

EOT2

EOT1?

EOT

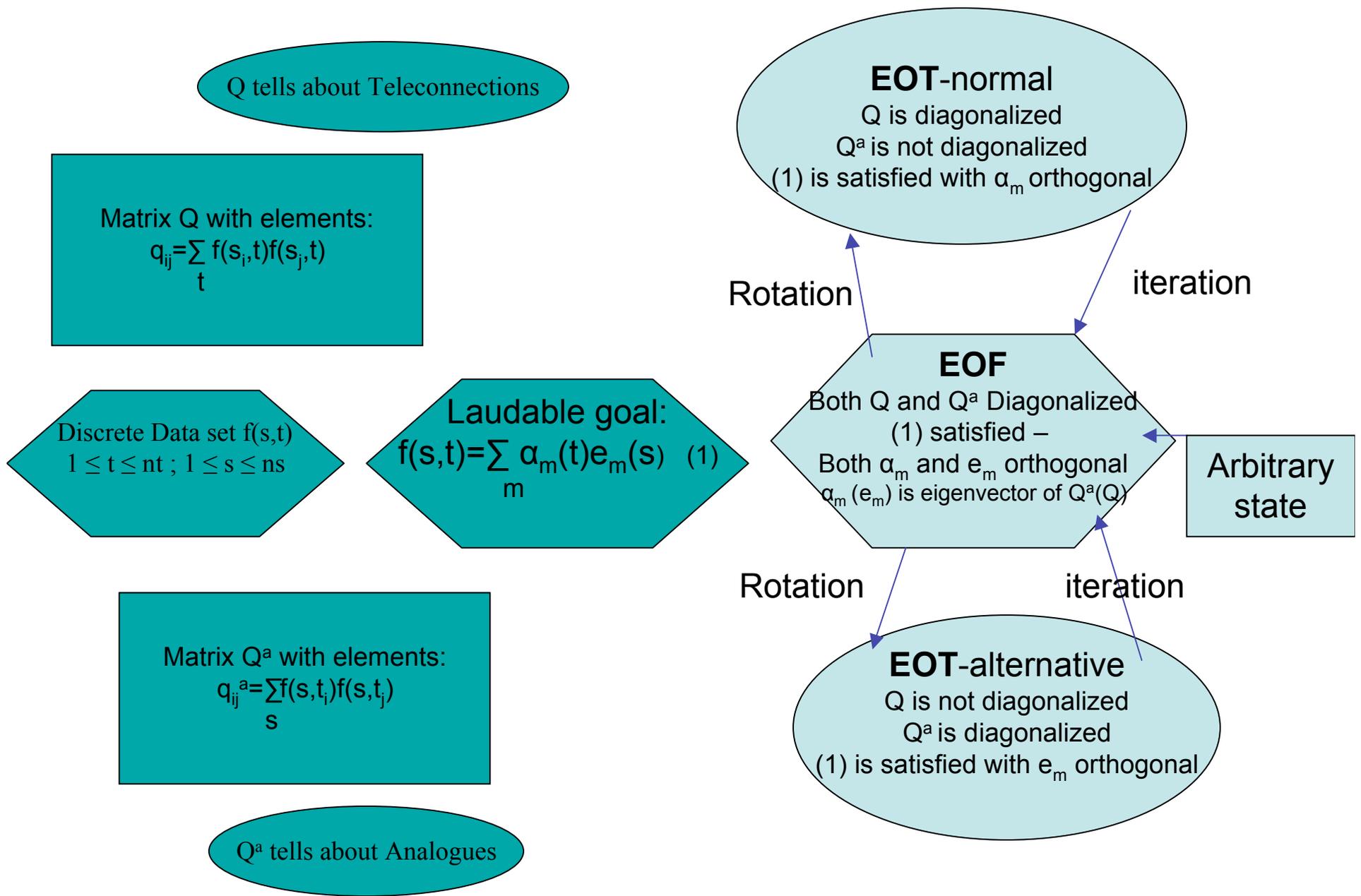


Fig.5.6: Summary of EOT/F procedures.

