I have now completed my review of the manuscript of Dimitru et al. I think it is an useful contribution with several interesting considerations, which would be further expanded in the future works. Considering I'm not an expert of the WALIS database I don't give feedback on the database itself even if the most relevant information seem to have been considered. I have several points along the text which I can summarise in some general comments:

- From the text there is no a clear discriminant petrographic, geochemical and morphological criteria to separate POS from other speleothems which forms in freshwater pools in caves. I think this would be very useful to give this description to clarify that these are unique speleothems typology.

A: We agree that this problem could be a concern and should be more extensively discussed. Nevertheless, there are only a handful of such studies on POS, mainly because their occurrence in coastal caves at distinct elevations clearly relate them with present and past still sea level stands. In order to highlight the morphological, geochemical and petrographic particularities of POS, we included in the manuscript the following text starting with line 80:

"With very few exceptions, the morphology of the POS is clearly different from that of speleothems precipitated at the fresh water level in pools from non-coastal caves, e.g., shelfstones and subaqueous freshwater pool spar, on which the overgrowths are truncated in the upper part and mainly accrete under the water level. Furthermore, the carbonate deposition of these speleothems is not symmetric with respect to the water level and the tide range, which is a particularity of POS. The only instance when POS form just under the water level is when the preexisting vadose speleothem (i.e., stalagmite) was not long enough to capture the full range of the tide, which is responsible for their spherical or elliptical morphology. POS can take a variety of shapes and sizes, depending on the morphology of the vadose support, for how long they were immersed in the cave's brackish water, and the tide amplitude. Only few petrological and geochemical studies have been performed so far (Pomar et al., 1976; Ginés et al., 2005, 2012; Csoma et al., 2006). The mineralogical and crystallographical data indicate calcite as the dominant phase with fibrous, elongated, and isometric crystals, but radial-fibrous/acicular aragonitic fabric can exceed 70 % in some samples (Ginés et al., 2012). A limited number of stable isotopes analyses showed an isotopic evolution towards heavier composition through the MIS 5a and 5e possibly due to excessive marine water intrusion in the cave ponds (Vesica et al. 2000). More in-depth studies have been undertaken to investigate the POS precipitation conditions and the relationships between surface conditions (temperature, barometric pressure, precipitation, tidal level of the sea) and the microenvironment of coastal caves (temperature, partial pressure of CO_2, and water level; Boop et al., 2014). The distinction between POS and shelfstones (flat deposits attached to cave walls or on partly immersed speleothems that grow inwards from the edge of the pool/speleothem) is clearly described in Onac et al. (2012)."

- SVS are basically terrestrial limiting points. The use of hiatus as indicator of sea level submersion in absence of other clear evidences is probably dangerous and risk to be overexploited (hiatuses form in speleothems form many reasons). This is clearly stated in the manuscript. But then is not considered anymore as criteria and probably a more critical approach for previous data should be considered.

A: The reviewer is absolutely right in that SVS are terrestrial limiting points. Various approaches were considered in tackling the presence of hiatuses, which as the reviewer

mentioned, could be due to other climatic and hydrologic factors. Detailed petrographic studies can confidently assess what caused a particular growth hiatus, especially if a speleothem is submerged. During the inundation, the following characteristic features may form: i) the dissolution at the halocline produces corroded layers; ii) biogenic encrustations; iii) traces of marine borings; and iv) deposition of various trace elements or minerals (halite, gypsum, etc.). The carbonate layer just below the hiatus will provide a maximum age estimate for when this location in the cave was air-filled and sea level was positioned below the speleothem elevation. For better understanding the limitations of the SVS as sea-level indicators we rewrote the introductory paragraph from Submerged vadose speleothems section from line 192-206:

