

Standardizing Access to Heliophysics Data: HAPI Specification Overview

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short welcome and overview of HAPI (why and what) (10 min)

quick demo of several HAPI capabilities (10 minutes)

discussion of GitHub HAPI projects and other helpful tools we've made available (10 min)

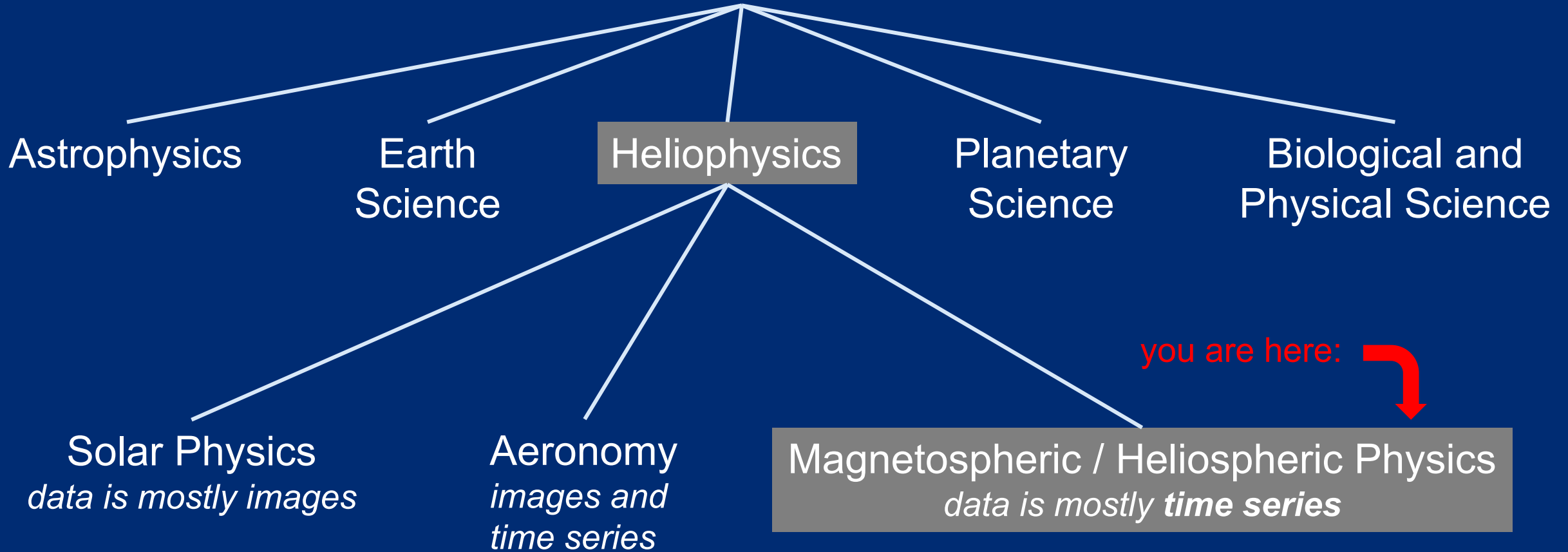
Q&A – gauging interest level, how to connect?, concerns?, desire for future topics / tutorials?

What is HAPI?

HAPI = Heliophysics Application Programmer's Interface

A standard interface for serving time series data.

NASA Science



Time	data1	scalar2	array	multiDimArray
t0	d0	s0	a0[11]	m0[3,8]
t1	d1	s1	a1[11]	m1[3,8]
t1	d2	s2	a2[11]	m2[3,8]
t2	d3	s3	a3[11]	m3[3,8]
t4	d4	s4	a4[11]	m4[3,8]
t5	d5	s5	a5[11]	m5[3,8]
t6	d6	s6	a6[11]	m6[3,8]

HOWEVER!! HAPI is not really Heliophysics-specific!

One possible discipline detail is the way HAPI represents time.

