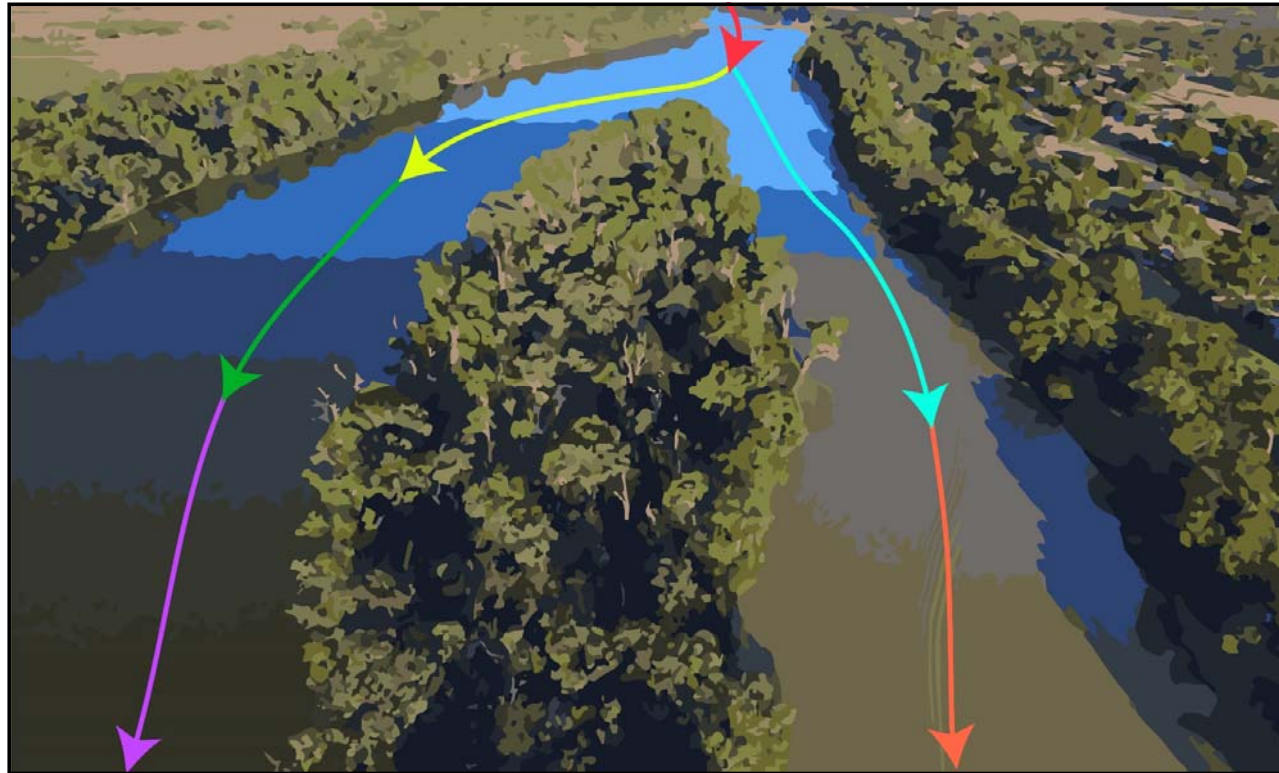


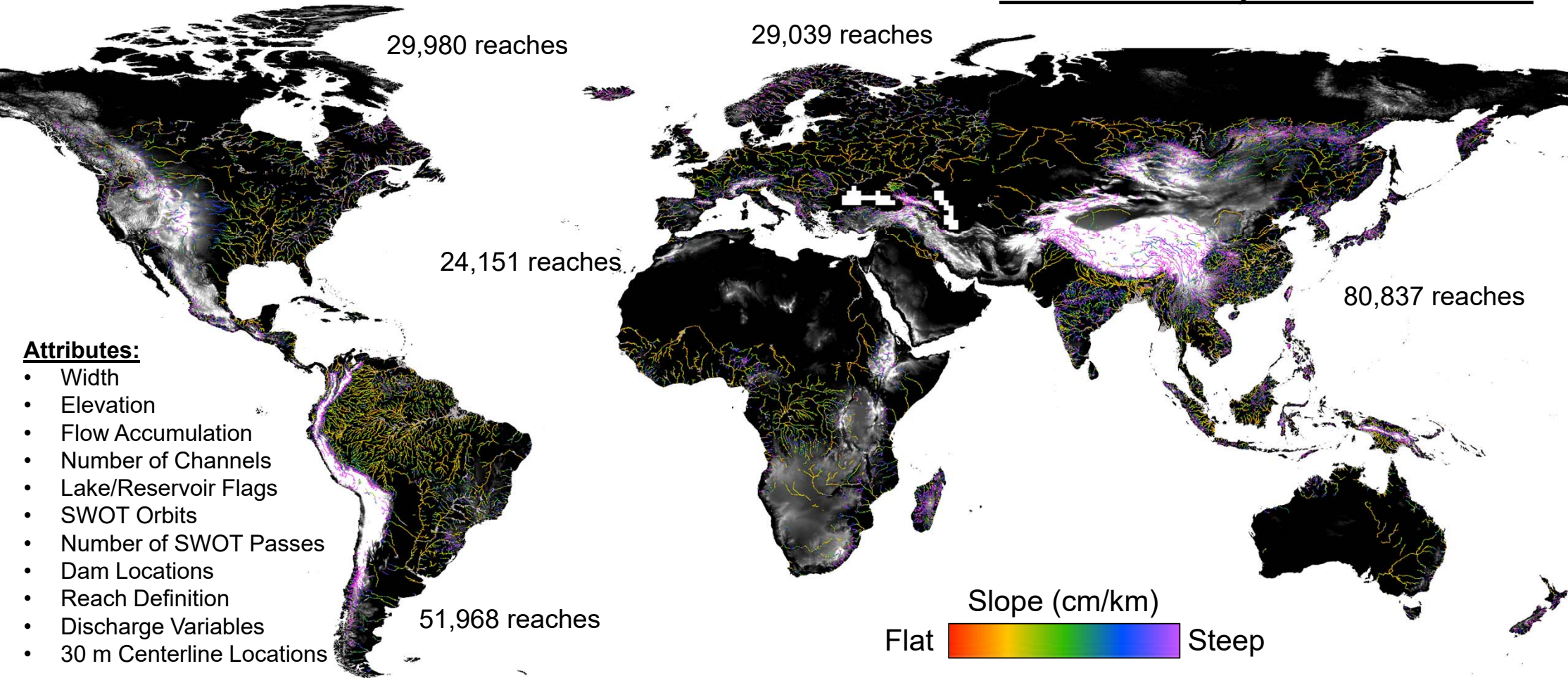
SWOT A priori River Database (SWORD) Update



Elizabeth Altenau, UNC
Tamlin Pavelsky, UNC
SWOT ST Meeting, Bordeaux, France
June 17-20, 2019

