The Role of Weather in Enhancing Aviation Efficiency and Reducing Carbon Emissions: Application of the Global Oceanic Model

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Outline of the Presentation

- **Global Oceanic Model Weather Enhancements**
  - Benefit Analysis Remote Oceanic Meteorology Information Operational (ROMIO) Demonstration
    - Convective Weather Avoidance Analysis
    - Simulation-Based Analysis
- **Global Oceanic Model Conflict Detection and Resolution Enhancements**
  - Conflict detection and resolution for oceanic separation standards described in FAA JO 7110.65Y: Air Traffic Control
  - Technical specifications contained in Advanced Technologies and Oceanic Procedures (ATOP): Algorithm Specifications, NAS-MD-4714.

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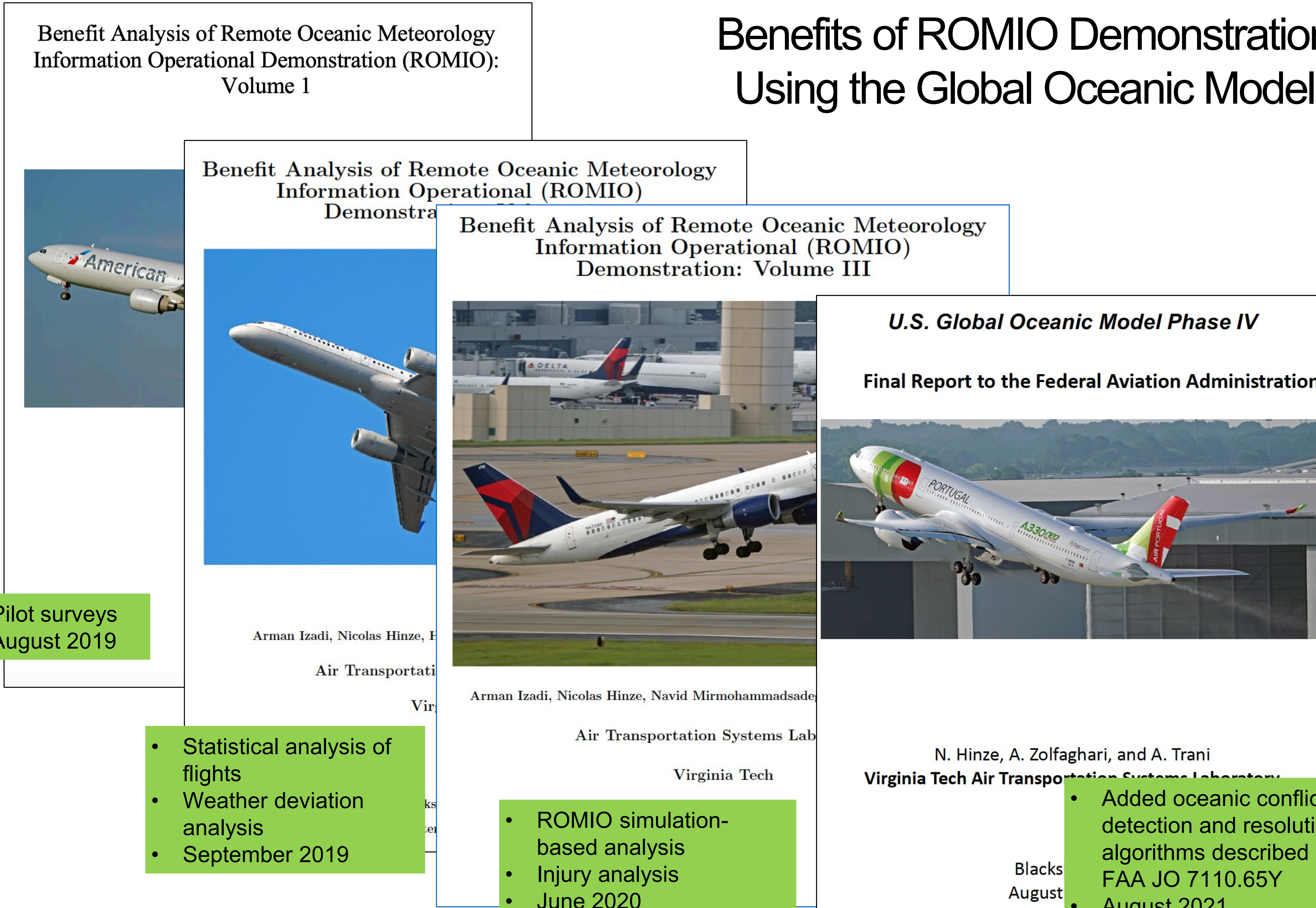
- Kimberly Noonan (FAA) and Paul Truong (FAA) participated in the modeling discussions

