atmosphere

Supplementary

Comparing Approaches for Reconstructing Groundwater Levels in the Mountainous Regions of Interior British Columbia, Canada, Using Tree Ring Widths

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Classifying the dominant recharge mechanism

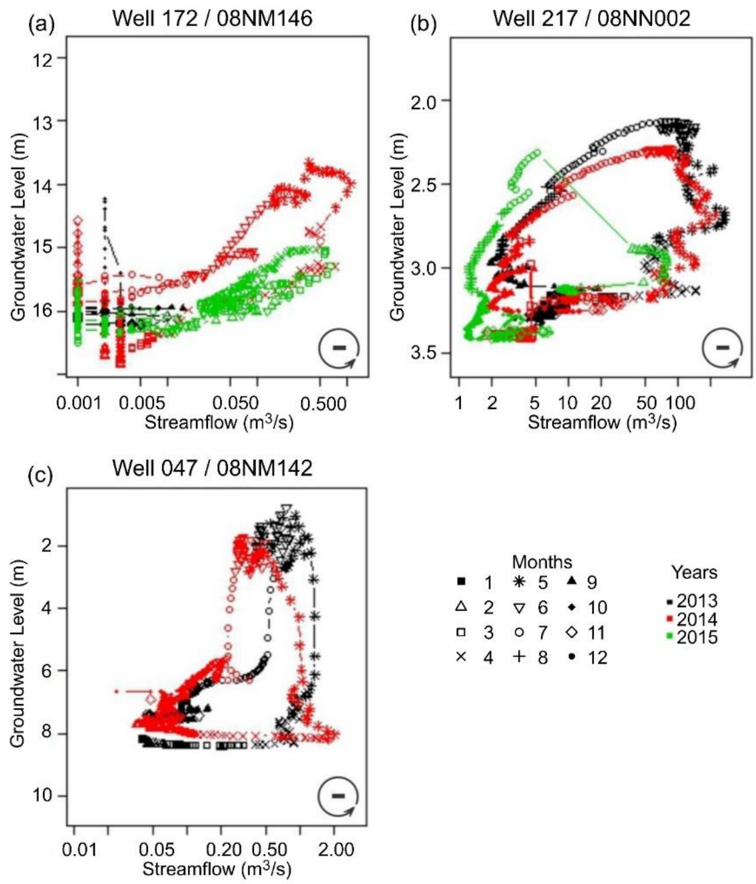


Figure S1. Hysteresis plots for a) OW172, b) OW217, and c) OW47, showing a negative hysteresis loop, indicating the aquifer-stream system is streamflow-driven. The aquifer-stream systems were classifed as streamflow-driven for observation well/streamflow gauge combinations (a) and (b), but as high-elevation recharge-driven for (c). The location of observation well 047 in a high-elevation bedrock helps with this classification, as otherwise the high-elevation recharge-driven systems appear to be very similar to streamflow-driven systems.

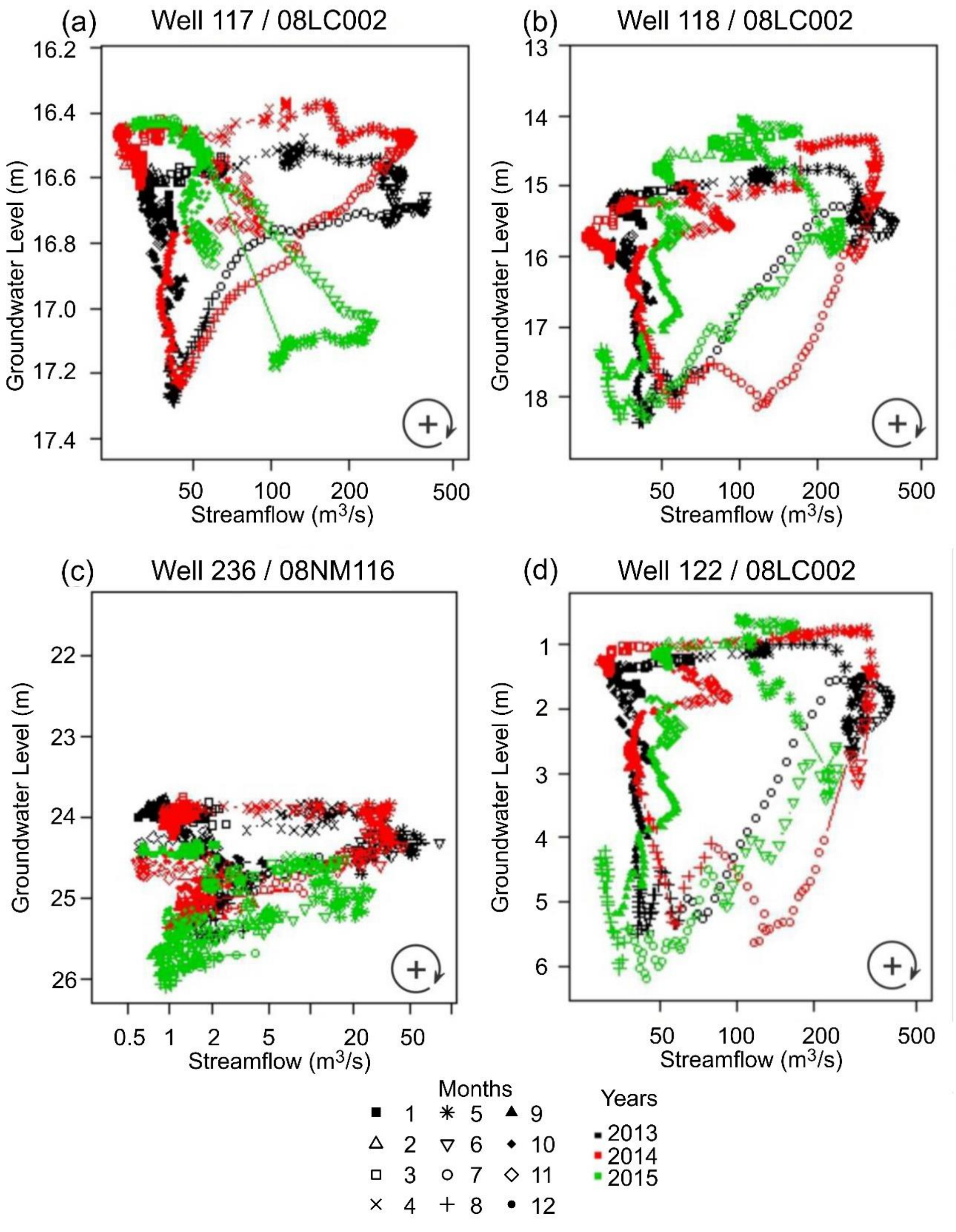


Figure S2. Hysteresis plots for a) OW117, b) OW118, c) OW236, and d) OW122, showing a positive hysteresis loops, indicating the aquifer-stream system is recharge-driven at a low elevation. All of these aquifer-stream systems were classififed as low-elevation recharge-driven.

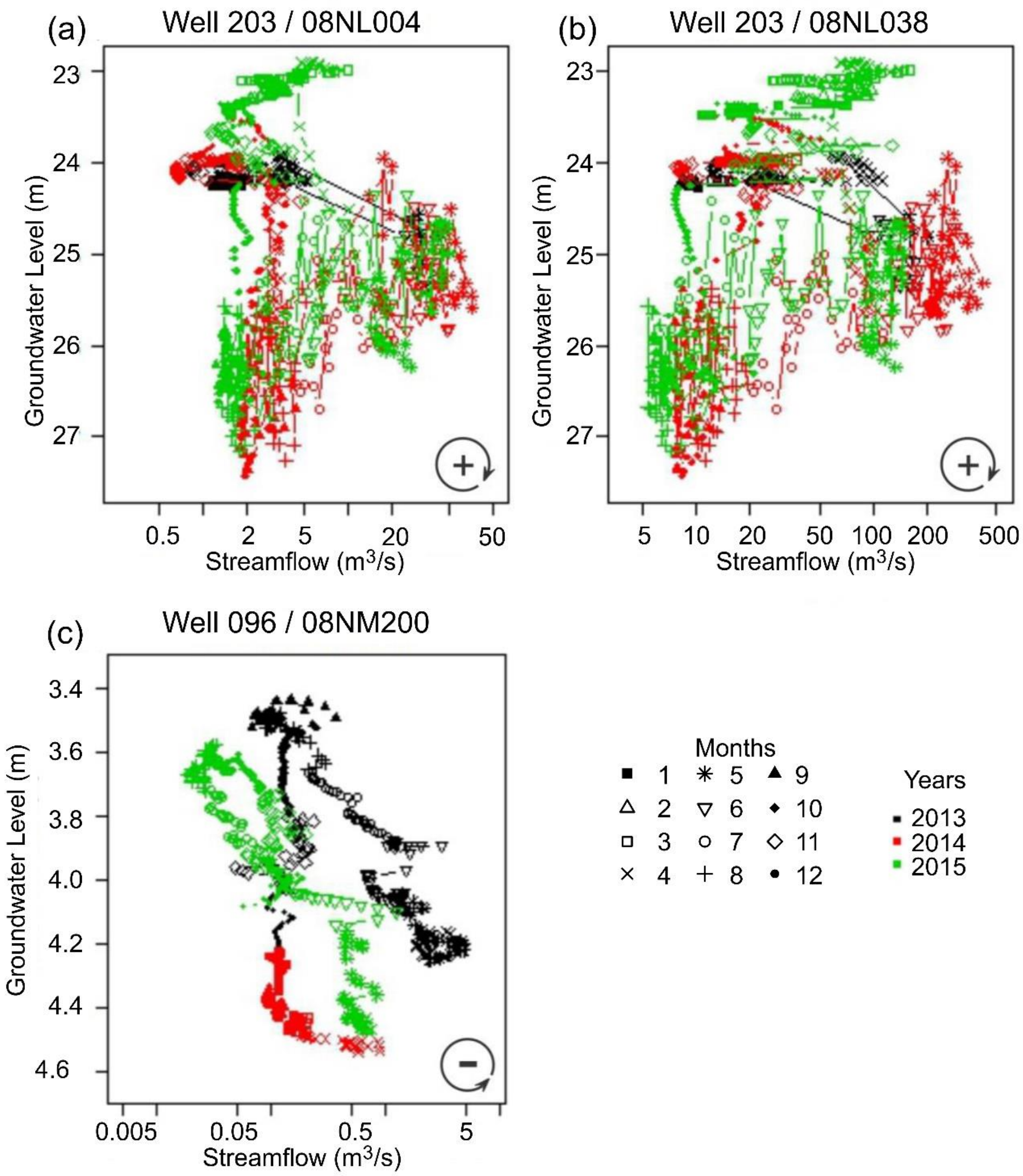


Figure S3. Hysteresis plots for a) OW203 with stream gauge 08NL004, b) OW203 with stream gauge 08NL038, and c) OW096. Two plots were created for OW203 because two stream gauges were located nearby; however, both hysteresis plots were extremely messy, and cross correlation analysis (not shown) suggested that OW203 was in a streamflow-driven system, while the hysteresis plots suggest a low-elevation recharge-driven system; therefore, OW203 was not classified into an aquifer-stream system for this study. The hysteresis plot in c) is also not a defined loop structure, although it appears to be part of a negative loop; but the hydrograph of OW096 suggests there may be influence from nearby irrigation; therefore, it was also not classified into an aquifer-stream system.

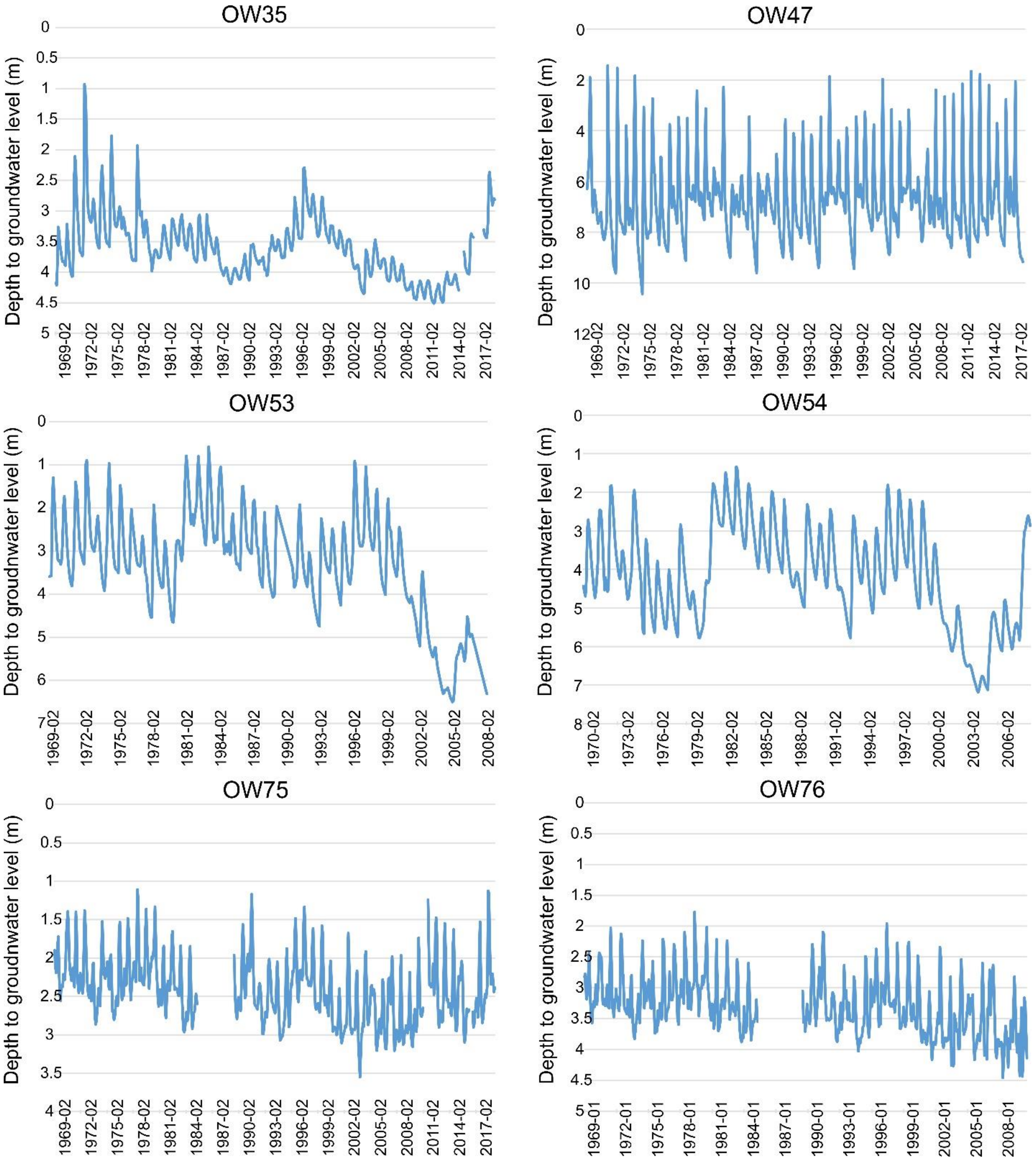


Figure S4. Groundwater level records for all wells analyzed for relationships to tree ring records. Each graph shows the entire period of records available. Note that measurements are in depth to groundwater, i.e. distance below ground surface.

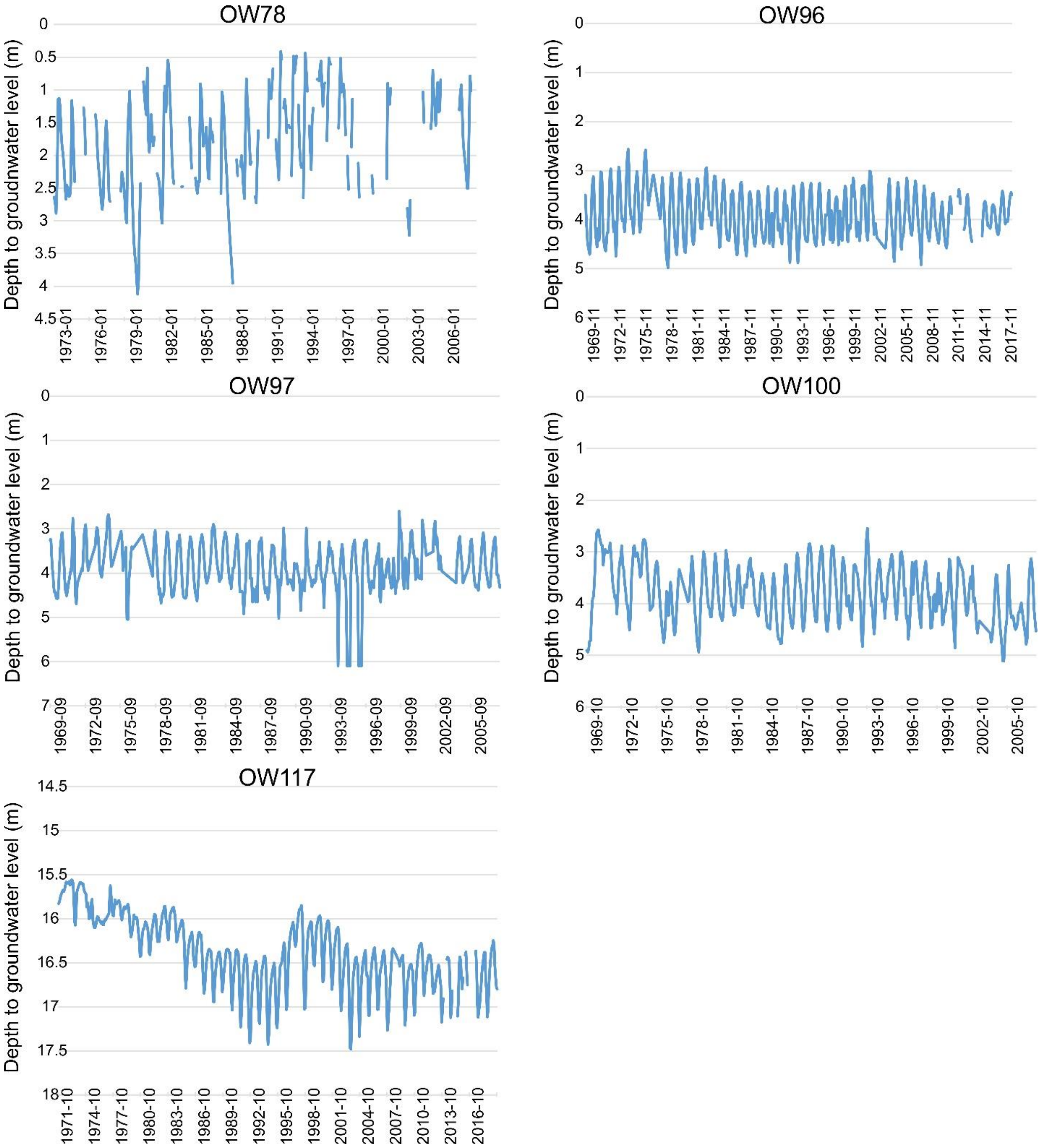


Figure S5. Groundwater level records for all wells analyzed for relationships to tree ring records. Each graph shows the entire period of records available. Note that measurements are in depth to groundwater, i.e. distance below ground surface.