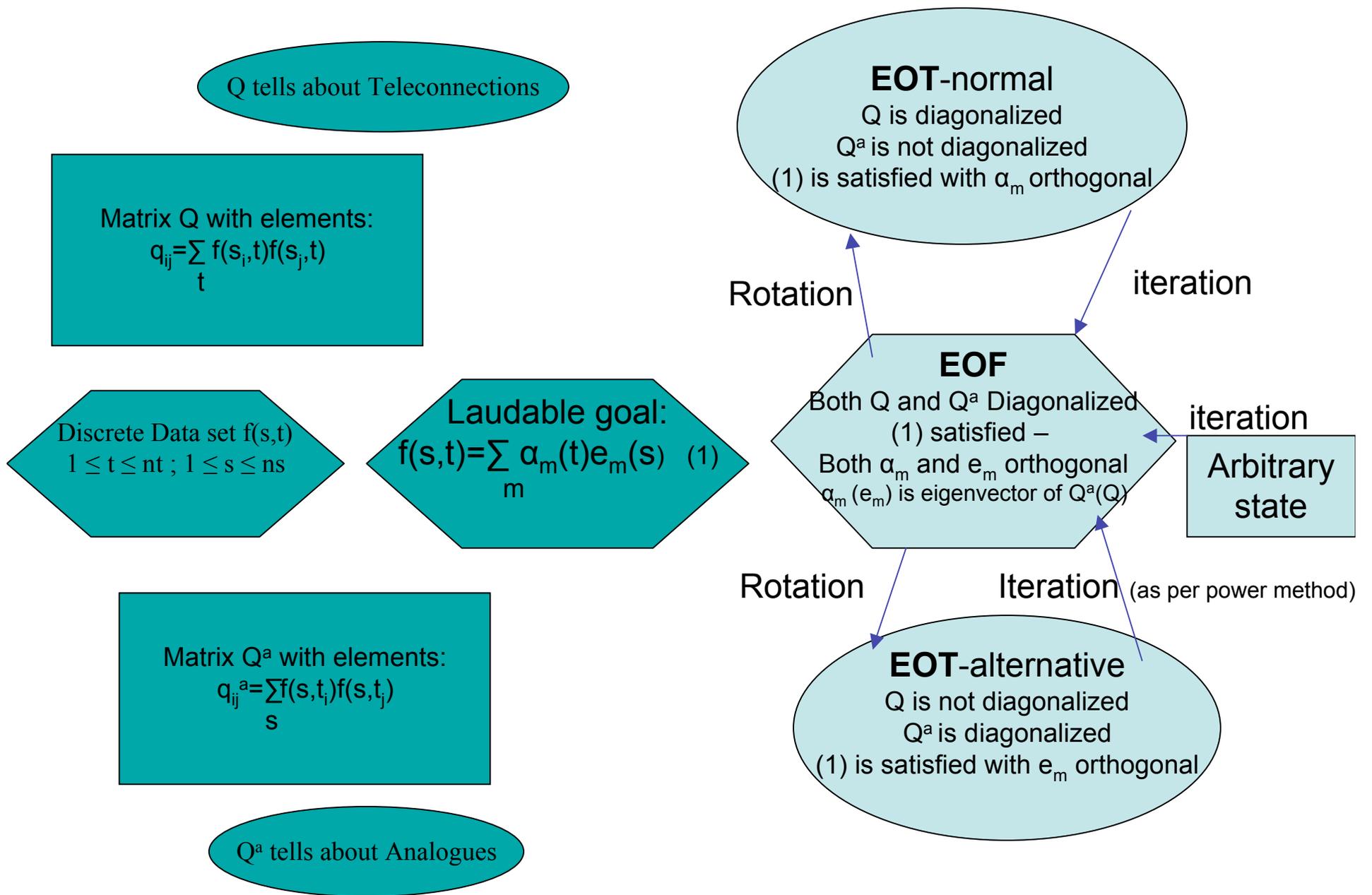
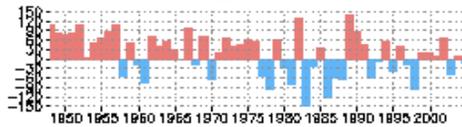
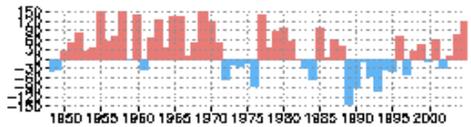
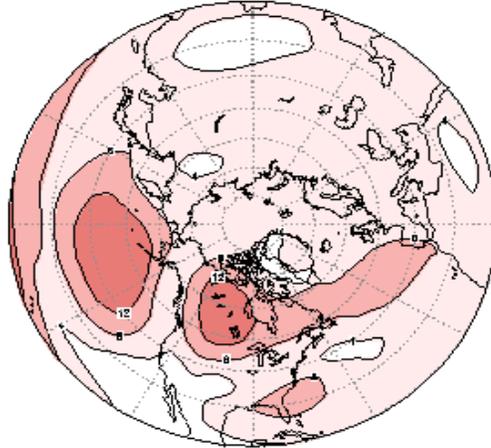
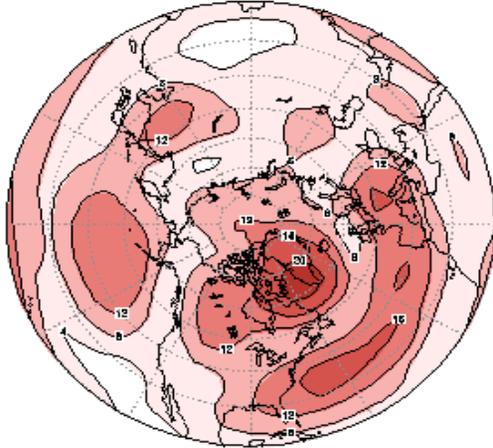


