Review on “Markedly different impacts of primary emissions and secondary aerosols formations on aerosol mixing states revealed by simultaneous measurements of CCNC, V/HTDMA and SP2” by Jiangchuan Tao et al.

General comments:

The presented study investigates the mixing state of aerosol particles using different techniques: H- and V-TDMA, CCNC, and SP2 measurements are available in connection with chemical measurements for a 1-month campaign in the North China plain (NCP). This combination provides a useful data set to investigate the aerosol mixing state. However, this combination of measurements gives a lot of information and in this study many parameters were calculated. To understand the relationships and differences between these parameters, they need to be explained and presented in more detail. I believe, the data itself are worth to be published, but the quality of analysis and publication should be improved. The authors use too many abbreviations that disrupt the flow of reading. Some abbreviations are not explained at all, but I think even those that are well known in a particular community should be written out at least once. Furthermore, the statistical analysis is not convincing. Linear correlations are applied to all data points, but in my view, they do not well describe the data in all cases. A critical analysis is needed here to determine which of these statistical results are meaningful. This is my main criticism of this work.

The quality of the language is not very good and the manuscript is not easy to read. I recommend a complete check by a native speaker.

Thus, the paper needs major revision regarding the statistical analysis. After that, the text should be partly rewritten or at least significantly revised before it can be accepted for publication in ACP.

Comments in detail:

There are basic criticisms of the manuscript, so I will go into less detail. Most of my comments are more general, only few of them focus on typos and so on, which does not mean, that these are all minor comments. But I would focus on the detail after the rest is done.

Examples for abbreviations, that are never written out:

SOA, POA, SSOA, BBOA, CCOA, FFOA, MAF..

Some of them are well known, others not. I do not know all of them which makes the reading really difficult. Each abbreviation has to be explained once, but I would suggest to use less abbreviations in general. Even if abbreviations are explained in the technical section and used later without explanations does not really help. I prefer written text, it helps a lot to understand the text much better. In my view it is required to explain those abbreviations, which are not widely known, such as MAF, CCOA, regularly again, also in figure captions.

Section 2.2:

Some more technical details about the aerosol measurements would be helpful. What type of inlet was used? Was the measurement flow dried? How was the relative humidity in the inlet flow?

Were losses in inlet line and sampling systems considered?

D_d is probably the dry diameter?! This is not explained. What means 'dry'? Just not humidified?

The same diameters D_d and D_P are used in the definition for the shrinking factor, what is the meaning here?

Section 2.3:

Parameterization of the SPAR function is not easy to understand without knowing how it looks like. Can the authors give an example?

People, who are not familiar with the SP2 do not understand the explanation given here. What does the lag time mean? Why is it called lag time? By the way, there are three different ways of writing in the manuscript: lagtime, lag-time and lag time, for consistency one should be chosen. I would take the latter one.

Section 3:

Figure 1 is very complex. Figures c – e also have a color scale on the right hand side, but this is not explained at all.

Line 316 ff: '…corresponding fitting parameters, Da…' Da is just one parameter and means probably the mean diameter? How are these diameters obtained? Da should probably be D_a?! Other fitting parameters are needed?

MAF seems to be another fitting parameter, but what does MAF mean?

There appear again lots of abbreviations, such as RexBC. This is explained once, but since it is not common, I had to look it up again and again. I would prefer reading without so many abbreviations.

Line 371, caption figure 4 and others: the word 'composition' is used in the wrong context. The authors mean probably component(s). This appears several times in the text.

Figure 4: what are the shaded areas? Standard deviations? Uncertainty? This has to be explained in the figure caption! My question is, if the differences e.g., between the different diameters are significant? For me, the shapes of the curves of NF for different diameters look very similar, in particular if the shaded area represents an uncertainty range.

In the description of this figure 4 the word 'peak' is frequently used, but I see only slight maxima between different times of the day. This has to be checked and needs to be adapted.

Line 388: What means 'consistency' here? I simply do not understand it.

Figures 5 – 9: linear correlations were fitted here, but the results do not always look convincing. E.g., Figure 7: 2 lowest plots show dots widely distributed and one does not expect a linear correlation. What is the meaning of such a correlation? I strongly suggest to check the quality of these correlations and reduce to number of these plots.

Figure 8: the lower plots seem to follow more an exponential growth, does the linear fit makes sense here?

Figure 9: what means OOA1 and OOA2?

All figure captions need more text to explain the figure. One should understand the general content of a figure without reading the full text around.

Line 472: exemplarily ‘difference between NF_V – NF_H’ means difference between NF_V and NF_H? This appears several times around this section.

Minor comments/ typos:

Comment: I did not look explicitly for all typos, because I think, several parts need to be rewritten und after that it should be read again carefully.

Line 293: PA means probably POA

Line 319: in large diameters ranges

Line 334:a dot after ‘size’ is missing

Line 439: ‘are presented’ should be ‘is presented’