



Risk
Prediction
Initiative

Annual Report 2015

Bermuda Institute of Ocean Sciences
rpi.bios.edu www.bios.edu

BIOS 

The Risk Prediction Initiative (RPI) is a non-profit industry membership organization, operating for more than 20 years at the Bermuda Institute of Ocean Sciences (BIOS). BIOS is an independent U.S. not-for-profit marine research and educational organization with 501(c)(3) status, and a Bermuda Registered Charity (#116). RPI re/insurance industry members select and guide scientific research at host academic institutions, which investigate catastrophic risk from natural hazards. Through synergistic funding for targeted research, and the development of operational tools and datasets, RPI answers the questions the industry is asking about the variability of natural catastrophe risk. RPI communicates this research through Member workshops and company meetings, with the goal of informing decision-making on business-relevant timescales. Through our publications, student mentoring, and outreach activities, RPI educates and benefits a wider society about the field of disaster risk assessment.

RPI Member Companies 2015



PartnerRe



As we move into the next phase of risk science, RPI will focus on research which allows us to operationalize datasets, and develop tools for model validation. Our strengths have traditionally been in weather and climate variability, associated with risks of interest to property catastrophe re/insurance. These core areas will remain our focus. However, this year, RPI has added expertise and experience in geohazards, and will begin to engage more with alternative risk markets. Additionally, we have expanded our outreach efforts by working more with university interns through our connections within BIOS, including student projects, and fostering a subset of our work to examine Bermuda-centric risks. With additional research themes in mind, closer linkages to science and education within BIOS, and the scope to work with more of the ILS market, we have moved beyond RPI2.0. Welcome to the new:



Contents

- 3 Selected Research and Collaborative Initiative
- 4 Newly Funded RPI Research Bermuda Risk
- 9 RPI Events
- 11 Students & Outreach
- 12 Publications
- 13 General Information

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Selected Research and Collaborative Initiatives

U.S. Wind and Flood

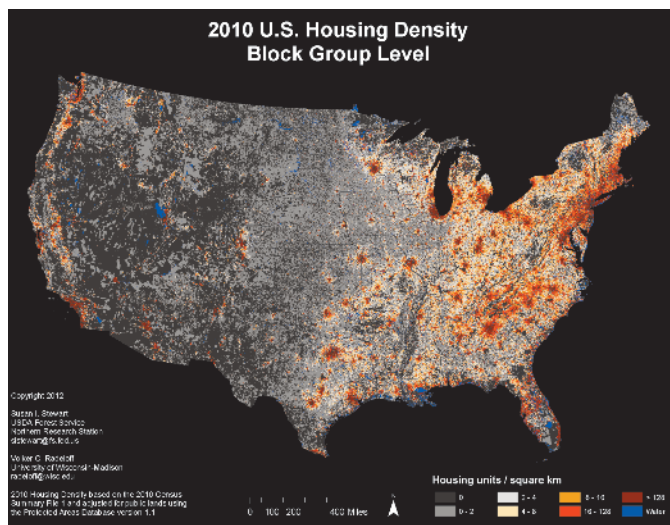
One of the key regions for insured catastrophe risk is the United States, with large concentrations of exposure at the coast, and insured risks resulting from hurricane, inland flooding, tornado/hail and seismic hazards.

In the last year, we have examined Atlantic hurricane landfall variability and predictability, as well as changes of exposure to inundation from storm surge, in the context of sea level rise and changing coastal populations. Research projects conducted during 2015 that developed insights into these subjects included:

Tropical Cyclone and Major Hurricane Return Periods from a Probabilistic Model of Hurricane Activity, by Dr. Amato T. Evan, Scripps Institution of Oceanography/University of California, San Diego

Evolution of Some Factors Influencing U.S. TC Landfall Probability: Formation Location, Steering, and TC-EC Interaction By Prof. Robert Hart, Florida State University

A Granular National Assessment of Coastal Flood Exposure Growth By: Dr. Ben Strauss - Climate Central
Development of an Improved Database of Tropical Cyclone Size Parameters By Dr. Jonathan L. Vigh, University Corporation for Atmospheric Research



RPI also explored questions focused on the variability of US tornado risk. In the following projects, we examined not only the climatological conditions that favor the development of tornadoes, and their preferred impact locations, but also their potential to inflict damage. Recent projects which RPI has funded on US tornado activity are listed below:

