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Field Validation of GEBCO Data in the Red Sea

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Abstract*—A comprehensive field data were collated analyzed and processed for the validation of open source bathymetry data GEBCO 30 sec arc resolution data in the selected location of the Red sea. Different software and techniques were used to verify the quality of GEBCO data in the field conditions. The image analysis using different software proves the poor quality and resolution of the GEBCO data in the nearshore areas. The analyses also brought out the complex topographical nature of the Red sea and precautions for the usage of open source bathymetric data in the nearshore areas of the Red sea, where high quality and fine resolution data required. The different statistical analyses also verified the results of image analysis. The statistical analysis also shows the poor quality and course resolution of the GEBCO 30sec resolution data in the Red sea especially nearshore areas. The study recommends hydrographic survey data for the nearshore areas, where high quality and resolution data are needed.

***Keywords* : GEBCO, Bathymetric data, Hydrographic survey**

I. INTRODUCTION

Hydrographic surveys are conducted for measurement and description of ocean, sea, and costal area for the primary purpose of safe navigation (Rifaat Abdalla and Salim Al-Harbi, 2018). In a hydrographic survey using survey vessel, the density of soundings is more in a short period of time and horizontal and vertical accuracies are controlled by precise positioning and tide measurements. The survey data gives accurate depth in the survey area. The satellite based data system lack the accuracy and hence for nearshore navigation, coastal engineering works, scientific models etc. The experts recommend for surveyed data than the open source data. The scientific studies on validation of open source bathymetric data in the Red sea is not available. This lack of due to different factors like lack of availability of survey data in the nerashore or open sea. The GEBCO data is a compilation of survey, ship based, satellite, model output data and the resolution is low compared to survey data (Smith and Sandwell, 1997 and Sandwell, and Smith, 1997).The older data prone to more error (Smith, 1993). Even though recently GEBCO released with 30 sec arc resolution data, cannot be used for nearshore areas, where high accuracy data is required (Marks et al., 2010). The Arctic Ocean data also available in the for geophysical and oceanographic analysis (Jakobsson et al., 2008)

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The present study focuses to prove the quality and resolution of survey data with open source bathymetric data. The hydrographic survey conducted at selected locations of the Red sea where used for the validation study and study can be used to prove the importance of survey data especially in the nearshore areas. Present investigations were conducted at the Red sea, where such studies are not available. The selected study has importance because of its complex topography (Shamji V R and T.C. Vineesh, 2016)

II. MATERIALS AND METHODS

The present study uses the bathymetry data from the global bathymetry data set GEBCO_08 Grid data (British Oceanographic Data Center (2003)). The bathymetry data of horizontal resolution 30 arc-second were extracted from the GEBCO grid (http://www.gebco.net/). The GEBCO 08 grid is a 30-second resolution worldwide help model of earth's surface that incorporates land geography and seas bathymetry. The data were shaped into appropriate format using software. The GEBCO data extracted for the whole Red Sea area and compared with the Survey data at selected location of the Red Sea (Fig. 1). The surveyed area are located at (38°54′16.45805″E,21°50′43.14174″N) and the depth in that area varies between 18.021m to 108.445m with average depth 59.848m Figure 2.

Fig. 1 Survey area location generated by google earth

A. GEBCO and Survey data

The latest release of the GEBCO 30 sec resolution grid was available from November 2008.The GEBCO 30 sec resolution grid is a global bathymetric grid that was based on the bathymetric contours in the GEBCO Digital Atlas. The plots of 30 sec grid are shown in the figure. The total survey area at the selected location of the Red sea is too small and it was 1km², validated with the GEBCO data same area

