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WATER RESOURCES
DEPARTMENT

SWIMS TAG Meeting #2

January 6th, 2026

Agenda

1. Welcome & Meeting #1 Recap (9:05 – 9:10)

2. Planned hydrologic analyses (9:10 – 9:30)

3. Selecting gages for model development (9:30 – 10:00)

4. Discussion (10:00 – 11:00)

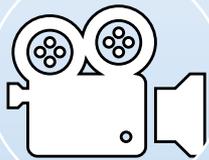
Meeting Rules



Use hand raise feature



Encourage interaction and cameras on
(please ask questions to group)



Meetings will be recorded and posted to
website

Legislative Directive



Legislature (2023) provided resources to update the statewide Water Availability Reporting System



Deliver accurate, up-to-date monthly surface **water budgets** for basins statewide



Expected completion date: **January 2030**

Agency Priority Project

SWIMS is a priority project at OWRD

- Identified in agency's Strategic Plan and interagency Integrated Water Resources Strategy (IWRS)

Actions and tasks

- Action 1A: Improve water resource data collection and management
- Task P2.1: Increase quality and accessibility of water availability, use, and demand information

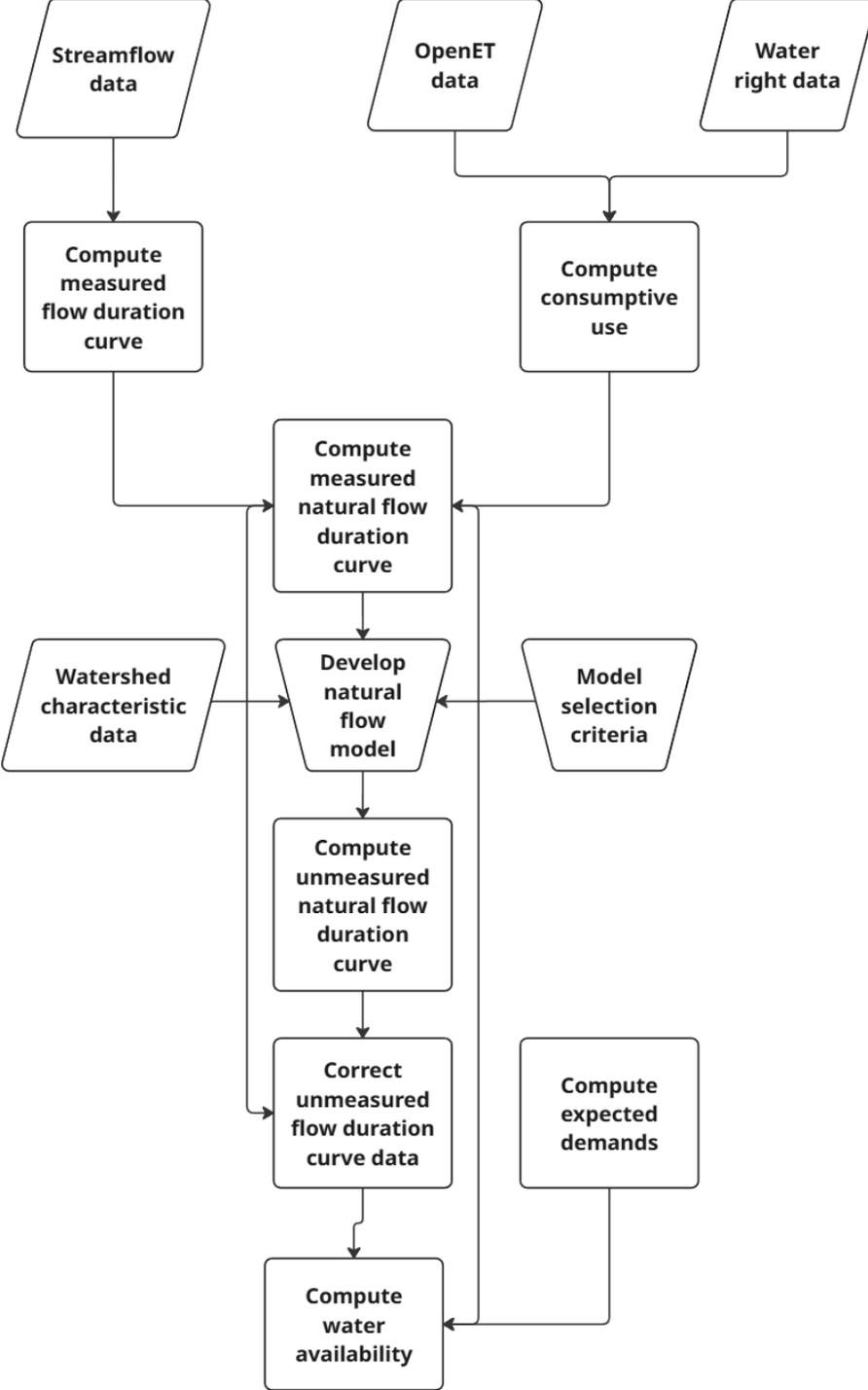
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Hydrologic Investigation Series

