REDAC / NAS Ops

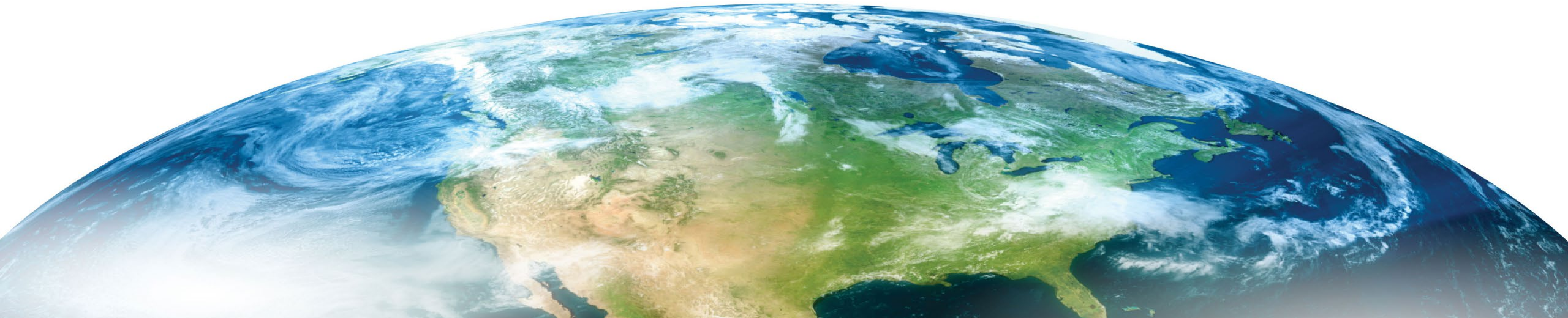
Name of Program: Weather Technology in the Cockpit (WTIC)

BLI Number: A11.q

Presenter Name: Gary Pokodner

Date: September 1, 2020

Review of FY 2020 - 2023
Proposed Portfolio



Weather Technology in the Cockpit (WTIC) Program Overview

What are the benefits to the FAA

- Enhanced safety by resolving/reducing adverse-weather safety risks before they result in an accident/incident
- Enhanced NAS efficiency and increased capacity resulting from consistent and predictable pilot adverse weather decision making due to established cockpit minimum weather service(s)
  - Reduced emissions due to enhanced efficiency
  - Reduction in flight delays
  - Enhanced flight routing in and around adverse weather
- Enhanced safety resulting from the resolution of pilot MET-training shortfalls

WTIC Program Overview

What determines program success

- Number of standards released incorporating WTIC MinWxSvc recommendations
- Number of transitions of WTIC MinWxSvc recommendations into commercial products or operations
- Number of transitions of WTIC training materials to use in courses, textbooks, guidance, Wings Credit Courses, FAA pilot exam questions, and commercial training products
- Number of MinWxSvc recommendations incorporated by pilots and other stakeholders into practice, guidance, or endorsements by representative groups such as Aircraft Owners and Pilots Association (AOPA), Air Line Pilots Association (ALPA), and National Association of Flight Instructors (NAFI)
- Benefits analyses using model simulations and demonstration/operational data

WTIC Program Support

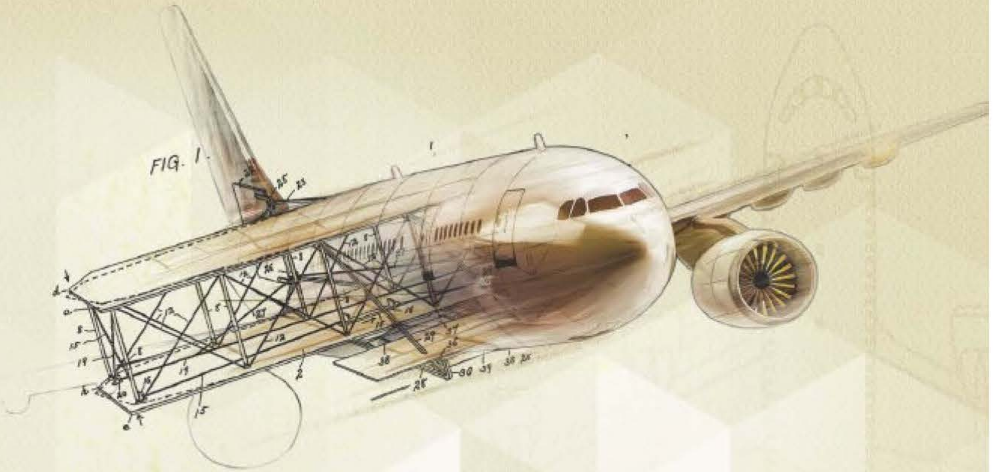
People:

