



The Enigma of 20th century sea level change

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Sea level has been constant at near-present levels from ~ 5500 calendar years BP to the end of the Little Ice Age at ~ 1860 AD. Since ~ 1900 , tide gauge measurements indicate that it has risen steadily at ~ 2 mm/yr by about 18 cm. The comparative stability of sealevel from 5500 cal yr BP to 1860 AD is robust, being suggested by near-shore Mediterranean archeological sites, the few sea level records that extend back to 1700 AD, and the impossibility of projecting the current sea level rise of ~ 2 mm/y back 5000 years (it would produce a global 10 m inundation, which is not observed) (Douglas et al., 2001, Academic Press).

The post 1870 sea level rise is not due to heating of the upper ocean (Liviticus et al., 2000, Science). Munk (2002, PNAS) characterized it as an “enigma”, dismissing an upper ocean steric sea level explanation as “too little” (~ 3 cm), “too late” (the rise started in 1860), and “too linear” (not accelerating with the accelerating CO_2 increase). GRACE gravity measurements show a near zero change in ocean mass. Cazenave et al. (2009, Global and Planetary Change) indicate a slight decrease in ocean mass between 2003 and 2008. The rate of meltwater mass being added to the oceans essentially equals the GIA correction (Chambers et al., 2010, JGR). Different GIA models give ocean mass increase ranging from 0.5 to 2 mm/y of equivalent sea level rise. Our GIA model suggests no ocean mass increases (~ 0 mm/y of equivalent sea level rise).

In this talk I show that the heating of a two layer ocean model driven by the temperature changes that have occurred over the last 1000 years since the peak of the Medieval Warm Period produces a ~ 2 mm/yr linear sea level rise over the last 100 years with much smaller preceding sea level changes. Ocean mass could be unchanging over the last century as well as the last ~ 5000 years. This result is compatible with GRACE measurements and eclipse data constraints, predictions of our GIA model, and it resolves the enigma the 20th Century sea level change noted by Munk.