Model Workflow Overview



- Workflow used to calculate components of water availability equation:
 - Natural streamflow
 - Expected demands
 - Water availability
- Inform requirements for each step via hydrologic analyses
 - Data selection
 - Assumptions
 - Methods
 - Model selection



Hydrologic Investigation Series

Data selection

- Evaluate gaged streamflow data to determine data requirements (quantity, quality)
- Analysis and literature review to determine common predictor variables for modeling flow

Watershed framework

- Evaluate possible extent of model coverage and resolution based on available data and accuracy requirements (i.e., how many points of interest can we accurately model?)

Expected demands

- Evaluate methods for computing consumptive use for various water use types (irrigation, municipal, etc.)
- Evaluate methods for quantifying impacts of groundwater use on natural streamflow and water availability

Natural streamflow

- Determine approach for computing natural flow hydrographs for gaged watersheds
- Compare modeling approaches for estimating natural streamflow in ungaged watersheds

Points to Think About

Do you have any recommendations for topics requiring further investigation?

What other objectives could improve understanding of appropriate use of data in model development?

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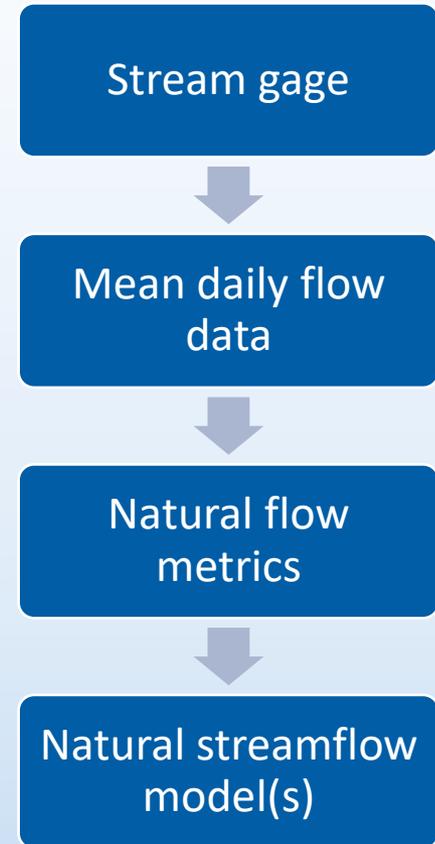


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Investigations to Support Stream Gage Selection

Selecting Gages of Interest

- Theme of discussion relates to selecting gaging stations that provide data appropriate for developing model to estimate natural streamflow
- Inform assumptions regarding model outputs
- Natural streamflow represents flow that is unaffected by consumptive use or reservoir storage
 - Establish reference condition



Supporting Analyses

Hydrologic disturbance index

- Quantify degree of disturbance in gaged watersheds
- Use to identify gages appropriate for modeling natural streamflow

Gap tolerance analysis

- Determine minimum data requirements to model monthly streamflow across range of flows

Stationarity analysis

- Evaluate whether streamflows are significantly changing over time
- Determine appropriate base period to model conditions to represent

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Hydrologic Disturbance Index

Ryan Andrews

Full details are in the report!

Purpose of HDI

Background

- GAGES-II data set and Falcone (2010, 2011)
 - Summarized geospatial attributes of USGS gaged watersheds

Goal

- Quantify the degree of anthropogenic disturbance among Oregon's gaged watersheds
- Mainly to understand factors affecting gaged streamflow data

Decisions to be made

- Establish disturbance tolerance thresholds
- Identify gages measuring natural or near-natural conditions

HDI Development

- Mimics GAGES-II data
- 631 gaged watersheds (OWRD, USGS) having at least 3 years of data since 1950
- Seven disturbance variables
 - Dam density
 - Dam storage
 - SW withdrawal
 - Irrigated lands
 - Fragmentation
 - Roads
 - Hydrologic modification

