

Sea level fluctuations in the Mar Menor (Spain) coastal lagoon

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Introduction

The Mar Menor, one of the largest (135 km²) Mediterranean coastal lagoons, is located on the southeastern coast of Spain (37°38' N, 0°42' W) in a semi-arid region. It has a mean depth of about 4 m with a maximum of 6 m. It is separated from the Mediterranean Sea by a sand bar of 100 to 1500 m width with several narrow channels to the sea.



Fig 1. Ubication of the Mar Menor on the southeastern coast of Spain. At right, the three inlets that communicate the lagoon with the Mediterranean sea.

The small sea level variations are one of the main forcing of the lagoon hydrodynamic and water exchange between the Mar Menor and Mediterranean sea

Methodology

Five sea level sensor (RBR DR-1050) were deployed from North to South along Mar Menor and one in the Mediterranean sea in front of El Estacio channel. All the sensor were deployed at 5 meters depth.



Fig 2. Ubication of the sensors deployed and one of the moorings.

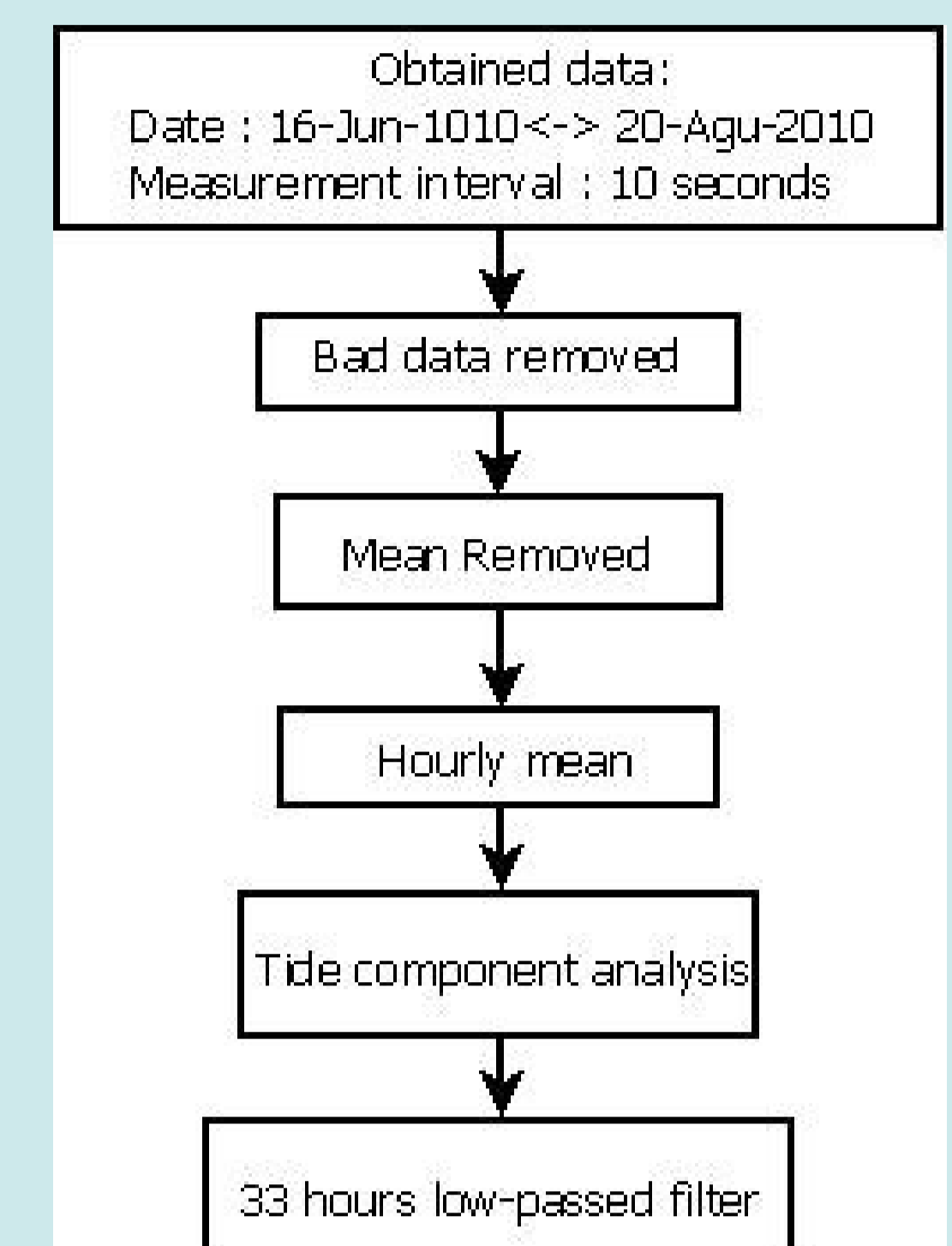


Fig 3. Data analysis flux.

