ISSN: 2148-9173 Vol: 9 Issue:4 December 2022

International Journal of Environment and Geoinformatics (IJEGEO) is an international, multidisciplinary, peer reviewed, open access journal.

# A Ship Maneuvers could be predicted in the Turkish Straits by Marine Science Effects?

**Hasan Bora USLUER, Güler BİLEN ALKAN, Osman TURAN**



**Abstracting and Indexing:** TR DIZIN, DOAJ, Index Copernicus, OAJI, Scientific Indexing Services, International Scientific Indexing, Journal Factor, Google Scholar, Ulrich's Periodicals Directory, WorldCat, DRJI, ResearchBib, SOBIAD

IJEGEO
*International Journal of Environment and Geoinformatics 9(4):095-101 (2022)*

**Research Article**

# A Ship Maneuvers could be predicted in the Turkish Straits by Marine Science Effects?

**Hasan Bora Usluer[1,*], Güler Bilen Alkan[2], Osman Turan[3]**

[1] Galatasaray University, Maritime Vocational School, Çırağan Cad.,Nu.36,34349 Ortaköy-Beşiktaş/İstanbul-TURKIYE
[2] Mersin University, Maritime Faculty, Tece Kampüsü Mezitli/Mersin-TURKIYE
[3] University of Strathclyde, Naval Architecture, Ocean And Marine Engineering, UNITED KINGDOM

* Corresponding author: H.B. Usluer
E-mail: hbusluerl@gsu.edu.tr

Received 31.05.2022
Accepted 18.06.2022

**How to cite:** Usluer et al., (2022). A Ship Maneuvers could be predicted in the Turkish Straits by Marine Science Effects?, *International Journal of Environment and Geoinformatics (IJEGEO)*, 9(4): 095-101. doi. 10.30897/ijegeo.1124160

## Abstract

The Turkish Straits System (TSS) or Sea Area consists of the Strait of Istanbul (Bosphorus), the Strait of Çanakkale (Dardanelles), and the Sea of Marmara, which is among the world's most extensive busiest natural waterways. Connecting the Asian and European continents increases national and international maritime trade, thus increasing maritime traffic. For this reason, it has gained the nature of an essential natural waterway in world maritime transport. As a result of the investigation of the dangers experienced by the ships passing through the Turkish Straits throughout history, the essential factor is the need to collect the marine science data periodically and to make it usable for the safety of the ships underway. In the study, an effort was made to evaluate the practical and beneficial use of Marine Science data on the effects of marine accidents such as Independenta, Nassia, and Vita Spirit. Their consequences were dangerous in the history of marine accidents in the Turkish Straits. Also, within the study, natural effects in the seas can be controlled by human reflex and appropriate technical equipment trying to find the answer to the species. As a result of the study, it has been determined that seasonally affected sea and meteorological data can be predicted in the natural waterway Turkish Straits and are essential for navigational safety.

**Keywords:** TSS, Marine Sciences, Maritime Transportation and Management, Oceanography, Collision

## Introduction

The Turkish Strait Sea Area is an acronym for TSSA. TSSA consists of The Sea of Marmara-SoM, the Strait Of Istanbul (old name was Bosphorus)-SoI, and the Straiı of Canakkale(old name was Dardanelle)-SoC. Fig.1 also shows the TSSA VTS chart and how it affects it. As clearly understood in Fig.1, The Straits link the Black Sea to the Aegean Sea. The Turkish Straits have become more critical in the last ten years due to energy transportation off the Black Sea. The Turkish Straits are not only essential but also a very strategic natural waterway. Due to this natural geographic form, having different values on the surface and bottom level cause different current speed on the Straits (Usluer and Alkan, 2016). The Turkish Straits depth varies from steep marine sciences data, especially hydrographical and bathymetric near the northern edge with three depressions inside in the form of a valley with a slight slope starting from the southern side (Jacopo Chiggiato, 2012)

