

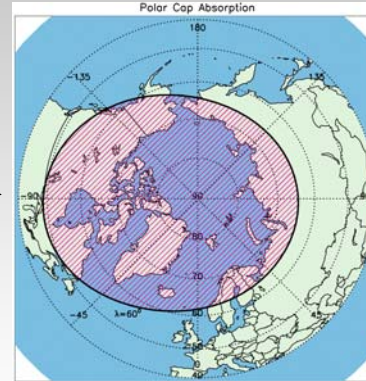
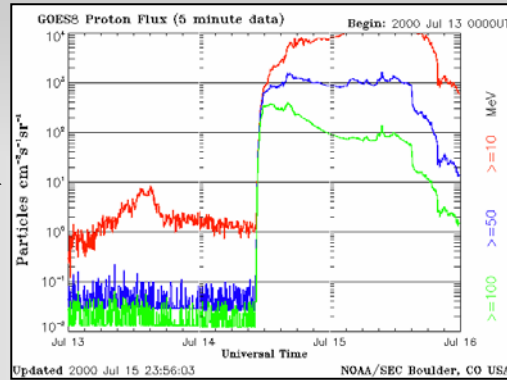
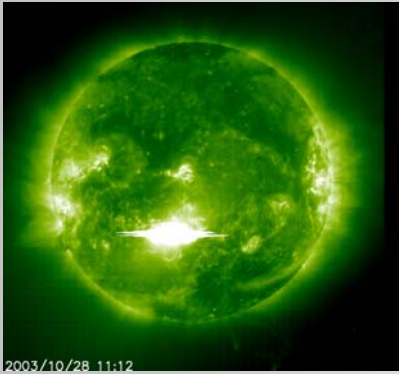


# Space Weather Aviation Operational Needs – Recent Progress

Bill Murtagh  
NOAA Space Environment Center  
Boulder, Colorado

Friends/Partners in Aviation Weather Forum  
September 2007

# Space Weather Storms: Timing & Consequences



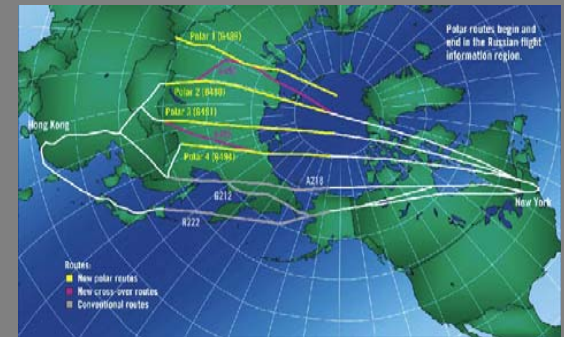
**INCREASED EXPOSURE TO RADIATION** – Flying polar routes during increased levels of radiation may result in an increase in exposure to harmful radiation.

**LOSS OF COMMUNICATIONS** – Radio blackouts are possible. FAA mandates reliable communications over the entire route of flight. When Radio Communications are poor or non-existent, flights must operate over less optimum routes. (HF, VHF, and SatCom are all impacted)

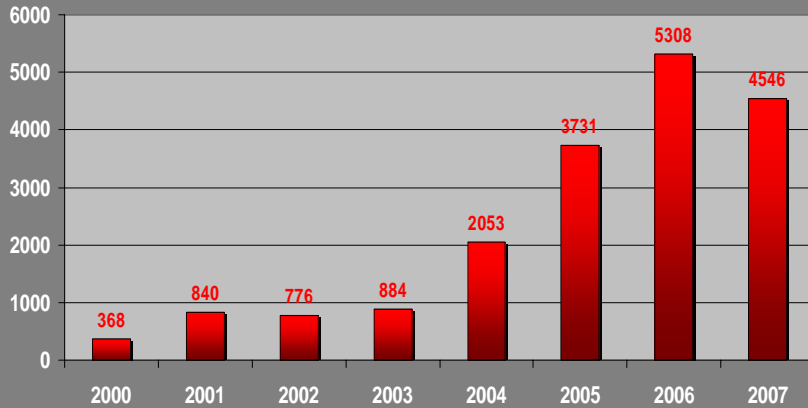
**DEGRADED NAVIGATION CAPABILITY** – Many aircraft are equipped with Inertial Reference Units which are dependent on Global Positioning Satellites (GPS).

