

# SSA-MTM TOOLKIT: BEST PRACTICES, TIPS & TRICKS

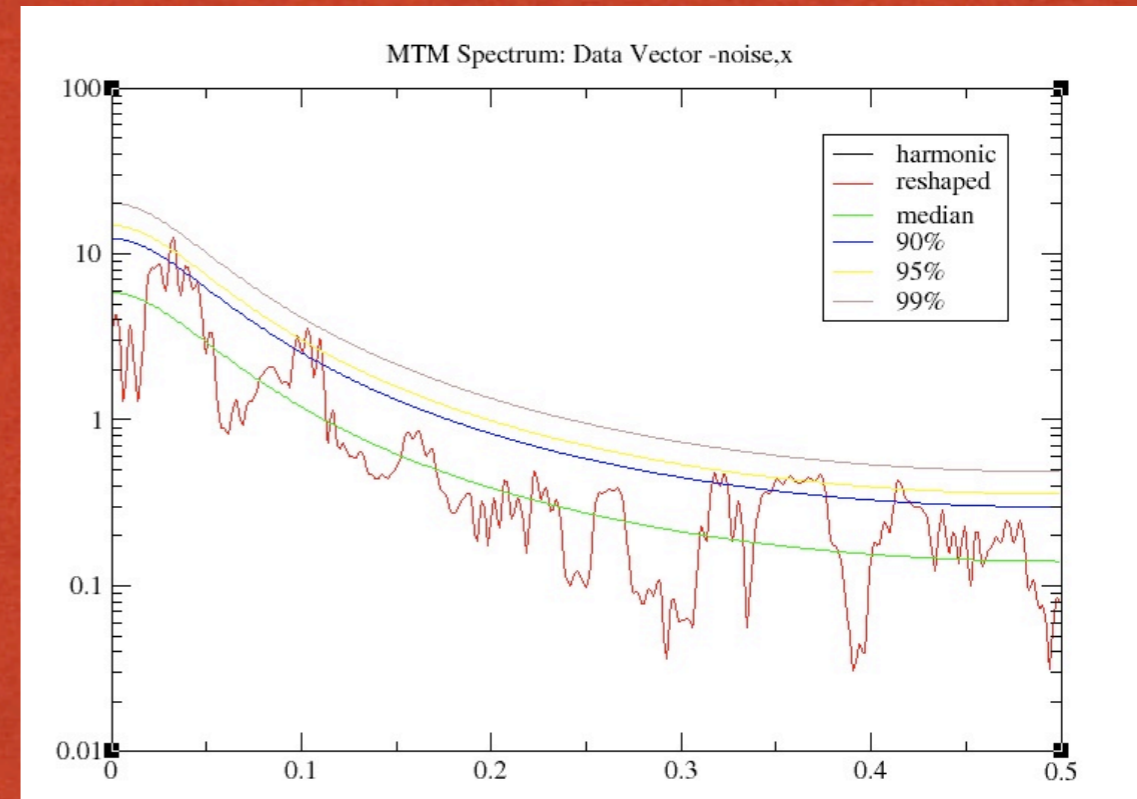
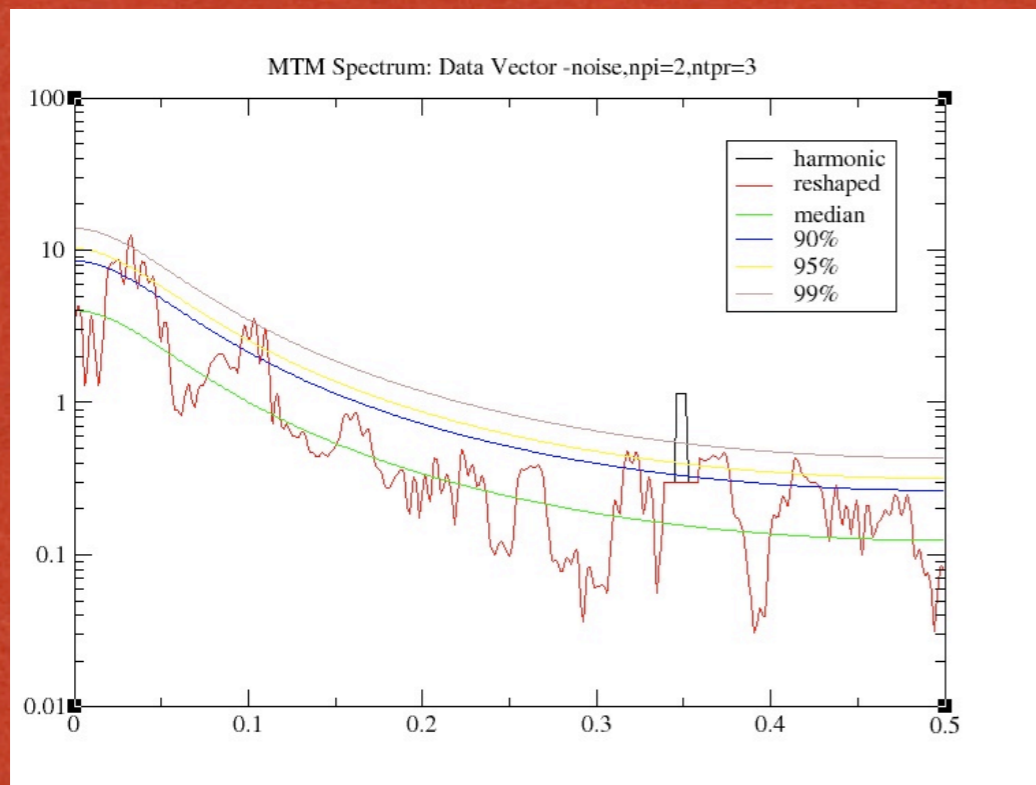
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Get <http://www.atmos.ucla.edu/tcd/school.tar.gz>