The water current system of SoI and SoC are divided into two parts, upper and lower layers. In contrast, the surface or upper layer flows towards the Sea of Marmara-SoM and the lower current moves towards the Black Sea. The speeds of water layers throughout the depth display remarkable changes over time with different seasons. Due to the Strait's different cartographic form, there appear to be differences in the direction and intensity of the current. The current sea system of the Turkish Straits is divided into two parts, upper and lower layers. Hence, the surface level or upper layer flows from the Black Sea to the Sea of Marmara, and the lower current moves towards the Black Sea (Gazioğlu and Okutan, 2016; Bayırhan et al., 2019). Also, this layer's sea current speed throughout the depth displays remarkable and survey able changes over time with different seasons. Due to the Strait's geomorphological and cartographic form, there appear to be differences in the current direction and intensity of the draft. From 1980 to now, technically talented scientists made efficient studies that approached very close the issues of the Turkish Straits. Çeçen et al. (1981) and Bayazıt and Sümer (1982) accomplished new perspectives, containing formulations were the first studies of Straits flows. Some accurate descriptions of the Strait of Istanbul were studied by Tolmazin (1985), Latif et al. (1991), and Yuce et al. (1996). First fluxes result in studies presented by Ünlüata et al. (1990), hydrography and oceanographic data details have been studied by many researchers like Beşiktepe et al.(1994), Gregg et al. (1999); Özsoy et al. (2001); Gregg and Özsoy (2002). Beşiktepe et al. (1993, 1994, and 2000) Gazioğlu et al., 2017 and Schroeder et al. (2012) prepared short reviews on the Turkish Straits and their extensive coupling layers (generally two, same places three). According to Demyshev and Dovgaya (2007), the

Turkish Strait's dynamics attracted considerable attention and literature on the numerical modeling of the general sea circulation of the Sea of Marmara. Another valuable piece of information, like the Straits' influence on the Black Sea and the Mediterranean Sea, could be presented and easily understood by Özsoy and Ünlüata (1997, 1998). Also some pollution studies prepared by İncaz et.al. (2008). The Strait of Istanbul's hydrographic measurements are the central geographical and geometrical constrictions in the flow path where strictly hydraulic controls are provided (Latif et al. 1990, Dorrell et al. 2016) and provided and verified by model results (Sözer 2013; Sözer and Özsoy 2016). Some areas have sub-maximal hydraulic control studies from (Latif et al. 1990; Ünlüata et al. 1990) and a single contraction at the subjects of the flow in Canakkale Strait's Nara Passage. According to Akten (2004), the Strait of Istanbul sea currents and darkness are the two dominant factors causing marine casualties. In the study, it is very important to mention how important it is to know the marine science data in a natural waterway such as the Turkish Straits and the benefit of using it for navigational safety.

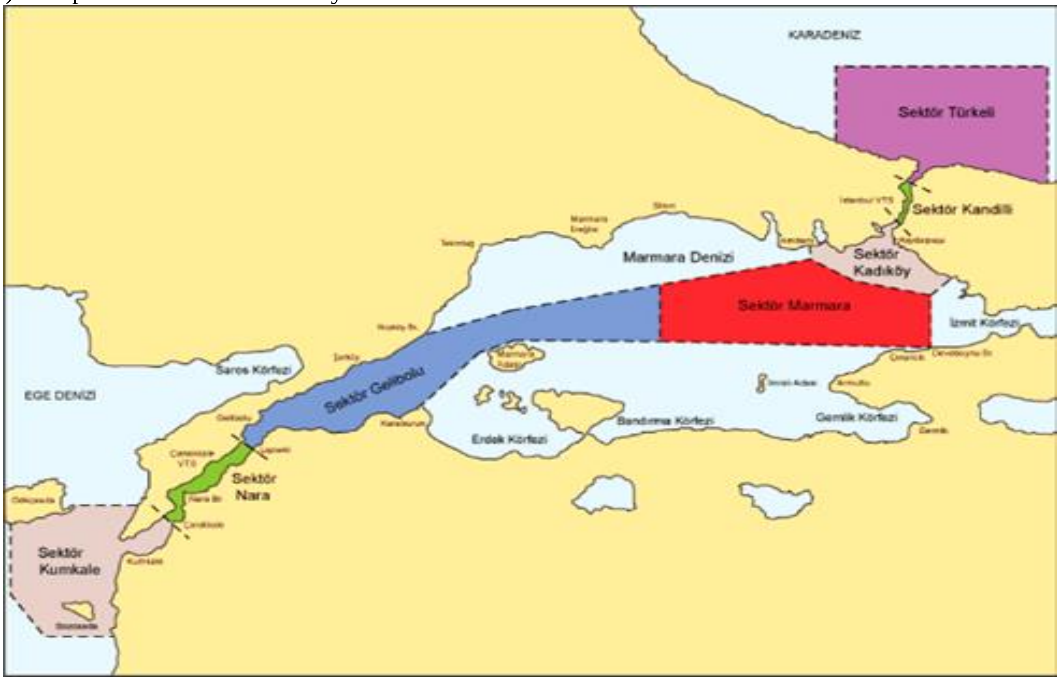


Fig. 1.The Turkish Strait VTS Scheme,2022.

