

Simons Observatory

Josh Borrow (University of Pennsylvania)



Image Credit: Dave Boettger



 **HEISING-SIMONS**
FOUNDATION



SIM NS
FOUNDATION



JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE
日本学術振興会



Science Goals

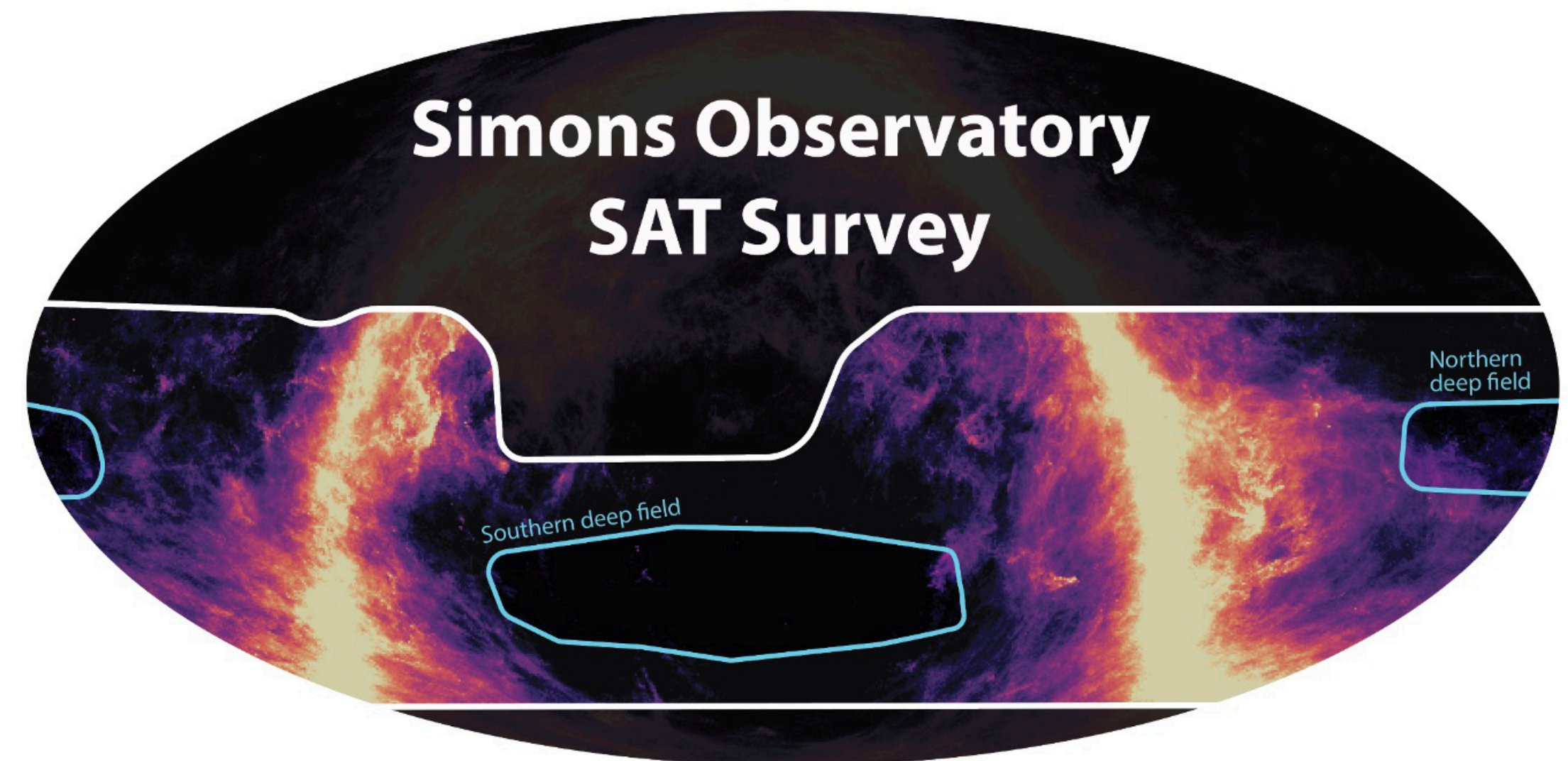
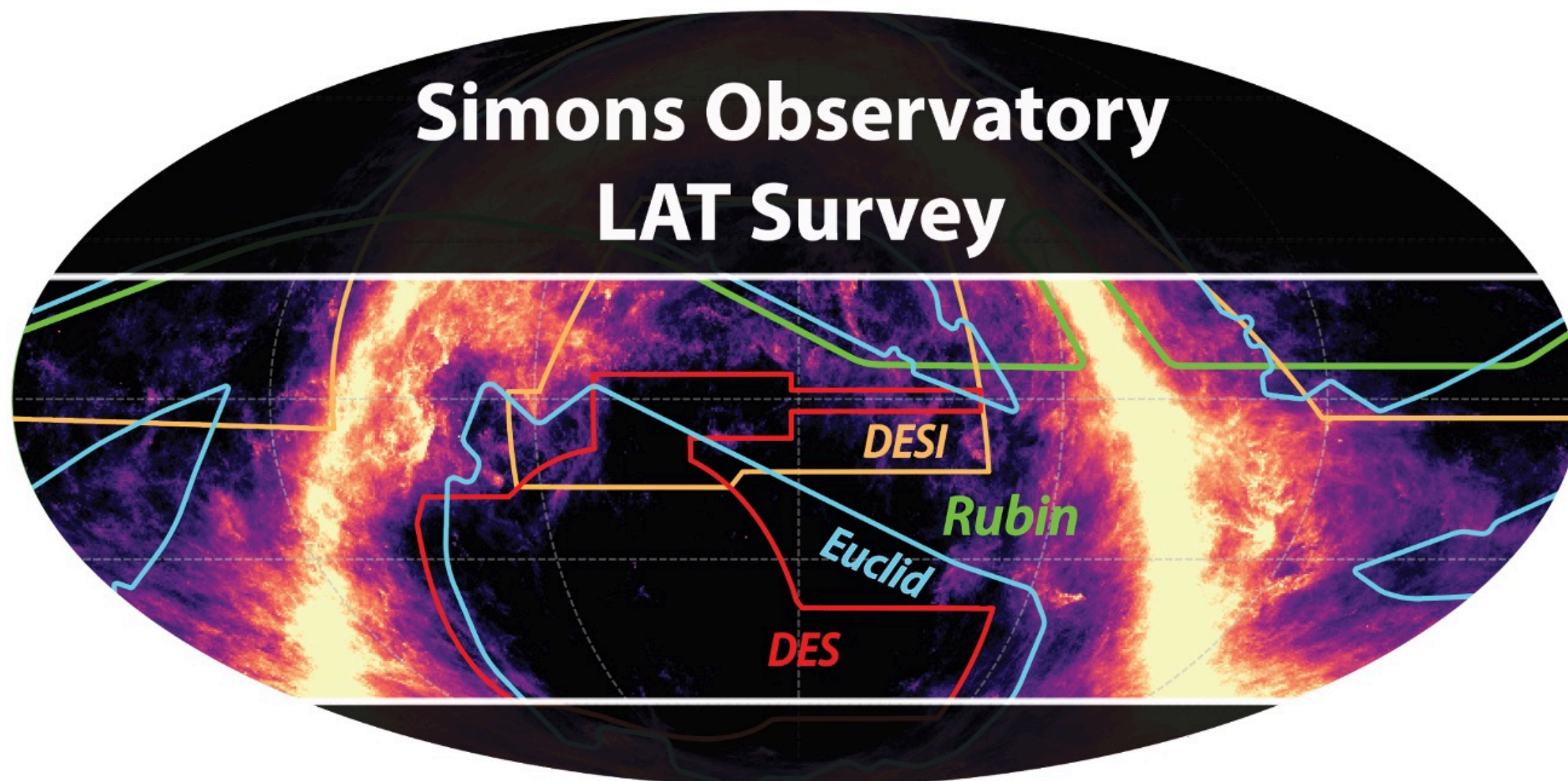
The Simons Observatory runs two coincident millimeter-wave surveys: the Large Aperture Telescope (LAT) survey focused on small scales and the Small Aperture Telescope (SAT) survey with multiple instruments focused on large scales and polarization.

