The web-based tool TRISH uses the R-script ReconAnalog.R to generated reconstructions from tree-ring data. TRISH has the advantage of a global water balance model (WBM) and sophisticated mapping capabilities to interactively provide the reconstruction predictand for a river basin or arbitrary region anywhere in the world (Prusevich et al., submitted).

ReconAnalog, the R script that makes reconstruction with with the web-based tool TRISH, was developed and tested in RStudio, outside of TRISH, where the user must provide the time series of the predictand from whatever source (e.g., Meko et al., 2024) . ReconAnalog required tab-separated input time series of predictand vector, a times series matrix of tree-ring chronologies, and tree-ring metadata. ReconAnalog also requires settings for reconstruction specifications, which it gets from a "json" (Java Script Object Notation) file, "Recon.init." You must build this json file. ReconAnalog assumes that the json file is called "Recon.init." In general use, you may be running ReconAnalog on different predictands, using different reconstruction settings, etc. It is a good idea, therefore to build multiple json files, each with a meaningful name, and then copy the desired json file with the name "Recon.init" when ready to run ReconAnalog.

The illustration (Katun River runoff reconstruction) in section 4 of Prusevich et al. (submitted) has the neame "Recon_Katun.init." Please use that file as a template for writing your json file.

This file explains each of entries in Recon_Katun.init as they apply when running ReconAnalog outside of TRISH. Some entries, as explained, are meaningful only within TRISH and are ignored in standalone running of ReconAnalog.

1. **"code_dir" :** "/home/dave/GitWork/TRISH-R/",
   The system folder where ReconAnalog.R and all the Meko-written R functions it calls are stored on Meko's laptop. He ran ReconAnalog for this example by using RStudio to create a new project in folder "/home/dave/AAAtrish2," opening ReconAnalog.R, and runnning it. First he created folder "/home/dave/AAAtrish2/test_out to hold the model output.
2. **"pdf_dir" :** "/home/dave/GitWork/TRISH-R"/**,**
   The system folder from which TRISH copies the pdf files describing reconstruction methods (e.g., "TrishOutputDescribeMLR1-PCA.pdf")
3. **"tr_file" : "treeData_Katun.txt"**,
   Tab-separated file of input tree-ring chronologies. See the file for format. First year must be complete (no missing data) for all files. Chronologies may end in different years.
4. **"trM_file" : "treeMeta_Katun.txt",**
   Tab-separated file of tree-ring metadata, trimmed accordingly so that included metadata just for those chronologies in treeData.txt. Make sure the site IDs exactly match the IDs in the tr_file, and are in the same order.
5. **"cl_file" : "hydroData_Katun.txt"**,
   Tab-separated file of hydrologic predictand. This is two-column, with a year and a seasonalizd hydrologic variable
6. **"outputDir" : "/home/dave/AAAtrish2/test_out/"**,
   The system folder to which ReconAnalog writes all graphics files, tables, time series, and auxilliary files. You will have to revise this line to match your computer.
7. **"NameNetwork": "ems1"**,
   Arbitrary name of the selected tree-ring network. Here, "ems1" refers to the journal *Environmental Monitoring and Software*. The Katun reconstruction of water-year runoff (RO) is used to illustrate TRISH in Prusevich et al. (submitted).
8. **"PrewhitenOrder" : 0,**
   The order of autoregressive (AR) model to use in prewhitening tree-ring chronologies. Specification of order 0 in the corresponds to no prewhitening. Allowable orders of AR models for prewhitening are 1, 2, or 3.

9. **LallowLags" : true,**
   Whether to allow SSR models to include lags. If “true”, the pool of potential predictors includes the tree-ring chronology lagged t-2 to t+2 from the predictand. If “false,” only lag-0 tree-ring chronology is in the pool. The stepwise regression might yield a no-lag SSR model even if lags are allowed in the pool of potential predictors -- for example, if entering lagged predictors fails to yield and increase in cross-validation skill.
10. **NsitesUserNetwork" : 38**,
    Number of sites in the user-supplied tree-ring network. This number should match the number of columns in the "tr_file".
11. **"YearScreen" : [1786, 1994]**,
    These are the first and last year for which ALL chronologies in "tr_file" have data (section with no missing data at any site). In other words, this is the common period for all series in "tr_file."
12. **"NafterYearScreen" : 38**
    The number of chronologies in time series matrix "tr_file." Disregard the "after year screen." TRISH has settings for screening the chronologies by year coverage. Running ReconAnalog outside of TRISH does not have such options.
13. **"NafterPolygon" : 38**
    TRISH also allows users to spatially select a subset of chronologies using map tools. ReconAnalog by itself does not have such capability. Therefore, set "NafterPolygo" equal to "NafterYearScreen."
14. **"HydroVariable" : "RO",**
    RO is the code for "runoff" in ReconAnalog. For this example, Meko used TRISH to generate water-year runoff (mm) averaged for the Katun River Basin, and downloaded the time series of runoff from TRISH.

    Note. ReconAnalog currently recognized five input codes for hydrologic variables: 'Q’,RO','SM’,’T’,’P','Flow1'. These correspond to discharge, runoff, soil moisture, temperature, precipitation and discharge(again) in units m^3/sec, mm, mm, deg C, mm, and kaf (thousand acre-ft). More water-balance variable will be added in the future.

