
IRENE: AE9/AP9/SPM Radiation Environment Model

Release Notes

Version 1.58.001

The IRENE (International Radiation Environment Near Earth): (AE9/AP9/SPM) model was developed by the Air Force Research Laboratory in partnership with MIT Lincoln Laboratory, Aerospace Corporation, Atmospheric and Environmental Research, Incorporated, Los Alamos National Laboratory and Boston College Institute for Scientific Research.

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The IRENE (AE9/AP9/SPM) model and related information can be obtained from AFRL's Virtual Distributed Laboratory (VDL) website: <https://www.vdl.afrl.af.mil/programs/ae9ap9>

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Highlights

Please refer to previous Release Notes documents for descriptions of the various revisions and enhancements of the model software since v1.50.001.

A feature was added to be able to generate variable timestep ephemeris, useful for elliptical orbits.

The CmdLineIrene, IreneGui and API methods were enhanced to simplify database input parameters by specifying just the model database directory name, instead of each individual file name.

The 'Adiabatic' coordinate information was expanded to now include the local magnetic field vector components (always in Geocentric Cartesian coordinates).

The Application-level API methods were enhanced to support the use of multiple accumulation modes and/or intervals.

An option to exclude the bremsstrahlung contributions from the electron dose calculations was added. The numerical stability of the dose results from the underlying ShieldDose2 model was improved.

The EphemModel API was expanded to provide methods for accessing magnetic field model results.

Software Changes

CmdLineIrene application (and its associated 'helper' applications):

- New features enable the end-user to generate orbital ephemeris at specified discrete times or at altitude-dependent variable timestep times. The variable timestep option is especially useful for elliptical orbits, as it minimizes the number of ephemeris points required to efficiently sample the flux environment, therefore reducing overall model run execution times.
- The new 'ModelDBDir' parameter may be used to specify the name of the directory containing the database files; this eliminates the need to specify each of the various database files individually.
- The 'ModelType' parameter was changed for the 'Plasma' specification, now requiring a suffix to identify the particle.
- The new 'DoseWithBrems' parameter may be used to exclude the bremsstrahlung contributions from the electron dose calculations.
- An issue with the log files of the Monte Carlo 'Worst Case' feature, occurring under specific conditions, was resolved.
- The optional 'Geomagnetic / Adiabatic Invariant Parameter Output' file was enhanced with the addition of the local B vector component values (in the Geocentric Cartesian coordinates).

IreneGui application:

- An option to generate variable timestep ephemeris was added to the 'Satellite' interface page.
- The database configuration dialog was enhanced with the ability to specify the primary database directory collectively.
- The option to exclude the bremsstrahlung contributions from the electron dose calculations was added to the 'Model' interface page.

API library:

- New methods were added to support the variable timestep ephemeris generation capability.
- Several Application-level API methods were added or revised to support the use of multiple accumulation modes and intervals. The argument lists of the API methods for data queries were expanded to be able to reference the specific set of results.
- New methods were added in both the Application- and Model-level API for specifying the name of the directory containing the database files; this eliminates the need to specify each of the various database files individually.
- The 'setModel' method was changed for the 'Plasma' specification, now requiring a suffix to identify the particle.
- New methods were added in both the Application- and Model-level API for excluding the bremsstrahlung contributions from the electron dose calculations.
- The methods of the AdiabatModel API were revised to include the return of the local magnetic field vector component values.
- Revised the internal 'depth-padding' scheme to further enhance the numerical stability of dose results produced by the underlying ShieldDose2 model.
- The source code for the underlying IGRF magnetic field model was ported from FORTRAN to C++, enabling it to be maintained and extended in the future.
- Several new methods were added to the Model-level EphemModel API, providing direct access to various magnetic field model results, such as the B vector, Bmag, Bmin and Lm.

Documentation Changes

- The User's Guide document was revised, adding the description of the new parameters for the variable timestep ephemeris generation capability and the corresponding GUI controls for this; further details were also added about this new feature. Added and revised information related to the new 'ModelDBDir' parameter.
- The Build Instructions document was revised with updated information for building the software on the CentOS/Rocky 8.x/9.x and Ubuntu 22.04 operating systems.
- The C++, C and Python API (Application Programming Interface) documents were all updated. Descriptions were revised for the Application-level methods related to the specification of the (multiple) accumulation modes and intervals, and the modified methods for queries of the various types of data (ie, 'flyin' methods). Added descriptions of the new methods in both the Application- and Model-level API for the generation of variable timestep ephemeris. Added and revised descriptions related to the new 'ModelDBDir' feature, enabling just the model database directory name to be specified instead of each of the individual database file names. Added descriptions of the new methods in both the Application- and Model-level API for excluding the bremsstrahlung contributions from the electron dose calculations. Added descriptions for the new magnetic field model-related methods in the Model-level API for EphemModel.

Contact Information

Please send any questions, comments and/or bug reports to: ae9ap9@vdl.afrl.af.mil

The IRENE (AE9/AP9/SPM) model package and related information can be obtained from AFRL's Virtual Distributed Laboratory (VDL) website: <https://www.vdl.afrl.af.mil/programs/ae9ap9>

Version Numbering Scheme: $Va.bc.ddd$

The '*a*' digit changes with major new architecture or feature changes in the model.

The '*b*' digit changes with updates of the model database files.

The '*c*' digit changes with minor new features in the model and/or interface software.

The '*d*' digits change with bug fixes and trivial feature tweaks.