Title: Modeling the Effects of Observational Gaps on P-mode Oscillations

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Abstract:

The Global Oscillation Network Group (GONG) operated by the National Solar Observatory observes the Sun continuously through measurements made at six sites around the globe. These observations are used to measure the resonant acoustic oscillations which probe the internal structure and dynamics of the Sun. However, poor weather and occasional technical breakdowns cause interruptions in observations and create gaps. These effects complicate analysis of the oscillation frequencies and other mode parameters. It is thus of interest to examine the effects of temporal window function on solar oscillation mode parameters, namely frequency, line width, and amplitude.

In order to assess the impact of the window function on the extraction of mode parameters of global solar oscillations, we simulate 108 different time series, each modulated by a different window function. In order to minimize the effect of solar activity, the primary time series was chosen during the activity minimum period (2008 October 1 -- 2009 January 16). The new window functions were randomly chosen from a set of observed window functions to cover the entire observed range of 71% to 94%. The modified time series was then processed through the standard GONG p-mode pipeline to extract the mode parameters.

The analysis of mode parameters as a function of the fill factor for each mode was carried out assuming a linear dependency between them. While the variation in mode amplitude and line width were found to be significant, the change in mode frequencies were found to be small. We then applied these linear relations to correct the mode parameters of 224 data sets (1995 - 2017) produced from the standard GONG pipeline. Both uncorrected and corrected mode parameters were analyzed for solar cycle variations by calculating rank correlations with 10.7 cm radio flux which represents a proxy of the solar activity. We find significant higher change in correlation for amplitudes and mode widths while the change in correlation for mode frequencies was found to be insignificant.