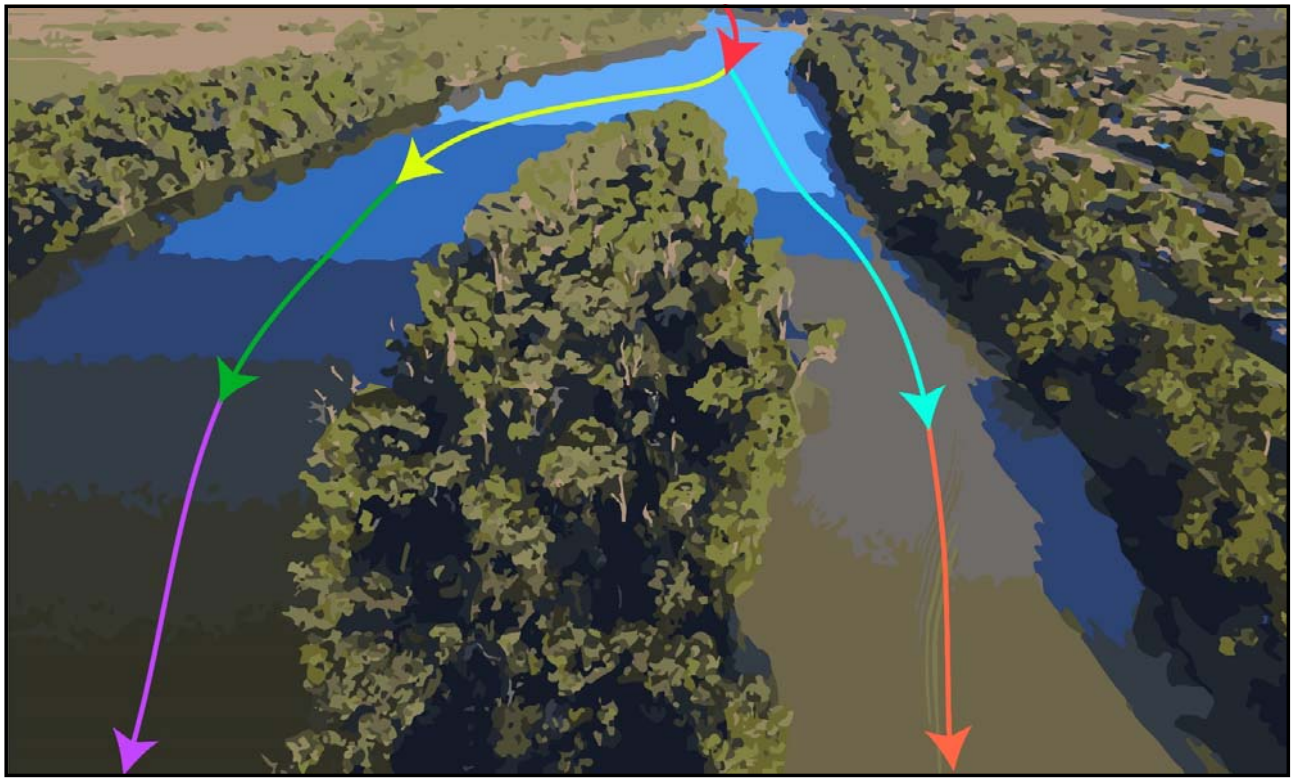
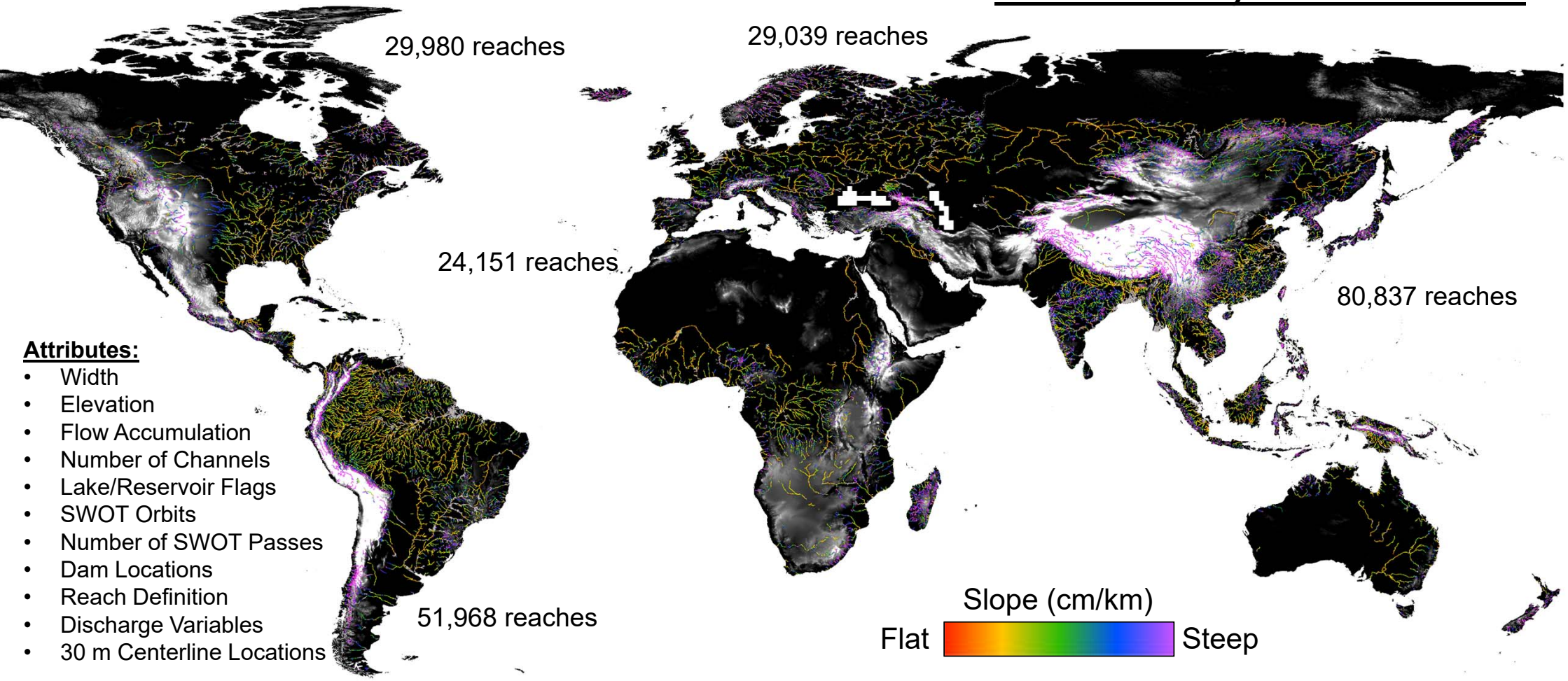
SWOT A priori River Database (SWORD) Update



