

Long-term Variations in Amplitudes and Phases of Harmonic Constants

IHO Tides and Water Level Working Group 5'th Meeting

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Long-term Variations in Amplitudes and Phases of Harmonic Constants

- **This study was conducted in support of TWLWG Work Plan Item H1 “The study of long term data sets for the determination of global sea level rise”**
- **One of ways took look at potential effects of global sea-level rise on the ocean tides is to look for long-term changes and trends in harmonic constants over time.**
- **At TWLWG4, we decided to look at these changes on a time and data availability basis.**
- **This study presents results from two U.S stations: Boston, Massachusetts; and Honolulu, Hawaii**

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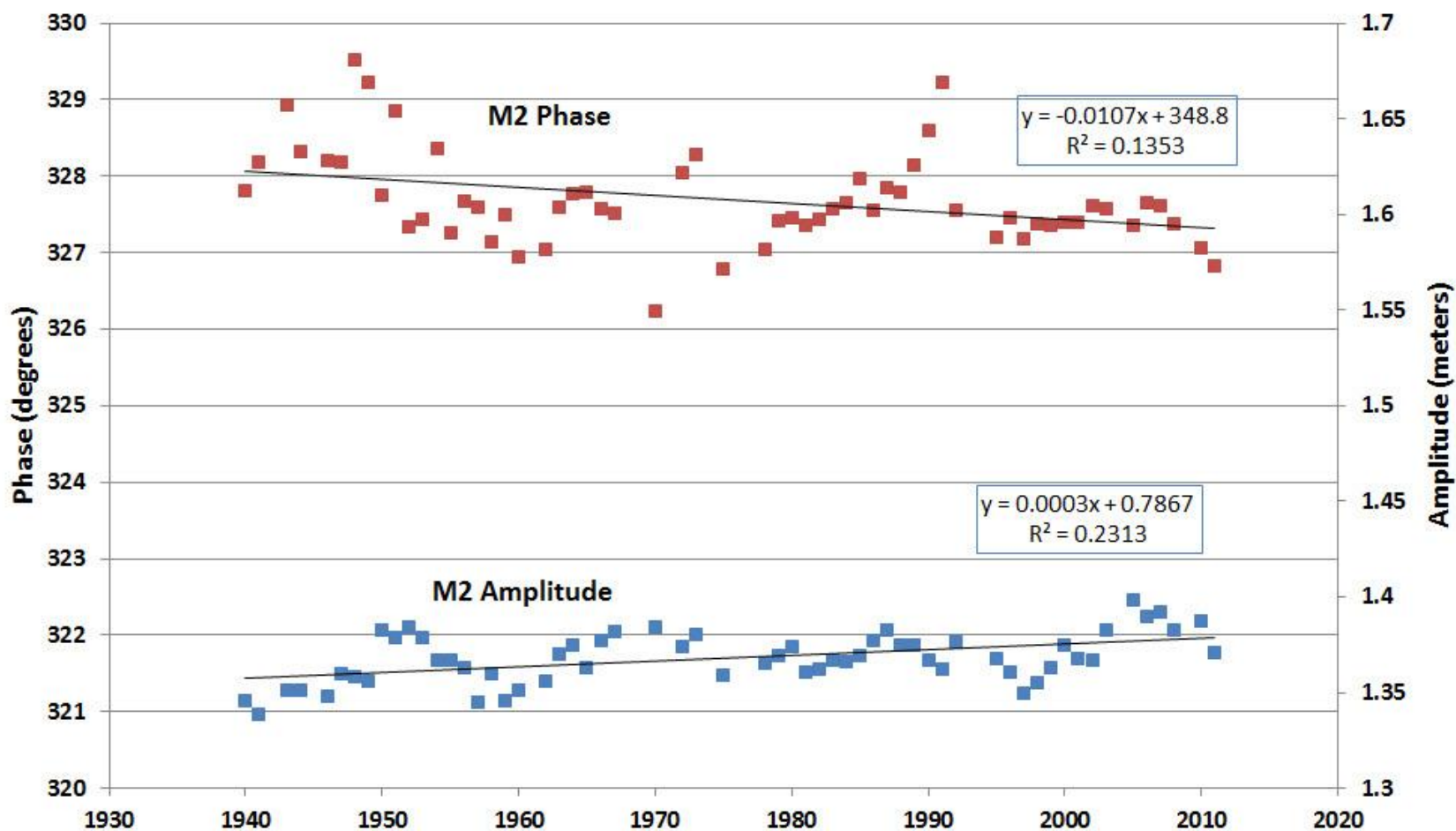
- **A series of standard NOAA least-squares harmonic analyses were run for each calendar-year of hourly height data for each station over the period of record.**
- **For this study, only the results for the M2, S2, K1 and O1 constituents are presented.**

