Supplementary Information:

An in-situ daily dataset for benchmarking temporal variability of groundwater recharge

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Contents of the supplementary information:

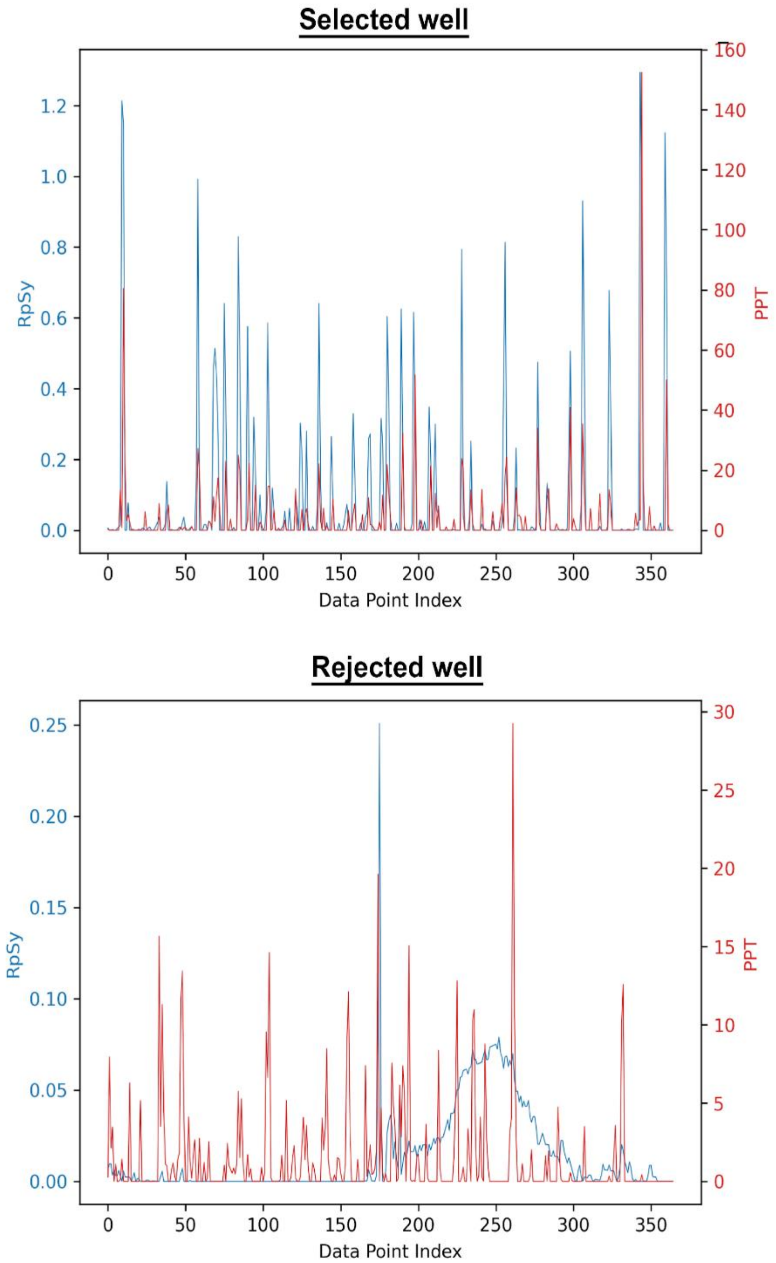

Figure S1: The hydrographs (a) and (b) show precipitation (Ppt) in mm, and estimated recharge per unit specific yield (RpSy, discussed later) in m per day, for a selected and a rejected well, respectively. The selection/rejection is implemented based on the maximum lag correlation threshold, which ensures that the well is more likely to experience event based GWR response to precipitation signals.

