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

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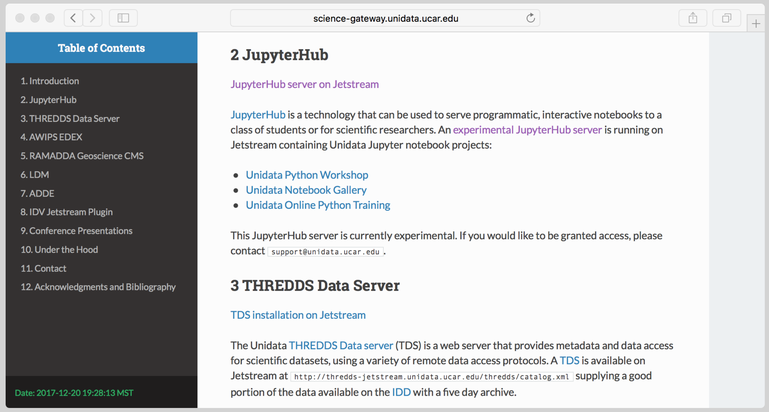
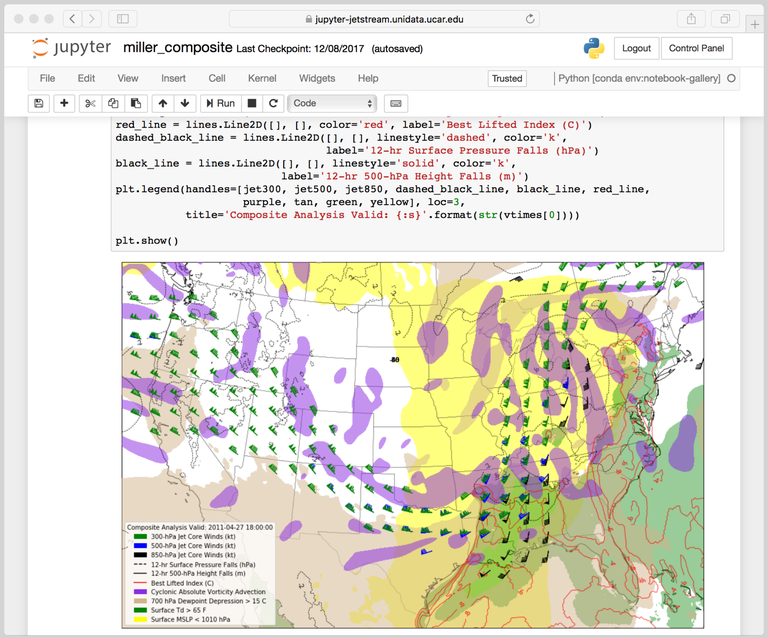
Abstract

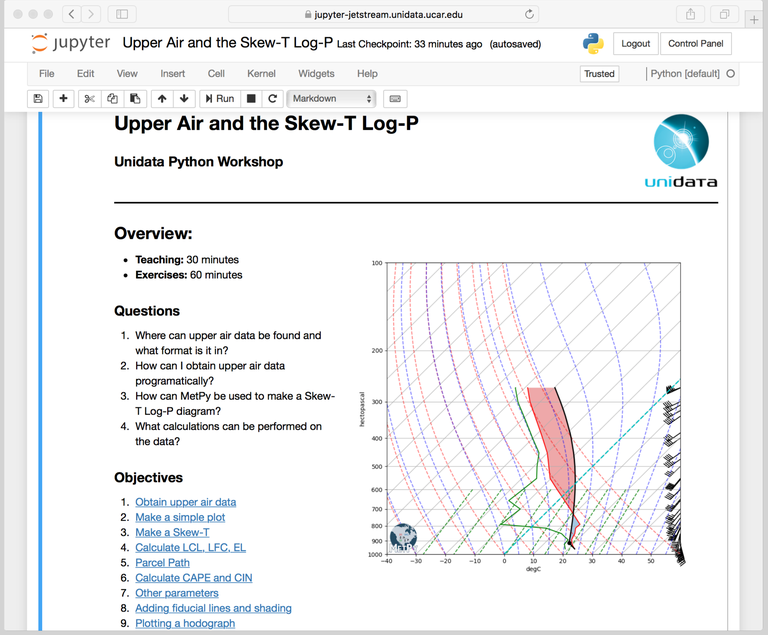
In recent years, the Python programming language coupled with Jupyter notebooks have become vital tools for atmospheric science educators and their students. Python's batteries-included philosophy along with an increasingly vast array of scientific libraries make it an excellent choice for explaining 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



JupyterHub with Unidata Notebooks





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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References

[1] J. Chastang and R. Signell. "Met/Ocean Modeling Workflows on XSEDE via HPC & Cloud". In: See also http://science-gateway.unidata.ucar.edu. Earth Science Information Partners. Bloomington, IN USA, 2017. DOI: 10.6084/m9.figshare.5249845.v1. URL: https://doi.org/10.6084/m9.figshare.5249845.v1.

[2] Chastang J. and M. K. Ramamurthy. "Unidata Science Gateway on the XSEDE Jetstream Cloud". In: *Gateways 2017*. See also http://science-gateway.unidata.ucar.edu. Ann Arbor, Michigan, USA, 2017.

[3] M. K. Ramamurthy. *Unidata 2018: Transforming Geoscience through Innovative Data Services*. Tech. rep. 3300 Mitchell Ln, Boulder, CO 80301 USA: Unidata Program Center, UCAR Community Programs, University Corporation for Atmospheric Research, 2013. URL: https://www.unidata.ucar.edu/publications/Unidata_2018.pdf.

[4] Craig A. Stewart et al. "Jetstream: A Self-provisioned, Scalable Science and Engineering Cloud Environment". In: *Proceedings of the 2015 XSEDE Conference: Scientific Advancements Enabled by Enhanced Cyberinfrastructure*. XSEDE '15. St. Louis, Missouri, USA: ACM, 2015, 29:1–29:8. ISBN: 978-1-4503-3720-5. DOI: 10.1145/2792745.2792774. URL: http://doi.acm.org/10.1145/2792745.2792774.

[5] John Towns et al. "XSEDE: Accelerating Scientific Discovery". In: *Computing in Science & Engineering* 16.5 (2014), pp. 62–74. ISSN: 1521-9615. DOI: 10.1109/MCSE.2014.80.

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