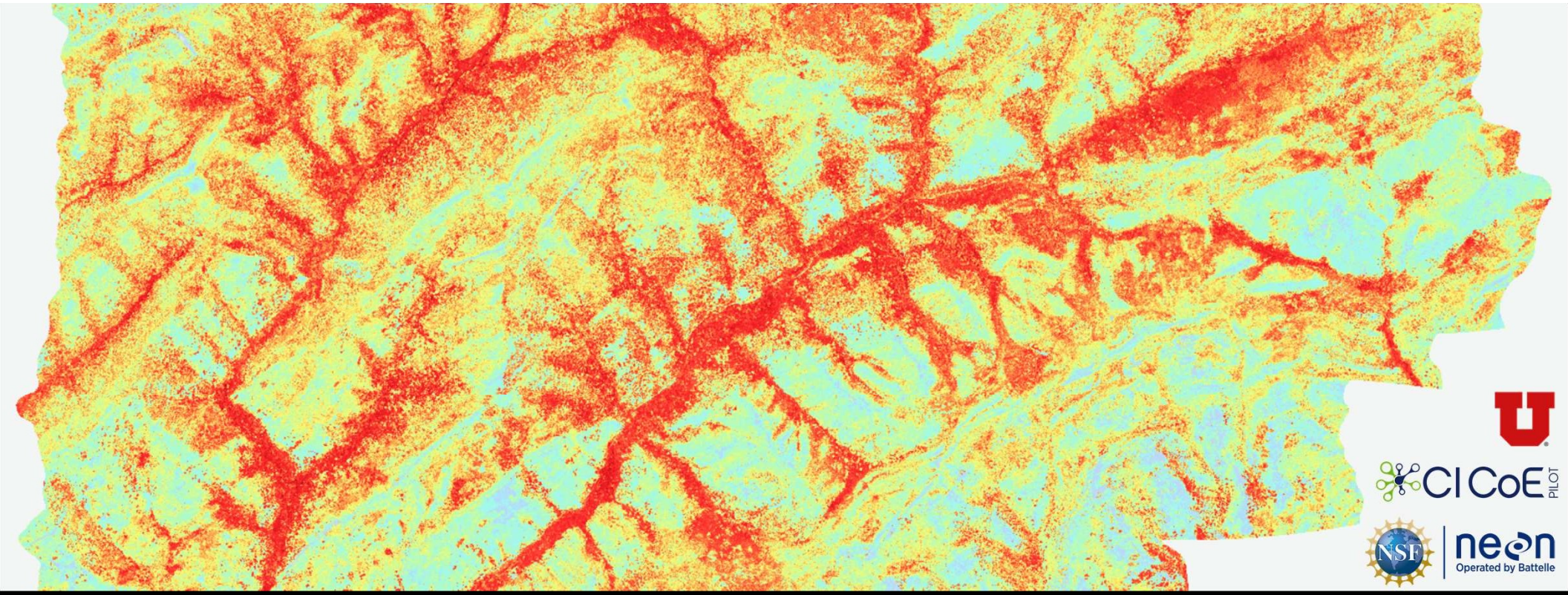

CI/CS WORKSHOP
THE COMMUNITY TOGETHER
ResearchSOC
CI CoE PILOT



Low-cost, interactive access and visualization of large scale scientific data

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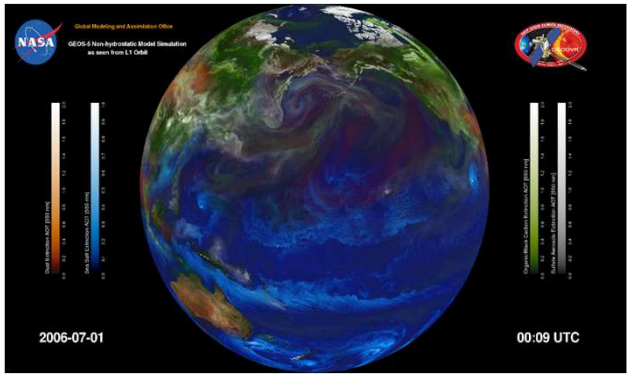
Giorgio Scorzelli,
Valerio Pascucci

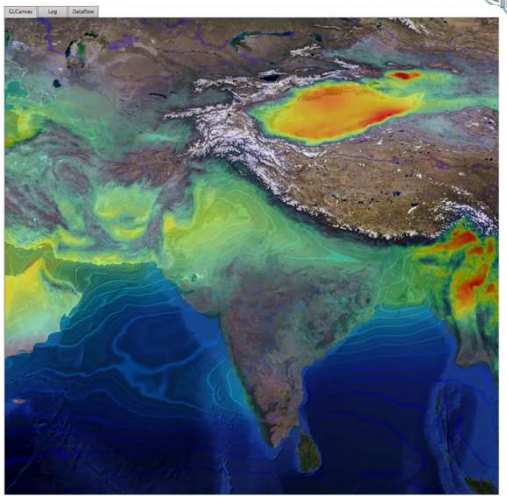
Scalable Deployment: Exploration of 3.5TB of Weather/Climate Data in Real Time

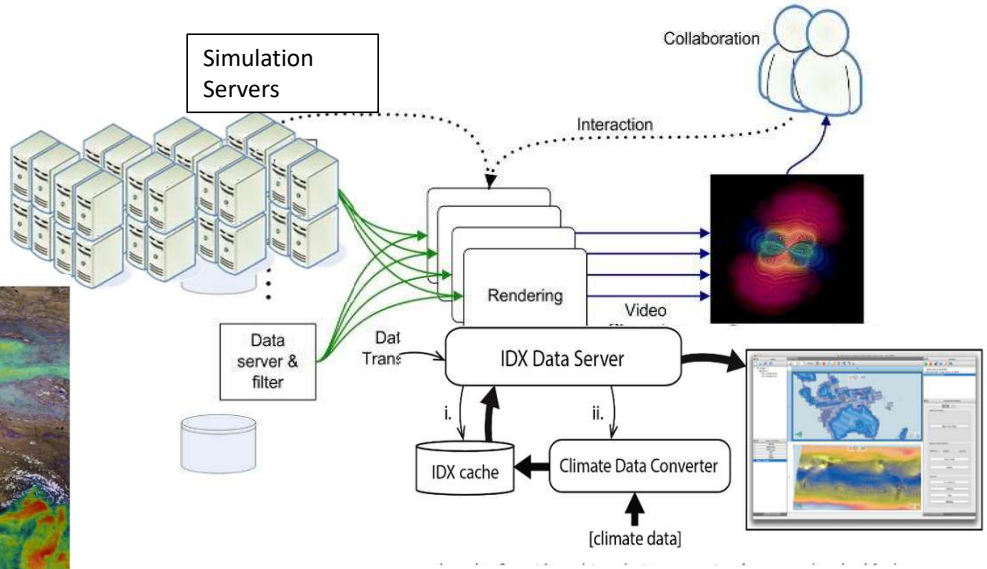
Workflow

- *Data creation*
- *Data Management*
  - Processing
  - Analysis
  - Visualization



- 7km GEOS-5 “Nature Run”
- 1 dataset, 3.5 PB
- theoretically: openly accessible
- practically: precomputed pics