Benefits of ROMIO Demonstration Using the Global Oceanic Model



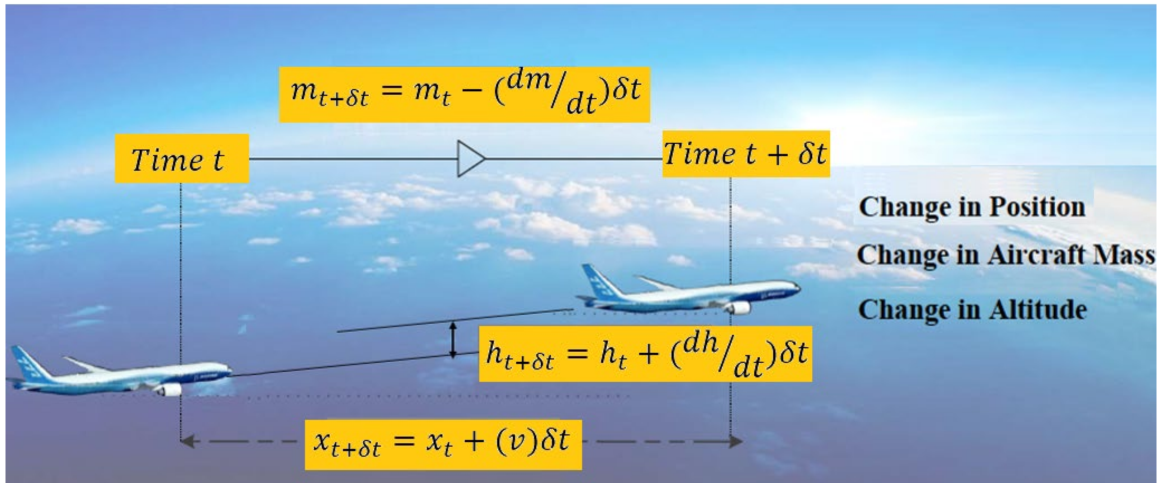
- Pilot surveys
- August 2019

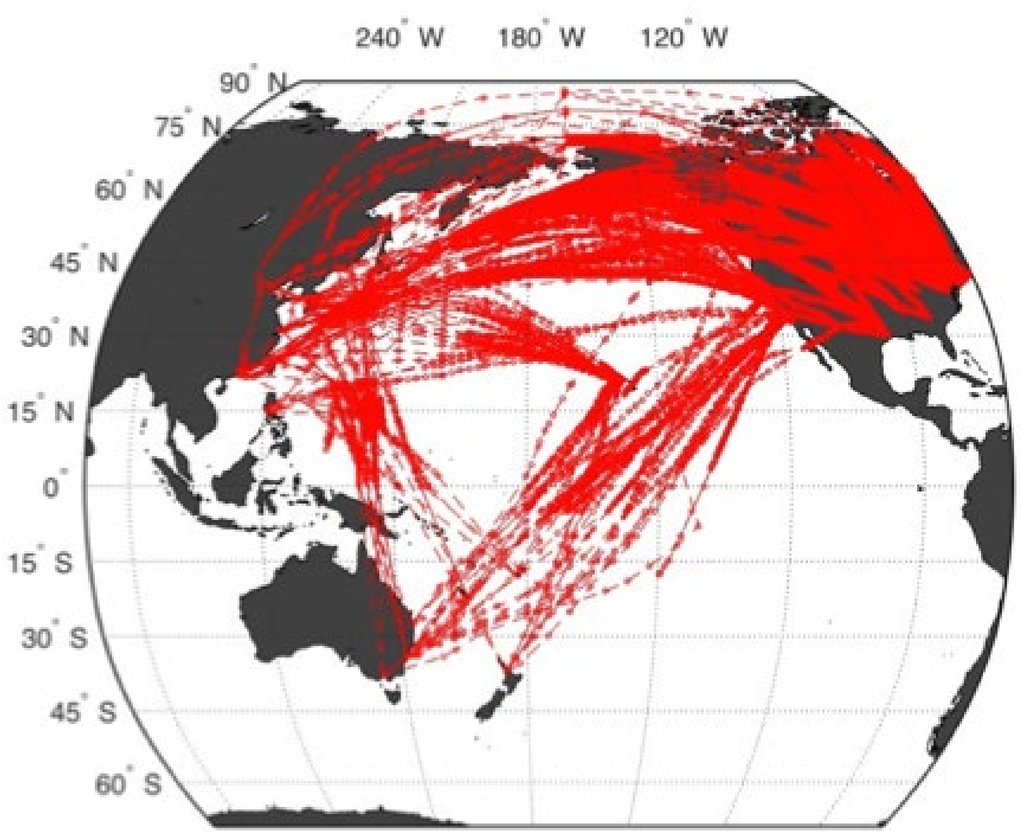
- Statistical analysis of flights
- Weather deviation analysis