SWORD: Version 1

GRWL + SRTM/HydroSHEDs + GRanD

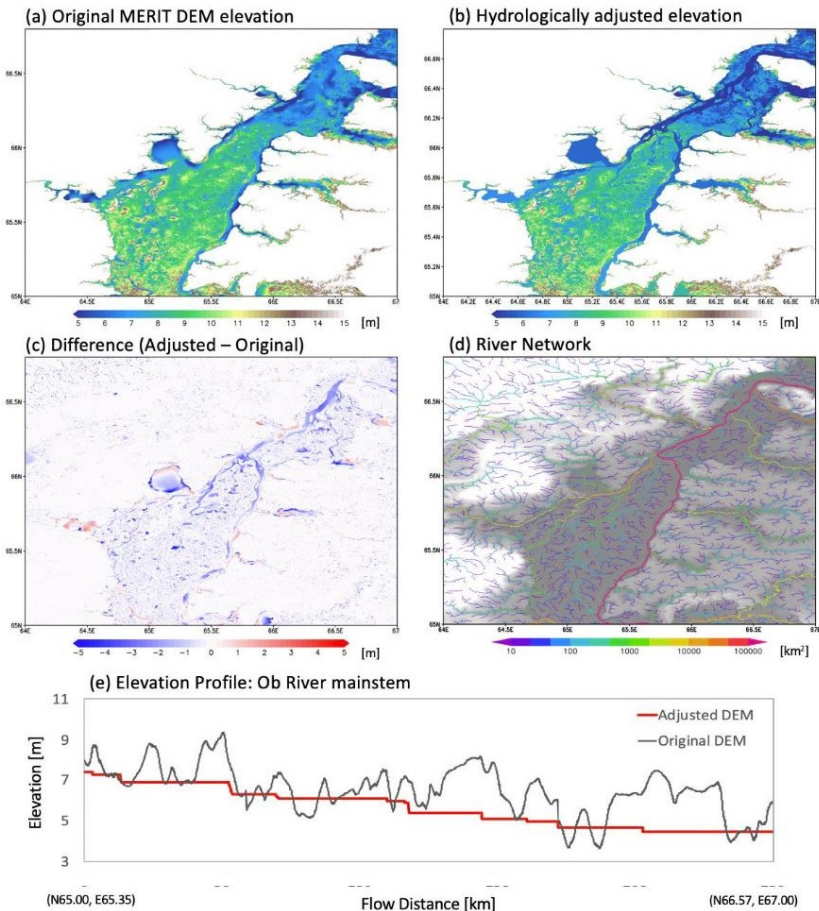


SWORD: Version 1 – Issues

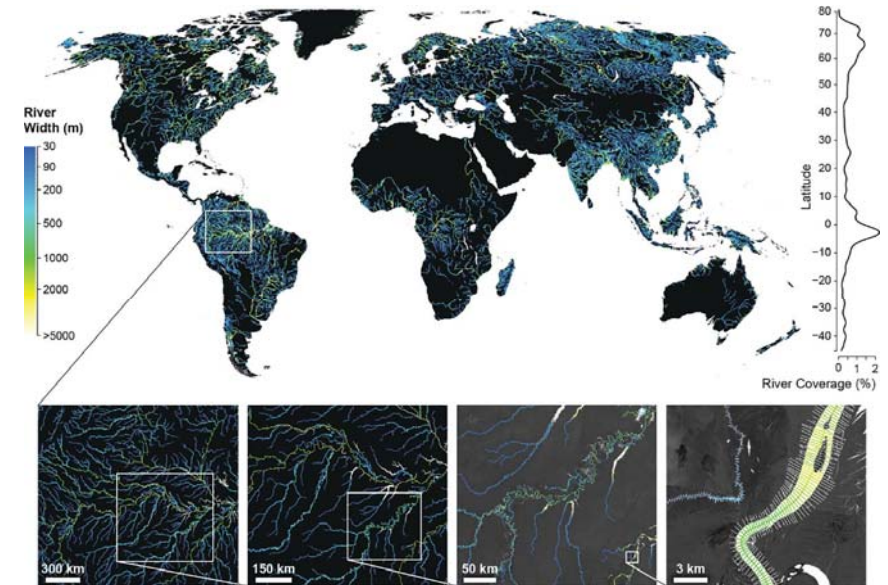
- Need to extend dataset above 60°N
- Fix GRWL database problems with connectivity and centerline representation in complex areas
- Improve reach definition
- Create a consistent, global topology ID for reaches and nodes

SWORD: Version 2 - Improvement Plan

- 1) Improve GRWL Dataset Connectivity
- 2) Use most advanced datasets of river attributes:
 - Primary Datasets: MERIT Hydro, GRWL
 - Secondary Datasets: HydroBASINS, GRanD, GROD, Delta Maps

