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There Is No Indication That the Extreme Water Levels in Rhode Island Have Strongly Accelerated Since the Start of the 20th Century

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Abstract

In Rhode Island, the extreme water levels vs. the mean sea level (MSL) trend are not increasing, while the frequency of hurricanes is reducing. The MSL trend is only apparently accelerating at a rate exceeding the few micrometers per year squared of the averages of world tide gauges' data sets only because of the local phasing of the multi-decadal oscillations. With proper time windows, the acceleration is negligible as everywhere else. There are therefore no accelerating extreme water levels.

Keywords

Sea Level Rise, Sea Level Acceleration, Cherry Picking

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1. Introduction

Ref. [1] discusses a "period of accelerating sea level rise and extreme sea level events" that is nowhere to be seen in anything measured in Rhode Island or the rest of the world. Aim of the paper is to show as the monthly average mean sea levels are rising but not accelerating in Rhode Island and nearby states similarly to the averages of world data sets, and the extreme sea levels are oscillating about this rising trend without any acceleration component.

Conventionally, the MSL trend is computed by linear fitting. The trend is the slope of the fitting. Conventionally, he MSL acceleration is computed by parabolic fitting. The acceleration is twice the second order coefficient of the fitting.

As was shown by Ref. [2], different observational data sets of tide gauges around the world show relatively small sea level trends, from +0.4 to +2 millimeters per year, and negligibly small sea level accelerations, just a few micrometers per year squared.

As the sea levels are very well known to oscillate with periodicities up to quasi-60 years around the world and along the Atlantic coast of the United States ([2], [3], [4], [5], [6], [7], [8], [9], [10], [11]), more than 60 years of data are needed to infer a proper trend by linear fitting, and more than 90-105 years are needed to infer a proper acceleration by parabolic fitting. This is explained in Figure 1 by considering a sample sinusoidal oscillation of periodicity 60 years:

1. If the measurements start at the time of a valley of the peaks and valleys oscillations, the trend will be overrated for 60 years, while the acceleration will be overrated for 30 years, and then underrated for other 60 years.
2. If the measurements start at the time of a peak of the peaks and valleys oscillations, the trend will be underrated for 60 years, while the acceleration will be underrated for 30 years, and then overrated for other 60 years.
3. If the measurements start at the beginning of a positive oscillation, the trend will be overrated for 30 years, and underrated for other 45 years while the acceleration will be underrated for 60 years, and then overrated for other 45 years.

