2022 Workshop: Snakes on a Spaceship

Long title
Snakes on a Spaceship: The Code Awakens
Conveners
Russell Stoneback
Alexa Halford
Angeline Burrell
russell@stoneris.com
Description

The pursuit of system science requires integrating measurements from multiple platforms, outputs from a variety of models, as well as calculated physical parameters into a coherent system for analysis. The variety of instrument types, model and data formats, and data sources makes this challenging. Typically these challenges are solved separately by different research teams, leading to duplicated efforts. The reproducibility of scientific results are also affected, since most journal articles do not include complete analysis descriptions. The study of the magnetosphere and the ionosphere as a system would be enhanced if solutions to these problems were made broadly available to the community. 'Snakes on a Spaceship: The Code Awakens' focuses on open scientific software and impacts to CEDAR science.

Agenda

Introduction Russell Stoneback (Stoneris)

Spectral methods for space physics: A tutorial using Dedalus Enrique Rojas (Cornell)
Spectral methods are well known for outstanding accuracy and scale very efficiently when simple boundary conditions are applicable and no shocks or discontinuities are expected. Numerous problems in space physics have these characteristics. This talk will briefly describe the "Dedalus" library for solving PDEs using spectral methods and outline some applications to ionospheric physics. We will use this library to

simulate simplified but interesting phenomena. These problems will allow us to explore different aspects of Dedalus' versatility. Furthermore, we will outline some research questions that may be investigated using this tool.

A path towards easier data access with the HAPI interface Jon Vandegriff (JHUAPL)

The pysat Ecosystem Russell Stoneback (Stoneris)

The Python Satellite Data Analysis Toolkit (pysat) is a package that provides a framework for obtaining, managing, analysing, and processing modelled and observational ground and space-based data sets for the space sciences. Since the start of its development it has evolved into an ecosystem that allows users to limit their local environment to focus on the tasks that are most important to them. This was done by creating an ecosystem of packages that are based on the pysat framework.

The core pysat package provides a framework that abstracts away tedious file and data handling challenges to support generalized data and metadata independent workflows and scientific analysis, including downloading, loading, cleaning, modifying, analyzing data, and producing standards compliant files. Packages such as pysatCDAAC, pysatMadrigal, pysatMissions, pysatModels, pysatNASA, and pysatSpaceWeather provide data support plug-ins for use within pysat to support a variety of scientific data sources and types across space science, from observational data sets to computer models. pysatSeasons builds upon pysat to produce seasonal analysis functions that work for any pysat data set.

Pysat’s design enables systematic versatility and has demonstrated the ability to easily couple a variety of data sets, models, and functionality from third-party packages, current or historical, to produce effective and functional systems. This feature set enables the creation of larger scale meta-packages that advance large scale science questions across space science without requiring that any component adopt any particular standard. This feature set also makes pysat more broadly applicable to python users outside space science.

Kamodo: Lowering the Utilization Barrier for Heliophysics Model Outputs
Rebecca Ringuette (ADNET Systems Inc.)

As the science community moves towards open science, we report progress in lowering the utilization barrier for heliophysics model outputs using Kamodo. The Community Coordinated Modeling Center (CCMC), in partnership with Ensemble Consultancy, have developed Kamodo to be a powerful open-source software tool that provides a uniform method for the community to access, utilize, and visualize the broad range of heliophysics model outputs provided by and hosted by the CCMC. Through collaboration with model developers and the community, we have developed a validated model-agnostic pathway for the community to use model data as a virtual reality in a variety of applications. In this talk, we will demonstrate a few of those applications now available through Kamodo, describe efforts towards interoperability with other commonly-used python packages, and provide a glimpse of planned capabilities and additional uses. In the spirit of open science, the capabilities described in the talk are available at https://github.com/nasa/Kamodo and https://github.com/EnsembleGovServices/kamodo-core.

The Python in Heliophysics Community (PyHC) and Contributions towards Open-Source Software Julie Barnum (LASP)

Since its genesis in 2018, the Python in Heliophysics Community (PyHC) has promoted and facilitated the use and development of Python for Heliophysics. Specifically, PyHC's core mission is to facilitate scientific discovery by promoting the use and development of sustainable open-source Python software across the solar and space physics community; improve communication and collaboration between disciplines, developers, and users; establish and maintain development standards; and foster interoperability and reproducibility. This talk will include an overview of PyHC and will delve into the ways in which the community has fulfilled the aforementioned core mission. In particular, this talk will revolve around the recent PyHC 2022 Summer School, held in coordination with the European Space Agency in Madrid, Spain.

Justification

Strategic thrust #6: manage, mine, and manipulate geoscience data and models

1) How the questions will be addressed: The challenge of performing system science is addressed by teaching the community about the existence and use of open source science software that enables system science.

2) What resources exist, are planned, or are needed: A variety of science python software already exists that helps the community achieve these goals, pysat, pydarn, Resen, etc. with more added each year.

3) How progress should be measured: Participation rates in open source science python software. Publications that use community tools, and software citation rate can also be tracked.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Manage, mine, and manipulate geoscience/geospace data and models
Keywords
Python, System Science, Open-Source
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