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WATER RESOURCES DEPARTMENT

SWIMS TAG Meeting #3

April 7th, 2026

Agenda

1. **Welcome** *(9:05 – 9:10)*
2. **Follow-up Meeting #2** *(9:10 – 9:20)*
3. **Strategizing Modeling Approach** *(9:20 – 9:55)*
4. **Discussion** *(10:05 – 11:00)*

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Meeting Rules

- Use hand raise feature
- Encourage interaction and cameras on (please ask questions to group)
- Meetings will be recorded and posted to website

SWIMS Status Report

Data acquisition

- Continuing to publish flow records from gages of interest
- Will not be using third-party data that has not been reviewed and published by OWRD or USGS
- Importing and processing environmental data

Gage installation

- Installed four gages to support SWIMS, two more awaiting install

System architecture

- Established system to support model development including computer, secure server, and database

Communications

- Established internal and external working groups to strategize model development and implementation

Follow-up Meeting #2

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Recap Meeting #2

Theme

- Selecting gages to establish reference conditions
- Determining minimum data requirements

Topics

- Disturbance index to evaluate factors influencing flow records
- Analysis to determine tolerance for gaps in flow data
- Analysis of streamflow trends to assess stationarity

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Addressing Feedback

Groundwater use metrics

- Estimated total groundwater withdrawals for gaged watersheds

Gap tolerance

- Climate-normal windows: identified short-record periods of climate-normal conditions within base period to expand gage pool
- Characterized typical patterns of missingness in real gage data

Hydroclimate trends (stationarity)

- Confirmed downward summer trends at many gages using AIC approach with ENSO and PDO
- Found relationship between some climate oscillations (i.e., PDO) and precipitation may be weakening over time
- Relationship between precipitation and streamflow remains strong

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For Further Discussion

Naturalized flow data from previous work

- What must be considered when evaluating other naturalized mean daily flow records for use in model development?
- Particularly interested in natural flow data below storage reservoirs (e.g., RMJOC, 2018)

