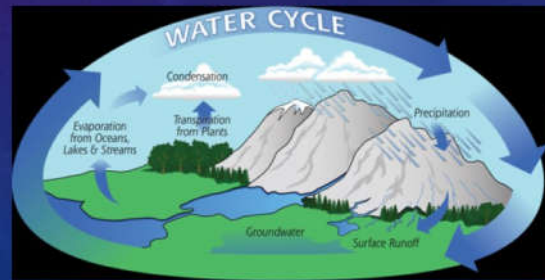


## Water on Earth

The Earth is a watery place. Several water sources exist on, in, and above our planet. About 71% of the Earth's surface is water-covered, and the oceans hold about 97.5% of all Earth's water.

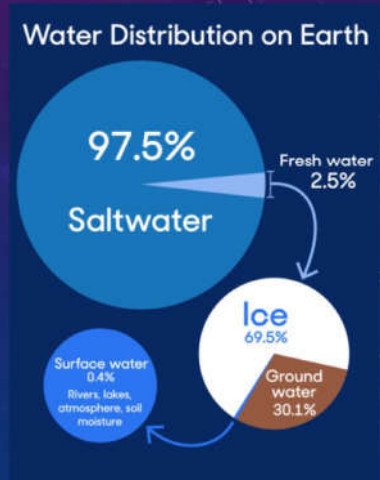
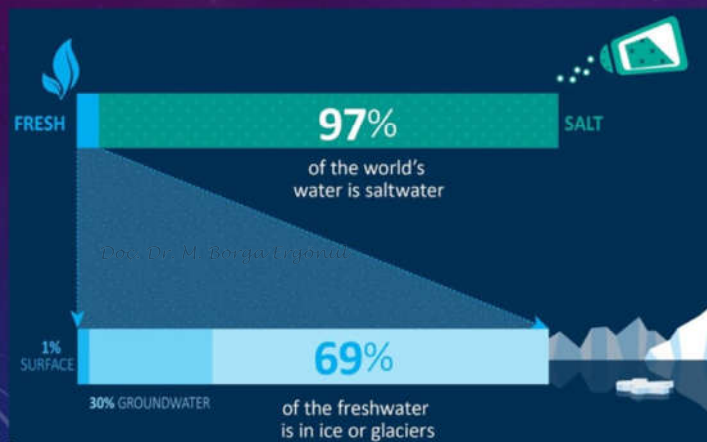
Fortunately water never ends on earth. The water cycle enables the earth to cycle the water. However, it is not possible to create more water on earth. It is limited!

