High-Resolution Global Mean-Annual Surface Runoff And River Flow Datasets For Use In Risk Assessments

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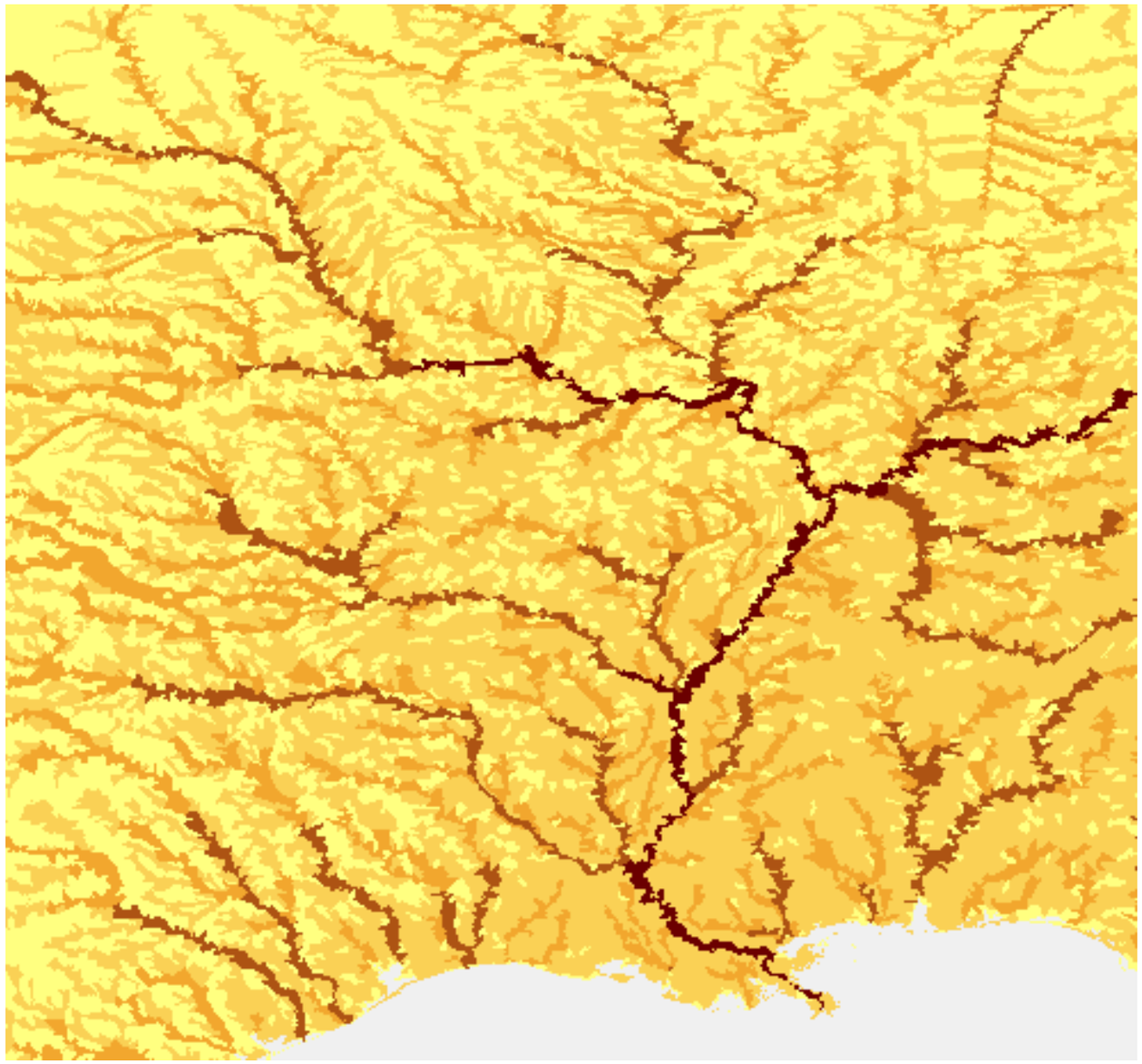
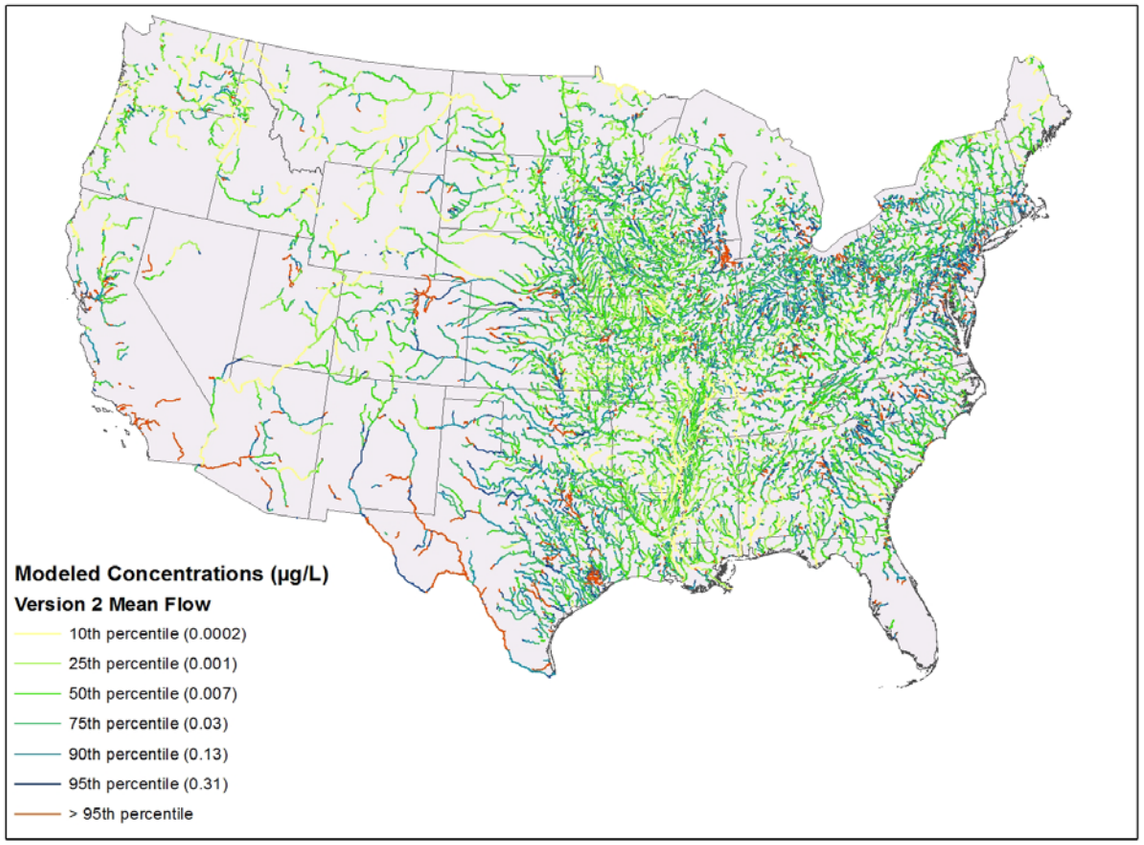
- Applications



Global River Flow – Introduction

- Outside the United States, no high-resolution river flow data publicly available for use
- Detailed river flow data needed for expansion of iSTREEM® beyond the United States and parts of Canada
  - iSTREEM® is a down-the-drain environmental exposure model to estimate chemical concentrations at wastewater facilities and effluent impacted rivers (www.istreem.org)



Global River Flow – Methodology

- River flow estimation is based on two steps:
  - Step 1: Estimating surface runoff, i.e., the amount of water that runs off a given area
    - Surface runoff from a single catchment
  - Step 2: Estimating river flow, i.e., capture the runoff water from a catchment, aggregate and route it downstream
    - Aggregating runoff from several catchments which becomes flow for a stream or eventually a river

Surface Runoff – Methodology

- Step 1: Surface runoff based on the Curve Number (CN) approach developed by the USDA (TR-55, 1986)

