This briefly summarizes the online reconstruction tool TRISH (Tree-Ring Integrated System for Hydrology). TRISH makes use of the University of New Hampshire (UNH) water balance model, online mapping tools at UNH, a driver script ReconAnalog.R and a set of R functions to explore reconstruction of hydroclimatic variables from a network of tree-ring chronologies. The steps for using TRISH are listed below. “You” is intended to mean the user of TRISH:

1. <optional> Using a template availabe from the developers of TRISH, upload an Excel file with a time series matrix of tree-ring chronologies and metadata. Optionally, you can use TRISH to explore the reconstruction signal in an existing network of tree-ring chronologies available from a dropdown menu.
2. In browser, go to https://trishproject.org/about/ and click “Explore Reconstruction”
3. TRISH screen 1 appears; this screen has a map and GUI for some initial settings.
4. At screen 1, do this
    1. Choose tree-ring network from dropdown menu; tree-ring sites appear on map
    2. Specify common-period year window for chronologies; all must have complete data for this period, and all others are disregarded; color coding of tree-ring sites on the map changes, with those to be eliminated grayed out
    3. Following the prompt, click on the map; TRISH highlighs the drainage area upstream of the point clicked, and this area is defined as the “drainage” for subsequent analysis. The hydrologic variable to be used as a predictand will be an average over this drainage for some season. You do not get to choose ths predictand or season at screen 1, but after a default intitial reconstruction of water-year total runoff you can change specifications at screen 2.
    4. Click radio button to indicate which of the following options you want for specifying the spatial domain of acceptable chronologies: 1) all chronologies that passed the common-period screening, and 2) only those chronologies in a to-be-drawn polygon on the map
    5. If (1) in preceding step, no action needed, and skip to “6”. If (2), follow prompt and draw the polygon enclosing the acceptable region for tree-ring sites. Color coding of tree-ring sites changes, with any additional sites to be eliminated grayed out. Boxes on screen are update in response to this and to the year-sreening that list number of sites (original, after year-screen, after polygon screen)
    6. Click “Go” to run an inital, default, reconstruction. See next page for more on this initial reconstruction.
5. A new TRISH screen (screen 2) appears with reconstruction results and GUI for changing settings and re-running reconstruction. For example, you can can choose to analyze chronologies prewhitened by and AR model of order 1, 2, or 3 instead of the original chronologies. Or you can choose another reconstruction method, calibration period, etc.
6. Explore the results using the GUI.
7. Using the dropdown menus, radio buttons, and edit boxes, change specifications for reconstruciton
8. Press “Re-run” for revised reconstruction; repeat as needed to explore
9. When satisified, press “Download” to get output files with graphics, statistics and data (see “Downloadable output” below
10. If you want to revise the initial tree-ring network and screening, click “Restart from map”
11. If you want to quit, press “Quit”

Default (initial) reconstruction

This initial reconstruction is likely not what you wanted, but specifications can be changed at the second screen and the reconstruction can be re-run. The default is a follows:

1. Chronologies are not prewhitened before modeling.
2. Runoff is the predictand variable; this is an average over the drainage highlighted at screen 1.
3. Water year (previous October to current September) is the season of predictand.
4. Reconstruction method is multiple linear regression of the predictand on principal components (PCs) of the tree-ring chronologies converted beforehand into single-site reconstructions (SSRs-- see Reconstruction Methods below)
5. Calibration period for the reconstruction model is the full available overlap of the predictnd with the PCs

All of the above and more can be changed using the GUI on screen 2 of TRISH.

Reconstruction Methods

Reconstructions can be done alternatively by four different statistical approaches. All begin with conversion of each chronnology to a single-site reconstruction (SSR) by stepwise multiple linear regression of the predictand on the chronology. The default initial reconstruction is for the SSR regression models includes the chronology lagged -2 to +2 year from the predictand in pool of potendial predictors. The SSRs and their statistics are themselves useful for assessing the strength of hydrologic signal in the individual chronologies. The SSR modeling includes validation by split-sample and cross-validation approaches, and a cross-validation cutoff rule for entry of predictors stepwise to guard against spurious predictors and overfitting. Cross-validation is leave-9-out instead of leave-1-out to ensure no tree-ring data used to generate cross-validation predictions are to fit the cross-validati0on models. [This is sufficient separation for the maximum postive or negative lag (2 years) allowed in ReconAnalog.] The four different methods for final, or multi-site reconstructions (MSRs) are variations on how the SSRs are combined to generate a single final reconstruction. These alternative methods are described in detail in a pdf that is automatically written to a system output folder when you generate a reconstruction in TRISH. The methods, with y the target predictand and $\hat{y}_i$ the SSR for site i are:

1. Simple linear regression of y on the arithmetic mean of all $\hat{y}_i$ that pass screening for strength of calibration, success of validation, and temporal stability
2. Stepwise multiple linear regression of y on
    1. A predictor pool of screened $\hat{y}_i$
    2. A predictor pool of scores of principal components of those $\hat{y}_i$
3. A non-regression analog approach in which the reconstruction for any year is set equal to the observed y for some “analog” calibration-period year. Considering some reconstruction year j, that analog year has tree-ring data most similar in a multivariate sense tot he tree-ring data in year j. Similarity is measured by the Euclidean distance of the the PC scores of SSRs in year j from the scores in each year of the overlap of PCs with observed y.

Downloadable output

Pressing “Download” at screen 2 allows you to download graphics files, tables of statistics, and time series data on the reconstruciton. The available output is described in detail in a pdf document also downloaded. The table output includes statistics of the single-site reconstructions. One SSR table is for all SSRs that were run, and another is for the subset of chronologies whose SSRs were accepted and used in the final reconstruction model. The SSR tables document the strength of signal for the predictand in each chronology, which lags – if any – entered the model, and how well the model verified by split-sample validation and cross-validation.