# DIARieS: Developing a Vision for Maturing the Heliophysics Infrastructure towards Open Science (AGU 2022)

Rebecca Ringuette[1], Alec Engell[2], Oliver Gerland[3], Ryan M Mcgranaghan[4], and Barbara Thompson[4]

[1]Affiliation not available
[2]NextGen Federal Systems
[3]Ensemble Government Services
[4]NASA/GSFC

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DIARieS publication DOI:
10.1016/j.asr.2022.05.012

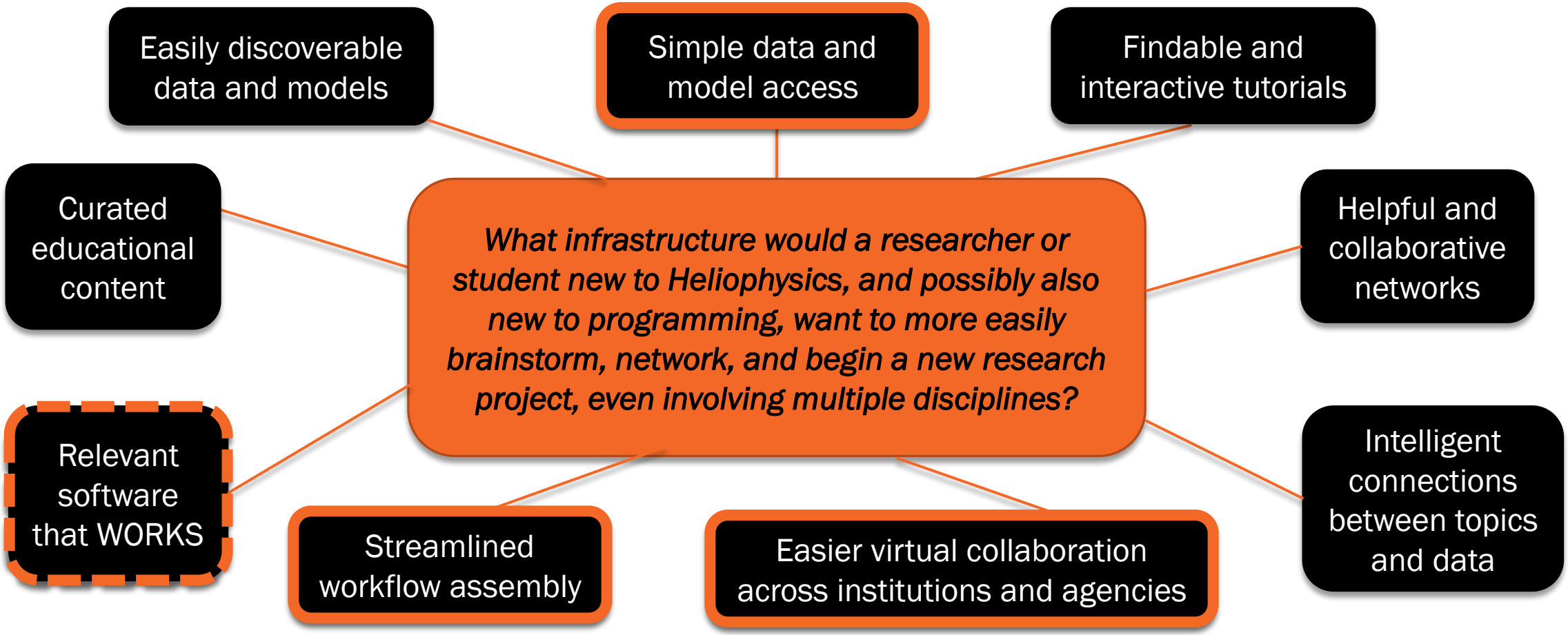
# DIARieS

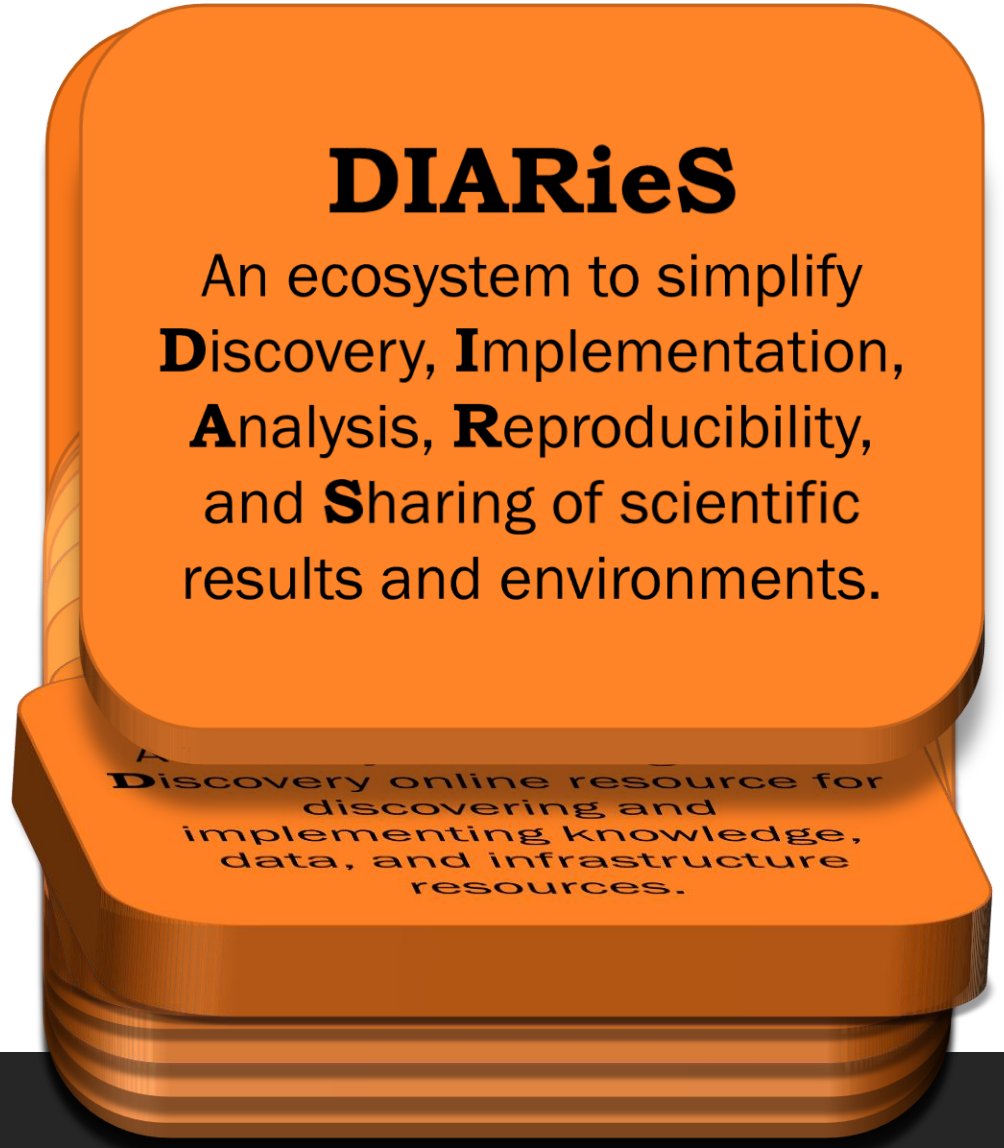
## DEVELOPING A VISION FOR MATURING THE HELIOPHYSICS INFRASTRUCTURE TOWARDS OPEN SCIENCE

*R. Ringuette*, A. Engell, O. Gerland, R. M. McGranaghan, and B. Thompson.