Eq. 1 $$S = \frac{1000}{CN} - 10$$

CN = value between 0 to 100 based on land cover and hydrologic soil groups

S = potential maximum retention after runoff

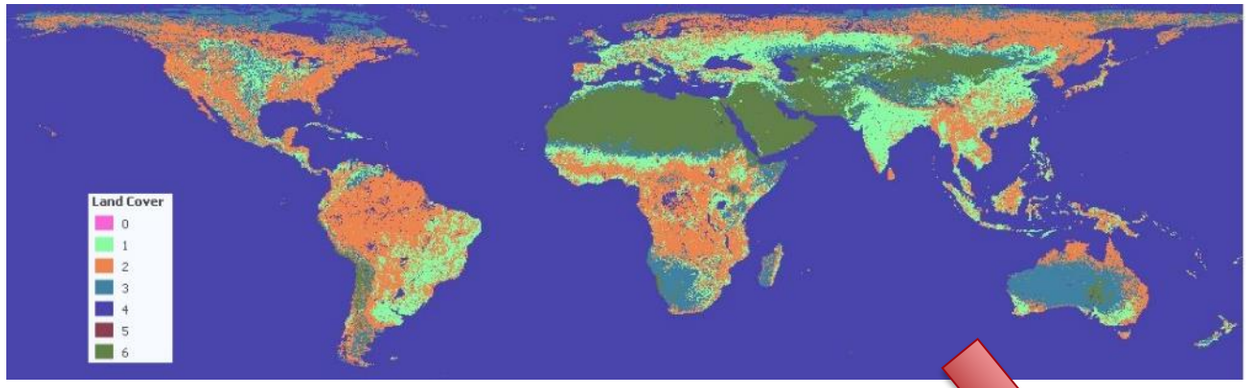
Eq. 2 $$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

P = rainfall

Q = surface runoff

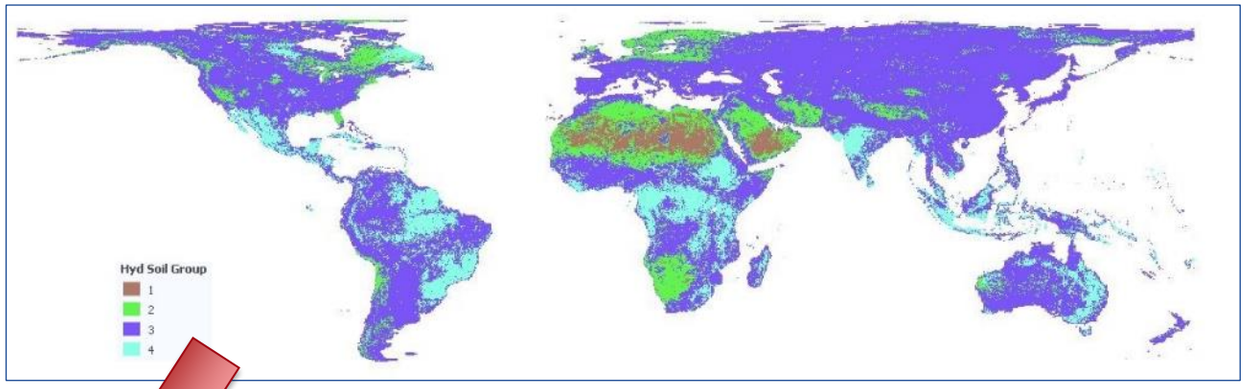
Surface Runoff – Processing

- Global input datasets and spatial data processing



Land Cover

(GlobCover, 2010)



Hydrologic Soil Group

(Ross et al., 2018. 10.1038/sdata.2018.91)

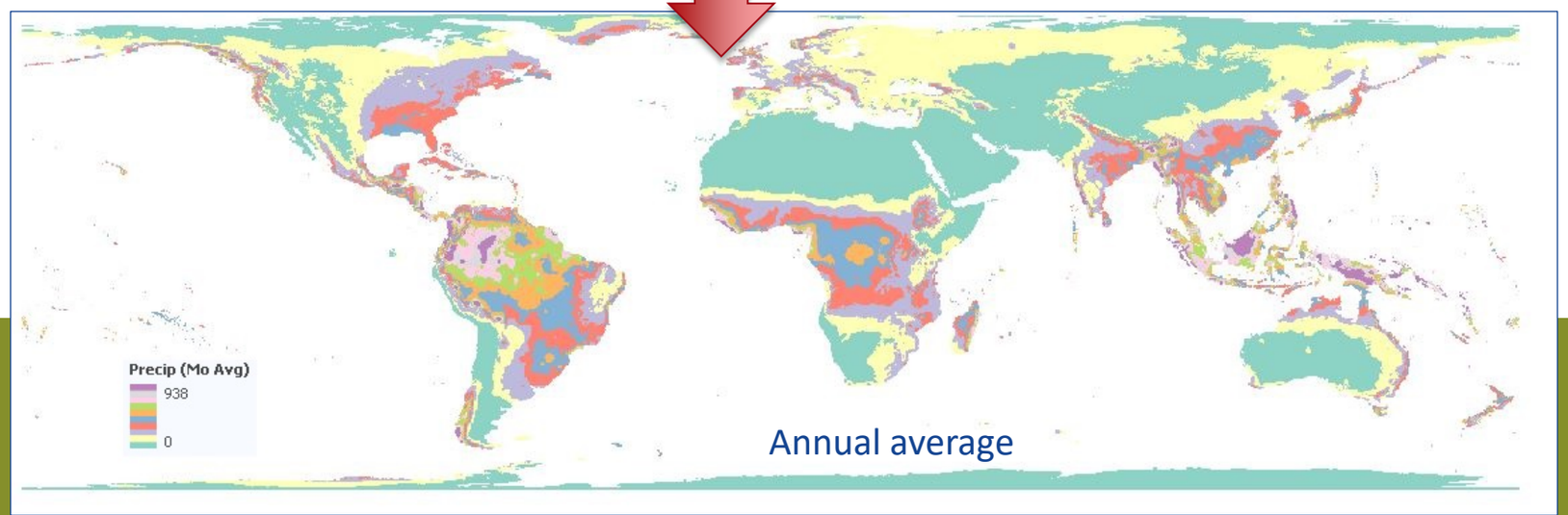
Spatial processing at 50m resolution

Land Cover/ Hydrologic Soil Group	A	B	C	D
Cultivated Land	67	76	83	87
Wood/Forest land	38	61	74	80
Meadow	30	58	71	78
Open Water	0	0	0	0
Urban Areas	74	83	88	91
Desert/Bare	63	77	85	88

Unique curve number values

Precipitation

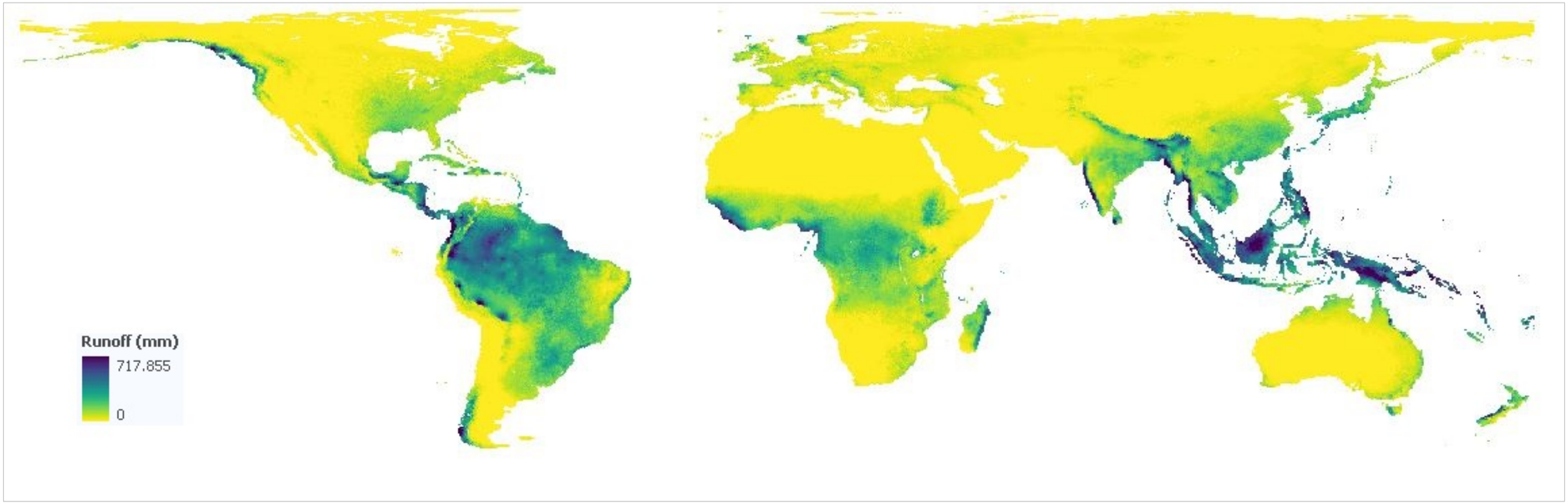
(Fick et al., 2017. 10.1002/joc.5086)