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- **Boston:** analyses run 1922 through 2012; however missing complete years of hourly heights for 2009, 2004, 1993, 1994, 1977, 1976, 1971, 1968, 1961, 1945, 1942, 1930, 1924, so analyses were not run for those years.
- **Honolulu:** analyses run 1912 through 2012; however missing complete years of hourly heights for 1992, 1991, 1982, 1979, 1978, 1977, 1976, 1974, 1973, 1972, 1967, 1962, 1954, 1953, 1950, 1949, 1942, 1921, 1918, 1917, 1914, 1913, so analyses were not run for those years.

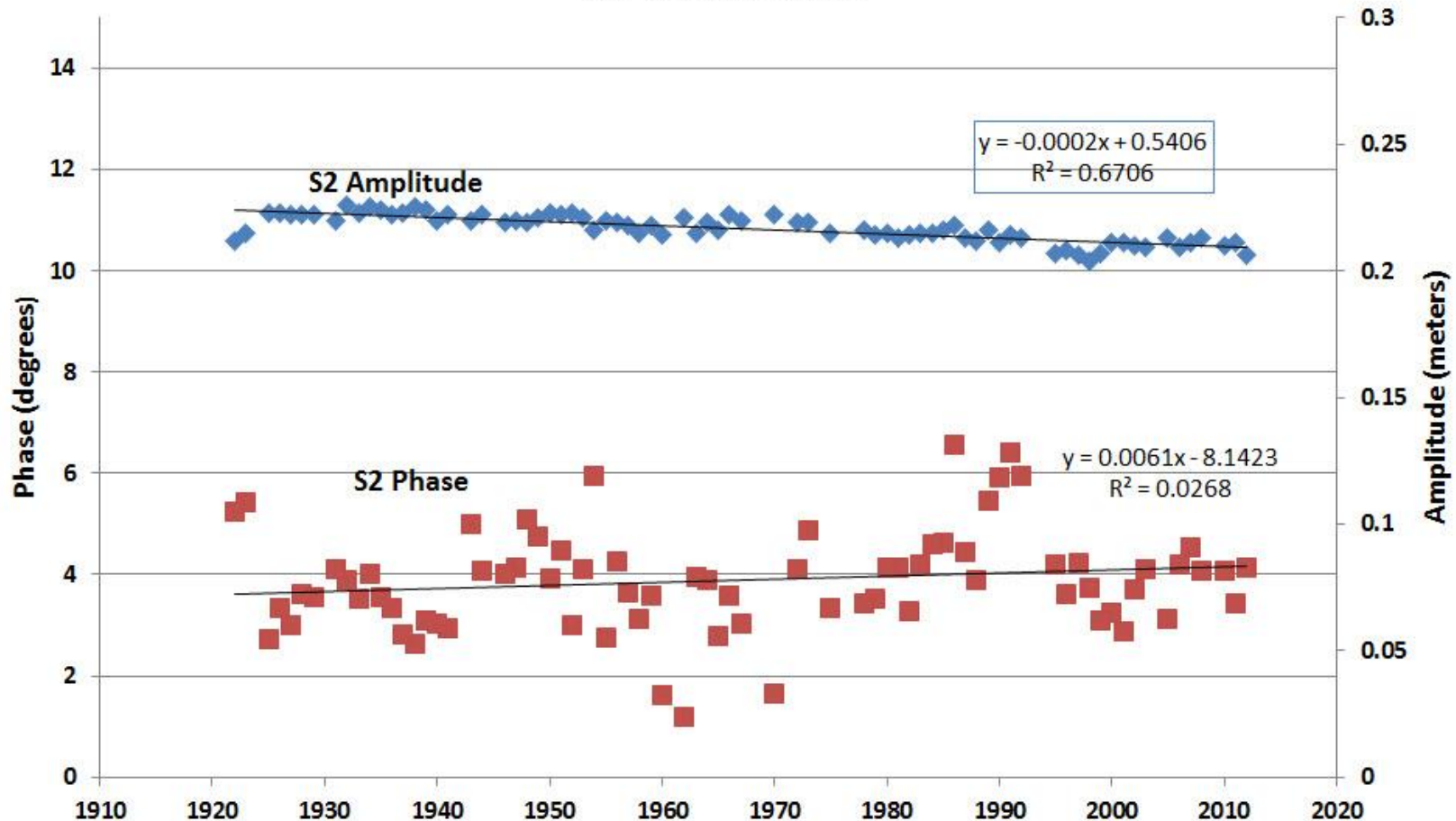
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Boston, MA Variations in Harmonic Constants 1922 - 2012
M2 Constituent