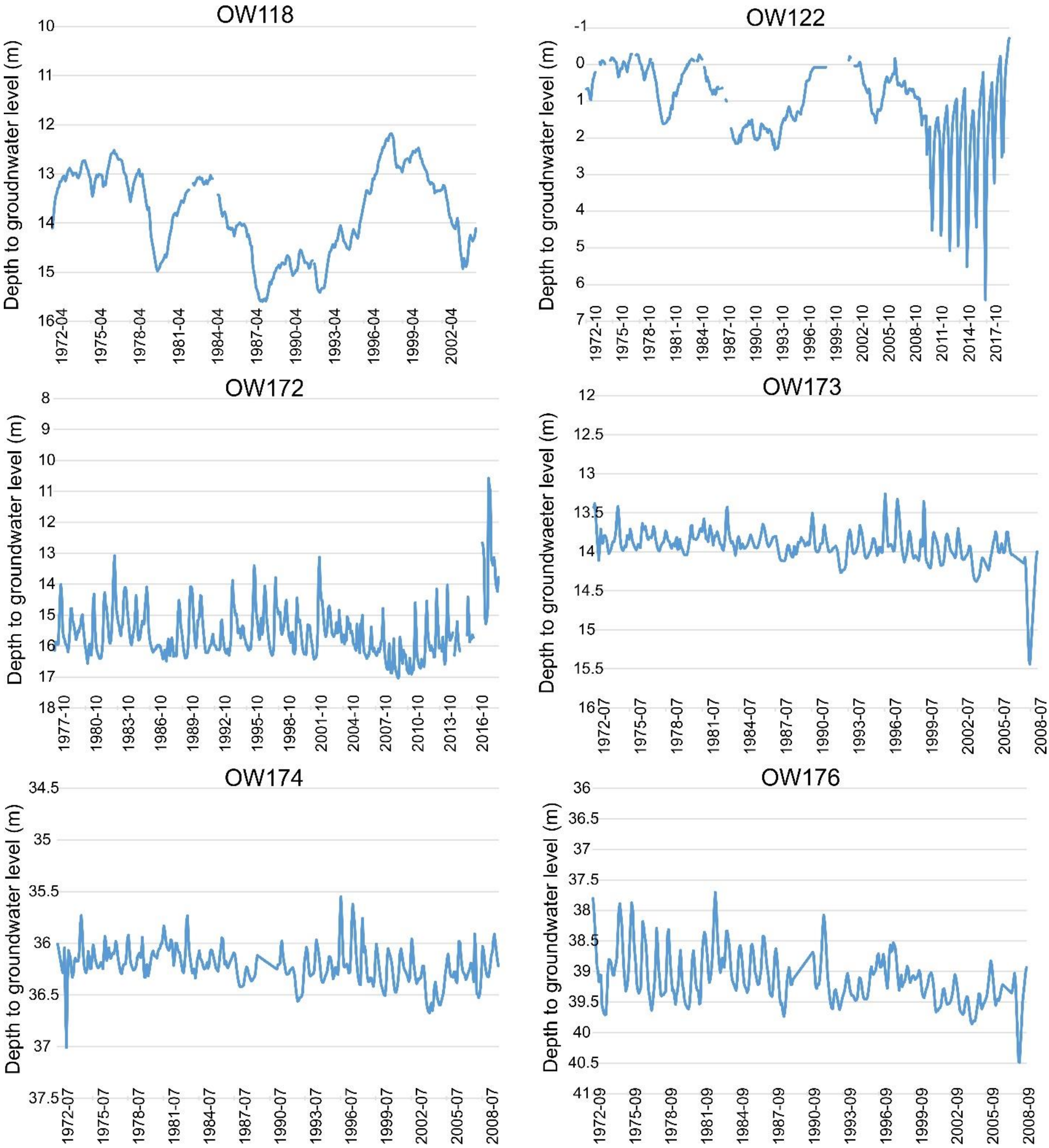


Figure S6. Groundwater level records for all wells analyzed for relationships to tree ring records. Each graph shows the entire period of records available. Note that measurements are in depth to groundwater, i.e. distance below ground surface.

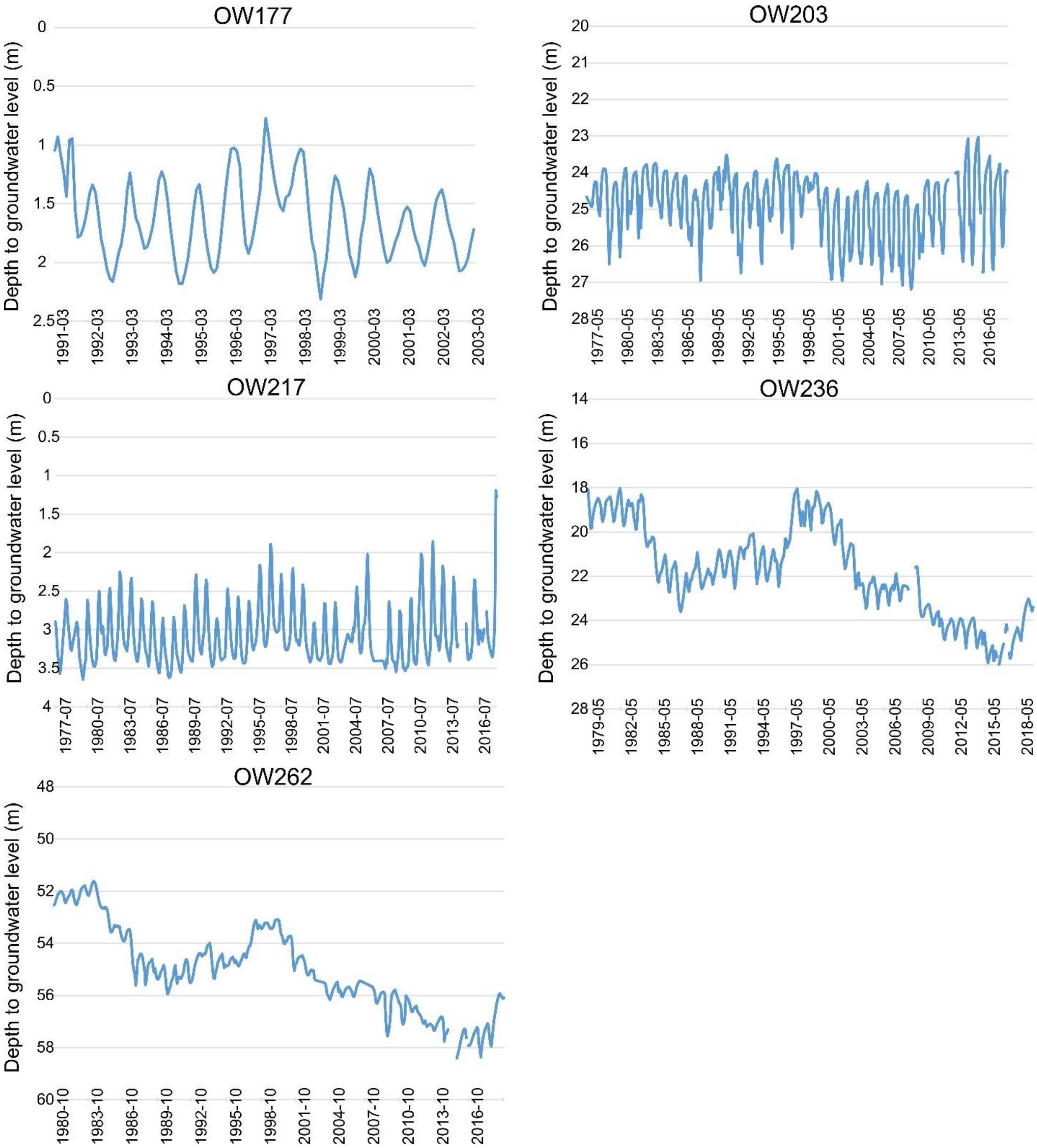


Figure S7. Groundwater level records for all wells analyzed for relationships to tree ring records. Each graph shows the entire period of records available. Note that measurements are in depth to groundwater, i.e. distance below ground surface.

Groundwater and tree ring data used

Table S1. Observation wells located in the interior of B.C. used for analysis of groundwater-tree ring width relationships.

Observation Well	Lat	Long	Elevation (m.a.s.l.)	Date Range	Aquifer-stream system
OW35	50.388	−120.313	762	1967–2020	Streamflow–driven
OW75	49.208	−119.825	413	1967–2020	Streamflow–driven
OW76	49.203	−119.828	415	1969–2010	Streamflow–driven
OW172	50.112	−119.357	409	1972–2020	Streamflow–driven
OW173	50.107	−119.361	405	1972–2009	Streamflow–driven
OW174	50.103	−119.365	427	1972–2009	Streamflow–driven
OW217	49.023	−118.434	512	1977–2020	Streamflow–driven
OW117	49.473	−115.719	52	1971–2020	Low-elevation recharge–driven
OW118	50.471	−119.130	52	1971–2020	Low-elevation recharge–driven
OW122	50.506	−119.129	52	1971–2020	Low-elevation recharge–driven
OW176	50.086	−119.376	434	1972–2009	Low-elevation recharge–driven
OW177	50.048	−119.398	397	1991–2003	Low-elevation recharge–driven
OW236	49.879	−119.399	398	1979–2020	Low-elevation recharge–driven
OW262	49.86	−119.422	N/A	1980–2020	Low-elevation recharge–driven
OW47	50.367	−119.087	1816	1965–2020	High-elevation recharge–driven
OW53	50.145	−119.4	966	1969–2008	High-elevation recharge–driven
OW54	50.145	−119.400	972	1969–2008	High-elevation recharge–driven
OW78	51.555	−121.203	1151	1972–2008	High-elevation recharge–driven
OW96	49.028	−119.477	306	1969–2020	Unclassified
OW97	49.028	−119.476	306	1969–2008	Unclassified
OW100	49.059	−119.511	317	1969–2008	Unclassified
OW203	49.175	−119.736	417	1975–2020	Unclassified

Table S2. Tree ring sites used to analyze groundwater-tree ring width relationships in the BC Interior.

Site	Lat	Long	Elevation (m.a.s.l.)	BGCZ	Species	Date Range	Authors
Cana 095	51.88	−121.25	810	Sub-Boreal Spruce	Douglas-Fir	1675–2000	Schweingruber, F.H.
Cana 147	50.82	−119.9	1550	Montane Spruce	Engelmann Spruce	1665–1994	Parish, R.
Cana 150	49.87	−118.85	1700	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1689–1998	Parish, R.; Small, B.
Cana 152	49.87	−118.85	1700	Engelmann Spruce-Subalpine Fir	Subalpine Fir	1712–1998	Parish, R.; Small, B.
Cana 161	51.03	−119.05	1900	Interior Cedar-Hemlock	Engelmann Spruce	1710–1996	Parish, R.
Cana 162	51.03	−119.05	1900	Interior Cedar-Hemlock	Subalpine Fir	1692–1996	Parish, R.
Cana 229	49.15	−117.9	1900	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1978–2014	Wilson, R.J.S.; Luckman, B.H.
Cana 231	50.56	−118.57	1830	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1477–1997	Wilson, R.J.S.; Luckman, B.H.
Cana 232	50.37	−119.07	1700	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1882–1997	Wilson, R.J.S.; Luckman, B.H.
Cana 233	49.9	−118.37	2050	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1712–1997	Wilson, R.J.S.; Luckman, B.H.
Cana 234	49.73	−118.93	2000	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1512–1997	Wilson, R.J.S.; Luckman, B.H.
Cana 235	49.17	−119.23	2000	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1569–1997	Wilson, R.J.S.; Luckman, B.H.

Cana 237	50.98	−121.72	1950	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1694–1997	Wilson, R.J.S.; Luckman, B.H.
Cana 238	50.7	−121.45	1980	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1554–1997	Wilson, R.J.S.; Luckman, B.H.
Cana 239	50.53	−121.58	1800	Engelmann Spruce-Subalpine Fir	Engelmann Spruce	1708–1997	Wilson, R.J.S.; Luckman, B.H.

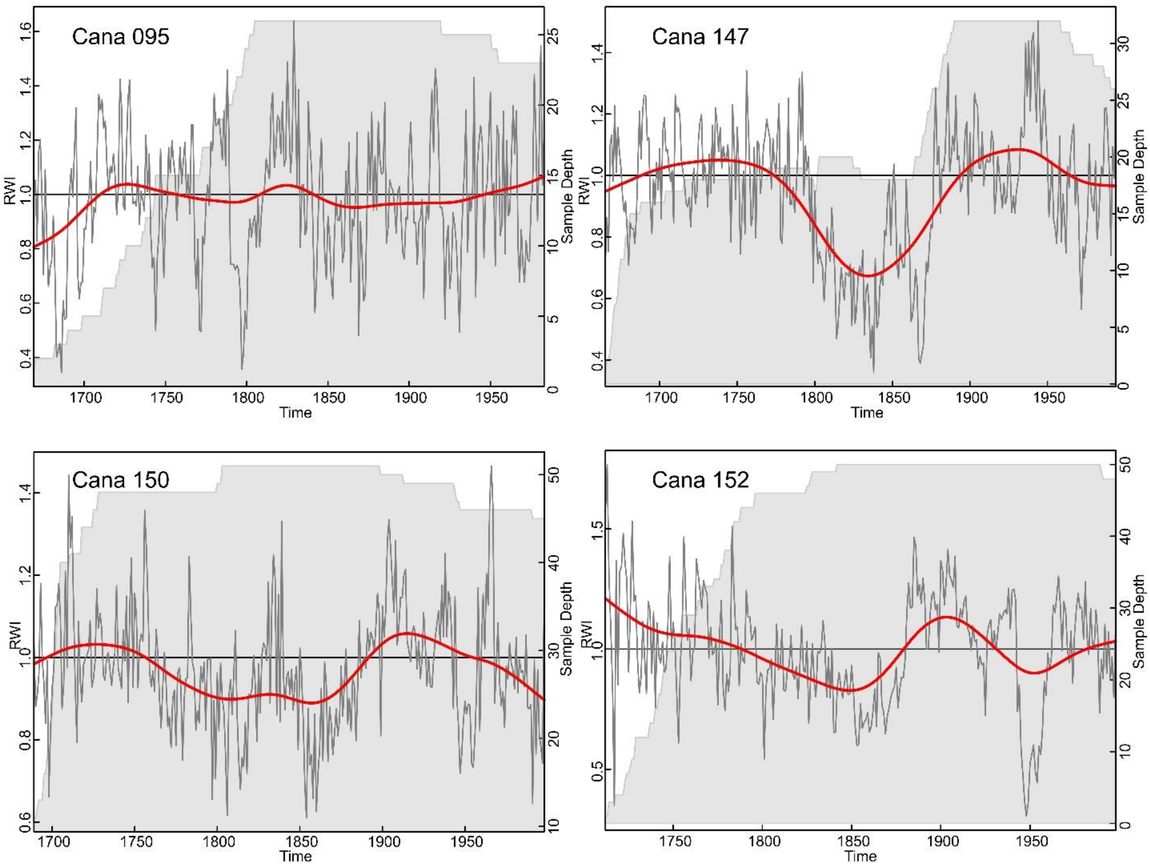


Figure S8. Standard chronologies of the tree ring records used to assess groundwater-tree ring relationships. Standard chronologies were created in R using the package dplR.