Annual average

Surface Runoff – Global gridded data

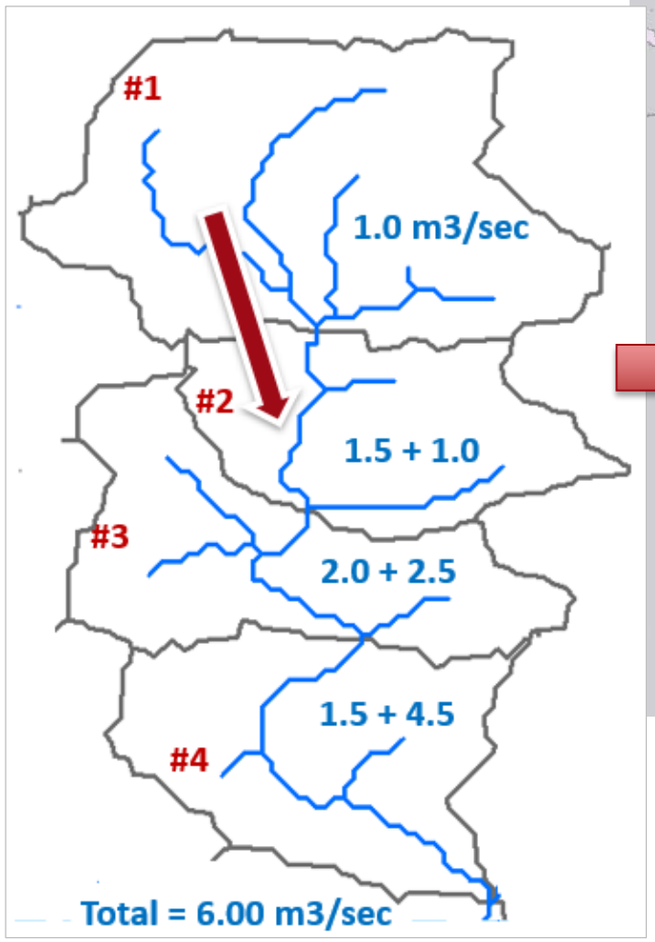
- Mean annual surface runoff for the globe
- Gridded data at 50m – highest resolution currently available

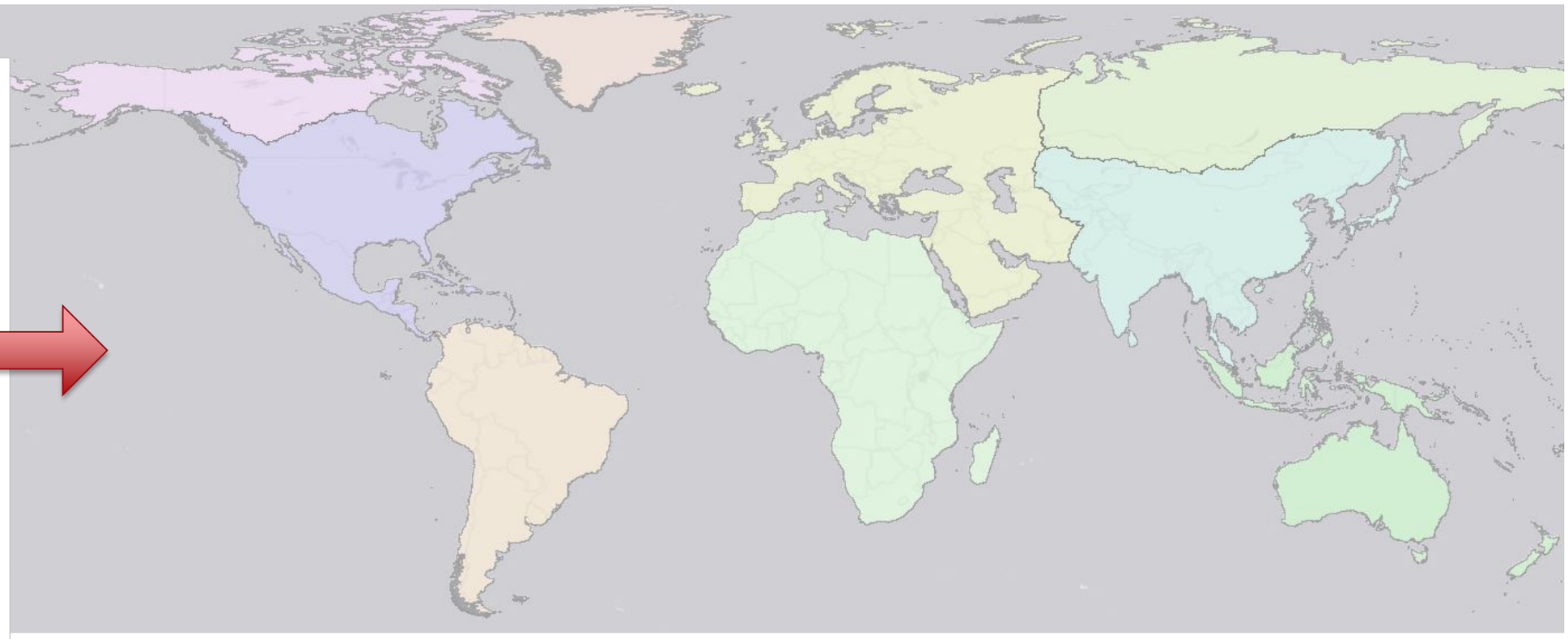


Global Surface Runoff to River Flow

- Step 2: Compute river flow from runoff data
- Hydrologic routing at HydroSheds/HydroBASINS level-12 catchment scale