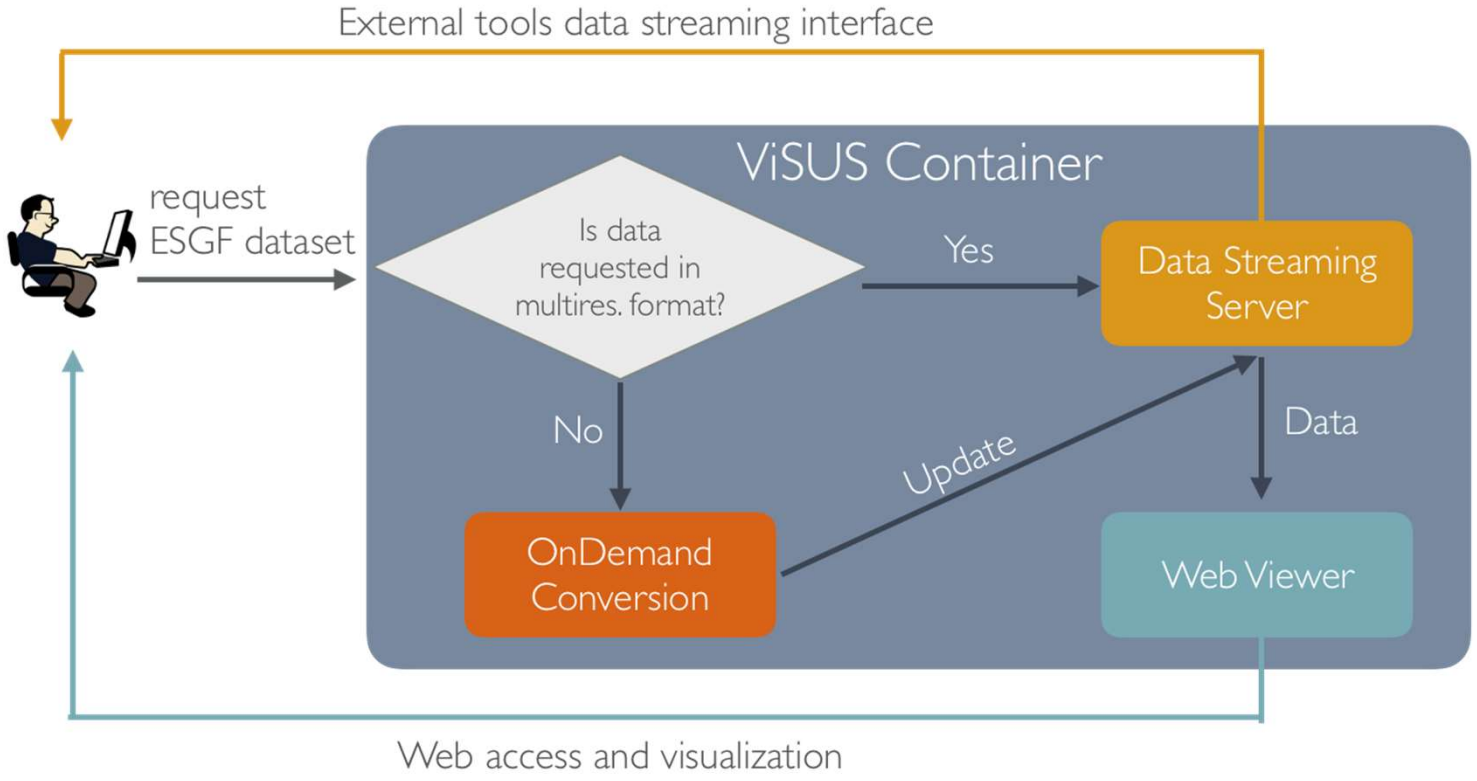




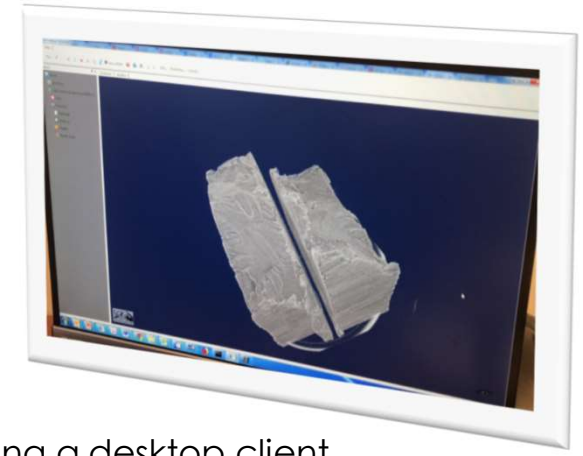
Distributed Resources

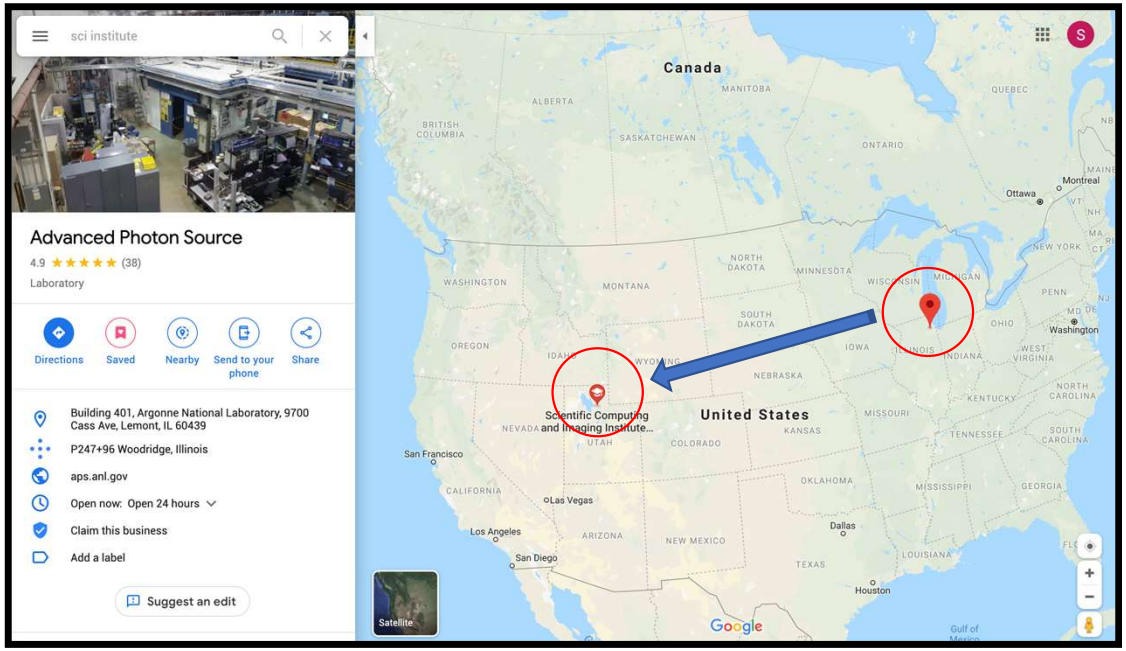
- 3.5 PB of *data store in NASA*
- *Primary ViSUS server in LLNL*
- *Secondary ViSUS server in Utah*
- *Clients connect remotely*
- *Work without additional HPC resources*

Containerized on-demand conversion and streaming service (for ESGF data)



High Performance Data Movements for Real-Time Access to Large Scale Experimental Data (Dockerized server)

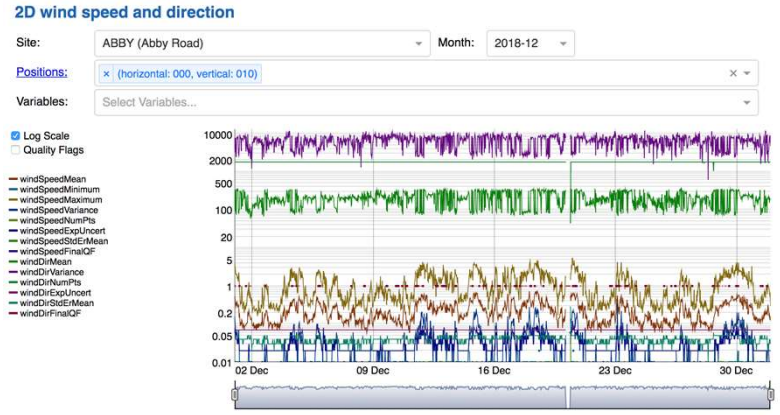




- Using a desktop client (or a webviewer)
  Prof. Ashley Spears was able to see the data being acquired at APS from her office at UoU
- Webviewer Demo:
  Aluminum Foam of similar size

NEON AOP data access

- NEON has a large amount of data that is shared with the community through their **data portal**
- There exist **APIs** to download those data in bulk
  (per site, per year, per data product, now also by area)
- For some data, such as sensor measurements, the portal provides an **interactive** navigation system
- For others, like **Airborne Observation Platforms data**, there is a long list of image files…
- There is a need to present all AOP data interactively, where the users can preview, navigate, and select/access/download the data they need



AOP data

CiCOE data access/visualization/management efforts

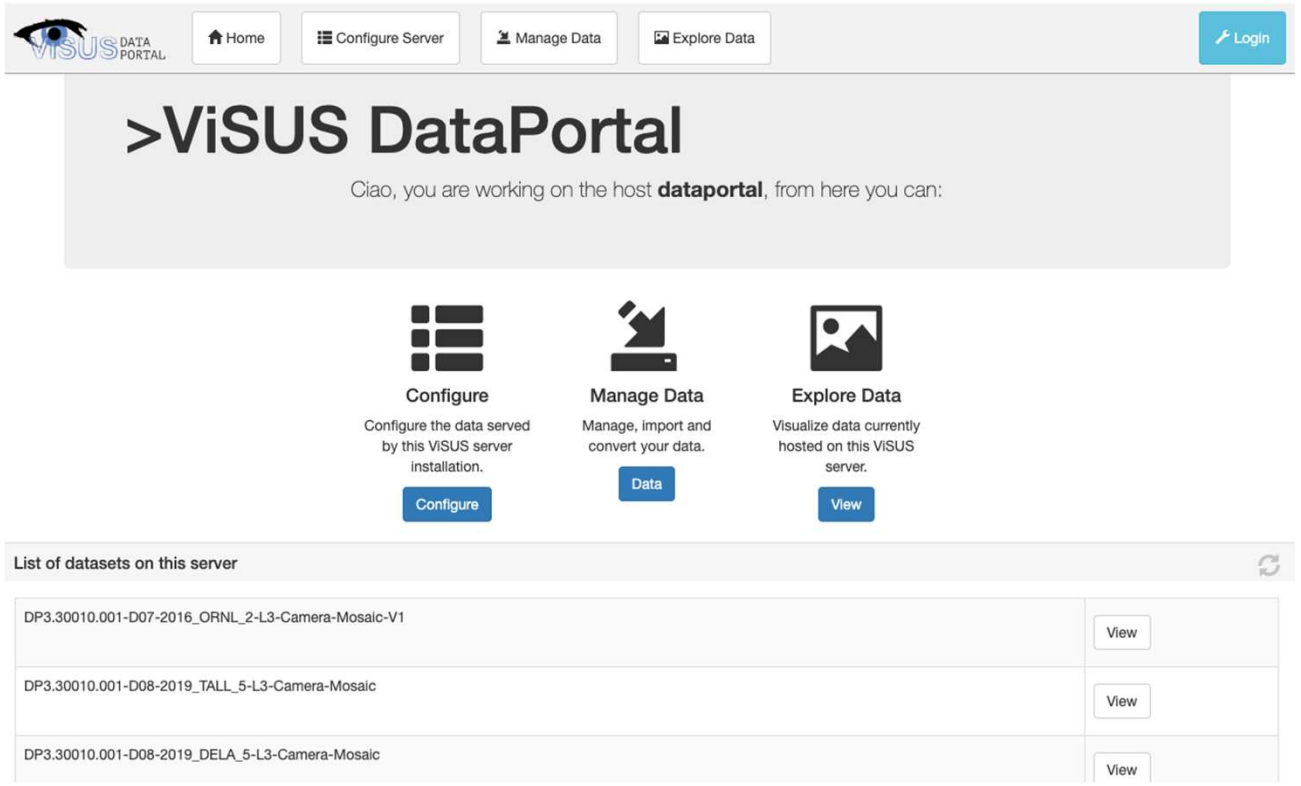
- AOP data ingestion and publication
- Multiresolution streaming data access (via javascript, python, C++)
- Experimented with time series and hyperspectral data
- Experimented with mixed tile sources (Google Earth+AOP data)
- NEON endpoint for data discovery and viewer embedding
- Deployment experiments on CloudLab