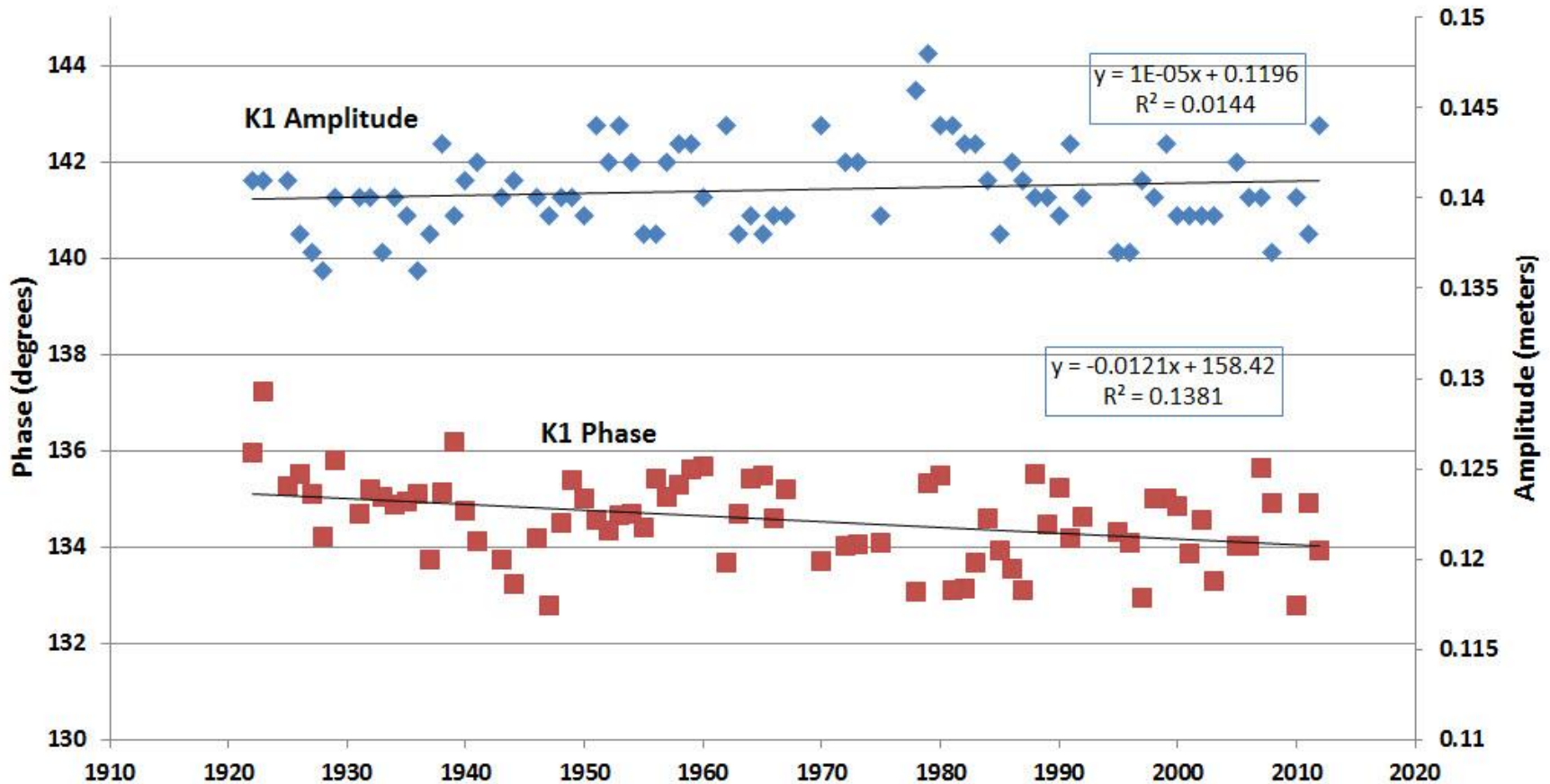
Long-term Variations in Amplitudes and Phases of Harmonic Constants