- September 2019

- ROMIO simulation-based analysis
- Injury analysis
- June 2020

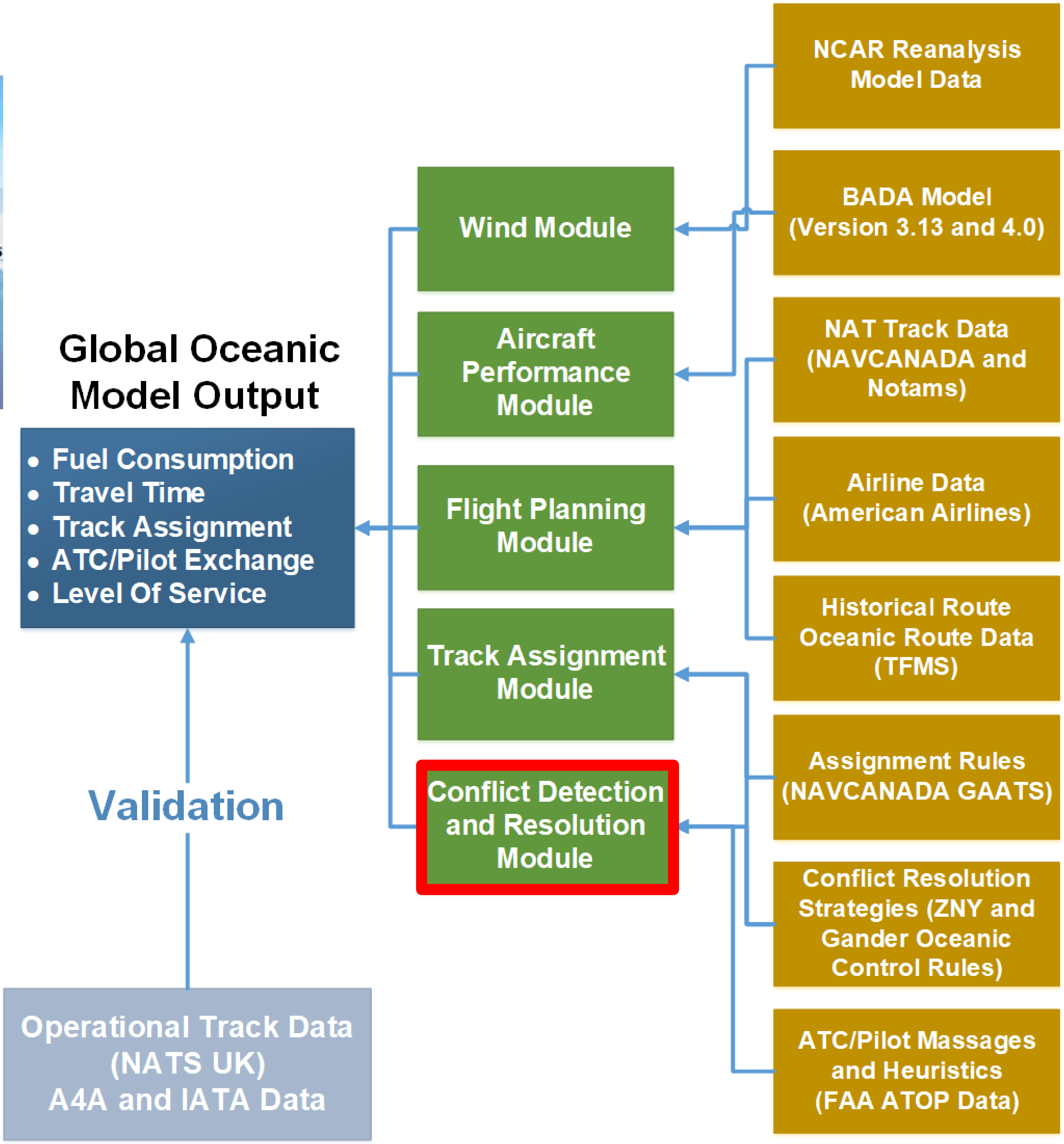
- Added oceanic conflict detection and resolution algorithms described in FAA JO 7110.65Y
- August 2021

