ARMAS builds on NAIRAS

- ARMAS (Automated Radiation Measurements for Aviation Safety) evolved from the highly successful NAIRAS (Nowcast of Atmospheric Ionizing Radiation System)
  - NAIRAS was a NASA LWS TRT funded Applied Sciences Program (2008-2011)
  - It developed an operational prototype for a global, real-time, data driven predictive system needed to assess biologically harmful radiation exposure levels for aviation.

Flight Module

- NASA Dryden Flight Research Center provided 29 flights aboard DC-8
  - DC-8 flights occurred over a range of magnetic latitudes and longitudes, obtaining GCR dose measurements.

Calibrations with TEPC

- Tissue Equivalent Proportional Counter (TEPC)
  - TEPC is the community standard for tissue equivalent dosimetric measurements
  - TEPC collects data as a function of time
  - Measures the dose and estimates the dose equivalent by making spectral measurements of the linear energy loss of the radiation as it passes through the detector volume
  - Omni-directional detector is surrounded by tissue equivalent plastic and internal propane gas to provide an energy deposition response similar to human tissue
  - Detector gas is at very low pressure (mass of gas is similar to a human cell)
  - TEPC HAWK instrument is maintained and operated by Prairie View A&M University

Data Integration and Test

- Preliminary Ground Test plan
  - Sunset flight experiment on DC-8 will measure real-time ambient dose rate with at least 1-minute time granularity and GPS position to within 200m (1s)
  - Use GPS on DC-8 and Iridium satellite link to transmit data in 5-minute packets
  - TEPC will fly simultaneously for cross comparison but will record data
  - CASES GPS will fly simultaneously for cross comparison of position
  - Pressure level flight logs will be used for NAIRAS post analysis
  - Sunset accumulated ambient dose and DC-8 GPS will be transited to the ground via Iridium satellite link
  - Ground data packet receipt will be verified by FPS and SET
  - Data will be assembled into ambient dose rate time series for each channel of data (nGy/minute) and inserted into database as archival and most recent files
  - SET database will separately contain most recent NAIRAS global ambient dose equivalent rate data
  - USU SWC will extract most recent NAIRAS and files from SET database
  - Sunset flight data will be reported as a difference from 3D NAIRAS cells (1°x1°x1km) using a flight tracking radius filter
  - Small-sized difference files will be returned to database for NAIRAS extraction and conversion to effective dose rate
  - Goal is real-time update latency of less than 1/2 hour
  - Successfully accomplished all the above and successful real-time update latency of 15-minutes achieved

Objectives:

- Deploy and obtain real-time data from a dosimeter flown at commercial aircraft flight altitudes
- Integrate real-time data into the NAIRAS modeled radiation environment
- Improve the accuracy of radiation dose and dose rates along flight paths
- Improve aviation safety by laying the groundwork for automated, reliable monitoring of the natural radiation environment at commercial aviation flight levels.

Team:

- Space Environment Technologies
- Prairie View A&M University
- Boeing
- Utah State University Space Weather Center
- FPS
- Collaborators: NASA LaRC, Aerospace Corp., ASTRA, Teledyne, aviation pilots

Vision and Progress

- ARMAS will utilize airborne micro dosimeters, calibrated to TEPC, to make dose and dose rate measurements in real-time, transmit the data to the ground for data implementation into NAIRAS, and then distribute the updated information on to the end user