

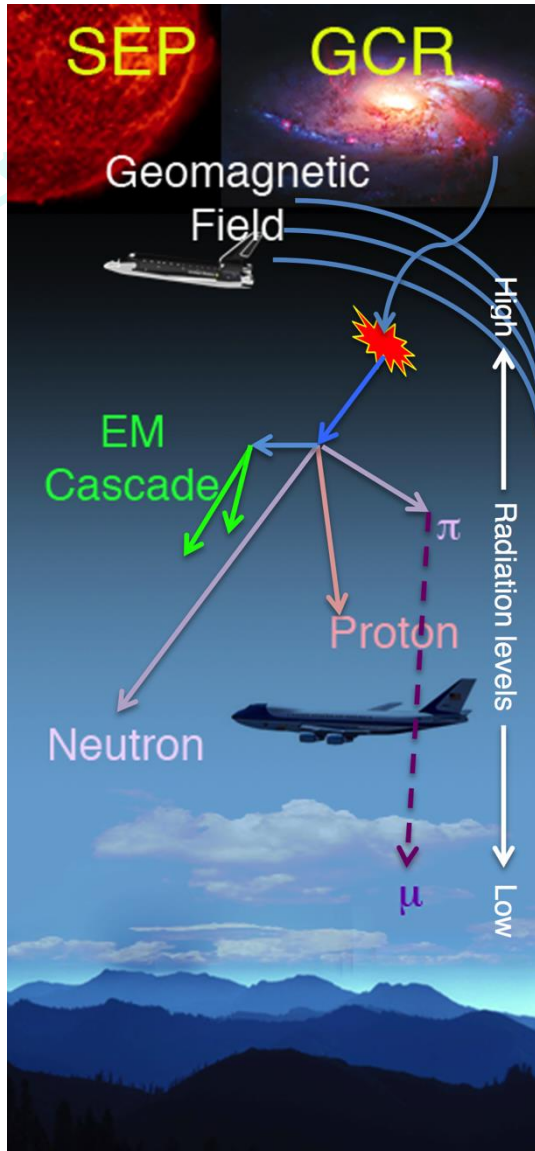


Real-time radiation weather for commercial aviation on the horizon

**SWW Panel Space Weather and Aviation
April 18, 2018**

W. Kent Tobiska

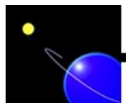
Space Environment Technologies and American Commercial Space Weather Association



