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Standardizing Access to Heliophysics Data: HAPI Specification Updates and Some New Usages for Cloud and Model Data

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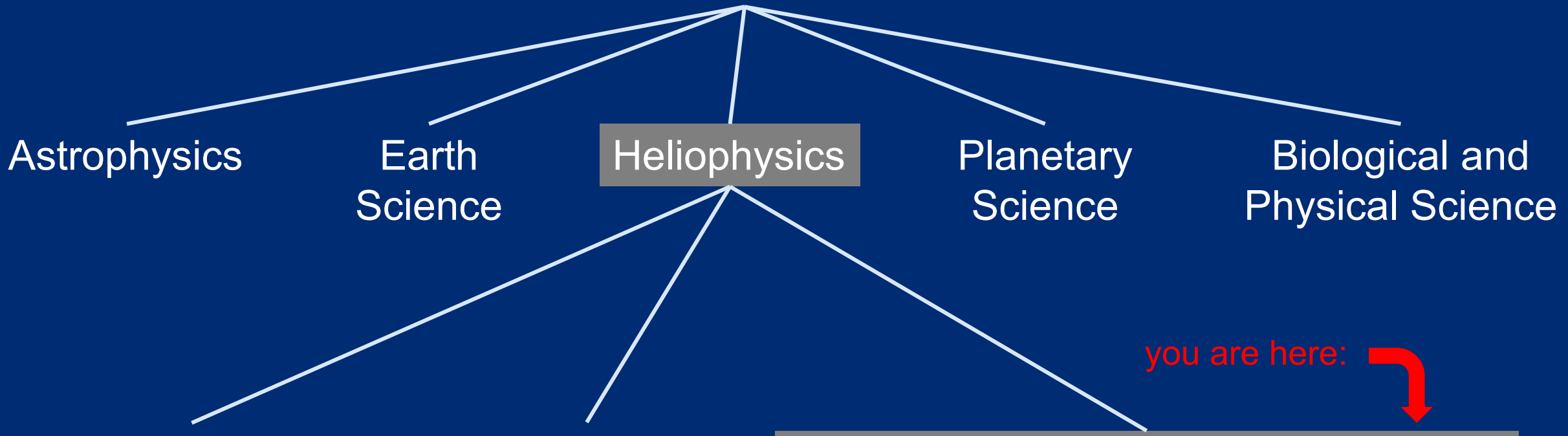
Context: What is HAPI?

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]

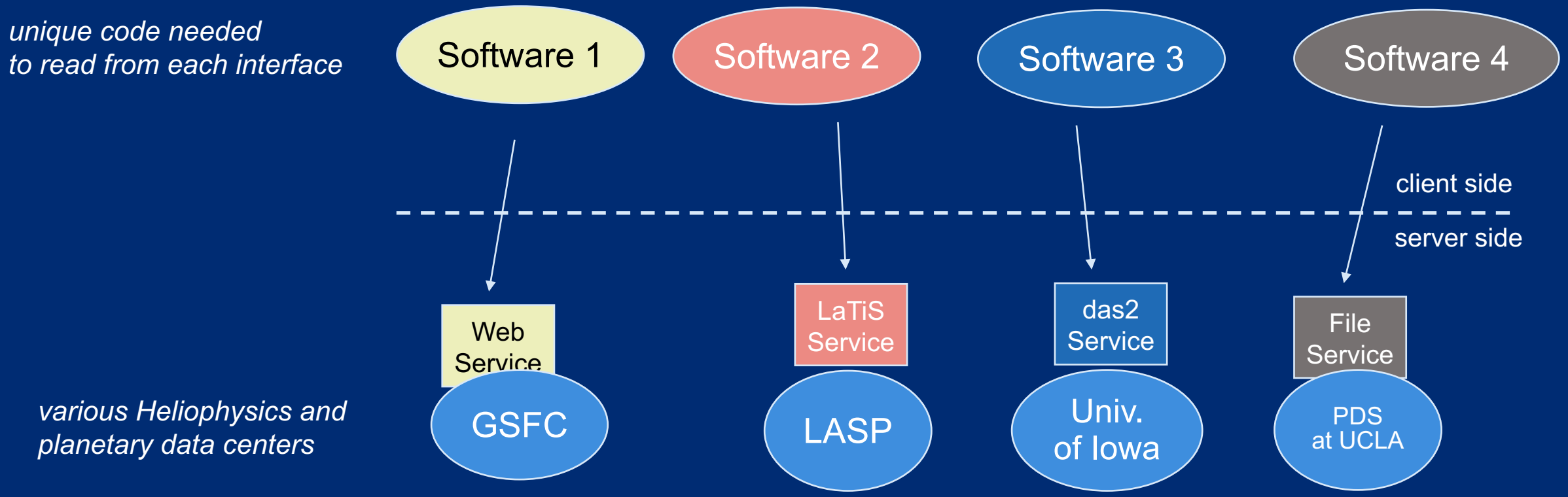
The only Heliophysics-specific aspect is possibly the way HAPI represents time.

