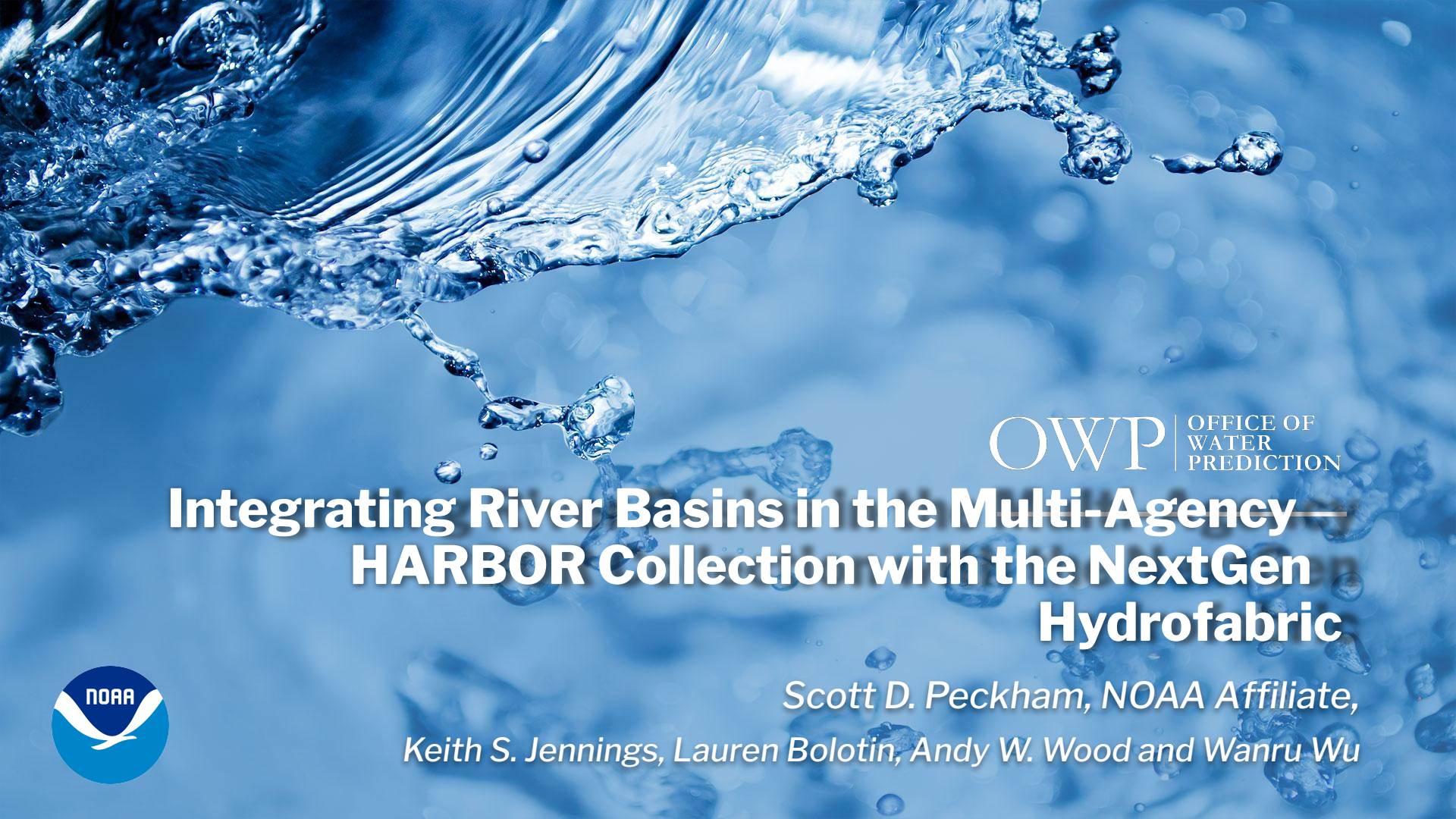

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Integrating River Basins in the Multi-Agency HARBOR Collection with the NextGen Hydrofabric

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Next Generation Water Resources Modeling Framework

NOAA's Office of Water Prediction (OWP) leads development of the Next Generation Water Resources Modeling Framework (NextGen). NextGen provides increased flexibility for dealing with the hydrologic heterogeneity that exists across CONUS by allowing different hydrologic models to be used for different basins.

