Textural and Compositional Characterization of Wadi Deposits, Using Optical and Radar Remote Sensing

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The present work aims at identifying favorable locations for groundwater resources harvesting and extraction along an arid stream, SW Sinai Peninsula, Egypt, in an effort to facilitate new development projects in this area. Landsat ETM+, Radarsat-1 and PALSAR images were used in this work to perform multisource data fusion and texture analysis, in order to classify the stream deposits based on grain size distribution and predominant rock composition as this information may lead to the location of new groundwater resources. An unsupervised classification was first performed on two sets of fused images (i.e., ETM+/Radarsat-1 and ETM+/PALSAR) resulting in five classes (hybrid classes) describing the main alluvial sediments in the wadi system.

Stream deposits are mixtures of parent rocks located further upstream often at a great distance. In order to classify such deposits in terms of individual rock types (endmembers), a spectral linear unmixing of the optical ETM+ image was performed. Subsequently, each class of the fused (hybrid) images was correlated with (1) individual rock type fractions (endmembers) obtained from spectrally unmixing the ETM+ image, (2) the geocoded and calibrated radar images (Radarsat-1 and PALSAR) and, (3) the slope map generated from the SRTM data. The goal was to determine predominant rock composition, mean backscatter and slope values for each of the five hybrid classes. Backscatter coefficient values extracted from both radar data (C and L-band) were correlated and checked in the field, confirming that both wavelengths produced more or less similar textural classes that correspond to specific grain or fragment sizes of alluvial deposits. Furthermore, both hybrid classification results showed that regardless of elevation, areas that are covered by fine and moderate grains (fine sand to pebble) and are located along gentle terrains are favorable for groundwater recharge; while areas that are covered by very coarse grains (cobble to boulder) and are located along steep terrains are more likely to be affected by flash floods.