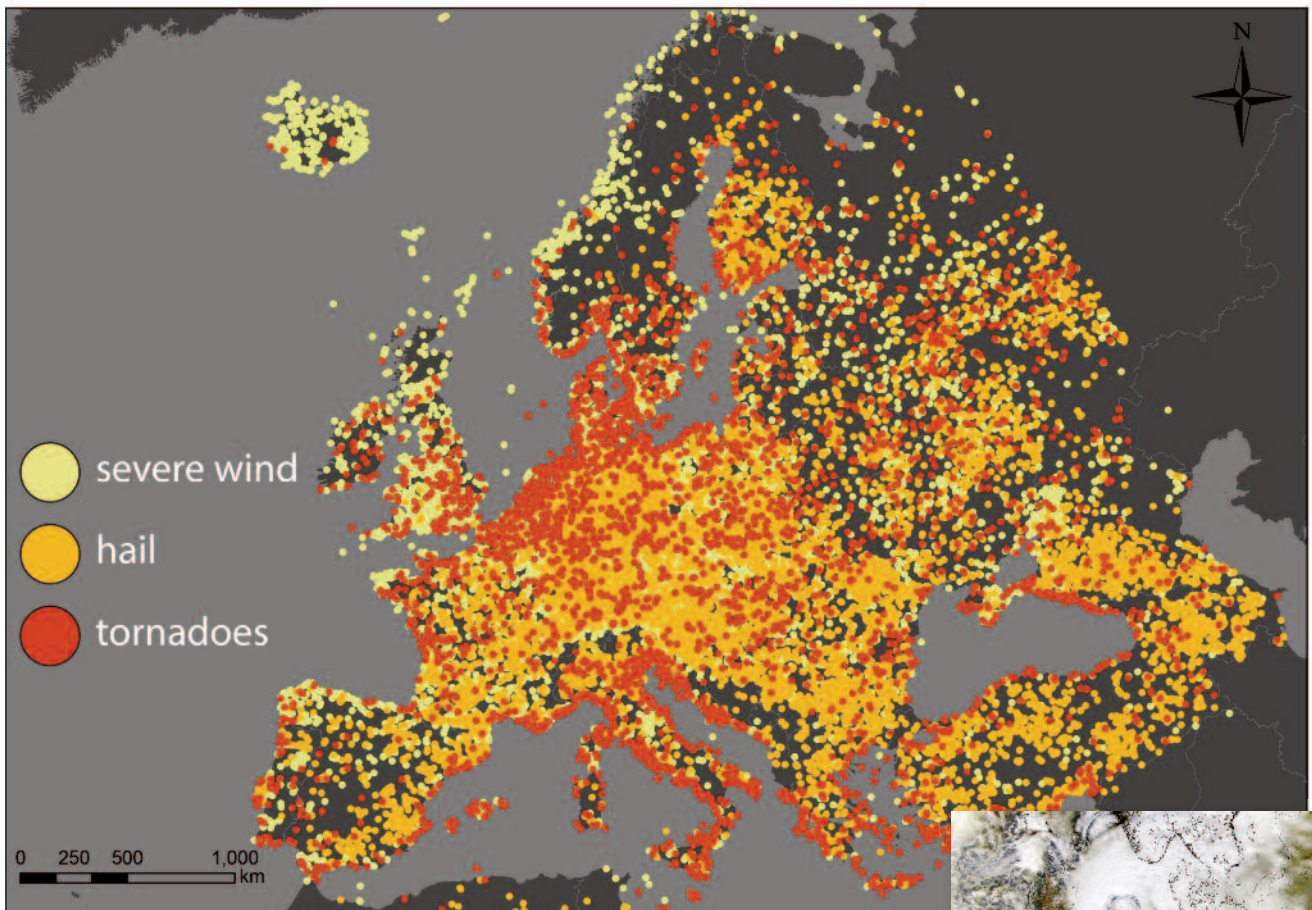
Prediction Models for Tornado Activity by: Prof. James Elsner - Florida State University

An Engineering Based Catastrophe Model to Predict Tornado Damage - Dr. David Prevatt, University of Florida

The last major hurricane to make landfall in the United States was Hurricane Wilma in October 2005. This decade long 'drought' in the landfall of major hurricanes has been the subject of discussion in the meteorological community, the media, and the risk industry. RPI sponsored and organized a workshop in London to discuss this ongoing major hurricane landfall 'drought' in the United States as well as other topics aimed at determining periods of higher variability on a decadal and sub-decadal scales.