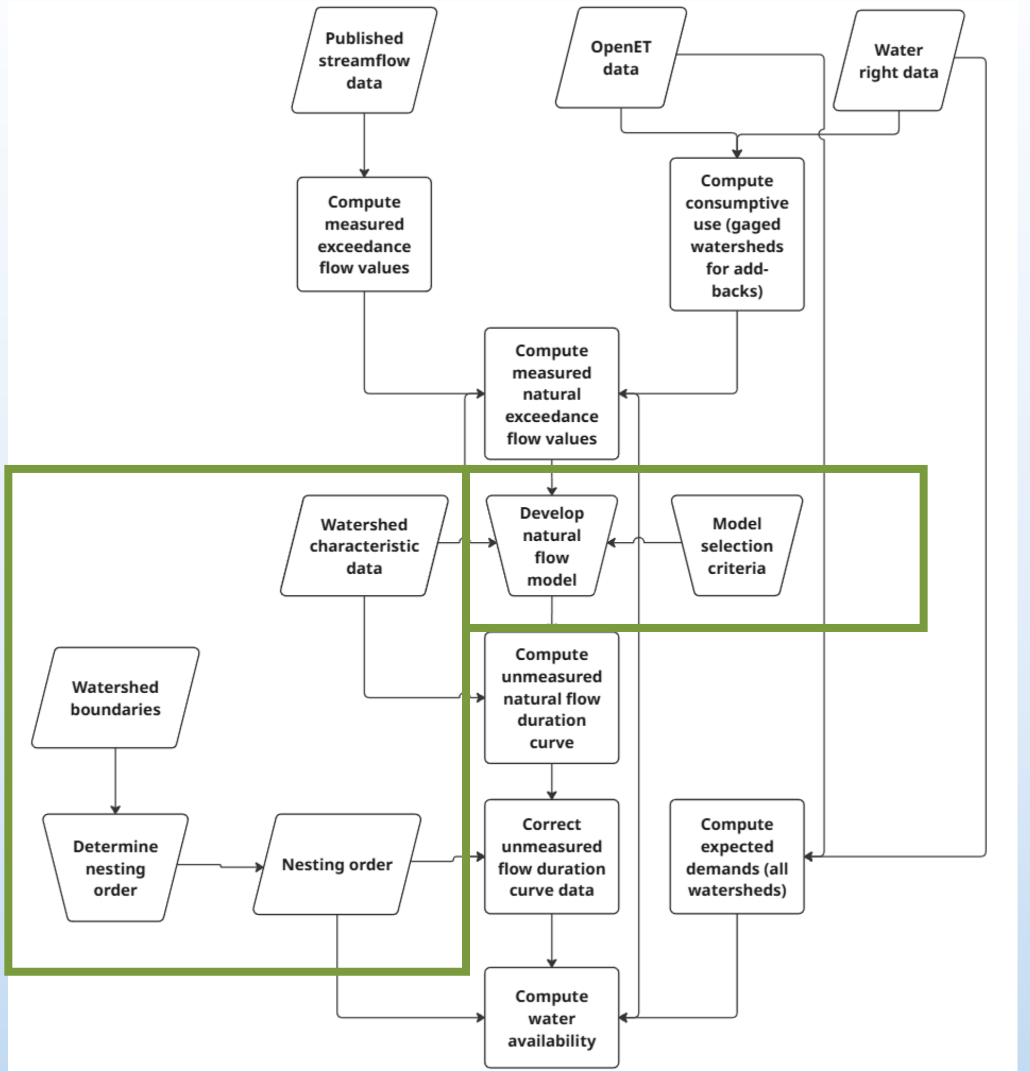
Naturalizing flow records

- What are the trade-offs of correcting mean daily flow records collected by ‘reference’ gages to represent natural flow?
- When should records be corrected to account for upstream use and storage?

Model Workflow Overview

Meeting theme

- Geospatial framework
- Predictor data
- Modeling approach
- Climate impacts



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Establishing the Geospatial Framework

Current Framework in WARS

- Water availability information is available for over 2,200 watersheds in Oregon
- Locations defined based on physiography and management needs
- Data gaps in areas with limited data, small coastal drainages
- Relies on watershed delineation tool to interpolate natural flow