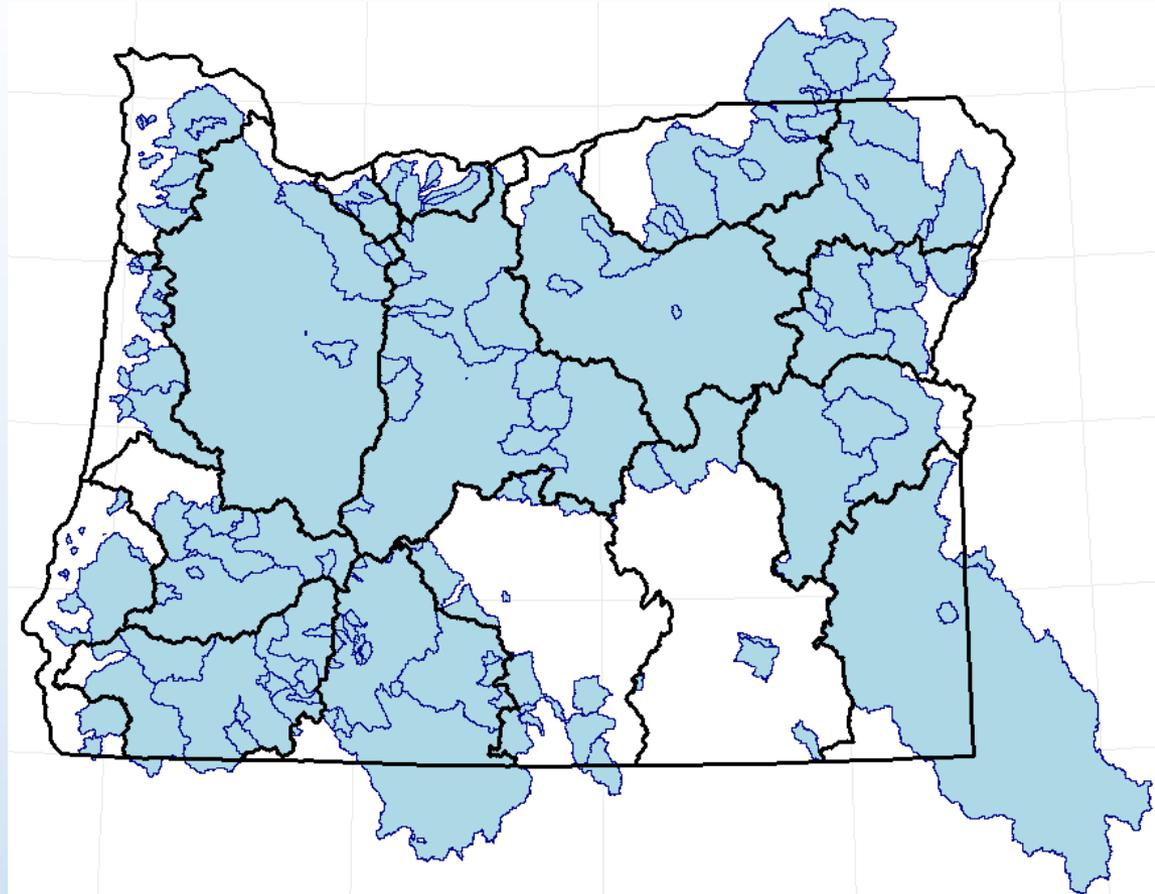


Figure: Gaged watersheds (blue) and OWRD administrative boundaries (black).

Results

- Significant regional differences in degree of impacts
 - West region relatively more impacted by fragmentation and roads
 - East region relatively more impacted by dam storage and withdrawals
- Withdrawals do not include groundwater*

Variable	West	East
Dam density (nbr/area)	0.02	0.01
Dam storage (% mean annual yield)	6.81	11.60
SW withdrawal (% mean annual yield)	23.5	76.1
Irrigated area (% area)	0.69	2.92
Fragmentation (% area)	7.68	3.62
Roads (length/area)	2.68	2.57
Artificial stream pathways (% stream miles)	2.45	4.80

Table: Moderate disturbance thresholds by region.

Low Impact Long-term Gages

- Gaged watersheds with complete record 1991-2020 (n = 51, blue)
 - Used in later analysis
- $\leq 10\%$ mean annual flow withdrawn
- $\leq 5\%$ mean annual flow stored