Data ingestion and publication

- R scripts to download AOP dataset (byFileAOP), can we do better?
- Data processing and management:
  - extract the bounding boxes information from GeoTIFF and generate scripts to convert each dataset
  - Query NEON APIs to derive "month" value from file paths
  - Populate Utah endpoint database
  - Update the streaming server with the new datasets to make available

Streaming server/data portal

- Apache module
- Provides streaming access to data hosted locally or remotely
- Available within a Docker container or standalone installation
- Web UI to manage and ingest new datasets

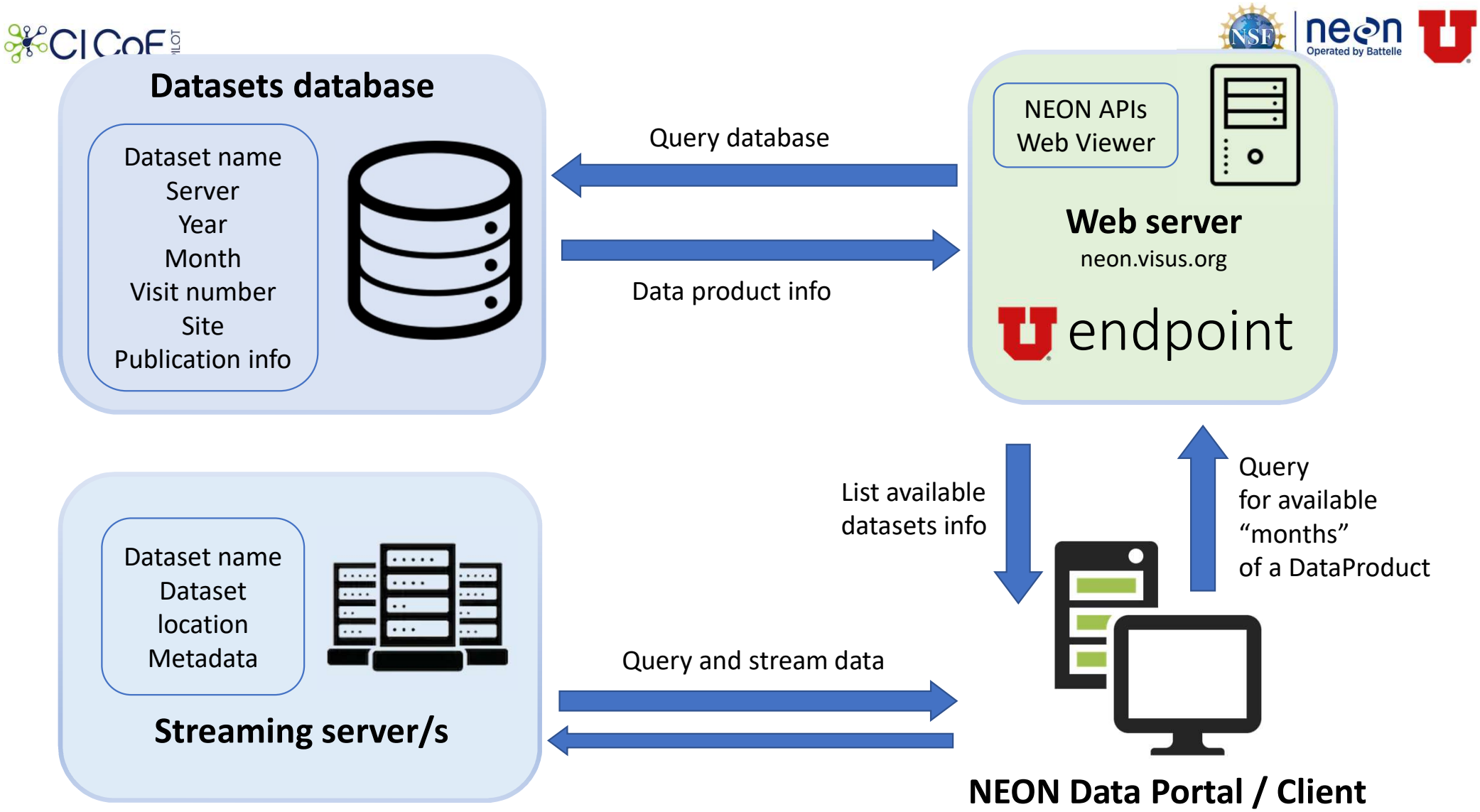


Utah NEON APIs endpoint

- Handles requests to /neonapi/products/{productCode}
- Follows NEON APIs syntax
- Provide configuration strings to access a specific dataset
- Datasets could be relocated to other streaming servers transparently


```
// https://neon.visus.org/neonapi/products.php/DP3.30010.001

{
  "data": {
    "productCode": "DP3.30010.001",
    "siteCodes": [
      {
        "siteCode": "ABBY",
        "availableMonths": [
          "2018-07",
          "2017-06"
        ],
        "availableDataUrls": [
          "server=https%3A%2F%2Fdataportal.sci.utah.edu%2Fmod_visus%3F&dataset=DP3.30010.001-D16-2018_ABBY_2-L3-Camera-Mosaic-V01",
          "server=https%3A%2F%2Fdataportal.sci.utah.edu%2Fmod_visus%3F&dataset=DP3.30010.001-D16-2017_ABBY_1-L3-Camera-Mosaic-V01"
        ]
      },
      {
        "siteCode": "ARIK",
        "availableMonths": [
          "2017-05"
        ],
        "availableDataUrls": [
          "server=https%3A%2F%2Fdataportal.sci.utah.edu%2Fmod_visus%3F&dataset=DP3.30010.001-D10-2017_ARIK_1-L3-Camera-Mosaic-V01"
        ]
      },
```


Datasets database
Dataset name
Server
Year
Month
Visit number
Site
Publication info
Query database
Data product info
NEON APIs
Web Viewer
Web server
neon.visus.org
endpoint
List available
datasets info
Query
for available
“months”
of a DataProduct
Dataset name
Dataset
location
Metadata
Streaming server/s
Query and stream data
NEON Data Portal / Client

First integration

- Component embedded as an iframe
- Datasets and time navigation
- The parent window pass the dataset settings (retrieved from the endpoint) to the iframe (GET) which provides the rest of the functionalities

NEON integration (live)

[Basic RGB]

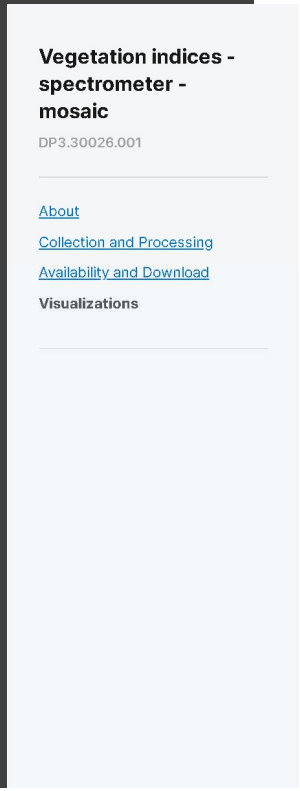
[Vegetation indices (hyperspectral)]