## Turkish Straits Sea Area Overview

The Turkish Strait Sea Area consists of three major parts the Strait of Istanbul, the Strait of Canakkale, and the Sea of Marmara. Hence, this area is working as a gate between Asia and Europe continents and linking the Caspian Sea to the Mediterranean Sea (Usluer and Alkan, 2016) (Figure1-3).

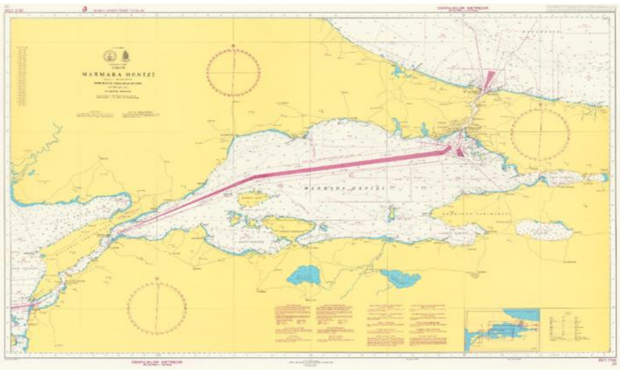

Fig. 2. TR29 Paper Chart which is show TSSA entirely.

Using the Turkish Strait term is very important, and it comes from 1923. The term first used in the 1923 Lausanne Straits Convention was still used in the 1936 Montreux Convention. Although the Marmara Sea is also used in transit and innocent passage through the Turkish Straits, Istanbul has not changed the legal (both national and international), political (even if the political power changes), and strategic existence and meaning of TSSA. (Pazarcı, 2015).

### *The Strait of Istanbul Details*

Recently, the Turkish Straits have gained more importance due to the energy industry, which has attracted global attention and an increase in transportation, and the Strait of Istanbul (its old name was Bosphorus) has come to the fore due to its unique coastal areas and a natural waterway that needs to be protected. According to the Ministry of Transportation and Infrastructure, official passing statistics show 41,112 vessels in 2019, 38,404 vessels in 2020, and 38,551 vessels in 2021 (Ministry of Transportation, 2022).

### *The Strait of Canakkale Details*

The Strait of Canakkale is 20 nautical miles longer than Istanbul. It constitutes 37 sea miles of The Turkish Strait Sea Area of 167 sea miles. In 2022, the 1915 bridge also served, helping the two sides unite. According to the T.R. Ministry of Transport and Infrastructure show that 43.759 vessels in 2019, 42.036 vessels in 2020, and 43.342 vessels used the Strait of Canakkale in 2021.

## Materials and Methods

Due to the geomorphological and cartographic structure of the Turkish Straits, it has a sloping valley structure. In addition, the layers formed due to the different water structures and different chemical properties of the Black Sea and the Marmara Sea cause the observation of two water columns with additional flow and speeds. Many studies have identified seasonal variations of different water columns and flow rates. One of the current studies has been turned into an atlas. Atlas book serves as an official publication thanks to marine science surveys made by TN-ONHO, Turkish Navy, Office of Navigation, Hydrography, and Oceanography between 2005 and 2007. The Turkish Straits, as well as being an important waterway, is one of the critical coastal areas known in the world due to its unique natural opportunities. It should be protected, and the habitat should be protected from all kinds of accidents caused by ships. Despite this, maritime accidents with significant effects have occurred in the past, especially in the Strait of Istanbul. Maybe some of them are due to technical flaws, but contrary to what is known, it is estimated that marine sciences are also not well known and used. As a result of this point of view, the study was carried out in response to the question of what it would be like to examine the marine sciences in detail to increase the safety of navigation in the Straits, to make foresight analysis for navigational planning in all seasons and conditions, and to present accurate and accessible data to the seafarers while navigating in the Straits. It had only 4,500 ships that passed through the Strait of Istanbul in 1936; it reached 24,000 in 1985, 46,954 in 1995, and 48,079 in 2000 (Taşlıgil, 2004). Now, 38,551 vessels use the Strait of Istanbul, and 43.342 vessels are used in the Strait of Canakkale.