LAT

Primordial perturbations, neutrino mass, dark energy constraints, galaxy clusters, astrophysical transients, with significant overlap with DES, Euclid, DESI, Rubin, ...

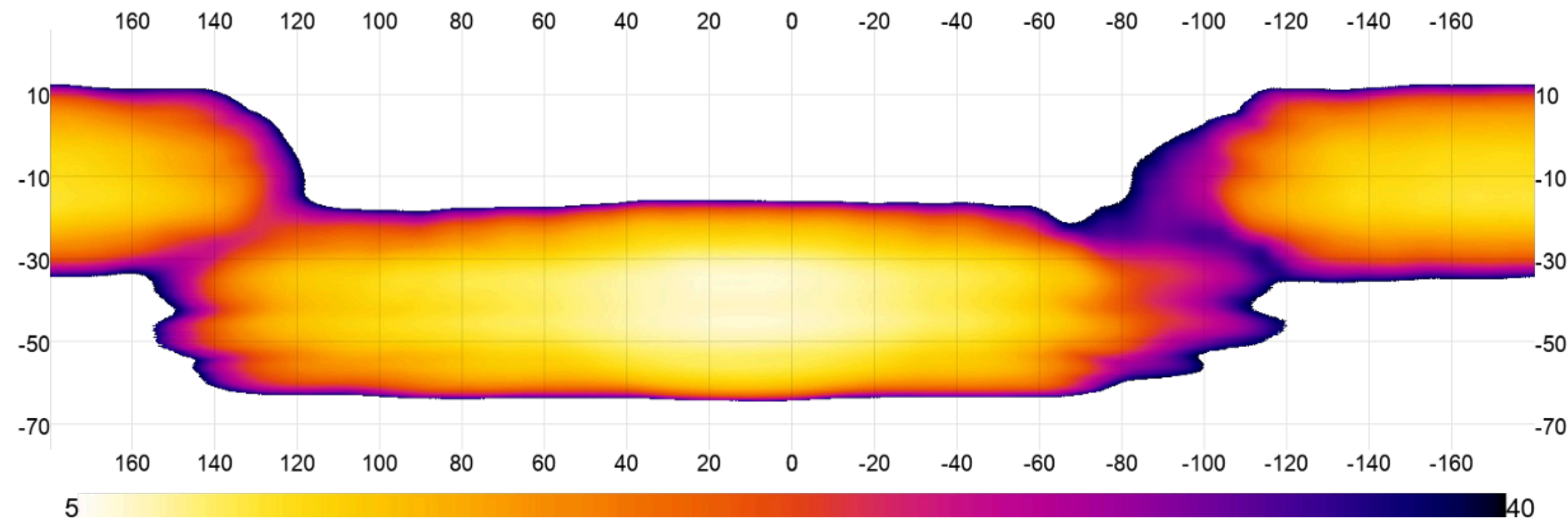
SATs

Focused on the low-dust 10% of the sky, designed for constraints on inflationary parameters, primordial gravitational waves, and large-scale polarization.

