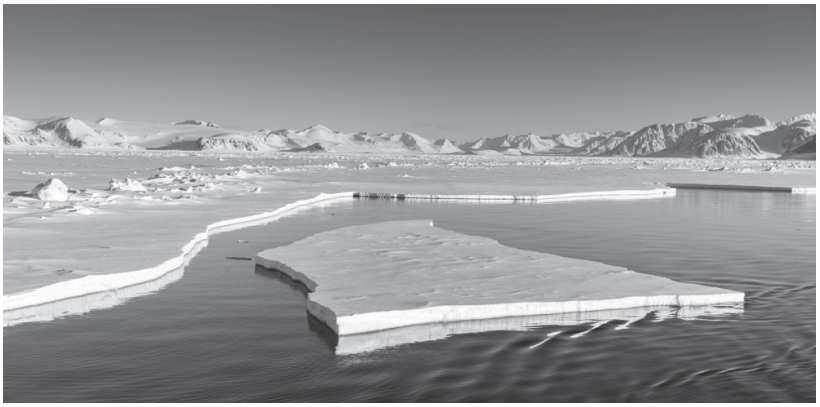
“22 ice floes for one steak”

HOW OUR ACTIONS ARE MELTING THE SEA ICE

Katharina Blaurock

The author presents the “ice floe currency”, which can be used to illustrate the climate impact of various decisions in a child-friendly way without having to resort to abstract CO_2 equivalents.



© Risto Raunio/Shutterstock

Ill. 1: The loss of sea ice not only threatens an entire ecosystem, but also increases the warming of the Arctic, as existing ice reflects a lot of heat

Climate change is complex. It is so complex, in fact, that thousands of new scientific articles are published on the subject every year. Scientists agree on the main points: climate change is real. Climate change is man-made. Climate change is dangerous. And: We can still do something. So it is up to us to act as quickly as possible to reduce greenhouse gas emissions. To do this, however, we need to understand what causes greenhouse gas emissions and how much we can influence them through our decisions. A concrete visualisation would help children and younger teenagers in particular to imagine how much each decision contributes to the climate crisis. For this purpose, an “ice floe currency” has been developed. But what is it?

SITUATION

Life on Earth is only possible because of the natural greenhouse effect. Various gases in the atmosphere (mainly water vapour) ensure that the heat brought in by the sun’s rays is not completely radiated back into space. Without the natural greenhouse effect, the average temperature on Earth would be –18° Celsius. However, we are intensifying the greenhouse effect by releasing more and more greenhouse gases into the atmosphere. These trap more and more heat – like the glass of a greenhouse. Many different greenhouse gases contribute to the man-made greenhouse effect to varying degrees. Around 75% of the greenhouse gases caused by humans worldwide are carbon dioxide (CO_2), 18% are methane (CH_4) and 4% are nitrous oxides (N_2O) (IPCC, 2021). The rest are mainly fluorinated gases (F-gases). However, all these gases contribute to climate change to varying degrees. Methane, for example, remains in the atmosphere for a very short time (about 12 years), but has about 28 times the warming effect of CO_2 over 100 years. For this reason, CO_2 equivalents (CO_2-eq) are often used to compare the greenhouse gas emissions of different products or activities. This scientific unit includes the weighted climate impact of all greenhouse gases produced, regardless of whether more CO_2, more methane or other greenhouse gases are produced.

CO_2-eqs are a good scientific method for visualising and comparing greenhouse gas emissions. But they are very abstract. A study from 2016 shows for the first time how greenhouse gas emissions – and therefore our actions – can be directly translated into the loss of sea ice in the Arctic. Researchers have calculated that the emission of one tonne of CO_2-eq leads to the loss of about 3 m^2 of sea ice (Notz & Stroeve, 2016). One tonne of CO_2-eq is roughly equivalent to an outward and return flight from Frankfurt to Ankara in Turkey.[1] The scientists based their calculations on the sea ice extent in September, the month with the smallest ice extent. A further study from 2020 specifies the figure to 2.7 m^2 using a new mathematical model (Notz & SIMIP, 2020). Due to the link between man-made greenhouse gas emissions and sea ice loss, it was also calculated that the Arctic will be completely ice-free in September for the first time before 2050. According to a study from 2023, this will become the norm in the future, even if we manage to significantly reduce greenhouse gas emissions (Kim et al., 2023).

