

**Senate Commerce Committee  
Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard**

**Improvements in Hurricane Forecasting and the Path Forward  
May 25, 2016**

**QFRs for Dr. Richard Knabb, Director of the National Hurricane Center**

**Response to Written Questions by the Honorable John Thune**

**Question 1.** *We have been monitoring the situation of the necessary relocation of NOAA's Aircraft Operations Center (AOC). Our understanding is that moving forward NOAA plans to award a short-term lease option on, or before, January 2017, that will not exceed 10 years. In order to retain AOC's highly specialized staff and meet the Atlantic hurricane mission requirements, NOAA has focused its short-term airfield and hangar options within 50 road miles of the MacDill AFB main gate. For the long-term solution, NOAA plans to initiate a Nationwide Business Case Analysis. If a nearby location for the long-term airfield and hangar solution cannot be found, what other locations would meet NOAA's mission requirements?*

**Answer:** NOAA's aircraft mission requirements cover many areas ranging from snow water equivalent detection, to air chemistry research, to winter storms, El Nino, and of, course, hurricanes. NOAA aircraft fly missions in areas spanning the entire United States, to include the central and eastern Pacific Ocean, and covering most of the Atlantic Ocean. Supporting NOAA's hurricane missions are arguably NOAA's most critical requirement and locating the NOAA aircraft Operations Center in the southeastern states, especially Florida, is most effective for meeting that particular mission. Extensive costs to "pre-stage" aircraft to be able to support the hurricane missions make other locations farther away from this region much less favorable and not affordable.

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**Response to Written Questions by The Honorable Marco Rubio**

**Question 1.** *Technology has taken us from a time where the only forecasting available was from the conditions fishermen and mariners were able to relay to shore, to a time of satellites, super computers, intelligent minds and a fleet of aircraft.*

- *What would you credit as the biggest advancement in hurricane forecasting?*

**Answer:** Multiple technological advancements during the past several decades have simultaneously contributed to our increased understanding of hurricanes and to improvements in our forecasting capabilities. Geostationary satellites arguably provide our forecasters with their most fundamentally critical observational data for monitoring all stages of a hurricane’s development and life cycle, leading to indispensable benefits to timely forecasts and warnings. Data from polar orbiting satellites are also extremely important, for our computer models to correctly depict and then forecast the state of the atmosphere on a larger scale, and these data also enhance human analyses of tropical cyclone internal structure and environmental factors that contribute to better forecasts. Advances in physical sciences knowledge, coupled with these improvements in observing, have also led to improvements in understanding and modeling. Aircraft reconnaissance data provide much needed smaller-scale data from within tropical cyclones and developing disturbances that are vital to our operational forecasts and warnings, and these data are also increasingly utilized by higher-resolution hurricane forecast models, including those currently in operational use and those still under development via programs like the Hurricane Forecast Improvement Project (HFIP). Overall, the combinations of advancements in satellite data observations, improvements in the understanding of the physical factors, and advanced computer model forecasts, augmented by aircraft reconnaissance in our areas of responsibility, have together produced the advancements in hurricane forecasting that we have seen and that we expect will continue.

**Question 2.** *Speaking of advancements, NOAA has been testing a small unmanned aircraft system (UAS) that is deployed directly from the P-3 Hurricane Hunter. This UAS, named “the Coyote,” is expected to better capture atmospheric data in areas of a storm where manned aircraft cannot travel. This technology is promising, especially as the costs of the unit can decrease.*

- *What is the status of the Coyote and its use for the 2016 season?*
- *Where do you see the technology taking us—what, in your opinion, is the next step in hurricane forecasting advancement?*

**Answer:** NOAA has six Coyote UAS aircraft available to test in 2016. The goal is to fly these Coyote into mature hurricanes and transmit critical data in real-time to NOAA's operational centers (National Hurricane Center and Environmental Modeling Center). While not currently a significant part of our operational analysis and forecasting process, operational forecasters can view and evaluate data from the Coyote, providing feedback to researchers. The goal for the NOAA UAS Coyote is to transform this promising R&D technology into a more economical operational tool. Operational forecasters are eager to see how this technology evolves, because platforms like the Coyote offer the potential to linger at specified flight levels and collect data in portions of the hurricane circulation where more data are needed more frequently. Modifying instruments currently used on the GPS dropsondes and integrating them with the targeted low level flight capabilities of the Coyote UAS has the potential to allow scientists to regularly and reliably sample the lowest regions of the hurricane for an hour or longer which could be valuable for increased understanding of hurricane physics, and ultimately operational model and forecast improvements. We still envision that the manned aircraft used by NOAA and the U. S. Air Force will continue to be our primary operational sources of aircraft data within hurricanes for the foreseeable future, due to many characteristics such as their fast speed, ability to survey a storm in the period of time needed for operational forecasts and warnings, and ability to carry a full payload of necessary instrumentation.

NOAA is pursuing other technological advancements that could prove important in advancing hurricane prediction, including the capability to enhance wind measurements in and around hurricanes through the use of Doppler Wind Laser Radar (Lidar) and evaluating the impact of real-time weather data gathered by the NASA Global Hawk Unmanned Aerial System on weather and hurricane prediction models.

We are also looking forward to the detailed data that will be available from GOES-R – which is scheduled to be launched later this fall.

**Question 3.** *I wholeheartedly agree that we need to be a Weather-Ready Nation, where our people, businesses and governments are prepared for, and able to respond quickly to, severe weather events.*

• *In terms of collaboration with federal, state and local officials, can you speak to how important those partnerships are, and what, if any gaps exist?*

**Answer:** The collaboration with federal, state, and local officials and the much broader community is essential to achieving a Weather-Ready Nation. We now have over 3,500 Weather-Ready Nation Ambassadors who are our partners, committed to working with NOAA and other Ambassadors to strengthen national resilience against extreme weather. In effect, the Weather-Ready Nation Ambassador initiative helps unify the efforts across government, non-profits, academia, and private industry toward making the nation more ready, responsive, and resilient against extreme environmental hazards. We are seeing much more weather awareness than ever before, and we are hoping this trend will continue as we realize our vision of a Weather-Ready Nation. Part of meeting this goal will be increased emphasis on social science research to complement NOAA's physical sciences research and operational activities. As an example of our proactive approach to promoting hurricane resilience, we

collaborated more closely than ever before with numerous Weather-Ready Nation Ambassadors in conducting the NOAA Hurricane Awareness Tour this past spring, resulting in increased media and public attention on tangible steps that individuals, families, and businesses must take well in advance of the next hurricane.