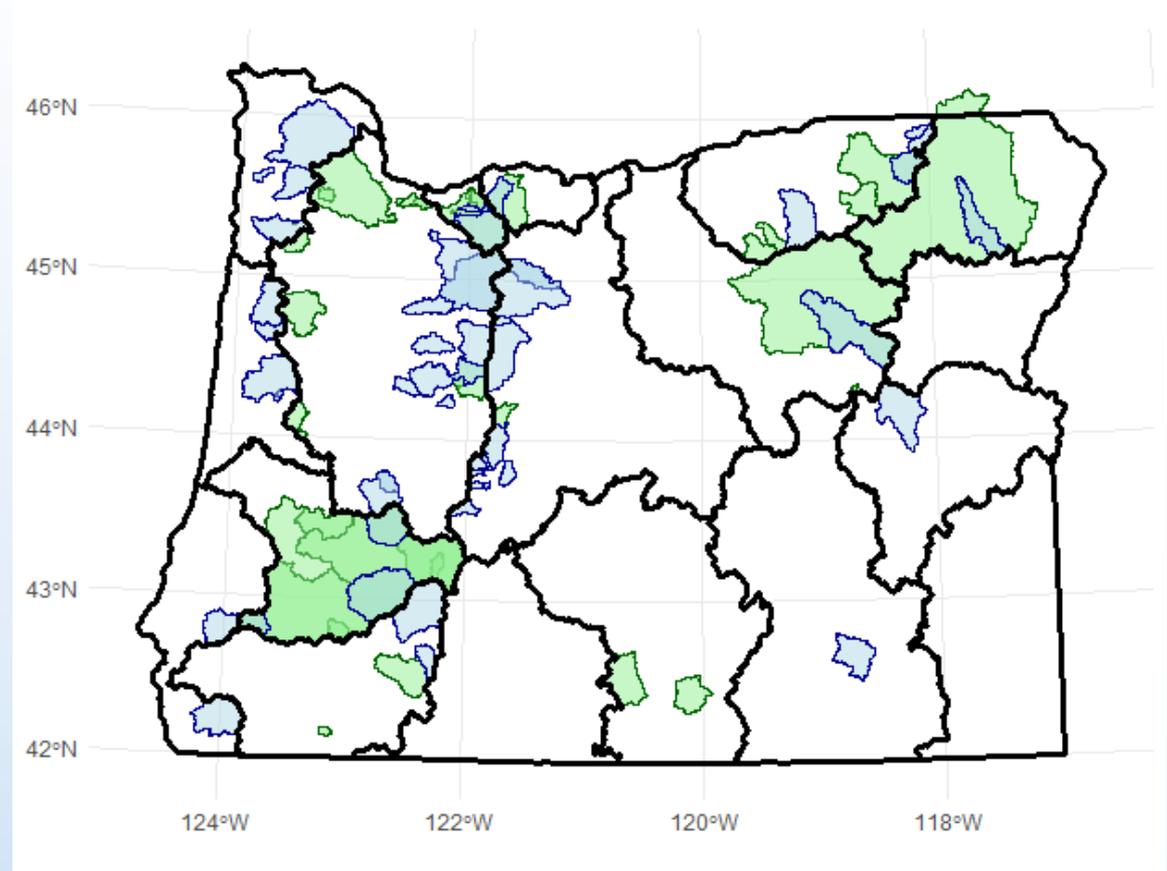


Figure: Gaged watersheds with complete 30-year record from 1991-2020 and low impact (blue, n = 51). Green polygons (n = 36) represent potential index sites if withdrawal criteria were relaxed to $\leq 20\%$ mean annual flow.

Variables

- Mainly considering how to correct for impacts caused by withdrawal and storage

Thresholds

- Preliminary thresholds of 5% annual yield for storage and 10% of annual yield for SW withdrawal

Outcomes

- 51 analysis gages with data 1991-2020 (29 west, 22 east)
- Results also used to inform gage network expansion

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Gap Tolerance

Cheng-Wei Huang

Full details are in the report!

Purpose of Analysis

Background

- Gaging stations are considered index stations if they have complete records throughout a 30-year base period
- Assumed requirement for maintaining integrity of FDC

Goal

- Establish **defensible gap-tolerance criteria** for daily streamflow records used to build 30-year flow duration curves (FDCs) for water-availability evaluations

Decisions to be made

- Determine minimum data requirements for gaging stations to qualify as index stations
- Identify gaging stations that can be considered index stations

- Mean daily streamflow data
- Relied on disturbance index to select minimally disturbed gaged watersheds
- 51 gaging stations measuring minimally disturbed streamflow
 - SW withdrawal \leq 10% of mean annual natural flow (natural flow from NHDPlus V2.1)
 - Storage \leq 5% of mean annual natural flow

Methods

FDC calculation

- Complete, continuous mean daily flow records from 1991 to 2020
- Compute 80%, 50% and 20% FDC characteristics

Random sampling

- Randomly select 15 of 30 years
- Randomly remove percent of daily values (10-75%)
- Remaining 15 years stay intact
- Iterate 100 times for each gage and FDC characteristic

Evaluating Results

Build FDC

- Average the 100 FDCs to get a **mean curve**; use **± 1 standard deviation** as the uncertainty band

Compare to baseline

- At **20%, 50%, 80% exceedance**, check whether the **entire mean ± 1 SD band** stays within **$\pm 15\%$** of the baseline FDC

