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Lysimetric calibration and uncertainty analysis of empirical parameters of the SEBAL algorithm in subtropical climate

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Understanding the spatio-temporal variation of evapotranspiration (ET) over irrigated agricultural areas is important to help to water management. Many remote sensing methods have been developed to estimate ET, among them the most widely used is the Surface Energy Balance Algorithm for Land (SEBAL). However, the SEBAL was developed for particular satellite sensors and regions, in which functions and empirical parameters within its algorithm are corresponding to these regions and sensors. Therefore, the aim of this study was to calibrate the SEBAL algorithm for images of Landsat 8, through calibration by lysimetric data in the subtropical climate. The study was carried out in two subtropical climate regions in Brazil. The first in the city of Piracicaba in the São Paulo state and the second in the city of Dourados in the Mato Grosso do Sul state. The images Landsat 8 and the meteorological data are matching for the year 2013 to 2017 on a monthly scale for images and of 15 minutes for the meteorological data. Utilizing the SEBAL algorithm, it was estimated all the components of the energy balance and consequently the ET. Toward to verify the parameters with more influence in the SEBAL algorithm, the technique Latin Hypercube One-factor At-a-Time was used for sensibility analysis. Next, the calibration, strictly speaking, was performed by minimizing the residual sum of squares in which the following Particle Swarm Optimization (PSO) methods were tested: (i) Standard PSO – 2007 (SPSO-2007); (ii) Standard PSO – 2011 (SPSO-2011); (iii) Fully Informed Particle Swarm (FIPS); (iv) Improved PSO (IPSO), and (v) Canonical PSO (CPSO). The best PSO method was selected by using goodness-of-fit measures. The sensibility analysis highlighted the empirical function parameters of the soil heat flux, incoming longwave radiation and, momentum roughness length were the most important SEBAL algorithm parameters. According to the PSO methods, the best was FIPS, thus the parameters calibrated on uncertainty levels were determined and may be used to compose the update of the SEBAL algorithm for images Landsat 8 in the subtropical climate.