

GEOGRAPHIC AND OCEANOGRAPHIC CHARACTERISTICS OF THE BLACK SEA

Midshipman Popa Gabriel, midshipman Boncu Paul

“Mircea cel Batran” Naval Academy in Constanta (Romania)

ABSTRACT

The article was written during the meteorology and oceanography classes conducted at the Polish Naval Academy in Gdynia as part of the term paper task, and during the ERASMUS+ program.

The article describes the geographical location of the Black Sea and its chemical and physical characteristics.

Keywords:

Black Sea, geographical conditions, chemical/physical characteristics

INTRODUCTION

The Black Sea is a large inland sea situated in southeastern Europe bordering six countries, Ukraine, Russia, Georgia, Turkey, Bulgaria, and Romania. It is of very important economic and strategic value for the said countries as it is one of the only access routes for maritime ships.

The origins of the name are unclear. According to one version, the reason why the Black Sea got this name is not the color on the surface, but the chemical processes in the depths. According to stories told by sailors since ancient times, any metal object that is submerged more than 100 m in the Black Sea turns black.

The surface area, excluding the Sea of Marmara but including the Sea of Azov, is about 461 000 km²; the Black Sea proper occupies about 422 000 km². A maximum depth of more than 2 210 m is reached in the south-central sector of the sea.



Figure 1. Location of the Black Sea

GEOGRAPHICAL CHARACTERISTICS

The climate of the landlocked Black Sea can be characterized generally as continental although climatic conditions in some parts of the basin are controlled to a great extent by the shoreline relief. A steppe climate, with cold winters and hot, dry summers, is found in the northwestern part of the basin exposed to the influence of air masses from the north.

The Black Sea has few islands. The most important islands are Snake Island and those formed by the Danube, beyond the spillway, such as Sacalin Island (Romania).



Figure 2. Snake Island (Ukraine)

The most important peninsula is the Crimean Peninsula, which is "split" with the Azov Sea. Black Sea bays are either wide, not fit for harboring ships during storms (such as Burgas Bay, Varna Bay, Sinop Bay, Samsun Bay, and others), or separated from the sea by transverse currents.

The area surrounding the Black Sea is commonly referred to as the Black Sea Region. Its northern part lies within the Chernozem belt (black soil belt) which goes from eastern Croatia, along the Danube (northern Serbia, northern Bulgaria) and southern Romania (Wallachian Plain) to northeast Ukraine and further across the Central Black Earth Region and southern Russia into Siberia.



Figure 3. The Black Sea near Constanta

Covered by high mountains in the southeast, it has a humid subtropical climate with abundant rainfall, warm in winter and cool in summer. In winter, tributaries of Siberian anticyclones (clear, dry high-pressure air masses) generate powerful cold air currents, and the northwestern part of the Black Sea is significantly cooled by periodic ice formations. In winter, the polar continental air (prevailing on average 185 days per year) invades, accompanied by strong northeasterly winds, rapid drop in temperature, and frequent precipitation, and the air becomes warm and humid after passing through the milder eastern regions of the sea. Tropical air from the Mediterranean region (average duration of influence 87 days) is always warm and humid. Occasionally, winds from the Atlantic Ocean via eastern Europe bring rain and sharp squalls.