Pass/fail

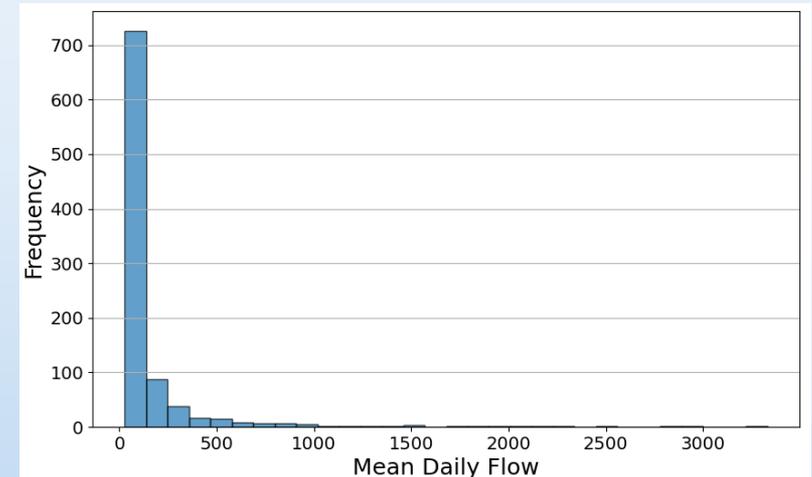
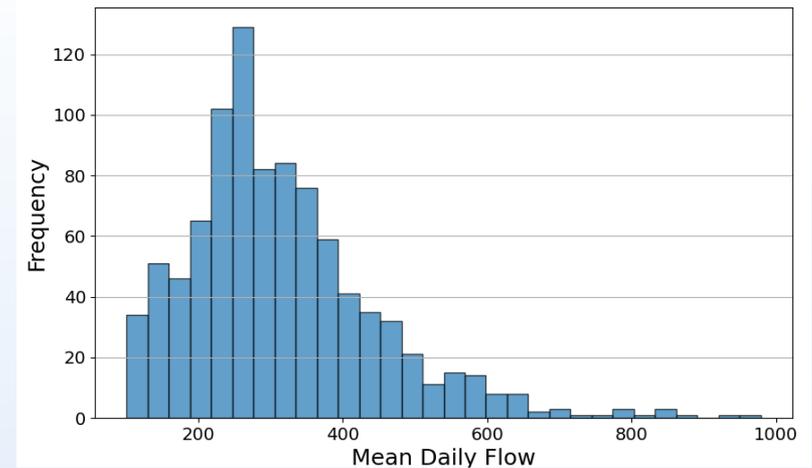
- Pass = with $\pm 15\%$ at all three exceedance flows
- Fail = any point exceeds $\pm 15\%$

Tolerance

- Largest gap that still passes

Results

- For most index gages, **$\geq 80\%$ overall retention** keeps 20/50/80% exceedance within **$\pm 15\%$** (mean ± 1 SD vs. baseline)
- **Sensitive (low-entropy, skewed) regimes need higher retention**—typically **$\geq 90\%$** —to meet the same $\pm 15\%$ rule



Conclusions

- Pool of index gages can likely be expanded (≥ 24 years)

Outcomes

- Include gages with less than complete 30 years of record throughout base period to accurately represent conditions

