Biogeosciences Discussions, 2, S16–S18, 2005
www.biogeosciences.net/bgd/2/S16/
European Geosciences Union

Biogeosciences Discussions

Interactive comment on "Control of phytoplankton production by physical forcing in a strongly tidal, well-mixed estuary" *by* X. Desmit et al.

Anonymous Referee #2

Received and published: 1 February 2005

Review of the paper by Desmit et al., on the control of phytoplankton production in tidal well-mixed estuaries.

General comments. This paper deals with the interplay of tidally-linked (SPM concentration, water height) and diurnal (incident light) forcings and their effect on algal primary production in strongly tidal and well-mixed estuaries. The authors conclude that net algal growth can be attained, even in turbid regions, provided that the ratio between the mixing depth and the euphotic depth is favorable. This of course is not a new finding. In addition, the authors show that the interactions between tidally-linked processes and incident light need to be taken into account when estimating primary production. When ignoring the short-term variations in light characteristics, primary production can be seriously underestimated (30The main strength of the paper is that they provide guidelines as to how the primary production estimates can be improved,

for instance how to include depth variations or how to calculate short-term variations in SPM concentrations.

Specific comments: The main flaw of this paper is the fact that the authors ignore the effect of bathymetry on algal growth, i.e. the occurrence of shallow areas (tidal flats). This may well be the main factor that allows net primary production, even in turbid systems. It is important not only because it allows benthic algal growth which may contribute to total net growth (also in the Scheldt). In addition, the balance between light-limited net growth and biomass-driven loss processes changes drastically along the bathymetric gradient, i.e. from the shallows to the deep channel. Therefore, this bathymetry should be taken into account when P/I curves are upgraded to calculate net growth in a stretch of an estuary. I would suggest that the authors use more realistic morphology, at least when they apply their model to the Scheldt. This implies that the integration of net growth (eqn 1) should be done over cross-sectional surface (or volume) rather than over depth. The authors may also want to consult Lucas et al. (1999) Mar. Ecol. Prog. Ser. 187: 1-30 or May et al. (2003), Mar. Ecol. Prog. Ser. 254: 111-128, who have explicitly modeled the effects of a shoal on estuarine production and who also deal with the importance of the timing of other forcings (e.g. wind).

The authors pinpoint the non-linear relationship between Gross Primary Production and extinction (kd) as the factor responsible for the discrepancy between the estimates obtained using time-dependent kd or constant mean kd (page 49). probably the relationship between GPP and kd is an exponential one (and becomes linear after log-transforming kd)? So perhaps the constant-mean estimates will be improved by taking geometric means (averaging based on log-transformed) kd rather than simple arithmethic means?.

Some reported settings of the model are very uninformative, such that it is not possible to recreate the model output. For instance: incident light is taken from an astronomical routine. Which routine, applied to which date, etcĚ What really matters here is the daily

BGD

2, S16–S18, 2005

light dose (PAR averaged or integrated over the day) AND the day length (i.e. how the light is partitioned over the day).

Technical corrections The units of the equations (1-11) are inconsistent: If the units of B, the algal biomass, are μg Chlorophyl l-1, then according to equation (1) the units of the rates NPP, EXC,RESP have to be expressed in μ chlorophyll l-1 hour-1 and NOT in μgC/l/hr as claimed in the manuscript or as is evident from equations 8, 11. I guess equation (1) needs an extra chlorophyll$_{c}arbonratio : (C : Chl * dBtot/dt = QB * C : Chl; +)$

Interactive comment on Biogeosciences Discussions, 2, 37, 2005.