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

SWORD: Version 1

GRWL + SRTM/HydroSHEDs + GRanD



Attributes:

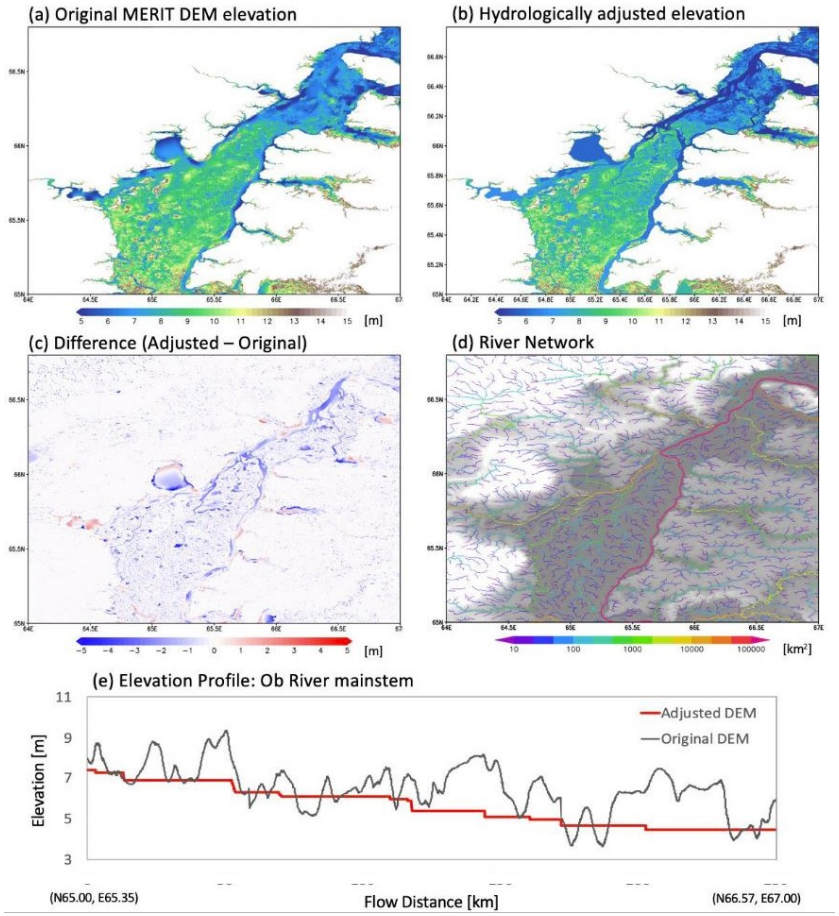
- Width
- Elevation
- Flow Accumulation
- Number of Channels
- Lake/Reservoir Flags
- SWOT Orbits
- Number of SWOT Passes
- Dam Locations
- Reach Definition
- Discharge Variables
- 30 m Centerline Locations

Frasson et al., 2019

SWORD: Version 1 – Issues

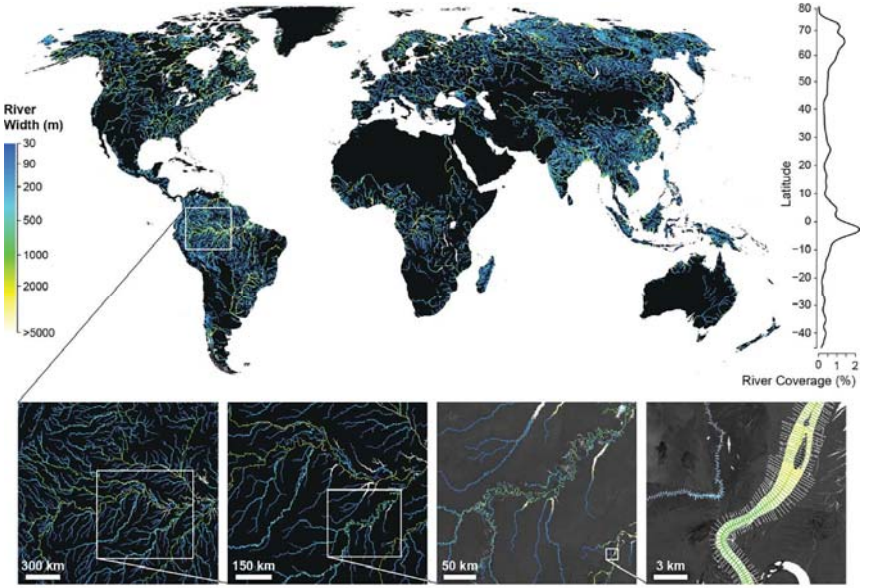
- Need to extend dataset above 60°N
- Fix GRWL database problems with connectivity and centerline representation in complex areas
- Improve reach definition
- Create a consistent, global topology ID for reaches and nodes