# LET'S GET IS STARTED!

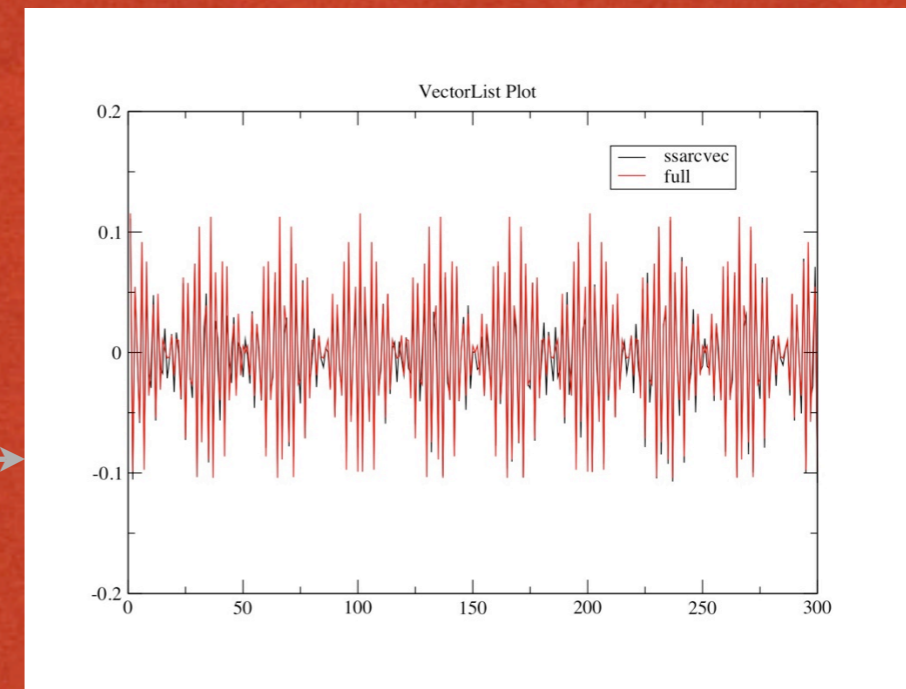
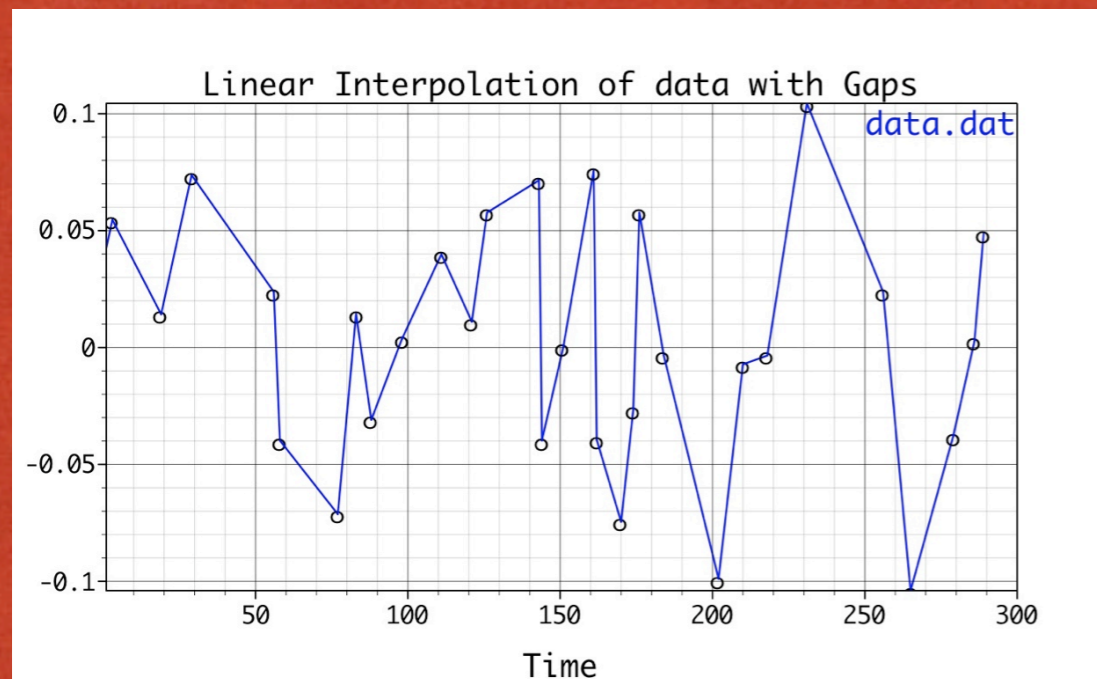
- Task: Obtain 14 figures (postscript files) as described in README files in SOI (6 figures), SIGNAL (5 figures) & GAPS (3 figures) directories.
- Detailed instructions for 12 figures in README files.
- The last figure in SIGNAL is a problem with answer provided but no instructions.
- The last figure for GAPS is a problem with answer provided, but no instructions :)
- I'll do some...in SOI 1st, SIGNAL 2nd and GAPS last.

# 5TH FIGURE FOR SIGNAL



- Find parameter settings for which MTM results of “noise” do not exceed 99% confidence level!

