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## ***Interactive comment on “The role of ocean acidification in *Emiliana huxleyi* coccolith thinning in the Mediterranean Sea” by K. J. S. Meier et al.***

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Received and published: 10 February 2014

Comment by Simen Linge Johnson and Jörg Bollmann

Meier and colleagues present a very interesting long term data set for the calcification of coccolithophores (*Emiliana huxleyi*). However, they apply a method first used by Beaufort (2005) that has several shortcomings (see Bollmann (2013)). The scientific value of the manuscript would benefit from a more detailed description of the method (e.g. optical resolution of the microscope, pixel resolution, error estimates (estimates of error bars in figure 2 are not clear), accuracy estimates (How accurate are the

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weight estimates?) and a detailed description of the calibration method including the raw data of the calibration. The length and weight measurements presented in Figure 2 are concerning. Variations in coccolith length and weight over time appear to be mainly within the resolving power of the applied method (see attached Fig. 1). Beaufort (2005) used a 50x NA 0.9 objective and a 0.9 NA condenser (optical resolution of  $0.31 \mu\text{m}$ ) and a camera with a pixel resolution of  $0.15 \mu\text{m}$ . Assuming that a similar system was used, each length measurement of a coccolith has a minimum uncertainty of  $\pm 0.15 \mu\text{m}$ . When this is taken into account, most variations of length and weight in figure 2 of Meier and colleagues are noise/random (see attached Figure 1, for details of the weight error estimates see Bollmann (2013)).

Furthermore, the weight estimates are puzzling. For example, the Biosope data set of Beaufort et al. (2008) shows an average length of coccoliths of about  $1.9 \mu\text{m}$  and a weight of about 6 pg. However, in the present study the average length is about  $3 \mu\text{m}$  and the weight is about 4.7 pg. Why is the average coccolith weight lower than that reported by Beaufort et al. (2008) although the coccoliths in the Mediterranean Sea are significantly larger compared to the Biosope data. Why are all coccoliths weights significantly larger than volumetric estimates based on the ks values reported by Young and Ziveri (2000) even when all coccoliths would belong to the heavy calcified type of *Emiliana huxleyi* type R (2.9 pg,  $3 \mu\text{m}$  length, ks factor 0.04; 1.0 pg for *Emiliana huxleyi* type B;  $3 \mu\text{m}$  length ks factor 0.014).

Beaufort, L.: Weight estimates of coccoliths using the optical properties (birefringence) of calcite, *Micropaleontology*, 51, 289-298, 2005.

Beaufort, L., Couapel, M., Buchet, N., Claustre, H., Goyet, C., Villefranche, D., Perpignan, D., and Alduy, A. P.: Calcite production by coccolithophores in the south east Pacific ocean, *Biogeosciences*, 5, 1101-1117, 2008.

Bollmann, J.: Technical Note: Weight approximation of single coccoliths inferred  
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from retardation estimates using a light microscope equipped with a circular polariser – (the CPR Method), *Biogeosciences Discuss.*, 10, 11155-11179, doi:10.5194/bgd-10-11155-2013, 2013.

Bollmann, J.: Interactive comment on “Technical Note: Weight approximation of single coccoliths inferred from retardation estimates using a light microscope equipped with a circular polariser – (the CPR Method)” by J. Bollmann, *Biogeosciences Discussions*, 10, C6961–C6981, 2013a.

Bollmann, J.: Interactive comment on “Technical Note: Weight approximation of single coccoliths inferred from retardation estimates using a light microscope equipped with a circular polariser – (the CPR Method)” by J. Bollmann, *Biogeosciences Discussions*, 10, C6989–C6994, 2013b.

Young, J. R., and Ziveri, P.: Calculation of coccolith volume and its use in calibration of carbonate flux estimates, *Deep Sea Res. Part II*, 47, 1679-1700, 2000. .

**Comment Caption Figure 1:** Modified figure 2 of Meier et al. (2013). The black lines on Fig A and B indicate the weight (average of 4.7pg +- 20%) and spatial resolution (average of 3.05 +- 0.15  $\mu\text{m}$ ) when using a light microscope with an 0.9 NA objective and condenser and pixel resolution of 0.15  $\mu\text{m}$ .

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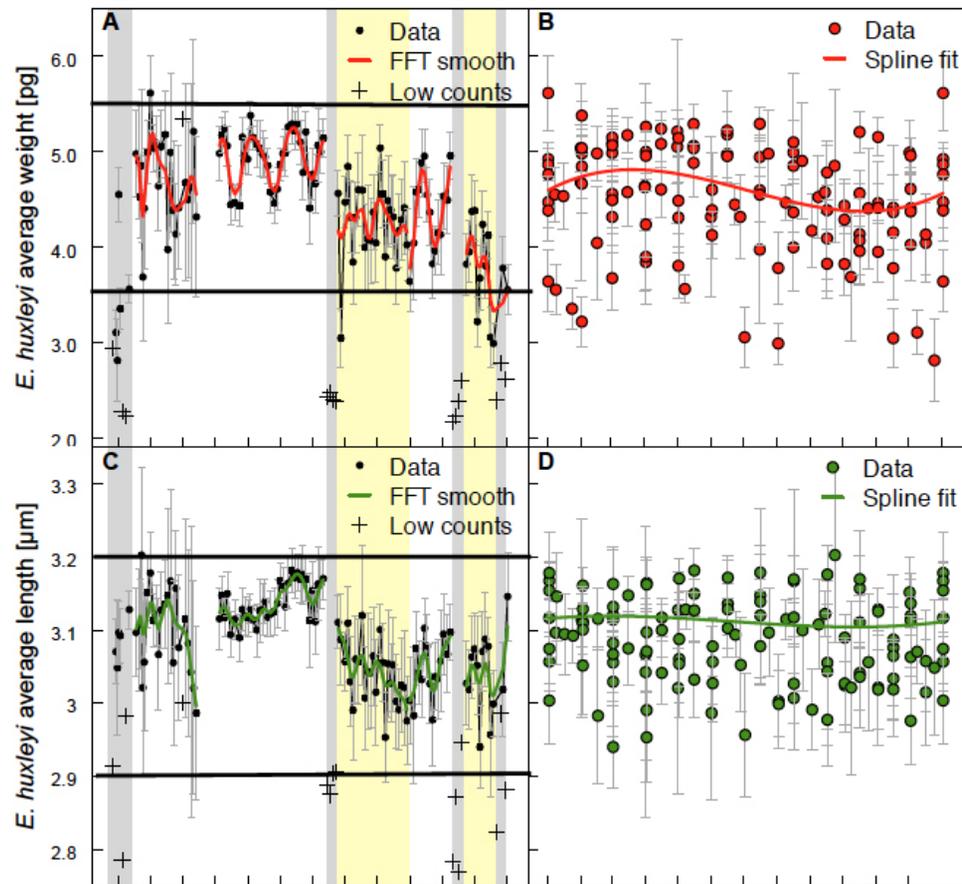


Fig. 1.

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