Tidal Datum Updates in the World with Sea Level Rise

What to do?

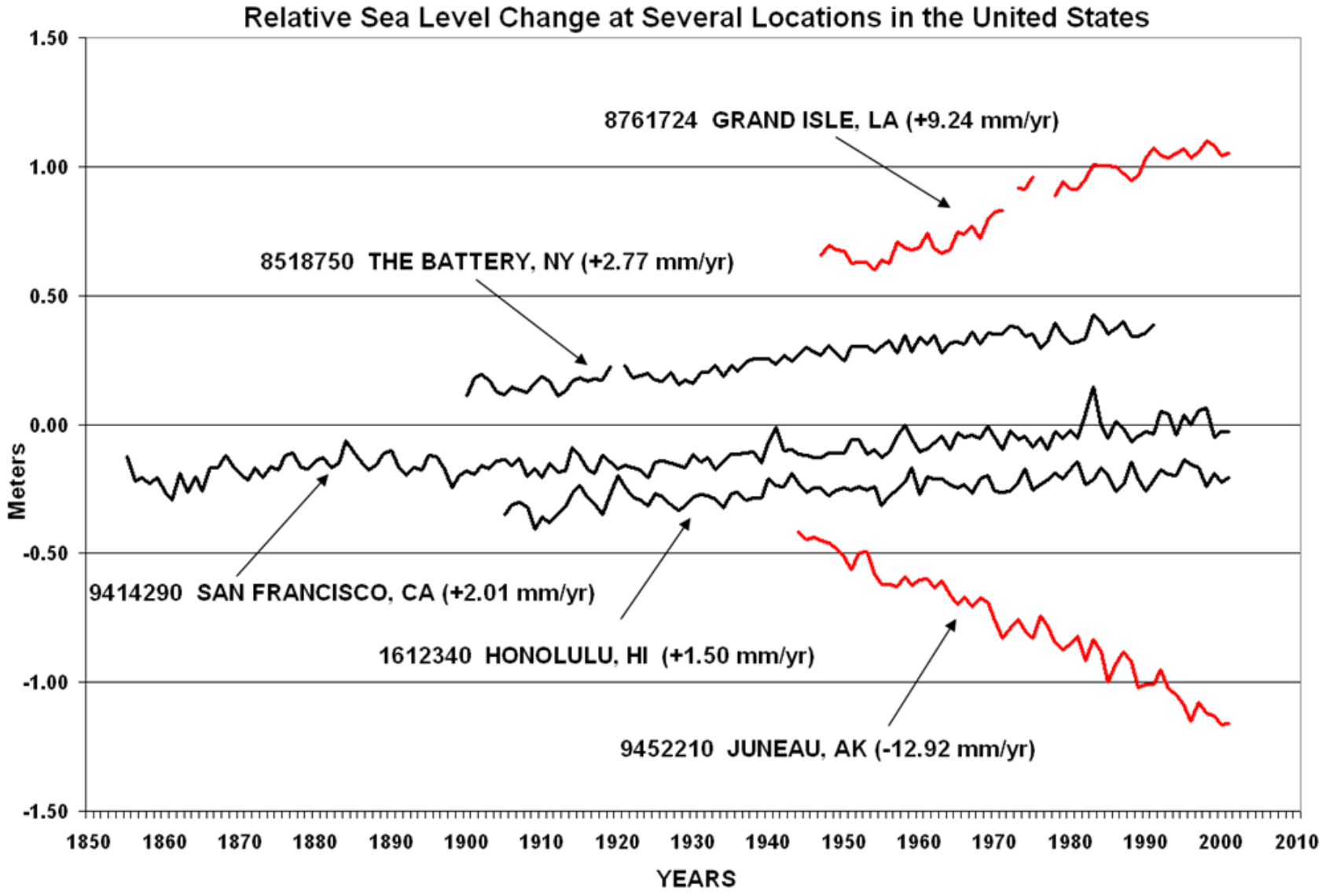
Most Graphics taken from NOAA Technical Report

