



Assessing and mapping crop vulnerability to drought using multi-criteria method

Maja Slejko (1), Klemen Bergant (1,2), Gregor Gregorič (2), and Samo Stanič (1)

(1) University of Nova Gorica, Nova Gorica, Slovenia, (2) Environmental Agency of the Republic of Slovenia, Ljubljana, Slovenia

Drought is a recurrent meteorological phenomenon that can cause economic, social and environmental damage. The extent of its impact largely depends on the vulnerability of the affected system. Agricultural vulnerability to drought is generally referred to as the degree to which agricultural systems (crops) are likely to experience harm due to drought stress. When drought occurs, vulnerability of crops depends on several parameters, the most important ones being the ability of the particular type of crops to adapt to drought stress and the micro-location of its growth (soil characteristics, amount of solar radiation and terrain configuration).

In the past decade there were four severe agricultural droughts within the territory of Slovenia, which resulted in the damage of most of non-irrigated crops and considerable economic loss. As a pilot case for drought management vulnerability assessment of the Goriška region was performed in 2008, which was further extended to the entire area of Slovenia in 2010. GIS based methods with multi-criteria evaluation can produce spatial information on the vulnerability of agricultural areas in the form of maps. We focused on the use of weighted linear average method within the Idrisi Taiga GIS software application where factors are combined by assigning weights to the assessment criteria. The weighted criteria are combined and multiplied by the constraints to yield the final vulnerability map with spatial resolution of 100m in both longitude and latitude. A pair-wise comparison technique developed by Saaty in 1977 was chosen for the selection of weights.

The significance of drought impact on agriculture was evaluated on a five-grade scale based on five different criteria, which were used according to the availability of the data. We have used digital data for soil water-holding capacity, slope, solar radiation, land use and irrigation infrastructure. Vulnerability distributions were arranged according to administrative units - Graphical Units of Agricultural Land (GERK). Although in the present study the evaluation grades were assigned subjectively, we are introducing objective tools and models to improve the evaluation. In the case of the assessment of the vulnerability of land use for certain types of crops in a specific GERK, we are using irrigation scheduling model IRRFIB, which estimates water consumption by crops during their growing and ripening season. The reliability of our vulnerability assessment model was checked through comparisons of its predictions to the data on agricultural damage in 2006, which were in good agreement. We are currently focused on the sensitivity analysis to determine robustness and stability of the final vulnerability maps. Reliable drought vulnerability maps will provide the necessary information to decision makers and stakeholders based on which they can decide on the optimal drought management strategies, such as appropriate choice of the crop hybrid, organic additives to the soil or irrigation.