Operational advances for atmospheric radiation dose rate specification

12th Conference on Space Weather Applications for end users

AMS 2015

January 5, 2015

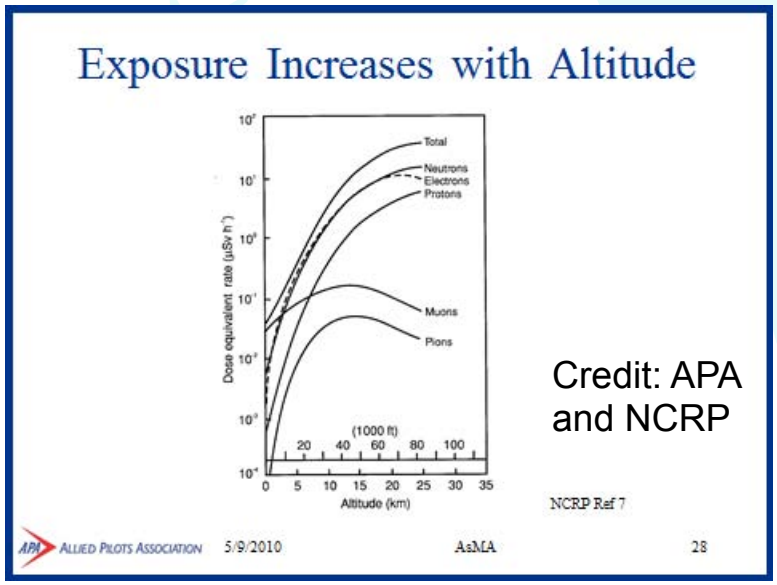
W. Kent Tobiska, Dave Bouwer, Justin J Bailey, Leonid V Didkovsky, Kevin Judge, Henry B Garrett, William Atwell, Brad Gersey, Richard Wilkins, Don Rice, Robert W Schunk, Duane Bell, Christopher J Mertens, Xiaojing Xu, Geoffrey Crowley, Irfan Azeem, Adam Reynolds, Michael J Wiltberger, Scott Wiley, Stephen Bacon, Edward Teets, Alec Sim, Laura Dominik, Bryn Jones, and the ARMAS Science Team

Real-time aviation radiation environment specification is expanding

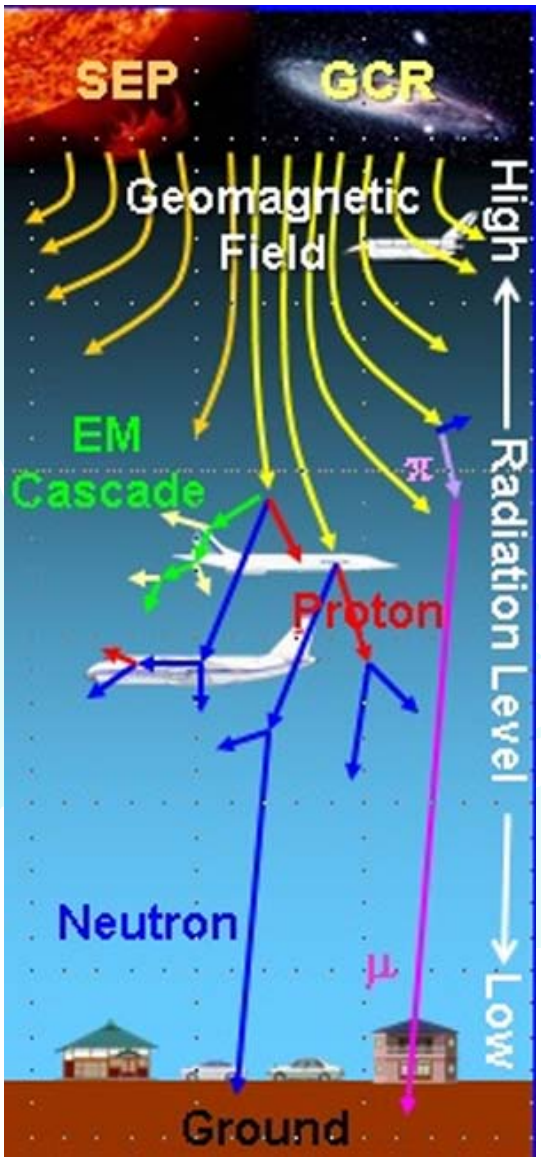
ARMAS real-time measurements from aircraft