"Speleothems such as stalactites and stalagmites form in air-filled passages, thus their periods of growth indicate times when sea level was lower; hence they are sea-level terrestrial limiting points. For vadose speleothems that are subject to sea-level submergence, hiatuses (i.e., no carbonate deposition) can be correlated with periods when sea level rose and inundated the cave causing speleothem growth to cease. However, speleothem growth cessation is not always related to sea level rise as other climatic and hydrologic factors could stop carbonate precipitation. When growth cessation is sea-level related, particular mineralogical and/or biological features can be visible using petrography. Some of these include: i) corroded layers when dissolution happens at the halocline; ii) biogenic encrustations; iii) traces of marine borings; and iv) deposition of various trace elements or minerals (halite, gypsum, etc.). Details regarding ways of deciphering different types of growth hiatuses are presented by Onac et al. (2012) and van Hengstum et al. (2015). Dating the carbonate layer immediately above each of these hiatuses provides a minimum estimate of when the cave became air-filled again constraining the minimum age for the sea-level fall. The carbonate layer below a hiatus indicates the maximum age, assuming no post-depositional alteration of the exposed surfaces, for when this location in the cave was air-filled and the sea level was clearly below the speleothem elevation. It is worth noting that the earliest layers deposited above the hiatuses are protected by further carbonate precipitation, whereas those below the hiatuses are susceptible to diagenetic alteration."

- Detrital correction in speleothem dating is critical. Probably a short mention on the fact that different laboratories applies different correction is useful (also in the past). It would be useful to have a range of 232Th/230Th values found is POS speleothems for the reader in the text.

A: We included this information in the revised manuscript and the text now reads as follows (lines 283-297):

"The correction for the initial non-radiogenic sources (i.e., hydrogenous, colloidal and carbonate or other detrital components; Richards et al., 2012) of ^{230}Th incorporated at the time of speleothem deposition is extremely important for age calculation and is sensitive for samples that contain very little uranium or an abundance of detrital thorium. The $^{230}Th/^{232}Th$ activity ratio of 0.825 with an arbitrarily assigned uncertainty of 50% found in the mean bulk Earth or upper continental crustal has been commonly assumed for initial ^{230}Th corrections. However, several studies have shown that this value may not cover all situations. Therefore, laboratories apply different corrections for the non-radiogenic detrital ^{230}Th fraction through either direct measurement of sediments associated with speleothems (Hoffmann et al., 2018) or computed

isochron methods and stratigraphical constraints (Hellstrom, 2006; Richards et al., 2012). Most POS included in this database fulfill the criterion suggested by Hellstrom (2006) that samples with ratios of $^{230}Th/^{232}Th$ higher than 300 are considered clean, with very few samples having lower such ratio values (Tuccimei et al., 2007). However, the use of this threshold value is arbitrary and depends on the ratio used for initial Th."

- Along the text there are many sentences unclear and/or not very precise (in my opinion). I have suggested modification. Some sentences need to be supported by references.
A: In the revised manuscript we addressed your comments and suggestions and included the requested references.

Overall the manuscript is easy to read (even if not all sentences are consequential) and general conclusions interesting even if probably (considering the nature of the special issue and that of the manuscript) a section including some general more methodological approach in selecting material and advices as use data for some conclusion would be useful.
A: We thank you for your suggestion. We consider including in the manuscript the following section with the necessary information that we strongly encourage researchers publishing new sea-level studies based on speleothems to report.

"To build a more valuable dataset that will have more longevity and use within the discipline, we strongly encourage researchers publishing new sea-level studies based on speleothems to include the following information:

- *Sea-level indicator and its relationship to sea level: i) site location (latitude and longitude of the cave); ii) the elevation of the sea-level indicator, the instrument type used and its precision, and the error associated with the elevation measurement (when using barometric altimeter or diver depth gauge for submerged samples, the elevations should be adjusted for density profile); iii) the sea level datum to which the elevations are referred and how the indicative meaning has been quantified.*
- *Screening results: XRD, petrography, and polarizing/scanning electron imaging, including information on mineral assemblage, as well as diagenetic and crystallization descriptions (e.g., fabric).*
- *U-series data: In order to collectively improve the utility of U-series data we encourage researchers publishing new sea-level studies based on speleothems to follow the recommendations suggested by Dutton et al. (2017) in reporting their data. These authors specify the required data to enable calculation and, if needed, re-calculation of the same ages using different parameters and also, to facilitate the interpretation in the context of other studies. The checklist of minimum data to report includes: uncertainties for all parameters, state whether uncertainties on ages include decay constant uncertainties; Names, descriptions, and reference values of reference materials; Decay constants; Isotopes in spike and method of spike calibration; Method of calibration for all activity or atom ratios reported; Activity or atom ratios for $^{230}Th/^{238}U$ (or $^{230}Th/^{234}U$) and $^{234}U/^{238}U$; $^{230}Th/^{232}Th$ activity or atom ratio; Details of procedures and values used to interpret ages using isochrons or other models; Date of analysis or reference age (e.g., BP, b2k, etc.). These recommendations will increase the usefulness of this type of analytical results in the U-series geochronology community (Dutton et al., 2017). We*

also recommend reporting continuous growth rate which allows to better define the onset and cessation of deposition for either POS or SVS samples.

