

Interactive comment on “A monthly tidal envelope classification approach for semi-diurnal regimes with variability in S_2 and N_2 tidal amplitude ratios” by Do-Seong Byun and Deirdre E. Hart

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Comments on 'A monthly tidal envelope classification approach for semi-diurnal regimes with variability in S_2 and N_2 tidal amplitude ratios' by Byun and Hart (OSD)

New Zealand has a predominantly semidiurnal tide all around its coast. However, there is a major difference between the west and east coasts. On the west coast, the semidiurnal tide varies over a fortnight (spring-neap) as it does in most parts of the world. However, the tides of the east coast of NZ are unusual in having a larger

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contribution from the N_2 constituent than S_2 , with the result that the tidal range varies over a month rather than a fortnight. This aspect has complicated an understanding of the local tides since the first measurements made by James Cook (Woodworth and Rowe, Hist. Geo and Space Sciences, 2018). Consequently, the authors suggest a new type of 'form factor' to indicate the extent to which the semidiurnal tide is 'normal' (i.e. spring-neap variation over a fortnight) or 'unusual' (i.e. varies over a month).

The idea behind the work is not a very profound one but I can see that the new form factor could be useful to coastal studies in NZ by providing a first-order description of tidal behaviour. Therefore, I have nothing against the paper as such, although I am surprised that NZ tidal scientists have not come up with similar classifications before. The paper is a short one and could be much shorter if the text was not so repetitive. I make some comments below which I hope are of use for a second draft. Many are trivial ones to do with the text and can be easily attended to, while a couple are more important.

Abstract - if I had written this abstract I would have used the useful words on lines 206-214 of the Discussion. For example, I can see that the new form factor could inform about shoreline ecology as ecology depends on the tidal climatology. However, I cannot see that it is much use in discussion of inundation hazards and climate change; for that one would be interested primarily in the character of sea level extremes and not just on simple descriptions of the tide.

12 - remove 'database'. 'theoretical experiments' → 'theoretical arguments' maybe.

14 - the symbol F_{sm} is a clunky one and even impossible to write on an ascii keyboard. What is it supposed to mean? A form factor showing S_2 's influence on M_2 ? But what about N_2 i.e. F_{nm} ? I would have invented a simpler symbol such as F -prime or maybe E for envelope?

20 - I don't see that the first two references are really relevant to this sentence. Cartwright is a history of tidal science. D'Onofrio discusses Buenos Aires only and

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not spatial variation. The Nicholls reference is ok.

24 - 'and gravimetry'. What does that refer to? Space gravimetry by missions such as GRACE? I would drop that. Then again the references are apparently random - Egbert et al. describes one particular model, while Stammer et al. describes many including Egbert. So why is Egbert here and not all the others?

26 - I would have the equation here i.e. $F=(K1+O1)/(M2+S2)$ and not just words, like your equation (1) below which would become (2)

26-27 - if you have four you can't add a fourth?

28 - aren't they the same form factor (singular)?

I am not familiar with the van der Stok and Courtier references which are very old and I don't think many other readers will be either. How did you come across them? If in a more recent history of tides or a text book on tides then please add that.

34-36 this is a garbled sentence. Could you please reword?

45-47 This isn't right. You say yourself that NZ tides are unusual so the reviews of Andersen etc. cannot be blamed for focusing on the main constituents relevant to global studies. However, that does not mean those authors were disinterested in other constituents. In fact one main aim of such studies was to determine how well the total tide could be determined which necessitates accuracy in N2 etc.

56 - as mentioned above I can't see form factors (of whatever kind) being directly relevant to coastal flooding hazards work, but if I am wrong please give references.

61 - why don't you just have a simple map here for the reader to refer to i.e. Figure 2, and not wording such as 'latitudinal gradient' - you mean range of latitude. Having the Type information in the figure is ok but you have to return to that later (see below about that)

62 - what are 'absolute tides'?