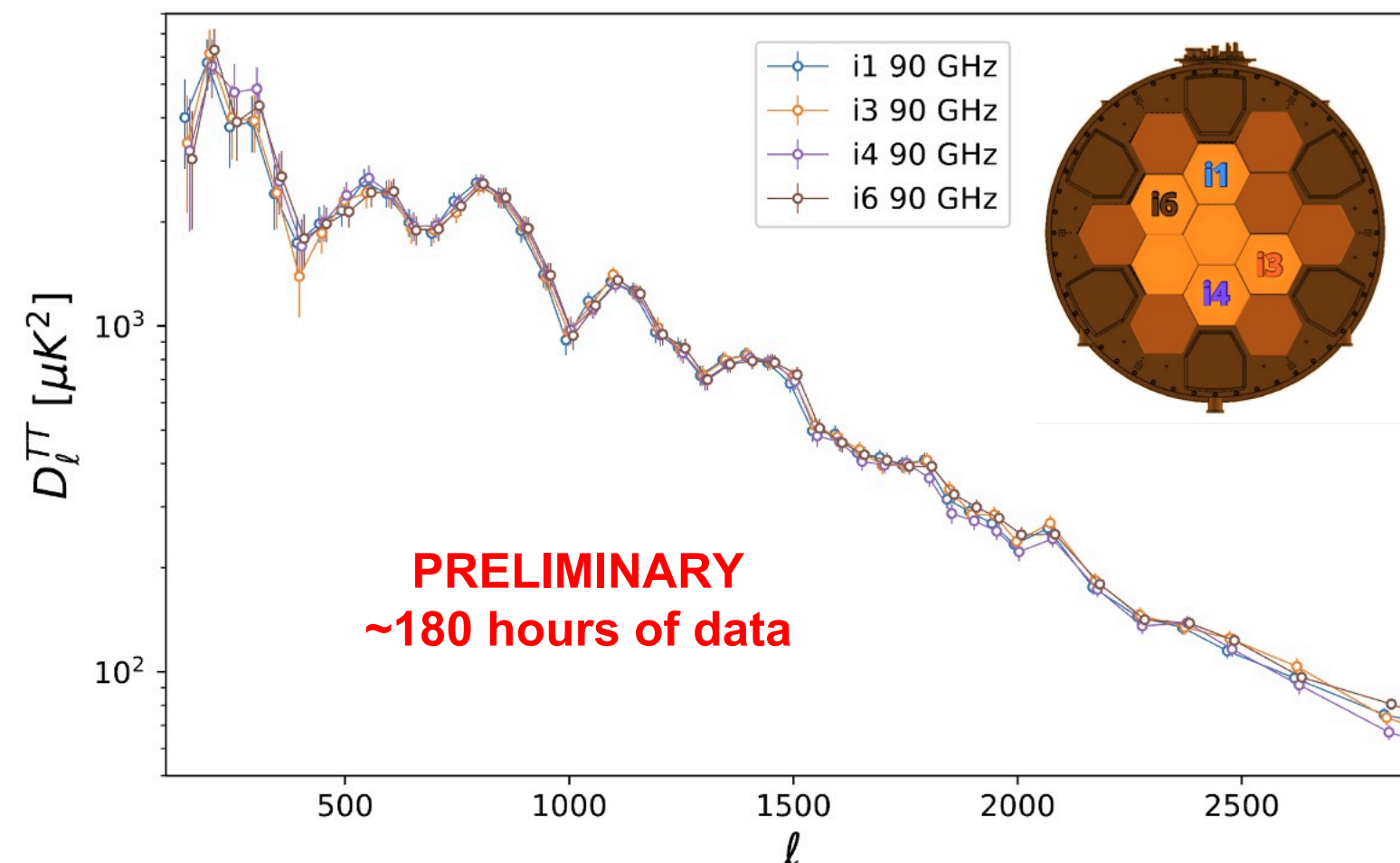


Recent Results !

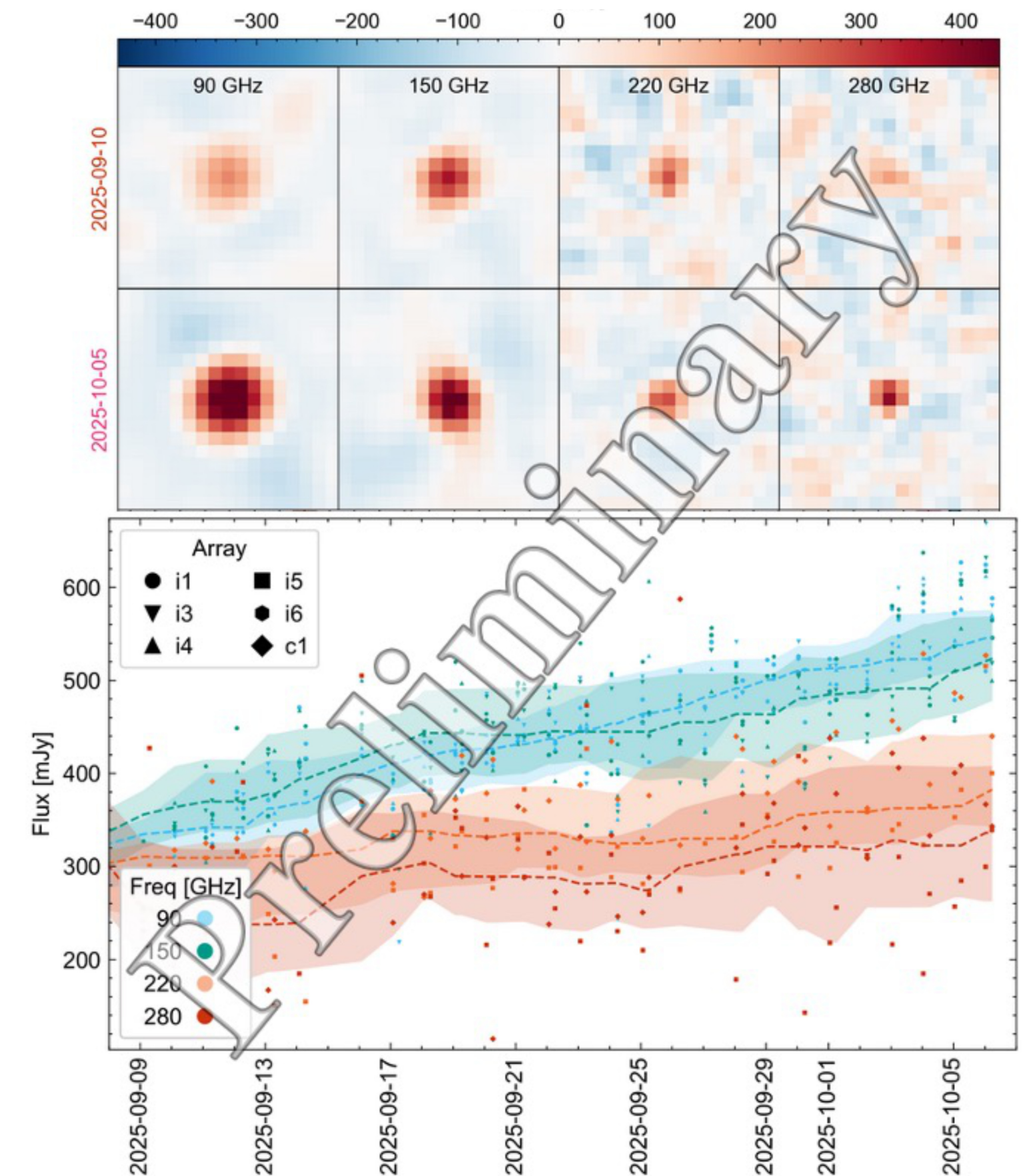
The SAT survey is moving along with earnest: this is a polarization depth map ($\mu\text{K-arcmin}$) for 300 days of observing.