Specific comments (generally minor)
Line 40 ".... (Capron et al., 2019), and MIS 5e is considered an analog for the Holocene." The Holocene is quite different in terms of insolation and sea-level history. Please avoid oversimplification. MIS5e is not a good analogue for the Holocene, but it is the closest interglacial we can study with relatively good details. The main point is that MIS5e has temperature higher than pre-industrial Holocene, but other boundary conditions are very different.
A: We agree with your comment and the text now reads: "MIS 5e is considered a potential analog for the future sea-level rise due to anthropogenic global warming since temperatures were on average ~ 1.5 °C higher than today (relative to the AD 1961–1990 period; Turney and Jones, 2010)."

Line 43 ". . .uncertainties in the reconstructed sea level." Please Insert a reference
Lines 42-43 "Fossil corals can be dated to relatively high precision but have meter scale uncertainties in the reconstructed sea level" Please insert references
A: We cited two of the main global compilations of corals sea-level indicators for MIS 5e: Hibbert et al., 2016 and Chutcharavan and Dutton, 2021, where the meter-scale constrained paleowater depth uncertainties are described in detail.

Lines 43-44 "Other indicators such as erosional notches pinpoint sea level, but lack age control". Please adds citation Are you sure you want refer to erosional notches (they
are not the best, but in case I can suggest Bini et al. 2014 Earth Surface Processes and Landforms, 39 (11),1550-1558). Note that this is the same problem for tidal notches, probably some like erosional sea level markers are difficult to be dated? Or? Some more general?
A: We agree that notches are not the best sea level indicators and we had mentioned in our text that they lack age control. Thank you for suggesting Bini et al. (2014). This reference and Antonioli et al. (2015) are now both included in the revised manuscript as examples of tidal notches being used to estimate sea level position.

Lines 44-45 For this reason, there is a growing demand in exploring additional sea level indicators that can complement the information derived from fossil corals, while simultaneously having robust chronology. Maybe the sentence is not completely true most of the indicators are well known but the point is to clarify the indicative meaning and to date correctly them.
A: The text was revised to read: "For this reason, there is a growing demand in exploring sea-level indicators that can simultaneously provide a robust chronology and a clear indicative meaning."

Line 46 ". . .as coral reefs (Thompson et al., 2011). . ." are these unique of karst environment?
A: Thank you for noting this mistake, as coral reefs are not necessarily associated with karst environments and consequently, we removed them from the list of sea level indicators specific to karst environments.

Line 50 ". . ..submerged vadose speleothems (SVS; suggesting maximum elevations of sea level position)." Not very clear. Why they should be maximum elevation? They indicate the cave inundation (see your line 80) or air filling, so they are terrestrial limiting points. I think we must be conservative in these concept or be more clear in the explanation I have the same observation to other points

A: The confusion comes from the fact that we have not included a more thorough discussion regarding the meaning of hiatuses in SVS. This has been now clearly explained in Section 1.1. - "The relationship between SVS deposition and sea-level changes", where we included the concept of "terrestrial limiting points" and also a brief explanation for the relationship between carbonate layers below and above a given hiatus in SVS as presented at your previous comment (lines 192-206).

Line 95 " was actually located throughout the bulk of the rise-fall cycle (Richards et al., 1994; Suric´ et al., 2009). Therefore, it can be difficult interpreting the relationship between vadose speleothems growth and sea-level history." Yes, I agree. Translating in a few word they are terrestrial limiting points? Is that you want to say? Probably this concept can be introduced here considering the general nature of the special issue, to avoid to return to the same concept later. I think this point should highlighter later in the conclusion or in a special section where it should be stated that use of SVS hiatus need to be considered with cautions. Maybe showing some examples.