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68-69 - this business of a pair of amphidromes to the NW and SE is not easy for the reader to appreciate from your wording alone, and the amphidromes are in fact a long way NW and SE and off the maps of Figure 3. So you have to point the reader to where he can see a map of M2 in the SW Pacific - ideally a map from FES2014 as you have focused on that. Or see Fig 5.1 of Pugh and Woodworth (2014) which was provided by Richard Ray - i.e. a wider area than you have used for Fig.3.

Anyway I don't think it is right to say S2 has a single wavefront and amphidrome in the SE. Take a look at Figure 4 of Walters et al. (2001) and you will see a pair of them close together in the SE.

And I would drop mention of the Coriolis effect and simply say that they rotate anti-clockwise.

77 - 'years' is misleading as it suggests you have used many years per station whereas Table A1 shows you used only one year for each. Have the amplitudes and phase lags in Table A1 been adjusted for nodal variations according to equilibrium relationships? Or are they the observed amplitudes for the years shown? See below for other comments on this table.

I would have prioritised the FES2014 model over the tide gauge data as the main aspects of what you are trying to show are best done with the model. Then at the end of the paper you can show your findings from FES2014 are consistent with those from the tide gauge positions.

80 - you mean 'in comparison with values obtained from the tidal potential or Equilibrium Tide'

81 - 'amplitude data' → 'amplitudes'. 'was sourced' → 'was obtained'

82 - days' length or days in length

83 - tides are the strongest

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85, 242 and 268 - Carrere has an accent over the first e
86 - dataset → model. experimental plots → studies (maybe)
88 - siderial → diurnal.
92-93 - mapped spatial variability
94-95 - .. those from the Equilibrium Tide (Defant, 1958).
It was not Defant's theory. Anyway you might better refer to Cartwright and Tayler (1971) for example.
95 - 'data results' → results
98 - reinforces → shows
101 - .. amplitude (Figure 3c).
102 - in the text and tables and figures it would be much simpler if you dropped the 'a' and have M2 for example to refer to its amplitude. All the a's make things messy. You would have to say you were doing that of course.
103 - drop relatively
The two bullets below. Could you mention them as determining Type 1 and Type 4.
109 - surely that is not referring to Figure 1, you can't see Cook Strait in that at all
110 - 75 to 90% of what? What are the adjacent coasts?
114 - 'anomalous timeframes' → 'a month' and drop the 27.5546 four decimals → 27.6 will do
116 Chatham Rise and Castle Point are not in Figure 2.
121 sentence 'By examining'. I would drop this sentence. You repeat yourself a lot.
126 - I would say spring-neap and then perigean-apogean as that is the order else-

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where

Two bullets. Can you mention them as Type 2 and 3

133 - amplitudes being only

139 - Sumner not in Figure 2

Equations 1 - drop the a's (see above). Also drop the 'more stable' words. I guess you mean similar locally? But the same situation would apply if the constituents varied a lot spatially. These are just simple algebraic relationships at a particular position - they have nothing to do with spatial scale or 'stability'.

161 Table 4 should be 3?

173 - it is strange to read of M2, which is the largest, moderating something smaller. I think this paragraph needs rewording. Also I don't understand (i) and (ii). What are the 'annual' and 'subsequent' things? I guess the R in MTR is ratio? Not clear. But note that MTR stands for Mean Tidal Range in usual tidal studies.

Anyway I found these experiments at lines 180-204 somewhat unconvincing, although I do understand why you felt the need to inject some rigour into the choice of boundary values between Types. But the experiments do not cover the whole space of possibilities for amplitude and phase lag of all constituents concerned. The main thing to me is Figure 6 which shows nicely how F_{sm} varies with x and y. Why don't you then just define the boundaries between Type 1 etc. in an ad hoc way, similar to the way as F is divided in an ad hoc way for 'semidiurnal' etc. After all, in the end all these form factors are just handy coarse descriptive subdivisions for the tide. Anyway lines 180-204 need rewriting - see my comment at line 173 also. It is just not clear what you are doing.

203 - see below. mention the other red blob.

217 - if you agree then drop 'theoretical experiments' here.

220 - these three do not all operate at 'synodic anomalous timescales'. Why not just '..

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three key constituents (M2, S2 and N2):

At this point it occurred to me that a similar exercise could be conducted for areas of predominantly diurnal (but a bit mixed) tides. Could you speculate in this Discussion which parts of the world could benefit that way?