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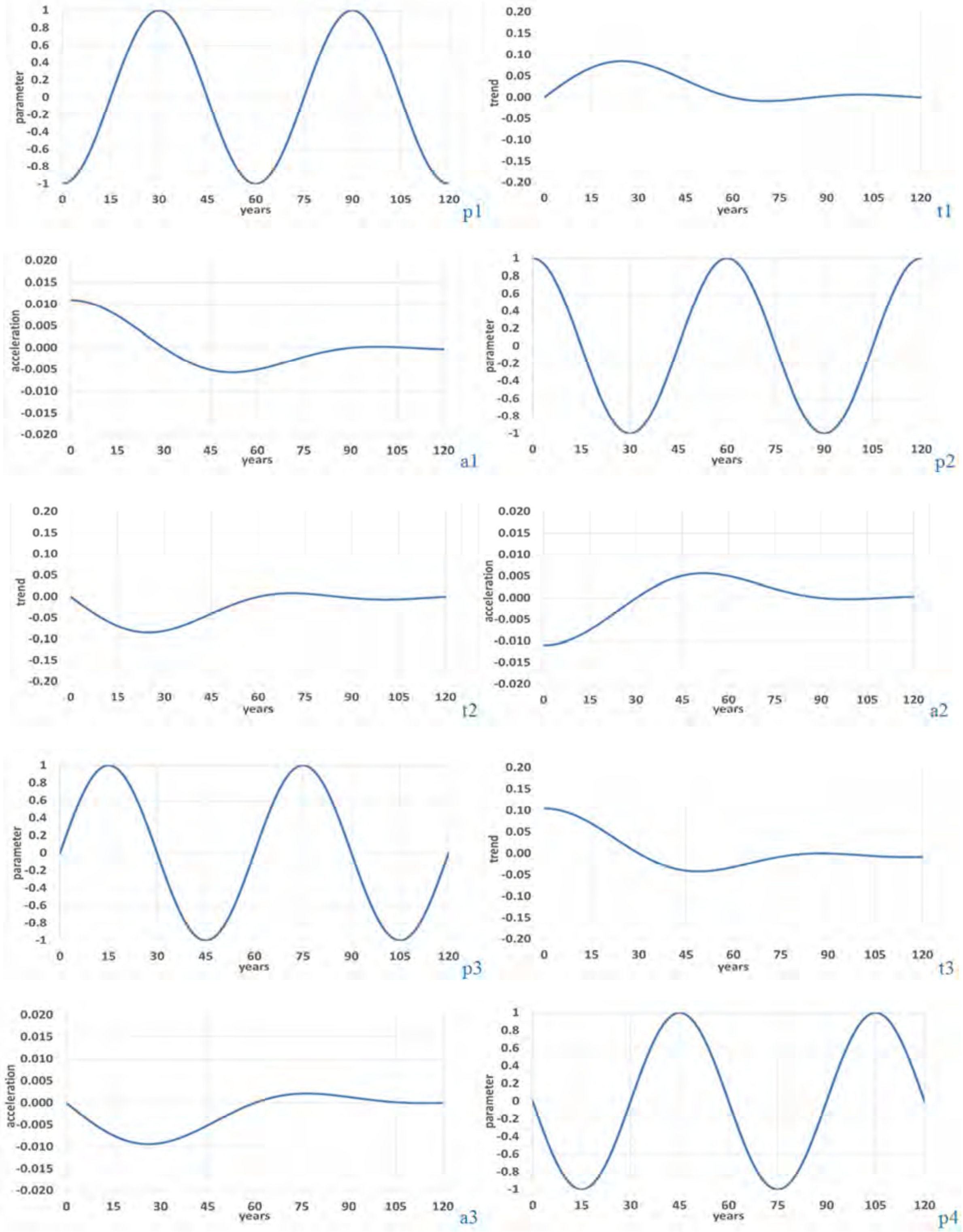
4. If the measurements start at the beginning of a negative oscillation, the trend will be underrated for 30 years, and overrated for other 45 years while the acceleration will be overrated for 60 years, and then underrated for other 45 years.



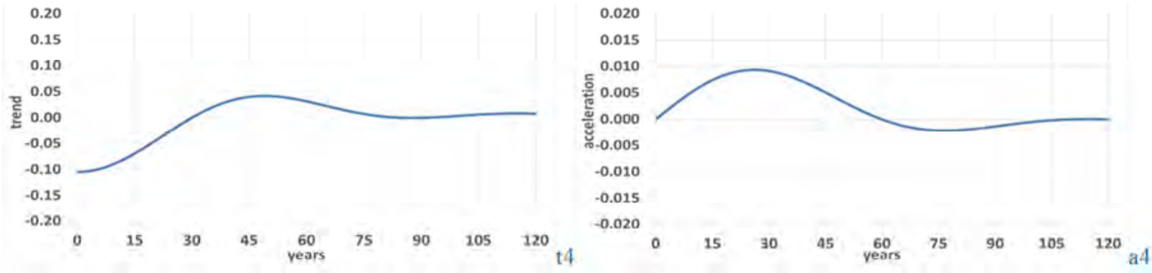


Figure 1. Influence of a sample 60 years sinusoidal oscillation on the trend and acceleration computed by linear and parabolic fittings. Moving left to right, top to bottom, first is the non-dimensional parameter, second the trend year^{-1}, third the acceleration year^{-2}.

2. Rhode Island Mean Sea Levels

The monthly average mean sea levels (MSL) in the tidal stations of Rhode Islands and in the nearby states are shown in Figure 2. The images are from sealevel. info, as well as the analyses. Trends and accelerations are given as follows:

1. In case of the tide gauge of Newport, RI, USA (NOAA 8452660, 960-161, PSMSL 351), with date range 1930/10 to 2016/11, completeness 98%, the sea level trend is 2.730 mm/year and the sea level acceleration is 0.0094 mm/year^2.
2. In case of the less reliable tide gauge of Providence, RI, USA (NOAA 8454000, 960-158, PSMSL 430), with date range 1938/6 to 2016/11, completeness only 84%, the sea level trend is 2.254 mm/year and the sea level acceleration is 0.0362 mm/year². This second tide gauge recording recorded data from 1938 to 1947 followed by a gap to 1956 when it resumed.
3. In the northern nearby tide gauge of Boston, MA, USA (NOAA 8443970, 960-171, PSMSL 235), with date range 1921/1 to 2016/11, completeness 99%, the trend is 2.805 mm/year and the acceleration is -0.00443 mm/year² (negative).
4. In the southern nearby tide gauge of Kings Point, NY, USA (NOAA 8516945, 960-141, PSMSL 362), with date range 1931/8 to 2016/11, the trend is 2.504 ±0.207 mm/year and the acceleration is 0.000715 ±0.018797 mm/year².

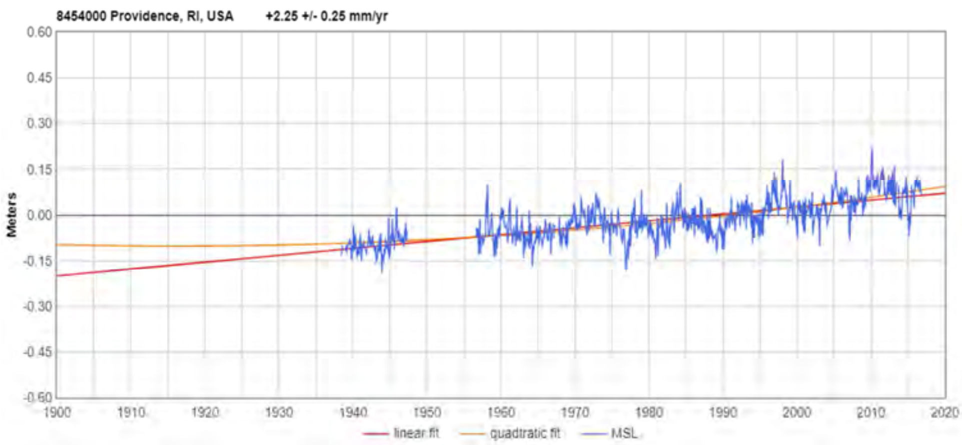
The higher acceleration for Rhode Island is only apparent. These numbers are larger than the averages of all the data sets analyzed in [2], but they are the result of a recent positive phase of the multi-decadal oscillations along the East Coast of the United States and the short records.

Along the West Coast of the United States the recent phase of the multi-decadal oscillations is opposite in sign and the accelerations are much smaller or even negative as it is shown in [9].

To compute realistic acceleration trends by linear fittings more than 60 years of recorded data are usually enough, but more than 90-105 years of data are needed to compute realistic accelerations by parabolic fittings.

In Providence, the record length is 79 years, but there is also a decadal gap. In Newport, the record length is 87 years. In Kings Point the record length is 86 years. In Boston, the record length is 96 years. The oscillations in the different tide gauges are very well synchronized each other.

We may conclude therefore that since the start of the 20th century, the sea levels are almost perfectly oscillating about a nearly constant trend in Rhode Island, just like everywhere else in the world.



