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The influence of spatial variability of lithological and morphometric characters on drainage network arrangement

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Several factors control the spatial setting and temporal development of the drainage systems: climate, sea level changes, lithology, tectonics, morphometry, land use and land cover. The present work deals with the role of spatial variability of lithology and morphometry on drainage networks arrangement and presents some preliminary evaluations. The test area was the Periadriatic belt of central Italy, composed of Plio-Pleistocene foredeep succession (clay, sands and conglomerate) arranged in a northeastern vergence monocline.

We analyzed 37 small basins directly flowing in the Adriatic Sea (18 in Abruzzi and 19 in Marche Region) that have homogenous climatic, eustatic, tectonic, land use and land cover features. For this reason, we could focus our research on lithology and morphometry. We used 10 m cell-size Italian DEM (TINITALY) supplying by INGV (National Institute of Geophysics and Volcanology) [from http://tinitaly.pi.ingv.it/] as source of morphometric data, and extracted watersheds and stream networks through an automatic procedure included in *TauDEM* toolbox within ArcGIS 9.3 [freely downloaded from http://hydrology.usu.edu/taudem/taudem5/index.html]. For each drainage basin, we reconstructed the topography prior to the inception of fluvial incision through the *Topo-to-Raster* interpolation tool, considering the heights of the watershed divide as *elevation points* and obtaining the pre-incision DEM in which the fluvial valleys resulted filled. On this DEM, we calculated the Morphometric Slope Index (*MSI*), developed by Buccolini et al. (2012), using the formula

$$MSI = R_c \cdot L \cdot A_r / A_{2D}$$

in which R_c is circularity ratio, L is slope length, A_{2D} and A_r are plane and surface area, respectively. In particular, A_r represents the three-dimensional area calculated on the pre-incision DEM. This index is a unique reference index for basin morphometry including both areal and linear features, such as size, shape, inclination, length and width. As drainage network parameter we calculated drainage density (D) computed by the ratio between total drainage length and basin area. We used National and Regional Geological Map as source of lithological characters. The data were analyzed via statistics in terms of average trend and fluctuations.

We split the basins into two groups according to the prevalent lithology. The first group included the basins prevalently made up of clays and sandy clays, the second includes the ones mainly constituted by conglomerates on surface. A Regression Analysis revealed that the influence of *MSI* on D was driven by the lithology. Indeed, we individuated two logarithmic trends of the *MSI*-D interpolators corresponding to the lithological groups. This finding demonstrated the great influence of lithology not only on D and *MSI*, but especially on their relation, depending on the different lithotechnical properties of the lithologies under study.

Further enhancements will focus on evaluating the influence of spatial variability of lithology and morphology on the evolution of the current drainage network. We intend to investigate the future development of the fluvial dynamic starting from the current DEM (instead of the pre-incision one) and considering other variables that are generally deemed as drivers of the fluvial dynamic (e.g. land use, land cover).