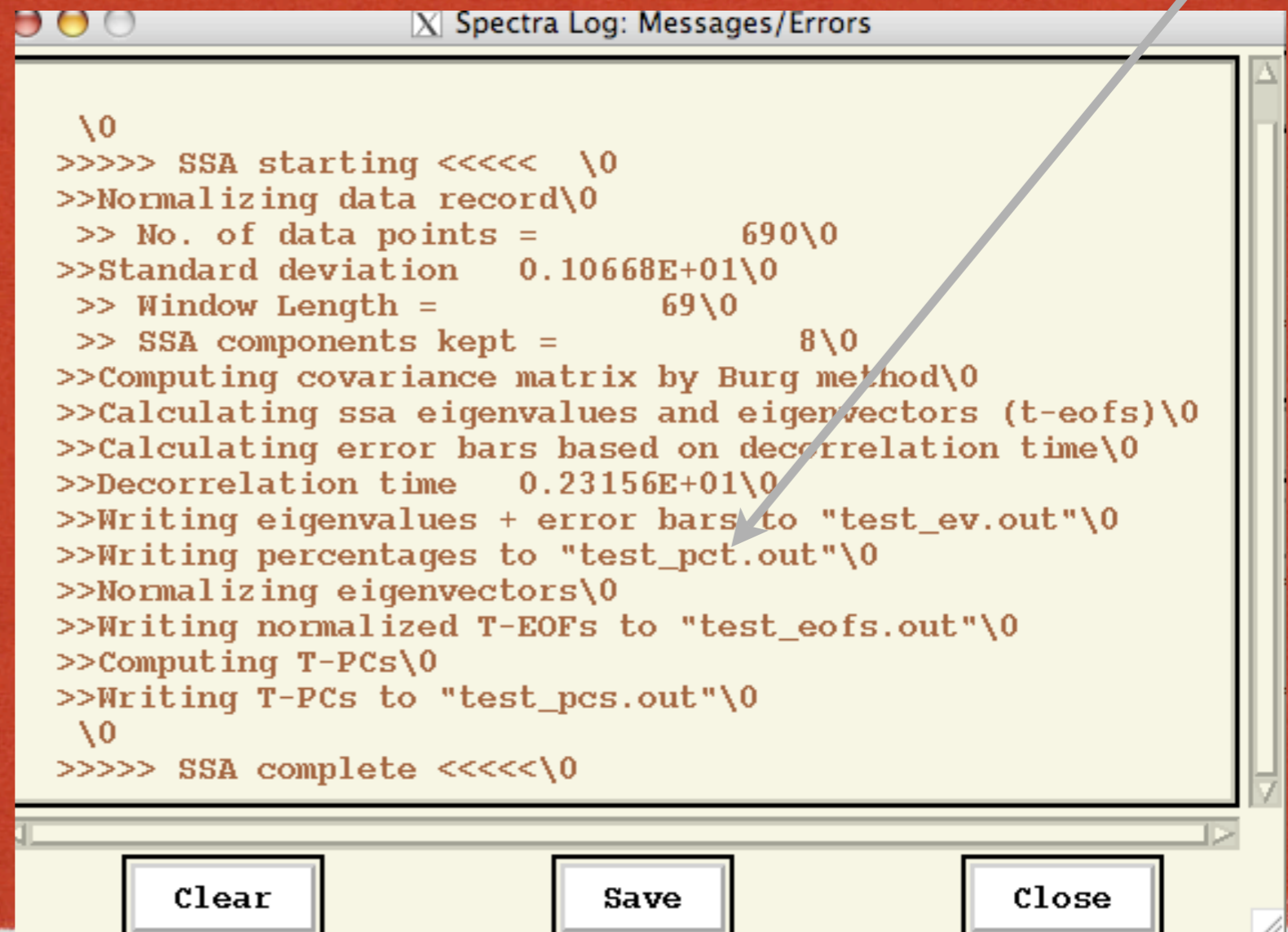
# 3RD FIGURE FOR GAPS



- The plot of gappy data with 3rd party software(Grace can not handle NaN's)
- Task: apply SSA gap-filling to obtain continuous data which is much more beautiful than linear interpolation!

# LOG FILE & TMP FILES

- Temporary files are created in the directory where you run the Toolkit:
- used to prepare input for Grace, if strange plots are obtained the files may have been corrupted and have to be removed by hand (rm \*.tmp)
- may contain some useful information, check the Log File.