- Program Manager – Gary Pokodner
- Engineering Lead – Eldridge Frazier
- Engineering Psychologist (Human Factors Lead) – Dr. Ian Johnson
- Weather Research Branch Manager – Randy Bass

Laboratories:

- National Center of Atmospheric Research (NCAR)
- FAA General Aviation (GA) Center of Excellence (PEGASAS)
  - Purdue University, Florida Institute of Technology, Iowa State, Georgia Tech, Western Michigan
- FAA Technical Center
- Civil Aerospace Medical Institute (CAMI)
- Virginia Tech

2019 FAA AWARDS CEREMONY



ADMINISTRATOR'S SAFETY AWARD

Presented to

Weather Technology in the Cockpit Team:

Eldridge Frazier

Ian Johnson

Gary Pokodner

in recognition of oustanding and notable achievement, as well as performance above and beyond normal responsibilities, in making aviation safer and smarter.

Federal Aviation Administration

Steve Dickson

Steve Dickson
FAA Administrator

WTIC Program FY 20 Accomplishments (Since Spring REDAC) and FY21 Planning

- **Remote Oceanic Meteorological Information Operational (ROMIO)**
  - Final report and briefing delivered and accepted
  - Simulated benefits (South America and North Atlantic route traffic) identified for safety and efficiency-based demo results:
    - 10 minutes additional time to plan deviations, 1.6 minutes average reduction in flight time
    - 253 lbs fuel saved per flight/Annual fuel savings of $15.3 million
    - 20% reduction in potential exposure to severe convective weather events resulting in approximately $6.89 million annual savings (Atlantic and Pacific Oceans)
  - Convective weather rules and strategies incorporated into FAA/VA Tech Global Oceanic (GO) Model
    - Potential applications for assessing benefits of other WTIC MinWxSvc recommendations
- **FY21 Planning**
  - Expand coverage in South Pacific via Himawari data and add global lighting data
  - Products - Updated technical transfer package and transition meeting for airlines

WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

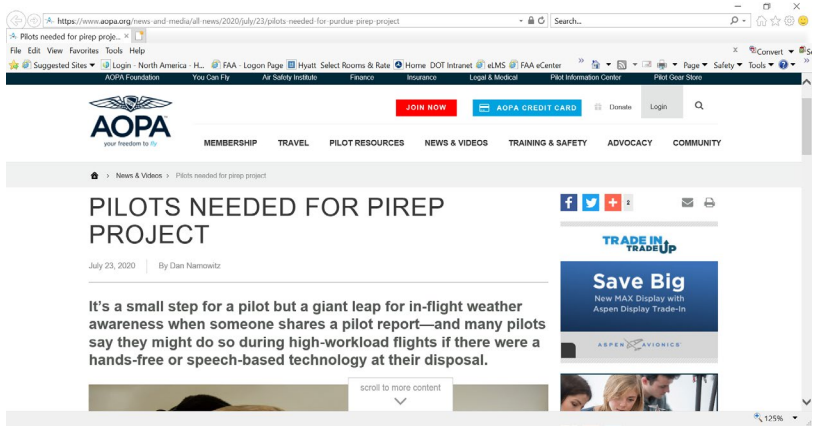
- **ADS-B Turbulence Study**
  - Developed algorithmic process to identify maneuvers to avoid false alarms
  - Confirmed consistent identification of turbulence encounters compared to in-situ algorithm using canned data
  - Compared ADS-B Vertical Rate magnitudes of Eddy Dissipation Rate (EDR) to in-situ values. Determined likely causes for the few magnitude differences.
  - Continuing research to address variations between in-situ and ADS-B
  - Investigating options for an operational comparison between in-situ and ADS-B
- **FY21 Planning**
  - Use live data and larger variety of aircraft in a more operational configuration. Develop concept of operations for a “beta” version release (PIREP vs model ingest). Evaluate impacts of variations with in-situ algorithms and applicability of RTCA standards.
  - Products – Transition plan for “beta” release, updated ADS-B Turbulence algorithms, final report on research progress

WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

- **Crowd Sourcing Hybrid Configuration (with MITLL edge detection software)**
  - Completed experiment identifying supplemental information to visibility distance including ceiling information, cloud base heights, and runway conditions.
  - Successfully completed demonstration of hybrid configuration with “expert crowd.”
  - Evaluated capabilities to photograph weather radar in Part 121 cockpits for downlink and crowd sourcing.
- **FY21 Planning**
  - Make updates to configuration (primarily ceiling information) based on FY20 demonstration results and then implement it on the AvCams experimental website to run in an “operational configuration.”
  - Products – Prototype hybrid configuration implemented on AvCams experimental site, technical transfer package, and final report

WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

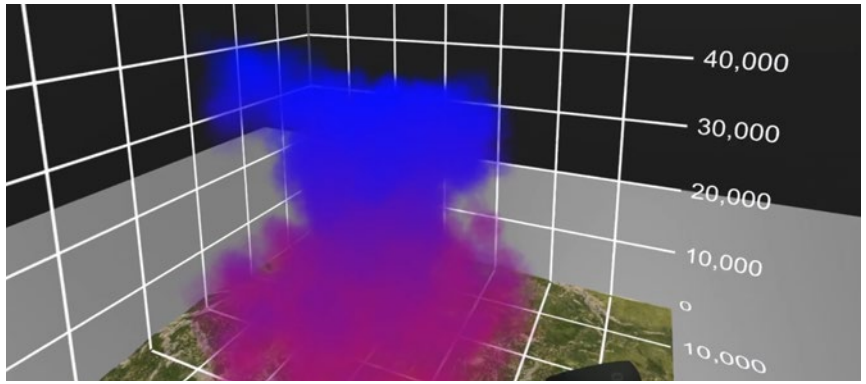
- **Augmented Reality and Pilot Report (PIREP) Enhancements**
  - Completed 10 mini weather training courses on various weather topics and transitioned them to Fly8MA and NAFI website, and placed them on Youtube channel.
  - Presented highly attended Mentor Live session to transition WTIC teaching aids to NAFI flight instructors (videos, WeatherXplore, knowledge gaps, etc.)
  - Developed thunderstorm scenarios to evaluate benefits of using virtual reality
  - Completed an analysis of PIREP information accuracy on icing and an analysis of weather information representativeness from non-collocated sensors
  - Updated WeatherXplore app for production release
  - Updated PIREP submission and dissemination flowcharts
    - Included barriers in the flow to show “No PIREP”

