

## ***Interactive comment on “Towards an improved organic carbon budget for the Barents Sea shelf, marginal Arctic Ocean” by I. Pathirana et al.***

### **Anonymous Referee #1**

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The authors adopted previously available modeling software tool to calculate modern organic carbon accumulation rates, the fractions of marine and terrestrial organic matter, primary productivity etc. The model is calibrated by previously reported data on 190 surface sediment samples and only 6 sediment cores.

General comments: The manuscript is generally very concise and well written but it seems a bit “heavy” for the reader. You just talk about the model results with little description/regional context and without a “key history”. The aim of the manuscript and the importance of the model results are not underlined. The role of the Arctic Ocean in the modern climate system is mentioned in the introduction but what new information your model can give us? It is written in the introduction that it will help to study modern climate changes (let’s say last 50 years changes). Then in the discussion (page 4961,

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line 20) you admit that your model covers much longer time span – last 10,000 years. So the recent climate changes would not be visible in this model?

I'm not the modeler so I'm not able to check the mathematical correctness of the model. But there are some points I can notice the weaknesses of the manuscript:

1. The calibration of the model with a 6 sediment cores. The sediment/carbon accumulation Barents Sea is very sensitive to local sedimentary conditions and patchiness of sediments. The sediment accumulation rate results in the Barents Sea may differ significantly even at stations located very close to each other. Eg. station I and XVIII located in Hopen Trench (Zaborska et al., 2008). Is it possible to calibrate sedimentary conditions in the whole Barents Sea based on the 6 cores only?

2. There are more references on the sediment accumulation rates available in the Barents Sea: - Zaborska et al., 2008: 14 sediment cores analyzed for both  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$  collected from the western Barents Sea. Maximum sediment accumulation rates ranged from 0.3-1.3 mm/yr. - Maiti et al., 2010: 9 sediment cores analyzed for both  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$  collected from the western and central Barents Sea. The maximum rates ranged from 0.6 to 1.7 mm/yr. - Boitsov et al. (2009): 5 sediment cores collected from the southern Barents Sea analyzed for both  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$ . The maximum rates are 0.7-1.2 mm/yr. - Heldal et al. (2002): 3 cores collected south off Svalbard analyzed for both  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$ . Maximum sediment accumulation was equal to 0.5-1.9 mm/year.

3. I always thought there may be a large uncertainty connected to  $^{14}\text{C}$  dating technique since the time scales of these tracers are completely different. So if you want to study modern processes (~100 years) the  $^{210}\text{Pb}$  should be used. But as I recently found out both techniques may agree (eg. Piotrowska et al., 2010). Maybe differences between your model and real (published)  $^{210}\text{Pb}$  results are caused by local variability of sedimentary environment eg. bottom structure? What may cause so large disagreement between  $^{14}\text{C}$  and  $^{210}\text{Pb}/^{137}\text{Cs}$  dating techniques?

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4. The largest accumulation of organic material in Storfjorden and Hopen Deep is not, in my opinion, caused by large phytoplankton bloom and ice margin in this area (page 459, line 9). Accumulated elsewhere sediments may be re-suspended and transported to deepest areas (canyons, deeps) eg. re-deposition processes on the steep slopes, turbidity currents (see: Dowdeswell et al. 1998; Kushnir et al., 2007; Sternberg et al., 2001, Thomsen et al., 2001). Did you add influence of turbidity currents, dense water formation currents (in Storfjorden) etc. to your model?

5. Why the concentrations of terrestrial organic carbon in sediments around mostly glaciated (whole eastern part) Edgeøya are much higher than around Sørkapland that is ice free during the summer?

Technical issues: Table 1: - no all published data included (see the paragraph 2), - why in the “core length (m)” column it is written “box core” - what is number of dating points? Number of layers with 210Pb excess? - mistake in reference - Carroll et al., 2008 calculated organic carbon burial rates, the sediment accumulation rates are given in Zaborska et al., 2008; - Zaborska/Carroll used both 210Pb/137Cs techniques not only 137Cs (137Cs may be used for 210Pb validation but it is not a dating technique!)

Summary This is a well written manuscript that includes very nice figures. I'm not a modeller but in my opinion it is valuable and I recommend it for publication. The time span of the model should be clarified however, did you mean modern climate change (as I understand from the introduction) or a long term climate variability?

Good luck with the publication.

Possible new references:

Heldal et al. (2002): Distribution of selected anthropogenic radionuclides (137Cs, 238Pu, 239,240Pu and 241Am) in marine sediments with emphasis on the Spitsbergen-Bear Island area. Science of the Total Environment, vol. 293, no1-3, pp. 233-245

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Boitsov et al. (2009). Geographical variations in hydrocarbon levels in sediments from the Western Barents Sea Norw.J.Geol. 89

Maiti et al., 2010. Sedimentation and particle dynamics in the seasonal ice zone of the Barents Sea. Journal of Marine Systems 79, 185-198.

Piotrowska et al. Intercomparison of radiocarbon bomb pulse and 210Pb age models. A study in a peat bog core from North Poland. Nuclear Instruments and Methods in Physics Research Section B, 268, 7-8 (2010) 1163-1166).

V. M. Kushnir et al., 2007. CURRENTS AND TURBULENT DIFFUSION IN THE BOTTOM BOUNDARY LAYER OF THE BARENTS SEA, Physical Oceanography, Vol. 17, No. 5

DOWDESWELL et al., 1998. GLACIMARINE SEDIMENTARY PROCESSES AND FACIES ON THE POLAR NORTH ATLANTIC MARGINS. Quaternary Science Reviews, Vol. 17, pp. 243-272

Sternberg et al., 2001. Long-term near-bed observations of velocity and hydrographic properties in the northwest Barents Sea with implications for sediment transport. Continental Shelf Research 21, 509-529

Thomsen et al, 2001. Particle transport processes at the slope environments: even driven flux across the Barents Sea continental margin. Marine Geology 175, 237-250.

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