Operational advances for atmospheric radiation dose rate specification

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Real-time aviation radiation environment specification is expanding

ARMAS real-time measurements from aircraft
- **Builds** upon NAIRAS data-driven physics-based global climatology
- **Utilizes** airborne Si micro dosimeters to collect real-time total ionizing dose (TID)
- **TID calibrated** to tissue equivalent proportional counter (TEPC) in NSRL, LANSCE, LLUMC, LLNL beam lines
- **Transmits** TID and GPS location to the ground via Iridium for data comparison with NAIRAS
- **Distributes** updated information with 15-minute latency
Atmospheric radiation from GCRs and SEPs is an issue for all aircraft >26,000 ft.

Credit: APA and NCRP

ARMAS builds upon NAIRAS

NAIRAS

ARMAS

ARMAS SBIR Phases I & II are successful

Pre-ARMAS: post flight thermoluminescent and etched track detector analysis

ARMAS Phase I
- TEPC - 7 commercial flights
- 2011–2012

ARMAS Phase II
- μDos - 49 FM1 DC-8 flights
- 2013-2014

ARMAS Flight Module 1 (FM1) ready on AFRC DC-8 prior to flight
ARMAS FM1 flight 18 example

• **Top:** ARMAS flight 18 (August 28, 2013)
• **Middle:** S2 event (September 30, 2013)
• **Bottom:** S3 event (March 7, 2012)

Typical FM1 flight profile (flight 18)
ARMAS FM1 FLIGHT SUMMARY:

49 flights during high to moderate solar activity (May 2013 to Sep 2014)

all GCR radiation (no SEPs)
**FM2 Deployments**

- Korea Space Weather Center has purchased two FM2s as part of ARMAS Phase IIE commercialization
- Deployment to NOAA G IV and NSF G V beginning in February 2015
- Data will be available to community beginning mid-2015

Tobiska *et al.*  

http://spacewx.com  

*SpaceWeather app*
FM3 Deployments

- NASA Armstrong Flight Research Center has purchased one FM3 as part of ARMAS Phase III commercialization
- Deployment to ER-2 in February 2015
- Second anticipated unit to NASA AFRC Global Hawk in late 2015
- Data will be available to community beginning mid-2015
Stratospheric balloon flights starting in mid 2015 through an MOU between World View and SET

Data will be extended to ~35 km as a World View pathfinder payload

Credit: World View
ARMAS-Lite on business jets

ARMAS-Lite FM5
• Flight Module 5 (FM5) configuration has μDos
• altitude range will be to 16 km on business jets
• μDos data will be reported in global context of NAIRAS data-driven climatology
• distributed network with multiple flight units to provide global situational awareness
• NAIRAS data validation for all flight data plus SEP event flight exposure mitigation