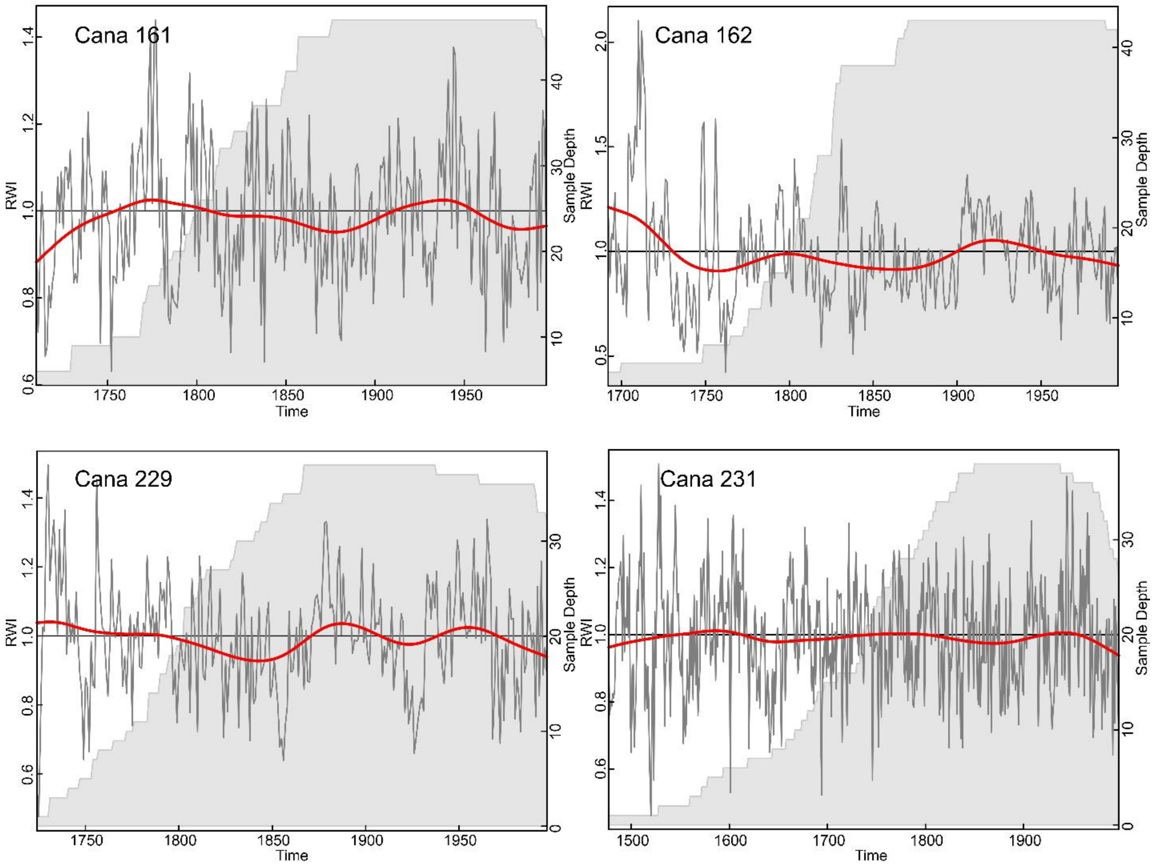


Figure S9. Standard chronologies of the tree ring records used to assess groundwater-tree ring relationships. Standard chronologies were created in R using the package dplR.

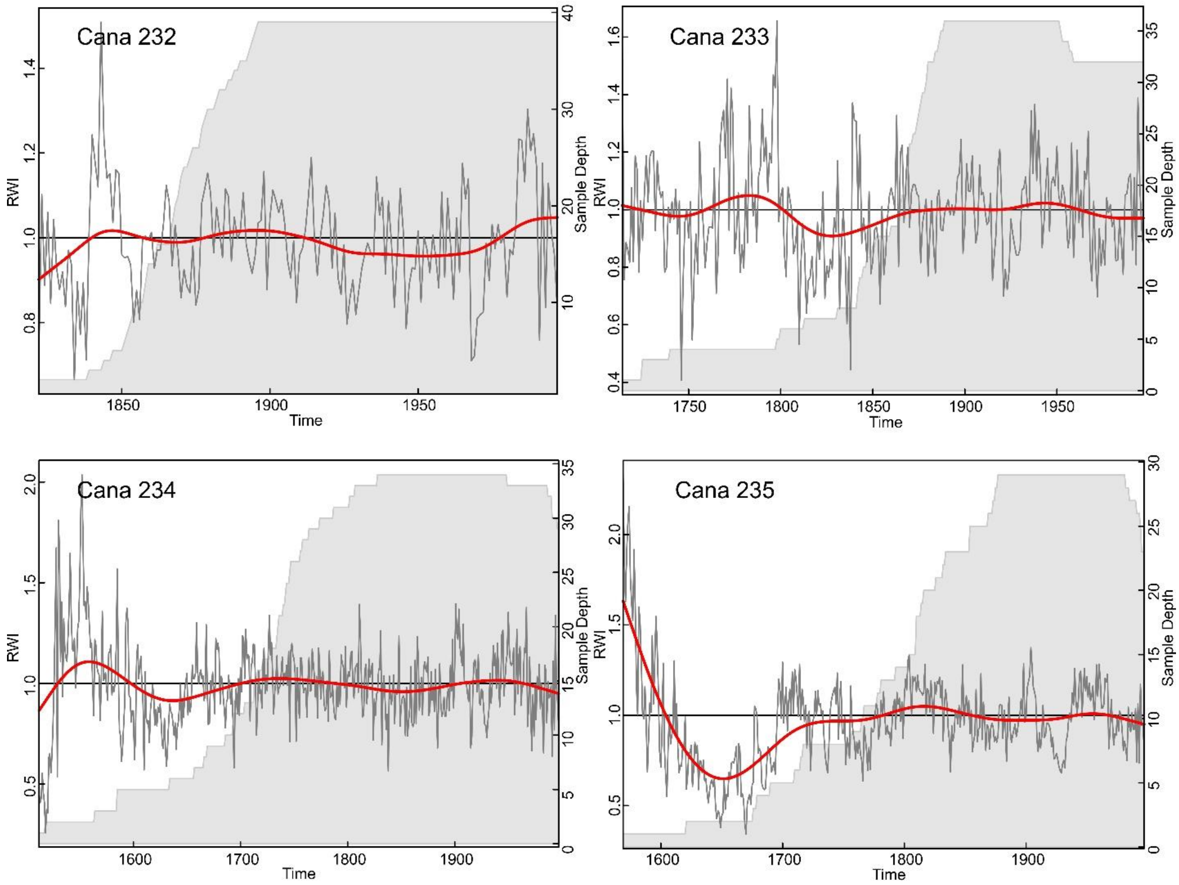


Figure S10. Standard chronologies of the tree ring records used to assess groundwater-tree ring relationships. Standard chronologies were created in R using the package dplR.

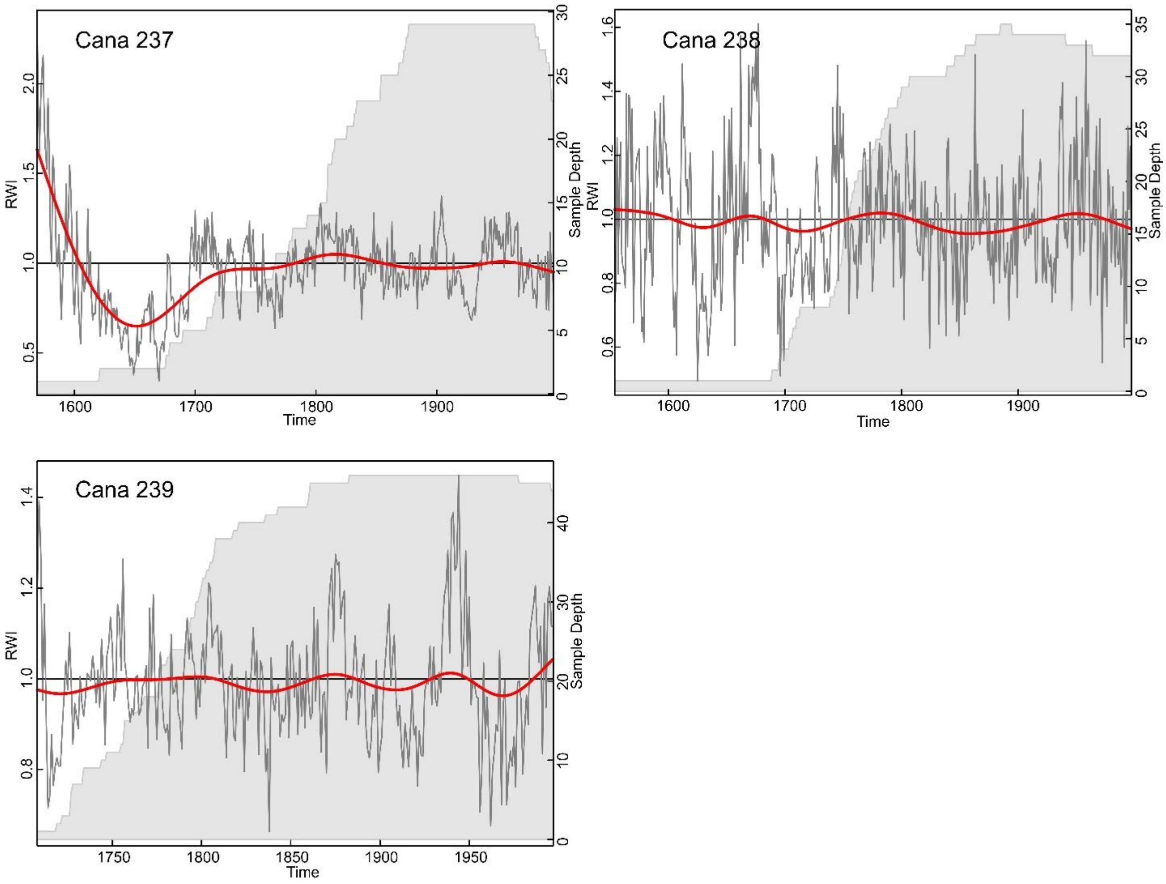


Figure S11. Standard chronologies of the tree ring records used to assess groundwater-tree ring relationships. Standard chronologies were created in R using the package dplR.

Tree ring width-groundwater level relationships

Table S3. Pairs of observation wells and tree ring sites used to determine months of significant correlations between the depth to groundwater level records and tree ring widths. Both previous-year and current-year relationships were assessed for correlations, but significant correlations were more common in the current year, so the relationships are shown for current year only.

Observation Well	Tree Ring Sites	Period of Overlap	Months with Significant Correlations	Significant Correlation Coefficients
OW35	Cana147	1967–1994	March–Oct	0.46–0.74
	Cana237	1967–1997	None	N/A
	Cana238	1967–1997	None	N/A
	Cana239	1967–1997	May-Oct	0.38-0.44
OW75	Cana235	1967–1997	June	0.32
OW96/97	Cana235	1969–1997	None	N/A
OW100	Cana235	1969–1997	None	N/A
OW203	Cana235	1975–1997	May–June	0.55
OW217	Cana229	1977–1997	July-October	0.40–0.50
OW47	Cana161	1965–1996	July–September	0.44–0.51
	Cana162	1965–1996	August–October	0.40–0.52
	Cana231	1965–1997	August–October	0.38–0.63
	Cana232	1965–1997	July & September	0.40–0.50
OW53	Cana150	1969–1998	None	N/A
	Cana152	1969–1998	None	N/A
	Cana233	1969–1997	May–Oct	0.42–0.63
	Cana234	1969–1997	June–Oct	0.48–0.60
OW172	Cana150	1972–1998	None	N/A
	Cana152	1972–1998	None	N/A
	Cana233	1972–1997	February–April	0.42–0.5
	Cana234	1972–1997	None	N/A
OW173	Cana150	1972–1998	None	N/A
	Cana152	1972–1998	March–April	-0.4–0.42
	Cana233	1972–1997	July–October	0.36–0.52
	Cana234	1972–1997	July–October	0.43–0.51
OW174	Cana150	1972–1998	April–May	-0.55–0.625
	Cana152	1972–1998	February-April	-0.38–0.48
	Cana233	1972–1997	July–October	0.32–0.44
	Cana234	1972–1997	July–August	0.41–0.45

Table S3. cont'd. Pairs of observation wells and tree ring sites used to determine months of significant correlations between the depth to groundwater level records and tree ring widths. Both previous-year and current-year relationships were assessed for correlations, but significant correlations were more common in the current year, so the relationships are shown for current year only.

Observation Well	Tree Ring Sites	Period of Overlap	Months with Significant Correlations	Significant Correlation Coefficients
OW176	Cana150	1972–1998	August–September	0.35–0.39
	Cana152	1972–1998	July–October	0.32–0.63
	Cana233	1972–1997	August–October	0.40–0.59
	Cana234	1972–1997	July–October	0.43–0.56
OW117	Cana147	1971–1994	September–October	0.47–0.50
	Cana161	1971–1996	September–October	0.56–0.58
	Cana162	1971–1996	None	N/A
	Cana231	1971–1997	None	N/A
	Cana232	1971–1997	None	N/A
OW118	Cana147	1971–1994	August	0.32
	Cana161	1971–1996	July–September	0.19–0.39
	Cana162	1971–1996	July–August	0.24–0.27
	Cana231	1971–1997	July–September	N/A
	Cana232	1971–1997	July–August	N/A
OW236	Cana150	1979–1998	None	N/A
	Cana152	1979–1998	None	N/A
	Cana232	1979–1997	June–October	0.49–0.70
	Cana233	1979–1997	September	0.42
	Cana234	1979–1997	September	0.375
OW262	Cana150	1980–1998	January–June	−0.5–0.53
	Cana152	1980–1998	January–May	−0.375–0.43
	Cana232	1980–1997	None	N/A
	Cana233	1980–1997	June–October	0.44–0.59
	Cana234	1980–1997	None	N/A
Average of all wells	Cana095	1969–2000	January–November	0.43–0.72
	Cana147	1969–1994	January–November	0.33–0.82
	Cana150	1969–1998	February	-0.43
	Cana152	1969–1998	None	N/A
	Cana161	1969–1996	January–November	0.43–0.71
	Cana162	1969–1996	None	N/A
	Cana229	1969–2014	June–November	0.36–0.54
	Cana231	1969–1997	June–September	0.4–0.48
	Cana232	1969–1997	June–November	0.49–0.70
	Cana233	1969–1997	January–November	0.31–0.71
	Cana234	1969–1997	June–November	0.43–0.53
	Cana235	1969–1997	None	N/A
	Cana237	1969–1997	None	N/A
	Cana238	1969–1997	None	N/A
	Cana239	1969–1997	June–November	0.42–0.68

