Ocean Sci. Discuss., 7, C115–C118, 2010
www.ocean-sci-discuss.net/7/C115/2010/

Ocean Science Discussions

Interactive comment on "The role of continental shelves in nitrogen and carbon cycling" *by* K. Fennel

K. Fennel

katja.fennel@dal.ca

Received and published: 6 April 2010

Responses to the comments of reviewer 1 follow below.

Reviewer 1: "I read the title with interest expecting to see a review paper about C and N cycling on the continental shelves but it turned out that the paper has data for only part of the NE American continental shelf. Several review papers have been published on the global view. Unfortunately the author did not seem to realize that."

Response: The reviewer seems to imply that the paper title does not adequately reflect the contents of the manuscript. The title has been changes to "The role of continental shelves in nitrogen and carbon cycling: Northwestern North Atlantic case study".

The reviewer also notes that relevant review papers have been published recently. The

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

author would have found it helpful if the reviewer had given references to the papers he/she had in mind. A review of continental margin carbon fluxes by Liu et al. (2000) and new book on carbon and nutrient fluxes at continental margins that just appeared in the IGBP book series are now cited in the Introduction.

The following text has been added: "Continental shelves serve as important link between land and the ocean interior and between the atmosphere and deep ocean (Liu et al. 2000)."

"Many aspect of continental shelf biogeochemistry are discussed in detail a the recent IGBP monograph (Liu et al., 2010)."

Reviewer 1: "Other than the limited scope the paper contains several fatal errors: 1.The author takes the view proposed by Tsunogai that downwelling of dense shelf water in winter transports, say, DIC, offshore. This view has been criticized several times as it does not agree with reality. Only a small portion of the global shelves generates downwelling.

Response: The author respectfully disagrees.

First, the author does not take the view that "downwelling in winter transports DIC offshore" as claimed by the reviewer. The author merely states that a physical shelf pump mechanism has been suggested by Tsunogai et al. (1999). On page 6, lines 11-16 this is explicitly stated:

"Two distinct mechanisms have been suggested and are collectively referred to as Continental Shelf Pump (CSP). The first CSP mechanism is physical in nature and thought to operate in mid- and high-latitude systems (Fig. 2). In these shelf systems surface water is cooled more strongly than surface water in the adjacent open ocean because it is not subject to deep convection."

And further on lines 24-25: "Tsunogai et al. (1999) suggested that this mechanism operates in the East China Sea and coined the term Continental Shelf Pump."

OSD

7, C115–C118, 2010

Second, the author is by no means suggesting that this mechanisms is important everywhere. As can be seen in the above quote from the manuscript, the author states that it is only plausible in mid- and high-latitude systems.

Third, the author did not use the word downwelling in the context of this physical shelf pump mechanism, but is referring to the simple fact that cold water is denser than warm water and will sink. This should not be confused with downwelling.

The reviewer states that Tsunogai's view has been criticized several times. The author would have found it useful had specific reference been provided.

Reviewer 1: "2. The model is also flawed in that, for instance, DON is not taken into account. "

Response: The lack of DOM is indeed a short coming (shared by many biogeochemical models) that warrants future study and development. This is reflected by the following text that has been added to Section 3.3: "Two significant sources of uncertainty in the model simulations described above are (1) the choice of initial and boundary conditions for DIC and alkalinity, which are based on climatological data mostly from the open ocean, and (2) the lack of dissolved organic carbon (DOC) dynamics. On the continental shelf the DOC pool is significantly larger than the pool of particulate organic carbon (by one to three orders of magnitude; Bauer et al. 2001) and strong gradients in DOC concentration exist between shelf waters and the open ocean (Hopkinson et al. 2002). Exchange of DOC across the shelf break may thus be a significant component of the shelf carbon budget. Adequate representation of DOC dynamics in biogeochemical models critically depends on a mechanistic understanding of DOC sources and transformations."

Reviewer 1: "3. Figures 2 and 3 are conceptually wrong. Upwelling provides DIN and DIC to support productivity on the shelves. "

Response: The arrow signifies net transport of carbon off the shelf, which is the key

OSD

7, C115–C118, 2010

feature of the continental shelf pump mechanism. However, since the schematics were confusing to the reviewer the author decided to remove those figures.

Reviewer 1: "The author mentioned the riverine and aeolien inputs of nitrogen but totally forgot about the DIN input from upwelling, which globally can be as much as 70%. "

Response: Yes, this was a mistake that was also pointed out by reviewer 2. Now rephrased as follows: "The high productivity of shelf systems is in part fueled by the input of nutrients from land, in part by the tight benthic-pelagic coupling that allows nutrients remineralized in shelf sediments to be returned to the euphotic zone on timescales on the order of a year, and in large part by up- and onwelling of nutrients from the open ocean."

Interactive comment on Ocean Sci. Discuss., 7, 177, 2010.