The Remote Oceanic Meteorology Information Operational (ROMIO) Demonstration


cathy kessinger1, e. frazier2, t. a. lindholm1, j. olivo3, b. barron1, g. blackburn1, b. watts1, r. stone3, d. keany4, d. tyler5, t. j. horsager6 and a. a. trani7

1national center for atmospheric research, boulder, co / 2federal aviation administration, washington dc / 3basic commerce and industries, inc., moorestown, nj / 4delta air lines, atlanta, ga / 5united airlines, chicago, il / 6american airlines, dallas, tx / 7panasonic corporation, newark, nj / 8gogo, chicago, il / 9virginia polytechnic institute and state university, blacksburg, va

poster 335

Introduction

The Federal Aviation Administration (FAA) Weather Technology in the Cockpit (WTIC) program is sponsoring an operational demonstration to evaluate the feasibility of uplinking convective storm information to commercial aircraft using oceanic routes over remote, oceanic regions for display on an electronic flight bag (EFB). The effort is called the Remote Oceanic Meteorology Information Operational (ROMIO) demonstration and is a collaborative effort between the FAA, the weather research community, the airlines and ground-to-air communications providers. The ROMIO will develop and demonstrate operational strategies for the use of rapidly updated Cloud Top Height (CTH) and Convective Diagnosis Oceanic (CDO) products on the flight deck, in the Oceanic Air Traffic Control Centers (ARTCC) and at Oceanic Flight Operations Centres (OFC). The demonstration will begin early in 2018 and be conducted for nine months. During the demonstration, feedback from pilots, other stakeholders, and Oceanic ARTCC Traffic Controllers will be solicited to ascertain the benefits associated with providing real-time, rapidly updated graphic information on convective structure to them.

Purpose and Goals of the WTIC ROMIO Demonstration

The operational demonstration will “exercise” the Aeronautical Information (A1) / Meteorological (MET) Data Link System infrastructure (DO-340, Concept of Use for Aeronautical Information Management; and MET Data Link Services). Its purpose is to provide link information to the flight deck and ingest that information using near-operational formats, links, and flight deck information transfer. The ability to display the same or similar graphic and textual information on the cockpit EFB as well as in ATC / AOC will be “exercised” to evaluate costs and benefits to the ATC / AOC functions.

The overall goal of this REKD project is to conduct a flight demonstration that will identify and validate the minimum MET information services required for safe and efficient flight in oceanic and remote airspace. In addition, identify MET information gaps that are not fully resolved by providing CTH / CDO information in the cockpit.

Objectives of the WTIC ROMIO Demonstration

1. Identify those decisions pilots make in the current environment without updates, and elicit pilot decisions that can be facilitated with more-frequent weather updates while enroute. This and findings described below will be solicited from airline pilots by direct observation or post-flight, on-line questionnaire.

• Does updated weather information affect timing of altitude and/or route deviation requests from the airspace?

• Does the updated information enhance operational safety? That is, does the availability of additional weather information that augments the airborne radar decrease the flight’s potential for a hazardous weather encounter?

• Does timely weather updates result in reduced flight time, workload, and/or fuel burn?

• Does the passive upload of CTH / CDO updates affect volume of pilot communications with dispatch and air traffic control?

• Does frequently updated information reduce airline cost and increase aircraft on-time performance?

2. Obtain initial AOC and/or Flight Dispatch Subject Matter Experts’ feedback on convective weather information needs and display concepts. Specifically:

• Does the increased potential for information transfer offered by a EFB display provide additional efficiency and safety benefits?

• To optimize benefits, how frequent are CTH / CDO updates needed for the AOC display? Or on the EFB? and other airborne weather uplinks needed?

3. Obtain initial flight crew feedback on convective weather information needs and display concepts. Specifically:

• Does the increased potential for information transfer offered by a EFB display increase airline cost and increase aircraft on-time performance?

• To optimize benefits, how frequent would the flight crew like to obtain updates on CTH / CDO? How frequent is too frequent? How frequent is not enough?

4. Identify situations where collaborative decisions between air traffic controllers, dispatch, and airlines, using updated weather information can facilitate flight operations. What are the benefits? At what costs (e.g., satellite communications)?

Roles of Participating Organizations

The National Center for Atmospheric Research (NCAR) Aviation Application Program (AAP) is responsible for the creation of the convective weather information products for the demonstrator. NCAR will distribute the data in XML format utilizing technology being implemented by the FAA’s NextGen Common Support Services – Weather (CSS-WS) Program.

AAP (Airport Access to SWIM [System Wide Information Management]) is part of the FAA NEXTGEN system architecture that provides access onboard aircraft to FAA data using SWIM’s Service Oriented Architecture interface. The Embry-Riddle Aeronautical University (ERAU) NextGen Testbed is used to demonstrate AAP capabilities.

Basic Commerce and Industries, Inc. (BCI) will receive the NCAR data via the NextGen Testbed and perform processing to minimize bandwidth requirements during transmission. BCI will utilize web services technologies to transfer data to participating broadband providers (Gogo and Panasonic).

