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Mapping Groundwater-dependent Ecosystems in Arid Central Asia: Implications for Controlling Regional Land Degradation

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Groundwater-dependent ecosystems (GDEs) exist all over the world, especially in water-limited regions. To achieve better water management, it is necessary to map and identify GDEs. Central Asia (CA) is one of the most arid regions in the mid-latitudes and one of the major regions with shallow groundwater tables. However, the role of groundwater in the impacts of climate change and regional anthropogenic activities on environmental risks, especially regional desertification, is inadequately understood due to the limited available research on GDEs. In the present study, a remote sensing-based method was used for mapping GDEs in regional CA, and three means—overlay analysis, correlation analysis, and the water balance method—were adopted to validate the accuracy of the mapping outcomes. Our results indicated that: 1) GDEs were concentrated around large lakes and in central Kazakhstan (between 46°N and 50°N latitudes), and areas "Very Likely" and "Likely" to be GDEs accounted for 36.89%, and 28.85% of the total natural vegetation areas, respectively; 2) at the watershed scale, the Sarysu Basin had the largest proportion (94.02% of the area) of potential GDEs while the Ysyk-Kol Basin had the lowest proportion (17.84%); 3) all the three validation methods indicated a good performance for our GDE mapping results. We concluded that the remote sensing-based GDE identification method can be considered a potential approach for mapping GDEs regionally. Better recognition of relationships among groundwater availability, ecosystem health and groundwater management policies should be developed by conducting further studies, to protect GDEs and to prevent regional land degradation.