ABSTRACT

The first objective of this minor thesis is to to understand the global performance of the water that goes in and out of the harbour. We want to analyse the annual situation as well as the situation for each month. If we achieve the objectives, we will understand how the water is moving inside the harbour.

To achieve this first objective we have analised the information of a Doppler currentimeter. This currentimeter is installed in the south harbour entrance of the Barcelona harbour. This machine is placed at approximately 17 metres above the sea floor, and it gives us information about the current direction and intensity of the water column, at intervals of 0,5 metres every 10 minutes. The analysis of this information was comprised between April of 2002 and March of 2003.

The second objective of this work is try to find and understand the causes of the water movements in the harbour entrance, as well as describe these movements.

To achieve these two objectives we have to do several different things. First of all, we have done a preliminary analysis of the current information to see what is happening in the water column this year. The results of this analysis are that basically there are three different layers of water. The performance of these layers is almost the same in all months. The water goes into the harbour through the deepest layer and the top-most layer, and out by the intermediate layer. But during January the water goes out of the harbour by the two deepest layers. Another interesting thing is that in some months that we have analised like May, February and March, the water is going out to the sea by the top-most layer. And finally the water is going in to the harbour by the intermediat layer during july.

We have transformed the information to make the analysis easier. We have transformed the ten minutes series to hour series. Also, we have considered all the times where there is no information. With this new information we have calculated the volumes that are entering and exiting the harbour using the three layers in the different months. The results have confirmed what we saw in the preliminary analysis. On the other hand the analysis lets us see that, except for February and March, the rest of the months have positive global volumes inside the harbour. Therefore, there is more water entering into the harbour by the harbour entrance than water that is exiting.

At this point we know how the water is moving inside the harbour , but we want to know what is causing these actions.

To do this, we will first search for a correlation between the sea level and the entering or exiting of water in the harbour. We can see that there exists a seasonal behavior in the water levels, but on the other hand we can see that it is not possible to establish a correlation because there are elements that we do not know that are distorting the analysis.

Now we are going to do an harmonic analysis using the current information to find the most important tide components. The most important components are SSA (half-yearly component) that we knew intuitively from the sea levels, NO1, SO1, K1 and O1 (all diurnal components) and S2 (semidiurnal component). The tide components all have a tricape structure and also have concordant inclinations with the harbour entrance orientation. The residual component of the harmonic analysis (Z0) also has a tricape structure and a similar inclination than the harbour entrance, as well as it was expected.

Finally it's time to find the causes of the three layer structure in the harbour entrance. First of all we will try to connect the top-most layer with the wind. The results let us see that there exists a very clear connection between this wind and the current. Then we will search for a connection between the movement of the intermediary and the deepest layers as well as the gradients of temperature, density and salinity. We know that when there is a fluid with different density characteristics, it tries to mix because there are horitzontal gradients of density, creating currents between both sides. If we analyse the three variables in different points we can see that there are horitzontal gradients causing these movements.

Finally we have searched some of the implications of the work to the harbour water quality. The calculation of the residence time of the water inside the harbour is very useful to know that the water renovation is important and in principle the quality will be good.