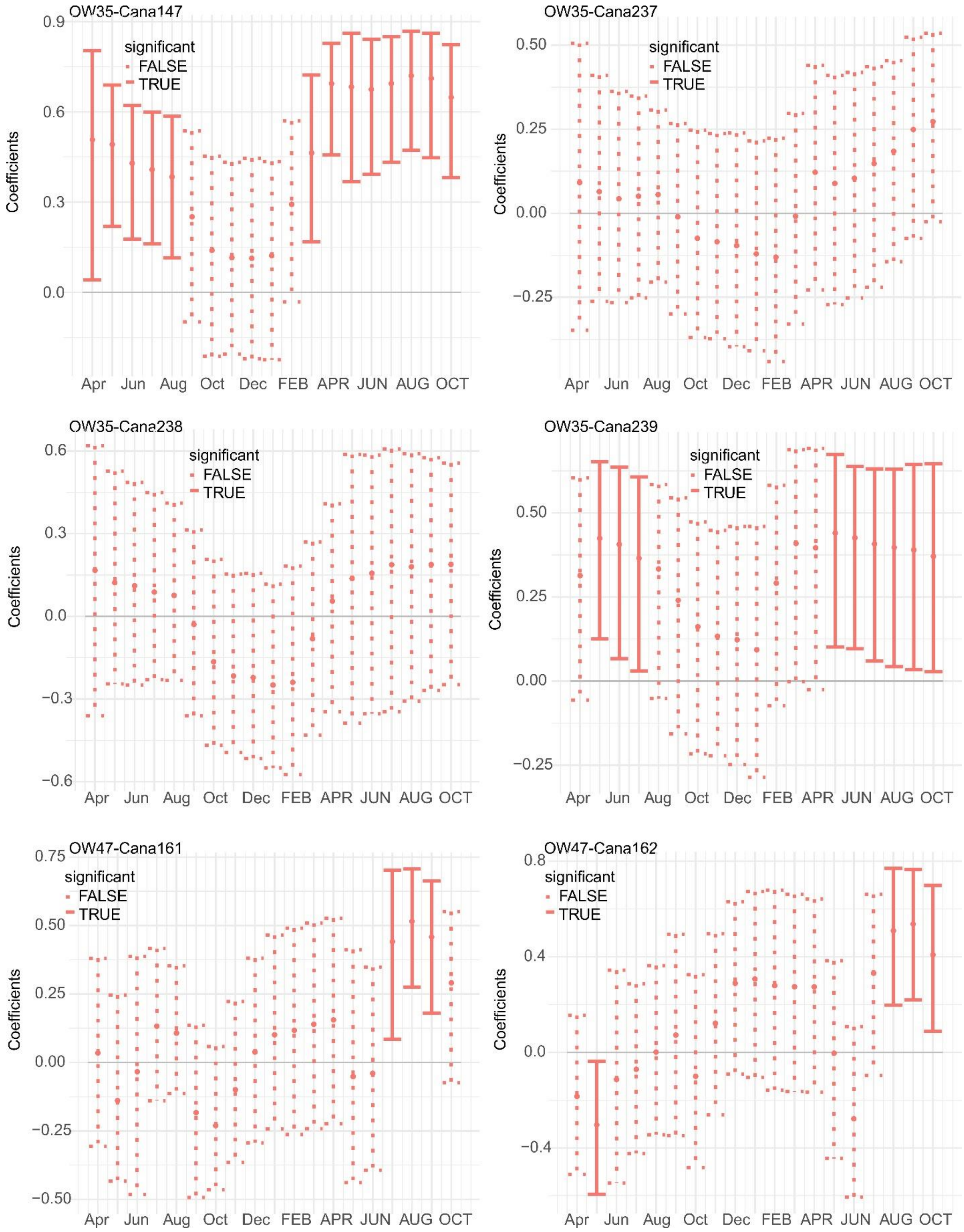


Figure S12. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

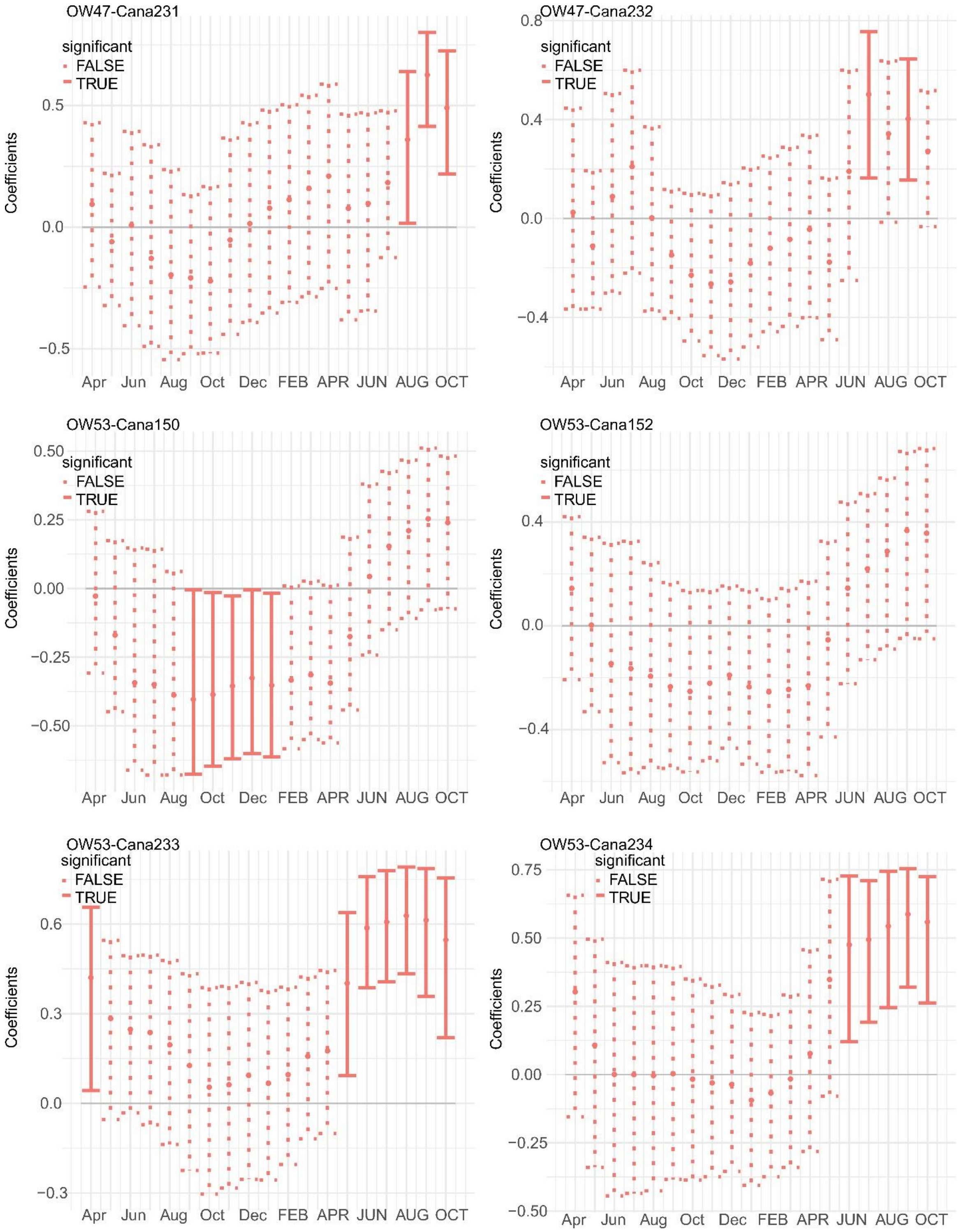


Figure S13. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

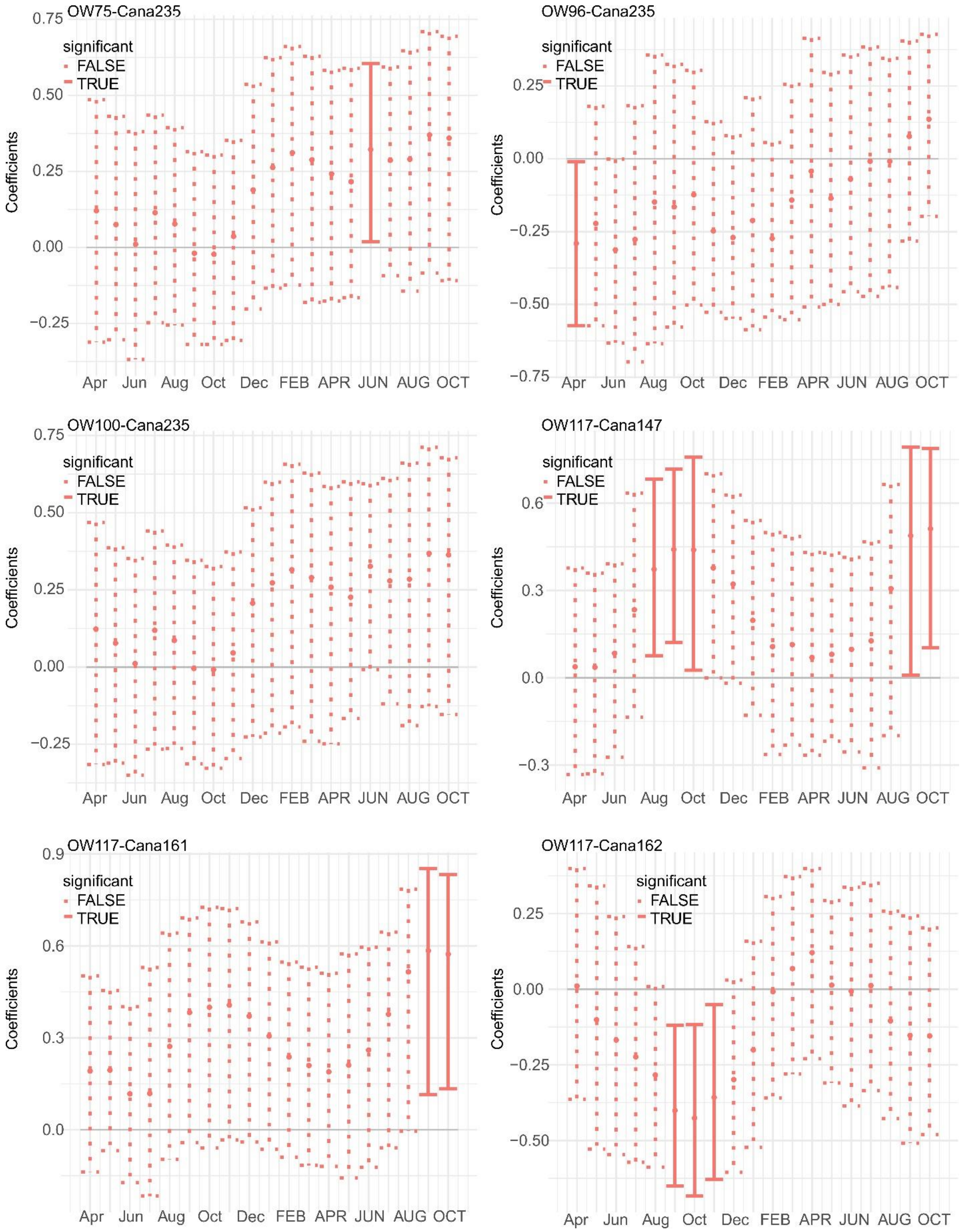


Figure S14. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

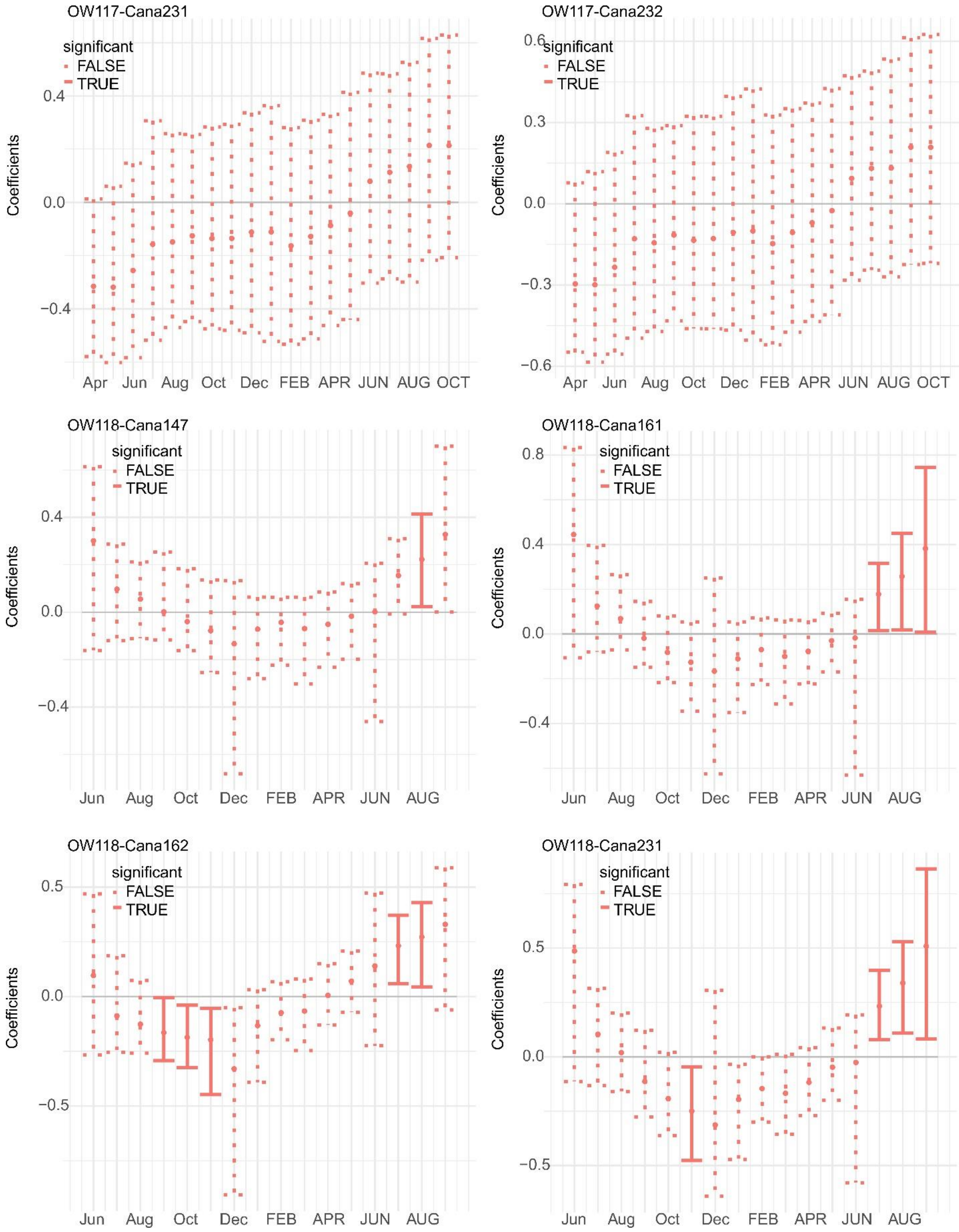


Figure S15. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

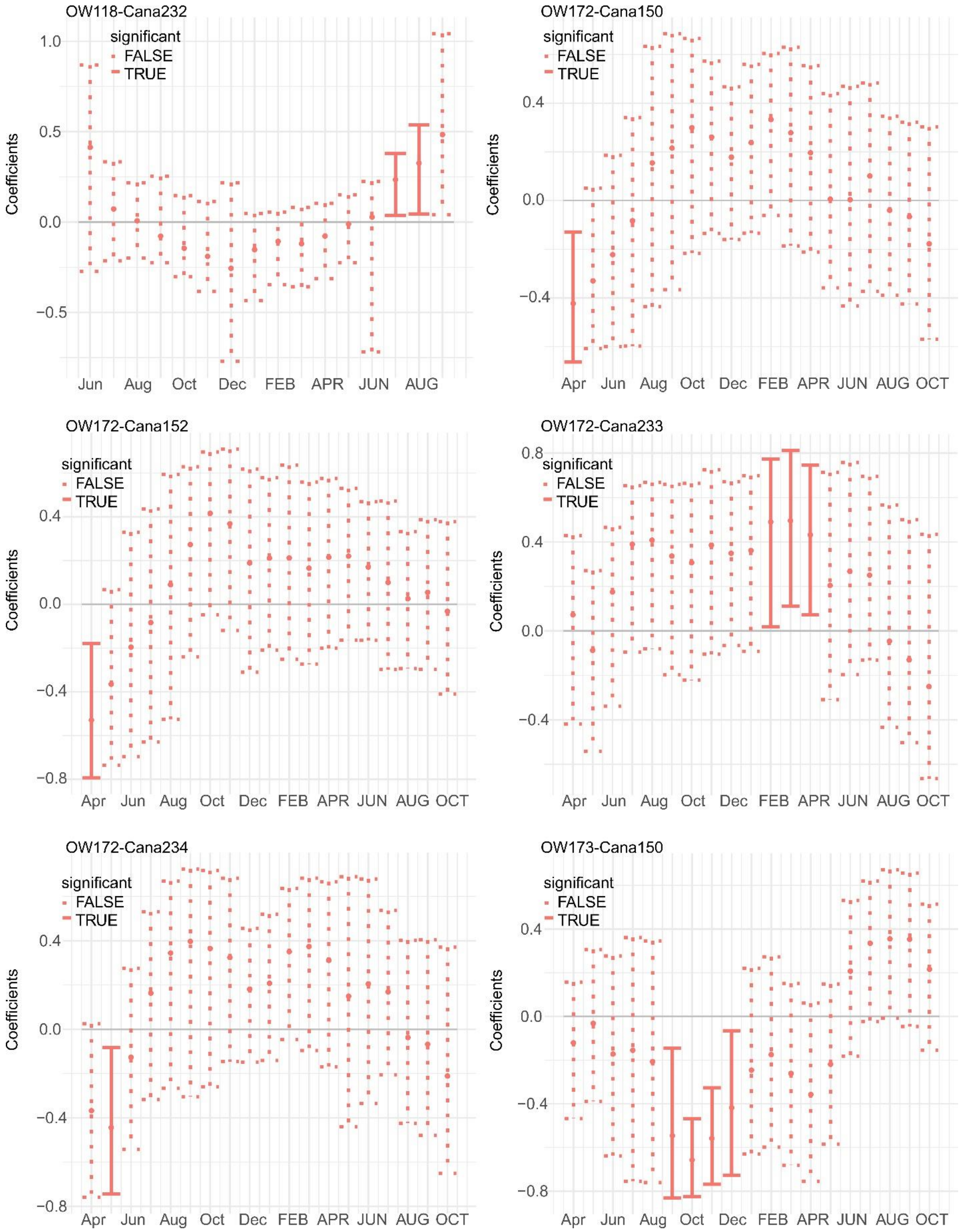


Figure S16. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

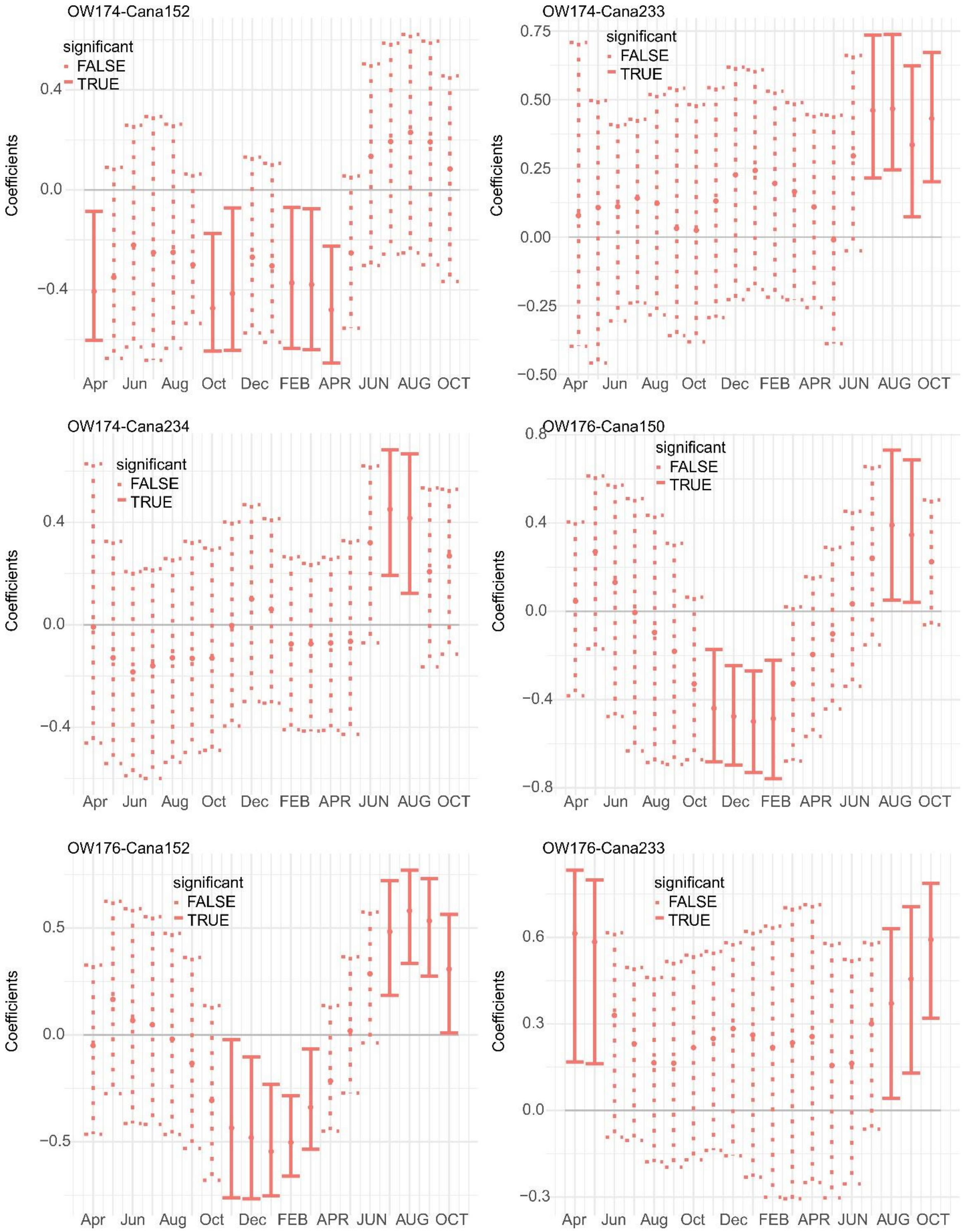


