Biogeosciences Discuss.,
doi:10.5194/bg-2017-38-SC1, 2017

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Also tropical freshwater ostracods show a seasonal life cycle" *by* Juliane Meyer et al.

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Received and published: 26 April 2017

We thank the referee Jonathan Holmes for his constructive comments on the open discussion paper. Although, he thinks it is an interesting dataset there are some important points that needs to be explained and/or changed. Comments will be given point by point as received in the referee comments:

Title. Southern Florida is subtropical, not tropical. The premise that the data can be used to argue that tropical ostracods show a seasonal lifecycle therefore needs to be re-evaluated and the title needs to be changed. The seasonal range of temperatures in Florida is quite large, for example, meaning that this might impact the timing of calcification of Cytheridella ilosvayi.

> Florida is located on the boundary between the tropical and subtropical region. The

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southern part of the state is defined as tropical, while the northern region is subtropical (Kottek et al., 2006). But, the transition between both climatic regions is gradual. Samples from southern watershed are all located in the tropical part of Florida, while samples from the southwestern watershed may belong to the subtropical region. However, a comparison of air temperatures and precipitation between the different watersheds did not show significant differences (we used the National Climate Change Viewer provided by the US Geological Survey) and were related to the same climate zone.

> The title will be changed from 'tropical' to '(sub-) tropical'.

> Of course our findings are limited to the northern edge of the tropical region, but the comparisons to a population of C. ilosvayi in Guatemala in the middle of the tropics also shows annual differences in their occurrence. > The influence of temperature is commented in section 5.3. But, additional discussion on the influence of temperature will be added.

Abstract. The MS includes carbon isotopes, but these are hardly mentioned in the abstract.

> Information on carbon isotopes will be added to the abstract.

Page 2 Line 22. Explain how carbon isotopes fit into the study.

> Aims of the study will be supplemented.

Page 3-4 Section 2.1. You include much more detail about the sites than is needed for this paper. Some of the information could also be summarized in a table.

> Section 2.1. will be abridged, relevant information on the sites will be integrated in table 1.

Page 5. Line 6. Here you refer to South Florida's climate as 'subtropical'

> A paragraph will be added to the section to point out the position of Florida at the

boundary between tropical and subtropical climate.

Page 7 Line 11. The 'bulked' samples, especially of 8 valves, will tend to cause averaging of the results and so reduce the variability. Previous studies investigating variability (e.g. Escobar et al., 2010 JOPL; Dixit et al., 2015, JOPL) have analyzed numerous single shells in order to assess variability. This point needs to be considered in the discussion.

> 'Bulking' is an important point comparing the variability of samples. We tried to avoid the use of multiple valves as far as possible. In most cases we used two adult valves for one measurement (if possible of the same individual) to avoid averaging. Especially in river samples, the number of single shell measurements is high. We tested the calculation of the optimal sample size (Holmes, 2008; Escobar et al., 2010; Dixit et al., 2015) for rivers (with a 10% acceptable error and a confidence level of 90%) and found, that the number of measurements from LX and CAL to be sufficient, while in Peace River the number of measurements may be too small.

> Respective comments will be given in the discussion on the averaging effect of 'bulked' samples and the number of measurements used for the comparison of within-sample variations.

> The number of used valves was stated wrong and will be corrected to 'one to nine' (page 7, line 11). Additionally, the number of valves used for each measurement will be added in the supplementary material.

Page 10. Section 4.2. Modelling the equilibrium values in terms of the isotopic composition of rainfall and water temperature is unlikely to be realistic. On lines 11-13 on the next page, you state that enrichment of heavy isotopes is considered to be constant during the year. In the absence of data to support this statement, I do not think it can be regarded as valid. For example, Sachs (2002) (which you cite), states that 'The isotopic composition of Lake Starr and Halfmoon Lake varied seasonally (fig. 15), primarily in response to net precipitation (rainfall minus evaporation).' Admittedly these sites are

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from Central Florida, not Southern Florida: however, I still feel that you need to provide evidence to support your statement about seasonally-constant evaporation if you believe that this assumption is valid, or modify your discussion if you cannot support your statement.

> The model we used refers to rivers, not lakes. In lakes evaporation is much more important than in any streaming water. The isotopic composition of rivers is always described as a mixture of overland flow and baseflow deriving from groundwater (e.g., Criss 1999; Clark and Fritz, 1996). If a river is influenced by direct evaporation this would be seen in the gradual enrichment of heavy 18O isotopes along the river. But this is not the case in the rivers we investigated. However, the enrichment of heavy isotopes in river samples that can be seen in Fig. 5 of this manuscript probably results from the addition of groundwater that has been recharged by evaporated surface water (Meyers et al., 1993; Wilcox et al., 2004; Price and Swart, 2006). This may vary seasonally, but the exact processes for the seasonal recharge of groundwater are beyond the means of this study. However, Price and Swart (2006) showed that surface water from wells and canals and groundwater in the everglades varies seasonally and are event driven (Fig. 7) with highest values in the end of the dry season and lowest values during the wet season. This is contrary to the findings of Sacks et al. (2002) and indicates that precipitation is the major influence on the isotopic composition of small surface waters in summer. Evaporation of surface water may get more important in winter, when precipitation amounts are low. But, it also has to be noted, that δ18O values of precipitation are also higher during the dry season.

> The respective sentence in page 10 will be deleted.

> Data on the isotopic composition of further river water samples will be added in a supplementary file.

> Comments on the possible influence of evaporation on the seasonal isotopic composition of the theoretical calcite will be given in the discussion.

