EMS Annual Meeting Abstracts
Vol. 11, EMS2014-115, 2014
14th EMS / 10th ECAC

Sensitivity of reference evapotranspiration to changes in meteorological parameters in Spain (1961-2011)

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This study analyzes changes in monthly reference evapotranspiration (ETo) by use of the Penman-Monteith equation and data from 46 meteorological stations in Spain from 1961 to 2011. Over the 51 year study period, there were trends for increasing average ETo during all months and annually at most of the individual meteorological stations. Sensitivity analysis of ETo to changes in meteorological variables was conducted by increasing and decreasing an individual climate variable holding the other variables constant. Sensitivity analysis indicated that relative humidity, wind speed, and maximum temperature had stronger effects on ETo than sunshine duration and minimum temperature. The analysis showed a dominant latitudinal spatial gradient in the ETo changes across the 46 meteorological observatories, mainly controlled by the increasing available solar energy southward. In addition, the role of different meteorological variables on ETo shows spatial differences controlled by the average climate conditions at each observatory. ETo trends are mainly explained by the decrease in relative humidity and the increase in maximum temperature since the 1960s, particularly during the summer months. The physical mechanisms that explain ETo sensitivity to the different physical variables and current ETo trends are discussed in detail.