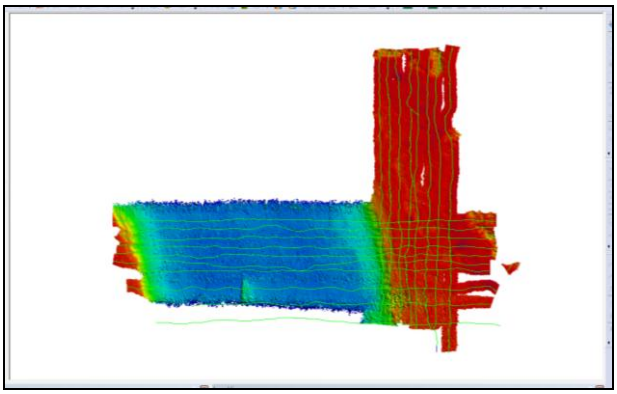

Fig. 2 Surveyed area at selected location of the Red sea

III. Results & Discussion

The GEBCO data validation carried out in the field conditions different techniques used for validation processes. The validation processes carried out using SURFER and QGIS software. The statistical analyses were also carried out to find the percentage of the error in validation processes. The different validation processes are included in the following sections

A. Validation of GEBCO data using surfer

The survey area processed and analysed using SURFER software and the results are given in figure 3.. The depth in the survey area varies from -15 m to -110 m, shows complex topography in this region. The depth varies irregularly and hence the selected area is more valid for validation study. The surfer software is used to generate contours for the survey area using GEBCO 30 sec arc data. The results showed that the contours generated are not matching with the hydrographic survey data. The results is given in Fig.4. The GEBCO 30 sec arc data showed maximum and minimum depths of -23.5 m and -7.9 m respectively

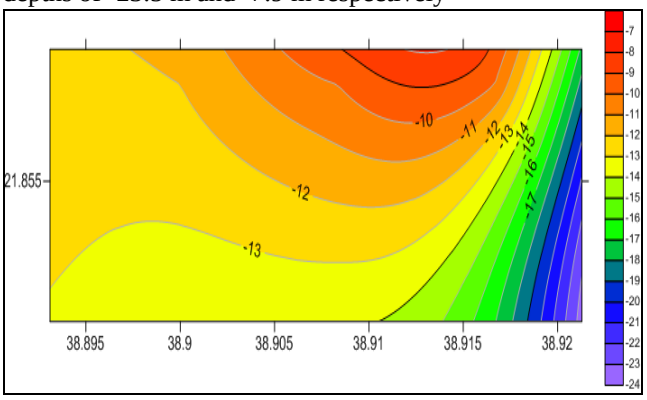

Fig. 3. Surveyed area generated by SURFER software

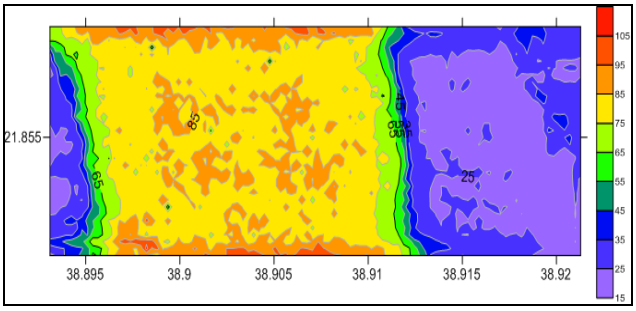

Fig. 4 Surveyed areas generated using GEBCO 30 sec data

B. Validation of GEBCO data using Q-GIS

The Q-GIS software is used to generate a DEM of the survey area using GEBCO 30 sec arc data. The results showed that the area generated is not matching with actual survey area. The comparison of GEBCO 30 sec arc resolution data in the survey area and actual survey data also close agree with the results of SURFER analysis. The survey data not agree with GEBCO 30 sec arc data in the same area. The color legends of survey data not matching with the color legend of GEBCO data (Fig 5 and Fig 6). Hence, the accuracy of survey data is proven in the nearshore area, where higher resolution data required for navigational and other scientific purposes. In deep ocean the GEBCO data can be used, where much accuracy not needed. In the nearshore area and areas of complex topography can not be use GEBCO data. For the modelling purpose, the open ocean GEBCO data should nest with nearshore survey data.