Figure S17. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

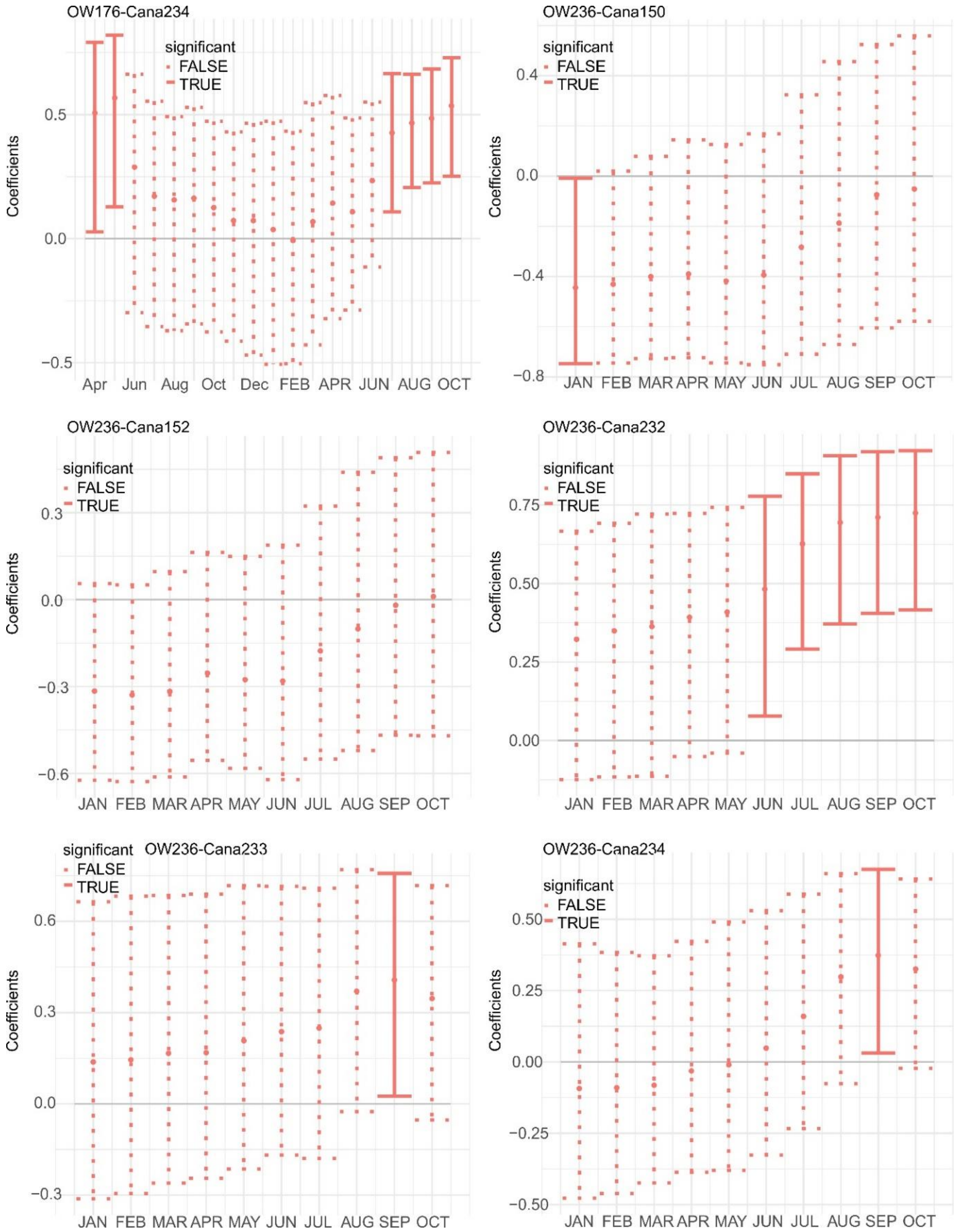


Figure S18. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

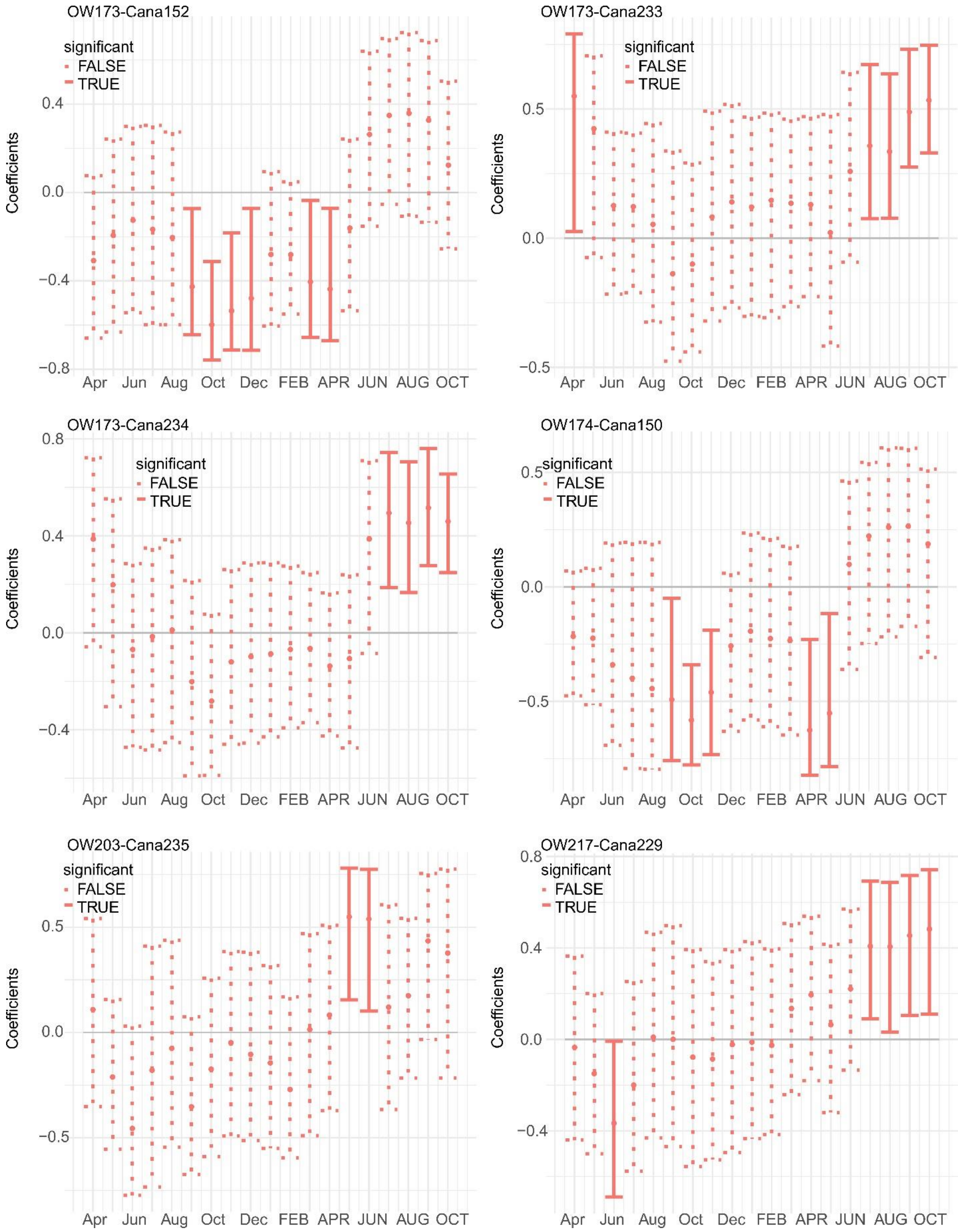


Figure S19. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

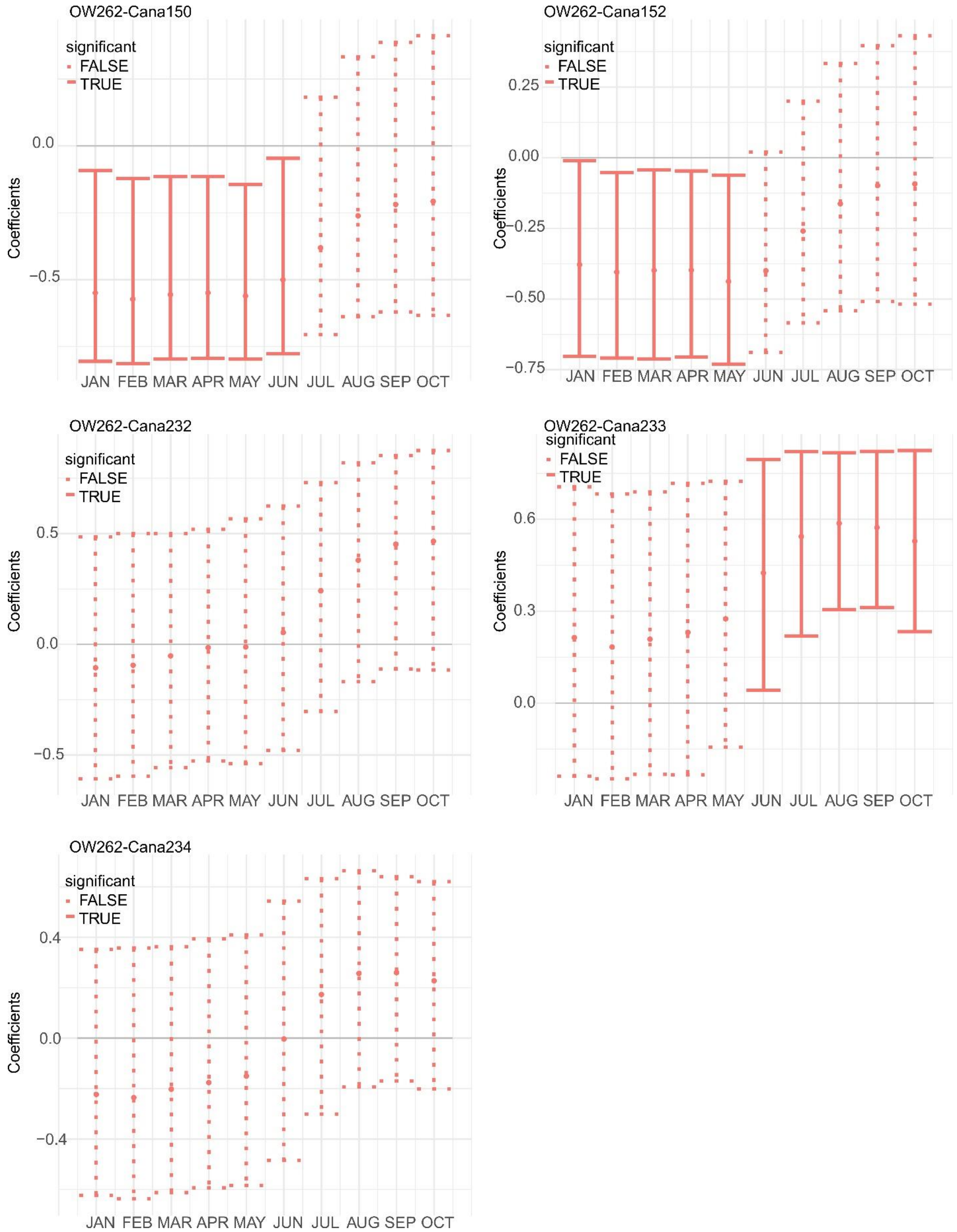


Figure S20. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

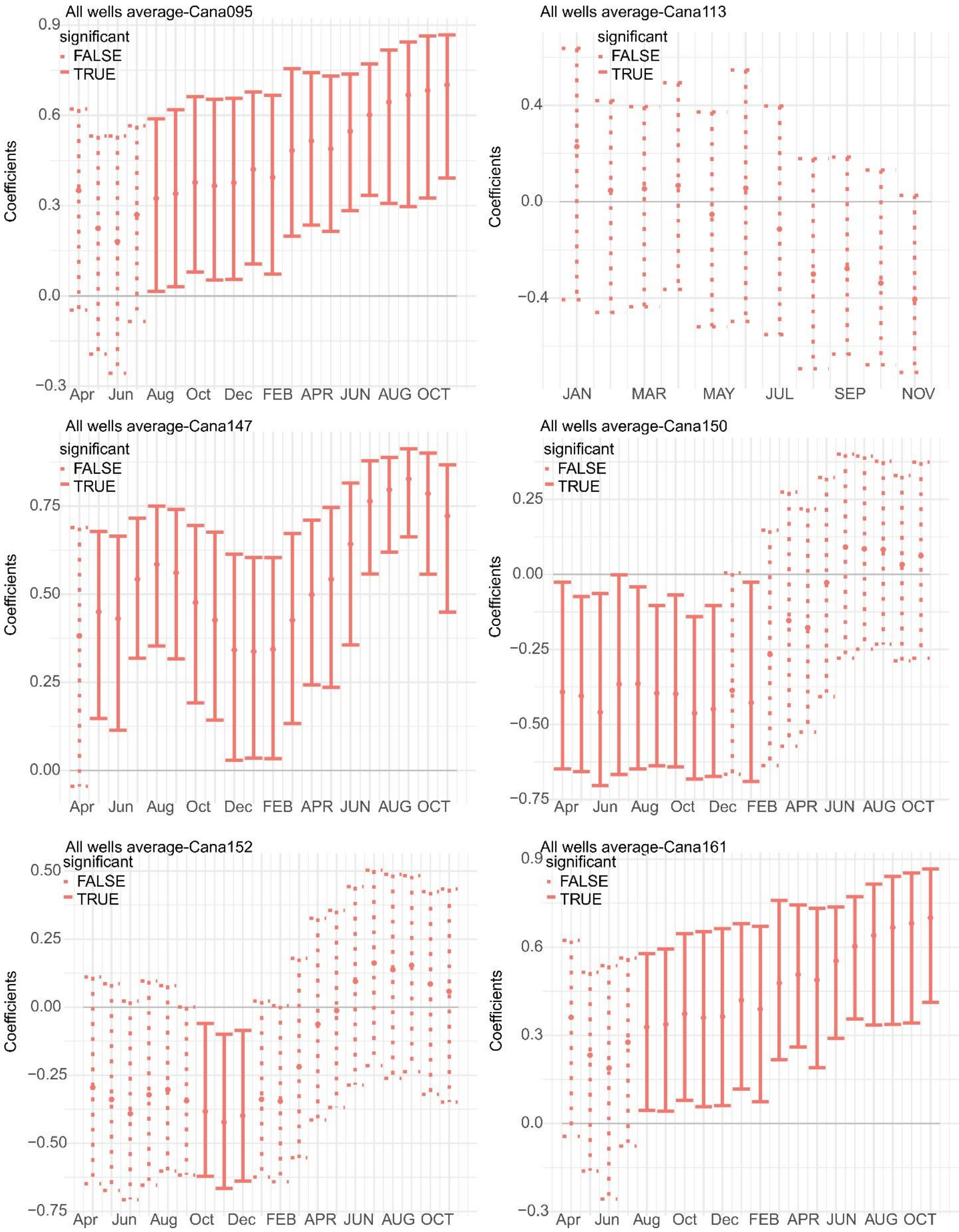


Figure S21. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package “treeclim”. Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