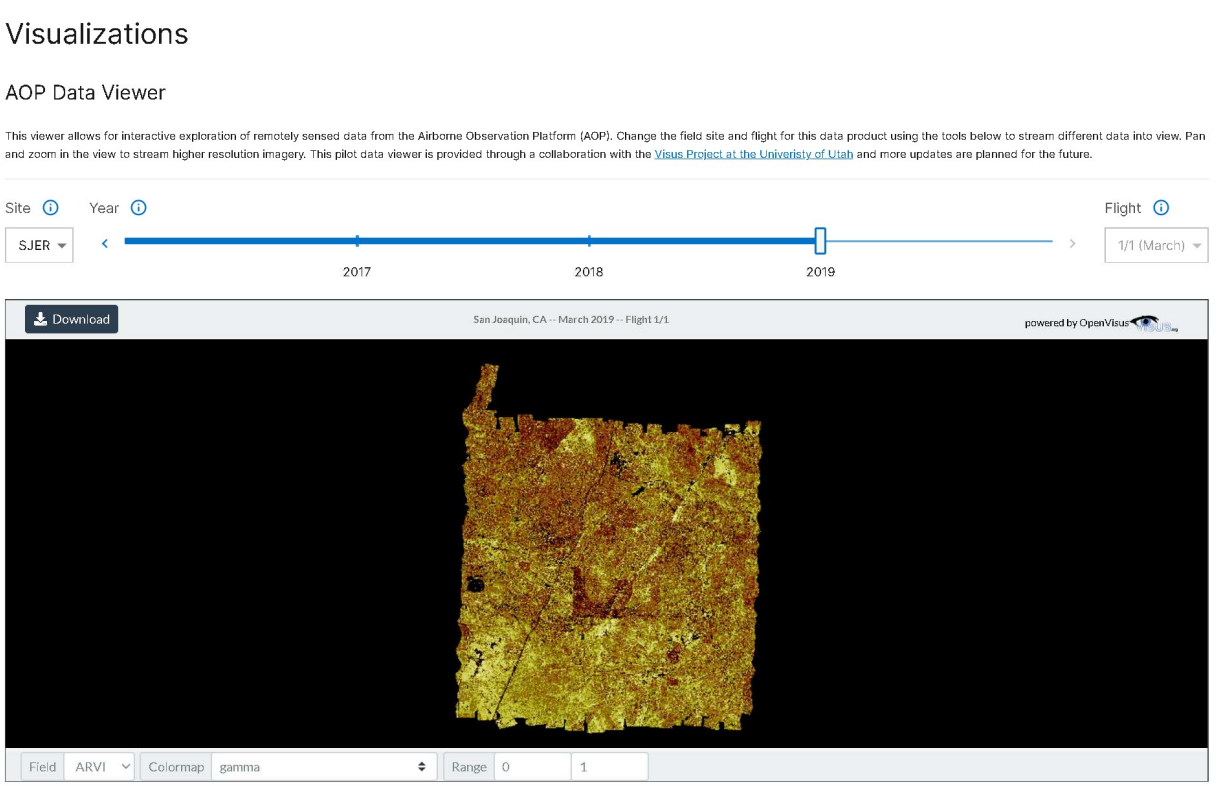
University of Florida deep learning tree classification (live):

[This is a link to the viewer with the trees]

[Detailed view]

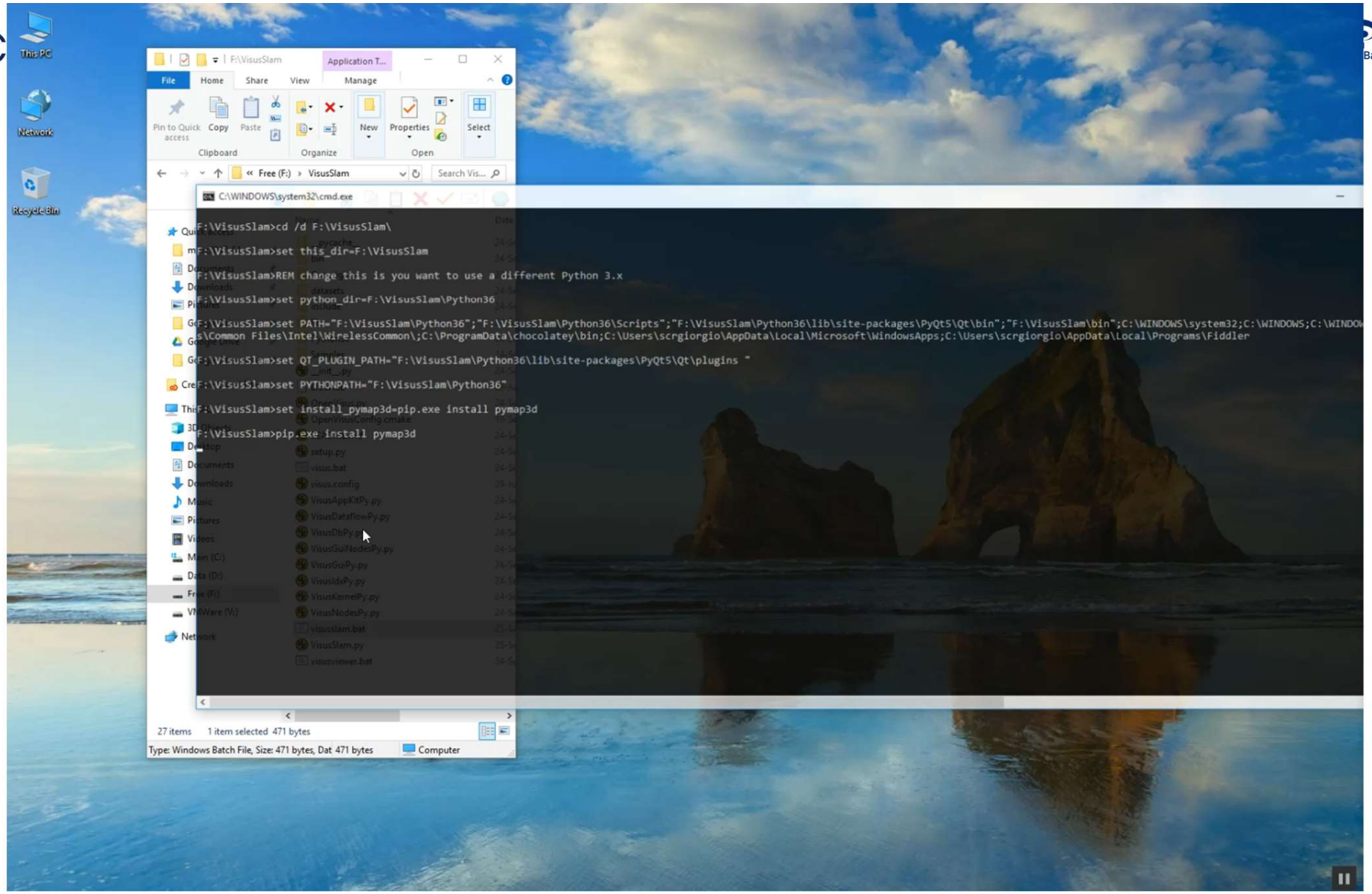
[Link to their main project]