A: We included the concept of terrestrial limiting points at your previous suggestion. We also added the following text in the Conclusions section:

Line 502-503: "This dataset paper represents the first compilation of cave deposits (POS as sea level index points and SVS as terrestrial limiting points) used to reconstruct sea-level histories for the last interglacial period."

Line 508-511: "Intervals of SVS growth is indicative of times when sea level must have been lower than their elevation. Hiatuses can also be used to indicate sea level position, however, they must be cautiously interpreted since there are several reasons which can lead to their occurrence. Hiatuses associated with biogenic encrustations or borings could potentially indicate more exactly where sea level was with respect to the SVS."

Lines 166-170 "Several tools with different uncertainties have been used to measure the elevation of the cave deposits: barometric altimeter (± 0.1 m; Moseley et al., 2013), metered tape or rod (± 0.5 m; Harmon et al., 1978), inclinometer (± 170 0.05 m; Dorale et., 2010)." I think here there is some confusion between instrumental precision and accuracy of the measure. Not clear. For instance barometric altimeter can give you this kind of precision, but it is quite far from the accuracy of the elevation measurement. All of this have been reported to local datum? Just to clarify.

A: The uncertainties cited in the paper are the errors in measurements as reported by the authors in their respective studies. Yes, all samples have been reported relative to present mean sea level and we included this information in the revised manuscript in line 216.

Line 175 ". . ..or that precise measurements are not so relevant because the uncertainties related to local tectonics are much larger (Suric´ et al., 2009)." Sentence unclear precise measurements are mandatory. Maybe delete?

A: We agree that precise measurements are mandatory, but nonetheless, the meaning of the sentence was just to emphasize that sometimes the corrections (e.g., tectonic uplift, GIA) are so much larger that the elevation uncertainty becomes less relevant when estimating a past sea level position. For more clarity, we updated the text to (line 223): "…or that the uncertainties related to local tectonics are so much larger that the measurement uncertainty (Surić et al., 2009).

Section 2.5 "Given that speleothems are less likely subjected to alteration and diagenesis when compared with organic precipitation of corals, an elaborate sample pre- screening is not critical. Thus, only some of the studies compiled here report the mineral assemblage of the samples by X-ray diffraction (Suric´ et al., 2009; De Waele et al., 2018). However, we cannot exclude the possibility that screening was performed, but not reported."

This is misleading section. XRD are fundamental in corals because they are aragonitic and tend to transform in calcite. Most speleothems are not aragonitic but calcitic. However, you stated at line 420 (why not before) that "The phreatic overgrowth mechanism that deposits calcite/aragonite at sea level. . .." So the problem for POS is real, and aragonite risk to be recrystalised all the same. However, it is a fundamental practice in speleothem science to select samples after a screening in thin section because also calcite can experience open-system behaviour. So this sentence should clearly state that (especially for POV and SVS) a check for potential alteration is necessary. A good case is the discussion made by De Waale et al 2017,2018, but for vadose speleothems there are many useful references for checking potential alteration. I think this section should be rewritten. I think what is lacking here which are the criteria to cite that POV are really POV and not formed in a lacustrine environment. I think there are not a very precise description here to discriminate them and to charaterised better POV.

Line 201-202 "While not always necessary, including information on mineral assemblage, and diagenetic and crystalline descriptions are useful." I think this is a mistake and I don't' think is the though of the writers. Petrographic and diagenetic description is fundamental and mandatory!

There is no mention here on the clastic contamination (but it is later). Presumably in POV would be minor but according the compilation proposed it would be nice to have a range here of measured 232Th/230Th and eventually to give a range of correction performed by different lavoratories. This can have an effect on the final age.

A: We agree and we rewrote this paragraph and it reads now as follows (lines 255-267):

"The geochemical setting and sample mineralogy may dictate the susceptibility to alteration. For example, samples that show conversion of aragonite to calcite or calcite recrystallization, could have been subjected to uranium loss, which is an important factor that impacts U-Th ages (Lachniet et al., 2012; Bajo et al., 2016). To allow recognition of diagenetic fabrics, XRD screening is desirable for dating purposes (aragonite is preferred vs calcite). In order to make the best selection of samples for successful dating, we encourage the use of petrographic investigation as well. Thin sections can help to best identify the speleothem layers just below and above the hiatus for dating purpose, and they also reveal the internal structure, hence areas affected by recrystallization can be avoided for dating. However, only some of the samples

compiled here have their mineralogy documented by X-ray diffraction (Surić et al., 2009; De Waele et al., 2018). De Waele et al. (2017), for example, complemented the screening method with petrographic investigations (thin sections) and imaging using scanning electron microscopy. We do not exclude the possibility that screening was performed in the other publications, but it has been not reported. For future studies, we recommend adding information on mineral assemblage, as well as diagenetic and crystalline descriptions."

