Office of Commercial Space Transportation (AST)

FAA AST Commercial Space Activities and Potential Space Wx Needs

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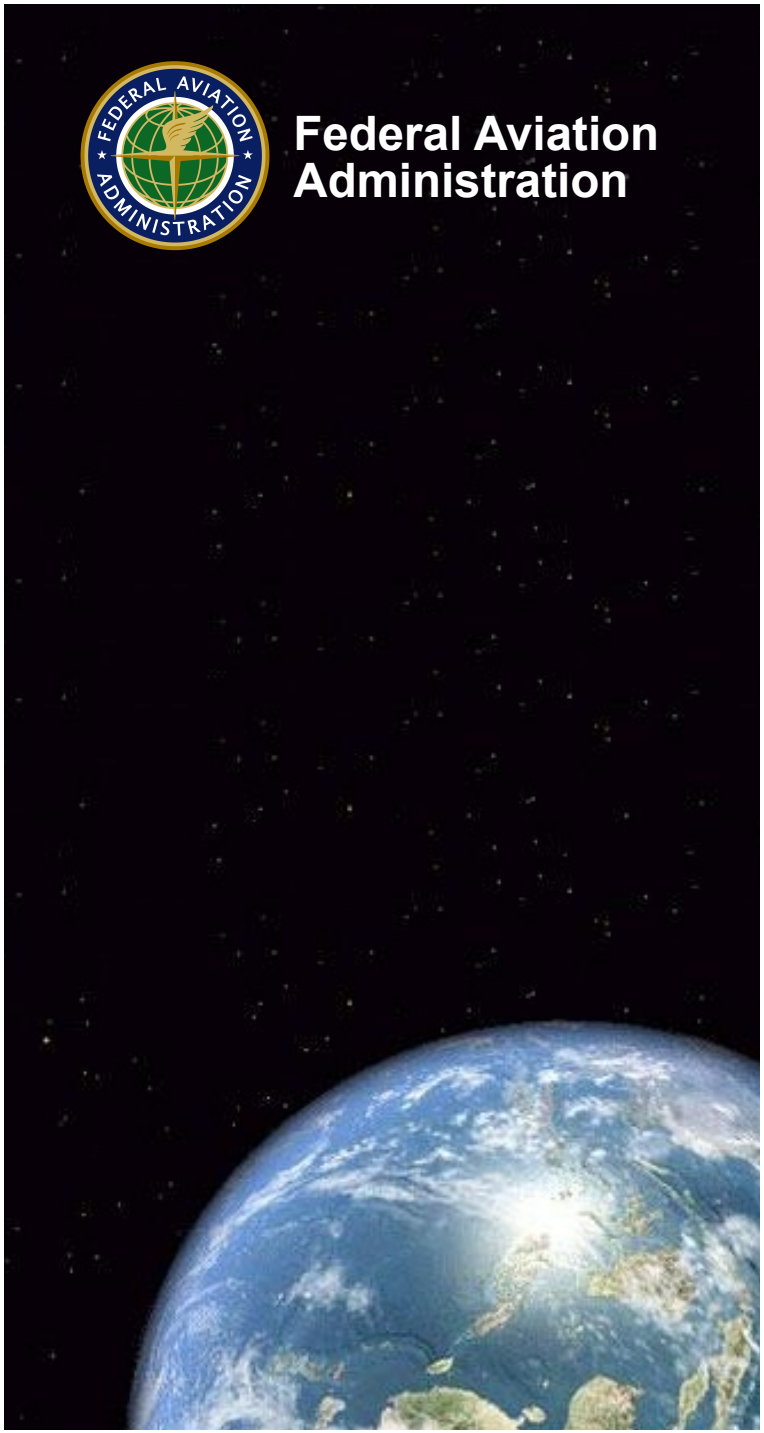


Agenda

- FAA/AST Mission
- Commercial Space Licensed Activity
- U.S. Commercially Licensed Launch Sites
- Current and Future Aviation & Commercial Space Operations
- Current and Future Partnering Activities

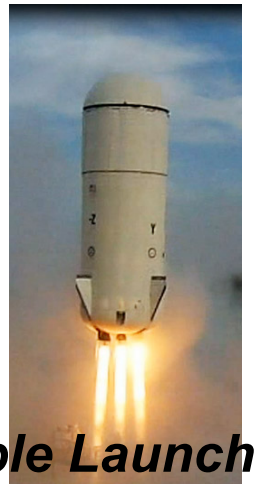
Mission

To ensure the protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch and reentry activities, and to encourage, facilitate, and promote U.S. commercial space transportation.