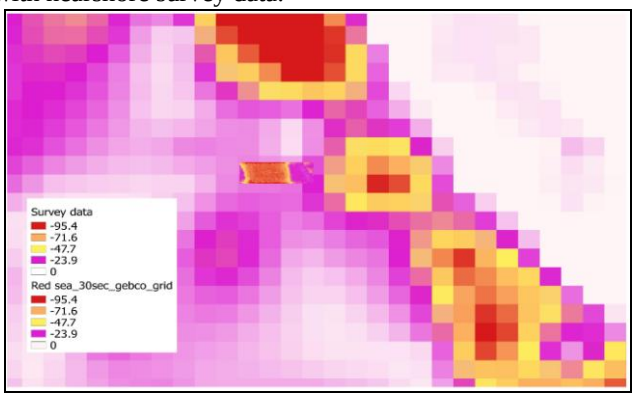

Fig. 5 GEBCO 30 sec resolution data without survey data

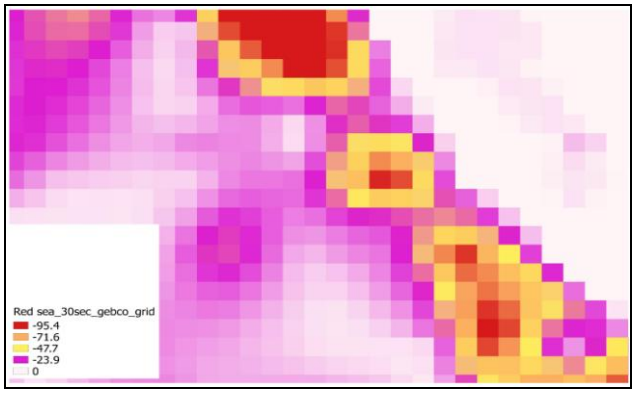

Fig. 6 GEBCO 30 sec resolution data with survey data merged

C. Statistical analysis

The statistical analysis was carried out for GEBCO data with field survey data. The analysis was carried out to find error between GEBCO data and field survey data. Different statistical techniques were adopted for the GEBCO data validations. The error calculations can be used to prove the quality of GEBCO data in the field conditions especially in near-shore area.

RMS error calculated between GEBCO 30 sec data and survey data and is given in the table 1.

The rms error is 10.98 for GEBCO 30 sec data and survey data. The RMS error shows the quality of GEBCO data in the field conditions and it is observed that GEBCO 30 sec resolution data are very poor in the field conditions, especially narshore area. The R-squared values for the GEBCO 30 sec data is 0.2252 against survey data. The R-squared values clearly indicate the poor quality of GEBCO 30 sec data in the field conditions.

TABLE 1
Statistical analysis of GEBCO and survey data

Sl. No.	Error statistics	GEBCO 30 sec data and Survey data
1	RMS error	10.9811
2	R-Square	0.2252
3	Correlation coefficient	-0.47455

IV. CONCLUSION

The study validates GEBCO 30 sec resolution data in the Red sea using high quality survey data using different software and techniques. All analyses were concluded with poor resolution of GEBCO bathymetry data in the Red sea, where complex topographical features are exists. The statistical analysis of GEBCO 30 sec resolutions with hydrographic survey data also verified the poor resolutions of GEBCO data in the Red sea, especially in the nearshore area. Hence the GEBCO data cannot be recommended for nearshore navigation purpose, coastal engineering activities, scientific purposes etc., where high resolution data demands

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Dr. Shamji V R working as assistant professor in King Abdulaziz University. He has experience over 15 year experiences in the field of education and Research. Published peer reviewed international paper. He working area is ocean modeling and Hydrography. He participated more than two Indian Ocean cruise for Tsunami and Data buoy deployment as part of the warning center. Experience in the data quality analysis of met and ocean data buoy. Experience in the deployments of various oceanographic equipment in the Indian ocean. Participated hydrographic survey in Arabian sea and Red sea. The Hydrographic survey carried out with single and Multibean as part of different projects.