We addressed the differences between POS and speleothems formed in cave pools as well as the detrital Th correction in our response to your comment above.

Line 215 "The development of TIMS and then MC-ICP MS in measuring U-series isotopes constituted a major step forward from the alpha spectrometric method." Maybe here a reference is necessary.
A: We added the reference: Hoffmann et al. (2007).

Line 223-224 "Hellstrom (2006) suggested that a ratio of 230Th/232Th larger than 300 can be considered as an indicator of clean samples not requiring correction for detrital thorium." It is probably useful to mention that different laboratories applies different correction (e.g. Bulk upper crust or iterative calculation of the initial ratio) (see also previous point).
A: We already addressed this concern in response to one of your previous comments.

Line 232 ". . ...age errors are now possible to ± 100 years. . .," yes, but this kind of error for speleothems is probably just an analytical error. Considering clastic contamination and growth rate to have such a high "accuracy" is highly improbable (but of course not impossible)."
A: We have now completed this sentence and it now reads (line 307):

"However, with the improvements made using MC-ICP MS (Cheng et al., 2013), ages on high quality samples (i.e., aragonite mineralogy, high U content, insignificant ^{230}Th correction) of last interglacial are now possible to uncertainties of ± 100 years (2σ), making how the age is reported more important (i.e., BP)."

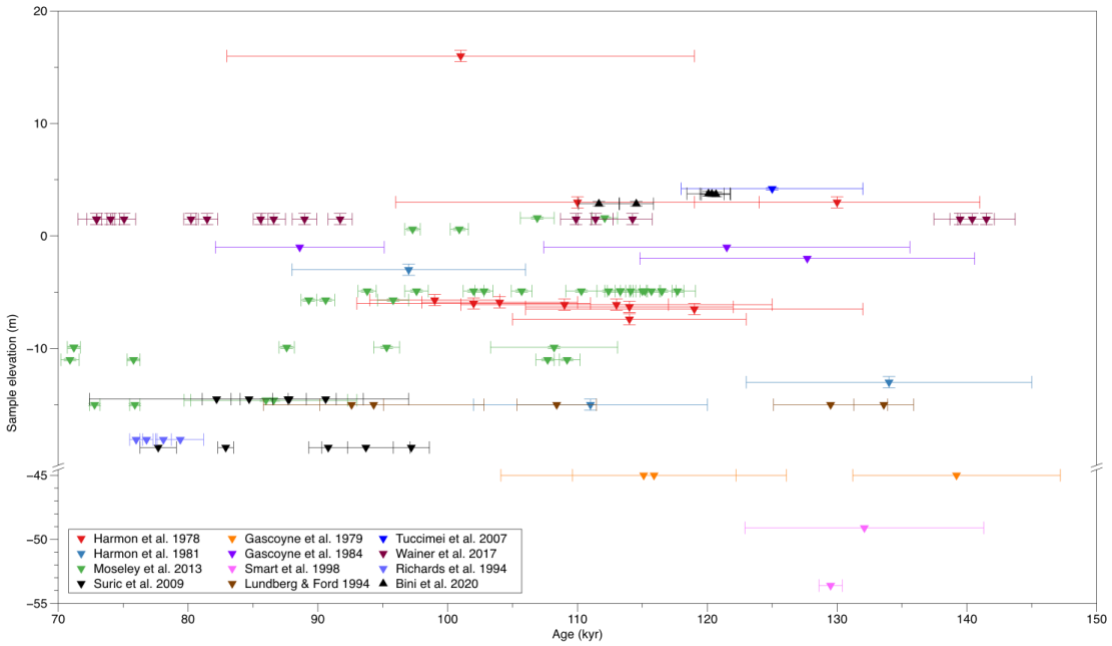
Line 241-242". . ... but the interpretation is hampered by the challenges of finding pristine and well-preserved corals and to the uncertainties related to the water depths above the corals." Considering the general sense of this short introduction in the conclusion the point of "well-preserved" is out of scope here.
*A: Not necessarily. A well-preserved coral will return a very precise age and only **if** the depth of the sample can be estimated with a good approximation, sea-level position could be reasonably reconstructed.*