- 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



Credit: J. Huang

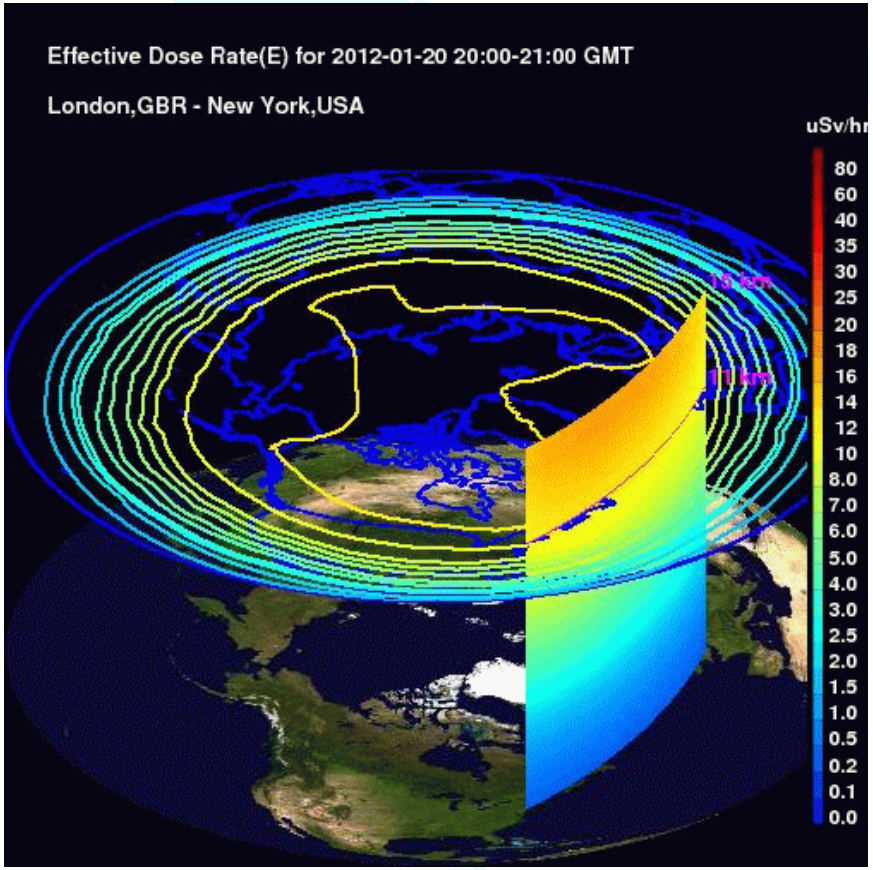
Tobiska *et al.*

http://spacewx.com

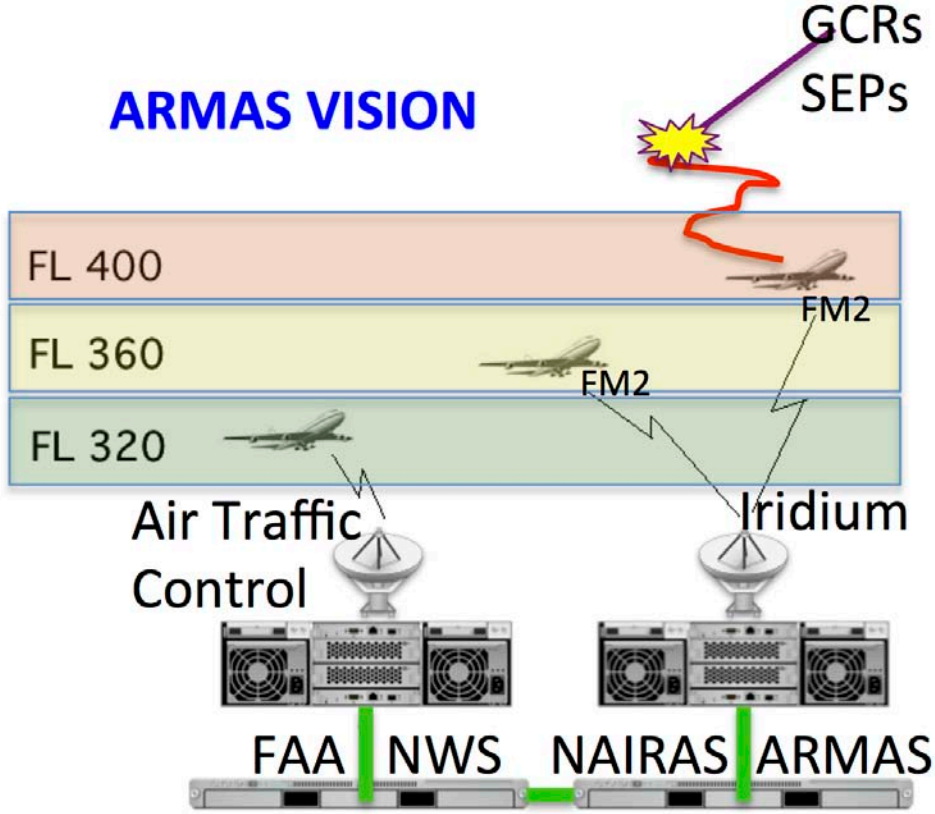
SpaceWeather app

ARMAS builds upon NAIRAS

NAIRAS



ARMAS

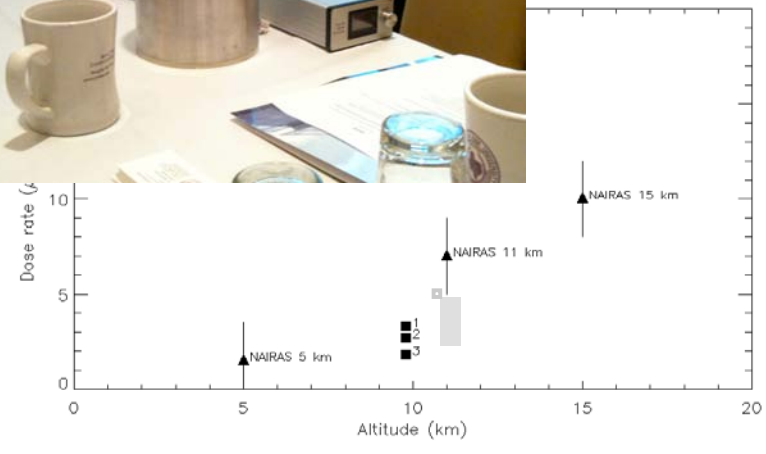


ARMAS SBIR Phases I & II are successful

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

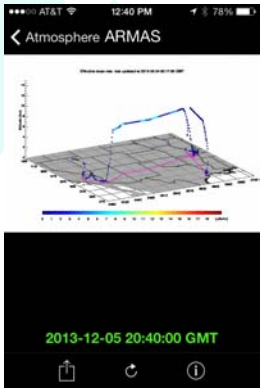
ARMAS Phase I

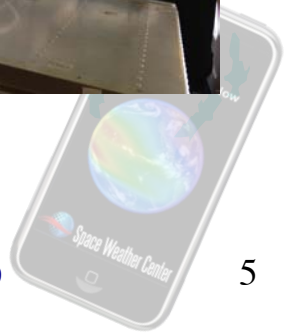
- TEPC - 7 commercial flights
- 2011–2012