Fig.5.6: Summary of EOT/F procedures.

Domain EV by points: JFM 1948–2005 HGT 500

(21.3%EV) (bspnt=65N,50W)

(16.0 %EV) (bspnt=45N,160W)(partial 1)



(7.6 %EV) (bspnt=55N,60W)(partial 1&2)

(7.1 %EV) (bspnt=70N,50E)(partial 1&2&3)

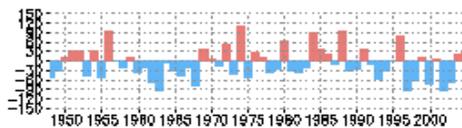
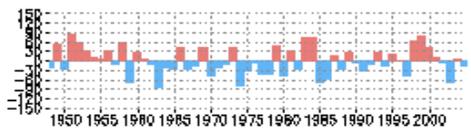
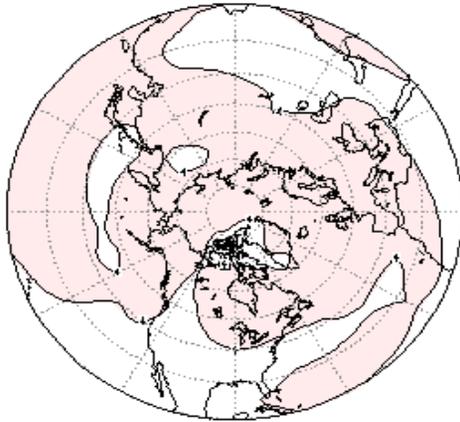
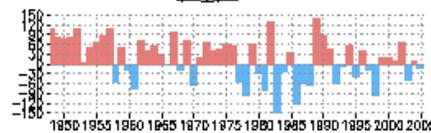
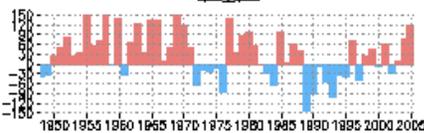
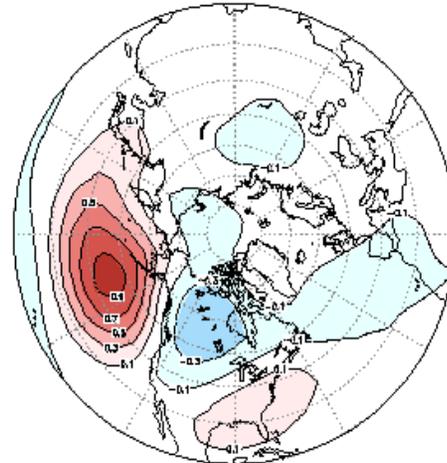
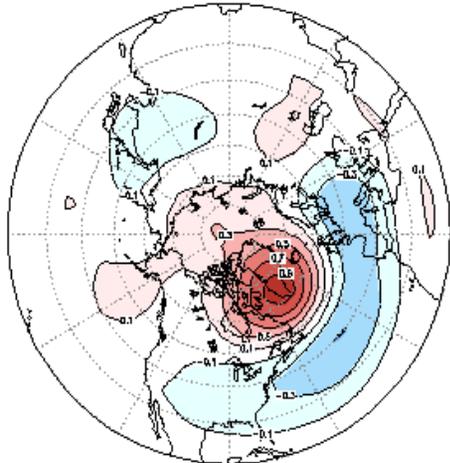


