	56.3	43.8	41.7
Area225	28.1	18.8	12.0	19.3	12.3	4.9
Area225+SHIPS	57.1	35.7	20.0	57.1	42.9	16.7
ring	29.6	18.2	13.6	33.3	25.0	13.9
Ring+SHIPS	64.3	35.7	21.4	90.0	80.0	50.0
Climatological mean	9.9	4.6	2.7	13.3	7.9	3.5

2d. Specific goals of the project

In this proposal, we plan to improve the 37 GHz ring RI index by changing it from a "yes" and "no" type of forecast into a probability-based forecast. Additional predictors from 85 GHz microwave observations will be used as described in section 2c.3. This newly developed probability-based 37 GHz ring RI index represents a storm inner core precipitation based predictor which is independent of the environmental predictors in the SHIPS RI index.

The specific scientific goals of this proposal include:

- Test the probability-based 37-GHz ring RI index in quasi-operational environment for ATL and EPA basins during year-1.
- Refine the probability-based 37-GHz ring RI index by using the first-year's testing results and more data from microwave sensors besides TMI. Real-time testing will also be done during the Atlantic hurricane season in the second year of the project at NHC.

3. Proposed work plan

3a.Tasks

This is a two-year project involving two tasks related to the specific goals mentioned in section 2d. The individual tasks are described below.

Task 1: Test the probability-based 37-GHz ring RI index in quasi-operational environment for Atlantic and East Pacific basins during year-1

The code for the automatic 37 GHz ring pattern detection has been developed during our previous JHT-FY11 project. Slightly modifications will be done based on some small problems found in the 2012 hurricane season real-time testing. The code for calculating 85 GHz predictors has already been developed using a TMI-based database during 1998-2008 (see section 2c). We plan to test the probability-based RI index quasi-operationally at NHC during year-1 of the project by using real-time observations from multi microwave sensors available and the real-time SHIPS RII (the SHIPS RII is an operational product available to NHC). This task requires a close collaboration with forecasters at NHC. The collocation of the PI's institute (FIU) with NHC will make this task easier.

Task 2: Refine the probability-based 37-GHz ring RI index by using the first-year's testing results and data from microwave sensors in addition to TMI

After the testing during year-1, we will identify successful and failed cases. Based on lessons learned, we'll be able to refine our index to make it better functional. Also during non-hurricane seasons when real-time testing won't take place, we will add microwave data from sensors other than TMI. Our probability-based RI index could be refined based on a larger database. The current plan is to obtain AMSR-E (from http://sharaku.eorc.jaxa.jp/TYP_DB/index_e.shtml) data back to 2002 and SSM/I and SSMIS data back to 1996 (available from Remote Sensing Systems). Real-time testing will also be done during the Atlantic hurricane season in the second year of the project at NHC. After the real-time testing and algorithm refinement, we plan to implement the final probability-based 37 GHz ring RI index for ATL and EPA basins. The final RI index will be produced and made available to NHC for operational use.

3b. Hardware and software needs

Florida International Univ. (FIU) will mostly use hardware and software already available. We only request $1000 per year for IDL software maintenance and update fees.

3c. Testing and evaluation approach

Evaluation of the progress of the work will depend on the testing and refinement of the developed probability-based 37-GH ring RI index, and its final implementation. The evaluation will consist of tests using the refined RI index with historical cases.

3d. Metrics for success

Work from this proposal will be considered successful upon the completion of the two major tasks: 1) Refinement of the probability-based 37 GHZ ring RI index based on lessons learned during year-1's quasi-operational testing and adding more microwave data in the statistics; 2) Implementation of the final probability-based 37 GHZ ring RI index for ATL and EPA basins. The implementation will then be transitioned and run at NHC.

3e. Project deliverables and timeline

Year 1 (September 2013- August 2014): Real-time testing and evaluation of the probability-based 37 GHz ring RI index will be done this year by the PI, postdoc, and graduate student Margie Kieper (Kieper is on FIU graduate student fellowship), in collaboration with forecasters at NHC. During year 1, another important task to be completed is to collect more 37 GHz data from AMSR-E, SSM/I, and SSMIS in order to refine the index.

Year 2 (September 2014- August 2015): We will refine the index by using more microwave data and based on the evaluation results during year-1. Our critical task during year 2 will be implementing the final refined version of the probability-based 37 GHz RI index, and continue to do real-time testing during the hurricane season at year-2. We will work closely with forecasters at NHC during both year 1 and 2.