Academic experts from our network of scientists and risk analysts from our Member companies presented their perspectives on the recent lull in major hurricane landfall in the United States. Three attendees at this workshop (Hart, Chavas, Guishard) decided to examine the sensitivity of the 'drought' definition to the metric chosen, and concluded a short study with a publication:

Hart, R., Chavas D., and Guishard, M., **The arbitrary definition of the current Atlantic major hurricane landfall drought**, Bull. American Meteorological Society, Early Online Release, October 2015.

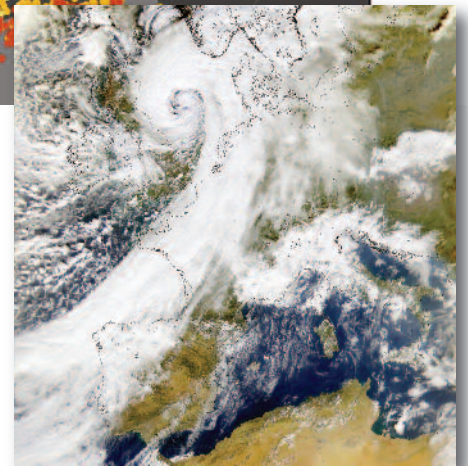


Europe Wind

Damaging winds from winter storms in Europe have been a focus of RPI work for several years. We continue to examine variability of this significant risk by funding the following research, which will conclude in early 2016. Datasets and statistical code will address annual (as well as seasonal) aggregation. The project on **Seasonal Extratropical Storm Clustering** by Dr. Gregor C. Leckebusch & Prof. Uwe Ulbrich (University of Birmingham & Freie Universitat Berlin, respectively) continues to reveal insights into insurance-relevant clustering.

Additionally, risk analysts have been interested in the contribution to the overall risk profile in Europe of severe convective storms, including tornadoes, hail events, and extremes in wind speeds. Our newly-funded project centers on the tail of the

damage distribution, by examining European severe convective events, and delivering footprint reconstructions of worst-case historical scenarios in the last 150 years. the project entitled, **What's the Worst That Can Happen? Re-examining the Most Destructive Convective Storms over Europe**, is being conducted by Prof. David Schultz and colleagues at the University of Manchester.



Above: Historical instances of severe weather in Europe. Source: Dr. Bogdan Antonescu, University of Manchester