BCI will also create a web display application for use by stakeholders categorized as Internet users at the AOCs and OCCs. Weather content of this web displays will match what is being displayed on-board aircraft.

The ROMIO demonstration will utilize existing Gogo and Panasonic broadband technologies to transfer the BCI formatted weather data to Electronic Flight Bag (EFB) type devices for use on pilots on BCI tablet displays. Pilots may also enter feedback on the ROMIO demonstration using the EFB devices. The feedback data will be sent via the Panasonic and Gogo broadband links back to BCI for collection.

A select group of pilots from Delta Air Lines, United Airlines and American Airlines will utilize the weather display on the EFB during flight and provide feedback on performance.

Virginia Polytechnic Institute and State University will develop a model to assess the safety and efficiency impacts, and/or benefits associated with the provision of meteorological information to aircraft operating in non-controlled / oceanic airspace.

Convective Hazard Products

The ROMIO domain includes the GOES-East and GOES-West coverage area. A mosaic is constructed with the two geostationary satellites.

Cloud Top Height (CTH) shows the heights of the cloud tops and is computed through a scaled and weighted combination of four inputs using a fuzzy logic, data fusion methodology. The algorithmic inputs include the CTH product, the Global Convective Diagnosis (GCD), (Goud, 2002) product, the GCD’s OShroud Tops (OTraps; Bedka et al. 2010) product and a lightning accumulation algorithm from the EarthNetworks global lightning network.

The CTH is described as above; the OCD indicates the location of mature updrafts using a channel differentiation technique; the OTraps finds the location of overshooting tops using a novel directional algorithm and the lightning accumulation algorithm describes lightning accumulation fields and then combines them within a fuzzy logic framework to produce an interest map that is input into the CDO.

The GOES-16 Advanced Baseline Image (ABI) convective products are being used within the ROMIO system and will be the source for and will be modified for ROMIO purposes. The Global Oceanic Model will be used to assess the safety and efficiency impacts and/or benefits associated with the provision of meteorological information to aircraft operating in non-controlled/oceanic airspace.

WTIC ROMIO Overall Communications Diagram

ROMIO Viewer

The ROMIO Viewer developed by BCI (right) is designed to display Cloud Top Height (CTH) and Convective Diagnosis Oceanic (CDO) weather products to pilots, dispatchers, and FAA controllers. The viewer provides a visualization of the situational awareness of convective weather over oceanic regions where ground-based or airborne weather radar coverage is lacking. This application is available on iOS, Windows 10, and the web. The application will share the same look and feel and user interface on all platforms to ensure a similar experience for all users. The features of the ROMIO Viewer include: Weather Control, Time Control, Ownership Control, Night Mode, Flight Route Control and Map.

Benefit Analysis

The Virginia Polytechnic Institute and State University will identify and model the benefits associated with providing updated convective weather information to the flight deck, within the Air Traffic Control (ATC) and as part of the Airport Operations Centers (AOC). User feedback from all stakeholders will be collected during the demonstration and will form the basis of the analysis. The analysis methodology will describe how the safety (i.e., cabin management) and efficiency (i.e., flight routing, airspace management, and cockpit/ATC communications) impacts and/or benefits will be evaluated and will describe where the impacts were identified and where benefits can be achieved. The Global Oceanic Model is a fast-time simulation tool that provides novel concepts (i.e., fuel burn, traffic routing) that will be modified for ROMIO purposes. The Global Oceanic Model will be used to assess the safety and efficiency impacts and/or benefits associated with the provision of meteorological information to aircraft operating in non-controlled/oceanic airspace.

ROMIO Demonstration Schedule

The ROMIO demonstration is planned to begin in early 2018 and will be conducted for 9 months.

Acknowledgements


Bedka et al., 2010: Objective satellite-based detection of overshooting tops using infrared window channel brightness temperature to improve with the NCEP Global Forecast System (GFS) model sounding and then 2) converting the pressure to a flight level using the standard atmosphere equation (Millier et al. 2005). The CTH product is right at hand.

The IR brightness temperature only measures the temperature of the tops of deep updrafts and cannot reveal interior structures. The anvil clouds can have a much larger area than the region covered by this algorithm.

Convective Diagnosis Oceanic (CDO) indicates the approximate location of the convective updraft and its associated hazards. The CDO is computed through a scaled and weighted combination of four inputs using a fuzzy logic, data fusion methodology. The algorithmic inputs include the CTH product, the Global Convective Diagnosis (GCD), (Goud, 2002) product, the GCD’s OShroud Tops (OTraps; Bedka et al. 2010) product and a lightning accumulation algorithm from the EarthNetworks global lightning network.

The GOES-16 Advanced Baseline Image (ABI) convective products are being used within the ROMIO system and will be the source for and will be modified for ROMIO purposes. The Global Oceanic Model will be incorporated within the ROMIO system and will be combined with the EarthNetworks ground-based lightning network to ensure coverage over the GOES-East and GOES-West domain.