Suggested Readings for Breakout Session J
'Modeling in Transformed Domains: Future Directions'

Listed below are four papers to help motivate the breakout session, but these just provide examples of a few of the many issues that arise in modeling in transformed domains – we will focus the session on whatever aspects of this topic are of most interest to attendees. Two directions are to adapt/extend existing transforms (i) to facilitate multiscale interpretation of space/time data and (ii) to handle data organized in nonstandard ways. Percival et al. (2011) give an example of the first direction by adapting the discrete wavelet transform to decompose time series into physically meaningful components that individually capture daily, subannual and annual variations. Sharpnack et al. (2013) and Wang et al. (2016) propose and use an extension to the wavelet transform to analyze data collected in the form of graphs having an associated spatial component. In cases in which there is more than one transform domain that could lead to fruitful data analysis, the question then arises as to which domain is the best to use. G. Faÿ et al. (2009) explore a problem (estimation of a parameter characterizing long memory dependence) for which the Fourier and wavelet transforms are both appealing and compare the relative merits of the two domains.

As additional motivation, here are some questions to consider.

[1] Wavelet transforms came to the forefront in the 1980s and have been popular ever since. Are there other transforms lurking in the background that should be better known in environmental data analysis?
[2] Are there interesting adaptations to existing transforms (Fourier, wavelet, etc.) that could be made to handle new environmental data analysis problems?
[3] Transforms that are intended to deal with distributional issues can adversely affect correlations; likewise, transforms that are intended to deal with correlations can lead to distributional issues. Are there any general recommendations on how to deal with the deleterious aspects of a transform?
[4] For transforms that do no preserve variance, are there ways in which we can do at least a quasi-ANOVA?

Suggested readings:

- G. Faÿ, E. Moulines, F. Roueff and M.S. Taqqu (2009) 'Estimators of long-memory: Fourier versus wavelets,' *Journal of Econometrics*, Vol. 151, No. 2, pp. 159–177.
- D.B. Percival, S.M. Lennox, Y.-G. Wang and R.E. Darnell (2011), 'Wavelet-Based Multiresolution Analysis of Wivenhoe Dam Water Temperatures,' *Water Resources Research*, Vol. 47, W05552, doi:10.1029/2010WR009657
- J. Sharpnack, A. Krishnamurthy and A. Singh (2013), 'Detecting Activations over Graphs using Spanning Tree Wavelet Bases,' *Proceedings of the 16th International Conference on Artificial Intelligence and Statistics'* (AISTATS), Scottsdale, AZ, USA. Vol. 31, JMLR: W&CP 31.
- Y.-X. Wang, J. Sharpnack, A. Smola and R.J. Tibshirani (2016), 'Trend Filtering on Graphs,' *Journal of Machine Learning Research*, Vol. 17, Article 15–147, https://arxiv.org/abs/1410.7690