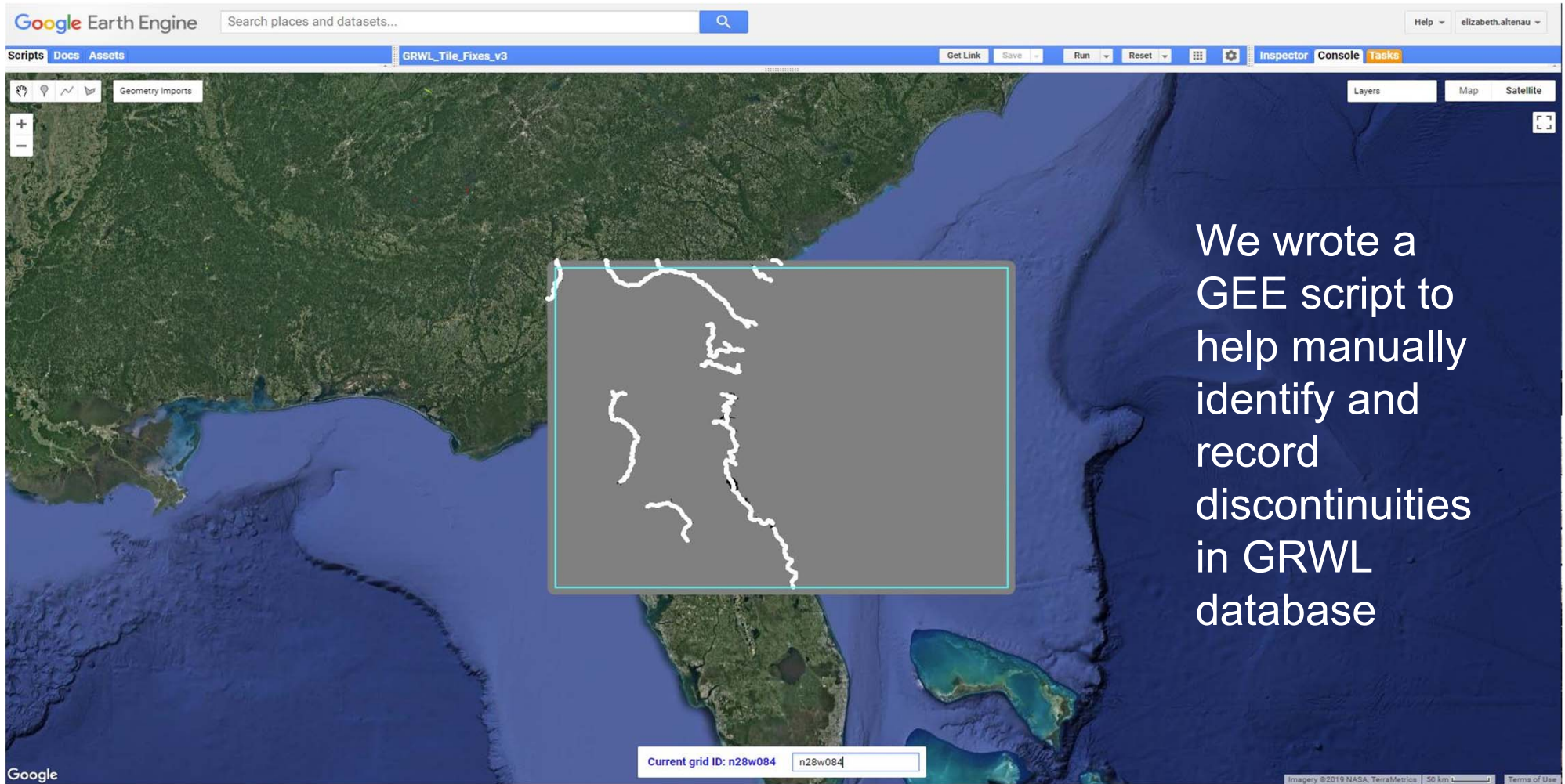


MERIT Hydro: A new global flow direction map derived from MERIT DEM and water body datasets (G1WBM, GSWO, and OpenStreetMap) (Yamazaki *et al.*, 2019)



GRWL (Allen and Pavelsky, 2018)

GRWL Improvements



The screenshot shows the Google Earth Engine web interface. At the top, there is a search bar with the text "Search places and datasets...". Below the search bar, the interface includes tabs for "Scripts", "Docs", and "Assets". The current script is titled "GRWL_Tile_Fixes_v3". The main map area displays a satellite view of the Pacific Northwest coast of the United States. A rectangular gray box highlights a specific region of the coast, where several white, irregular lines are overlaid, representing discontinuities in the GRWL database. The interface also features a "Layers" panel, "Map" and "Satellite" view options, and a "Current grid ID" field at the bottom showing "n28w084".

We wrote a GEE script to help manually identify and record discontinuities in GRWL database

GRWL Improvements

The screenshot shows the Google Earth Engine interface with a project named 'GRWL_Tile_Fixes_v3'. The left sidebar displays a 'Geometry Imports' panel with the following layers:

- mask_connect (141 lines)
- linearly_interpolate (559 lines)
- dilate_mask_connect (166 lines)
- fill_mask_islands_connect
- tile_boundary_mask (56 lines)
- tile_boundary_linear (111 lines)
- manual_deletion (336 lines)
- geometry

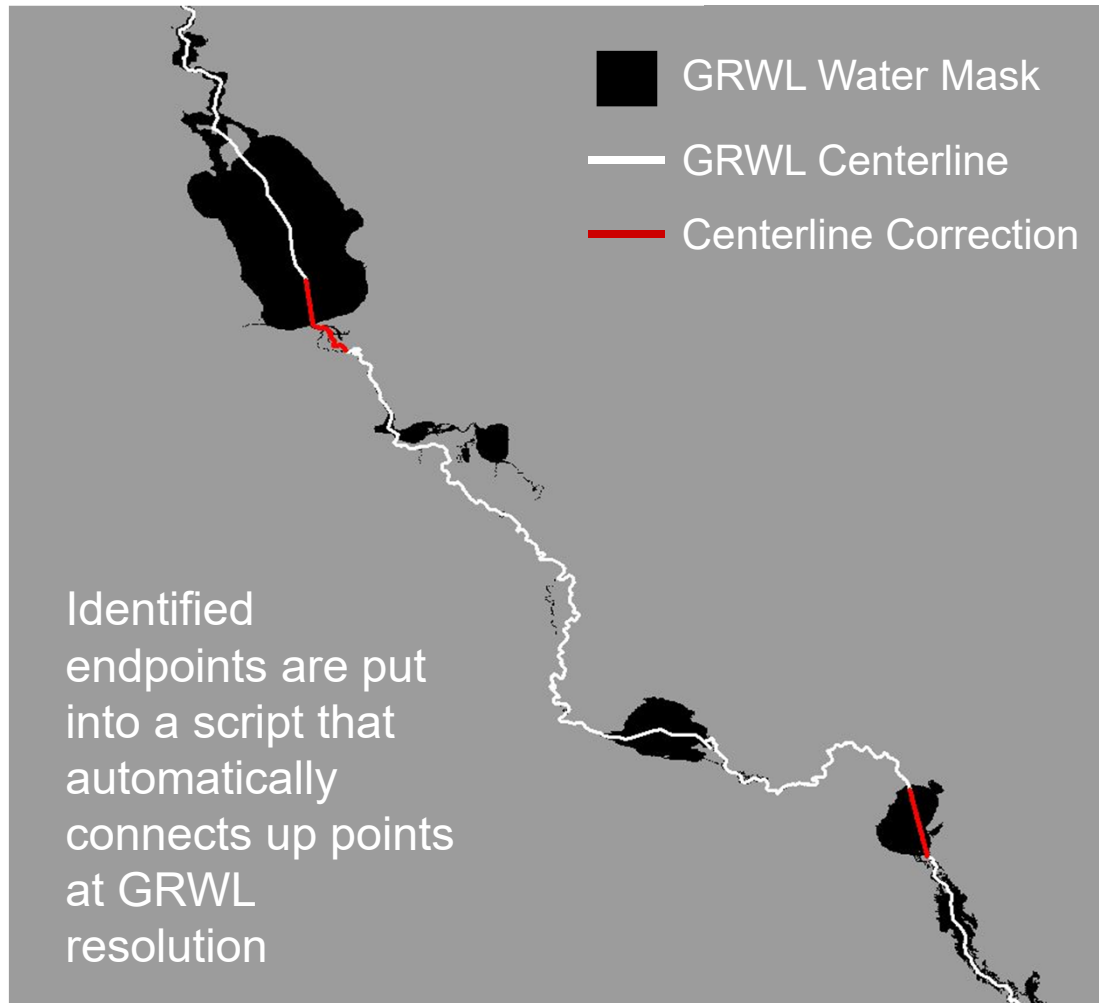
The main map area shows a black 'GRWL Water Mask' and a white 'GRWL Centerline'. Two white arrows labeled 'Discontinuities' point to specific locations where the centerline is broken or misaligned. A legend in the bottom right corner identifies the black area as 'GRWL Water Mask' and the white line as 'GRWL Centerline'. The bottom status bar shows 'Current grid ID: n28w084' and 'n28w084'.