	Greenhouse gas emissions (kg CO_2-eq)	Sea ice loss in m^2	Number of ice floes	Source
Means of transport				
5 km bike ride	0.08	0.0002	0.2	European Cyclists' Federation (2011), Climpact (2024)[3]
5 km car journey (medium-sized, combustion engine)	1.40	0.0038	3.8	Bieker (2021), Climpact (2024)[3]
5 km car journey (medium-sized, electric)	0.53	0.0014	1.4	Bieker (2021), Climpact (2024)[3]
5 km train journey (in Europe)	0.13	0.0003	0.3	Bieler & Sutter (2021), Climpact (2024)[3]
Outbound flight Frankfurt–Ankara	504.00	1.3608	1360.8	Atmosfair (2024)[4]
Outbound flight London–New York	1065.00	2.8755	2875.5	Atmosfair (2024)[4]
Groceries				
300 g beans	0.19	0.0005	0.5	European Cyclists' Federation (2011), Climpact (2024)[3]
300 g lentils	0.31	0.0008	0.8	Clune et al. (2017), Climpact (2024)[3]
300 g chicken	2.02	0.0054	5.4	Clune et al. (2017), Climpact (2024)[3]
300 g pork	2.08	0.0056	5.6	Clune et al. (2017), Climpact (2024)[3]
300 g beef	8.09	0.0218	21.8	Clune et al. (2017), Climpact (2024)[3]
100 g milk chocolate	0.41	0.0011	1.1	Bianchi et al. (2021)
Other				
Smartphone	104.70	0.2827	282.7	Belkir & Elmeligi (2018)
Single-use plastic bag (HDPE)	9.32	0.0252	25.2	Civancik-Uslu et al. (2019)
Single-use paper bag (recycled)	29.50	0.0797	79.7	Civancik-Uslu et al. (2019)
20x reusable plastic bag (PP)	24.20	0.0653	65.3	Civancik-Uslu et al. (2019)

Ill. 2: Examples of the conversion of greenhouse gas emissions (kg CO_2-eq) into sea ice loss (m^2) and number of ice floes[2]

The loss of sea ice not only threatens an entire ecosystem, but also exacerbates the warming of the Arctic, because existing ice reflects a lot of heat (Ill. 1). An ice-free Arctic is also of geopolitical interest, as it would open up new shipping routes and access to natural resources.

Man-made greenhouse gas emissions are now contributing to the loss of Arctic Sea ice tonne by tonne. This fact can be used to convert the emissions of different activities directly into sea ice loss. This is because we now know the average emissions caused by different products, means of transport and activities. And sea ice loss is a real and visible consequence of climate change and therefore more tangible than figures for invisible gases.

THE "ICE FLOE CURRENCY"

Especially for children and teenagers (but probably not only for them), the figures in CO_2-eq are too abstract to be helpful in everyday decisions. However, they can be visualised with the help of scientific evidence. As part of the project "For Us – No Planet B!", we have used the link between man-made greenhouse gas emissions and sea ice loss to illustrate the climate impact of various decisions without having to resort to the abstract CO_2-eq. Instead, we translated them into an "ice floe currency".

To stick with the example of the return flight from Frankfurt to Ankara: These flights are responsible for about one tonne of CO_2-eq, which is the equivalent to 2.7 m^2 less sea ice in the Arctic. To visualise the melted sea ice, we have translated the m^2 into ice floes.

We decided to use a factor of 1,000, because this resulted in a meaningful number of ice floes that can be easily visualised. A sea ice loss of 0.001 m^2 thus corresponds to one visualised ice floe. The flight from Frankfurt to Ankara and return is therefore equivalent to just over 2,700 ice floes.

The new currency can now be applied to any CO_2-eq value. A 5-kilometre bike ride is equivalent to 0.2 ice floes and a 5-kilometre car journey can be represented by 4 ice floes. In the area of nutrition, the ice floe currency can help to illustrate the impact of different foods on the greenhouse effect. If you compare different protein sources with each other, the ice floe currency clearly illustrates the differences in climate impact.

For example, 300 g of beans is equivalent to half an ice floe, 300 g of chicken is equivalent to 5 ice floes and 300 g of beef is equivalent to 22 ice floes (Ill. 2). The climate impact of technical products can also be visualised in this way. The greenhouse gas emissions from a smartphone that is used for 3 years are equivalent to around 280 ice floes.