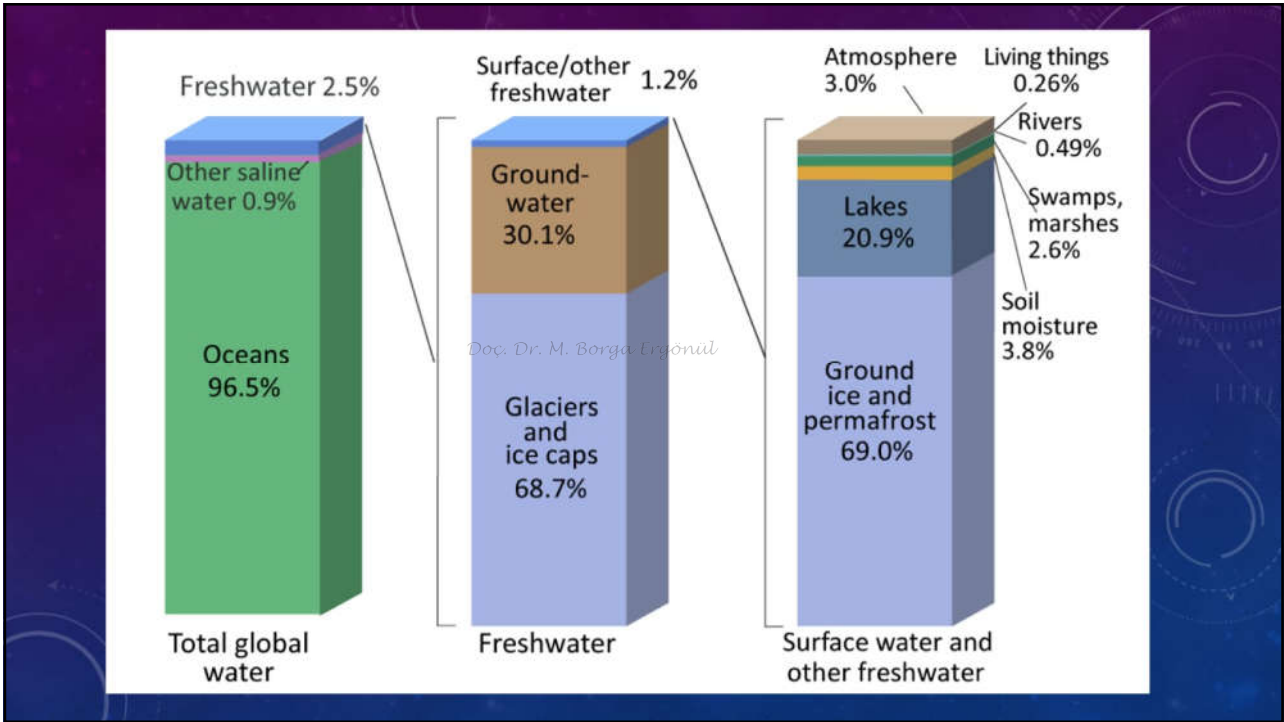
### Water Distribution on Earth



### What about fresh water sources?

We already mentioned that only the 2.5% of water on earth is freshwaters. So what is the most significant freshwater source? Lakes? Rivers? or atmospheric water vapor? or maybe freshwater stored in living organisms? soil? icecaps?





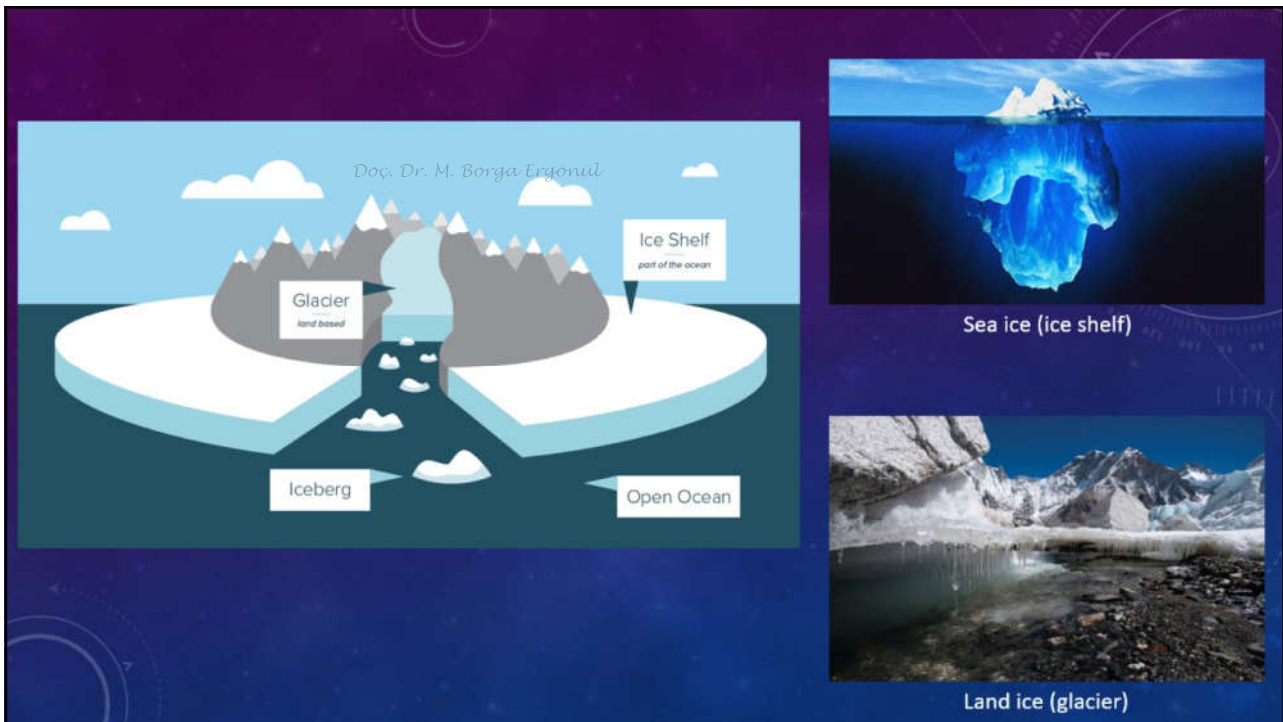
- The larger sphere represents Earth's liquid fresh water in groundwater, swamp water, rivers, and lakes. The volume of this sphere is about 10,633,450 km<sup>3</sup>. Yes, all of this water is fresh water, which we all need every day, but much of it is deep in the ground, unavailable to humans.
- The tiny bubble represents fresh water in all the lakes and rivers on the planet. Most of the water people and life on earth need every day comes from these surface-water sources. The volume of this sphere is about 93,113 km<sup>3</sup>.