Boston, Ma Variations In Harmonic Constants 1922 - 2012
S2 Constituent



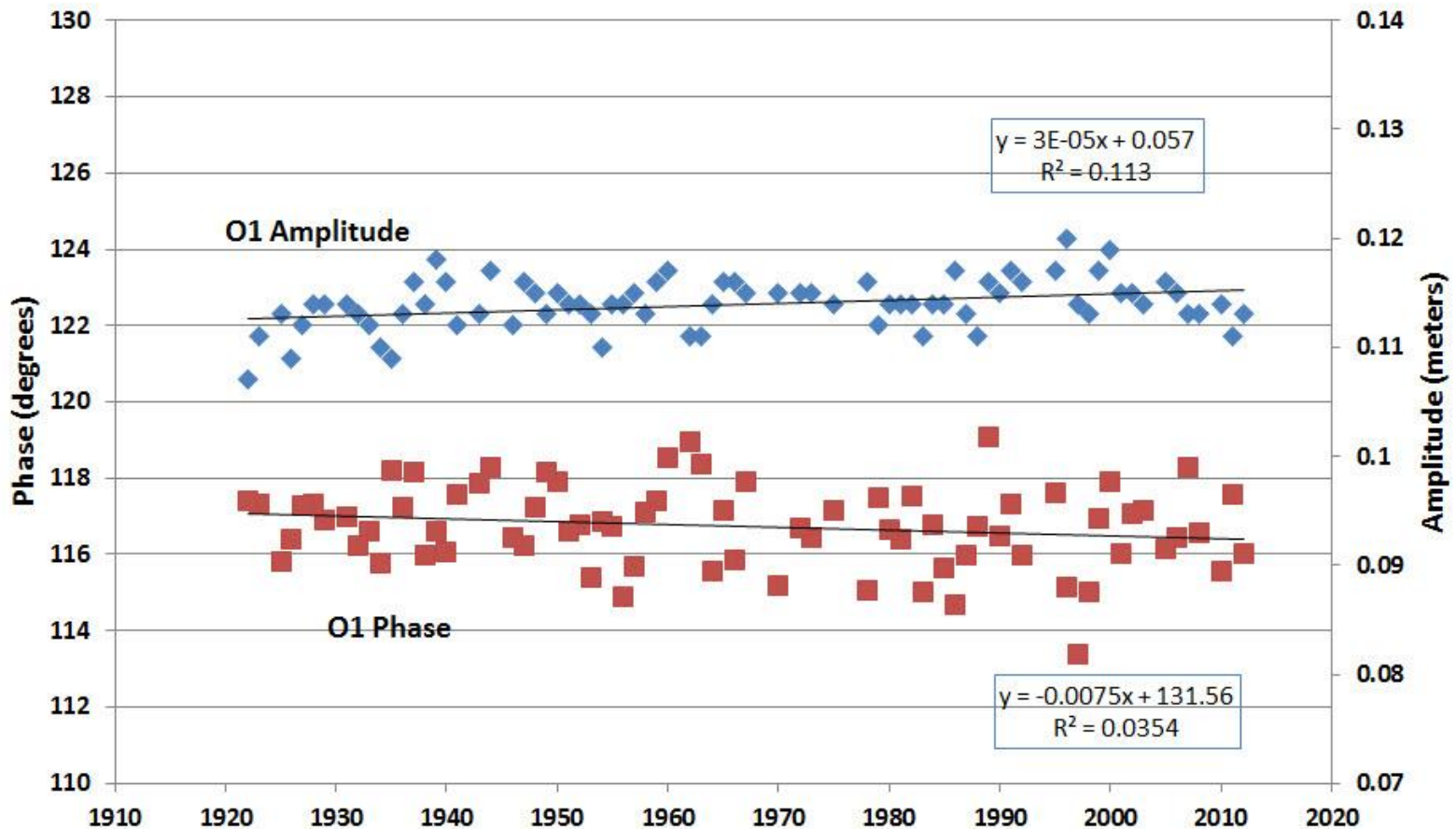
Long-term Variations in Amplitudes and Phases of Harmonic Constants

