FESC
Florida Energy Systems Consortium

# Florida State University

## *Meteorological Factors Affecting Solar Energy Efficiency in the Tropics*

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**Description:** There are numerous meteorological factors that limit the efficiency of solar energy systems in the tropics. Depletion of available solar energy at the surface by increased water vapor, cloudiness, temperature of the solar panel system, pollution, are sometimes overlooked, because engineering specifications for design are often based upon midlatitude continental air masses. The typical tropical atmospheric reduction factors are reviewed in this paper, using a state-of-the-art solar energy model. In addition, meteorological variability can be quite extreme in the tropics and many engineering studies on feasibility of renewable energy sources in general are often based upon "typical." year criteria, rather than longer term climatologies. It is suggested that climatological data be utilized to more accurately portray the variability of output to be expected at a typical installation. Many of these variables are already widely available from a combination of surface and upper air meteorological stations, as well as remote sensing data from satellites. We will demonstrate the sources for these data as well as strategies for teaching about solar energy efficiency using routine observations from school-based weather stations.

**Budget:** $14,481
**Universities:** FSU

## Executive Summary

**Project Impact and Conclusions:** The establishment of new monitoring stations that allow for the collection and integration of meteorological and solar energy data will improve our ability to ascertain solar energy efficiency as well as the role that various meteorological factors play in decreased efficiency, compared to that expected from industrial ratings of solar systems. The utility of a Department of Energy approved model, SMARTS, has also been demonstrated. This model allows for a wide range of experiments designed to focus on those factors that can have the most benefit (or detriment) to an efficiently and well-designed solar energy system for those pursuing such applications. It also helps to understand some unmet needs, particularly with respect to the adverse effects of cloudiness which are not directly treated in SMARTS, and which are only crudely attempted in most engineering applications.

**Proposed Future Activities and their Potential Impact:** I will be submitting a proposal to DOE/NREL for proposed improvements to monitoring and modeling solutions that were brought about during this research. It will also help to develop further applications of these methods with our Caribbean partners and other locations where solar energy can be expected to be of widespread use. A long-term goal is the development of a new ASTM standard for solar energy rating systems appropriate for the tropics, as suggested by Case et al. (2008).

This project has been completed.