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Identification, mapping, and eco-hydrological signal analysis for groundwater-dependent ecosystems (GDEs) in Langxi River basin, north China

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Table S1. Sensor parameters of various bands of Landsat series satellites.

Bands	Blue	Green	Red	Nir	Swir1	Swir2
Landsat5TM	0.0315	0.2021	0.3102	0.1594	-0.6806	-0.6109
Landsat7ETM+	0.1509	0.1973	0.3279	0.3406	-0.7112	-0.4572
Lansat8OLI	0.1511	0.1973	0.3283	0.34067	-0.7117	-0.4559

Note: Nir, Swir1 and Swir2 are the near red band, mid infrared band 1, mid infrared band 2.

Table S2. Resources of the remote sensing datasets.

Dataset	Resource	Description
USGS Landsat 8 Level 2, Collection 2, Tier 1	Cook, M., Schott, J.R., Mandel, J., Raqueno, N. Development of an Operational Calibration Methodology for the Landsat Thermal Data Archive and Initial Testing of the Atmospheric Compensation Component of a Land Surface Temperature (LST) Product from the Archive. Remote Sens-Basel. 2014; 6(11):11244-11266. https://doi.org/10.3390/rs61111244	This dataset contains atmospherically corrected surface reflectance and land surface temperature derived from the data produced by the Landsat 8 OLI/TIRS sensors. These images contain 5 visible and near-infrared (VNIR) bands and 2 short-wave infrared (SWIR) bands processed to orthorectified surface reflectance, and one thermal infrared (TIR) band processed to orthorectified surface temperature. They also contain intermediate bands used in calculation of the ST products, as well as QA bands.
NASA SRTM Digital Elevation 30m	Farr, T.G., Rosen, P.A., Caro, E., Crippen, R., Duren, R., Hensley, S. Kobrick, M., Paller, M., Rodriguez, E., Roth, L., Seal, D., Shaffer, S., Shimada, J., Umland, J., Werner, M., Oskin, M., Burbank, D., Alsdorf, D. (2007), The Shuttle Radar Topography Mission. Rev. Geophys., 45, RG2004, doi:10.1029/2005RG000183.	The Shuttle Radar Topography Mission (SRTM digital elevation data is an international research effort that obtained digital elevation models on a near-global scale.

This SRTM V3 product (SRTM Plus) is provided by NASA JPL at a resolution of 1 arc-second (approximately 30m). This dataset has undergone a void-filling process using open-source data (ASTER GDEM2, GMTED2010, and NED), as opposed to other versions that contain voids or have been void-filled with commercial sources.

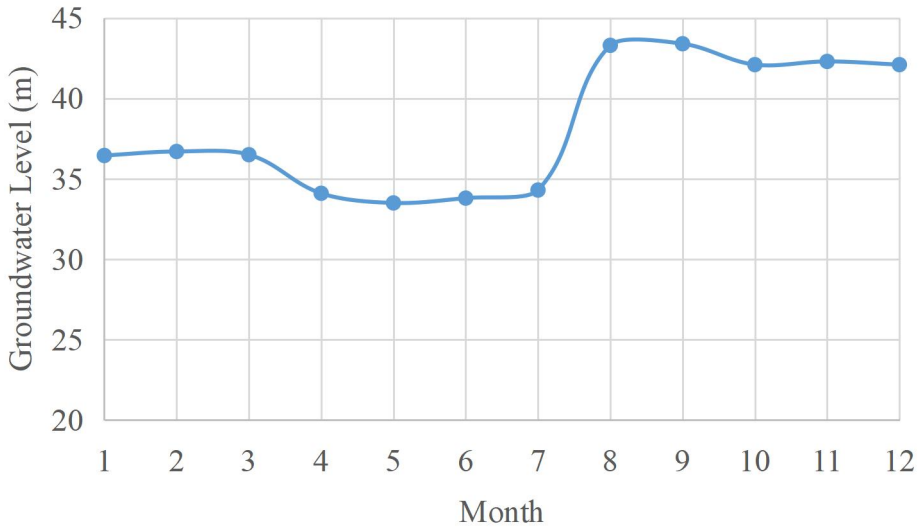


Figure S1. Time series of the average groundwater level in Langxi River Basin in the research period.

