MONITORING OF VENICE INLET CHANNELS

Sharing knowledge to make data available for everyone

Introduction

What does “hydrography” really mean? IHO defines hydrography as a description of the physical features of the ocean in support of different marine activities. In this work, we want to show how hydrographical datasets can provide knowledge useful for many different purposes: from marine spatial planning to environmental studies. We focus on the Venice Lagoon, where history and modernity, natural and anthropogenic factors are fused together in a complex system.

Material and Methods

The key strategy is “once at sea in support of different activities”. With this aim in 2015, the Italian Hydrographic Institute (IIM) and the Institute of Marine Sciences of the National Research Council (CNR-ISMAR) shared their own available data of the Venice Lagoon tidal channel network (Fig. 1) and made them open to the public, the scientific community and stakeholders through the paper *High resolution multibeam and hydrodynamic datasets of tidal channels and inlets of the Venice Lagoon*. Sci. Data 4:170121 doi: 10.1038/sdata.2017.121. (Madricardo et al. 2017).

In 2016, within the Italian flagship project RITMARE, a common multibeam echosounder survey was carried out within the Lido Inlet of the Venice Lagoon (Fig. 1) by mean of a single head dual swath Multibeam Echosounder (MBES) Kongsberg EM2040C connected to an attitude and heading reference system Seatex Seapath 330 and a Fugro 9002 GNSS receiving Fugro HP differential corrections (DGNSS mode).

The key operational rules of procedure were:

1) Conduct the survey with water column data (WCD) logging always ON. It is a way to look into the future. Hydrographic software is improving and soon we will be able to extract further information and knowledge from WCD as we can already do for seafloor data.

2) Record data with best resolution, sometimes lowering the speed of the vessel especially for best backscatter (BS) data acquisition.

3) Connect data to a 4D reference frame. A measure is basically a number given by the instrument which must always be connected with a frame.

Primarily, within the International Terrestrial Reference System 89, the frame ITRF2008 was chosen as horizontal component.

Secondly, the vertical component chosen was the ZMPS (Zero Mareografico Punta della Salute), the zero level connected with the ellipsoidal and geoidal vertical reference frames (including the local mean sea level and the tidal datums). ZMPS was defined as the medium value of level observations at Punta della Salute between 1885 and 1909.

Finally, UTC was chosen for the timing.

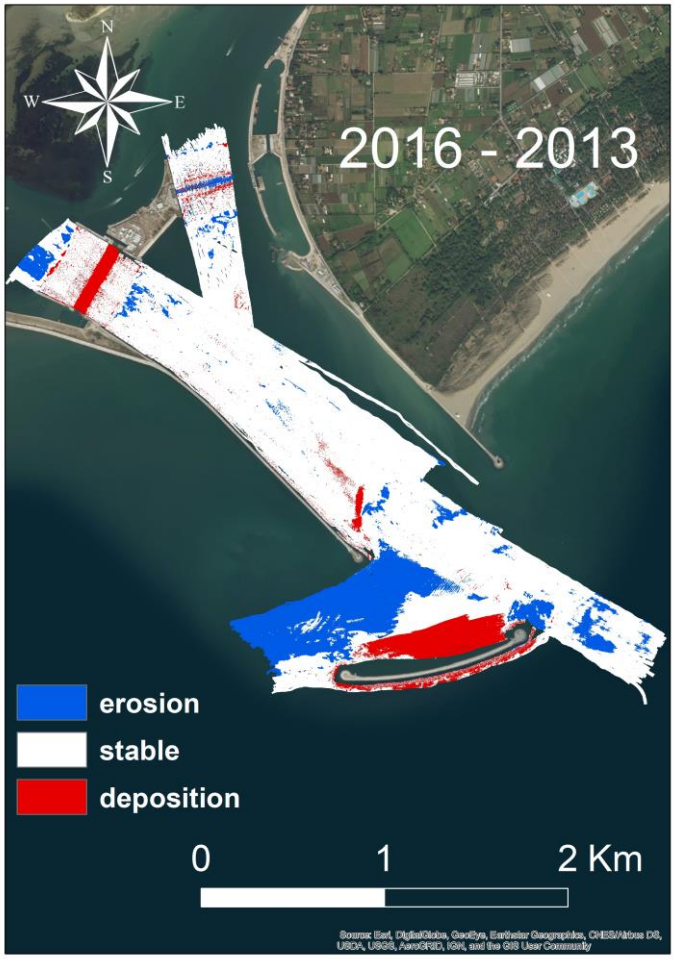

Fig.1: The area surveyed in 2013 (left) and the area of the Lido inlet surveyed in 2016.

Results

The result of the survey is a complete data package (WCD, BS, bathymetry) useful for different applications, such as safety of navigation, research, dredging and future other applications. In Fig. 2 we show an example of WCD mapped over the BS mosaic draped over bathymetry. We notice how the presence of submerged aquatic vegetation could affect the bottom detection, therefore affecting the resulting bathymetry. Beside bathymetry, BS intensity can change over time depending on the submerged aquatic vegetation orientation.