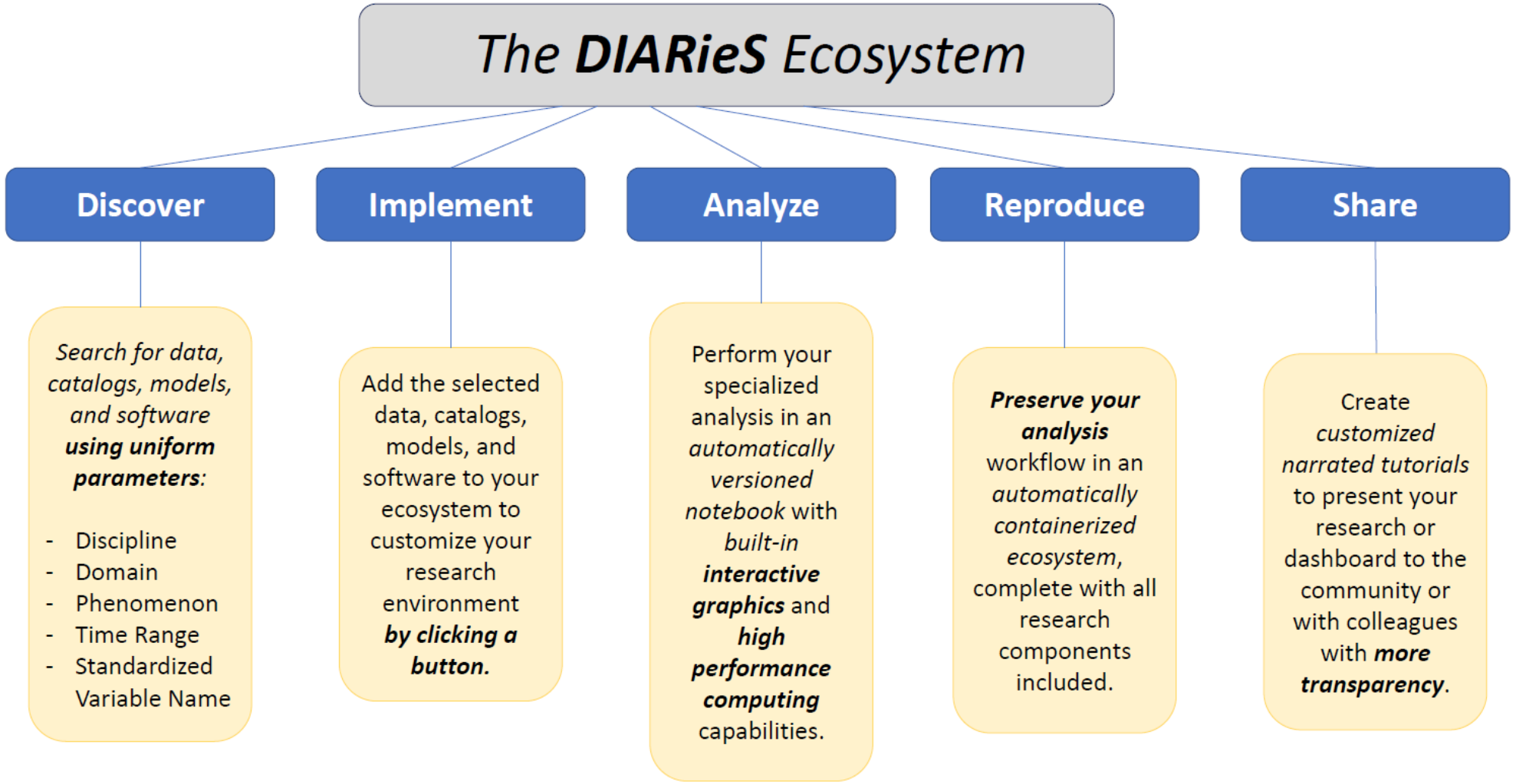
AGU 2022 Fall Meeting

# Motivation


Easily discoverable data and models
Simple data and model access
Findable and interactive tutorials
Curated educational content
What infrastructure would a researcher or student new to Heliophysics, and possibly also new to programming, want to more easily brainstorm, network, and begin a new research project, even involving multiple disciplines?
Helpful and collaborative networks
Relevant software that WORKS
Streamlined workflow assembly
Easier virtual collaboration across institutions and agencies
Intelligent connections between topics and data




# Proposed Solution


The DIARieS Ecosystem
Discover
Implement
Analyze
Reproduce
Share
Search for data, catalogs, models, and software using uniform parameters:
- Discipline
- Domain
- Phenomenon
- Time Range
- Standardized Variable Name
Add the selected data, catalogs, models, and software to your ecosystem to customize your research environment by clicking a button.
Perform your specialized analysis in an automatically versioned notebook with built-in interactive graphics and high performance computing capabilities.
Preserve your analysis workflow in an automatically containerized ecosystem, complete with all research components included.
Create customized narrated tutorials to present your research or dashboard to the community or with colleagues with more transparency.

# Welcome to the DIARieS Ecosystem

File Add Templates Packages Variables Citations Recording Share Help

**Menu options (in above drop-down menus)**

File:
- New
- Open
- Save/Save as
- Close

Add:
- Data/Model Outputs/Catalogs
- Software
- Widget
- Notebook
- Computing Resource

Templates:
- Template search
- Import template
- Create new template

Packages:
- None added

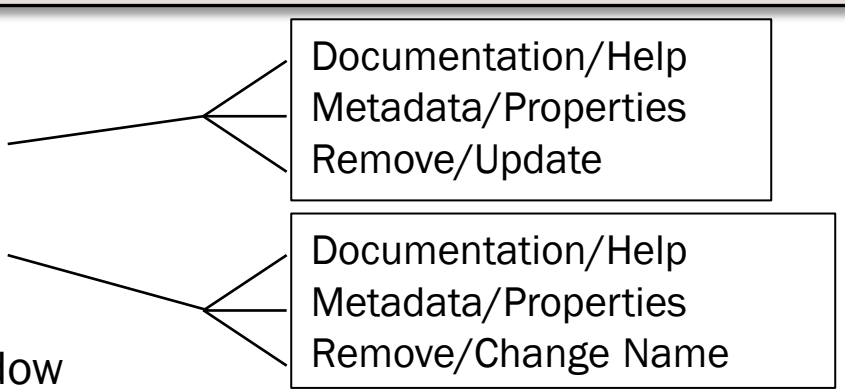
Variables:
- None added

Citations:
- (Pop up window with citation list and export options)