Asia Typhoon and Tsunami

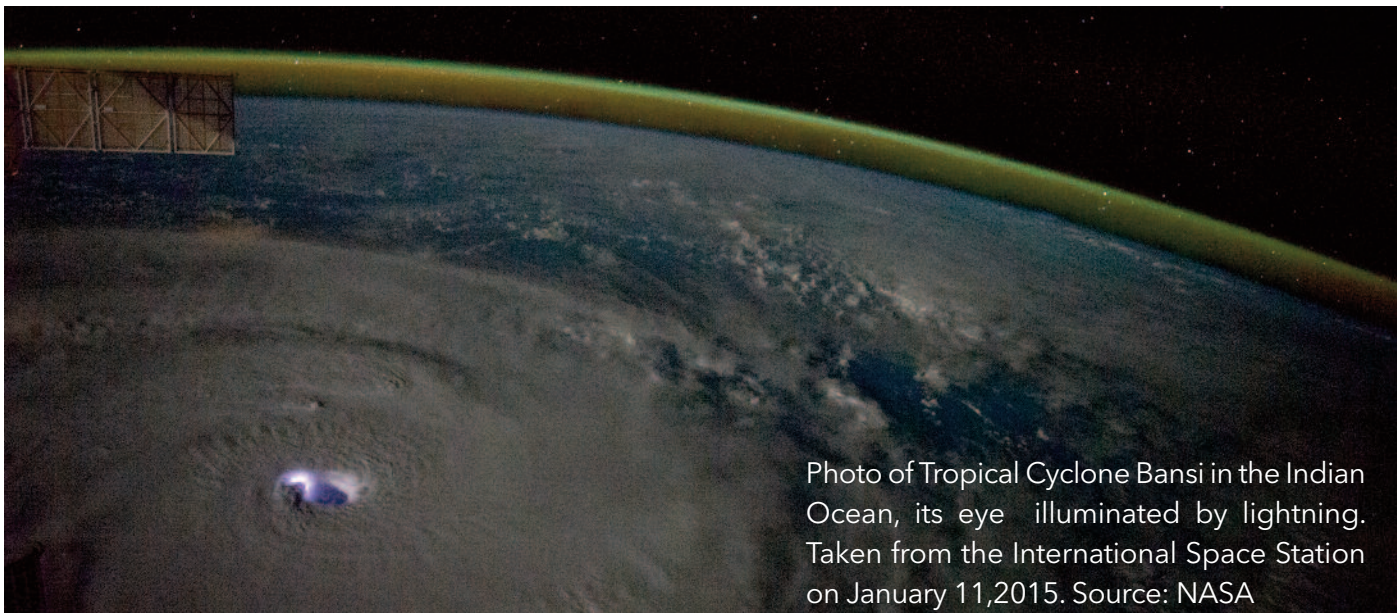


Photo of Tropical Cyclone Bansi in the Indian Ocean, its eye illuminated by lightning. Taken from the International Space Station on January 11, 2015. Source: NASA

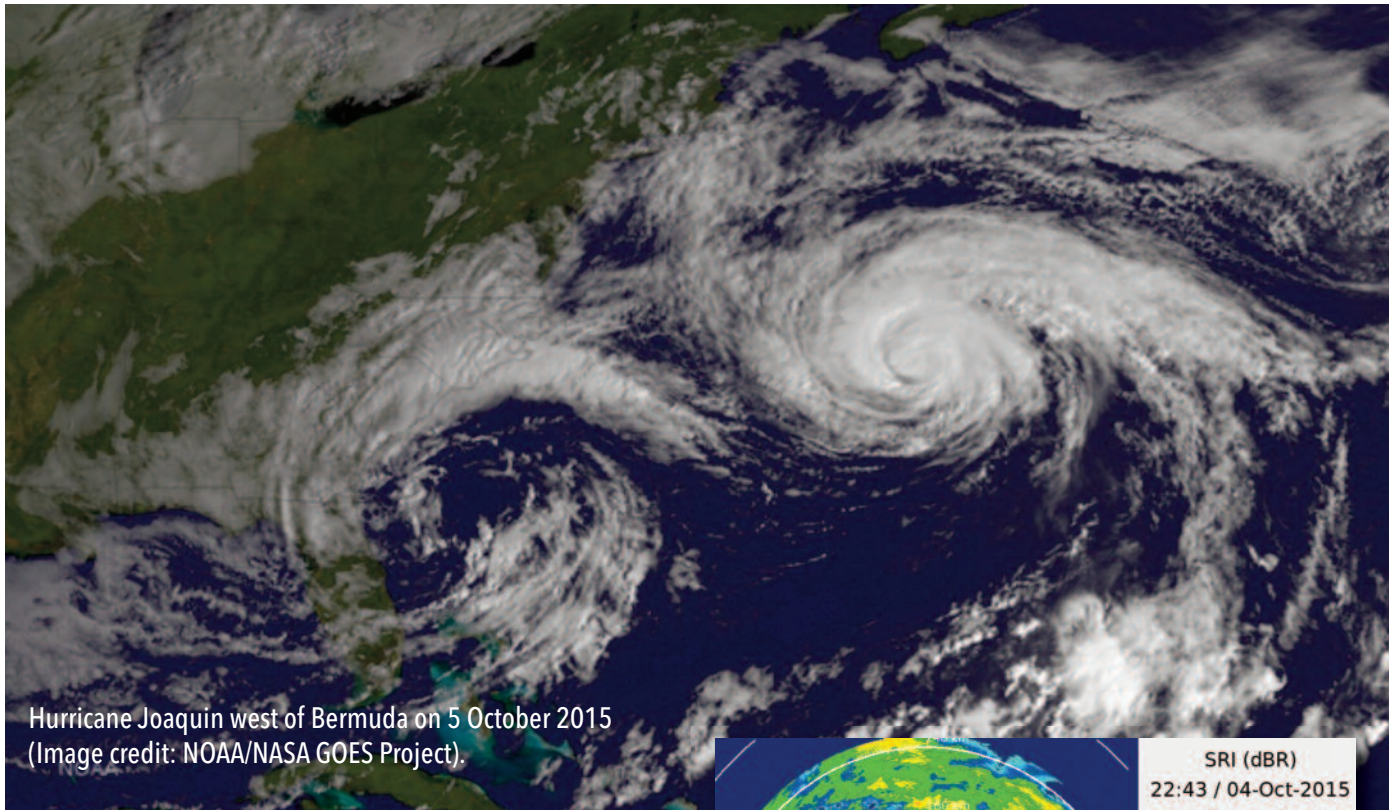
Asia is host to both traditional and emerging risk markets, and we have been able to leverage the expertise of our academic network into research that enhances the available data for this complex region.