Data in the **HARBOR** repo helps to identify river basins that match a user's modeling objectives and to then obtain data from the **NextGen Hydrofabric** to simplify modeling them within the NextGen framework.

Multi-Agency HARBOR Collection

HARBOR = Harmonized Attributes of River Basins in One Repo
= an extensive collection of river basin data sets

CAMELS (Catchment Attributes and Meteorology for Large-sample Studies). 671 CONUS basins with minimal human impact that span a wide range of hydroclimatic conditions. 52 basins also in MOPEX.

MOPEX (Model Parameter Estimation Experiment). 431 well-monitored, lower-impact basins with focus on parameter estimation for hydrologic models.

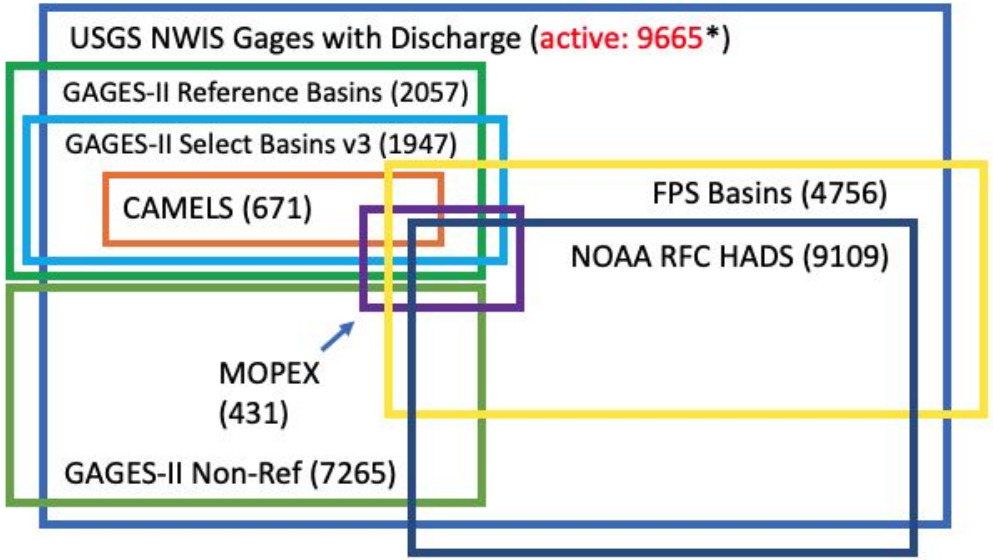
NOAA RFC (River Forecast Center) Basins. US is divided into 13 RFCs that collaborate with USGS to monitor 9109 basin DCPs via GOES.

USDA ARS (Agricultural Research Service) Experimental Watershed Network. 771 basins, many with long discharge records. In STEWARDS.

USGS GAGES-II (Geospatial Attributes of Gages for Evaluating Streamflow v2). 2057 "reference" (least-disturbed) sites and 7265 "non-reference" basins (9322 total). Most have discharge data for 20+ years. Has all but 7 MOPEX basins. **CONUS SB3** is a subset of 1947 "selected basins" with many additional attributes & includes all CAMELS basins and 743 HCDN basins.

USGS NWIS Basins w/ Discharge Data. 27890 stations, about 9665 active.

Multi-Agency HARBOR Collection



The HARBOR data collection collates information from many different river basin data collections for the US. It provides over 50 attributes for each basin and classifies basins into ***hydrologically similar*** groups using several different methods.

Multi-Agency HARBOR Collection

Each cargo ship in this harbor represents a federal agency or group that provides river basin data. The shipping containers represent the data, while the cranes represents Python utilities for extracting and harmonizing the data.