- Records endpoints to connect
- Multiple options for connecting

Discontinuities

■ GRWL Water Mask
— GRWL Centerline

GRWL Improvements

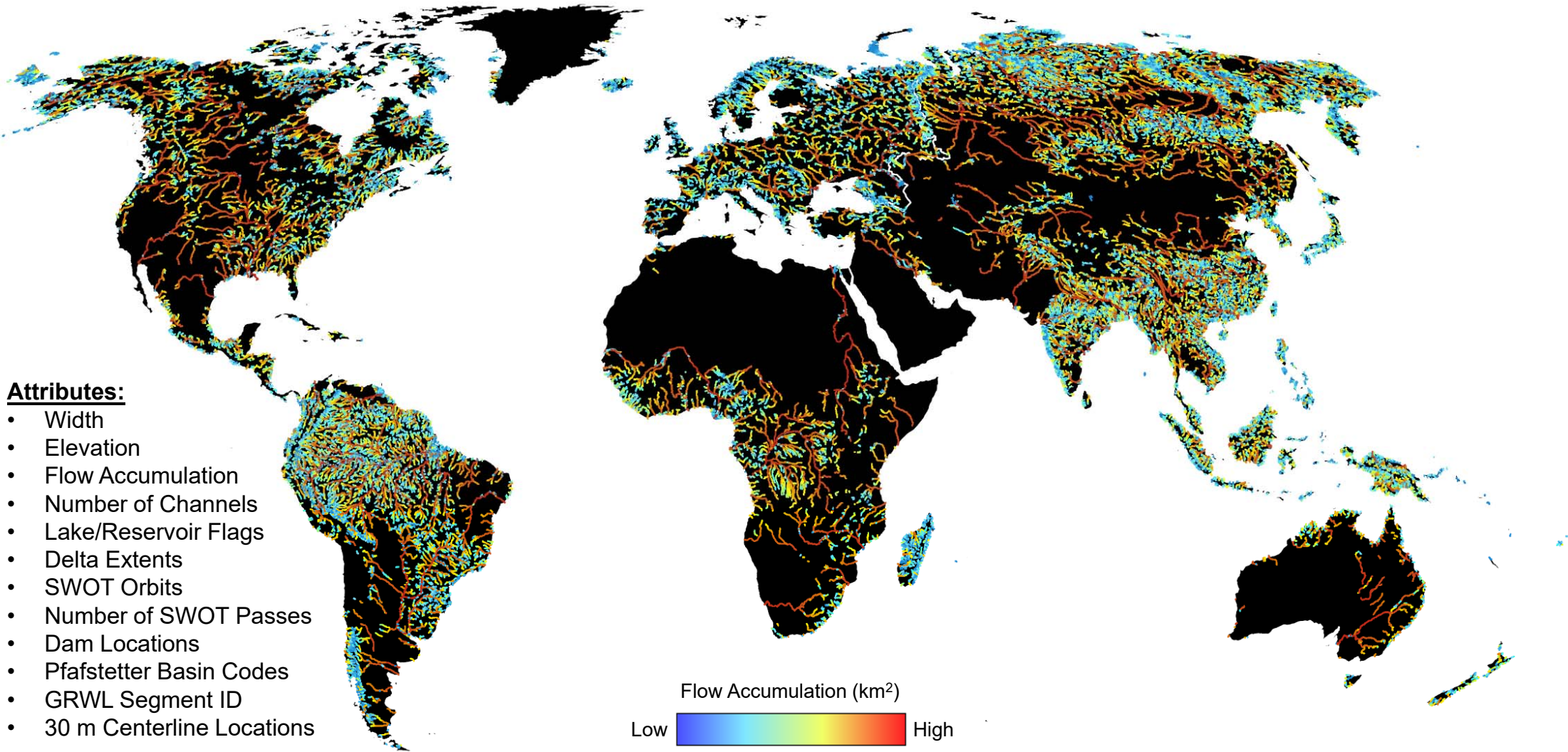


- North America discontinuities identified and fixed.
- Europe, South America, Africa, Oceania discontinuities identified.
- 3,164 discontinuities identified so far.

Datasets

Dataset	Attribute Contribution
Global River Widths from Landsat (GRWL) <i>(Allen and Pavelsky, 2018)</i>	Provides river centerline locations at 30 m resolution and associated width, water body type, and number of channels attributes.
MERIT Hydro <i>(Yamazaki et al., 2019)</i>	Provides river surface elevation and flow accumulation at 3 arc-second resolution.
HydroBASINS <i>(Lehner and Grill, 2013)</i>	Provides Pfafstetter basin codes.
Global Reservoir and Dam Database (GRanD) <i>(Lehner et al., 2011)</i>	Provides global locations for large dams.
Global River Obstruction Database (GROD) <i>(under development, UNC)</i>	Provides global locations of all river obstructions along the GRWL river network.
Global Delta Maps <i>(Tessler et al., 2015)</i>	Provides the spatial extent of 48 of the world's largest deltas.

