Improving Shadows Detection for Solar Radiation Numerical Models

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Abstract

Solar radiation numerical models need the implementation of an accurate method for determinig cast shadows on the terrain or on solar collectors [1]. The aim of this work is the development of a new methodology to detect the shadows on a particular terrain. The paper addresses the detection of self and cast shadows produced by the orography as well as those caused by clouds. The paper presents important enhancements on the methodology proposed by Montero et al. [2] to detect the shadows caused by the orography. The domain is the terrain surface discretized using an adaptive mesh of triangles. A triangle of terrain will be under cast shadows when, looking at the mesh from the Sun, you can find another triangle that covers all or partially the first one. For each time step, all the triangles should be checked to see if there are cast or self shadows on it. The computational cost of this procedure eventually resulted unaffordable when dealing with complex orography such as that in Canary Islands thus, a new methodology was developed. This one includes a double filtering system to identify which triangles are those likely to be shadowed. If there are no self shadowed triangles, the entire mesh will be illuminated and there will not be any shadows. Only triangles that have their backs towards the Sun will be able to cast shadows on other triangles. Detection of shadows generated by clouds is achieved by a shadow algorithm using satellite images. In this paper, Landsat 8 images have been used. The code was done in python programming language using arcpy (ArcGIS Functions), numpy (Matrix Functions) and bitarray (Bits Functions) libraries. Clouds and shadows detection have been used through surface and clouds temperature estimation algorithms. Finally, the outputs of both approaches, shadows generated by the orography and generated by clouds, can be combined in one map. The whole problem has been tested in Gran Canaria and Tenerife Island (Canary Islands - Spain), and in the Tatra Mountains (Poland and Slovakia).

References

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