

Integration of Geographical Information Systems and Multi-Criteria Decision Analysis

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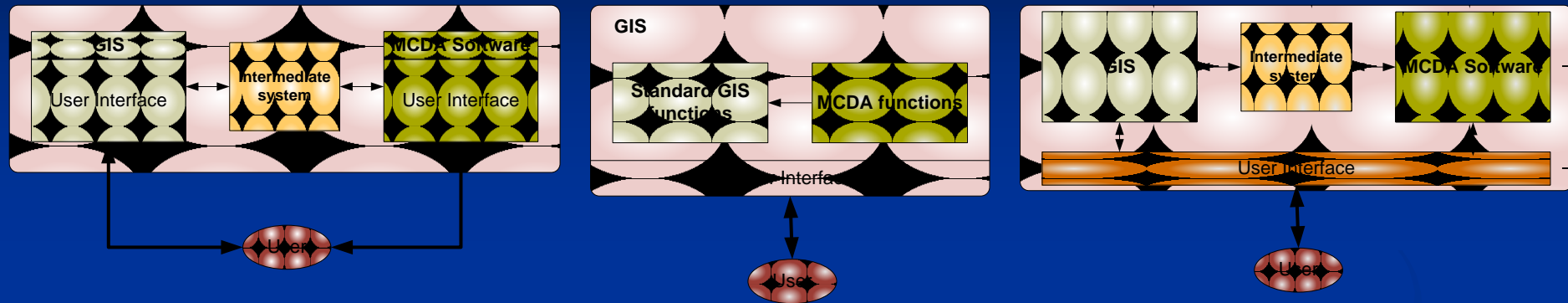
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GIS-based MCDA

- Many decision tasks are concerned with spatial preferences and/or patterns
- Decision problems that involve spatial data and information are referred to as *spatial decision problems*
- Spatial decision problems often require that a large number of feasible alternatives be evaluated based on multiple criteria; thus, spatial decisions are multi-criteria in nature

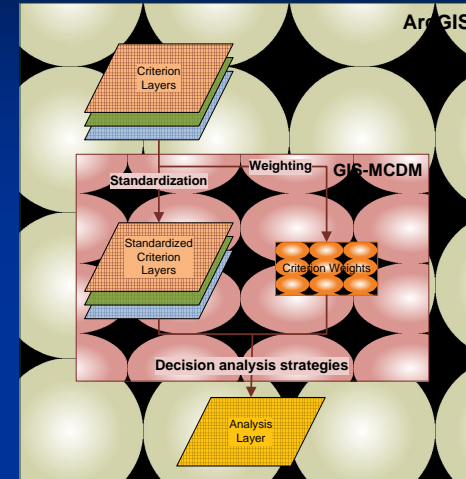
Integration of GIS and MCDA



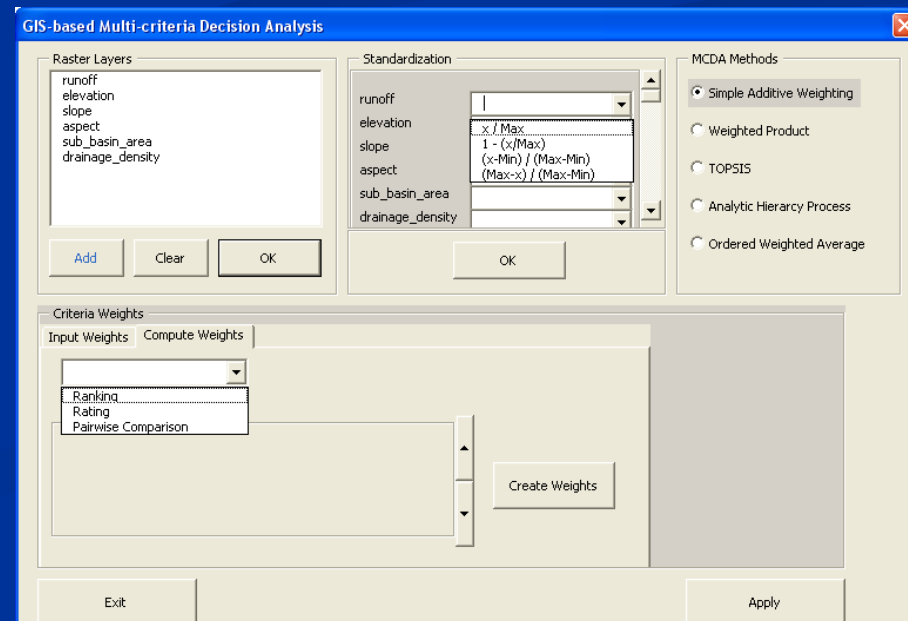
- **Loose integration mode:** The integration of GIS software and a stand-alone MCDA software is made by the use of an intermediate system
- **Tight integration mode:** A particular MCDA model is directly added to the GIS software. The MCDA model constitutes an integrated but autonomous part with its own database. The use of the interface of the GIS part alone increases the interactivity of the system
- **Full integration mode:** A fully GIS-MCDA integrated system that has a unique interface and a unique database. Here, the MCDA method is activated directly from the GIS interface, as any GIS basic function