Supplementary text S1: Comparison of the nearest stream and groundwater level

Jasechko et al. (2021) compared the elevations of the groundwater level and a constant stream level at bank full height. This study uses a similar approach by identifying the nearest streams to individual wells using high-resolution National Hydrography Dataset Plus Version 2 (McKay et al., 2012). Groundwater well and stream bank elevations are extracted using a 10m resolution 3DEP digital elevation model (DEM) (U.S. Geological Survey, 2019), along with groundwater level time series and bank full-depth estimates (Wieczorek et al., 2019). The elevation difference between groundwater and river levels (E_{diff}) is calculated as follows.

$$E_{diff} = E_{GWL} - med(Depth_{GWL}) - E_{Stream} + BFH_{stream} \quad \text{(S1)}$$

Here E_{GWL} and E_{Stream} denote groundwater level and river level elevation which are extracted from the DEM. The terms $med(Depth_{GWL})$ and BFH_{stream} represent the median of depth to groundwater level observations and bank full height of stream respectively. Eq. (S1) assumes that the elevations extracted using DEM correspond to the elevation of the bank. Since NHD data represents a high-resolution stream network, this assumption is valid due to the likelihood of DEM resolutions being coarser than stream widths. The locations of the wells, distances to nearest streams, differences in elevations, bank full depth and bank full-width estimates are plotted in Figure S2 and S3. Streams with negative E_{diff} values can be classified as losing or influent streams, but this classification also depends on the distance to the nearest well. When the distance is large, the influent flux from stream to well may be negligible. Another important factor is bank full width; this study assumes that rivers with a bank full width of less than 5m are narrow enough to not significantly contribute to groundwater recharge. Considering these criteria, the number of wells used for benchmarking can be narrowed down, as given in Table S1 and Figure S2, S3.