ISO8601 string values:

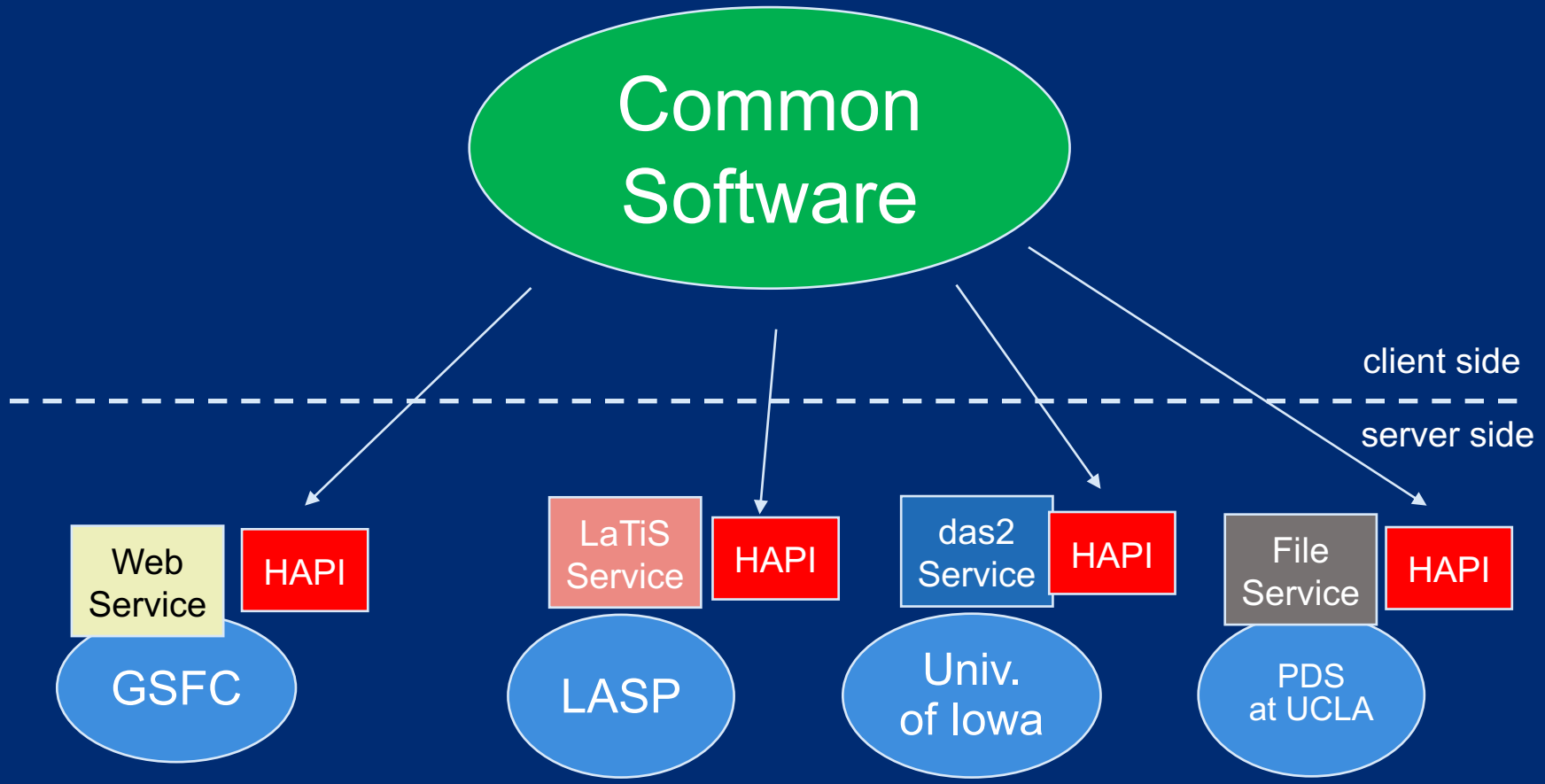
2021-351T14:35:00.000Z

2021-12-16T14:35:00.000Z

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



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*

