DZnmf

Saylor et al. (2019)

DZnmf is a program used for non-negative matrix factorization (NMF) of detrital zircon U-Pb age distributions. The program was developed by Joel Saylor at the University of Houston, Department of Earth and Atmospheric Sciences, and Kurt Sundell at the University of Arizona, Department of Geosciences. DZnmf implements an inverse approach to characterizing sediment source age distributions from a suite of basin (sink) age distributions. DZnmf determines potential source age distributions from only the basin sink data, without any *a priori* knowledge of the sediment sources themselves, and is capable of estimating the optimal number of sources from the suite of basin data. NMF is widely used in signal processing and image analysis (e.g., Lee and Seung, 1999) and was first applied to detrital geochronology by Sharman and Johnstone (2017); before that NMF has been used to unmixing grain size data (Paterson and Heslop, 2015).

Saylor et al. (2019) explain in detail the NMF method applied to detrital geochronology. In short, NMF determines two matrices, W (m-by-k), and H (k-by-n), where V ≈ WH + E (via matrix multiplication); E is the residual calculated as V – WH. V is composed of m equally-spaced probabilities along an age distribution probability density plot (PDP) or kernel density estimate (KDE) for n distributions. W is composed of m probabilities for k factorized sources. H is composed of k weighting functions for each of the factorized components within n samples. W and H are estimated by iterative update seeking to minimize E using the alternating non-negative least squares algorithm of Li and Ngom (2013) and Van Benthem and Keenan (2004).

For a detailed description of the methods implemented in DZnmf, and for proper citation, please reference the following paper:

Saylor, Joel E., K. E. Sundell, and G. R. Sharman. "Characterizing sediment sources by non-negative matrix factorization of detrital geochronological data." Earth and Planetary Science Letters 512 (2019): 46-58.

Note that this program requires the MATLAB Runtime. The Runtime is free and only needs to be installed once. Following installation and upon running DZnmf, the Runtime will automatically be accessed; there is no need to open the Runtime directly. If you have comments/questions about any of the files, please contact or Joel Saylor (joelsaylor@gmail.com) or Kurt Sundell (kurtsundell@gmail.com).

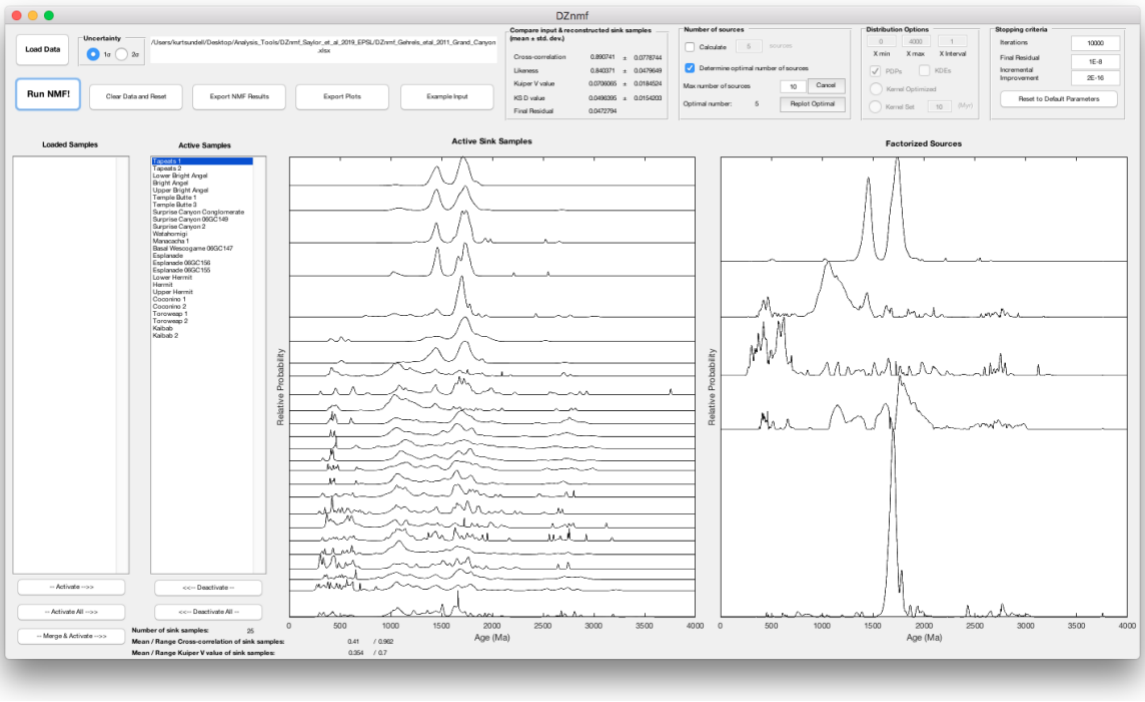
Following are links to the latest version of DZmds, example data sets, user manual, and a PDF of Saylor et al. (2019), and MATLAB Runtime:

