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Remote sensing and geomorphometry application in riverscapes evolution in the south-eastern Arabian Peninsula (Sultanate of Oman)

Andrea Pezzotta[1], Alessia Marinoni[1], Mohammed Al Kindi[2], Michele Zucali[1], and Andrea Zerboni[1]
[1]Università degli Studi di Milano, Dipartimento di Scienze della Terra "A. Desio", Milano, Italy (andrea.pezzotta@unimi.it)
[2]Earth Sciences Consultancy Centre, Muscat, Sultanate of Oman

Riverscapes in arid and semi-arid environments serve as crucial archives, enabling us to understand the landscape evolution and the active and fossil geomorphological processes that shape the Earth's surface. Such environmental contexts are generally wide, and these settings are routinely investigated with remote sensing tools. We selected two distinct study areas from the south-eastern margin of the Arabian Peninsula (Sultanate of Oman) to detect climate and tectonic imprints over landform development: 1) Jebel Akhdar (JAK), and its surrounding areas, located in the Al-Hajar Mountains (to the North), is a wide anticline formed by the Late Cretaceous obduction of the Semail Ophiolite and the associated time-equivalent tectonics, followed by the Cenozoic tectonic events; and 2) Jebel Qara (JQA), situated in the Dhofar Mountains (to the South), is placed along the Gulf of Aden transform margin, featuring transtensional faults giving rise to stepped escarpments and grabens. The extant landscapes of both regions are characterized by a network of narrow and deep canyons that incised limestone massifs, while the surrounding plain areas show the development of important alluvial fan systems.

The application of remote sensing is essential for investigating the development of fluvial systems at a regional scale, combined with field survey to validate specific sites of interest, thereby understanding the geomorphological evolution at various scales. Specifically, remote sensing techniques include the processing of satellite imagery and the comparison with the available historical imagery and maps to detect changes in geomorphic processes. Remote sensing and field survey allow the recognizing of different geomorphological features; the dominant ones are represented by elements and landforms related to structural setting, fluvial activity, and karst processes. The associations of the abovementioned landforms make it possible to assess the structural influence on drainage and karstic network development. Data collected from remote sensing implements the geomorphometric quantification of geomorphological processes, mostly considering changes in topography and river network analyses. The most meaningful morphometric indices applied (such as drainage divide stability, normalized steepness index, knickpoint detection, and swath profiles...) suggest their values strongly vary along faults in JAK, highlighted even with the alignment of knickpoints; while, in JQA, values show little changes in correspondence of faults and knickpoints are controlled both by karst and structural settings. In this way, the combination of remote sensing and morphometrical analyses permits to quantify the

central role of litho-structural influence on the development of riverscapes in the south-eastern Arabian Peninsula. This approach facilitates the identification of the primary geomorphological processes that have shaped the landscape in arid and semi-arid contexts of the Sultanate of Oman, making it a versatile method that can be applied to understand the riverscapes evolution processes in analogous regions.