



# AFRL



## IRENE V1.60 Plans

IRENE Industry Virtual Day, March 1-2 2023

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# Summary

- V1.60 release is planned for 2024
- Will update flux maps with additional data sets
- Solar protons to be added in V1.6 or V2.0 (see SAPPHIRE-2S talk)
- Minor feature updates also planned
  - Some features could be released early (V1.58)

# New data sets

Data Set	Orbit	Time	Species/energies	Notes
Van Allen Probes/ HOPE, RBSPICE, MagEIS, REPT, RPS	GTO (600 x 22000 km, 10°)	2012-2019	electrons 20 keV->10 MeV protons 20 keV-2 GeV plasma <10 eV-50 keV	Final mission data sets; some MagEIS, REPT, RPS data used in V1.2
PROBA-V/EPT	LEO (820 km circ., 99°)	2013-2022	electrons 0.5-20 MeV protons 9.5-300 MeV	
Resurs-DK1/PAMELA	LEO (350 x 600 km, 70°)	2006-2009	protons 80 MeV-4 GeV	
AMPTE-CCE/CHEM	HEO (1100 x 50000 km, 5°)	1984-1989	plasma 1.5-300 keV/e	
DSX/CEASE I, LEESA, LCI, HEPS	MEO (6000 x 12000 km, 42°)	2019-2021	electrons 80 keV-4 MeV protons 1-400 MeV GeV plasma 30 eV-30 keV	Initial data as available; final data sets will be added in V2.0
INTEGRAL/IREM	HEO (10000 x 153600 km, 72°)	2002-2022	electrons 0.5-5 MeV	
PROBA-1/SREM	LEO (570 x 670 km, 99°)	2001-2021	electrons 0.3-6 MeV	
GIOVE-A/Merlin/SURF	MEO (23300 km circ., 56°)	2006-2021	electrons 0.8-1.6 MeV	

These data sets are targeted to address several needs:

- More coverage for very high energy protons (0.4-4 GeV)
- Clean observations of inner zone electrons from Van Allen Probes
- Improved plasma coverage
- More data sets covering the last two solar cycles—modern climatology

# Other updates

- Feature updates
  - Variable timestep ephemeris auto-generation (supports optimizing for high time resolution only where needed for accurate results, e.g., for eccentric orbits)
  - Simplified database specification parameter inputs
  - New option to separate bremsstrahlung contributions from direct electron ionization in dose calculations
  - API enhancements
  - Update and improve neural net calculations of adiabatic invariants (for flux map querying)
  - Update source code to be compatible with C++17 standards
  - High level Python interface (more “Pythonic”)
  - Additional input/output options (e.g., YAML-format input, magnetic field output)
  - Some features could be released early (V1.58?)
- Update to use of IGRF 2020 magnetic field model
  - V1.57 employs IGRF 2015 with extrapolation to 1/1/2020 and fixed internal field after that
  - V1.60 will employ IGRF 2020 with extrapolation to 1/1/2025, fixed after that
  - Note that IGRF 2015/2020 differences yield only small differences in IRENE results (less than other model uncertainties)
- Other minor feature updates as feasible and needed (**feedback welcome!**)