Global Dominant River Tracing (DRT) based Hydrography Datasets for Macroscale Hydrological Modeling

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Notice

Please direct any questions to the authors above. **Additional updates to the DRT global datasets may occur as higher quality baseline hydrography data become available.** This directory contains two sub-directories; each directory contains a set of global digital hydrography layers derived using the DRT upscaling approach (Wu et al. 2011). The **/by_HYDRO1k** directory contains a set of DRT upscaled global hydrography layers that were derived from a baseline HYDRO1K fine scale (1-km spatial resolution) hydrography layer (Gesch et al., 1999); a detailed description and global evaluation of the HYDRO1K based DRT upscaled global hydrography layers is provided by Wu et al. (2011). The **/by_HydroSHEDS_Hydro1k** directory contains an alternative set of DRT hydrography layers derived from a merged baseline, fine scale global hydrography from HYDRO1k for high latitude (> 60°N) land areas and HydroSHEDS for other land areas (Wu et al., 2012). The HYDRO1k database has limitations over some regions (e.g. lowlands). As the successor of HYDRO1k, HydroSHEDS is now available for many regions and may provide superior scale and quality relative to its predecessor (Lehner et al., 2008). As HydroSHEDS currently does not include high latitude areas, we combined the HydroSHEDS and HYDRO1k fine resolution databases (i.e. 0.00833333 degree, ~ 1 kilometer) to create the baseline inputs for DRT, by using the northern portion of HYDRO1k to fill areas currently not covered by HydroSHEDS. The DRT upscaled hydrography layers developed from HydroSHEDS and HYDRO1k may have greater accuracy for some areas relative to the HYDRO1k based DRT datasets. A detailed description and global evaluation of the HydroSHEDS&HYDRO1K based DRT upscaled global hydrography layers is provided by Wu et al. (2012).

DRT Database Reference

Wu, H., J. S. Kimball, N. Mantua, and J. Stanford, 2011. Automated Upscaling of River Networks for Macroscale Hydrological Modeling. Water Resources Research, 47, doi:10.1029/2009WR008871.

Wu H., J. S. Kimball, H. Li, M. Huang, L. R. Leung, R. F. Adler, 2012, A New Global River Network Database for Macroscale Hydrologic modeling, Water Resour. Res. (submitted).

Overview

We developed a hierarchical Dominant River Tracing (DRT) algorithm for automated extraction and spatial upscaling of basin flow directions and river networks using fine scale hydrography inputs (e.g. flow direction, river networks and flow accumulation). The DRT algorithms are based on the D8 single direction flow method. In contrast with previous upscaling methods, the DRT algorithms utilize information on global and local drainage patterns from baseline fine scale hydrography inputs to determine upscaled flow directions and other critical variables including upscaled basin area, basin shape and river lengths. The DRT algorithm preserves the original baseline hierarchical drainage structure by tracing each entire flow path from headwater to river mouth at fine scale while prioritizing successively higher order basins and rivers for tracing. We applied the algorithm to produce a series of global hydrography data sets from 1/16° to 2°spatial scales in two geographic projections (WGS84 and Lambert azimuthal equal area). The DRT results were evaluated against other alternative upscaling methods and hydrography datasets for continental USA and global domains. These results show favorable DRT upscaling performance in preserving baseline fine scale river network information, including: (1) improved, automated extraction of flow directions and river networks at any spatial scale without the need for manual correction; (2) consistency of river network, basin shape, basin area, river length and basin internal drainage structure between upscaled and baseline fine scale hydrography; (3) performance largely independent of spatial scale, geographic region and projection. The DRT upscaling process also generates other products useful for hydrological modeling, including flow distance, upstream drainage area, channel gradient and fractional area of basin boundary cells. These data include a set of DRT upscaled global hydrography maps derived from HYDRO1K and HydroSHEDS baseline fine scale hydrography inputs; these digital data are available online for public access (ftp://ftp.ntsg.umt.edu/pub/data/DRT/). These data are suitable for a range of continental to global scale studies, including GCM and macroscale hydrological modeling. A detailed description of the DRT algorithms and resulting global hydrography products are available from Wu et al. (2011 & 2012). These products are considered suitable for a range of regional and global hydrological applications including, terrestrial water balance, runoff routing and river discharge modeling within large river basins.

Dataset Description

The DRT software was applied using global HYDRO1k baseline hydrography inputs to generate upscaled hydrography data layers in two projections (World Geodetic System 1984 and Lambert Equal Area). Each Projection Folder contains 3 parameter datasets with multiple resolutions (2, 1, ½, ¼, 1/8, 1/16 degree) ASCII files. The parameter files include:

- Flow Direction (flow direction values are same as ArcGIS)
- Flow Distance
- Upstream Drainage Area

For the HydroSHEDS/Hydro1k combined baseline based DRT derivations, ArcGIS shapefiles are also provided for convenience of usage and users comparison/evaluation with Hydrosheds/Hydro1k baseline or available higher quality local river maps.

