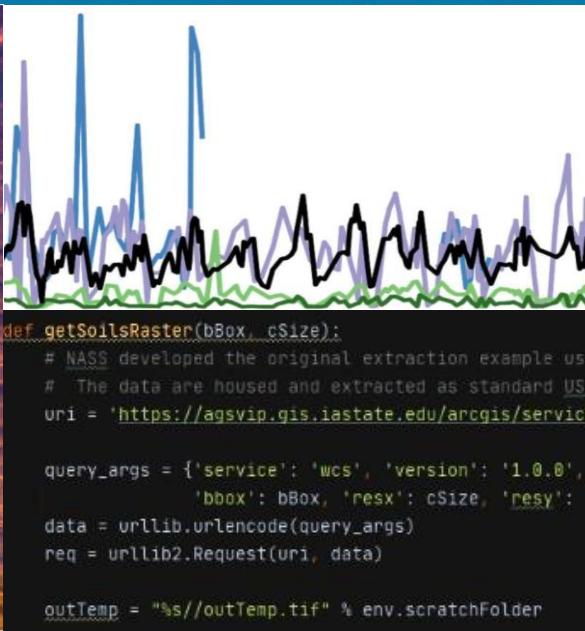


# Open-Source Scripting

## Day 3: Hydrology and Water Quality

September 22, 2021



# Day 3 Agenda

- **Overview presentations (30 min) – Kateri Salk, Tetra Tech**
- **Acquiring and wrangling hydrologic and water quality data (90 min)**
  - Flow data – Eric Hettler, Wisconsin
  - Water quality data – Kateri Salk, Tetra Tech
- **Break (10 min)**
- **Examples of using hydrologic and water quality data in modeling (45 min)**
  - Automated post-model run data analysis & visualization with R and RESTful web services – Joey Kleiner and Rob Burgholzer, Virginia
  - R Shiny apps for long term water quality in WI rivers – Eric Hettler, Wisconsin
  - Utah Division of Water Quality open source data tools and interactive dashboards – Jake Vander Laan, Utah
- **Break (5 min)**
- **Visualizing and understanding model outputs (45 min)**
  - Graphing outputs from common water quality models (e.g., WASP) – Tim Wool, EPA Region 4
  - Chlorophyll TMDL regression – Ansel Bubel, Florida
- **Wrap-up and closing comments (15 min)**



# Ground Rules

- **Mute your mic unless asked to speak**
- **Questions during sessions**
  - During session: add your question/comment to the chat
  - After session: may solicit people to raise hand and turn on mic
- **Tech issues?**
  - Add your issue to the chat, but may not have time to troubleshoot on the fly
  - Follow along on the screen, code is available for use later
  - Can attempt to fix issues following session or after hours



# Considerations: Assessment, TMDLs

- **Sampling frequency**
- **Exceedance frequency**
- **Sampling location**
  - **Lakes:** pelagic/littoral, riverine/transitional/lacustrine
  - **Streams:** spatial representativeness (e.g., reach), relation to tributaries, diversions, dams



# Data Sources

## Hydrology/Streamflow

- USGS gages (R package: dataRetrieval)
- Agencies/other entities
- StreamCat
- StreamStats (R package: streamstats)
- NHDPlus (R package: nhdplusTools)