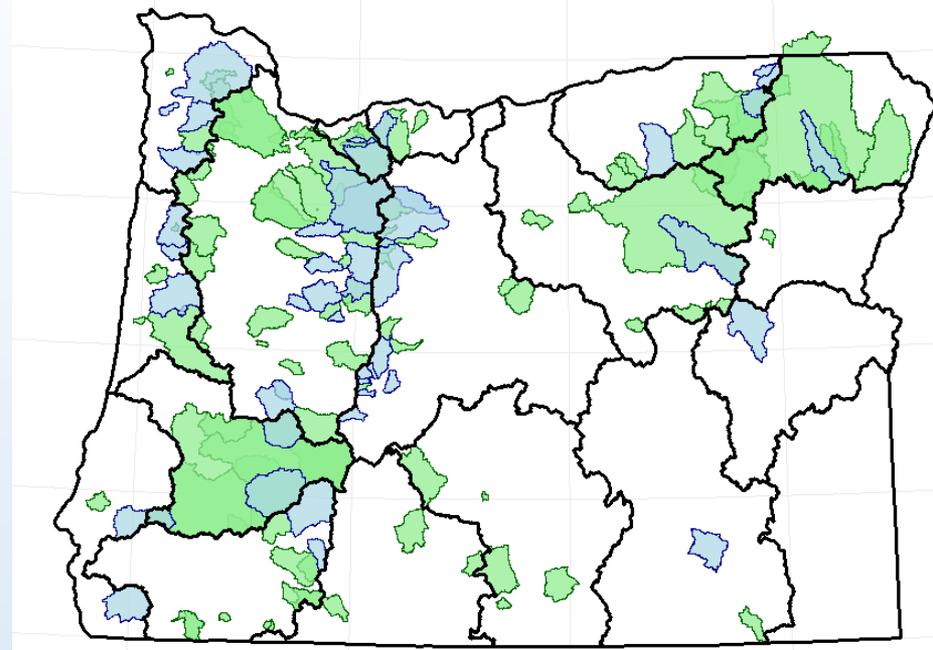


Figure: Gaged watersheds with complete 30-year record from 1991-2020 and low impact (blue, $n = 51$). Green polygons ($n = 72$) represent potential index sites if withdrawal criteria were relaxed to $\leq 20\%$ mean annual flow and data requirements relaxed to 24 years of record within the base period.

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Stationarity Analysis Summary

Cortney Cameron

Full details are in the report!

Purpose of Analysis

Goal

- Is streamflow changing over time?

Decisions to be made

- Identify data (temporally) that are best to use for updating a model (base period)

Background

- Previous literature is mixed but generally shows (for low-disturbance stations) stable mean annual flows and, in some places, declining summer flows

Methods

Data

- 51 low-disturbance, long-term stations (same as gap tolerance analysis)

Temporal scales

- POR and WYs 1991-2020
- Annual and monthly (e.g., Januaries)