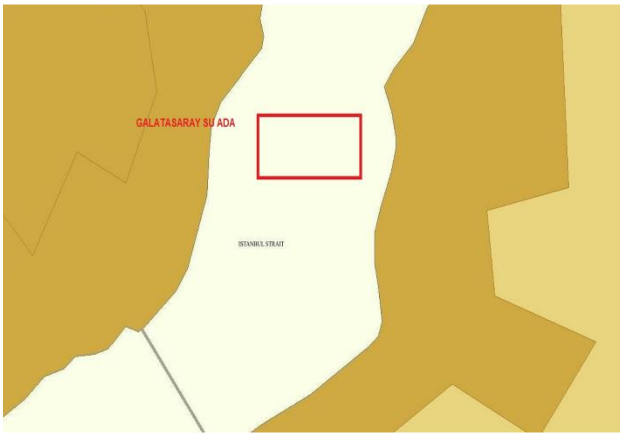


Fig. 3. Selected sample Area Galatasaray Island.

The defined area is the marine area called Galatasaray Island, located between Kuruçeşme and Çengelköy. The region between 41-03.20 N & 29-02.60 E and 41-03.60 N -29-03.00 E coordinates of the mentioned location have been considered. Surface level sea current velocity and direction in the region were calculated separately for 0-10 meters, 10-20 meters, and 20-30 meters. Its survey data from winter 2005 to summer 2007 (Usluer, 2016). CTD (Conductivity, Temperature, Depth) and ADCP (Acoustic Doppler Current Profiler) were used for sampling. 300kHz RDI Broadband ADCP measured all data. The marine science data were processed differently, but the best solutions came from MATLAB and sub-applications. This study includes linear regression from regression analysis and Least square fits (Usluer, 2016). Three water columns were determined in the selected study area. These columns are; It was chosen to study currents and their directions at depths of 0-10 meters, 10-20 meters, and 20-30 meters.7X11 matrix calculation was also used to evaluate the three selected water columns in the field numerically. The aim was to work with predictive analytics using data mining. The process also emphasized that the data surveyed had been repeated three times in the same season, considering the availability of more used and reliable results and the acquisition of archival features. (Usluer,2016) The following tables 3,4 also include summer season values. The tables below provide characteristic information for the same region and the same season. (Atlas,2009) The method means of adjusting the fit are all parameters, which include. Fitting a straight line is the primary helpful way for a solution. Furthermore, the best way to find fitting a straight line is known as regression analysis. Regression analysis is a statistical tool for the investigation of relationships between variables, and also, Regression analysis is the method of analysis used to measure the relationship between two or more data. Now, try to know how the relative relationship between the two variables is calculated; if possible, we can develop a regression equation to forecast or predict the expected and desired variable. Basically, formula is f (x) = a +bx or y = bx+a. The symbol y is the value that, trying to forecast, the "b" is the slope of the regression, the "x" is the value of our independent value, and the "a" represents the y-intercept. A linear regression analysis depends on two values with a dependent and an independent variable. It is called Simple Linear Regression. Mathematically aim is to obtain the smallest value of ε (error term) in the equation Y = α + βX + ε. f (x) = a +bx or y = bx+a formula is also shows fitting straight line.

$$S(a,b) = \sum_{i=0}^{n} [yi - f(xi)]^2 \text{ and; } = \sum_{i=0}^{n} [yi - a - bxi]^2.$$

Eq.1. The standard formula for prediction analysis.

Although the systems measuring marine science data were activated after 2018, the list below with Table 1. shows the summer season data of 2005 from the past measurements and data obtained. There is not much change in the sea and its structure in the region since tides are not observed much because it is a natural waterway and a protected sea area.

Table 1.2005 Summer Season 0-10 meters data.

**GALATASARAY ISLAND (0-10 METERS)**

| LAT | LONG | DIRECTION | CURRENT |
|---|---|---|---|
| 41-03,20 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,20 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,20 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,20 | 29-02,72 | 207.24 | 1.6 KNOTS |

| | | | |
|---|---|---|---|
| 41-03,20 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,20 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,20 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,20 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,20 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,20 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,20 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,24 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,24 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,24 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,24 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,24 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,24 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,24 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,24 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,24 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,24 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,24 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,28 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,28 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,28 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,28 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,28 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,28 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,28 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,28 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,28 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,28 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,28 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,32 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,32 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,32 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,32 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,32 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,32 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,32 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,32 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,32 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,32 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,32 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,36 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,36 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,36 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,36 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,36 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,36 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,36 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,36 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,36 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,36 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,36 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,40 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,40 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,40 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,40 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,40 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,40 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,40 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,40 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,40 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,40 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,40 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,44 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,44 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,44 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,44 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,44 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,44 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,44 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,44 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,44 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,44 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,44 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,48 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,48 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,48 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,48 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,48 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,48 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,48 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,48 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,48 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,48 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,48 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,52 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,52 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,52 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,52 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,52 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,52 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,52 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,52 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,52 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,52 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,52 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,56 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,56 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,56 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,56 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,56 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,56 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,56 | 29-02,84 | 181.52 | 2.0 KNOTS |