Lines 243-245 "i) POS have the ability to define the discrete position (Fig. 3), hence, they are considered sea level index points, whereas ii) SVS provide only an upper bound, and they are called limiting points (Fig. 4)." I'm wondering if considering the nature of the special issue this discussion on the indicative meaning of the two archives can just mentioned before and this section starting directly with the discussion of the indicative meaning of POS.
A: We agree. We define POS as sea level index points and SVS as terrestrial limiting points in the introduction section, hence, we avoid using here redundant information.

Line 255 ". . ..with absolute errors. . .." What do you mean precisely?
A: For clarity, we replaced "absolute errors" with "ages uncertainties".

Line 315-329 I think that SVS are just terrestrial limiting point. So they cannot used to infer any special cases for the position of the RSL. Also hiatuses if not accompanied by clear evidences of marine deposition, for speleothems above sea level are dangerous to be considered as indication RSL changes. A more critical approach probably is necessary also considering the discussion you made at the beginning of the manuscript. Moreover, here would be important to discuss a little also Yucatan Peninsula (which is mentioned as important at line 342)
A: The ways in which a SVS could be used in reconstructing sea level position is now discussed in more details in Section 1.1, where we showed that hiatuses are not only caused by sea-level rise. Nevertheless, some features (biologic encrustations, borings) associated with hiatuses in SVS are clearly indicative of sea level. How precisely these are, is a different issue. Yet, for areas where no other RSL indicators exist, SVS could be used to at least estimate the position of past sea levels.

Figure 4. SVS elevation indicating maximum positions of RSL during the time of their deposition. Not very clear SVS are terrestrial limiting point so the RSL is below them, and it is not always clear when they stop, it is an assumption that they stop just during flooding. They can stop also before. The top can experience dissolution and so on. Just a note of caution. Considering Fig. 4 there also included not submerged speleothems now above sea level and (on the contrary some need to better explained to the reader). If it is the case probably some other papers are forget. For instance in the Mediterranean there is the recently published paper Bini et al. 2020 QSR but there are also others. So, I think probably there Maybe the original paper explain why these speleothems can be considered SVS, but this not emerge from the manuscript. Note that Wainer et al. stated: "The timing of growth of speleothems, at elevations close to sea level can provide records of minimum relative sea level (RSL) (note you often state maximum?).
A: We updated Figure 4 and its caption which now reads: "SVS (terrestrial limiting points) sample elevations and their U-series ages indicating RSL below (down-pointing triangles) or above (up-pointing triangles) them. Note that these are ages only and not growth periods. None of the data are corrected for GIA or long-term deformation."



We also included references that we overlooked in our first draft. As we explained in our answers above, the intervals of speleothems growth are indicative of maximum sea levels. It is unclear to us why Wainer et al. associate the duration of the hiatuses with minimum RSL in their abstract. The same authors state later in their text that: "the duration of the hiatuses requires a ***minimum*** *RSL above the elevation of the ceiling from which the stalactite grew".*

In this study we used U–Th dating to precisely date growth periods of speleothems from Bermuda which were found close to modern-day sea level." This is a special prerequisite (even if in my opinion growth stop is not enough evidence of sea level changes. . ...). I think the reader looking at figure 4 maybe confused, so some more explanation is necessary.
A: The reviewer is correct in assuming that not all speleothem growth is due to sea level rise. However, in coastal caves subjected to periodic flooding this is the main reason. We updated Figure 4 and its caption which now clarifies that RSL must be below the samples marked by the down-pointing triangles and above the ones marked by up-pointing triangles.

Overall, I think the manuscript needs some clarification and expansion of the discussion in some points but careful (moderate) revision I hope will help improving the general quality and importance of this contribution.
A: Thank you for your useful suggestions which have been very helpful in improving the manuscript.