World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:17, No:10, 2023

An Assessment of Floodplain Vegetation Response to Groundwater Changes Using the Soil & Water Assessment Tool Hydrological Model, Geographic Information System, and Machine Learning in the Southeast Australian River Basin

Authors : Newton Muhury, Armando A. Apan, Tek N. Marasani, Gebiaw T. Ayele

Abstract : The changing climate has degraded freshwater availability in Australia that influencing vegetation growth to a great extent. This study assessed the vegetation responses to groundwater using Terra's moderate resolution imaging spectroradiometer (MODIS), Normalised Difference Vegetation Index (NDVI), and soil water content (SWC). A hydrological model, SWAT, has been set up in a southeast Australian river catchment for groundwater analysis. The model was calibrated and validated against monthly streamflow from 2001 to 2006 and 2007 to 2010, respectively. The SWAT simulated soil water content for 43 sub-basins and monthly MODIS NDVI data for three different types of vegetation (forest, shrub, and grass) were applied in the machine learning tool, Waikato Environment for Knowledge Analysis (WEKA), using two supervised machine learning algorithms, i.e., support vector machine (SVM) and random forest (RF). The assessment shows that different types of vegetation response and soil water content vary in the dry and wet seasons. The WEKA model generated high positive relationships (r = 0.76, 0.73, and 0.81) between NDVI values of all vegetation in the sub-basins against soil water content (SWC), the groundwater flow (GW), and the combination of these two variables, respectively, during the dry season. However, these responses were reduced by 36.8% (r = 0.48) and 13.6% (r = 0.63) against GW and SWC, respectively, in the wet season. Although the rainfall pattern is highly variable in the study area, the summer rainfall is very effective for the growth of the grass vegetation type. This study has enriched our knowledge of vegetation responses to groundwater in each season, which will facilitate better floodplain vegetation management.

Keywords : ArcSWAT, machine learning, floodplain vegetation, MODIS NDVI, groundwater
Conference Title : ICGWH 2023 : International Conference on Global Warming and Hydrology
Conference Location : Tokyo, Japan
Conference Dates : October 09-10, 2023