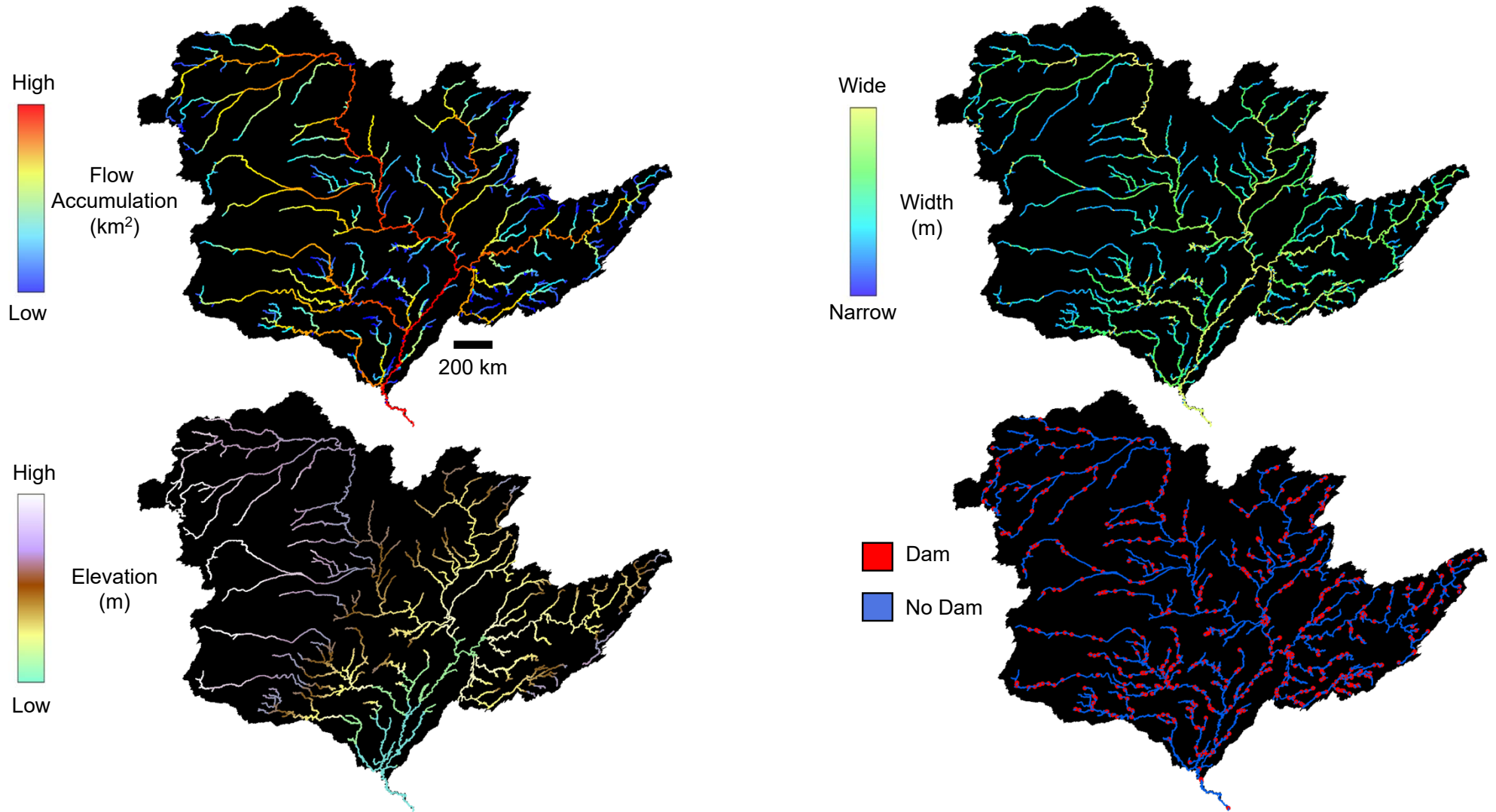
Global Merge (Improvements Ongoing)



Attributes:

- Width
- Elevation
- Flow Accumulation
- Number of Channels
- Lake/Reservoir Flags
- Delta Extents
- SWOT Orbits
- Number of SWOT Passes
- Dam Locations
- Pfafstetter Basin Codes
- GRWL Segment ID
- 30 m Centerline Locations

High Resolution Attributes: Mississippi Basin



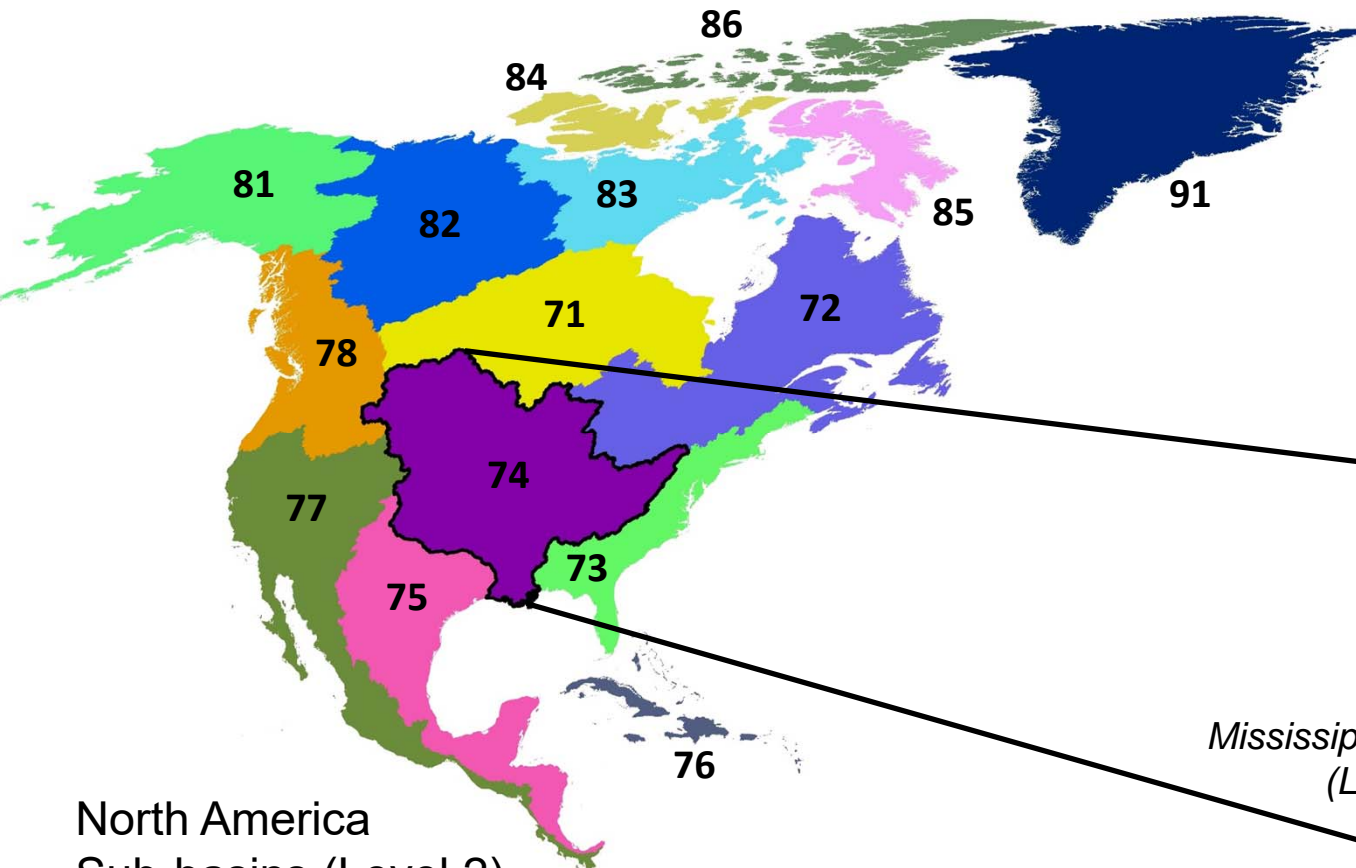
SWOT River ID Format

CBBBBRRRRNNNT (all will be integers)

