

EVALUATING THE IMPACT OF CIVIL WORKS ON WATER FLOW IN THE INLETS OF THE VENETIAN LAGOON

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Abstract

Local fishermen in the Venetian lagoon reported an increase in the currents velocities at Chioggia inlet. A deeper insight into ADCP records revealed an increase in the flow energy even though the average remains statistically unchanged. Also a significant change in the relationship between vertically averaged current time-series and water flux rate has been detected directly connected with the reduction of cross-sectional area due to civil works carried out inside Chioggia inlet.

Keywords : Currents, Lagoons, Time Series.

Long-term monitoring has been going on in the inlets of the Venetian lagoon within the framework of CORILA project to study variability of water exchange at different time scales between the lagoon and the open sea. Current measurements have been carried out with bottom mounted ADCP (Acoustic Doppler Current Profiler) since June 2001 in Lido and Malamocco inlets and since February 2002 in Chioggia inlet.

Since the Italian government approved major works in order to prevent the flooding of the city (locally called "Acqua Alta") this record has become essential in order to study possible changes in the dynamics due to civil works carried out. Previous analysis have revealed a highly tidal driven flow with 95% of the energy due to astronomical signal [1], [2]; an other property is the high polarisation along the channels with more than 99% of energy in the principal axe at each channel.

Commenting of local fishermen about changes in the velocity of currents in Chioggia became evident by the end of 2005. Also minor precision in the tidal predictions based on the bottom-mounted ADCP was noticed. Once failures at instrumental level were discarded, Principal Component Analysis (PCA) and Harmonic Analysis (HA) were applied to currents time series on a monthly basis to obtain series of estimates of main HA parameters as well as energies, maxima and minima currents.

including wave-breaking barriers and navigation lock. In Malamocco constructions are outside of the inlet while they are inner in Chioggia. Moreover, the cross-sectional area has decreased in Chioggia by about 18% causing the increasing of currents magnitudes even though they are the same in average. Thinning of channel changed also the linear relationship between water transport (Q_T) and the vertically averaged velocity (V), which was used as a predictor in the estimation of water flux rates. While this relationship was $Q_T = 4969.2V - 159.61$ with $R^2=0.9808$, now it is $Q_T = 4023V - 18.07$ with $R^2=0.9940$. So, higher velocity is required in order to produce the same water transport. The transport, which is mainly astronomically driven, tends to be steady. Additional studies are necessary to complete the picture of impact of civil interventions in the water exchange rate.

References

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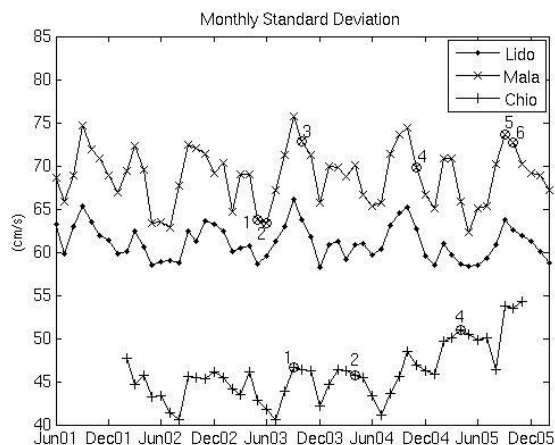


Fig. 1. Standard deviation of vertically averaged time-series of currents in the inlets of the Venetian lagoon with the major civil interventions indicated: 1.- Beginning of works. 2.- Barrier under the sea surface. 3.- Barrier start emerging. 4.- Ending of works. 5.- Construction of navigation lock. 6.- Finishing of navigation lock.

Statistic tests yielded no detectable change in the mean currents values, but a gradual increase of velocity maxima and minima has been found in Chioggia since late 2004. This indicates an increase in the variability as apparent in the Figure 1. Also estimates of magnitudes of K1, M2 and S2 tidal constituents denoted an increase in Chioggia, which is connected also with the velocities reported by the fishermen. However, the average remains statistically unchanged so an increase in the energy follows as a consequence.

Chronology of major civil interventions is also shown in the Figure 1