Fig. 4.3 EV(i), the variance explained by single gridpoints in % of the total variance, using equation 4.3. In the upper left for raw data, in the upper right after removal of the first EOT mode, lower left after removal of the first two modes. Contours every 4%. The timeseries shown are the residual height anomaly at the gridpoint that explains the most of the remaining domain integrated variance.

normal EOT JFM 1948–2005 HGT 500 mb

EOT1 (21.3%EV) (bspnt=65N,50W)

EOT2 (16.0 %EV) (bspnt=45N,160W)(partial 1)



EOT3 (7.6 %EV) (bspnt=55N,60W)(partial 1&2)

EOT4 (7.1 %EV) (bspnt=70N,50E)(partial 1&2&3)

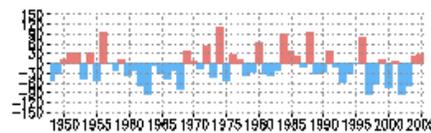
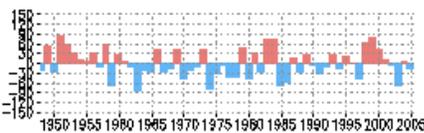
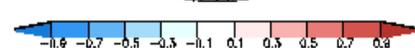
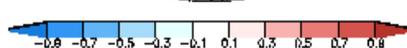
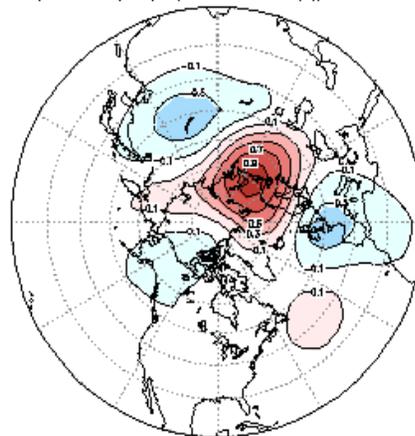
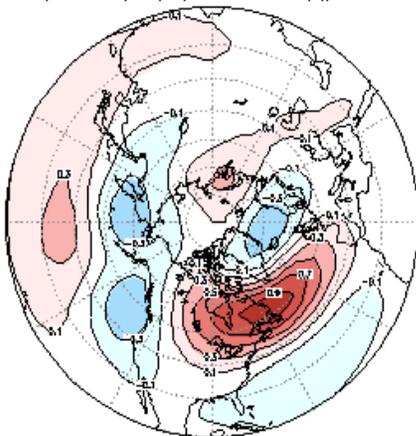


Fig.4.4 Display of four leading EOT for seasonal (JFM) mean 500 mb height. Shown are the regression coefficient between the height at the basepoint and the height at all other gridpoints (maps) and the timeseries of residual 500mb height anomaly (geopotential meters) at the basepoints. In the upper left for raw data, in the upper right after removal of the first EOT mode, lower left after removal of the first two modes. Contours every 0.2, starting contours +/- 0.1. Data source: NCEP Global Reanalysis. Period 1948-2005. Domain 20N-90N

