H41E-1360

Characterizing Worldwide Patterns of Fluvial Geomorphology and Hydrology with the Global River Widths from Landsat (GRWL) database

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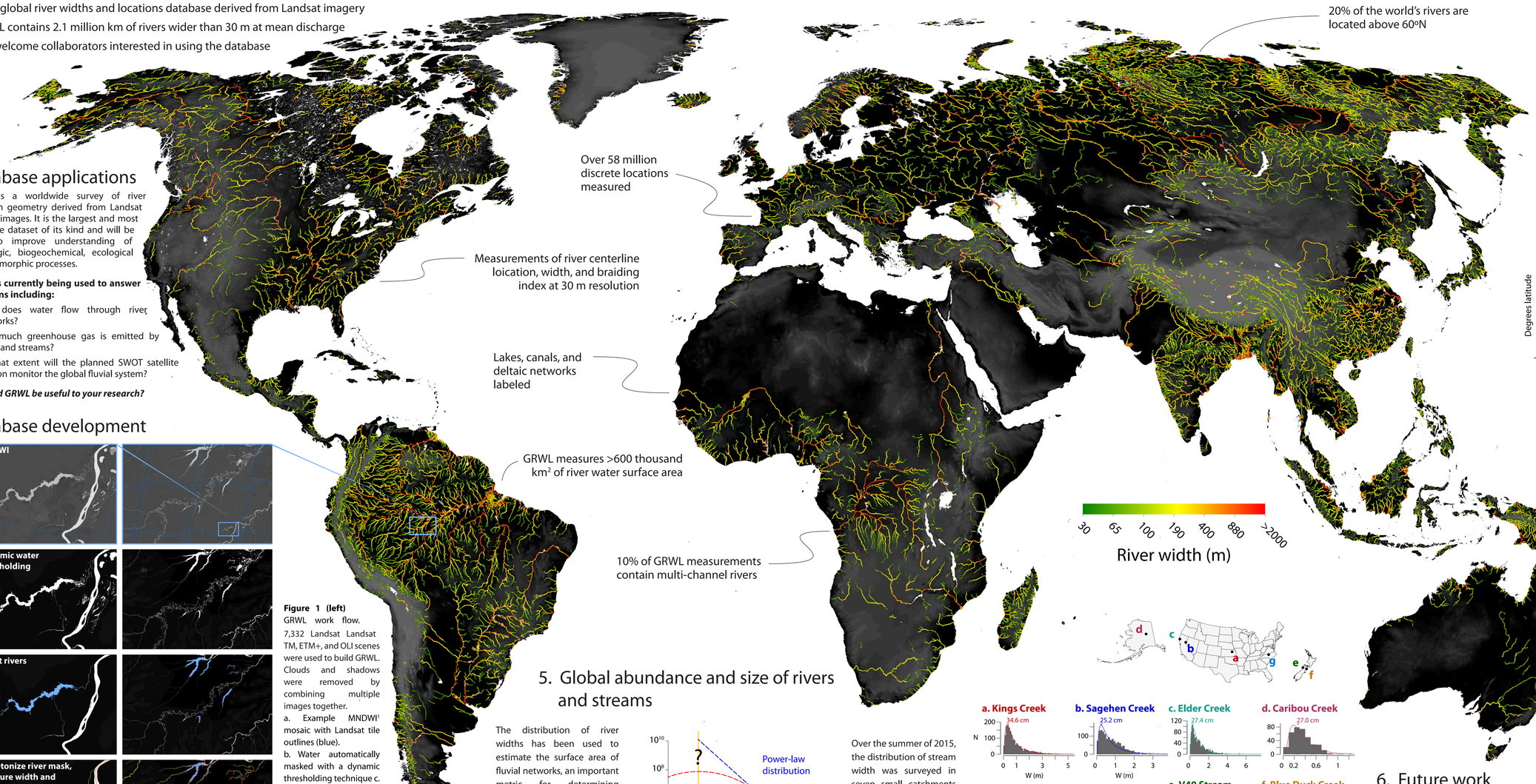
1. Key points

- New global river widths and locations database derived from Landsat imagery
- GRWL contains 2.1 million km of rivers wider than 30 m at mean discharge
- We welcome collaborators interested in using the database



2. Database applications

GRWL is a worldwide survey of river planform geometry derived from Landsat satellite images. It is the largest and most complete dataset of its kind and will be used to improve understanding of hydrologic, biogeochemical, ecological and geomorphic processes.

GRWL is currently being used to answer questions including:

- How does water flow through river networks?
- How much greenhouse gas is emitted by rivers and streams?
- To what extent will the planned SWOT satellite mission monitor the global fluvial system?