| | | | |
|---|---|---|---|
| 41-03,56 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,56 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,56 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,56 | 29-03,00 | 173.17 | 2.8 KNOTS |
| 41-03,60 | 29-02,60 | 212.09 | 1.6 KNOTS |
| 41-03,60 | 29-02,64 | 214.09 | 1.6 KNOTS |
| 41-03,60 | 29-02,68 | 213.54 | 1.6 KNOTS |
| 41-03,60 | 29-02,72 | 207.24 | 1.6 KNOTS |
| 41-03,60 | 29-02,76 | 195.25 | 1.8 KNOTS |
| 41-03,60 | 29-02,80 | 186.55 | 1.8 KNOTS |
| 41-03,60 | 29-02,84 | 181.52 | 2.0 KNOTS |
| 41-03,60 | 29-02,88 | 178.36 | 2.0 KNOTS |
| 41-03,60 | 29-02,92 | 170.08 | 2.4 KNOTS |
| 41-03,60 | 29-02,96 | 170.47 | 2.4 KNOTS |
| 41-03,60 | 29-03,00 | 173.17 | 2.8 KNOTS |

**Results**

To observe the ship movements in the three water columns determined following the scenario determined in the study;

1- A 100-meter long ship moving at 7 Knots speed, the draft is 7 meters; if the draft is 7 meters,

2- A 100-meter long ship moving at a speed of 7 Knots, the draft is 12 meters; if the draft is 12 meters,

3- Evaluations have been made for a 100-meter-long ship moving at 7 Knots speed and a draft-draft of 21 meters

A study was carried out for a ship moving from the Black Sea to the Marmara Sea with a speed of 7 knots on the starting route 195.35° from 41.0564 & 29.0466 location, and a ship moving from the Marmara Sea to the Black Sea with a speed of 7 knots on the 15.05° course (Usluer, 2016).

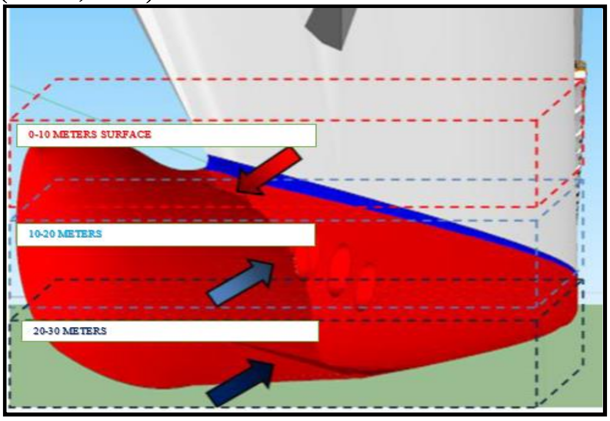


*Fig. 4.The direction of the water column at Istanbul Strait and effects on the vessel.*