The use of the ice floe currency avoids the need for complicated CO_2-eq values and provides a child-friendly way of illustrating the differences in climate impact of different products. Nevertheless, the ice floe currency is a simplification. It is not directly the greenhouse gases emitted by a particular action that cause the ice in the Arctic to melt. Rather, it is a complex interplay of the climate impacts of many emitted greenhouse gases with different climate effects and different residence times in the atmosphere as well as other effects that influence the formation or melting of sea ice. The use of the ice floe currency also focuses on the responsibility of individuals according to the motto "If you eat one less steak, less ice melts". Although we all influence the greenhouse effect with our decisions, it is at least as important that political decisions are taken to rapidly limit greenhouse gas emissions. But we can also contribute to this by using the ice floe currency which shows us where the major opportunities for reducing emissions lie.

USE OF THE ICE FLOE CURRENCY

The purpose of the ice floe currency is to be disseminated and further developed. It can be used to represent a wide range of greenhouse gas emissions in ice floes. The corresponding CO_2-eq values can be found in scientific literature or databases. Depending on the topic, it may be more or less difficult to find the correct data. Some CO_2-eq values are shown in Ill 2. It is important to note that many factors are usually included in the calculation of CO_2-eq values and therefore they may vary depending on the source. For example, when travelling by car, the size of the vehicle, the fuel used, the number of people travelling, etc. all play a role. It is therefore advisable to compare several sources in order to use plausible values as a data base. The greenhouse gas emissions (kg or t CO_2-eq) can then be translated into sea ice loss (m^2) and finally into ice floes, whereby the conversion factor for ice floes can be adjusted as needed, depending on the range of the m^2 values. The ice floe currency helps children and young people understand the connections between our actions and our impact on the climate through images.

NOTES

[1] *Atmosfair (2024). https://www.atmosfair.de/de/kompensieren/flug/, Hin-/Rückflug FRA-ANK, Economy, Linie [5.3.24]*

[2] *The conversion factor from greenhouse gas emissions (converted to tonnes of CO_2-eq) to sea ice loss is 2.7 based on Notz & SIMIP (2020). The conversion factor from sea ice loss to number of ice floes is 1,000 and can be adjusted as required. Average values were used when several sources were cited.*

[3] *Climpact (2024). Data base "actions.xlsx". Available at: https://climpact.ch/about [5.3.24]*

[4] *Atmosfair (2024). https://www.atmosfair.de/de/kompensieren/flug/ [5.3.24]*

REFERENCES

Belkir, Lofti & Elmeligi, Ahmed (2018). Assessing ICT global emissions footprint: Trends to 2040 & recommendations. Journal of Cleaner Production, 177, *448-463.*

Bianchi, Fiammetta, Moreschi, Luca, Gallo, Michaela et al. (2021). Environmental analysis along the supply chain of dark, milk and white chocolate: a life cycle comparison. The International Journal of Life Cycle Assessment 26*(4), 1-15.*

Bieker, Georg (2021). A global comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars. International Council on Clean Transportation (ICCT). *Available at: https://theicct.org/publication/a-global-comparison-of-the-life-cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/ [5.3.24]*

Bieler Cuno & Sutter, Daniel (2021). Ökologischer Verkehrsträgervergleich auf ausgewählten Relationen. *INFRAS. Available at: https://www.tgv-lyria.com/sites/default/files/inline-files/Verkehrstr%C3%A4gervergleich_TGVLyria_DEF%2017.Juni%2021.pdf [5.3.24]*

Civancik-Uslu, Didem, Puig, Rita, Hauschild, Michael et al. (2019). Life cycle assessment of carrier bags and development of a littering indicator. Science of The Total Environment, 85, *621-630.*

Clune, Stephen, Crossin, Enda & Verghese, Karli (2017). Systematic review of greenhouse gas emissions for different fresh food categories. Journal of Cleaner Production, 140, 766-783.

European Cyclists' Federation (2011). Cycle more often 2 cool down the planet: Quantifying CO_2 savings of cycling. *Available at: https://ecf.com/groups/cycle-more-often-2-cool-down-planet-quantifying-co2-savings-cycling [5.3.24]*

IPCC (2021). Climate Change 2021: The physical science basis. *Contribution of working group I to the 6th Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.*

Kim, Yeon-Hee, Min, Seung-Ki, Gillett, Nathan et al. (2023). Observationally-constrained projections of an ice-free Arctic even under a low emission scenario. Nature Communications, 14*(1), 3139.*

Notz, Dirk & Stroeve, Julienne (2016). Observed Arctic sea-ice loss directly follows anthropogenic CO_2 emission. Science, 354, *747-750.*

Notz, Dirk & SIMIP Community (2020). Arctic sea ice in CMIP6. Geophysical Research Letters, 47, *e2019GL086749.*

THE AUTHOR

Dr. Katharina Blaurock is an environmental scientist and currently project manager at the Sustainability Office of the University of Basel/ Switzerland.