Results

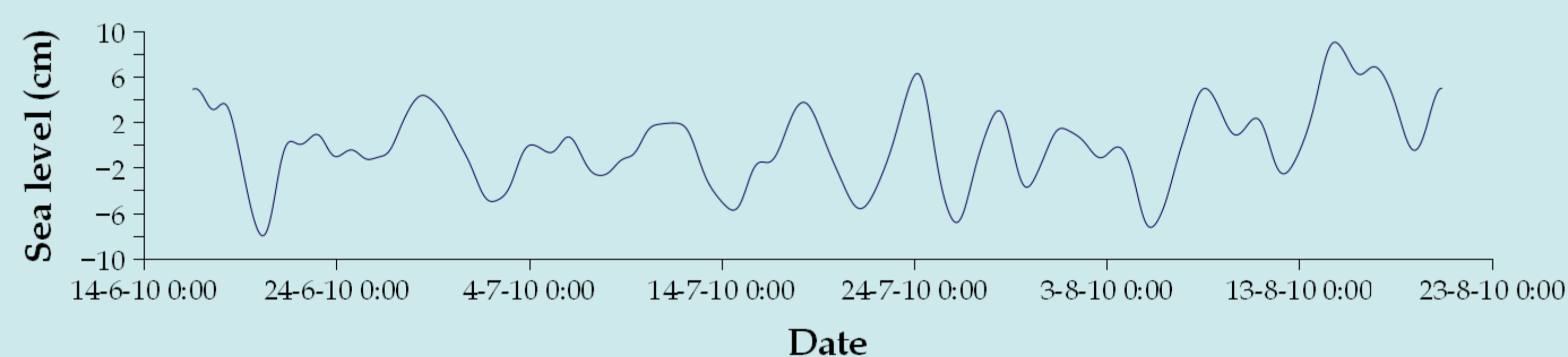


Fig 4. Sea level for station 3. Media removed and 33 h low-pass filtered

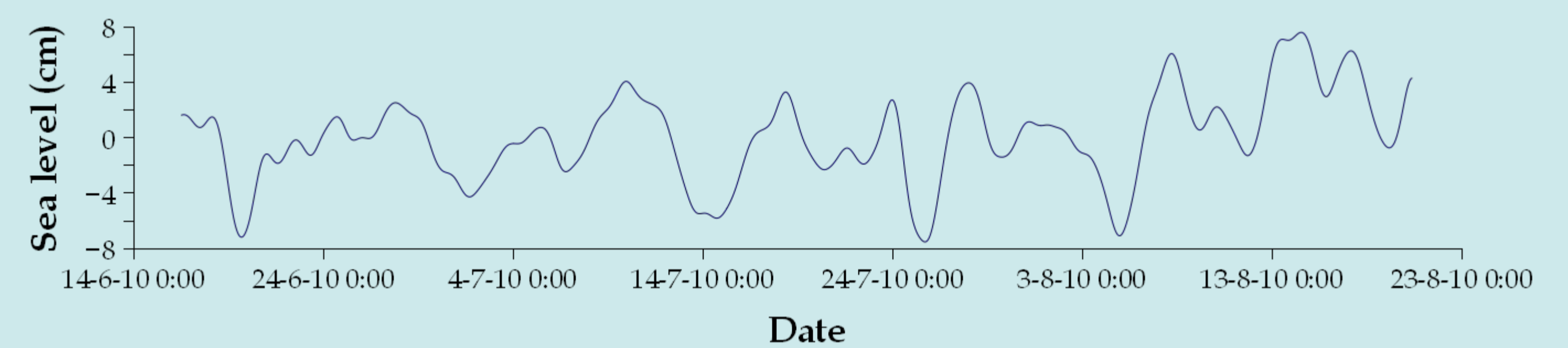


Fig 5. Sea level for station 4 (Mediterranean). Media removed and 33 h low-pass filtered