Boston, MA Variations in Harmonic Constants 1922 - 2012 K1 Constituent



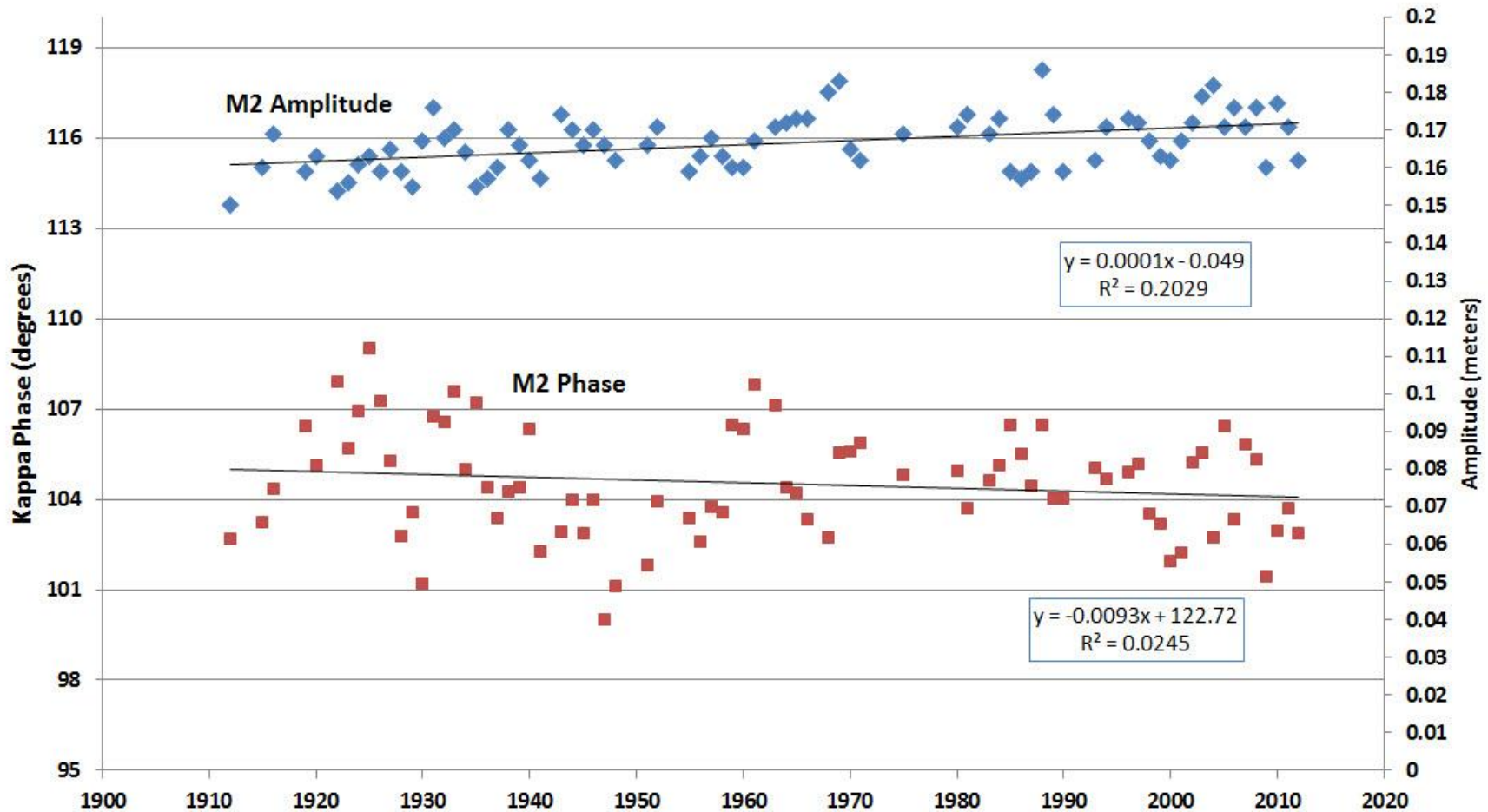
Long-term Variations in Amplitudes and Phases of Harmonic Constants