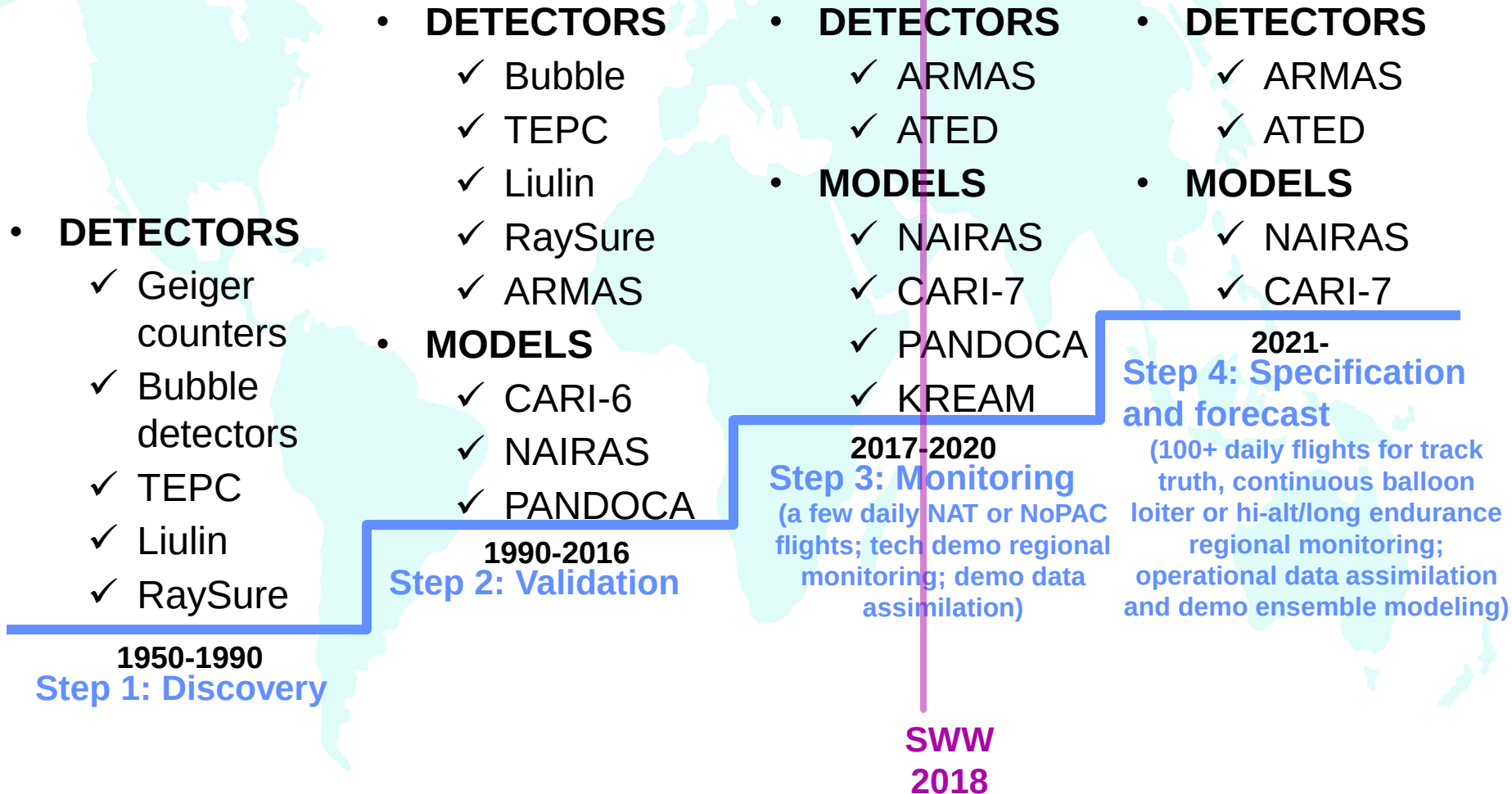
Space weather creates a dynamic radiation environment at aviation altitudes

Aviation radiation sources

- ✓ **global phenomenon** GCRs (career health issue and avionics SEUs)
- ✓ **high latitude phenomenon**
 - ✓ **Extended major events** SEPs (fleet operations and aircrew/passenger safety issue)
 - **Short-term minor events** precipitating outer radiation belt energetic electrons (career health issue)
 - **Instantaneous minor events** terrestrial gamma-ray flashes (TGFs) (avionics EMI)



