

Kamodo – a tool for simulation output onboarding and community utilization



Written in Python 3

- Open Source
 - community collaboration encouraged (11 branches so far)
- Functional programming style
 - easily define derived variables (such as plasma-beta, Alfvén velocity, etc.) from primary model outputs
 - automatic unit conversion (in input positions and output values)
- Operates with popular Python packages:
 - Scipy, Sympy, PlasmaPy, Pandas — taking advantage of powerful capabilities

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Supported models:

- SWMF (GM/BATSRUS, IE/Ridley_serial, UA/GITM), IT/TIE-GCM, IT/CTIPe (versions 3,4), IRI (NetCDF files in run-on-request), Tsyganenko (T89, T96, TS04) – natively in Python 3
- ENLIL, SWMF/GM, CTIPe (version 2.0), OpenGGCM – via Kameleon (bridge via Python 2)

Currently working on:

- OpenGGCM (GM and IE) using Fortran library of readers (via f2py).
- GUMICS TecPlot outputs.
- Field line tracing (MAS Fortran library), generic tracer in spherical coordinates
- Block-adaptive Octree grid interpolation (GUMICS – native in Python, planned for SWMF/BATSRUS)
- Visualization of nested iso-surfaces
- Time series interpolations

Plans:

- Add more SWMF models via pySWMF (ring current models, BATSRUS solar, BATSRUS in heliosphere,...)
- Field line tracing, generic tracer for cartesian coordinates.
- Fast interpolation (reduce memory footprint – direct file access for data as needed, shared library).
- Visualization: Multi-element scenes (slices, isosurfaces, satellite positions and trajectories, etc).
- Link Kamodo to external model (C++/C/Fortran interfaces).

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Current projects:

- Support more models:
 - CorHEL Solar and heliosphere models
 - add ring current and radiation belt models
 - complete magnetosphere, ionosphere-thermosphere models
- Faster interpolations:
 - utilize external libraries written in Fortran or C and direct file access (reduce data loaded to memory)
- Operate Kamodo from external models:
 - Kamodo called as a subroutine
 - thermosphere densities and derivatives provided to satellite orbit propagator
- Interpolarability
 - SpacePy, AstroPy, PlasmaPy, PhHC compatibility.

Presentations on Kamodo

- Darren De Zeeuw: Kamodo Web Demo, Notebook Backend, HAPI, and Metadata use
- Rebecca Ringuette – Calling Kamodo from C++
- Asher Pembroke – Kamodo Web API
- Oliver Garland – Demo of the Front-end Dashboard Prototype