Surface Water Information Modeling System (SWIMS)

Short-Record Periods Representing Climate Normal Windows Within the 1991-2020 Base Period

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Executive Summary

This item is an addendum to the draft gap tolerance report and will be appended to the final version. This analysis evaluated whether shorter time periods can adequately represent key percentiles calculated from the full 30-year base period (water years 1991-2020). Of 323 possible contiguous windows (5-23 years length) tested, 97 windows (30%) met representativeness criteria for both P80 and P50 percentiles across 51 index stations. Representative windows ranged from 9 to 23 years in length and were distributed throughout the base period, with valid windows beginning as early as WY1991 and as late as WY2008. These results suggest that stations with continuous record within specific time periods may be suitable for inclusion in model development, potentially expanding the pool of available index stations.

Introduction

OWRD completed a gap tolerance assessment to understand the amount of missing data that can exist at a station while still producing reliable estimates of key percentiles (Huang, 2025). The gap tolerance analysis randomly removed half of years, and then 5% to 37.5% of data within those years were randomly removed. The results showed that 24 complete years of streamflow data (in any configuration of years) could reasonably characterize key percentiles for the WY1991-2020 base period.

A panel of scientific experts convened to review the work recommended that OWRD evaluate whether specific time periods may be representative of the proposed base period, potentially allowing additional stations to be included in model development (Andrews, 2026). This memorandum evaluates the representativeness of shorter time windows (5-20 years) relative to a 30-year base period (water years 1991-2020).

Methods

Published and provisional mean daily flow values were acquired for the base period from OWRD (January 8, 2026 database version) for the 51 index stations analyzed in Huang (2025). Flow data were used rather than climate data, as flow integrates multiple processes acting over various spatiotemporal scales and represents the response of direct interest.

Identification of Representative Windows

For each station, monthly exceedance percentiles (P80 and P50) were calculated from the full base period using a flow duration curve approach as in Huang (2025). This results in 2 percentiles for each of the 12 months of the year, for a total of 24 percentiles at each station. Each percentile represents a mean daily flow value for the specified month; for example, for March, the P80 is the mean daily flow value corresponding to the lower quintile from the 930 mean daily flow values in the 30-year the base period.

Percentiles were also calculated for each for each possible contiguous window of 5-23 years length within the base period (323 windows). A maximum window length of 23 years was selected based on Huang's (2025) finding that any 24-year period is likely reasonably representative. For simplicity and based on typical missingness patterns (Cameron 2026), only consecutive years were tested, not every possible combination that results in the window length.

Percentage differences between window-derived and base period percentiles were calculated for every station and month. A window was considered representative for a given month if percentile values were within 15% of base period values for both P80 and P50 for ≥75% of stations each month for ≥10 (80%) of months. The 15% threshold follows the rationale of Huang (2025).

Factors Influencing Pass Rates

Stations

Station-level pass rates were calculated as the percentage of all window-month-percentile combinations where the station's percentile value was within 15% of the base period value. Variance decomposition compared the between-station and between-month variance in pass rates to determine whether failures were systematic or random.

To investigate drivers of station-level differences in representativeness, Shannon entropy was calculated from the entire daily flow record and correlated with average station pass rates (i.e., all windows).

Percentiles

To assess whether one percentile was easier to represent, station-level pass rates for the P80 and P50 were compared. For each percentile, station-level pass rates were calculated as the percentage of all window-month combinations where the station's percentile value was within 15% of the base period value. A Wilcoxon signed-rank test was used to compare P80 and P50 differences.

Seasons

To assess seasonal differences in pass rates, each window-month combination was classified as passing if ≥75% of stations met the 15% tolerance threshold for both P80 and P50. Pass rates were calculated as the percentage of windows meeting this criterion for each month. A chi-square test was used to evaluate whether the proportion of passing windows differed significantly across seasons (DJF, MAM, JJA, SON).

Results

Representative Windows

Of the 323 windows evaluated, 97 (30%) met the representativeness criteria. All representative windows were 9-23 years in length. Table 1 summarizes the representative windows by starting water year.

Table 1. Representative windows by starting water year, showing the range of valid ending water years and the number of qualifying windows.

Starting WY	Valid Endpoints (WY)	Number of Windows	Window Length(s)
1991	2003, 2005–2013	10	13, 15–23
1992	2006–2014	9	15–23
1993	2010, 2013, 2015	3	18, 21, 23
1994	2010–2011, 2013–2016	6	17–18, 20–23
1995	2015–2017	3	21–23
1996	2015–2018	4	20–23
1997	2015–2019	5	19–23
1998	2007, 2011, 2015–2020	8	10, 14, 18–23
1999	2008–2013, 2015–2020	12	10–15, 17–22
2000	2010–2011, 2013–2020	10	11–12, 14–21
2001	2009, 2011, 2014–2020	9	9, 11, 14–20
2002	2015–2020	6	14–19
2003	2017–2020	4	15–18
2004	2016, 2019–2020	3	13, 16–17
2005	2019	1	15

2006	2019–2020	2	14–15
2007	2020	1	14
2008	2020	1	13

Factors Influencing Pass Rates

Note that overall window pass rates are lower than numbers reported below because windows were required to meet combined criteria: ≥75% of stations within 15% for both percentiles and ≥10/12 (83%) months passing.

Stations

The mean station passed 78% of individual tests (window-month-percentile combinations), though this ranged from 33% to 99% across stations. Flow entropy was strongly correlated with station pass rates ($r = 0.68$, $p < 0.001$). Variance decomposition showed that between-station variance was 4.6 times greater than between-month variance.

Percentiles

Across stations, P80 and P50 pass rates (falling within 15% of base period values) were highly correlated ($r = 0.90$, $p < 0.001$). However, station-level pass rates were significantly higher for the P50 than the P80 ($p < 0.001$).

Seasons

Pass rates varied by month, ranging from 41% (June) to 80% (September). Seasonal differences were significant ($p < 0.001$). Summer months (JJA) had the highest pass rate, with 61% of window-month combinations meeting the 75% station threshold for both percentiles. Winter months (DJF) had the lowest pass rate at 48%.

Discussion

Representative windows are available across the full base period (Table 1). These findings may allow stations with shorter but representative records to be considered for inclusion in natural flow model development.

This analysis is limited by its assumption that sample stations are representative of the entire network and that sample-level results (i.e., ≥75% of stations criterion) translate to specific stations. However, stations with lower entropy consistently exhibited poor performance across windows; this is consistent with Huang's (2025) finding that such stations require greater data retention to achieve reliable percentile estimates. Finally, choices around acceptable error thresholds are subjective.

Conclusion

This analysis suggests that continuous streamflow records of 9-23 years can adequately characterize monthly percentiles (P80 and P50) relative to the full 30-year base period for the majority of index stations. Forty-seven representative windows were identified and were distributed across the base period from starting water years 1991-2008. These findings may allow stations with shorter but representative records to be considered for inclusion in natural flow model development.

References

Andrews, R. 2026. TAG Meeting #2 - Feedback Summary. Oregon Water Resources Department.

Cameron, C. (2026). Missingness Patterns in Oregon Streamflow Data (draft). Oregon Water Resources Department.

Huang, C. (2025). Gap tolerance analysis for streamflow data. Oregon Water Resources Department.