We are producing the first power spectra from the LAT instrument, with great progress and different optics tubes (separate instruments inside the receiver) well-calibrated and generating consistent results.



The SO LAT transient and source monitoring campaign is producing its first results, like this light-curve of a nearby AGN flaring.



Entering Operations

SO has successfully entered the operations phase, with a fully upgraded Large Aperture Telescope (years ahead of schedule) and 3 Small Aperture Telescopes, along with associated Data Management operations.

Large Aperture Telescope

3 active Small Aperture Telescopes

3 under construction Small Aperture Telescopes

New 3 MW Photo-voltaic Array (Not Pictured)

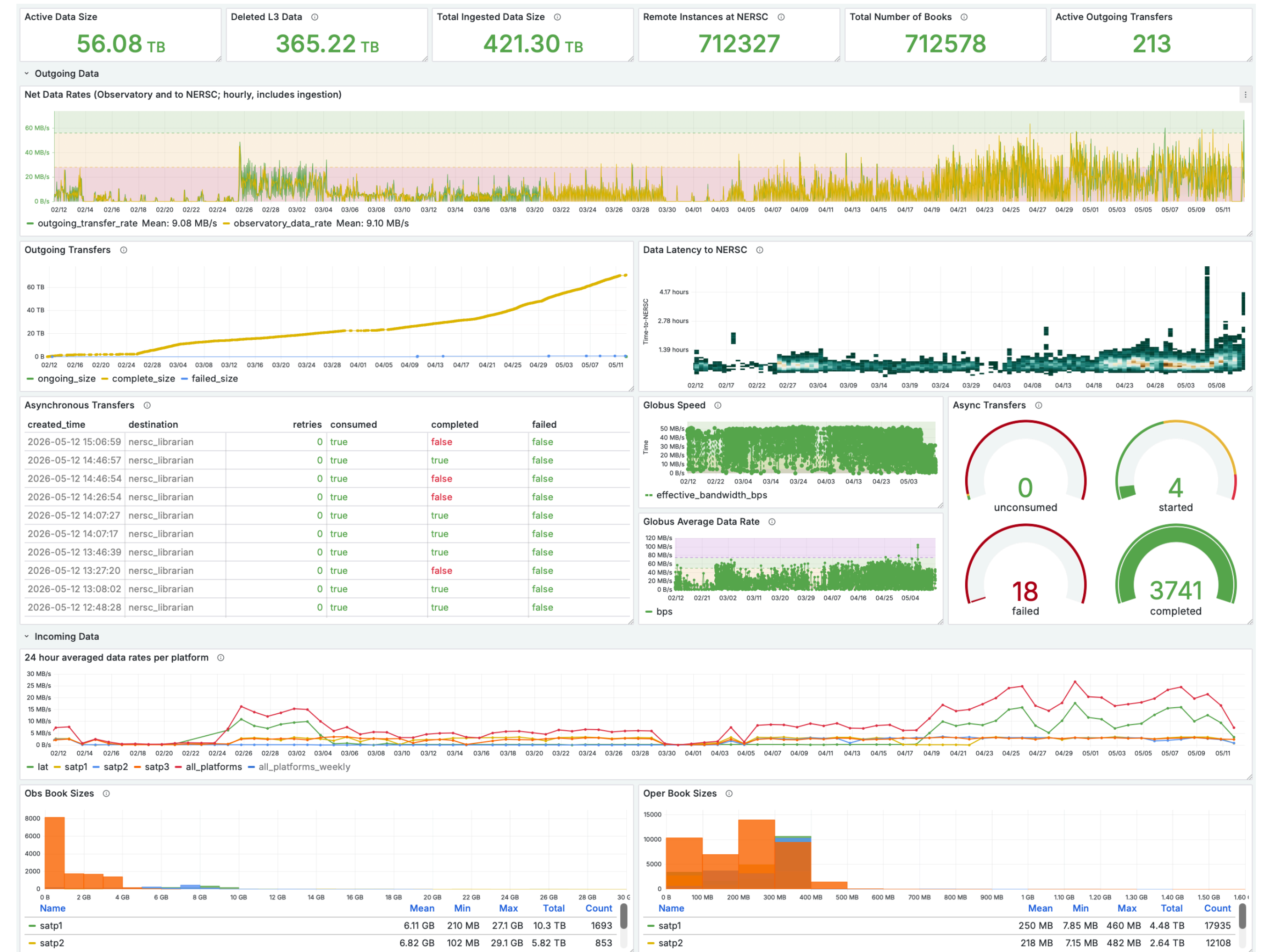


Primary Data Transfer

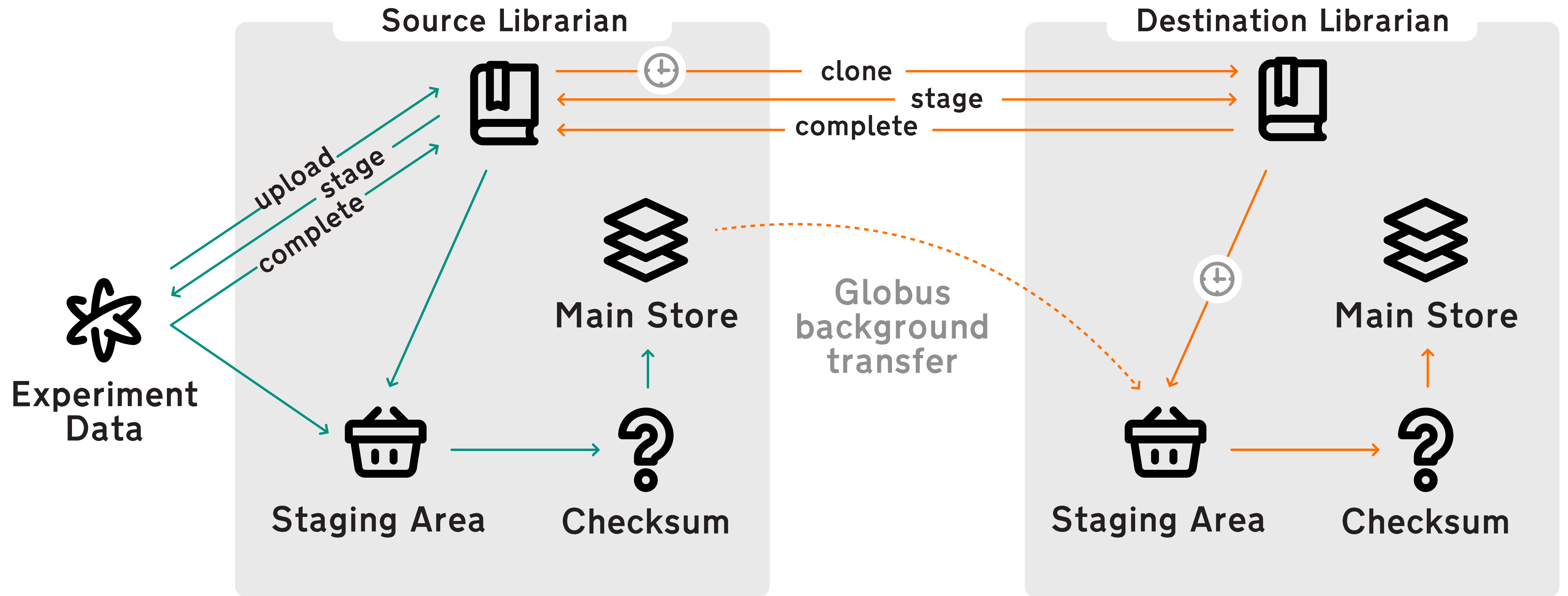
We use a homegrown, open-source, tool called Librarian to manage our data transfers. Librarian is fully distributed and holds metadata and instrumentation in an attached PostgreSQL database.

We use Grafana as our observability platform, directly connected to the metadata database. We can track transfers, data rates, and our corpus of data (now at 450 TB since the start of the project, expected to grow by 1 PB per year from now on).

Librarian was published in SciPy 2024 (<https://proceedings.scipy.org/articles/HWGA5253>) and has documentation available at solibrarian.readthedocs.io.

