GeoData: High Performance Python for Geoscience

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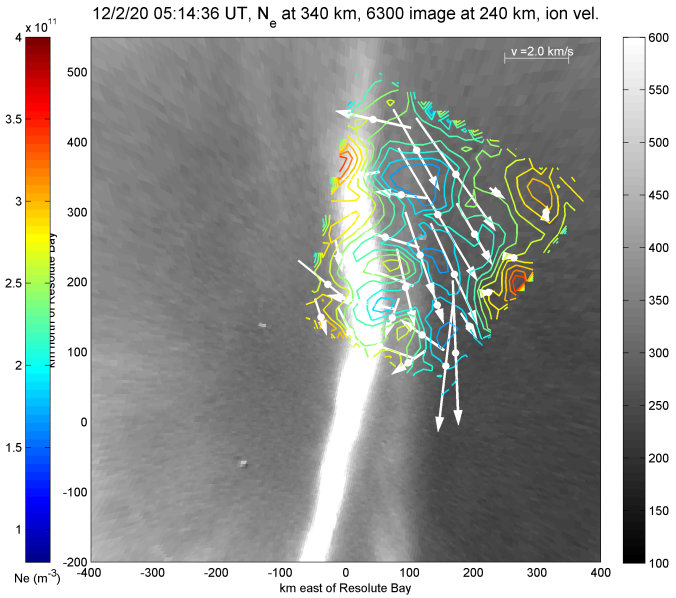
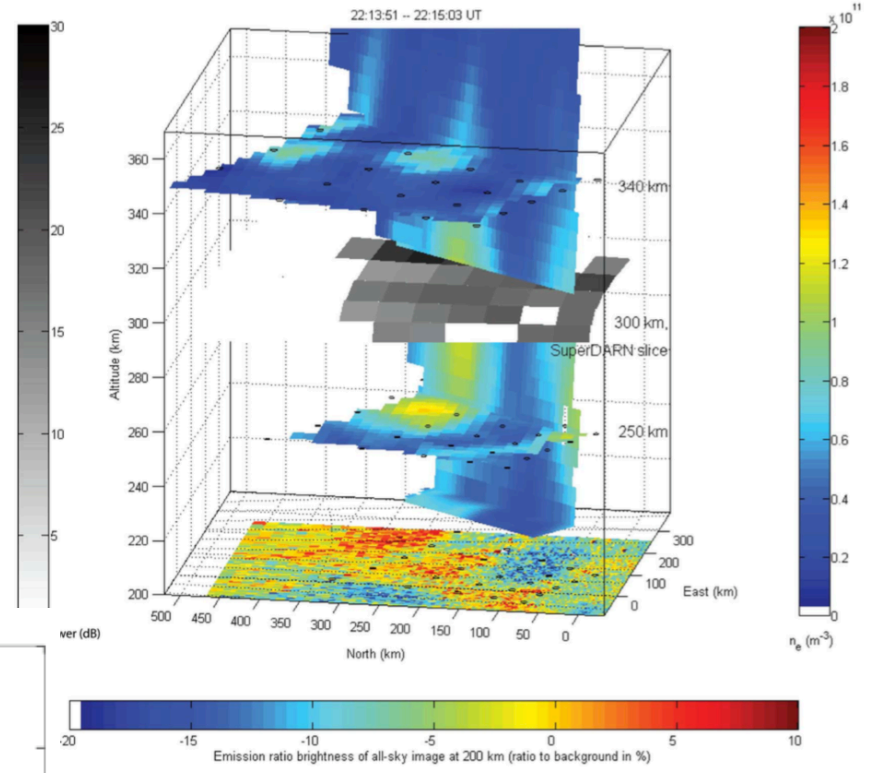
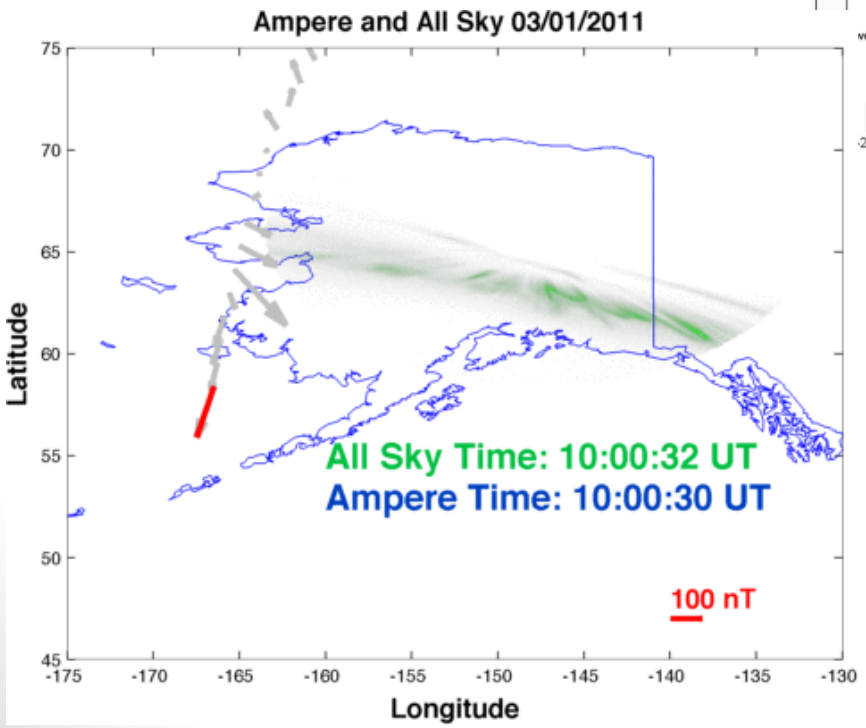