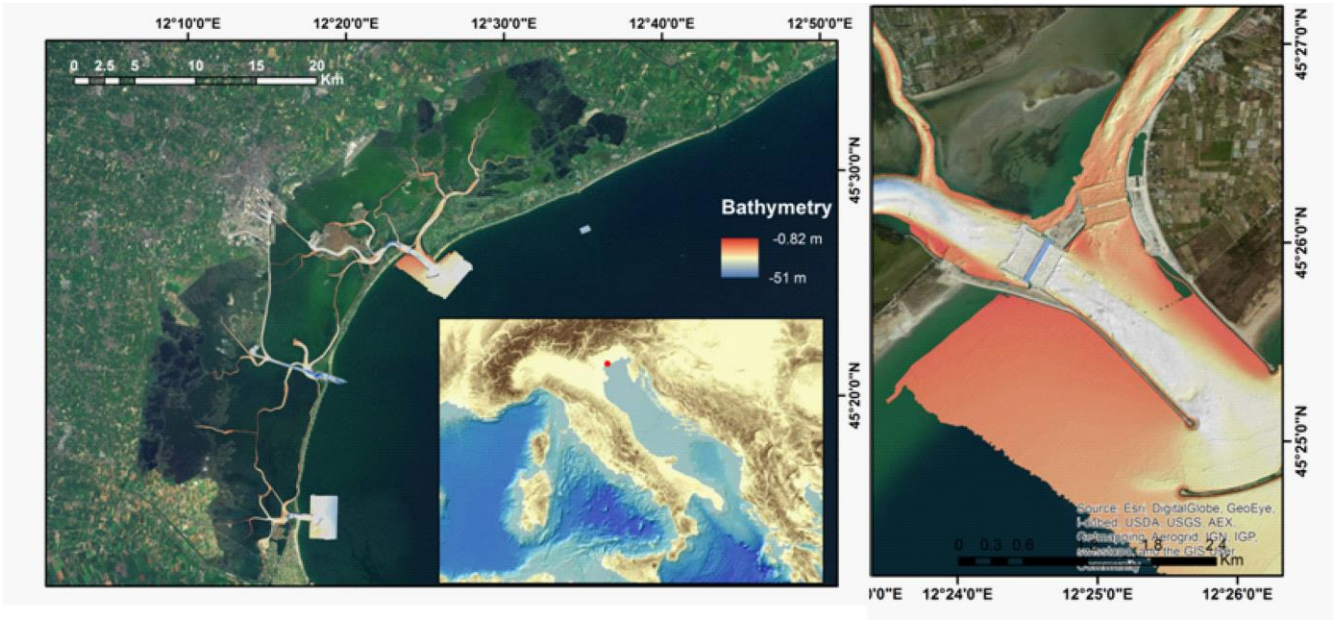

Fig. 2. Left Up: Example of the MBES echogram extracted from the central beam of the WCD mapped over the BS and bathymetry maps. The green colour close to seafloor shows part of the signal reflected by the presence of macroalgae on the seafloor. Left down : Zoom in of the echogram where the black line represent the location of the signal presented on the inset. The greenish rectangle highlights the part of the signal reflected by the macroalgae volume (Modified from Kruss et al. 2005). Right: Zoom in of the backscatter mosaic where the presence of algae was documented.

The 2016 MBES survey can be compared to previous surveys conducted in the area, taking into consideration different final uncertainties and resolution of different datasets. On the contrary, comparisons such as difference between sea bottom grids or backscatter can be done only when the reference frames are fixed and shifts among them are known with a good estimation, at least comparable with uncertainty of the measures.
In Fig. 3, we show the difference between the bathymetric data in 2013 and 2016 of the main lagoon inlet channel showing the area in deposition and erosion, taking into account that the construction of large mobile barrier is ongoing at the inlets. These data have different stakeholders, not only connected with safety of navigation or dredging, but also with the study of geomorphological evolution of the inlet over time.
On the one hand, the erosion ongoing close to the edge of the breakwater (indicated by the black arrow in Fig. 3) just outside the seaward inlet entrance could affect the stability of the structure in the next years.
On the other hand, deposition ongoing close to the barriers could possibly interfere with the mobile barrier functioning.

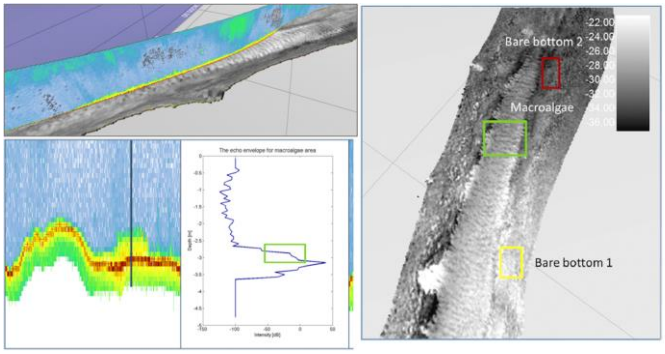

Fig. 3 Example of bathymetric comparison between 2013 and 2016 where blue, white and read indicate areas in erosion, stable or deposition, respectively.

Conclusions

Hydrographic surveys are often very expensive and time consuming. Therefore, it would be very effective to set up common acquisition protocols in order to collect data useful to different purposes, such as geomorphological studies and benthic habitat mapping.

Bathymetric comparisons can provide precious data not only to the scientific community, but also to stakeholders responsible for coastal management, as it was shown for the Lido Inlet in the Venice Lagoon.

The acquisition of WCD is strategic not only for future possible applications, but also because it could be crucial for the right assessment of depth in very shallow waters in the presence of submerged aquatic vegetation.

Finally, pooling and sharing between hydrographers and scientists can improve data acquisition and processing leading to benefits for both communities as well as for general public interest.

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