Air Force Research Laboratory

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AE9, AP9, and SPM: New Features and Future Version Plans

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Recent AE9/AP9 Improvements

CmdLineAe9Ap9 Program

- Support more ShieldDose2 options
- Improved Linux compiler optimization settings
- Documented command-line options
- Multiple file limit resolved
- MJD conversion fixed

User's Guide Document

- Additional information provided for
  - ShieldDose2 model parameters
  - Legacy model 'advanced' options
  - Model performance tuning
  - Orbit definition parameters
  - Coordinate system details
  - Modified Julian Date conversions

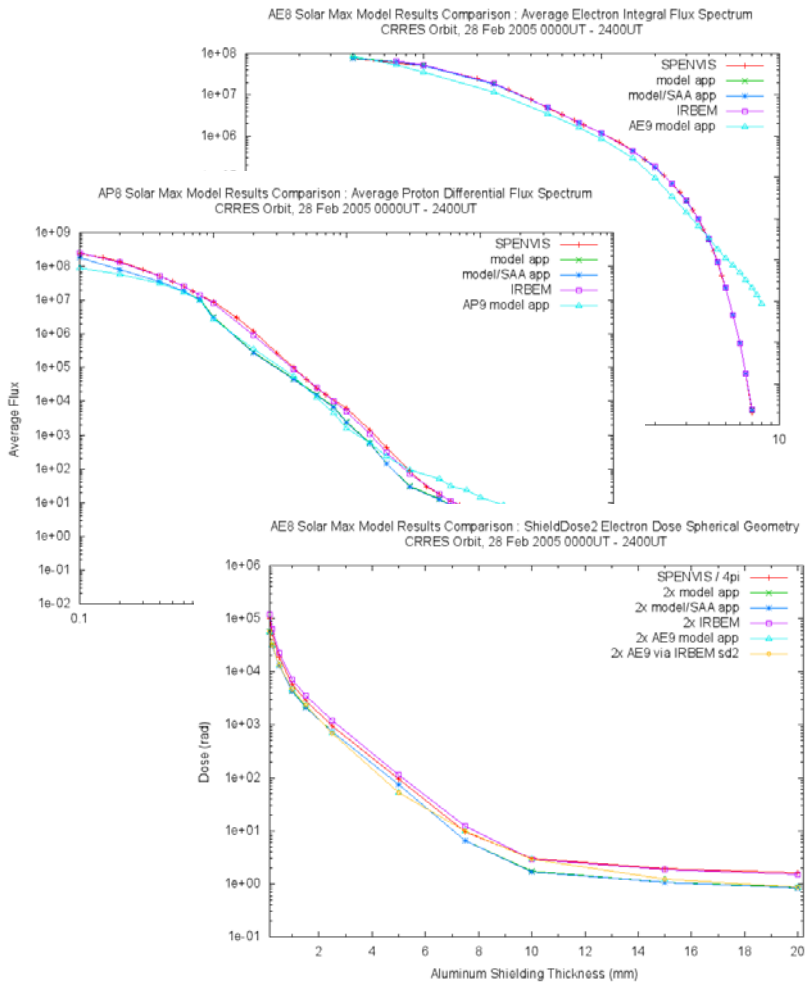
Graphical User Interface

- Clarified labels & error messages
- Added more 'tooltip' information
- Various GUI behavior fixes

New Utility Programs

- PlasmaIntegral
  - Adjusts Plasma integral flux calculations (for non-GUI runs)
- CoordsAe9Ap9
  - Calculates 'Adiabatic Invariant' coordinates from satellite ephemeris

Comparison of AE8/AP8 (legacy) models to external implementations



Model Run Parameters

- Ax8 in CmdlineAe9Ap9, IRBEM and SPENVIS
- CRRES satellite orbit (GTO)
- Fixed Epoch & Shift SAA options ‘on’
- 28 Feb 2005 (arbitrary), 24 hours, Δt=120 sec