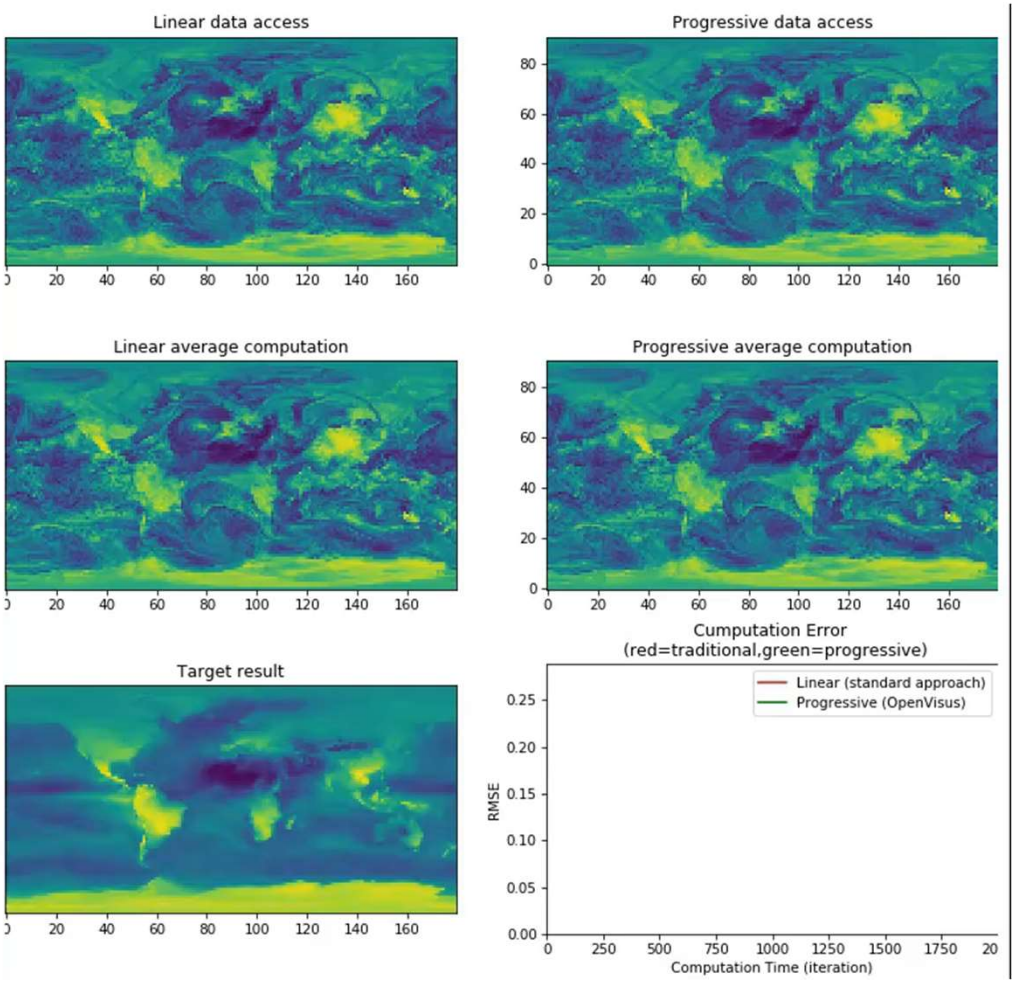


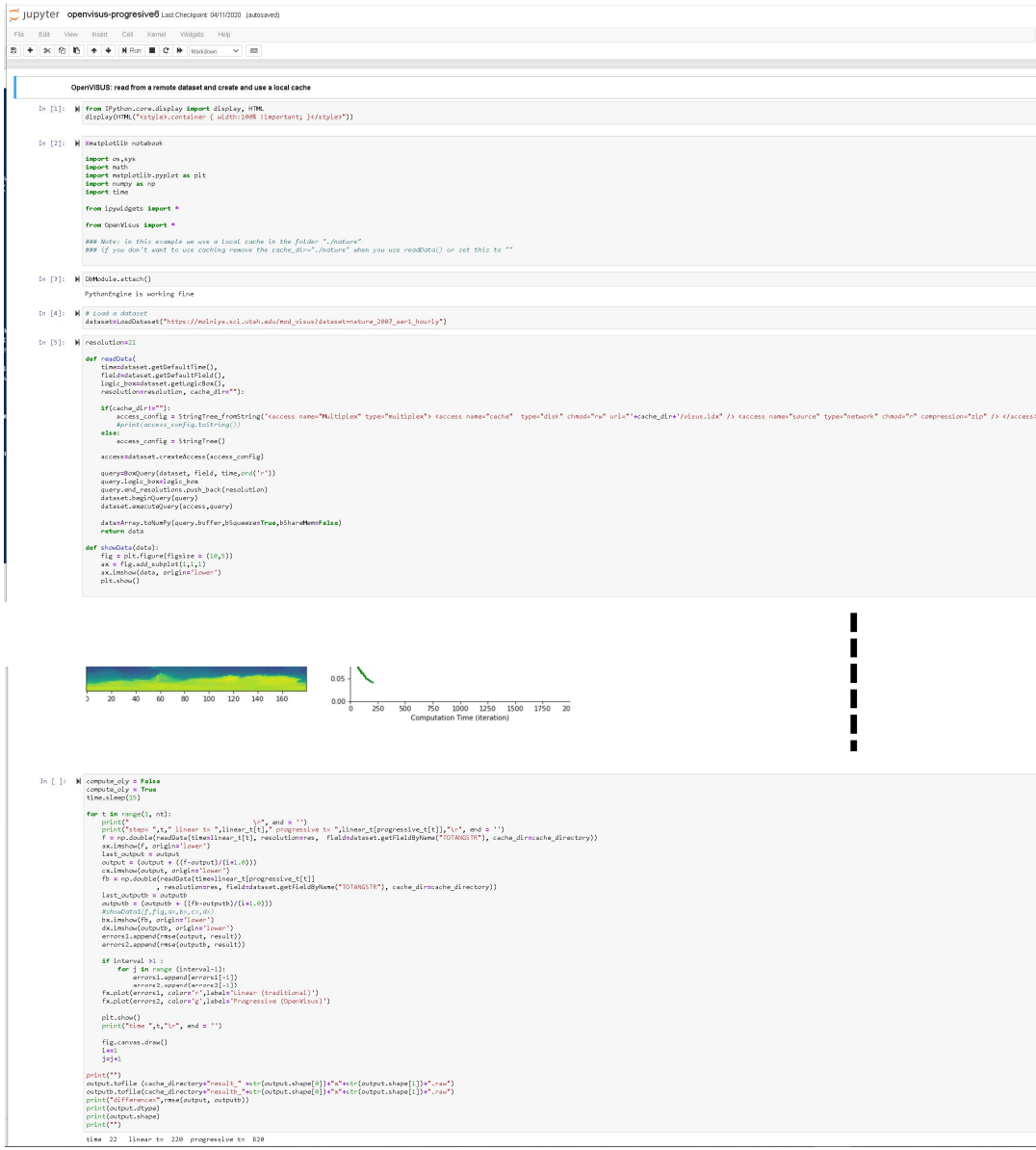
Interoperability

- Explored solutions to integrate in the same visualization multiple “tile” sources
- Proof of concept of use AOP data and Google Earth
- New version of data format and server will allow to visualize AOP data in their geographical context


This PC
Network
Recycle Bin
F:\VisusSlam
Application T...
File
Home
Share
View
Manage
Pin to Quick access
Copy
Paste
Clipboard
Organize
New
Properties
Open
Select
« Free (F:) › VisusSlam
Search Vis...
C:\WINDOWS\system32\cmd.exe
F:\VisusSlam>cd /d F:\VisusSlam\
F:\VisusSlam>set this_dir=F:\VisusSlam
F:\VisusSlam>REM change this is you want to use a different Python 3.x
F:\VisusSlam>set python_dir=F:\VisusSlam\Python36
F:\VisusSlam>set PATH="F:\VisusSlam\Python36";"F:\VisusSlam\Python36\Scripts";"F:\VisusSlam\Python36\lib\site-packages\PyQt5\Qt\bin";"F:\VisusSlam\bin";C:\WINDOWS\system32;C:\WINDOWS;C:\WINDOWS\System32\Wbem;C:\WINDOWS\System32\WindowsPowerShell\v1.0\;C:\Program Files\Intel\WiFi\bin\;C:\Program Files\Common Files\Intel\WirelessCommon\;C:\ProgramData\chocolatey\bin;C:\Users\scrgiorgio\AppData\Local\Microsoft\WindowsApps;C:\Users\scrgiorgio\AppData\Local\Programs\Fiddler
F:\VisusSlam>set QT_PLUGIN_PATH="F:\VisusSlam\Python36\lib\site-packages\PyQt5\Qt\plugins "
F:\VisusSlam>set PYTHONPATH="F:\VisusSlam\Python36"
F:\VisusSlam>set install_pymap3d=pip.exe install pymap3d
F:\VisusSlam>pip.exe install pymap3d
27 items
1 item selected 471 bytes
Type: Windows Batch File, Size: 471 bytes, Dat 471 bytes
Computer

Progressive vs Linear Computation of Time Averages for Climate Simulations

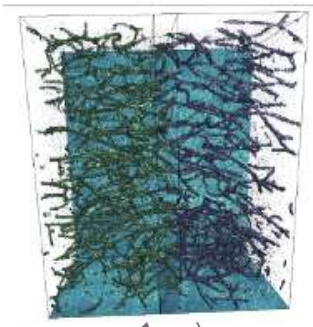




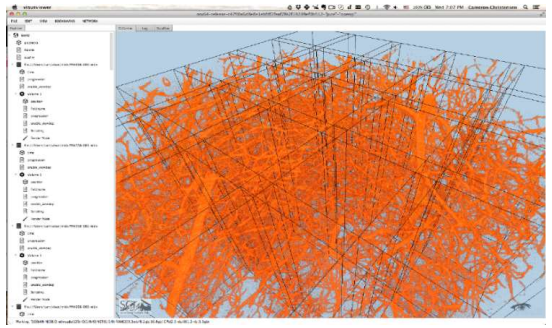
Integrated Data Acquisition, Management and Computation for Neuroscience