The image shows a globe of Earth with two spheres of water overlaid. A large blue sphere represents all liquid fresh water, and a tiny blue bubble represents fresh water in lakes and rivers. A watermark 'Doç. Dr. M. Borge Ergönül' is visible on the globe.

**All water on, in, and above the Earth**

- Liquid fresh water
- Fresh-water lakes and rivers

Howard Perlman, USGS,  
 Jack Cook, Woods Hole Oceanographic Institution,  
 Adam Nieman  
 Data source: Igor Shikomanov  
<http://ga.water.usgs.gov/edu/earthhowmuch.html>



- ground ice: a general term referring to all types of ice contained in freezing and frozen ground
- permafrost: any type of ground—from soil to sediment to rock—that has been frozen continuously for a minimum of two years and as many as hundreds of thousands of years. It can extend down beneath the earth's surface from a few feet to more than a mile—covering entire regions, such as the Arctic tundra, or a single, isolated spot, such as a mountaintop of alpine permafrost.

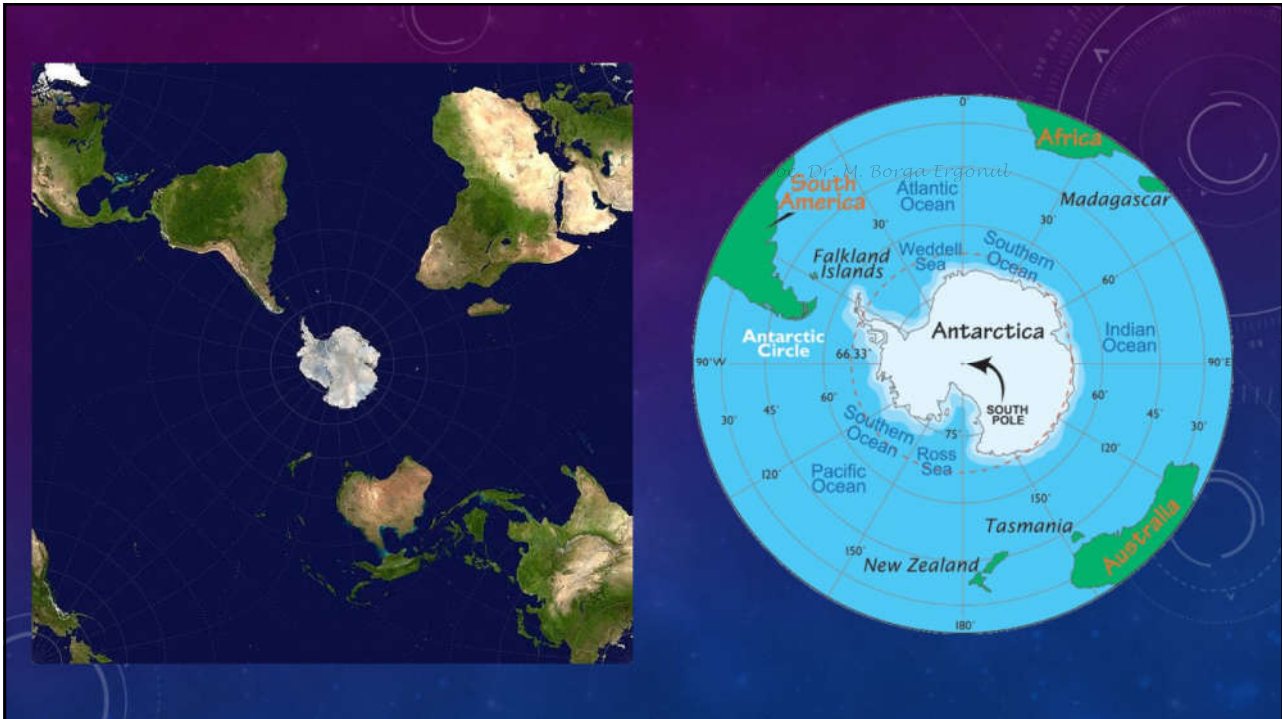


## What happens when ice sheath, glacier and permafrost thaws?

Doç. Dr. M. Borge Ergonul



The mean thickness of the Antarctic ice sheet is 2.16 km; the maximum known thickness of the ice sheet is 4776 m (Terre Adélie). Without the ice, Antarctica may be the lowest lying continent. Only about 0.4% of Antarctica is not covered by ice. Antarctic ice is melting, contributing massive amounts of water to the world's seas and causing them to rise. If all the ice covering Antarctica, Greenland, and in mountain glaciers around the world were to melt, sea level would rise about 70 meters.



Thawing of the permafrost can have dramatic impacts on our planet and the things living on it. The major outcomes might be:

- Many northern villages are built on permafrost. Permafrost is harder than concrete. However, thawing of the permafrost can destroy houses, roads and other structures.
- The plant material stored in the permafrost soil—called organic carbon—can't decompose, or rot away. As permafrost thaws, microorganisms begin decomposing this material. This process releases greenhouse gases like carbon dioxide and methane to the atmosphere.
- When permafrost thaws, so do ancient bacteria and viruses in the ice and soil. These newly-unfrozen microorganisms could lead to new diseases. Scientists have discovered microorganisms more than 15 000 years old in thawed permafrost.



The second danger might be viruses trapped in mountain glaciers. If they melt new virus-borne diseases might be observed.

**Ancient never-before-seen viruses discovered locked up in Tibetan glacier**  
 By Laura Geggel - Associate Editor January 22, 2020