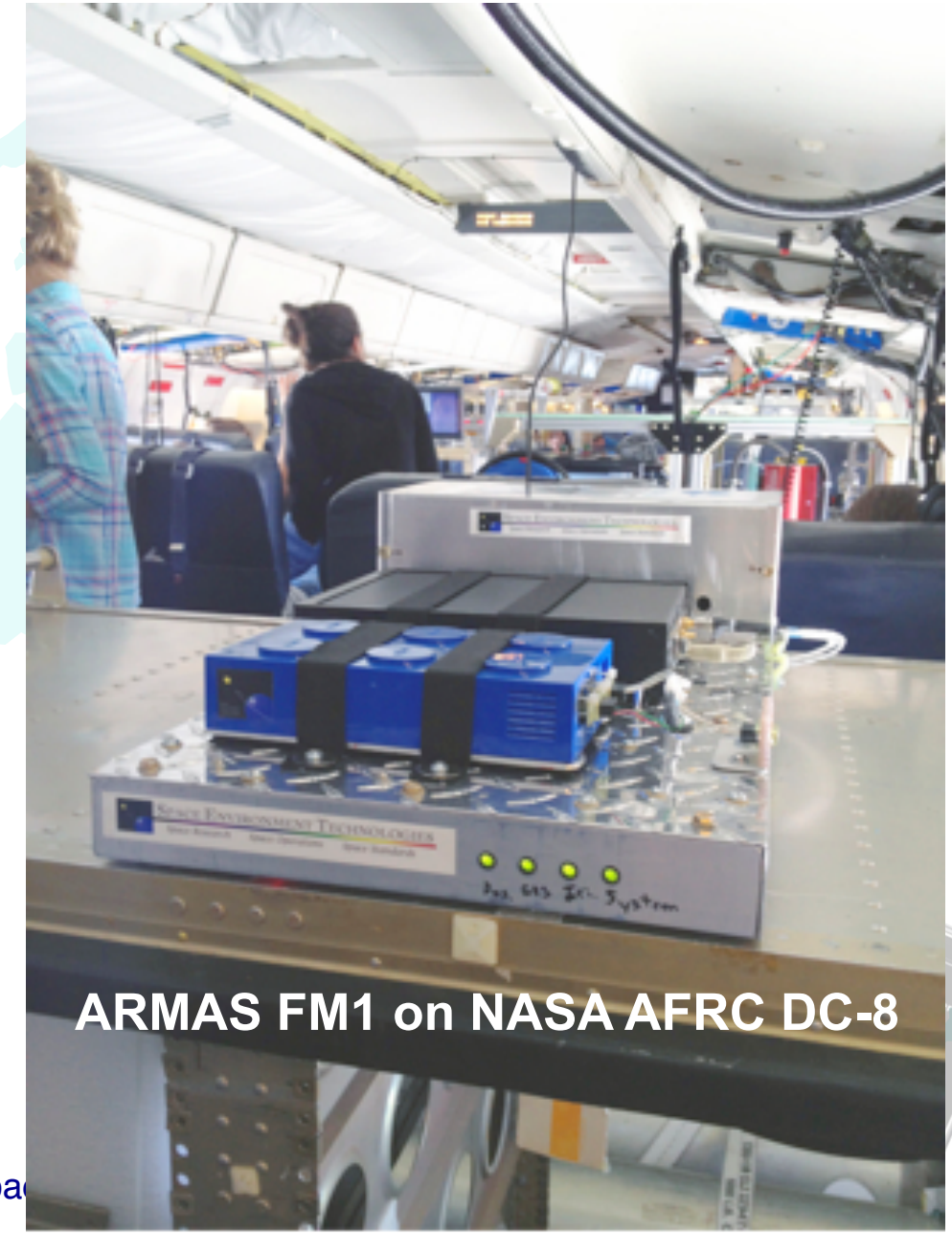
ARMAS Phase II

- μDos - 49 FM1 DC-8 flights
- 2013-2014

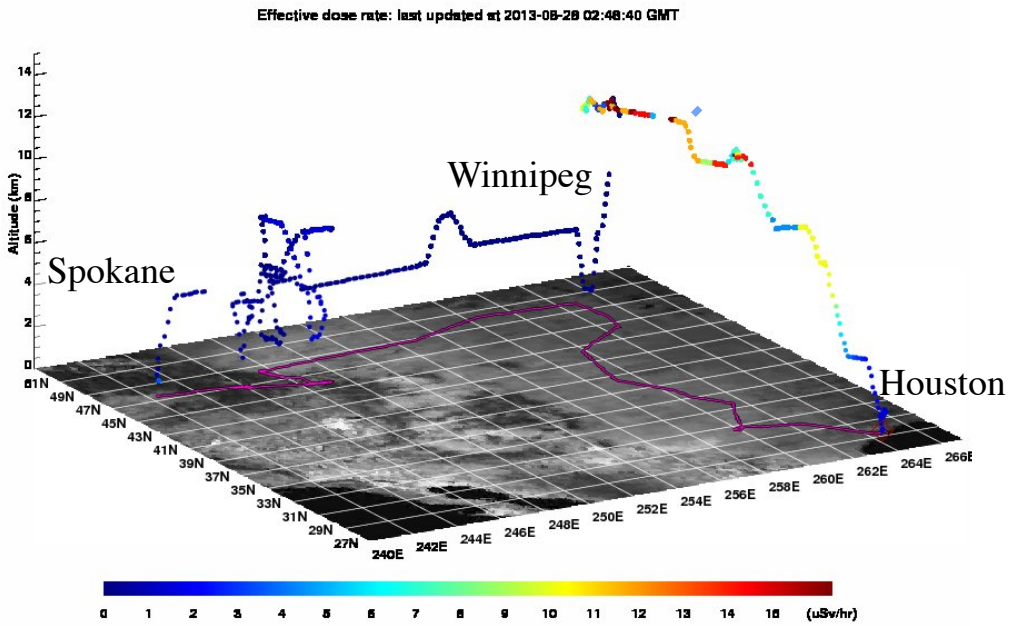


