Weather & Risk

COSMIC Hurricane Data:
Improving intensity forecasts with radio occultation from space

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I. Description

While hurricane-track forecasts have improved greatly, forecasting hurricane intensity has advanced little during the past 20 years. This lack of progress indicates that important forecast information is either missing or not well understood. One hypothesis for the poor intensity forecasts is that the initialization of water vapor in weather models may be incorrect for hurricane forecasts. In particular, poor measurements of water vapor may be an important reason for this problem. Water vapor fuels hurricane development, however measuring it over the oceans is difficult. Typically, atmospheric observations come from microwave and infrared (MW/IR) satellite instruments. These measurements, however, are often subject to large uncertainty because of the satellites’ coarse vertical resolution and clouds in the atmosphere, which pollute the images.

COSMIC, a constellation of six microsatellites launched in 2006, improves observational accuracy and vertical resolution of water vapor measurements over the tropics in all weather conditions. COSMIC’s specialized Global Positioning System receivers track signals from 24 U.S. GPS satellites. Using radio occultation (RO) techniques, COSMIC provides high-resolution atmospheric data in real time in support of weather forecasting and similar research. The soon-to-launch COSMIC-2 mission will provide 10 times more coverage than COSMIC-1. COSMIC observations, which complement traditional microwave and infrared satellite data, enhances model initialization of water vapor over oceans and in doing so will improve hurricane intensity forecasts.

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1 Radio occultation measures changes in the atmosphere’s physical properties (e.g., moisture or temperature) by detecting changes in the GPS signal as it passes through the atmosphere.
II. Stage of Research

UCAR scientists have done preliminary studies with COSMIC-1 RO data, obtaining promising results. Ongoing and further research includes:

- RO data quality control, observational error specifications
- Developing advanced (2D) observation operators for better RO assimilation in the lower troposphere over the tropics
- Coupling COSMIC data with ground-based GPS water vapor data from the Continuously Operating Caribbean GPS Observational Network (COCONET)
- Coupling COSMIC data with traditional satellite MW/IR total precipitable water or radiance data

UCAR scientists are working to demonstrate the value of COSMIC-2 data on hurricane forecasts using both regional and global high-resolution models in combination with other satellite data.

III. Advantages

This research leverages UCAR scientific expertise and leadership in:

- COSMIC data processing and RO science
- Data assimilation research
- Regional and global modeling
- Hurricane science

IV. Applications

- More-accurate estimation of water vapor over oceans
- Better RO data assimilation methodologies with regional and global numerical weather models
- Improved hurricane genesis, intensity, and track forecasts

V. Funding and IP Status

Primary: Taiwan government.

Seeking additional funding to do research on improving the quality of RO data and improving assimilation strategies using RO data, as well as demonstrating the impact of COSMIC-2 data on hurricane forecasting.

VI. Research Partners

Naval Research Laboratory – Monterey

Contact

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