HEPEX Workshop 2023

# A reproducible data-driven workflow for probabilistic seasonal streamflow forecasting over North America

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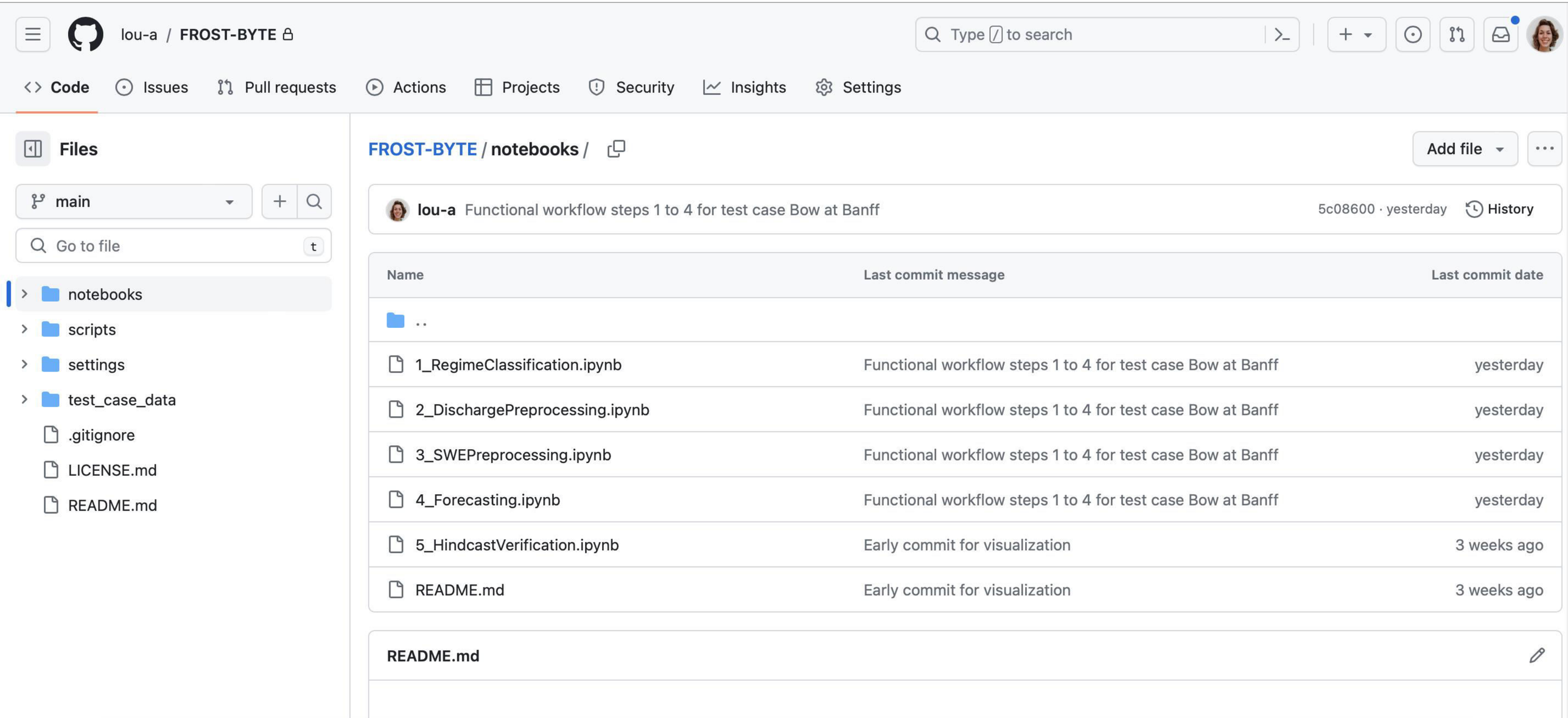
1. **Develop a reproducible workflow for data-driven seasonal streamflow forecasting.**
2. **Quantify the range of predictability in snowmelt-driven river basins across N. America.**

# Workflow

- FROST BYTE: Forecasting River Outlooks from Snow Timeseries: Building Yearly Targeted Ensembles.
- Organized as a series of Jupyter Notebooks.
- Each Notebook contains a user-friendly step-by-step overview.
- Test data are provided for 2 river basins.
- It will be made openly available on GitHub alongside the article.

