Extending Tucson Solar Map with new data

The Tucson Solar Map as published currently has a minimal set of data. Specifically only the University of Arizona's main campus has been published. The software behind the Tucson Solar Map was written with that in mind, and as such extending the dataset is a fairly straightforward process. In general terms the process can be broken down into three steps:

1) Generate monthly solar insolation maps
2) Convert maps to OpenLayers tiles
3) Import new tiles to OpenLayers directory
4) Merge new maps with existing maps in GRASS

Our developers did run into compatibility problems so we have decided to write a more detailed guide of our process.

1. Generate month solar insolation maps

These maps can either be generated by hand (simply run r.sun for every day of the year, outputting global irradiance, and sum each day of the month).

We decided to use the software Sol to generate our solar insolation maps. Step by step documentation can be found on the projects page (www.github.com/Nocsaron/Sol) or at the PIs page at (https://pods.iplantcollaborative.org/wiki/display/~tyson_swetnam/UA+HPC+Workflow)

Using Sol is highly recommended as it will speed up the generation of the maps immensely.

2. Convert to OpenLayer style tiles

The output from Sol returns single-band rasters without color tables. While this is fine (and in fact preferred for data accuracy), this caused problems for the generation of tiles for use in OpenLayers.

We used *gdal2tiles.py* from GDAL to convert from the raster to tiles. *Gdal2tiles* requires a 3 band raster however, so we had to do some conversion.

To work around this limitation we created a color relief of the raster using *gdaldem*. Once you have a color relief raster, it is a simple matter of running *gdal2tiles* with that new raster as the input. As an example here is the series of commands we used to generate the tiles.

```
gdaldem color-relief total_sun_apt_sum.tif /scratch/apps/grass_7.0.3/grass-7.0.3/etc/colors/bgyr sun_color_relief.tif
gdal2tiles.py sun_color_relief.tif –resampling=bilinear --z 15-22
```

3. Import the new tiles into the OpenLayer's directory structure

The exact path of where the new tiles will go will depend on your installation of apache. The default installation of Apache 2.2 on Ubuntu puts the web pages in */var/www/html*. When you installed the Tucson Solar Map, you should have placed *index.html, css, fonts,* and *js* into that directory. We recommend creating a directory called *solar_tiles* in /var/www/html. Then you can just copy the folders created by *gdal2tiles* to there. For example:

```
cd sun_colo_relief
cp –r * /var/www/html/solor_tiles
```

4. Import the solar insolation maps into GRASS

As currently designed in version 1.0, Tucson Solar Map is designed to only handle contiguous regions of data. This is planned to be updated in the future. However for now when importing new data into GRASS there are two options:

1) Overwrite existing data

   If you only need the data you are importing, importing your data into GRASS will be a breeze. Once you have your GRASSDB created use *r.in.gdal* to import your datasets into GRASS. The naming scheming is the first 3 letters of the month in all lower-case. (i.e. January = jan, March = mar, November = nov).

2) Merge with existing data

   If the data you are importing forms a contiguous block with existing data, GRASS includes the functionality to merge the rasters. Using r.patch(https://grass.osgeo.org/grass71/manuals/r.patch.html) will allow you to combine the rasters. As in the first option, ensure you follow the naming convention if you do not wish to modify the codebase.