NOTICE: The Weather Focus Area programs will not be competed in ROSES-2015.

1. **Scope of Program**

The Weather Focus Area represents the cooperation among NASA programs for Atmospheric Dynamics, Weather Forecast Improvement, and Ocean and Land Remote Sensing. It has strong ties to other Focus Areas, especially Climate Variability and Change and Water and Energy Cycle, and it has a supporting role in Carbon Cycle and Ecosystems and the Atmospheric Composition Focus Areas.

The Weather Focus Area is primarily designed to apply NASA scientific remote sensing expertise to the problem of obtaining accurate and globally distributed measurements of the atmosphere and the assimilation of these measurements into research and operational weather forecast models in order to improve and extend U.S. and global weather prediction. This Focus Area is implemented in coordination with other U.S. agencies’ programs, and it is guided by the question from the 2003 Earth Science Enterprise Strategy:

How can weather forecast duration and reliability be improved?

NASA sponsored research continues to gain new insight into weather and extreme-weather events by the utilization of data obtained from a variety of satellite platforms: Geostationary Operational Environmental Satellite (GOES), Tropical Rainfall Measuring Mission (TRMM), Aqua, Terra, CloudSat, and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and a hurricane field experiment. The European Centre for Medium-Range Weather Forecasts (ECMWF) was the first center to adopt operational use of Atmospheric Infrared Sounder (AIRS) data and has found the impact on operational forecasts of assimilating AIRS and Infrared Atmospheric Sounding Interferometer (IASI) data to be roughly comparable and second only to the collective impact of assimilating four AMSU units. Major Numerical Weather Prediction (NWP) centers in the U.S. – National Oceanic and Atmospheric Administration (NOAA)/National Centers for Environmental Prediction (NCEP), NASA Global Modeling and Assimilation Office (GMAO), and the U.S. Navy – have also all shown notable improvements from the assimilation of AIRS data into their operational forecast systems. One study concludes that a consensus exists among NWP centers that AIRS is one of the highest-ranked contributors to forecast skill.

An extra benefit of AIRS data assimilation at NWP centers is its use in establishing readiness to assimilate data from other current and future operational instruments, as has been demonstrated for the Crosstrack Infrared Sounder (CrIS) launched on the Suomi NPP satellite in October 2011.

Through collaborations in the NASA-NOAA-DOD Joint Center for Satellite Data Assimilation (JCSDA), observations from Suomi-NPP were assimilated into the operational weather forecast systems in a record seven months after the satellite launch in October 2011. Subsequent tests with the NOAA operational system showed that the Advanced Technology Microwave Sensor...
(ATMS) had a neutral impact on 500 hPa forecast skill. However, observation impact analyses conducted with NASA Goddard Earth Observing System model, version 5 (GEOS-5) in the NASA Global Modeling and Assimilation Office, showed that, in concert with other observations, ATMS makes a significant impact on a global integrated forecast metric. Preparatory work and channel selection for the assimilation of the Cross-track Infrared Sounder (CrIS) data and tests of the impact of that sensor have been completed. The preparations involved modifications to the Community Radiative Transfer model, passive monitoring of systematic and random errors in the CrIS data products, observation minus forecast residuals, and finally preoperational data assimilation/forecast experiments. CrIS was assimilated operationally into the NCEP operational forecast system starting late August 2013.

The NASA Short-term Prediction Research and Transition (SPoRT) program is an end-to-end research-to-operations (R2O) activity focused on improving short-term weather forecasts through the use of unique high-resolution, multispectral observations from NASA and NOAA satellites, nowcasting tools, and advanced modeling and data assimilation techniques. The SPoRT program has established a successful R2O paradigm in which the end-users (mainly forecasters at NOAA/NWS forecast offices and National Centers) are involved in the entire process. SPoRT also partners with universities and other Government agencies to develop new products that are transitioned to applicable end user decision support systems (DSS; typically the Advanced Weather Interactive Processing System [AWIPS], next-generation AWIPS [AWIPS II], and the National Centers AWIPS [N-AWIPS]). A review by an external Science Advisory Committee (SAC) in March 2012 noted SPoRT’s success in broadening its activities to other NWS Regions, including Alaska and Hawaii and its active participation in NOAA Proving Ground activities and Testbeds as key contributions to the NWS mission. Recent advancements in product development and dissemination, modeling and data assimilation (DA); product applications in various DSS; and transition, training, and assessment activities have significantly helped in improving operational weather forecasts and in disaster response. Extensive progress was made to transition new, cutting-edge satellite datasets and products to existing and new operational partners. A NWS Southern Region modeling collaboration was established with the forecast offices in Houston, TX, and Mobile, AL, to assess the impacts of these datasets on their local model forecasts of CI, and to provide in-house model verification capabilities. Data assimilation research has focused on a collaborative project with NOAA’s Hydrometeorological Testbed (HMT), in which AIRS temperature and moisture profiles are assimilated over a Pacific domain to improve the tracking of atmospheric rivers affecting the U.S. West Coast.

The Hurricane and Severe Storm Sentinel (HS3) Mission is a five-year Earth Venture Class Suborbital mission that was awarded in 2010. The mission involved three deployments to the Wallops Island Flight Facility (WFF) on the coastline of Virginia during the hurricane seasons of 2012-2014, and used two Global Hawk (GH) unmanned aircraft systems (UAS) with distinct payloads. WFF provides easy access to Atlantic, Gulf of Mexico, or Caribbean storms. The HS3 Mission was designed to investigate some basic questions regarding changes in hurricane intensity:

1. What impact does the large-scale environment, particularly the Saharan Air Layer (SAL), have on intensity change?
2. What is the role of storm internal processes such as deep convective towers?
3. To what extent are these intensification processes predictable?

HS3’s first deployment in September 2012 involved only one GH, which carried three instruments to examine the environment and outflow layer of storms. The scanning High-resolution Interferometer Sounder (S-HIS), the Advanced Vertical Atmospheric Profiling System (AVAPS), also known as dropsondes, and the Cloud Physics Lidar (CPL) collectively provided measurements of the vertical structure of temperature, relative humidity, winds, Saharan dust, and clouds. Both GHs flew in 2013. The over-storm Global Hawk has flown over hurricanes before and it was its first time in support of HS3. The High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) conically scanning Doppler radar provided three-dimensional wind and precipitation fields; the Hurricane Imaging Radiometer (HIRAD) measured surface wind speeds and rainfall; and the High-Altitude Monolithic Microwave Integrated Circuit Sounding Radiometer (HAMSR) microwave sounder provided measurements of temperature, water vapor, and liquid water profiles, total precipitable water, sea-surface temperature, rain rates, and vertical precipitation profiles. Most of these instruments represent advanced technologies developed by NASA that in some cases are precursors to future satellite sensors.

In June 2012, NASA selected the Cyclone Global Navigation Satellite System (CYGNSS) satellite mission under its Earth Venture program. CYGNSS data will enable scientists, for the first time, to probe key air-sea interaction processes that take place near the inner core of the storms, which are rapidly changing and play large roles in the genesis and intensification of hurricanes. The CYGNSS Mission satellites are expected to launch in 2016.

2. Point of Contact for Further Information

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