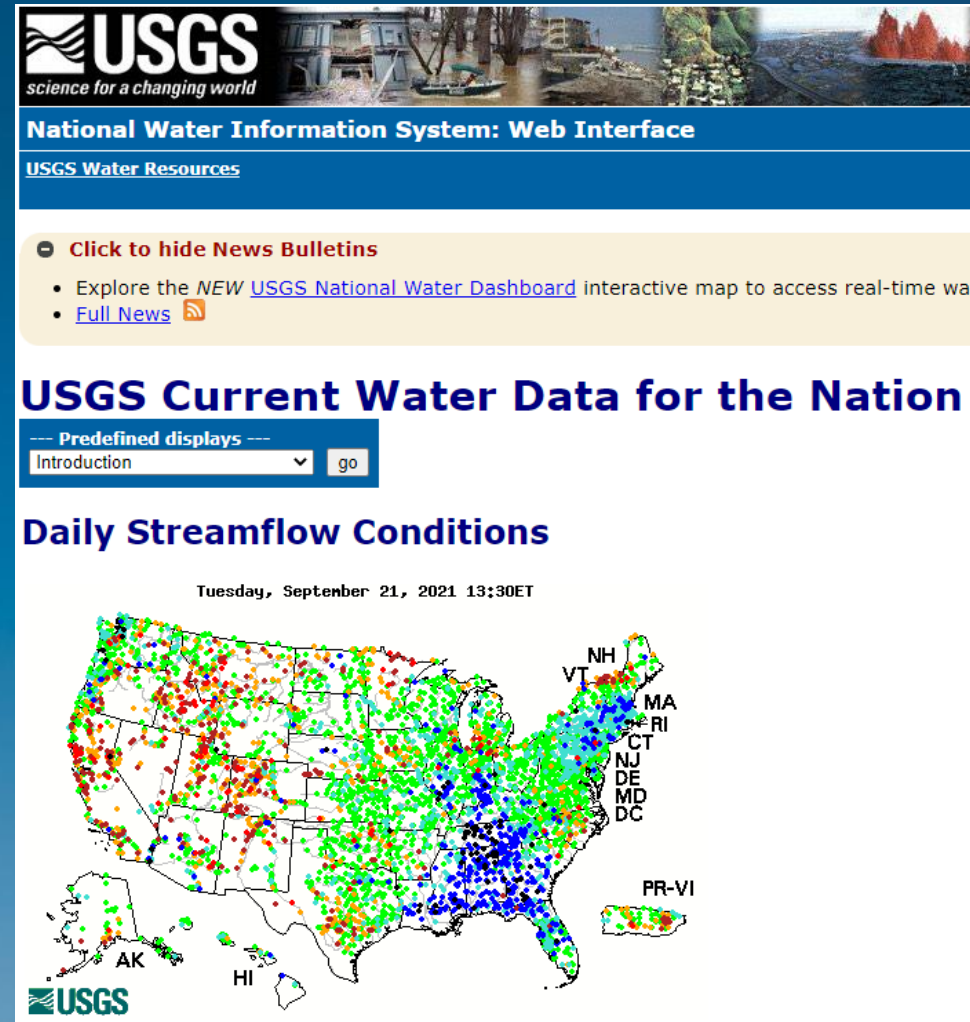




# USGS Gage Data

<https://cran.r-project.org/web/packages/dataRetrieval/vignettes/dataRetrieval.html>

<https://github.com/USGS-R/dataRetrieval>



## dataRetrieval

Retrieval functions for USGS and EPA hydrologic and water quality data.


For complete tutorial information, see:

<https://usgs-r.github.io/dataRetrieval>

<https://owi.usgs.gov/R/dataRetrieval.html>



# StreamCat


United States  
Environmental Protection  
Agency

Search EPA.gov

Environmental Topics ▾
Laws & Regulations ▾
Report a Violation ▾
About EPA ▾

National Aquatic Resource Surveys

CONTACT US

National Aquatic Resource  
Surveys Home

Background

Indicators

Manuals

Map of Sampled Sites

**NARS Data**

Journal Articles

Applying the Data

**Related Studies and Tools**

## StreamCat Dataset

StreamCat currently contains over 600 metrics that include local catchment (Cat), watershed (Ws), and special metrics. The special metrics were derived through modeling or by combining other StreamCat metrics. These variables include predicted water temperature, predicted biological condition, and the indexes of catchment and watershed integrity. See [Geospatial Framework and Terms](#) below for definitions of catchment and watershed as used with the StreamCat Dataset.

These metrics are available for ~2.65 million stream segments and their associated catchments across the conterminous US. StreamCat metrics represent both natural (e.g., soils and geology) and anthropogenic (e.g., urban areas and agriculture) landscape information.