Hydraulic Routing



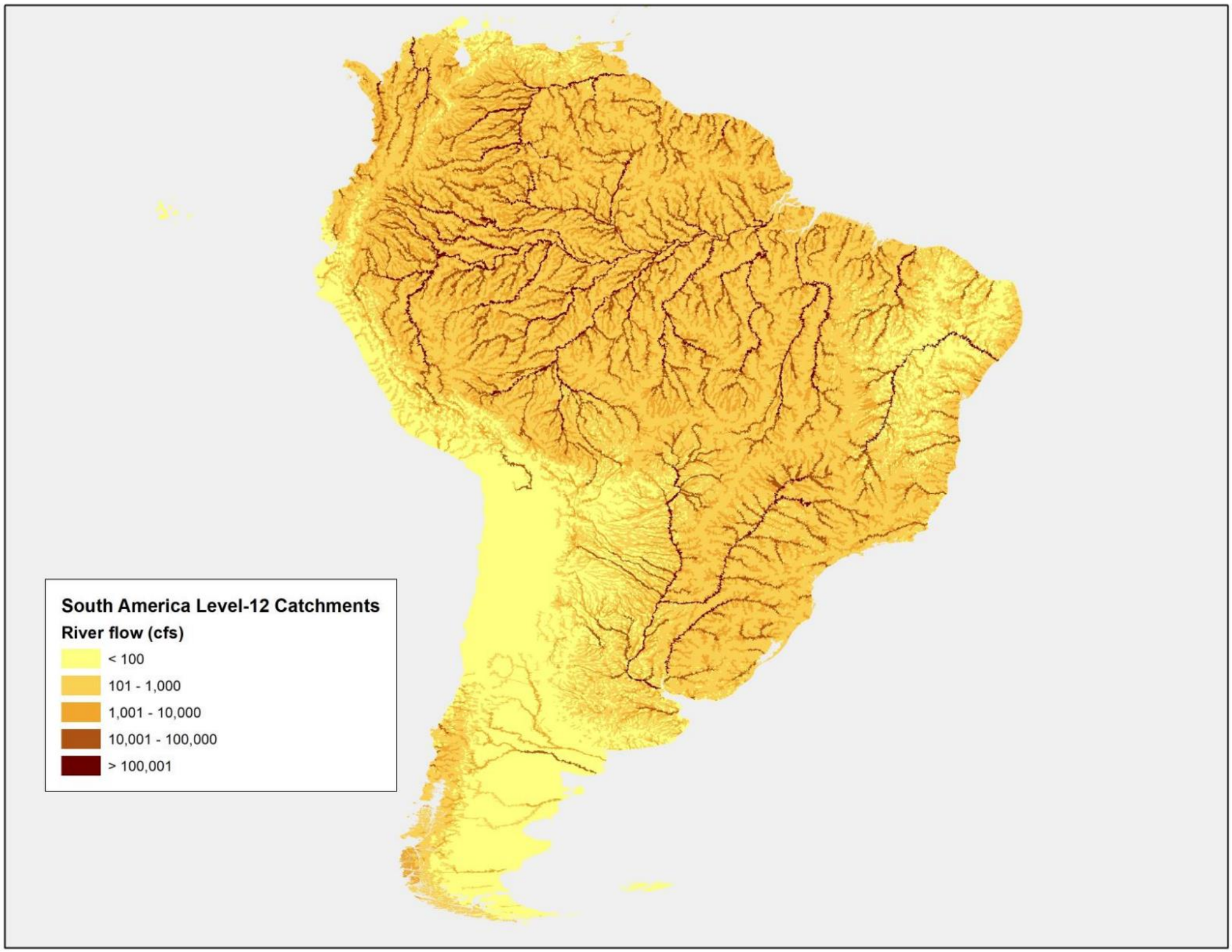


Global coverage: 8 regions

Source: HydroSHEDS and HydroBASINS (https://hydrosheds.org/)

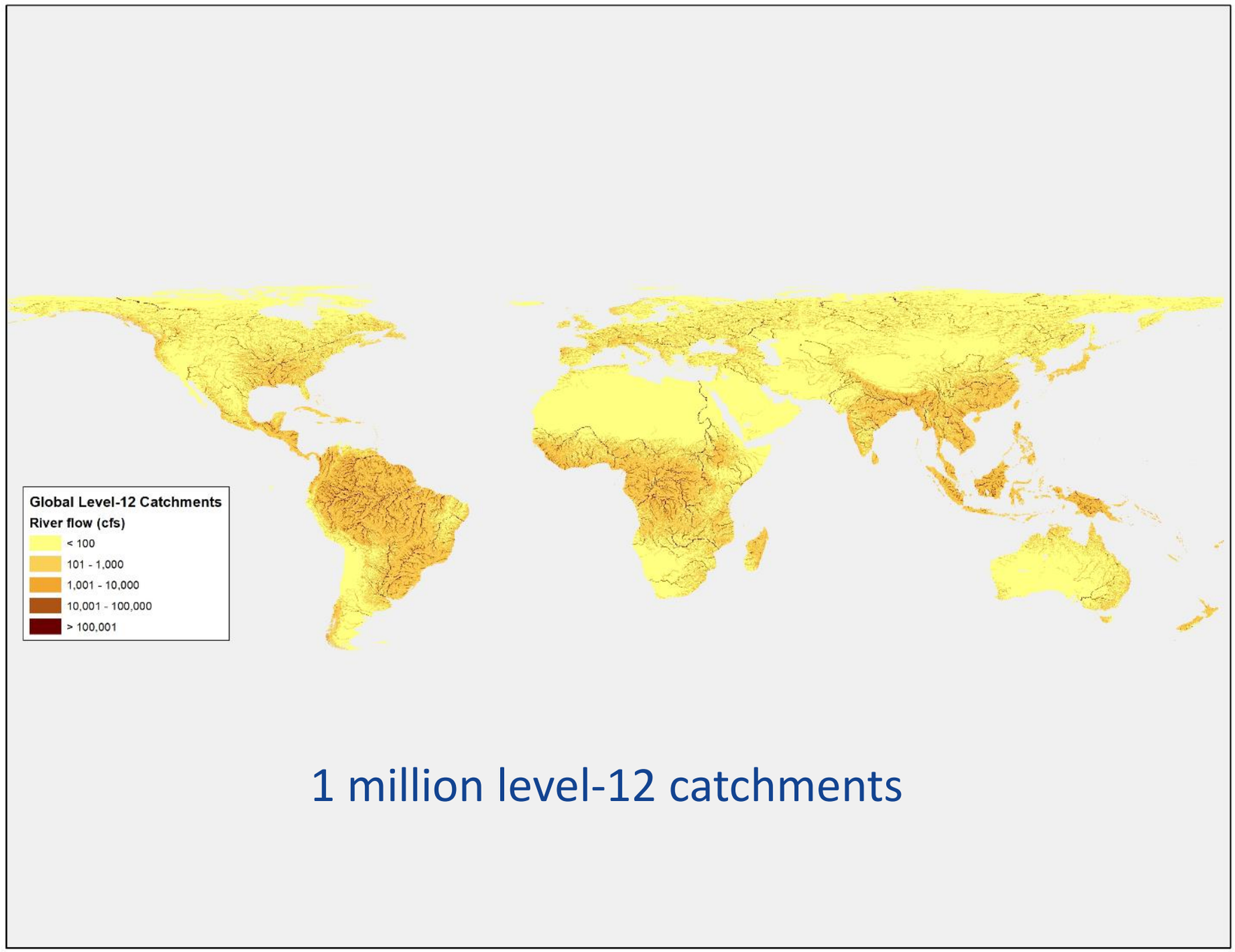
Global River Flow – Results

- Mean annual river flow by region



Global River Flow – Results

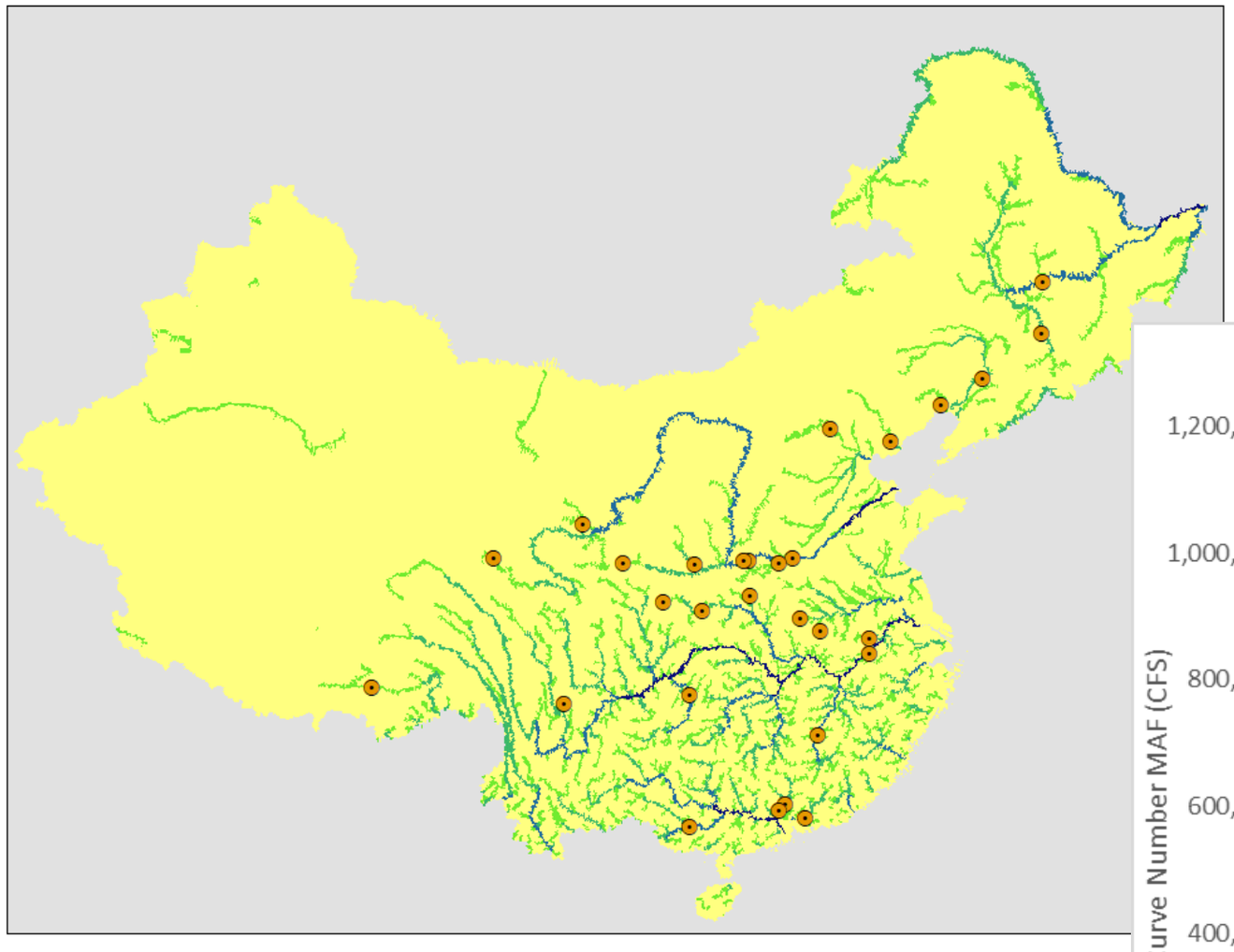
- Global mean annual river flow
- Based on HydroSheds level-12 catchments



