Review of "Vehicle-based in-situ observations of the water vapour isotopic composition across China: spatial and seasonal distributions and controls" by Di Wang et al. submitted to ACP

Summary:
This paper serves really well in characterizing the seasonal and spatial variability over a broad region of China over the pre-monsoon and monsoon periods using a vehicle-based isotope analyzer and other meteorological measurements. The synoptic effects from the continents and oceans along with their entanglement with seasonal characteristics are thoroughly investigated using water vapor isotope observations. This paper would be a good fit for ACP publication after the authors address some of the outstanding major and few minor issues.

Major comments:

1) The start of the introduction is strong but it still needs to incorporate a discussion about the current knowledge of synoptic and seasonal processes within the continental region. Why is it important and what do the previous studies broadly say? What is the isotope perspective adding to the traditional methods of study? An expanded version of the first paragraph of Section 2.1 is more fitting for the introduction in my opinion.

2) Since synoptic vs seasonal influences on the isotope observations is the major conclusion of this paper (it literally is in the title of the manuscript), it would help to talk and explain these influences in the introduction. Mention all the factors that you are examining for the two categories. I see that you have classified them in the abstract but it would serve the readers well to know about them from early on. Are there earlier studies that you can compare your results with? Also, whenever you use terms like "altitude effect" and "continental-recycling", use a line or two to give the readers a gist. This would make it convenient for the readers lest they need a jolt to their memory or are not acquainted with the terms well.

3) Another point regarding the synoptic vs seasonal comparison is that although this is the focal point of the paper, and it is only talked about formally in section 4.7. This leaves the readers hanging for the major part of results and discussions. I understand that you talk about the seasonal effects followed by the synoptic effects individually, and then you use Iso-GSM to compare the two effects. However, for more clarity, once you end discussing the seasonal/synoptic effects, write a summary sentence or two to tie up the results to the final seasonal vs synoptic comparison. This will keep the audience' attention till they reach section 4.7. No major editing is necessary. Just adding/shuffling some summary sentences at the end of subsections of sections 3 and 4 would do.

4) Paragraph 3 of Introduction is important since it provides a transition from previous work to your work. However, the phrasing seems weak. If it is a first of its kind study conducted using the isotope analyzers over the continental China, then you should

emphasize it, by all means. Readers would appreciate the new science and techniques that this work is doing.

5) It is scientifically sound to not use the city datasets that may have been impacted by the traffic pollution. However, I am curious, if you can totally eliminate the role of water vapor emitted from country sources like irrigation, farms, power plants etc. in affecting the water vapor isotope or the humidity measurements in any way? If this is an assumption made, then please state it somewhere.

6) I have some concerns regarding the use of Iso-GSM for the disentanglement of seasonal and synoptic influences. From figures 11 and 12, the model does not seem to simulate the observations well, especially in the monsoon period. Moreover, the grid spacing for the models is way coarser compared to the observations. I would suggest using the observations to perform the same analysis discussed in 4.7, and only use model inputs where observations are not available. Then in table 2, compare the Iso-GSM vs observation-based fractions. This would be far more accurate. Since the main result of this paper is disentangling the seasonal vs synoptic effects, I think it is crucial to be thorough with your methods here.

Minor comments:

1) Line 76: Isn't Bailey et al. (2013) a Hawaii-based study? Are there other studies based on larger continental settings?
2) Section 2.1, 1st paragraph: Include continental recycling as well.
3)
4) Line 124: Maybe write a few lines about the advantage of using d-excess, how does d-excess vary in comparison with d18O.
5) Line 146: What is the value of calibration humidity correction term f? Is equation 3 a standard equation for these calculations? Any references?
6) Figure 2,3: Have you tried using the same y-scale for pre-monsoon and monsoon period?
7) Figure 2: Are the meteorological observations also 10-minute average? What is the resolution of P-daily and P-mean respectively? It is not clear to me how P-mean is calculated. If P-mean is the temporal-mean of the precipitation amount over the sampling days, then P-mean should have a single value for each season. Please clarify. Also, mention the grid size of the GPCP precipitation. How is the grid average precipitation calculated?
8) Is the humidity (figure 2e,f) and q (figure 2i,j) obtained from the Picarro sampler and the rooftop weather station, respectively? Do they correlate well? Can the humidity (ppm) also be expressed in (g/kg) for ease of comparison?
9) Line 249: "During the pre-monsoon…..than in any other regions". Here you say that in the pre-monsoon period, the humidity, P-mean and d18O are higher in southwestern

China than in other regions. However, since the data is not available for the entire pre-monsoon period in the northeast and northwest regions, are you assuming that the humidity, p-mean and d18O remain consistent for the entire pre-monsoon period? Have you estimated a sampling bias? It would be good to write this assumption too.

10) Line 277: Alternatively, the high d-excess in south China could also be coming from the moisture flow from Indian/Pacific Ocean as is talked about later. Or, it could be resulting from the deeper convective mixed layer in south China compared to north China where vapor with high d-excess is transported towards the surface as shown in figure 9.
11) Line 314: I find it exciting to see that the controls on d18O (temperature correlation) and d-excess (precipitation-line correlation) can be differentiated so well just based on the observations alone.
12) Change reference Noone and David, 2012 to Noone, 2012.
13) Figure 6: Can you explain the reason for a significant number of WR_1 dried and depleted dots below Rayleigh curve? Are they within the uncertainty range of the Rayleigh curve?
14) Since figure 10 is referred at multiple places in the paragraph starting at line 413, maybe change index of figure 10 to 7 to maintain the flow of the paper.
15) Line 439: replace 'bring' with 'brought'.
16) Line 442: "As continental….". Wrong grammar.
17) Continental recycling from WR2, SR1 and SR3 is a strong factor influencing the isotope ratios. Perhaps, defining it in one line or so will help the readers.
18) Line 458: "…with a steepest slope….". Replace 'a' with 'the'.
19) Line 493: Not all observations exhibit temperature effect. WR3 does not.
20) Line 509: Another factor for the dominating effect of q at least for SR2,3,4 can be rain evaporation.
21) Line 512: Explain the altitude effect in a separate line.
22) What is the difference between daily precipitation amount (P-daily) and temporal-mean precip amount for sampled dates (P-mean)?
23) Line 540: Define 'dtra'.
24) Section 4.7: Going back to my major comment, why start the spatial vs synoptic comparison so late in 4.6 when you introduced the concept at the beginning of section 3? Tie this section with the previous sections.
25) Table 2 description is incomplete.
26) I really like the summary plot 13. It provides a summary of all the meteorological processes described in the paper. Two questions: What is the significance of upward and downward pointing triangles for d-excess? Please explain all the colored arrows in the figure description.
27) 'Bay of Bengal' spelt wrong in the figures 5 and 13.