**Looking for data on lakes?**

Data for 378,088 lakes also available from the [LakeCat Dataset](#)

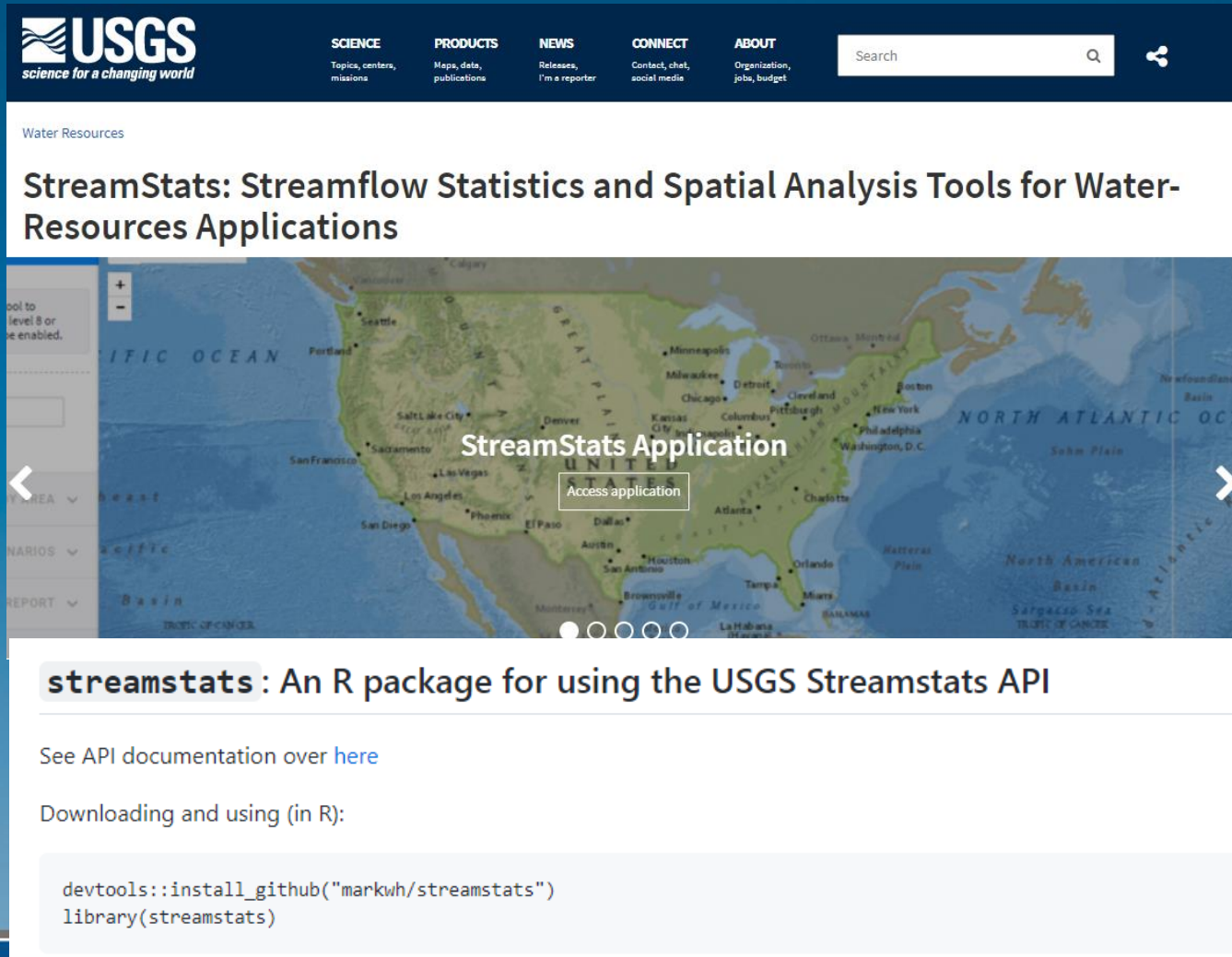
## StreamCatTools

lifecycle experimental R-CMD-check failing

`StreamCatTools` is a draft R package for accessing StreamCat data via the in-development StreamCat API and for working with site data in conjunction with StreamCat and NHDPlus. The StreamCat API is currently behind the agency firewall so the functions in the package will not currently work for those outside the EPA. `StreamCatTools` is in pre-alpha development - this is a work in progress, look for a working package release in the next year.

