Designing Sustainable Landscapes:
Incident solar radiation settings variable

A project of the University of Massachusetts Landscape Ecology Lab

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- North Atlantic Landscape Conservation Cooperative (US Fish and Wildlife Service, Northeast Region)
- Northeast Climate Science Center (USGS)
- University of Massachusetts, Amherst

Reference:

McGarigal K, Compton BW, Plunkett EB, DeLuca WV, and Grand J. 2017. Designing sustainable landscapes: incident solar radiation settings variable. Report to the North Atlantic Conservation Cooperative, US Fish and Wildlife Service, Northeast Region.

General description

Incident solar radiation is one of several ecological settings variables that collectively characterize the biophysical setting of each 30 m cell at a given point in time (McGarigal et al 2017). The amount of sun (**Fig. 1**) affects temperature, moisture, and plant growth, affecting the communities found in each place.

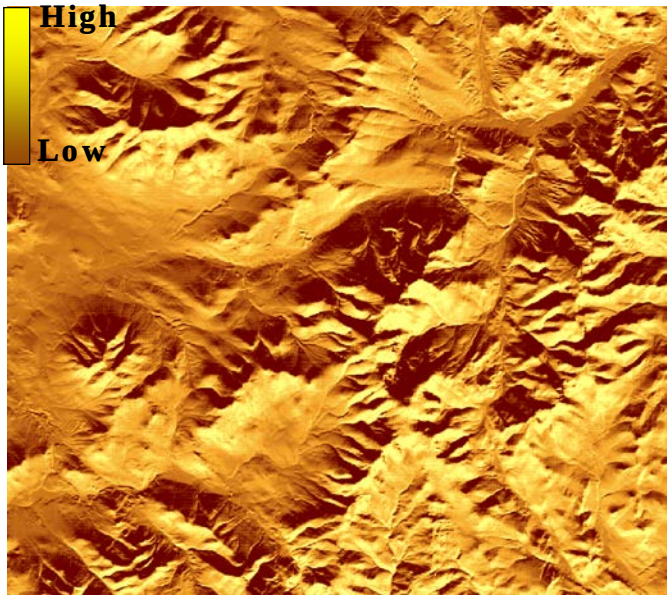

Figure 1. Incident solar radiation in the Presidential Range, New Hampshire.

Use and interpretation of this layer

This ecological settings variable is used for the similarity and connectedness ecological integrity metrics.

This layer carries the following assumptions:

- The digital elevation layer is accurate. Although the DEM we used has errors, in general it is adequate for these purposes, although minor rectilinear artifacts do occur.
- This approach involves interpolation and approximations of unshaded solar radiation and latitude and longitude. The slight errors introduced by the approximation are inconsequential.
- The mean amount of shading from 9 am to 3 pm on April 15, May 15, and June 15 adequately represents the effect of topographic shading of solar radiation on natural communities.

Derivation of this layer

Data source

- Digital elevation model (DEM). We used the National Elevation Dataset's (NED) 10 m DEM, resampled to 30 m.

Algorithm

Incident solar radiation is calculated with two separate algorithms. First, we calculate unshaded direct incident solar radiation based on latitude, longitude, slope, and aspect (McCune and Keon 2002). Second, topographic shading due to hills and mountains is included by drawing a ray from the sun to points on the ground spaced at 25 m for each hour from 9 am to 3 pm on the 15th day of April, May, and June. The proportion of rays not occluded by landforms are calculated, weighted by the angle of incidence for each hour;

months are treated equally. Topographic shading is multiplied by the unshaded incident solar radiation from the first step to yield a final estimate of incident solar radiation.

GIS metadata

This data product is distributed as a geoTIFF raster (30 m cells). The cell values are in arbitrary units, ranging from 0 to 3.3. This data product can be found at McGarigal et al (2017).

Literature cited

McCune, B., and D. Keon. 2002. Equations for potential annual direct incident radiation and heat load. Journal of Vegetation Science. 13:603-606.

McGarigal K, Compton BW, Plunkett EB, DeLuca WV, and Grand J. 2017. Designing sustainable landscapes products, including technical documentation and data products. https://scholarworks.umass.edu/designing_sustainable_landscapes/