**General comments for Chueh-Chen (cc. Chih-Lin)**

The page number cited below is based on the revised Word file. For editorial comments, see the attached Word file.

1. Considering the complicated topic under discussion, the thesis was very well written and easy to read. I enjoyed reading it. I also enjoyed this study which used mathematics to help understand complex natural systems. This is indeed an excellent study.
2. Section 2.4.1 (p. 22): “the OC stock was sediment mass multiplying TOC content (%) and divided by the sampling area to the unit of mg C/ m2.” How would the integration depth of TOC affect the model output?

These two sites have different mass accumulation rates, hence 10 cm depth refers to different cumulation history.

儘管兩地的沉積歷史不一樣，但我主要的model範圍就是限制在有生物活動/存在的沉積物表層10公分的位置，TOC intergration只是算出這個範圍中的沉積物非生物的碳

Section 3.6 (p. 46): “For example, the turnover rate of total carbon was calculated as the sum of detrital and biotic carbon divided by in situ TOU.” 1) The analytical procedure of TOC does not differentiate detrital and biotic OC. 2) How about adjusting the TOC stock to the same deposition elapsed time?

1) yes

2) deposition elapsed time在這個model中的意義<生物在空間的限制，但我們如果要做turnover勢必需要校正?(雖然文獻沒有做校正等)

Section 4.4 (p. 63): “The turnover time of total OC estimated by the model results (Table. 15) was in the time scale of decades in the canyon head, while it appeared to be over a century on the slope.” The text seems contradictory to earlier arguments. On one hand, OC flux (Pb-210-based estimates) is insufficient to sustain the system. On the other hand, the OC turnover time is decades to a century. How the sediment OC stock is calculated (integration depth) will strongly affect the turnover time.

Yes,???

1. Section 4.3 (p. 59): “DOM is expected to be taken up more easily than POM for bacteria because they need to produce enzymes to hydrolyze polymeric sinking particles before the material pass through cell membranes and the metabolization (Verdugo et al., 2004). Moreover, Pape et al. (2013) conducted experiments to evaluate the fate of DOM carbon in different benthic environments (North Atlantic and Western Mediterranean slope sites), which resulted in bacteria dominating DOM carbon uptake.” DOM in sediment is mostly mobilized from sediment POC as degradation intermediates instead of from the overlying water column. I don't think DOM can be treated as another major source of OC input. I think the influence of DOM is less an issue than the temporal scale offered by different methods to determine flux.

一開始在做model的時候，雖然有trap的資料，但實際進到(表層沉積物+生物系統)的量不知道是多少->burial flux一定是小於等於這個介面所留存的碳所以才會想說用這個data

DOM的影響: 因為用了burial flux發現無解後+用model回推發現有誤差=有可能真的是POC的被消耗掉或經過一些process後離開系統+當初看到細菌的作用很強(問了中山的塗老師他說有沒有可能是DOM也占了一部分的貢獻+過去LIM他們是有很明確的區分每個flow來源(eg把C來源partition的很細) 但我們目前的資料做不到這件事

1. Section 4.3 (p. 59): “As a result, the reference value (53.85 mg C/ m2/ d, Huh et al., 2009 ) was insufficient to supporting the whole system.” This rate (Pb-210 based) is more like burial rate. Better compare with trap data.

有提過trap data (liu&lin) maybe 在這邊補充

Section 4.3 (p. 60): “the OC demand for the two sites (GC1: 131.08 mg C/ m2/ d; GS1: 78.95 mg C/ m2/ d) was larger than the reference values, especially in the canyon head, which was larger by a factor of three.” The reference value (Pb-210 based estimates) is mostly considered as OC burial flux by geochemists.

See Q3的回答

Section 4.3 (p. 60): “This discrepancy has also been found in the Nazaré Canyon (de Stigter et al. 2007), which may be resulted from the sediment resuspension triggered by the strong bottom currents.” The Pb-210 method measured the average flux over 100-200 years. Traps measured flux over weeks. TOU measured OC flux over hours. The disparity between different methods has been attributed to the Sadler effect.

Yes, actually this sentence is not appropriate to put it here.

1. Section 4.2 (p. 55): Would be great to tabulate the model outputs, and compared modeled vs measured/literature values (e.g., modeled BMU vs observed (calculated) BMU).

OK? But why?

1. Section 3.5 (p. 42): “The main problem arose from the contradiction between low biomass and relatively high oxygen utilization.” 1) Could this be caused by the underrepresented meiofauna data? For example, for the cruises with high TOU and BMU (OR1-1219 and -1242), meiofauna was not analyzed. 2) Might want to check DOU values again using Berg's original calculator.

Section 4.2 (p. 54): “The most straightforward and robust procedure to evaluate the fauna activities in mixed communities is to subtract DOU from TOU.” By BMU = TOU-DOU, does BMU exclude the effect of bioirrigation and bioturbation? Again, you might want to check the calculation of DOU again, using the original Berg's calculator.