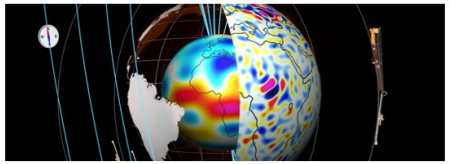
Physics Department (Autoplot)

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

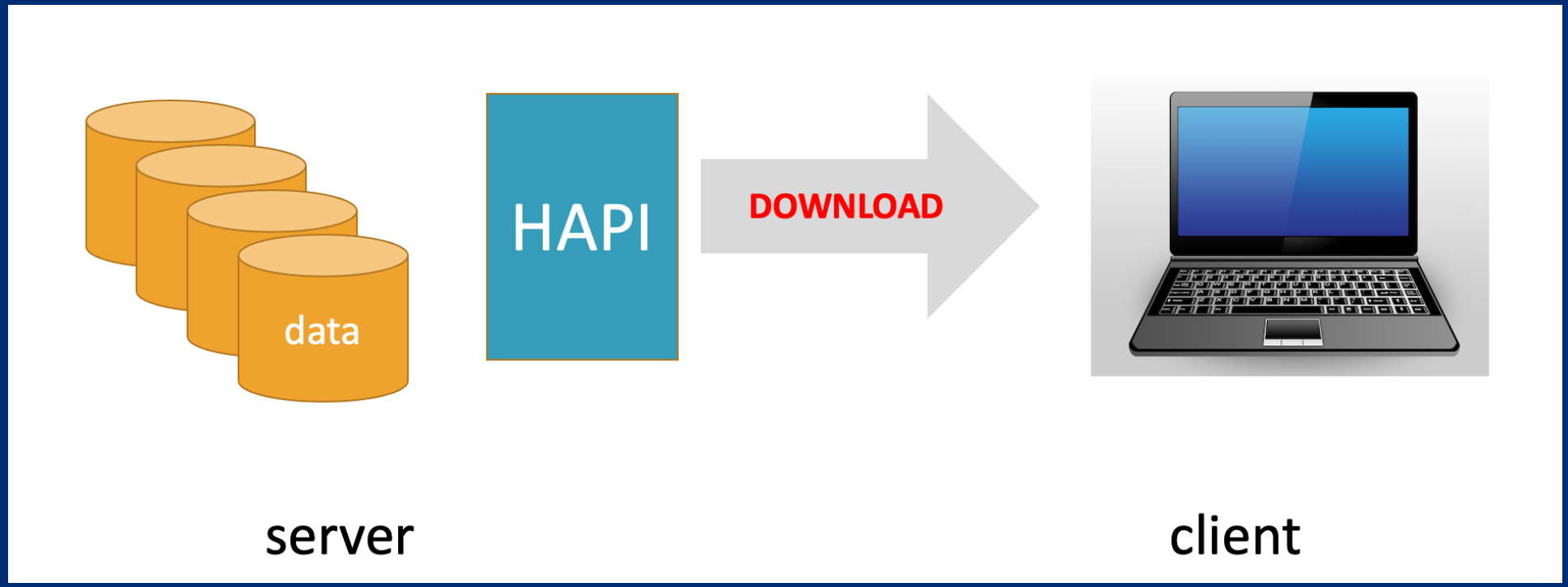


ESA's SWARM Mission (VirES toolkit)