Examples of Licensed Commercial Space Activity

- Launch or Reentry Site Licenses
- Launch/Reentry Licenses
- Experimental Permits
- Safety Approvals
- Launch Safety Inspections

•Launch or Reentry Launch Sites



•Expendable Launch Vehicles

•Reusable Launch Vehicles

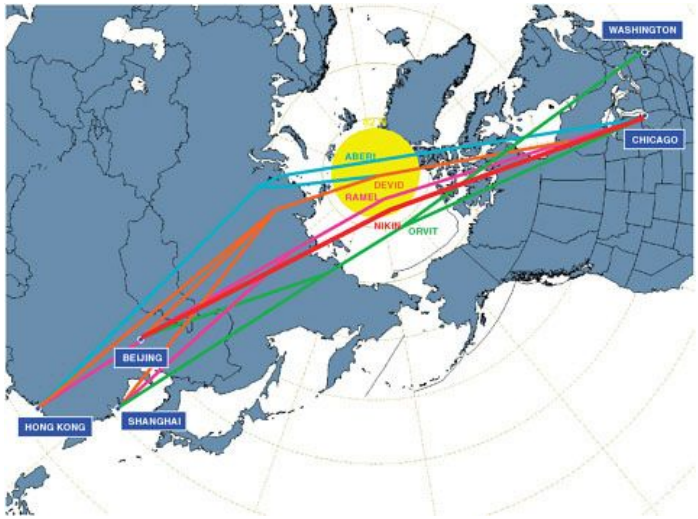
U.S. Launch Sites – "Spaceports"

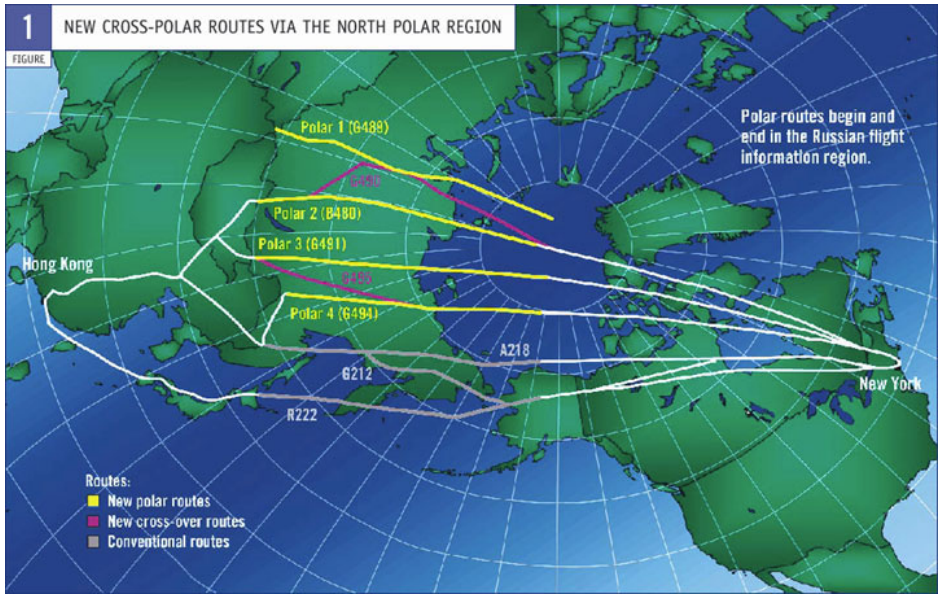
Reagan Test Site
Kwajalein Atoll, Marshall Islands

Current and Future Aviation Operations

Air Crew and Passengers:

- Flights at polar altitudes face special communication & crew exposure concerns
- Flights may have to be re-routed if there is evidence or forecast indicating that the aircraft may be exposed to higher levels of radiation or the communication may be disrupted





•Polar and Cross Polar Routes:

•Since the year 2000, commercial airline traffic over the pole has increased from a few hundred annual operations at more than 10,000 (2011)