# StreamStats

<https://github.com/markwh/streamstats>



**USGS**  
science for a changing world

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Topics, centers, missions

PRODUCTS  
Maps, data, publications

NEWS  
Releases, I'm a reporter

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ABOUT  
Organization, jobs, budget

Search

Water Resources

## StreamStats: Streamflow Statistics and Spatial Analysis Tools for Water-Resources Applications

StreamStats Application  
Access application

### streamstats: An R package for using the USGS Streamstats API

See API documentation over [here](#)

Downloading and using (in R):

```
devtools::install_github("markwh/streamstats")
library(streamstats)
```



# nhdplusTools

<https://github.com/USGS-R/nhdplusTools>

## nhdplusTools

R-CMD-check passing codecov 94% downloads 15K CRAN 0.4.3



🔗 nhdplusTools: Tools for Accessing and Working with the NHDPlus

### Terminology:

The following definitions have been used as much as possible throughout the package.

Terms for rivers:

**Flowline:** The NHD name for a hydrographic representation of a flowing body of water. Flowline is generally used when referring to geometry.

**Flowpath:** The HY\_Features name for a hydrologic feature that is the primary path water follows through a catchment; either from headwater to outlet or inlet to outlet. Flowpath is used when describing aspects of the abstract flowpath featuretype, generally in relation to a flowpath's relationship to a catchment.

Terms used for hydrologic units:

**Catchment:** The most abstract unit of hydrology in HY\_Features is the catchment. It is a physiographic unit with zero or one inlets and one outlet. It does not inherently have any conceptual realizations. Rather, a given catchment can be realized in a number of ways; flowpath, divide, and networks of flowpaths and divides are the primary realizations.

**Catchment divide:** NHD "catchment" polygons are more accurately described as "catchment divide" features. Because of the overlap with the HY\_Features abstract "catchment" feature type, "catchment divide" is used for polygon representations of catchments.

# Data Sources

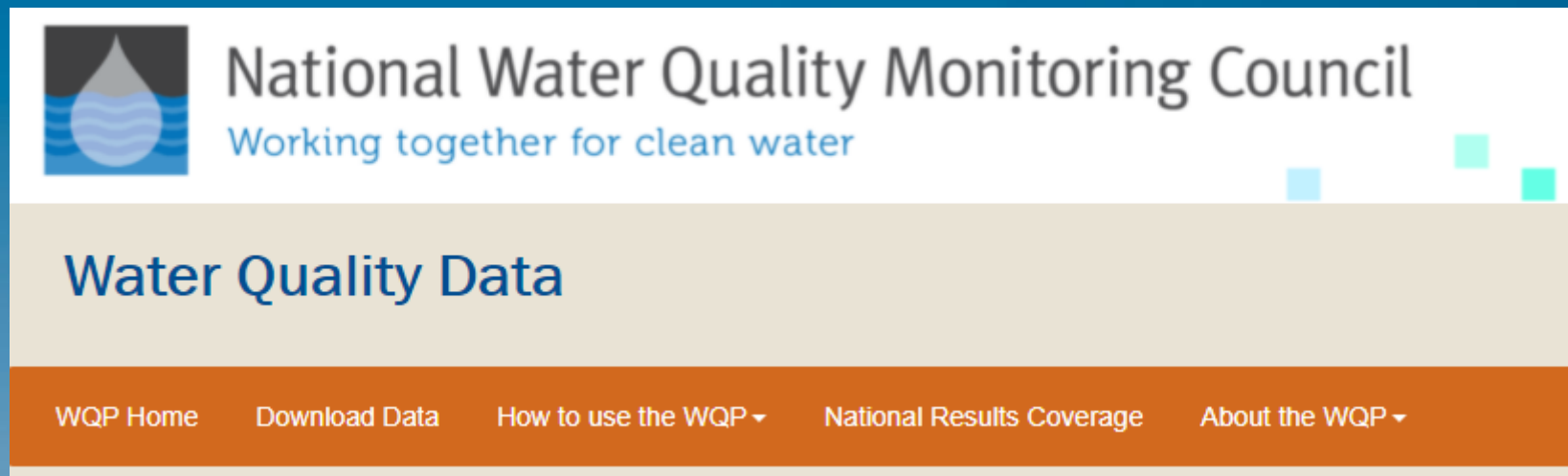
## Water Quality

- USGS NWIS (R package: dataRetrieval)
- EPA STORET (R package: dataRetrieval)
- Agencies/other entities
- National Lakes Assessment, National Rivers & Streams Assessment
- LAGOS-NE (soon, LAGOS-US) (R package: LAGOSNE)