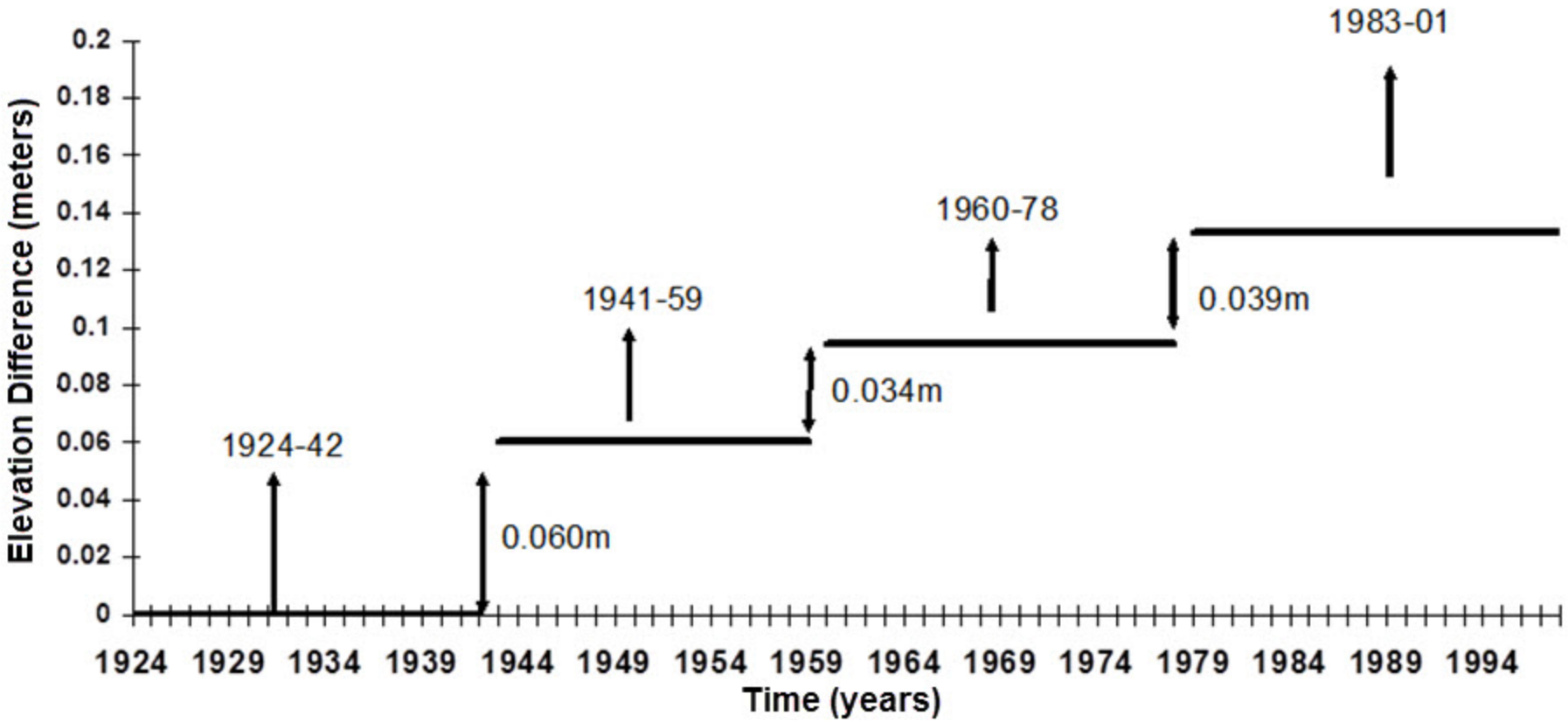
NOS CO-OPS 068

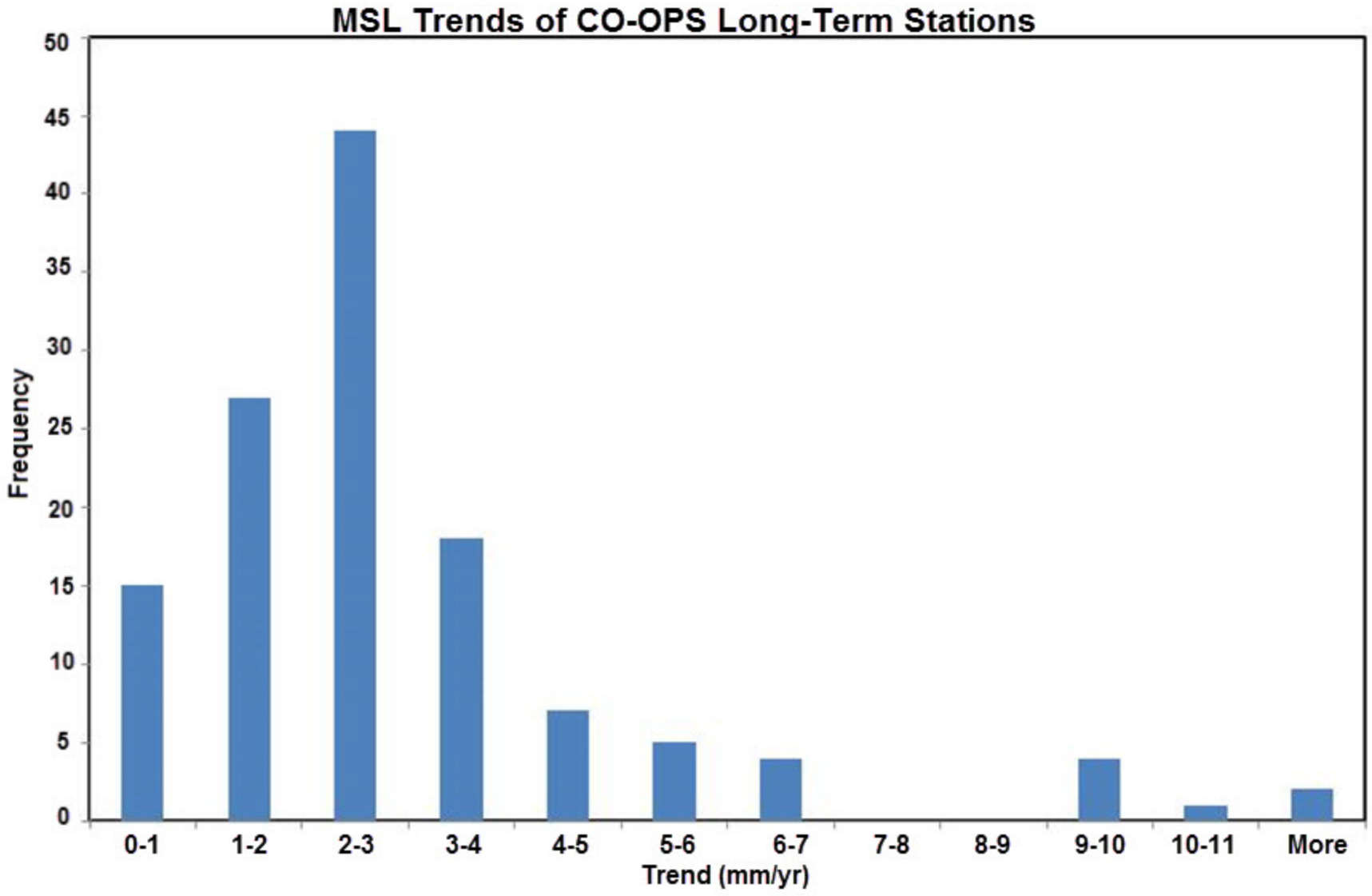
http://tidesandcurrents.noaa.gov/publications/NOAA_Technical_Report_NOS_COOPS_68.pdf