1 million level-12 catchments

Global River Flow – China

- Comparison against measured river flow gage data from the Global Runoff Data Center (GRDC)



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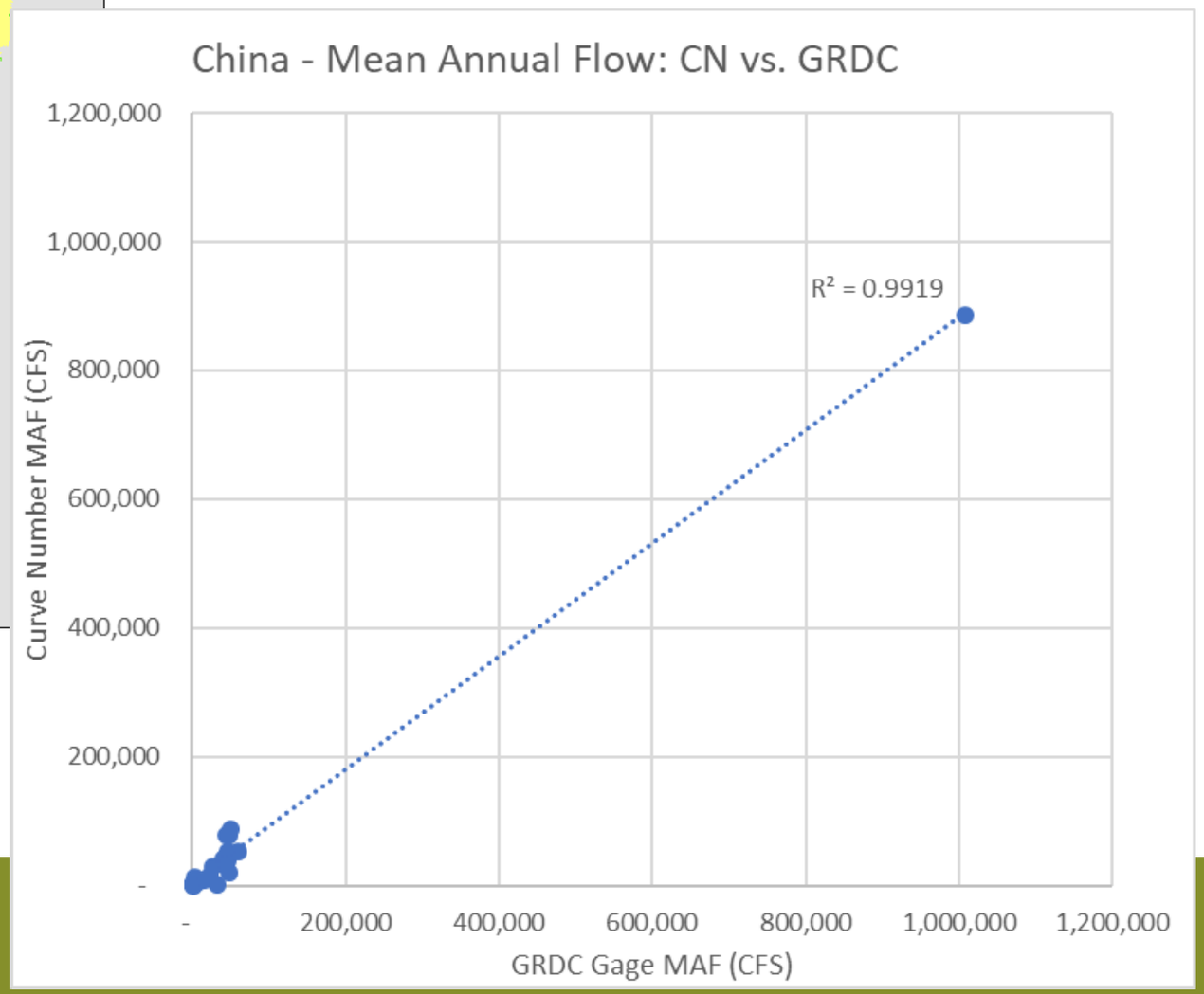
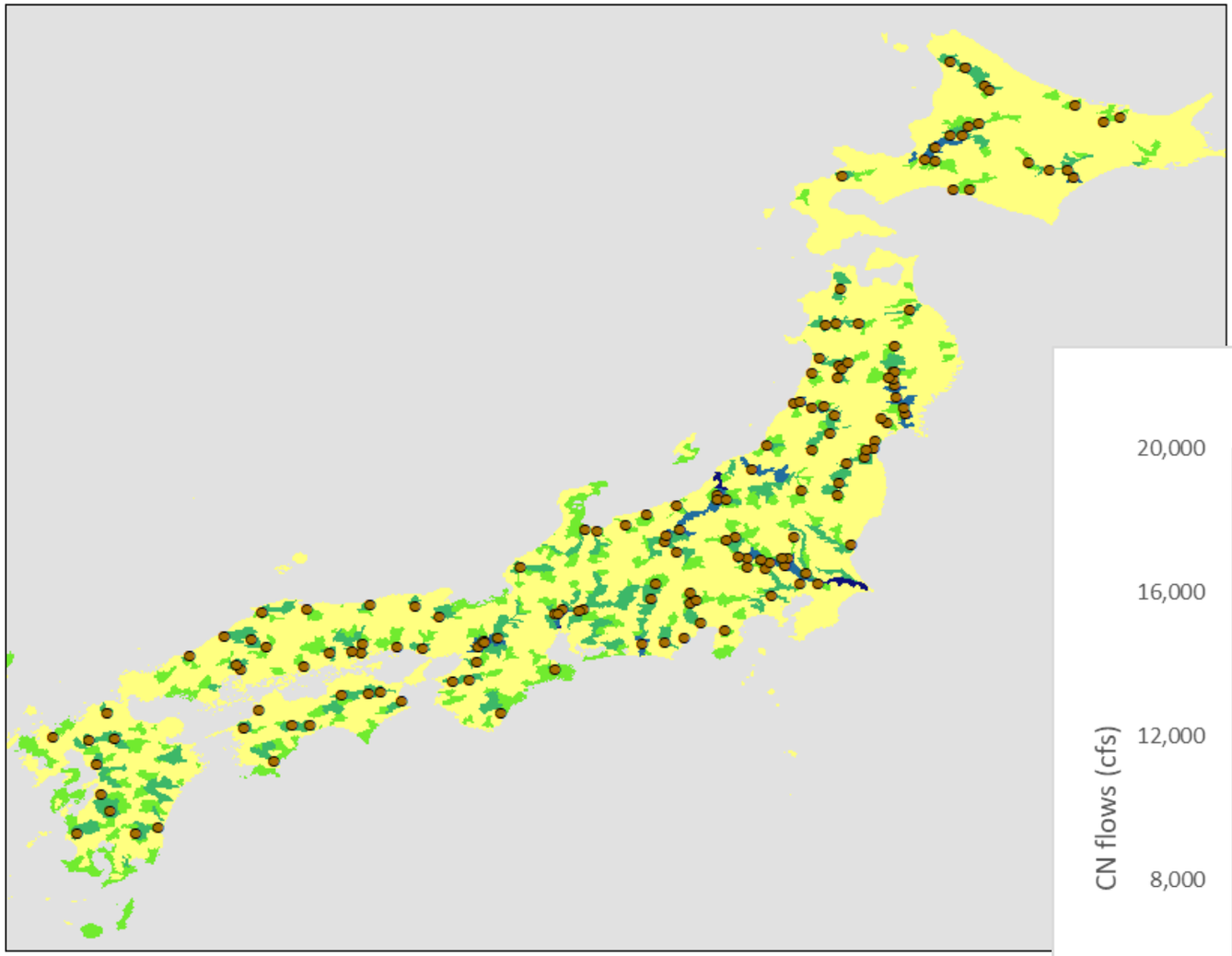