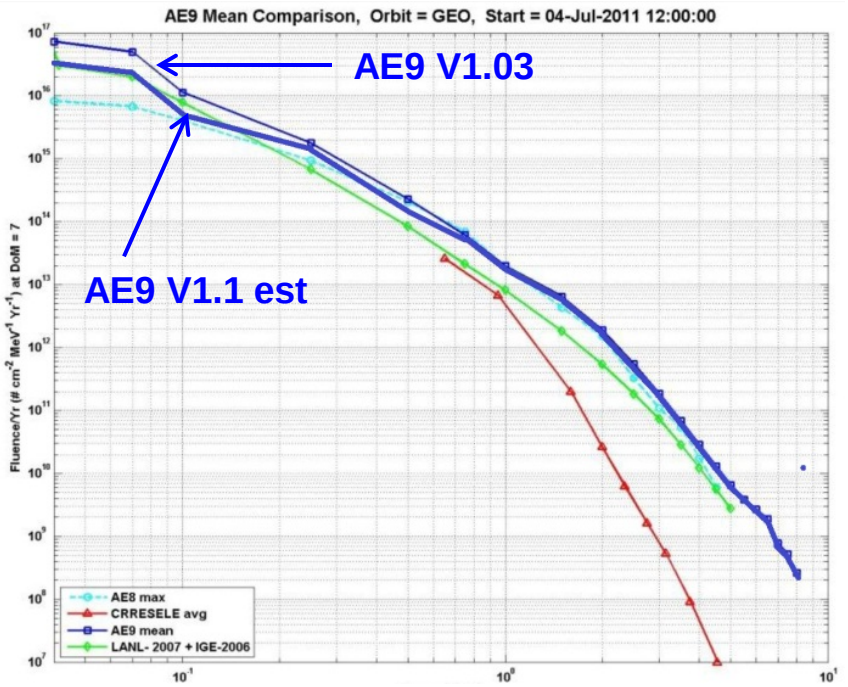
Comparison Results

- Most model results *nearly* matching
  - Different magnetic field models used
- Integral Flux results match
- Differential Flux results near match
  - Differences due to calculation method
- ShieldDose2 results mostly match
  - Slight offset due to Diff Flux differences

Full report documents all findings

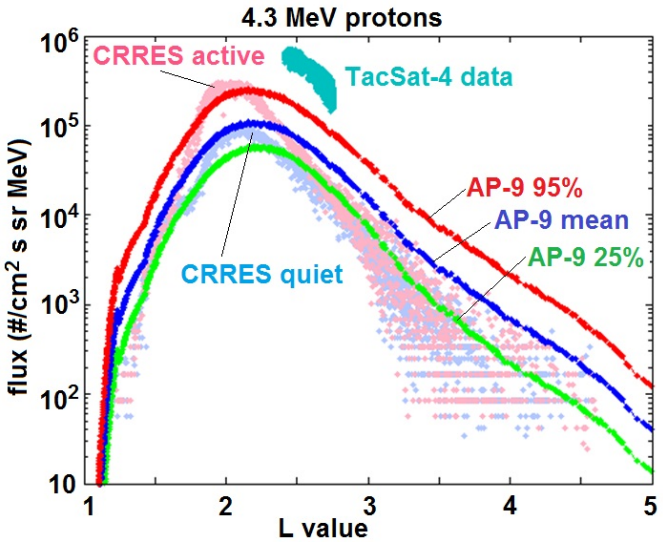
Version 1.1

- We recently identified an error affecting some cross calibrations in AE9
  - Incorrect data set version was used in CRRES to LANL-GEO cross calibration
- Result affects relative calibration of LANL-GEO/SOPA datasets, along with error estimates for LANL-GEO/SOPA, CRRES, and POLAR datasets
- Effect is likely small:
  - GEO flux ~20% greater for E>1 MeV
  - GEO flux ~20-50% less for E<0.5 MeV
  - Plot illustrates estimated effect on GEO electron spectra
- Expected public release in July 2013



Version 1.2

- New data set (first new data to be added):
  - TacSat-4/CEASE proton data—captures new observations of elevated 1-10 MeV protons
  - Additional plasma data, TBD but likely THEMIS/ESA
- New electron templates
  - Improvements for inner zone electrons and for >3 MeV spectra
- Feature improvements
  - More options for orbit element input and coordinates
  - Fix flux-to-fluence calculations to cover variable time steps—supports optimizing time steps for shorter run times
  - Allow selection of time period for calculation of fluence—supports different time periods for different effects
  - Mac OSX build
- Expected public release in January 2014



Version 1.5

- New data:
  - Protons: Azur, Van Allen/MagEIS & REPT
  - Electrons: DEMETER/IDP, Van Allen/MagEIS & REPT
  - Plasma: SCATHA/SC8, AMPTE/CCE & CHEM
- New features
  - Parallelization capability for runs on clusters—needed to speed up long runs
  - Pitch angle tool—make internal pitch angle calculations accessible to users
- Expected public release in October 2014
- International collaborators on board—with new model name

Version 2.0

- Major feature changes:
  - Standard solar cycle—introduces a full solar cycle reanalysis as a flythrough option
  - New module frameworks for e.g. plasma species correlations, SPM stitching with AE9/AP9, auroral electrons, additional coordinates for MLT variation in SPM
  - AP9 improvements: solar cycle variation in LEO, east-west effect
  - Improved algorithms for faster run times
- New data
  - Van Allen/MagEIS & REPT protons and electrons
  - PAMELA protons—addresses high energy proton spectra
  - Other international data sets: possibilities include Cluster/RAPID-IIMS, ESA SREMs, CORONAS, NINA, Akebono/EXOS-D, SAC-C, Jason2
- Expected public release in December 2015
- Subsequent releases will include new data
  - DSX/SWx, ERG