SWORD: Version 2 - Improvement Plan



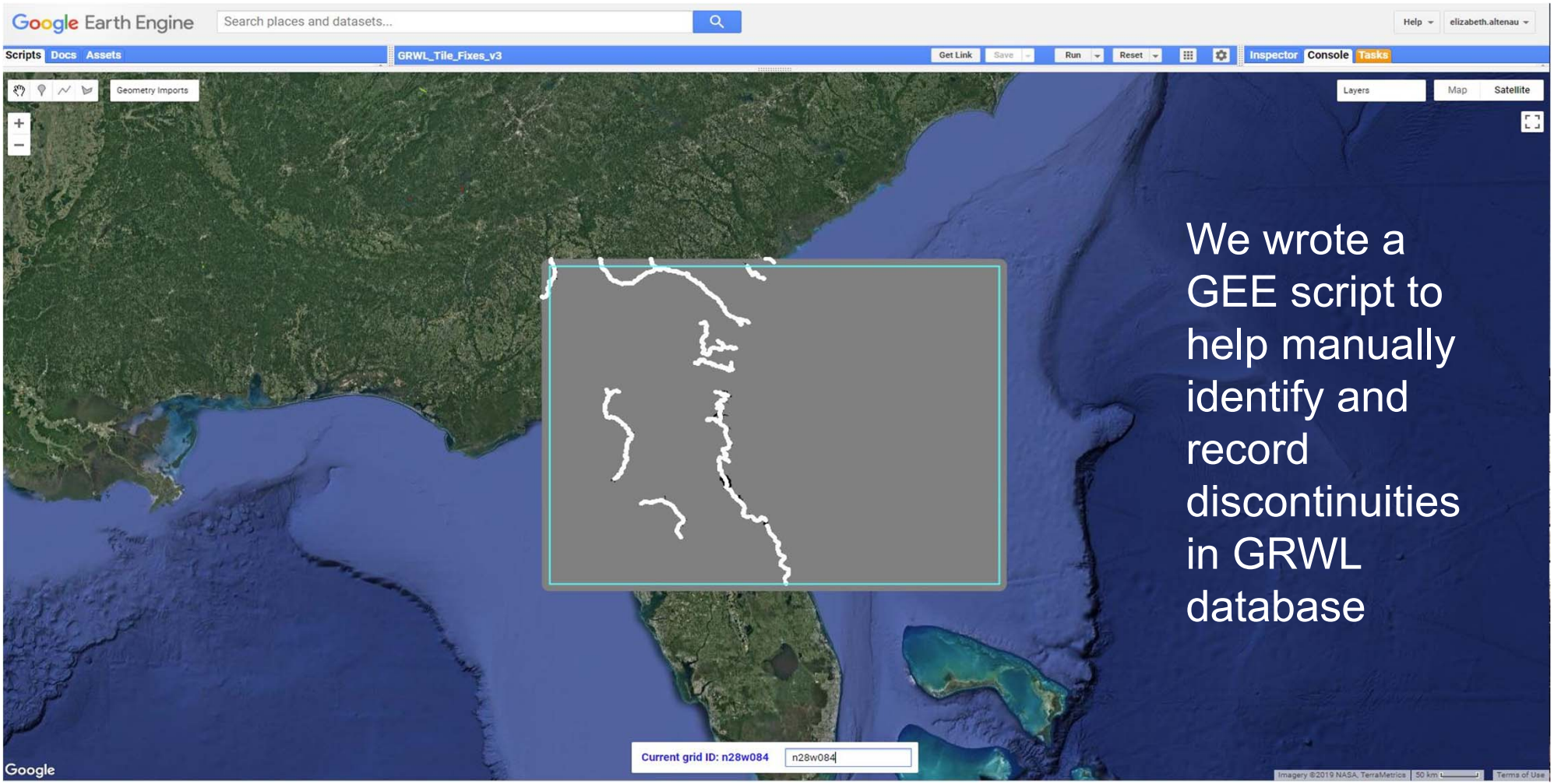
1) Improve GRWL Dataset Connectivity
2) Use most advanced datasets of river attributes:
   - Primary Datasets: MERIT Hydro, GRWL
   - Secondary Datasets: HydroBASINS, GRanD, GROD, Delta Maps

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

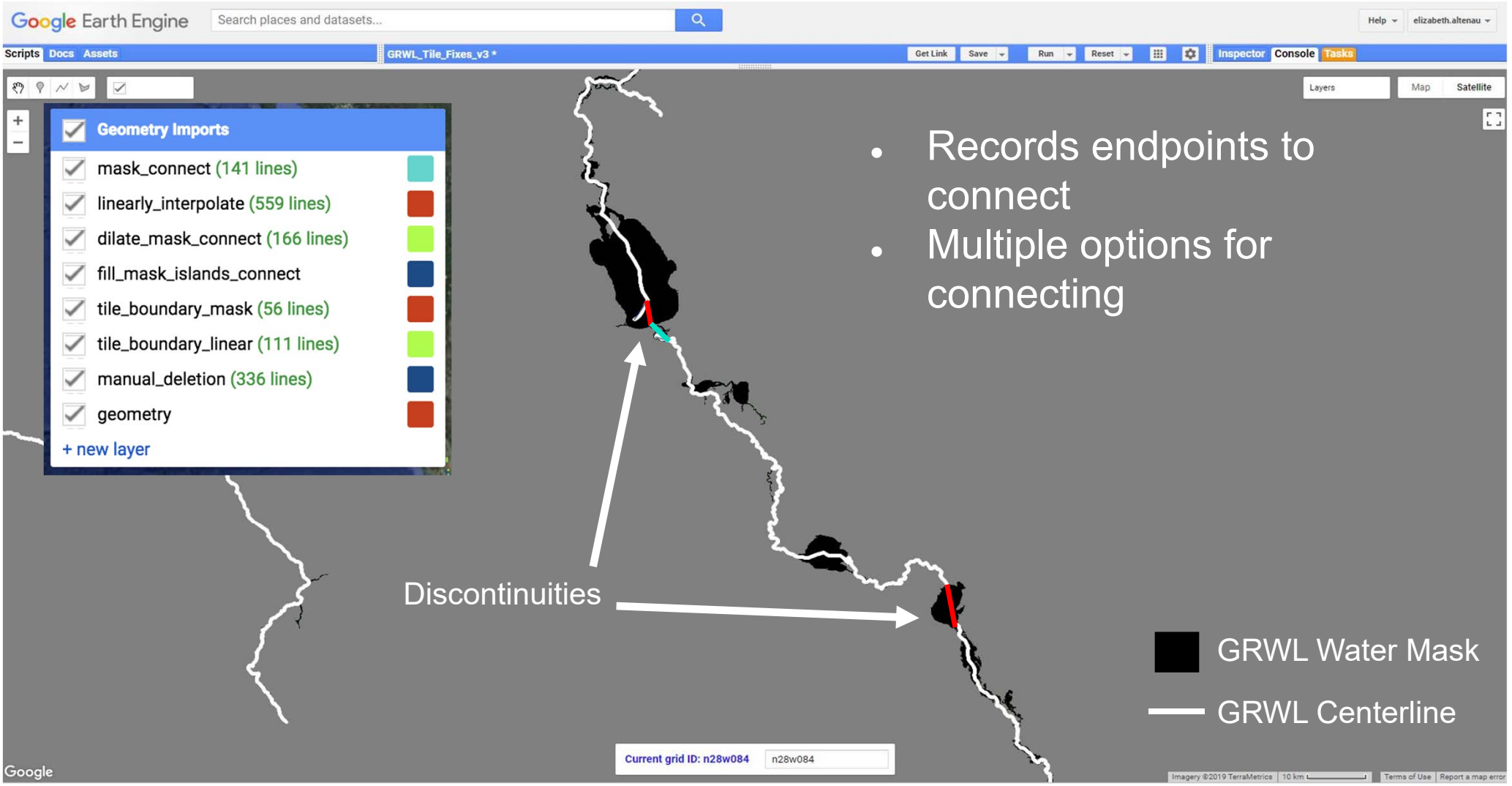


GRWL (*Allen and Pavelsky, 2018*)