Source: Global Runoff Data Center (www.bafg.de/GRDC)

Global River Flow – Japan

- Comparison against GRDC gage data



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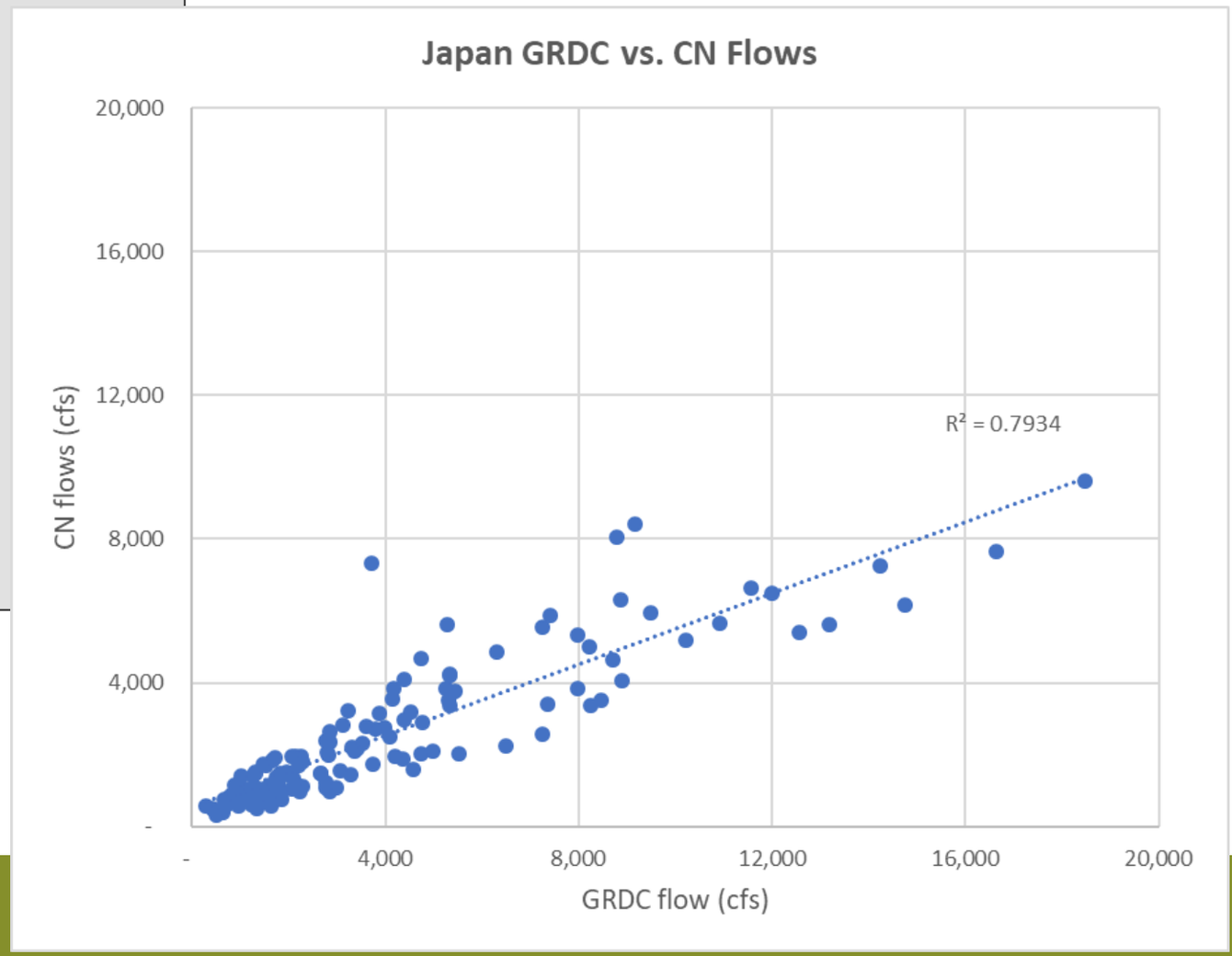
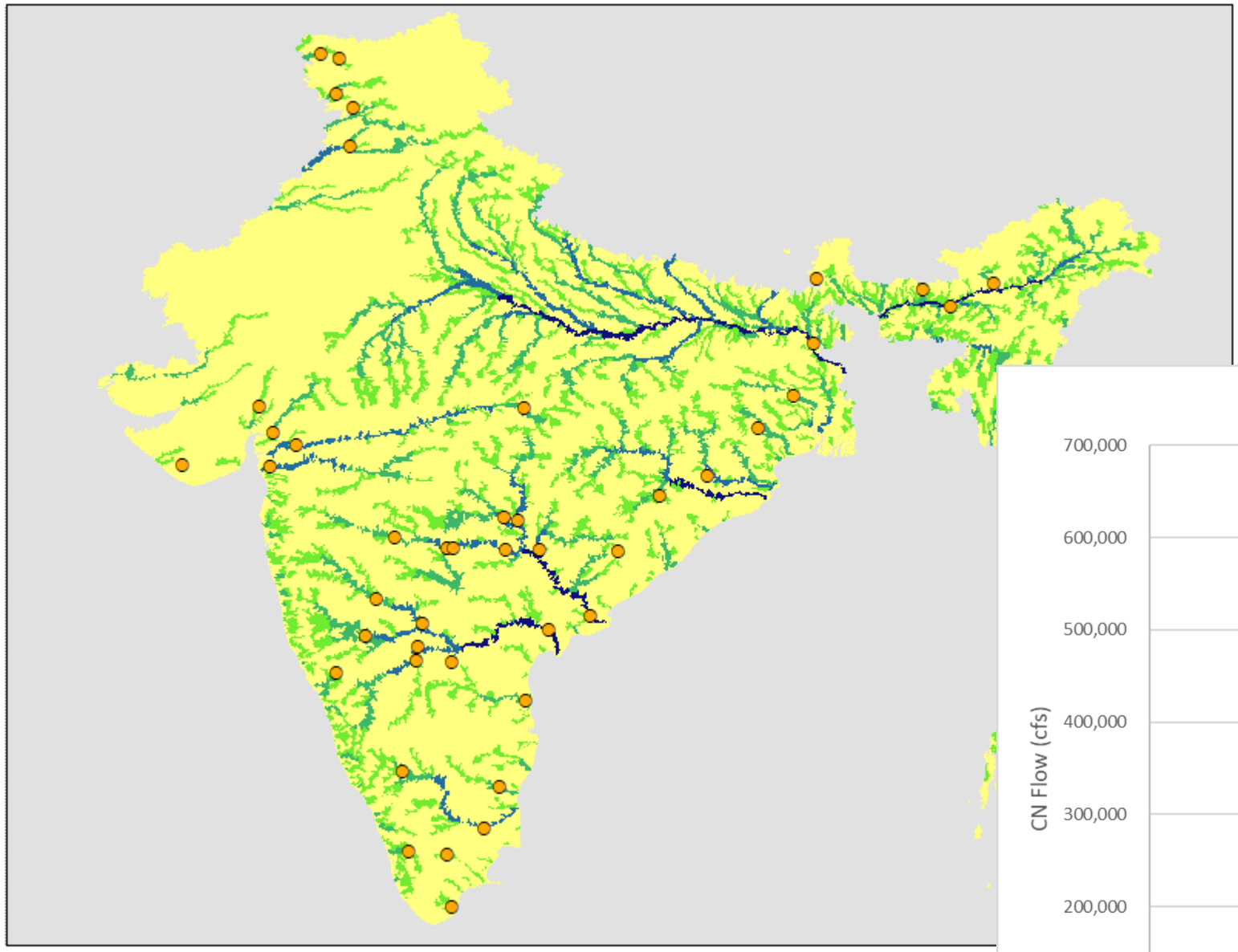


