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Hydrology and Earth System Sciences
Discussions

Interactive comment on "An approach for data-driven characterization of tide and current fluxes in coastal basins" *by* Elvira Armenio et al.

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This is my review of 'An approach for data-driven characterization of tide and cur- rent fluxes in coastal basins ' by Elvira Armenio, Francesca De Serio, Michele Mossa, submitted to NHESS. This is the second version of the paper. The first version was reviewed by the Editor.

The authors used a set of recorded data to identify the main physical processes which drive the coastal site "Mar Piccolo", in the inner part of the Ionian Sea. This basin is joined to open-sea by means of one artificial channel and one natural channel. The goal was to assess the relative strength of tides, wave and currents measured simulta- neously, inferring on shallow water basin dynamics. Measurements were made only in the artificial channel.

Current velocities were extracted from selected phases along the tidal period which allowed to compute correlations between tides and currents. Current measurements were made at different depths of the channel, and interesting up-flow/down-flow asym- metries were found with hysteresis-like behaviors, with different delayed dynamics at different depths.

This work brings new interest to the coastal hydrological community, relatively to the understanding of the input/output dynamics of shallow-water semi-enclosed basins, at local scales. Data are of high quality, recorded continuously during three months, thus bringing a nice data-set useful for the water dynamics, sediment transport, and pollution spreading understanding. This work is of high quality, and i think that the paper could be published without modification.

Reply: We would like to thank Referee #1 for his very positive comments on our manuscript, for his careful revision work and for his suggestion which certainly will improve the paper in its final form.

I draw some minor remarks here after:

My own opinion is that the water density difference between Mar Grande water (heav- ier water due to cold temperature and high salinity) on one side and Mar Piccolo water (lighter water due to warm temperature and low salinity) on the other side, is the main process that could explain all the observed differences between the upper layer dy- namics of the channel and the bottom layer one. As the authors suggested it in their discussions and conclusions, an intensive and long-time experiment on salinity and temperatures at different depths is now required to better understand the thermohaline circulation.

Reply: We agree with Referee #1 opinion and we think that the knowledge of the vertical thermohaline structure in the Navigable Channel (and possibly also in the two basins) could be of great help, in order to prove the consistency of the analyzed and discussed fluxes. Actually, the daily monitoring of salinity and temperature along a vertical profile in the Navigable Channel is under arrangement (on the basis of other funds) and we are confident that we will have the possibility to acquire and examine these data in the near future.

No measurements were made in the natural channel, which is 3 times larger than the artificial channel. An open question is now what could be the dynamics in this channel. Does the authors think that the depth-dependent phase-lag between tides and currents is the same? (for example longer duration of the flood at the bottom and longer duration of the ebb at the surface ..)

Reply: As written in the original paper, the natural channel is 150m wide, but it is only 2.5m depth. Along this very limited depth we had technical limitations to locate any measurement instrument. On the basis of what observed in the Navigable channel, (i.e. considering the vertical distance necessary to allow an inversion of the flow) we hypothesize that in this natural channel the flow has only a prevalent direction induced by the tidal forcing. Moreover, considering that in the superficial layer (up to about -4m depth from sea surface) of the artificial channel, a prevailing outflow is recorded, consistently with the ebb dominance, also in the natural channel the predominance of ebb is expected, referring to the same investigation period.

Trying to evaluate and confirm this perception, we can refer to numerical modelling. Armenio et al. (2016) and De Pascalis et al. (2016) provide maps of the annual mean current velocities, relatively to year 2013, where clearly the dual flux (outward on the surface and inward on the bottom) is shown for the Navigable channel, while the flux of Porta Napoli channel is totally offshore directed.

Figure 9 is a nice example of the depth-dependent tide/current interaction that occurred on 24.11.2015. It should be good later on (future work . . .) to make the same plots, but phase-averaged over the whole period. The phase-averaged current (I mean current averaged respectively to the tide phase) will kill the noise level, and probably a good and quantitative average-lag between current and tide will appear more clearly at all the different depths.

Reply: We appreciate Referee #1 suggestion and, agreeing with him, we modified our Figure 9 in this revised version, applying the phase averaging to both tide signal and longitudinal currents (at different depths). The reciprocal behavior of tide and currents was confirmed and we think that the Figure is now more readable and greatly improved.

equation (2): tide components: may be add in the text that O1 is the principal lunar diurnal, K1 is the lunisolar diurnal, M2 is the principal lunar semidiurnal and K2 is the principal solar semidiurnal.

Reply: Ok, done

figure 9: put in the legend that blue line is the longitudinal current velocity.

Reply: OK, done.

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