

Comment on

Essd-2018-53 Submitted on 13 Apr 2018
Global Sea Level Budget 1993-Present
WCRP Global Sea Level Budget Group

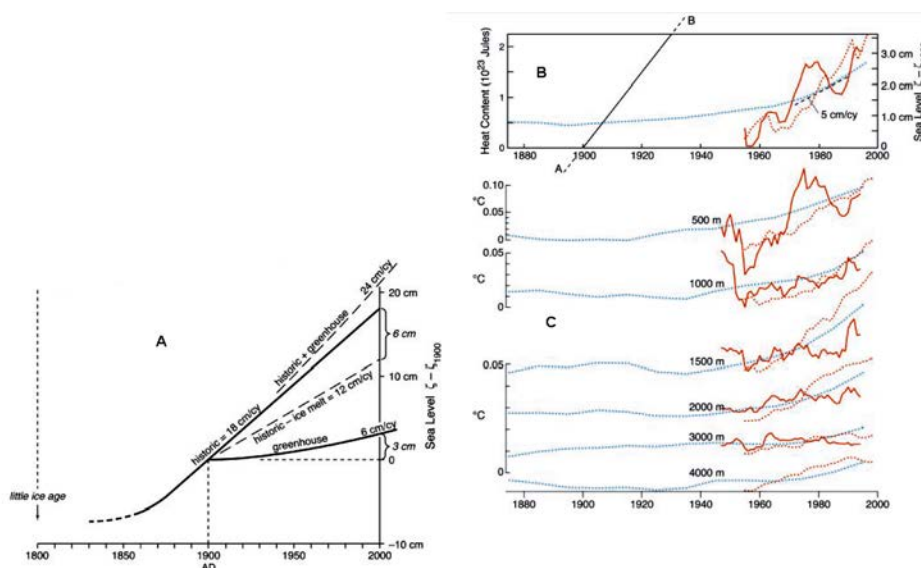
The paper is presenting a very good overview of works on sea level rise.

It could be complete if the authors introduce a small discussion on the little glacial era (see the lines 78 – 82 of the introduction) and also the so called Munk enigma.

A key study is presented in a paper by Walter Munk published in 2002¹. Its importance is lying on the careful analysis made on causes and effects, as in schematised in Figure 1.

It is a seminal study since is obliging researcher to give attention to all factors influencing sea level.

Studies were demonstrating that after the little ice age early in the 19th century, sea level rose at 18 cm/century (cm/cy - the historic rate) with no measurable acceleration until the mid-20th century, when thermal expansion associated with greenhouse warming became significant, contributing an additional 3 cm by the year 2000. Greenhouse-related sea level rise has accelerated to the present rate of 6 cm/cy, making the historic + greenhouse rate 24 cm/cy (Figure 4.2.1A). The relative heat content between the sea surface and 3000 m depth (Figure 2B) and the global temperature changes² (Figure 4.2.1C) are providing the base for the calculation of a steric sea level rise by 12 cm/cy, as represented by the line AB.



¹ Munk Walter (2002). Twentieth century sea level: an enigma. Proceedings of the National Academy of Sciences of the United States of America, vol. 99 no. 10, 6550–6555, doi: 10.1073/pnas.092704599

² Levitus, S., Antonov, J. I., Wang, J., Delworth, T. L., Dixon, K. W. & Broccoli, A. J. (2001) Science 292, 267–270.

Figure 1. Cartoon from Munk 2002, showing the contribution to sea level trends.

Munk addressed the attention of researchers to the IPCC 2001³ rate of sea level rise that was composed by the sea level in 2000 referred to 1900 (21 cm), the greenhouse contribution (3 cm) and the ‘best estimate’ of eustatic contribution (6 cm):

$$\zeta - \zeta_{\text{greenhose}} - \zeta_{\text{eustatic}} = 21 - 3 - 6 = 12 \text{ cm}$$

rise unaccounted for (the Munk sea level rise enigma)!

It can be published after the revision suggested by the referee and additional text related to the above comments.

³ Church, J. A., Gregory, J. M., Huybrechts, P., Kuhn, M., Lambeck, K., Nhuan, M. T., Qin, D. & Woodworth, P. L. (2001) in *Climate Change 2001: The Scientific Basis* (Cambridge Univ. Press, Cambridge, U.K.), pp. 639–694.