# Polar Operations

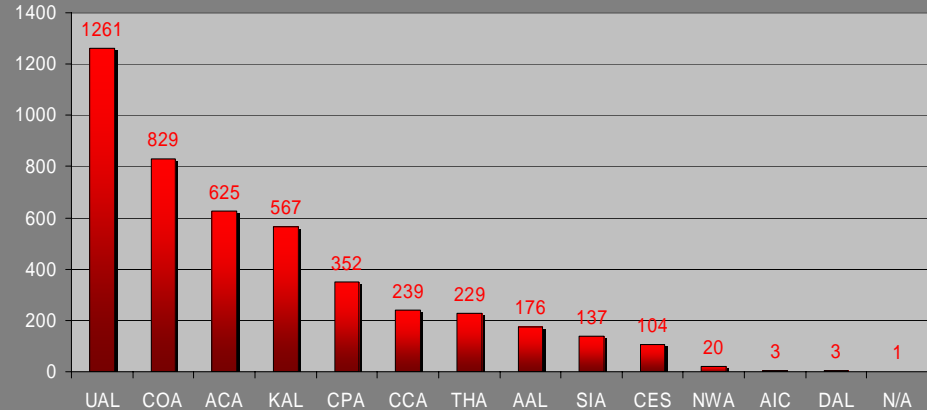
Rapid growth since first flights in 1999



Crosspolar Traffic Counts  
from 2000 through Aug 2007



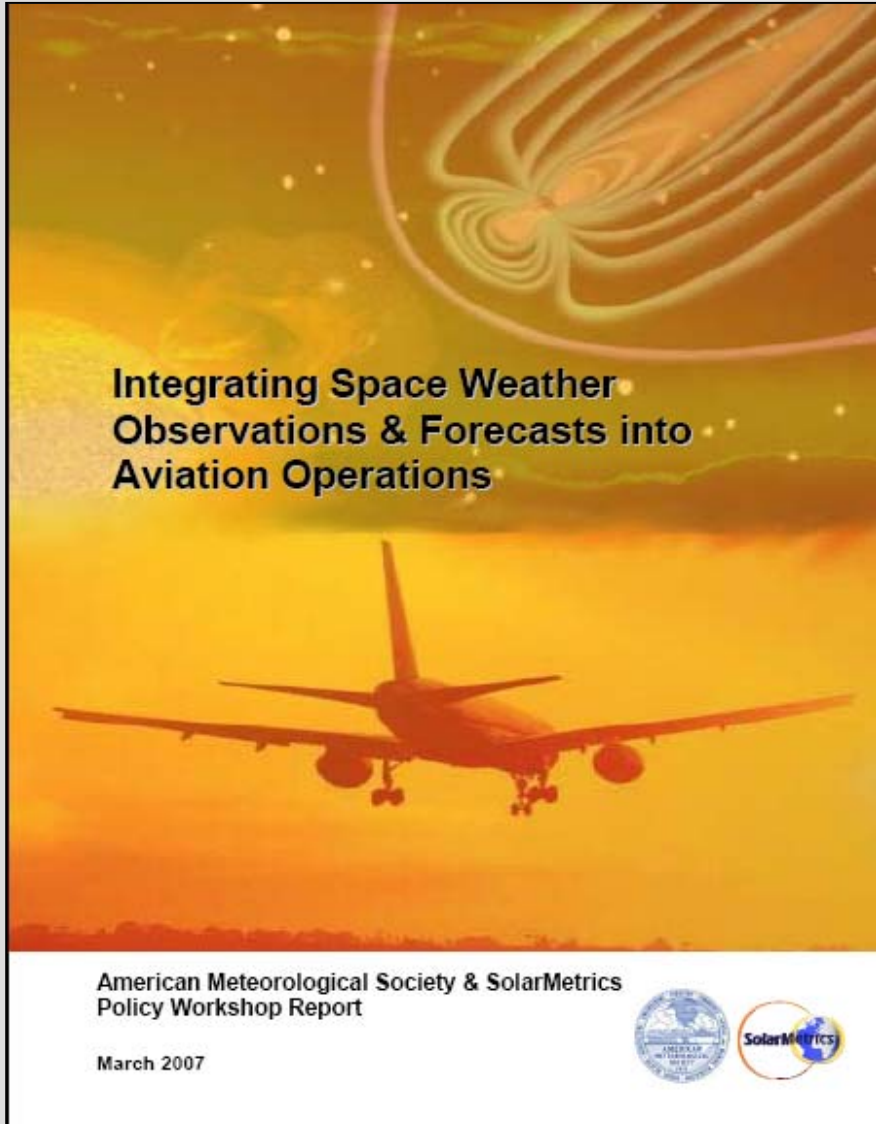
Annual Traffic Per Carrier in Jan - Aug 2007



