FLOOD MANAGEMENT DECISION MAKING USING SPATIAL COMPROMISE PROGRAMMING WITH REMOTE SENSING AND CENSUS BLOCK INFORMATION

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Flooding is a frequently occurring natural hazard, which costs human hardship and economic loss. Although floods are triggered by natural geophysical processes, the level of hazard caused by a flood depends not only on exposure to flood waters, but also on vulnerabilities that involve consideration of various socio-economic factors such as population at risk, presence and degree of protection offered by flood defense works, early warning systems, etc. Therefore, the selection of an optimum flood control management strategy from a number of potential alternatives requires a complex Multi-Criteria Decision Making approach (MCDM), which takes into account all these criteria.

In the current practice, flood-control management studies are generally carried out using steady, one-dimensional (1D) numerical simulations. This approach does not give reliable information on water depths, velocities, and arrival times. Traditional MCDM approaches rank alternatives based on criteria values averaged over relatively large areas. This approach overlooks the spatial variability of decision criteria and does not address the issue of conflicting preferences of stakeholders.

The present study introduces the use of Spatial Compromise Programming (SCP) technique for flood control management decision making based on 2D flood simulations with CCHE2D-FLOOD (Ying et al., 2003, and Ying and Wang, 2004). Spatial Compromise Programming (SCP) is a recently developed MCDM technique (Tkach and Simonovic, 1997). In contrast to other MCDM approaches, SCP has the ability to rank alternatives based on a distance metric, which is a weighted sum of deviations of decision criteria from their respective best values. The metric distance is spatially varied and measures how close an alternative is to the ideal solution. Using this technique, a new toolbox has been developed within the framework of widely used GIS software, ArcGIS. This toolbox provides a user friendly interface to build various user-defined criteria, such as loss of life and flood damage, based on 2D hydrodynamic simulation results, classified Remote Sensing (RS) image layers, and other GIS feature layers. The SCP computations are carried out using raster algebra. The final result is a raster map (Fig. 1) showing the index of alternatives with the smallest distance metric.

The capabilities of the SCP toolbox are demonstrated by solving a test case concerning the evaluation and ranking of hypothetical flood control alternatives for 100-year flood mitigation of a river in southeastern United States. It is found that the SCP toolbox provides a highly versatile environment for spatial multi-criteria comparison of flood mitigation alternatives, and it may greatly facilitate decision making process. The SCP toolbox can be easily modified for use in a large variety of planning and management applications, and multi-criteria decision making in planning sustainable use of water and land resources.

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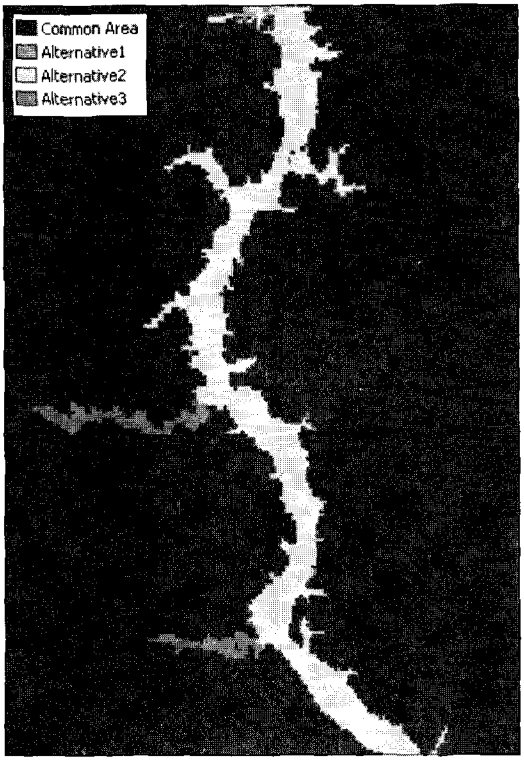

Fig. 1 Spatially distributed ranking of alternatives using SCP analysis