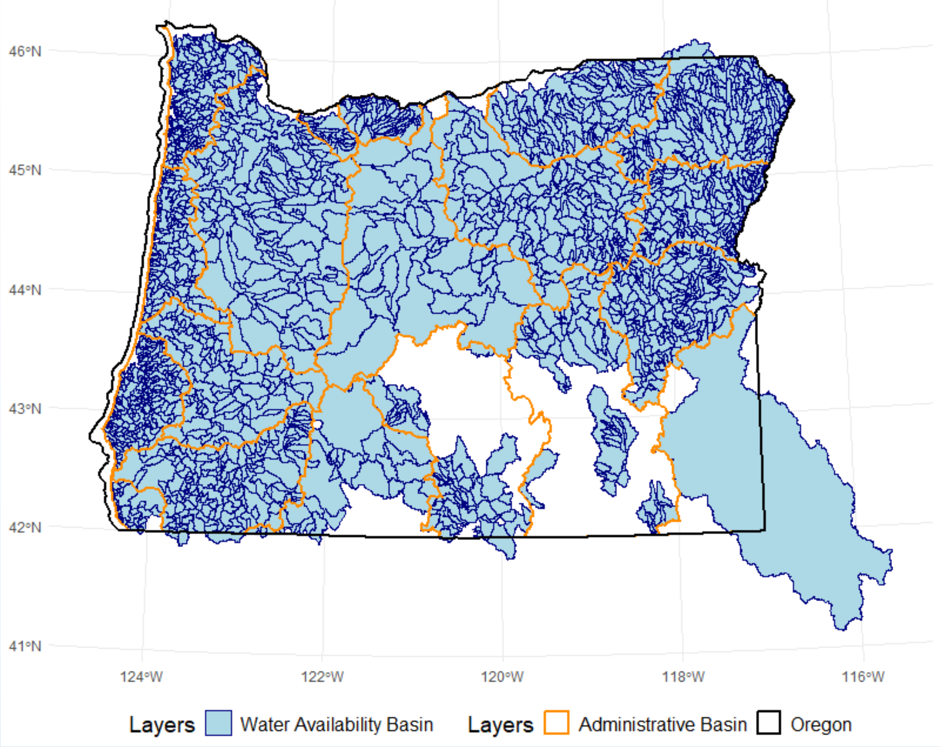

Figure: Water availability basins (blue) that define the current geospatial framework in WARS.

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Evaluating Alternatives

- Considered available data products in terms of:
  - Watershed boundary data set
  - Stream hydrography
  - Flow routing information
  - Tools to support business needs
  - Computational requirements
- Other influential factors:
  - Available training data
  - Consistency with scale of data sets or other hydrologic modeling products for comparing output
  - Adaptable to advancements in modeling and computing

Products

- Water Availability Basins
- Streamcode watersheds
- National Hydrography Dataset (NHD) Plus V2
- NHD High-Resolution
- National Hydrology Model

National Hydrography Dataset

- National Hydrography Dataset (NHD) provides all necessary components of geospatial framework
- Offers statewide coverage and improved resolution in problematic areas (coastal drainages, small tributaries to mainstem rivers)
- Consistent and systematic definition of watershed boundaries – HUC-12 scale aligns well with other modeling and data products
- Manageable via nhdplustools (R) or similar (Python, custom, etc.)
- Adaptable to advancements in data and modeling

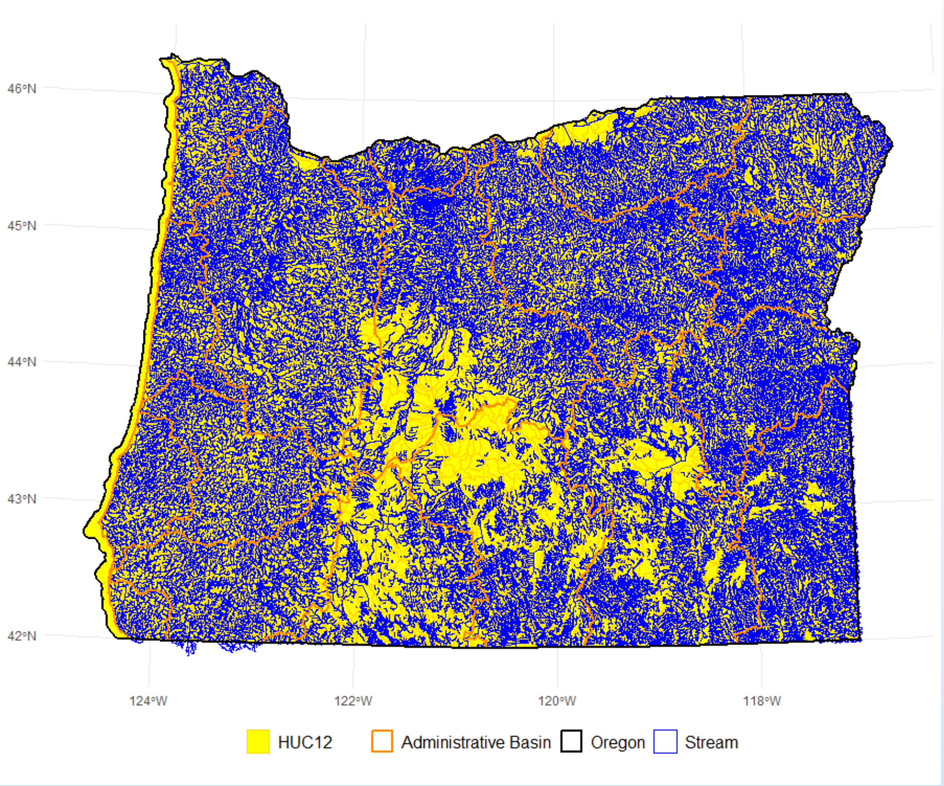

Figure: HUC12 watershed boundary dataset (yellow) with flowlines (blue) representing stream segments from NHDPlus V2.