<i>Polar Route Passenger Movement</i>				
	2004	2009	2014	2019
Capacity	228,000	384,000	972,000	1,768,000
Avg. Annual Growth Rate		13.9%	20.4%	12.7%

**DURING ADVERSE SOLAR ACTIVITY, AIRLINES RESTRICT FLIGHTS TO SPECIFIC ROUTES AND ALTITUDES**

# Aviation & Space Weather Policy Study



**Policy Workshop, 29-30 Nov 06**

- **Organized by AMS and SolarMetrics, in coordination with the FAA, NOAA/SEC, NSF, and NextGen/JPDO.**
- **Objective was to improve the safety and operations of the nation's aviation system through better integration of space weather information.**

**Highlights & Full Report online at:**

**[www.ametsoc.org/atmospolicy](http://www.ametsoc.org/atmospolicy)**

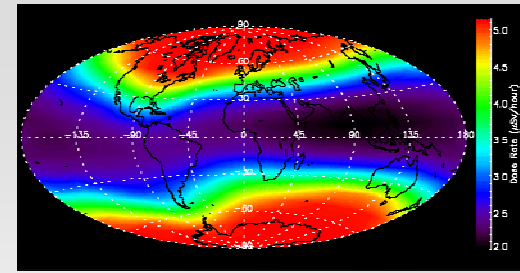
**[www.solarmetrics.com](http://www.solarmetrics.com)**

# Policy Workshop Recommendations

## Improve Communication of Space Weather Information

- Define requirements for space weather information and how it is incorporated into the operational decision making process
  - Cross Polar Trans East Working Group (CPTEWG), NOAA SEC, International Space Environment Services (ISES)
- Deliver space weather information in an internationally agreed upon standardized format as defined by the aviation user requirements
  - ISES Regional Warning Centres, FAA
- Increase the interaction between the aviation community and the space weather research and service provider community
  - NextGen sub-Groups, SESAR

# Major Activities since Workshop



## Workshop Report presented to Congressional Offices

- Space Weather Research introduced into FAA Reauthorization bill (HR 2881)  
SEC. 912. Research Reviews and Assessments
  - (1) *conduct or supervise research projects on impacts of space weather to aviation, including communication, navigation, avionics systems, and on airline passengers and personnel*

## Cross Polar Working Group Space Weather Sub-group (UAL HQ; August 10, 2007)

- First draft of requirements developed
- New radiation storm alerts and thresholds proposed
- New host identified for “one-stop” shopping for space weather products

## Cross Polar Working Group general meeting (Edmonton, Alberta; Sept. 2007)

- Draft requirements presented to members including FAA, major airlines, ICAO, IATA, and NavCanada
- ATC needs added

# Establishing Requirements

	7-Day	24 hour	12 hour	6 hour	Current	
Outlook	X	X	X	X		
Warning			X	X		
Alert					X	
Update						As needed

