

UNIVERSITY OF CENTRAL FLORIDA
Concentrating Solar Power Program

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Description: The objective of this effort is to produce a detailed Florida map of the solar direct beam and global resource available for use in Florida whereby a potential user of solar energy can enter their location latitude and longitude and receive a table of solar energy monthly averages for that specific site as derived from the past eleven years of data. The concept is to use NOAA satellite photos and utilize the brightness of the cloud cover as a clearness factor predictor of the solar energy that gets through to the ground below.

Past progress: A literature search was completed and the equations to predict theoretical optimum clear sky daily insolation (H_c) were programmed. The clearness value (x) of each pixel in satellite photos was used to mediate the clear sky insolation values to produce ground level predicted values (H) for that pixel area (5 miles x 5 miles) by the general equation:

$$H = H_c (a + b \text{EXP}(-x/c))$$

Where a , b , and c are correlation coefficients. The hypothesis was tested by using NOAA weather satellite data from summer and fall of 2010 retrieved over the internet, and real irradiance values measured at FSEC. Correlations (r^2) of predicted vs. real values were found to be above 0.90 at the 95% confidence level. This work validated the concept.

Budget: \$52,000

Universities: UCF/FSEC

External Collaborators: FPL

Progress Summary

Daytime satellite photos of the past eleven years were purchased from NOAA archives. In each photo, a pixel covers a 5 mile x 5 mile square and there are 10,272 pixels over the Florida area in each photo. Using printed NOAA navigational charts, latitude-longitude values were assigned to each pixel. The 20,075 photos were reviewed and if any anomalies (blank areas or bands across the photo) were found, the photo was corrected. Because the gray scale map varied among photos, a program was written to correct all photos to represent a standard gray scale map and all photos' pixels were adjusted to this gray scale base with this program. A program was written that searched the pixel files to determine the darkest and lightest tone recorded for each location and these were determined. A program was written that calculated the normalized brightness value (value x in the equation above) for each pixel of each photo and these were loaded into master "clearness" files. A program was written that calculated and output the theoretical clear sky direct beam solar energy available for each day of the year for each Florida location (value H_c in the equation above).

Effort Remaining to Be Completed:

Using the NOAA historical data sets now developed and actual data taken at FSEC, new correlations need to be developed that calculate the ground measured direct beam and direct diffuse solar daily insolation. Using these correlations, solar direct beam and direct diffuse radiation values need to be calculated for each day of the eleven year data base for each of the 10,272 Florida locations. Each daily value for each location needs to be averaged across the 11 years of data. Daily values need to be averaged to produce direct beam and direct diffuse monthly averages for each of the Florida locations into a master table. A program needs to be written that will run on the internet that when given a Florida latitude and longitude, will provide a table of the expected monthly direct beam and direct diffuse averages for that location.

