ACHIEVEMENTS

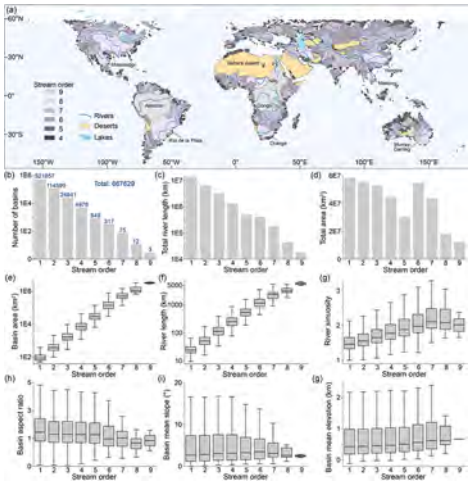
A Global Dataset of the Shape of Rivers and Drainage System

Drainage basins divide the Earth's surface into separate water collection units. The geometry of rivers and drainage basins affects the transportability of water and sediments, as well as the connectivity of freshwater species between ecosystems. For example, the shape of a drainage basin determines the length of groundwater paths, affecting the distribution and transport of nutrients and pollutants. The shape also determines whether the landscape is narrow river valley or wide floodplain, which in turn affects habitat distribution and biodiversity.

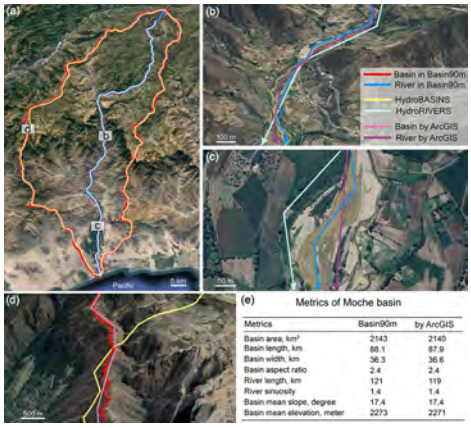
Yang Ci-Jian, Assistant Professor at the Department of Geography, College of Science, NTU, collaborated with an international research team to investigate this vast, intricate subject. Utilizing a supercomputer, they identified a staggering 670,000 drainage basins in a comprehensive global terrain model, each basin characterized in terms of 8 key parameters, such as main stream length, average slope gradient, and roughness.

Their pioneering study tested Hack's Law, a classic geomorphological principle that relates drainage area (A) to main stream length (L). The team's data analysis found a very strong correlation coefficient of 0.97 between drainage basin length and main stream length, indicative of a co-evolutionary relationship between basins and main streams. Consequently, they were able to refine Hack's Law to L=2.1A^0.54 on a global scale, casting fresh light on landscape evolution and hydrological processes.

The team's research report, "A global dataset of the shape of drainage systems," was published in *Earth System Science Data*. This collaborative effort leveraged the research facilities of such venerable institutions as MIT, NTU, and the Helmholtz Centre Potsdam, in Germany. By providing an extensive drainage basin database for scientific research, this study hopes to catalyze further exploration and understanding of the Earth's intricate drainage systems on a global scale.



Global drainage systems with nine stream orders. (a) The spatial distribution of basins with orders from 4 to 9. Rivers with stream orders from 7 to 9 are displaced. (b–g) Morphological metrics displayed by stream orders.



Spatial accuracy of the drainage system in Basin90m compared against HydroSHEDS, drainage systems identified by ArcGIS, and © Google Earth images. The Moche Basin in Peru simultaneously combines a low-relief plateau, deep canyons, and farming land in plains. **(a)** The drainage system of the Moche Basin. A comparison between river channels in a deep-canyon region **(b)** and a flat region **(c)**. **(d)** A comparison between drainage divides. **(e)** A comparison of the metrics for the Moche Basin between Basin90m and those identified by ArcGIS.

Click or Scan the QR code to read the journal article in *Earth System Science Data*.