The GIS-MCDA Tool

- ✓ was written in VB using ArcObjects, which is the development platform for ArcGIS
- ✓ deals with raster-based data sets and allows the user to input raster layers, runs the MCDA functions, and displays the analysis result as a layer in ArcMap
- ✓ includes standardization, weighting and multi-criteria analysis methods



- **Standardization**
 - Linear scale transformation
- **Weighting**
 - Ranking
 - Rating
 - Pair-wise comparison
- **Multi-criteria analysis**
 - SAW
 - WPM
 - TOPSIS
 - AHP
 - OWA



A Case Study

- The study area is the South Marmara Basin in Turkey
- The area of the basin is about 6300 km²
- Six evaluation criteria were taken into account: runoff, elevation, slope, aspect, sub-basin area and drainage density
- Annual rainfall data collected from 82 meteorological stations, 1/25000-scale topographical maps, digital elevation data and soil data, and ASTER-1B satellite images were used to prepare the criterion layers
- AHP was implemented to produce a flood vulnerability layer

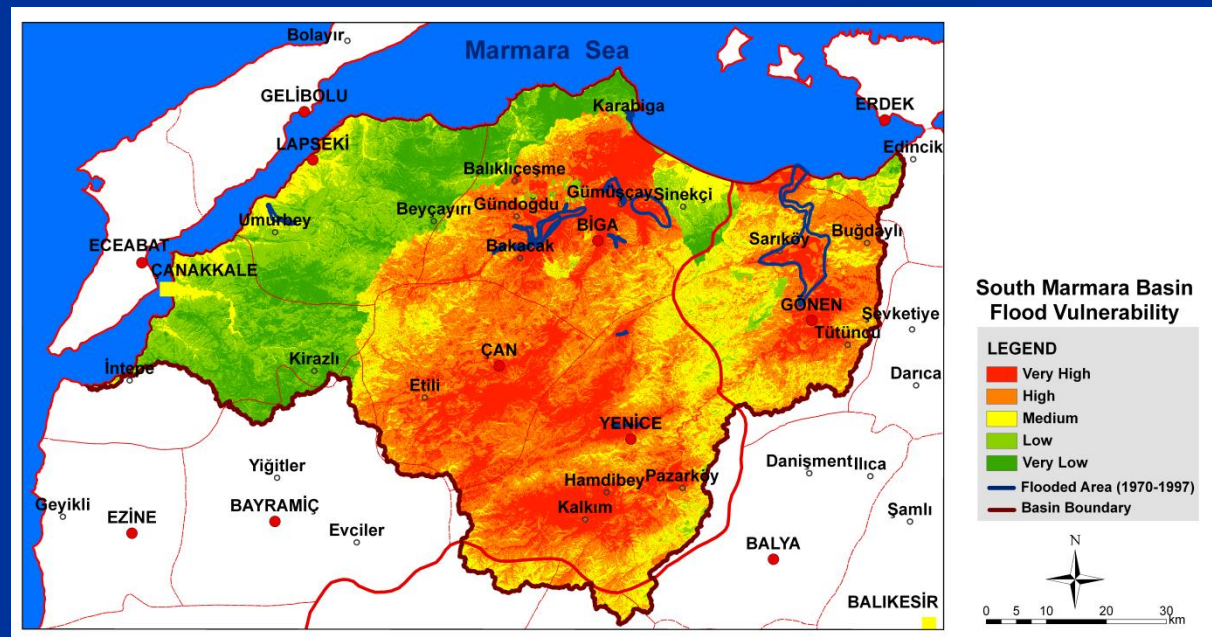
very high (0.89-0.75)

high (0.75-0.71)

medium (0.71-0.65)

low (0.65-0.59)

very low (0.59-0.41).



Conclusion

- **The tool, GIS- MCDA,**
 - integrates GIS and MCDA
 - has a range of multi-criteria evaluation capabilities, including criterion standardization, criterion weighting and decision analysis procedures
- **An application of GIS-based MCDA by applying the GIS-MCDA tool to a real-world problem that involved determining flood vulnerability in the South Marmara Basin in Turkey**
 - The analysis gave realistic results
 - It is anticipated that such methodologies can play an important role in disaster management
- **Because the methods performed by GIS-MCDA are generic, the tool can be used for many other decision applications, including natural resource management, land-use planning and suitability evaluation**