Where are we today? Progress towards aviation radiation specification & forecast

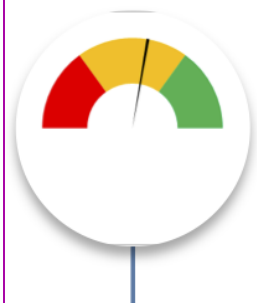
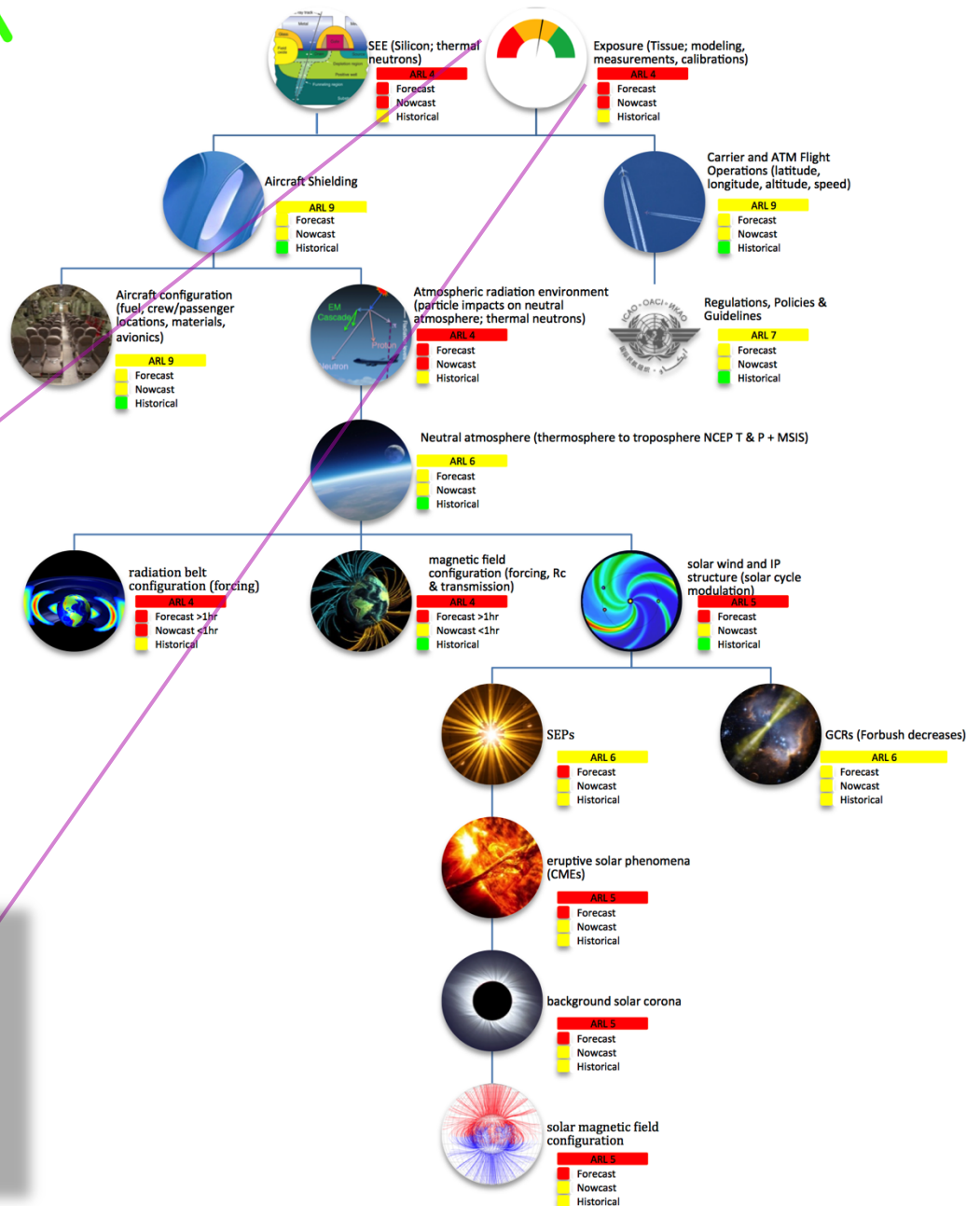


SAFESKY ROADMAP

status: 5
papers in
preparation
for SWJ

PRIORITY

Roadmap for Aviation Radiation Safety



Exposure (Tissue; modeling, measurements, calibrations)

ARL 4

Forecast
Nowcast
Historical



ARMAS real-time measurements demonstrated





Features:

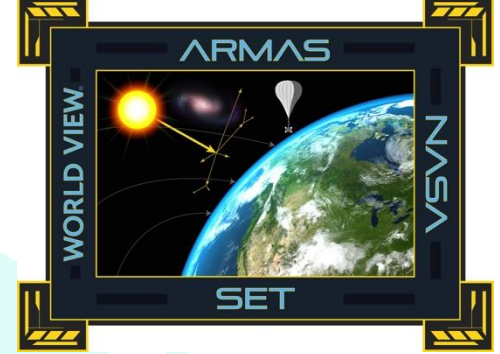
- Measurement of absorbed dose in silicon
- Small size and mass
- Data retrieval via Bluetooth pairing with smartphone or tablet app
 - Display current status on app
 - use plane's WiFi to transmit to ground as needed
- Level 4 real-time dose rates provided (effective dose rate)

Status:

- First 6 units in production for specific customers
- FM6A delivered Jan 2018
- FM6B-F deliveries in June 2018

ARMAS FM6





ARMAS World View

SUCCESS!