Boston, Ma Variations in Harmonic Constants 1922 - 2012
O1 Constituent



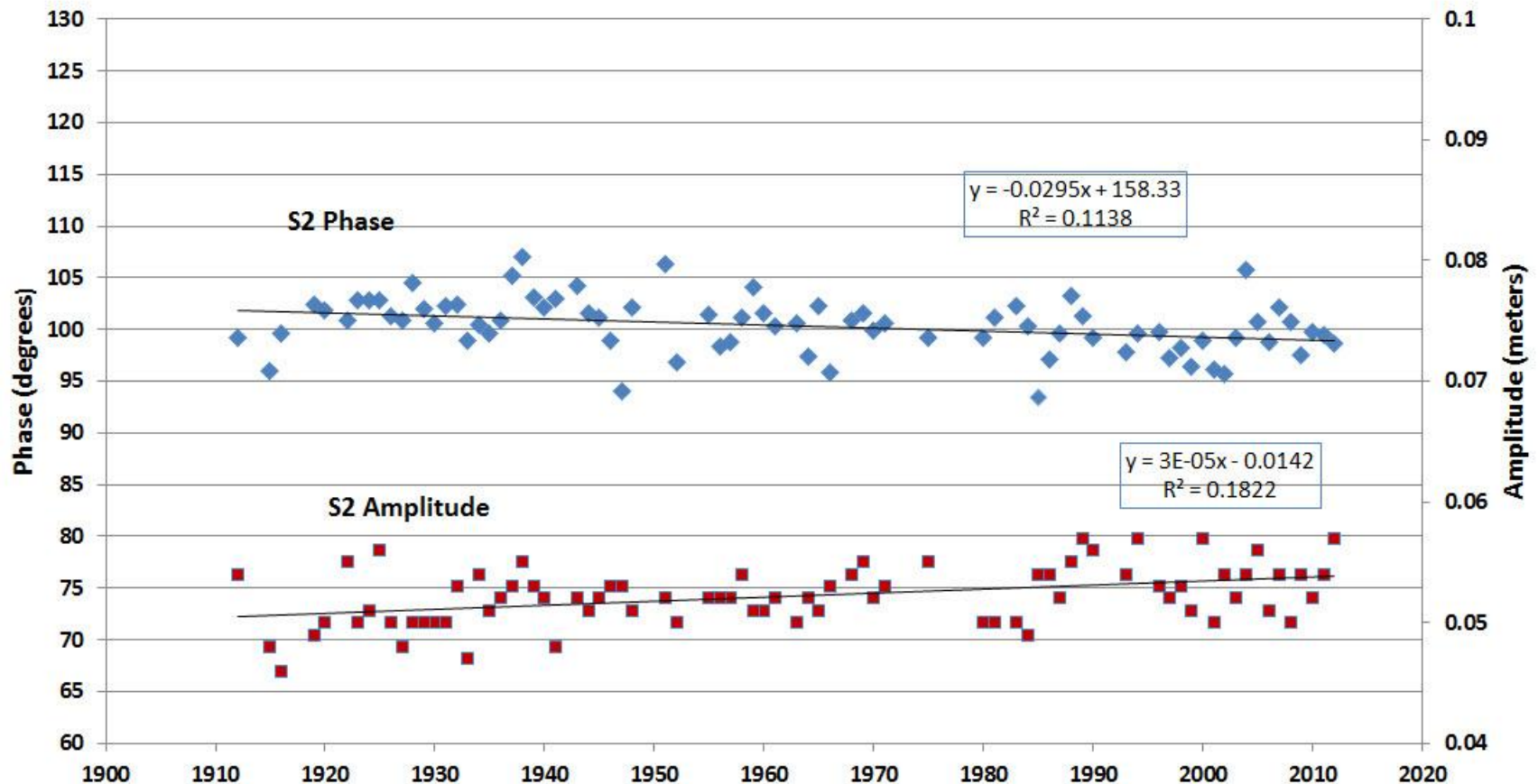
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Honolulu, HI Variation in Harmonic Constants 1912-2012 M2 Constituent



