

PyMapLib for Rapid Development of Geospatial Data Analysis Tools

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Outline

- Introduction (HUBzero and GABBS)
- Motivation
- System Design
- Implementation
- Use cases
- Conclusion

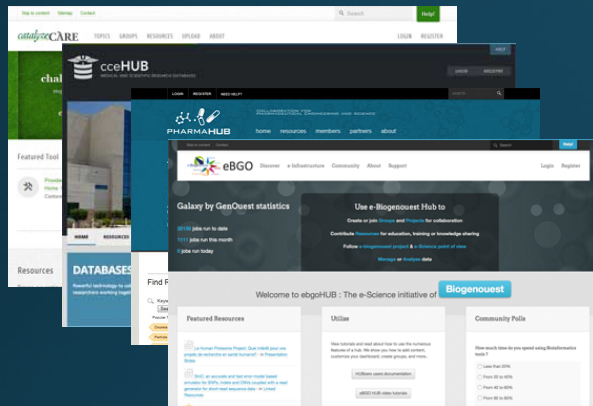


Introduction to HUBzero

- An open source science gateway platform
- Collaborative research environment for community
 - Groups, projects, blogs, wikis, forums, tickets
- Data sharing and publication
- Tool development and contribution
 - Desktop tools launched in a OpenVZ container
 - User interaction through web browser via VNC and HTML5
- Education support
 - Courses, tutorials, lectures, groups



The HUBzero Community



Medical Research



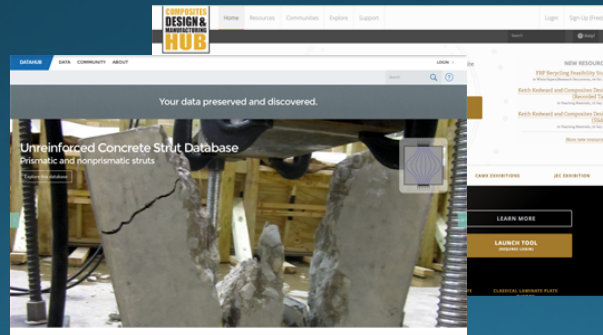
Nanotechnology



Education, Outreach



Data Management



Civil, Materials and Manufacturing



HPC



GABBS Project

- Geospatial Data Analysis Building Blocks (GABBS)
- A project funded by the NSF DIBBS program
- Develop reusable building blocks for geospatial data management and processing using the HUBzero platform
 - A missing piece of the HUBzero platform
 - Addressing the ever-increasing need of utilizing and analyzing geospatial data
- More info at: <https://mygeohub.org/groups/gabbs>



Why PyMapLib?

- HUBzero tools are desktop applications running inside a virtual container (OpenVZ)
- Lack of easy to use open source map libraries for HUB tool developers
- Existing geospatial mapping libraries
 - Google Maps, OpenLayers, Leaflet – for web applications
 - Mapnik - lack support for interactive operations
 - GRASS, GeoTools Java library, QGIS – complex and require GIS expertise