ISO8601 string values:

2021-351T14:35:00.000Z

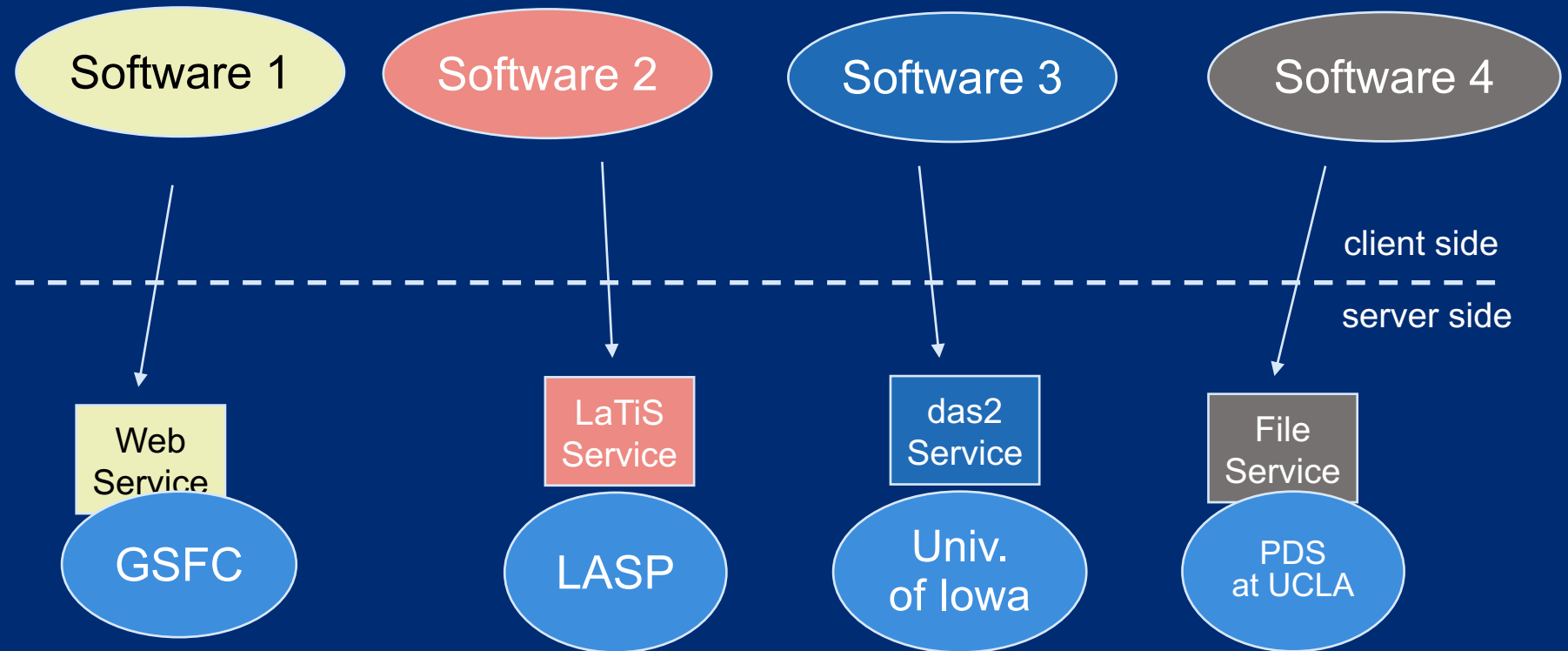
Day-of-year -- or --

2021-12-16T14:35:00.000Z

Yr-Mon-Day both allowed

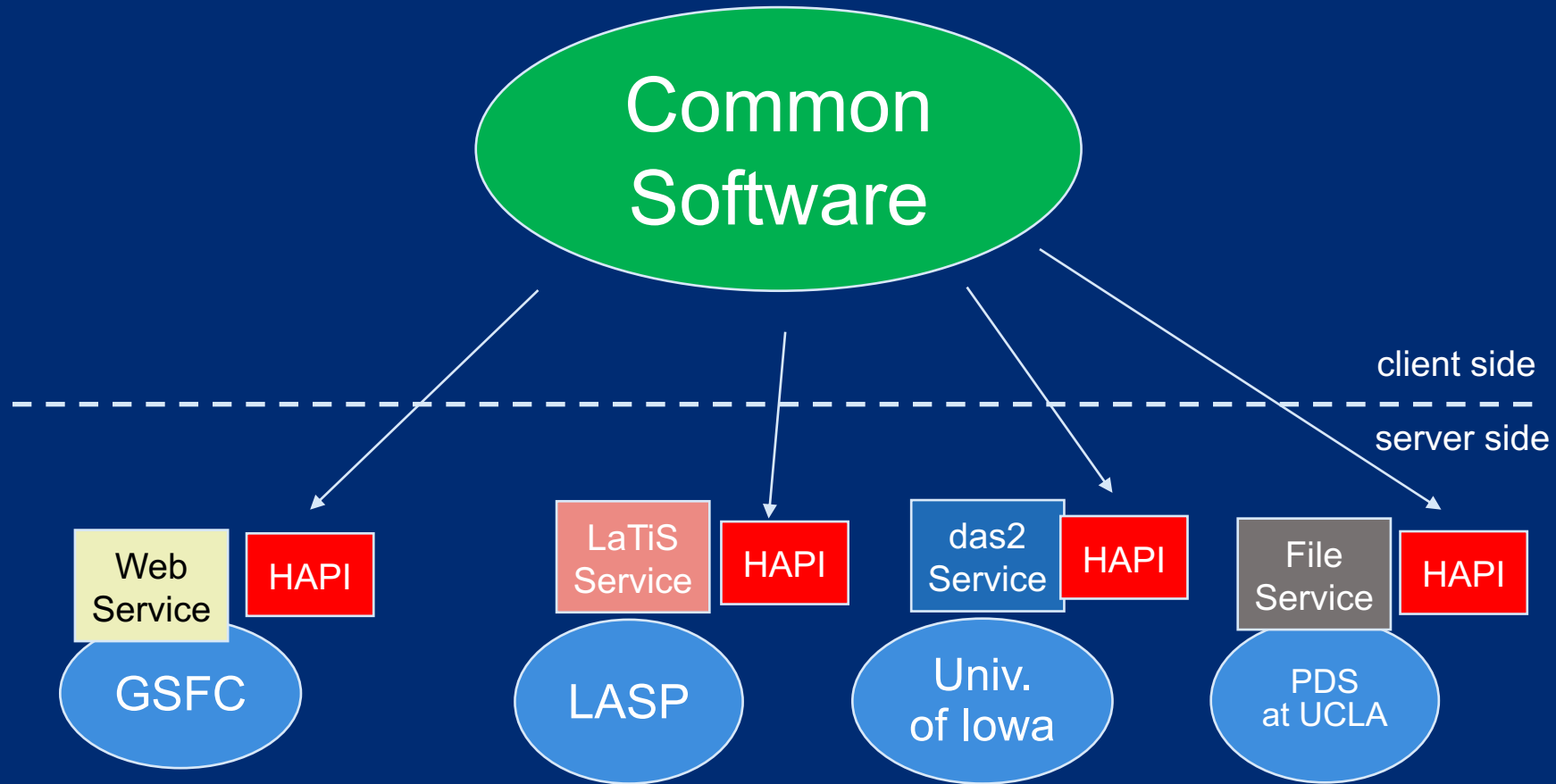
When data centers use a custom interface, interoperability is harder.

unique code needed to read from each interface



various Heliophysics and planetary data centers

If a data center adds a HAPI server => interoperability increased.



HAPI Adoption



Community Coordinated
Modeling Center (CCMC)
Coordinated Data Analysis
Web (CDAWeb)



SuperMAG,
GAMERA
in progress



Planetary Data System
(node for plasma, particles
and fields). *in progress*



Physics Department
(Autoplot)



Automated Multi-Dataset
Analysis (AMDA) at Plasma
Physics Data Centre (CDPP)



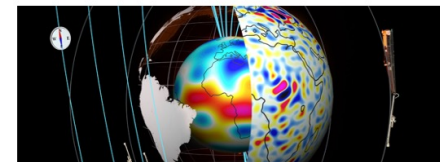
European Space Astronomy
Centre (ESAC). *in progress*



LASP Interactive Solar
Irradiance Data Center
(LISIRD)



Physics Department



ESA's SWARM Mission
(VirES toolkit)

HAPI is also a COSPAR recommended standard for time series Space Weather data.

