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The mountain chain topography as evidence of the linkage between deep and surface earth processes: the case of central Apennines (Italy)

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At the scale of a mountain chain, the surface topography results from the interaction of dynamic mantle processes, crustal tectonics and surface processes. Through DEM-based topographic analysis, we examined the regional tectonic geomorphology of the Apennines, a growing mountain chain contemporary affected by extension on the Tyrrhenian side and by shortening on the Adriatic side. Beginning in the Early Pleistocene, the Apennines have been regionally uplifted resulting in peculiar geomorphic features: deeply incised fluvial valleys, hillslopes widely affected by mass movements, fluvial and marine terraces. Remnants of the pre-uplift topography, a low relief landscape generated in relatively stable base level condition, are still locally preserved on mountain summits. In this context, we investigated the central Apennines topography focusing on regional topographic metrics and drainage morphometry. In detail, we investigated the signature of dynamic mantle and crustal tectonics processes by smoothing a 250 m pixel size DEM in the frequency domain. Attenuating the high frequency signals by a low pass filter with cut-off wavelengths of 30 and 10 km, we are able to illustrate undulations perpendicular to the chain axis. A long wavelength (>30 km) peak (the “Sibillini-Maiella high”) corresponds to a Bouguer gravity anomaly low and a low velocity area at a depth of 40 km, thought to be related to the upwelling of hot asthenospheric material below central Italy. In contrast, the short wavelength (>10 km) undulations are coincident with exposed and buried thrusts. Moreover, streams respond to these undulations by changes in main trunk channel orientation and variation in the concavity and steepness of their longitudinal profiles. The present shape of the stream network and the longitudinal profiles seem to indicate a strong influence of the “Sibillini-Maiella high”, whereas recent activity of buried thrusts on the Adriatic piedmont belt are reflected in lower concavity and steepness of the Periadriatic streams.