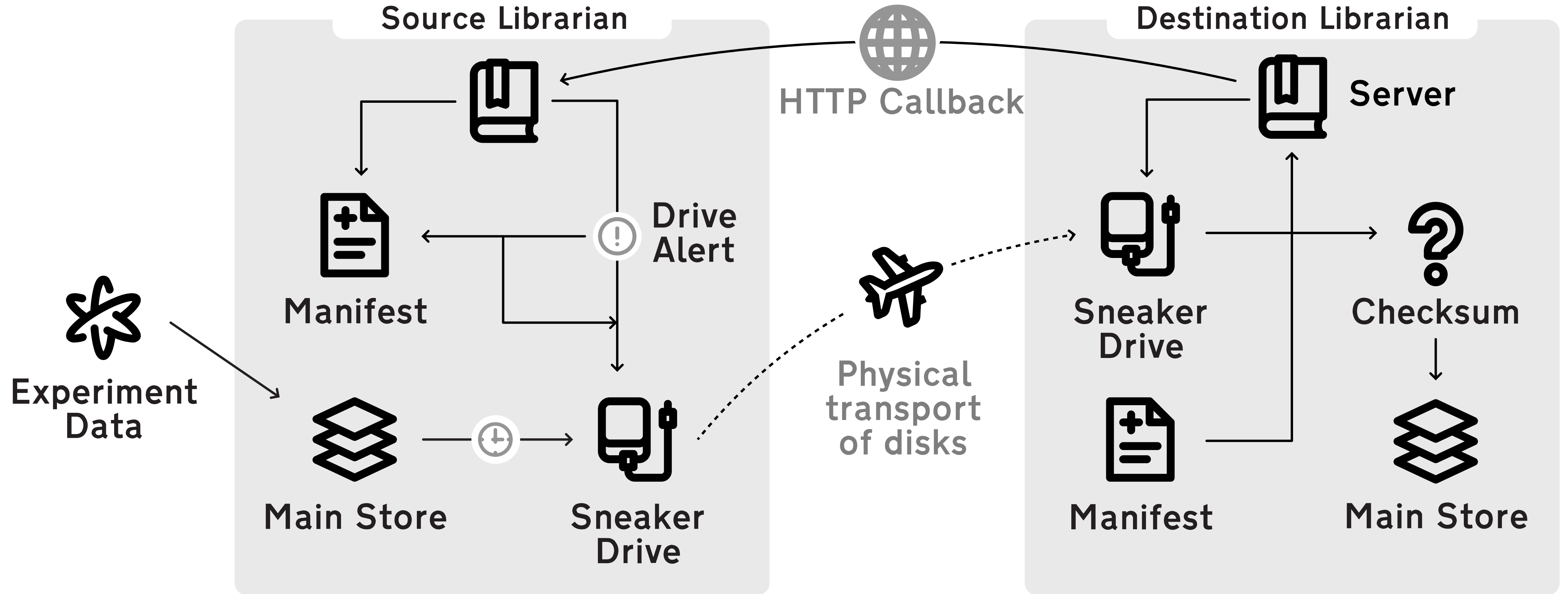


Librarian Architecture

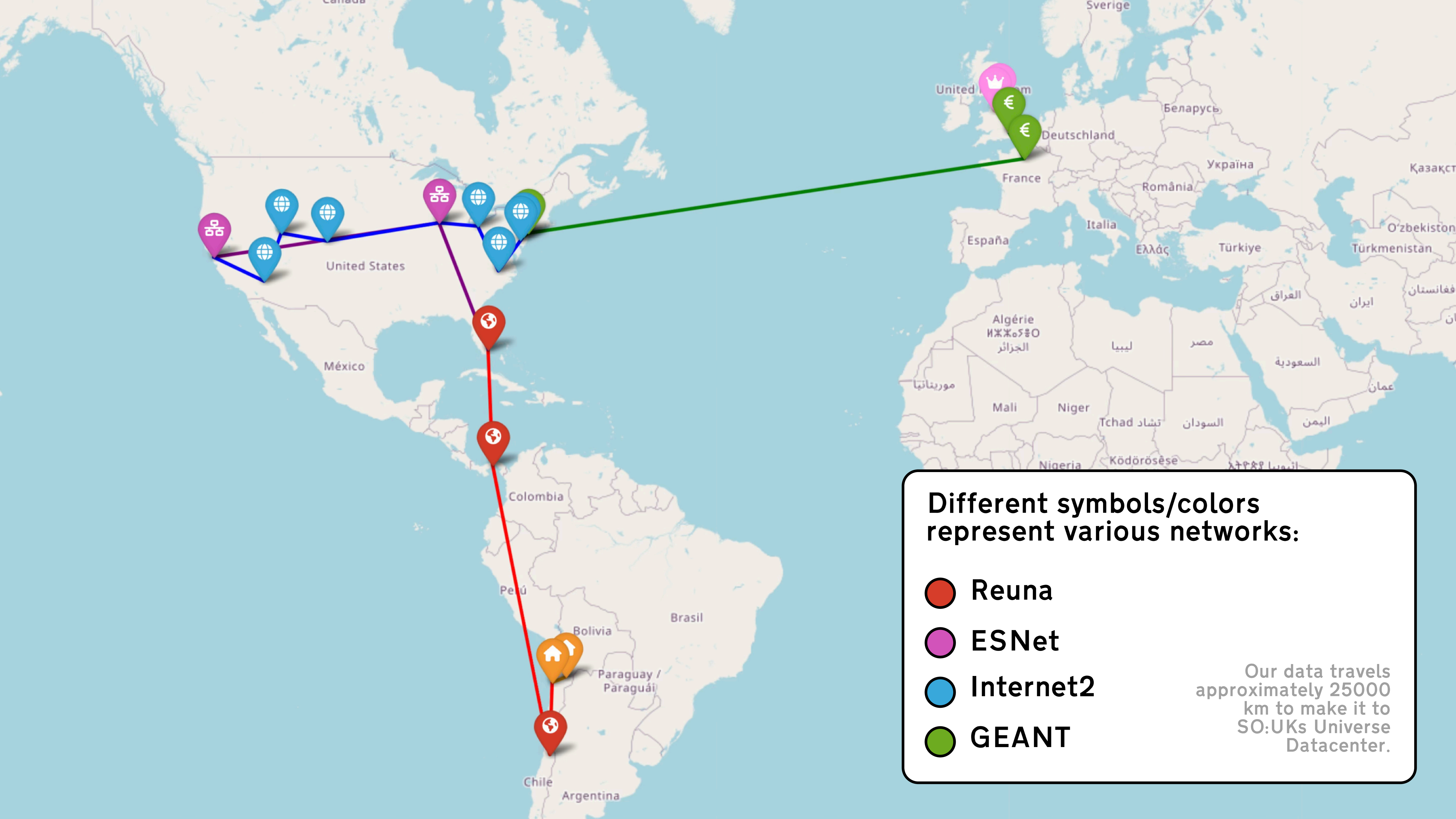


See <https://proceedings.scipy.org/articles/HWGA5253> for full details