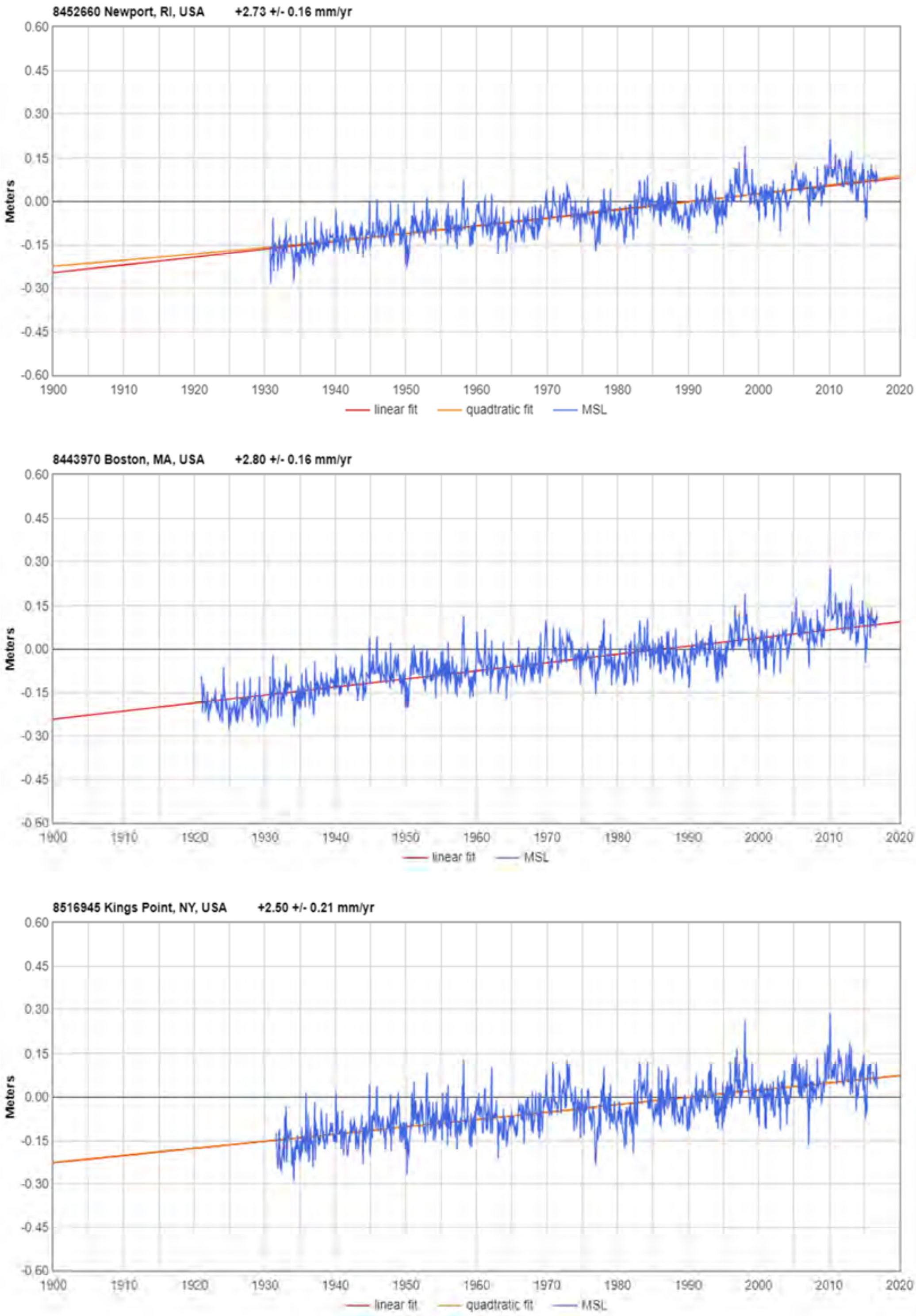


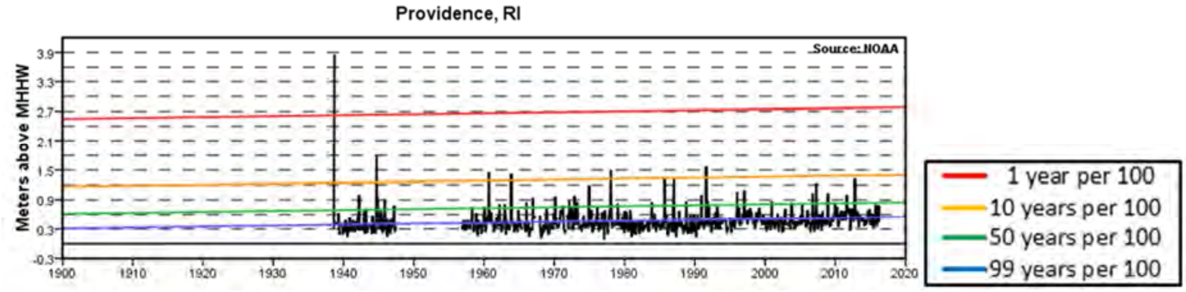
Figure 2. Monthly averaged mean sea levels in Providence, RI, Newport, RI, Boston, MA and Kings Point, NY. To be noted the perfect synchronization of the tide gauge records, with the different accelerations only originating from the missing data of one record vs. the other. Analyses and images are from sealavel. info.

