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Biogeosciences Discussions

Interactive comment on "Understanding Mn-nodule distribution and related deep-sea mining impacts using AUV-based hydroacoustic sensing and optical observations" *by* Anne Peukert et al.

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Reviewer's comments for manuscript entitled 'Understanding Mn-nodule distribution and related deep-sea mining impacts using AUV-based hydroacoustic sensing and optical observations' Journal: Biogeosciences Authors: Peukert et al. A. General comments:

The manuscript deals with a detailed study on distribution of mn-nodules, associated bathymetry and impact of small-scale disturbance using ebibenthic sledge by high res-

olution mapping and imaging techniques. The study throws light on important issues such as distribution patterns of mn-nodules on the seafloor in a restricted area and the likely impact. The results offer sound inferences and important conclusions towards understanding the nodule occurrences with the associated environment that can be used as key inputs for planning of mining operations.

B. Specific comments:

In order to improve the readability and content of the manuscript, following suggestions may be considered :

1. Page 1 - Title: Suggest making it sharper. Delete 'understanding' and 'sensing' from 'Understanding Mn-nodule distribution and related deep-sea mining impacts using AUV-based hydroacoustic sensing and optical observations'.

2. Page 4 – Study area (line 28-29): Introduce a map showing general location of the study area with latitude, longitude and depth contours to give a general perspective to the reader (these details are not required for the subsequent figures given in the manuscript).

3. Page 8 – AUV based bathymetry ....abundance (line 7) : The word 'abundance' signifies 'quantity of resource per unit area (Kg/sqm)' where as here the nodule occurrence is expressed in 'percentage'. So 'abundance' should be replaced with 'coverage'.

4. Page 8 – Large-scale variability (line 24) : The term 'large-scale variability' is misleading and suggest that it can be replaced with 'Macrotopographic variability'.

5. Page 10 – Fig. 5D : Mean size of nodule is given as 6.7 cm2, 15cm2, 17.4 cm2. 'Mean size' should be replaced with 'Mean area' as size cannot be expressed as square.

6. Page 11 – Small-scale variability (line 21) : The term 'small-scale variability' is misleading and suggest that it can be replaced with 'Microtopographic variability'.

7. Page 17 – Broad-scale correlation. . .... (line 18) : Use of the term ‘Broad scale . . .’ is confusing and may be replaced with ‘Regional scale. . ..’ as it covers large area.

8. Page 17 - lines 25-28: Comment – Regional differences in nodule exposure (burial) could also be reason for this as nodules in Central Indian Ocean appear smaller due to more sediment cover as compared to those in the Pacific which could be due to differences in current velocities that influence settling of sediments.

9. Page 19 – Broad vs small scale : In cartography ‘large (broad) scale’ means representing small distances (area) and ‘small scale’ means covering larger distances (areas) for a given unit. To avoid any confusion for the reader, suggest that authors clarify the meaning of ‘large scale’ and ‘small scale’ or make necessary corrections (for example use the terms such as ‘regional’ and ‘local’).

10. Page 19-22 – Sediment plume resettling : This section is too long and without any breaks, so difficult to follow. Suggest that it could be divided into sub-sections with individual heading if possible and/or with paragraphs.

11. Page 22 - Conclusions – line 17 : Start new para from ‘With respect to. . ..’

C. Technical / editorial comments:

1. Editorial corrections have been made in the document as track changes (attached separately). Authors are requested to see the same and accept / reject as suitable. 2. At a few places where it is not clear, a question (?) mark is inserted in the text where the authors can make necessary corrections / additions as required. 3. A few general editorial corrections required are as follows: i. Apply superscript for ‘2 (square)’ wherever required ii. All references should be in bracket / parenthesis including author and year eg. (Page 2 – line 7 : Purser et al. 2016; Vanreusel et al. 2016). iii. Ship-based and AUV based may be replaced with ship-borne and AUV-borne

D. Recommendation:

It is recommended that the paper is suitable for publication after carrying out necessary

additions / corrections as suggested.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-506, 2017.

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Fig. 1. Reviewer's comments

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Understanding Mn-nodule distribution and related deep-sea mining impacts using AUV-based hydroacoustic sensing and optical observations

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Abstract. In this study ship- and AUV-based multibeam data from the German Mn-nodule license area in the Clarion-Clipperton Zone (CCZ; eastern Pacific) are linked to ground truth data from optical imaging. Photographs obtained by an AUV enable semi-quantitative assessments of nodule coverage at a spatial resolution in the range of meters. Together with high resolution AUV bathymetry this revealed a correlation of small-scale terrain variations (<5m horizontally, <1m vertically) with nodule abundance. In the presented data set, increased nodule coverage could be correlated with slopes >1.8° and concave terrain. On a more regional scale, factors such as the geological setting (existence of horst and graben structures, sediment thickness, outcropping basement) and influence of bottom currents seem to play an essential role for the spatial variation of nodule abundance and the related hard substrate habitat. AUV imagery was also successfully employed to map the distribution of re-settled sediment following a disturbance and sediment cloud generation during a sampling deployment of an Epibenthic Sledge. Data from before and after the 'disturbance' allows a direct assessment of the impact. Automated image processing analyzed the nodule coverage at the seafloor, revealing nodule blanketing by resettling of suspended sediment within 16 hours after the disturbance. The visually detectable impact was spatially limited to a maximum of 100m distance from the disturbance track, downstream of the bottom water current. A correlation with high resolution AUV bathymetry reveals that the blanketing pattern varies in extent by tens of meters, strictly following the bathymetry, even in areas of only (?) slightly undulating seafloor (<1m vertical change). These results highlight the importance of detailed terrain knowledge when engaging in resource assessment studies for nodule abundance estimates and defining minable areas. At the same time, it shows the importance of high resolution mapping for detailed benthic habitat studies that show a heterogeneity at scales of 10m to 100m. Terrain knowledge is also needed to determine the scale of the impact by seafloor sediment blanketing during mining-operations.

Fig. 2. Manuscript with track changes