General Comments:

This study evaluates a Keeling-style approach for determining the deuterium-excess signature of combustion derived water vapor (CDV) in the Salt Lake City area. The new approach is consistent with values reported in the group's earlier paper, Gorski et al., 2015. The paper also develops criteria for filtering observational periods when atmospheric conditions are most conducive to the accumulation of CDV. These criteria could be used as a starting point for similar studies conducted in other cities. This is the first study that reports multiple years of water vapor isotope measurements to study CDV. While the study is certainly novel, and the quantification of CDV is important, I think the authors could improve the paper by (1) explicitly stating why this study is important using detailed examples, (2) discussing the broader impacts of the work (how does this work further the field, and where else are improvements needed), and (3) providing quantitative support to put the results of the study into context. For example, the reasons some parameter values are used (e.g. emission factors (ef) from 1-2, CDV mole fractions ranging from 100-500 ppm) should be supported with more explanation. The paper is well-written and concise. The specific suggestions listed below, if incorporated, will provide readers with greater context for interpreting the results of the study.

Specific Comments:

1. Pg. 1. Ln 21. This might be the only sentence in the paper that explicitly states why quantifying CDV emissions is important. Could you expand this idea by detailing possible CDV impacts in urban areas, e.g. impacts on downwind clouds/weather, link between enhanced humidity/temperatures and heat stroke/fatalities in at-risk groups (elderly, sick), influence on photochemistry/aerosol, etc.
2. Pg. 2. Ln 11. This is an appropriate place to introduce the idea of the SLV's seasonally shifting fossil fuel use (and H2O:CO2 combustion stoichiometry), which adds to the complexity of quantifying CDV emissions. Furthermore, fossil fuel use trends differ from city to city. Describing the complexities of (1) CDV isotope measurements and (2) uncertainties regarding stoichiometry, fossil fuel consumption, and the impacts on CDV d-excess and emissions estimates bolsters your statements regarding the need for refinements to the method (last sentence of abstract). It would also help to communicate the novelty of these types of studies, and the need to continue work in this area.
3. Pg. 2. Ln 16-19. The last line of the introduction indicates that an objective of this study is to investigate relationships involving CDV amount. Does your analysis allow you to report CDV contributions to the SLC boundary layer (Gorski et al reports up to 13% CDV), or do you mean to say your approach allows for the estimation of CDV mole fractions (based on CDV moistening lines in Figure 1, 7-9), or do you mean to say this study intends to report general relationships between atmospheric stability and CDV amount (not necessarily quantitative estimates). Please clarify.
4. Pg 3 ln 4. Why is 2200 msl used in the VHD equation? Is it because that's roughly the height of the mountains surrounding the SLV? Or does it have to do with average mixing height (1290 m + 1500 m = 2790 m, so maybe not?)