Discussion Questions

- How does data availability constrain the ability to model at various scales?
- What are the differences in modeling at the catchment scale compared to the watershed scale?
- Do any products provide more stability in terms of their technical support or consistency with other hydrologic modeling efforts?

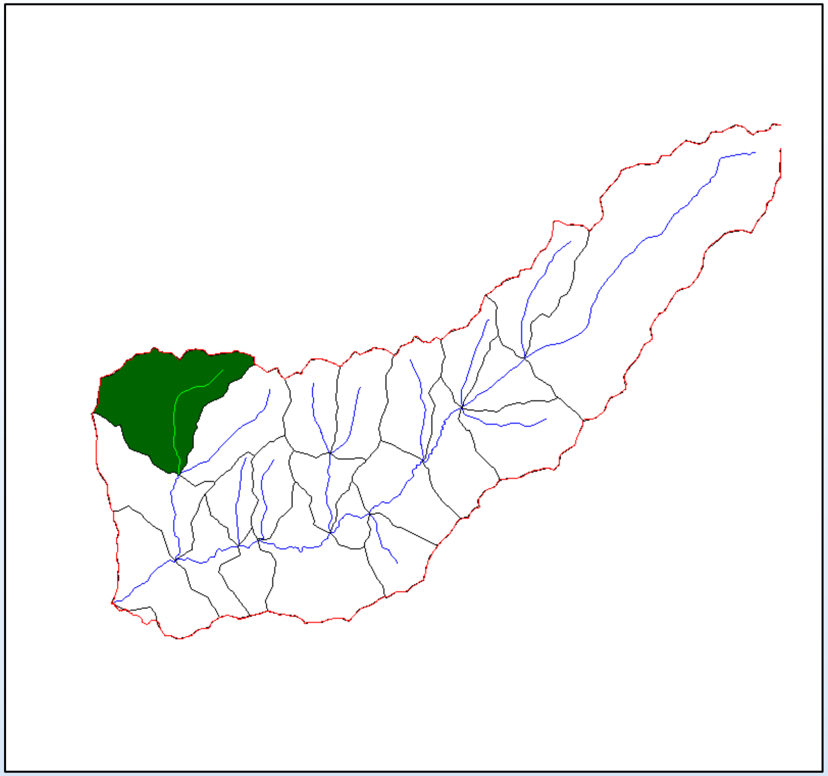

Figure: Example watershed boundary (red) from the NHD, with catchments (black) for tributaries and mainstem reaches nested within. Created with nhdplustools via R.

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Environmental Data & Predictor Variables

Cortney Cameron

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Purpose & Approach

- 💧 SWIMS needs datasets as inputs for natural flow modeling
- 🔍 Identify broad categories of predictors used in previous studies
- 🛢 Identify datasets covering these predictors
- ⬆️ Generally, prioritize datasets with these features:
  - Publicly accessible
  - Statewide coverage
  - Gridded or polygon format (i.e., not point-based)
  - Coverage of proposed base period
  - Higher spatial resolution
  - Performance or use in Oregon or the Pacific Northwest
- ➡️ Generally deprioritized:
  - Sub-daily datasets
  - Human flow management indices

Broad Predictor Categories

- 🌧️ Climate
- 📐 Watershed Morphology
- 🌋 Soil & Geology
- 🌲 Land Cover
- ⛓️ Hydrologic Network
- 🔥 Fire