Upon completion of this project, the following deliverables will be provided:

- Code (in IDL) that will produce the probability-based 37 GHz RI index
- A detailed document of the guidance for running the code, and predicting RI using the 37 GHz index with the SHIPS RI index

3f. Real-time operational data needed as input

TC current intensity, future track forecast, SHIPS RII for the next 24-h, and TMI, SSM/I, SSMIS, AMSR-2, and WINDSAT 37 and 85 GHz brightness temperatures will be needed as input.

3g. Plan to port necessary codes to operational environment

Code to run the probability-based 37 GHz RI index will be ported to NHC upon completion of the project.

4. Time line for delivering scientific and technical documentation and training materials

A description of the code necessary for running the code will be provided at the end of the second year.

5. Travel schedule and needs

Jiang, her postdoc and graduate student plan two trips each year, to the IHC meeting to present progress and/or results from the project.

6. JHT staff and computational requirements

The home institution (FIU) will provide the necessary computing equipment for the refinement and implementation of the proposed index. Deployment to NHC will require access to a Linux/Unix workstation for completing the transition to operations and running the probability-based 37 GHz RI index during hurricane seasons.

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Budget Details:

Two year period from Sep. 1, 2013 to Aug. 31, 2015

Salaries	Year 1	Year 2	Total
PI (1 mo/yr, assume 3% inflation rate)	9426.87	9709.68	19136.55
Postdoc Researcher (6 mo/yr, assume 3% inflation rate)	25000.00	25750.00	50750.00
Subtotal Salaries	34426.87	35459.68	69886.55
Benefits			
Faculty/Staff @ 29.73%	10235.11	10542.16	20777.27
Subtotal Benefit	10235.11	10542.16	20777.27
Total Salaries and Benefits	**44661.98**	**46001.84**	**90663.82**
Supplies			
Software, Disk, telephone, printing, copying, etc	1000.00	1000.00	2000.00
Total Supplies	**1000.00**	**1000.00**	**2000.00**
Travel			
Domestic: 2,2 trips for PI/postdoc/student to IHC meeting or other conferences (Airfare@$520, 5 days @$156/day)	2600.00	2600.00	5200.00
Total Travel	**2600.00**	**2600.00**	**5200.00**
Total Direct Costs	**48261.98**	**49601.84**	**97863.82**
Total Direct Costs Subject to Indirect Costs	**48261.98**	**49601.84**	**97863.82**
Indirect Cost @ 45%	**21717.89**	**22320.83**	**44038.72**
Total Costs	**69979.87**	**71922.67**	**141902.54**

Budget Justification:

A. Senior Personnel: Dr. Haiyan Jiang, as the primary grant PI, will overall direct the effort. Total Year 1 costs for Senior Personnel covers 1 month of summer salary Dr. Jiang ($9,426.87). Total Year 2 costs for Senior Personnel covers 1 month of summer salary Dr. Jiang ($9,709.68). This salary is increased 3% from Year 1.

B. 6 months per year of support for Dr. Tie Yuan as a postdoc visiting scholar is requested. He will be responsible for refining the objective algorithm of 37 GHz ring pattern during the real-time testing of the technique.
Year 1 salary (6 months) for Dr. Tie Yuan is $25,000.00.
Year 1 salary (6 months) for Dr. Tie Yuan is $25,750.00. This salary is increased 3% from Year 1.

C. FIU is currently using a fringe benefit rate of 29.73% for full time employees and 0.43% for OPS employees.

D. Materials/Supplies: $1,000 per year is requested for IDL software upgrade and maintainence.

E. Travel: A total of $2,600 per year in domestic travel is requested, which is estimated based on two trips of 5 days each to IHC meeting for the PI and/or postdoc visiting scholar. This is estimated based on Airfare ($520) and Hotel+Per Diem ($156 per day).

F. F & A costs at Florida International University are calculated at 45% (07/01/10-until amended) of the modified total direct cost which excludes equipment, capital expenditures, charges for patient care, tuition remission, rental costs of off-site facilities, scholarships and fellowships and the portion of each subcontract and/or subgrant in excess of $25,000 regardless of the period covered. Equipment means an article of nonexpendable tangible personal property having a useful life of more than one year, and an acquisition cost of $5000 or more per unit.