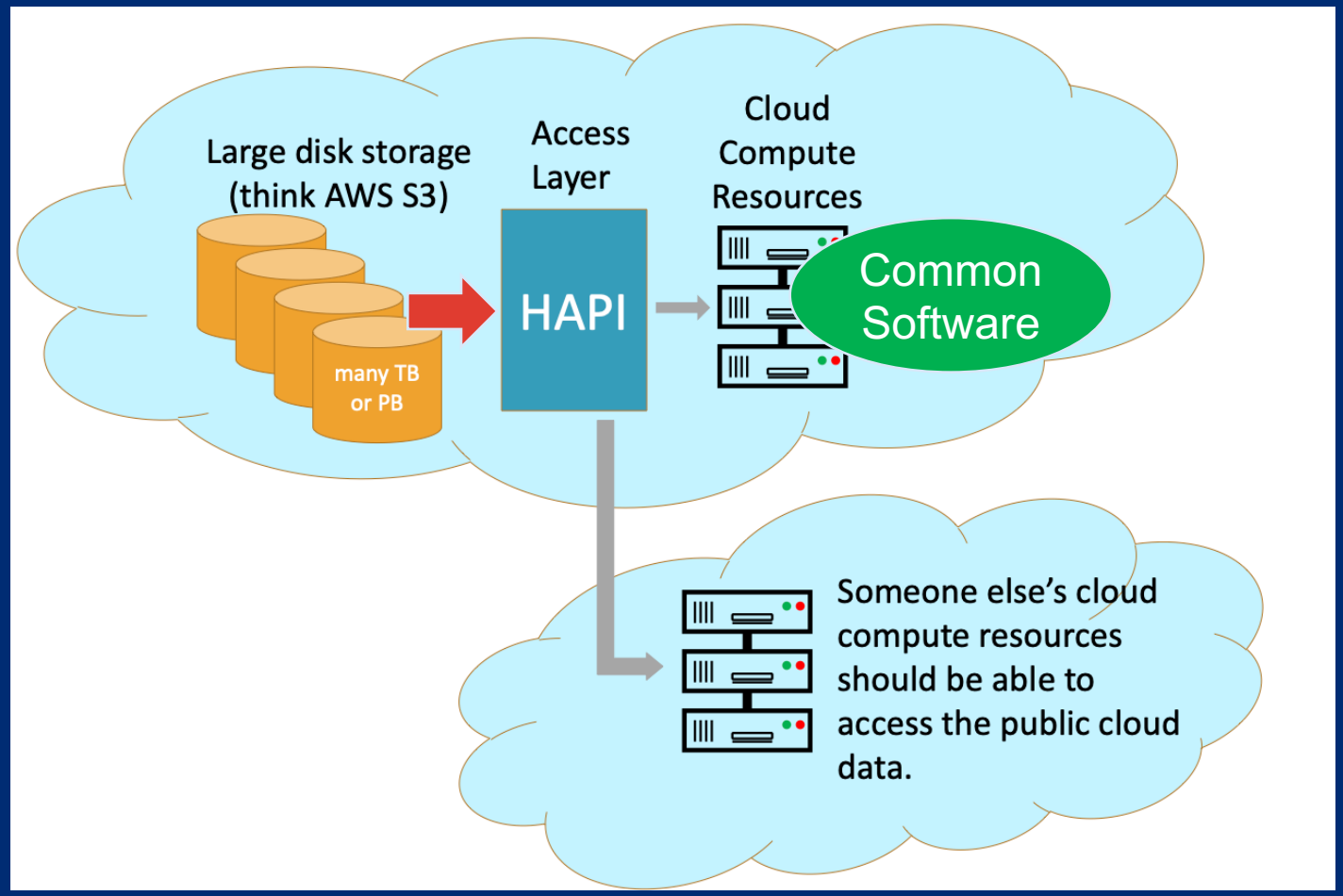
HAPI is also a COSPAR recommended standard for time series Space Weather data.

HAPI in the cloud

Non-cloud, “traditional” data analysis:



Cloud-based analysis: a) data stays in the cloud
b) analysis tools also in the cloud