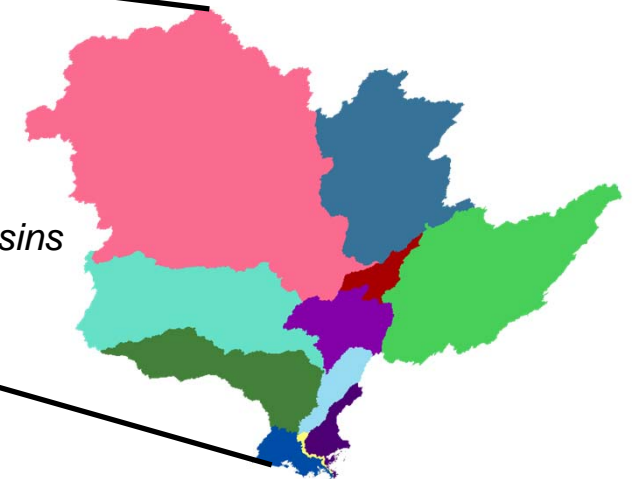
- **C** – Continent (HydroBASINS codes)
1 = Africa, 2 = Europe, 3 = Siberia, 4 = Asia, 5 = Oceania,
6 = South America, 7 = North America, 8 = Arctic
9 = Greenland
- **B** – Pfafstetter Basin Code
- **R** – Reach Number
- **N** – Node Number
- **T** – Type
1 = River, 2 = Coastal, 3 = Lake, 4 = Dam

Mississippi Basin: Level 2
(4th sub-basin in North America)

740000RRRRNNNT



Mississippi Sub-basins
(Level 3)



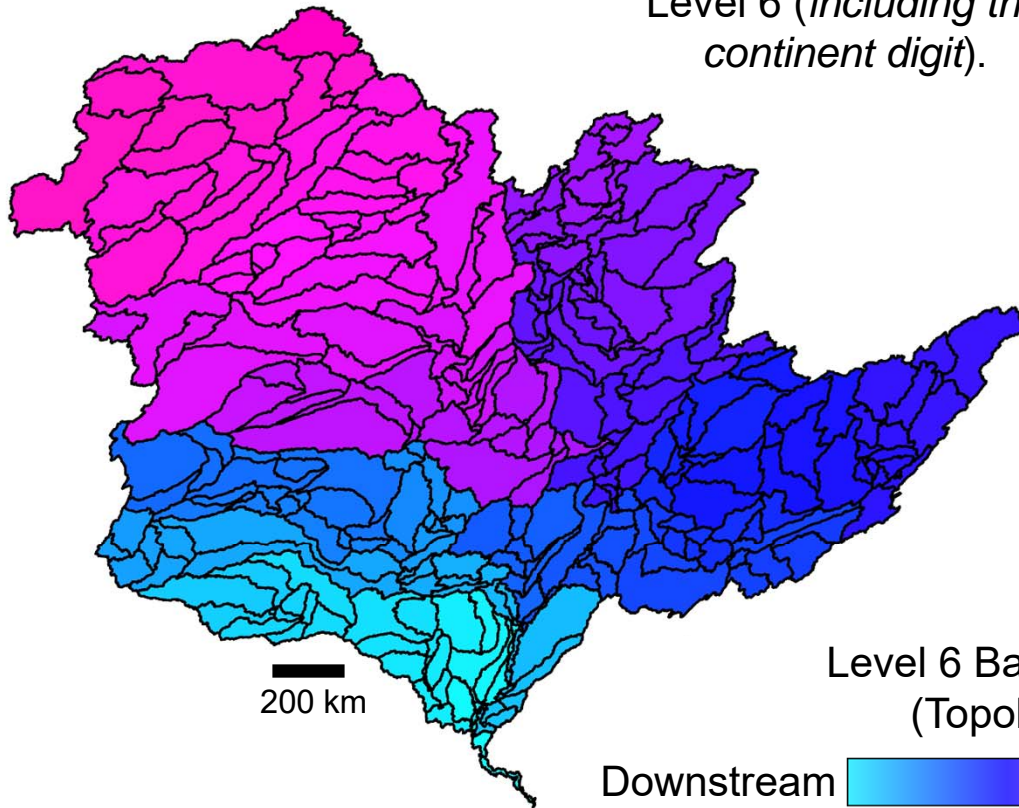
SWOT River ID Format

* Topology for the river networks will build off the Pfafstetter codes up to Level 6 (*including the continent digit*).

CBBBBRRRRNNNT (*all will be integers*)

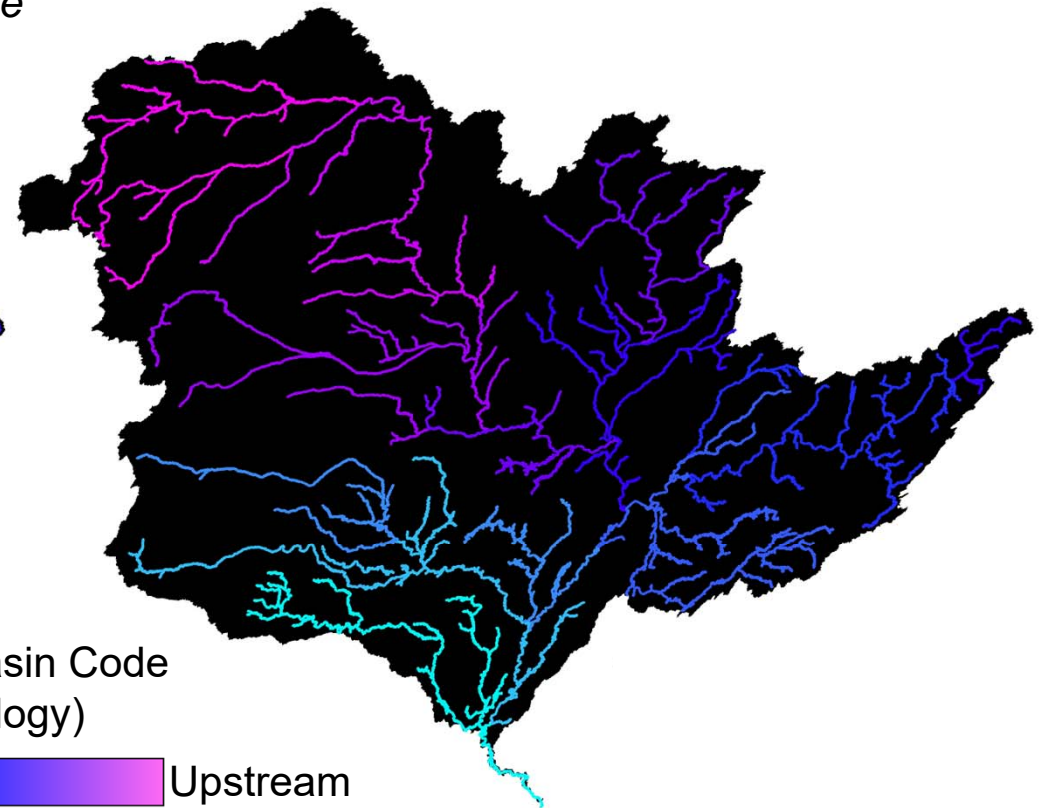
- C – Continent
- B – Pfafstetter Basin Code
- R – Reach Number
- N – Node Number
- T – Type

