

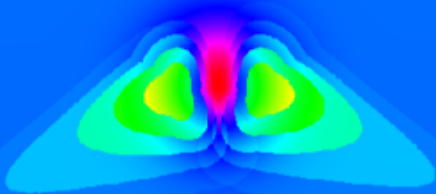
PORTABLE, SCALABLE, HIGH  
THROUGHPUT GEOSPATIAL  
ANALYSES WITH SINGULARITY  
CONTAINERS ON CLOUD AND HIGH  
PERFORMANCE COMPUTING.

TYSON LEE SWETNAM

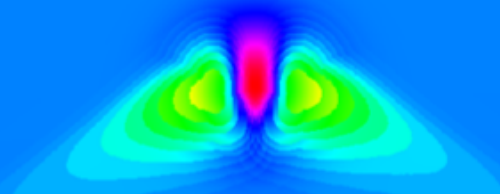
Goal: Model solar irradiation at very high spatial and temporal resolution, anywhere on the Earth.

Bottleneck: Many calculations required to integrate time

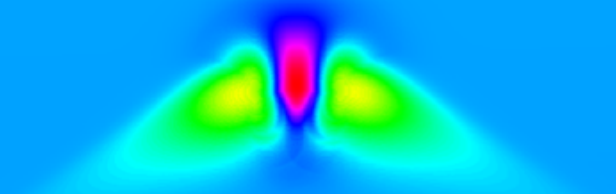
**30 minute**



**15 minute**



**3 minute**



3 minute interval  $\times$  365 days  $\times$  (10,000  $\times$  10,000 pixels [300 Mb])  
= ~120,000 CPU hours  
~200GB output



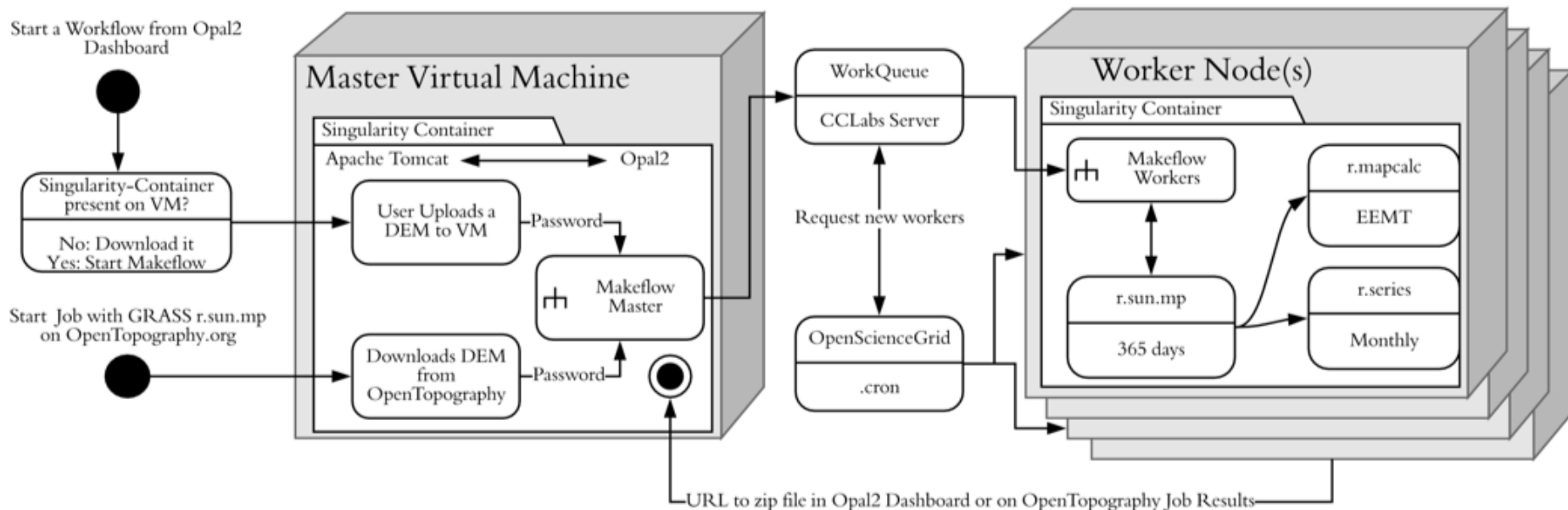
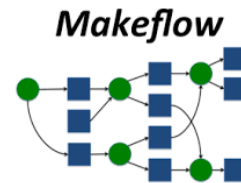
**GRASS r.sun.mp**