Global Oceanic Model



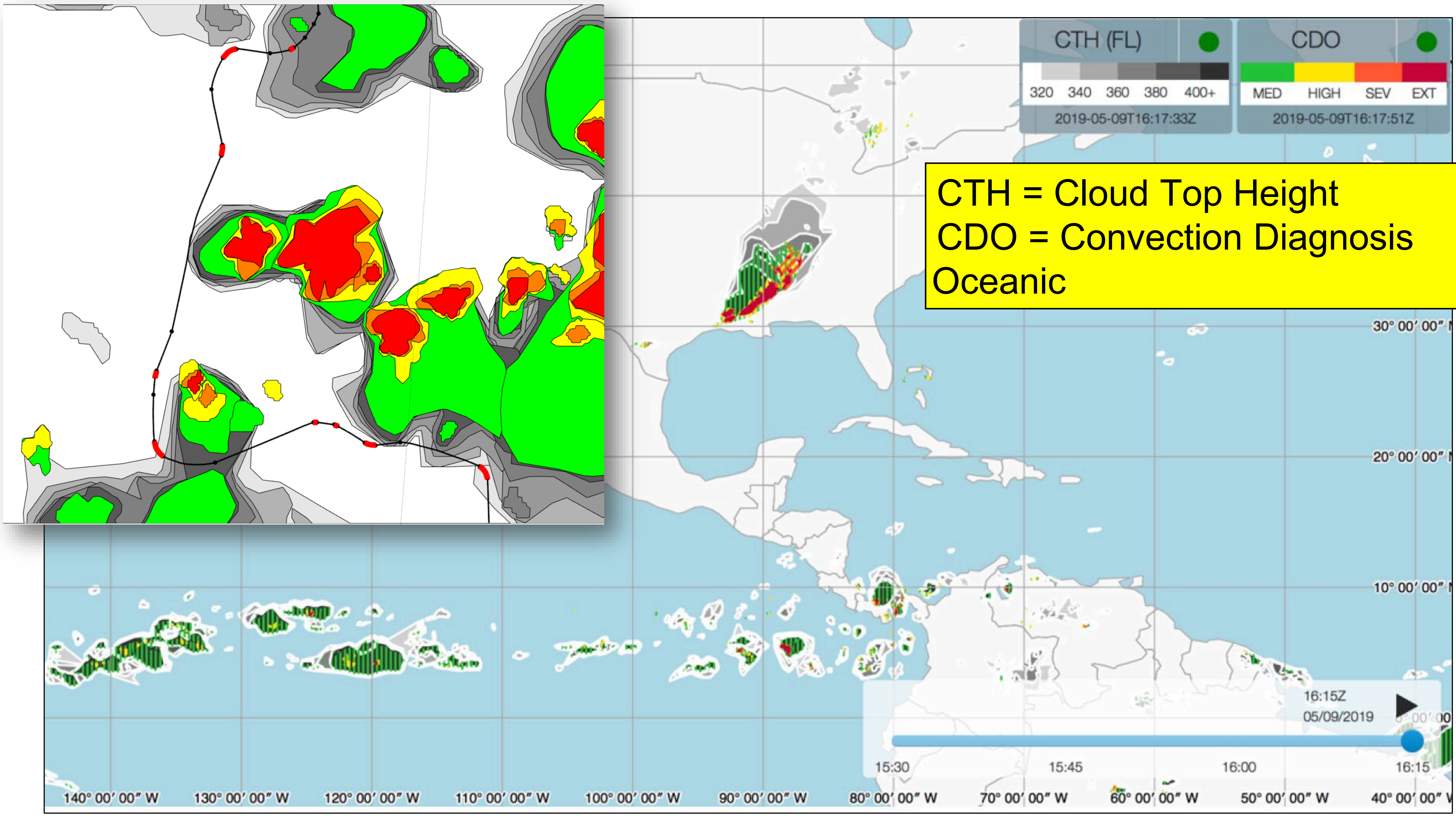


TFMS Flight Plan Data



ROMIO – An Onboard Weather Situational Display System

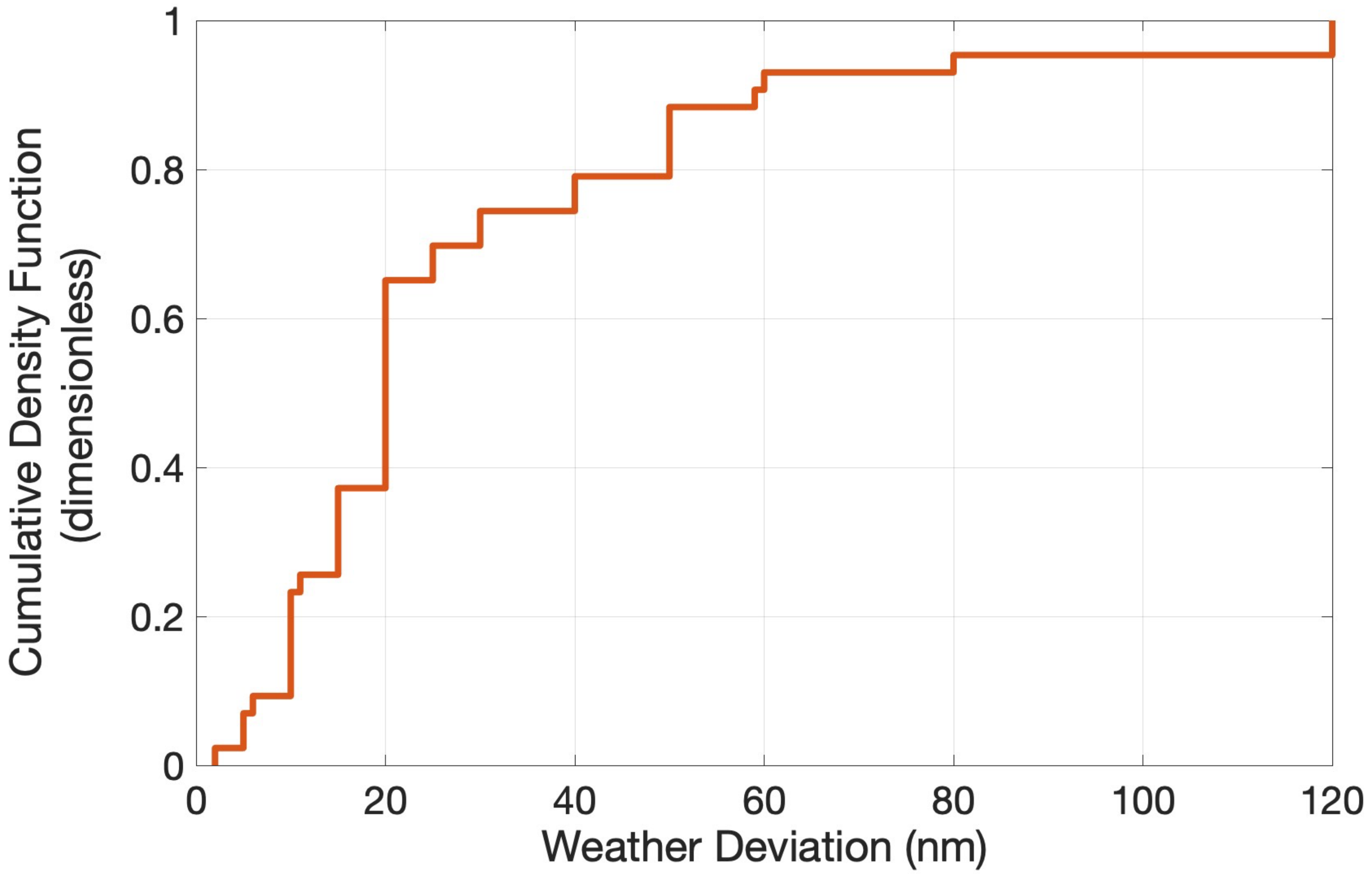
- Provides 15-minute convective weather update