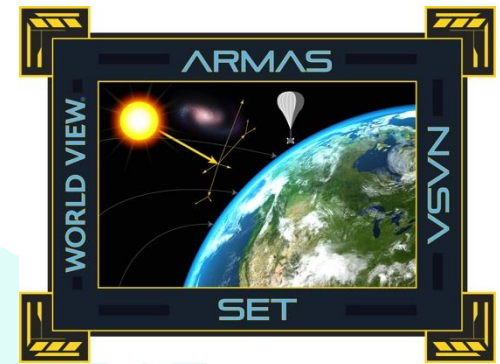
- Stratospheric balloon flight 29 March 2018
- Real-time data extended to 35 km
- Highly dynamic environment found



SPACE ENVIRONMENT TECHNOLOGIES

Space Weather Division

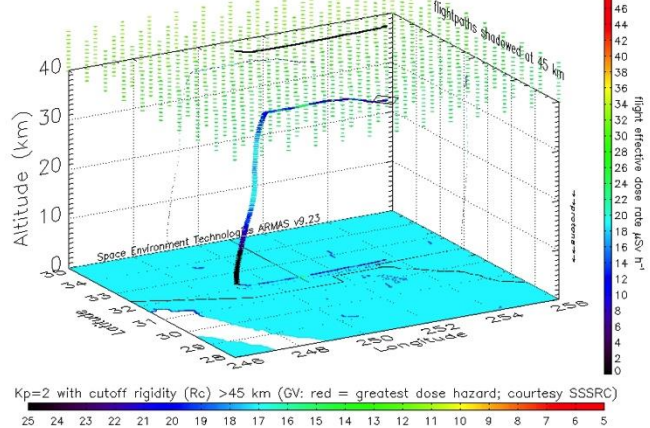
