

EduS4EL © - Worksheet

Melting of the glaciers

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Glaciers are considered climate indicators because they react sensitively and quickly to changing climatic conditions. What developments can be observed in Europe's glaciers? Are glaciers only interesting for glaciologists and skiers?



The melting of glaciers is one of the immediately visible consequences of climate change. Even in photos taken only a few years apart, frightening changes can sometimes be seen.

According to the National Geographic¹, our planet's glaciers have lost more than 9,625 gigatonnes of ice since 1961, causing sea levels to rise by 27 millimetres. In

other words, every year, three times the amount of ice that covers the Alps melts worldwide. An environmental disaster with a clear culprit is global warming.

Glaciers react sensitively and quickly to changing climate conditions.

The effects of melting glaciers on the ecosystem are:

- Changes in hydrological systems and thus in the water supply for people and ecosystems.
- A huge increase in the amount of water is expected in winter, while at the same time the dryness increases in summer.
- Increased risk of landslides and rockfalls
- rising sea levels

¹https://www.nationalgeographic.com.es/ciencia/glaciares-han-perdido-96-billones-toneladas-hielo-50-anos_14140

Exploring the data

In the following, data on the development of glacier masses are examined. The glacier data come from the database of so-called reference glaciers of the World Glacier Monitoring Service. To be considered a reference glacier, measurement data must be available for at least 30 years. In addition, no events such as artificial snow, avalanches or protective measures may affect the condition of the glacier. Reference glaciers from North and South America were selected for the study. The data sets consist of the variables: Country, name, year, longitude, latitude, annual mass balance and cumulative mass balance. The unit of mass balance is given in metres of water equivalent (mWE) (see box).



Karte

Equivalent unit of measurement in water

Glaciologists indicate the annual mass balance, i.e. the increase or decrease in glacier mass in metres of water equivalent (m WE).

The water equivalent indicates the water content of the measured thickness changes in the ice. One metre of ice corresponds to about 0.9 metres of water equivalent.



Setzen einer Messstange auf der Gletscherzunge.
Bild: D. Vonder Mühll, Universität Zürich

The following table shows a section of the data set.

Name	Kontinent	Land		Index	Jahr	Jahresbilanz (m WE)	Kumulierte Jahresbilanz (m WE)
CARESER	Europa	IT		1	1966	0	0
ENGABREEN	Europa	NO		2	1967	-0.39	-0.39
GRIES	Europa	CH		3	1968	0.26	-0.13
HINTEREISFERNER	Europa	AT		4	1969	0	-0.13
NIGARDSBREEN	Europa	NO		5	1970	-0.63	-0.76
SARENNES	Europa	FR		6	1971	-0.65	-1.41
SILVRETTA	Europa	CH		7	1972	0.4	-1.01
STORGLACIAEREN	Europa	SE		8	1973	-1.28	-2.29
COLUMBIA (2057)	Amerika	US		9	1974	-0.32	-2.61
DEVON ICE CAP NW	Amerika	CA		10	1975	0.17	-2.44
ECHAURREN NORTE	Amerika	CL		11	1976	-0.27	-2.71

Source: World Glacier Monitoring Service, https://wgms.ch/products_ref_glaciers



For data exploration we work with the software Common Online Data Analysis Platform CODAP.



CODAP is a free educational software for data analysis. This web-based data science tool is designed as a platform for developers and an application for students in grades 6-14.

Click [here](#) to get started²

Tasks:

1. Where have you had an experience with glaciers yourself or heard about glaciers (Alpine hiking, reports about Ötzi, television)?
2. Which statements related to the context and background are not clear to you? Which unfamiliar technical terms are used?
3. Our guiding question here is: ***Is the ice mass of the glaciers decreasing over the years? What is the evidence for a temperature assumption?*** Try to come to conclusions through suitable graphical representations and statistical calculations
4. Create a graph with the year on the horizontal axis and the cumulative glacier mass on the vertical axis. For better visibility of trends, select "Connect lines" in the menu on the right of the graph under the symbol .
 - a. Why is the cumulative mass balance value at the first data point zero for all glaciers?
 - b. What differences in glacier development can you observe? Can you see any patterns?
 - c. In which periods of the year is the glacier melt particularly strong? Take the variable continent and drop it into the middle of the graph. Do the glaciers melt faster on the American or on the European continent?
5. Now view individual glaciers. To do so, click on the symbol  select "Show higher-level visibility". Now you can see the names of the individual glaciers at the top of the graphic. First click on "Hide all" and then select individual glaciers in turn by clicking on them.

<https://codap.concord.org/app/static/dg/en/cert/#shared=https%3A%2F%2Fcfm-shared.concord.org%2FHfqHnKQBcl8Ebf7iEdoq%2Ffile.json>



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- a. Which glaciers are melting particularly quickly?
 - b. Obviously, there are two glaciers whose mass over the years has been increased. In which country are these glaciers located? Is there no climate change there?
6. What are the impacts of glacier retreat (water supply, sea level, ecosystems, tourism)?