RPI Members agreed the support ongoing work of Cyclone Center, whose goal is to improve the tropical cyclone intensity record via a crowd-sourced approach. Cyclone Center facilitates multiple intensity estimates by educating amateur analysts on how to classify tropical cyclones, and allowing them to submit their analysis. This is a useful approach for assessing tropical cyclones with few or no intensity estimate data points other than satellite retrievals.

In 2015 RPI funded a project entitled Cyclone Center: **Toward a Global Reanalysis of the Tropical Cyclone Record**, undertaken by Dr. Chris Hennon of UNC Asheville. This 'crowd-sourcing' of intensity estimates enables the development of a distribution of wind speed probabilities, rather than a sole source. This is particularly valuable for the Pacific, where areas of typhoon impact can vary from devoid of data to multiple agencies making conflicting estimates of intensity.

Augmenting existing windstorm research for Asia, RPI has supported work that examines coastal inundation from storm surge and tsunamis. A different perspective is revealed upon examination of the geologic record for evidence of intense typhoon landfall, as was done in southwestern Japan. This approach has yielded millennial-scale return periods of major typhoons for Japan, augmenting the existing historical database. RPI research in this field has recently been published on **Depositional Evidence for the Kamikaze Typhoons and Links to Changes in Typhoon Climatology**; also in preparation is a publication on the Sedimentological record of the C.E. 1707 Hoei Tsunami from the Bungo Channel, southwestern Japan. These pieces of work result from RPI projects conducted in 2013/14 by Dr. Jonathan Woodruff and colleagues at the University of Massachusetts.

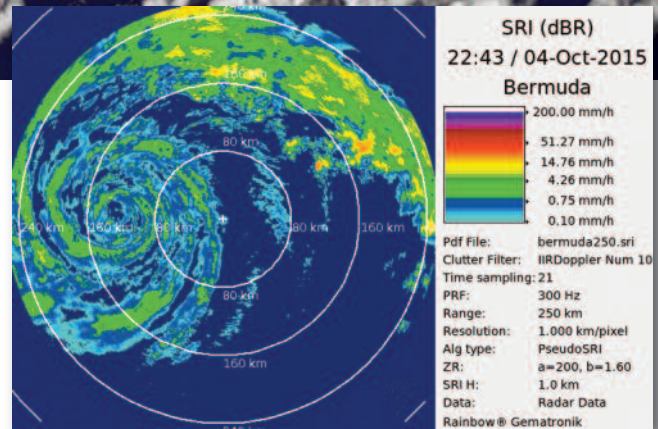
Leveraging some recent research on inland flood risk by Dr. Philip Ward of VU Amsterdam, **Strong Influence of El Niño Southern Oscillation on Flood Risk Around the World** along with previous work on typhoon landfall variability, RPI has been able to develop short reports on specific flood risks for Chinese exposure.



BermudaRisk

In 2015, RPI Member companies and local sponsors agreed to fund a project entitled **Additional Chronology for Spittal Pond and Mangrove Lake Hurricane Reconstructions**, by the University of Southern Mississippi's Dr. Davin Wallace. The purpose of the research is to reconstruct a pre-historical record of hurricanes in Bermuda, using information gained from examinations of sediments deposited by storm surges and waves in two inland water bodies.

Additionally, efforts were led by RPI to conduct an examination on the environmental conditions and impacts following Hurricane Joaquin's passage near Bermuda in October 2015. Underwater glider data procured by BIOS's Mid-Atlantic Glider Initiative and Collaborative (MAGIC lab) of near-surface temperatures collected during Hurricane Joaquin also added to the understanding of interactions between hurricanes and the ocean.



Doppler Radar imagery of Category 2 Hurricane Joaquin, with the eye approaching its nearest passage to Bermuda (Source: Bermuda Weather Service).

Through these new efforts and collaborations, RPI secured sponsorship from local organizations to promote disaster risk reduction and foster an interest in hurricane data.

