

Interactive comment on “Effect of incubation time and substrate concentration on N-uptake rates by phytoplankton in the Bay of Bengal” by S. Kumar et al.

S. Kumar et al.

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We thank the reviewers for their comments. The common concern which has been expressed by both reviewers is the lack of measurements of the ambient ammonium and urea concentrations and hence the ammonium uptake values are not “quantitative”. However, we would like to mention that the ammonium addition to experiment 1 (effect of time on uptake rates) and experiment 3 (comparison of deck versus insitu experiment) were only $0.01\ \mu\text{M}$. The ammonium addition to experiment 2 was from 0.01 to $0.04\ \mu\text{M}$, which is justified because the whole experiment was to examine the effect of concentration on the uptake rate. We agree that we could not measure the ambient ammonium concentration due to logistic problems. However, we have substantiated the uptake rates by calculating ammonium and urea based on their regeneration by the zooplankton. Although we have cited literature, the first reviewer has expressed

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some concern regarding the technique employed to calculate the ammonium and urea (Mullin et al., 1975, Jawed 1973, Wiebe et al., 1975, Wafar 1986). We agree with second reviewer that our calculation is based only on mesozooplankton and micro zooplankton too could contribute to the regeneration of these nutrients. Overall, the idea during the whole exercise was to show that the ammonium addition made during the experiments were not arbitrary despite the lack of ambient ammonium and urea measurement using chemical techniques. However, we do not argue that nutrient calculated by regeneration technique can be as accurate as calculated by chemical methods. As indicated by our calculation the ammonium and urea concentrations were found to be 0.013 and 0.0036 μM respectively and given the uncertainties in biomass measurement and equation parameters it is near the detection limit of ammonium measurement through available robust chemical techniques ($\sim 0.01 \mu\text{M}$). We concur that we were wrong to write “near zero” in the previous manuscript which we have replaced with “near detection limit” in the revised manuscript. Since the concentration found is near the detection limit, the additions are also in the same range. This is consistent with JGOFS protocol which clearly states that “for waters where ambient concentrations are below the analytical limit of detection, tracer additions should be at the limit of detection”.

First reviewer has expressed concern over our conclusion of the third experiment that deck experiment result is more in agreement with the ^{14}C experiment result performed on previous day. However, we stand by our conclusion. The difference found between in situ and deck incubation is too large ($> 200\text{mg C m}^{-2} \text{ d}^{-1}$) to be explained by the difference in light conditions alone (as pointed out by the reviewer). However, in the manuscript we have already pointed out these differences in the experimental set up. The first reviewer has also expressed concern over our choice of C: N of 6.6 for the conversion of nitrogen uptake to carbon uptake rates. There is no doubt that N-uptake and C-fixation mechanism are decoupled but our choice of C: N of 6.6 is due to the statistical average of stoichiometry observed in the world ocean (Arrigo 2005) and in agreement with the actual observation of the Indian Ocean (Sambrotto , 2001). So

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far as the nutrient addition during experiment 3 is concerned, one can not calculate the percentage addition of tracers by the actual values observed (because the values are near detection limit) as has been done by reviewer and pointed out that additions for NH₄ and urea were 73 and 833%. Since we have already argued that ammonium and urea concentration found by the employed technique to be near detection limit, our additions are consistent with protocol.

We agree with the reviewer about the lack of replication during these set of experiments and uncertainties expressed in the data are analytical uncertainties. However, we have performed similar experiments (but not with tracer and time manipulations) to calculate new production in the Bay of Bengal during the same cruise and those were done with replications and results are well within the observed experimental limits (Kumar et al. 2004).

Second reviewer has asked to add the detailed hydrographic information, nitrate and station map in the paper. This work is in line with the two previous works published by the group (Kumar et al 2004a, Kumar et al. 2004b) where we have provided the detailed station map, hydrographic information and nitrate concentrations. We are providing the references of these papers in the revised manuscript.

All the technical errors pointed out by the reviewers have been corrected.

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