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Solar energy assessment in the Alpine area: satellite data and ground instruments integration for studying the radiative forcing of aerosols.

M. Castelli (1,2), M. Petitta (2), and E. Emili (2)

(1) DICA, Department of Civil and Environmental Engineering, University of Trento, Via Mesiano 77, I-38123 Trento, Italy, (2) EURAC, Institute for Applied Remote Sensing, Bozano, Italy (mariapina.castelli@eurac.edu)

The primary objective of this work is to purpose an approach for estimating the effect of aerosols on surface incoming shortwave radiation (SIS) in the Alpine region, which is based on the integration of different instruments: we develop a GIS model, whose output is corrected by monthly atmospheric coefficients, and then we progressively add details by daily updated atmospheric information.
The assessment of solar energy availability at the earth's surface over a specific geographic area is crucial for planning photovoltaic panels installation. When modeling SIS with GIS instruments or retrieving it from satellites measurements, we have to account for terrain shadowing and atmospheric extinction, both of which are difficult to describe in the Alpine area, because of the topographic complexity and the local atmospheric circulation influence on the atmospheric composition. While advanced methods were developed to carefully describe the effect of topography, the atmospheric attenuation was considered so far only through monthly turbidity values, and the question remains whether it be possible to develop a time-effective routine to model the atmospheric effect on SIS at daily scale.
As a first step we produced a WebGIS for the town of Bressanone, Italy, showing a classification of the roofs of the buildings according to the yearly amount of global irradiance. Furthermore we provide the annual electricity production based on the efficiency of the most common PV technologies. At this stage clear sky irradiance was computed with a GIS based model, and afterwards monthly correction coefficients were applied to add real sky conditions to the merely geometrical computations, which were obtained from 20 years of measurement collected by the pyranometer in the closest meteorological station.
As a second step we investigate the influence of aerosol optical properties on SIS by running the radiative transfer model libRadtran by using as input the aerosol model defined for the measurement site of Bolzano, where we installed an AERONET sun-photometer for measuring aerosol optical properties and column water-vapor amount. The impact of aerosols on the surface irradiance was already demonstrated, in fact the literature shows that the daily aerosol direct forcing on the surface radiation in the Italian Po valley amounts on average to -12.2 Wm-2, with extremes values beyond -70 Wm-2. In particular here we examine the role in the radiation budget of the Alpine valleys of aerosol microphysical characteristics, such as size distribution, and optical properties, such as phase function, derived from the inversion of spectrally resolved sky radiances.
After provided evidence of the radiative impact of atmospheric aerosols on solar energy availability in the Alpine area, the final step will be the enhancement of the most advanced existent algorithm for retrieving SIS in the Alpine area from satellite data, developed by MeteoSwiss in the framework of CM-SAF, which thoroughly considers the effect of topography and clouds, while can still be improved in terms of atmospheric input data.