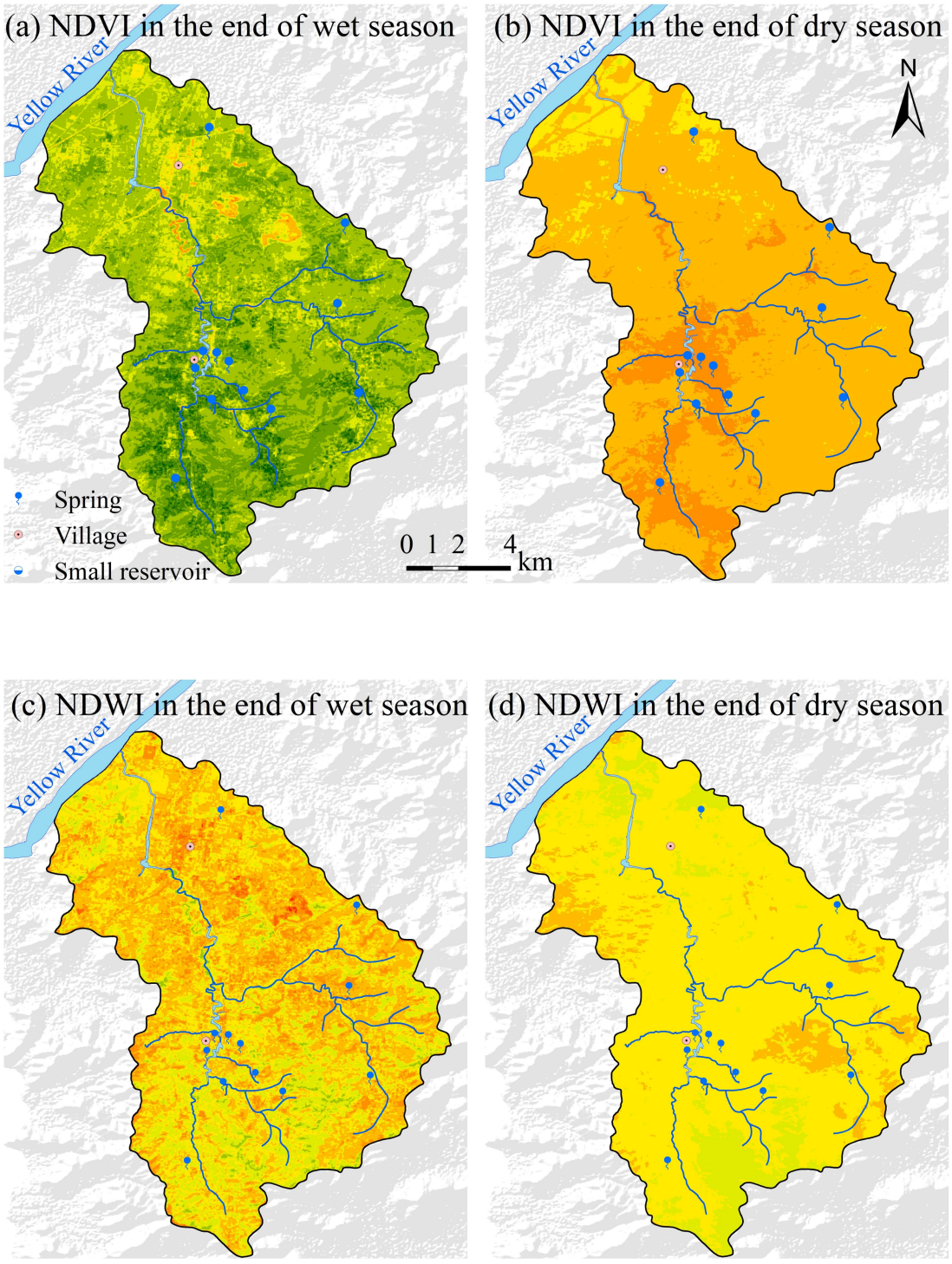


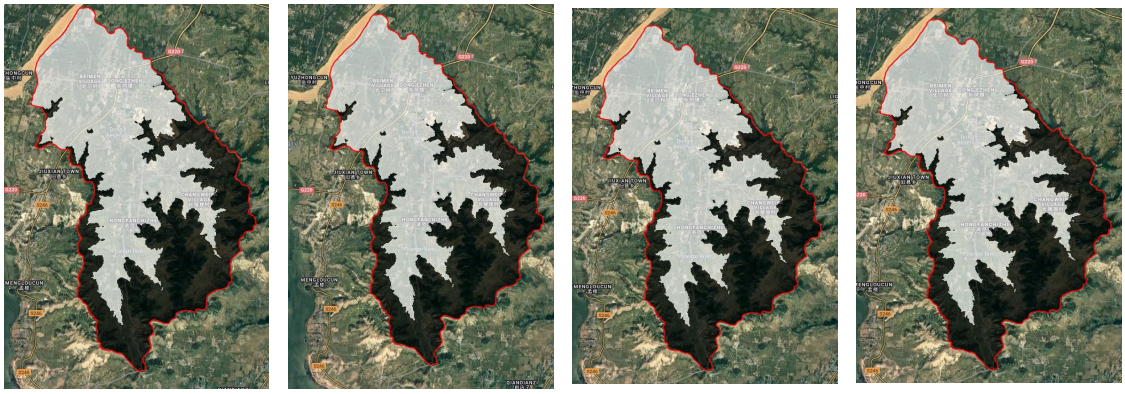
Figure S2. NDVI (a, b) and NDWI (c, d) data for the end of the wet season (a, c) and the end of the dry season (b, d) (2020 to 2021).

In this study, we use elevation and slope to differentiate between plain and hilly areas. The purpose of distinguishing between the two is to judge from a macro perspective whether groundwater can directly supply the surface and near-surface ecosystems above.using digital elevation model (DEM) and slope (calculated by DEM), we can distinguish the plains and hills of the basin (Eq.S1), and further divide the plains of shallow fissure rocks according to the surface lithology, which is the area with the conditions for the formation of GDEs.

$$grid_{plain} = grid_{(slope \leq \Delta_{slope}) \cap (elevation \leq \overline{elevation})} \ , \qquad \text{(Eq.S1)}$$

where, $grid_{plain}$ represents the grid divided into plains; Δ_{slope} is the threshold of the maximum plain slope, in this paper we take $\Delta_{slope} = 10°$. The determination of this parameter can be manually adjusted based on one-third of the average slope of the basin until the plains and mountains are clearly distinguished. $\overline{elevation}$ is the average elevation of the basin. When applying this method in a basin with a significant difference in elevation, we highly recommend adjusting the value instead of simply using the average value.

Below, Figure S3 shows our results of plain and hill classification using 4 different slopes. It can be seen that except for minor differences in details, overall slope does not have a great impact on plains and hills in LRB. This is due to the fact that the mean elevation limits the role of slope in this basin.



(a) $\Delta_{slope} = 5°$ (b) $\Delta_{slope} = 10°$ (c) $\Delta_{slope} = 15°$ (d) $\Delta_{slope} = 20°$

Figure S3. Different slopes distinguish the plain and hilly results of LRB. (Maps are provided by ESRI)