Anticipated in Year 2

- Conduct a detailed observational study of structure variations of Atlantic and East Pacific tropical cyclones (1995-2011)
    - What environmental factors are responsible for TC growth?
    - Is the purported relationship between environmental relative humidity verified by observations?
    - What is the climatology of TC size?
    - Can forecasts of the environment be used to forecast TC structure changes?
- Finish radius of maximum wind climatology by using aircraft-based wind analyses to document how the RMW evolves
    - What is the climatology of RMW with respect to intensification, location, pedigree?
    - What environmental factors influence RMW?
- Sensitivity tests with WRF
    - What are the sensitivities to microphysical schemes and vertical resolutions?
    - How do necessary assumptions (microphysical) affect the generation of synthetic ABI radiances?
- Modeling TC structure change
    - What are the physical causes of observational relationships discovered in year1 and year 2?
    - Can empirical models for storm size prediction be developed?
- Documentation of results in referred journals.

Feedback from Potential Users

Understanding the processes that modify structure, including size and intensity of the wind field has become every important as tropical cyclone track forecasting has dramatically improved over the last decade. There are a number of public and private enterprises that have voiced interest in the prospect of 1) developing climatologies of tropical cyclone size and 2) developing forecast methods for tropical cyclone size change, in particular statistical methods to complement successes of intensity forecasts. These are motivated by efforts in tropical cyclone risk, storm surge, and operational watch/warning practices and the following facts:

1. Statistical analysis of tropical cyclone damage (the Willis Hurricane Index) shows that duration of hurricane force winds rather than intensity is best related to sustained damages; implying that storm translation speed and size matter more that the traditional metric of maximum wind speed (personal communication Greg Holland 2012)
2. The potential for tropical cyclone storm surge at landfall is better related to the kinetic energy of the wind field (e.g., Powell and Reinhold 2009)
3. Forecasts of wave heights, particularly 12 ft seas that adversely affect naval operations, are dependent on accurate depictions of the wind field, including accurate estimates of RMW, TC size and strongly correlated wind radii of significant winds (see Sampson et al. 2010)
4. From estimates of TC size central pressure estimates can be made (see Knaff and Zehr 2007), which offer another metric for tropical cyclone intensity – one that is better related to kinetic energy and is more commonly used for initialization of storm surge and rick modeling activities.
5. Routing estimates of TC size using IR data and storm characteristics can be used to better refine the Advanced Dvorak Technique (Olander and Velden 2007), which currently uses operational estimates of TC size. Noting that operational errors are on the order of 40% (personal communication, James Franklin) and are often inconstant due to data availability.

What is Possible with Year-3 Funding?

Third year funding, if available, would be used to develop to use the research and techniques developed in the first two years of the work in order to develop techniques that estimate and predict tropical cyclone size changes. Such methods would be complementary to operational statistical hurricane forecasting systems (i.e., the Statistical Hurricane Intensity Prediction Scheme and the Logistic Growth Model) and the Advanced Dvorak Technique/ Hurricane Intensity Estimate and thus would provide a relatively easy path to operations. Two specific tasks are shown below.

TC SIZE FORECASTS

* ATLANTIC SHIPS INTENSITY FORECAST *
* GOES AVAILABLE, OHC AVAILABLE *
* IRENE AL092011 08/22/11 12 UTC *

TIME (HR)	0	6	12	18	24	36	48	60	72	84	96	108	120
V (KT) NO LAND	70	76	81	84	88	92	92	96	100	102	100	99	92
V (KT) LAND	70	76	81	84	88	92	92	96	100	102	100	99	62
V (KT) LGE mod	70	77	82	85	86	86	86	87	90	92	93	93	62
Storm Type	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP
MSLP (MB)	989	975	970	966	965	960	960	952	947	943	946	943	946
AVG R34 (N MI)	95	105	105	100	105	120	115	115	120	135	135	145	140
AVG R50 (N MI)	40	45	45	45	50	55	55	60	65	70	70	75	75
AVG R64 (N MI)	25	25	25	25	25	30	30	35	35	35	35	40	35

ADVANCED DVORAK TECHNIQUE

Currently the TC size used for the estimation of MSLP within the ADT/HIE is a function of the radius of gales (R34) or the radius of outer closed isobar (ROCI). R34 and ROCI are quanties that vary in quality for the global ADT applications. An infarred imagery-based estimate could more directly estimate size parameters need for the Knaff and Zehr (2007) wind pressure relationship. Such changes could result in improved MSLP estimates from ADT.

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