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Biogeosciences Discussions

Interactive comment on "Large clean mesocosms and simulated dust deposition: a new methodology to investigate responses of marine oligotrophic ecosystems to atmospheric inputs" *by* C. Guieu et al.

Anonymous Referee #2

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Aeolian inputs of trace elements are important to maintain primary production in the ocean. The best understood examples are high nitrate: low chlorophyll regions where there is little dust deposition and phytoplankton growth is limited by the availability of dissolved iron. A number of manipulation experiments have been done to investigate the response of phytoplankton to added dust but these have tended to be small scale experiments. The authors of this paper describe some large-volume mesocosm experiments that have been carried out to investigate the effect of dust addition. The purpose of the paper is to describe the methodological approach in some detail; the

actual results will be presented in other papers (which are in submission or in preparation).

The experiments were done in a pristine region off the coast of Corsica. The site is in a National Preservation Area, where there are no industrial influences. The water is highly oligotrophic (chlorophyll < 0.1 μg l-1, NO3- <0.2 μmol l-1, PO43- $\sim$2 nmol l-1 and Fe $\sim$2.5 nmol l-1). So this is a good candidate site in which to investigate the consequence of Aeolian inputs for marine productivity.

The dust which was used in the experiments was collected in Tunisia and the authors describe in some detail with the way in which the material was treated to make it is similar as possible to natural dust that might arrive at the sea surface. They have used clean techniques throughout – acid cleaned plastic material, clean room facilities – in handling the dust. They have also attempted to simulate the 'aging' processes that occur in the atmosphere where secondary acids (H2SO4 and HNO3) modify the dust and greatly increase solubility of iron and other trace elements. On the basis of the data provided, the prepared dust would appear to have very similar properties to the natural dust that is deposited on the sea surface in the region and a good level of detail is provided on the geochemical characterization of the experimental dust. So the information provided in the paper gives some confidence that the results obtained in these experiments will have relevance to open ocean systems.

In terms of the mesocosm enclosures, the strategy for filling the bags differed from most previous experiments, which have used pumps. In this case, the authors designed two-part mesocosms – a basic cylinder which is open at both ends and a separate, diver-attachable base cone. The bags were filled by releasing the cylinders from the sea surface to fall gently through the water, so capturing a column of water. The cylinders were kept open at the base for 24h to stabilize and allow particles to sediment out; the base-cones were then attached by divers. There are clear advantages and disadvantages to this approach. Clearly it is of considerable advantage to avoid pumps which may damage sensitive organisms as they are pumped into the bags. It also avoids

any trace metal contamination that is a common problem with pumps which often have crucial metal parts that cannot be replaced. The disadvantages include the reliance on divers (although they remained outside the bags, there is a danger of contamination of the water by the diver) and also the problem of achieving a good seal between the 2 parts of the enclosures. We are told that the seams were not leak-proof. Even though the authors state that there was no pressure difference between the inside and outside of the enclosure, it would have been nice to see an estimate of the degree of water exchange during the course of the experiment.

There were three enclosures for each treatment and the authors include a discussion about variability between these replicates. Some variables showed little difference between treatments, but others, notably nitrogen fixation and sedimentation were more variable. There is a continuing debate about whether enclosures can be considered as statistical replicates. My view is that they cannot and that, with such large volumes (in this case 52 m2) and long time period of the experiments, it is almost inevitable that different assemblages will develop in bags with apparently identical initial conditions. There may be small variation in initial inocula, one bag may shade another, or there may be other factors which favour the development of one organism over another. In this case, I would like to have seen some information on phytoplankton species composition, or detailed pigment analysis, or 18S sequence analysis, or something, to give an indication of the potential assemblage variation within and between treatments.

Overall, this is an impressive experimental approach that investigates a difficult problem. It will be interesting to see the more detailed results of the experiment as they are published.

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