- iPad or Surface Tablet hardware/software



CTH = Cloud Top Height
CDO = Convection Diagnosis Oceanic

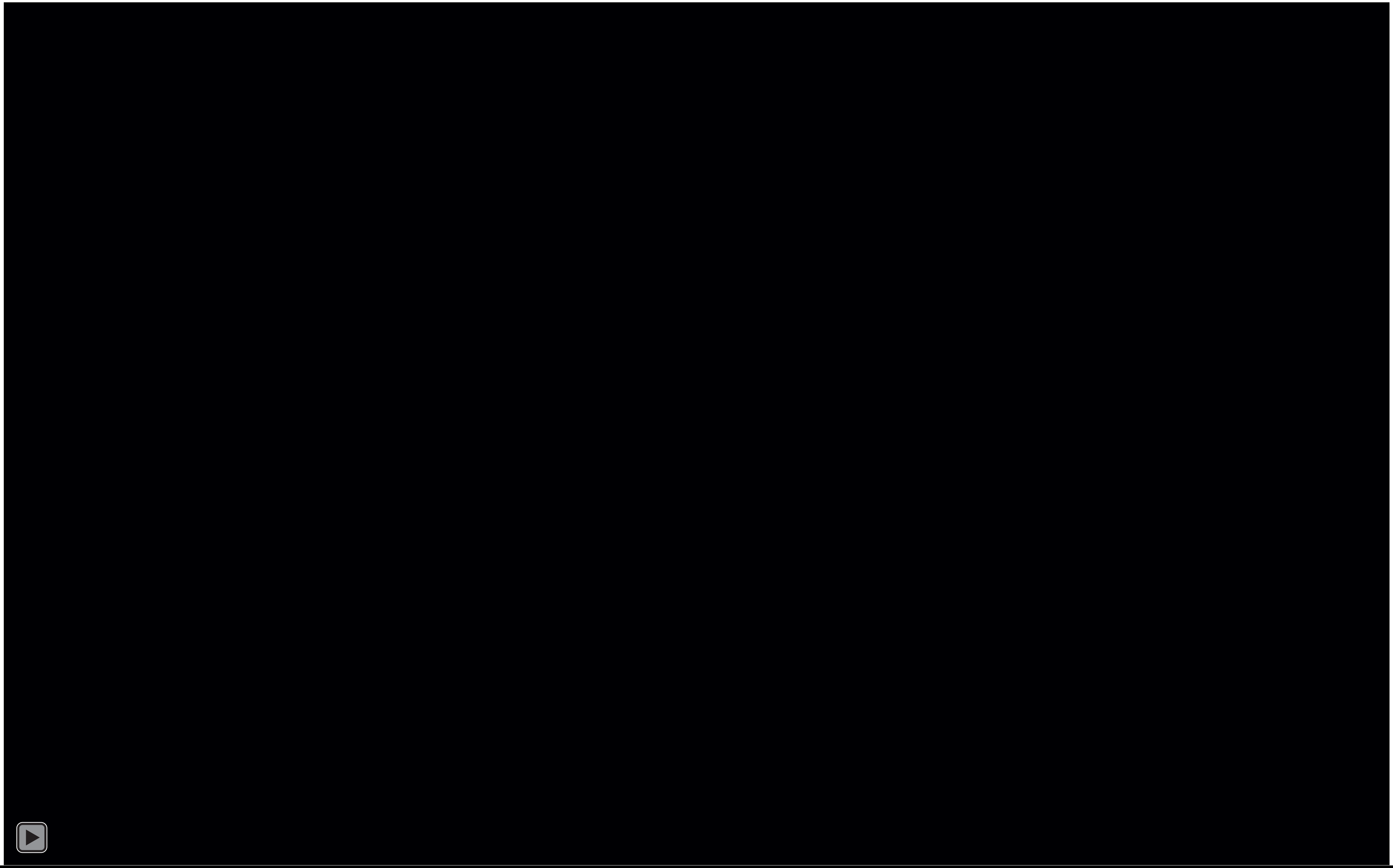
95% of the Pilots Perceive Equal or Improved Situational Awareness with ROMIO (110 surveys)