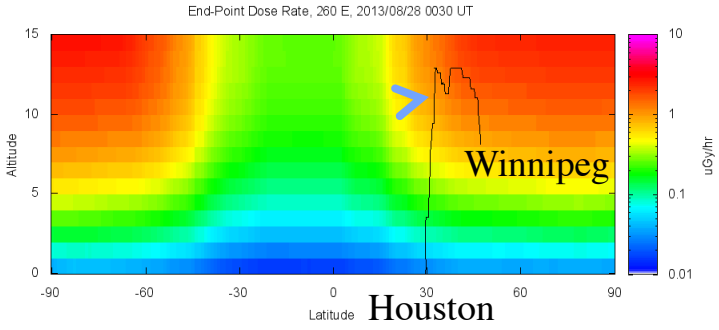


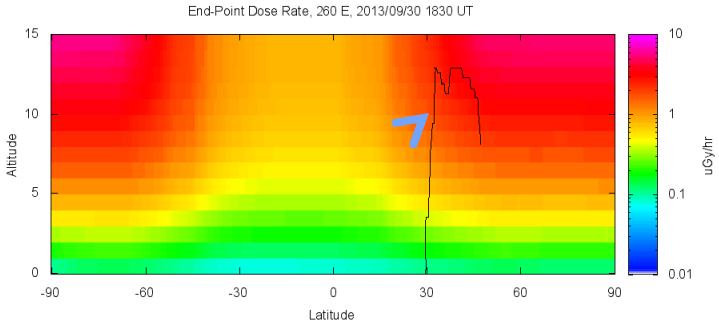
ARMAS Flight Module 1 (FM1) ready on AFRC DC-8 prior to flight

