

ANALYSIS OF SOLAR INSOLATION AND SOLAR ENERGY PRODUCTION AT AN OKLAHOMA MESONET SITE

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EXTENDED ABSTRACT

Renewable energy sources, including solar energy, present opportunities for sustained development and electrical generation with minor impacts on Earth. Solar energy systems are becoming more affordable and, despite Oklahoma's abundant sunny days each year, the solar energy field remains untapped. From April 2017 to April 2018, a field experiment was carried out at the Oklahoma Mesonet site at the National Weather Center to analyze the solar insolation and solar energy production. A solar panel was instrumented with its own pyranometer to measure the global downwelling solar radiation at a tilt angle of 47 degrees, along with solar panel temperature, current, and voltage. This experimental data was compared with the standard data set of the Mesonet site, where a seasonal variation was observed in the relationship between the horizontal solar radiation and the solar radiation at the tilted surface. A cubic equation defined the relationship between the observed power and the solar radiation at the solar panel. Using the relationship to estimate power, coupled with the observed power and the panel's temperature, we found no temperature dependency for the energy production efficiency in the solar panel. The highest average total solar radiation accumulation at the 47 degrees tilted surface was 29.01 MJ/m², observed on 16 March 2018. This date was between the highest 4% for observed energy accumulation for the year, with an accumulation of 0.161 kWh. Future work will include estimating the direct and diffuse radiation from the pyranometer data based on a clearness index and verifying it with our data. It is also of interest to use tracking solar systems to assess how solar panel orientation might change the power production curve. Using the power estimations based on solar radiation, we want to analyze the potential for solar energy production across Oklahoma, and then apply our findings in other locations around the world.