Shahrood University of Technology

JOURNAL OF RESEARCH ON APPLIED GEOPHYSICS

(JRAG)

2016, VOL 2, NO 1

(DOI): 10.22044/JRAG.2016.706

Investigation of magnetic field fluctuations due to sea waves in the Strait of Hormuz

Mohammad Reza Khalilabadi [1] and Seyed Hossein Hassantabar Bozrodi[2*]

1- Assistant Professor, Malek-Ashtar University of Technology, Shiraz, Iran
2- M.Sc., Malek-Ashtar University of Technology, Shiraz, Iran

Received: 29 May 2016; Accepted: 19 September 2016

Corresponding author: shh.tabar@yahoo.com

Keywords

Magnetic Field
Numerical Modelling
Sea Wave
Strait of Hormuz

Extended Abstract

Summary

Magnetic induction caused by sea characteristics has recently been the focus of attention of several studies. Since water is an electrically conductive liquid, its movement in the Earth's magnetic field produces a transverse magnetic force at each unit of charge. Therefore, it seems essential to identify the factors affecting the fluctuations of these magnetic fields and the effect of these factors on the marine, navy, and military applications. In this research, the changes of magnetic fields caused by sea waves in the Strait of Hormuz have been investigated. For this purpose, we use the waves parameters obtained from numerical model of MIKE21, and then, calculate the magnetic field and observe the magnetic field fluctuations in the study region. The results show that the values of magnetic field vary between 0 and 0.2 nanotesla. Moreover, magnetic field values in Bandar Abbas coast and Iran shoreline within the study region are less than the magnetic field values in the Islands of Qeshm, Hormuz and Larak. In general, it can be said that the magnetic field fluctuations are completely caused by changes in the waves parameters so that the trend and pattern of changes of three variables of the waves including height, period, and magnetic field within the study region are almost the same. Therefore, due to the low height and low period of the waves in the Strait of Hormuz, the magnetic field caused by the waves is not considerable, and thus, its effect on magnetic field fluctuations is not also noticeable. As a result, in some maritime applications, like determination of the range of magnetic field fluctuations for the purpose of setting sensors of a torpedo and preventing the torpedo deviation from the goal, the effect of waves on the magnetic field fluctuations can be ignored.

Introduction

The magnetic fields in a sea are affected by the Earth's core, the solar winds, and sea water movements. In the absence of these movements, their effects on the magnetic fields equal zero. These magnetic fields have the frequency of ocean waves, which are in turn affected by wind. Therefore, analyzing the magnetic fields caused by these waves and their fluctuations have recently been the focus of attention. The application of magnetic field in exploration and identification of underwater equipment and communications, the adjustment of torpedoes, magnetic sensors, and also the effect of magnetic field fluctuations on subsurface navy and military equipment, all reminds the importance of studying magnetic field fluctuations. This magnetic field can be generated by sea features such as waves. As a result, it is obvious that magnetic field fluctuation range is affected by several sources. Hence, to be able to attribute the magnetic field to the sea waves, the effect of other sources needs to be eliminated. This elimination is possible only through numerical calculations and mathematical formulas. The Strait of Hormuz is considered to be one of the most important waterways in the world that has high fluctuation rates in the wave characteristics due to its connection to the Sea of Oman and the Indian Ocean and therefore, plays an important role in the magnetic field fluctuations caused by the waves.

Methodology and Approaches

In this research, the bathymetry map of the study region has been obtained from GEBCO Database. Then, grid generation and interpolation of the bathymetry data have been conducted using the mesh generation subroutine of MIKE21-MIKE ZERO software package. The mesh, which includes irregular elements of triangular shapes, has been produced to discretize the computational domain considering geometry and bathymetry problems. The final mesh, which has been used in this model, includes 49819 elements and 27915 nodes. Two water borders in the west and east of the Strait of Hormuz and two land areas in the north and south of the Strait have been considered in this study. The data of the sea borders that consist of the heights, periods and the directions of the waves are used for implementation of the simulation.

After implementation of the model, in order to calculate the waves induced magnetic fields, we use the output data of wave model (MIKE21-SW). Afterwards, the data are inserted into the calculating equations of magnetic field and as a result, the magnetic field in the study region is calculated.

Results and Conclusions

This study shows that the amounts of magnetic-filed due to sea waves in the study region vary between 0 and 0.2 nanotesla, which are not considerable amounts. The fluctuation of the waves has a direct effect on the size of magnetic field. As expected, magnetic field changes directly relate to the changes in the waves parameters so that their changes are almost the same.