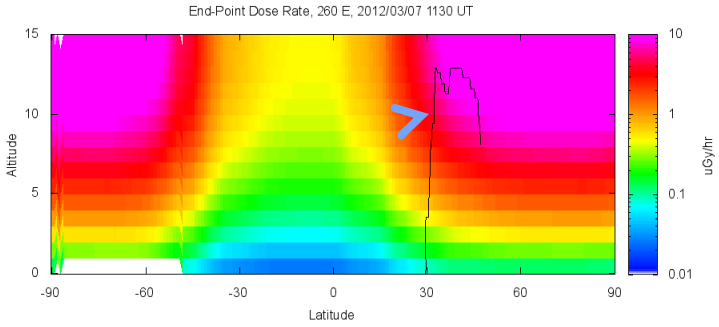


ARMAS FM1 flight 18 example



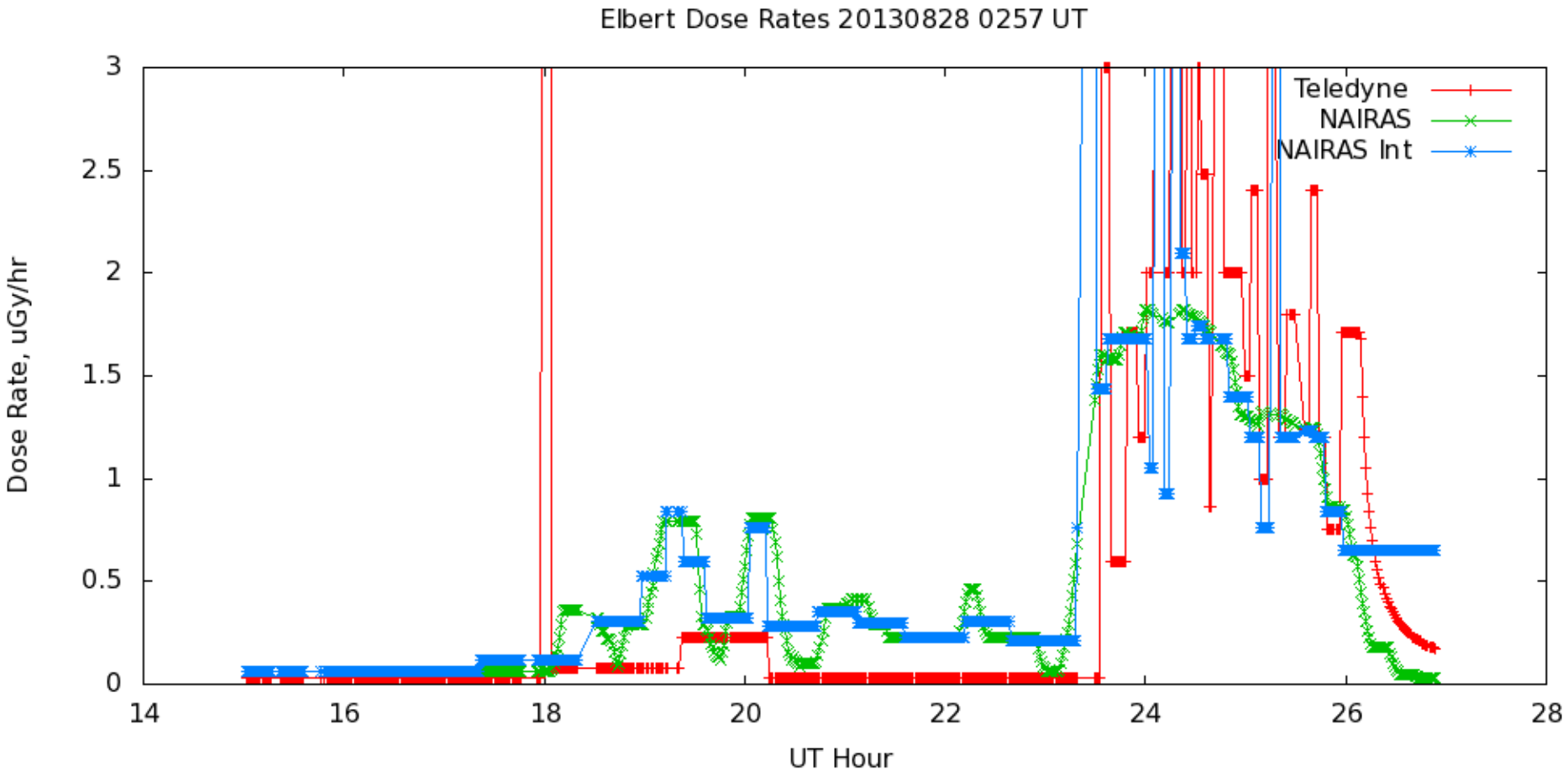






- **Top:** ARMAS flight 18 (August 28, 2013)