# Workflow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3_SWEPreprocessing.ipynb
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4_Forecasting.ipynb
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5_HindcastVerification.ipynb
Early commit for visualization
3 weeks ago
README.md
Early commit for visualization
3 weeks ago
README.md

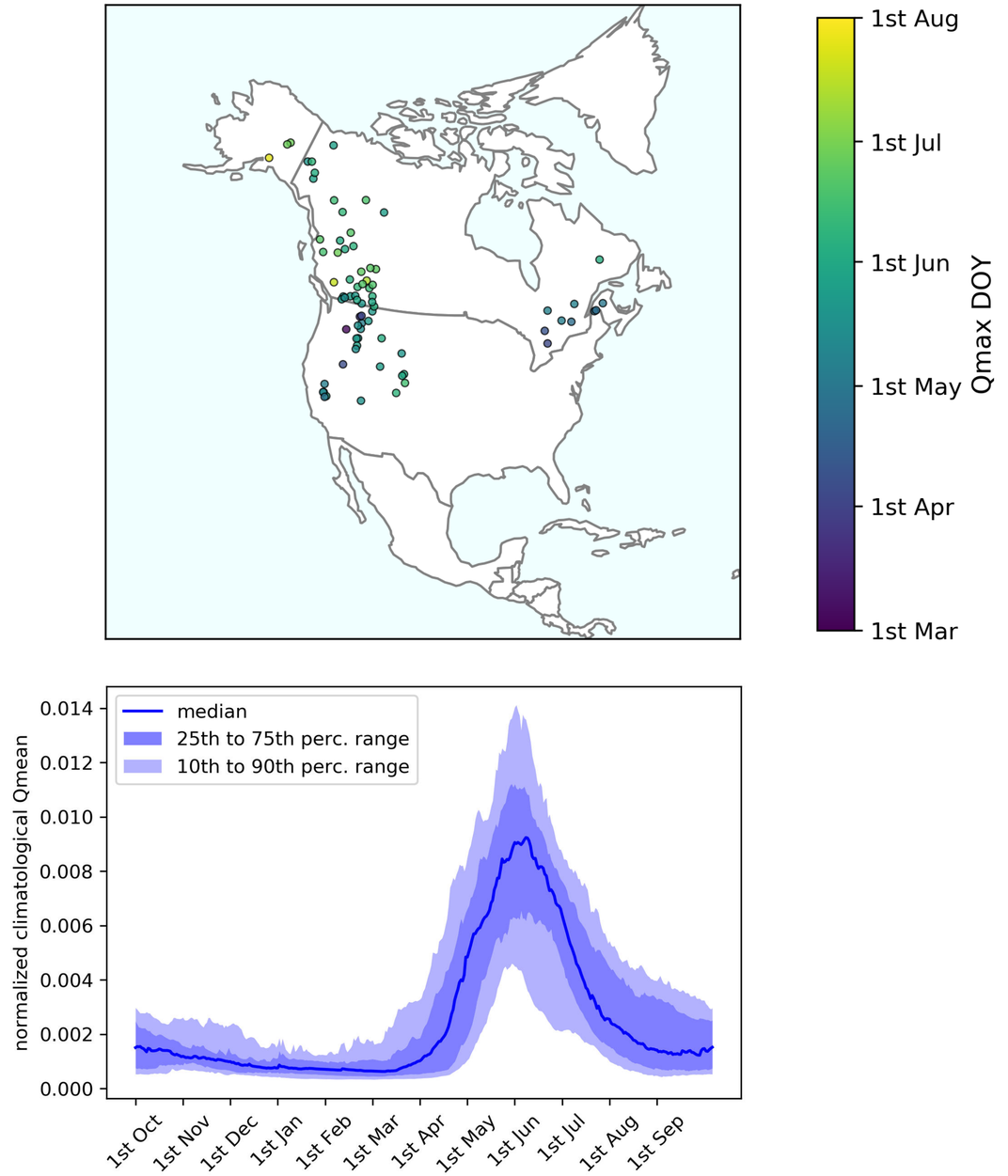
# Basins selection

**We identified 75 basins across N. America with:**

1. **A snowmelt-driven (nival) regime.**

2. **Limited regulation.**
   - **Canada: HYDAT Reference Hydrometric Basin Network (RHBN).**
   - **USA: USGS Hydro-Climatic Data Network (HCDN-2009).**