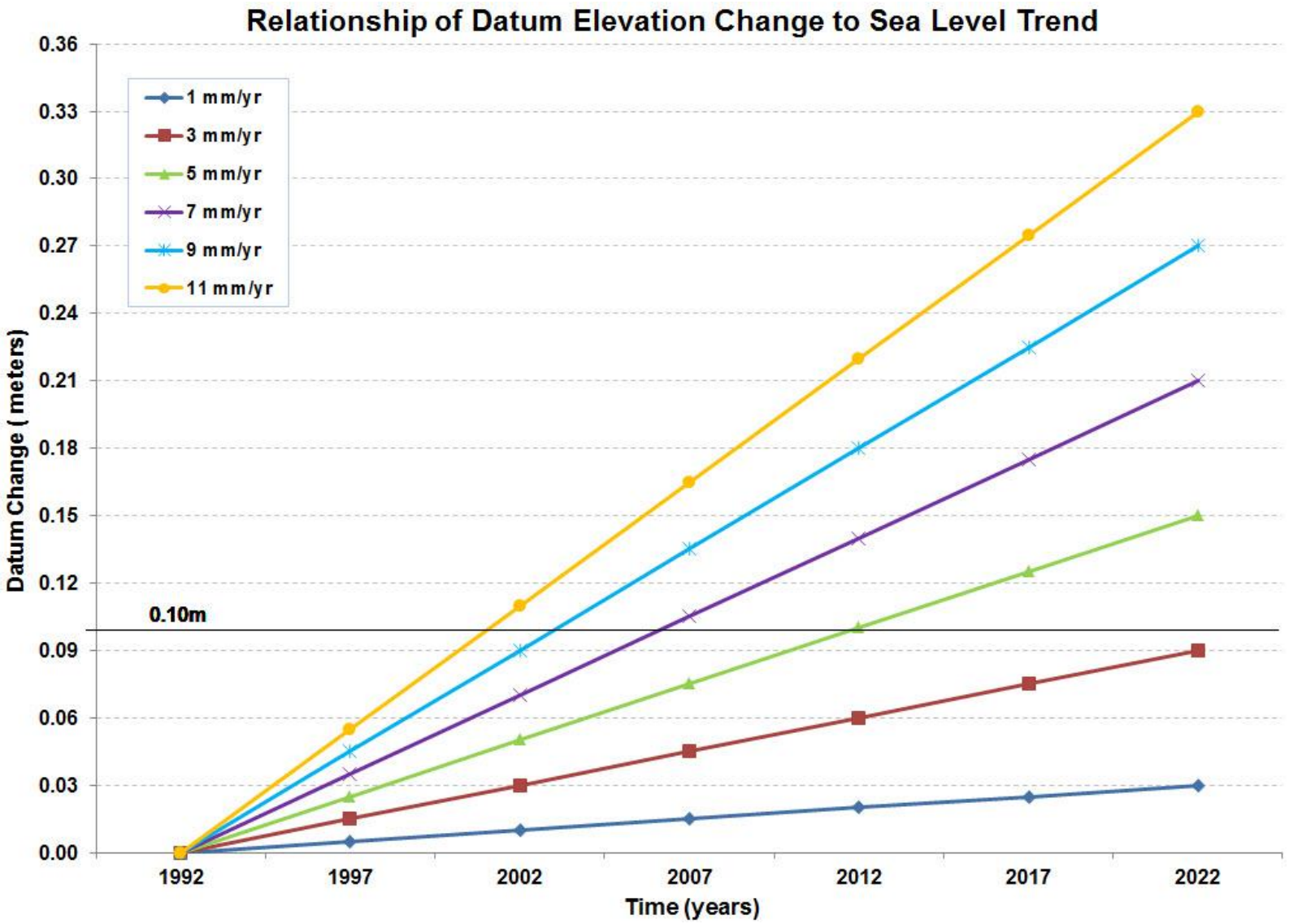
Issue

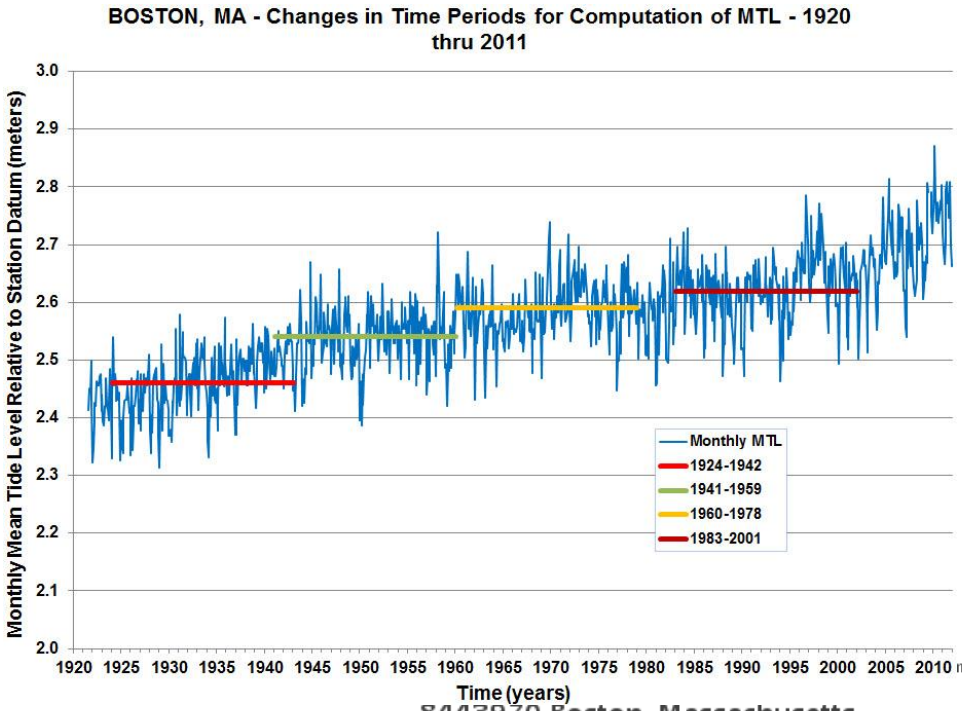
- NOAA updates its tidal datums approximately every 20 – 25 years.
- MSL is averaged over epoch thus it is 10 years out of date.
- A small number of stations are modified (i.e. MSL, MTL, DTL updated) every 5 years.
- What are the options if/when sea level accelerates?
- What are the repercussions?