- **Middle:** S2 event (September 30, 2013)
- **Bottom:** S3 event (March 7, 2012)

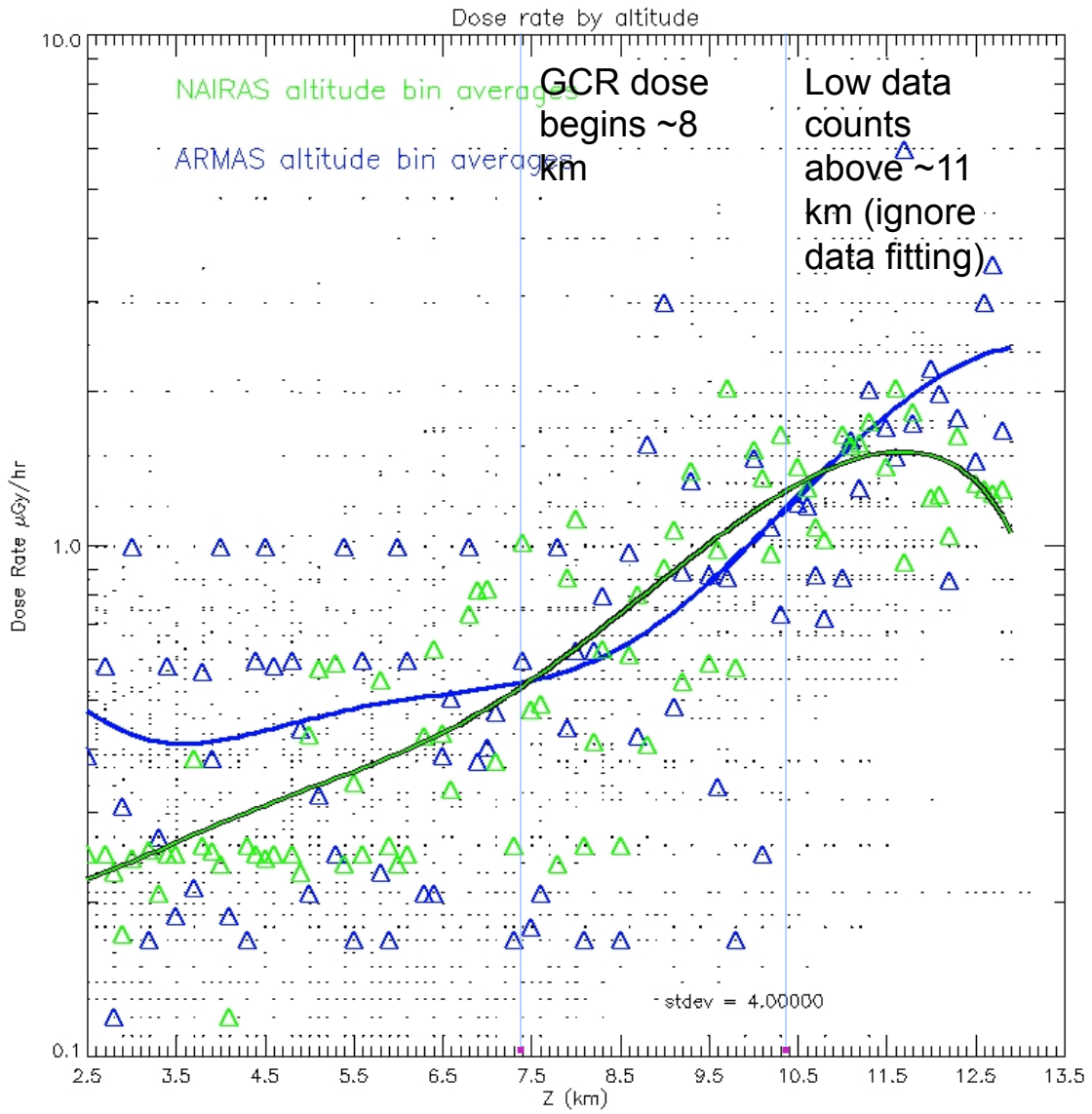
Typical FM1 flight profile (flight 18)