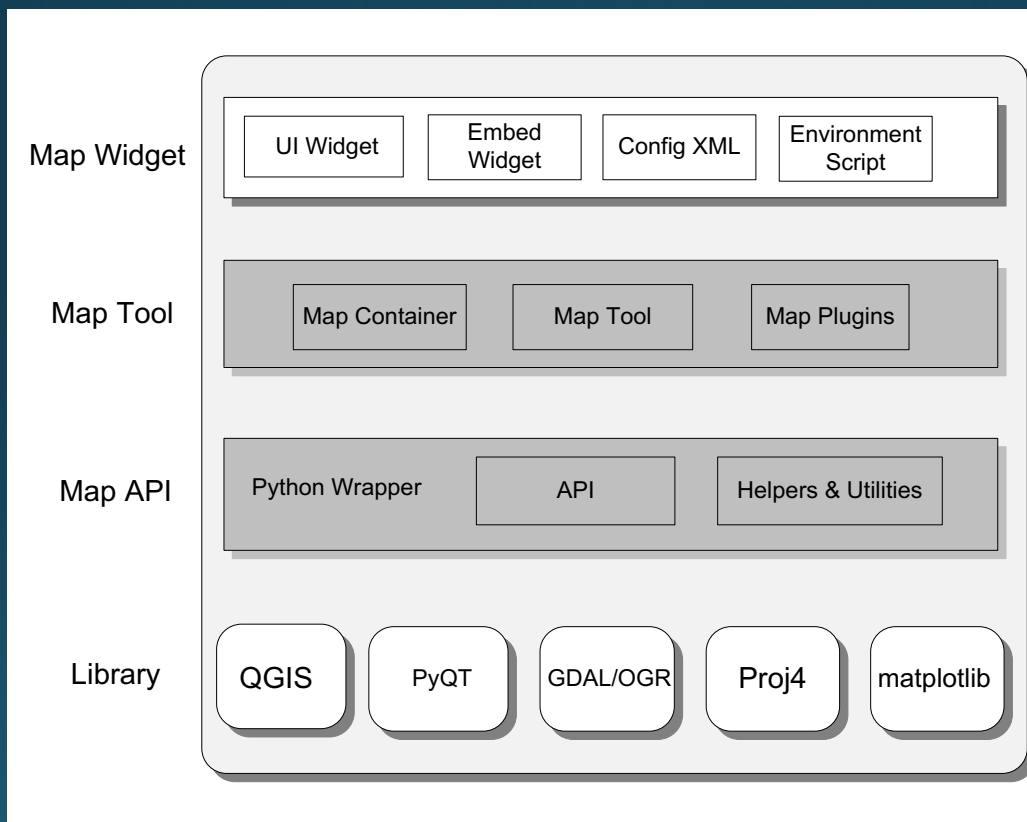


What does PyMapLib do?

- A generic framework for geospatial data visualization
- Lower the barrier of developing map enabled geospatial tools for non-expert scientific users
- Features:
 - Common geospatial data types and protocols
 - User interaction with the map for input selection or output display and exploration
 - Simple geospatial data analysis and visualization
 - Light weight
 - Minimal programming effort



System Design



More about implementation

- Follow Google Maps API style
- Use PyQGIS as the basic geospatial data rendering engine
- Configurable map tools for the map viewer widget
 - Pan, zoom, select, map tips, layer management, map overview, map value inspection and plotting, map style
- Default map viewer widget
 - Import as a QT widget and extend as needed in Python code
 - Embed as-is in Java or C++ tools
- Not HUBzero specific, can be used in any standalone python program



Sample code snippet

Add an Open Street Map as the base layer

```
self.map = gabbs.maps.Map("WorldMap")  
self.map.setMapCenter(-86, 39)  
self.map.setMapZoom(7)  
self.map.setMapScale(3, 9)  
self.mapContainer.addLayer(self.map)
```



Sample code snippet

Add map tools to the map viewer as toolbar buttons

```
self.mapContainer = gabbs.maps.MapContainer()  
self.mapContainer.setLayerControl(True)  
self.mapContainer.setPanControl(True)  
self.mapContainer.setZoomControl(True, size = "CUSTOM", options =  
"ZOOMIN, ZOOMOUT")  
self.mapContainer.setSelectControl(True, size = "CUSTOM", options =  
"SINGLE, RECTANGLE, POLYGON")  
self.mapContainer.setPlugin("drawing")
```



Sample code snippet

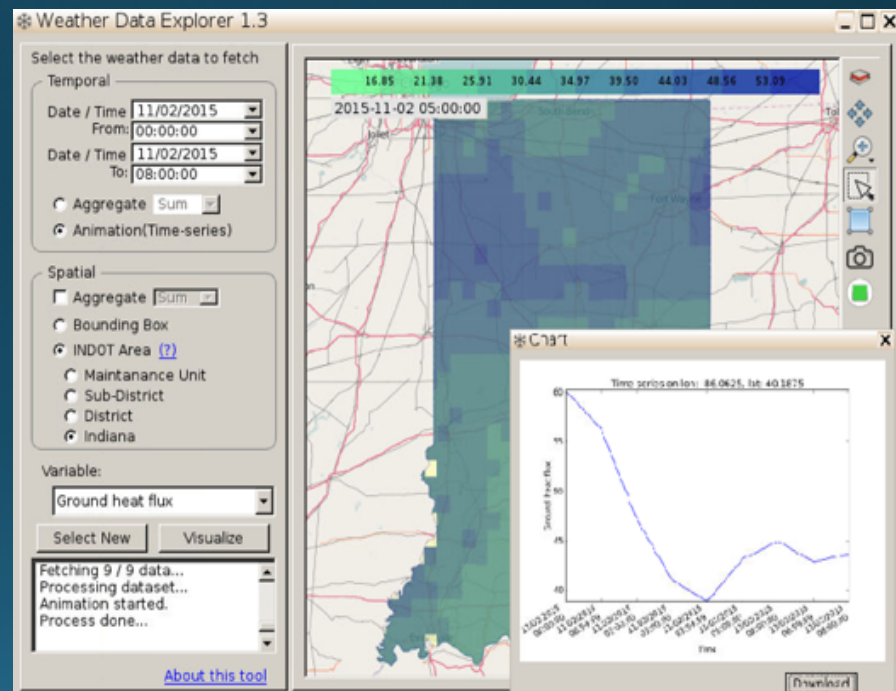
Add the map viewer widget

```
self.appLayout.addWidget(self.mapContainer)
```



Use Case I – Winter Weather Data Explorer

- Multi dimensional atmospheric dataset visualization tool
- GRIB, NetCDF
- Temporal and geospatial queries
- Interactive map display and exploration
- MySQL fabric DB, REST API, PyMapLib



