**Report from Breakout J, Transformations:**

Why do we transform?
    to find patterns (maybe we just need Random Forests, ML for this)
        spatially agnostic methods are easier to implement, but explaining why more difficult
    to find scale on which correlation makes sense
What do we do when we don’t have gridded data on rectangle? (For gridded data we have: wavelets, Fourier)
    needlets (for gridded data on sphere)
    methods exist for wavelet-like transforms for nearest neighbors (Sweldon?)
        but these can’t be interpreted as being on a fixed scale
    for arbitrary domains, can use transformations
Transformations on graphs: how do we do them?
    wavelets (Sharpnack)
    Laplacians
    e.g. Laplacian smoothing of data on a graph, use sparsity
Transformations of parameters instead of data
    we can impose restrictions (e.g. Effi mentioned we can constrain the direction of the flow of a river for directed graphs)
    what kinds of transformations will help?
        reparameterization of AR process coefficients can help immensely
        GMRFs, look at partial autocorrelations, sparsity
How do we model nonlinear dynamics?
    you cannot model this fully with covariances (El Nino year dependencies versus la Nina year dependencies are completely different)
        you cannot model this well with GMRF because of teleconnections when predicting far into the future
    Can you use multiscale models and relate the different scales together?
        linear functions with interactions on multiple scales can cause nonlinearity.  Nonstationarity may be necessary
Can we combine different transforms?
    independent component analysis?
        for non-Gaussian processes, but currently has limited success
        no unique definition of it, and it performs poorly in Gaussian case
    random projections
Empirical mode decomposition
    similar to EOF in that it’s difficult to interpret, analyze
    not explored well in statistical literature
Dynamic mode decomposition
    added frequencies and damping rates
    how does this match with EOFs and dynamic mode decomposition
We need transforms that are spatially and temporally aware
    this is a problem with EOFs, for instance
        upweights clusters rather than down weights them
        how can you compare PCs for different datasets
            Peter C. mentioned a solution?
How do you do ANOVA when your transformation dines’t preserve variance?
    What about when it induces correlation in observations?
        FT does this, e.g. tomography data, stripe errors