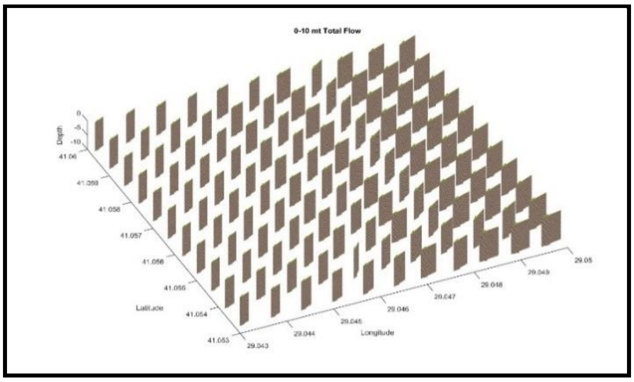


Fig. 5. 0-10 meters flow diagrams

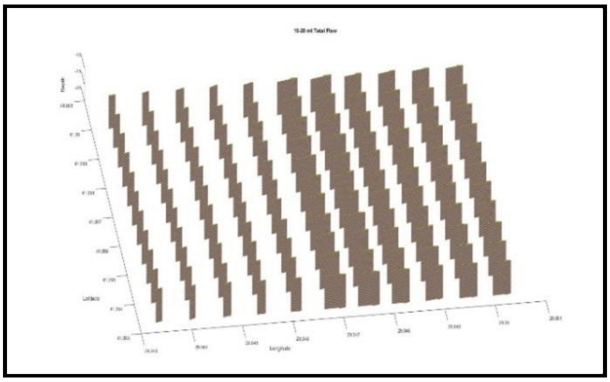

Fig. 6 10-20 meters flow diagrams

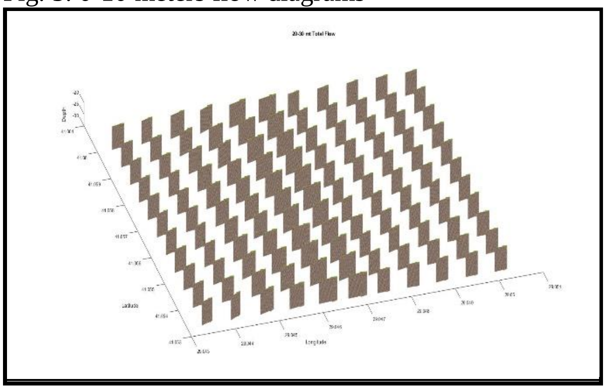

Fig. 7From the Black Sea to the Sea of Marmara, 20-30 meters flow diagrams.

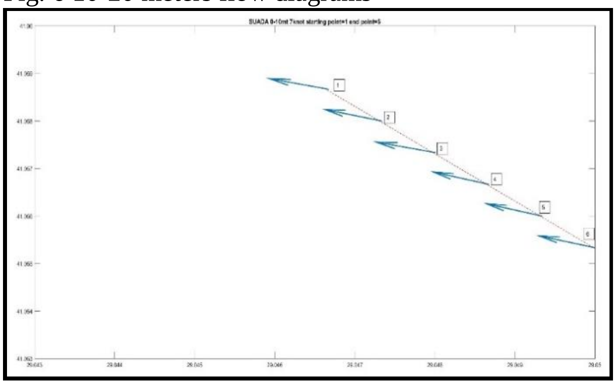

Fig 8.From the Black Sea to the Sea of Marmara 0-10 meters.

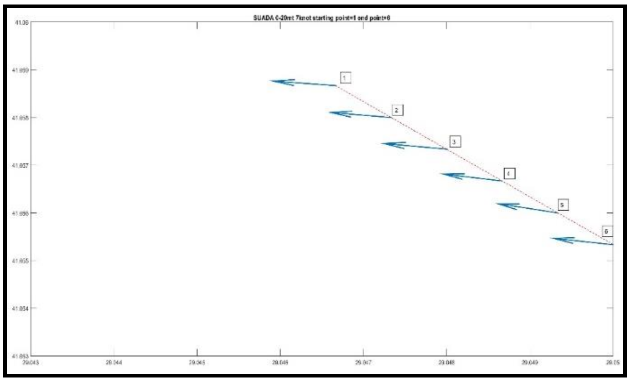

Fig 9. From the Black Sea to the Sea of Marmara 0-20 Meters.

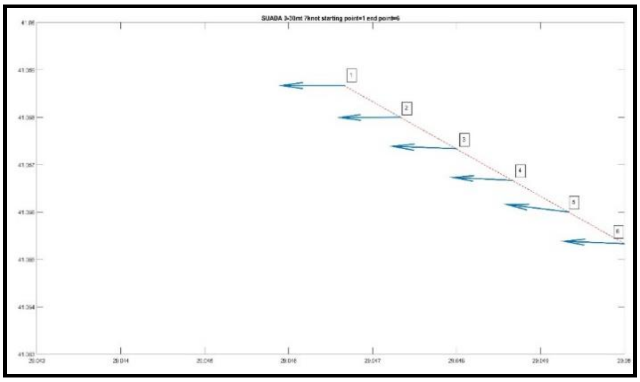

Fig 10. From the Black Sea to the Sea of Marmara 0-30 meters.

**Discussion and Conclusion**

The Turkish Straits have been under the influence of two water columns formed because they are in a structure like a natural valley descending from the Black Sea to the Marmara Sea and the chemical structure of these two seas is different. As a result of the marine sciences surveys, these two water branches are under the effects of surface currents up to 20 meters at their deepest point and between 12 and 14 meters at average depths. This effect is a seasonally variable but continuous current effect from the Black Sea to the Marmara Sea. On the other hand, it is affected by low-level currents from the Marmara Sea to the Black Sea at a depth of 20 meters at its deepest point and 12 to 14 meters at other places.