HAPI is primarily a specification:

<https://github.com/hapi-server/data-specification>

In 2018, it was approved by COSPAR as the recommended standard for Space Weather and space science data.



COSPAR Panel on Space Weather Resolution on Data Access

Accepted at COSPAR PSW Business Meeting on 18 July 2018 (updated 15 October 2021).

Taking into account that:

1. It is in the general interest of the international heliophysics and space weather community that data be made as widely accessible as possible,
2. The open exchange of data benefits from well-defined and standardized methods of access,
3. The ILWS-COSPAR Roadmap has recommended to standardize metadata and harmonize access to data and model archives, and
4. The Heliophysics Application Programmer's Interface (HAPI) specification has demonstrated that it is comprehensive and can meet the needs of the community,

The COSPAR PSW resolves that there is a need for at least one common data access API to facilitate and enhance international access to data.

Therefore, it is recommended that:

1. HAPI (<https://doi.org/10.5281/zenodo.4757597>) be the common data access API for space science and space weather data.
2. Funding agencies provide encouragement and adequate support to enable data produced by projects to be accessed by using HAPI compliant services.

HAPI – how it works

- HAPI as a specification – what to do on your server to make your data accessible

`https://hapi-server.org/`

- two key parts:
 - request interface – very simple URLs
 - response format – independent of underlying file format and streaming (no file boundaries)
Comma Separated Values (CSV) data response is default – very easy to interpret (faster options are supported too)

HAPI: a RESTful interface with 5 endpoints

All endpoints must be directly below a URL that ends with 'hapi'

Endpoint	Inputs	Outputs	Output Format
http://example.com/hapi/about		server contact and citation info	JSON
http://example.com/hapi/capabilities		which options are implemented (which data formats)	JSON
http://example.com/hapi/catalog		list of dataset ids and names	JSON
http://example.com/hapi/info	dataset id	header-like metadata with a list of parameters and record structure, units, fill, etc	JSON
http://example.com/hapi/data	dataset id, time range, parameters (optional)	stream of data from requested parameters in given time range	CSV (reqd) JSON (opt) binary (opt)

Request:

```
http://example.com/hapi/info
```

Response:

```
{
  "HAPI": "2.0",
  "status": { "code": 1200, "message": "OK"},
  "startDate": "2004-001T00:00:04.734Z",
  "stopDate": "2017-258T10:31:10.425Z",
  "sampleStartDate": "2004-183T00:00:00.000Z",
  "sampleStopDate": "2004-184T00:00:00.000Z",
  "description": "Cassini magnetometer data as used by the MIMI team",
  "cadence": "PT5S"
  "parameters": [
    { "name": "epoch",
      "type": "isotime",
      "length": 24,
      "units": "UTC",
      "fill": null,
      "description": "time as ISO 8601 UTC string to milliseconds"
    },
    { "name": "B_SSO",
      "type": "double",
      "units": "nt",
      "size": [3],
      "fill": "-1.0e+38",
      "description": "magnetic field vector in the SSO frame"
    }
  ],
}
```

Other topics today

- demo of ways to use HAPI to get data
- overview of HAPI-related efforts on Github
- open-mic Q&A

HAPI Server Verifier

If you implement your own server, how can you test it?

Github project with code to run through a series of tests (that you can run locally).

<https://github.com/hapi-server/verifier-nodejs>

<https://hapi-server.org/verify/>

Q&A

Discussion priming topics:

If you want to serve data:

- How do I implement a server?

- Verifying a server?

Doing science analysis:

- what datasets are available now?

- what clients can read from HAPI servers?

- can I write my own client in Python, IDL, Matlab, Java, R, etc.

How stable is the spec? What changes are planned?

How do I get connected or get help?



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