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Spatiotemporal rain-fed wheat modeling using a land surface model and a crop stress index

Sadegh Ghazanfari (1), Amin Alizadeh (2), Alireza Faridhosseini (2), and Saket Pande (3)

(1) Graduate University of Advanced Technology, Kerman, Iran, (2) Ferdowsi University of Mashhad, Iran, (3) TU Delft, Delft, Netherlands

Rain-fed wheat yield estimation is an important issue in crop modeling. Regression and empirical equations are generally used to estimate wheat yields based on effective factors. These equations also need to be calibrated for each study area. Further, employing inaccurate inputs increases prediction uncertainty. Precipitation is the most important input for the rain-fed crops modeling and often interpolated data for areas without rain gauges is used. In this study, the outputs of two precipitation estimation models based on remotely sensed data, PERSIANN and TRMM, are used as alternatives to interpolated data. Results show that the precipitation estimation models outputs are more correlated with observed data than the interpolated precipitation data. Correlation coefficient at a meteorological station in Iran based on Kendall's test is 0.8 for PERSIANN while it is 0.4 and 0.5 for two interpolation methods, Inverse Distance Weighting and Kriging respectively. A simple evaporation/transpiration scheme (SETS), which is a distributed land surface model, has also been developed to estimate actual evaporation and transpiration. Finally a new crop stress index based on actual by potential transpiration (APT) is introduced to model crop yield by using SETS outputs at field scale. Results show that modeling crop yields based on APT, when SETS is forced by local field datasets at 10 sites, can estimate yields reasonably well when compared with other methods. The correlation coefficient with the observed yield data is at least 0.5 and the LSD (Least Significant Difference) test show no significant difference between measured and modeled yields at all sites. Our estimation method performs better than other methods in estimating yields based on the yields predicted by the other methods at the same sites.