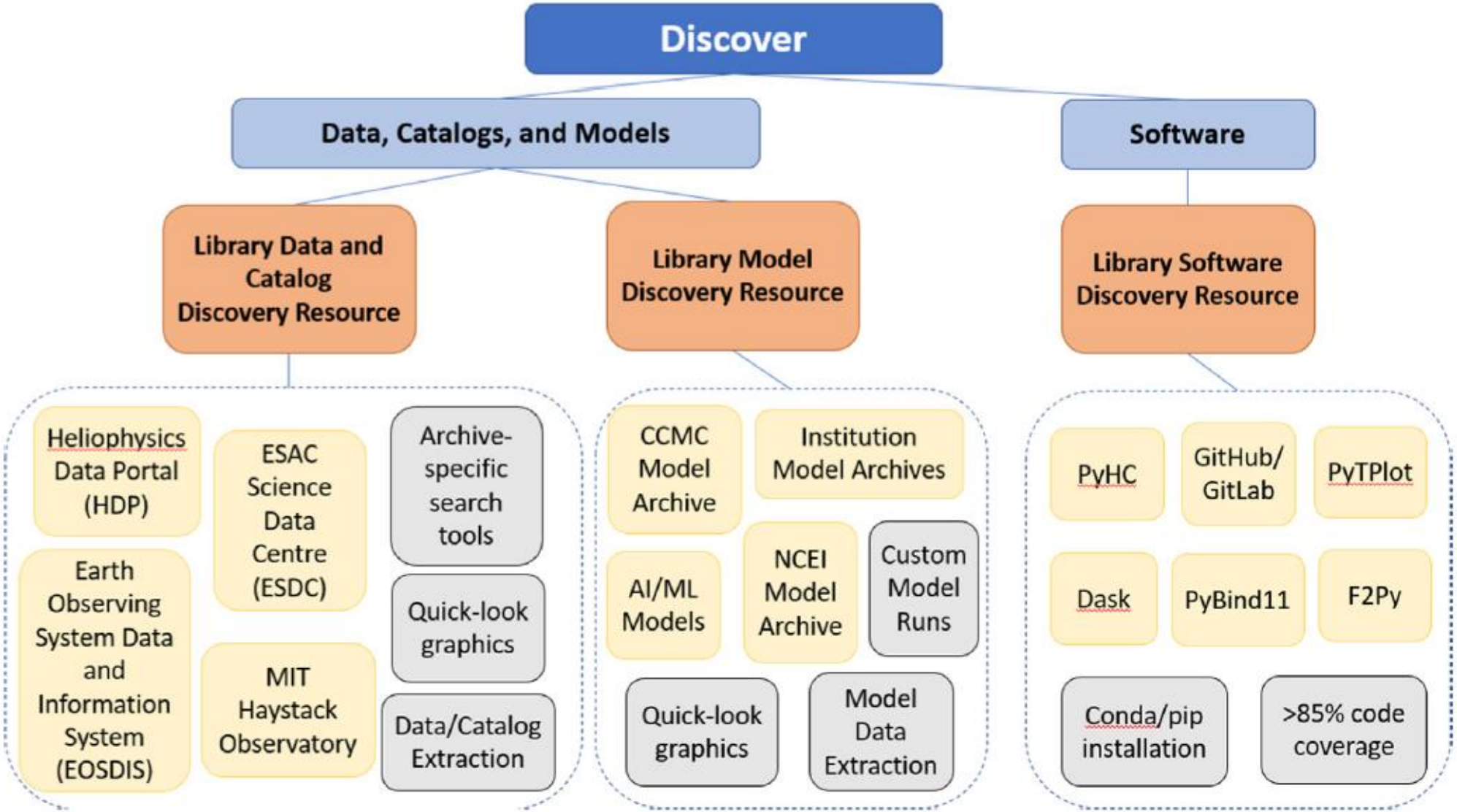
Recording:
- Create recording
- Edit recording
- View recording

Share:
- Add/Remove authors/viewers
- Change permissions
- Create demo/user mode
- Publish

Help

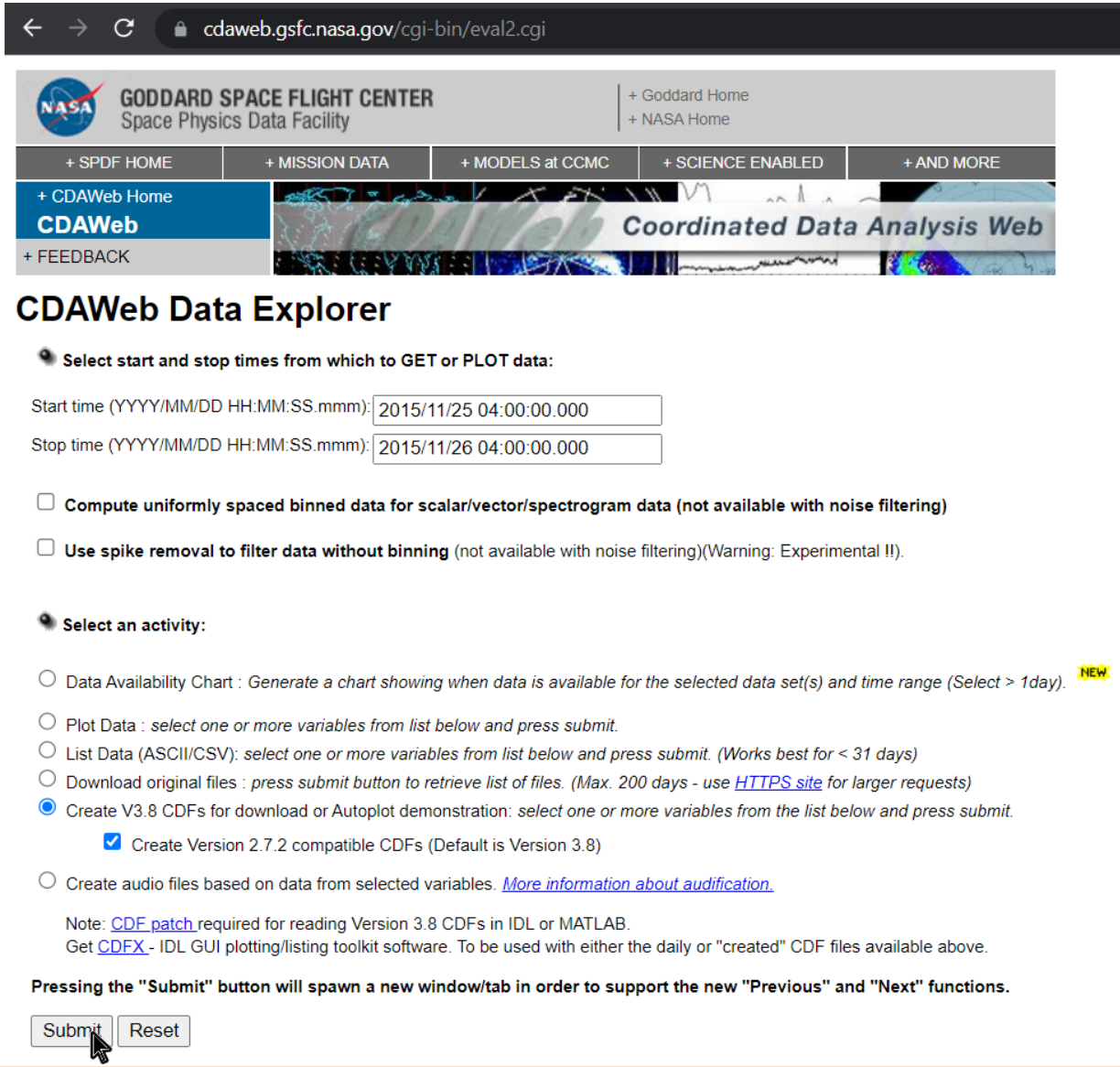



Create or open a DIARieS ecosystem to get started
or click here for a narrated tutorial