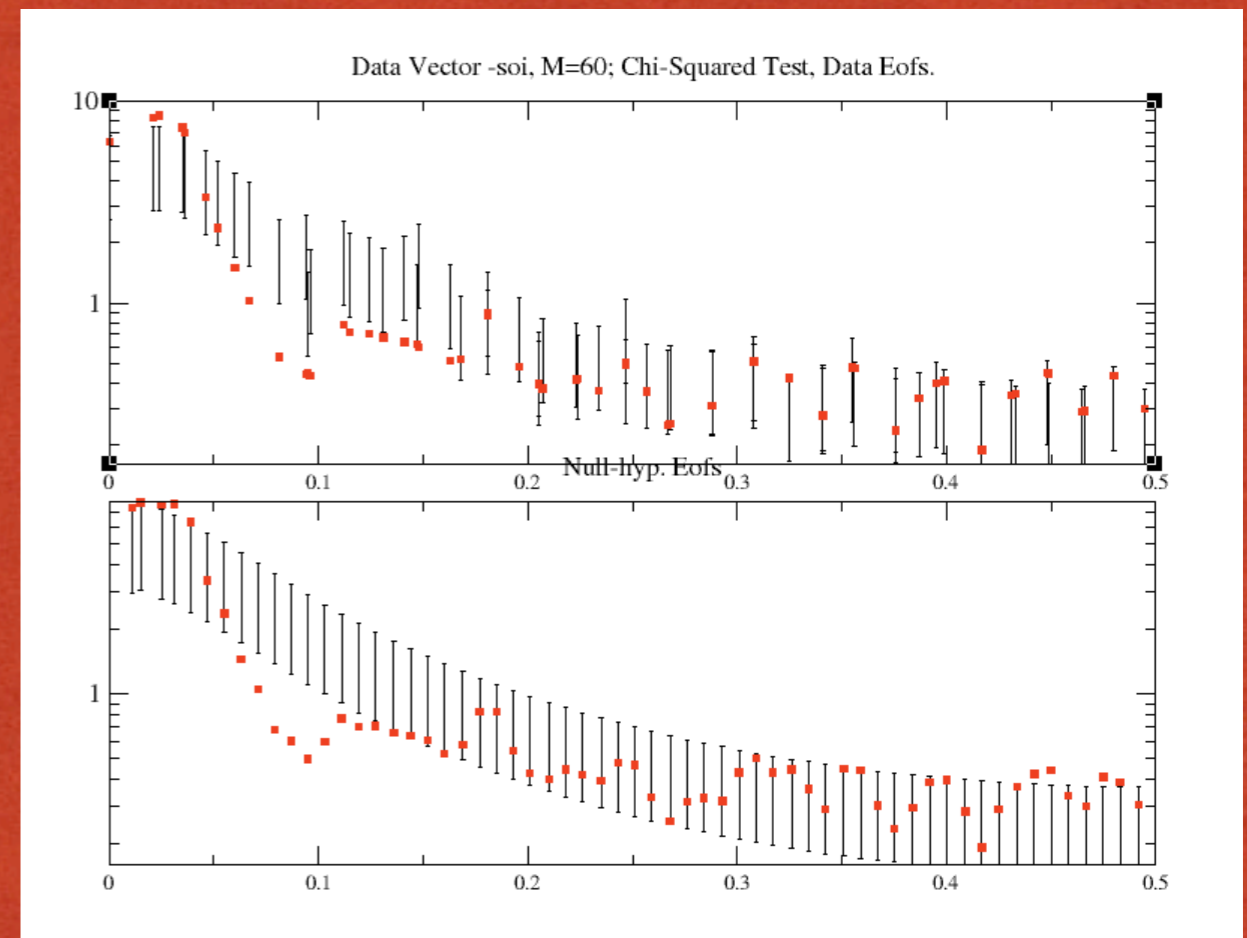
The screenshot shows a window titled "Spectra Log: Messages/Errors" with a yellow background. It displays the following text:

```
\0
>>>> SSA starting <<<<< \0
>>Normalizing data record\0
  >> No. of data points =          690\0
>>Standard deviation  0.10668E+01\0
  >> Window Length =          69\0
  >> SSA components kept =          8\0
>>Computing covariance matrix by Burg method\0
>>Calculating ssa eigenvalues and eigenvectors (t-eofs)\0
>>Calculating error bars based on decorrelation time\0
>>Decorrelation time  0.23156E+01\0
>>Writing eigenvalues + error bars to "test_ev.out"\0
>>Writing percentages to "test_pct.out"\0
>>Normalizing eigenvectors\0
>>Writing normalized T-EOFs to "test_eofs.out"\0
>>Computing T-PCs\0
>>Writing T-PCs to "test_pcs.out"\0
\0
>>>> SSA complete <<<<<\0
```

At the bottom of the window, there are three buttons: "Clear", "Save", and "Close". A grey arrow points from the top right of the slide towards the "test\_ev.out" line in the log output.