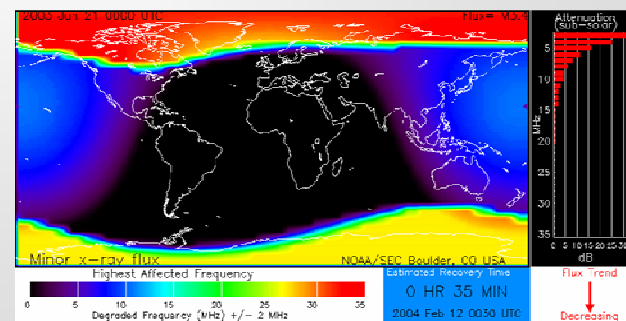
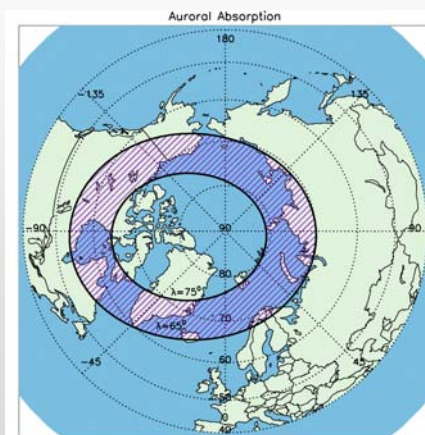
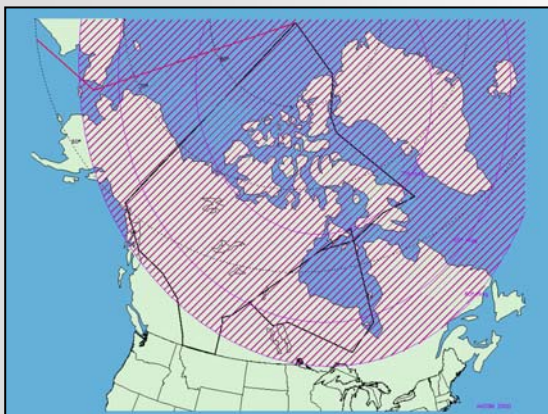
## Sample Text Products

### Space Weather Outlook

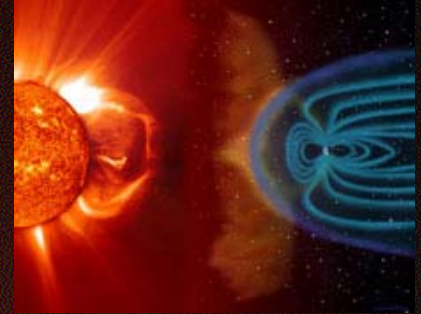
06 December – 13 December 2007

Solar activity is expected to be at moderate to high levels, with isolated major flare activity possible. HF communications will likely experience periods of blackout conditions at high latitudes due to solar radiation storms. A major radiation storm is possible. The geomagnetic field is expected to be at active levels through 11 December, and quiet thereafter....

## Sample Graphical Products



# The Way Ahead...

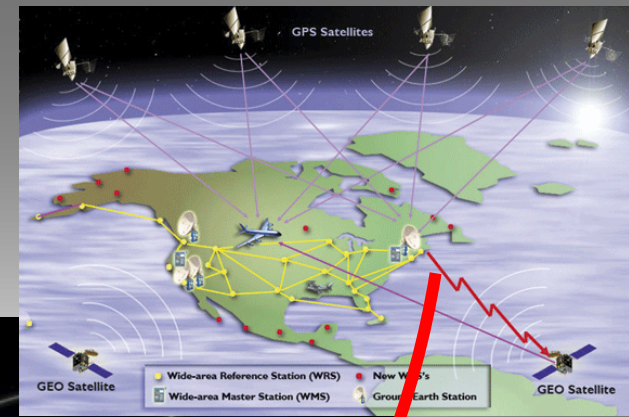


- Initiate new Space Weather Services website ([spaceweather.org](http://spaceweather.org))
- Complete installation of Riometer network to measure real-time radio absorption (Geological Survey of Canada)
- Finalize requirements document through coordination with the Cross Polar Working Group
- Introduce new radiation alerts and thresholds to help decision making during Solar Radiation Storms
- Introduce new radio absorption product
- Continue efforts to develop aviation space weather training curricula for aviation operators and meteorologists



# Evolving Customer Needs

Avionics  
Communications  
Humans  
GNSS



R  
I  
S  
K



Technological Development