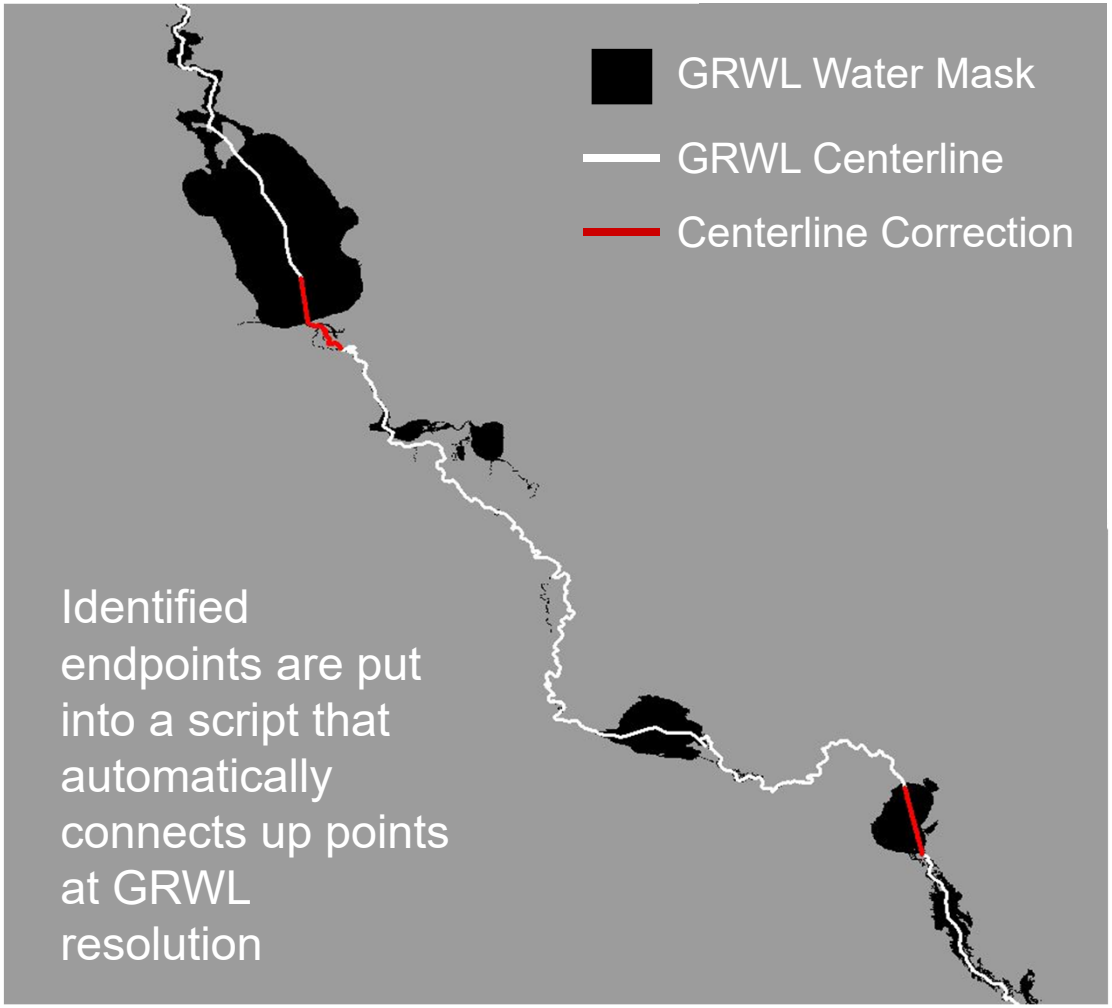
GRWL Improvements



GRWL Improvements



GRWL Improvements

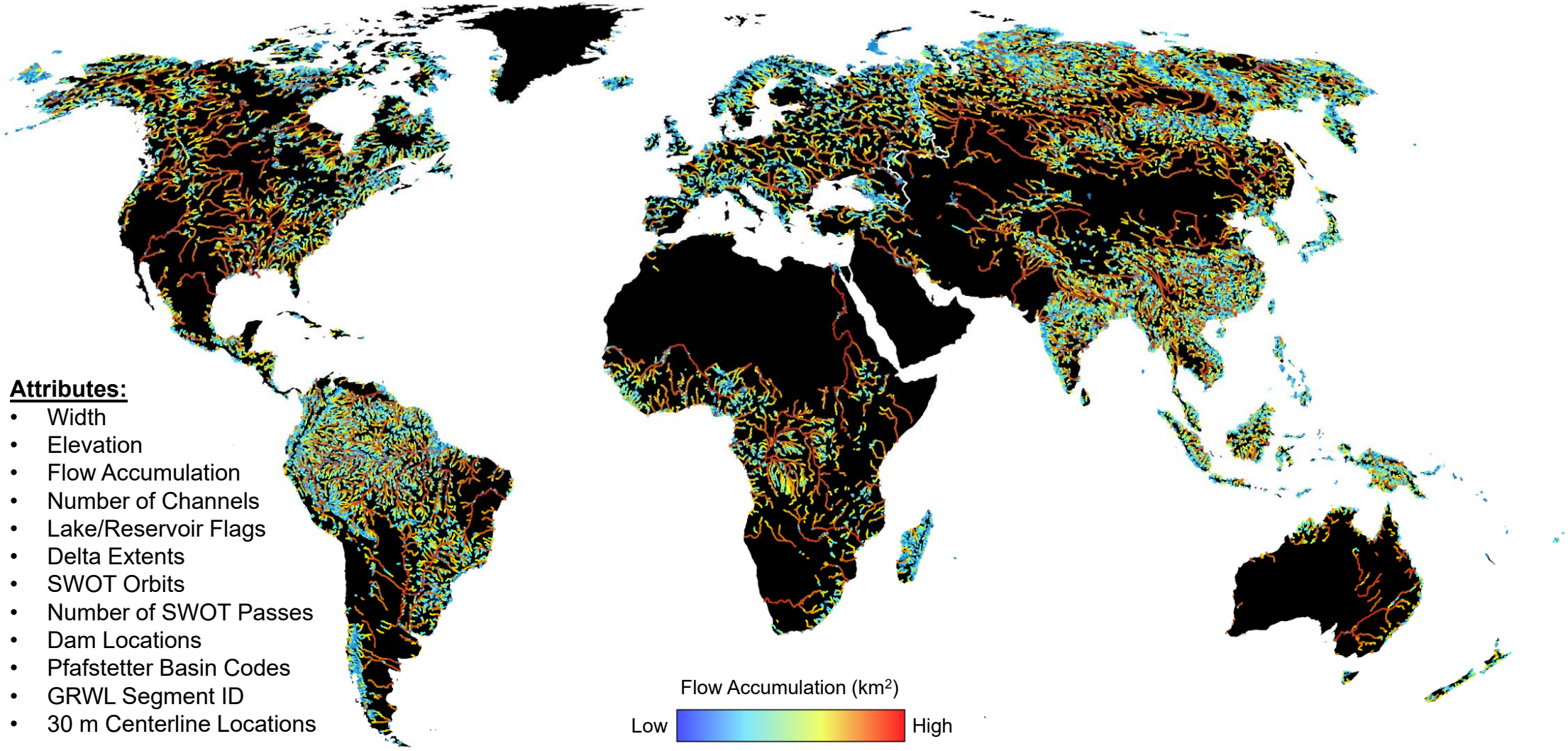


- North America discontinuities identified and fixed.
- Europe, South America, Africa, Oceania discontinuities identified.
- 3,164 discontinuities identified so far.