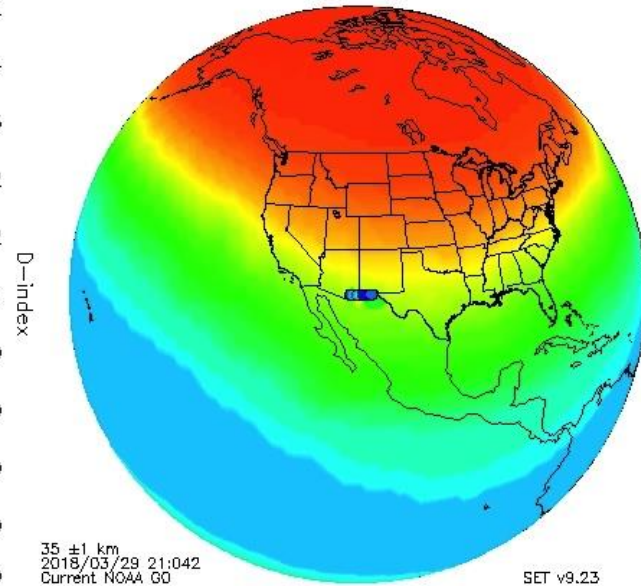
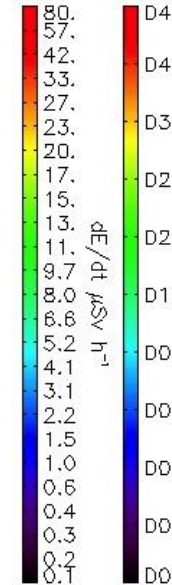
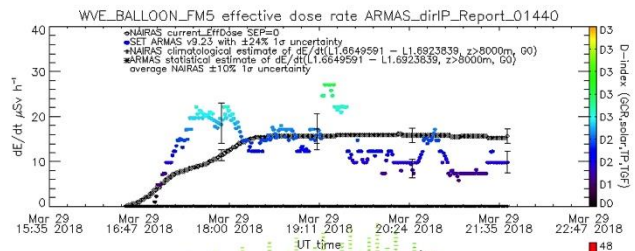
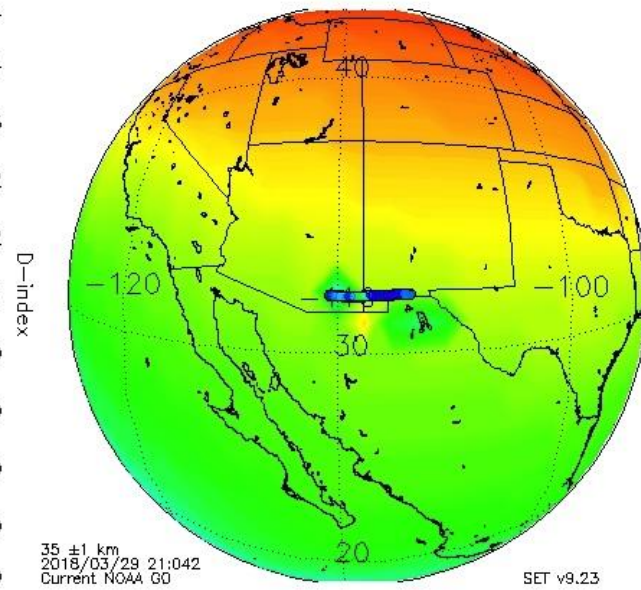
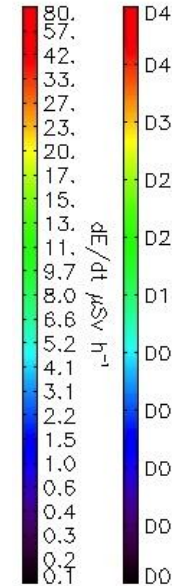
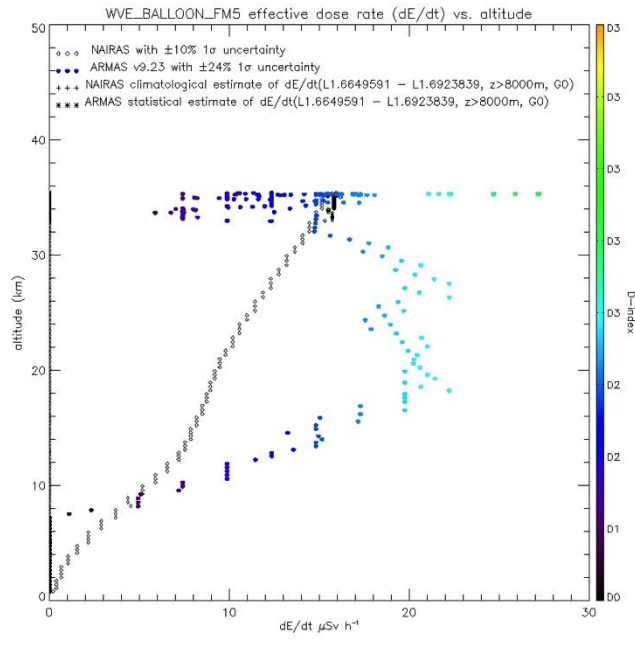
ARMAS World View





