Avoiding Dangerous Weather on Long Oceanic Flights

Flight crews for the first time can now anticipate hazardous storms while navigating long-range, oceanic routes. Knowing a 40,000-foot convective storm is ahead allows flight crews to reroute its flight path, saving on fuel costs, manpower and agita to the passengers on board.

Lufthansa Airlines, Basic Commerce & Industries, Inc. (BCI), NCAR and the Weather Solutions Division of the Sutron Corporation are nearing completion of a 2-year operational effort that has provided, for supplemental use only, two convective hazard products that assist the pilots in identifying and strategically avoiding storms beyond the range of the airplane’s onboard radar. Pilots have found that the two products, the Cloud Top Height (CTH) and the Convective Diagnosis Oceanic (CDO), are overwhelmingly useful in the cockpit, thus revolutionizing how flight crews can avoid dangerous convective storms. Global coverage of the CTH and CDO products gives pilots a comprehensive knowledge of storm systems that may impact their flight route.

In the U.S.A., the FAA WTIC program is preparing for a similar demonstration of the CTH and CDO products to evaluate the costs and benefits associated with the display of weather products in the cockpit of domestic airlines.

There's a good reason why the airline proactively adopted this new technology; oceanic flights have limited access to detailed weather information that is available to over-land flights due to the lack of ground-based radar networks. Ground-based radar coverage available when flying over continents provides a clear, real-time snapshot of storms that the aviation community uses extensively. Not so over the oceans. Here, geostationary satellites and global lightning networks provide real-time coverage of storm location and intensity.

Leveraging Years of Basic Research and Applied Science

NCAR has decades of experience and successes helping domestic and international airlines improve flight safety and efficiency. Since the early 1980s, NCAR was a leader in the study of microbursts, those violent and deadly storms that took down a number of flights before scientists understood the phenomena and developed radar-based technologies to detect them. NCAR’s unique structure of partnering atmospheric scientists conducting basic research with engineers who design custom systems to address the problem, has resulted in life-saving applications to other aviation hazards, such as icing and turbulence.
Since 2016, the FAA WTIC program has been preparing for the Remote Oceanic Meteorology Information Operational (ROMIO) demonstration, a 1-year demonstration to evaluate the costs and benefits associated with the display of convective products in the cockpit, at the Airline Operations Centers (AOC) and in the FAA Air Route Traffic Control Centers (ARTCC) that is expected to begin in late 2017. This evaluative research will focus on decisions made by pilots, airline dispatchers and air traffic managers. The ROMIO demonstration is a collaborative effort with partners that include the FAA, NCAR, BCI, Delta Air Lines, United Airlines, American Airlines, Panasonic and GoGo. The domain of interest includes areas covered by the GOES-West and GOES-East satellites with products updated every 15 minutes.

Distilling and Translating a Mountain of Data to Help Pilots Make Route Decisions

Over the oceans, geostationary satellites provide critical information by measuring the brightness temperatures of the tops of clouds. Matching the brightness temperature to an atmospheric temperature and then to the pressure level from a numerical model sounding (i.e., the Global Forecast System, or GFS) provides an estimate of the height of the cloud top. The resulting gridded output is called the Cloud Top Height (CTH) product. Particular CTH contours are selected for their relevance to aircraft flying transoceanic routes (i.e., between 30,000-50,000 feet) and used to create polygons.

The Convective Diagnosis Oceanic (CDO) product defines hazardous regions by utilizing additional satellite-based algorithms to better define storm structure in conjunction with global lightning data. These inputs are combined using a scaled and weighted, data fusion methodology whose gridded output defines the likelihood of a convective hazard. Polygons are created at CDO values related to storm intensity. While the CTH product defines the entire storm structure, including the anvil, the CDO product illuminates the location of the updrafts where the convective hazards reside.

Both CTH and CDO products are simplified by converting a specified contour value into a small number of latitude/longitude pairs that define a polygon. For ROMIO, transmission of the polygons to the aircraft is achieved using broadband technologies. The airline displays the CTH and CDO polygons on a tablet in the cockpit. The polygons are displayed over geographic charts developed by BCI to give pilots situational awareness of storm hazards over the planned flight route.

Resulting products focus on the needs of pilots, dispatchers, air traffic managers and forecasters within the oceanic aviation community.

Back at Home: Products Will Support NextGen

On the home front, NCAR has been a leader in supporting the FAA NextGen, the national priority of meeting the growing air transportation needs of the future. Demand for air traffic services is expected to rocket, possibly on the order of three times today’s demand levels. Because weather conditions can seriously restrict aircraft operations, how this information is observed, forecast, disseminated, and used in decision-making is of critical importance. The Cloud Top Height and Convective Diagnosis Oceanic products have been designed to fulfill this need for the transoceanic aviation community.

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