



## **NOAA's Ongoing Work to Enhance Hurricane Program**

At the conclusion of each hurricane season NOAA conducts a review of operations and considers options to enhance its products and services. Following the annual post-season NOAA Hurricane Meeting that took place in November 2012, the NWS will be exploring two proposals that, if adopted, would result in some changes to National Weather Service (NWS) products and warnings. The first of these proposed changes originates from the unique situation posed by Hurricane Sandy; it would give the National Hurricane Center (NHC) the option to continue issuing formal advisories on post-tropical cyclones as long as those systems pose a significant threat to life and property, and it would give the NWS the option to keep hurricane and tropical storm watches and warnings in place for those systems. The second proposal would set a target date of 2015 for NOAA to implement explicit Storm Surge Watches and Warnings, a goal NOAA has been working toward for several years. The NWS Office of Climate, Weather, and Water Services (OCWWS) will review these two proposals in conjunction with a Hurricane Sandy service assessment and the NWS looks forward to continued engagement with its partners and users about these proposals.

Forecasts by the NWS of the track, intensity, storm surge and rainfall for both hurricanes Isaac and Sandy in 2012 were remarkably accurate and were largely well received by its customers and partners. During both events, extensive interactions between the NWS and emergency managers (EMs) resulted in EMs issuing evacuation instructions based on NWS storm surge forecasts. Both of the proposed changes noted above would further enhance the ability of the NWS to highlight the multiple hazards posed by tropical and post-tropical cyclones in the future.

Sandy posed some unprecedented forecast challenges, in addition to the expectation that it would affect a large portion of the U. S. with a wide array of hazards. Not only was it a massive hurricane as it approached the U. S., it was also forecast to lose its tropical characteristics and evolve into a wintertime low at some point prior to making landfall. The implications for NWS products and warnings, the continuity of information, and potential options for dealing with the transition were discussed within the NWS, and between the NWS and emergency managers, beginning five days before landfall. After considering many approaches, three days before Sandy reached the U.S. coast the NWS decided to communicate Sandy's specific impacts in the landfall area with NHC advisories, and with watches and warnings issued by local NWS Weather Forecast Offices. An overarching consideration in making this decision was the NWS understanding of the preference of the emergency management community that the warning type not change once watches and warnings were initiated, because that would

cause an unacceptable level of confusion and disruption during critical periods of preparation that included evacuations.

At the time hurricane watches would have been issued, about two to three days before landfall, the timing of the expected offshore transition to a post-tropical cyclone was uncertain. Based on current NWS policy and procedures, had the NWS used hurricane watches and warnings initially, and had Sandy become post-tropical well offshore, we would have had to choose from one of three unacceptable options:

One option would have been to follow existing protocol and transfer forecast responsibility to other NWS offices, cancel the hurricane warning, and switch to local Weather Forecast Office warnings. NHC advisories would have ceased. This would have caused widespread confusion, potentially impeded preparations and evacuations, and directly contradicted the desires and efforts of the EMs.

Another option would have been to continue to call Sandy a hurricane when it really wasn't one (potentially for a full day or two) in order to maintain NHC advisories and the hurricane warning. Intentionally misrepresenting Sandy as a hurricane would have severely damaged the credibility of the NWS and undermined its ability to serve the public for years to come.

A third option would have been to properly call Sandy post-tropical but continue to issue NHC advisories and leave up the hurricane warning. However, a procedure for disseminating post-tropical advisories with tropical warnings had never been developed, tested, or publicized, and the NWS feared that hurriedly crafting and implementing untested procedures could easily break automated vendor software and disrupt the flow of information to users at a crucial moment.

To avoid these possible outcomes and comply with EM preferences, the NWS decided to issue non-tropical warnings, communicating clearly this warning strategy to NWS partners, while placing special emphasis on Sandy's hazards, including via numerous interactions with federal, state, and local EMs and national and local media.

With the proposed changes, the NWS would eliminate the product and warning dilemma faced during Sandy, and have more options to handle any tropical or post-tropical cyclone in a more seamless fashion. The hurricane warning definition would be broadened to apply to systems after their tropical cyclone stage has ended, thus allowing hurricane or tropical storm watches and warnings to remain in effect for post-tropical cyclones. In addition, the NWS would ensure the continuity of service in any situation by allowing the NHC to issue advisories through the post-tropical cyclone stage as long as the system poses a significant threat to life and property.

A second proposal is to implement new NWS watches and warnings explicitly for the storm surge hazard by 2015. Tropical cyclones have killed more than 25,000 people in the continental United States, with a majority of those deaths attributable to storm surge. Except for the 1940s, storm surge claimed hundreds or even thousands of lives in at least one storm in each decade from at least as far back as the 1870s through the 1960s. More than a thousand lives again were lost in the decade just concluded,

with most of these attributable to Katrina's storm surge. And it was the surge hazard that caused numerous fatalities and most of the damage with Sandy, as well as the extensive evacuations necessary to prevent an even larger loss of life. Despite this history, multiple studies have shown significant confusion on the part of the public regarding their storm surge risk, and highlighted the need for improved communication of this hazard. With the implementation of a storm surge warning, the NWS will warn explicitly for the phenomenon that presents the greatest weather-related threat for a massive loss of life in a single day.

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