

# A Unidata JupyterHub Server: An Online PyAOS Resource for Students and Educators

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## Abstract

In recent years, the Python programming language coupled with Jupyter notebooks have become vital tools for atmospheric science educators and their students. Python’s batteries-included philosophy along with an increasingly vast array of scientific libraries make it an excellent choice for explaining scientific concepts. Programming notebooks excel at teaching objectives by allowing expository prose and equations to be interspersed with executable cells of code performing data analysis and visualization. Installing this software, however, can be intimidating, time-consuming and confusing. We describe the deployment of a JupyterHub server on the NSF-funded Jetstream cloud[4, 5] targeted at students and educators. JupyterHub is a multi-user server for Jupyter notebooks. We provide Jupyter notebooks from three Unidata projects: Unidata Python Workshop, Unidata Notebook Gallery, Unidata Online Python Training. These notebooks include pre-built Python environments needed to run them. The notebooks can be used for instruction and as templates for scientific experimentation. This Unidata JupyterHub server will enable students and educators to spend less time managing their software and more time learning and teaching.

<http://science-gateway.unidata.ucar.edu>

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2 JupyterHub

JupyterHub server on Jetstream

JupyterHub is a technology that can be used to serve programmatic, interactive notebooks to a class of students or for scientific researchers. An [experimental JupyterHub server](#) is running on Jetstream containing Unidata Jupyter notebook projects:

- Unidata Python Workshop
- Unidata Notebook Gallery
- Unidata Online Python Training

This JupyterHub server is currently experimental. If you would like to be granted access, please contact: [support@unidata.ucar.edu](mailto:support@unidata.ucar.edu).

3 THREDDS Data Server

TDS installation on Jetstream

The Unidata THREDDS Data server (TDS) is a web server that provides metadata and data access for scientific datasets, using a variety of remote data access protocols. A TDS is available on Jetstream at: <http://thredds-jetstream.unidata.ucar.edu/thredds/catalog.xml> supplying a good portion of the data available on the IDV with a five day archive.

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## JupyterHub with Unidata Notebooks

jupyter miller\_composite Last Checkpoint: 12/08/2017 (autosaved)

File Edit View Insert Cell Kernel Widgets Help

Trusted Python [conda env:notebook-gallery]

Code

```
red_line = lines.Line2D([], [], color='red', label='Best Lifted Index (C)')
dashed_black_line = lines.Line2D([], [], linestyle='dashed', color='k',
                                label='12-hr Surface Pressure Falls (hPa)')
black_line = lines.Line2D([], [], linestyle='solid', color='k',
                           label='12-hr 500-hPa Height Falls (m)')
plt.legend(handles=[jet300, jet500, jet850, dashed_black_line, black_line, red_line,
                    purple, tan, green, yellow], loc=3,
            title='Composite Analysis Valid: {s}'.format(str(vtimes[0])))

plt.show()
```

jupyter Upper Air and the Skew-T Log-P Last Checkpoint: 33 minutes ago (autosaved)

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Trusted Python [default]

Markdown

### Upper Air and the Skew-T Log-P

Unidata Python Workshop

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**Overview:**

- Teaching: 30 minutes
- Exercises: 60 minutes

**Questions**

- Where can upper air data be found and what format is it in?
- How can I obtain upper air data programmatically?
- How can MetPy be used to make a Skew-T Log-P diagram?
- What calculations can be performed on the data?

**Objectives**

- Obtain upper air data
- Make a simple plot
- Make a Skew-T
- Calculate LCL, LFC, EL
- Parcel Path
- Calculate CAPE and CIN
- Other parameters
- Adding fiducial lines and shading
- Plotting a hodograph

## Methods

- Cloud Technologies: Jetstream, OpenStack, Linux VMs, Docker
- Unidata Python APIs: netCDF4-python, MetPy, Siphon

## Conclusions

Deploying a multi-user JupyterHub server on the Jetstream cloud with pre-configured Unidata notebooks has many benefits. Cloud computing environments are fast, reliable and scalable. Students and educators analyze, and visualize data using only browser-based Jupyter notebook and JupyterHub technology. No local specialized desktop software or fast Internet connection are required. Future work will explore cloud elasticity, in a classroom setting for example, where students may be running many Jupyter notebooks at once. This effort is part of Unidata’s broader cloud-based science gateway project[2, 1] aimed at Unidata’s investigation of cloud computing[3].

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