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Quantifying The Effect of Bora Wind Conditions on the Current Velocities at the Inlets of the Venetian Lagoon

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The response of current velocities in the inlets of the Venice lagoon to Bora wind conditions are studied in detail. Current velocities have long been monitored by Acoustic Doppler Current Profilers (ADCP) installed in the bottom of the inlets connecting the lagoon with the Adriatic Sea, i.e. Lido, Malamocco and Chioggia. Wind velocity vectors are constantly being measured in the oceanographic platform offshore facing the lagoon. While over 90% of the energy in the current-velocity dataset is astronomically driven, still the remaining percentage accounts for non stationary variablity like seiches and meteorological forcing which have an importance impact in Venice city. Hourly averaged time series of wind are decomposed into its principal components for a better classification of wind conditions as “Bora”, “Scirocco”, “Calm” or “Other winds”. While hourly vertically averaged current velocities are detided in order to obtain a series mostly with seiches and other small variability. Exploration of the energy of the time series carried out via Wavelet transformation show that Bora winds have a strong correlation with the inflow in Lido inlet which in turn shows a not so strong correlation with the outflowing at Chioggia inlet, while the Malamocco record shows little or no influence from Bora. The effect is noted at different time scales reaching a maximum in the 512-1024 hours scale (which enclose the monthly variability). A statistical test was done to assess the difference between the mean velocities in the inlets with and without Bora wind. There is a net inflow through Lido and Malamocco inlet and outflow at Chioggia in the long term, but during Bora conditions the average inflow can increase by 280% at Lido, likewise out flowing in Chiggia can duplicate its rate while Malamocco shows little change. The nature of this increase is evidenced after classifying Bora winds by velocity classes and comparing with corresponding current-speed averages, following an exponential law with rates of 0.1164 at Lido and 0.0812 in Chioggia. Malamocco seems unaffected for most of this forcing but some triggering mechanism appears to exist when Bora wind reaches a velocity of 20m/s or higher.
Additional studies are still going on regarding all the other wind conditions.