Datasets

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

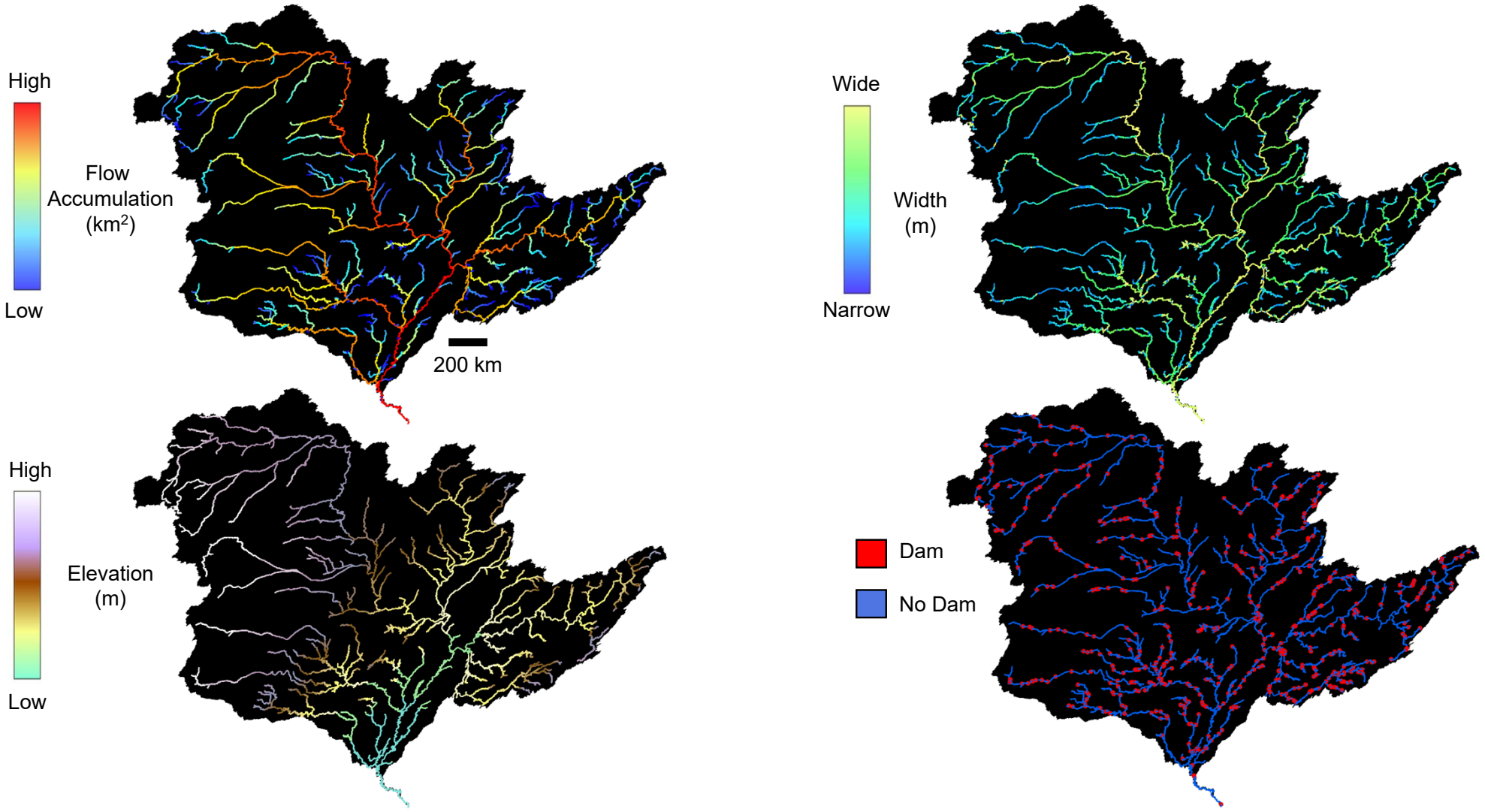
Global Merge (Improvements Ongoing)



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

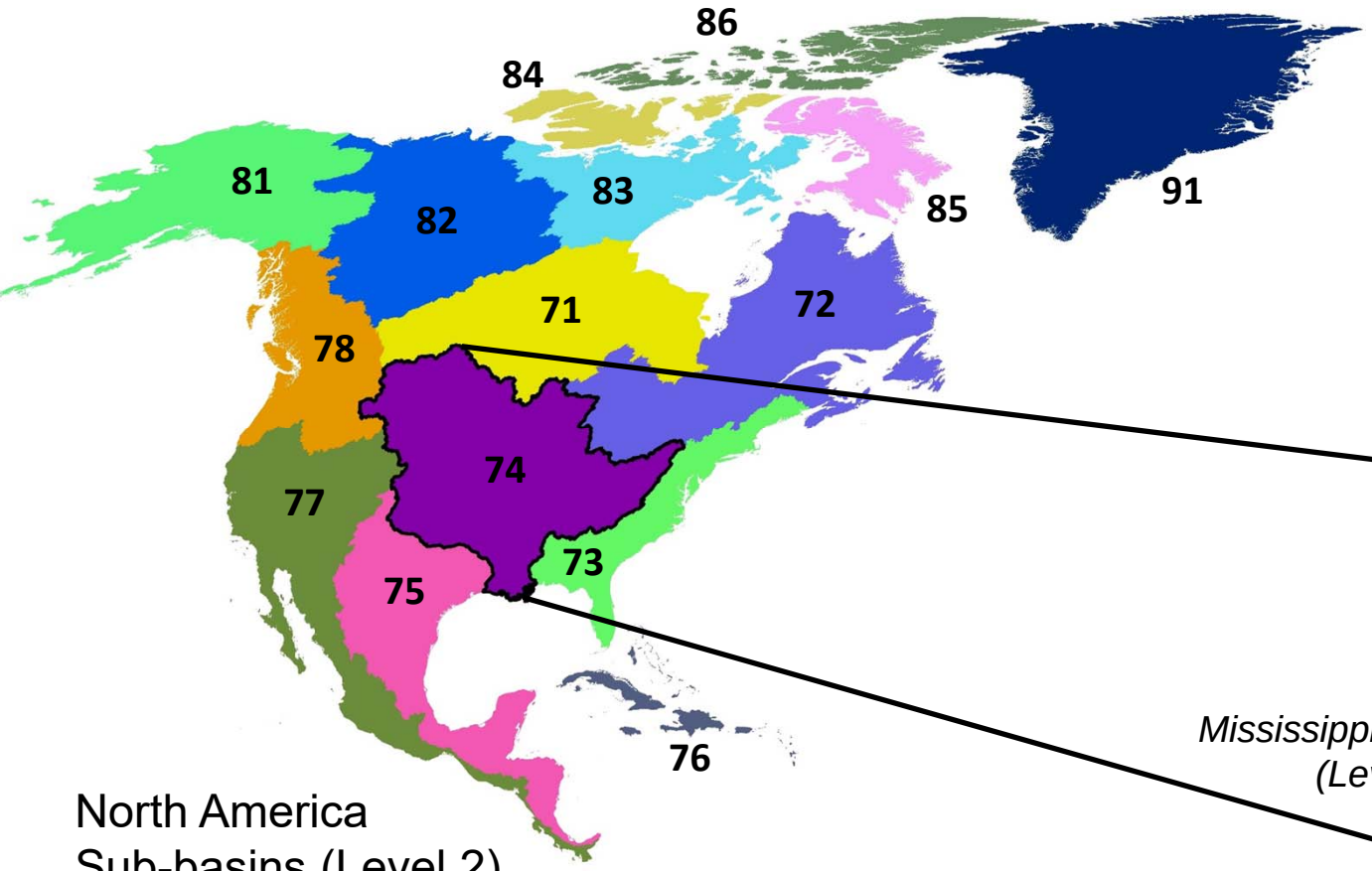
High Resolution Attributes: Mississippi Basin