Spatial Resolution

- 1 Degree
- 2 Degree
- 1/8th Degree
- 1/10th Degree (only for the HydroSHEDS/Hydro1k combined baseline)
- 1/12th Degree (only for the HydroSHEDS/Hydro1k combined baseline)
- 1/16th Degree
- Half Degree
- Quarter Degree

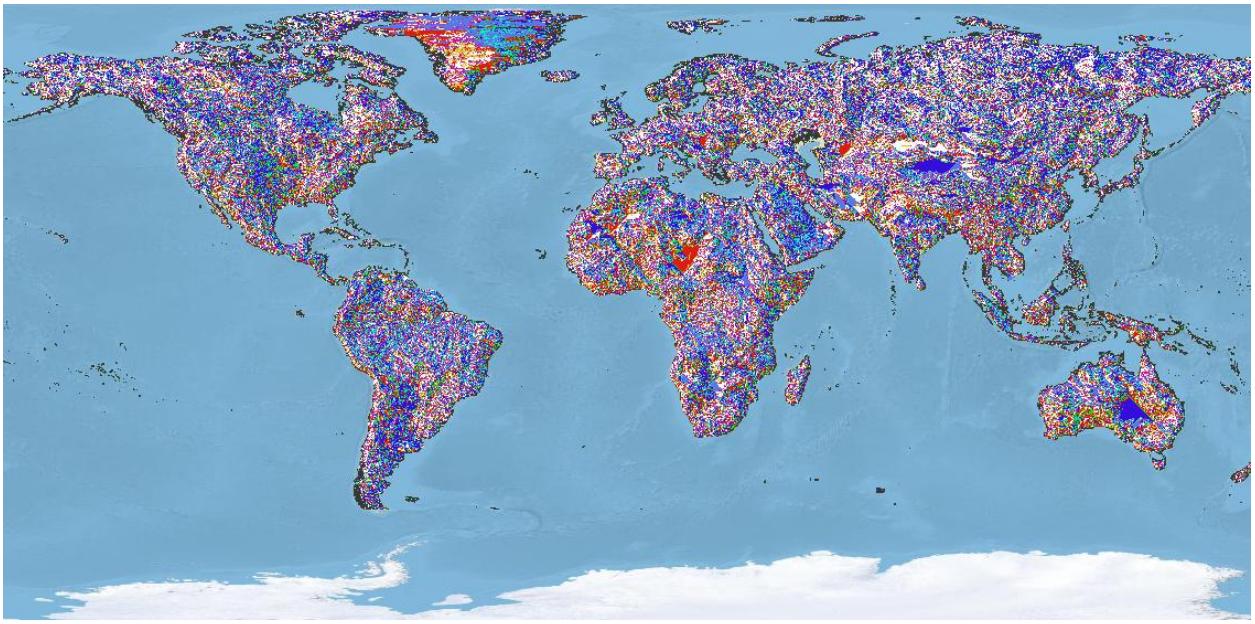
Format

- ASCII Text File
-Shape file (only for the HydroSHEDS/Hydro1k combined baseline)

Geographic Projection

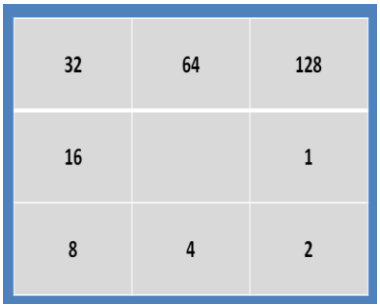
- World Geodetic System 1984
- Lambert Equal Area (only for the Hydro1k baseline)

Spatial domain of the DRT hydrography layers



Flow Direction coding

The values for each direction from the center are:



For example, if the flow direction of center cell is to the left, its flow direction would be coded as 16.

DRT Accuracy

A detailed description of the DRT product accuracy in relation to other available methods, including NSABE and DDM30 for global and continental USA domains is provided by Wu et al. (2011). These results show improved DRT upscaling performance in preserving baseline fine-scale river network information. These results also show robust DRT performance relative to baseline fine-scale hydrography inputs, including 1) assigning as many upscaled flow directions as possible to drain a majority of runoff to immediate downstream cells, while preserving the overall dominant drainage structure of the fine-scale hydrography; 2) preserving river shape and length, basin shape and area, and internal drainage structure for all considerable river basins of a given region; and 3) deriving upscaled flow directions and river networks automatically and with globally consistent performance across different scales and map projections. The DRT results show similar or better performance than DDM30 results derived from intensive manual correction. The DRT algorithm results are consistent with and directly traceable to the baseline fine-scale hydrography inputs. The upscaled flow direction and river network results approach the accuracy limits of the D8 single direction flow method in representing coarse-scale flow directions and river networks, while DRT river length and basin area calculations are consistent with the baseline fine-scale hydrography inputs and are appropriate for GCM- and macroscale hydrology model applications.

References

Gesch, D. B., K. L.Verdin, and S. K. Greenlee (1999), New Land Surface Digital Elevation Model Covers the Earth. Eos Trans. AGU80(6): 69-70.

Lehner, B., Verdin, K., Jarvis, A. (2008), New global hydrograhy derived from spaceborne elevation data. Eos, Transactions, AGU, 89(10): 93-94.

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