NASAfacts

Cyclone Global Navigation Satellite System

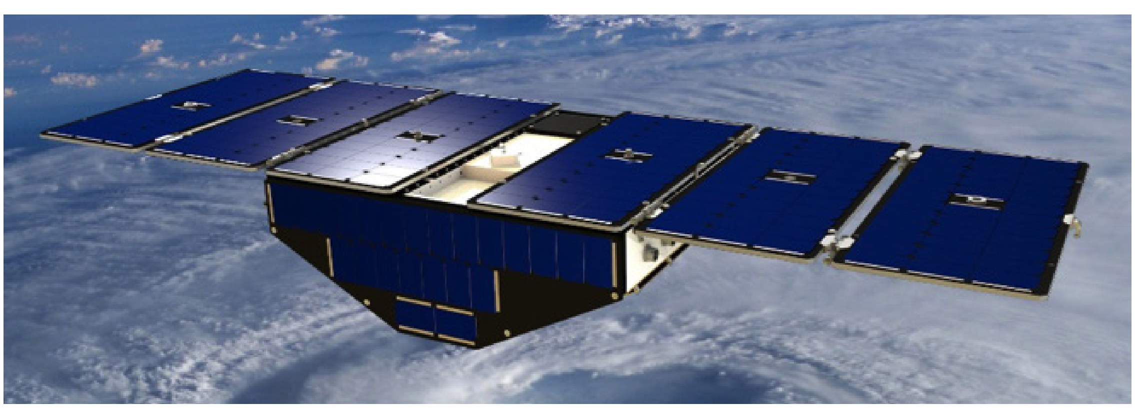
Hurricane Katrina was the costliest, and one of the deadliest, hurricanes in U.S. history [1]. Much of the catastrophic damage that occurred with the storm has been attributed to the wind-generated storm surge that exceeded 20 feet above high tide across parts of the central Gulf Coast as the storm moved onshore. The intensity of Hurricane Katrina's winds varied between Category 1 (winds 64 to 82 knots) and Category 5 (winds > 135 knots) as the storm moved through the Gulf of Mexico and toward the Gulf Coast during the period of August 26-29th, 2005.

The ability to monitor and predict the rapid changes in hurricane intensity such as those observed with Hurricane Katrina is critical to hurricane forecasters, hydrologists and the emergency managers who together are responsible for the protection of the health and welfare of coastal communities. The Cyclone Global Navigation Satellite System (CYGNSS) will measure surface winds in and near the inner core of hurricanes, including regions beneath the eyewall and intense inner rain-bands that could not previously be measured from space. These measurements will help scientists obtain a better understanding of what causes the hard-to-predict variations in hurricane intensity, such as those observed with Hurricane Katrina.

Mission Overview

Previous space-borne instruments have been unable to accurately measure ocean surface winds in the inner core of hurricanes because their signals are degraded in regions of heavy precipitation. The lack of accurate wind speed estimates in the inner core of hurricanes has limited the ability of scientists to understand the complex processes associated with intensification of hurricanes. As a result, while hurricane track forecasts have improved in accuracy by about 50% since 1990, during that same period there has been very little improvement in the accuracy of the hurricane intensity forecasts.

The data collected by CYGNSS will have significant applications for both the scientific community and the general public. The added quality and quantity of surface wind data to be provided by CYGNSS, combined with precipitation fields produced by NASA's Global Precipitation Measurement mission, will provide data that will allow hurricane forecasters to improve weather forecast models used to predict both the track and intensity of land-falling hurricanes. Given that the track and intensity of hurricanes play a key role in the development of storm surge, improvements in the forecast of these variables will provide emergency managers a powerful tool in their efforts to provide adequate warning to the general



One of the eight micro-satellites in the CYGNSS constellation.

public regarding the likely location and magnitude of dangerous hurricane storm surge. Such advanced warning will be vital in the implementation of action plans designed to protect the human health and welfare of coastal communities.

The CYGNSS Science Applications team is working with groups and individuals that will likely be the first users of the data generated by the constellation. These “early adopters” include individuals from from the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), university scientists and private research organizations.

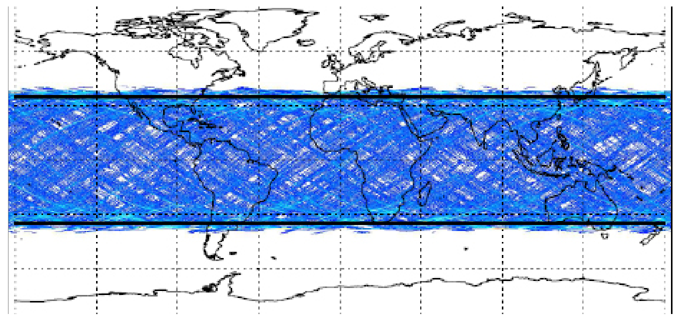
Instrument Overview

CYGNSS will use a constellation of eight micro-satellite observatories carried to orbit on a single launch vehicle. The measurement methodology to be employed by CYGNSS will rely on the characterization of the signal propagation from the existing constellation of Global Positioning System (GPS) satellites located at approximately 20,000 km above the Earth’s surface, as well as on the nature of the scattering of these signals by the ocean surface. In orbit, each CYGNSS observatory will receive both direct and scattered signals from the GPS satellites. The direct signals will help pinpoint CYGNSS observatory positions, while the scattered signals respond to ocean surface roughness, from which wind speed is retrieved.

Each CYGNSS observatory will carry a Delay Doppler Mapping Instrument (DDMI). The observatories will use under 60 watts of power, less than an incandescent light bulb, and weigh less than 30 kg. In orbit, they deploy solar panels to reach the size of a full grown swan. The solar panels will be used to collect incoming radiation (energy) from the sun that will recharge the onboard batteries that power the observatories. A benefit of using a constellation of microsatellite observatories is that they will pass over the ocean more frequently than a single satellite would, resulting in a more detailed view of the ocean’s surface.

Launch and Orbit

CYGNSS is scheduled for launch in October 2016 from the Kennedy Space Center, Florida. USA. The single launch vehicle for the constellation is an Orbital Sciences Corporation Pegasus XL expendable rocket. The constellation of eight microsatellite observatories will be deployed in Low Earth Orbit (LEO) at approximately 510 km above the surface and at an inclination of approximately 35° from the equator. The complete constellation will provide nearly gap-free Earth coverage with a revisit time of three hours (median) and seven hours (mean) over the critical latitude band for tropical cyclone formation and movement: 35° North latitude to 35° South latitude.



Ground tracks for a full day of wind samples are shown above.

Mission Duration

CYGNSS is designed to operate for at least two years.

Partners

The University of Michigan is responsible for directing all aspects of CYGNSS mission design and implementation, including the design of the constellation and production of retrieved surface wind speed estimates. The Science Operations Center is located at the University of Michigan. Southwest Research Institute (SwRI) is responsible for building and testing each of the eight CYGNSS microsatellite observatories, and is the host of the Mission Operations Center. SwRI is also responsible for risk management, systems engineering, and mission assurance. Surrey Satellite Technology, Ltd. in the UK is responsible for the design of the Delay Doppler Mapping Instrument, which is the science payload on each CYGNSS microsatellite observatory.

[1] Knabb, R.D, J. R. Rhome, and D. P. Brown (2005): Tropical Cyclone Report, Hurricane Katrina, 23-30 August 2005. National Hurricane Center.

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