(1) Data Source

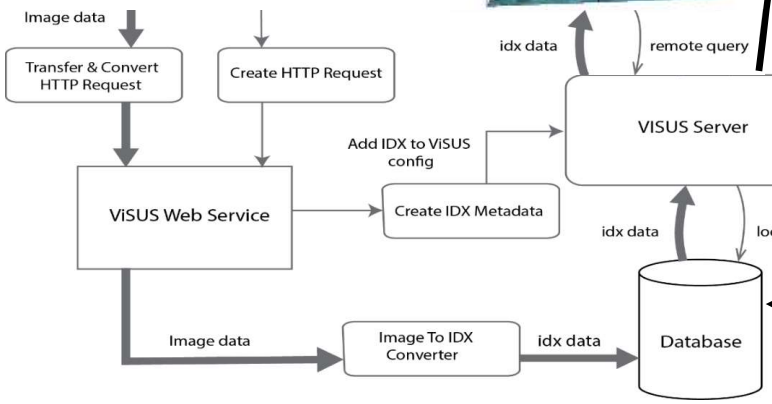
(2) Preliminary Interactive Analytics



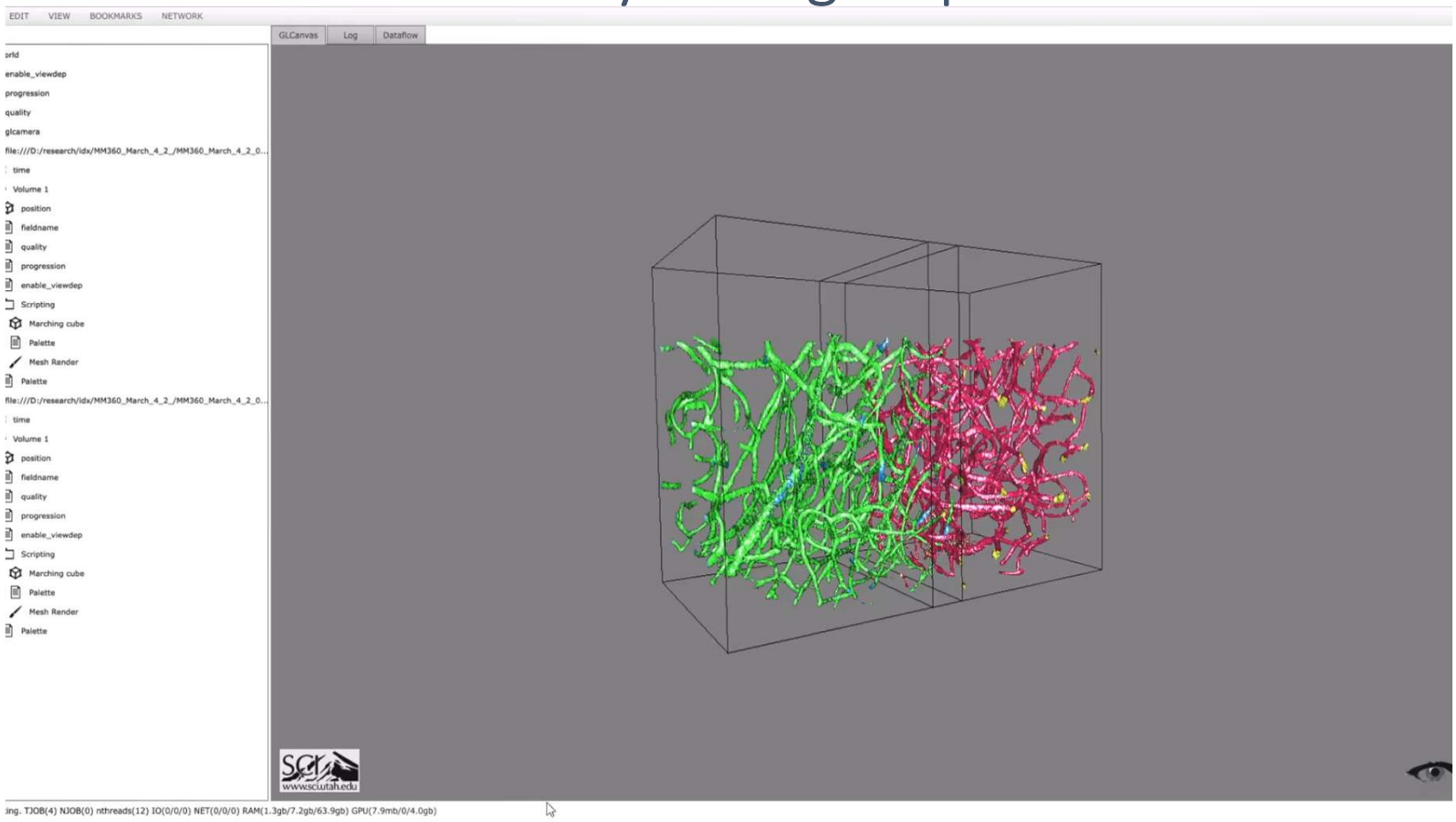
(4) Interactive, Exploratory Assessment and Feedback



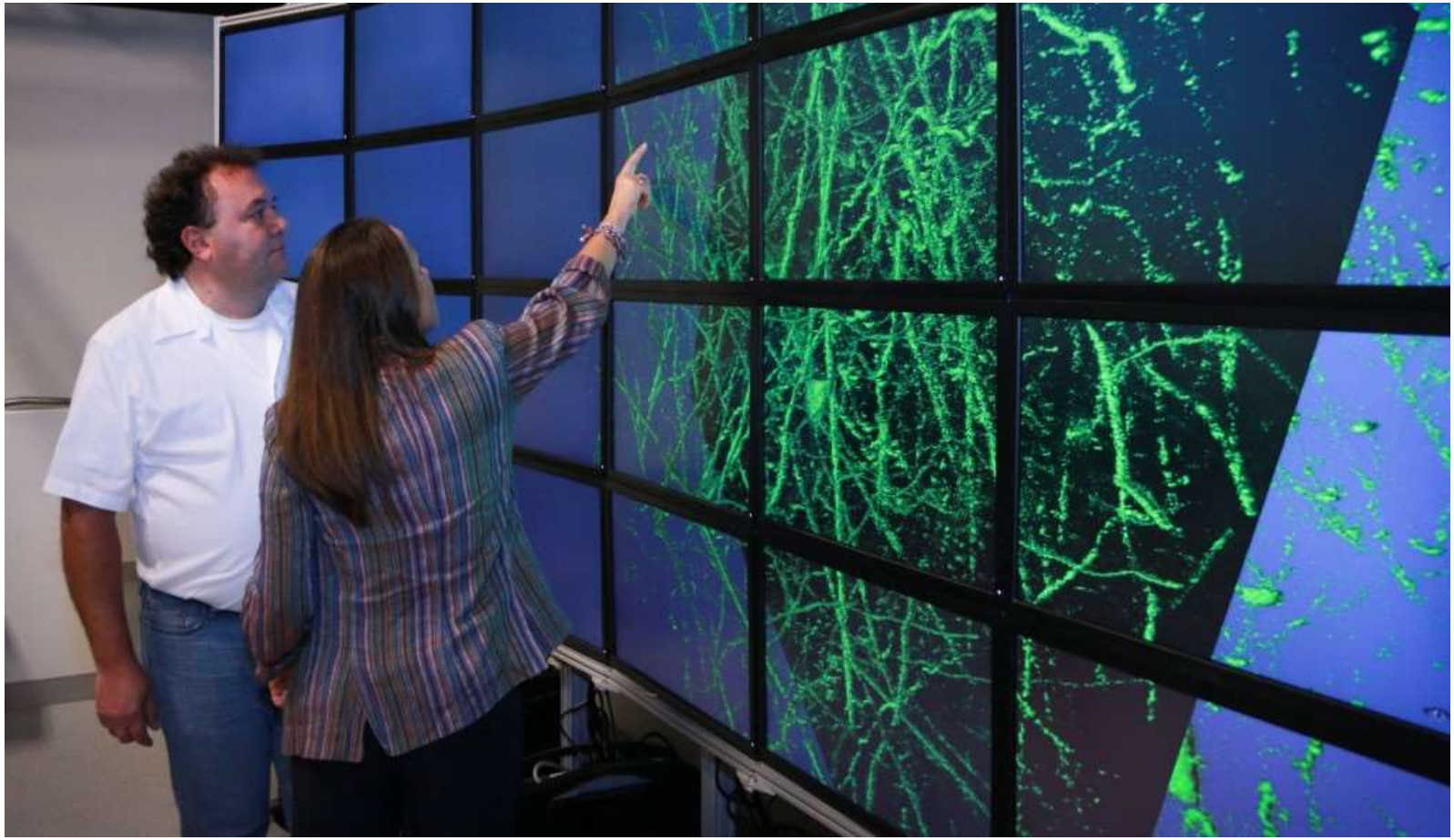
(3) Asynchronous Parallel Processing



Remote Monitoring of Data Quality During Acquisition



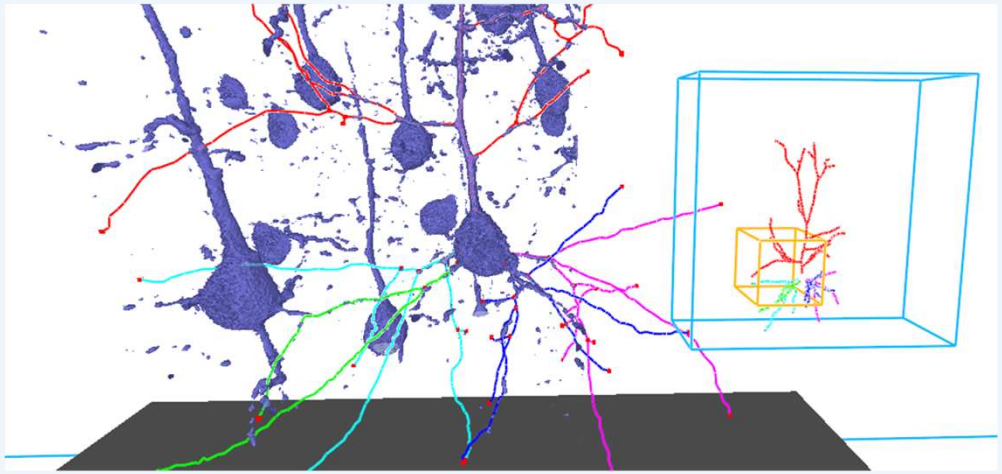
Online Acquisition and Interactive Visualization of Terascale Microscopy