Quintiles

- 0.2, 0.5, 0.8

Stationarity tests

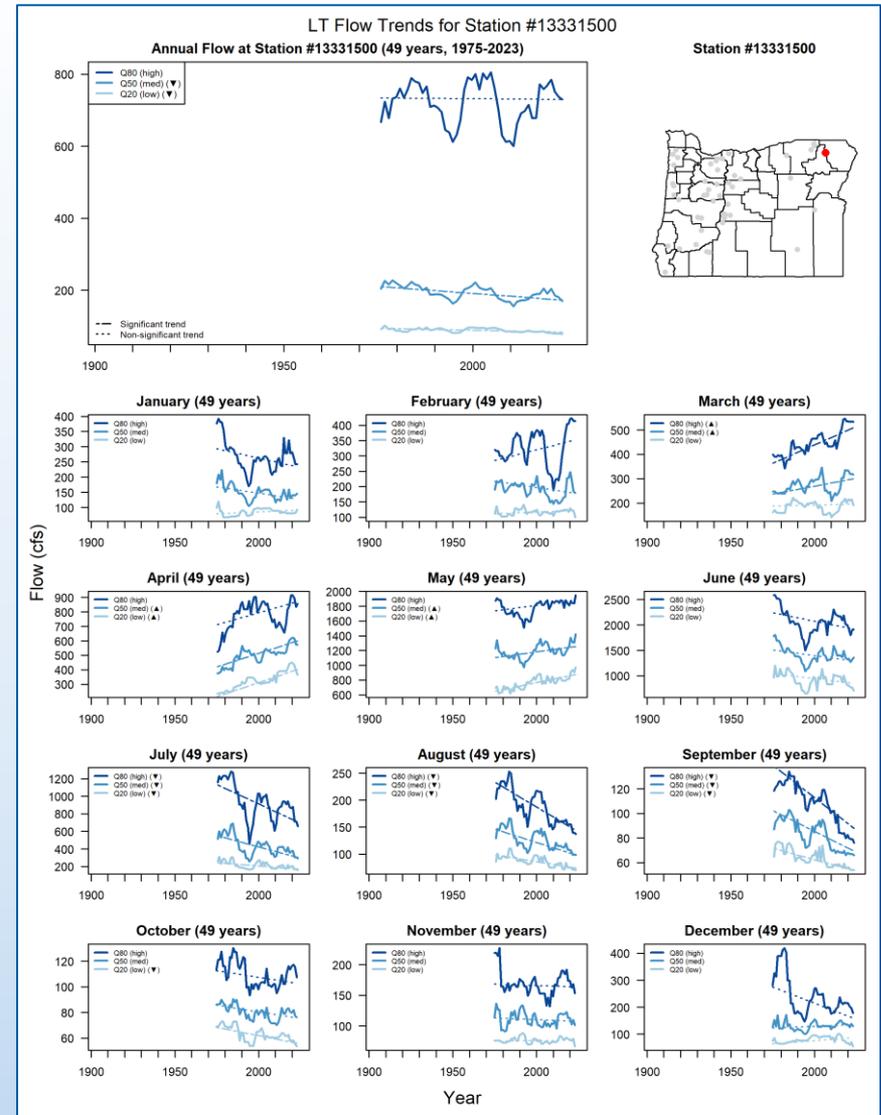
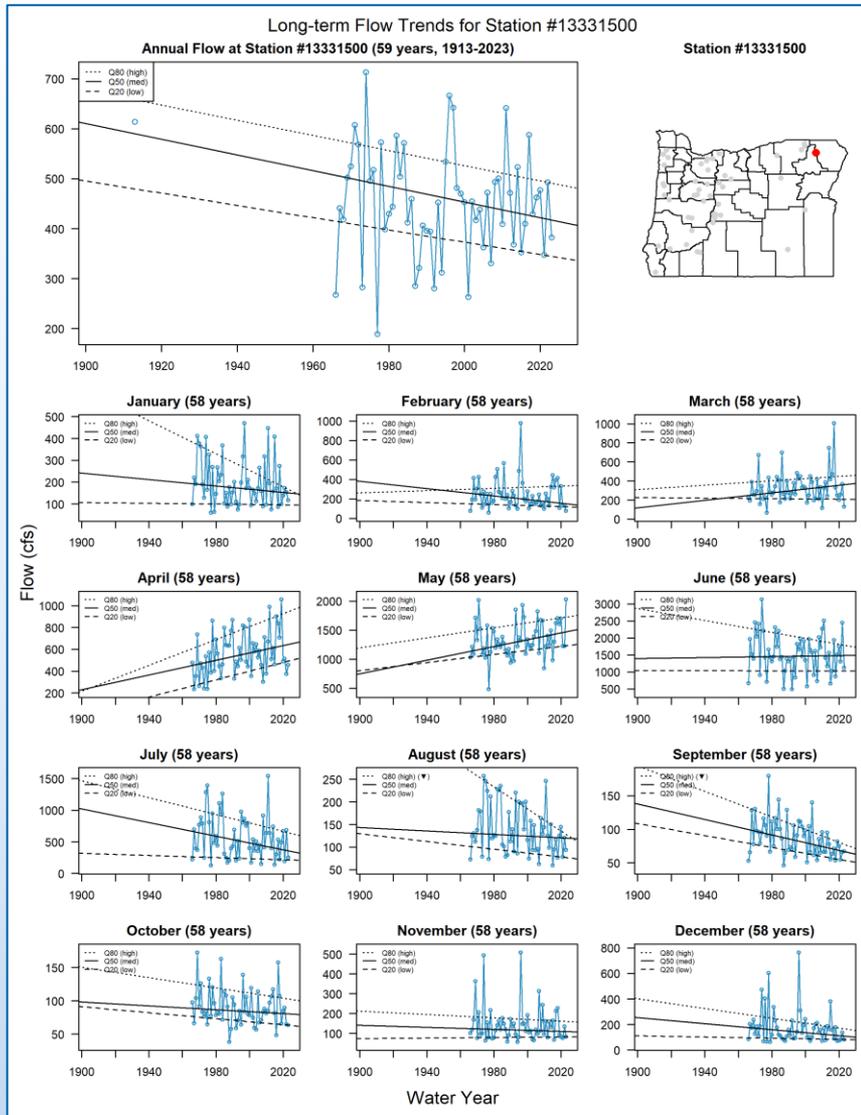
- Quantile regression – calculates quintile from annual/monthly mean
- 10-year moving windows (Mann Kendall) – calculated on 10-year moving quintile
- Autocorrelation (lag-1) – calculated from annual/monthly mean

False discovery rate correction

- Applied for each method-period-percentile-month group (182 families, each with 51 stations)

Quantile Regression

Moving Window



Moving Window
(Long-term)

- Up, sig.
- Non-sig.
- Down, sig.