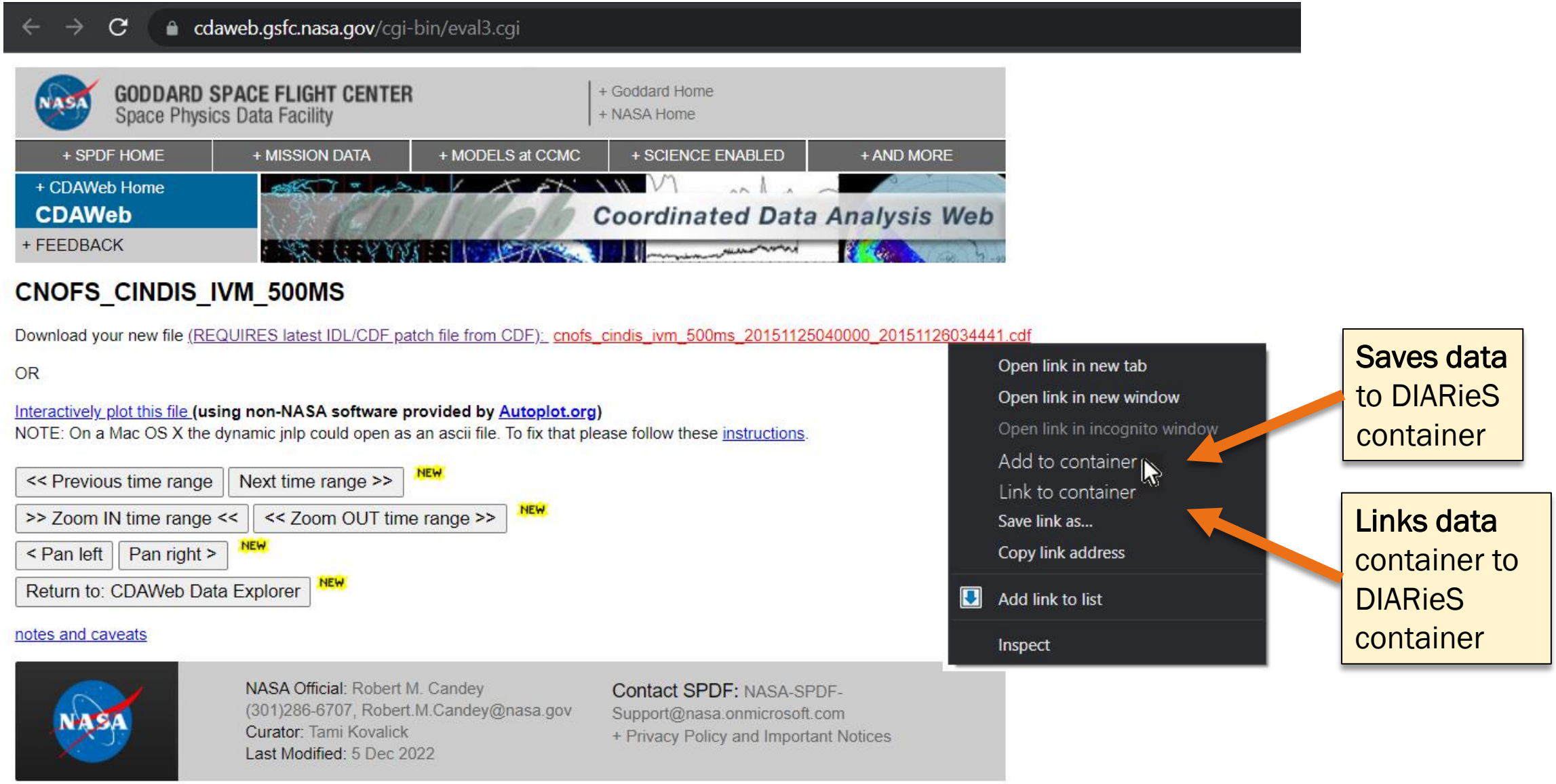

- Built on LIKED – an intelligent search interface built using data science technology.
- Two sections based on type of expected mechanisms: Data and Software

# DIARieS container: Data Discovery and Implementation Interface




- Users first use the LIKED interface (accessible inside and outside of DIARieS) to find the desired archive (e.g. SPDF as shown here),
- Then use the search interface and mechanisms of the archive to find desired data.
- DIARieS simplifies how to add that data to the analysis environment.