SWOT River ID Format

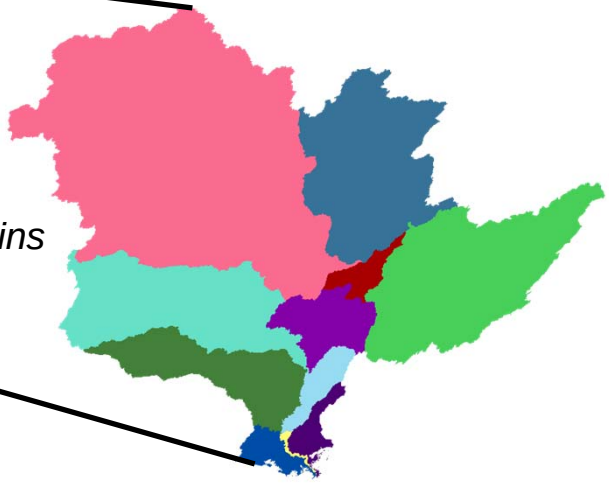
CBBBBBRRRNNNT *(all will be integers)*

- **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



North America
Sub-basins (Level 2)

Mississippi Basin: Level 2
(4th sub-basin in North America)
740000RRRNNNT



Mississippi Sub-basins
(Level 3)

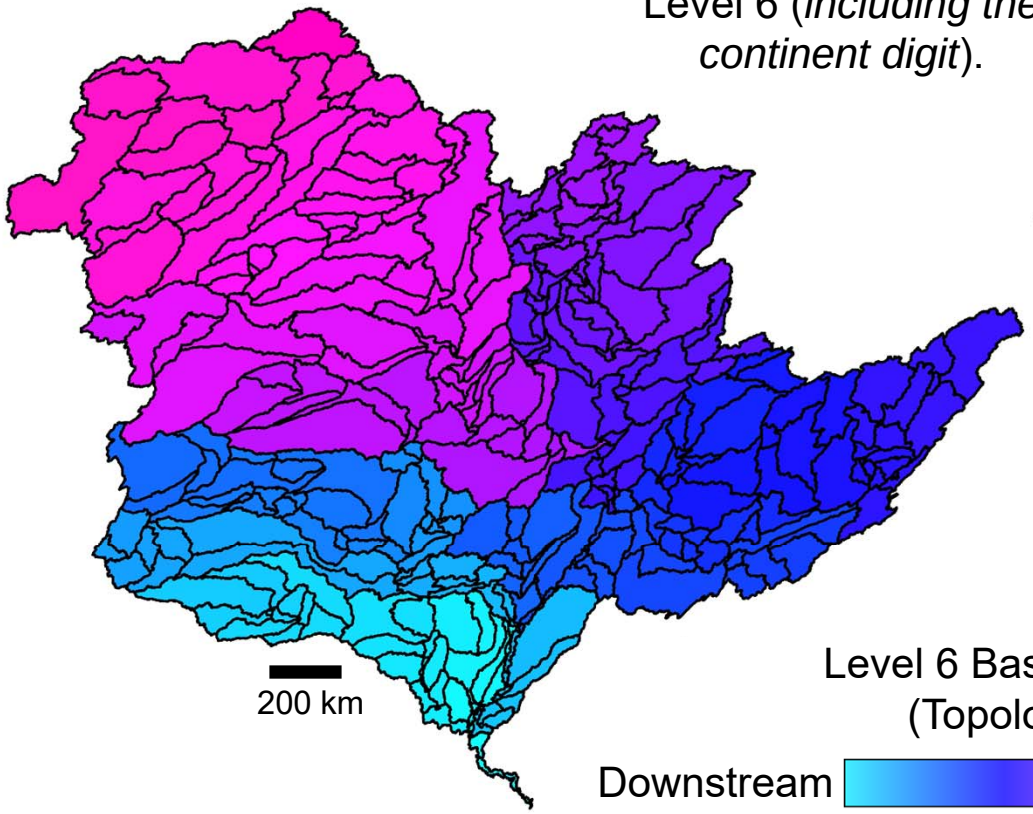
