Reply to comments from anonymous referee #1

We thank this referee for their useful and constructive comments and feedback, which have been very helpful in improving our manuscript. Our responses to the referee's text (in blue) are listed below (in black).

Specific comments:

"Thoning et al. 1989 used 50 as the short term cutoff, but the current code for ccgcrv released by NOAA/ESRL uses 80 days as the default… it would be nice if the comparisons could be redone using the 80 value…"

We thank the reviewer for pointing out this update by NOAA in the recommended cutoff value. We have redone all the analyses that used the default short term cutoff, using a period of 80 days rather than 50 days. This change caused a small difference in some of the results; consequently we have updated the text, figures and Tables 2 and 3 to reflect these changes.

"What I'd like to see is less emphasis on the comparison with the typical settings, and more emphasis on section 3.5, the program input parameters. What parameters will give each curve similar 'stiffness'?

Referee #2 made a related comment on section 3.5. So we have added some new text in Section 3.5 and made two new figures (figures 9 and 10) that emphasis the differences caused by changing the program input parameters. To keep the number of figures reasonable, we have removed figure 1, which displayed very similar information about the curve fitting programs as figure 2.

There are many combinations of input smoothing parameter settings that could result in the three programs fitting with similar 'stiffness', since this depends on the variability of the time series data, and what level of curve fitting 'flexibility' one is trying to achieve. We have added some text in section 3.5 that states the combination of input smoothing parameter settings that we have found to produce curve fits of a similar 'stiffness' for the time series that we used, and while still maintaining a relatively flexible curve fit.

"The ccgcrv technique explicitly states the frequency response that is used. Can something similar be found for the HPspline and stl techniques?"

We don't believe that the HPspline technique has anything equivalent to the frequency cutoff response of CCGCRV based on the mathematical functions employed by HPspline (sinusoidal harmonics, polynomials and cubic splines). Although we have explained the basics of the mathematics behind the three curve fitting programs, we have not delved any deeper than this, and such investigations are beyond the scope that we intended for this paper. Instead, for the interested reader, we have cited the relevant publications on the three techniques.

"Perhaps an artificial data set can be constructed using a trend, harmonic and noise, and then find the settings for each technique that come closest to the underlying trend and harmonic."

We have implemented this suggestion and added the results into section 3.5, as well as an additional figure (figure 12). We found this to be a useful exercise in helping us to better understand the differences in the ability of each curve fitting program to decompose a time series. As such, we are grateful to the reviewer for suggesting this.

"I think recommendation number 11 should be given more prominence though, maybe being the number one recommendation."

We agree with this feedback (also made by referee #2), and have moved recommendation 11 to the top of the list. We have also changed recommendations 12 and 13 to become recommendations 2 and 3.

"In Section 2.1.1., it is stated that the HPspline routines originated from Numerical Recipes in Fortran. What routines from this book were used?"

We have now included this information in section 2.1.1.

"In equation 5, the (f/fc)^4 term used by ccgcrv is the value used in Thoning et al 1989. Current ccgcrv code used is (f/fc)^6."

We have made this change.