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Interactive comment on "Common features of iodate to iodide reduction amongst a diverse range of marine phytoplankton" *by* Helmke Hepach et al.

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Interactive comment on "Common features of iodate to iodide reduction amongst a diverse range of marine phytoplankton" by Helmke Hepach et al Anonymous Referee #2

General comments: This paper describes changes in iodate and iodide concentrations over the entire growth cycle in cultures of various species of phytoplankton, in order to better understand the purpose and mechanism of iodate to iodide reduction in marine phytoplankton, which would help with the development of process-based models of inorganic iodine cycling in the oceans.It clearly falls within the scope of the journal

biogeosciences and it is a clearly written, well-organised manuscript. However, I feel they should have tried to determine what the 'missing iodine' was in this study, since this is an issue that was already discussed in previous papers, and needs to be resolved. Knowing what this missing iodine is will help to achieve a better understanding of the purpose and mechanism of iodate reduction. Also, I do not entirely agree with their conclusion that I–production is a result of cell scenescence. Although this process does seem to occurr, the observation that I–production rate was often higher during the log phase clearly indicates that (an)other mechanism(s) must be at least as important (see specific comments).

Author: We thank the reviewer for this helpful review. We agree that finding the mechanism behind the 'missing iodide' may be the key to determining the processes behind iodate reduction and iodide production, especially with respect to potential functions of this process. However, we do not feel like we can resolve the 'missing iodine' any further on the basis of our experiments. We therefore strongly advice for future studies to further estimate this. We agree that cell senescence per se is not the (only) driver for iodide production, since we could see release of iodide during all stages. Senescence however does play a significant role with respect to the total iodine budget added in the beginning of the experiments as our statistical analysis shows. 'Missing iodine' decreases strongly when algal cultures reached a later stage of senescence (or the iodine budget is more balanced with progressing stage of senescence, respectively), which hints towards a release/production in the latter growth stages. This could potentially be explained with storage of iodine, either in the form of iodate or iodide, within the algal cells (which is then transformed or released later on). The latter interpretation, release after storage, is added into the respective section. Changes in the manuscript according to suggestions from Reviewer 2 will be marked in bold green.

Specific comments: l220-222, 'Media used...in this nutrient'. Since they did not measure nitrate in the culture media at the end of the experiment, nor C:N ratio in the phytoplankton, they cannot state that nitrogen was not limiting. Moreover, 2.5 μM is

not a high concentration of nitrate for microalgal cultures and since cultures stopped growing, some element (or light) must have become limiting, although not necessarily nitrogen.

Author: It is true that we did not measure nitrate. We also agree that some factor must have become limiting. With this section, we wanted to point out that nitrate was not added in low concentrations to the medium, especially with regard to nitrate values generally found in oceanic regions (Bristow et al., 2017). As the reviewer also pointed out, many cultures released iodide also during the log phase, where nitrate was surely not limiting yet. Thus, we still believe that nitrate was not involved in the process that led to iodide production from iodate. We edited accordingly.

l315-316, 'Some cultures...in the post-log phase.' I would say that in 6 of the 10 phytoplankton cultures I–production rate was higher in the log phase than in the post-log phase. l. 325-326, 'It has been established...Bluhm et al., 2010)' Also Van Bergeijk et al., 2013 (J. Phycol. 49:640-647).

Author: Of the 30 cultures we investigated, 14 had the highest release in the log phase, while 16 released most iodide post-log. We added the actual numbers and we include the reference.

l387-393, 'Overall our findings...during active growth.' In my opinion, I- production mainly as a result of cell scenescence is not evident from Figs. 2-5. Although an increase in I- is seen with a decrease in viable cells at the end of the cultures in Fig. 2b, d, e, 3b and f, in several cases I- concentration was higher at the end of the log phase (Figs 1b, c, 4b, d) than at the end of the scenescent phase, and in most cases, I- production rate was higher during the log phase than during post-log phases. It is highly unlikely thas this was due to the presence of scenescent cells, as they suggest. The fact that more IO3- was consumed than I- produced could also indicate that IO3- reduced to I-was stored as I- inside the cells, which was only released when cells lysed. I- has been described as an inorganic antioxidant in macroalgae, and although proba-

bly present at lower intracellular concentrations in microalgae, it could be used as an intracellular antioxidant during active growth. My point is that although in most cases at the end of the microalgae culture experiments, when cells were lysing, an increasing I- concentration was observed, this clearly was not the only or most important process for I- production. Please comment.

Author: We agree (also see comment further up) that cell senescence may not be crucial for iodide reduction itself but it seems from our experiments that it plays a role in iodide release (in comparison to iodate added into the medium, 'missing iodine'). Storage of iodate or iodide (or another form of iodine) may play a significant role. Thus, the phenomenon 'missing iodine' is one key factor to untangle the processes behind iodate reduction to iodide production and what exactly triggers the release or transformation to iodide, respectively. As mentioned above, this is added in now.

l412-413, 'These findings suggest...highest iodide concentrations.' It would be more correct, based on their findings, that highest iodide concentrations will be observed during later stages of phytoplankton blooms, not production rates.

Author: We agree that iodide could be stores within the cells. Thus, we corrected to "iodide release rates".

l428-430, 'Furthermore,...in marine systems.' Here also, it would be more correct to say maximum iodide concentrations, instead of production rates.

Author: We again corrected to "iodide release rates".

Technical corrections: l. 39, 'O'Dowd et al., 2002' should be O'Dowd et al., 2010

Author: Actually, the 2002-citation directly addresses iodine involvement in aerosol formation/new particle formation. Thus we prefer leaving the 2002-paper in as citation.

l. 71 (and rest of the ms), 'Kupper' should be 'Küpper'.

Author: Done.

l. 102, ‘Javier et al., 2018’ should be ‘Hernández et al., 2018’, and l. 525, ‘Javier, L. H.’ should be ‘Hernández Javier, L.’

Author: Done.

l. 186, ‘less than events 1,000 per second’ should be ‘less than 1,000 events per second’.

Author: Done.

l. 288, ‘With our estimated I:C ratios lieing...’ should be ‘With our estimated I:C ratios lying...’

Author: Done.

l. 340-341, ‘...Fig. 8Fehler!...werden.’ Delete phrase in German.

Author: Done.

References: Bristow, L. A., Mohr, W., Ahmerkamp, S., and Kuypers, M. M. M.: Nutrients that limit growth in the ocean, Curr. Biol., 27, R474-R478, 10.1016/j.cub.2017.03.030, 2017.

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