T-mode*

The spatial variance-covariance matrix is defined as

$$\mathbf{C}_{tt} = X'^T X' = \begin{pmatrix} \vdots & \rightarrow & T \\ \downarrow T & .. & .. \\ & .. & .. \end{pmatrix}. \quad (8.13)$$

The T-mode Empirical Orthogonal Functions (EOFs) of $\mathbf{X}_{rt}$ are defined as:

$$\mathbf{C}_{tt}\vec{e_t} = \lambda\vec{e_t}. \quad (8.14)$$

The spatial variance-covariance matrix can be expressed in terms of the SVD products:

$$\mathbf{C}_{tt} = \mathbf{X'}^T\mathbf{X'} = (\mathbf{U}\mathbf{W}\mathbf{V}^T)^T\mathbf{U}\mathbf{W}\mathbf{V}^T = (\mathbf{V}\mathbf{W}\mathbf{U}^T)\mathbf{U}\mathbf{W}\mathbf{V}^T = \mathbf{V}\mathbf{W}^2\mathbf{V}^T. \quad (8.15)$$

A right operation of $\mathbf{V}$ gives:

$$\mathbf{C}_{tt}\mathbf{V} = \mathbf{V}\mathbf{W}^2. \quad (8.16)$$

Hence, $\mathbf{V} = \mathbf{E}_t$ and $\sigma_i^2 = \mathbf{W}$, and the SVD routine applied to $\mathbf{X}$ also gives the T-mode EOFs of $\mathbf{X}$.

The T-mode has been employed where temporal evolution of coherent spatial structures have been discussed.

The SVD method extract both the S- and T-modes, whereas the eigenvector solutions only give either or. The T-mode forms the basis for both canonical correlation analysis (CCA) and regression.