Dahlgren



Dahlgren 2012



Usual Procedure

- Read in the data
  - Different sensors
  - Same data, different sources
- Register the data in time and space
  - Different coordinate systems
  - Different time systems
- Map data into a common coordinate system
  - Different interpolation/projection methods
- Plotting
  - Everything is just screwed up by then

Can We Do Better?

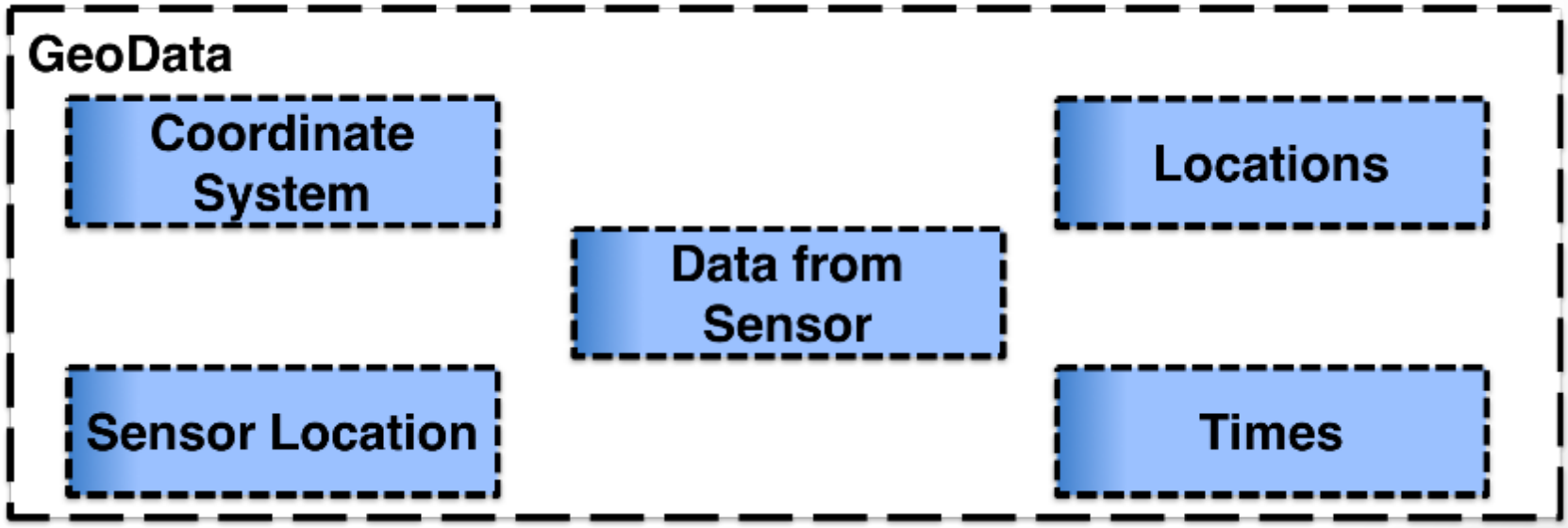
- Reuse code more effectively and reduce OTR
  - Save Time!
  - Save Money!
- Need to be able to use multiple sensors
- Must be able to incorporate new sensors as data becomes available
- Plotting in multiple spatial dimensions

