

## Supplementary Material 1

### Coding material

#### S1.1 Computing the anomaly matrix in R

```
# S is the spatio-temporal matrix (n . p)  
# 1/ Compute the temporal average map.  
temp_m <- apply(S, 1, mean, na.rm=T)  
# 2/ Center the spatio-temporal dataset and  
# obtain the anomaly matrix Sprim  
Sprim <- S - outer(temp_m, rep(1, nT))  
  
## Alternatively, this can be performed with:  
Sprim <- sweep( S, MARGIN=1, STATS=rowMeans(S), FUN="-" )
```

#### S1.2 Perform SVD on the anomaly matrix

```
E <- svd(Sprim)  
SpFactors <- E$u # factors, dimension (n . r)  
TempLoadings <- E$v # loadings, dimension (p . r)  
SgValues <- E$d # singular values, vector of dimension (r)  
# where r = min(n,p)
```

### S1.3 Perform CCA between EOFs results and a seasonal variable

```
## Construct the seasonal variable
p <- ncol(S) # number of time steps
times_steps <- seq(1,p,1) # sequence of time steps
component_strength = 1 # amplitude of the signal
component_freqs = 1/12 # frequency of signal (month-1)
f.0 = 2 * pi # fundamental frequency (month-1)
component_del = 1 # delay of signal components (radians)
# Create the seasonal signal
signal_vec = - component_strength *
  sin(component_freqs * f.0 * times_steps + component_del)

## Filter EOFs dimensions and apply CCA
ndim <- 2 # number of dimension to filter in the EOFs
EOFset1 <- E$u[,1:ndim] # filter the loadings
cca_res = stats::cancor(EOFset1, signal_vec) # perform CCA

## Rotate the loadings and factors
## with CCA results
# Rotate the loadings of the EOFs
ccavar1_temp <- (as.matrix(EOFset1) %*% cca_res$xccoef)[,1]
# Rotate the factor of the EOFs
ccavar1_spat <- as.matrix(E$u[,1:ndim] %*% cca_res$xccoef[,1])
```