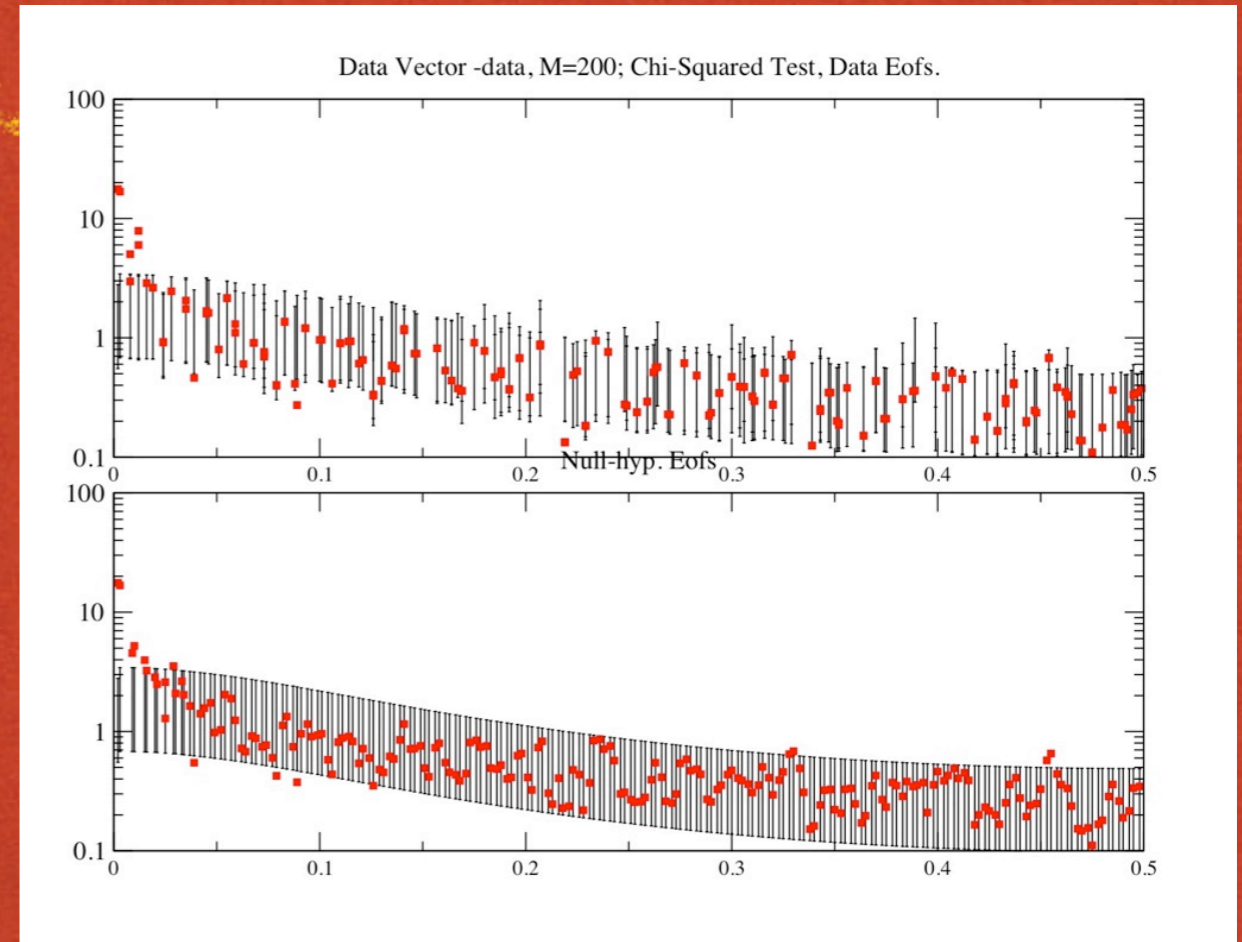