Results

Mean annual flows

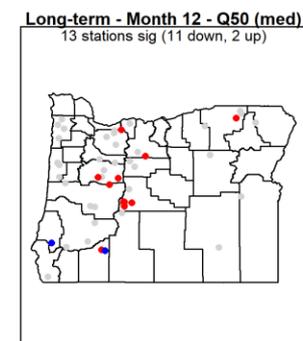
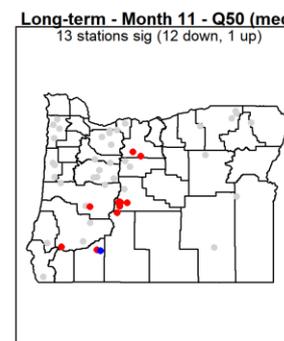
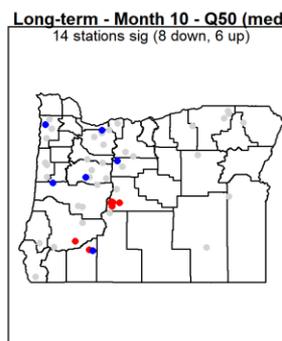
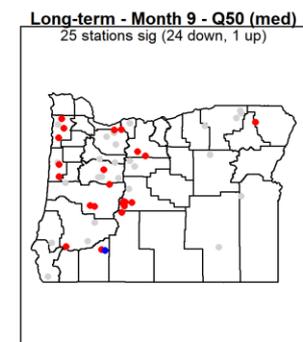
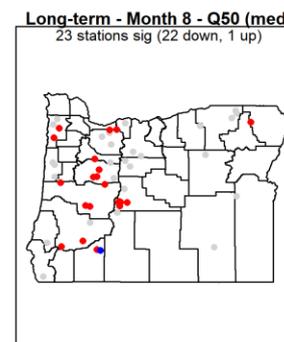
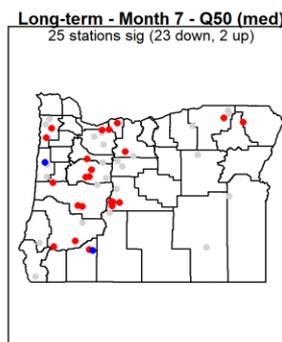
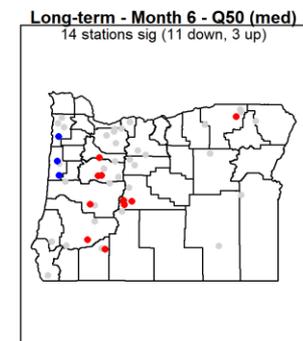
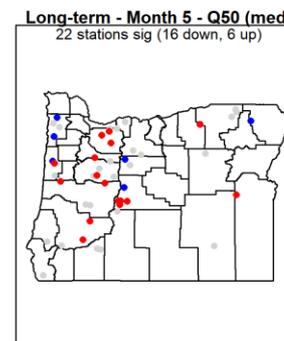
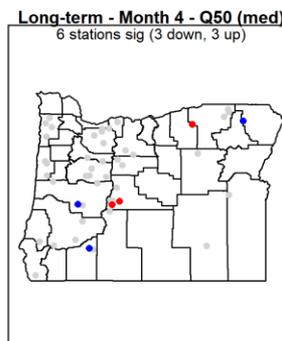
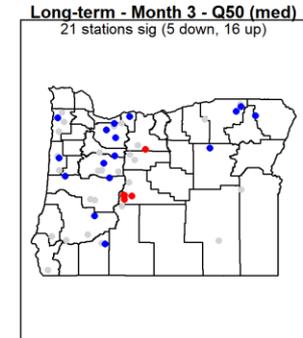
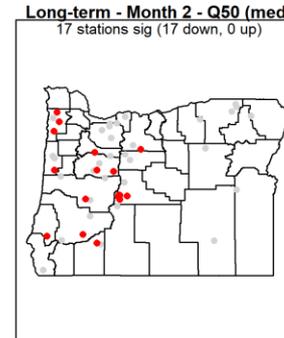
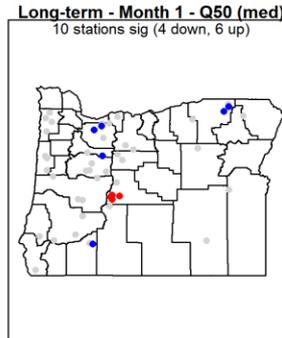
- Majority of trends non-significant

Monthly flows

- Many summer months significantly downward

Spatial patterns

- Significant stations tended to occur along the eastern Cascades



Base period

- A more recent period is more representative of future flows
- Suggest WY1991-2020 on the balance of data availability, meteorological standard practice, and streamflow data publishing timelines

Other considerations

- Many basins already fully allocated in summer
- Indicates need for more frequent model updates

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Discussion

Points to Think About

Do you have any recommendations for topics requiring further investigation?

What other objectives could improve understanding of appropriate use of data in model development?

Points to Think About

How do you interpret the results of these analyses?

What other objectives could improve understanding of appropriate use of data in model development?

Specific Discussion Questions

Hydrologic disturbance index

- Is this an appropriate definition of “natural streamflow” for water availability modeling?
 - Natural streamflow represents flow that is unaffected by consumptive use or reservoir storage.
- What should be considered when determining disturbance thresholds?

Gap tolerance analysis

- What other items should be addressed when establishing minimum data requirements?

Stationarity

- Does analysis support use of WY1991-2020 base period?
- How should we utilize gages with evidence of non-stationarity in modeling?

What other items should be addressed when establishing minimum data requirements?



Questions?