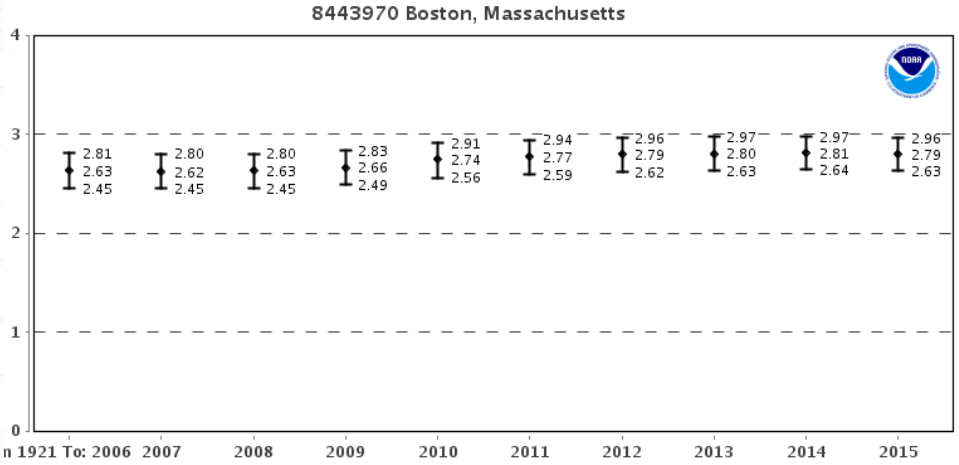

Relative Sea Level Change at Several Locations in the United States
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
Meters
8761724 GRAND ISLE, LA (+9.24 mm/yr)
8518750 THE BATTERY, NY (+2.77 mm/yr)
9414290 SAN FRANCISCO, CA (+2.01 mm/yr)
1612340 HONOLULU, HI (+1.50 mm/yr)
9452210 JUNEAU, AK (-12.92 mm/yr)
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
YEARS