# DIARieS container: Data Discovery and Implementation Interface



# DIARieS container: Data Discovery and Implementation Interface

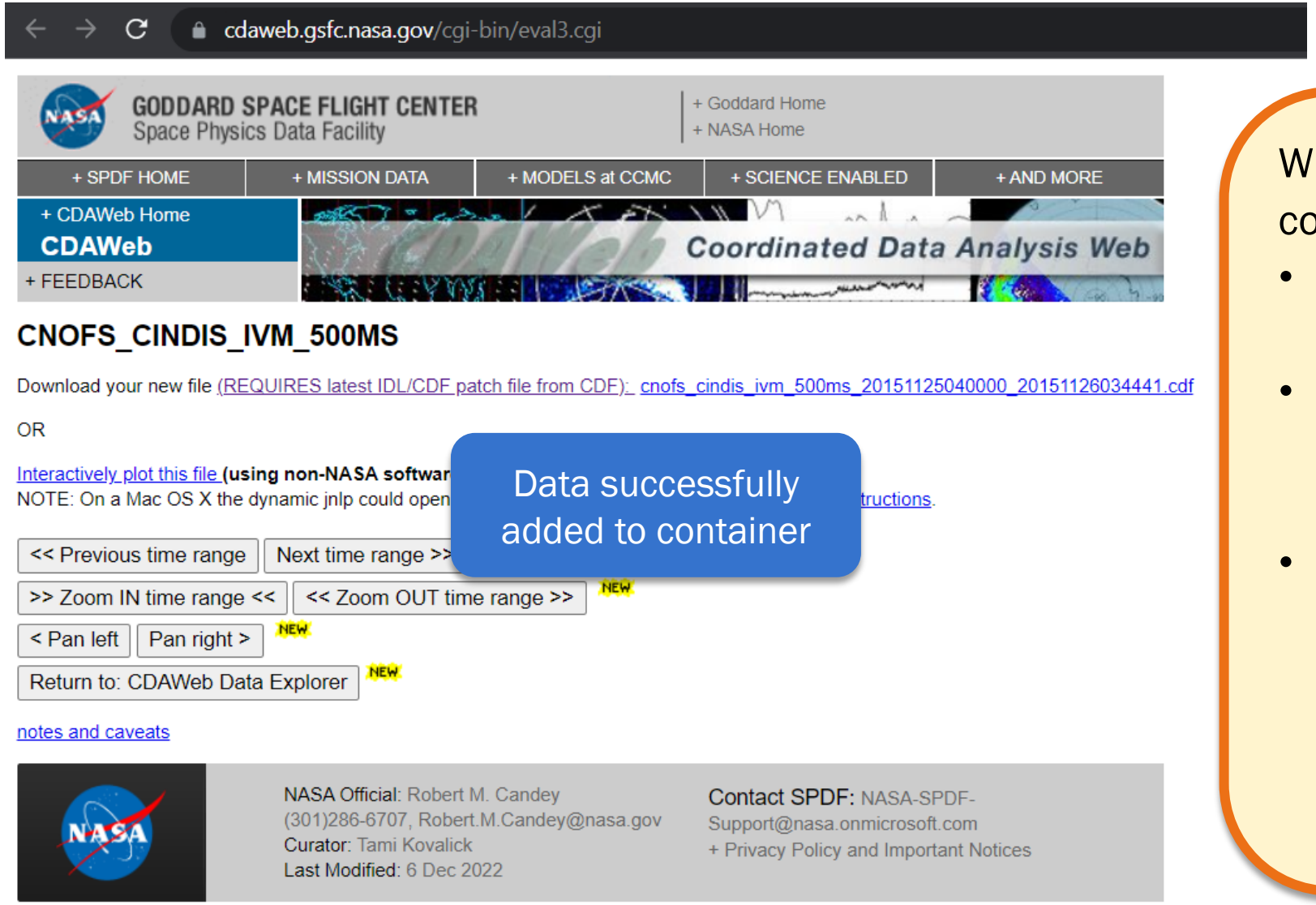
cdaweb.gsfc.nasa.gov/cgi-bin/eval3.cgi

GODDARD SPACE FLIGHT CENTER | + Goddard Home

| Save | Description | Units | Default Name | Enter custom name |
|---|---|---|---|---|
| ☐ | RPA data quality flag: 0=high 9=low (https://spdf.gsfc.nasa.gov/pub/data/cnofs/cindi/QualityFlagDesc.doc) | | RPAflag | |
| ☑ | Ion density in cm-3 | cm-3 | ionDensity | rho_ion |
| ☑ | Ion temperature in Kelvin | K | ionTemperature | T_ion |
| ☑ | Ion 1 (normally O+) -------> Atomic Mass Number | AMU | atomicMass_ion1 | Oplus |
| ☑ | Ion 2 (normally H+) -------> Atomic Mass Number | AMU | atomicMass_ion2 | Hplus |
| ☐ | Ion3 (normally He+) -------> Atomic Mass Number | AMU | atomicMass_ion3 | |
| ☐ | Ion4 -------> Atomic Mass Number | AMU | atomicMass_ion4 | |
| ☐ | Ion 5 -------> Atomic Mass Number | AMU | atomicMass_ion5 | |
| ☑ | UT in seconds | s | time | |
| ☑ | Geographic latitude in degrees | deg | glat | |
| ☑ | Geographic longitude in degrees | deg | glon | |
| ☑ | Altitude in km | km | altitude | |

Reset Form | Add all with defaults | Save | Cancel

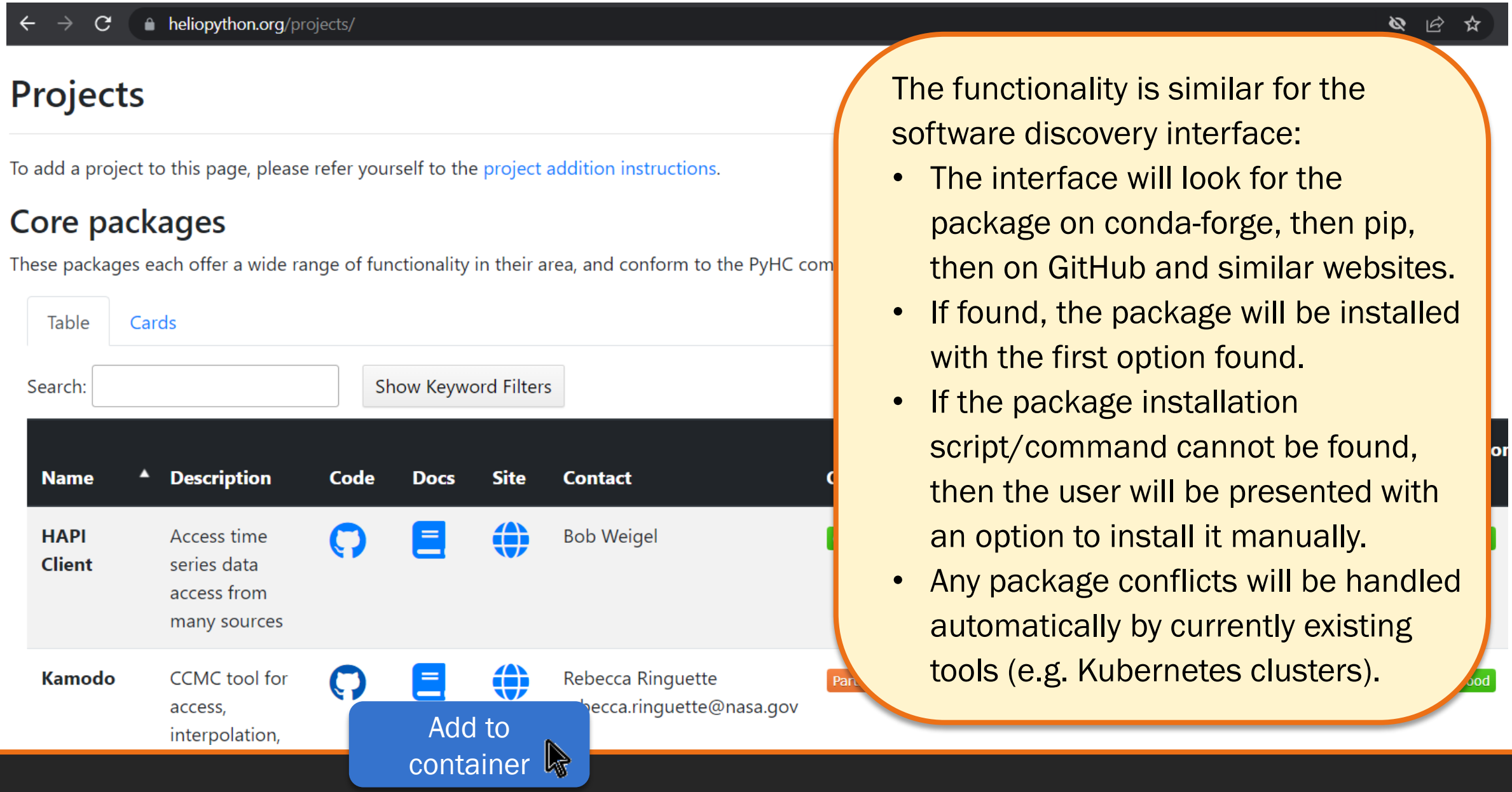
# DIARieS container: Data Discovery and Implementation Interface