SWOT River ID Format

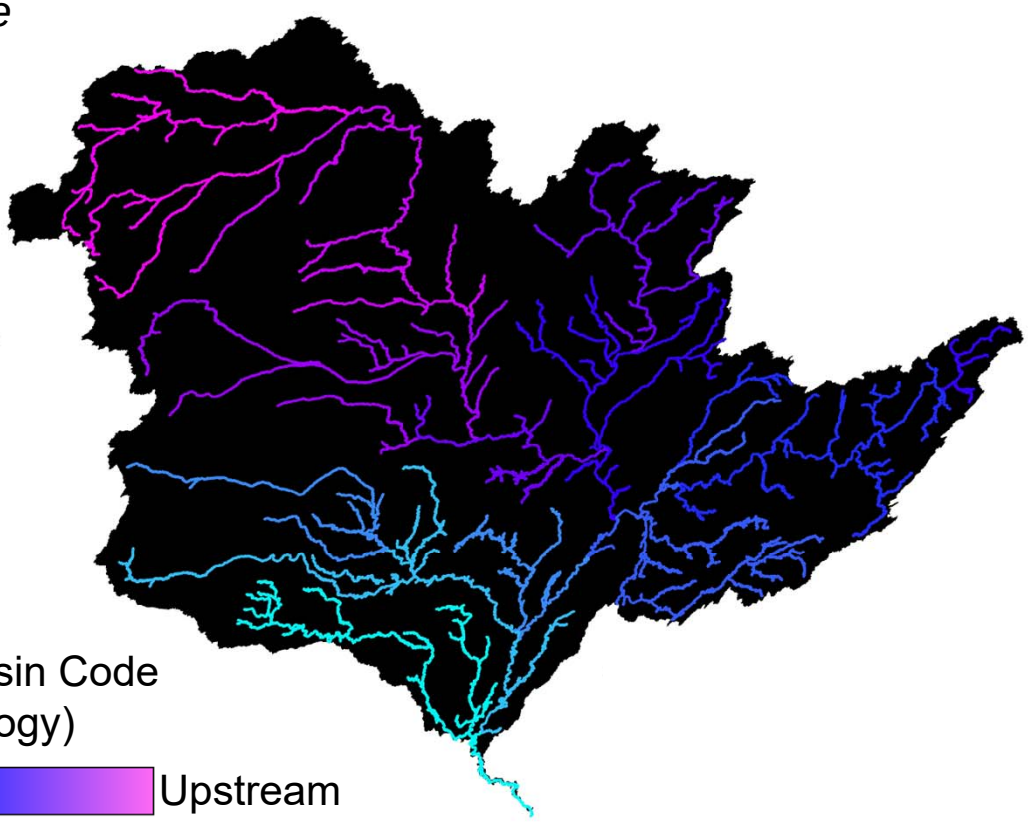
CBBBBBRRRRNNNT *(all will be integers)*

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

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

Mississippi Level 6 Basins

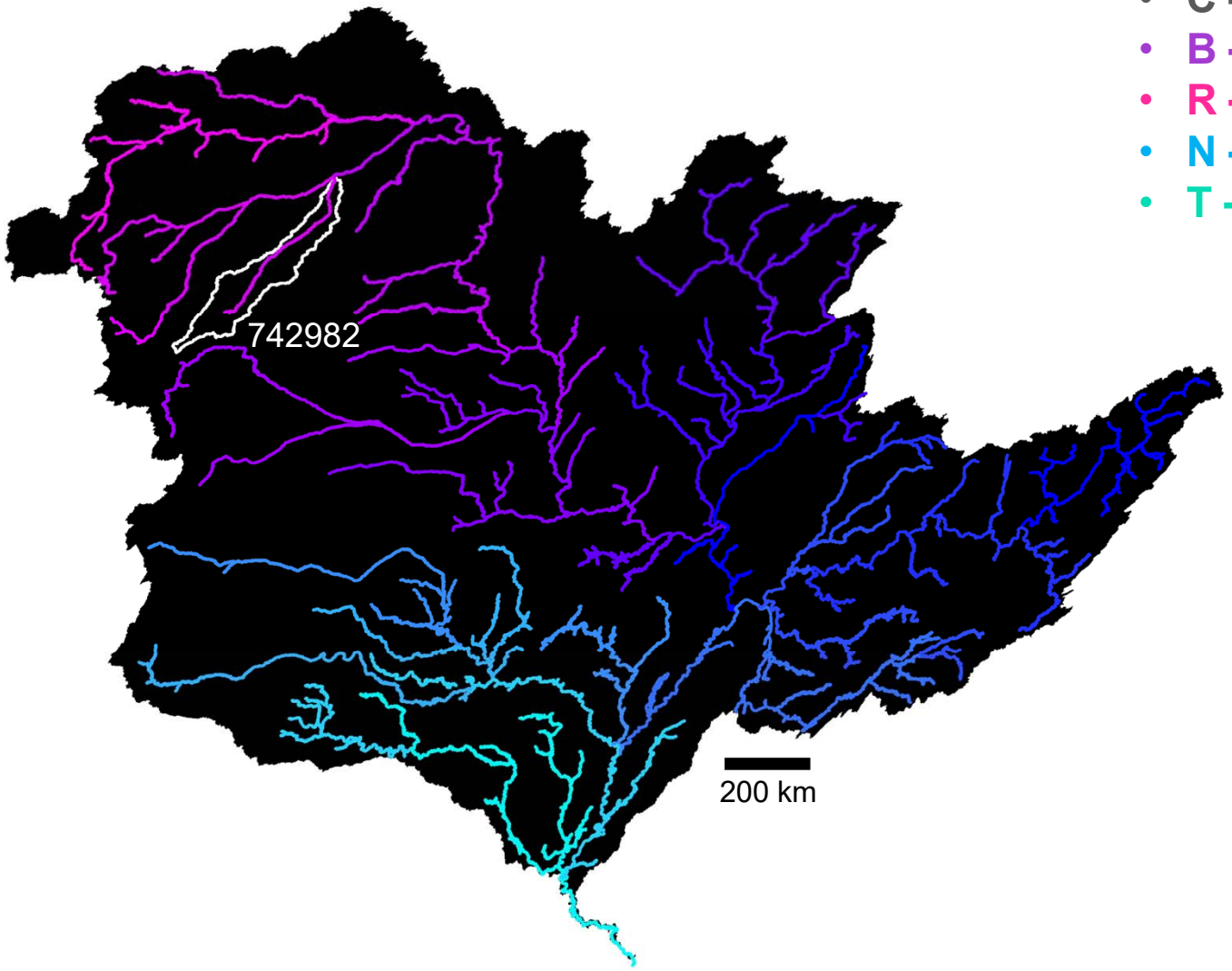




Level 6 Basin Code (Topology)

