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GEOS 597e

PREWORK 7

1. Singular spectrum analysis is useful when one wants to get information out of a short time series that contains noise in order to give hints about underlying dynamics of the system.

rule of thumb for dimension M: make the ratio N/M as large as possible → generally $M < N/3$

principal components: eqn 10 $A = E_x^T X$

estimation of covariance trajectory matrix: eqn 9 $C_x = \frac{X X^T}{N-M+1}$ $C_x = \frac{X X^T}{N'}$

reconstructed components w/ normalization factors: Eqn 11.12 $R_k(i) = \frac{1}{M_i} \sum_{k \in K} \sum_{j=L}^{U} A_k(i-j+1) w_k(j)$

eigen decomposition of covariance trajectory matrix: eqn 8 $C_x = E_x^T \Lambda_x E_x$

spell out what you mean here. $(m, L, U) = \begin{cases} (\frac{1}{i}, 1, i) & 1 \le i \le M-1 \\ (\frac{1}{M}, 1, M) & M \le i \le N' \\ (\frac{1}{N-i+1}, i-N+M, M) & N'+1 \le i \le N \end{cases}$

3. In the SOI example, only five of the first sixty EOF's were deemed high enough above noise. EOFs 1-2, as well as EOFs 3-4, are plotted together because their eigenvalues are very close and their error bars overlap, indicating that they correspond to the nonlinear part of a sine-cosine pair in Fourier analysis. I would stick to five EOFs for reconstruction because the rest were statistically insignificant. I believe there are 3 'going-ons' in this data set – the annual cycle, 2-7 year cycle and a decadal cycle. These can be roughly inferred from figure 6 as spectral peaks.

ok! we'll see!

4. a The primary uncertainties in SSA are in the signal to noise ratio. The time averaging window may affect which noise is present and can distort the signal as well. Statistical significance may be lost in this way.