ARMAS FM1 FLIGHT SUMMARY:

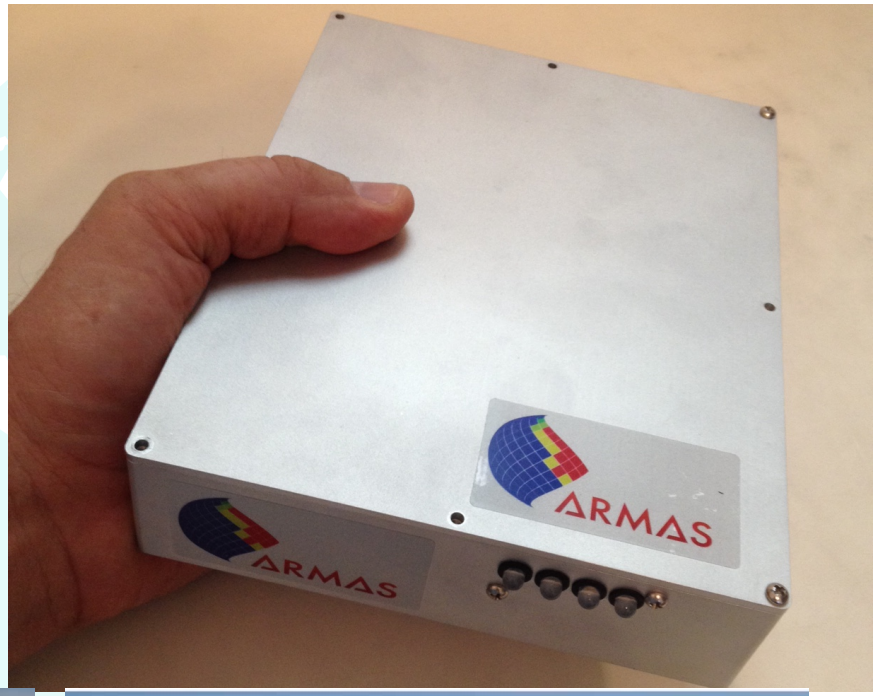
49 flights during high to moderate solar activity (May 2013 to Sep 2014)

all GCR radiation (no SEPs)