Figure 8 shows; how a ship that is 100 meters long, moving at 7 knots, and has a draft of 7 meters, traveling from the Black Sea to the Sea of Marmara, acting following the scenario in the study, will be affected by the effect of 0-10 meters of surface current.

Figure 9 shows how a 100-meter-long ship with a 12-meter draft, traveling from the Black Sea to the Marmara Sea, acting following the scenario in the study, will be affected by the 0-20 meters surface current effect. In this context, since the surface and subsurface flow moves in the opposite direction, the movement starts to change gradually, according to Figure 8.

Figure 9 shows how a 100-meter-long ship with a 21-meter draft, traveling from the Black Sea to the Marmara Sea, acting following the scenario in the study, will be affected by the 0-30 meters surface current effect. In this context, since the surface and subsurface flow move in the opposite direction, the movement started to change gradually, according to Figures 8 and 9. Opposite surfaces and two undercurrents cause significant changes in the ship's movement. The study is based on the summer season data of 2005, 2006, and 2007, how the surface and subsurface (bottom current regime) observed in the Turkish Straits, which are located in the natural waterway and valley structure, affect the ships while navigating, and how the safety of navigation is affected, by predicting until the summer of 2016. It shows how and how much it changes. In the following process and studies, instant measurements will be made, and real-time measurements will be provided to the users as a real-time service from the moment of navigation.

**Acknowledgements**

This article was produced from Hasan Bora USLUER's Ph.D. thesis which was supervised by Prof. Dr. Güler Bilen ALKAN and Prof. Dr. Osman TURAN titled "Investigation about benefits of effective using vessel traffic system-VTS at the Turkish Straits (Türk Boğazlarında Gemi Trafik Hizmetlerinin Etkin Faydalarının İncelenmesi)" written at Istanbul University, Engineering Faculty, Maritime Transportation and Management Engineering Department.

**References**

Akten, N. (2004) Analysis of Shipping Casualties in the Bosphorus, *Journal of Navigation*, 57(3), 345-356.

Bayazıt, M., Sümer, M. (1982) Oceanographic and Hydrographic Study of the Bosphorus. İTÜ, T.B.T.A.K. Report No: 28 (in Turkish).

Bayırhan, İ., Mersin, K., Tokuşlu, A., Gazioğlu, C. (2019). Modelling of Ship Originated Exhaust Gas Emissions in the Strait of Istanbul (Bosphorus). *International Journal of Environment and Geoinformatics*, 6(3), 238-243: doi. 10.30897/ ijegeo.641397.

Beşiktepe, Ş., Özsoy, E. and Ü. Ünlüata 1993. Filling of the Marmara Sea by the Dardanelles Lower Layer Inflow. *Deep-Sea Res.* 40: 1815-1838.

Beşiktepe, Ş.T., Sur, H.I., Özsoy, E., Latif, M.A., Oğuz, T. *et al.* 1994. The circulation and hydrography of the Marmara Sea. *Progress in Oceanography* 34 (4): 285-333.

Beşiktepe, Ş.T., Mutlu, E., Okyar, M., Özsoy, S.T. and A. Yılmaz 2000. The sea of Marmara and the Turkish Straits System. *In: National Marine Research and monitoring program, Mediterranean Sea, Marmara Sea, Turkish Straits system, Black Sea and the atmosphere sub-projects The Period 1995-1999, Synthesis Report İ. Salihoğlu and E. Mutlu (Ed.).* Ankara, Turkey: TÜBİTAK. 143–238 (in Turkish).

Beşiktepe, Ş., Sur, H.İ., Özsoy, E., Latif, M.A., Oğuz, T. and Ü. Ünlüata 1994. The Circulation and Hydrography of the Marmara Sea. *Prog. Oceanogr.* 34: 285-334.

Çeçen, K., Beyazıt, M., Sümer, M., Güclüer, S., Doğusal, M. and H. Yüce, (1981).Oceanographic and hydraulic investigations of the Bosphorus: Section I, *Final Report, submitted to the Irrigation Unit of the Turkish Scientific and Technical, Research Council, İstanbul Technical University.* İstanbul. 166.