H. Total Direct Costs: $97,863.82.

PRINCIPAL INVESTIGATOR BIOGRAPHICAL SKETCH: HAIYAN JIANG

Education

2004 Ph.D. Meteorology, University of Utah
1995 M.S. Atmospheric Remote Sensing, Chinese Academy of Meteorological Sciences (CAMS)
1992 B.S. (with honors) Atmospheric Physics, Nanjing Institute of Meteorology, China

Professional Experience

2010-present: Assistant Professor, Florida International University
2007-2009: Research Assistant Professor, University of Utah
2004-2006: Research Associate, Joint Center for Earth Systems Technology, University of Maryland Baltimore County, and NASA Goddard Space Flight Center, Greenbelt, MD
2000-2004: Research Assistant, University of Utah
2001: Summer work, NOAA Hurricane Research Division (HRD)
1998-2000: Research Associate, Research Center for Disastrous Weather, CAMS, China
1995-1998: Research Assistant, Institute of Mesoscale Meteorology, CAMS

Honors and Awards

NASA GRIP Group Achievement Award 2010
NASA New Investigator Award in Earth Science 2008-2011
NASA Earth System Science Fellowship Award 2003-2004

Graduate Students Supervised

Margaret Kieper, Ph.D student (in progress); Joseph Zagrodnik, M.S. Student (defensed); Cheng Tao, Ph.D Student (in progress); Yongxian Pei, Ph.D Student (in progress); Ellen Ramirez, M.S. Student

Postdoc Scholar Supervised

Tie Yuan (Sep. 2010-Sep. 2011; Mar. 2012-Aug. 2012)

Past Funded Research Projects

- 2007-2012: NASA New Investigator Program (NIP)**:** The Relationship between Environmental Factors, Convection, and Precipitation in Tropical Cyclones. (Principal Investigator)
- 2008-2011: NASA Precipitation Processing System (PPS): Population of Precipitation Systems Observed by Space-borne Radar and Microwave Radiometers. (Co- Investigator)
- 2007-2010: NASA Precipitation Measuring Mission (PMM): Differences and Similarities of Tropical Cyclone Rainfall Over Land and Sea Using Multisatellite Analyses: Implications for Inland Flooding Prediction. (Principal Investigator)
- 2003-2004: NASA Earth System Science (ESS) Fellowship: Variability of Ice and Liquid Precipitation Contents and Shape of Radar Reflectivity Profiles in Tropical Cyclones. (Principal Investigator)

Professional Service and Activities

Panel Review Committees for NASA 2009, 2011, 2012
Proposal reviewer for NASA 2012
Proposal reviewer for NSF 2012
Journal article reviewer for AMS and AGU journals 2003-present
Chaired Session on "*Comparisons of the 2008 and 2010 Snapshots of Tropical Cyclone R & D*" at the NOAA 65th Interdepartmental Hurricane Conference, Miami, Florida, Feb. 28-Mar. 3, 2011.
Convener of the session "*Remote Sensing of Tropical Cyclones and Tropical Convective Systems: Observations and Data Assimilation"* at the American Geophysical Union Fall Meeting, San Francisco, CA, December 3-7, 2012.

Selected Journal Publications

Xu, W., H. Jiang, and X. Kang, 2012: Rainfall Asymmetries of Tropical Cyclones Prior to, During, and After Making Landfall in South China and Southeast United States. *Geophys. Res. Lett.*, submitted.

Zagrodnik, J., and H. Jiang, 2012: Validation of PR and TMI Version 6 and Version 7 Rainfall Algorithms in Landfalling Tropical Cyclones Relative to the NEXRAD Stage-IV Multi-sensor Precipitation Estimate Dataset. *J. Appl. Meteor. Climatol.*, in review.

Jiang, H., and E. M. Ramirez, 2012: Necessary conditions for tropical cyclone rapid intensification as derived from 11 years of TRMM data. *J. Climate*., under revision.

Tao, C., and H. Jiang, 2012: Global distribution of hot towers in tropical cyclones based on 11-year TRMM data. *J. Climate*, in press.

Zagrodnik, J., and H. Jiang, 2012: Properties of Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) and Microwave Imager (TMI) Rainfall Retrievals in Tropical Cyclone Inner Cores and Rainbands. *J. Geophys. Res.*, in press.

Jiang, H., E. M. Ramirez, and D. J. Cecil, 2012: Convective and rainfall properties of tropical cyclone inner cores and rainbands from 11 years of TRMM data. *Mon. Wea. Rew.*, in press.

Kieper, M., and H. Jiang, 2012: Predicting tropical cyclone rapid intensification using the 37 GHz ring pattern identified from passive microwave measurements. *Geophys. Res. Lett.*, in press.

Jiang, H., 2012: The relationship between tropical cyclone intensity change and the strength of inner core convection. *Mon. Wea. Rev*., 140, 1164-1176.

Jiang, H., C. Liu, and E. J. Zipser, 2011: A TRMM-based Tropical Cyclone Cloud and Precipitation Feature Database. *J. Appl. Meteor. Climatol.*, 50,1255-1274.