EV as a function of moc JFM Z500

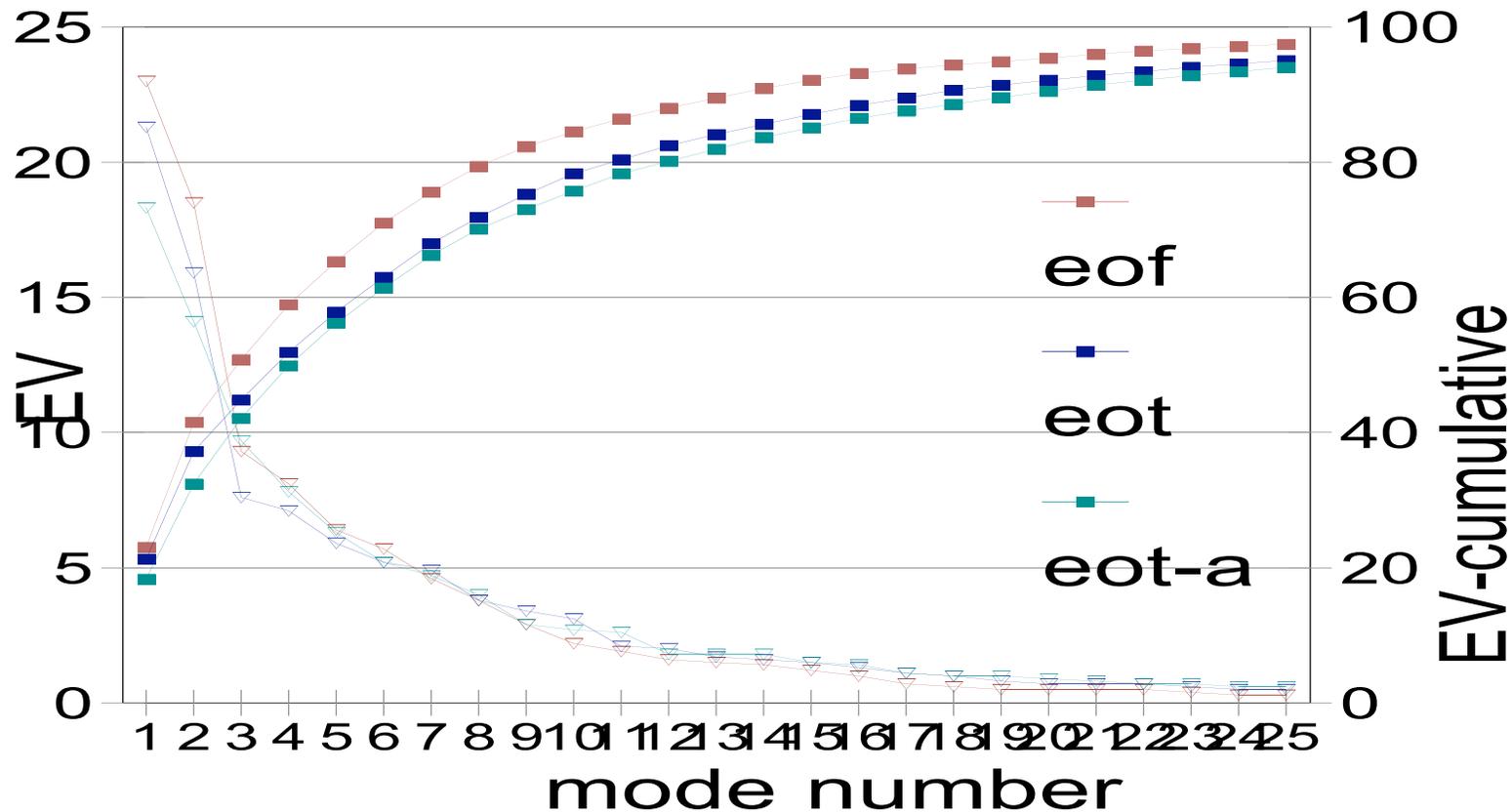


Fig 5.7. Explained Variance (EV) as a function of mode ($m=1,25$) for seasonal mean (JFM) Z500, 20N-90N, 1948-2005. Shown are both EV(m) (scale on the left, triangles) and cumulative EV(m) (scale on the right, squares). Red lines are for EOF, and blue and green for EOT and alternative EOT respectively.

EOT2
 (1) and (2) satisfied
 α_m and β_m orthogonal (homo-and-heterogeneous)
 $C_{ff}(\tau=0)$, $C_{gg}(\tau=0)$ and C_{fg} diagonalized
 One time series, two maps.