Sneaker Architecture



See <https://proceedings.scipy.org/articles/HWGA5253> for full details

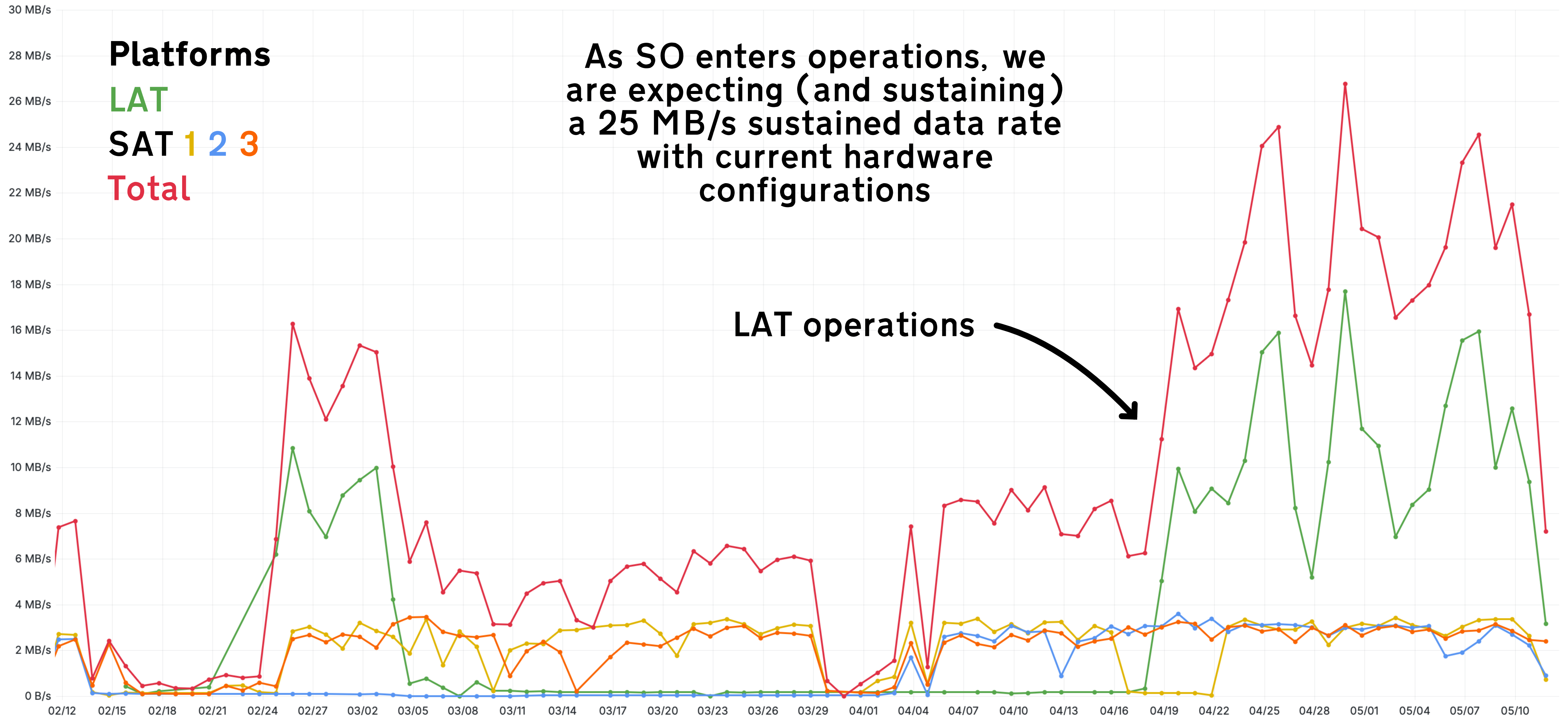


Different symbols/colors represent various networks:

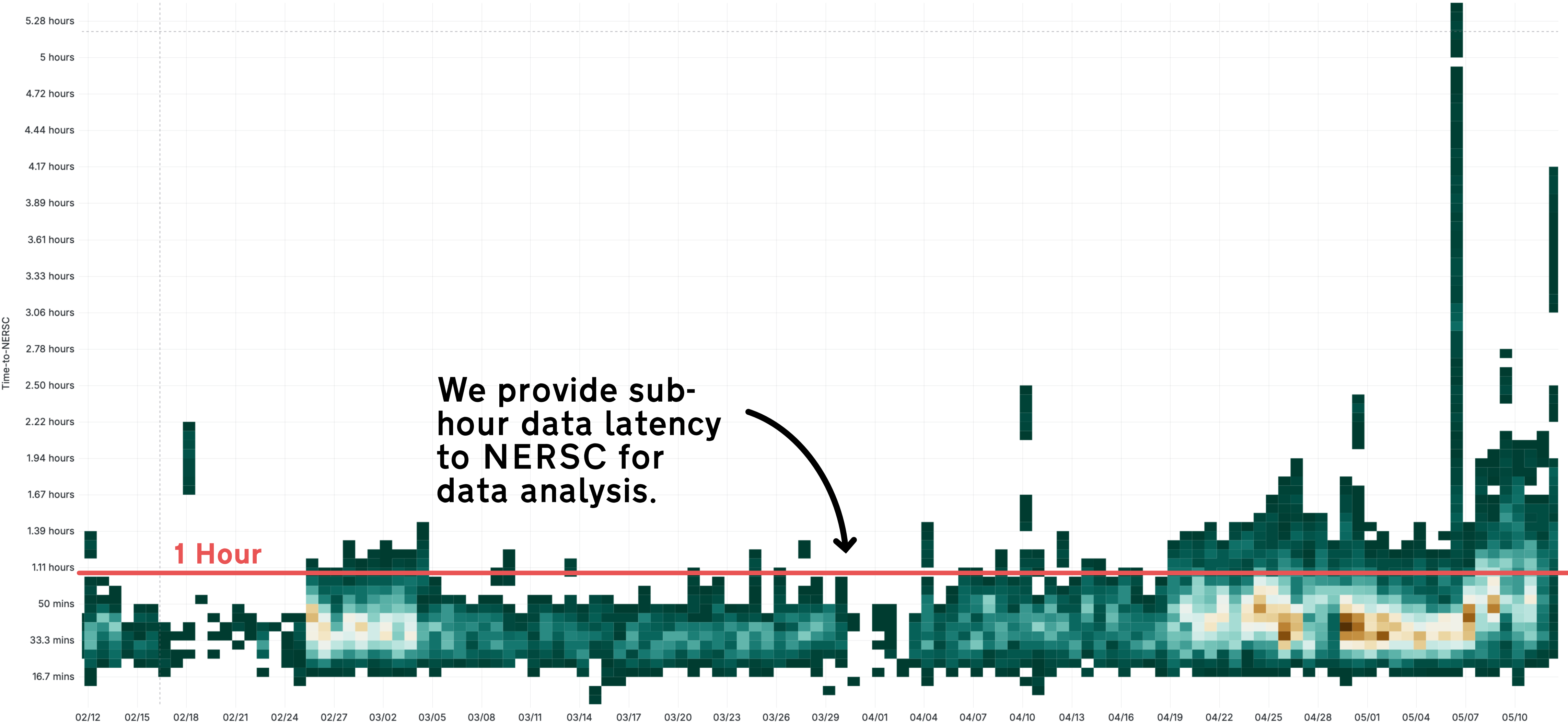
-  Reuna
-  ESNet
-  Internet2
-  GEANT

Our data travels approximately 25000 km to make it to SO:UKs Universe Datacenter.