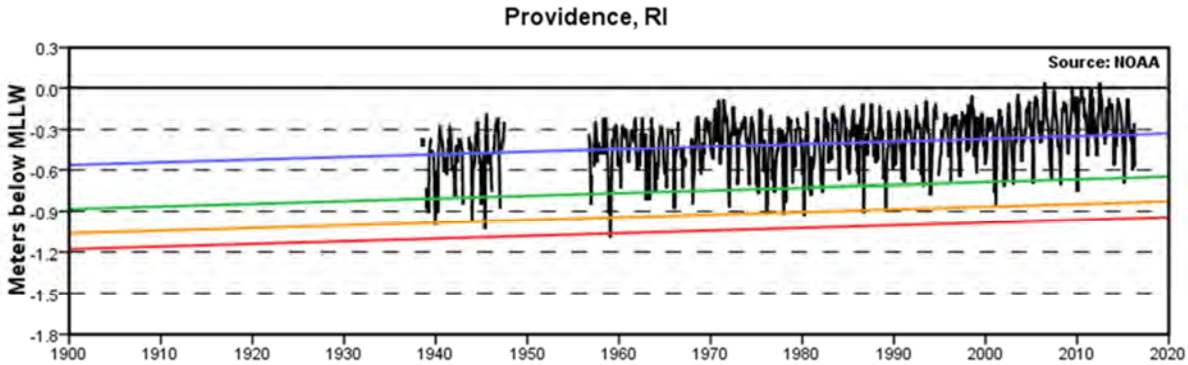
3. Rhode Island Extreme Sea Levels

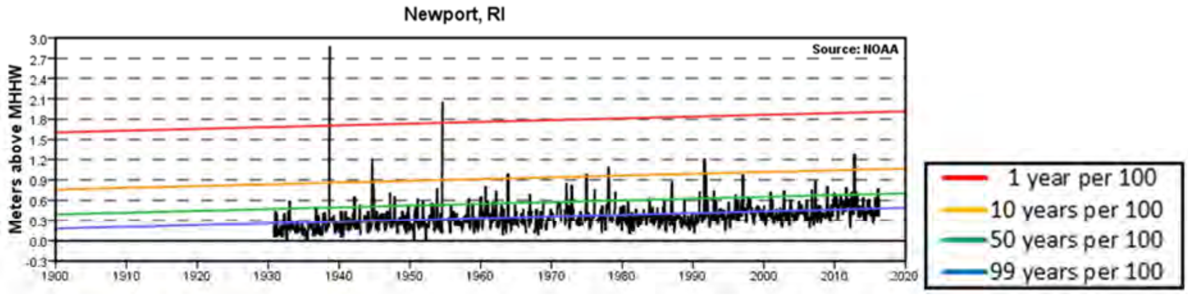
Concerning extreme events such as hurricanes, their number is drastically reducing, along both the Atlantic and the Pacific coasts of the United States, as shown in [11]. The chronological list of all hurricanes which affected the Continental United States shows indeed a drastic reduction of the frequency and intensity of hurricanes. In Rhode Island, there has been no recorded event after Hurricane Bob, of Saffir-Simpson Category 2, that landed on August 19, 1991. Bob was preceded by Carol of category 3 landed August 31, 1954, Edna of category 1 landed September 11, 1954 and

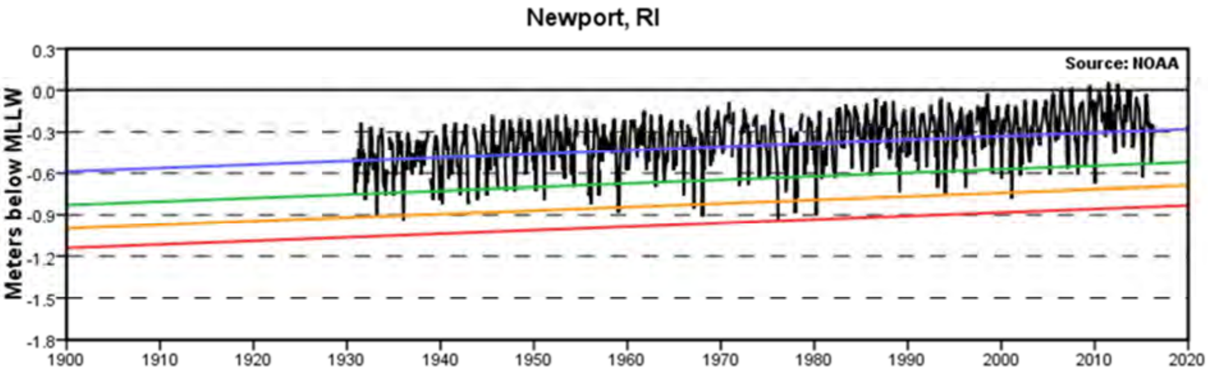
Donna of category 1 landed September 12, 1960.