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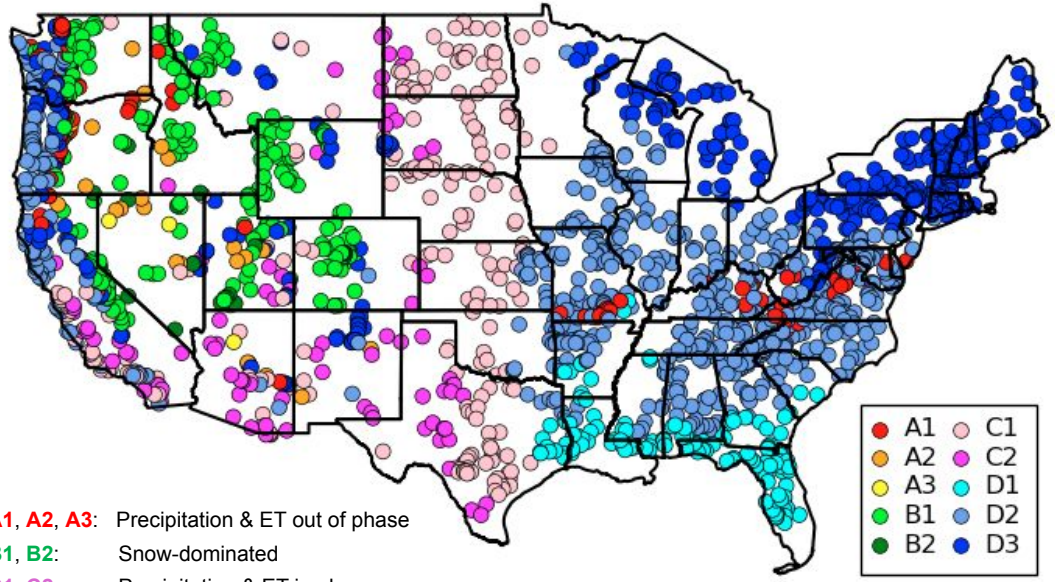
Basin Classification in HARBOR



A1, **A2**, **A3**: Precipitation & ET out of phase
B1, **B2**: Snow-dominated
C1, **C2**: Precipitation & ET in phase
D1, **D2**, **D3**: Mild seasonality and humid

HARBOR classifies basins by multiple methods, including the **Seasonal Water Balance (SWB) method** of Berghuijs et al. (2014). Dots represent GAGES-II basins classified into one of the 10 SWB classes. Within the A, B, & C classes, a higher number has *higher aridity*. D1 has no snow.

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51 Harmonized Attributes in HARBOR

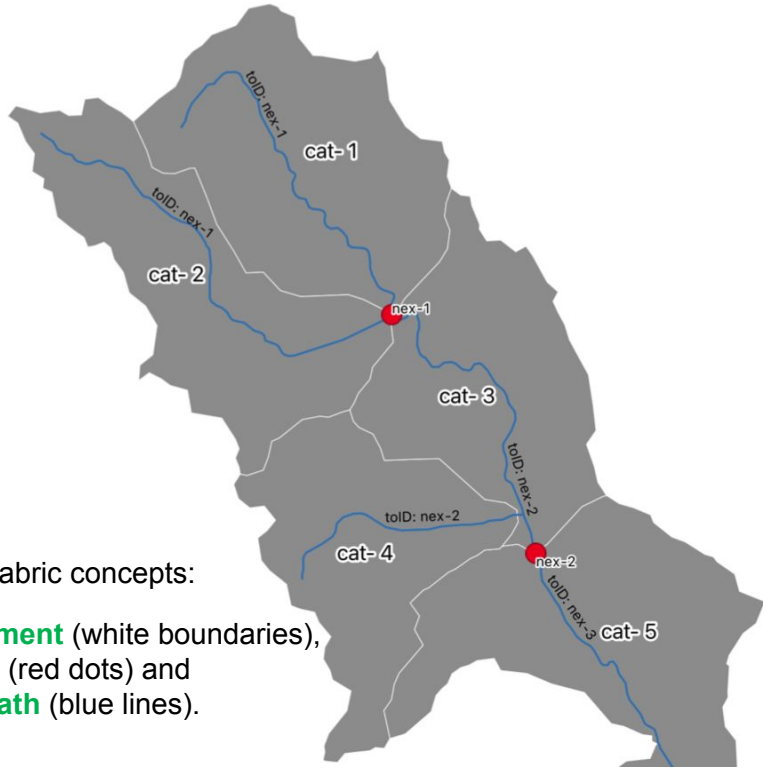
USGS Site ID
NWS Location ID
GOES satellite ID
RFC ID
WFO/CWA ID
Hydro. Service Area
HUC code (12 digits)
USGS Site Name
USGS Site Type
Stage Data Type
PEDTS param. Code
State Code
Country Code
Outlet Longitude
Outlet Latitude
Outlet Elevation
Elevation Units