CCA
 Very close to EOT2, but
 two, maximally correlated, time series.

Cross Cov Matrix C_{fg} with elements:

$$c_{ij} = \sum_t f(s_i, t)g(s_j, t + T)/n_t$$

Discrete Data set $f(s, t)$
 $1 \leq t \leq n_t$; $1 \leq s \leq n_s$
 Discrete Data set $g(s, t + \tau)$
 $1 \leq t \leq n_t$; $1 \leq s \leq n'_s$

Laudable goals:
 $f(s, t) = \sum_m \alpha_m(t)e_m(s)$ (1)
 $g(s, t + \tau) = \sum_m \beta_m(t + \tau)d_m(s)$ (2)
 constrained by a connection between
 α and β and/or e and d .

Alt Cross Cov Matrix C^a_{fg} with elements:

$$c^a_{ij} = \sum_s f(s, t_i)g(s, t_j + T)/n_s$$

EOT2-alternative
 (1) and (2) satisfied
 e_m and d_m orthogonal
 α_m and β_m heterogeneously orthogonal
 $C^a_{ff}(\tau=0)$, $C^a_{gg}(\tau=0)$ and C^a_{fg} diagonalized
 Two time series, one map.

SVD
 Somewhat like EOT2a, but
 two maps, and
 (heterogeneously) orthogonal time series.

Fig.x.y: Summary of EOT2 procedures.

EOT2
 (1) and (2) satisfied
 α_m and β_m orthogonal
 $C_{ff}(\tau=0)$, $C_{gg}(\tau=0)$ and C_{fg} diagonalized
 One time series, two maps.

CCA
 Very close to EOT2, but
 two, maximally correlated, time series.

Cross Cov Matrix C_{fg} with elements:

$$c_{ij} = \sum_t f(s_i, t)g(s_j, t + T)/n_t$$

Discrete Data set $f(s, t)$
 $1 \leq t \leq n_t ; 1 \leq s \leq n_s$
 $M = Q_f^{-1} C_{fg} Q_g^{-1} C_{fg}^T$
 Discrete Data set $g(s, t + \tau)$
 $1 \leq t \leq n_t ; 1 \leq s \leq n'_s$

Laudable goals:

$$f(s, t) = \sum_m \alpha_m(t) e_m(s) \quad (1)$$

$$g(s, t + T) = \sum_m \beta_m(t + T) d_m(s) \quad (2)$$

 Constrained by a connection between
 α and β and/or e and d .

Alt Cross Cov Matrix C_{fg}^a with elements:

$$c_{ij}^a = \sum_s f(s, t_i)g(s, t_j + T)/n_s$$

EOT2-alternative
 (1) and (2) satisfied
 e_m and d_m orthogonal
 $C_{ff}^a(\tau=0)$, $C_{gg}^a(\tau=0)$ and C_{fg}^a diagonalized
 Two time series, one map.

SVD
 Somewhat like EOT2a, but
 two maps, and
 (heterogeneously) orthogonal time series.

Fig.x.y: Summary of EOT2 procedures.

CCA:

1) Make a square $M = Q_f^{-1} C_{fg} Q_g^{-1} C_{fg}^T$

2) $E^{-1} M E = \text{diag} (\lambda_1, \lambda_2, \lambda_3, \dots, \lambda_M)$

→ $\text{cor}(m) = \sqrt{\lambda_m}$

SVD:

1) $U^T C_{fg} V = \text{diag} (\sigma_1, \sigma_2, \dots, \sigma_m)$

Explained Squared Covariance = σ_m^2

Assorted issues:

- 1) Prefiltering f and g , before calculating C_{fg}
- 2) Alternative approach complicated when domains for f and g don't match
- 3) Iteration and rotation: CCA \leftrightarrow EOT2-normal; SVD \leftrightarrow EOT2-alternative ???

Keep in mind

- EV (EOF/EOT) and EOT2
- Squared covariance (SC) in SVD
- SVD singular vectors of C
- CCA eigenvectors of M
- LIM complex eigenvectors of L (close to C)
- MRK no modes are calculated (of L)