

Response to Referee #2

Anonymous Referee #2

Received and published: 6 September 2017

General comments

This paper contains original contribution to analytical tide modeling using an Taylor' method. Although there are quite many thing to be clarified and improved, it is believed that authors can revise the manuscript without much difficulties. This paper is therefore recommended for the publication in OS with minor corrections.

Reply: We sincerely thank the Referee for his careful reading of our manuscript, as well as the constructive comments and suggestions which are of great help for improving our study. We have addressed all these comments; our responses are given below.

In this response, the Referee's comments are copied in black, our replies are shown in red, and the following abbreviations are used:

OM - original manuscript,

R1 – Revision #1 - an updated manuscript, which will be submitted as a supplement to this response.

Specific comments

Title

Pg.1, lines 1-2 Better to replace "the extended Taylor's method" to "an extended Taylor's method".

Reply: The expression "the extended Taylor's method" has been replaced with "an extended Taylor method" in R1. Here, we have also removed "s" according to the suggestion of Referee #1.

Abstract

Pg. 1, line 8: Again use "an extended Taylor's method Pg. 1, lines 21-22: The sentences are a little bit unnatural. Include how much the northward KW is strengthened, that is, quantitatively, saying it is of secondary importance.

Reply: Here, the expression "the extended Taylor's method" has also been replaced with "an extended Taylor method". Since the results of Ex. 3 (with the Luzon Strait input being considered) contain some uncertainties (please see discussion in Section 5) we would not give a quantitative estimate in Abstract, but just state that "the forcing is thus of some (but lesser) importance to the M_2 tide in the TS."

1 Introduction

Pg. 2, line 4: The expression "anti-nodal band" is not familiar. Is there anyone to use the expression?

Reply: We call the area where the vertical movement of an oscillating wave is greatest the "anti-nodal band". The word "antinode" can be found, for example, in Figure 5:3 of the monograph *Tides, Surges and Mean Sea-Level*, by David T. Pugh, 1987. (In the

USA it is called a “loop”; please see page 14 of *Tide and Current Glossary* by the Center for Operational Oceanographic Products and Services, NOAA. Since OS is a European journal, we have followed Pugh’s usage).

Pg. 2, line 18: Again use "an extended Taylor’s method"

Reply: The phrase "the extended Taylor’s method" here has also been replaced with “an extended Taylor method”.

Pg. 2, lines 27-28: What is the basis of "The statement "the topographic step south of the TS acts as a permeable interface which can only partially reflect the incident wave andby nearly 180 degree at the step". Previous studies? If not, authors already assume partial reflection of northward and southward waves at the step. More careful writing is needed.

Reply: Yes, this is a result of previous studies. In R1, we have added a citation for Dean and Dalrymple (1984, Section 5.5) as a reference to the reader.

Pg. 4, line 9: Again use "an extended Taylor’s method."

Reply: The phrase "the extended Taylor’s method" here has also been replaced with “an extended Taylor method”.

3. An analytical model for the Taiwan Strait

3.1 Model configuration and solution

Pg. 7, lines 1-2: Reference for the friction coefficient formula is required.

Reply: We have cited “e.g., Chapter 8 of Dronkers, 1964” here and added “Dronkers, J. J.: *Tidal Computations in Rivers and Coastal Waters*, North-Holland Publishing Company, Amsterdam, 518 pp, 1964” to the reference section of R1.

Pg. 7, line 5: The expression "observed harmonic constants from the global tide model" is a little bit strange. It is computed results not observed values. Recommend to change the expression.

Reply: Since this global model is not numerically simulated but is based on satellite observations, we regard the model values as observations. For clarity, we have added the following sentence to the Introduction of R1: “Figure 2 displays the distribution of the M2 tidal constituent based on the global tidal model DTU10, which is constructed on the basis of multi-mission altimeter observations. Hereafter, we shall regard the DTU10 model results as observations.” It seems that the words “observation-based” are more accurate than “observed”, but we feel the former is too lengthy.

Pg. 7, line 6: In Figure 3(a) open boundary values appear to be somewhat different with Figure 2. Describe how the global model results were adopted to the analytical model.

Reply: The open boundary values are derived from the DTU10 model values through linear interpolation. The impression of the difference mentioned in this comment may be caused by the following two issues. (1) The rectangle shown in Fig. 1 in the OM is a sketch diagram and is not accurate. Now Fig. 1 has been replaced in R1 with a new figure, in which the rectangle is plotted at its exact location. (2) The other cause might be that we use different contour intervals for Fig. 2 and Fig. 3. To eliminate this impression, we redrew Fig. 2 with a finer interval (10 degrees) for phase-lags, as shown below.

