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The Effects of Topography on Shortwave solar radiation modelling: The JGrass-NewAge System way

Wuletawu Abera, Giuseppe Formetta, and Riccardo Rigon
Department of Civil and Environmental Engineering, University of Trento, Trento, Italy

The NewAGE-SwRB and NewAGE-DEC-MOD's are the two components of JGrass-NewAge hydrological modeling system to estimate the shortwave incident radiation. Shortwave solar radiation at the land surface is influenced by topographic parameters such as slope, aspect, altitude, and skyview factor, hence, detail analyses and discussions on their effect is the way to improve the modeling approach. The NewAGE-SwRB accounts for slope, aspect, shadow and the topographical information of the sites to estimate the cloudless irradiance. The first part of the paper is on the topographic parameter analysis using Udig GIS spatial toolbox, which is integrated in JGrass-NewAge system, and indicates the effect of each topographic parameters on the shortwave radiation. A statistical study on station topographic geometry (slope, aspect, altitude and Sky-view factor) and correlation of pairs of measurements of station analyzed to get closer look at the impact of rugged topography. The jackknife correlation coefficients has been used to analyze the estimate bias between shortwave radiations in different topographic geometric position, thereby helping to develop generalized linear models to explain the impacts of those topographic features.

In addition to the NewAGE-SwRB accounts for the topographical parameters, there are three (an estimation of the visibility extent(V), the single-scattering albedo fraction of incident energy scattered to total attenuation by aerosols (Wo), and fraction of forward scattering to total scattering (Fs)) parameter needed to run the NewAGE-DEC-MOD's component. Sufficient knowledge regarding the magnitude and spatial distribution of the these parameters are very crucial. In this paper, the particle swarm NewAge component of the NewAge System used for automatic calibration of NewAGE-DEC-MOD's parameters for each stations based on different optimization and objective functions.

Finally, the estimated parameters for all measurements station are interpolated in space, and, Kriging spatial interpolation techniques has applied to give their spatial structure. Different variogram models were determined to explain the spatial corrologram of parameters over space, and in return, used to estimate spatially distributed parameters using kriging. Jackknife kriging, which is a rekriging of each station by eliminating one sample from the original sample set and then taking the average of the rekriged estimates, has been used to test the practical validity of the model. The method gives better estimation and also resulting with standard deviation as useful indicator of uncertainty associated with station estimates. This analysis helps to understand spatial variability of radiative transmittance with position, height, aspect, slope and other topographic features. Two basin shortwave radiation data set (one in flat topography and the other in mountainous topography) are used to test statistical analysis of the modeling components of JGrass-NewAGE model systems.