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Holger Ruf (1,3), Konstantin Ditz (1), Marion Schroedter-Homscheidt (2), Hans Georg Beyer (3), Carmen Köhler (5), Florian Meier (4), and Gerd Heilscher (1)

(1) Ulm University of Applied Science, Institut for Energy Systems and Automation, Ulm, Germany (ruf@hs-ulm.de), (2) Deutsches Zentrum für Luft- und Raumfahrt e.V., Oberpfaffenhofen, D-82234 Weßling, (3) University of Agder, Jon Lilletuns Vei 9, NO-4876 Grimstad, (4) Stadtwerke Ulm/Neu-Ulm Netze GmbH, Karlstr. 1-3, 89073 Ulm, (5) i-EM S.r.l., Via Lampredi 45, 57121 Livorno

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Holger Ruf^{1,3}, Konstantin Ditz¹, Marion Schroedter-Homscheidt², Hans Georg Beyer³, Carmen Köhler⁵, Florian Meier⁴, Gerd Heilscher¹

1Hochschule Ulm, Eberhard Finckh-Str. 11, D-89075 Ulm, Tel.: +49 731 / 50-28348, Fax: +49 731 / 50-28363, ruf@hs-ulm.de, heilscher@hs-ulm.de

2Deutsches Zentrum für Luft- und Raumfahrt e.V., Oberpfaffenhofen, D-82234 Weßling, Tel.: +49 8153 / 28-2896, Fax: +49 8153 / 28-1363, marion.schroedter-homscheidt@dlr.de

3University of Agder, Jon Lilletuns Vei 9, NO-4876 Grimstad

4 Stadtwerke Ulm/Neu-Ulm Netze GmbH, Karlstr. 1-3, 89073 Ulm, florian.meier@ulm-netze.de

5i-EM S.r.l., Via Lampredi 45, 57121 Livorno, carmen.koehler@i-em.eu

Abstract

The successful implementation of a feed in tariff in Germany and many other countries has led to a growing number of small photovoltaic (PV) systems with less than 10 kWp, in private households, increasing rapidly. More than 98 % of these systems are connected to the low voltage grid.

The distribution system operators (DSO) had planned their distribution grids historically only in view of the demand of their customers. Nowadays, they have to adapt their planning and operation rules to an increasing influence of decentralized generators with a volatile feed-in characteristic as well as high load and high feed in times.

The irradiance data provided by the CAMS radiation services are available for the observation window of the Meteosat Second Generation in 15-minutes resolution. This irradiance time series data can support DSOs during the planning process of electric grids with a significant installed PV power as in e.g. Southern Germany. The irradiance data are validated with ground measurements within Germany. The results of this validation show an average ME of 10 %. The average RMSE is 27.5 % and the average CC is 0.93.

A scheme using satellite-derived irradiance measurements to model the load flow of a medium-to-low voltage transformer in a low voltage distribution grid area is described. This scheme is validated by comparison with measurements at the transformer at a test site with 21 residential PV systems in the city of Ulm, Germany. The load flow simulation model is based on a PV model, accounting for the nominal power and location of the PV systems as provided by the DSOs as well as the orientation angles taken in high resolution from aerial laser-scan data. The load data are assumed by use of load profile time series from standard load profiles. Modell quality is assessed by a comparison of modelled and measured power.

Overall, the study indicates the usefulness and applicability of satellite-derived irradiance data for utility applications like load flow monitoring of transformers in areas with a high amount of residential PV systems.