Researcher part of team studying ways to better predict intensity of hurricanes

July 25 2014

They are something we take very seriously in Florida – hurricanes. The names roll off the tongue like a list of villains – Andrew, Charlie, Frances and Wilma.

In the past 25 years or so, experts have gradually been improving prediction of the course a storm may take. This is thanks to tremendous advancements in computer and satellite technology. While we still have the "cone of uncertainty" we've become familiar with watching television weather reports, today's models are more accurate than they used to be.

The one area, however, where there is still much more to be researched and learned is in predicting just how intense a storm may be. While hurricane hunter aircraft can help determine wind speed, velocity, water temperature and other data, the fact is we often don't know why or how a storm gets stronger or weaker. There has been virtually no progress in hurricane intensity forecasting during the last quarter century.

But, thanks to new research being conducted, all that's about to change.

"The air-water interface – whether it had significant waves or significant spray – is a big factor in storm intensity," said Alex Soloviev, Ph.D., a professor at Nova Southeastern University's Oceanographic Center. "Hurricanes gain heat energy through the interface and they lose mechanical energy at the interface."

Soloviev is also an Adjunct Professor at the University of Miami Rosenstiel School of Marine and Atmospheric Science (UM RSMAS) and a Fellow at the Cooperative Institute for Marine and Atmospheric Studies (CIMAS.) He and his fellow researchers used a computational fluid dynamics model to simulate microstructure of the air-sea interface under hurricane force winds. In order to verify these computer-generated results, the group conducted experiments at the UM's Rosenstiel School Air-Sea Interaction Salt Water Tank (ASIST) where they simulated wind speed and ocean surface conditions found during hurricanes.

The study "The Air-Sea Interface and Surface Stress Under Tropical Cyclones" was published in the June 16, 2014 issue of the journal *Nature Scientific Reports*. Soloviev was the lead author of this study, which was conducted by a multi-institutional team including Roger Lukas (University of Hawaii), Mark Donelan and Brian Haus (UM RSMAS), and Isaac Ginis (University of Rhode Island.)

The researchers were surprised at what they found.

Under hurricane force wind, the air-water interface was producing projectiles fragmenting into sub millimeter scale water droplets. This process is known from some engineering applications, including rocket science, as the Kelvin-Helmholtz (KH) instability. This new study then looked at how changes in microphysics of the air-sea interface can make a storm grow or weaken in intensity. With wind speed exceeding a Category 1 threshold, the ocean surface unexpectedly became more "slippery."

When the wind exceeded Category 3 hurricane force, the "slippery" effect started gradually disappearing and was completely gone at Category 5. The conclusion was that some hurricanes might rapidly intensify to Category 3 and then stay in a "comfortable" zone around Category 3 status. This finding is consistent with the global best-track

tropical cyclone statistics on maximum intensity for 1982-2009. So far, these early results showed that physical conditions where the air and the ocean interact must be a vital part of any successful hurricane forecasting model and would help explain, and predict, how a storm might intensify as it moves through across the water based on the physical stress at the ocean's surface.

This work has been supported by the NOPP project "Advanced coupled atmosphere-wave-ocean modeling for improving tropical cyclone prediction models" (PIs: Isaac Ginis, URI and Shuyi Chen, UM) and by the Gulf of Mexico Research Initiative (GoMRI) Consortium for Advanced Research on the Transport of Hydrocarbons in the Environment – CARTHE (PI: Tamay Özgökmen, UM). GoMRI is a 10-year, $500 million independent research program established by an agreement between BP and the Gulf of Mexico Alliance.

The plan is for the team to continue their research and experiments at UM's Alfred C. Glassell, Jr. SUSTAIN facility, which has recently been designed by one of the *Nature* article co-authors, Brian Haus (UM). It's the unique lab facility where they can recreate the conditions found in a Category 5 storm.

"We've got more work to do, but this is a great first step," Soloviev said. "But remember, no matter how good we get in predicting a storm's intensity, people in the path need to prepare accordingly regardless of what Category it is – that's most important."

More information: *Scientific Reports* 4, Article number: 5306 [DOI: 10.1038/srep05306](#)

Provided by Nova Southeastern University