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Finding climatologically teleconnected sites with a network of tree ring chronologies

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Objective
- Identify existing tree ring chronologies that correlate with August streamflow of the North Fork Nooksack River.

Background
- Trees act as proxy climate records, allowing us to reconstruct past climate and climate-driven phenomena like streamflow. In the Pacific Northwest, dendrochronologists can extend records hundreds of years into the past, providing vital context for present and future conditions.
- Each tree species responds to climate fluctuations in a unique way:
  - Including multiple species in reconstruction models allows us to explain more variance in paleorecords, increasing the accuracy of these records.
- This study identifies existing tree ring chronologies within 100km of the North Fork Nooksack watershed and assesses their viability for dendrochronological reconstruction of North Fork Nooksack August streamflow.
- I include 37 tree ring chronologies available from the International Tree Ring Data Bank, consisting of 8 tree species.

Methods
- **Tree ring chronologies**
  - Detrend with a 50-year spline
  - Remove age-related growth trends
- **Construct master chronology for each site**
  - Average series within a site with Tukey’s biweight mean, pre-whitened
- **North Fork Nooksack August streamflow**
  - Average monthly discharge in cfs
- **Tree ring correlations**
  - Non-parametric Kendall method
- **Correlated chronologies with August streamflow**
  - Kendall’s tau

Results
- **Correlation coefficient (r)**
  - $t = -0.3$
  - $0.3 < t < 0.2$
  - $0.2 < t < 0.1$
  - $0.1 < t < 0$
  - $0 < t < 0.1$
  - $t < -0$

Conclusion
- **Chronologies of certain species near the North Fork Nooksack watershed correlate with August streamflow inside the watershed.**
- These trees respond to the same large-scale climate conditions that drive streamflow of the North Fork Nooksack.
- Significant correlations with August streamflow were found with mountain hemlock (Tsuga mertensiana) chronologies, subalpine fir (Abies lasiocarpa) chronologies, Engelmann spruce (Picea engelmannii) chronologies, and one subalpine larch (Larix lyallii) chronology.
- All significant correlations were negative, meaning there was reduced growth in years of high August streamflow.

Snowcover is likely the major growth-limiting factor of these trees and the major factor driving August streamflow in the North Fork Nooksack.

Future Work
- **Reconstruct August streamflow of the North Fork Nooksack and Sholes Glacier Mass Balance with tree ring chronologies identified in this project plus additional I collect this summer.**
- **Reconstructed streamflow and mass balance records will be inputs to the Distributed Hydrology Soil Vegetation Model, informing present and future hydrological conditions in the North Fork Nooksack watershed.**

References