# NWIS and STORET: Water Quality Portal

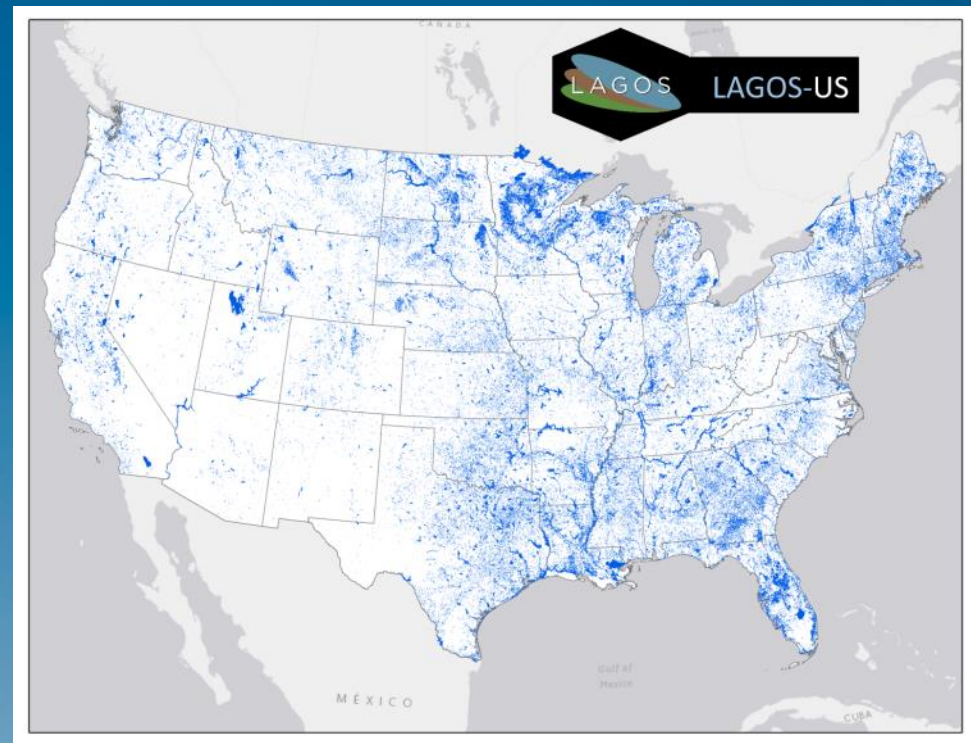
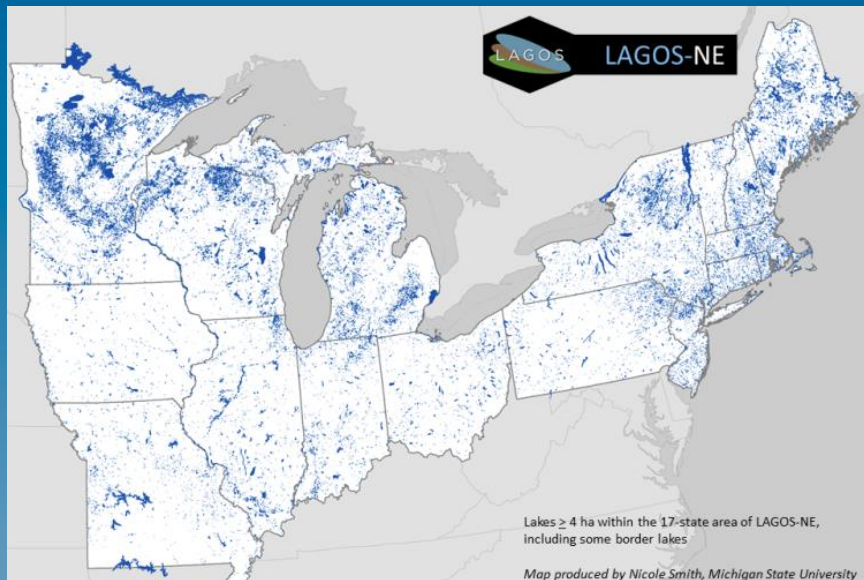
- USGS
- EPA
- NWQMC
- >400 state, federal, tribal, local agencies



# LAGOS-NE (soon, US)

<https://lagoslakes.org/>

<https://github.com/cont-limno/LAGOSNE>





# NLA and NRSA

- National & Regional focus (includes AK & HI)
- Statistically representative
- Not linked to R packages

