Geophysical Research Abstracts,
Vol. 11, EGU2009-1863, 2009
EGU General Assembly 2009

Multi-component mapping of karst features with remote sensing, digital elevation data and GIS: a case study from Central Crete

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The application of remote sensing (RS) and GIS techniques based on high resolution satellite imagery in combination with digital elevation models (DEMs) can provide detailed information for geomorphologic purposes such as karst feature mapping. Moreover, area wide surveying is significantly improved and supported, as computer applications allow a very cost and time effective proceeding.
The exemplary focus of the project at hand is on the Ida-Ori in Central Crete, a high mountain range predominantly consisting of Palaeozoic to Mesozoic limestones and dolomites. Subdivided into several vast high plateaus, its main geomorphologic characteristics are dry valleys of Miocene age and an intense karstification reaching from the base up to the highest peak at 2456 m a.s.l. Nearly all types of karst forms appear in immediate adjacency, while dolines, uvalas and poljes are the most frequent objects. Such depressions provide sediment traps for eroded soils or aeolian deposits and, thus, can be significantly filled with colluvial materials. Since the area wide karstification of Mount Ida has not been fully explored so far, the prime objective is to evaluate the potential and suitability of satellite data and DEMs (SRTM 90m, ASTER 15m) for the precise mapping of those structures. Furthermore, the dominant influencing variables of karst processes are investigated.
To acquire spatially comprehensive information, Quickbird MS tiles (0.6 m resolution) were used for land surface classifications with RS-techniques. Subsequent to image correction and enhancement, a hybrid parallelepiped maximum likelihood classification approach was carried out. Postprocessing and conversion of raster data into vector format finally allowed spatial analyses in a GIS environment. Derivatives of DEMs (slope, aspect, contours, curvature, hydrologic drainage pattern) were generated in order to assess their suitability for karst mapping and to specify the remote sensing outcomes, particularly by conducting GIS layer intersections.
The results indicate a significant altitudinal change of typical karst forms due to changing climatic thresholds. Larger depressions mostly appear at medium altitudes, while dolines are ubiquitously distributed. Besides elevation, heterogeneous petrographic attributes as well as tectonic stress lead to a spatially different intensity of karstification. Size and shape of karst features may also vary considerably with regard to the geological setting.
As demonstrated by our investigations, standard RS-techniques based on satellite imagery are of great value for morphological studies but - just as the exclusive use of DEMs for karst landform detection - they can not record area wide karstification comprehensively, if solely implemented. Since applicability problems caused by unsuitable spatial and spectral resolution may hamper these methods, a multi-component approach with supplementary data as additional detection criteria helps to improve the analysis. Hence, the combination of high resolution imagery and digital elevation models offers promising prospects to further karstmorphologic mapping.