Xu, W., E. J. Zipser, C. Liu, and H. Jiang, 2010: On the relationships between lightning frequency and thundercloud parameters of regional precipitation systems. *J. Geophys. Res.*, 115, D12203, doi:10.1029/2009JD013385.

Jiang, H., and E. J. Zipser, 2010: Contribution of tropical cyclones to the global precipitation from eight seasons of TRMM data: Regional, seasonal, and interannual variations. *J. Climate.*, 23, 1526-1543.

Jiang, H., J. B. Halverson, and E. J. Zipser, 2008: Effects of environmental moisture on tropical cyclone precipitation: Land/ocean difference. *Geophys. Res. Lett.*, 35, L17806, doi:10.1029/2008GL034658.

Jiang, H., J. B. Halverson, J. Simpson, and E. J. Zipser, 2008: Hurricane "rainfall potential" derived from satellite observations aids overland rainfall prediction. *J. Appl. Meteor. Climatol.*, 47, 944–959.

Jiang, H., J. B. Halverson, J. Simpson, and E. J. Zipser, 2008: On the differences in storm rainfall from Hurricanes Isidore and Lili. Part II: Water budget. *Wea. Forecasting*, 23, 44-61.

Jiang, H., J. B. Halverson, and J. Simpson, 2008: On the differences in storm rainfall from Hurricanes Isidore and Lili. Part I: Satellite observations and rain potential. *Wea. Forecasting*, 23, 29-43.

Jiang, H., and E. J. Zipser, 2006: Retrieval of hydrometeor profiles in tropical cyclones and convection from combined radar and radiometer observations. *J. Appl. Meteor. Climatol.*, 45, 1096-1115.

Jiang, H., P. G. Black, E. J Zipser, F. D. Marks, and E. W. Uhlhorn, 2006: Validation of rain rate estimation in hurricanes from the Stepped Frequency Microwave Radiometer: algorithm correction and error analysis. *J. Atmos. Sci.*, 63, 252–267.

Current and Pending Support for PI (Jiang)

Current Support:

NASA: Earth System Science Fellowship for Cheng Tao: Climatology of Hot Towers in Tropical Cyclones and Their Role in Tropical Cyclone Intensity Changes Based on 12 years of TRMM data. (HJ as the Principal Investigator). Sep. 2011-Aug. 2014. Current year budget $30K.

NASA: Earth System Science Fellowship for Joseph Zagrodnik: Diurnal Cycle of Precipitation Features and Quantitative Comparison of Precipitation Algorithms in Tropical Cyclones. (HJ as the Principal Investigator). Sep. 2011-Aug. 2014. Current year budget $30K.

NASA: Hurricane Science Research Program (NNH08ZDA001N-HSRP): A TRMM-based Tropical Cyclone Precipitation Feature Database and Its Usage on Intensification Study. Feb 2009 – Jan. 2013. Current year budget $95K, 2 summer month PI time.

NASA: Supplemental Education Awards for ROSES investigators, "Undergraduate Summer Education and Research Program in Hurricane Monitoring and Forecasting Using Remote Sensing Observations". September 2011 – August 2013. Current year budget $14K, 0.6 summer month/year PI time.

NOAA: FY 11 Joint Hurricane Testbed (JHT): Enhancement of SHIPS Rapid Intensification (RI) Index Using Satellite 37 GHz Microwave Ring Pattern. Sep. 2011- Aug. 2013. Current year budget $70K, 1 summer month PI time.

Pending Support:

NSF: CAREER: Roles of Symmetric Precipitative Ring and Asymmetric Intense Convection in Tropical Cyclone Rapid Intensification. Feb. 2013-Jan. 2018. Total budget requested: $788K.

NASA: Precipitation Measuring Mission (PMM): Use of TRMM and Other Satellites to Study the 37-GHz Ring Pattern and Hot Towers in Relation to Tropical Cyclone Rapid Intensification. . Feb. 2013-Jan. 2016. Total budget requested: $299K.

Areas Affected:

N/A

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: Florida International University Board of Trustees

* b. Employer/Taxpayer Identification Number (EIN/TIN): 650177616

* c. Organizational DUNS: 0712988140000

d. Address:

* Street1: 11200 SW 8th Street

Street2:

* City: Miami

County/Parish: Miami-Dade

* State: FL: Florida

Province:

* Country: USA: UNITED STATES

* Zip / Postal Code: 33199-0001

e. Organizational Unit:

Department Name:

Division Name:

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

Prefix: Dr.

