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The Use of Optical-Radar Remotely-Sensed Data for Characterizing Geomorphic, Structural and Hydrologic Features and Modeling Groundwater Prospective Zones in Arid Zones

Authors : Mohamed Abdelkareem

Abstract : Remote sensing data contributed on predicting the prospective areas of water resources. Integration of microwave and multispectral data along with climatic, hydrologic, and geological data has been used here. In this article, Sentinel-2, Landsat-8 Operational Land Imager (OLI), Shuttle Radar Topography Mission (SRTM), Tropical Rainfall Measuring Mission (TRMM), and Advanced Land Observing Satellite (ALOS) Phased Array Type L-band Synthetic Aperture Radar (PALSAR) data were utilized to identify the geological, hydrologic and structural features of Wadi Asyuti which represents a defunct tributary of the Nile basin, in the eastern Sahara. The image transformation of Sentinel-2 and Landsat-8 data allowed characterizing the different varieties of rock units. Integration of microwave remotely-sensed data and GIS techniques provided information on physical characteristics of catchments and rainfall zones that are of a crucial role for mapping groundwater prospective zones. A fused Landsat-8 OLI and ALOS/PALSAR data improved the structural elements that difficult to reveal using optical data. Lineament extraction and interpretation indicated that the area is clearly shaped by the NE-SW graben that is cut by NW-SE trend. Such structures allowed the accumulation of thick sediments in the downstream area. Processing of recent OLI data acquired on March 15, 2014, verified the flood potential maps and offered the opportunity to extract the extent of the flooding zone of the recent flash flood event (March 9, 2014), as well as revealed infiltration characteristics. Several layers including geology, slope, topography, drainage density, lineament density, soil characteristics, rainfall, and morphometric characteristics were combined after assigning a weight for each using a GIS-based knowledge-driven approach. The results revealed that the predicted groundwater potential zones (GPZs) can be arranged into six distinctive groups, depending on their probability for groundwater, namely very low, low, moderate, high very, high, and excellent. Field and well data validated the delineated zones.

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