SEMI-AUTOMATIC DERIVATION OF HYDROGRAPHIC NETWORK

IMPACTS OF HUMAN ACTIVITIES ON HYDROGRAPHIC NETWORK

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INTRODUCTION

The mapping of the channel network plays a fundamental role in manifold landscape management issues, such as geo-hydrological risk analysis, legal matters related to land use, technical cartography and water resources management.

Human activities in mountain regions results in a wide variety of environmental impacts. Human activities that influence runoff generation and drainage pattern have reflections in the context of hydro-geological hazard and water resources management. In some cases, channel network has been modified for drainage and irrigation purposes, in other the alteration of drainage patterns is due to the presence of man-made features, such as roads and new urbanized areas. The last 40 years have seen relevant changes in land use in mountain regions, with an important increase of urbanized areas and road network, and consequent modifications of the hydrographic network. Accordingly, an up-to-date detailed recognition of the channel network is needed for landscape management purposes.

The availability of high-resolution digital terrain models (HR-DTMs) of regional coverage opens interesting prospects for the analysis and the definition of the channel network. These terrain models offer an unprecedented capability to interpret surface morphology and the related geomorphic and hydrological processes. Moreover, the availability of regional HR-DTMs is increasing, thanks to technological developments and decreasing costs of data acquisition and processing.

In this study, we present our experience in the derivation of channel network from regional HR-DTM for an alpine region (Autonomous Province of Trento, Northern Italy), covering an area of 6500 km^2. The derivation of the channel network is conducted via a geomorphometric approach. Moreover, we analyze the interaction between human activities and the channel network by comparing the channel network derived from the HR-DTM with field evidences collected during extensive field surveys.

METHODS

A HR-DTM (cell size of 2 m), derived from an airborne LiDAR survey in 2006, is available for the Autonomous Province of Trento. We tested two different morphological algorithms for extracting the channel network from the HR-DTM: a curvature-based and a modified slope-area approach. Both approaches generate suitable results in terms of drainage density and channel heads location, but the curvature-based algorithm was preferred for its better performance in low-slope areas. However, the automatically derived channel network represents a raw hydrographic network that needs a supervised control analysis. The check and correction procedure was carried out by means of interpretation of high-resolution orthophoto imagery (panchromatic and near-infrared, pixel size 0.5 m), geomorphometric indexes derived from the HR-DTM (shaded relief, openness, local anomalies, curvature, etc.), technical cartography (1:10000 and 1:25000 scale).

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The final result is an accurate and scale independent definition of channel network of the study area. Nevertheless, where man-made features (roads, culverts etc.) and urbanized areas are present, this method is not capable of deriving the effective channel network. In these areas, where the aerial photo and geomorphometric indexes interpretation is also difficult, field surveys are needed in order to revise the flow paths defined by the automatic derivation procedure (Fig. 1).

CONCLUSIONS

The analysis conducted shows that the channel network derived from the HR-DTM represents a powerful tool in the context of landscape management issues. The "raw" derived channel network proved to be highly representative in areas less affected by human activities, also in presence of dense vegetation cover and complex morphology. In urban area and in zones with a strong anthropic influence, the raw channel network has to be complemented and corrected via field surveys and expert supervision. Nevertheless, it is worth to stress that the raw channel network in urban areas, although not realistic for ordinary flow regimes, can represent the real flow paths for extreme floods (Fig. 2).
The HR-DTM derived channel network represents an objective tool for the cartographic definition of channel network. This approach constitutes a cost/time efficient methodology that fits well with the today needs of a dynamic and constantly up-to-date cartography.

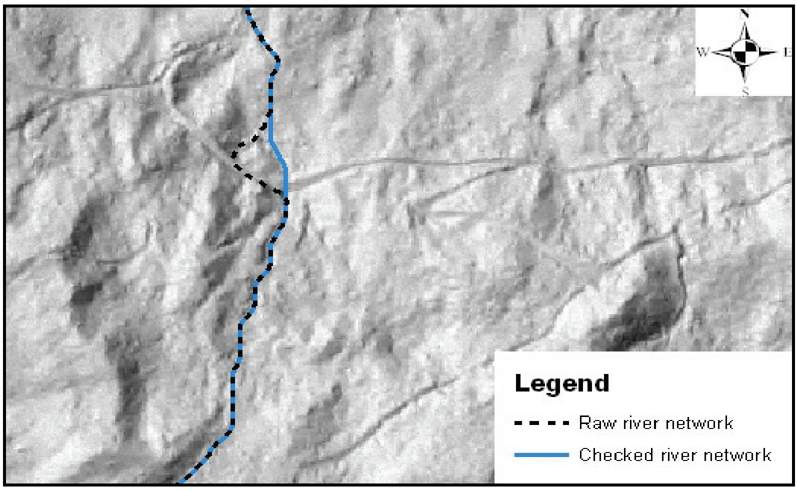

Fig. 1 An example of raw channel network (black dashed line) and corrected flow path (blue line).

Fig. 2 Secondary road after an extreme flood (by courtesy of Moreschini R.).

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