→ ***Could GRWL be useful to your research?***

3. Database development

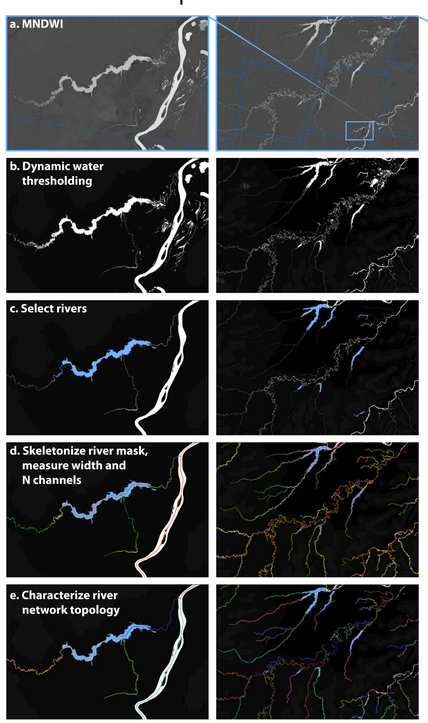


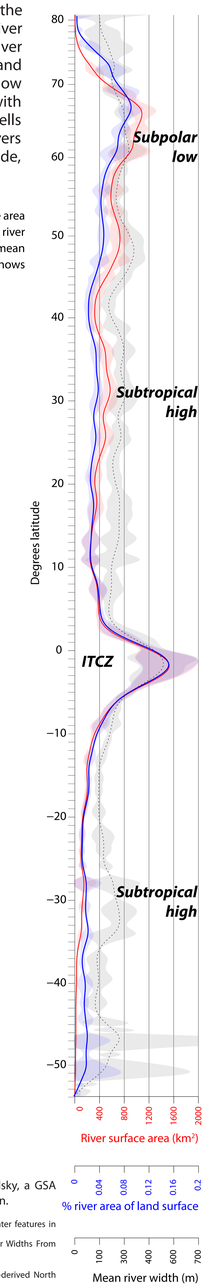
Figure 1 (left) GRWL work flow. 7,332 Landsat Landsat TM, ETM+, and OLI scenes were used to build GRWL. Clouds and shadows were removed by combining multiple images together. a. Example MNDWI[1] mosaic with Landsat tile outlines (blue). b. Water automatically masked with a dynamic thresholding technique c. Rivers and connected water bodies semi-automatically selected. d. Skeletonization and vectorization of rivers using RivWidth software.[2] River Width, N channels, and location measured every 36.2 m downstream. e. River network topology (i.e. river segments, nodes, downstream distance) organized to be joined with topographic data.

Figure 2 (above) Global patterns of river width at mean discharge from GRWL. Note color bar is scaled geometrically to emphasize width variability.

4. River morphology by latitude

GRWL allows for the first global scale analysis of the spatial distribution of river planform geometry. River width, surface area, and surface area density show systematic variation with atmospheric circulation cells (Fig. 3). Multichannel rivers are more common in wide, southern rivers (Fig. 4).

Figure 3 (right) Total river surface area per degree latitude (red), and river surface area density (blue) and mean river width (dotted). Shading shows intra-latitudinal variability (1σ).



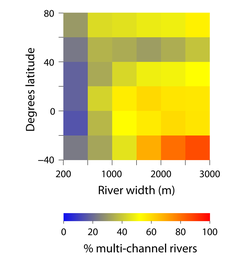


Figure 4 Abundance of multichannel rivers in relation to latitude and width and river width.

5. Global abundance and size of rivers and streams

The distribution of river widths has been used to estimate the surface area of fluvial networks, an important metric for determining greenhouse gas emissions from fluvial systems.[3] The global distribution of river widths can be described with a power-law or a lognormal distribution (Fig. 5). These distribution fits can be used to extrapolate the width, length, and surface area of smaller rivers and streams.[4] However, no empirical information exists to constrain this extrapolation.

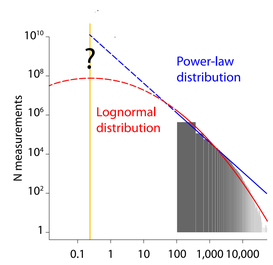


Figure 5 The statistical distribution of river width from GRWL (gray histogram) described by a power law and lognormal function.

Over the summer of 2015, the distribution of stream width was surveyed in seven small catchments spanning a wide range of physiographic and hydrologic conditions (Fig. 6). Stream width distributions were found to be remarkably across all catchments. These results suggest a lognormal distribution may best describe the global abundance of river widths and surface area.

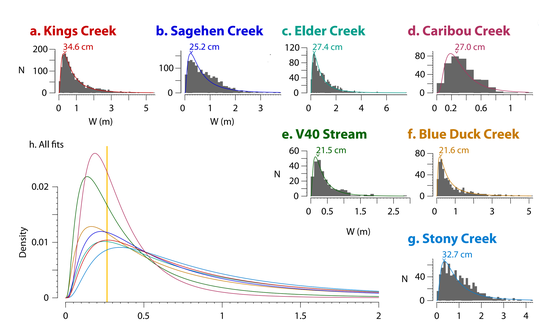


Figure 6 Stream width of headwater catchments follow a lognormal distribution with a mode width spanning a narrow range of 21.5 to 34.6 cm, average = 27.1 cm (orange line).

6. Future work

- Fuse GRWL with topographic data (**see nearby poster H41E-1362**)
- Validate GRWL database outside of North America
- Ensure data consistency across continents

7. Acknowledgements and references

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2. Pavelsky, T. M., and L. C. Smith (2008), RivWidth: A Software Tool for the Calculation of River Widths From Remotely Sensed Imagery, GRSL IEEE.
3. Raymond, P. A., et al. (2013), Global carbon dioxide emissions from inland waters, Nature
4. Allen and Pavelsky (2015), Patterns of river width and surface area revealed by the satellite-derived North American River Width (NARWidth) dataset, Geophys Res Lett.