Automatic extraction of geomorphologic features using Digital Elevation Models

Eleni Kokinou (1,3), Costas Panagiotakis (2,3), Efstathia Toulia (1), and Mandi Kavouri (1)

(1) Laboratory of Applied Geology and Hydrogeology, Department of Environmental & Natural Resources Engineering, Technological Educational Institute of Crete, Chania, Crete, Greece (ekokinou@staff.teicrete.gr, efi_toulia@yahoo.gr, mandykvr@gmail.com), (2) Department of Business Administration, Technological Educational Institute Crete, 72100, Agios Nikolaos, Crete, Greece (cpanag@staff.teicrete.gr), (3) Foundation for Research and Technology-Hellas, Institute of Computer Science, 70013, Heraklion, Crete, Greece

The automatic extraction of geomorphologic features using digital elevation models (DEMs) belongs to the remote sensing techniques used to improve our understanding in a variety of disciplines in the geosciences (i.e. remote sensing, topography, geology, archaeology, oceanography and others) prior the fieldwork and later during data processing and interpretation. This approach highly contributes towards a rapid, objective and lower cost fieldwork. In the present work, recently developed techniques of pattern recognition in the context of European Projects (NEREIDs, Sea4All), are applied on digital elevation models (DEMs) from onshore and offshore areas of the Mediterranean aiming to a) demonstrate their efficiency, and b) partly compare the results of the automatic detection with geological data provided either from previous researches or ground truth data.

Panagiotakis and Kokinou (2014, 2015, and 2017) have implemented the two-step methodology, to process digital elevation models. It was applied partly or in whole in previous onshore and offshore geological and environmental studies. The proposed approach is based on a) the automatic detection of topographic highs and computation of the geomorphologic features (orientation, eccentricity, average slope, and shape complexity) and b) the automatic detection of lineaments, possibly related to the presence of geological faults or other subsurface processes.

The two-step methodology has been evaluated on real and synthetic digital elevation models of medium and high accuracy that correspond to onshore and offshore environment. The experimental results demonstrate the high performance of the proposed approach on several real and synthetic topographic data. In our tests major and accompanying geomorphologic structures (lineaments, geological faults, topographic highs and depressions und others) are estimated with high precision concerning their location, shape, and orientation. Furthermore, the financial cost of the fieldwork severely decreases, since prior to the fieldwork geomorphologic structures of interest are identified with great precision and scheduled to be examined.