Source: Global Runoff Data Center (www.bafg.de/GRDC)

Global River Flow – India

- Comparison against GRDC gage data



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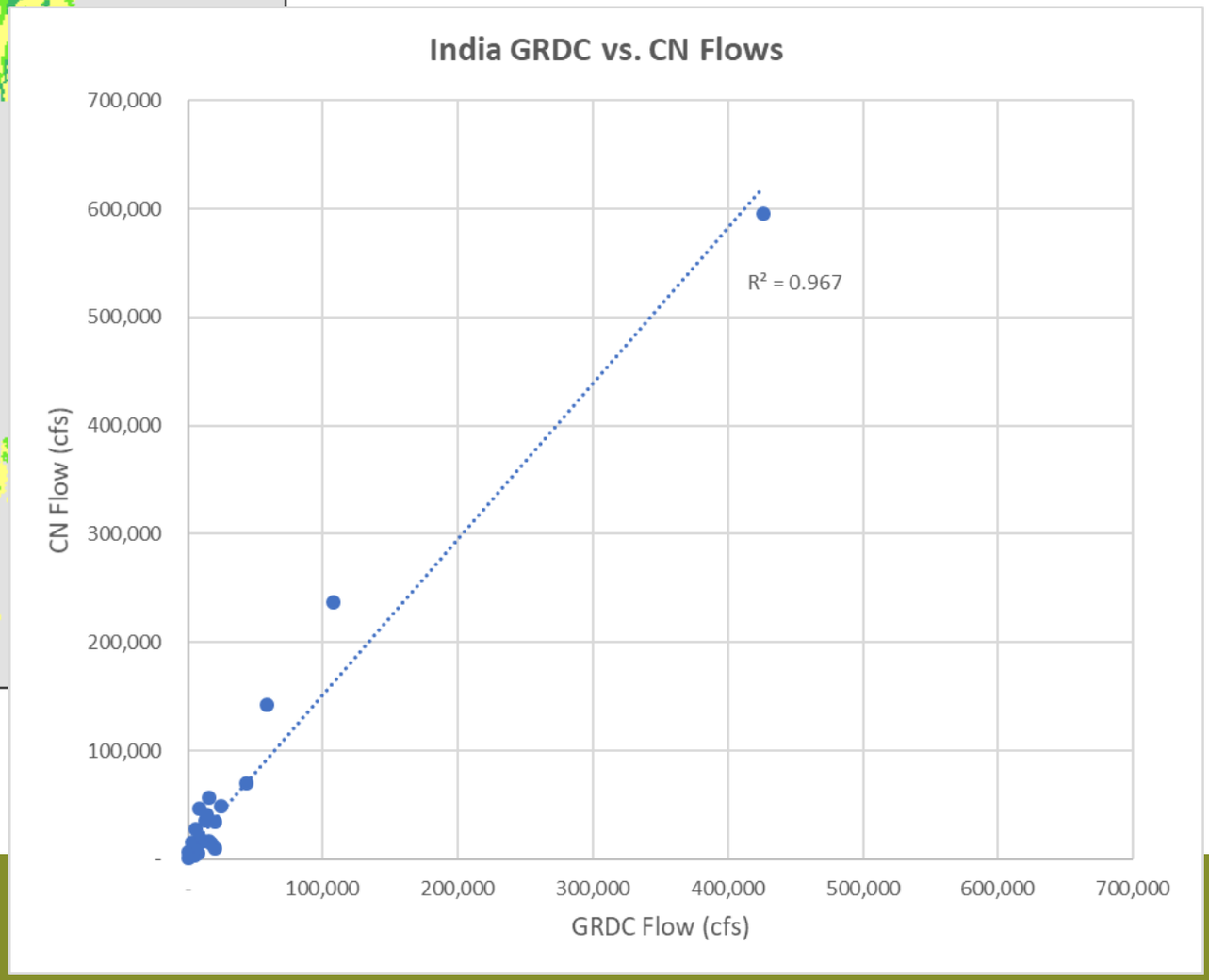
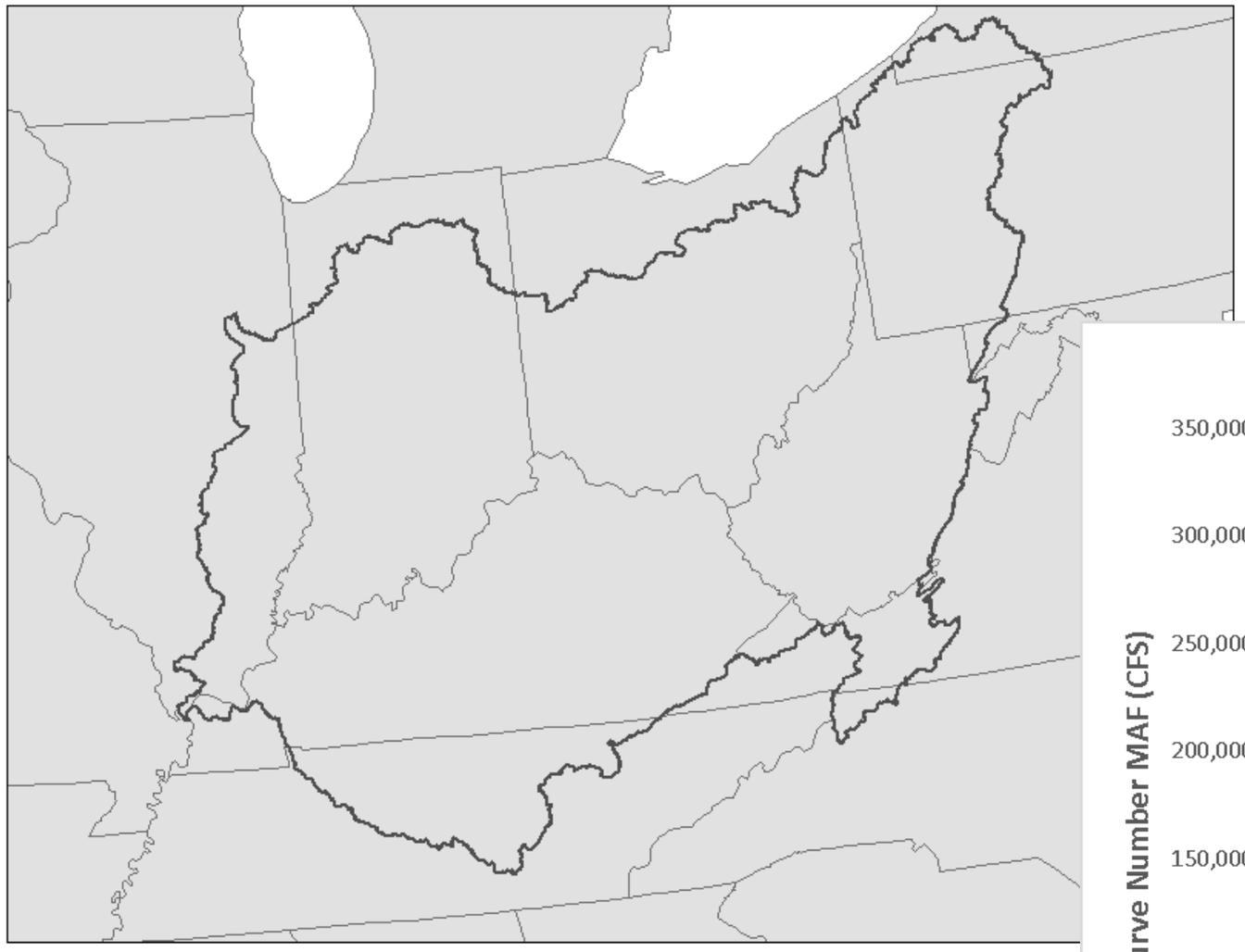


Source: Global Runoff Data Center (www.bafg.de/GRDC)