About "extreme water levels" not explicitly related to extreme events such as hurricanes, the values computed by NOAA for Providence, Newport, Boston and Kings Point are shown in Figure 3 below. The images show the monthly highest and lowest water levels with the 1%, 10%, 50%, and 99% annual exceedance probability levels in red, orange, green, and blue. The values are in meters relative to the Mean Higher High Water (MHHW) datum or the Mean Lower Low Water (MLLW) datum. On average, the 1% level (red) will be exceeded in only one year per century, the 10% level (orange) will be exceeded in ten years per century, and the 50% level (green) will be exceeded in fifty years per century. The 99% level (blue) will be exceeded in all but one year per century.









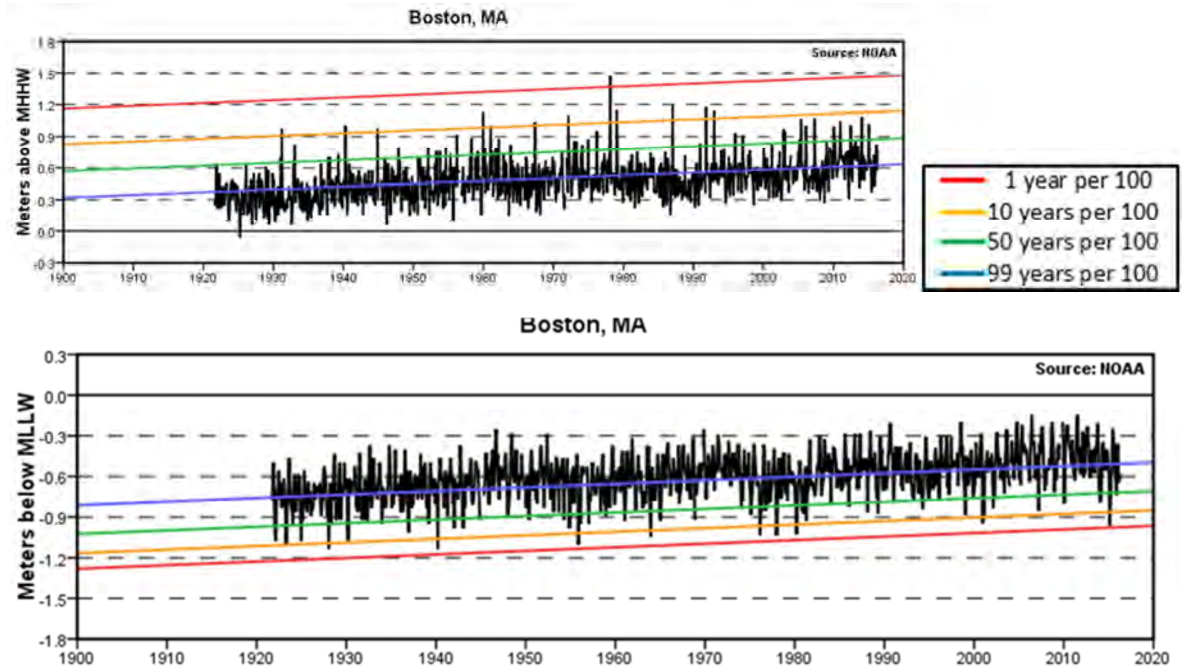


Figure 3. Extreme water levels for Providence, RI, Newport, RI, Boston, MA and Kings Point, NY. Images are from tidesandcurrents.noaa.gov/est/. The different records show significant similarities between the different locations, with no particularly increasing oscillation above or below the linear trend.

There is therefore no indication that the meters above MHHW are increasing above the increment of the MSL trend. The extreme water levels do not seem to occur more frequently and to become more intense.

4. Conclusions

There is no evidence to support the claim of a current period of rapidly accelerating sea level rise coupled with more frequent and relevant episodic events of extreme increases in water levels.

The sea level is rising, but not accelerating, with regular oscillations about a nearly perfect linear trend since the start of the 20th century.

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