Downstream — Upstream

SWOT River ID Format



CBBBBBRRRNNNT *(all will be integers)*

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

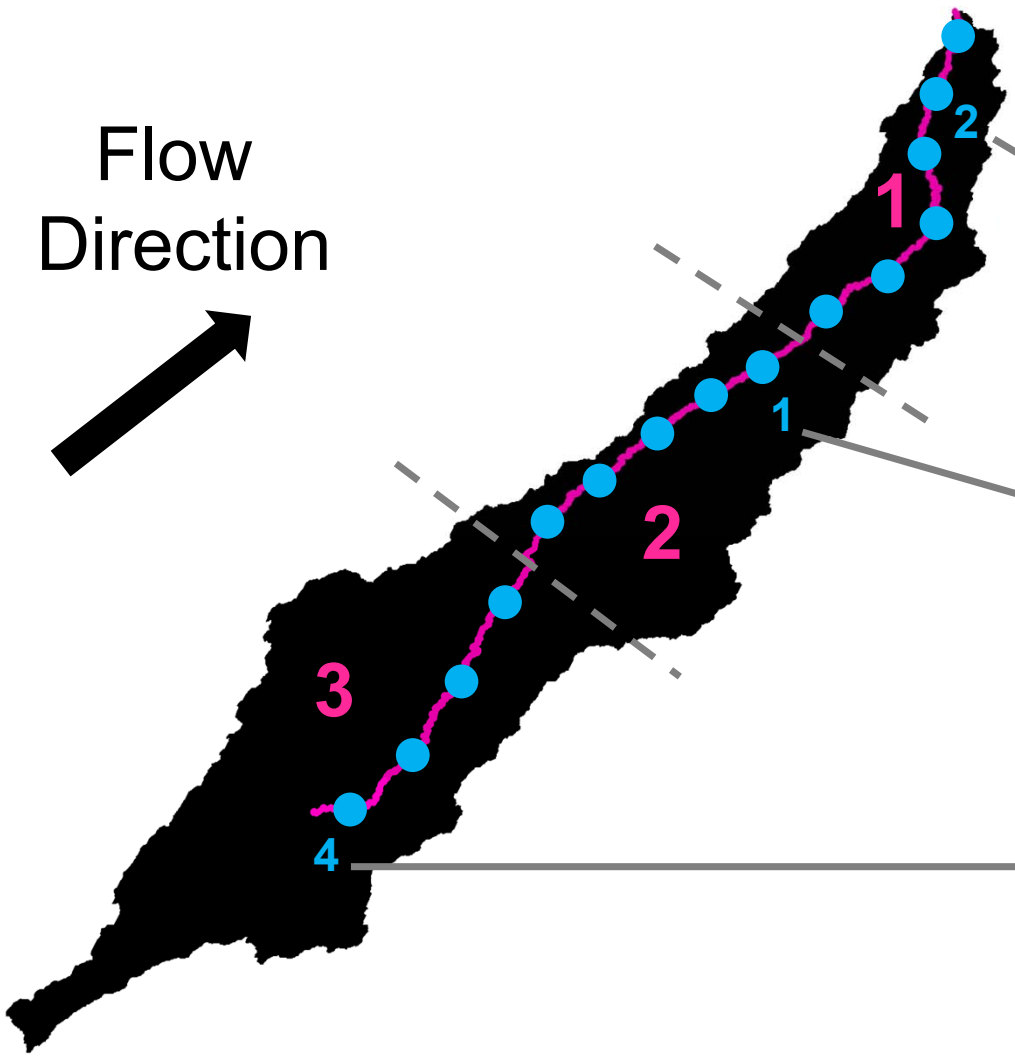
Level 6 Basin: 742982
(within Mississippi Basin):
742982RRRNNNT

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



CBBBBBRRRNNNT *(all will be integers)*

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

7429820010021 *(node id)*
7429820011 *(reach id)*

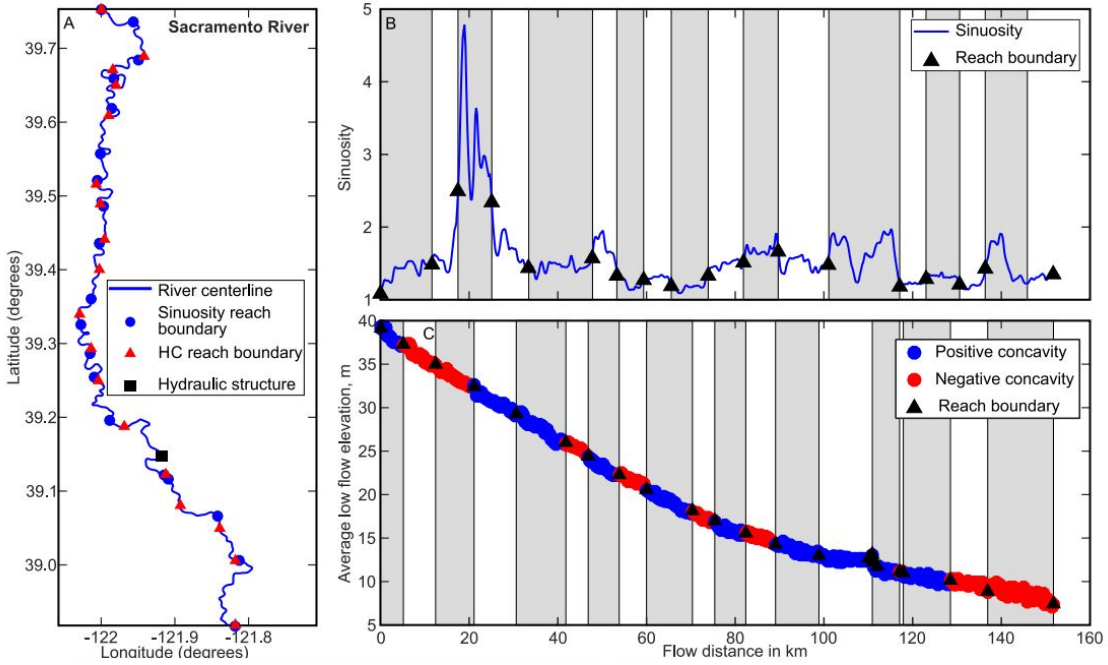
7429820020011 *(node id)*
7429820021 *(reach id)*

7429820030041 *(node id)*
7429820031 *(reach id)*

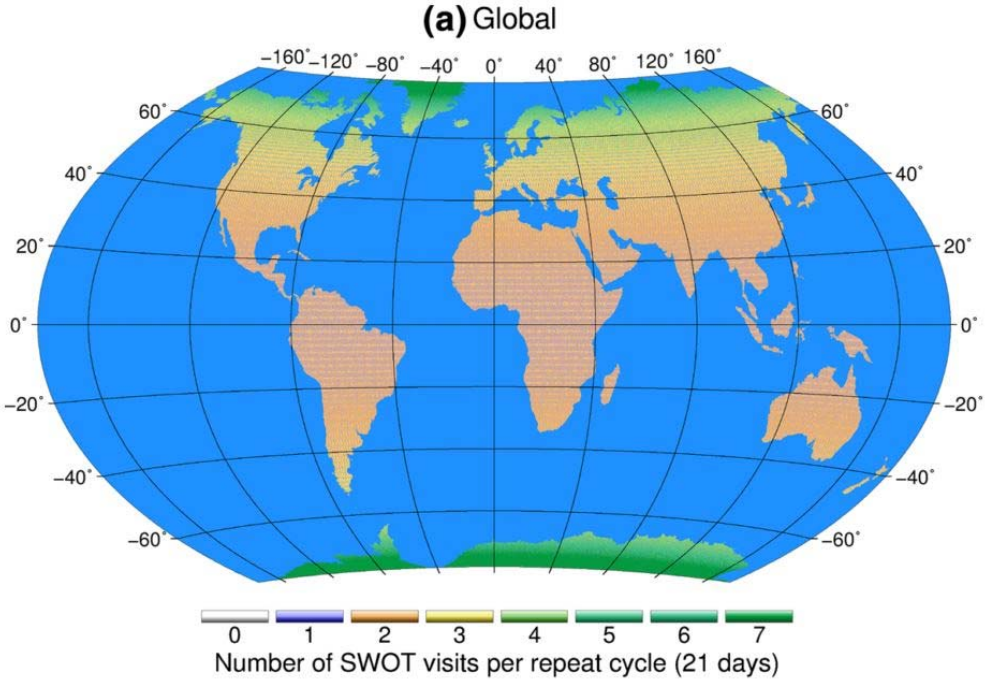
Reach Definition Plan

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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