Global River Flow – Ohio River, US

- Comparison of river flows against the NHDPlus V2



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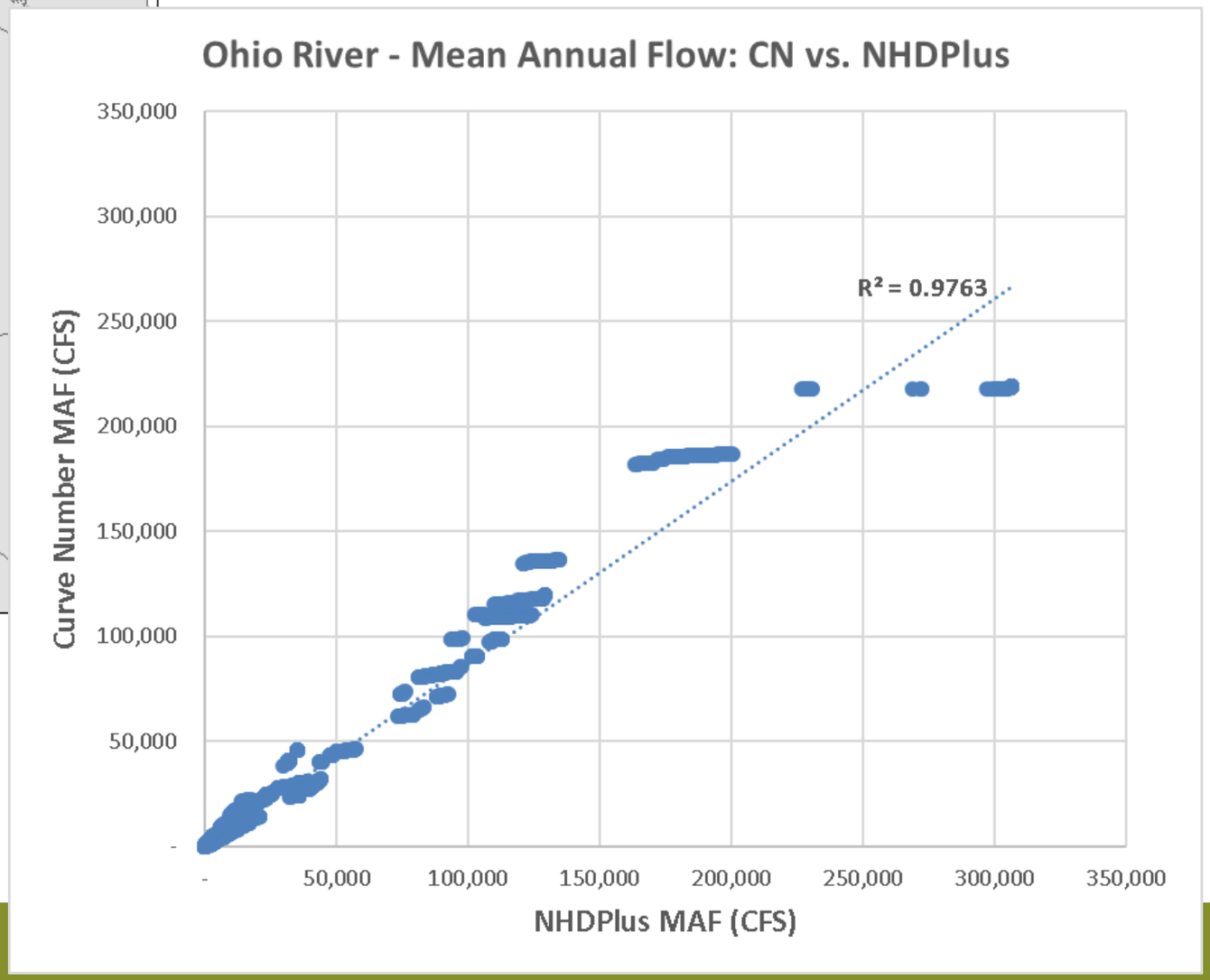


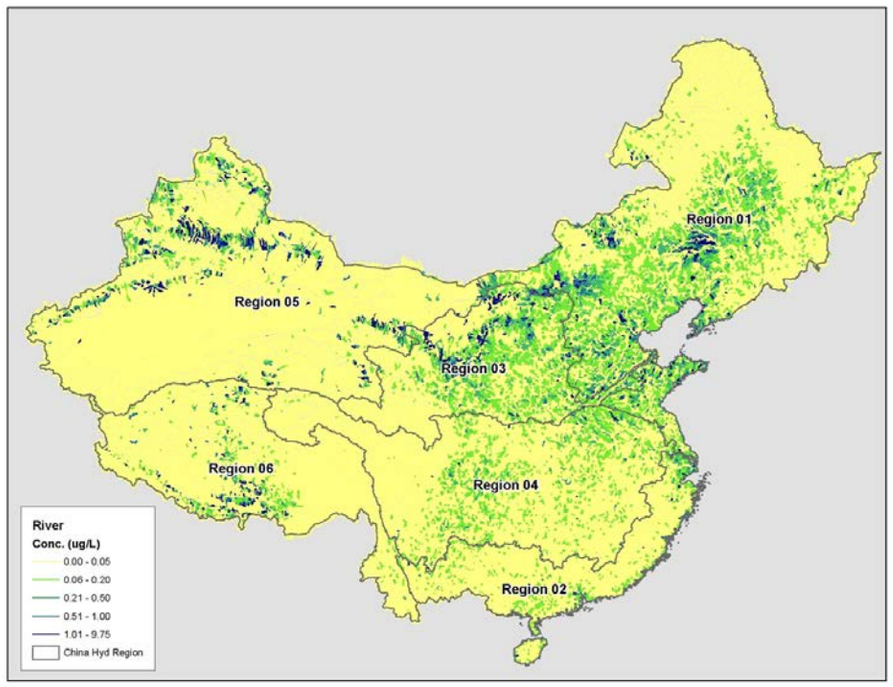
NHDPlus dataset by US EPA/USGS:
(http://www.horizon-systems.com/nhdplus/)

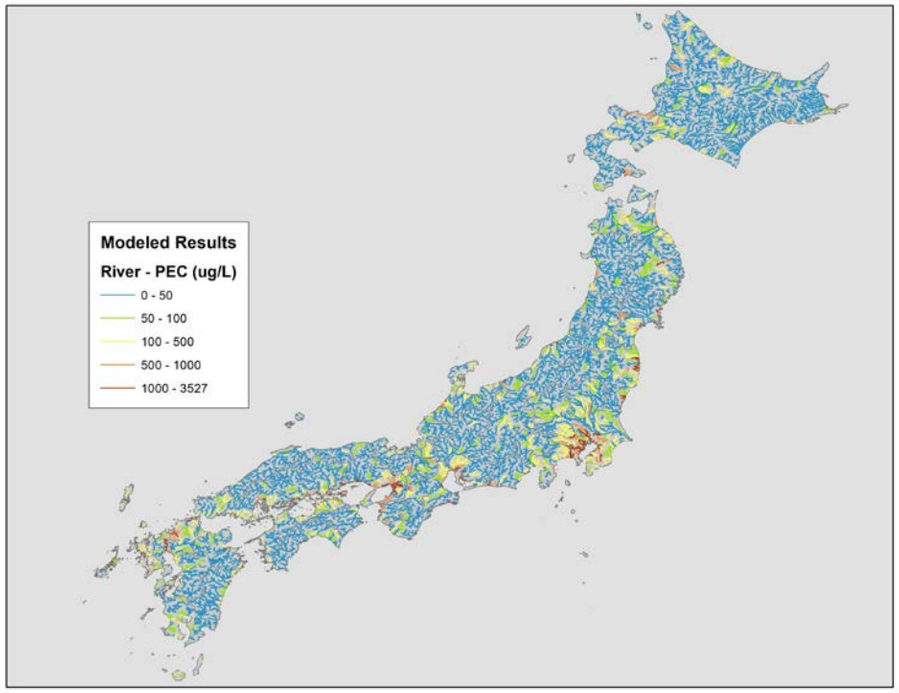
Global River Flow – Summary

- Global surface runoff gridded data based on CN
  - Highest resolution currently available (50m)
- Global mean annual river flows
  - Estimated based on HydroSHEDS and HydroBASINS
- Comparison of flow data with
  - Existing river gage data in a few countries across diverse landscapes provided positive correlations
  - NHDPlus data for the Ohio River was positive too
- Next steps
  - Publication is in the works
  - Global runoff and river flow data will be made available for public use

Global River Flow – Application

- The mean annual river flow data is currently being used for iSTREEM® expansion
  - China – Integrated ERA Framework (Ming et al., Platform 30)
  - Japan – Global exposure model (Csiszar et al., MP123)
  - Canada and Mexico – in development





Thank you!

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