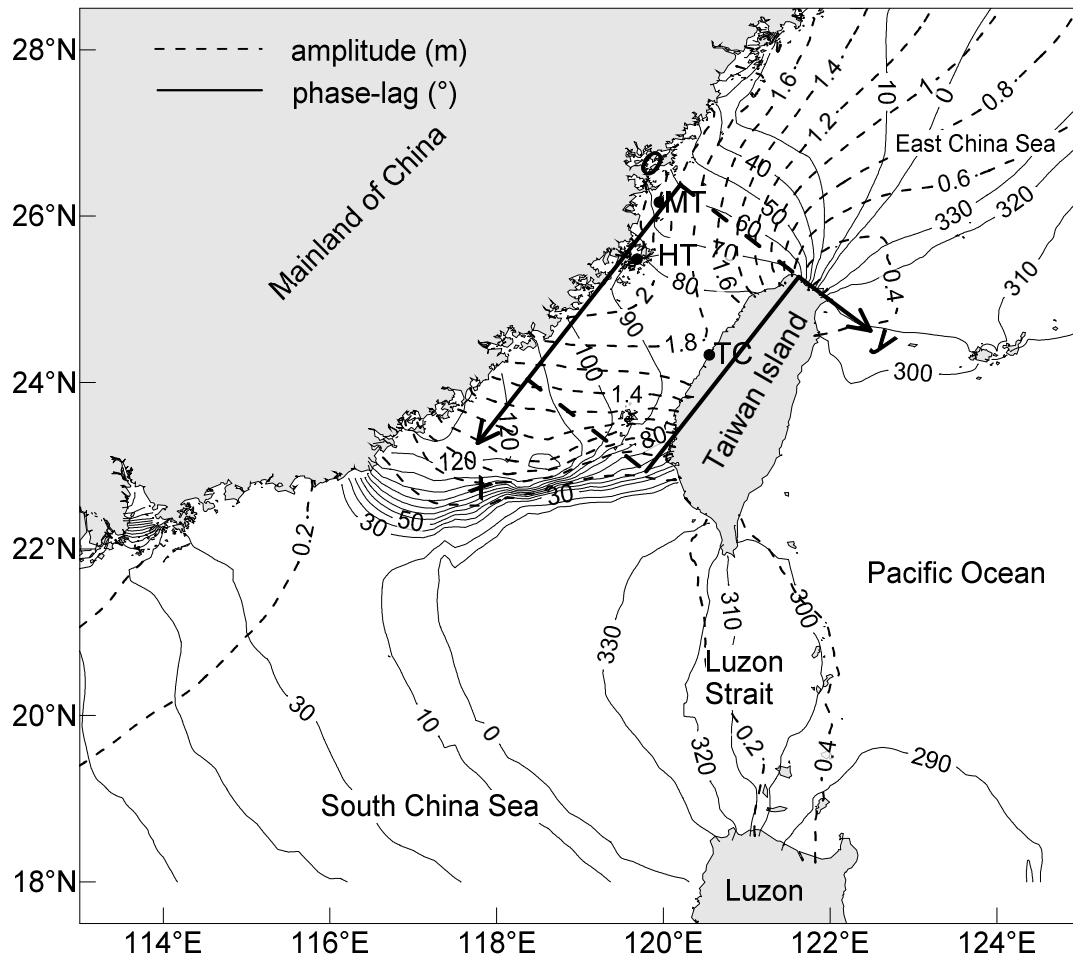


Fig. 2.1 The M_2 tidal system in the Taiwan Strait and its neighbouring area. This figure is the same as Fig. 2 of our manuscript but uses a finer contour interval (10 degrees) for phase-lags.
(In the figure number, the first “2” represents the “Author’s Response to Referee #2”.)

Pg. 7, lines 15-16: The statement "that is, the wave propagates southward in the northeast area and propagate northward in the southeast area" may be incorrect in strict sense. Figure 4 shows in whole area there are southward and northward Kelvin waves. Rewriting is needed.

Reply: This statement refers to the tidal patterns given in Fig. 3. The propagation directions are shown with arrows in the following figure.