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Priority Datasets Selected

Climate	• PRISM – precipitation, temp • UA SWE • GridMET – PET
Watershed Morphology	• 3DEP – elevation, derived variables (slope, etc.)
Soil & Geology	• National Geologic Map Database • BFI (Wolock, 2003) • STATSGO: Schwarz & Alexander (1995) & Miller & White (1998)
Land Cover	• NLCD – classes, impervious surfaces • LANDFIRE – vegetation type, height, cover, etc.
Hydrologic Network	• NHD Plus v2 • Channel Geometry (Zarrabi et al., 2025)
Fire	• LANDFIRE – fire regime, return intervals

General Limitations

- 🕓 Multiple datasets fall outside the proposed base period or are static
- 📏 Spatial resolutions vary
- 🗺️ Some datasets may have incomplete spatial coverage
- 🚰 Some datasets may inherently include some human flow management effects
- 🎯 Dataset-specific accuracy generally not assessed
- 📈 Multicollinearity and variable selection must be addressed

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Discussion Questions

- Are there any data sets you recommend?
- Are there any considerations we should be aware of with proposed datasets?
- Are there any variables or derived variables that you recommend?
- Do you have any suggestions for approaches on identifying key predictor variables?

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Modeling Approaches for Estimating Natural Flow

Cortney Cameron

Purpose & Approach

🔀 Overview certain model-related choices to be made as part of SWIMS model development

Recall: need to predict natural mean daily flow exceedances at lower (80^{th}) and median (50^{th}) percentiles for each month of the year (24 percentile-month combinations). For example, a March median would be calculated using 930 days in a WY1991-2020 base period.

💭 Solicit feedback from experts on available options and best approaches

- Model options
- Variable selection
- Regionalization
- Performance/selection

Model Options

Multiple linear regression

- OLS, GLS, WLS, TLS, etc.

Cubist regression

Machine learning (ensemble/kernel)

- Random forest
- XGBoost
- Support vector regression

Geostatistical methods (traditional/ML)

Note on OHM

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Other Decisions

Time series vs. percentile modeling

- Generate daily time series and calculate percentiles
- Predict percentiles directly

Variable selection

- Expert prioritization
- Variance inflation factors
- Principal component analysis
- LASSO
- Forward/backward approaches

Regionalization

- Define/refine regions, develop different models by region
- See if ML can implicitly “identify” regions through variable combinations

Model Performance/Selection

🎯 Determining if model is fit for use

- Performance metrics
- Benchmarking
- Professional judgement

⚖️ Selecting among multiple decently-performing model options

- Performance metrics
- Interpretability/accessibility

Discussion Questions

Do any model approaches offer significant advantages over others?

Are there other model approaches we should consider?

What types of model selection criteria should be applied?

How should regionalization be factored into the modeling approach?

What methods do you recommend for selection of predictor variables?

Climate Impact Assessment

Junjie Chen

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Purpose

Objectives

- Summarize observed climate trends in Oregon
- Explain how climate trends affect hydrologic stationarity and modeling water availability
- Document rationale for adopting PRISM as historical climate data for SWIMS

Why it matters

- Water availability estimates depend on climate-hydrology relationships
- Assumed climate signals were stationary when developing WARS
- Evidence now shows hydroclimate relationships are evolving

Implications for Hydrologic Stationarity

Summarized from Oregon's 7th Climate Assessment

🌧️ Key Climate Signals

- Sustained warming (dominant signal)
- Declining snowpack + earlier snowmelt
- Shift from snow → rain (mid-elevation basins)
- Precipitation: no clear annual trend (Increased variability and extreme events)

💧 Hydrologic Response

- Earlier peak streamflow timing
- Reduced summer baseflows
- Increased evapotranspiration demand
- Shifting predictor relationships (e.g., SWE relevance)

💬 Key Take Away Relevant to SWIMs

- Observed climate trends are altering hydrologic processes that influence water availability
- Weakening historical climate–streamflow relationships

Stationarity, Variability, and Reliability

Traditional assumption

- Stationary conditions – historical data represents future conditions
- Fixed base period in WARS: 1958–1987

Climate variability (PDO &ENSO)

- ENSO (2–7 yr)
  - Controls interannual variability
  - Warm/dry vs cool/wet winters
- PDO (20–30 yr)
  - Historically linked to multi-decadal streamflow patterns

What's changing?