5. Pg 3. Ln 6. You reference Whiteman et al., 2014 for the PCAP definition, but more explanation of Whiteman et al.'s 4.04 MJ/m2 number would be useful.
6. Pg 3. Ln 23. What were the dD and d18O values of the standards, and did they bracket the range of observed delta values?
7. Pg 3 ln 28 / Section 2.2. Please comment on the reproducibility of the calibrations and robustness of the calibration correction. Is it a linear or non-linear correction, both (over certain [H2O] ranges)? There is also no statement regarding instrument precision in the deltas. There is no statement about uncertainty analysis for d-excess (as a function of water vapor concentration). Figure 10 is the only part of the paper that indicates an uncertainty analysis was conducted.
8. Pg. 5. Ln 28. What amount of fossil fuel (for CH4 for example) would be required to produce 500 ppm CDV? It would be helpful to provide this information to put the numbers into context. Figure 1 shows isohumes from 100-500 ppmv, but I don't know if this range of CDV is what contributes to the SLV boundary layer on average or if it's an upper limit estimate. You could frame this is the context of CO2 emissions. Hestia CO2 is available for SLC, so you could estimate what average CDV mole fractions would be on a non-PCP day (using ef = 1-2), and then make estimates of PCAP CDV contributions assuming 24+ hours of emissions accumulate within a lower (average observed PCAP) boundary layer.
9. Pg. 6. Ln. 4. What are the expected ef values, and why?
10. Pg. 6. Ln 9. What type of linear fitting routine is used here? There is error in the x and y variables presumably, which should be accounted for in the fitting.
11. Pg. 7. Ln 10. Again, cross correlations were determined with what kind of fitting routine? There is error in both x and y, although in this case, the error would be much higher in d-excess than CO2. It also would be useful to report in a table the correlations observed during PCAP periods and non-PCAP periods in addition to those reported for the four winters.
12. Pg. 9 ln. 4. During PCAP events, is there an average observed decrease in d-excess per ppm increase in CO2? What magnitude of CO2 enhancement is required to observe a change in d-excess (at the d-excess LOD)?
13. Pg. 9 Ln 12. What about the deposition of vapor to a snow or ice-covered surface when RH w.r.t. ice is 100%. In the presence of ice/snow, would the deposition of vapor result in drier air with a more negative d-excess value? This effect would be more important at night as temperatures fall?
14. Pg. 9 Ln 28-30. This is true, but the measurements you present were all from winter months. There is EIA fossil fuel consumption data available which provides information about the distribution of fossil fuel types consumed for regions in the US at monthly(?) resolution. You surely can make some educated guess about the fossil fuel consumption-weighted emission factor for SLC during winter months.
15. Pg. 11 Fig 5. It is difficult to distinguish between the circles and squares in Figure 5. Could you try larger markers, or filled vs unfilled markers, or circles vs crosses?

16. Pg. 14 Fig 7 (and Figures 8, 9). Can you change the color scale to one that goes from red-purple. It would be easier to distinguish the PCAP periods in the (a) d-excess vs q plots where the PCAP observations track with the CDV moistening lines.
17. Pg. 20 Figure 10 caption. This is the first time that measurement uncertainty is discussed. You report that the shading reflects the standard error, but there is no quantitative discussion of d-excess uncertainty. This should appear in the Methods.
18. Pg. 21 ln 7. This is an indicator that this phenomenon is difficult to observe (even in SLC). This would be an appropriate place to discuss whether the CDV d-excess measurement precision is good enough to observe CDV d-excess in other cities (that may be naturally more humid).
19. Pg 21. Ln 19-20. This is a repeat of one of my comments above, but what about deposition of vapor in ice supersaturated conditions? Is there snow on the ground during this study period? I think this would impart a more negative d-excess value in the remaining vapor.
20. Pg. 21. Ln 24. This is another repeat of one of my earlier comments. I think reporting CDV d-excess ranges are fine for ef=1 or ef=2, but I think you could also make an educated guess based on Patarasuk et al., 2016, EIA, and other literature to say if you believe ef is closer to 1 or 2 (probably closer to 1?). This shows that the community needs information about the partitioning of the fossil fuels consumed in various cities, at the very least at seasonal resolution.
21. Pg. 22. Ln 2. What type of refinements?
22. Pg 22 ln 8. The statement regarding the lack of a robust relationship b/n CDV or CO2 and mixing height refers to the entire wintertime period, or just PCAP events?
23. Pg. 22 Conclusions. The single conclusions paragraph is essentially a summary. Please provide a discussion about the impacts of your work from a broader perspective. Can these studies only be done in wintertime in semi-arid environments? What refinements would advance this science? Where are improvements needed?

Technical Corrections:

1. Pg 2. Ln 3. VSMOW abbreviation not defined
2. Pg 2. Ln 6. “produce” not “product”?
3. Pg 2 Ln 33. VHD abbreviation should appear on previous line after first instance of “valley heat deficit”
4. Pg 4. Ln 3. Meteorological*
5. Pg. 13 ln 25. Remove “a” between “likely” and “due”