ARMAS World View Results

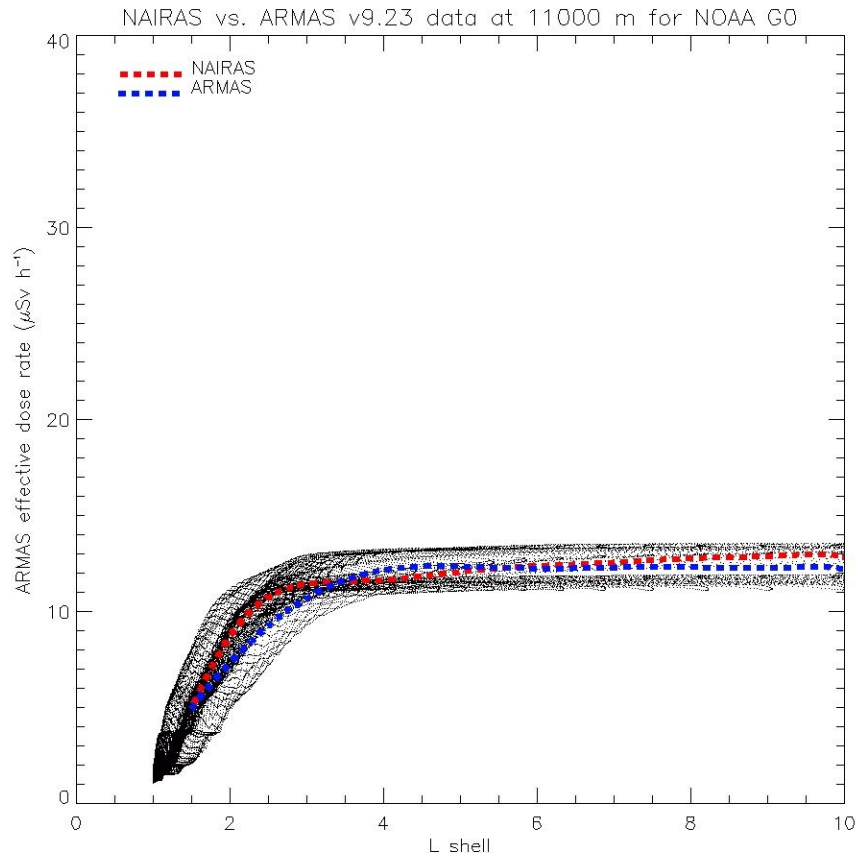
Tobiska



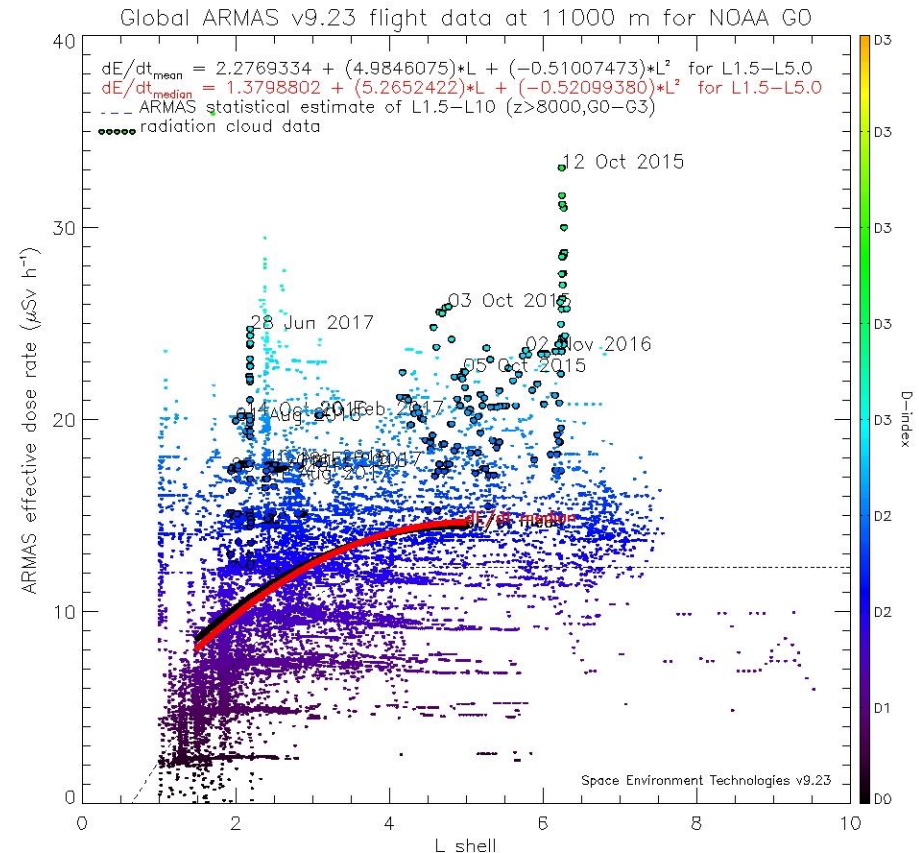