Data Rates



Data Latency

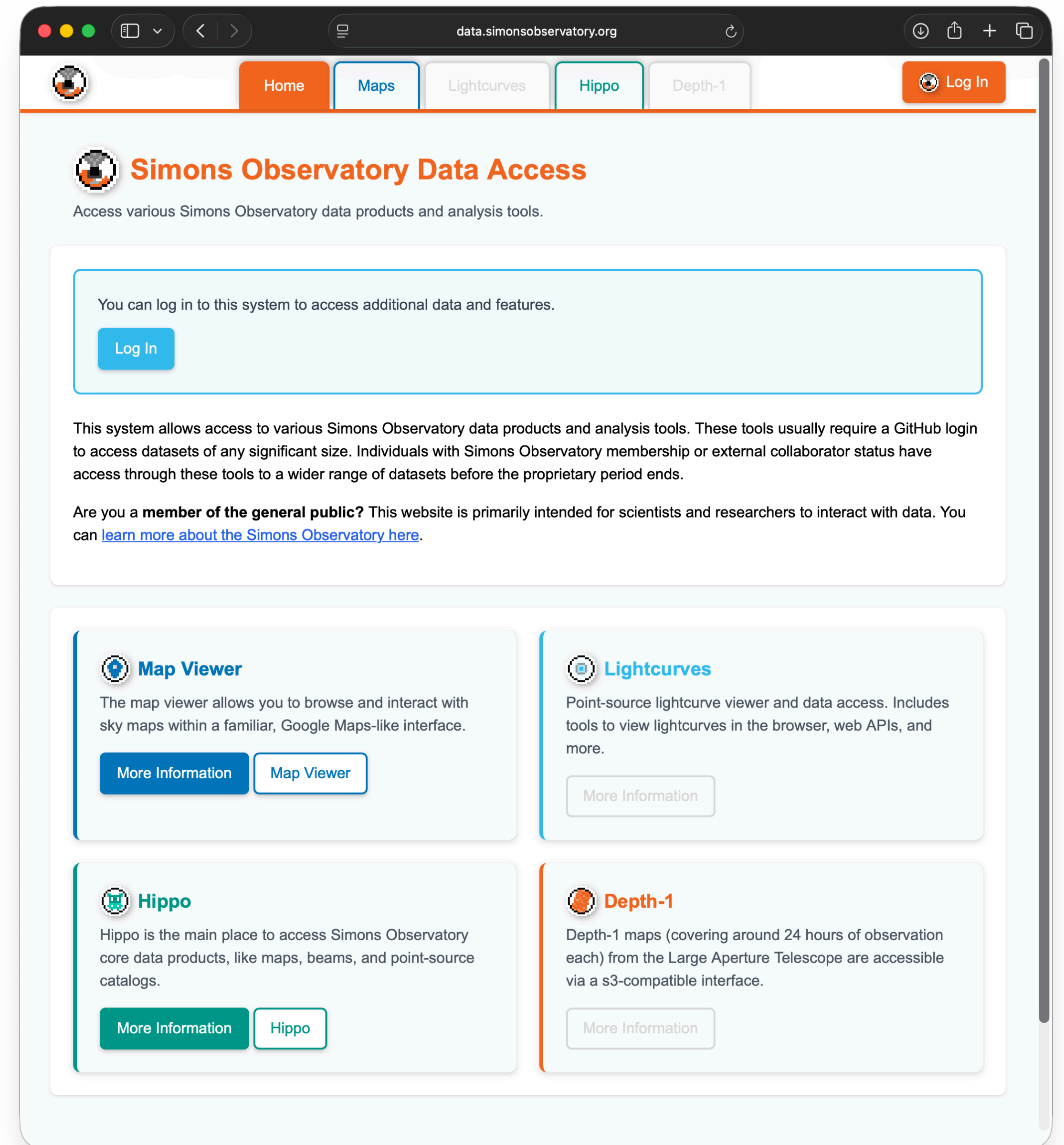


Data Releases ?

SO is targeting its first data release as early as this fall, with data scheduled to be published at data.simonsobservatory.org.

We are very committed to open science, and are currently developing our data licensing policies to ensure as much of the community and world can make use of our processed data as possible (likely to be CC-BY-4.0).

We will be providing data in multiple forms through our wide-ranging Data Delivery services, including daily and season maps, power spectra, astrophysical transient data within hours of observation, and the software stack to analyze it.



The screenshot shows the homepage of the Simons Observatory Data Access website. The browser address bar displays data.simonsobservatory.org. The navigation menu includes links for Home, Maps, Lightcurves, Hippo, and Depth-1, along with a Log In button. The main heading is "Simons Observatory Data Access" with the subtitle "Access various Simons Observatory data products and analysis tools." A prominent light blue box contains the text "You can log in to this system to access additional data and features." with a "Log In" button. Below this, a paragraph explains that the system allows access to various data products and analysis tools, typically requiring a GitHub login. A link is provided for users to learn more about the Simons Observatory. The page features four data product cards: "Map Viewer" (describing sky map browsing), "Lightcurves" (describing point-source lightcurve viewing), "Hippo" (describing core data products), and "Depth-1" (describing maps from the Large Aperture Telescope). Each card includes a "More Information" button and a direct link to the product.

Summary

SO is operational with a fully upgraded LAT and 3 SATs. We expect 3 additional SATs online by the end of the year, boosting our net data rate to over 30 MB/s continuously.

Our transfers all move over the REUNA network via Globus and our in-house tool Librarian, which is available fully open source (very happy to discuss external uses).

We are actively taking science grade data and are looking forward to the first publications later this year.

Watch out for SO data releases at data.simonsobservatory.org.

Thanks to REUNA and AmLight for making all of this possible !

josh@joshborrow.com