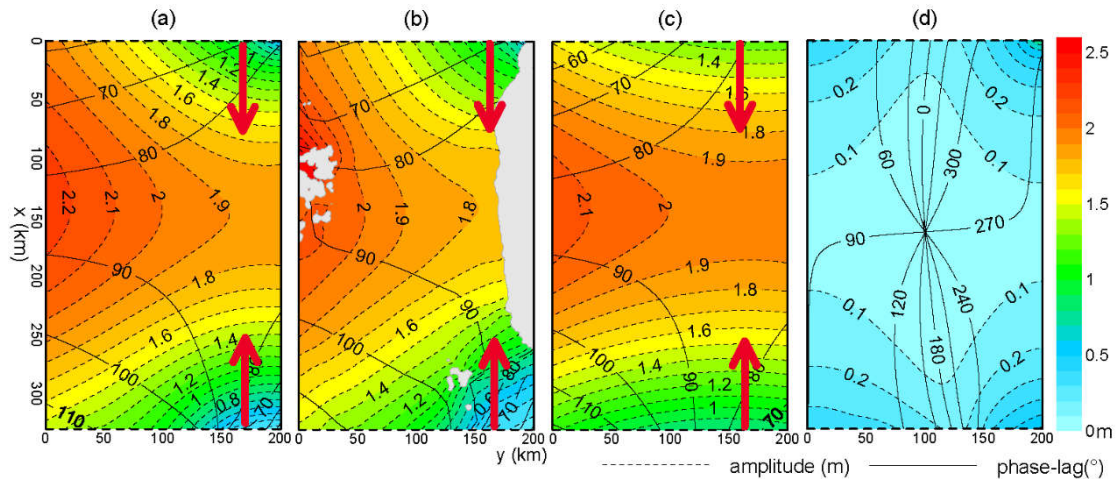


Fig. 2.2 Propagation directions of M2 tide in the north-eastern and south-eastern areas of the Taiwan Strait.

(In the figure number, the first “2” represents the “Author’s Response to Referee #2”.)

3.2 Kelvin waves and Poincare modes

Pg. 8, line 6: In Figure 3(a) open boundary values appear to be somewhat different with Figure 2. Describe how the global model results were adopted to the analytical model.

Reply: Please see the reply to the comment on Pg. 7, line 6 above.

Pg. 8, lines 9-10: The statement "the amplitude variation along the northern boundaryowing to the fact that the M2 tide is from the Pacific Ocean" is obscure. The northern boundary values of Fig. 3c and Fig.3a can be different from each other even though the M2 tide did not come from Pacific Ocean. More careful discussions are required.

Reply: To make the description clearer, the statement “This is owing to the fact that the M₂ tide is from the Pacific Ocean, its amplitude increases from the deeper outer shelf toward the shallower inner shelf” in the OM has been replaced with the statement “This shows that near the boundary, the Poincaré modes are of a certain importance. The existence of the Poincaré modes is related to the fact that the M2 tide is from the Pacific Ocean; its amplitude increases from the deeper outer shelf toward the shallower inner shelf.” in R1.

Pg.8, lines 17-18: The statement "it is not a controlling factor" is too much definite. Obliqueness might be partly effective. Improve the statement.

Reply: We have changed “it is” to “it seems”.

4 Formation mechanism of the northward Kelvin wave in the Taiwan Strait

4.1 Reflection of the incident wave from the East China Sea at the topographic step

Pg. 9, line 17: "observation taken from the global tide model" needs to be changed as mentioned earlier.

Reply: The design of experiments 1-3 has been changed according to your comment on Pg. 14, line 1-2; these words have been deleted in R1. Please see the response to your comment on Pg. 14, line 1-2 below.

Pg. 10. 4: Include reference for "the resonant period of the ECS(13.7h)".

Reply: We have added “, obtained by Cui et al., 2015” after “13.7 h”.

5. Summary and discussion

Pg. 14, lines 1-2: Regarding the statement "the reflected wave is slightly weaker", authors implied that there is a partial reflection of southward KW at the step. It is noted that at the northern open boundary southward KW, northward KW and Poincare waves are all specified in Ex.1. If there is northward KW at the northern open boundary, there should be northward KW at the southern open boundary, regardless of topography. It is curious to know what will happen if only southward KW is imposed at the northern boundary in Ex.1. Additional experiment is recommended to clarify the partial reflection at the step. You may include results in appropriate place.

Reply: This is an important suggestion. According this comment, we have redesigned our experiments and replaced Figs. 5, 6, 7 and the related discussion with these new results. In particular, the statement describing the original experiments “As in the single basin solution, the open boundary condition (7) is used at the northern opening with values of $\hat{\zeta}$ equal to those taken from the global tidal model DTU10” in the OM has been replaced with the statement describing the redesigned experiments “The experimental design for area A is similar to that of Roos and Schuttelaars (2011): a southward Kelvin wave is specified to be identical to the single basin solution, as shown in Fig. 4a in the preceding section. The Poincaré modes trapped at the cross section $x = 0$ are neglected, while those trapped at the cross section $x = 400$ km are retained.” in R1.

Technical corrections

Pg. 1, line 29: Better to replace "M2 amplitudes" to "M2 tide".

Reply: We already use “tide” for the subject of this sentence, so it does not seem appropriate to use “tide” again.

Pg. 3, lines 5-6: Definition of phase lag needs to be added.

Reply: In R1, we have added “Solid lines represent Greenwich phase-lag (in degrees)” into this figure caption.

Pg. 11, line 2: In Figure caption, there is no (d).

Reply: Amended: “(d)” has been added.