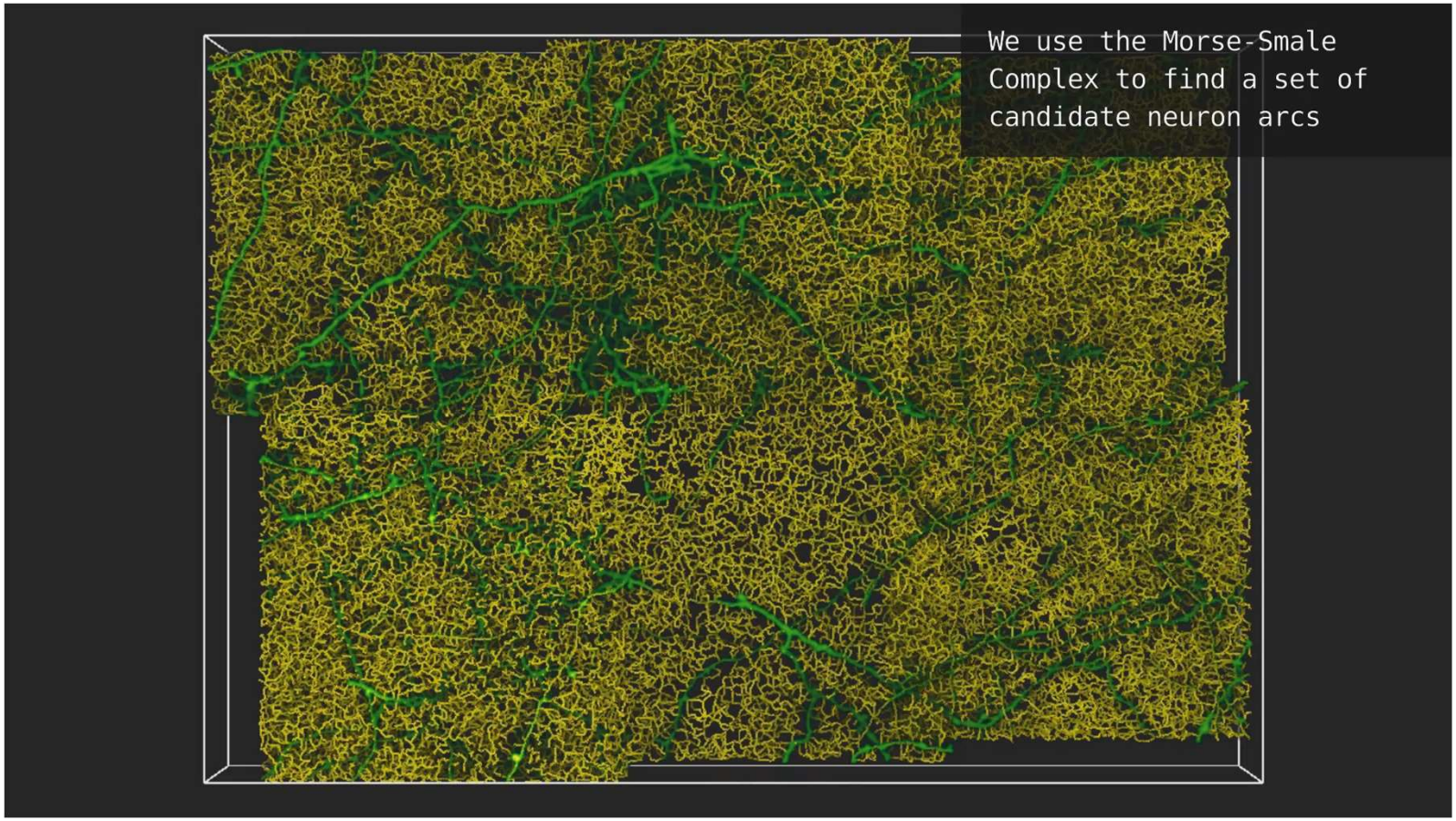
A Virtual Reality Visualization Tool for Neuron Tracing (VRNT)

Conducted a design study with neuroanatomists at the Moran Eye Center to develop a new tool for manual neuron tracing in VR

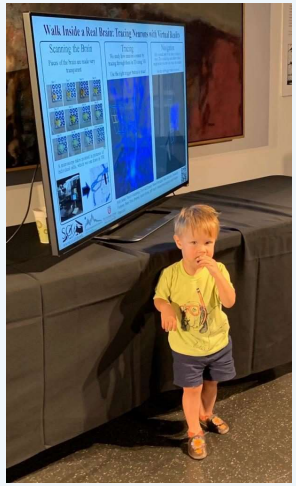
Tracing works similar to tilt brush, faster and more intuitive than desktop software

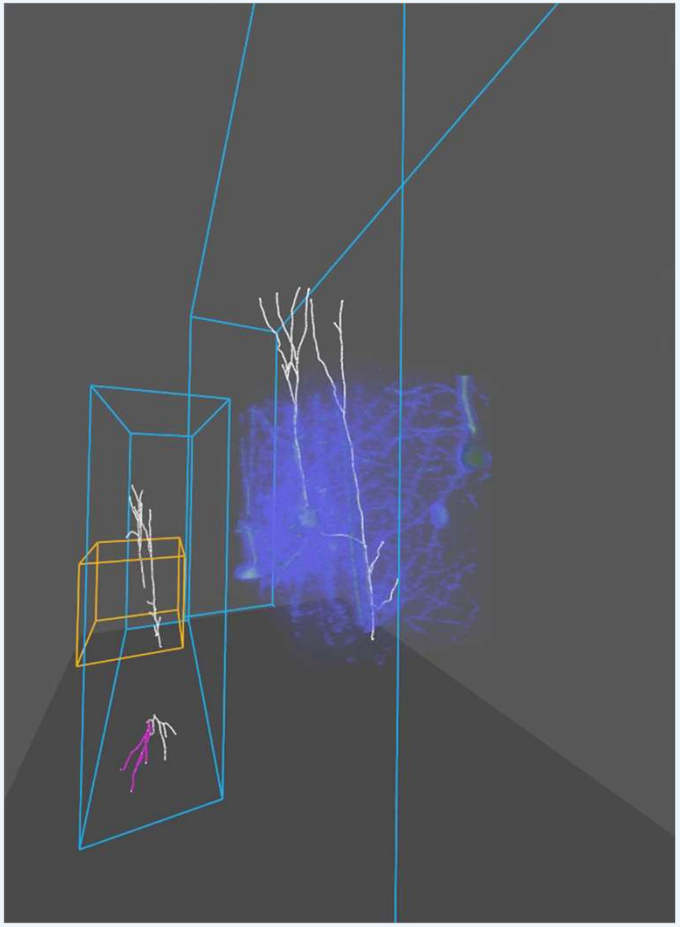


Topology Aided Neuron Tracing in a Virtual Environment

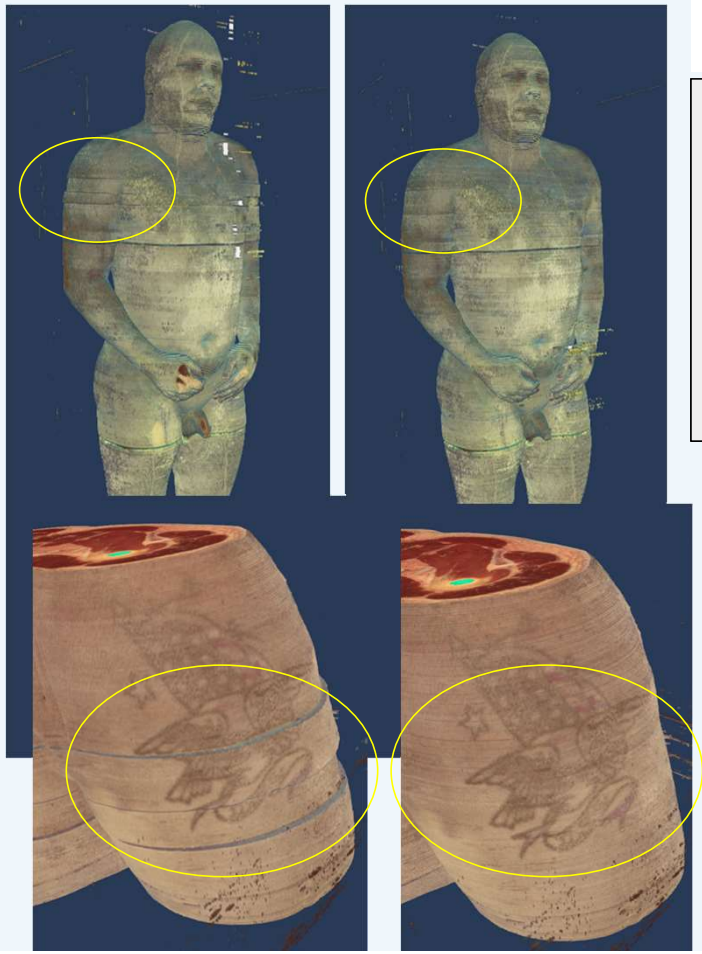


Evaluation in a neuroscience lab and outreach in a science museum





Python (Jupyter) scripting for local/remote data processing and visualization on demand



