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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The lacustrine-water vapor isotope inventory experiment L-WAIVE" *by* Patrick Chazette et al.

Anonymous Referee #2

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The paper poses a series of interesting questions to begin: "What is the role of lakes [in] the...water cycle...? What is the relative contribution of evaporation from the lake to the atmosphere...downwind...?" but quickly pivots away from these questions and does not return to them in the conclusions. Instead, the paper describes in detail the measurement platforms involved in the L-WAIVE experiment, provides an overview of the synoptic conditions from reanalysis, and gives readers a first look at the various types of measurements made. There were clearly a lot of exciting new data collected as part of L-WAIVE. Perhaps it would be most appropriate if the paper stated upfront that this is a campaign overview paper and that much of the investigation of lake evaporation will take place in future work.

Below, I have organized my comments into major comments, related to the scientific

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analysis, interpretation, and discussion, and minor comments, related to clarity, grammar, and presentation.

Major comments

Section 4.1 argues that a high pressure ridge brought warmer temperatures to the study site on the 14th of June, and a surface low over the British Isles brought colder temperatures on the 17th of June. However, it is not clear from the reanalysis maps that this was the case. Figure 9 shows equivalent potential temperature, which is also a measure of moisture content, not strictly temperature. Meanwhile, Figure 8 shows the study site more squarely within the center of a high pressure ridge on the 17th compared to the 14th. The British Isles appear to sit under a low on both days. In addition to these concerns, I wonder whether it wouldn't be simpler to show maps for each of the "golden" days (approximately one week), since it was such a short experiment, rather than seeing geopotential height for some days and RH for others. That way readers could see the progression from one synoptic state to the next clearly. Space could be saved by combining maps, for example, by adding geopotential height contours to temperature shading.

The paper thoroughly describes measurement and collection methods for nearly all observations except the precipitation samples, which are mentioned near line 412. How were these collected and analyzed? On which days were they collected?

Section 5.2.1 argues that strong vertical gradients in dD were observed on flights 5-10 and well-mixed conditions during flights 13-15; however, it is not clear Figure 16 supports this. First, Fig 16b shows vertically uniform isotope ratios for nearly all flights within the bottom 2 km of the atmosphere. (Flight 2 seems to be the exception.) This would indicate well-mixed conditions at these lower elevations. Most flights then show a near-step change at some height above 2km, but the gradient is still hard to gauge because, in most cases, there is almost no data from the free troposphere. Thus, the isotopic change in the vertical cannot be quantified. Perhaps the clustering of points on

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Fig 16a could be used to estimate the degree of mixing within the lower atmosphere, but the number of observations at each altitude would have to be taken into account. An important related question: if the atmosphere is essentially well-mixed up to about 2km, wouldn't lake evaporation also influence the atmosphere to that height? What evidence is there that evaporated moisture only reaches 500 m?

In further reference to "vertical gradients," is Section 5.2.1 essentially talking about the height of the well-mixed boundary layer changing with synoptic conditions? The Section suggests these "gradients" change with air mass transport, but isn't atmospheric stability the more fundamental factor?

In Section 5.2.4, it is not clear how equilibrium fractionation is being calculated for lake water. Is the assumption here that water vapor condenses onto the lake as dew? This seems unlikely as a dominant mechanism. Clarification would be appreciated. Also, the relative depletion of lake water on Jun 18 and 22 is attributed to another (external) source. Yet, couldn't the depletion be caused by upwelling of water from lower depths from within the lake?

Section 5.2.5 argues that this is the first paper to present in-situ samples of cloud water and water vapor in cloud. This is certainly not the case. Presumably, the paper intends to say "isotopic" samples. Even so, previous studies have reported in-cloud water isotopic measurements. Examples include Lowenthal et al. 2011 (https://doi.org/10.1016/j.atmosenv.2010.09.061) and Lowenthal et al. 2016 (https://doi.org/10.1175/JTECH-D-15-0233.1). Also, Noone et al. gave presentations at the 2012 and 2017 Fall Meetings of the American Geophysical Union on isotope ratios collected in cloud water during two aircraft campaigns: the NSF ICE-T mission (2011) and the NASA ORACLES mission (2016-2018).

Minor Comments

Abbreviating "Alpine mountain lakes," which is redundant in and of itself, seems unnecessary. "Alpine lakes" could easily be shortened to "lakes" without confusion. Simi-

larly, I would not abbreviate “water vapor mixing ratios.” There are enough other new acronyms associated with the various measurement platforms.

Line 66 - I don’t understand this sentence or why tall towers would provide “incomplete information” about evaporation. Is the suggestion here that they are not tall enough?

Line 80 - No need for “so”.

Line 85 - no need for “a” after “original.”

Line 161 - “of” is required after “out.”

Figure 2b - could the lines be colored by aircraft to distinguish the two flight patterns? What do the red and purple straight lines represent?

Line 206 - is “flow” the right word?

Line 268 - It appears there is some redundancy in the next few lines.

Line 379 - Values are given for the EVAP standard, why not for GSM1?

Line 423 - Substitute “gives” for “allows to get.”

Line 440 - Should this read “at altitude?”

Line 441 - It’s not clear how the labels “Rain” and “Thunderstorm” provide information about cloud type.

Line 446 - Should this read “above 3.5 km?”

Figure 11 - The white shading and labels make it difficult see the aerosol scattering ratio signals. Also, the caption says that dust and pollution aerosols are labeled, but where?

Line 469 - It would help to remind the reader of when the “dust transport” event occurred.

Figure 15 - Can the flight humidity profiles be overlain on top of the lidar (Figure 14a)

for easier cross-comparison?

Line 535 - What does “partly” mean here? Some of the time? Somewhat strong?

Line 635 - “reservoir” seems somewhat confusing here, as I’m not sure most readers would think of distinct atmospheric layers as being distinct reservoirs.

Line 642 - Could the confidence interval equation be referenced? Also, seeing where the notches end in Fig 19 is not easy.

Fig 16 - Is the “mean mixing line” actually a best fit through all observations?

Fig 17 - It is not clear to me where the highlighting is for the gas-phase and liquid water samples.

Fig 18 - perhaps add “estimates” after “equilibrium condensate”

Line 702 - Is it fair to say this is “local” water vapor, which could have a lake source?

Appendix A is not particularly intuitive. What do the numbers represent in the table?

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