Human-waterscape interactions during the early-mid Holocene: insights from a multi-disciplinary approach in Southern Mesopotamia (Iraq)

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The question of human-waterscape interactions worldwide has been and still is a central topic in historical and archaeological research. The Southern Mesopotamia Plain, where the ancient State of Lagash developed, represents an ideal case study. Indeed, at Tell Zurghul archaeological site, extensive field-works have been recently carried on by the Italian Archaeological Mission and an interdisciplinary approach, combining field surveys and geomorphological mapping through remote sensing techniques, has been applied for analyzing the function and role of the waterscape on the early civilization. Indeed, the geomorphological analysis through remote sensing techniques and archaeological surveys are essential for the reconstruction of a complex environmental system, where landforms due to different morphogenetic processes occur, related to the presence of a wide fluvial-deltaic paleo-system and the human activities.

The Southern Mesopotamian Plain coincides with the Tigris and Euphrates deltaic plain, developed starting since the Mid-Holocene: the maximum marine ingression reached Nasiriyah and Al-Almara about 6000 yrs BP; after that, the paleo-delta progradation shifted the shoreline up to the modern position. The development of a typical bird-foot delta guaranteed an amount of water indispensable for agriculture, settlements, and transport. Indeed, the high mobility of the channels and avulsions processes (i.e. levees breaks and related crevasse splays formation) are the main features typically connected to a multi-channel system, guarantying the water supply through seasonal floods. In the area, the management of water during the mid-Holocene, digging an extensive network of canals and building dams, improved the socio-economic conditions. However, the occurrence of the so-called Megadrought Event, dated 4.2 ka BP, drastically modified the hydroclimatic conditions of the area, favoring arid conditions and improving the frequency of unpredictable extreme hydrological events.

The main aim of the work is to contribute to the reconstruction of the waterscape surrounding the archaeological sites of Tell Zurghul and Lagash and know more about waterscape-human interactions during the Holocene. A multi-sensor approach has been adopted to identify the main geomorphological features and describe the associated morphogenetic processes. The availability of the multispectral Landsat-8 satellite imagery and 30-meter spatial resolution DEMs (i.e. the optical DSM from ALOS and the infrared DTM from ASTER) allowed a supervised classification.
through specific spectral signature and a microtopographic analysis. The spectral signatures of active and inactive crevasse splays have been extracted, discerning among crevasse channels, proximal and distal deposits characterized by coarsest and finest sediment respectively. Moreover, the microtopographic analysis led to recognize channels above inter-floodplains, upward convexity of active crevasse splays and roughly flat topography of inactive ones. The excavations in Area B of the archaeological site shows evidence of the presence of water and the proximity of the sea. Brackish-marine marshes environment has been confirmed by fish vertebrae (belong to “Bull Shark”, i.e. *Carcharhinus leucas*) and fishing net recovered into a mudbrick structure. Moreover, the patron deity of the city in the 3rd millennium BC, was the goddess of the sea and sea species (fish and birds), confirming the strong connection between water and the ancient settlement.