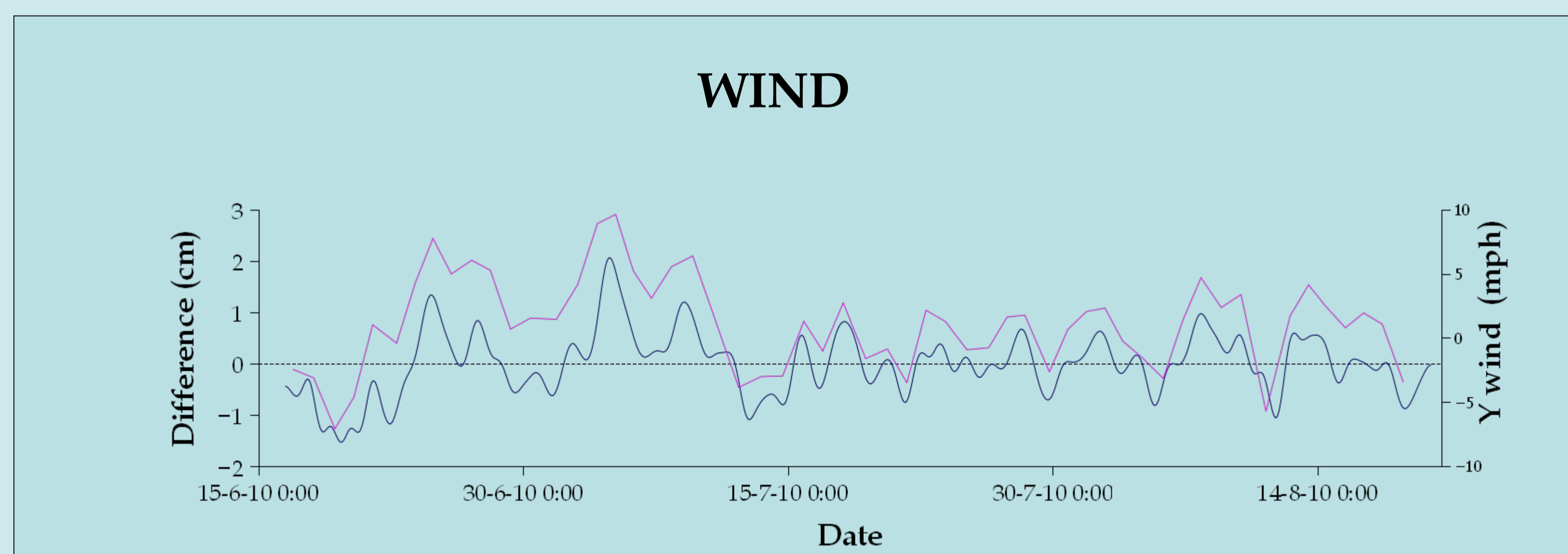


Fig 6. In blue color, sea level difference between Station 1 (Southern) and Station 5 (Northern). In red color, Y wind component.