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*Doç. Dr. M. Borgia Ergönül*

(Image: © Shutterstock)

For the past 15,000 years, a glacier on the northwestern Tibetan Plateau of China has hosted a party for some unusual guests: an ensemble of frozen [viruses](#), many of them unknown to modern science.

Extreme Life - Bacteria

### There are diseases hidden in ice, and they are waking up

Long-dormant bacteria and viruses, trapped in ice and permafrost for centuries, are reviving as Earth's climate warms

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By Jasmin Fox-Skelly  
4 May 2017

Throughout history, humans have existed side-by-side with bacteria and viruses. From the bubonic plague to smallpox, we have evolved to resist them, and in response they have developed new ways of infecting us.

We have had antibiotics for almost a century, ever since Alexander Fleming discovered penicillin. In response, bacteria have responded by evolving antibiotic resistance. The battle is endless: because we spend so much time with pathogens, we sometimes develop a kind of natural stalemate.

Some 2.5 million square miles of permafrost – 40 percent of the world's total – could disappear by the end of the century.

Doç. Dr. M. Borgia Ergönül

What we do know is that if the Arctic continues to warm as quickly as climatologists are predicting, an estimated 2.5 million square miles of permafrost – 40 percent of the world's total – could disappear by the end of the century, with enormous consequences. The most alarming is expected to be the release of huge stores of greenhouse gases, including methane, carbon dioxide, and nitrous oxide that have remained locked in the permafrost for ages. Pathogens will also be released.

But less well appreciated are the sweeping landscape changes that will alter tundra ecosystems, making it increasingly difficult for subsistence indigenous people, such as the Inuit, and Arctic animals to find food. The disintegration of subterranean ice that glues together the peat, clay, rocks, sand, and other inorganic minerals is now triggering landslides and slumping at alarming rates, resulting in stream flows changing, lakes suddenly draining, seashores collapsing, and water

Thawing permafrost turns Arctic from carbon sink into carbon emitter, study finds

Some 1.7 billion tonnes of carbon released by ice melt during winter – twice as high as previous estimates

Fluoride Wireless Science Correspondent | @fluorid0 | Wednesday 23 October 2019 13:43



Another danger is the alteration of arctic wildlife. Many animals adapted to live here will go extinct by the end of this century due to loss of ice sheeth...



