Early use of 'hurricane hunter' data improves hurricane intensity predictions

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Data collected via airplane when a hurricane is developing can improve hurricane intensity predictions by up to 15 percent, according to Penn State researchers who have been working with the National Oceanic and Atmospheric Administration and the National Hurricane Center to put the new technique into practice.

Prior to this study, no hurricane prediction model incorporated the vast amount of data collected by 'hurricane hunters,' which are NOAA or U.S. Air Force airborne reconnaissance missions that fly into hurricanes to collect data.

"Hurricane hunting has existed in the U.S. since the 1940s, and planes have included on-board radar since the 1970s," said Yonghui Weng, meteorology research associate, Penn State. "Unfortunately, before our study, only a small portion of this radar data was being used in predictive hurricane models. Their main use was to probe the intensity and structure of the storm, and this information is given to forecasters."

Hurricane hunters initiate their first mission as soon as the hurricane is within flying distance, and they continue to fly missions to collect data throughout the duration of the hurricane. This data is fed into statistical and dynamical models that generate many variations of possible hurricane paths and intensity.

"Typically, aircrews use three different types of equipment—radar, on-plane sensors and devices dropped into the hurricane called

dropsondes—to collect data on the physical structure, wind speed, direction, temperature and moisture of storms," said Fuqing Zhang, professor of meteorology, Penn State. "Because of technological advances in data processing, statistical algorithm and scientific computing, we are now able to assimilate more of this data into prediction models than previously."

For example, prior to this study, the National Hurricane Center's hurricane prediction model used data collected from the outside portion of the storm but not the inner core.

Predicting a hurricane's path has increased in accuracy in the past few decades, but predicting intensity has been a longstanding challenge for researchers. Weng and Zhang investigated whether better use of hurricane hunter data could lead to improved intensity forecasts. They present their findings in an invited paper in the August issue of the *Journal of the Meteorological Society of Japan*, currently online.

Using Penn State's real-time hurricane prediction system, developed by Zhang's team, in particular Weng, they 'hindcasted,' or retroactively forecasted, the intensity and path of 23 hurricanes and tropical cyclones occurring between 2008 and 2012. Using one forecast with reconnaissance data and one without, they compared their predictions with the storm's actual path and intensity. Then in 2013 Weng and Zhang tested the use of reconnaissance data in real time with 11 storms.

For 2008 through 2012, the team found that airborne reconnaissance data reduced forecast errors by more than 10 percent for both wind speed and sea level pressure, two major components of a hurricane's intensity. In 2013, the Penn State model reduced forecast errors for wind speed and sea level pressure by between 5 and 15 percent, compared to existing models.

"In our study, we have demonstrated the benefit of integrating or incorporating reconnaissance data at an early stage into high-resolution weather prediction models through advanced data assimilation," said Zhang. "Improving forecasts even 5 to 15 percent could translate to billions of dollars in savings, and this also could help agencies provide more notice to people if they are in the path of a storm."

This is the third major hurricane prediction model improvement Zhang's team has investigated in recent years that has been transitioning to practice. They also showed that an ensemble-based approach, in which many variations of models are run to show uncertainty of predictions, and the use of on-plane Doppler improves forecasts, could improve predictions.

The team is now investigating whether better use of satellite data can further improve hurricane predictions.

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