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Interactive comment on "Effects of global climate change and organic pollution on nutrient cycling in marine sediments" *by* C. Sanz-Lázaro et al.

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The objective of the study is to determine the response of benthic ammonium and phosphate fluxes to climate change via an increase in temperature (T) and organic matter (OM) loading. The authors set out to answer this question by incubating homogenized coastal sediment at different temperatures (16, 22 and 26 oC) under control conditions (no additional OM loading) or enhanced loading (OM mixed in with the homogenized sediment) for a period of around five weeks. This follows from other studies that predict a T increase in Baltic Sea coastal waters of around 1oC per decade. They also added worms (Nereis spp.) to the experiment cores to allow for bioirrigation that is observed at site where the sediments were taken. They broadly conclude that an increase in T and OM loading lead to an increase in NH4 and PO4 fluxes from the sediment, implying that climate change could have important impacts on pelagic productivity. There are a limited number of studies of this nature and the idea is good and certainly timely.

The main question addressed by this paper is both interesting and important. The authors should be commended for their effort in tackling this complicated issue because the benthic feedbacks to outside forcings are not well understood. In my opinion, though, the results do not support the conclusions because the experimental period was too short given the study objectives and because the sediment cores were not properly acclimated. If it was the authors' intention to determine how climate change and OM loading affect benthic fluxes, the cores should have been left to reach a quasi-steady state. It is obvious from the plots that steady-state was not reached during the incubations, meaning that the final result and thus conclusions could have been very different if the experiment was conducted for, say, another few months or even weeks. A sufficiently long time frame is required to allow the microbial community to respond to the new conditions and for the solute transport fluxes to equilibrate. In that case, the relative change in CNP ratios of the fluxes and the net budget of these elements could have been quantified more accurately and effect of the external variables more readily determined. At present the N,P and Fe contents are hardly different (statistically speaking) among the different treatments. The information gained from the present study is of limited value because we see only the initial stages of an evolving system. There is no careful constraint using mass balances to try and identify the processes in the sediment that are most sensitive response to T and OM loading. This would have been extremely useful information for ecological modelling studies even despite the short incubation length. There is currently no way to isolate the sources and sinks of NH4 and PO4 with the data presented, which makes is almost impossible to evaluate the results in a rigorous manner and greatly devalues their significance. It should come as no surprise to the readership of Biogeosciences that sediment nutrient fluxes increase under the experimental conditions imposed.

According to Section 2.2., the sediment cores were accumulated for 3 days at the various T and OM loadings before the worms were added. If the objective is to study the effect of T, the cores should have been acclimated with the worms before increasing temperature. It appears that the opposite is true: the experiment began as soon as the

worms were added, although the methods are not very clear on this point. If this is the case, the results would largely reflect the re-organization of fluxes due to the addition of worms, rather than due to the increase in T.

Treatment of the initial conditions is not well justified either because no worms were added to the 'initial condition' cores and then allowed to equilibrate. Any comparison of these cores to the experimental cores is highly dubious because the irrigation effect cannot be subtracted from the effect of increasing T and OM.

How were the sediment cores and the nutrient fluxes measured? We are not shown the concentration versus time data for each of the cores to judge the reported values for ourselves. This information should be made available in an appendix or supplement.

Interactive comment on Biogeosciences Discuss., 12, 21, 2015.