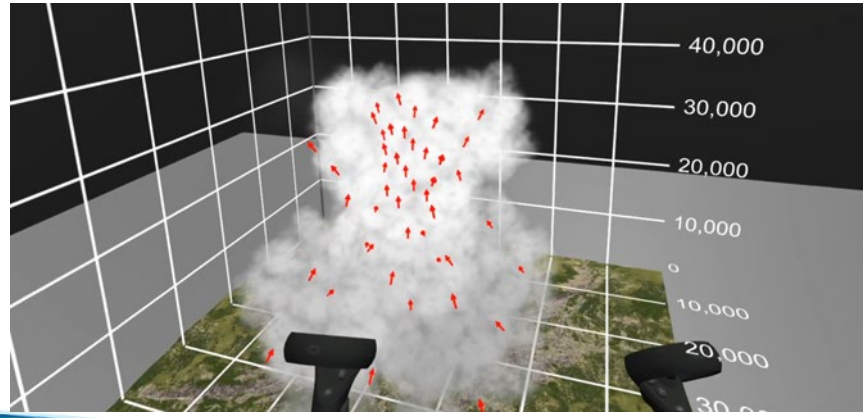


WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

Augmented Reality and Pilot Report (PIREP) Enhancements

- **FY21 Planning**
  - Evaluate learning benefits of using Augmented Reality and Virtual Reality
  - Development of PIREP tool prototype to mitigate submission errors and barriers
  - Evaluate voice recognition protocol for PIREP submission (trust, reliability, etc.)
  - Develop “how to” Minimum Weather Service recommendations to enable stakeholders to produce their own Augmented Reality weather applications





WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

- **Helicopter Operations Weather Information (HOWI)**
  - Performed gap analyses via survey and text mining of NTSB and other databases
  - Evaluated rotorcraft-specific weather information representativeness (including dynamics, resolution, and specificity)
  - Developed weather-related bow tie and flow tie diagrams based on identified gaps
- **FY21 Planning**
  - Research pilot awareness and decision support availability regarding weather-related risk of winds at landing sites
  - Research technology capabilities to support improved pilot weather-related situation awareness at accident / incident / landing sites
  - Evaluate pilot understanding of reduced representativeness of official weather information not collocated with flight
  - Products – White papers and formal reports

Helicopter Operations Weather Information (HOWI)

Weather Gaps

Category	Description
Training	Pilots are not well trained to recognize weather hazards that can cause emergencies such as loss of orientation. Spatial disorientation has only one reference in the knowledge exam [PLT334, Learning Statement Reference Guide for Airman Knowledge Testing].
Risk Assessment	[135.617], but is not mandatory for other type of operations [ANC13GA036, ERA09FA537].
Risk Assessment	Risk Assessment tools can fail to capture risk. Risk Assessment Tool returned low risk for missions that ended with multiple fatalities [CEN10FA509, CEN13FA096, ERA13FA273] or in an accident [GAA16LA031]. The FAA FRAT risk available is tailored for fixed wing.
Risk Assessment	Risk assessment tends to not be reevaluated even if conditions have significantly
Skills and Abilities	Pilots that are both trained and aware of risk can still fail to recognize the impending emergency [ERA09FA537].
Weather Technology	There can be a lack of information along a route of flight [WPR16FA037]. Some adverse weather conditions that affect helicopters can be very localized [Pinchak pilot interviews, p62]. As demonstrated by Michael Splitt Analysis, linear interpolation between weather stations is inappropriate to estimate conditions between observations. Emergency responders or hospital personnel are at the site but are not trained to provide good weather information to helicopter pilots.
Weather Technology	many weather products are tailored for fixed-wing operations and are not adequate for the scale, altitude and type of weather that matter for helicopter operations
Weather Technology	weather avionics (such as ADS-B IN) or contact with ATC or OCC are not mandatory and can be lost due to terrain. Electronic wind indicators not mandatory.
Weather Technology	delay in radar data. Weather can change quickly, there can be 15 minutes before the pilot is made aware that there has been a change in forecast, observation along its route [Rex Alexander interview].
Weather Technology	Data available to pilots in cockpit is limited, e.g. HEMS tool data is not available in the cockpit
Human Weather Interface	In many accidents pilots did not call a weather briefer prior to their flight. Pilots favor electronic tools.
Human Weather Interface	Workload can be high and a synthetic image of the weather is difficult to get in the cockpit [Rex Alexander interview]
Training	Helicopter pilots are not required to have received training for IIMC recovery contrary to fixed wing pilots [14 CFR part 61.109]. Proper VFR into IMC recovery procedure is not tested as part of the emergency procedures during the practical test [Practical Test Standards: private FAA-S-8081-15A and commercial FAA-S-8081-16B]. Except for HEMS pilots, pelicopter pilots can operate without having ever received any IFR training. IFR currency or recent IIMC training is not mandatory for night operations.
Training	Military pilots are often used to having a co-pilot, but this is very rare for civilian operations in the United States.
Skills and Abilities	Trained and warned pilots can still fail to recover from IIMC emergencies
Helicopter Technology	due to safety requirements from the FAA IFR-rated helicopters are expensive, most helicopters are VFR only and lack helpful avionics (artificial horizon, autopilot)
Helicopter Technology	Tools like autopilot can be useful to lower pilots workload but can only be engaged in specific attitudes which can make them ineffective in IIMC situation. In IIMC the workload is very high.
Helicopter Technology	VFR into IMC accidents are often fatal for everyone involved. The weather the pilot had access to was not recorded if a third-party briefer was used. This makes understanding the go/no-go decision more difficult to understand. The flight track shows what happened to the helicopter but not why. Flight Data Recording is not mandatory and is on the NTSB most wanted list.

WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

- **Precipitous Terrain Project**
  - Evaluated how meteorological might result in adverse precipitous terrain effects
    - Focused on 3 selected airports, and occurrences of turbulence and pressure perturbations
  - Analyzed specific met conditions that might be hazardous at selected airports
    - Finalized full year climatology study
    - Numerous verification model runs using observational sources
  - Evaluations of the suitability of meteorological forecasts to predict hazardous conditions

- **FY21 Planning**
  - TBD – currently no FY21 plans

WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

- **RTCA SC-206 Technical Support**
  - Successful RTCA SC-206 Joint plenary in Prague that worked on adding new Service Descriptions for DO-364 and initiated SC-206 Terms of Reference update
  - Developing DO-358 (MOPS FIS-B with UAT) updates and scope for MASPS Aeronautical Information/Meteorological Data Link Services
  - Development of a Collaborative Decision Making (CDM) service
    - Establish the aircraft / aircrew as participant in CDM, such as decisions for opening and closing airspace during MET events

- **FY21 Planning**
  - Continue support of RTCA SC-206
  - PMC date for MOPS Dec 2020, for MASPS Dec 2021

WTIC Program FY20 Accomplishments (Since Spring REDAC) and FY21 Planning

- **Nulling NEXRAD Latency Evaluation**
  - Updating evaluation software and methods for statistical assessment of benefits
  - Conduct of experiment on hold due to Covid 19

- **Visual Flight Rules (VFR) Not Recommended (VNR)**
  - Completed scenarios for assessment, but on hold due to Covid 19
  - Adding additional scenarios to phase while demonstration is on hold

- **FY21 Planning**
  - TBD – currently no FY21 plans for either project

Anticipated Research in FY21

- **Planned Research Activities and Expected Research Products**
  - Complete Industry Perspective of WTIC Minimum Weather Service Recommendations and impacts of NextGen. Product will be questionnaire results and recommendations for future WTIC research.
  - Evaluation of the effectiveness of self weather briefings versus a flight service station provided briefing. Product will be final report.
  - Expand tactical turbulence product to global application and host technical transfer conference (in conjunction with ROMIO) for the final configuration. Product will be an updated technical transfer package and conference.

Anticipated Research in FY22

Planned Research Activities

- WTIC budget is currently zero for FY22 and beyond.
- Planned research areas if program is funded:
  - Complete ADS-B Turbulence algorithms and technical transfer package.
  - Continue gap resolution for helicopter operations.
    - Address representativeness gaps for official weather not collocated with flights.
  - Develop technical transfer package to crowd source ceiling information using webcams.
  - Address gaps from Industry Perspective.
  - Service analysis on anticipated weather data from advancing and new technologies to identify potential utility (i.e. fully digital cockpit weather radar).
  - Gap analyses of cockpit weather for new entrants.

Expected Research Products

- N/A due to no FY22 budget.