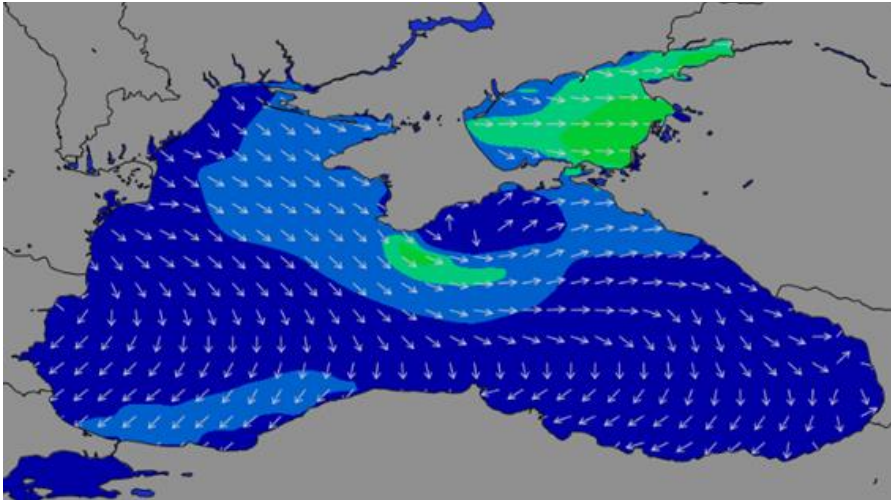


Figure 4. Black Sea Wind Chart

The currents in the Black Sea are wind-driven, with the main current rotating counterclockwise, its branches forming gyres and largely closed rotations. The current is relatively slow on the surface in full but near of the shore, it reaches 40 to 50 cm/s; its speed is about only 2.5 cm/s in the depths. The flows in the Bosphorus are complex, with surface waters from the Black Sea flowing out and deeper saltier waters flowing from the Sea of Marmara.

The flora and fauna of the Black Sea are predominantly Mediterranean, the result of a series of invasions in the area. Caspian elements predominate in freshwater estuaries and estuaries. Oceans are rich in biological productivity in certain regions.



Figure 5. Giant Black Sea bass

There are about 180 species of fish, a fifth of them of commercial importance. The most important are sprat, horse mackerel, bass, and others, including the spiny dogfish, a type of small shark that is especially prolific in the Black Sea. Some seasonal migration of fish occurs, notably through the Bosphorus.

The Black Sea is an important year-round transport artery, connecting Eastern European countries to markets. Odessa, the historic Ukrainian city, together with the port of Illichivsk, accounts for a major part of the maritime turnover. The ports of Novorossiysk and, to a lesser extent, Batumi further east specialized in the petroleum trade. In Bulgaria, Varna and Burgas are the main ports. Constanta, in Romania, connects oil-bearing regions with foreign markets. Istanbul on the Sea of Marmara is Turkey's main port, while the Danube acts as a huge trade artery for the Balkan countries.



Figure 6. Novorossiysk port (Russia)

CHEMICAL AND PHYSICAL CHARACTERISTICS

The salinity of surface waters in the open sea averages between 17 and 18 parts, or about half that of the oceans. In contrast, the salinity of the Black Sea is as high as 20‰ in the south and as low as 6‰ the north. A marked increase in salinity, up to 21‰, occurs at depths of about 50 to meters, below which the increase in salinity is more gradual. The deepest parts of the sea, about 400 m are distinguished by temperatures

between 8.5 and 9 °C and salinities of 30‰. Salinity increases to 38‰ at the Bosphorus, where waters from the Sea of Marmara intrude. The chemical composition of Black Sea water is almost the same as that of the oceans.

The water density depends on salinity and temperature. It is lowest at the mouths of rivers and the Kerch Strait - 1.010–1.014 g/cm³ on average and increases towards the open sea and downward it is 1.017 g/cm³ on average at a depth of 150 m and almost constant below that depth.

The transparency of the water in the Black Sea is 16–22 m of depth on average. It is lowest near the shore (2–3 m) and highest in the middle of the sea (20–27 m).



Figure 7. The Black Sea near Odessa

From a scientific point of view, at more than 200 m deep, the Black Sea is characterized by a complete lack of oxygen, which is replaced by hydrogen sulfite (H₂S) which gives metals a dark colour.

On the surface of the open part of the sea, the annual pH ranges from 8.35 to 8.41 with a mean pH value of 8.38. Low values of pH are attributed to the eastern and western parts of the sea, where there are the centers of cyclonic gyres formed by the Black Sea Rim Current. These areas are characterized by the presence of ascending waters with low values of Ph.

