Drought vulnerability assessment for the agriculture: a case study for the west part of Slovenia

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Motivation

During recent years concern is raising about the frequency and impact of drought, also climate change scenarios predict increase in water-related stresses in Europe, likewise in Slovenia. Recent drought events in the west part of Slovenia and the magnitude of drought losses indicate the continuous vulnerability of the area to drought. There is a need to develop a methodology for drought vulnerability assessment and mapping of agricultural systems at regional and local scale. We aim to identify areas which are the most vulnerable and to develop appropriate actions that can be taken to reduce vulnerability before damage occurs.

Approach

We checked and collected data related to past drought events in the region. With the use of interaction matrices we identified the most significant impacts of drought on agricultural systems and find out that there is a number of parameters that influence drought vulnerability in agricultural system. We prepared a vulnerability model with the use of Geographic Information Systems (GIS) software (ProVal 2000 – developed in Slovenia). The model was adjusted to the available and appropriate spatial data set. We used the overlay technique with weighting score. On the basis of the vulnerability model and spatial data, vulnerability levels were estimated with agrometeorological model IRRFIB and expert judgments and mapped.

Elements of the interaction matrix were determined subjectively; however, objective tools and models could be applied to improve estimation. For that purpose we have applied an irrigation scheduling model IRRFIB (developed at AgMet Department of Meteorological sector of Hydrometeorological Institute of Slovenia) which calculates water consumption by crops during their growing and ripening season taking into account soil characteristics, phenological phases of crops, rooting depth and naturally atmospheric conditions. Water demand of certain crops on certain soil type is closely related to their vulnerability to drought. We used IRRFIB model for the objective assessment of the vulnerability according to the land use, e.g. individual plants, which are representatives of the vulnerability classes.

Results

The output was drought vulnerability map with classes identifying geographical areas - Graphical Units of Agricultural Land (in Slovene: GERK) with different vulnerability to drought in a colour-coding ranging from white (low vulnerability) to red (high vulnerability). The vulnerability map provides information on the exposure of particular geographic areas to drought. Spatial resolution is 100 m x 100 m.

Conclusions

The main result of this study is homogeneous and complete drought information which has many potential uses, e.g.: the map can provide decision makers and land owners with information about which area is under a great risk of being affected by drought, identifying of agricultural drought vulnerability can lead to actions to adjust and select appropriate agricultural practices to reduce the impacts on agricultural production and income loss during drought years.

Future work

* Comparisons between results of vulnerability assessment and past data about damage on agriculture in 2006 (attribute: Level of estimated damage to the spatial unit GERK), to check the reliability of our results - accuracy assessment.
* Work on formulation of weather and climate anomalies and their integration into the model.
* We expect input data from regular drought monitoring activities to improve the drought risk assessment.

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