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Drought early-warning driven by Remote sensed data in Henan Province, China

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Drought is the most common natural disaster that heavily affects the crop yield in Henan Province, the major food producer in China. Although there has been lots of study on drought monitoring during the past decades, drought early-warning is still difficult. In order to decrease the losses that come with drought as much as possible, it is necessary to combine remote sensing data and soil water budget model to monitor and predict the trend of drought. This paper describes the building, validation and application of a drought early-warning model.
The model is designed to simulate the soil water balance for the winter wheat & maize growing areas in Henan Province on a daily basis. The model is a simple soil water budget model and is initialized by the soil moisture retrieved from MODIS data, which results in the application of model at a spatial resolution of 1 km. The input data include meteorologcal data (daily precipitation, air temperature, air humidity, wind speed and sunshine period), soil physical data (soil texture and available soil water capacity), topographical data (elevation, slope, aspect) and auxiliary data (crop growth period, latitude and so on). Emphasis is put on the estimation of actual and potential crop evapotranspiration by FAO Penman-Monteith equation, in this way, a daily drought warning index is defined by the ratio of actual to potential evapotranspiration. Through the simulation of soil evaporation and vegetation transpiration, soil moisture and drought index can be predicted if weather forecast data are available.
The initialized soil moisture is vital for this model. In this study, an Advanced Temperature Vegetation Dryness Index (ATVDI) is used to monitor initialized soil moisture status using an improved surface temperature and a vegetation index space that is formed by the theoretical dry edge determined by the surface energy balance principle and the wet edge extracted from water surface temperature. The ATVDI can be calculated from MODIS land surface temperature and vegetation index data.
The model is preliminary tested in Henan Province in July, 2007 as a case study. The soil moisture was firstly estimated with MODIS data in the Julian day of 185, and then daily soil moisture and drought warning index maps were produced in the next 8 days. The time series of drought warning index show that drought was gradually decreased in the south-central area, which was in good agreement with the temporal and spatial pattern of precipitation. The soil moisture and drought warning index data in Julian day of 193 were compared with MODIS retrieved ATVDI. The results show that the model has the potential to predict the dynamic changes of drought, and the spatial pattern of drought index is close to that of ATVDI on a whole, while the agreement is relatively higher in the southern, which is probably relevant to the soil texture. . Nevertheless, the statistical estimation of soil moisture at deeper depth from surface layer data and the simplified method to simulate soil water processes are the two main factors to limit the accuracy, the model is still need to be improved.