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Difference in the performance of satellite based DNI nowcasts in complex and flat terrain

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For the optimized operation of concentrating solar technologies, reliable forcasting of direct normal irradiance (DNI) is important. DNI is highly dependent on clouds and aerosols, hence it is necessary to have a good forecast of clouds and aerosols for a good forecast quality.
Within the project DNIcast (http://www.dnicast-project.net/) we developed a nowcasting method combining actual satellite images to retrieve the cloud state with numerical weather models to calculate trajectories at a fix altitude to propagate the clouds for four hours into the future [1]. This approach showed to be sensitive to locations within complex terrain versus locations within flat areas. Locations to test the forecast performance were in Northern Africa (flat terrain) and the Plataforma Solar de Almeria (PSA) in the Sierra Nevada mountain range in Southern Spain representing the complex terrain. Cloud evolution and cloud propagation in complex terrain leads to significant differences in the accuracy of this forecast approach. As cloud formation and dissolving is neglected in the model, which occurs more often in complex terrain, there is more forecast uncertainty there compared to location in more flat area. E.g. standing clouds in form of mountain lee wave clouds or fog is transported away by the wind trajectories, which leads to wrong future cloud positions. In addition a post-processing was applied to the forecast based on ground measurements of the past hours. While at PSA the effect was small, the uncertainty of the forecasts was lowered by 40% for the locations in the Saharian desert.
Overall for locations in the North African desert a root mean square error (RMSE) of22% increasing to 55% with forecast horizon up to four hours has been found, whereas for the location in complex terrain the RMSE range was from 45% to 80%.

[1] Müller and Remund, 2016, SHORTEST TERM FORECASTING OF DNI FOR CONCENTRATED SOLAR TECHNOLOGIES, 32 European PV Solar Energy Conference, Munich

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