15. **"ClimDatSet" : "CRU",**
    Ignore this setting. In TRISH, it specifies that the CRU gridded climate data should drive the water balance model.
16. **"HydroSeason" : [9,12],**
    The ending month and number of months in the “season” representing the time series in "cl_file." This input is meaningful only in TRISH, which seasonalized data from monthly data. Outside of TRISH, you simply supply the seasaonal time series. For the record, [9,12] specifies water year, or 12 month period ending in September.
17. **"yrgoc" : 1940,**
    First year of predictand allowed to be used in calibrating any single-site reconstruction (SSR) models. Note that the hydrologic data in "cl_file" begins with water year 1938. Because ReconAnalog allows the possibily of lagged predictors -- up to 2 years lag -- the start of the calibration period is specified to beging two years later than 1938.
18. **"yrspc": 1992 ,**
    Last year of predictand allowed to be used in calibrating any single-site reconstruction (SSR) models. Analogous to yrgoc, including the truncation to two years before the end of the time series in "cl_file."

    Note: You may set yrgoc and yrspc to -99999, which lets ReconAnalog compute the calibration period individually for each SSR depending on overlap of the predictand with the tree-ring chronology.

19. **"ktran" : 1,**
    Numeric code for transformation to be applied to predictand before any reconstruction modeling. Codes

are: none (1), square root(2) or log10 (3). The requested transformation may be incompatible with the data. For example, negative temperature values are incompatible with square root and log10 transformations and zero precipitation is incompatible with a log10 transform. ReconAnalog checks compatibility writes error message to system when bombing out if needed.

20. **"methMSR" : 2,**
    Numeric code for method to be used for multi-site reconstruction (MSR). Options are (1) simple linear regression (SLR), (2) MLR on SSRs or their PCs, and (3) analog nearest neighbor PCA.

21. "**PCApredictors" : true,**
    Whether predictors are to be principal components (PCs) of the original chronologies (true), or the chronologies themselves (false). This option is ignored for all except "methMSR" settings 2. If true, the predictand is regressed on PCs of the SSRs. If false, the predictand is regressed on the SSRs themselves.

22. **"kHowPCA" : 2,**
    Whether the PCA of SSRs is to be done on the correlation matric (1) or covariance matrix (2) of the SSRs. The covariance matrix makes the most sense, because the variance of an SSR reflects the strength of its signal for the predictand.

23. **"PCoption" : 1,**
    This option dictates how the PCs of SSRs are made available to the reconstruction. If 2, the PCs most highly correlated with the predictand comprise the pool of potential predictors. How many are in the pool depends on your setting for the factor "f" (see below). If PCoption=1, the pool of potential predictors is those with the highest eigenvalues. How many depends on the setting for "nPCsKeep.

24. **"nPCsKeep" : 1,**
    Number of PCs to keep in pool. This setting is ignored unless PCoption=1. The number, *k*, that you enter corresponds to the k most important PC of the SSRs, as ranked by eigenvalue. For example, if *k*=3, PCs 1, 2, and 3 are included in the predictor pool for the MLR-PC reconstructions method, or analogs are dependent on just those three PCs for the analog method.

25. **"f" : 0.10,**
    The factor “f” constrains the number of variables in pool of potential predictors for the MSR stepwise regression models, and may also constrain the number of PCs used for analog identification with the combination methMSR=3 and PCoptions=2. The factor “f” is intended to help guard against overfitting and chance relationships. Depending on some other settings, the size of the pool of potential predictors for the MSR is restricted to be less than a decimal fraction f of the number of observations in the calibration period. So, if 100 years in the calbration period and f=0.1, no more than 9 variables would be allowed in the pool of potential predictors. This fraction f is ignored with the following combinations of other settings:

    1. methMSR=1
    2. methMSR=2 and PCApredictors=true and PCoption=1
    3. methMSr=3 and PCoption=1

26. **alphaR" : 0.05,**
    Threshold alpha-level for screening of PCs when using analog reconstruction method (methMSR=3) with PCoption=2. Only those PCs whose scores are signficantly correlated with predictand at thie alpha level (two-tailed test, no adjustment for autocorrelation). For any other settings of methMSR and

Pcoption, alphaR s ingored by ReconAnalog. The only acceptable levels for alphaR are members of the set {0.05, 0.01, 0.001}.

27. **"Lcausal" : true**
    Whether to require that lagged SSR models make sense causally to be accepted. If Lcausal=true, the SSR model is rejected if the only predictor(s) in the model are negative, implying that the current year's predictand can be reconstructied from previous years' tree rings only (illogical). The setting "true" is generally appropritate, but Lcausal is allowed to be changed for exploratory sensitivity analysis.

28. **"RequireStable" : true**
    Whether to require that SSR models have positive RE statistic for both halves of split sample validation for acceptance. True is generally appropriate because a negative RE on one of the split-sample halves indicates that a model fit to one half generates predictions for the other half no better than substituting the calibration-period mean as the prediction for each year. In other words, no skill. The user is allowed to set RequireStable to false for sensitivity studies. It is also possible that with a very short overlap of hydro and tree-ring data the split samples are ridiculously short. Or maybe one half of the data has very little year-to-year variability in the predictand. Then it might not be surprising that the small variations are not tracked well by the tree-ring predictions.

References

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