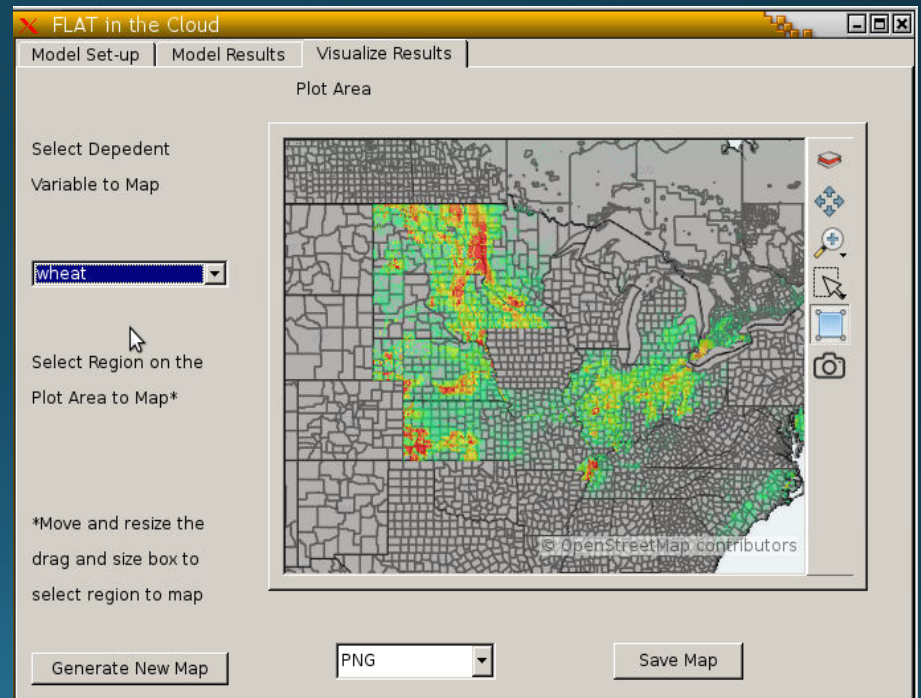
Winter Weather Data Explorer

- [Demo](#)



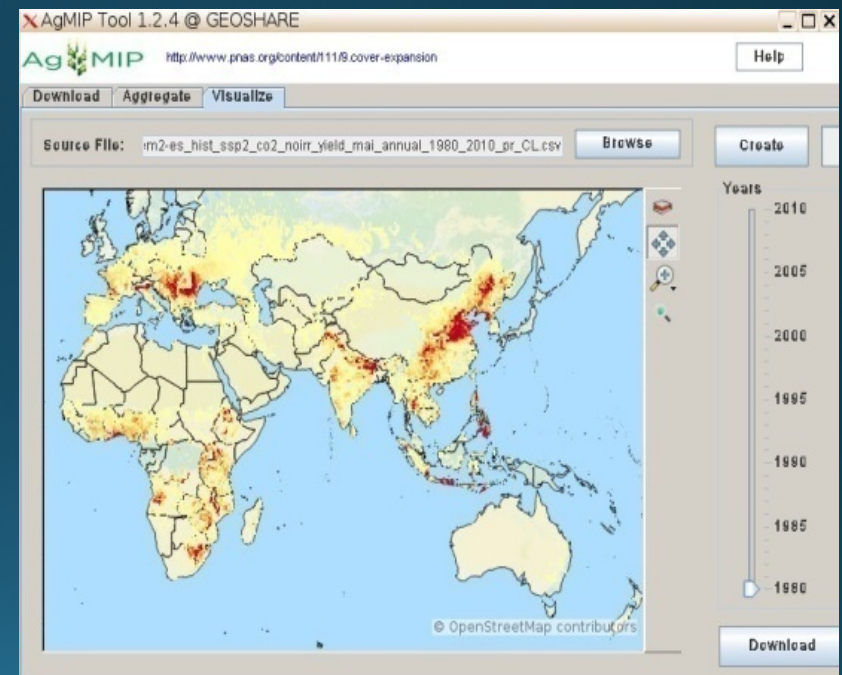
Use Case II – Fine-scale Land Allocation Tool (FLAT)

- Downscale national agricultural data to pixel level
- Biophysical measurements and statistics processing
- Python, R, GAMS, PyMapLib
- Render model result over tiled global county maps
- Development time: 3 months, 1 graduate student



Use Case III – AgMIP Data Aggregator

- Agricultural Model Intercomparison project (AgMIP) initiative
- Help connect social scientists to the large global gridded crop model intercomparison data archive
- Data browsing, downloading, aggregation, and visualization
- Java, GlobusOnline, PyMapLib, XEmbed
- An example of embedding PyMapLib map widget into a Java tool



Conclusion

- A general purpose Python map library
- Part of the GABBS project to build reusable geospatial data analysis software building blocks
- Makes it easy for non-GIS experts to add map rendering and visualization capabilities to their desktop applications
- Applied in several use cases to help scientists web enable their geospatial data processing and analysis tools using the HUBzero platform
- <https://github.com/waneric/PyMapLib>
- Contact: cxsong@purdue.edu, lanzhaoy@purdue.edu



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