Geophysical Research Abstracts
Vol. 16, EGU2014-6740, 2014
EGU General Assembly 2014

Solar Tyrol project: using climate data for energy production estimation. The good practice of Tyrol in conceptualizing climate services.

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The scientific community in the last years is largely discussing the concept of "Climate services". Several definitions have been used, but it still remains a rather open concept.
We used climate data from analysis and reanalysis to create a daily and hourly model of atmospheric turbidity in order to account the effect of the atmosphere on incoming solar radiation with the final aim of estimating electric production from Photovoltaic (PV) Modules in the Alps.
Renewable Energy production in the Alpine Region is dominated by hydroelectricity, but the potential for photovoltaic energy production is gaining momentum. Especially the southern part of the Alps and inner Alpine regions offer good conditions for PV energy production. The combination of high irradiance values and cold air temperature in mountainous regions is well suited for solar cells. To enable more widespread currency of PV plants, PV has to become an important part in regional planning. To provide regional authorities and also private stakeholders with high quality PV energy yield climatology in the provinces of Bolzano/Bozen South Tirol (Italy) and Tyrol (Austria), the research project Solar Tyrol was inaugurated in 2012.
Several methods are used to calculate very high resolution maps of solar radiation. Most of these approaches use climatological values. In this project we reconstructed the last 10 years of atmospheric turbidity using reanalysis and operational data in order to better estimate incoming solar radiation in the alpine region.
Our method is divided into three steps: i) clear sky radiation: to estimate the atmospheric effect on solar radiation we calculated Linke Turbidity factor using aerosols optical depth (AOD), surface albedo, atmospheric pressure, and total water content from ECMWF and MACC analysis. ii) shadows: we calculated shadows of mountains and buildings using a 2 meter-resolution digital elevation model of the area and GIS module r.sun modified to fit our specific needs. iii) Clouds effect: clear-sky irradiance is modified using cloud index provided by Meteoswiss with very high temporal resolution (15 min within 2004 and 2012).
These three steps produce daily (eventually hourly) dataset of incoming solar radiation at 25 m of horizontal resolution for the entire Tyrol region reaching 2 m horizontal resolution for the inhabited areas .
The final steps provide the potential electric energy production assuming the presence of two PV technologies: cadmium telluride and polycrystalline silicon. In this case the air temperature data have been used to include the temperture-efficency factor in the PV modules.
Results shows an improved accuracy in estimated incoming solar radiation compared to the standard methods used due to clouds and atmospheric turbidity calculation used in our method. Moreover we set a specific method to estimate shadows effects of close and far objects: the problem is in adopting an appropriate horizontal resolution and maintain the calculation time for the entire geographical domain relatively low. Our methods allow estimating the correct horizontal resolution for the area given the digital elevation model of the region.
Finally a web-based-GIS interface has been set up to display the data to public and a spatial database has been developed to handle the large amount of data.
The current results of our project demonstrate how is possible to use scientific know-how and climate products to provide relevant and simple-to-use information to stake holder and political bodies. Moreover our approach show how is possible to have a relevant impact in current political and economical fields associated to local energy production and planning.