When data is added to the container…

- A link for each variable is added to the variable list,
- And the proper citation is added to the container's citation list.
- The link in the variable list links to three items:
  - Documentation/Help
  - Metadata/Properties
  - Remove/Change Name Options

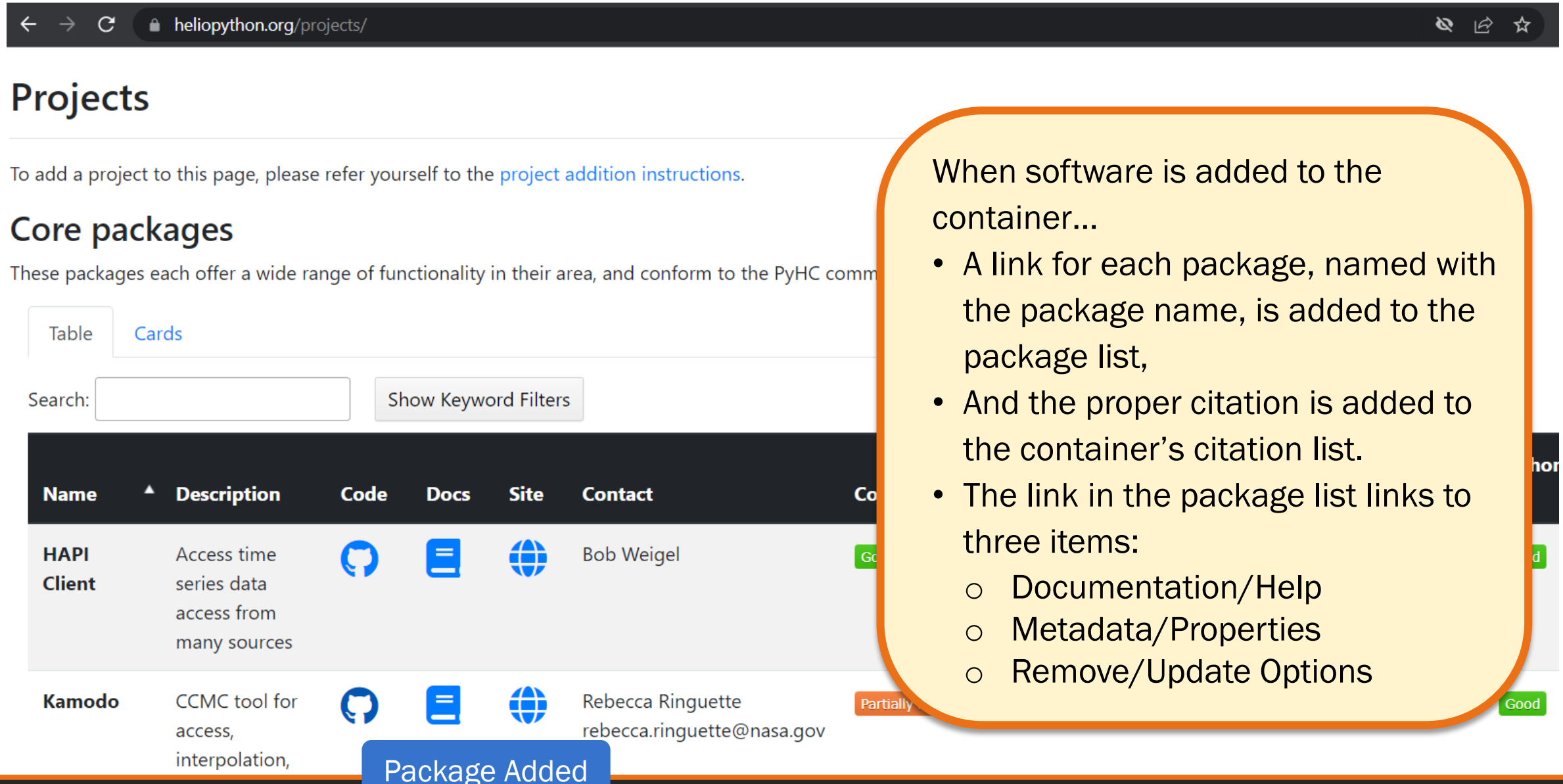
# DIARieS container: Software Discovery and Implementation Interface




The functionality is similar for the software discovery interface:

- The interface will look for the package on conda-forge, then pip, then on GitHub and similar websites.
- If found, the package will be installed with the first option found.
- If the package installation script/command cannot be found, then the user will be presented with an option to install it manually.
- Any package conflicts will be handled automatically by currently existing tools (e.g. Kubernetes clusters).

# DIARieS container: Software Discovery and Implementation Interface




When software is added to the container…

- A link for each package, named with the package name, is added to the package list,
- And the proper citation is added to the container's citation list.
- The link in the package list links to three items:
  - Documentation/Help
  - Metadata/Properties
  - Remove/Update Options

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- Notebook
- Computing Resource

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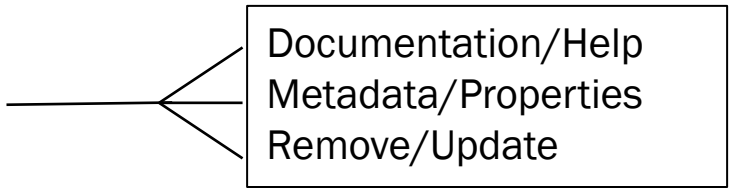
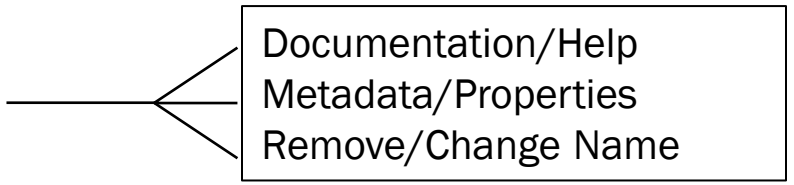
- Import template
- Create new template

