Biogeosciences Discuss., 7, C261–C264, 2010
www.biogeosciences-discuss.net/7/C261/2010/

Biogeosciences Discussions

Interactive comment on "Increased bacterial growth efficiency with environmental variability: results from DOC degradation by bacteria in pure culture experiments" *by* M. Eichinger et al.

Anonymous Referee #1

Received and published: 19 March 2010

In this work the authors try to asses the effect of DOC availability and supply on bacterial growth efficiency (BGE) values by simultaneously using experimental and modeling approaches. Specifically they incorporate the cell maintenance equations that normally is not considered in biogeochemical models using three different bacterial growth models. They calibrate the model parameters using biodegradation assays in batch mode and pulse modes. The authors show how the temporal variation in substrate availability affects the BGE values showing that pulsed substrate additions increase the BGE values. The authors further suggest that pulsed substrate additions mimic in situ substrate release by the microbial food web. The authors conclude that " typical" experimental designs such as batch mode cultures with single substrate addition underestimate BGE

values and consequently overestimate the bacterioplancton role as biogenic source of CO2.

Comments This is a very interesting work highly significant to biogeosciences. The correct estimation of BGE is important for modeling microbial carbon cycling and has important implications for flux of carbon through food webs and ultimately for the flux of carbon dioxide from oceans to the atmosphere. The authors present a novel approach in calculating BGE of relevance for modeling the carbon flux in the ocean.

I would adhere to most of the author's conclusions except for one point that I am not sure about. It is not clear to me if the very high substrate concentration used (8 mM) and high respiration rates observed did not deplete oxygen at some point during the experiments. This would be limiting the whole bacterial metabolism and would leave L-DOC unconsumed. In fact that could be a reason for the DOC accumulation. The experimental design described includes agitation of the cultures but apparently it was not aerated and oxygen concentration in the cultures is not reported. The authors do not discuss this issue. I am not sure if the head space left in the culture bottles was enough to keep well oxygenated the culture or if ultimately limited further substrate degradation. My criticism would not affect the general conclusions reached by the authors. In general this is a very good work, the manuscript is clear and well presented except for some minor details in the text and figures (see specific comments).

Specific Comments:

Abstract : No comments

Introduction: page 791 line 10: please indicate here the three models used

Materials and methods:

Page 792 line 16 please indicate the vitamins used and concentrations

Page 792 line 23: .....cultures continuously agitated not aerated? Most likely the oxygen was totally exhausted after L-DOC consumption. Was the time gap between

BGD

7, C261–C264, 2010

pulsed substrate additions enough to replenish oxygen concentrations in the cultures? Please clarify.

Page 793 line 3: bacterial cell density is written 6.106 cells cm-3 I am not familiar with this notation I am rather used to 6 x 106 cells cm-3.

Page 793 line 10: Are you sure that bacteria were under starving conditions? Remaining organic substrate is substantial. Was there any oxygen limitation?

Page 794 line 9: should read analyzer instead of analyser?

Page 794 line 10: Please provide information regarding the accuracy and precision of the oxygen determinations. It is not clear if a very high cell concentration is needed to get enough sensitivity.

Page 794 line 20: Zero percent oxygen saturation. . . instead to 0% oxygen saturation?

Page 794 line 26: What was the cell density in the oxygen measurements? It is not clear what is the sensitivity of the oxygen technique used.

Page 795 line 10: Epifluorescent microscope? Or Epifluorescence microscope?

Results:

Page 800 line 2: It is difficult to follow the respiration dynamics from the description given in the text. The description would be improved if the authors also refer to the incubation time.

Page 800 line 8: same as above

Discussion:

Page 804 line 26: the term jEM is not defined in text or in tables

Page 804 line 29: the term jVM is not defined in text or in tables

Page 805 line 10: Please discuss in this section the possibility that substrate consump-

BGD

7, C261–C264, 2010

tion might be limited by oxygen concentration

Page 806 line 26: Please explain what do you mean with “widely used methods underestimate BGE values” there are a number of methods that different authors use to calculate BGE.

Page 807 line 1: Please explain what do you mean with the “ overestimation of the role of bacteria as CO2 producers”. If for instance ïĄĎPOC and ïĄĎCO2 production is measured how one can possibly underestimate the BGE. Please explain.

Page 808 line 6: I am not sure if a “ threshold value” during starvation existed in the experiments because again, the oxygen concentration in the cultures is not reported.

Figures: In general I had a problem to distinguish the dotted lines from the continuous lines particularly in figures 1 and 2 but all the figures in general would be better if the legends and numbers are in a larger size.

Interactive comment on Biogeosciences Discuss., 7, 787, 2010.