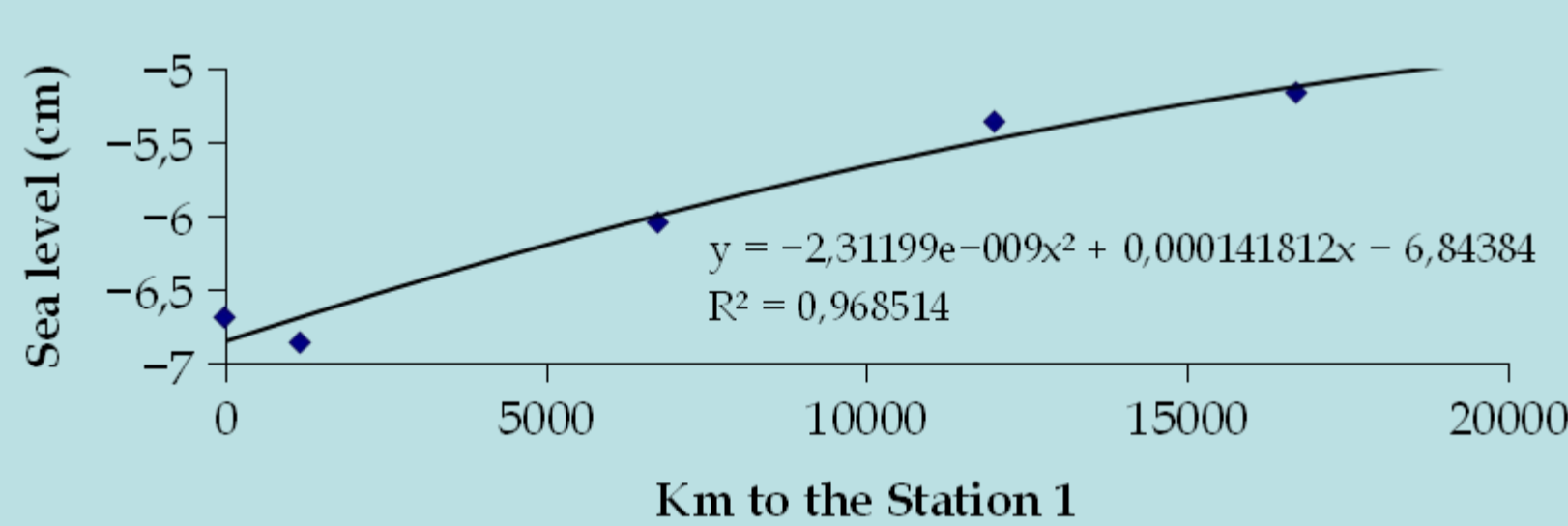


Fig 7. Polynomial second grade regression of the sea level registered at Mar Menor stations. The X axis represents the distance between the southern station and the others

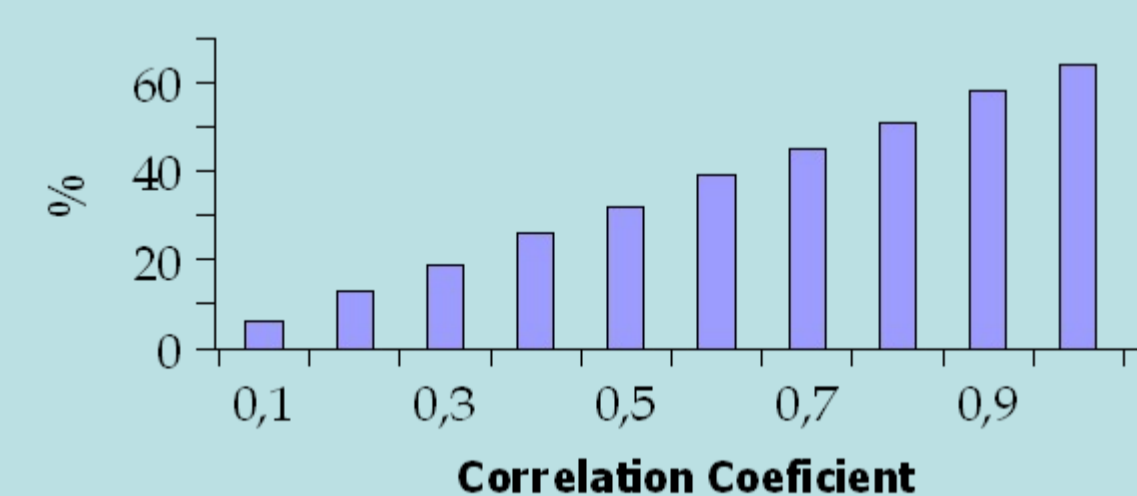


Fig 8. Histogram of the coefficient correlation of the polynomial regression and the data registered.