DZnmf for Windows and macOS, example data, user manual, publication

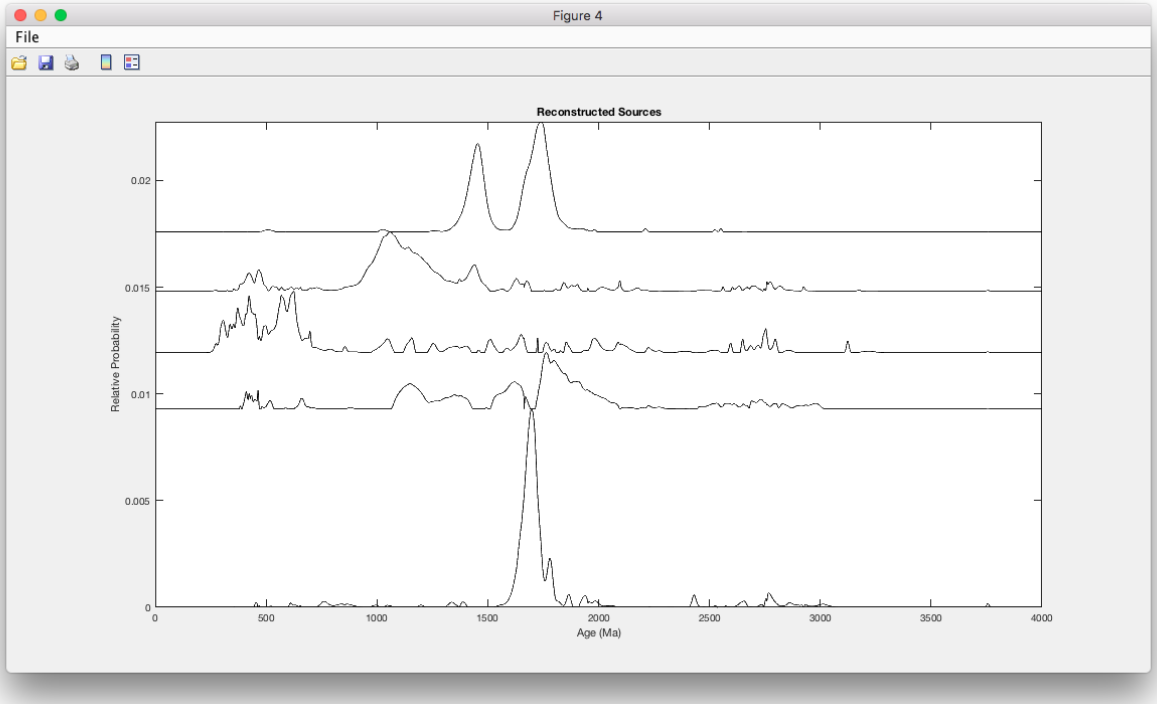
MATLAB Runtime Compiler for Windows (free, and required to run DZnmf)

MATLAB Runtime Compiler for macOS (free, and required to run DZnmf)

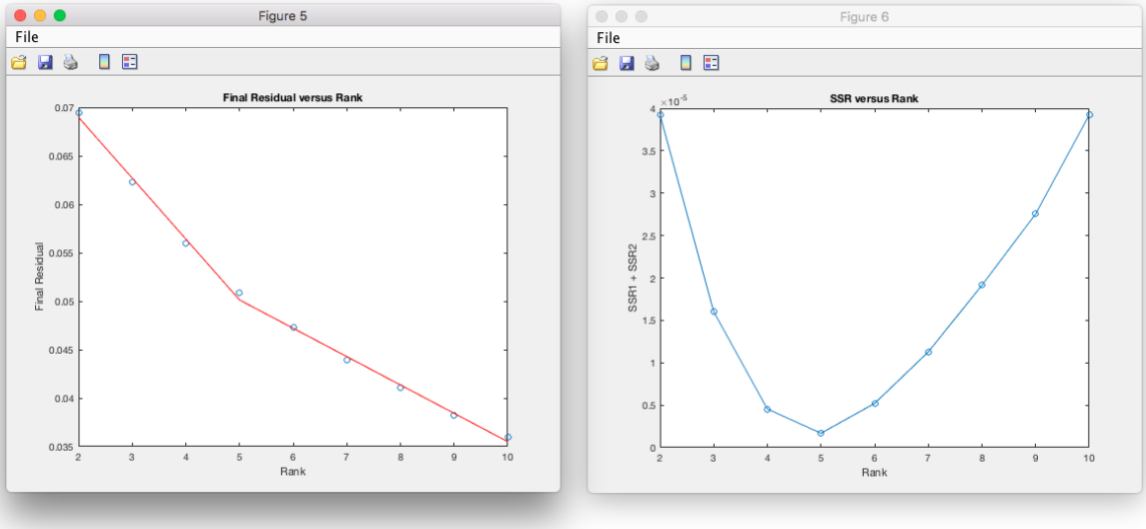
Example: Grand Canyon detrital geochronology (Gehrels et al., 2011)



Reconstructed source distributions to the Grand Canyon



Optimal number of sources = 5



References

Gehrels, George E., Ron Blakey, Karl E. Karlstrom, J. Michael Timmons, Bill Dickinson, and Mark Pecha. "Detrital zircon U-Pb geochronology of Paleozoic strata in the Grand Canyon, Arizona." Lithosphere 3, no. 3 (2011): 183-200.

Lee, Daniel D., and H. Sebastian Seung. "Learning the parts of objects by non-negative matrix factorization." Nature 401, no. 6755 (1999): 788.

Li, Yifeng, and Alioune Ngom. "The non-negative matrix factorization toolbox for biological data mining." Source code for biology and medicine 8, no. 1 (2013): 10.

Paterson, Greig A., and David Heslop. "New methods for unmixing sediment grain size data." Geochemistry, Geophysics, Geosystems 16, no. 12 (2015): 4494-4506.

Saylor, Joel E., K. E. Sundell, and G. R. Sharman. "Characterizing sediment sources by non-negative matrix factorization of detrital geochronological data." Earth and Planetary Science Letters 512 (2019): 46-58.

Sharman, Glenn R., and Samuel A. Johnstone. "Sediment unmixing using detrital geochronology." Earth and Planetary Science Letters 477 (2017): 183-194.

Van Benthem, Mark H., and Michael R. Keenan. "Fast algorithm for the solution of large-scale non-negativity-constrained least squares problems." Journal of Chemometrics: A Journal of the Chemometrics Society 18, no. 10 (2004): 441-450.