Contributing Area
Area Units
Horizontal Datum
Vertical Datum
Bounding Box minlon
Bounding Box maxlon
Bounding Box minlat
Bounding Box maxlat
Long USGS name
Closest USGS Site ID
Closest Site Distance
USGS Site URL
HUC URL
NWS URL
Status as FPS gage
Start Date
End Date

Ecological Region
HLR Code at Outlet
Seasonal Water Bal. Class
Hydrograph Type
Is USGS NWIS Web?
Is GAGES2 Any?
Is GAGES2 Ref?
Is GAGES2 SB3?
Is FPS?
Is HCDN?
Is RFC?
Is CAMELS?
Is MOPEX?
Is CZO?
Is LTER?
Is NEON?
Is ARS?

4 classification methods

NOAA's NextGen Hydrofabric



Hydrofabric concepts:

Catchment (white boundaries),
Nexus (red dots) and
Flowpath (blue lines).

The **NOAA-USGS reference hydrofabric** is based on **E2NHD+** and provides a flow network for the USA with a standardized representation of the connectivity of water bodies, including catchment boundaries and channel flowpaths.

It is usable at a variety of scales and supports basins as small as a few square kilometers in size. It conforms with the **HY_Features** standard for hydrologic data as part of the **OGC WaterML2** standard.

NOAA's NextGen Hydrofabric is derived from this reference product and is extended with a suite of flowpath and divide level attributes. This extension underpins the NextGen modeling framework, which will support successors to the **National Water Model** beyond version 3.1.