Line 21. It is approximately 0.2 ‰ – the relationship is not linear. Also why cite Chivas et al. (1986) here? Why not cite the authors of the equation you use i.e. Kim and O'Neil (1997)?

> The reference will be changed.

Page 11 Line 26. Oxygen isotopes in your individual samples might be expected to show less variability than carbon isotopes because the latter are affected by small-scale microhabitat variations in the carbon-isotope composition of the DIC. The fact that you see the reverse could be argued to be linked to seasonal variations in evaporation, meaning that the actual water-isotope values vary more than you have modelled simply based on temperature and the isotopic composition of rainfall. In any case, comparing variability of carbon and oxygen is only really meaningful if you know the actual seasonal variation in water and DIC isotope values.

> The sentence will be deleted as we have no further information on the seasonal variation of DIC isotopes.

Page 12 Section 5.1. Much of the detail in this section can be cut as it is not really relevant to the main focus of the paper.

> Much of the details on the ionic composition were given in order to illustrate potential influences on the seasonal isotopic composition.

> Some details on the ionic composition of the sites will be summarized and shortened.

Page 13. Line 21. Doesn't this statement suggest that evaporation might also vary seasonally as well?

> As stated before, direct evaporation has a minor influence on rivers.

> Paragraphs will be added in the manuscript on the seasonal influence of evaporation on rivers.

Page 14 Section 5.2 and figure 7. This is the key figure in the paper and it suggests

to me that the specimens of Cytheridella ilosvayi may have calcified quite close to the sampling time – this would explain the fairly strong correlation between the measured isotope composition of the water and the DIC, and the isotopic composition of the ostracod shells.

> This is already considered in this section. If calcification took place close to the sampling, than the within-sample variability has to co-vary with the calculated theoretical calcite range before sampling. But, this is not the case. The further discussion on the within sample variability aims to examine if there is any period during the year where the ranges fit to each other.

Page 15-16 Line 33 (page 15) to line 2 (page 16). But surely this depends on the length of time over which the shells calcified. If they calcified over a short time in the season, then the degree of variability would be small even if site conditions changed seasonally. In addition, you need to consider the fact that you did not measure single shells (see my point above). This will have the effect of reducing the observed variability.

> I agree with the referee, the isotopic variation will depend on the length of time in which a species calcifies and will only display the variation of the environment during this time. The exact duration of this timescale is unclear, but considering the small climatic differences within South Florida, this will not differ significantly. Thus, comparing the isotopic range from several populations can only be environmentally induced.

> As stated before discussion on bulked valve measurements will be considered.

Page 16 Lines 11-12. I could not see evidence in the cited paper for a 1‰ range in lake water in Lake Okeechobee. For sure, there are a few datapoints from this lake in Figure 4 of Harvey and McCormick, but it is unclear whether these are representative of seasonal variations in the isotopic composition of Lake Okeechobee or are samples from different locations in the lake from one single sampling period. Also, by themselves, these data do not support the suggestion that the amount of evaporation of this lake is seasonally constant (see also my point above).

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> Considering the uncertainty of the referred data, this sentence will be rewritten.

Page 17. Section 5.3. This method will only work if you can assume that the isotopic composition of water at each of your sites is closely coupled to the isotopic composition of rainfall. As noted above, you have very little evidence to support this. As I also note above, figure 7 is the key figure in the paper and it suggests to me that the specimens of Cytheridella ilosvayi may have calcified quite close to the sampling time. In this case, I wonder whether these theoretical calcite calculations are really very necessary.

> As I noted above, rivers are influenced by the isotopic composition of surface runoff from precipitation and groundwater inflow, which is again seasonally controlled by precipitation.

> Respective references and comments will be given to support the applied model approach and qualitative discussion on the influence of evaporation will be given.

Page 18. Lines 17-19. I am not convinced that this is valid, because your calculations of theoretic equilibrium calcite composition assume that you know the isotopic composition of the water at each site in detail, and I am not convinced that you do.

> As every model approach, the calculation is an approximation of the real situation at any site. Any other comparison of theoretical calcite from environmental studies has to deal with assumptions to overcome uncertainties between the calcification time and sampling (e.g., 'best fit' correlation of Decrouy 2009). As shown before, the isotopic variation of rivers mainly depends on the isotopic composition of groundwater and precipitation. Precipitation is also the main source of groundwater and its isotopic composition develops similar to precipitation will lower amplitudes. We assume that the monthly variation of river water is restricted to the isotopic variation of precipitation. Then, our calculations represent the highest possible variation of the theoretical calcite. However, at page 18, lines 20 to 30 we discuss the reduction of the variation of the calculated calcite (by a high influence of groundwater) and the possibility of other calcification times for Cytheridella during the year.

Line 34. Cytheridella ilosvayi may be a neotropical species, but Florida is a subtropical locality and the seasonal variations in temperature, although certainly not as large as at higher latitudes, are not negligible. In any case, it is misleading to state that your work shows that 'tropical' ostracods show seasonality.

> As stated before, the southern part of Florida is tropical indeed and temperature differences will be discussed in more detail.

General comment. You emphasize oxygen-isotopes in your paper. Although the carbon-isotope results are referred to, your comments about these are more limited and speculative, not least because you have very little information about the variations in the carbon-isotope composition of the DIC. It would be useful to comment on the carbon-isotope data in a little more detail.

> More detailed discussion will be given.

Technical comments

Page 2 Line 3 and elsewhere. von Grafenstein (not Von)

> This will be changed.

Line 10. No need to include the word 'stable'

> This will be deleted.

Page 5 Lines 2-4. What has happened here?

> This was a relic from the manuscript preparation from the Copernicus Word template and will be deleted

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