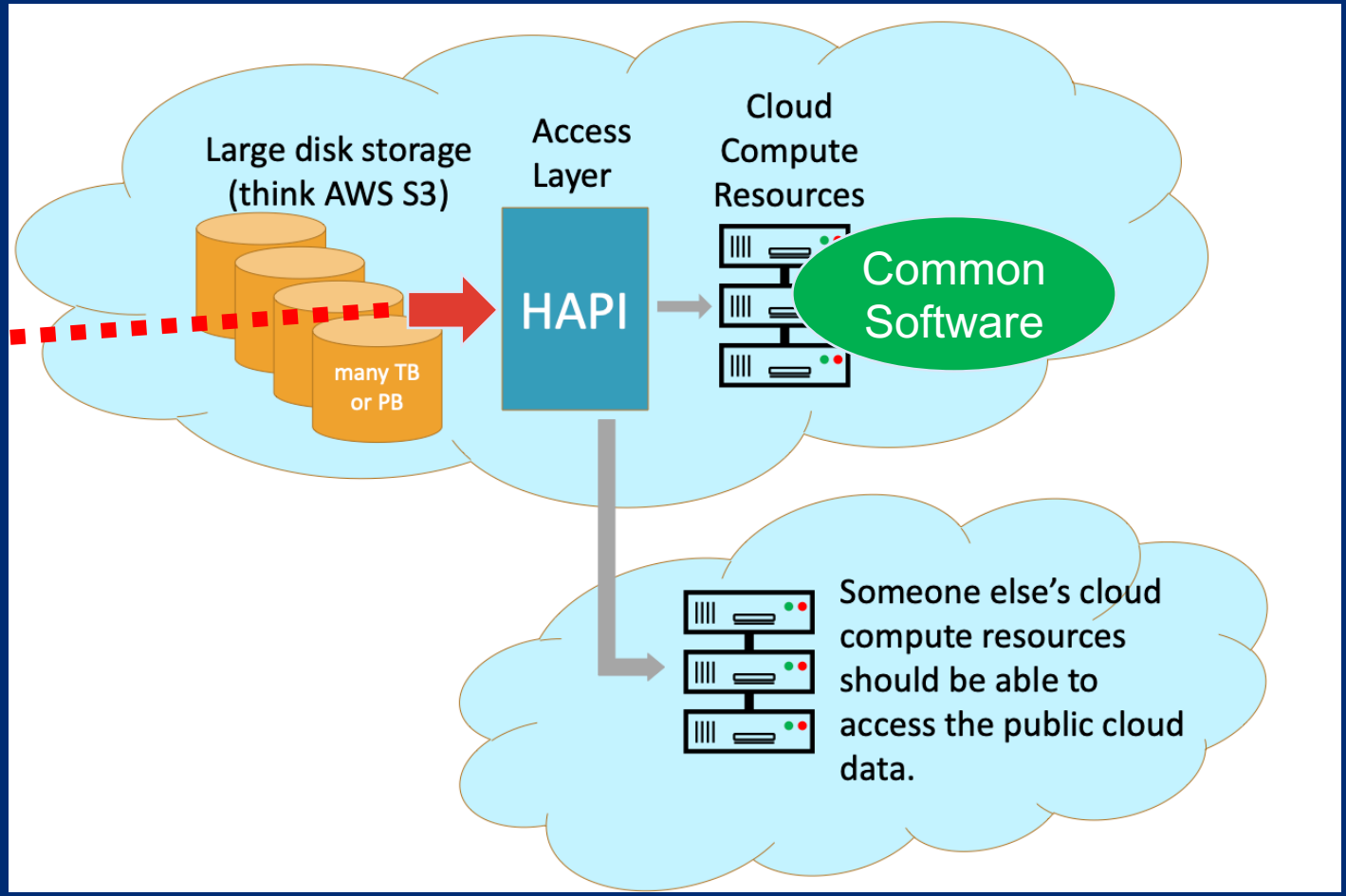
HAPI server and client
both in the cloud
(no egress)

cloud-to-cloud transfer --
not always free but cheap
(within single provider)

HAPI server now reads from AWS S3 buckets.

Questions:
how to store the data in S3?
how to manage the read?

Does data need to be reformatted for the cloud?



Probably not – but might need to update the CDF reader library to optimize for S3.
See AGU talk by Gallagher and Quinn: IN32B-08.