Current and Future Space Operations: Extremely Dynamic and Diverse

Federal Aviation Administration

Current & Future Commercial Suborbital Space Operations

Current trend is suborbital flights from low latitudes

- Space Flight Participants:
  - Probably one-time, short duration exposure
  - **Total Cumulative Ionized Radiation Dose likely insignificant**
- Crew:
  - Short exposure but may have high operational demand such as 2-3 times a day
  - **Total Cumulative Ionized Radiation Does Rate may be significant**
- High latitude suborbital launches (>60 deg) – could experience increased dose rates as well as impacts to:
  - High-frequency communication (radio signals (3-30 MHz))
  - Microelectronics (SEEs)
  - GPS
- Suggested best practice:
  - Maintain situational awareness (SA) over space environment prior to launch
  - No launches during a severe geomagnetic storm (no matter the latitude)
  - Space Flight Participants should be informed of the total and effective radiation dose amounts expected for the suborbital flight and should be informed of the actual dose received after the flight

Future Commercial Space On-Orbit Operations

Radiation exposure will depend on inclination, vehicle shielding, vehicle orientation & location within vehicle

Space Flight Participants and Crew:

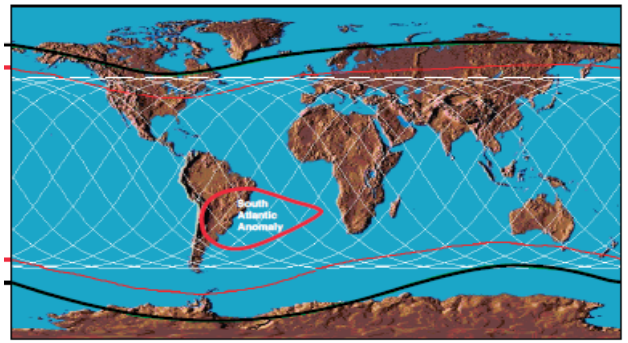
- ✓ Longer duration and increased ionized radiation exposure

South Atlantic Anomaly (SAA):

- ✓ High inclination flight operations will pass through the SAA several times per day.
- ✓ The largest fraction of the dose received by a spacecraft in LEO will be from this region.

Vehicles in orbits >= 60degrees:

- ✓ Spacecraft Charging/Arcing
- ✓ Single Event Effects on microelectronics
- ✓ Communication/navigation impacts
- ✓ Deterioration of surface materials and sensors



Suggested best practice:

- ✓ Maintain Situational Awareness over space environment prior to launch
- ✓ No launches during a severe geomagnetic storm at whatever latitude
- ✓ Take precautionary measures when traversing through the SAA
- ✓ Space Flight Participants should be informed of the total and effective radiation dose amounts expected for the suborbital flight and should be informed of the actual radiation dose received after the flight

Space Weather Operations, Research, and Mitigation (SWORM) Task Force

- DOT actions are to lead, co-lead or support efforts to develop plans, tools, training, and guidance on responding to extreme space weather events

- DOT SWORM activities include:
  - » Assess ionizing radiation benchmarks & datasets (Supporting Agency (SA))
  - » Develop training materials (SA)
  - » Define requirements for real-time monitoring of charged particle radiation environment to protect the health and safety of crew and passengers (SA)
  - » Define scope and requirements of a real-time reporting system for SA of the radiation environment (Lead Agency (LA))
  - » Develop or improve models for real-time assessment of radiation levels at commercial flight altitudes (Co-Lead)
  - » Develop international standards for provision of space weather info for air navigation services (LA)

Current and Future Operational Needs

Need to Minimize Space Weather Impacts with Respect to:

- Crew/Spaceflight Participant
- Safety Critical Components
- Safety Critical Communication/Navigation

Decision support tools for Go/No-Go conditions related to: Crew/Spaceflight Participant, communication, navigation, or vehicle (avionics) constraints

Improved Real-time Observation and Prediction of SPEs

Improved Radiation Modeling of GCRs

Partnering Activities with CCMC/SWRC

- **Continued Collaboration with CCMC**
  - Identify research models/tools/education & activities to benefit operators
- **Identify mutual goals between FAA and CCMC to improve Aviation/Commercial Space Safety**
  - V&V testing of current (CARI 7.0) and future Radiation model
- **Conduct Space weather educational activities for NAS Stakeholders**
  - Details
  - Space weather workshops for AST engineers
  - AST participation at CCMC/SWRC workshops, educational events

Questions?