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Methodology for predicting solar irradiance

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The proposed methodology is related to the development of a dynamic data assimilation model for intra-hour forecasting of solar irradiance over a specific area taking into consideration the presence of clouds/aerosols over the area.
The innovative concept of the methodology is based on the fact that the model does not utilise any meteorological data (satellite data - low spatial and temporal resolution) or specialized equipment (i.e. all sky cameras, solar irradiance measuring devices - high capital cost). Instead, the inputs will derive from the time-series of the power output of a dense multipoint grid of grid-connected Photovoltaics (PVs). The input data will be processed in order to extract the normalized power output of each PV, regarding the installed equipment and technical characteristics of the PV and computational clear sky models for the area.
The integration of the continuous input data from the PVs of the network will be linked to “energy maps” over the desired areas (towns/regions/countries) that will be generated at predefined intervals. In the maps, the attenuation of the normalized power output will be considered attributable to the presence of clouds/aerosols casting a shadow and thus causing a decrease in the solar irradiance reaching the PV. Then, the dynamics of the change of the values at the sequential “energy maps” will be computed using techniques similar to cloud motion vectors computation. The calculated energy motion vectors will reveal the motion and development of clouds in time, thus the future state of the sky and corresponding solar irradiance will be computed.
The proposed methodology aims to address a major problem of meteorological forecasts, which is the low temporal and spatial resolution of solar irradiance forecasts, which are unable to estimate the sudden fluctuations of irradiance over a specific relatively small area, caused by clouds obscuring the sun. The dense network of PVs providing continuous data will enable very high temporal and spatial resolution of forecasts from the model. However, due to the nature of clouds, the nowcasting horizon will be intra hour (1-60 minutes).