Grid-based Calculation of Tilt Factors for an optimal Orientation of photovoltaic Systems in Europe

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Some information useful for solar energy applications can not easily be obtained but requires large data and computing resources. One example are tilt factors for photovoltaic systems which indicate at which direction and inclination angle a system generates the most power. The tilt factors depend on the mean sun inclination angle and are thus correlated with the geographical latitude. But regional weather patterns, such as notoriously cloudy months, can influence the tilt factors as well.

In our study, we use a 10-year period of satellite images from the METEOSAT series covering Europe. With one image every 30 minutes, the number of daylight images is more than 100000. For each time slot and each pixel, the cloud information is used to calculate the irradiation on the horizontal plane and the insolation at various angles according to [Klucher 1979, Solar Energy 23/2, 111-114]. Fortunately, the task can easily be data-parallelized. We divide the time series of images into smaller data sets and define a Grid job for each set. Scheduled locally with Condor, the jobs are then automatically sent to computing clusters of the German Grid (D-Grid) running Globus Toolkit 4. Data transfers are realized with GridFTP. The resulting arrays of tilt factors are transferred back and converted to maps of monthly means for evaluation.

The underlying method has been known for more than 30 years. However, in the past, due to hardware limits, the method could not be explored in such detail as is now possible. Today's Grid computing allows rapid evaluation of large data sets in order to

gain new insights and hints for an improved usage of existing methods.