Mississippi Level 6 Basins

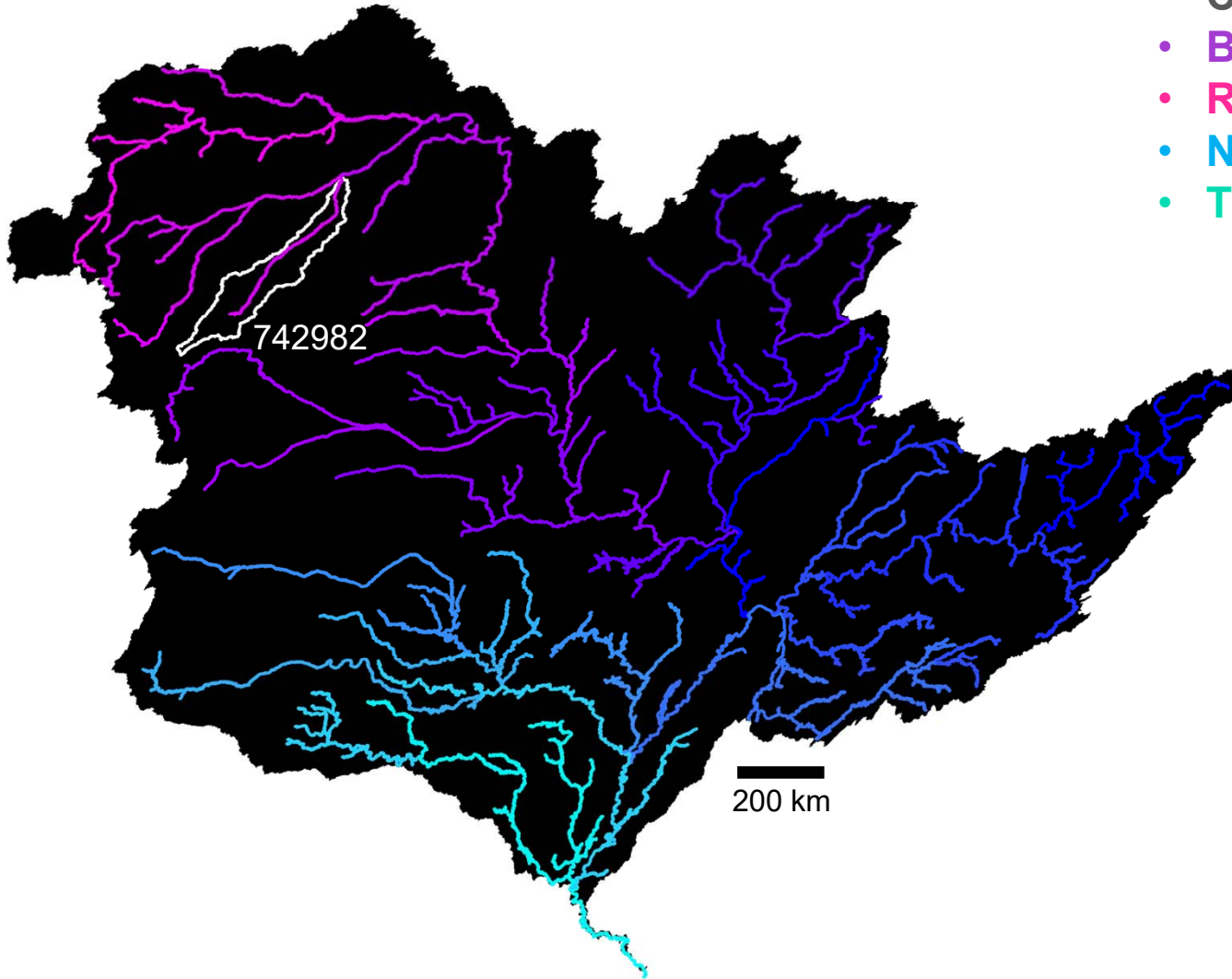


Level 6 Basin Code
(Topology)

Downstream  Upstream



SWOT River ID Format



CBBBBRRRRNNNT (all will be integers)

- C – Continent
- B – Pfafstetter Basin Code
- R – Reach Number
- N – Node Number
- T – Type

Level 6 Basin: 742982

(within Mississippi Basin):

742982RRRRNNNT

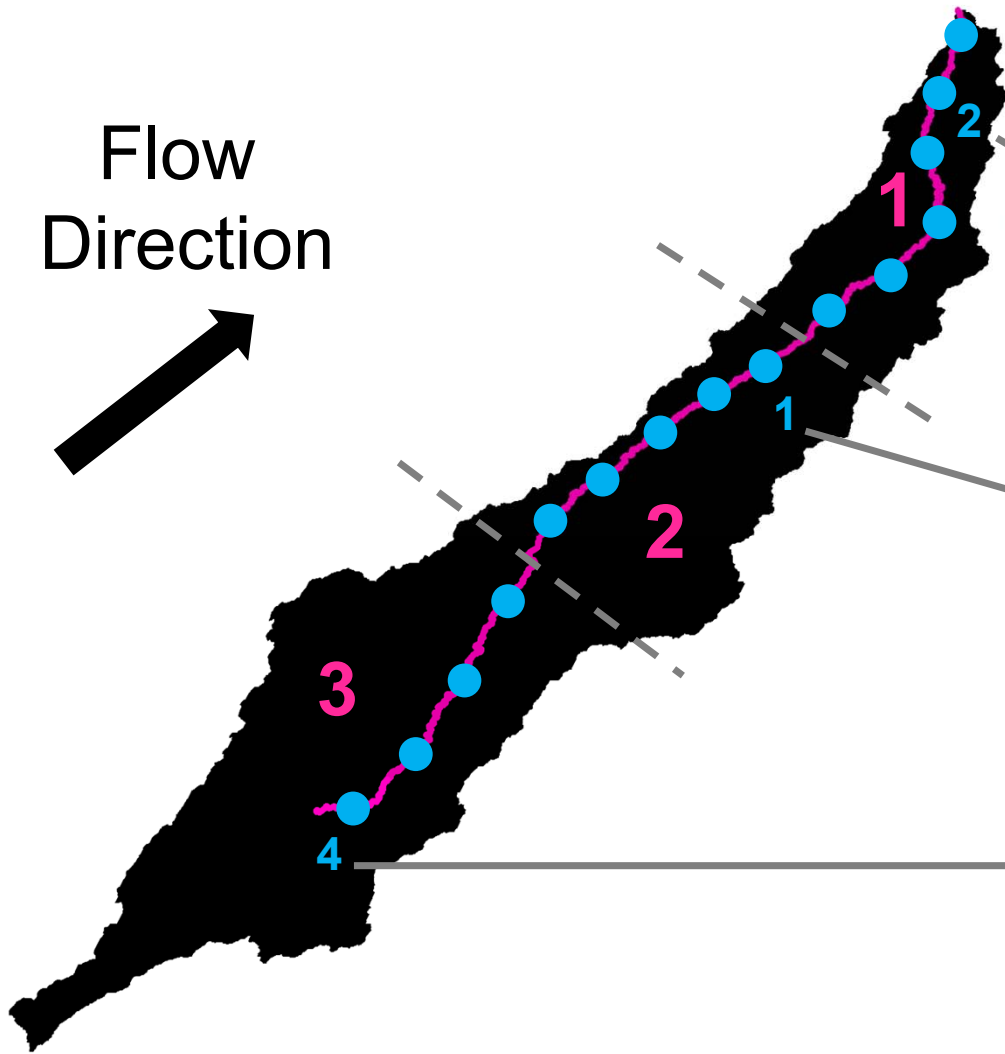
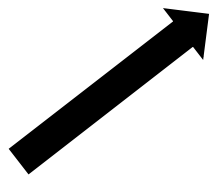
Final Pfafstetter
Basin ID