GeoData

- API for using sensor data
  - Reading
  - Registration in time and space
  - Interpolation
  - Plotting
    - Matplotlib for 1 and 2D
    - Mayavi for 3D
- Standard format for data
  - Also have methods to save out data
- New sensors/data can be used once data is in format

GeoData

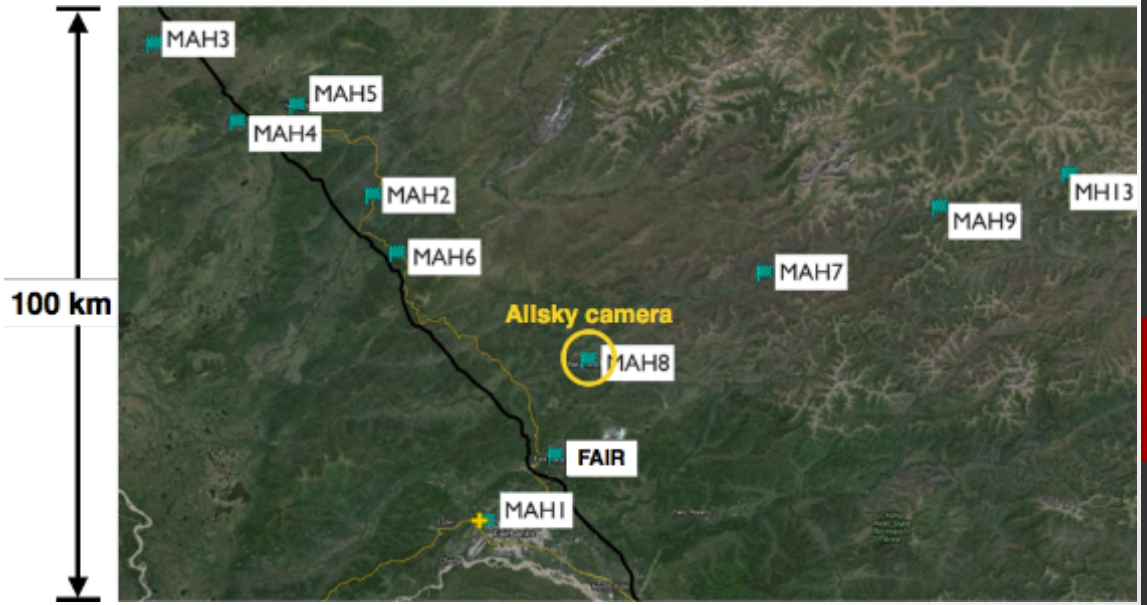
- GeoData class abstracts a data set into an object
  - The data, location, times, coordinate systems are all attributes of this object