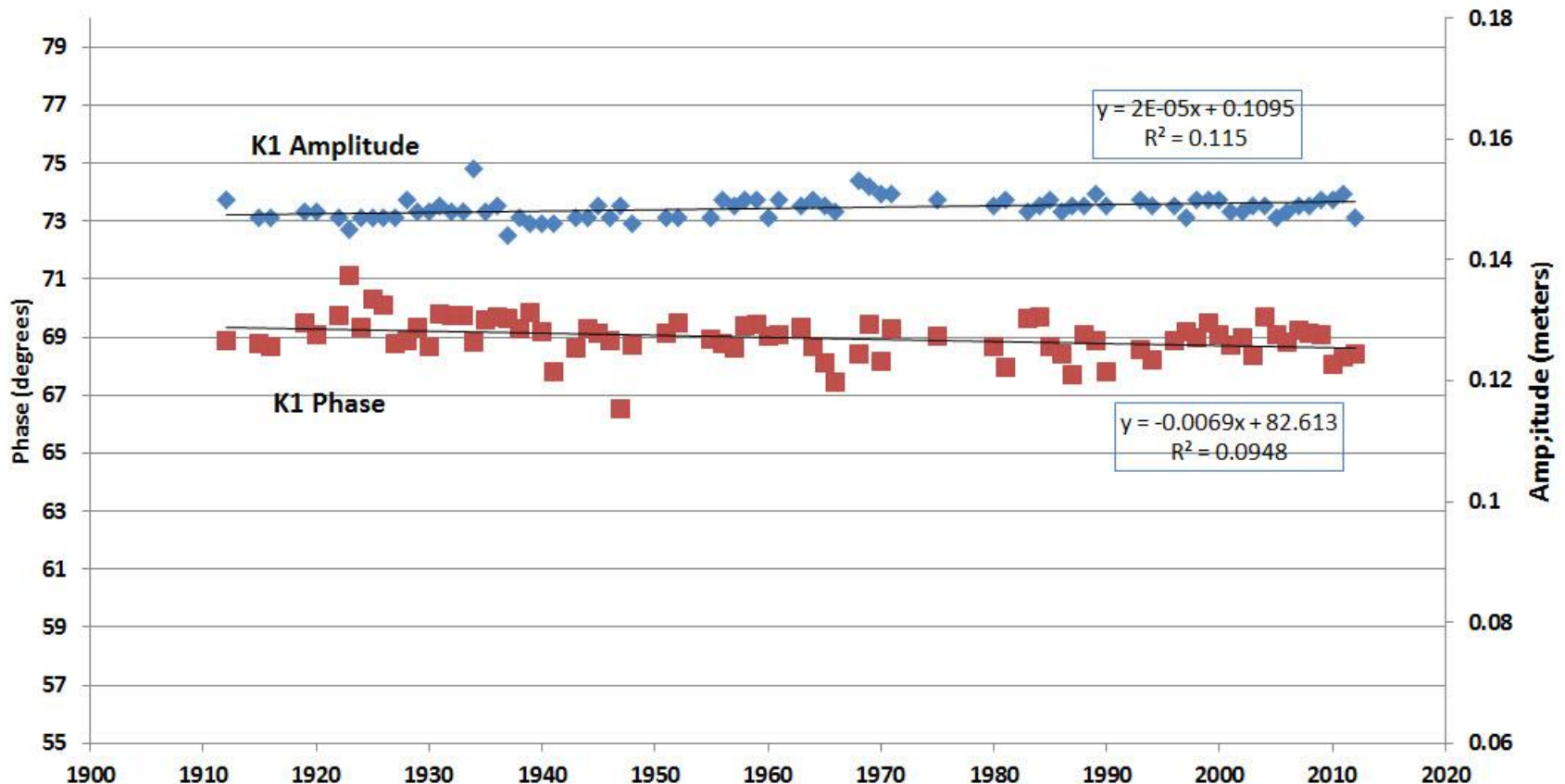
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Honolulu, HI Variation in Harmonic Constants 1912-2012
S2 Constituent



