

## Comment ESSD-2022-03

Need to measure water vapor accurately - a hard-enough problem - then determine isotopic composition which adds substantial additional challenges. Authors apparently have skipped first step, going directly to the second step. But, the first step provides very necessary constraints on instrument performance? E.g laser-based instruments - according to manufacturers - lose precision at high humidities? These authors tend to focus on low humidities more typical of natural environments but still minimize those effects? Dismissed here as so-called 'baseline effects' (line 156).

Authors present data compiled from ground-, air-, ship-, and lab-based systems using platform-specific inlets, standard or customized instruments of varying reliability, response time and sensitivity, calibrated (or, not) through independently-determined procedures. None of which they control or even influence! Remarkable effort to even present such an assemblage; good on them for the effort. Strongly agree with one of their summary sentences, e.g. from line 793 "challenge of accurately characterizing and correcting for all relevant biases in field-deployable water vapor isotopic instruments". This reader thinks they provide very skillful assessments; who if anyone could have handled and described such a variety of data. ESSD should publish careful data compilation efforts regardless of 'success' or 'failure' which mostly derive from needs and interests of users. Authors could/should make better presentation!

Basically, we need cautions and overall disclaimers upfront, e.g. in Abstract. Even to finish with a sentence or two about necessary cautions in many uses of these data? As now presented, the abstract offers only deployment summaries, e.g numbers of instruments on which platform. Substantial uncertainties and cautions only emerge in section 4. Give readers an earlier hint?

Line 47 conflicts with line 45. E.g. if ships collected seawater (line 45, also at line 64) then vertical extent of samples can not start "a few meters above sea level". Perhaps for vapor phase but not for all isotopic samples?

ESSD will require DOI information (referred here to Section 5) repeated at end of abstract. Section 5 unfortunately reports URLs (unreliable), not DOIs (reliable). Table 3, with individual data sets references by DOI seems, again unfortunately, incomplete. Or, incompletely documented. User needs easy access to full set of products. Either convert one of the AERIS or NCEI links to a DOI labelled product or put all products together under a third-party archive service (e.g. Zenodo?) which will provide top-level encompassing DOI, reliable off-site storage, plus very good version control. Not acceptable in current form or format.

Line 95: "last" I think you mean 'most recent'?

Line. 118: "new" I think you mean additional, especially because you have just expended several sentences to justify isotopic measurements based on past data.

Section 2: not clearly specified, perhaps will clarify later, but I suspect:

7 vapor-phase measurements: 2 at BCO, 1 on ATR, 1 on P-3, 3 on ships, sum = 7?

5(?) liquid-phase (precip) measurements: 1 at BCO, 3 on ships above, 1 on additional ship = 5?

3 seawater samplers on 3 ships = 3?

From Fig 2, rainwater samples occurred mostly along longitude approx 57W, with relatively few exceptions.

Line 145: very strong statement here: "... no island effects ...". No upwind island effects? This needs referencing to back it up?

Line 148, "regionally representative": I think you mean representative across tropical trade wind environments globally but as written readers could interpret statement as referring only to local BCO environment? Needs some revision.

Line 198, "stored at room temperature": this reader doubts that authors could keep samples at steady temperature during long-range (BCO to Freiburg lab) long-duration transport and storage. Perhaps not important for isotopes? Need some justification here?

Line 219: that the Picarro instrument worked (acceptably?) during deployment nearly a decade earlier provides little help here about reliability, precision, accuracy?

Line 222: please give temperatures consistently in K or C, or explain why one seems appropriate in some cases but not others? Here readers confront inlet reference temperatures in K followed - within same sentence - by tubing heating temperatures in C! One or the other? Not both unless justified for valid reasons.

Line 292: text here, e.g. "limit particle debris" bears (too) remarkable similarity to earlier text describing aircraft inlets (e.g. line 224). One suspects authors adopted text from ship and aircraft sources - fair enough - and no doubt particulate contamination proves troublesome in both cases but authors either need to acknowledge similarity of text (and sampling challenge) or take more care about repeating identical phrases.

Line 294: "sniff tests"? Sloppy, at best. Sniff for RH changes? For odiferous tracers? Certainly not for isotopic composition! Again one suspects authors repeat text from ship-board operators / data providers but seems seriously out-of-place in a careful presentation of isotope data.

Line 427, Section 3 on data processing expends several sentences on water vapor quantification, both as mole fraction and as humidity. Surprised because not addressed in measurement sections?

Line 439: "water vapor isotopic measurements varied widely". Okay, not really a surprise, but have authors given us tools to adjust expectations and make use? For this reader, no.

Side-by-side systems at BCO should have provided "reference dataset with 1 minute time resolution". Failed. Authors conclude (line 793): "unexpected discrepancy between the BCO analyzers". Comparable systems on ATR and P-3 also failed intercomparison criteria. Data not bad from ATR (albeit with uncertain response times and corrections) but not - unfortunately - comparable to P-3 data which, apparently, only reference to prior P-3 data. Comparable systems on ships? Only barely useful. Authors know these discrepancies better than any reader but fail to provide a coherent summary. If they can't extract useful summary, who can?

Authors informed assessments of data utility (e.g. Section 4):

For vapor phase, perhaps a "subtle" (or, later, "very subtle) latitudinal pattern emerges. This reader can neither see nor credit such spatial patterns but accepts that authors and other users might. These cautions need to move earlier, e.g. in abstract?

Storage effects, which vary from 'frozen' to even 'poisoned then frozen' to room temperature and even 'subject to drastic heating', impose evaporation and biological effects on isotope

ratios. Authors recognize such issues and provide (where possible) summaries of storage protocols but only rarely deal with the larger issue? E.g. Brown samples should differ substantially from Meteor samples due to differences in storage? Systematic or erratic? Not clear and not well addressed?

Line 1425: Given the scale of aircraft tracks, land mass (grey) in Figure 2 represents South America with Trinidad/Tobago clearly visible. Barbados (13N, 59W), apparently in black, fails to appear to these old eyes even under extreme zoom. All land masses should stay dark grey, particularly if you want color matching to Fig 3. Show location of Deebles Pt BCO? As readers find later, this scale driven by satellite products while less helpful for immediate locale.

Authors make extensive reference to and use of column-integrated satellite products, on two or more spatial scales. Not surprising given EUREC4A relevance and motivation, and authors have offered good access and reasonable interpretation. Summary (in my words): not bad, nothing in remotely sensed data proves or disproves EUREC4A in situ data but subsequent users should take great care in any such intercomparisons for a variety of reasons. Some such caution should emerge as a clearer outcome?

Because of focus on vertical profiles driven by remote sensing, this reader notes again absence of radiosonde profiles (e.g. BCO must launch sondes daily) and of dropsonde profiles from HALO and P-3. Because EUREC4A expended efforts in track planning and resources in sondes themselves, and because correlation with water vapor / humidity turns out such an important factor in isotope measurements, why have authors not at least mentioned sonde humidity profiles? Even to say 'not useful'. To this readers, seems a strange omission.

Authors use term 'diurnal' when in fact they mean 'diel'. Strictly, diurnal refers to daylight, nocturnal refers to night, diel refers to full 24-hour cycle.