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Editorial

Editorial for the Special Issue "Solar Radiation, Modeling, and Remote Sensing"

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Abstract: Surface-solar radiation is of vital importance for life on Earth, radiation–energy balance, photosynthesis, and photochemical reactions, meteorological and climatic conditions, and the water cycle. Solar radiation measurements are growing in quality and density but they are still scarce enough to properly explain the spatial and temporal variability. As a consequence, great efforts are still being devoted to improving modeling and retrievals of solar radiation data. This Special Issue reviews techniques for solar radiation modeling and remote sensing using satellite and advanced statistical techniques for solar radiation. Satellite remote sensing of solar radiation provides better spatial coverage, and various methods have been presented on this issue covering several aspects: updated models for solar radiation modeling under clear sky conditions, new approaches for retrieving solar radiation from satellite imagery and validation against ground data, forecasting solar radiation, and modeling photosynthetically active radiation.

Keywords: solar radiation; radiative transfer; solar energy systems; solar radiation forecasting

1. Overview of the Issue: Solar Radiation Modeling and Remote Sensing

Accurate solar radiation knowledge and its characterization on the Earth's surface are of high interest in many aspects of environment and engineering sciences. Radiative transfer that takes place in the atmosphere leads to the high spatial and temporal variability of solar radiation along the planet. This variability, which has important consequences in both climatic studies and in solar system performance analysis, has promoted the effort in improving the modeling capabilities for the determination of the solar irradiance components [1]. In the absence of clouds, the models for estimating solar irradiance are denoted as clear sky models, in which the accuracy mostly resides on the detail and quality knowledge of the atmospheric components that act as attenuators of the solar radiation traversing the atmosphere [2,3]. The evolution of clear sky models has brought significant improvements in parallel to the advanced reached in atmospheric retrievals; in this issue, the first contribution is precisely a paper containing the update of a well-known and widely used clear sky model named SOLIS [4].

Modeling solar irradiance from satellite imagery has become the most widely used models for retrieving solar irradiance under total sky conditions, particularly in the solar energy community [5]. Satellite-based models can be divided into different criteria. Thus, according to the kind of satellite, models using polar orbiting satellite imagery and models for geostationary satellites can be found, each with different applicability. On the other hand, depending on the approaches and assumptions used in the algorithms the classification divides the models into physical models and semi-empirical (or cloud index based) models [6]. There has been enormous growth in the amount of work, authors,

research, developments, and improvements in satellite-derived solar radiation through the last 30 years and this growth is still ongoing. This Special Issue is witness to this assessment, since contributions 2 to 6 deal with different aspects of solar radiation modeling and validation using satellite information [7–11]. Moreover, this is not the only evidence of the ongoing progress in satellite-derived solar radiation since there are many thorough reviews elsewhere and groups of experts working on improving the modeling capabilities and accuracy (task 16 IEA-PVPS, http://www.iea-pvps.org/).

Contributions 7 and 8 make use of remote sensing techniques and solar radiation for a different approach [12,13]. The former is focused on the canopy and forest information obtained from LIDAR and Solar Analyst model from ESRI's ArcGIS to estimate solar radiation at forest stands in various scales. Contribution 8 focuses on statistical techniques for improving the photosynthetically active radiation (PAR) derived from satellite Kato bands CM-SAF product.

Satellite-based models can be also used for forecasting purposes and this is a broad area of research and development during the last decade. The impact of solar radiation forecasting tools in solar energy penetration is clearly highlighted by the number of scientific publications in recent years [14]. Contribution 9 of this Special Issue is one example; it deals with the methods for nowcasting solar irradiance using Meteosat Second Generation images [15]. The next contribution, paper 10, focuses on forecasting aerosols using remote sensing and its impact on solar energy plants performance in sites with high aerosol loading climatology [16].

Finally, the last contribution of this Special Issue is aimed at studying solar radiation variability at different temporal scales and the connection with satellite-derived cloud properties using GOES images [17].

2. Conclusions

Solar radiation modeling, forecasting, and characterization have been and still are broad areas of study, research, and development in the scientific community. This Special Issue contains a small sample of current activities in this field. Both the environmental and climatology community, as part of the solar energy world, share a high interest in improving the modeling tools and capabilities for more reliable and accurate knowledge of solar irradiance components worldwide. The work presented in this Special Issue also remarks on the significant role that remote sensing technologies play in retrieving and forecasting solar radiation information.

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