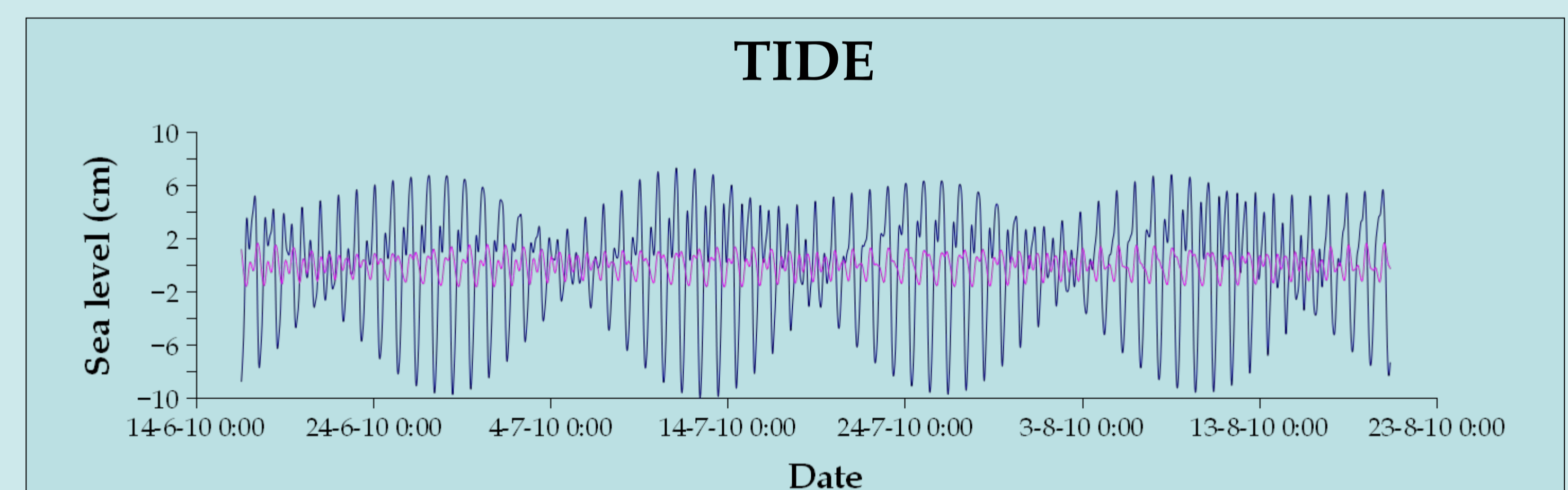


Fig 9. In blue color, station 4 tide (Mediterranean sea). In red color, station 6 tide (Mar Menor)

Tab 1. M2 tide component gap between the station 4 (Mediterranean) and Mar Menor stations.

Station	1	2	3	5	6
Gap (°)	96,52	95,87	95,86	96,6	99,8
Gap (Hours)	3,33	3,31	3,31	3,33	3,44

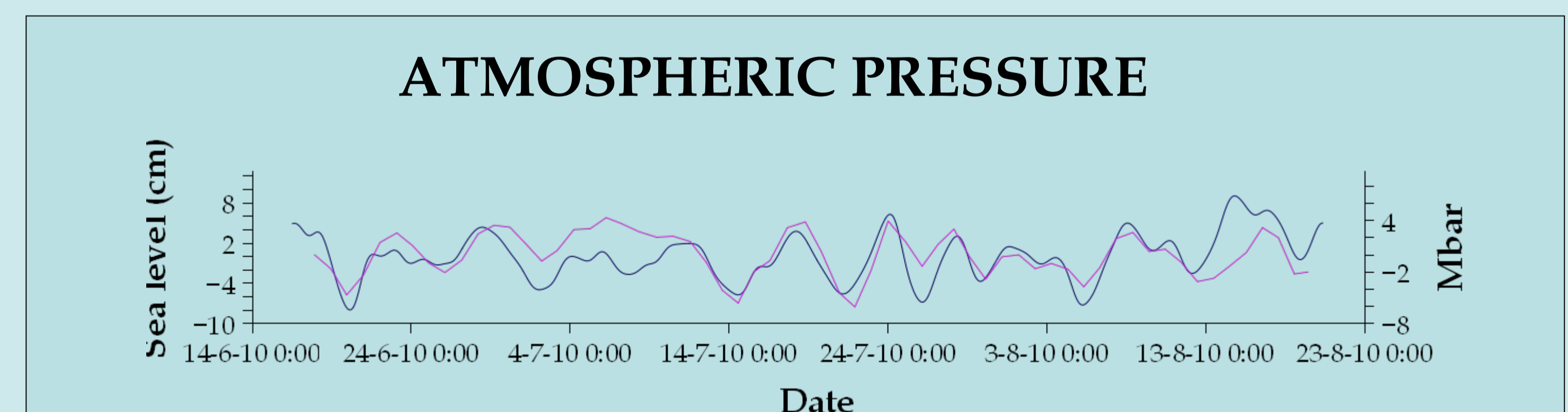


Fig 10. In blue color, sea level variation for station 1. In red color, atmospheric pressure variation.

Conclusions

- The sea level difference between Mar Menor and Mediterranean sea is mainly due to the tide. (Figure 4, 5 and 9)
- Winds from the North or South push water to the south or north of the lagoon, with a sea level variation about 2.5 cm between northern and southern station (Figure 6). The sea level slope between north and south could be approximate with a second degree polynomial, the correlation coefficient between the polynomial and the data are higher than 0.8 over 70% of the data. (Figure 7, 8)
- Inverse barometric effect can be observed in some windows of the time serie, further analysis is needed to evaluate the magnitude of this effect. (Figure 10)
- The range of sea level change in Mar Menor is about 16 cm and the tide range is about 4 cm. (Figure 4, 7)
- There is a tidal lag of 3 hours between the lagoon and Mediterranean sea (Table 1)