BermudaRisk's first report was authored in November of 2015, by RPI staff Dr. John Wardman and Dr. Mark Guishard on **Hurricane Preparedness in Bermuda: Impacts to Critical Infrastructure and Primary Industries from Hurricane Joaquin**.

RPI Events

Hosted Workshops

RPI hosts science/industry workshops for the benefit of its Members, and to facilitate feedback to scientists who want to enhance the applicability of their research into natural hazards.

In late September 2015, RPI hosted another of its annual **Research Update Workshop** in Bermuda. RPI researchers attended to present their progress and gather feedback from Member companies on their work. This collaborative event is useful for developing questions and solutions for risk analysis and scientific scrutiny.

Meetings Attended

In addition to the workshops RPI conducts, Members receive the benefit of having at least one in-house event at their company to delve deeper into the science of a chosen topic. In most cases, the in-house meeting will involve representatives from RPI, plus at least one invited science speaker. Traditionally, these meetings entail a detailed examination of an RPI-funded project, but in some instances, Members companies may wish to obtain a new perspective on a field that is not actively being currently supported by RPI. In other cases, RPI presents specific subject material to investors or at client conferences on behalf of Member companies. In 2015, RPI delivered several in-house meetings to its Members in Zurich, London, New York, Boston, Illinois, and of course, Bermuda.

RPI also attends science and industry conferences to keep abreast of current insurance issues and cutting edge science. This also enables us to network with existing and prospective Members. By combining conference and meeting travel, we are able to leverage the availability of Members and academics who may be in a given region for a scientific or industry meeting (incidentally, also making these productive trips cost-effective).

For each academic conference we visit, RPI produces a meeting summary to report any specific items that may be of interest to Members. In 2015, RPI attended three academic events, and produced reports for our Member companies to summarize the state of the science presented. In addition to these meetings, RPI was represented at industry events and conferences.

- Bermuda Business Development Agency Reception and Dinner at SIFMA IRLS 2015 - March 5, 2015, New York City, NY
- 3rd Workshop on Private Sector Climate Change Adaptation and CICS-NC's third Executive Forum on Business and Climate, March 19-20, 2015, University of North Carolina Center for Law, Environment, Adaptation and Resources (CLEAR)
- 5th International Summit on Hurricanes and Climate Change, June 9-14, Chania, Crete
- Oasis Bermuda Seminar: ARA's Hurloss US Wind-storm model now available in Oasis, October 7, 2015, RenaissanceRe, Hamilton, Bermuda
- ILS Bermuda Convergence 2015, November 11-13, 2015, Hamilton Bermuda
- American Geophysical Union 2015 Fall Meeting, San Francisco, December 14-18, 2015



RPI has been a consistent supporter of the International Summits on Hurricanes and Climate Change, spearheaded since 2007 by RPI researcher Prof. James Elsner. This year, as Prof. Elsner shifted his meeting focus to tornadoes, Dr. Rick Murnane (former Program Manager of RPI) co-organized of the 5th Summit in Crete. Dr. Mark Guishard, current head of RPI, presented and assisted with this summit, and we also supported the attendance of RPI researchers Dr. Dan Chavas of Princeton and Dr. Louis-Philippe Caron of IC3 Barcelona.

Students & Outreach

This year we have expanded our outreach program and linked more intimately with BIOS activities. We began a specific focus on fostering students in work related to risk management and natural hazard science. RPI is engaged in exposing students and young scientists to careers in re/insurance and risk analysis to augment their academic coursework. We believe the way forward in both sectors is more interdisciplinary connections. With this in mind, RPI was represented at the following recent events.

Dr. Mark Guishard presented at Penn State's Meteorology departmental seminar in conjunction with their Center for Solutions to Weather and Climate Risk, on Oceans, Hurricanes and Risk in October 2014. He also gave a talk to the Students' Weather Risk Club and the local students' chapter of the American Meteorological Society on meteorology

and re/insurance industry.