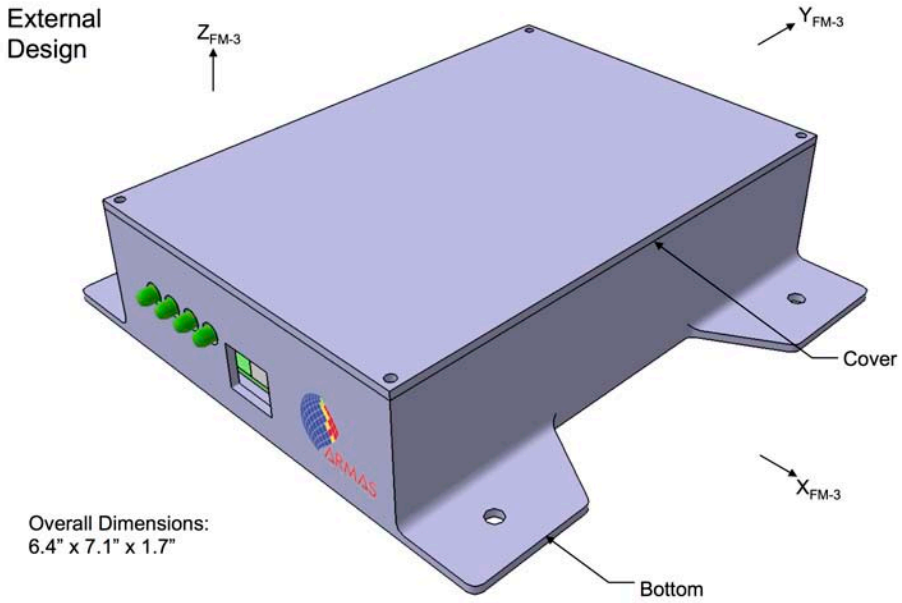
FM2 Deployments

- 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




NSF G V

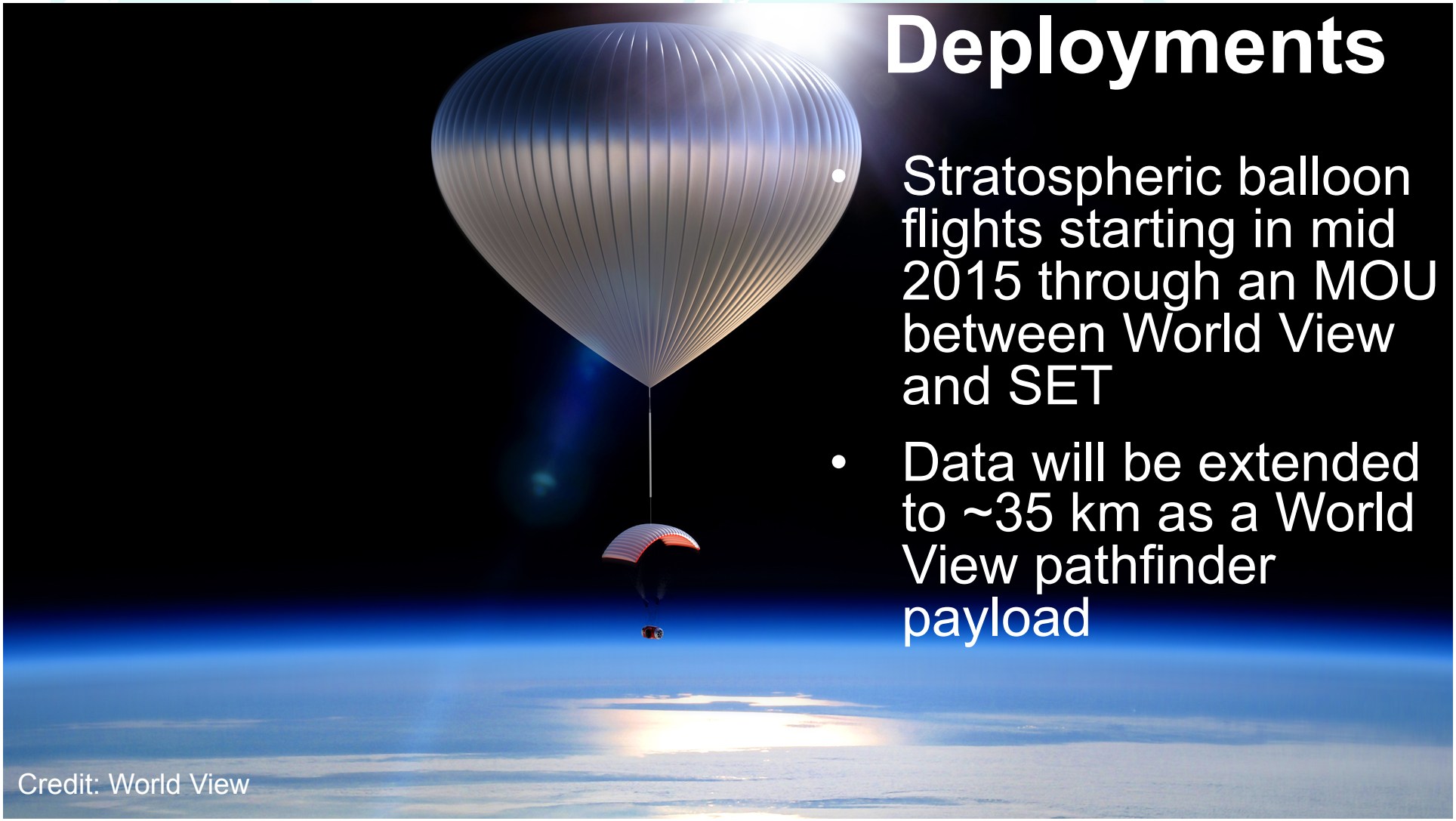

NOAA G IV



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

FM4 Deployments



- 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