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Atmospheric Measurement Techniques Discussions

Interactive comment on "Robust extraction of baseline signal of atmospheric trace species using local regression" *by* A. F. Ruckstuhl et al.

Anonymous Referee #2

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General comments:

Determination of baseline data and/or curves, and subsequent estimation of the trend (growth rate), is extremely important and required for any monitoring station making long-term measurements of the changes in atmospheric composition, particularly trace gas species. Some methods employ purely statistical techniques, some use environmental conditions (such as wind speed and direction, particle counts, trace gas concentration stability, etc.) with iterative outlier filters, while others utilize back trajectories, atmospheric transport models or other meteorological methods to determine baseline data. And naturally, combinations of these types of methods are also used. Each have their advantages and disadvantages which are summarised nicely in the manuscript.

The main advantage of statistical, and especially non-parametric techniques, is that they can be applied to any trace gas dataset at any location without the need for extra environmental parameters to be known, or for back trajectories or transport/dispersion models to be utilised.

This manuscript details a statistical technique for determining the baseline or background signal (ie well-mixed air masses of background origin) of atmospheric trace gas species. It specifically uses a non-parametric statistical method based on robust local regression (called REBS for Robust Extraction of Baseline Signal) to determine the background signal from CO measurements made at Jungfraujoch, Switzerland and to estimate the baseline curve. The boot-strap technique is used to give an estimate of the uncertainty on the baseline curve.

This manuscript is well suited to AMT and is a useful contribution on this topic. I was glad to see that uncertainty estimates have been placed on the baseline curves which are increasingly important, if not necessary. However, similar to anonymous referee #2, I was disappointed that more examples in the application of the method to different trace gas species were not presented, along with comparisons to more of the other cited methods.

I recommend the manuscript be published in Atmospheric Measurement Techniques subject to the following comments being addressed.

Specific comments:

1) Some more examples are needed of the REBS technique applied to a range of other trace gas species measured at Jungfraujoch eg. CH4, CH2Cl2, HFC-134a, CCl2CCl2, ... others? Especially, examples of the technique applied to a trace gas species where there are many 'pollution' episodes (whether they be anthropogenic or natural or both) would be an interesting test of its robustness.

2) Comparison of the REBS technique with more than just the Thoning et al. 1989/Nov-

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elli et al. 2003 method would certainly add weight to the manuscript. As a minimum, it would be good to see a comparison of the REBS method (statistical), with the Thoning et al. 1989/Novelli et al. 2003 method (iterative filtering/curve fitting - already done), with the AGAGE statistical approach (O'Doherty et al., 2001/Prinn et al. 2001), and an air mass origin/back trajectory/modelling approach (eg using the UKMO NAME model, Ryall et al. 2001/Derwent et al. 1998).

3) on page 5594, line 17, the authors mention 'Since the regional signal must be non-negative, ...' - this highlights that this method is not suitable for all trace gas species. In particular carbon dioxide (CO2) and hydrogen (H2) both have terrestrial sinks (photosynthesis for CO2 and soil bacteria for H2) that result in 'negative' pollution episodes or draw down events. It should be explicitly mentioned in the manuscript somewhere that the method is not suitable for these species or others that have below baseline events.

4) on page 5602, line 6 of the manuscript the authors mention that 'The differences in the classification of background measurements have a rather small impact on the estimation of average background CO concentrations.' - I disagree with this, especially if looking at monthly averages that would be produced from the blue (REBS) and red (smooth curve fit) lines in figure 3. There are considerable differences during the peaks in the CO seasonal cycles for most years, which the authors mention at the bottom of page 5602/top of page 5603. So there seems to be conflicting statements between line 6 P5602 and line 28 P5602/line 1 P5603.

5) in the manuscript on page 5604, line 16, it is mentioned that the REBS technique can handle gaps in data, an example(s) illustrating this would be good to see.

Technical comments:

Page 5591, lines 13-14: suggest adding the reference Ryall et al., Estimating source regions of European emissions of trace gases from observations at Mace Head, Atmospheric Environment, 35, 2507-2523, 2001. This paper outlines the baseline selection method that utilises the UKMO NAME model.

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Page 5591, line 16: suggest change '... statistical methods have not to be ...' to '... statistical methods do not have to be ...'

Page 5591, line 18: insert comma after generally.

Page 5592, line 5 and page 5603, line 3: 'Simmonds et al. (2001)' should be 'Simmonds et al. (2006)'. This needs correcting in the reference list as well (page 5608, line 3).

Page 5596, line 8: three months.

Page 5598, line 15: proportions.

Page 5598, lines 18-19: suggest 'This idea does not, however, take into ...'

Page 5598, line 27: insert 'bands' after 'confidence'.

Page 5599, line 1: insert 'at' between 'station' and 'Jungfraujoch'.

Page 5599, line 3: insert 'World Meteorological Organization (WMO)' before 'Global Atmosphere Watch (GAW)'.

Page 5601, line 1: lifetimes.

Page 5601, line 5: months.

Page 5601, line 6: insert comma after '... season and location,'

Page 5604, line 4: 'site' should be 'side'.

Page 5604, line 14: '... and will be the subject of ...'

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5589, 2010.