In terms of Bermuda outreach, RPI has given several talks to members of the public and mentored local students at BIOS and other institutions. Examples of groups we have spoken to in the last year include:

- BIOS & Appalachian State University - Business and Society in Bermuda - Re/insurance, Risk and Catastrophe Modelling, May 2015
- BIOS & Furman University - Oceans and Human Health course - Marine Disasters, May 2015
- BIOS & Lehigh University The Future of Sustainability: Wave Energy course - Natural Disasters and Alternative Energy, June 2015
- Probus - a Bermuda-based group of retired business-people, October 2015
- Bermuda College - The Atmosphere: Weather & Climate class, November 2015
- Bermuda High School - Career Fair, December 2015



RPI has mentored students through BIOS's Bermuda Program, a summer internship for local university students. During these internships, this past summer, three Bermudian students had introductions to meteorology, re/insurance, climate change and catastrophe modeling. They undertook short research projects to develop their data analysis skills and science communications abilities. These projects included research into local weather and its correlation with asthma occurrence and the exploration of the validity of shark oil barometers, a traditional Bermuda fishermen's forecasting tool.

Publications in 2015

Caron, L.-P., L. Hermanson and F.J. Doblas-Reyes (2015). Multi-annual forecasts of Atlantic U.S. tropical cyclone wind damage potential. *Geophysical Research Letters*, doi:10.1002/2015GL063303.

Chavas, D.R., and J. Vigh, 2014: QSCAT-R: The QuikSCAT Tropical Cyclone Radial Structure Dataset. NCAR Technical Note NCAR/TN-513+STR, 25 pp, DOI: 10.5065/D6J67DZ4.

Curry R and Guishard M (2015) Upper Ocean Observations During Hurricane Gonzalo: Cold Wake Interactions and Inertial Currents, poster at the 5th International Summit on Hurricanes and Climate Change, Crete, Greece, June 2015

Hart, R., D. Chavas, and M. Guishard, 2015: The arbitrary definition of the current Atlantic major hurricane landfall drought. *Bull. Amer. Meteor. Soc.* doi:10.1175/BAMS-D-15-00185.1, October 2015.

Christopher C. Hennon, Kenneth R. Knapp, Carl J. Schreck III, Scott E. Stevens, James P. Kossin, Peter W. Thorne, Paula A. Hennon, Michael C. Kruk, Jared Rennie, Jean-Maurice Gadéa, Maximilian Striegl, and Ian Carley, 2015: Cyclone Center: Can Citizen Scientists Improve Tropical Cyclone Intensity Records?. *Bull. Amer. Meteor. Soc.*, 96, 591–607; doi: <http://dx.doi.org/10.1175/BAMS-D-13-00152.1>

Vigh, J., 2015: VDM+: The Enhanced Vortex Message Dataset: Structure, Intensity, and Environmental Parameters from Atlantic Tropical Cyclones. NCAR Technical Note NCAR/TN-517+STR, 72 pp, doi:10.5065/D6PR7T26.

Woodruff J.D., K. Kanamaru, S. Kundu and T.L. Cook. Depositional evidence for the Kamikaze typhoons and links to changes in typhoon climatology. *Geology* December 4, 2014, doi: 10.1130/G36209.1

RPI Reports

Guishard, M.P., 5th International Summit on Hurricanes and Climate Change, June 2015

Guishard, M.P., Proceedings of the Workshop on Atlantic Hurricane Volatility, September 2015

Wardman, J., Volcanic Hazards and Selected Impacts to Critical Infrastructure, Feb 2015

Wardman, J. and Guishard M.P., Bermuda Risk Report: Hurricane Preparedness in Bermuda: Impacts to Critical Infrastructure and Primary Industries from Hurricane Joaquin, December 2015

Key Personnel

RPI had a few changes in personnel in the last year, expanding our expertise and developing capacity to undertake more work on behalf of the RPI Members. We welcome Dr. John Wardman as our new Science Program Coordinator, who has expertise in geologic hazards and disaster management.

Dr. Mark Guishard, BIOS Director of Corporate and Community Relations

Dr. John Wardman, Science Program Coordinator

Charles King, M.Aq., Research Specialist; Web, Communications and Data Management

Contact Information

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Membership Levels

- **RPI Bronze Membership - \$65K/year**

The basic subscription includes Member-only access to current and past research projects and reports, one in-house presentation, data/modelling deliverables, and your corporate logo displayed prominently on the RPI website. These services are also included in Silver and Gold membership.

- **RPI Silver Membership - \$85K/year**

The Silver Membership facilitates more access to the researchers, with a view to developing more targeted and specific research deliverables and reports. There are two additional in-house events, one of which includes attendance by an independent scientist.

- **RPI Gold Membership - \$125K/year**

This membership level includes specific support for a graduate student at one of our world-renowned partner universities, or an internship in a relevant discipline. In addition, quarterly visits to your company will be made, two of which include attendance by an independent scientist.



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