<https://grasswiki.osgeo.org/wiki/R.sun>



# Solution: Makeflow + Singularity

Use a workflow manager and container software to run jobs on  $n$  nodes



<http://ccl.cse.nd.edu/software/makeflow/>

<http://singularity.lbl.gov/>

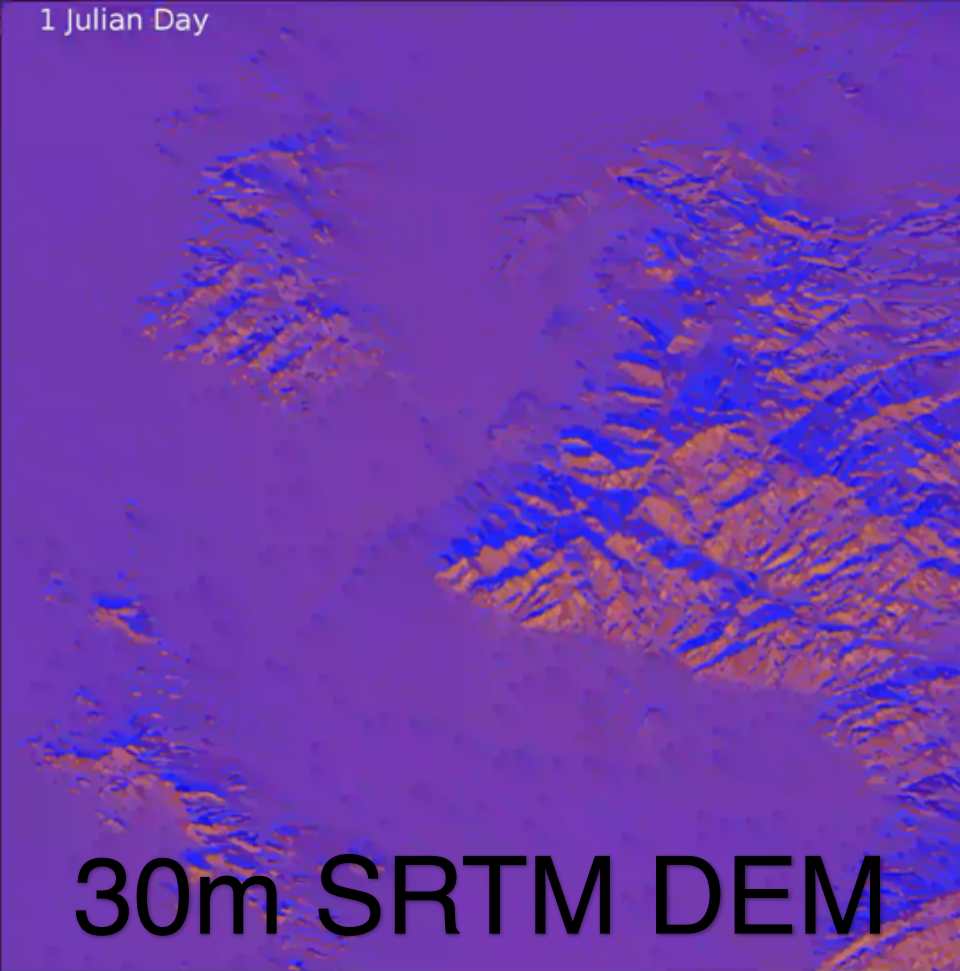




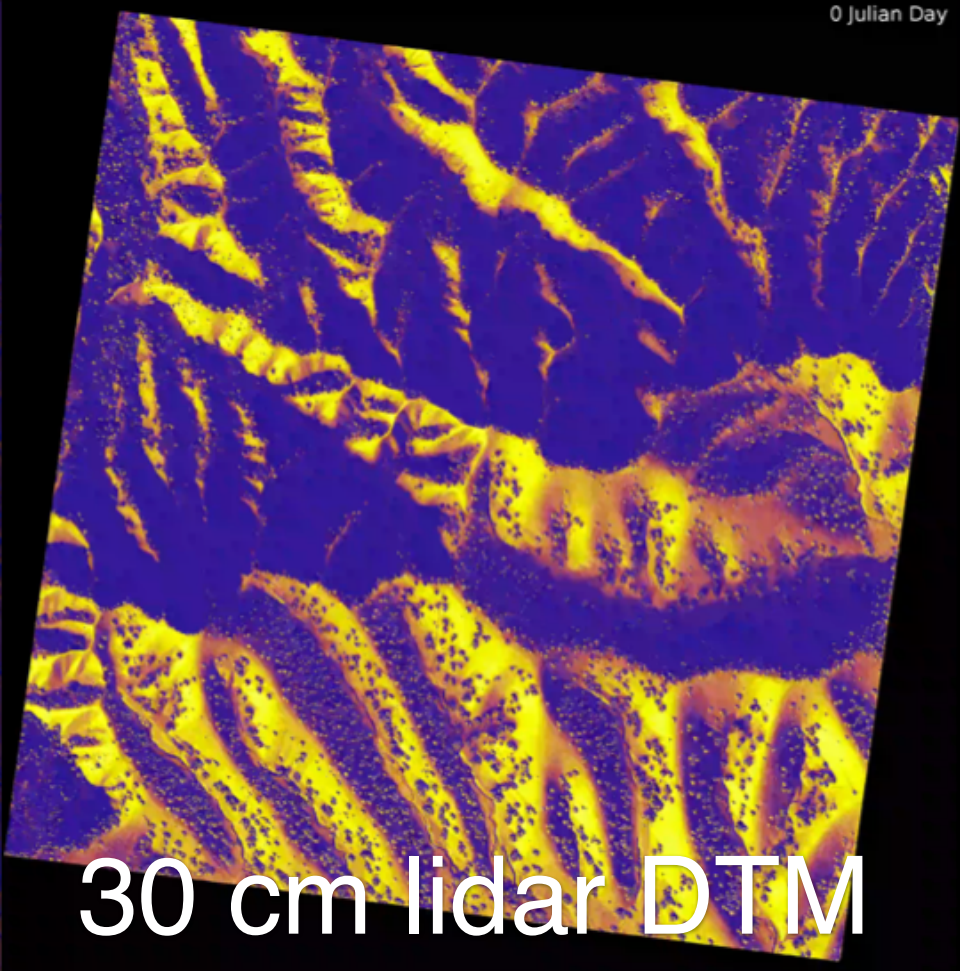
# Results

Generate high resolution daily data in any environment

1 Julian Day



0 Julian Day



# Outcomes

## Reproducibility, usability, and availability

- Source code and wiki on Github:  
<https://github.com/cyverse-gis/eemt>
- Tool is deployed publically on:



**OpenTopography** Selection Coordinates:  Manually enter selection coordinates

HOME ABOUT DATA TOOLS LEARN COMMUNITY

A<sub>min</sub> = -111.220737 T<sub>min</sub> = 32.133323 A<sub>max</sub> = -110.444163 T<sub>max</sub> = 32.863830

The selection area is approximately 4,168 km<sup>2</sup>.

### 2. Data Output Formats

Select Data Output Format:

### 3. Visualization

☒ Generate hillshade images from DEM  
☐ Generate additional color-relief and color  
☐ Generate additional Google Earth KMZ

### 4. Hydrologic Terrain Analysis Products

### 5. GRASS r.sun daily and monthly

☒ Calculate monthly global (beam + diffuse + indirect) solar irradiation and hours of sunlight

Time step when computing all-day radiation sums:

Link atmospheric turbidity coefficient:  (range between 1.0 and 7.0)

Ground albedo coefficient:  (range between 0.01 and 0.99)

**SOL:**

OpenTopography will generate basic derivative products from the DEMs you produce in previous steps above.

Note that this option is only available if GeoTiff is selected.

Sol calculates monthly global (beam + diffuse + indirect) solar irradiation, and hours of sunlight based on the DEM or DSM surface. Surface shading effects are turned on. Atmospheric turbidity and surface albedo use default parameters for GRASS 7.2 R.Sun.mp

Global\_Radiation: Monthly sum of global irradiation (Wh.m-2.day-1) for each pixel.

Hours: Monthly sum of hours each pixel receives sunlight.

For more detail see <https://grass.osgeo.org/grass72/manuals/r.sun.html>

45 (in range: [0-90] degrees)  
315 (in range: [0-360] degrees)