1. Section 2.9.3 (p. 32): “As Mahaut et al. (1995) suggested, the value of bacterial carbon remineralization (the flow of bacteria to DIC in our model) represented about 30% of the TOU.” Why noy using DOU?

Section 4.2 (p. 53): “Surprisingly, the estimated DOU flows seem to increase the confidence level in the model. In GC1, the measured DOU was 19.81 mg C/ m2/ d, which was slightly higher than that resulting from LIM (15.13 mg C/ m2/ d); In GS1, the modeled DOU was 11.66 mg C/ m2/ d, which corresponded well to the direct measurement (11.53 mg C/ m2/ d).” This raises the question whether you can simply use the measured DOU values instead of presumed values (30% TOU).

因為constraint的使用其實很tricky->用太精確的數字只要稍微有誤差就會error

In fact, the measured DOUs were 27% of the measured TOU in the GC1 and 22% of the measured TOU in the GS1, suggesting that the maximal constraints were reasonable.

1. Section 3.6 (p. 47): Bacteria turnover = bacteria biomass/DOU?

yes

1. Section 3.5 (p. 46): How was "predation (as an export pathway)" modeled?

There was no constraint used in predation processes, therefore, mass balance was the only assumption to calculate the predation flows.

1. Section 3.5.2 (p. 45): “Likewise, in GS1, the meiofauna-related flows were an order of magnitude higher than those related to macrofauna.” This is surprising given that macro has twice more OC stock than meio.

事實上在食物較豐富的深海環境，macrofauna的生物量會比較高，因為比較大的體型去快速攝取食物是比較有效的方式，例如在陸棚區域，甚至先前提過的兩個文獻的食物網也都有這個趨勢，而一般認知體型越小的生物越多則是普遍在食物較缺乏(像深海平原之類的棲地)。

1. Section 3.5 (p. 43): “24% of POC input as the minimal burial rates (Hsu et al., 2014)” How did Hsu et al. (2014) estimate burial efficiencies?

Burial efficiency of terrestrial organic carbon (%) = (accumulation flux of terrestrial organic carbon/annual river particulate organic carbon flux).

1. Section 2.9.3 (p. 31): Eq. 7 seems to be wrong.

Answer in ppt

Section 3.1.1 (p. 37): “the calculated Tlim equaled 1.05 and 1.09 for GC1 and GS1, respectively” Why does temperature lower than 20 oC lead to a correction factor higher than 1?

Answer in ppt

1. Section 2.4.1 (p. 22): “The volume was then converted into mass by assuming the sediment bulk density of 2.65 (g/cm3).” Sure? 2.65 g/cm^3 is close to the density of quartz and usually used as the density of sediment dry mass. Check Su et al. (2018, TAO) for measured bulk density.

Yes, 2.65 g/cm^3 is for sediment dry mass. It should be revised

(p27)This can lead to the perception that you focus only on phytodetritus, and neglect terrestrial OM transported via gravity flow).

從定義上說是，但是依照目前model的structure來說我們沒有特別區分沉積物OM來源

Eq. 7 seems to be wrong. ->see ppt

LIM equaation: E, A, G (流量方向的矩陣)

(p35). For example, if the straight pathway was 10 and FCI=0.5, meaning that an average unit of inflow travels 15 because it cycled through the system

15=10\*(1+0.5)

(p42) The main problem arose from the contradiction between low biomass and relatively high oxygen utilization .

1) Could this be caused by the underrepresented meiofauna data? For example, for the cruises with high TOU and BMU (OR1-1219 and -1242), meiofauna was not analyzed.

有可能->meiofauan的資料太少了，但覺得主因不是meio

(p43)Do you mean these numbers were used for both sites as min and max?

yes

(p46) How was "predation (as an export pathway)" modeled?->see ppt

(p46)

1) The analytical procedure of TOC does not differentiate detrital and biotic OC

Yes, but TOC sampling only contains 2 ml of sediment. The influence of fauna might be relatively few.

2) How about adjusting the TOC stock to the same deposition elapsed time?

(p.51)Lack of megafauna and fish in the food web model or in the field observations?

both-> no field observation->not included in the model

(p.53)What are "generally accepted values"?

the burial efficiency in other place in the world/ or common used ref

(p59)This one (Pb-210 based) is more like burial rate. Better compare with trap data.

(p62)"...it would be higher in low disturbance conditions." What is the basis for this?

根據developmental status->發展越高=系統越成熟(演替階段後期)

但GC1長期處於物理擾動中，系統發展=可能一直在演替初期(loop) 但GS1相對的擾動較低發展程度較高

!(p63)The text seems contradictory to earlier arguments. On one hand, OC flux (Pb-210-based estimates) is insufficient to sustain the system. On the other hand, the OC turnover time is decades to a century.

How the sediment OC stock is calculated (integration depth) will strongly affect the turnover time.->yes

(p64)this literature source is still accepted as less strict data (van Ovelen et al., 2010).

unclear, why?

因為不是跟採樣同時進行而是文獻裡儘管跟採樣點相近位置(就被認為是lower quality)