EGUsphere, author comment AC2
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Reply on RC2

Richard Ray

Author comment on "Technical note: On seasonal variability of the M_2 tide" by Richard D. Ray, EGUsphere, https://doi.org/10.5194/egusphere-2022-252-AC2, 2022

I thank the two anonymous reviewers, along with Haidong Pan, for their feedback. A number of the points brought up are actually somewhat general questions on tidal analysis, not specifically on the paper itself, so these online discussions are a useful way to address them. To augment the earlier discussion prompted by Dr Pan, I can respond to two topics brought up by Referee 2.

One relates to the length of time series needed for this kind of tidal analysis, and notably what are the consequences of having "less than a year's worth of data." For the examples in the paper, I had purposely chosen tide gauges with many years of high-quality data. A long time series ensures that computed spectra (Figure 1) have adequate spectral resolution and that computations of monthly mean amplitudes and phases have relatively small error bars. But there is no hard rule for the minimum amount of data needed before one can proceed.

Of course, it is implausible to study seasonal variability without data spanning most of a full year. Multiple years are required if a computed spectrum is to have sufficient resolution to separate constituents with frequencies differing by 1 cpy. Spectral analysis is not mandatory, but it is certainly helpful to determine whether a spectrum contains isolated lines (as is the case for Figure 1) or instead is simply a wide cusp of energy surrounding M2. One's interpretation of tidal variability would be sharply different in these two cases.

A simple Rayleigh criterion for separating constituents would also call for at least one year of data. Yet that criterion is only a rough rule-of-thumb and depends on noise levels. Munk and Cartwright (1966) emphasized this by noting that it is possible to separate two nearby sine waves with only four perfect, noise-free observations, but with real-world noise something like a Rayleigh criterion is probably required. Of course, bottom pressure measurements of tides are usually much less noisy than surface height measurements, so there is flexibility in all this.

A second point of Referee 2 concerns large gaps in the Port Orford time series before May 2002, which I can confirm. These gaps could conceivably impact spectral analyses, but the gaps are followed by at least seventeen years without gaps, which are more than sufficient to support spectral calculations of good frequency resolution. The calculations of monthly mean harmonic constants are unaffected, as each monthly mean is based on between 22 to 24 monthly estimates. Admittedly, the amplitudes in Figure 2 do not perfectly overlay. This likely stems as much from unavoidable estimation error (from inherently noisy measurements) as it does from any gaps. Yet one should not belabor

these small amplitude differences. In fact, the amplitudes differ by a span of only 3 mm, and so they are actually quite consistent.

One item left unaddressed in Dr Pan's discussion is his suggestion to include more constituents than M2. While I sympathize with this desire, doing so would turn this "note" into a much longer paper, which I am unprepared to tackle at present. Moreover, any discussion of solar tides would likely be unsatisfactory owing to complications from radiational tides, as noted.

The revised paper now acknowledges the possibility of seasonality in KO2 adding to seasonality in M2, in those rare cases where M2 is very small and KO2 unusually large. Finally, although not prompted by the reviews, I have inserted a sentence at the beginning of Section 3 which gives an additional technical detail on how monthly tides were estimated.