

Guidelines for Computing Monthly Radiation Grids Using the Solar Radiation Toolset in ArcGIS

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These guidelines represent one approach to computing monthly radiation grids, which can then serve as input grids for the Water Balance Toolbox. Users are encouraged to also read the “Help” documentation for the Solar Radiation Toolset provided with ArcGIS.

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General reminders about using grids in ArcGIS:

- Grid names should be =13 characters, begin with a letter, and there should be no spaces in grid names or folder names (such as ...\\Documents and Settings\\)
- You won't be able to delete or rename grids if they have been open in the current session of ArcMap.
- Estimates of radiation computed with the Solar Radiation Toolset are in Wh/m²

Part I

Using the Solar Radiation Toolset to parameterize Diffuse Proportion (D) and Transmittivity (T) at a single point:

This part of the analysis allows you to determine the values of monthly D & T that you will use in Part II, in which you will compute solar radiation for an entire study area grid. Part I requires that you have the DEM for the study area, as well as a point shapefile representing the location of your solar radiation collection site*. The objective is to find the combination of D & T that yields the most accurate estimate of solar radiation measured at the collection site. “All possible combinations” of D & T are evaluated (e.g., in the eastern U.S., it would be advisable to evaluate D = 0.2 to 0.7, and T = 0.3 to 0.7, in 0.1 increments).

In ArcToolbox: Spatial Analyst Tools – Solar Radiation – **Points Solar Radiation.**

Use default values except for the following:

- Input Raster = study area's DEM (e.g., Coweeta_DEM)
- Input Points Feature = point shapefile of solar radiation collection site (e.g., *sol_pt.shp*)
- Output global radiation feature = “*name_D_T*” (where D_T are the particular values of diffuse proportion and transmittivity under investigation, e.g., *sol_pt_4_5*)
- Latitude = latitude of the site (to two decimal places if possible)
- Sky size = 512
- **Time configuration: Whole year with monthly interval**
 - Year: *Specify appropriate year for radiation data*
 - Be sure to check “Output for each interval”

Topographic Parameters

Slope and Aspect input type = FLAT_SURFACE (since solar collectors are horizontal)

Radiation Parameters

- Azimuth division = 16
- Diffuse Proportion – *Value being tested as part of “all possible combinations”*
- Transmittivity – *Value being tested as part of “all possible combinations”*

After the model run, open the Attribute Table of the newly created “global radiation values” layer (e.g., sol_pt_4_5.dbf), copy the data, close the Attribute Table, then paste the values into a spreadsheet that also contains the “actual” radiation values measured at the collection site. (Be sure to identify the combination of D & T used for each row of data copied.) After running all possible combinations of D & T, determine the particular combination that gives the most accurate estimate of measured radiation for each month. You will use these D & T values in Part II.

Part II

Once monthly D & T parameters are obtained for the study area, Solar Radiation can be run on the entire grid:

You will be using the same DEM grids used when running Solar Radiation for Points.

The Solar Radiation Toolset allows the user to compute solar radiation grids for each month in the year, or for a single month. Both options are described below. In terms of time to run the program, initial investigations suggests that Option 1 is faster if two or more months have the same D & T values, whereas Option 2 is faster if only one month has a particular D & T combination.

Option 1 – “Whole year with monthly interval”

This method will create one grid for each month for the particular D/T combination (e.g., Cow_3_5_c0, Cow_3_5_c1, ..., Cow_3_5_c11 – Note that month “0” is January, and month “11” is December). For D/T combinations that are needed for multiple months, this might be the best approach – to create twelve monthly grids, even though all twelve won’t be retained for further analysis.

In ArcToolbox: Spatial Analyst Tools – Solar Radiation – **Area** Solar Radiation.

Use default values except for the following:

- Input Raster = study area’s DEM (e.g., Coweeta_DEM)
- Output global radiation raster = “*name_D_T*” (where D_T are the values of diffuse proportion and transmittivity determined from Part I, e.g. “Cow_3_5”)
- Latitude = latitude of the site (to two decimal places if possible)
- Sky size = 512
- **Time configuration: Whole year with monthly interval**
 - Year: *Specify appropriate year for radiation data*
 - Be sure to check “Output for each interval”

Topographic Parameters

No changes; use default “slope and aspect from DEM”

Radiation Parameters

- Azimuth division = 16
- Diffuse Proportion – *As determined for each month from Part I*
- Transmittivity – *As determined for each month from Part I*

You’ll need to run Solar Radiation for each combination of D/T (from Part I) for the study area.

Option 2 – “Multiple days in a year”

For D/T combinations that are only needed for one month, it might be faster to create only that one grid.

In ArcToolbox: Spatial Analyst Tools – Solar Radiation – **Area** Solar Radiation.

Use default values except for the following:

- Input Raster = study area’s DEM (e.g., Coweeta_DEM)
- Output global radiation raster = “*name_D_T*” (where D_T are the values of diffuse proportion and transmittivity determined from Part I, e.g. “Cow_3_5”)
- Latitude = latitude of the site (to two decimal places if possible)
- Sky size = 512
- **Time configuration: Multiple Days in a Year**
 - Year: *Specify appropriate year for radiation data*
 - Use two calendars to select first & last days of the month for start/end dates
 - Do not check “Output for each interval”

Topographic Parameters (same as Option 1)

No changes; use default “slope and aspect from DEM”

Radiation Parameters (same as Option 1)

- Azimuth division = 16
- Diffuse Proportion – *As determined for each month from Part I*
- Transmittivity – *As determined for each month from Part I*

You’ll need to run Solar Radiation for each combination of D/T for that particular site (see table).

File Maintenance

After Solar Radiation is finished running, use ArcCatalog to rename those grids that you wish to keep. Instead of the D/T combination in the name, it will be more helpful to have the particular month indicated: “Cow_3_5_c8” can be renamed “Cow_09.” Note that the Solar Radiation tool will have named the grids it created starting with “c0” for January (e.g., Cow_3_5_c0). So in renaming them, grid c0 = month 01, c1 = 02 ... c11 = 12. After renaming the “keeper” grids, you can delete the D/T grids for months that you do not need. (Just be sure before you delete!)

If you used “Option 2” (only creating a grid for a single month), there will not be a “c##” extension on the grid name. Since there is no month designation at all with the name (e.g. Cow_5_6), it is imperative that you use ArcCatalog to change its name before you “forget” what the grid represents (e.g., Cow_02 for February’s grid).

* **Creating a point shapefile of your solar radiation collection site**

If you are using SUNY 10-km gridded radiation data, the downloaded filename represents the coordinates of the site, e.g. 105454105.csv contains data for 105.45° W 41.05°N. A spreadsheet with headings “site,” “latitude,” and “longitude” can be created, populated with a site descriptor, 41.05, and -105.45. Add this table to ArcGIS, right-click on it, and Display XY Data. X Field = Longitude, Y Field = Latitude, Coordinate System = GCS_WGS_1984. This XY Event can then be saved as a point shapefile (right-click, Data – Export Data).