3D MODELING OF THE MARINE RELIEF

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Abstract
The article detail the systematic process for transformation the 2D representation to 3D representation, likewise the systematic process for gather up of data, and the considerations and instrumentation necessary for this action.

Keywords *- 3D, acoustics, bathymetry*

INTRODUCTION
Nowadays, a series of marine experiments in acoustic field are being made, in order to verify a mathematical model for calculating the speed of sound in the marine environment with its associated uncertainty value. To perform this experiment, noise sources as well as reading instruments like hydrophone, temperature, salinity and pressure sensors are needed This equipment are located at OBSEA[1]. SARTI, a research group of UPC, launched the OBSEA in May 2009. The OBSEA is located moored 2 miles from the Vilanova I la Geltrú coast, Barcelona, at 20 meters depth It is also needed a GPS (Global Position System) in RTK mode [1] for the georeferencing of the underwater laboratory OBSEA, which has some of the measuring equipment used to characterize the marine environment.
An important factor to consider for the verification of the mathematical model is the bathymetric map (relief of the ocean floor) of the zone, in order to evaluate the rebounds, and the location of the transmitter-receiver. Nowadays there are a lot of nautical charts that have represented basic contour line of the sea and the need to transform this relief from 2D to 3D is considered necessary, because this point is the objective of this article.

DEVELOPMENT
The first step to obtain a 3D bathymetry is getting it on a 2D plane so that it can be transformed. This information is located on different servers on marine cartography, such as the Generalitat de Catalunya (SIG-Pesca [3]), which offers geographic information of the coast of Catalunya. However, these bathymetries maps are not precise enough for our project.

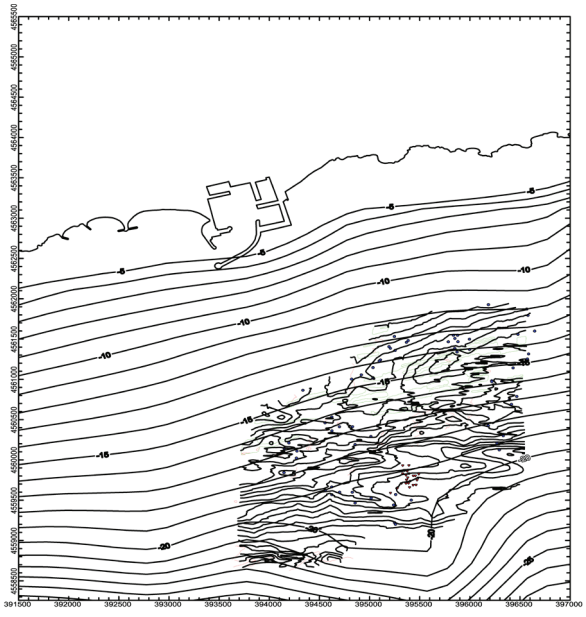

Figure 1. Bathymetry of the Vilanova coast

In this project is used a 2D marine cartography provided by the CSIC (Consejo Superior de Investigaciones Científicas) in which there are contour line with a vertical scale of 1 meter, see figure 1.
Once the information is available in 2D, emphasize in the coordinates of the map is needed, as there are different geodetic reference systems such as ED50 and ETRS89. Since 1950, in Spain, the ED50 (European Datum) reference system is used, which have an expiration date in 2015, in accordance with Royal Decree 1071/2007 [4], and until this time the coordinates have to be replacing by the ETRS89 (European Terrestrial Reference System 1989).