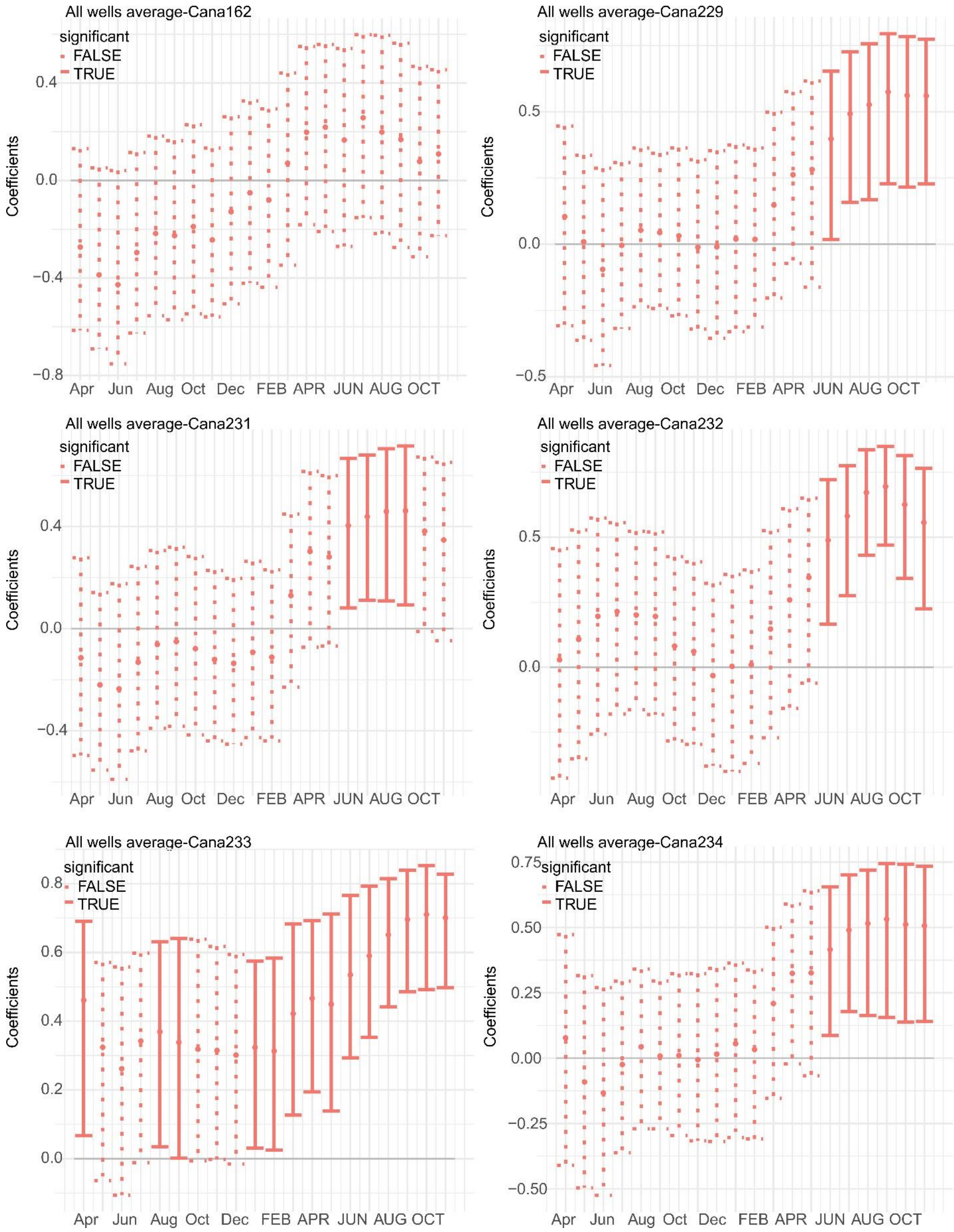


Figure S22. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

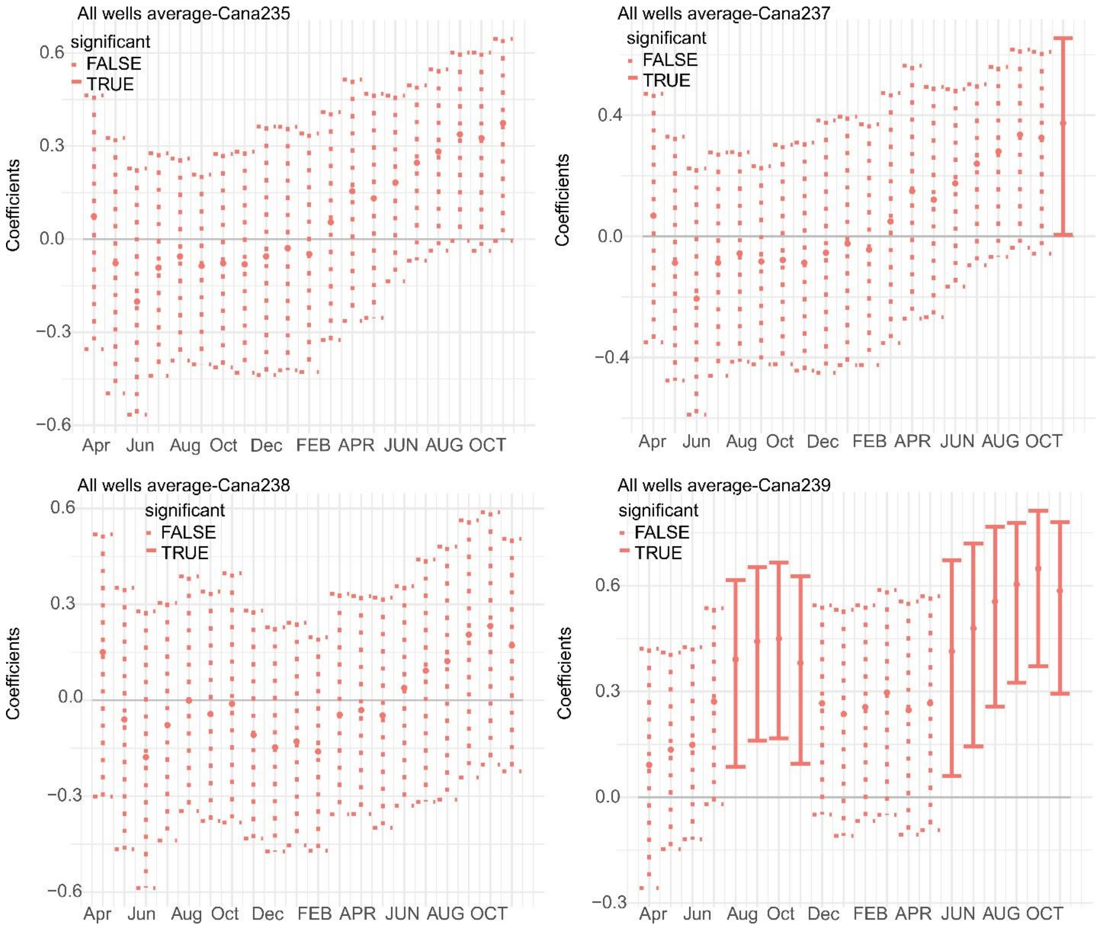


Figure S23. Correlation plots between the pairs of observation wells and tree ring records shown in Table S3. Correlation plots were created in the R package "treeclim". Months with significant correlations are shown with a solid line, while non-significant months are identified with a dotted line.

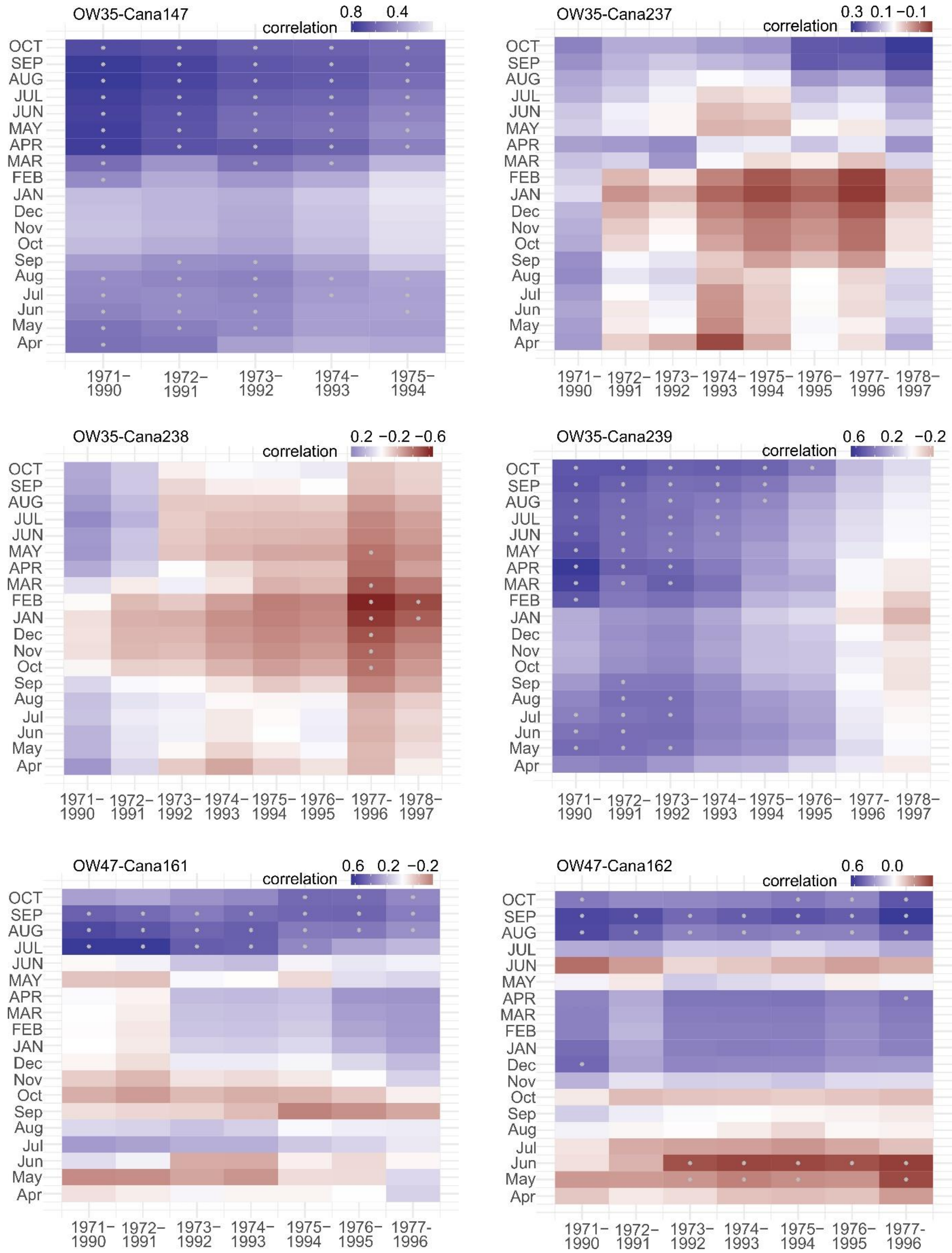


Figure S24. Moving correlation plots between the pairs of obersvation wells and tree ring records shown in Table S3. The depth of blue (positive) and red (negative) shading indicates the strength of the correlation, with white asterisks symbolizing windows of significant correlations.

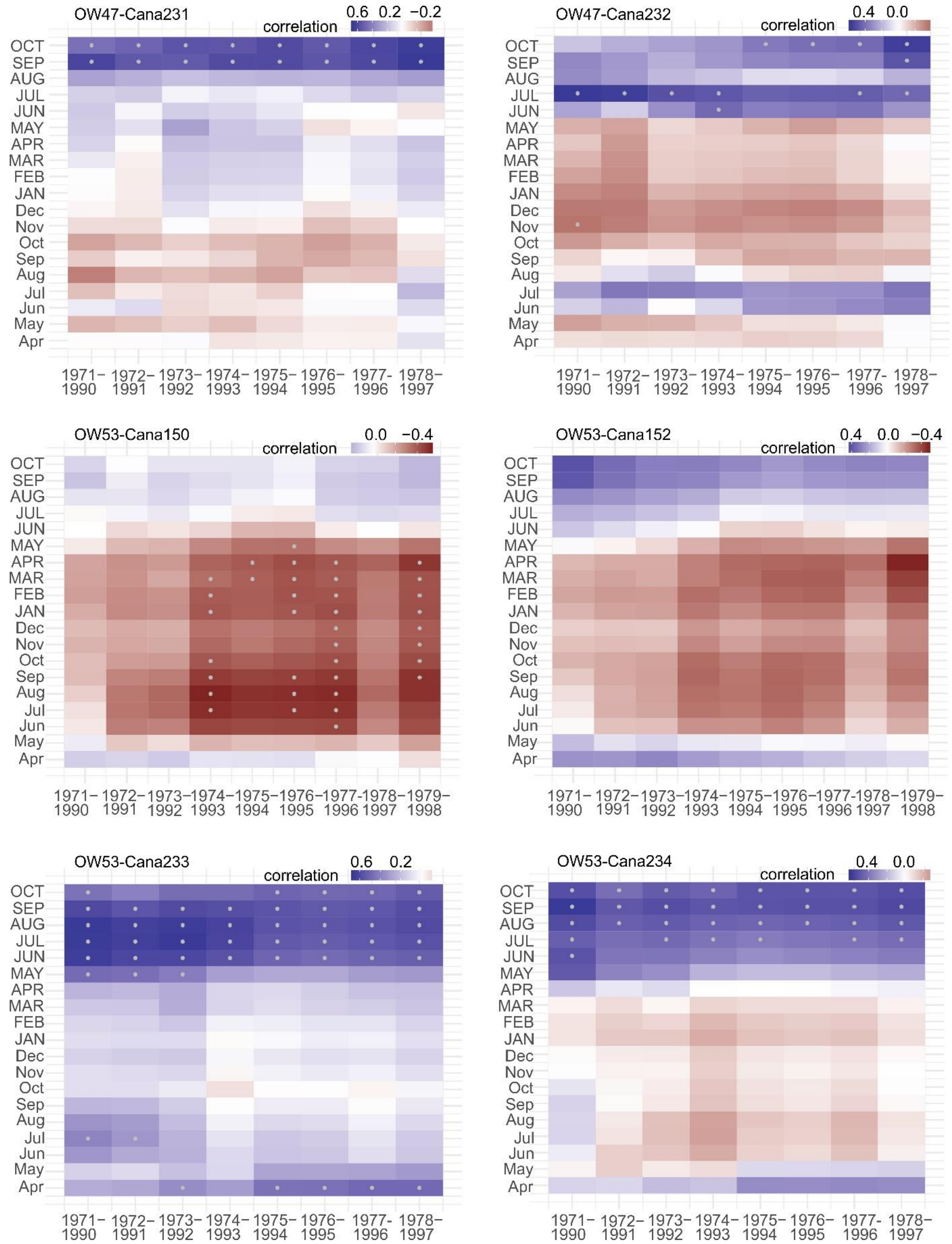


Figure S25. Moving correlation plots between the pairs of obersvation wells and tree ring records shown in Table S3. The depth of blue (positive) and red (negative) shading indicates the strength of the correlation, with white asterisks symbolizing windows of significant correlations.

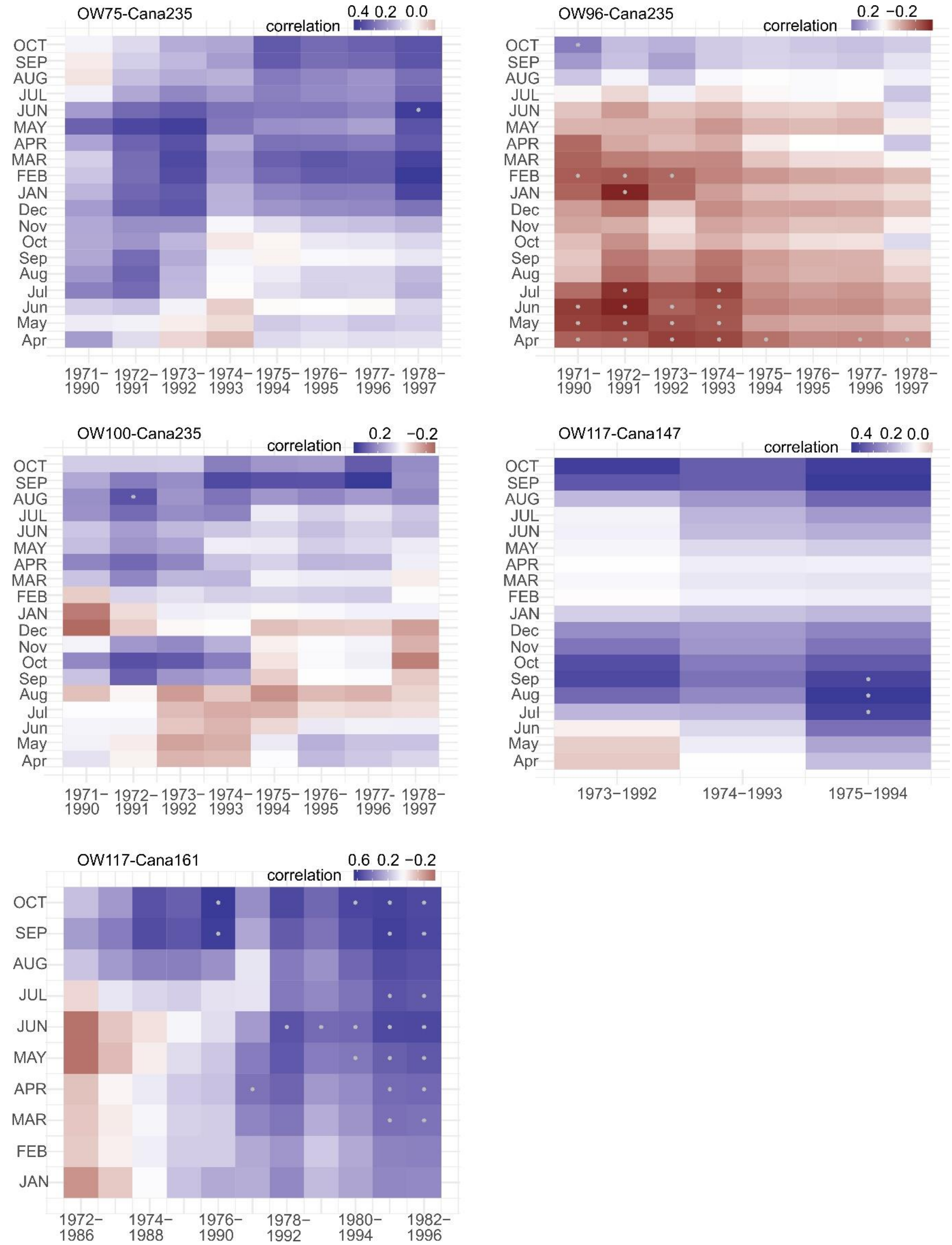


Figure S26. Moving correlation plots between the pairs of obersvation wells and tree ring records shown in Table S3. The depth of blue (positive) and red (negative) shading indicates the strength of the correlation, with white asterisks symbolizing windows of significant correlations.