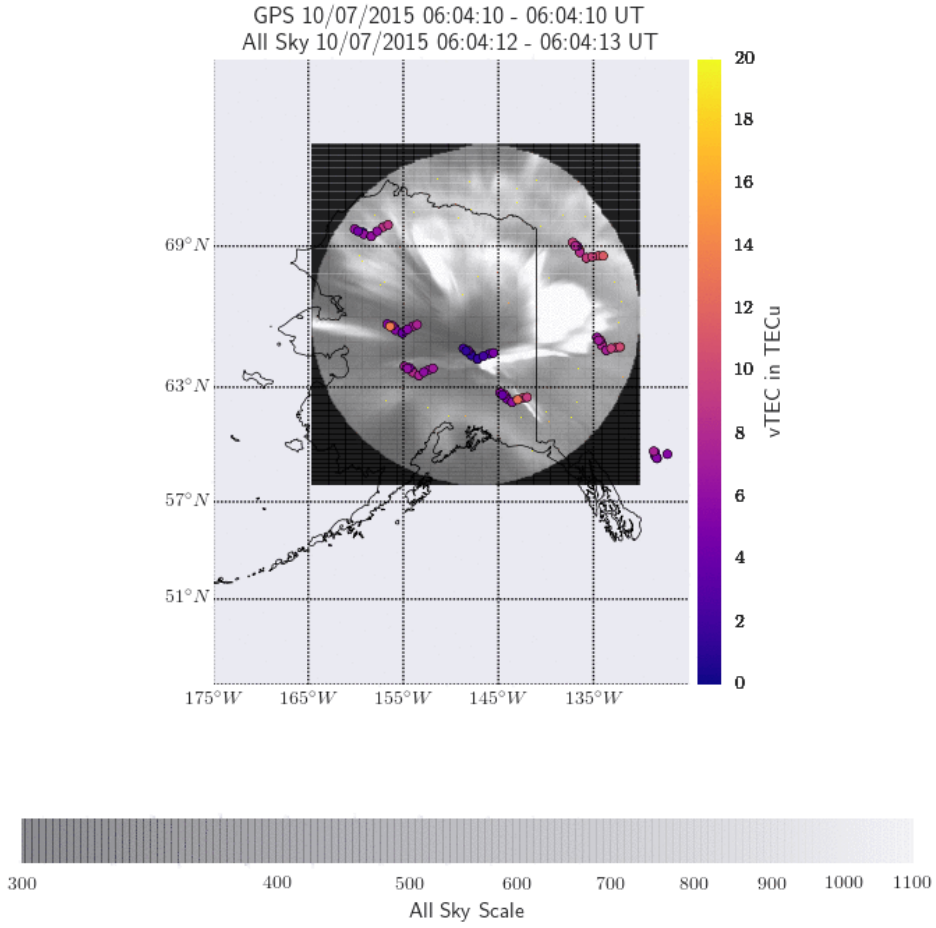
Mahali

- Funded research project to test the utility of a dense network of GPS receivers
  - Use GPS Total Electron Content (TEC) measurements