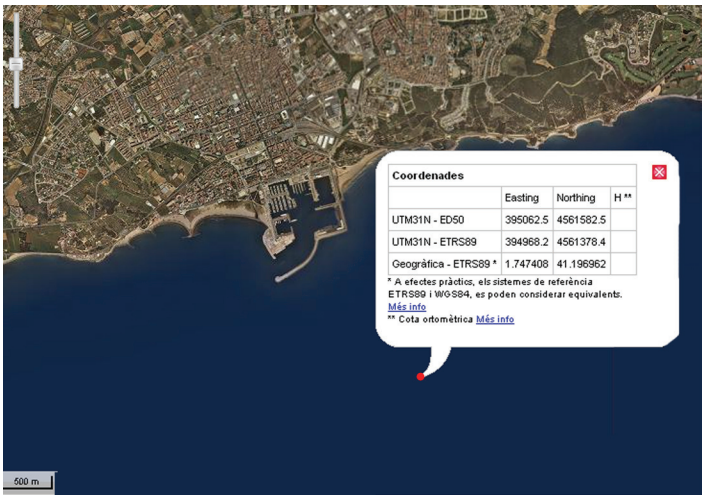

Figure 2. Different coordinates for the same point

Before transforming the 2D representation of the marine relief to 3D is necessary to check the axis scale, since the cartography is deformed as a result of the coordinate system, in this case UTM of the plane and its dimensions. To perform this scaling specific image programs are used, in this case, Adobe Illustrator, which can save your work in CAD format.
The 3D model, of the 2D bathymetry previously saved, will be generated with the AutoCAD Map program. First, is necessary that the drawing is georeferenced with the corresponding UTM zone. Vilanova is in the 31N WGS84 Datum UTM zone. Once the work area is georeferenced, the units are change to meters and the 2D bathymetry is inserted in the corresponding coordinates.
Secondly, the drawing will proceed to specify the elevation of the contour lines. Thus the contour lines are selected one by one and their elevations corresponding to the z coordinate are assigned using the menu.
Thirdly, blue colored meshes that go from contour lines to another will be created and also the coastline will be extruded, to give a sense of 3D bathymetry.
Since the drawing is georeferenced, different rigid bodies can be inserted by allocating coordinates, in our case the submarine laboratory OBSEA that was designed previously with Solid Works program.
To complete the 3D modeling, details such as the shore station, power station and marine and ground wiring have been added to the cartography in the corresponding coordinates.

CONCLUSIONS
In conclusion, the transformation of a 2D plane to 3D does not involve excessive difficulties, in contrast of getting a basic 2D bathymetry and the correct interpretation of geodetic coordinates with different sys-

tems which is the complicated issue. Depending of precision that is needed, we can use nautical charts that have represented basic contour line of the sea. If the bathymetry has to be very accurate is necessary to use more accurately bathymetries performed by standard methods [5]. The 3D marine cartography allows us to know precisely the seabed, where the observatory equipment as well as the anchors of the buoy is placed, with their corresponding coordinates. The article detail the systematic process for the purpose of evaluates the echo and rebounds of the sonic wave for the numerical method of the sound velocity.

REFERENCES

[1] Mànuel, A.; Nogueras, M.; Del Rio, J. "OBSEA: an expandable seafloor observatory" Sea technology, ISSN: 0093-3651

[2] Clarkj R.L., Lee R. "Development of topographic maps for precision farming with kinematic GPS", Department of Biological and Agricultural Engineering, University of Georgia, Athens, Georgia 30602, ETATS-UNIS; 1998, vol. 41, no4, pp. 909-916 (12 ref.)

[3] SIG-Pesca http://www10.gencat.net/darp_dgp/index.htm

[4] Real Decreto 1071/2007 de 27 de julio de 2007

[5] "Manual de hidrografía", Publicado por el bureau hidrográfico internacional MÓNACO. 1ra Edición, Mayo 2005.

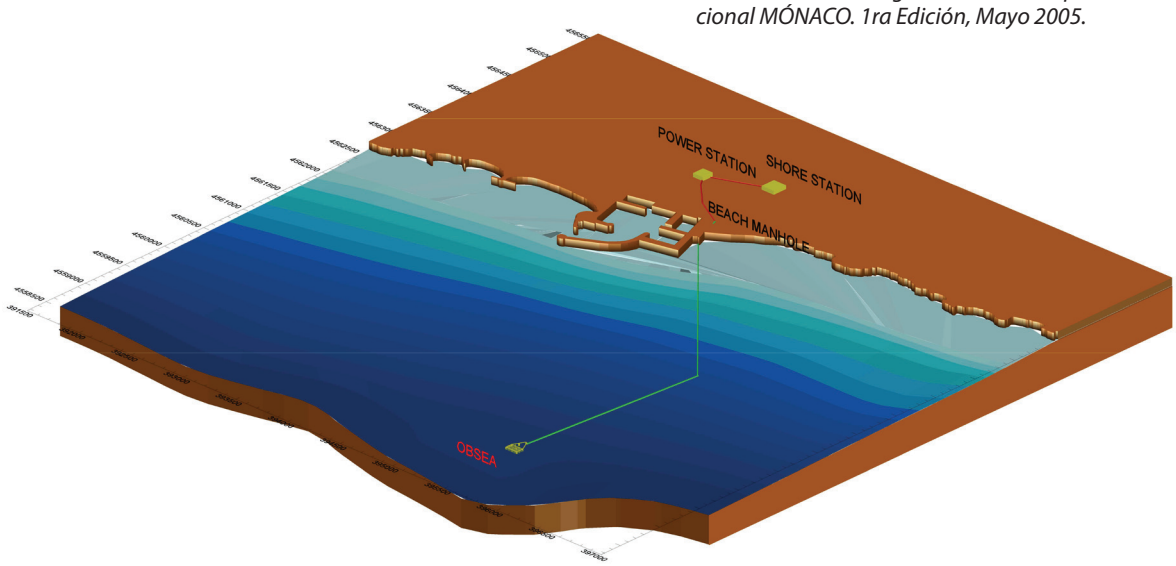

Figure 3. 3D modeling the OBSEA situation

Vilanova i la Geltrú's Shore in 1956 and 2012