- 54% of the flights involved in the survey performed a weather deviation
- Pilots comment that ROMIO provides ***10-minutes of additional time*** to plan weather deviations compared to on-board weather radar
- ROMIO provides excellent capability for cabin crew coordination
- Average weather deviation for flights in survey is 29 nautical miles



Example of Weather Deviation in the Amazon Region

Aircraft Type: B777-300ER

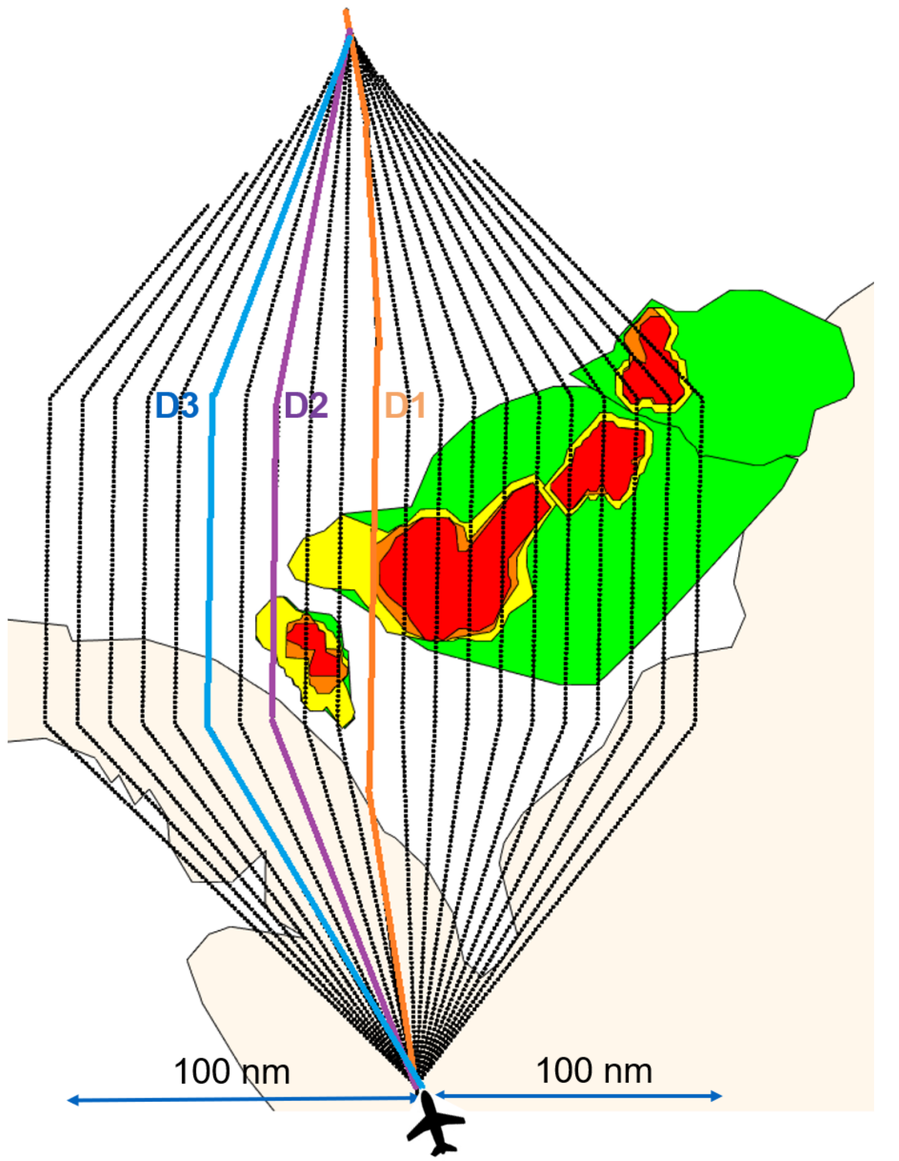


Weather Conflict Detection and Resolution

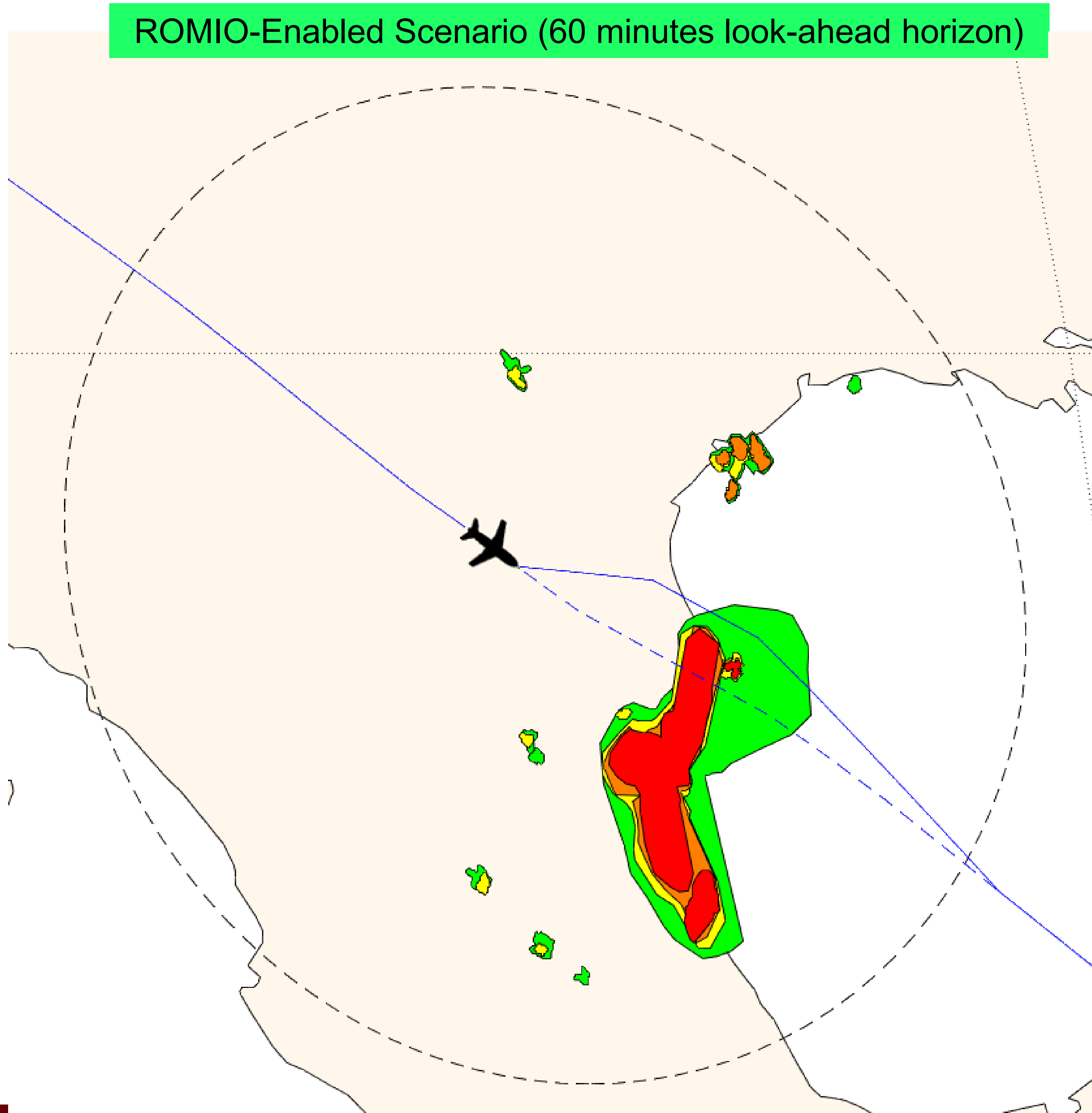
The weather conflict detection and resolution is programmed using the rules and strategies from 18,632 oceanic flights

1) Historical flight analysis
2) FAA advisory circular for thunderstorms (AC-0024C)

Deviation Alternative	Lateral Deviation	Travel Distance in CDO Contours	Min Distance to Severe and Extreme CDO Contours
D1	0 (Flight Plan)	Medium: 28 nm High: 26 nm Severe: 4 nm	0 nm
D2	30 nm to the Right	Medium: 22 nm High: 22 nm	4 nm
D3	50 nm to the Right		24 nm



Strategic Decision-Making for Avoiding Convective Weather Beyond Onboard Radar



ROMIO-Enabled Scenario Statistics : Flights that Deviate from Weather and Affected Flights