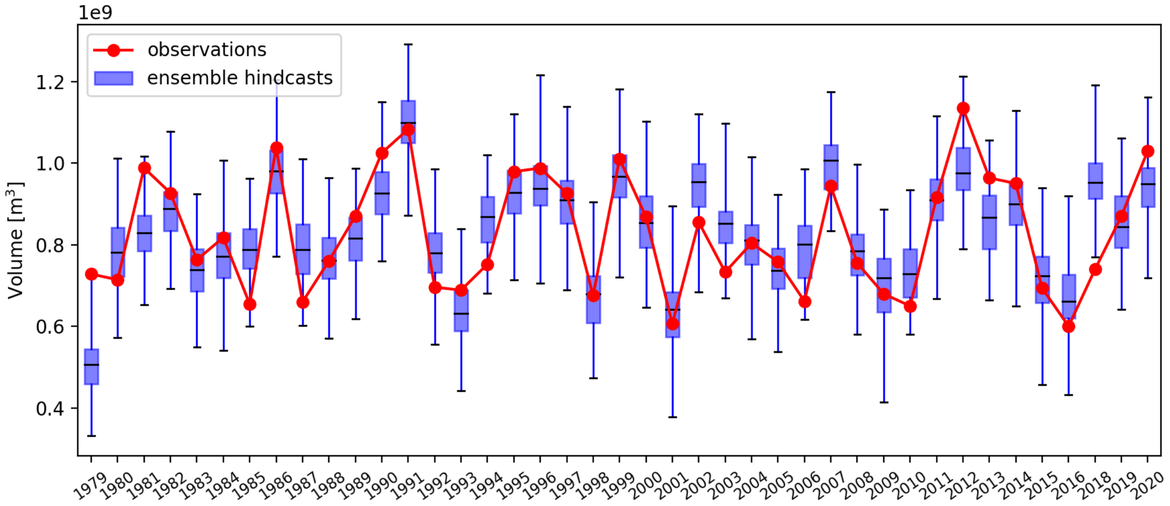
3. **≥ 20 years of SWE-Q data.**




Map & hydrograph of the 75 selected basins.

# User-oriented evaluation

1. We analyze hindcasts using various deterministic & probabilistic metrics.




Example hindcasts for the Bow River at Banff.