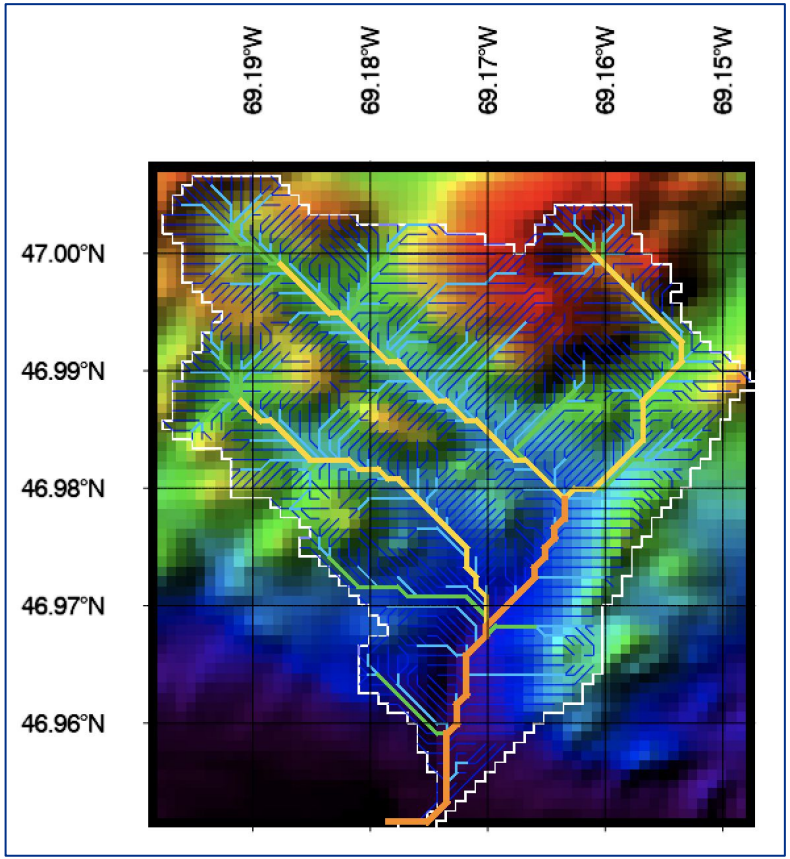
HARBOR + Hydrofabric + NextGen

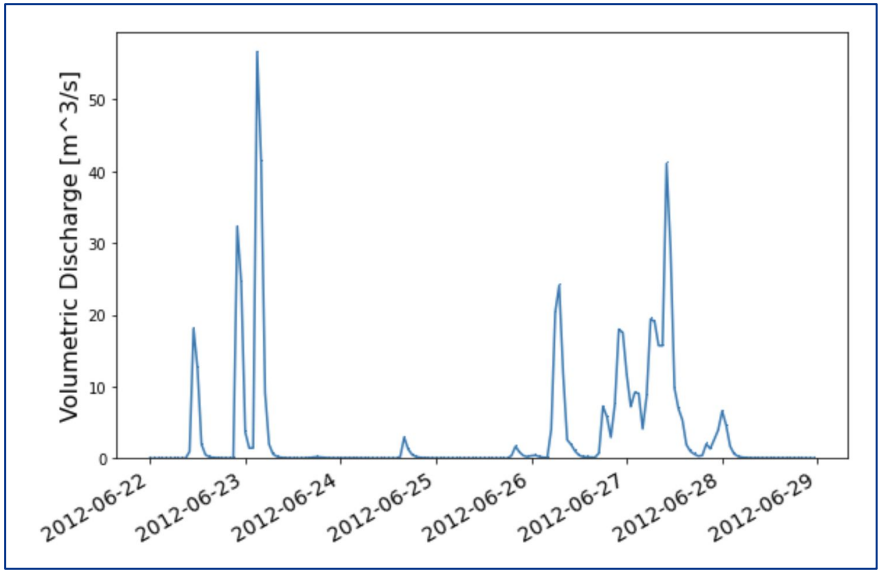
For this work, a Python module: hydrofab_tools.py was written that uses river basin data from **HARBOR** to extract info from the Hydrofabric that is needed to run NextGen for basins of interest. The **NextGen Hydrofabric** is provided in the Geopackage (.gpkg) or GeoJSON formats.

✔ To create HARBOR, a collection of **Python** utilities (**over 16,000 lines of code**) were written to extract, clean, & collate info from all the basin data collections. See: github.com/peckhams/topoflow36/utils/ngen

✔ The HARBOR repo consists of many individual TSV files, a "master" TSV file, references, shapefiles, URLs, and other related resources. See: github.com/peckhams/nextgen_basin_repo

Simplified Hydrologic Modeling in NextGen





(Left) Shaded relief image overlain with basin boundary (white) and channels for "**cat-209**", a headwater catchment in the NextGen Hydrofabric.
This river basin is **Little McKinnon Brook** in Maine.

(Top) Simulated hydrograph for "cat-209", due to June 2012 rain storms, computed by **TopoFlow** in NextGen.

HARBOR Paper Coming Soon

We are about to submit a paper on HARBOR to Hydrology and Earth System Science (HESS)

Peckham, S.D., K. Jennings, W. Wu, A. Wood, and L. Bolotin (2025) HARBOR – Harmonized Attributes for River Basins in One Repo: Collated river basin data from multiple collections with a software toolkit.

Thank You!

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Lynker