HAPI for Model data

SuperMAG

Global magnetic field observations and products made

Data from SuperMAG sensors

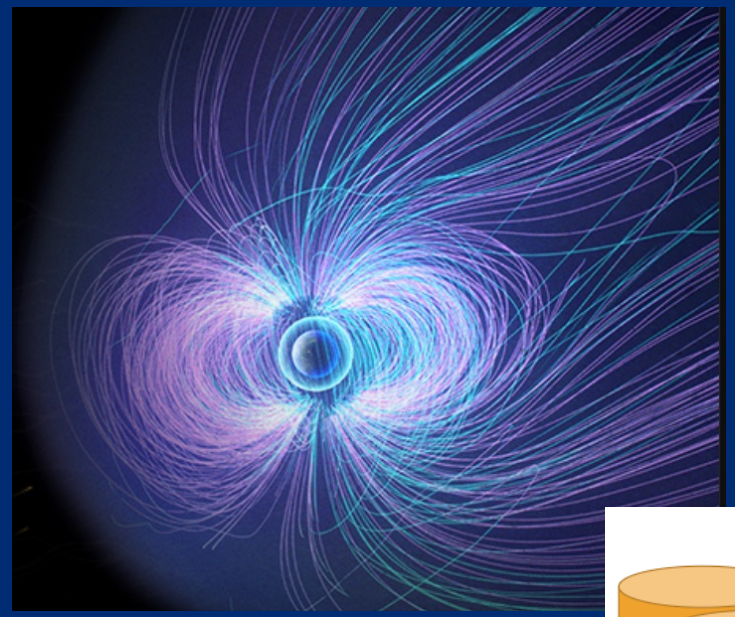
`http://supermag.jhuapl.edu/`**`data`**`/hapi`

`http://supermag.jhuapl.edu/`**`model`**`/hapi`

Data from the same positions as SuperMAG stations, formatted in exactly the same way as the HAPI data for the measurements, but coming from **a simulated magnetic field** (such as the APL GAMERA model).

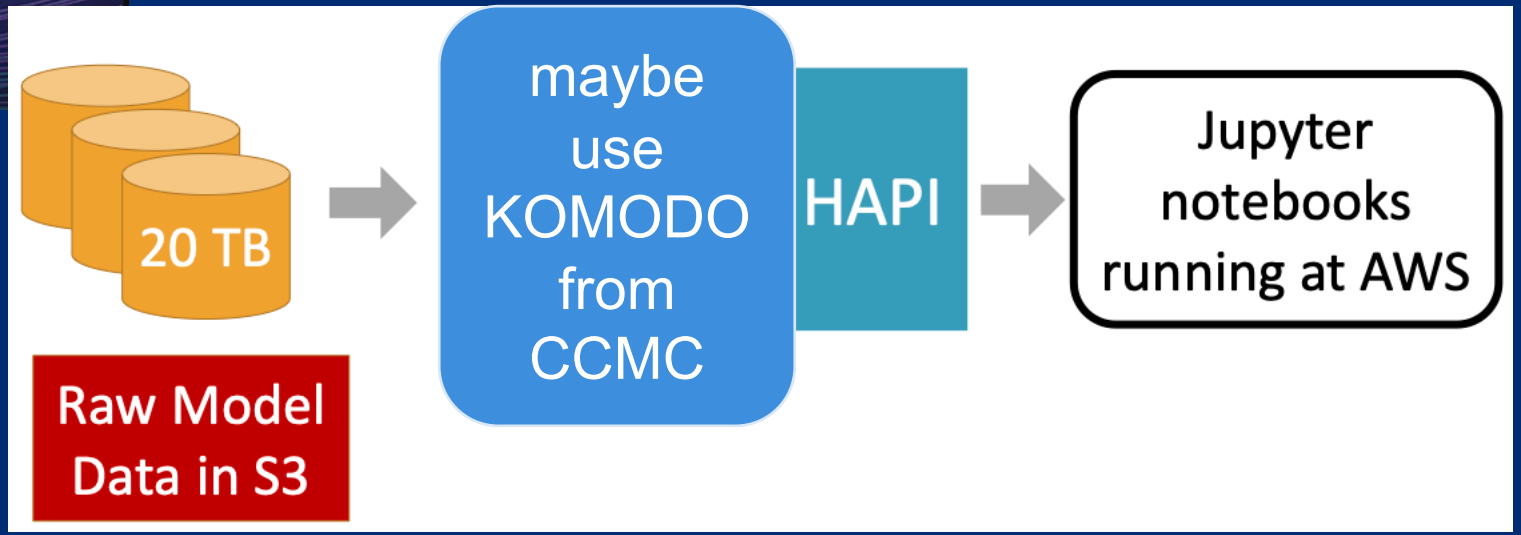
Note: you could do this with any spacecraft dataset too – just fly the spacecraft through the model.

HAPI for Model data, part 2



Field lines from APL's GAMERA MHD model.
(many other plasma parameters available!)

HAPI can serve as a layer on top of "regularized" model output.



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