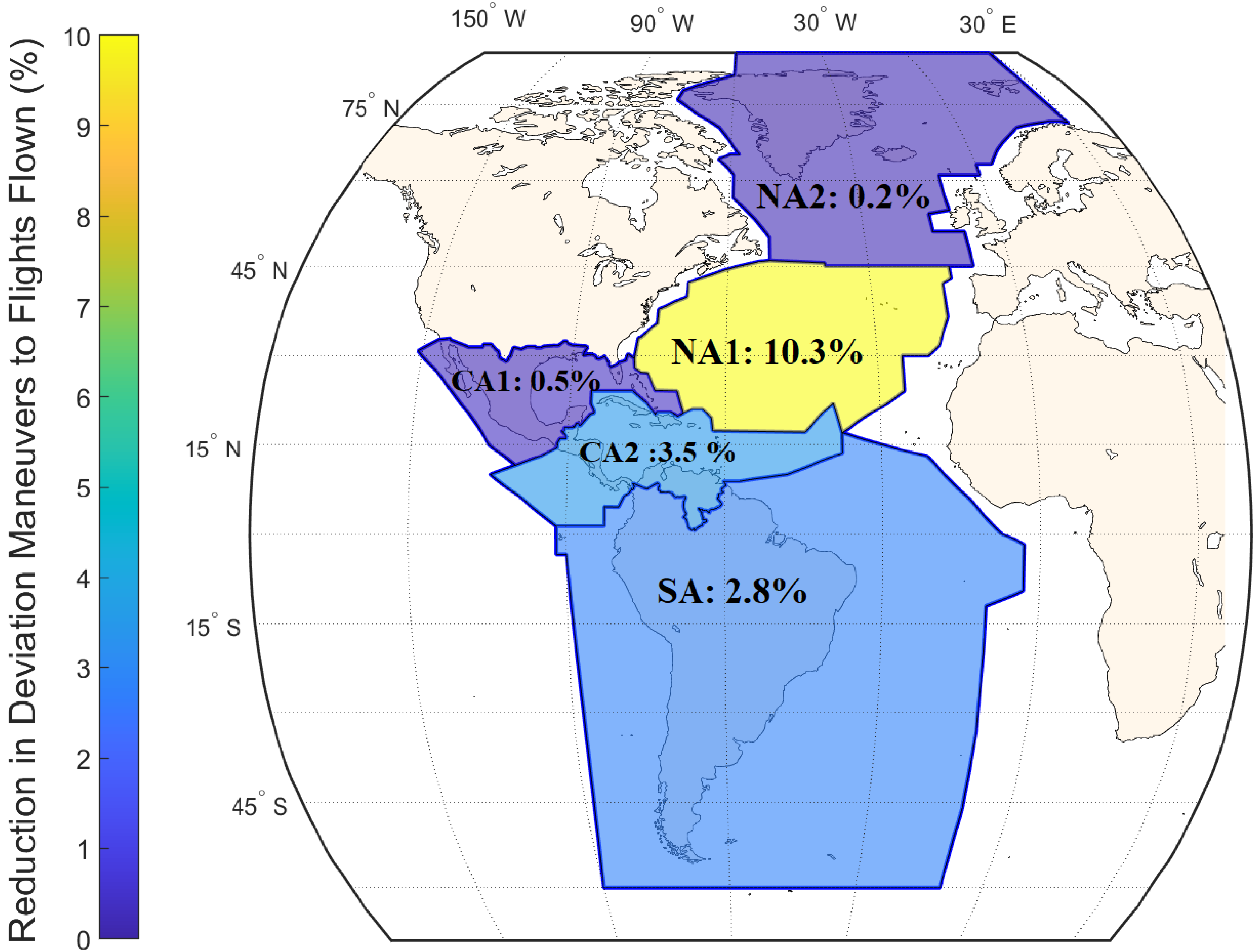
Flights affected by traffic deviation and Flights that deviated from their original track due to weather

Scenario Set	Average Fuel Consumption Saving (kg)	Average Travel Distance Saving (nm)	Average Travel Time Savings (min)	Average Greenhouse Gas Emission Saving (kg)
Medium Traffic, Moderately-Dynamic Weather	86	9.1	1.5	271
Medium Traffic, Highly-Dynamic Weather	84	7.6	1.0	264
High Traffic, Moderately-Dynamic Weather	88	8.3	1.4	277
High Traffic, Highly-Dynamic Weather	91	6.9	1.0	289
Average	**87**	**8.0**	**1.2**	**275**

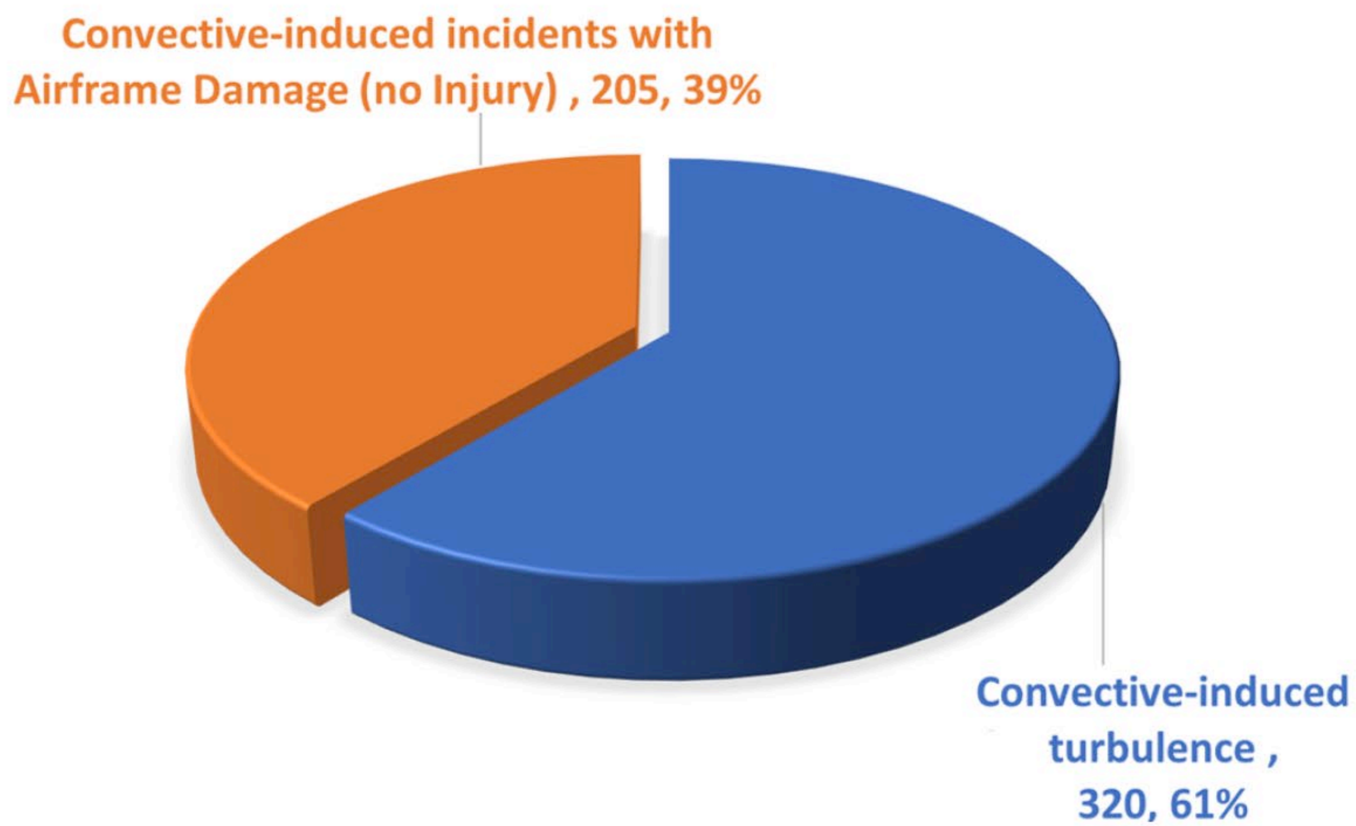
Flights that deviated from their original track due to weather