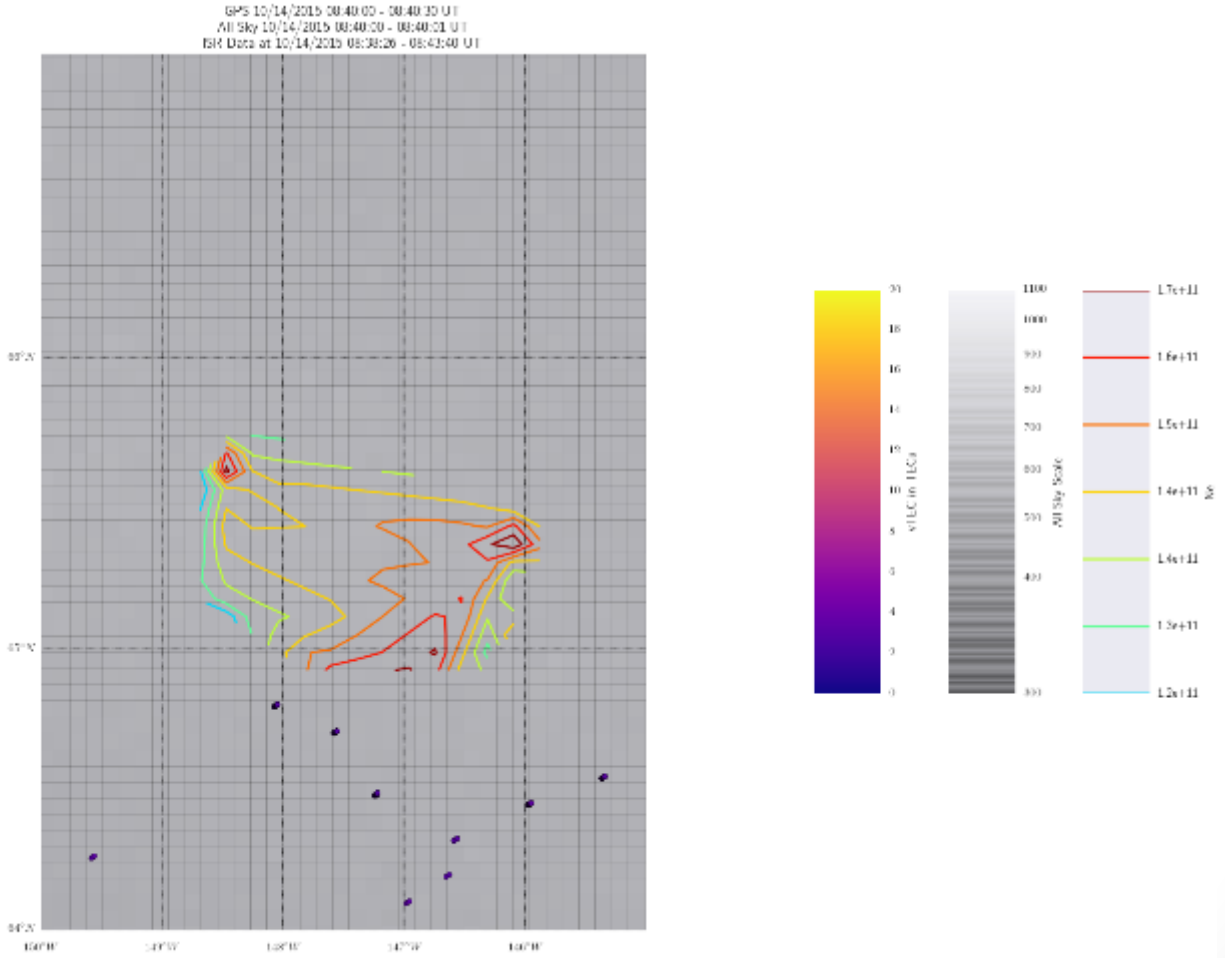
- Fuse different different data sets together
  - GPS
  - Optical, Allsky
  - ISR



Mahali


GPS 10/07/2015 06:04:10 - 06:04:10 UT
All Sky 10/07/2015 06:04:12 - 06:04:13 UT
69°N
63°N
57°N
51°N
175°W
165°W
155°W
145°W
135°W
20
18
16
14
12
10
8
6
4
2
0
vTEC in TECu
300
400
500
600
700
800
900
1000
1100
All Sky Scale