Packages:
- cdflib
- Xarray
- Kamodo
- …



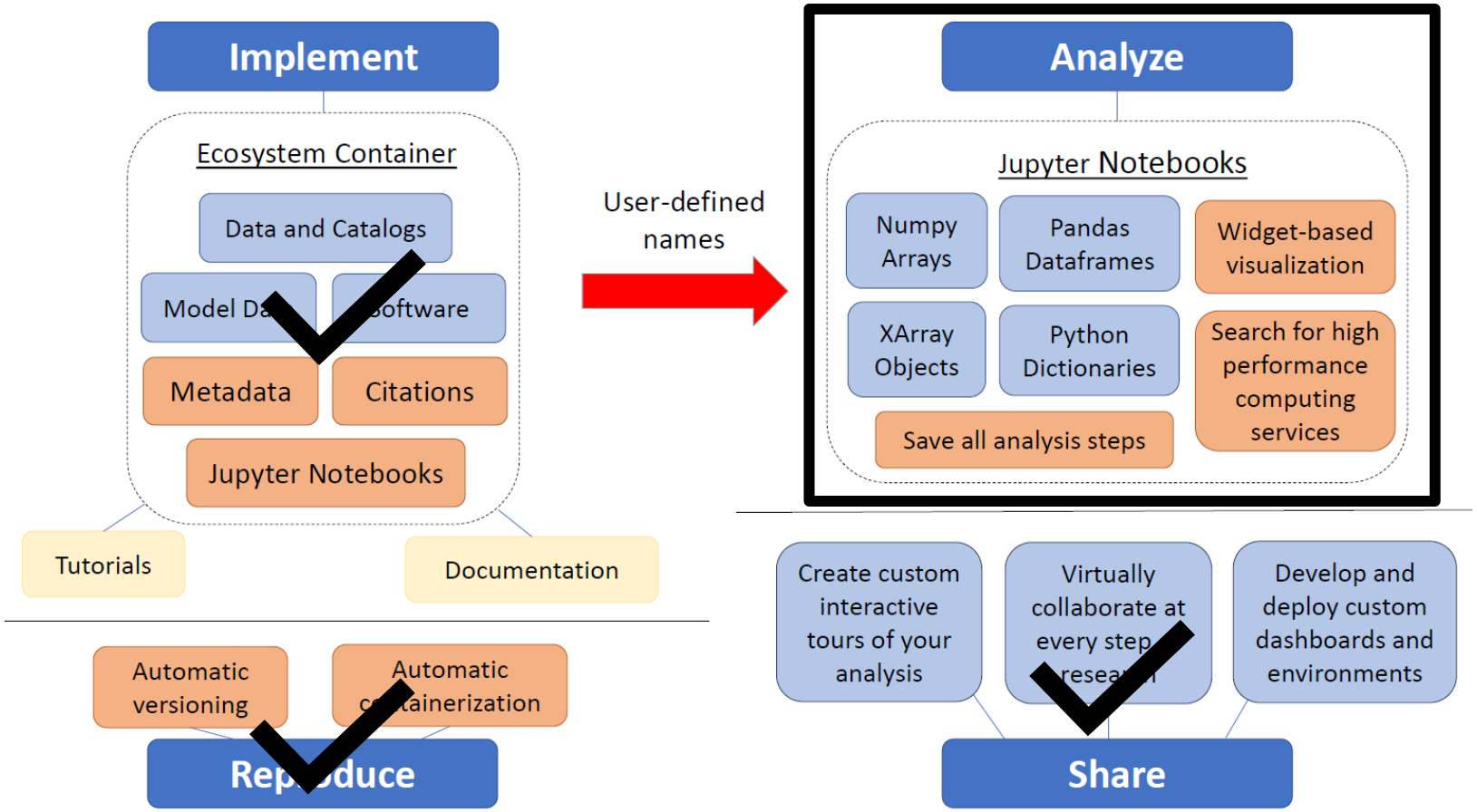

Variables:
- rho_ion
- T_ion
- Oplus
- time
- …




Citations:
- (Pop up window with citation list and export options)

Recording:
- Create recording
- Edit recording
- View recording

# DIARieS: Simplifying AIR




(AIR = Accessibility, Interoperability, and Reproducibility)

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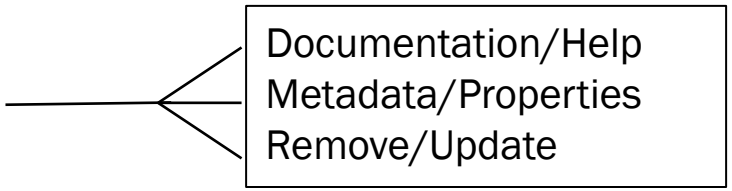
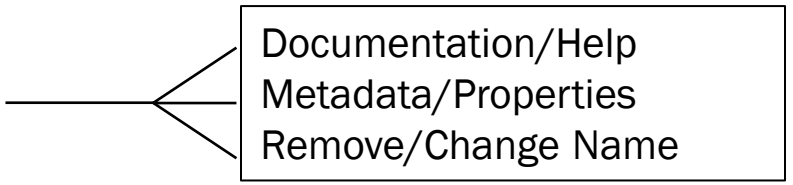



Variables:
- rho_ion
- T_ion
- Oplus
- time
- …




Citations:
- (Pop up window with citation list and export options)

Recording:
- Create recording
- Edit recording
- View recording

# DIARieS container: Analysis Interface

## Widget Library

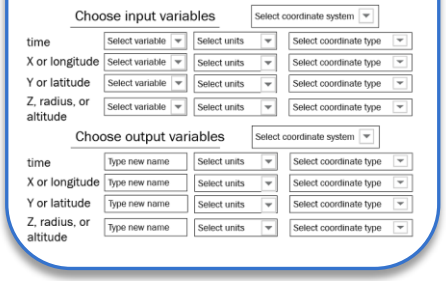
Search: _____

- Kamodo visualization
- CDF visualization
- PlasmaPy function library
- pysat data retrieval
- Kamodo model data interface
- SpacePy SWMF tools
- SunPy data filtering
- SciPy