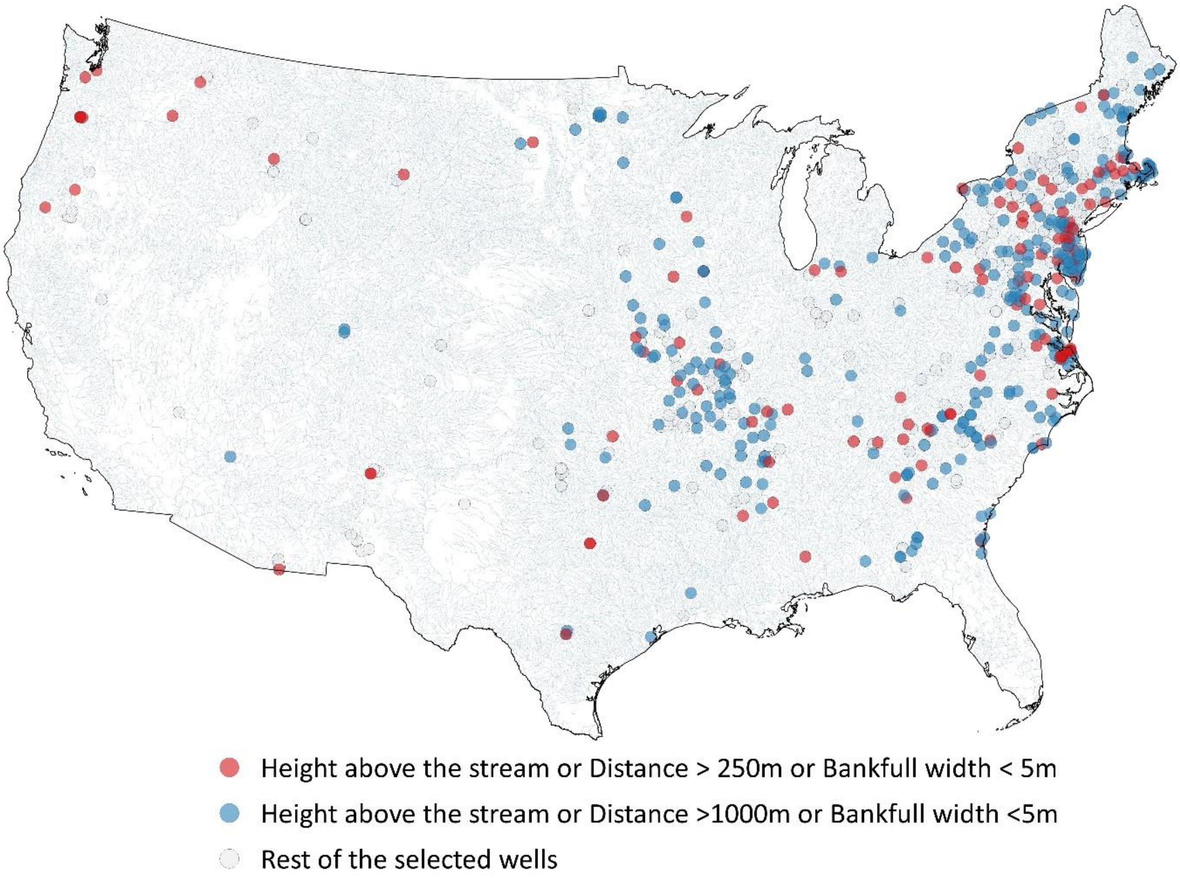

Figure S2: The number of wells selected based on different criteria, which includes distance the nearest stream (shown using blue lines).

Table S1: The number of wells selected based on different criteria of the nearest stream

Condition of selection of wells	**No. of stations**
Height above the stream or Distance >250m	388
Height above the stream or Distance >1000m	304
Height above the stream or Distance >250m or Bankfull width <5m	420
Height above the stream or Distance >1000m or Bankfull width <5m	380

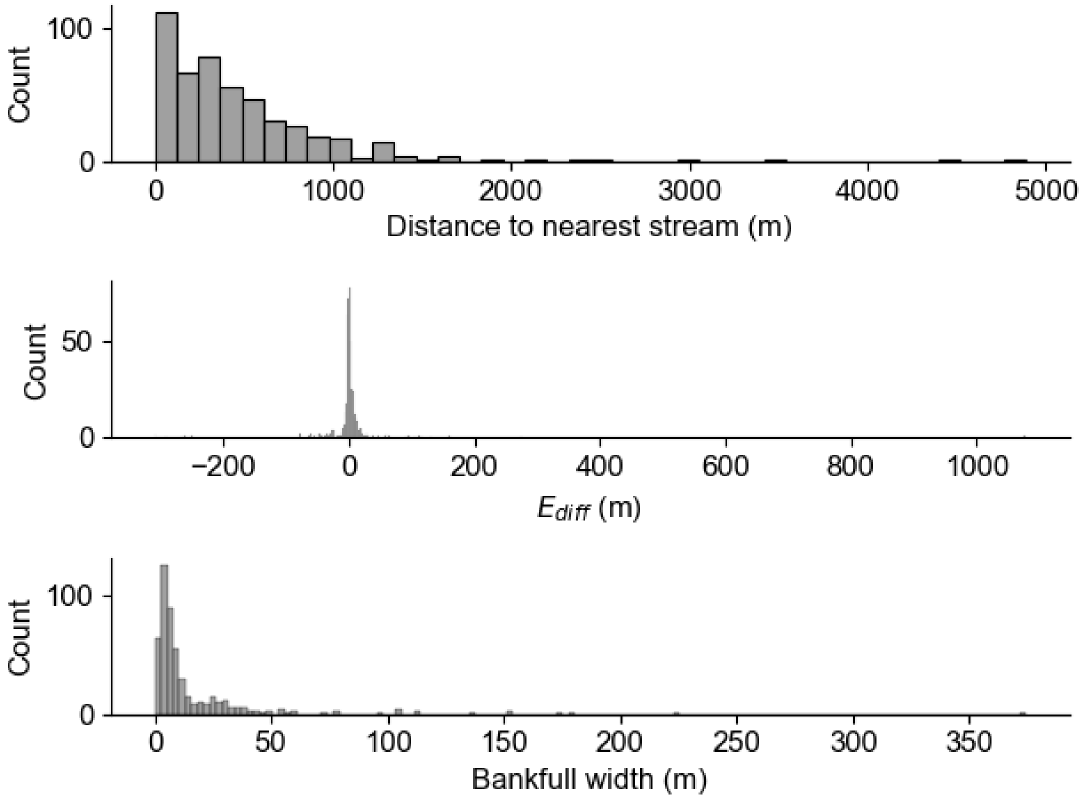

Figure S3: Number of wells with respect to distance to the nearest stream, E_{diff} and bank full width (in meters)