Dose rates vs. L shell at 11 km during NOAA G0 conditions

CLIMATOLOGY

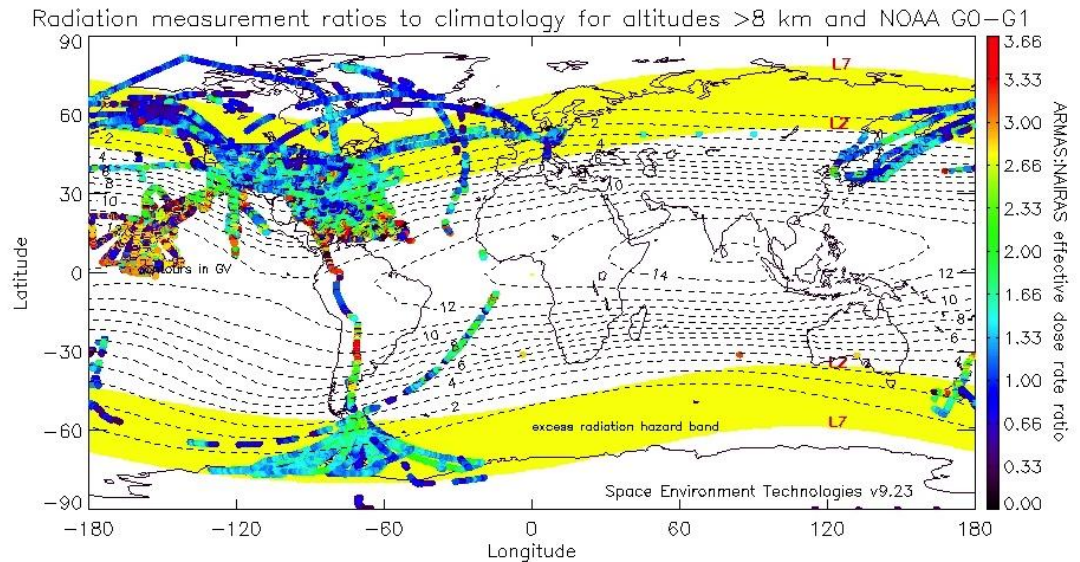
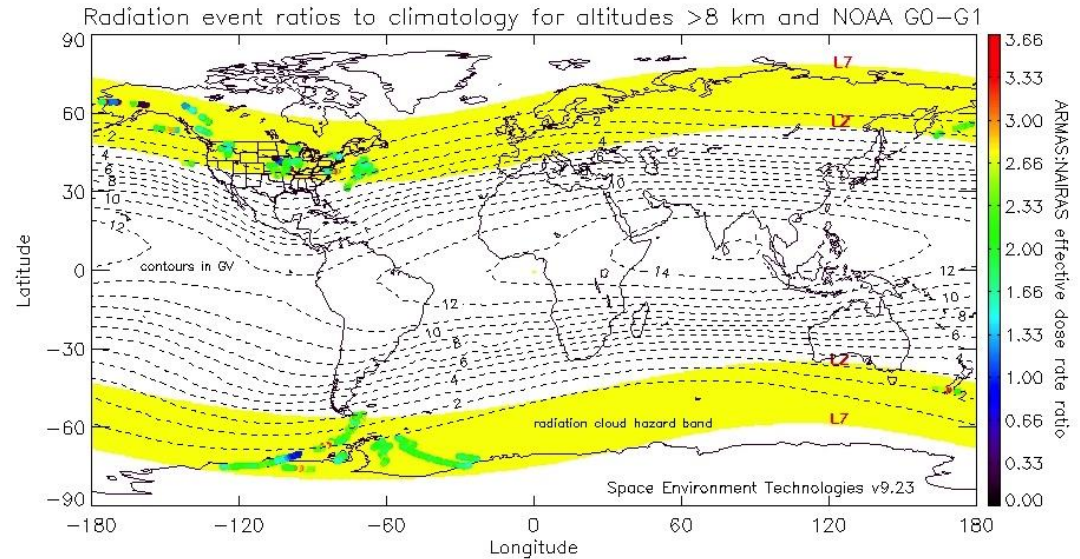