The average volume of water in the Black Sea is 547 000 km³. The volume changes depending on the following factors: precipitation, which is usually 230 000 km³; the inflow from the continent – 310 000 km³; the flow

from the Sea of Azov – 25 000 km³; evaporation loss – 357 000 km³; and outflow through the Strait of Bosphorus – 208 000 km³.

The temperature of the Black Sea's upper layer has a marked yearly periodicity. In winter, the temperature of water ranges from -0.5 in the northwest to about 9 to 10 °C. In winter cooling forms an upper mixed layer extending from depths of about 50 to 100 m, with lows at the lower limit of about 6.5 to 8°C. In summer the surface layer is warmed to between 23 and 26°C. At depths of about 50 to 75 m, a cold layer remains at 7°C, and lower depths do not change from their winter levels.

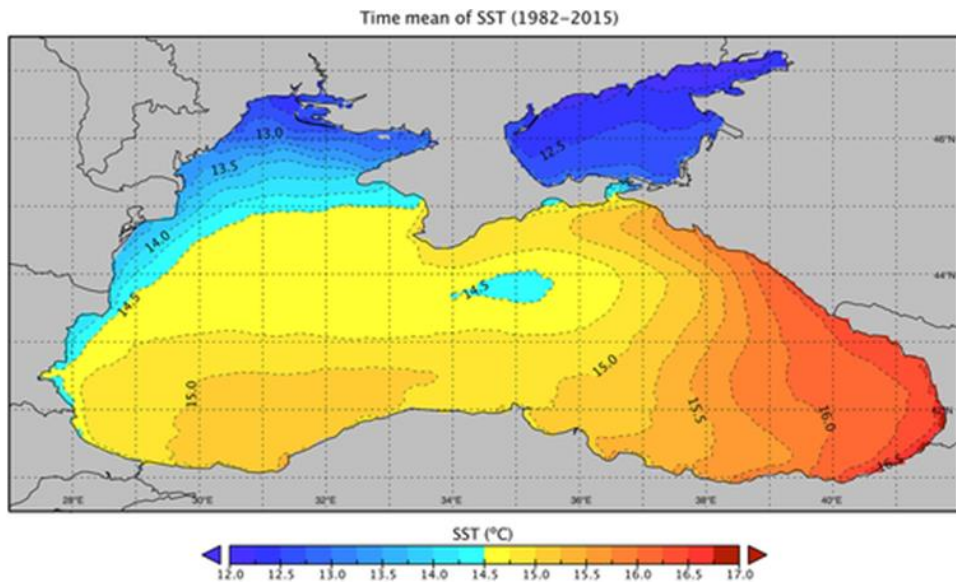


Figure 8. Mean sea temperature of the Black Sea

SUMMARY

The Black Sea is an important asset of Eastern Europe because it influences the climate and fauna and flora of these places. It is of extremely economical use because the rich resource area can get to the world oceans by the ships that come through it.

Its importance can be seen through its history, from the first people that sailed the Black Sea and established the first ports, and the further fight for dominance around it.

The tourist value of it can be seen by the many people that come to visit these ancient cities founded hundreds of years ago and their beaches in the holiday season.

Because of these significant roles, the Black Sea proves that it had a huge impact on this area and the people in it, and so the nations that border the Black Sea will not be the same that are today without it.

We thank the Black Sea for being there because without it, Romania might not exist today and we will not be able to realize our dream and become one day, navy officers.



Thank you, Black Sea, for giving the Naval Academy of Romania the chance to sail the seas of the world!

BIBLIOGRAPHY

- [1] <https://www.britannica.com/place/Black-Sea/Climate>
- [2] <http://www.encyclopediaofukraine.com/display.asp?link-path=pages%5CB%5CL%5CBlackSea.htm>
- [3] https://en.wikipedia.org/wiki/Black_Sea#Hydrology
- [4] <https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/joc.5688>
- [5] <https://www.sciencedirect.com/science/article/pii/S0012825297818594>
- [6] https://echo2.epfl.ch/VICAIRE/mod_2/chapt_2/main.htm
- [7] https://ro.wikipedia.org/wiki/Marea_Neagr%C4%83