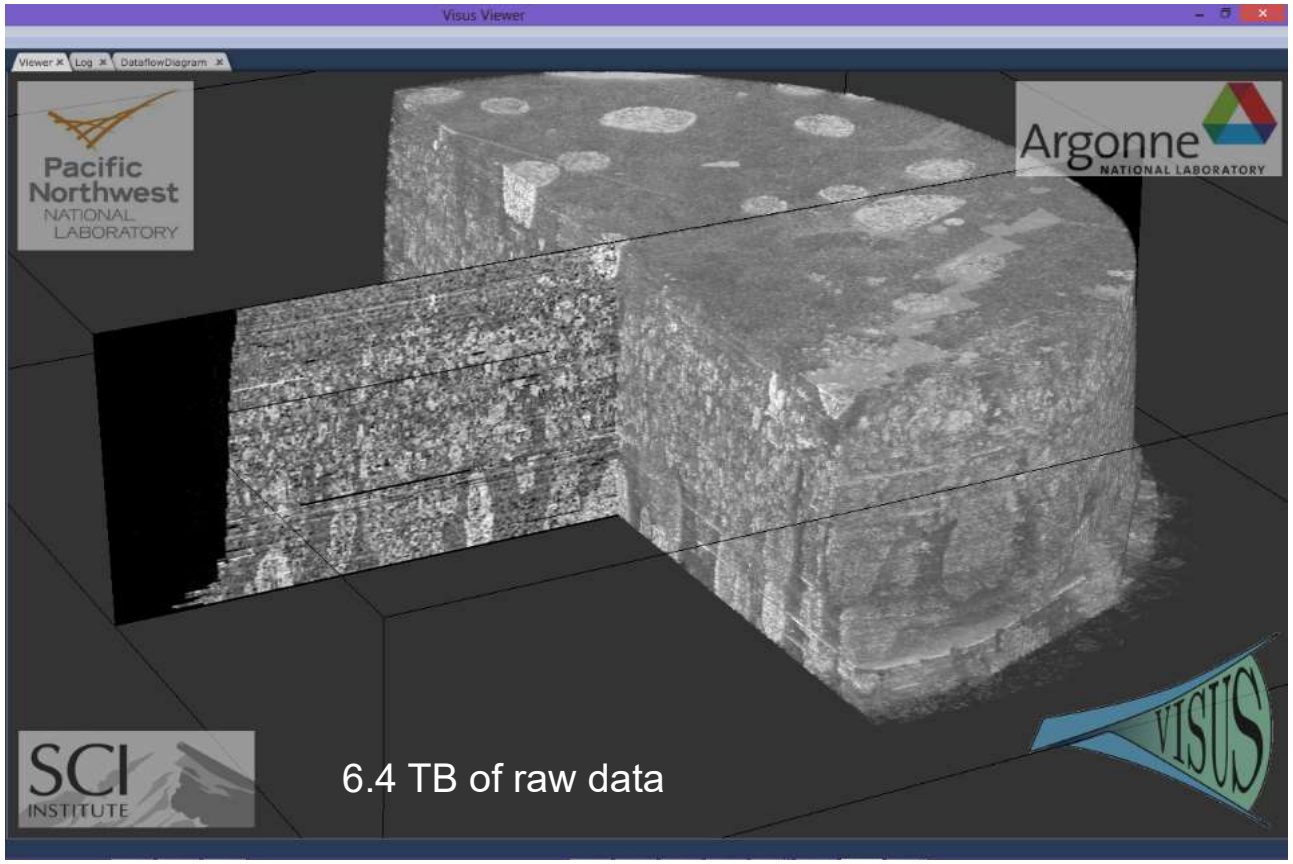
PyDataset and **PyViewer** to simplify data exploration

```
region=(0.04, 0.95, 0.05,0.73,
0.15,0.15+0.1)
dataset=LoadDatasetPy("visus.idx")
RGB, bounds=dataset.readData(region,-6)

...
viewer=PyViewer()
viewer.addVolumeRender(RGBA, bounds)
```

Demo: Interactive Remote Analysis and Visualization of 6TB Imaging Data

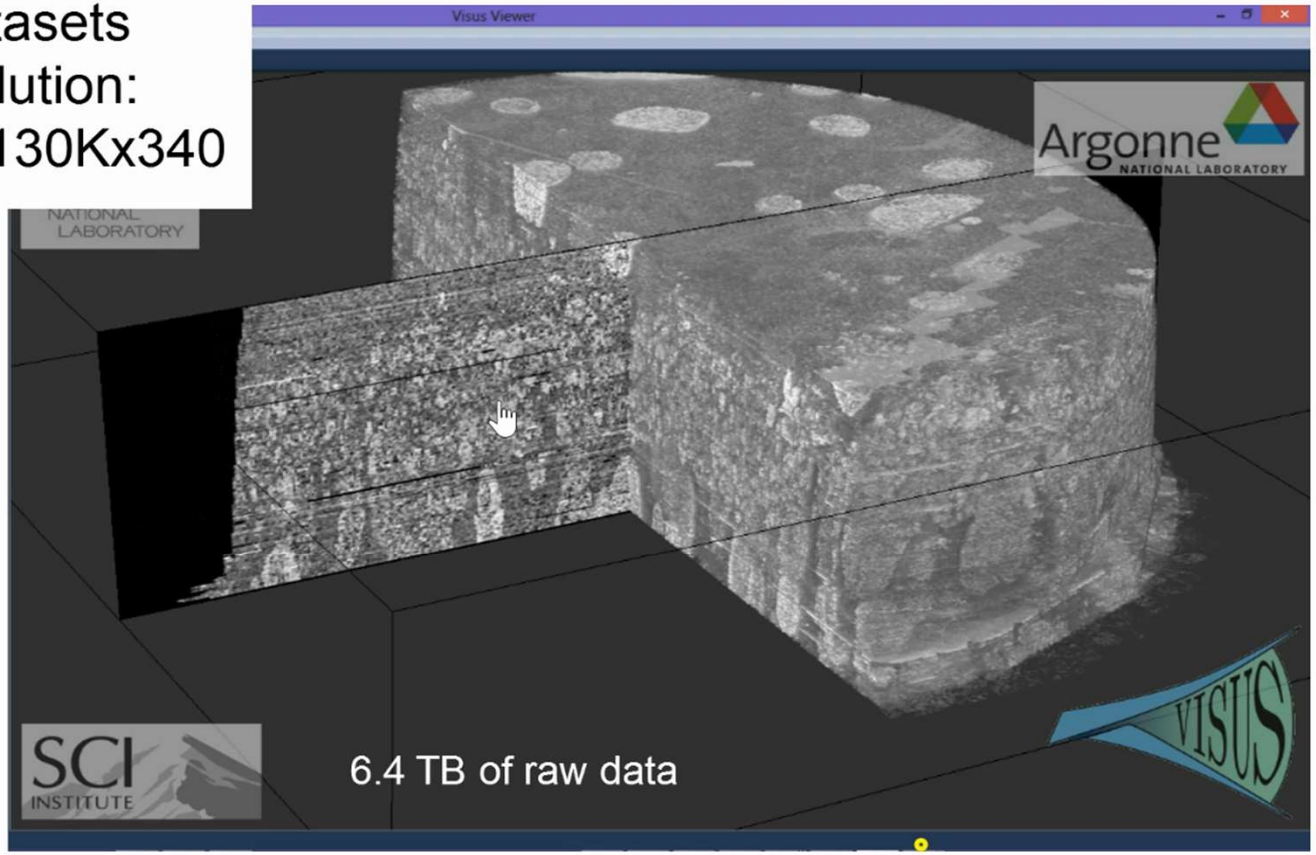
- EM datasets of resolution: 130Kx130Kx340



Web Server

Demo: Interactive Remote Analysis and Visualization of 6TB Imaging Data

- EM datasets of resolution: 130Kx130Kx340



Web Server

Deployment targets and extensions

Live addition to NEON website

- Identify data products
- Complete data ingestion pipeline
- Dedicated data portal
- Management of geospatial coordinate system
- Interoperability with google maps for context
- Implement testing procedures
- Basic enhancements of visualization and navigation
- Improve embedding (e.g., share)

Continuing support and advanced features

- Scaling of and addition of new data products
- Improve color blending of orthomosaics
- Python support (for download and scripting
- Collaborative user interface
- Support for LIDAR data
- Support for user/NEON data upload

References

- Utah endpoint https://neon.visus.org/neonapi/products/{productCode}
- Endpoint and web viewer source code repository https://github.com/sci-visus/neon-visus
- Documentation and other use cases www.visus.org