STATISTICAL DATABASE



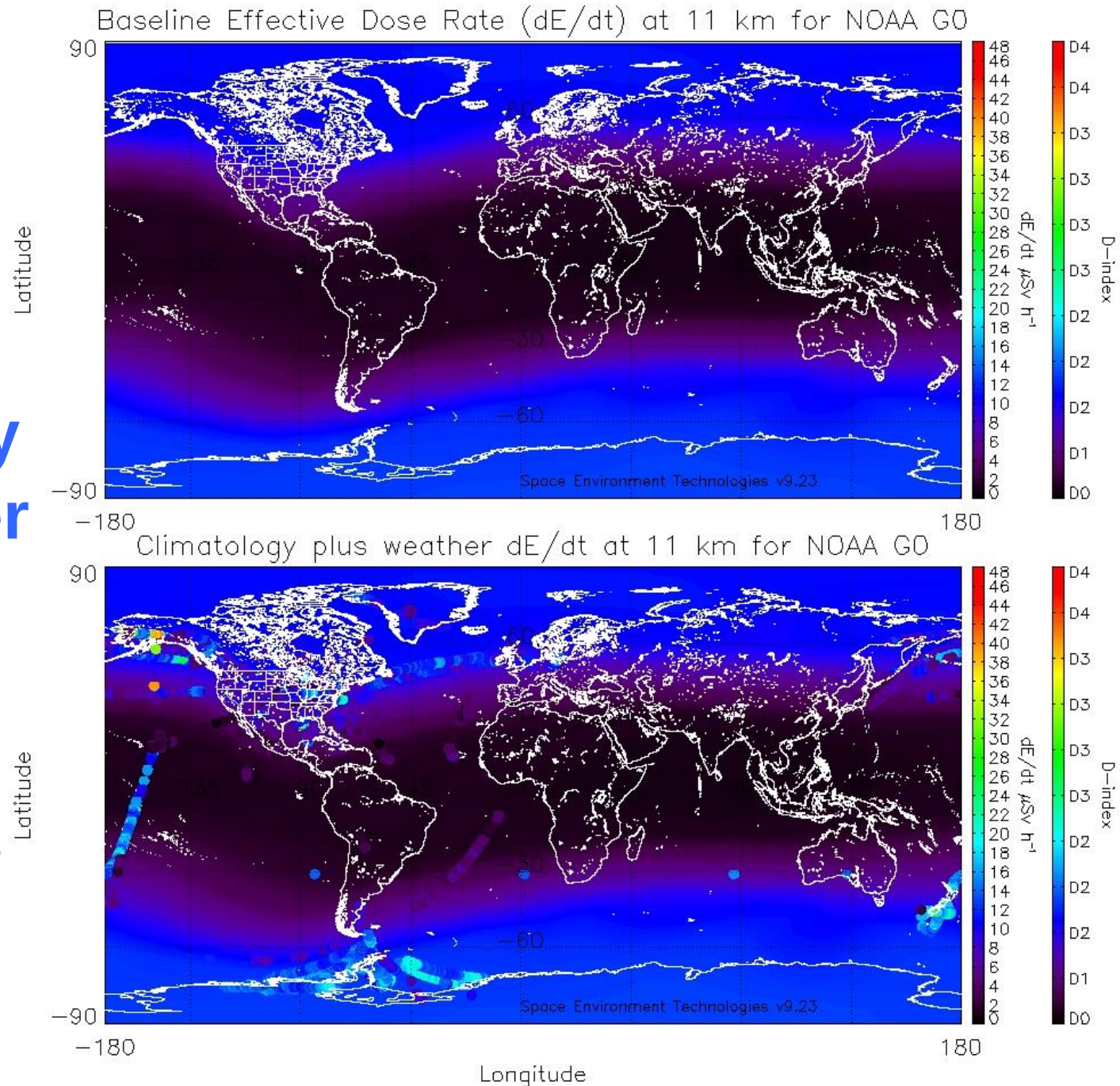


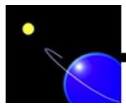
Event and
database
ratios to
NAIRAS in
preparation
for data
assimilation



Dose rate climatology and weather at 11 km during NOAA G0 conditions

Tobiska





Specification and forecasting

Users: air traffic
management,
company
operations, pilots

- 24-hour forecast (climatology, top left)
- Current epoch (specification, bottom left)
- Flight track (due diligence archive, top right)
- Regional track (situational awareness, bottom right)