Mahali



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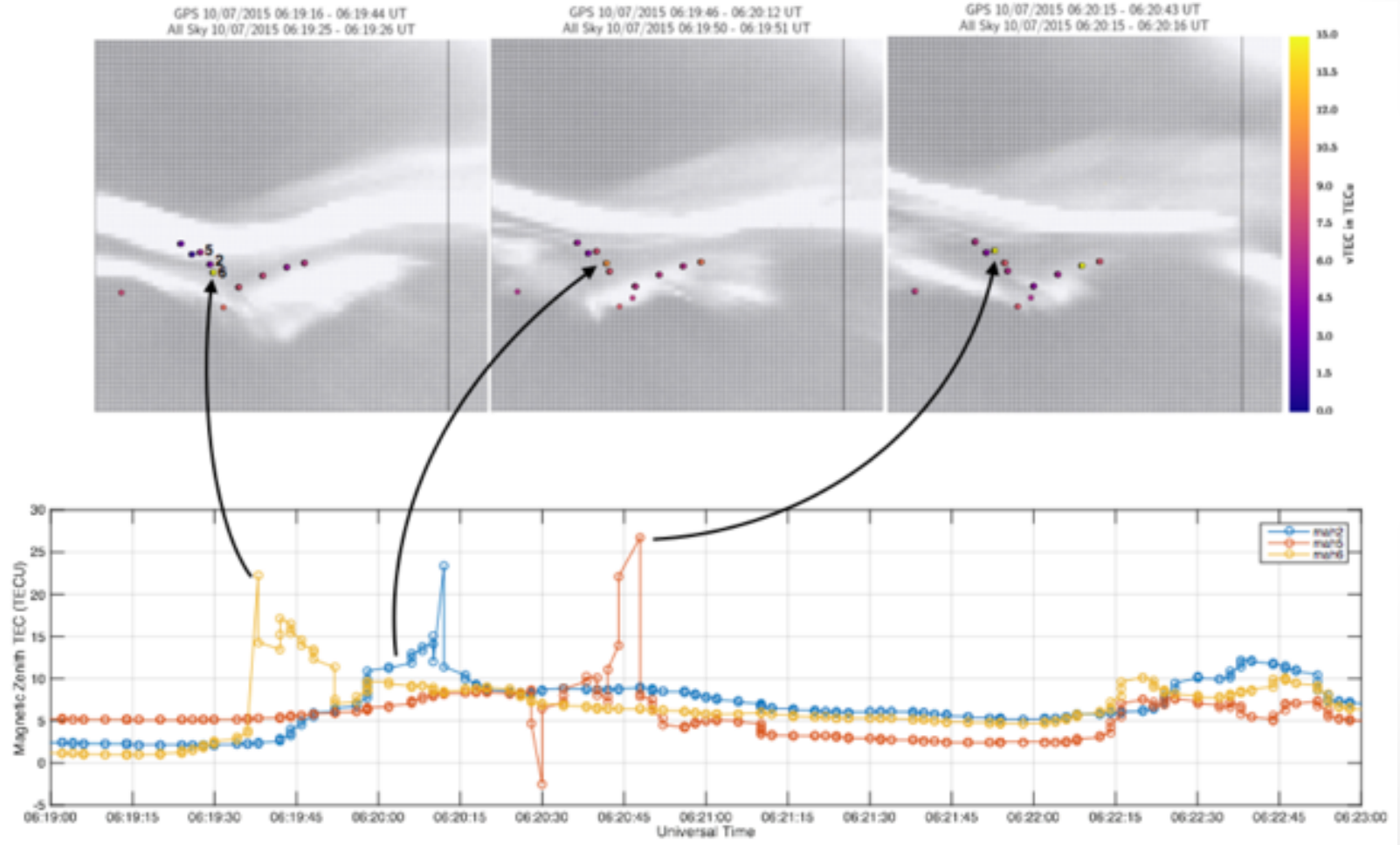
GPS 10/07/2015 06:19:16 - 06:19:44 UT
All Sky 10/07/2015 06:19:25 - 06:19:26 UT
GPS 10/07/2015 06:19:46 - 06:20:12 UT
All Sky 10/07/2015 06:19:50 - 06:19:51 UT
GPS 10/07/2015 06:20:15 - 06:20:43 UT
All Sky 10/07/2015 06:20:15 - 06:20:16 UT
vTEC in TECu
Magnetic Zenith TEC (TECU)
Universal Time

References and Software

Software

- GitHub: jswoboda
  - https://github.com/jswoboda
- GeoData
  - Contributors
    - John Swoboda
    - Michael Hirsch
    - Greg Starr
    - Anna Stuhlmacher

Reference

- H. Dahlgren, G. W. Perry, and J. L. Semeter, “Space-time variability of polar cap patches: Direct evidence for internal plasma structuring,” *J. Geophys. Res. Space Physics*, 2012.

Demo Tools and Notes

- Vex
  - Wrapper for virtual environments
  - Helps manage numerous projects with conflicting requirements
  - https://pypi.python.org/pypi/vex

- Jupyter Notebooks 

  - Create documents with live code
  - Works with Python and a whole host of other languages
  - Available through Anaconda
  - https://jupyter.org/

- Can see this notebook in github
  - https://github.com/jswoboda/GeoDataPython/blob/master/Examples/FusionExample.ipynb