Type will be 1
for River

Next step is to
break down river
into reaches and
nodes.

SWOT River ID Format

Flow
Direction



CBBBBRRRNNNT (all will be integers)

- C – Continent
- B – Pfafstetter Basin Code
- R – Reach Number
- N – Node Number
- T – Type

7429820010021 (node id)

7429820011 (reach id)

7429820020011 (node id)

7429820021 (reach id)

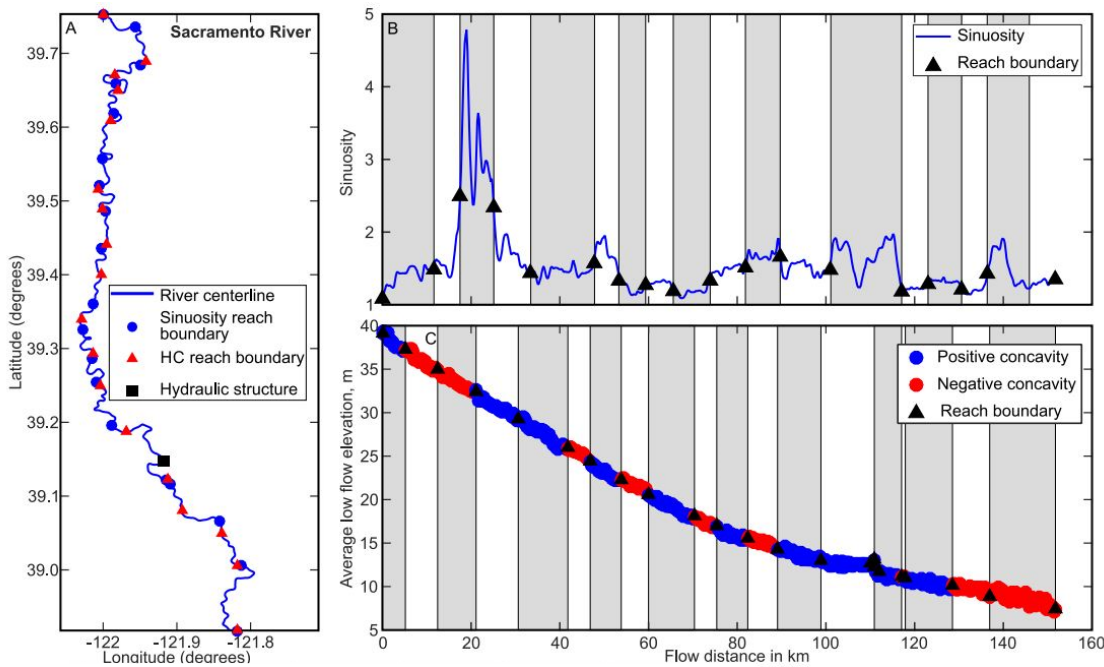
7429820030041 (node id)

7429820031 (reach id)

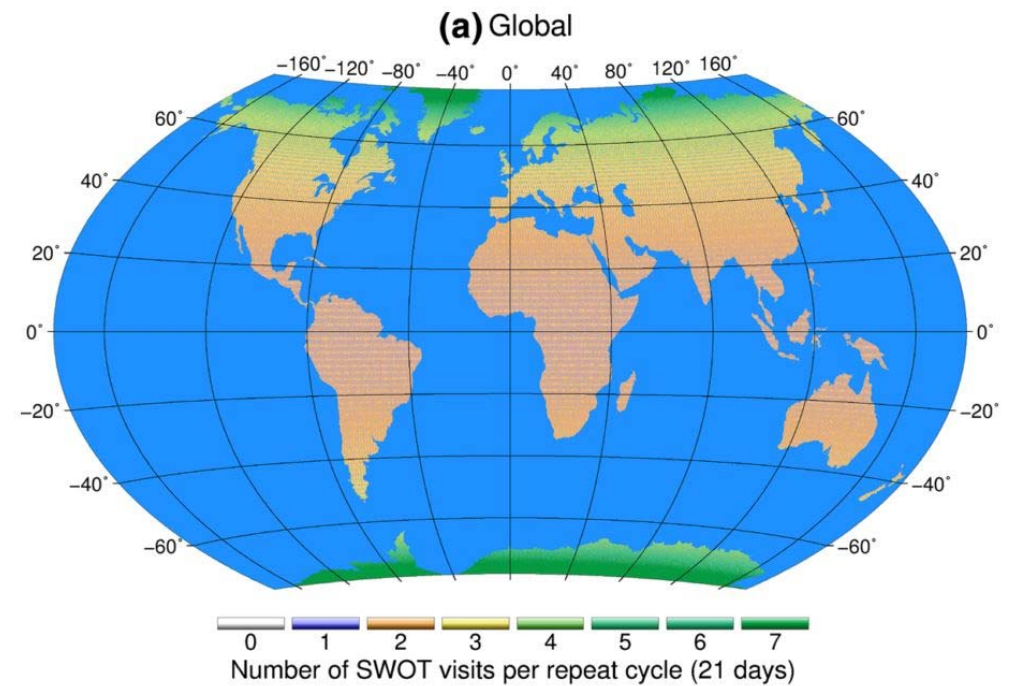
Reach Definition Plan

Basin Boundaries -> Tributary Junctions -> Sinuosity -> SWOT Boundaries -> Dams

Target average length ~10 km



Frasson et al., 2017



Biancamaria et al., 2016

Next Steps

- Finalize and implement reach definition plan.
- Assign topology to reaches and nodes.
- Gather feedback and improve.
- Final database will be provided in shp and netCDF file formats with reaches represented as polylines (shp) and nodes represented as points.

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