* First Name: Haiyan

Middle Name:

* Last Name: Jiang

Suffix:

Title: Assistant Professor

Organizational Affiliation: Earth & Environment

* Telephone Number: 305-348-2984

Fax Number: 305-348-3877

* Email: haiyan.jiang@fiu.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:

S: Hispanic-serving Institution

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.):

AreasAffected.pdf | Add Attachment | Delete Attachment | View Attachment

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

Improvement to the Satellite-based 37 GHz Ring Rapid Intensification Index

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-021 | b. Program/Project: FL-021

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	141,903.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	141,903.00

*** 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: Mr. | * First Name: Roberto

Middle Name:

* Last Name: Gutierrez

Suffix:

* Title: Director, Pre-Award

* Telephone Number: 305-348-2494 | Fax Number: 305-348-4117

* Email: gutierrr@fiu.edu

* Signature of Authorized Representative: Roberto Gutierrez | * 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. FY 2013 Joint Hurricane Testbed	11.459	$	$	$ 141,903.00	$ 0.00	$ 141,903.00
2.						
3.						
4.						
5. Totals		$	$	$ 141,903.00	$	$ 141,903.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	FY 2013 Joint Hurricane Testbed				
a. Personnel	$ 69,887.00	$	$	$	$ 69,887.00
b. Fringe Benefits	20,777.00				20,777.00
c. Travel	5,200.00				5,200.00
d. Equipment					
e. Supplies	2,000.00				2,000.00
f. Contractual					
g. Construction					
h. Other					
i. Total Direct Charges (sum of 6a-6h)	97,864.00				$ 97,864.00
j. Indirect Charges	44,039.00				$ 44,039.00
k. TOTALS (sum of 6i and 6j)	$ 141,903.00	$	$	$	$ 141,903.00
7. Program Income	$ 0.00	$	$	$	$

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Prescribed by OMB (Circular A -102) Page 1A

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. FY 2013 Joint Hurricane Testbed	$ 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	$ 69,980.00	$ 6,330.00	$ 6,330.00	$ 28,660.00	$ 28,660.00
14. Non-Federal	$	0.00	0.00	0.00	0.00
15. TOTAL (sum of lines 13 and 14)	$ 69,980.00	$ 6,330.00	$ 6,330.00	$ 28,660.00	$ 28,660.00

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. FY 2013 Joint Hurricane Testbed	$ 71,923.00	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 71,923.00	$	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges:

22. Indirect Charges: Provisional-7/1/11, 45% x $97864 = $44039

23. Remarks:

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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
Roberto Gutierrez	Director, Pre-Award
* APPLICANT ORGANIZATION	* DATE SUBMITTED
Florida International University Board of Trustees	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

Florida International University Board of Trustees

* AWARD NUMBER

* PROJECT NAME

Improvement to the Satellite-based 37 GHz Ring Rapid Intensi

Prefix: Mr.

* First Name: Roberto

Middle Name:

* Last Name: Gutierrez

Suffix:

* Title: Director, Pre-Award

* SIGNATURE: Roberto Gutierrez

* DATE: 12/07/2012

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C.1352

Approved by OMB
0348-0046

1. * Type of Federal Action:
- [ ] a. contract
- [x] b. grant
- [ ] c. cooperative agreement
- [ ] d. loan
- [ ] e. loan guarantee
- [ ] f. loan insurance

2. * Status of Federal Action:
- [ ] a. bid/offer/application
- [x] b. initial award
- [ ] c. post-award

3. * Report Type:
- [x] a. initial filing
- [ ] b. material change

4. Name and Address of Reporting Entity:

[x] Prime [ ] SubAwardee

** Name* Florida International Unviersity

** Street 1* 11200 SW 8th Street *Street 2*

** City* Miami *State* FL: Florida *Zip* 33199-0001

Congressional District, if known: FL-021

5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime:

6. * Federal Department/Agency:
Department of Commerce

7. * Federal Program Name/Description:
Weather and Air Quality Research

CFDA Number, *if applicable:* 11.459

8. Federal Action Number, *if known:*

9. Award Amount, *if known:*
$

10. a. Name and Address of Lobbying Registrant:

Prefix ** First Name* na *Middle Name*

** Last Name* na *Suffix*

** Street 1* *Street 2*

** City* *State* *Zip*

b. Individual Performing Services (including address if different from No. 10a)

Prefix ** First Name* na *Middle Name*

** Last Name* na *Suffix*

** Street 1* *Street 2*

** City* *State* *Zip*

11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

*** Signature:** Roberto Gutierrez

***Name:** *Prefix* Mr. ** First Name* Roberto *Middle Name*

** Last Name* Gutierrez *Suffix*

Title: Director, Pre-Award **Telephone No.:** 305-348-2494 **Date:** 12/07/2012

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