## Loaded Widgets

Search: _____

PyHC Coordinate Converter

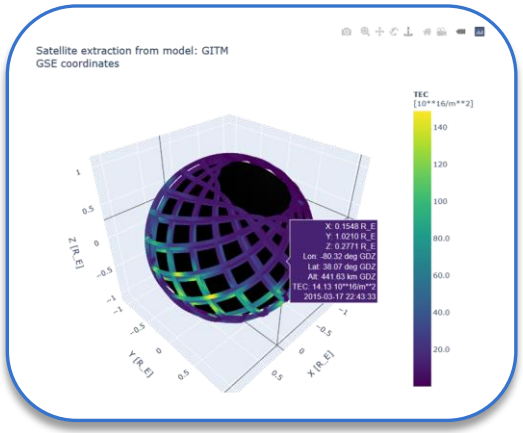



AstroPy Unit Converter

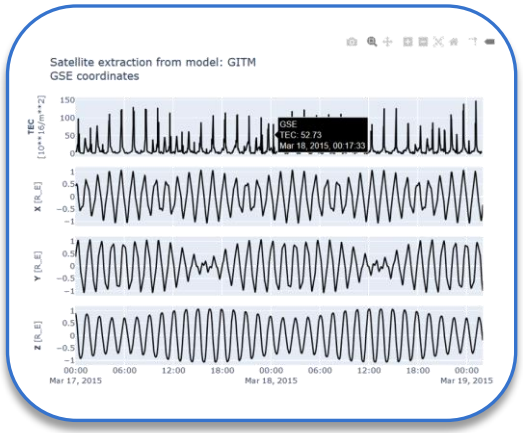
Kamodo Flythrough

## Active Widgets

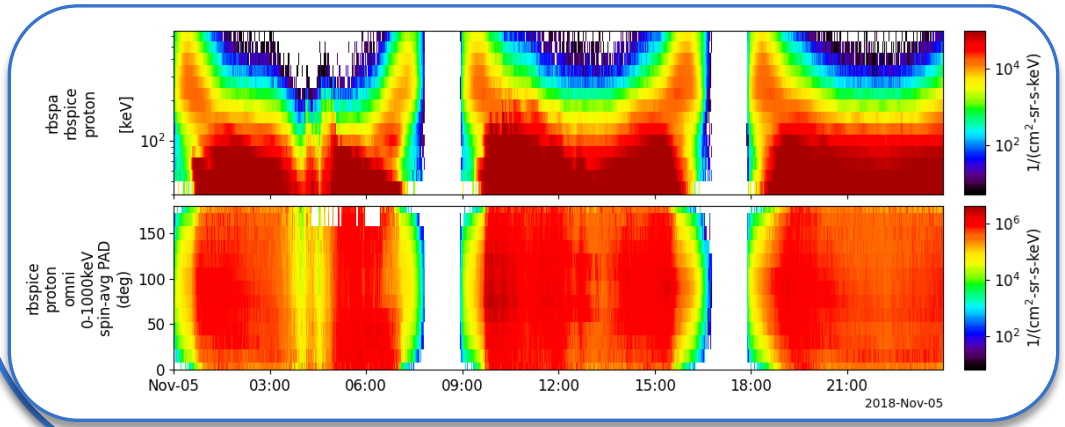
Search: _____




Kamodo 3D visualization




Kamodo 1D visualization




pySPEDAS visualization

# DIARieS container: Analysis Interface

## Variable Library

- rho_n
- T_ion
- X_GEO
- Y_GEO
- Z_GEO
- time_UTC
- TEC_GITM
- glat

## Loaded Widgets

PyHC Coordinate Converter

Choose input variables

Select coordinate system

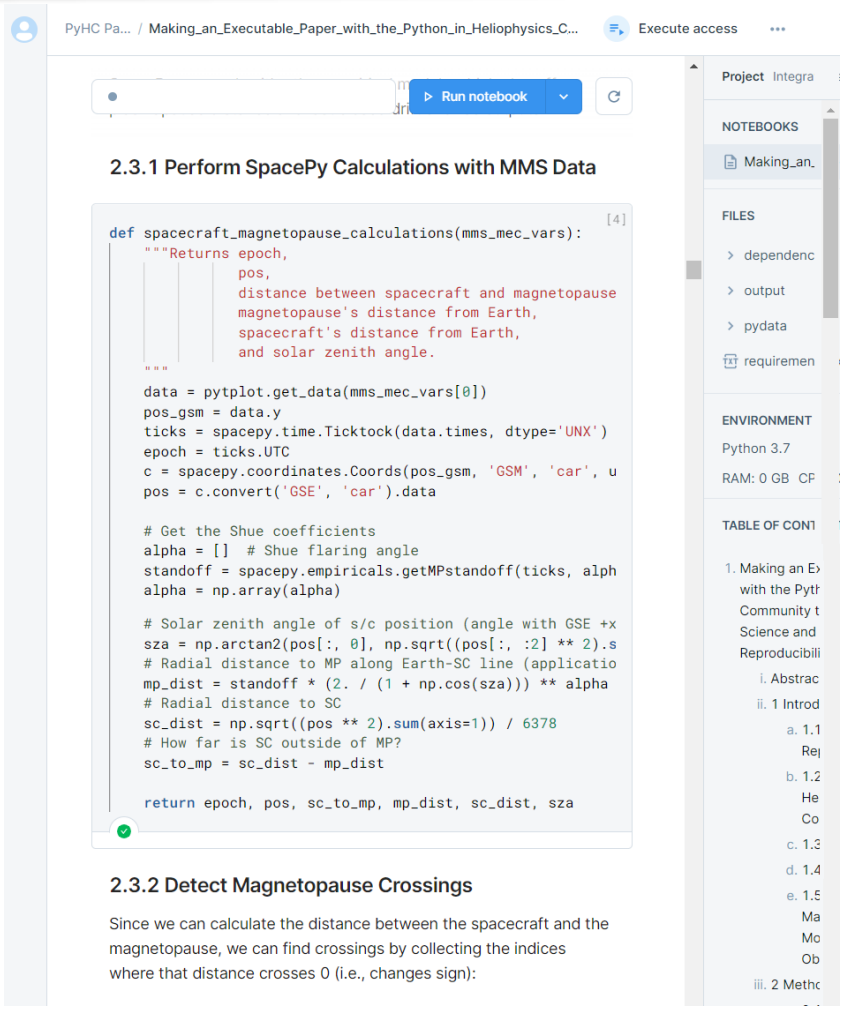
| | | | |
|---|---|---|---|
| time | Select variable | Select units | Select coordinate type |
| X or longitude | Select variable | Select units | Select coordinate type |
| Y or latitude | Select variable | Select units | Select coordinate type |
| Z, radius, or altitude | Select variable | Select units | Select coordinate type |

Choose output variables

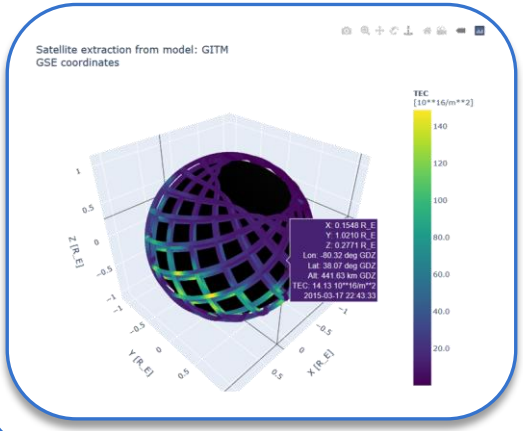
Select coordinate system

| | | | |
|---|---|---|---|
| time | Type new name | Select units | Select coordinate type |
| X or longitude | Type new name | Select units | Select coordinate type |
| Y or latitude | Type new name | Select units | Select coordinate type |
| Z, radius, or altitude | Type new name | Select units | Select coordinate type |

## Interactive Notebook




## Active Widgets




## Widget Help

Select a widget to see the tutorials and documentation.

## Presentation Tools

Add a narration | Record a tutorial | Presentation Mode

Link to recorded talk on YouTube:
https://youtu.be/aP7VAHMO6M4

# Summary

Heliophysics currently needs a coordinated push to make our work FAIR and efficient.

*Connect* our archives based on a 'system of systems' approach.

*Build* on the successes of current efforts and technology.

*Assemble* our various advances into a streamlined workflow

*We call on the community to work together on this goal to launch our field into the future.*

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