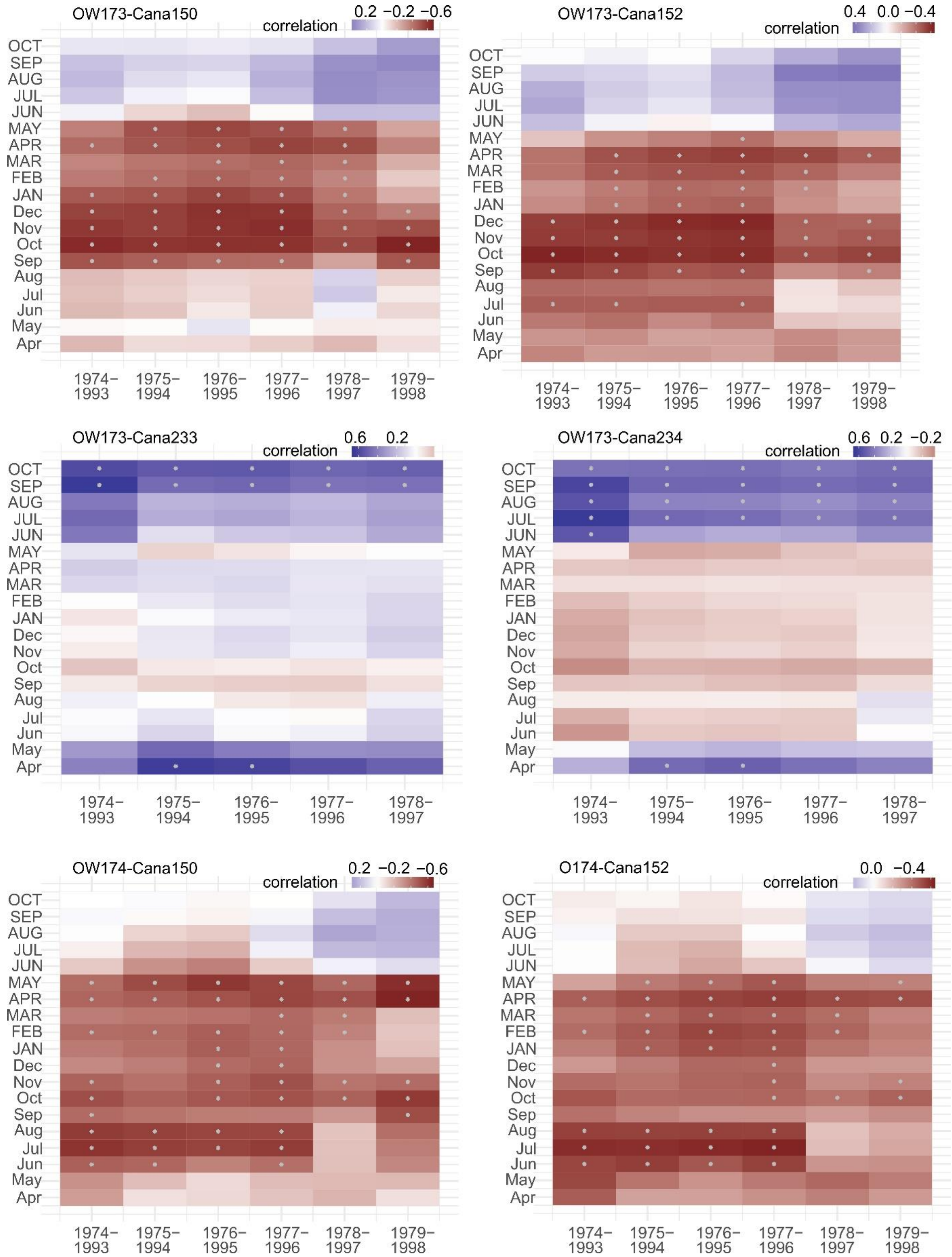


Figure S27. Moving correlation plots between the pairs of obersvation wells and tree ring records shown in Table S3. The depth of blue (positive) and red (negative) shading indicates the strength of the correlation, with white asterisks symbolizing windows of significant correlations.

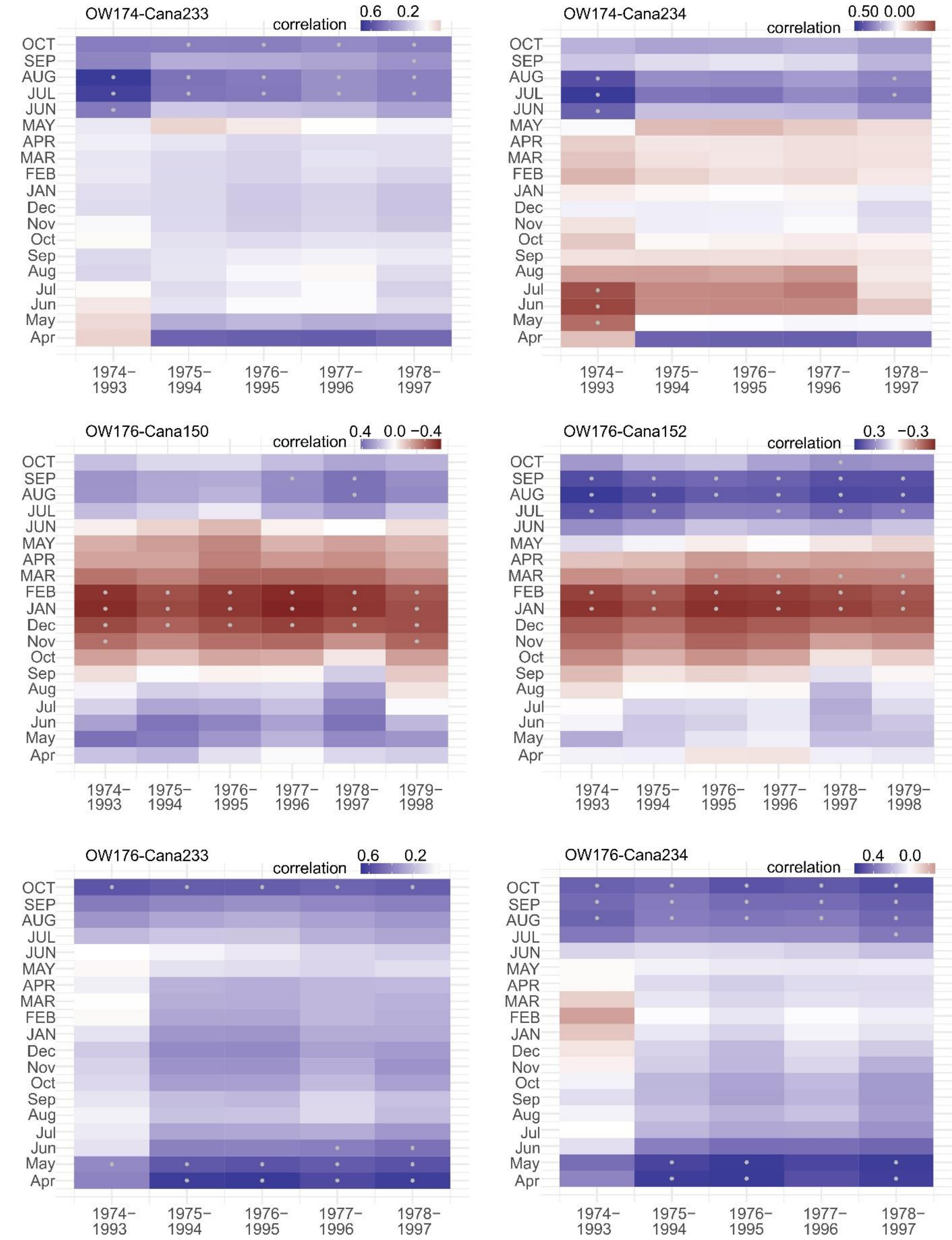
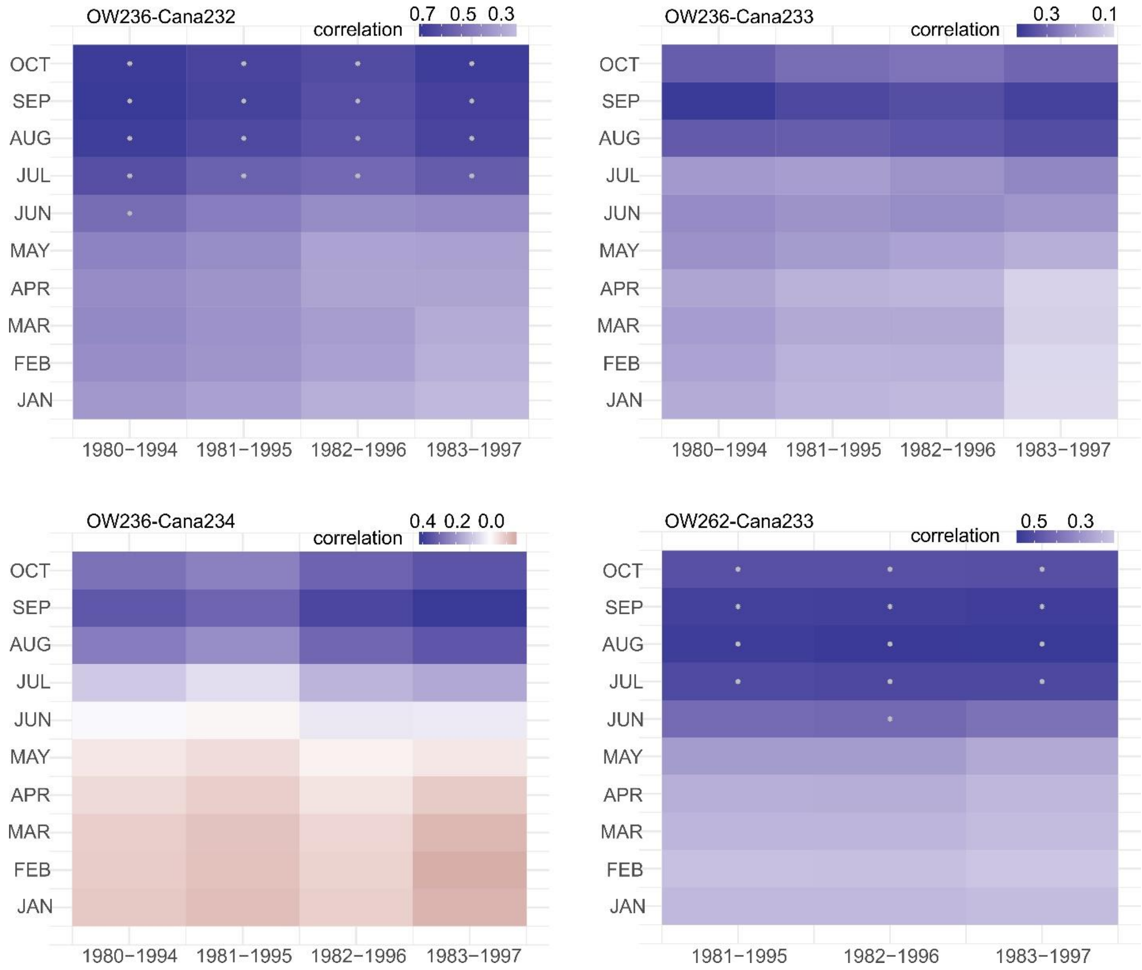


Figure S28. Moving correlation plots between the pairs of obersvation wells and tree ring records shown in Table S3. The depth of blue (positive) and red (negative) shading indicates the strength of the correlation, with white asterisks symbolizing windows of significant correlations.



SFigure 29. Moving correlation plots between the pairs of obersvation wells and tree ring records shown in Table S3. The depth of blue (positive) and red (negative) shading indicates the strength of the correlation, with white asterisks symbolizing windows of significant correlations.

Tree species used

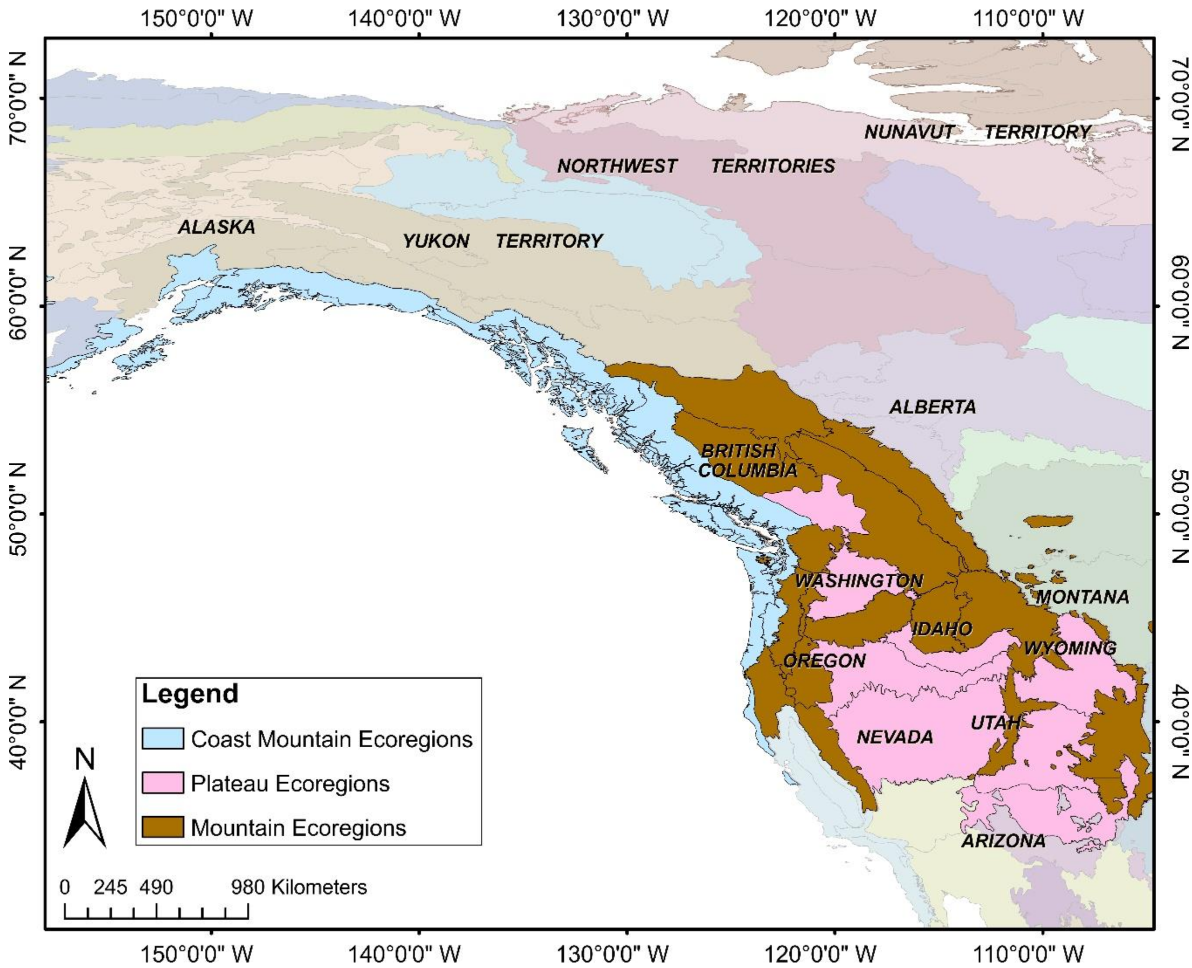


Figure S30. Level 2 North American Ecoregions. The three ecoregions considered for this study (Coast Mountain, Plateau, and Mountain) are shown in opaque blue, pink, and brown.

Table S4. Species of tree ring records which were included as potential predictors in the reconstruction models, listed by the ecoregions each species is present in. The last column indicates if this species was ever used in a reconstruction model using any of the ecoregions to select tree ring records. As the Coast Mountain, Plateau, and Mountain ecoregions are subsets of the climate footprint area used to select tree ring records, the climate footprint contains a combination of these species as well.