Scenario Set	Average Fuel Consumption Saving (kg)	Average Travel Distance Saving (nm)	Average Travel Time Savings (min)	Average Greenhouse Gas Emission Saving (kg)
Medium Traffic, Moderately-Dynamic Weather	120	13.6	1.7	379
Medium Traffic, Highly-Dynamic Weather	119	12.7	1.7	377
High Traffic, Moderately-Dynamic Weather	97	14.1	1.6	306
High Traffic, Highly-Dynamic Weather	122	15.7	2.0	386
Average	**115**	**14.0**	**1.8**	**363**

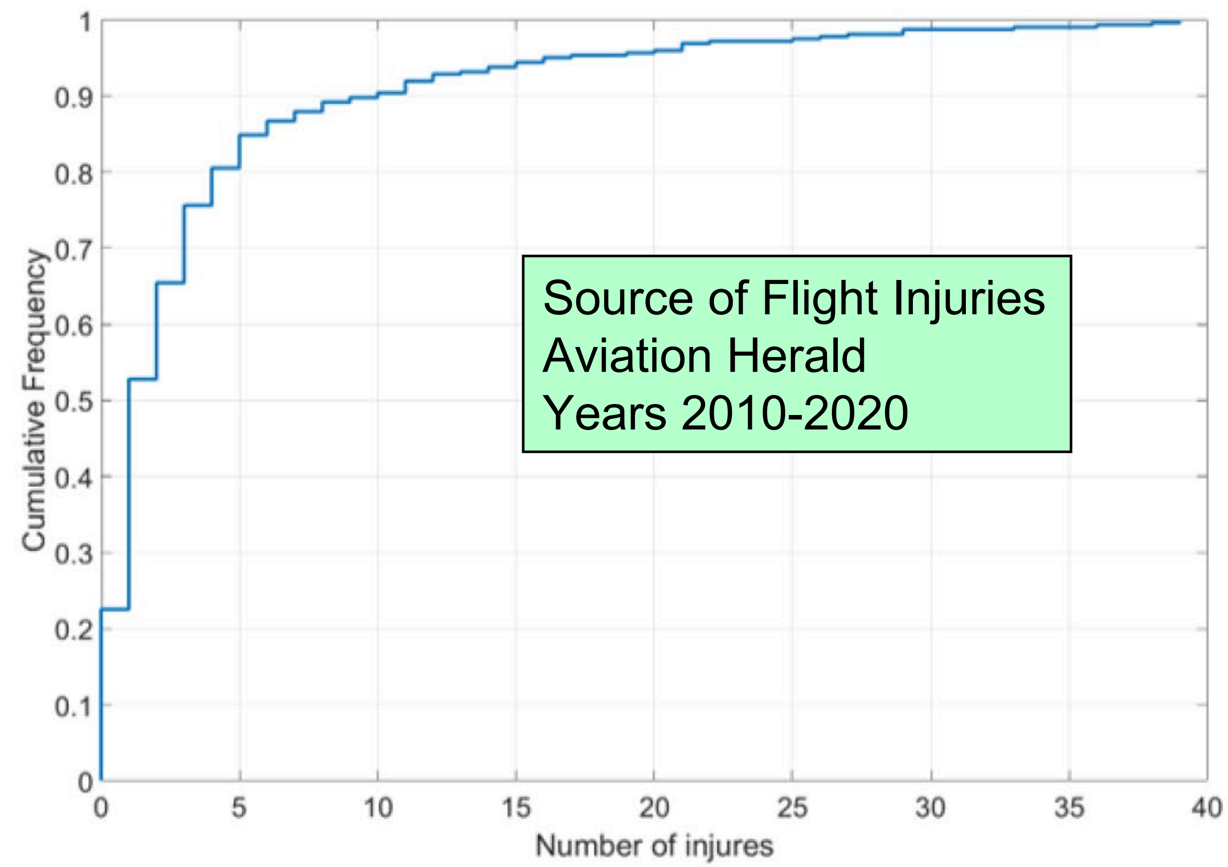
ROMIO May Reduce in the Number of Lateral Deviation Maneuvers in all Regions Simulated



Historical Flights with Injuries and Cost of Injuries



(a) Types of convective-induced incidents.



(b) Distribution of number of injuries.

Table 9: Annual convective-induced turbulence statistics.

Injury Category	Number of Injuries (2009-2014)	Percentage of Injuries	FAA Injury Value
Serious	26	57%	1,084,469
Minor	20	43%	30,947

Source: Campbell et al. (2015) – MIT Lincoln Laboratory Study

Summary of Findings

- **ROMIO Weather Product**
  - Pilot surveys shows that ROMIO provides 10-minute additional situation awareness to plan weather deviations vs on-board weather radar
- **Convective Weather Deviation Analysis**
  - Analysis of 18,326 commercial flights shows that strategic weather deviations using ROMIO could save 1.6 minutes per flight (355 lbs. in fuel savings per flight)
  - Annual fuel consumption savings of **6.8** million pounds of fuel savings
- **Simulated-Based Benefits Analysis**
  - Considered South America and North Atlantic traffic
  - 115 kilograms (253 lbs.) saved per flight
  - Annual fuel savings: $15.3 million
- **Injury and Airframe Mitigation Cost**
  - 20% reduction in potential exposure to severe convective weather events
  - $5.54 million in injury avoidance for Atlantic Ocean flights

More Information about the Virginia Tech/FAA Global Oceanic Model

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