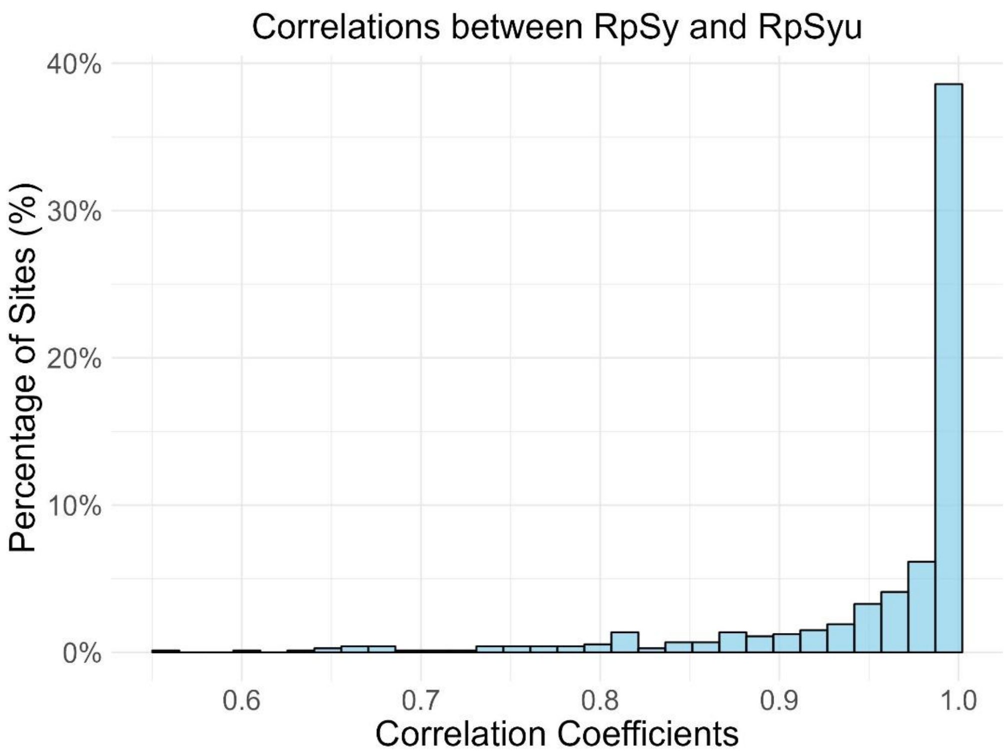

Figure S4: Correlations between RpSy and RpSyu.

RpSy data files for each wells

Date	RpSy (m)	RpSyu (m)
$mm_1/dd_1/yyyy_1$	$rpsy_{111}$	$rpsyu_{111}$
$mm_1/dd_2/yyyy_1$	$rpsy_{121}$	$rpsyu_{121}$
$mm_1/dd_3/yyyy_1$	$rpsy_{131}$	$rpsyu_{131}$
$mm_1/dd_4/yyyy_1$	$rpsy_{141}$	$rpsyu_{141}$
$mm_1/dd_5/yyyy_1$	$rpsy_{151}$	$rpsyu_{151}$
$mm_1/dd_6/yyyy_1$	$rpsy_{161}$	$rpsyu_{161}$
$mm_1/dd_7/yyyy_1$	$rpsy_{171}$	$rpsyu_{171}$
.	.	.
.	.	.
.	.	.
$mm_2/dd_1/yyyy_1$	$rpsy_{211}$	$rpsyu_{211}$
$mm_2/dd_2/yyyy_1$	$rpsy_{221}$	$rpsyu_{221}$
.	.	.
.	.	.
.	.	.
$mm_1/dd_1/yyyy_2$	$rpsy_{112}$	$rpsyu_{112}$
.	.	.
.	.	.
.	.	.
$mm_p/dd_q/yyyy_r$	$rpsy_{pqr}$	$rpsyu_{pqr}$

Site information for all selected wells

ID	Lat	Long	Depth (m)
j_1	x_1	y_1	d_1
j_2	x_2	y_2	d_2
j_3	x_3	y_3	d_3
j_4	x_4	y_4	d_4
j_5	x_5	y_5	d_5
j_6	x_6	y_6	d_6
j_7	x_7	y_7	d_7
.			
.			
.			
j_{81}	x_{81}	y_{81}	d_{81}

Figure S5: File format of the RpSy and RpSyu dataset.

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