2. We draw insights relevant for various users.

**snow surveyors**

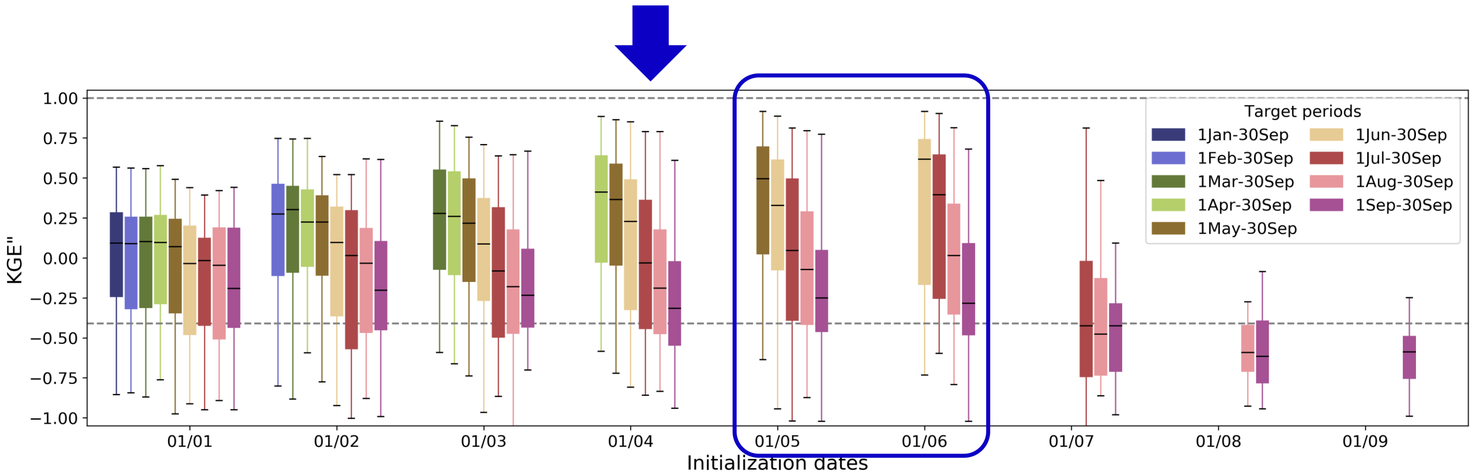
**streamflow forecasters**

**workflow developers**

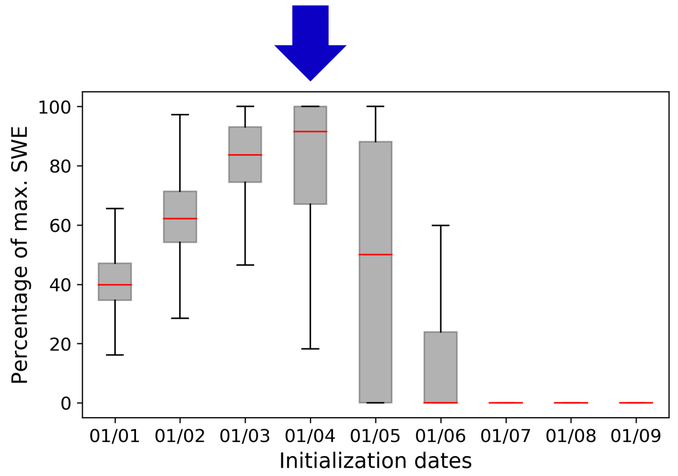
**decision-makers**

# For snow surveyors

- Which SWE measurement dates are most important for forecasting streamflow volumes?
- We anticipate the highest performances for hindcasts initialized around the peak SWE in each basin (typically on 1st April).
- However, high scores can still be achieved up until 1st June, suggesting that the late-season snowpack holds significant predictability for spring/summer volumes.




KGE" of the hindcast medians for each target period as a function of hindcast initialization dates. The boxplots display values for all basins. The upper dashed line (KGE"=1) represents the perfect value and the lower dashed line (KGE"=-0.41) represents the mean flow benchmark.




SWE content as a function of hindcast initialization dates.

**KGE": deterministic and combined measure of the forecast correlation, bias and variability.**

# For workflow developers

- Reproducibility of hydrology research is still low.
- Building workflows that are **intuitive** & **reproducible** is essential to providing platforms for purposeful testing of scientific advancements and for applying research in practice.
- This workflow follows the principles of open & collaborative science, facilitated by its design and code-sharing.
- Users have the flexibility to modify, enhance, or replace specific components of the workflow to suit their needs.

**Assessing data availability and research reproducibility in hydrology and water resources**

James H. Stagge, David E. Rosenberg, Adel M. Abdallah, Hadia Akbar, Nour A. Attallah & Ryan James

*Scientific Data* **6**, Article number: 190030 (2019) | Cite this article

**7846** Accesses | **53** Citations | **74** Altmetric | Metrics

An Author Correction to this article was published on 24 April 2019

**Abstract**

There is broad interest to improve the reproducibility of published research. We developed a survey tool to assess the availability of digital research artifacts published alongside peer-reviewed journal articles (e.g. data, models, code, directions for use) and reproducibility of article results. We used the tool to assess 360 of the 1,989 articles published by six hydrology and water resources journals in 2017. Like studies from other fields, we reproduced results for only a small fraction of articles (1.6% of tested articles) using their available artifacts. We estimated, with 95% confidence, that results might be reproduced for only 0.6% to 6.8% of all 1,989 articles. Unlike prior studies, the survey tool identified key bottlenecks to making work more reproducible. Bottlenecks include: only some digital artifacts available (44% of articles), no directions (89%), or all artifacts available but results not reproducible (5%). The tool (or extensions) can help authors, journals, funders, and institutions to self-assess manuscripts, provide feedback to improve reproducibility, and recognize and reward reproducible articles as examples for others.

# Thank you!
# Merci!

Keep an eye out for the paper which will be submitted to HESS soon.

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