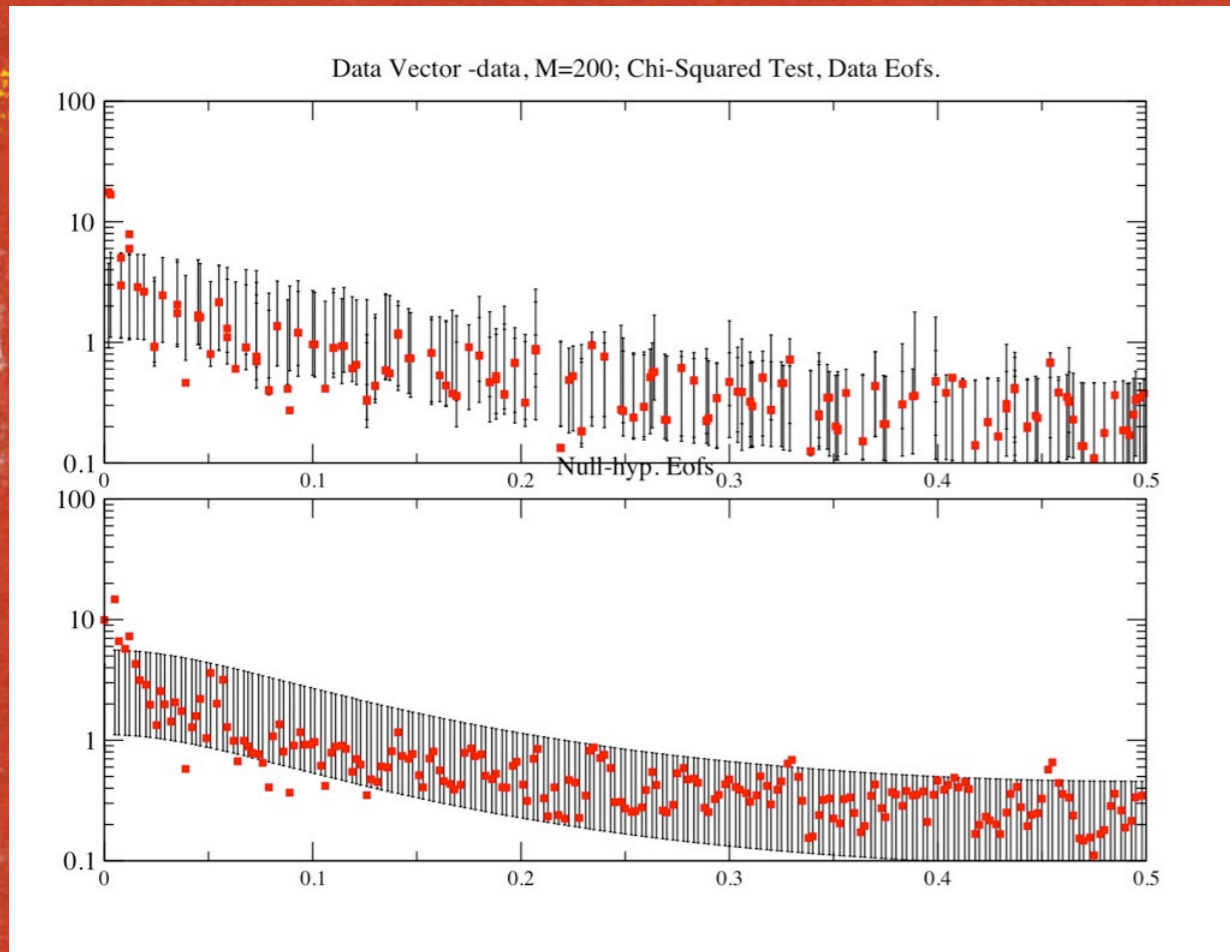
# MONTE CARLO SSA