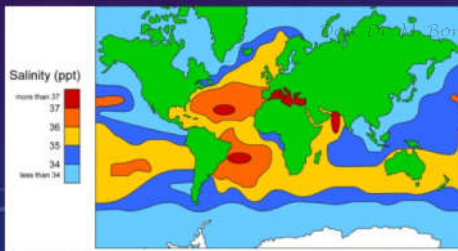
Doç. Dr. M. Borgia Ergönül



# A BRIEF LOOK INTO THE MARINE ENVIRONMENTS AND FRESHWATER ECOSYSTEMS

An ocean is a large body of saline water that composes much of a planet's hydrosphere, surrounding continents.

- Pacific
- Atlantic
- Indian
- Southern
- Arctic Ocean





An inland sea is a shallow sea that covers central areas of continents during periods of high sea level that result in marine transgressions. In other words Inland seas are landlocked seas that are only connected to the ocean through narrow channels. Marmara Sea, Baltic Sea, Black Sea and even Mediterranean Sea are inland seas.



### The Black Sea

The Black Sea is the most isolated inland sea from the World Ocean - connected to the oceans via the Mediterranean Sea through Istanbul, Canakkale (Turk Straits) and Gibraltar straits and with the Sea of Azov in the northeast through the Kerch Strait. The Black Sea has very unique features such as its very low salinity: approximately 17‰. The large rivers carrying large quantities of freshwaters to Black Sea leads to low salinity which increases in the deeper parts (~21‰).



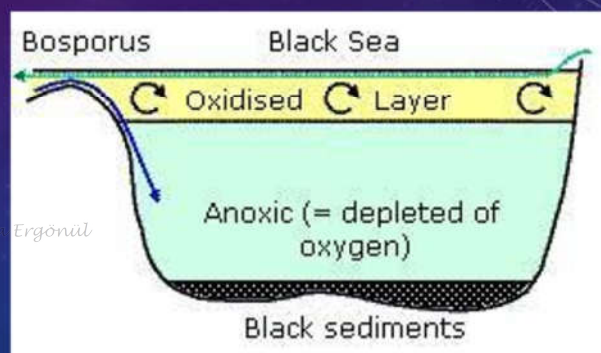
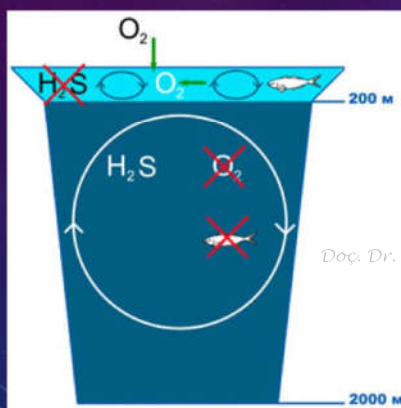
The aquatic biodiversity in the Black Sea is very low compared to other Turkish Seas. Why?

*Doç. Dr. M. Borge Ergönül*

	Mediterranean	Black Sea
Bivalve animals	358	60
Amphineurian	22	3
Gasteropods	965	58
Pteropods	26	-
Scaphopods	14	-
Cephalopods	72	-

Many of the marine organisms are not able to tolerate salinity lower than 20‰.

Another important feature observed in the Black Sea is the deep anoxic layers located deeper than 200 m. This layer is also rich in  $H_2S$  which is toxic for many organisms. Thus, due to high  $H_2S$  and low oxygen levels only certain bacteria are able to survive here. The deep and surface layers never mix in Black Sea due to the density gradients formed by temperature and salinity differences. Deeper layers are colder and more saline.



Another important feature is observed in the narrow channels located between the Black Sea and Marmara (also to the Aegean Sea) (the Bosphorus and Dardanelles). There is a continuous, bi-directional water flow between those two seas. The upper layers flow from Black Sea to the Marmara Sea and vice versa in the deeper layers. The great mass of freshwater carried by the rivers flowing into the Black Sea and the very narrow channel (the Bosphorus) leads to a small rise in the sea levels of Black Sea. This is the main reason of the flow from Black Sea to the Marmara Sea. The very narrow channel in Dardanelles and the density difference between the waters of Marmara and Black Sea creates an opposite flow from Marmara to the Black Sea.

