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NEW METHOD STRIKES AN IMPROVEMENT IN LIGHTNING PREDICTIONS

A new lightning index that uses measurements of water vapor in the atmosphere from Global Positioning Systems has improved lead-time for predicting the first lightning strikes from thunderstorms. The index will help greatly aid NASA Space Shuttle launches at Kennedy Space Center, Fla, and other commercial and U.S. Department of Defense launches from Cape Canaveral Air Force Station, Fla.

“Better forecasting and more advance warning of lightning strikes will help reduce the delays or cancellations of shuttle launches from Kennedy Space Center (KSC),” Steven Businger of the University of Hawaii, Honolulu, said. Nearly 75% of all space shuttle countdowns between 1981 and 1994 were delayed or scrubbed, with about one-half of these due to weather.

The new Global Positioning System (GPS) Lightning Index combines data on the changing amount of water vapor in the atmosphere from a GPS receiver site with other meteorological data. One GPS receiver is located at the KSC on Florida’s east coast.

“According to the National Lightning Detection Network, the region where KSC is located has one of the highest lightning flash densities in the country, which makes this new Index extremely valuable,” said Robert A. Mazany, also of the University of Hawaii.

Mazany and Businger worked with Seth Gutman at NOAA’s Forecast Systems Laboratory in Boulder, Colo., and William Roeder at the 45th Weather Squadron, Patrick Air Force Base, Fla., on the new GPS Lightning Index.

Warm moist air from the Atlantic Ocean and Gulf of Mexico provides the needed fuel for summer thunderstorms occurring almost daily over Florida. Southwest airflow accounts for two-thirds of the lightning strikes during the summer at KSC. Southwest flow collides with the east coast sea breeze and forces the warm moist air to suddenly rise and form thunderstorms over east central Florida. Then those same southwest winds push the thunderstorms eastward over KSC.

It's important to look at water vapor in thunderclouds because water and ice molecules help to create the positive and negative charges in a thundercloud that generate lightning. Warmer air tends to hold more water droplets. When there is enough of a difference in the positive and negative charges in a cloud, lightning results.

An important weather challenge is to forecast lightning within a 20 mile radius of the launch complexes, 1-8 hours before a first strike, depending on the operation being supported. For instance a Shuttle landing requires a 90 minute lightning forecast, whereas the movement of solid rocket boosters requires a four hour forecast, and the movement of the Shuttle to the launch pad requires an 8 hour forecast. Benefits of better forecasts include the safety of personnel and protection of multi-billion dollar rocket launching systems, payloads, and supporting infrastructure. Accurate lightning forecasts can save \$1M by avoiding either a 24 hour launch delay or the need to land the Space Shuttle at another facility and transport it back to KSC.

Businger said that data from the 1999 summer thunderstorm season was used to test the Index. The Index combines four predictors, including a prediction tool of atmospheric electric charge, the amount of water vapor detected in a cloud or air mass, the change in the amount of that water vapor over 9 hours, and a scale called the "K Index" that predicts how unstable the air will become.

During initial testing, the new index improved the lead-time for lightning strikes by nearly 10% at the Kennedy Space Center. When Businger matched the index with meteorological conditions from the summer of 1999, results revealed a 26% decrease from the KSC's previous season's false alarm rates.

The GPS Lightning Index provides useful guidance to forecasters for preparing lightning forecasts, when combined with other resources such as radar and satellite data. Further testing will continue to consider using the index to also forecast related weather hazards such as heavy rain and flash flood events.

The article, "A New Lightning Prediction Index That Utilizes GPS Integrated Precipitable Water Vapor," appears in the October 2002 issue of the American Meteorological Society's Weather and Forecasting.

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For more information and images, see:

<http://www.gsfc.nasa.gov/topstory/20021031lightning.html>