- Spectral view of SSA results (vs. scree diagram) & test against red-noise.
- Complimentary to other pairing tests (phase-quadrature of EOFs in Plot Options; “Same-frequency” & “Strong FFT” in Test Options)
- Distribution of diagonal elements of projected lag-covariance matrix  $C$  of surrogate red-noise time series onto the EOFs of the data time series:  $E^T C E$
- Projections are plotted against a dominant frequency of EOFs, need to look for the pairs above error bars.



- For lower panel E are EOFs of the expected covariance matrix of red noise, and is useful when testing significance of **leading** SSA components when projection onto data EOFs may give false significance.

# “INCLUDE EOFs”



- Useful for MC-SSA when the data contains a very dominant oscillatory mode capturing large variance, shifts the spectrum “up” in low-freq. part
- E.g. set “1 2” in Test Options.

SIGNIFICANCE TESTS PREFERENCES

SSA Pairing Criteria

Same Frequency  Strong FFT  Do Trend Test

Decorrelation weight

CHI-SQUARED AND MCSSA SETTINGS

Include EOF'S  Confidence levels

MCSSA only

Eigenspectrum Shape  Ensemble Size

Advanced Options

# SSA RECONSTRUCTION

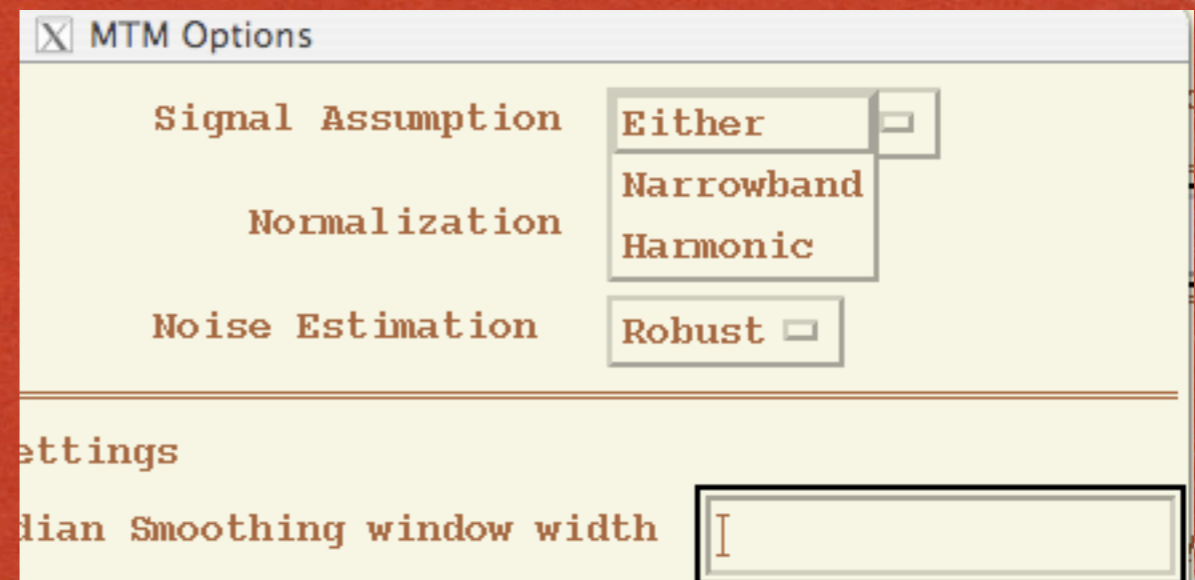
- Find significant modes and do time-domain reconstruction to the time series.
- % of variance in test\_pct.out temporary file.
- Reconstruction in SSA menu.





# MULTI-TAPER METHOD IN A NUTSHELL

- Classical variance F-test (Thompson) vs. white noise (Harmonic test in Plot Options & 'Signal Assumption')
- Mann & Lee test ("Narrowband" in 'Signal Assumption') vs. red-noise (could be also used for "white-noise" and "locally white" noise); set in 'Null Hypothesis' of MTM Options.
- The two tests are combined when using "Either" in 'Signal Assumption' of MTM Options.



# MULTI-TAPER METHOD IN A NUTSHELL (CON'TD)

- If changing sampling from default (=1) use “Get Default Values”
- Time-domain Reconstruction of significant frequencies (Reconstruction in menu).

Component(s)	Frequency	Seletion
0.00236686	99%	
0.01074219	99%	
0.01562500	90%	
0.02832031	90%	
0.05468750	90%	
0.13964844	95%	
0.17382812	90%	
0.17871094	90%	
0.20800781	95%	
0.23339844	95%	

Make selection

Selected frequencies:

Store RC-s Matrix

Store RC-sum Vector

# MULTI-TAPER METHOD IN A NUTSHELL (CON'TD)

- “Reshaping” to visualize significant spectral peaks.