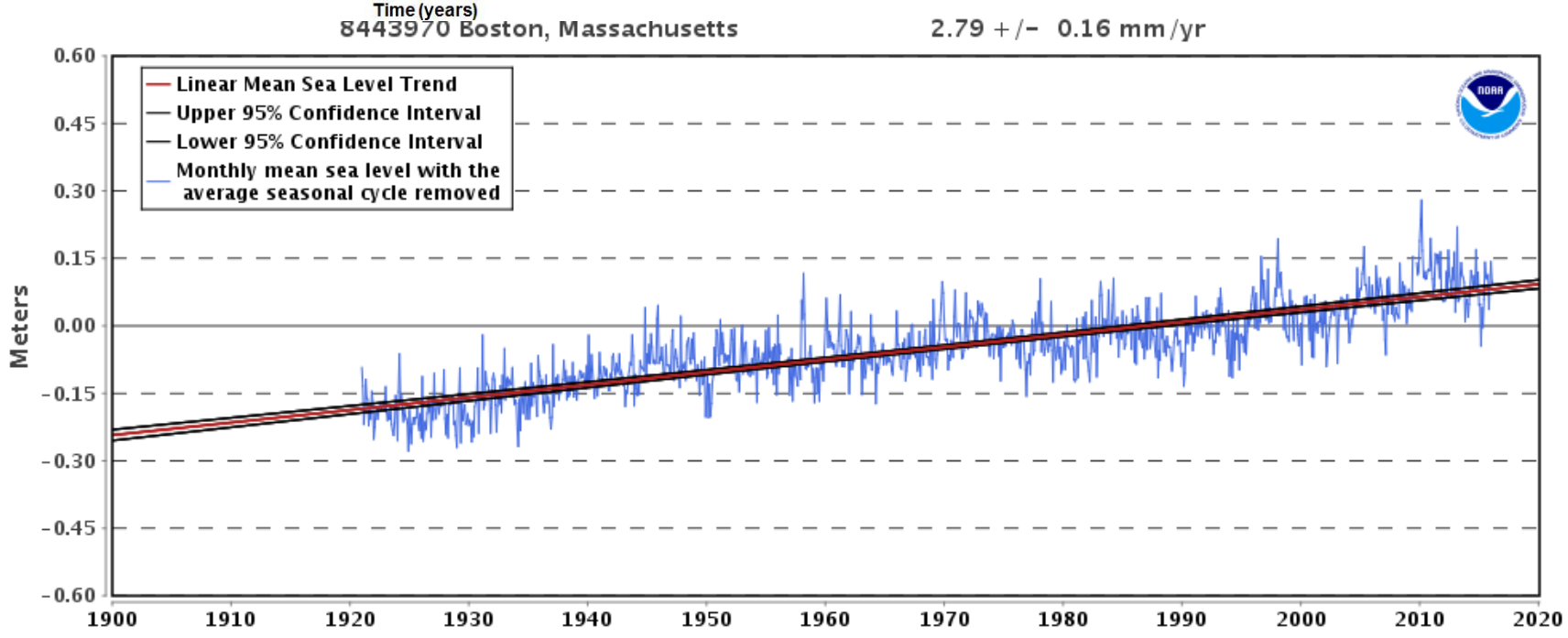

Average Differences in 19-Year MSL Between Epochs
Using 32 Long Term Stations
Elevation Difference (meters)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1924-42
0.060m
1941-59
0.034m
1960-78
0.039m
1983-01
1924 1929 1934 1939 1944 1949 1954 1959 1964 1969 1974 1979 1984 1989 1994
Time (years)


MSL Trends of CO-OPS Long-Term Stations
Frequency
50
45
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
More
Trend (mm/yr)


Relationship of Datum Elevation Change to Sea Level Trend
1 mm/yr
3 mm/yr
5 mm/yr
7 mm/yr
9 mm/yr
11 mm/yr
0.10m
Datum Change (meters)
0.36
0.33
0.30
0.27
0.24
0.21
0.18
0.15
0.12
0.09
0.06
0.03
0.00
1992
1997
2002
2007
2012
2017
2022
Time (years)


BOSTON, MA - Changes in Time Periods for Computation of MTL - 1920 thru 2011
Monthly Mean Tide Level Relative to Station Datum (meters)
Time (years)
Monthly MTL
1924-1942
1941-1959
1960-1978
1983-2001


8443970 Boston, Massachusetts
n 1921 To: 2006
2.81 2.63 2.45
2.80 2.62 2.45
2.80 2.63 2.45
2.83 2.66 2.49
2.91 2.74 2.56
2.94 2.77 2.59
2.96 2.79 2.62
2.97 2.80 2.63
2.97 2.81 2.64
2.96 2.79 2.63
2007
2008
2009
2010
2011
2012
2013
2014
2015


8443970 Boston, Massachusetts
2.79 +/- 0.16 mm/yr
Linear Mean Sea Level Trend
Upper 95% Confidence Interval
Lower 95% Confidence Interval
Monthly mean sea level with the average seasonal cycle removed
Meters