Tree Species	Ecoregions	Used in reconstruction models
Mountain hemlock	Coast Mountain, mountain	Yes- Coast Mountain & Mountain
Yellow cedar	Coast Mountain	No
Sitka spruce	Coast Mountain	No
Western hemlock	Coast Mountain	No
Subalpine fir	Coast Mountain, Plateau, Mountain	Yes- Coast Mountain & Mountain
Pacific silver fir	Coast Mountain	No
Pinyon pine	Plateau, Mountain	Yes- Plateau & Mountain
Ponderosa pine	Plateau, Mountain	Yes- Plateau & Mountain
Douglas-fir	Plateau, Mountain	Yes- Plateau & Mountain
Limber pine	Plateau, Mountain	Yes- Mountain
Blue Oak	Plateau, Mountain	Yes- Plateau
Bristlecone pine	Plateau, Mountain	Yes- Plateau
Jeffrey pine	Plateau, Mountain	No
Western juniper	Plateau, Mountain	No
Engelmann spruce	Plateau, Mountain	Yes- Mountain
Whitebark pine	Mountain	No
Lodgepole pine	Mountain	No
Incense cedar	Mountain	No
White fir	Mountain	No
Sugar pine	Mountain	No
California red fir	Mountain	No
Subalpine larch	Mountain	Yes- Mountain
White pine	Mountain	Yes- Mountain
Rocky Mountain juniper	Mountain	No
Quaking aspen	Mountain	No
Utah juniper	Mountain	No
Jack pine	Mountain	No
White spruce	Mountain	No
Western larch	Mountain	Yes- Mountain

Reconstruction models

Table S5. Tree ring records used as predictors in the streamflow-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
Cana 308	49.5833	-116.6833	2197	Mountain	Subalpine larch	1200-2005	Colenutt, M., Colenutt, R., Luckman, B.H., Watson, E., Pederson, G.T.
Cana 424	49.4361	-117.1294	2060	Mountain	Subalpine larch	1700-2005	Luckman, B.H., Watson, E., Pederson, G.T.
Cana 464	50.35	-123.35	N/A	Mountain	Subalpine fir	1850-2012	Smith, D.J., Coulthard, B.L.
Cana 468	50.35	-122.48	1430	Coast Mountain	Mountain hemlock	1711-2012	Smith, D.J., Coulthard, B.L.
Cana 469	52.28	-126.89	1310	Coast Mountain	Mountain hemlock	1750-2010	Smith, D.J., Coulthard, B.L., Pitman, K.
Cana 471	50.22	-126.35	1005	Coast Mountain	Mountain hemlock	1490-2008	Smith, D.J., Coulthard, B.L., Laroque, C.
Cana 476	52.22	-126.34	N/A	Coast Mountain	Mountain hemlock	1658-2010	Smith, D.J., Coulthard, B.L., Starheim, C.
Cana 485	52.07	-126.13	N/A	Coast Mountain	Subalpine fir	1533-2009	Smith, D.J., Coulthard, B.L., Starheim, C.
Cana 490	52.28	-126.9	N/A	Coast Mountain	Mountain hemlock	1623-2010	Smith, D.J., Coulthard, B.L., Pitman, K.
Grouse Ridge, Mt. Baker	48.789	-121.924	1450	Mountain	Mountain hemlock	1600-2018	LaGassey, H. (personal communication)
MT 117	48.72	-113.65	2150	Mountain	Subalpine fir	1850-2006	Bekker, M.F., Tikalsky, B.P., Fagre, D.B., Billis, S.D.
MT 119	46.0167	-113.3667	2700	Mountain	Subalpine larch	1570-2005	Littell, J.S.

Table S5 cont'd. Tree ring records used as predictors in the streamflow-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
OR 091	44.31	-118.68	1915	Mountain	Western larch	1180-2008	Laubli, L., Voelker, S.L.
OR 097	44.2167	-121.8667	1454	Mountain	Mountain hemlock	1837-2013	Ratcliff, C.J., Voelker, S.L., Nolin, A.W.
OR 098	42.92	-122.05	2198	Mountain	Mountain hemlock	1600-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 099	42.97	-122.15	2221	Mountain	Mountain hemlock	1620-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 100	42.93	-122.17	2186	Mountain	Mountain hemlock	1500-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 101	42.93	-122.02	2352	Mountain	Mountain hemlock	1650-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 102	42.98	-122.1	2075	Mountain	Mountain hemlock	1600-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 103	42.91	-122.07	2198	Mountain	Mountain hemlock	1690-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 104	42.97	-122.07	2050	Mountain	Mountain hemlock	1690-2012	Appleton, S.N., Smoter, E., St. George, S.
WA 134	48.87	-121.68	1310	Mountain	Mountain hemlock	1650-2006	Bunn, A.G.
WA 135	48.2667	-120.45	2190	Mountain	Subalpine larch	1450-2005	Littell, J.S.
WA 143	48.8607	-121.6850	1297	Mountain	Mountain hemlock	1750-2011	Marcinkowski, K., Peterson, D.L.
WA 144	48.5733	-120.8264	1540	Mountain	Mountain hemlock	1830-2011	Marcinkowski, K., Peterson, D.L.
WA 145	48.5048	-121.2088	1769	Mountain	Mountain hemlock	1690-2011	Marcinkowski, K., Peterson, D.L.

Table S5 cont'd. Tree ring records used as predictors in the streamflow-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
WA 146	47.8444	-121.0359	1703	Mountain	Mountain hemlock	1800-2011	Marcinkowski, K., Peterson, D.L.
WA 148	48.6798	-121.3227	1473	Mountain	Mountain hemlock	1746-2011	Marcinkowski, K., Peterson, D.L.
WY 041	42.55	-108.8167	2731	Mountain	Limber pine	1017-2007	Gray, S.T., Pederson, G.T., Abel, K.
UT 535	40.5667	-111.5833	3000	Mountain	Limber pine	1350-2006	Tikalsky, B.P., Bekker, M.F., DeRose, R.J., Kershner, M., Bright, B.C.

Table S6. Tree ring records used as predictors in the high-elevation recharge-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
Cana 308	49.5833	-116.6833	2197	Mountain	Subalpine larch	1200-2005	Colenutt, M., Colenutt, R., Luckman, B.H., Watson, E., Pederson, G.T.
Cana 424	49.4361	-117.1294	2060	Mountain	Subalpine larch	1700-2005	Luckman, B.H., Watson, E., Pederson, G.T.
Cana 464	50.35	-123.35	N/A	Mountain	Subalpine fir	1850-2012	Smith, D.J., Coulthard, B.L.
Cana 468	50.35	-122.48	1430	Coast Mountain	Mountain hemlock	1711-2012	Smith, D.J., Coulthard, B.L.
Cana 469	52.28	-126.89	1310	Coast Mountain	Mountain hemlock	1750-2010	Smith, D.J., Coulthard, B.L., Pitman, K.
Cana 471	50.22	-126.35	1005	Coast Mountain	Mountain hemlock	1490-2008	Smith, D.J., Coulthard, B.L., Laroque, C.
Cana 476	52.22	-126.34	N/A	Coast Mountain	Mountain hemlock	1658-2010	Smith, D.J., Coulthard, B.L., Starheim, C.

Table S6 cont'd. Tree ring records used as predictors in the high-elevation recharge-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
Cana 485	52.07	-126.13	N/A	Coast Mountain	Subalpine fir	1533-2009	Smith, D.J., Coulthard, B.L., Starheim, C.
Cana 490	52.28	-126.9	N/A	Coast Mountain	Mountain hemlock	1623-2010	Smith, D.J., Coulthard, B.L., Pitman, K.
Grouse Ridge, Mt. Baker	48.789	-121.924	1450	Mountain	Mountain hemlock	1600-2018	LaGassey, H. (personal communication)
MT 117	48.72	-113.65	2150	Mountain	Subalpine fir	1850-2006	Bekker, M.F., Tikalsky, B.P., Fagre, D.B., Billis, S.D.
MT 119	46.0167	-113.3667	2700	Mountain	Subalpine larch	1570-2005	Littell, J.S.
OR 091	44.31	-118.68	1915	Mountain	Western larch	1180-2008	Laubli, L., Voelker, S.L.
OR 097	44.2167	-121.8667	1454	Mountain	Mountain hemlock	1837-2013	Ratcliff, C.J., Voelker, S.L., Nolin, A.W.
OR 098	42.92	-122.05	2198	Mountain	Mountain hemlock	1600-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 099	42.97	-122.15	2221	Mountain	Mountain hemlock	1620-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 100	42.93	-122.17	2186	Mountain	Mountain hemlock	1500-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 101	42.93	-122.02	2352	Mountain	Mountain hemlock	1650-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 102	42.98	-122.1	2075	Mountain	Mountain hemlock	1600-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 103	42.91	-122.07	2198	Mountain	Mountain hemlock	1690-2012	Appleton, S.N., Smoter, E., St. George, S.

Table S6 cont'd. Tree ring records used as predictors in the high-elevation recharge-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
OR 104	42.97	-122.07	2050	Mountain	Mountain hemlock	1690-2012	Appleton, S.N., Smoter, E., St. George, S.
WA 134	48.87	-121.68	1310	Mountain	Mountain hemlock	1650-2006	Bunn, A.G.
WA 143	48.8607	-121.6850	1297	Mountain	Mountain hemlock	1750-2011	Marcinkowski, K., Peterson, D.L.
WA 144	48.5733	-120.8264	1540	Mountain	Mountain hemlock	1830-2011	Marcinkowski, K., Peterson, D.L.
WA 145	48.5048	-121.2088	1769	Mountain	Mountain hemlock	1690-2011	Marcinkowski, K., Peterson, D.L.
WA 146	47.8444	-121.0359	1703	Mountain	Mountain hemlock	1800-2011	Marcinkowski, K., Peterson, D.L.
WA 148	48.6798	-121.3227	1473	Mountain	Mountain hemlock	1746-2011	Marcinkowski, K., Peterson, D.L.
WY 046	44.7333	-109.9	2961	Mountain	Engelmann spruce	1730-2012	King, J.C.

Table S7. Tree ring records used as predictors in the low-elevation recharge-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
Cana 308	49.5833	-116.6833	2197	Mountain	Subalpine larch	1200-2005	Colenutt, M., Colenutt, R., Luckman, B.H., Watson, E., Pederson, G.T.
Cana 424	49.4361	-117.1294	2060	Mountain	Subalpine larch	1700-2005	Luckman, B.H., Watson, E., Pederson, G.T.
Cana 464	50.35	-123.35	N/A	Mountain	Subalpine fir	1850-2012	Smith, D.J., Coulthard, B.L.

Table S7 cont'd. Tree ring records used as predictors in the low-elevation recharge-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
Cana 468	50.35	-122.48	1430	Coast Mountain	Mountain hemlock	1711-2012	Smith, D.J., Coulthard, B.L.
Cana 469	52.28	-126.89	1310	Coast Mountain	Mountain hemlock	1750-2010	Smith, D.J., Coulthard, B.L., Pitman, K.
Cana 471	50.22	-126.35	1005	Coast Mountain	Mountain hemlock	1490-2008	Smith, D.J., Coulthard, B.L., Laroque, C.
Cana 476	52.22	-126.34	N/A	Coast Mountain	Mountain hemlock	1658-2010	Smith, D.J., Coulthard, B.L., Starheim, C.
Cana 485	52.07	-126.13	N/A	Coast Mountain	Subalpine fir	1533-2009	Smith, D.J., Coulthard, B.L., Starheim, C.
Cana 490	52.28	-126.9	N/A	Coast Mountain	Mountain hemlock	1623-2010	Smith, D.J., Coulthard, B.L., Pitman, K.
Grouse Ridge, Mt. Baker	48.789	-121.924	1450	Mountain	Mountain hemlock	1600-2018	LaGassey, H. (personal communication)
MT 117	48.72	-113.65	2150	Mountain	Subalpine fir	1850-2006	Bekker, M.F., Tikalsky, B.P., Fagre, D.B., Billis, S.D.
MT 119	46.0167	-113.3667	2700	Mountain	Subalpine larch	1570-2005	Littell, J.S.
MT120	46.0167	-113.3833	2750	Mountain	Subalpine larch	1450-2006	Littell, J.S.
OR 097	44.2167	-121.8667	1454	Mountain	Mountain hemlock	1837-2013	Ratcliff, C.J., Voelker, S.L., Nolin, A.W.
OR 098	42.92	-122.05	2198	Mountain	Mountain hemlock	1600-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 099	42.97	-122.15	2221	Mountain	Mountain hemlock	1620-2012	Appleton, S.N., Smoter, E., St. George, S.

Table S7 cont'd. Tree ring records used as predictors in the low-elevation recharge-driven reconstruction model.

Site	Lat	Long	Elevation (m.a.s.l.)	Ecoregion	Species	Date Range	Authors
OR 100	42.93	-122.17	2186	Mountain	Mountain hemlock	1500-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 101	42.93	-122.02	2352	Mountain	Mountain hemlock	1650-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 102	42.98	-122.1	2075	Mountain	Mountain hemlock	1600-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 103	42.91	-122.07	2198	Mountain	Mountain hemlock	1690-2012	Appleton, S.N., Smoter, E., St. George, S.
OR 104	42.97	-122.07	2050	Mountain	Mountain hemlock	1690-2012	Appleton, S.N., Smoter, E., St. George, S.
WA 134	48.87	-121.68	1310	Mountain	Mountain hemlock	1650-2006	Bunn, A.G.
WA 135	48.2667	-120.45	2190	Mountain	Subalpine larch	1450-2005	Littell, J.S.
WA 143	48.8607	-121.6850	1297	Mountain	Mountain hemlock	1750-2011	Marcinkowski, K., Peterson, D.L.
WA 144	48.5733	-120.8264	1540	Mountain	Mountain hemlock	1830-2011	Marcinkowski, K., Peterson, D.L.
WA 145	48.5048	-121.2088	1769	Mountain	Mountain hemlock	1690-2011	Marcinkowski, K., Peterson, D.L.
WA 146	47.8444	-121.0359	1703	Mountain	Mountain hemlock	1800-2011	Marcinkowski, K., Peterson, D.L.
WA 148	48.6798	-121.3227	1473	Mountain	Mountain hemlock	1746-2011	Marcinkowski, K., Peterson, D.L.

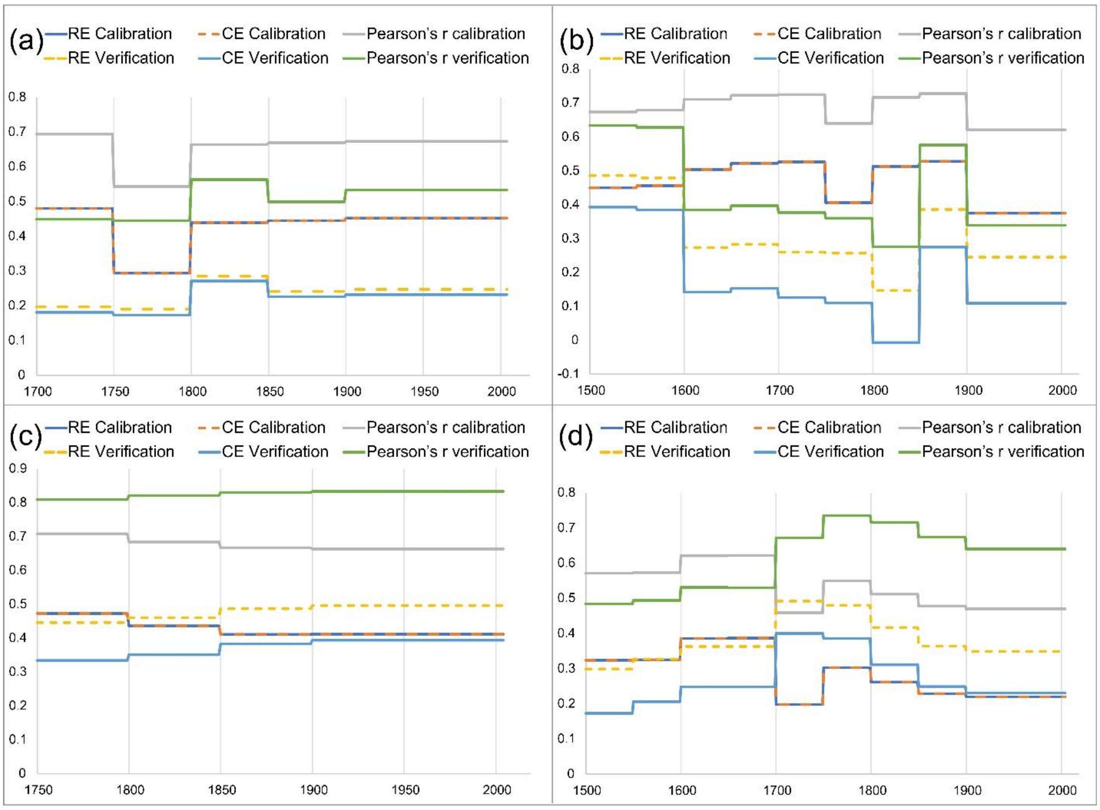


Figure S31. Calibration and verification statistics for extended reconstructions for a) streamflow-driven and b) high-elevation recharge-driven models using the climate footprint, and the c) all-wells and d) high-elevation recharge-driven models created using the Coast Mountain Ecoregions to select tree ring records.