230 - this isn't necessarily true. Figure 1c shows where S2 is small compared to M2. It doesn't necessarily follow that perigean influences dominate.

239 - what is 'low-frequency coastal flooding'?

Table A1. Line 1 - you don't show tidal ranges, this will be confusing for most people. What you show on the last line are ranges of amplitudes and phase lags in your data set. Also the 'ranges' shown are crazy for some as shown e.g. see 6-360 for K1. But 360 degrees is the same as 0 degrees! Line 2 - values. Also the header should mention you show Types. Say if the phase lags shown are in Greenwich Mean Time or local time? if Greenwich then they are usually denoted by G.

Figure A1. I don't understand the 'under conditions summarised in Table A1'. Surely all one needs to know is which stations were used for these 3 examples.

261 - doesn't matter much but Figure 2 looks like a simple coastline map to me that one could make with GMT or Matlab, so where do the fancy 'map layers' come in? And with an undesirable national coordinate system to boot instead of lat/lon?

Table 1. Line 1. The word 'interval' in tides refers to the times of high tide since passage of the moon. What you are showing here are not intervals but the periods of beating of the shown pairs of constituents. And personally I would abandon columns 3 and 4 - you are not writing a text book here - certainly drop column 3 (and in M2/S2 - drop 'axial'. M2/N2 - drop 'relative'. line 3 'during the sidereal month' → during a month). And I would drop the Note which doesn't add anything.

Table 2. I would have a column 1 showing Type. And I would move Example Sites to be a column 2. First line of that: Equilibrium Theory (no footnote and no Note - you

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have already mentioned Defant in the text).

Table 3 - I guess this does no harm but it just repeats what has been given in the text. I would drop it. Pp..

Table 4 - I don't understand this table. It is tied up with mention of the experiments, see comments above. I would drop this table as well.

Figure 1 - just a suggestion but perhaps all panels could be made the same size. You have (a) large but that is for the normal F which is not the subject of this paper and can be found in many text books.

Also for this, and also for the other colour maps in Figs 3,4 etc. could you have an arrow on the max colour as you have points on the maps with values which are in overflow.

As for Figure 1 (c), you should mention somewhere in the text where the other red blob is. Near Tahiti?

line 4 of caption '.... monthly tidal envelope using criteria described in section 3.' Then for (c) see my comment for line 230.

Figure 2 - please use conventional lat/lon and not a national coordinate system no-one else will understand. As mentioned above there are places in the text (e.g. Stewart Is.) not shown. '&' → 'and'.

When Figure 2 is first mentioned in the text there is no mention of the Type 1, 2 etc. So you have to return to this figure after you discuss Figures 6 and 7 and mention the Types in Fig.2, and then please also use the same colours for the Types here as in Fig 6.

Fig 3 - arrows needed on colour scales e.g. for the overflow top-left of 3(d). The contour annotation bottom right of 3(f) is messy, please thin out the annotations. Also drop 'Unit' in 'Unit mm'.

line 1 of caption - 'Amplitudes for'. Drop 'horizontal'. Line 2 - drop 'derived and'. drop

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'database'. 'at a scale of' → 'on a grid of'

Fig 4 - as mentioned I would drop the a's in the headers and captions. Arrows on colour scales.

line 1 of caption - drop 'horizontal'. Line 2 - drop 'database'. 'at a scale of' → 'on a grid of'

Fig 5 - drop a's

Fig 6 - this is actually a useful plot. Use another colour instead of pink which is too much like red. drop a's. Use same colours for the Types as in Fig 2.

Add dotted or dashed lines also for the Fsm boundary values chosen to define Types 1-4.

Also what would be useful also would be to have values from FES2014 for the whole NZ coastline - that might be a fiddly computing exercise but is obviously possible.

Fig 7 - overflow arrow. could roughly the same colours be used as for Fig 6 as far as possible? That has red-green-blue-pink for types 1-4 whereas this has green-yellow-red more or less (the blue is not used).

line 2 - .. see Figure 5 for definitions and examples of ..

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