Demyshev, S.G., Dovgaya, S.V. (2007). Numerical experiment aimed at modeling the hydrophysical fields in the Sea of Marmara with regard for Bosporus and Dardanelles. *Phys Oceanogr* 17**,** 141–153.

Dorrell R.M., Peakall J., Sumner E.J., Parsons D.R., S.E. Darby, R.B. Wynn, E. Özsoy, D. Tezcan,'' Flow dynamics and mixing processes in hydraulic jump arrays: Implications for channel-lobe transition zones marine *Geology*, 381, 2016, 181-193, ISSN 0025-3227

Gazioğlu, C., Karabay, U., Demir, V. (2017). Risk assessment of Q-Max LNG Tanker accident in Bosphorus, *19th MESAEP Symposium on Environmental and Health Inequity., Roma, ITALYA, 3-6 Dec 2017.*

Gazioğlu, C., Okutan, V. (2016). Underwater Noise Pollution at the Strait of Istanbul (Bosphorus). *International Journal of Environment and Geoinformatics*, 3(3), 26-39, doi. 10.30897/ijegeo. 306478.

Gregg, M.C., Özsoy, E., M.A. Latif 1999. Quasi-Steady Exchange Flow in the Bosphorus, *Geophysical Research Letters*, 26: 83-86.

Gregg, M.C., E. Özsoy 1999. Mixing on the Black Sea Shelf North of the Bosphorus, *Geophysical Research Letters* 26: 1869-1872.

Gregg, M.C., E. Özsoy 2002. Flow, Water Mass Changes, and Hydraulics in the Bosphorus. *Journal of Geophys. Res.* 107 (C3), 1

İncaz, S., Alkan., G.B., (2008) Studies of marine chemical pollution at Turkish Straits and Sea of Marmara, *Asian Journal of Chemistry,* 20(5). 4037-4040,

Jacopo Chiggiato, E. J.-M. (2012). Dynamics of the circulation in the Sea of Marmara: numerical modeling experiments and observations from the Turkish Straits system experiment. *Ocean Dynamics*, 139–159.

Latif, M.A., Özsoy, E., Oğuz, T., Ü. Ünlüata 1991. Observations of the Mediterranean inflow into the Black Sea. *Deep-Sea Res.* 38 (2): 711–723.

Pazarcı H. (2015). Uluslararası Hukuk. s. 724, Ankara, Turhan Kitabevi Yayınları.

Sözer, A. 2013. Numerical Modeling of the Bosphorus Exchange Flow Dynamics. Ph.D. thesis. pp..Institute of Marine Sciences of the Middle East Technical University. Institute of Marine Sciences, Middle East Technical University, Erdemli, Turkey.

Sözer, A., E. Özsoy 2002. A three-dimensional model of Bosphorus Strait dynamics, *in The 2nd Meeting on the Physical Oceanography of Sea Straits, Villefranche*, 15th- 19th, 207-210.

Taşlıgil, N., (2004). Boğazı'nın Ulaşım Coğrafyası Açısından Önemi. *Marmara Coğrafya Dergisi* 10: 1-18.

Third United Nations Conference on the Standardization of Geographical Names,1979

Tolmazin, D. 1985. Changing Coastal Oceanography of the Black Sea, II. Mediterranean Effluent. *Prog. Oceanogr*. 15: 277-316.

T.R. Ministry of Infrastrucure and Transportation Statistics (2022).

Usluer, H. B., Alkan, G. B. (2016). Importance of the Marine Science and Charting about Environmental Planning, Management and Policies at the Turkish Straits. *European Journal of Sustainable Development Research*, 16-25.

Usluer, H.B.,(2016) Ph.D.Thesis''Investigation About Benefits of Effective using vessel Traffic System-VTS at the Turkish Straits''58-83,

Ünlüata, Ü., Oğuz, T., Latif, M.A., E. Özsoy (1990). On the Physical Oceanography of the Turkish Straits In: L.J. Pratt (Ed) The Physical Oceanography of Sea Straits, NATO/ASI Series, Kluwer, Dordrecht, 25-60 pp.

Örs, H., (2003), Oil Transport in the Turkish Straits System: A Simulation of Contamination in the Istanbul Strait. *Energy Sources*, 25(11), 1043-1052

Özsoy, E., Di Iorio, D., Gregg, M., J. Backhaus (2001). Mixing in the Bosphorus Strait and the Black Sea Continental Shelf: Observations and a Model of the Dense Water Outflow. *J. Mar. Sys.* 31: 99-135.