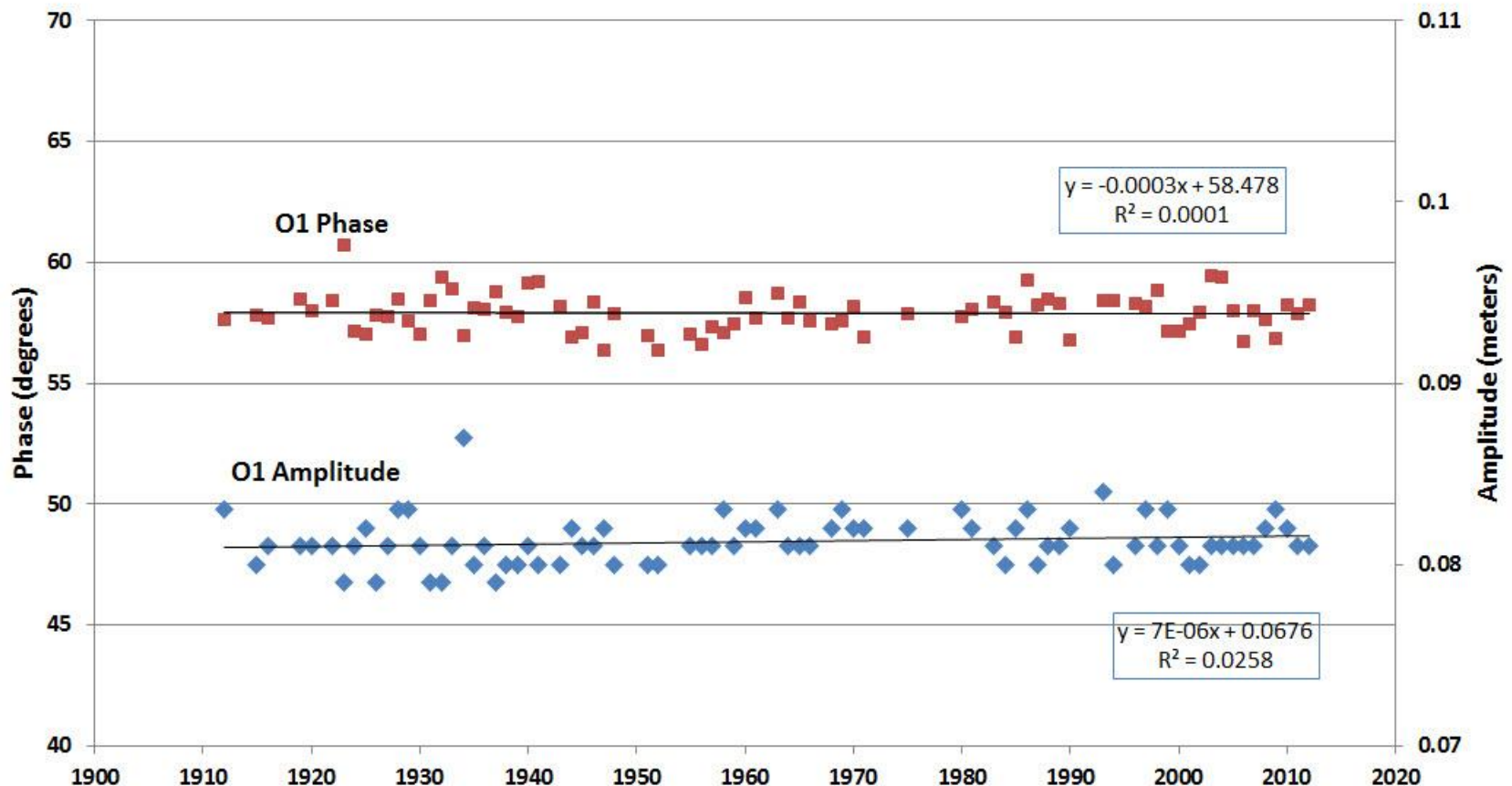
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Honolulu, HI Variation in Harmonic Constants 1912 - 2012
K1 Constituent



Long-term Variations in Amplitudes and Phases of Harmonic Constants

Honolulu, HI Variations in Harmonic Constants 1912 - 2012
O1 Constituent



Long-term Variations in Amplitudes and Phases of Harmonic Constants

- **Boston M2 Constituent:** Trends for amplitudes and phase are inconclusive with low slopes and low regression (R-squared) coefficients for the linear fits. The amplitude plot shows a residual 19-year period however, indicating the nodal correction factor is insufficient perhaps.
- **Boston S2 Constituent:** The amplitude trend shows a significant downward trend over time with a quite large R-squared coefficient for the linear fit. The S2 Phase does not have a significant trend.
- **Boston K1 and O1 Constituents** do not show significant trends in either amplitude or phase.

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- **Boston K1 and O1 Constituents** do not show significant trends in either amplitude or phase.
- **Honolulu M2, S2, K1., O1 Constituents :** Trends for amplitudes and phase are inconclusive with low slopes and low regression (R-squared) coefficients for the linear fits.

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- **Next Steps:**
 - **Get feedback on these results from TWLWG**
 - **Look at nearby stations to see if S2 constituent amplitudes show the same downward trend as Boston and investigate cause**
 - **Investigate source of 19-year modulation in the annual amplitudes of the M2 constituent at Boston**
 - **Look at additional stations in other basins**
 - **Encourage other members to conduct similar analyses for their own stations**