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Interactive comment on "A global viral oceanography database (gVOD)" *by* Le Xie et al.

Le Xie et al.

xiele@stu.xmu.edu.cn

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We thank both reviewers for their very constructive comments and suggestions that greatly helped us improve our manuscript. We have responded (in blue fonts) to the comments point by point and revised the manuscript accordingly.

To Reviewer 1:

The authors of the manuscript construct the first global viral oceanography database containing viral abundance (VA) and viral production (VP) data with host and environmental parameters which are collected from published papers. Based on the database, the authors estimate the total viral number and biomass in the global ocean, and compare the technological bias of different methods of data generation. This database can be valuable for field and modeling studies in marine ecology, biogeochemistry and other areas of oceanography. This manuscript needs to be improved before accep-

tance for publication.

Response: We would thank the reviewer for her/his careful reading and the positive comments on our work. We have improved the quality of the manuscript according to your valuable suggestions. Please see the detailed response below.

Specific comments:
1) Line 175-180: "VA counted by the three methods distribute in similar ranges and do not show systematic difference". In the database, each data point is only used one of three methods to obtain the viral population data. So, how do the authors compare the difference of three methods? Are there some samples which use two of the three methods?

Response: Sorry for the confusion. Yes, the reviewer was correct that in our database, the viral abundance of each sample was determined by only one of the three methods. Thus, we were not trying to directly compare three methods which required parallel experiments for same samples. Please note that there were some classic and excellent papers directly compared these methods such as Brussaard et al., 2010; Marie et al., 1999; Payet and Suttle, 2008 but their data can not be included in our database due to the lack of crucial information (e.g., sampling position, exact number, etc.). Instead, our analysis here supported previous technical comparison studies that viral counts with different methods were consistent in similar environments (although for different samples). Nevertheless, our database provides references for methodological comparison in the future.

We then added the discussion in the revised manuscript (**line 175-181**): "Previous studies have showed that the VA counted using FCM, which became more popular in studies after 2014 (Table S1), had a strong correlation with those using EFM (Brussaard et al., 2010; Marie et al., 1999; Payet and Suttle, 2008). Our data demonstrated that the VA obtained by FCM and EFM methods has consistent results in similar environments. For deep open ocean samples, VA using TEM are substantially lower

than those using the other two methods (Fig. 8). But considering much fewer VA data points using TEM than others (Fig. 8 Table S1), we cannot conclude TEM substantially underestimated VA in the deep water samples. Nevertheless, our database provides references for methodological comparison in the future."

References:
Brussaard, C. P. D., Payet, J. P., Winter, C., and Weinbauer, M. G.: Quantification of aquatic viruses by flow cytometry. In: Manual of aquatic viral ecology, https://doi.org/10.4319/mave.2010.978-0-9845591-0-7.102, 2010.
Marie, D., Brussaard, C. P. D., Thyrhaug, R., Bratbak, G., and Vaulot, D.: Enumeration of marine viruses in culture and natural samples by flow cytometry, Appl Environ Microbiol, 65, 45-52, 10.1128/AEM.65.1.45-52.1999, 1999.
Payet, J. P. and Suttle, C. A.: Physical and biological correlates of virus dynamics in the southern Beaufort Sea and Amundsen Gulf, J Marine Syst, 74, 933−945, https://doi.org/10.1016/j.jmarsys.2007.11.002, 2008.

2) Line 196-206: It is same as above. Five methods are used to generate the VP data. But no sample is used more than two of the five methods. The authors should describe how they compare the differences of these methods.

Response: The reviewer was correct that only one or two methods were used to determine the lytic VP of each sample in our database. As that for VA, we had not directly compared these five methods. However, in similar environments, our statistics showed that the lytic VP rates determined by FLVT and VRA were higher than those measured by RIA. This also provided certain support for previous methods comparison studies (Helton et al., 2005; Karuza et al., 2010; Rastelli et al., 2016).

we added the discussion in the revised manuscript to avoid confusion (**Line 198-209)**: "Several studies have tried to compare different approaches estimating the lytic VP, revealing that the VRA method was more reliable and less laborious, compared to

the probable overestimation by FLVT approach and the potential underestimation by RIA method, though such comparisons were mainly constrained to the coastal ocean (Helton et al., 2005; Karuza et al., 2010; Rastelli et al., 2016; Winget et al., 2005). Additionally, although a meaningful comparison of reported lytic VP values between disparate marine ecosystems is complicated by the inherent variability among approaches, the lytic VP rates in this database might provide a tentative global-scale insight into methodological comparison. Our statistics showed that, in similar environments, the lytic VP rates determined by FLVT and VRA were higher than those measured by RIA. For coastal samples, such difference among methods was not obvious (Fig. 9). However, due to the limited number of samples using the methods other than VRA (Fig. 9 and Table S2), we did not have adequate data to tell if the difference in VP was caused by the measurement methods, or the randomness of the samples. Hence, more measurements of lytic VP using multiple approaches simultaneously will be certainly needed to better evaluate the differences among them."

References:
Helton, R. R., Cottrell, M. T., Kirchman, D. L., and Wommack, K. E.: Evaluation of incubation-based methods for estimating virioplankton production in estuaries, Aquatic Microbial Ecology, 41, 209-219, DOI 10.3354/ame041209, 2005.
Karuza, A., Del Negro, P., Crevatin, E., and Fonda Umani, S.: Viral production in the Gulf of Trieste (Northern Adriatic Sea): Preliminary results using different methodological approaches, J Exp Mar Biol Ecol, 383, 96−104, https://doi.org/10.1016/j.jembe.2009.12.003, 2010.
Rastelli, E., Dell'Anno, A., Corinaldesi, C., Middelboe, M., Noble, R. T., and Danovaro, R.: Quantification of viral and prokaryotic production rates in benthic ecosystems: A methods comparison, Front Microbiol, 7, 1501, https://doi.org/10.3389/fmicb.2016.01501, 2016.

3) In Figure 2, it may be better that the figure of each fraction is shown.

Response: Thank you for the specific suggestion. We added the percentage of each fraction in the figure (see figure 2 in the revised manuscript)