Current Modified Procedure

- Use Mn and Gt over 19 year NTDE
- Calculate 5 year MSL, MTL, and DTL
- Calculate other datums using these formulas (for semi diurnal, diurnal, and mixed diurnal)

$$MLW = MTL_5 - 1/2\ Mn_{19}$$

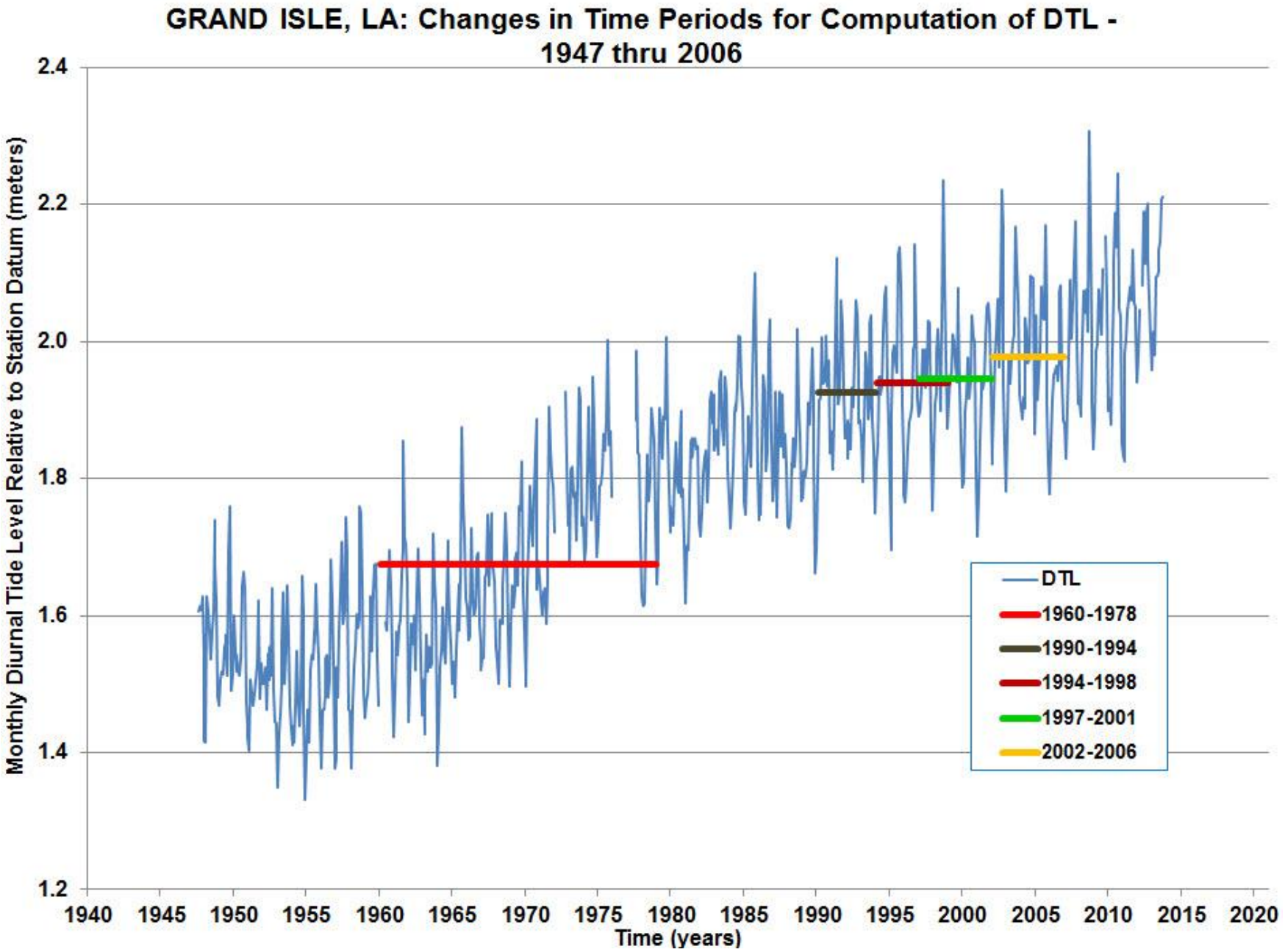
$$MHW = MLW + Mn_{19}$$

$$MLLW = DTL_5 - 1/2\ Gt_{19}$$

$$MHHW = DTL_5 + 1/2\ Gt_{19}$$

$$DHQ = MHHW – MHW$$

$$DLQ = MLW – MLLW$$


GRAND ISLE, LA: Changes in Time Periods for Computation of DTL - 1947 thru 2006
Monthly Diurnal Tide Level Relative to Station Datum (meters)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Time (years)
DTL
1960-1978
1990-1994
1994-1998
1997-2001
2002-2006