Emerging FY23 Focal Areas

- **WTIC budget is currently zero for FY22 and beyond**
  - Anticipated research areas if the program is funded are to continue FY22 research areas (based on funding level)

- **Sample of Unfunded FY23 Focal Research Areas for WTIC Include:**
  - Approximately 30 identified cockpit weather information and technology gaps along with associated training updates
    - Includes helicopter and special operation gaps, and gap tracking spreadsheet (sample presented in Fall 2020 NAS Ops briefing)
  - Gap analyses of Remote Weather Sensors to Support New Entrant and GA Pilot Weather Decisions
  - Traffic Flow Management Collaborative Weather Decision
    - Identify minimum weather information and associated cockpit presentation for collaborative information exchange to enable aircrews to easily respond and to improve decision-making
  - Applications of increase in weather-related data (i.e. digital cockpit Wx radar)

Weather Technology in the Cockpit (WTIC)

Research Requirements

- Develop Part 121/135 and Part 91 MinWxSvc recommendations for cockpit weather information and technology.
- Sponsored by ANG-C6, ALPA, AFS, industry, airlines, NextGen, AOPA, industry, NAFI, Alaska and other remote areas
- POC: Gary Pokodner, ANG-C61, 202-267-2786

Outputs/Outcomes

- Currently the program is not funded in FY22 and beyond.

FY 2023 Planned Research

- Currently the program is not funded in FY22 and beyond.

Out Year Funding Requirements

	FY20	FY21	FY22
RE&D	$1.95M	$0.97M	$0 M

Backup Slides

ROMIO Backup Slide

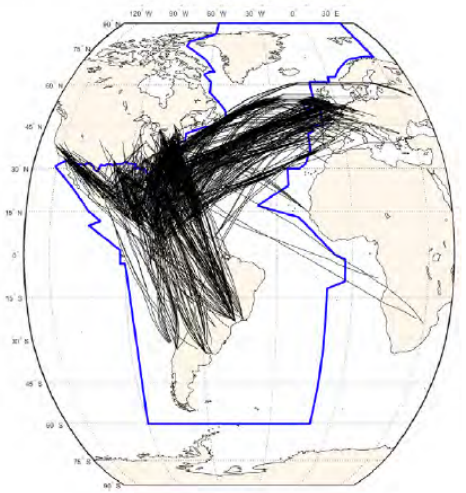
Operational Benefits of 10-Minute Earlier Deviation Maneuvers

No	Aircraft Type	Average Travel Distance Savings (nm)	Average Travel Time Savings (min)	Average Fuel Consumption Savings (lb)	Average Greenhouse Emissions Savings (lb)
1	'A332'	13.2	1.6	320	1001
2	'A333'	12.5	1.6	315	983
3	'B763'	9.4	1.2	211	660
4	'B764'	10.7	1.3	248	774
5	'B772'	12.3	1.5	355	1111
6	'B77L'	13.0	1.8	525	1640
7	'B77W'	14.6	1.8	543	1697
8	'B788'	13.0	1.6	282	882
9	'B789'	16.5	2.1	397	1241
Average		**12.8**	**1.6**	**355**	**1110**

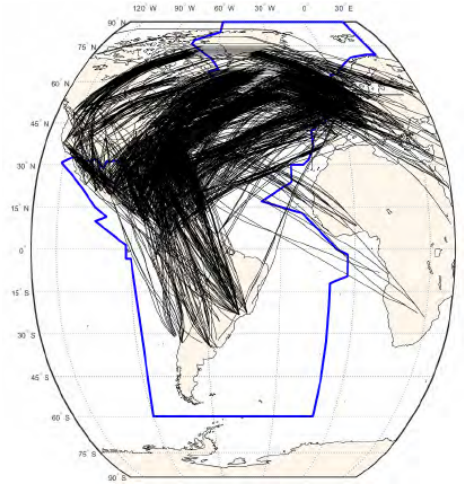
Assuming **60** flights crossing ITCZ per day, **320** operational days per year and **1.82** ($/gal) dollars per gallon as the current jet fuel price, the annual fuel consumption saving is approximately **6.8** million pounds or **1.8** million dollars. This is the lower bound for the benefits.

Simulated Traffic in the Global Oceanic Model

The traffic is derived from the Traffic Flow Management System (TFMS) for June 24,25,26, 2016 with forecast to 2019.



Medium Traffic
2050 flights in three-day simulation
1051 flights in middle day of simulation



High Traffic
4437 flights in three-day simulation
2258 flights in middle day of simulation