- Non-stationarity arises from:
  - Natural variability (PDO, ENSO)
  - Superimposed long-term warming
- Result
  - Watersheds reflect combined effects of variability and long-term trends
  - Climate indices alone are less predictive
- Reliability of historical data is declining due to weakening climate–streamflow relationships and shifting climate regimes

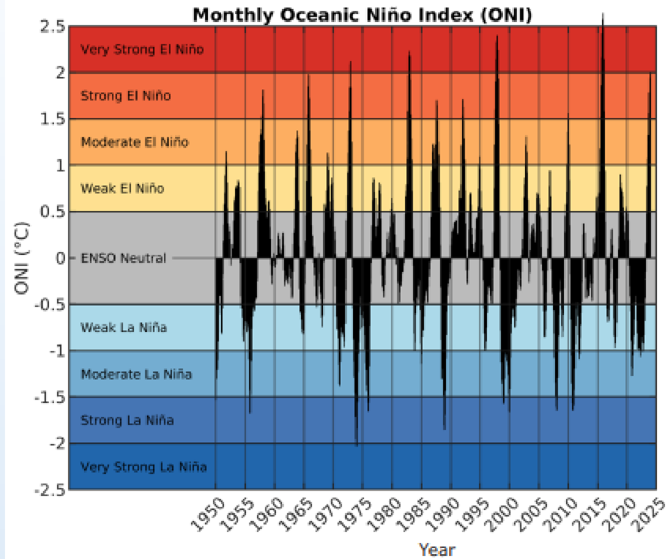

Figure 2. Time series of the monthly Oceanic Niño Index (ONI) since 1950. Data source: NOAA Climate Prediction Center.

Monthly Oceanic Niño Index (ONI) since 1950, highlighting ENSO-driven variability that influences interannual hydroclimate patterns, but does not fully explain long-term changes in streamflow behavior.

Climate Data in SWIMS Framework

The PRISM dataset

- Spatially explicit climate inputs (P, T)
- Captures Oregon’s complex gradients
- Enables ongoing dataset updates

SWIMS Improvement Over WARS

- Climate-driven modeling:
  - PRISM → supply (streamflow drivers)
  - OpenET → demand (consumptive use)

Update & Recalibration Strategy

- Data updates: as available
- Model evaluation: every 5–10 years
- Constraint: Data availability + QA lag (PRISM, OpenET) is limiting factor

Strategy to Adapt to Changing Climate

Tier 1: Routine updates

- Incorporate latest PRISM/OpenET as available
- No recalibration

Tier 2: Periodic evaluation

- Test model performance every 5-10 years
- Reassess relationships

Tier 3: Rebuild

- Triggered by major structural shifts

💭 How often should data be updated and the model re-calibrated to adapt to climate trends?

Discussion

Specific Discussion Questions

Follow-up Meeting #2

- What must be considered when evaluating other naturalized mean daily flow records for use in model development?
- What are the trade-offs of correcting mean daily flow records collected by ‘reference’ gages to represent natural flow?

Geospatial Framework

- How does data availability constrain the ability to model at various scales?
- What are the differences in modeling at the catchment scale compared to the watershed scale?

Modeling approaches

- Do you have any suggestions regarding data sets, base variables, or derived variables to consider when developing predictor variables?
- Do any modeling approaches offer significant advantages over others?
- What types of model selection criteria should be applied?
- What methods do you recommend when selecting predictor variables?

Climate impacts

- How often should data be updated to account for impacts of a changing climate?

Questions?