

## AMOC collapse - what you need to know

### The headline: new research shows high risk of dangerous climate tipping point

New research<sup>1</sup> has shown that the ocean circulation system which maintains Atlantic weather systems, including our mild climate here in the UK, is very likely to stop functioning, either in the lifetimes of people alive today, or in the lifetimes of their children or grandchildren.

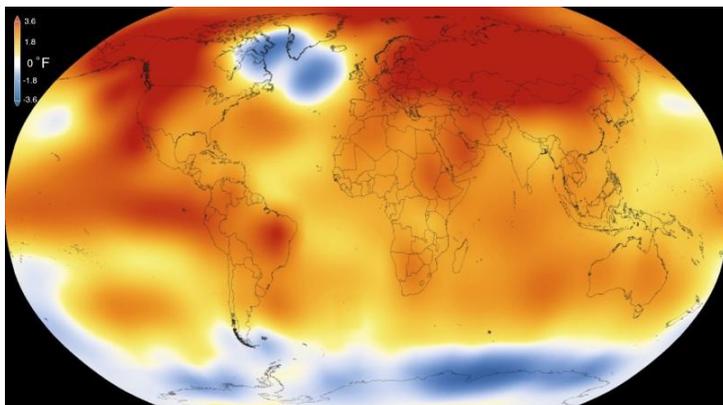
Previously, collapse of the AMOC (Atlantic Meridional Overturning Circulation) was considered unlikely to happen any time soon. However, a recent study which looked at climate models over a longer timeframe (beyond 2100) found that the tipping point which would make future collapse inevitable is likely to occur in the next few decades. Cutting our emissions can reduce but not eliminate this risk. **The consequences of AMOC shutdown can best be described as 'cataclysmic'.**

### What is the AMOC?

The Atlantic Meridional Overturning Circulation (AMOC) is an important part of the global climate system. A current of warm surface water running from the tropics to Europe and the Arctic brings a vast amount of heat energy north (equivalent to fifty times the energy used by all of humanity). The water then gives this energy up to the cold air and the cooled water sinks to form a deep return current. The effect this system has on our climate here in north western Europe is demonstrated by comparing London to Calgary, Alberta, which is on a similar latitude. In Calgary, temperatures in winter are almost constantly below freezing, and air temperature drops to or below -20C for 22 days in winter on average.

### What impact have our emissions already had on the AMOC?

Melting ice sheets and higher rainfall caused by global warming have diluted seawater in the North Atlantic, making the water less salty. Less salty water is less dense therefore sinks less easily, creating a blockage which slows down the entire circulation system. This can be seen through a persistent 'cold blob' of abnormally cool temperatures in the North Atlantic, visible in the map below showing global temperature anomalies in 2015 (NASA). As ocean surface temperatures everywhere else in the world are rising due to global warming, this indicates a slowing down of the system that brings warm water to the area.



## **Why would the AMOC shut down altogether?**

Cooling water in the North Atlantic becoming less salty and slower to sink makes the whole AMOC slow down. Since water in the tropics is more saline because of evaporation, the AMOC brings water northwards which is not just warmer, but more salty. So the AMOC slowing down further reduces water salinity in the North Atlantic - a reinforcing feedback loop which at a certain point, would cause the AMOC to pass a tipping point and collapse altogether.

## **Have we seen this happen before in the Earth's history?**

Paleoclimatologists studying ancient climates have found some of the most abrupt and sudden temperature changes in the past have been caused by AMOC instability. This caused alarm about possible future AMOC collapse.

## **When might the AMOC shut down?**

The recently published research<sup>1</sup> found that if we don't reduce global emissions significantly, **the tipping point which makes an AMOC shutdown inevitable is likely to be passed within a few decades.** The collapse itself may not happen until 50 to 100 years later. **In this high emissions scenario, the study found a 70% risk of AMOC collapse.** Even for intermediate and low emissions scenarios the study predicted an alarmingly high risk of collapse (37% and 25% respectively). There is uncertainty in the modelling, and we also don't know how severe the impacts of a slowing AMOC might be before complete collapse occurs. What is clear is that higher levels of global emissions increase this risk.

## **What would Europe look like in future after an AMOC shutdown?**

If the AMOC shuts down, Europe's future climate will be colder and drier. But what it looks like depends on how severe overall global heating is - in other words whether we manage to rapidly reduce greenhouse gas emissions or whether fossil fuel burning continues at high levels in the coming decades. A [recent research paper](#)<sup>2</sup> modelled what the European climate could look like 200 years after AMOC had 'strongly reduced'. Researchers modelled two different scenarios: one in which this takes place against a background of 2C global warming (a hotter world than today with more extreme weather disasters and serious damage to ecosystems) and another higher emissions 4C scenario (a much more dangerous world with widespread extreme heatwaves, drought, flooding and sea level rise).

In the 2C scenario, AMOC shutdown would cause 'ice age' winters in north-west Europe, with models showing **Arctic sea ice extending to the coast of Scotland and eastern England.** There would be increased winter storms due to a greater temperature contrast between northern Europe and southern Europe. Summer temperatures would be less dramatically affected, being cooler than today, but with greater fluctuations of temperature and heatwaves still possible.

Under the 4C scenario there would be no extreme winters or sea ice expansion. Northern Europe would be expected to see warming below the global average, with more instability including increased storms caused by a greater temperature difference between northern and southern Europe, and other dramatic shifts in weather systems caused by extreme global heating.

As well as affecting temperature, AMOC collapse would also significantly reduce rainfall, which according to an [earlier study](#)<sup>3</sup> would be the most damaging impact on agriculture, **reducing the proportion of Britain's land area suitable for arable farming from 32% to just 7%**. The direct impacts on the UK's infrastructure and capacity to grow food would of course be multiplied by global effects of AMOC shutdown.

### **How would AMOC collapse affect the rest of the world?**

There are huge uncertainties here as well, but with the northern hemisphere cooling relative to the southern hemisphere warms, areas of high rainfall would be likely to shift south, weakening of the African and Asian monsoons, with consequent drought in West Africa and South Asia, and strengthening Southern Hemisphere monsoon rains. [Research](#)<sup>4</sup> commissioned by the OECD found that a collapse of the AMOC with 2.5C warming would pose a critical threat to global food security, and **reduce the amount of land available worldwide for growing wheat and maize by more than half**.

There are many complex ways in which AMOC collapse could interact with other systems and tipping points as global temperatures rise, for example the impacts of a warming southern hemisphere on Antarctic ice sheets or of a cooling northern hemisphere on the Greenland ice sheets, of changed rainfall and temperature on the Amazon rainforest and boreal forests and on many other systems. We are essentially conducting a giant experiment with our planet where we are unsure what feedback loops may be triggered and how fast.

### **A full AMOC collapse would be a massive, planetary-scale disaster. Why isn't this talked about more?**

One reason is scientific. For various reasons, the standard climate models used in IPCC reports tend to [overestimate AMOC stability](#).<sup>5</sup> When we observe what is happening in the real world, we can see, as shown above, a 'cold blob' already developing in the North Atlantic. However, the climate models which are generally used don't show this developing until higher levels of warming. Scientists have issued urgent warnings about the consequences of global warming, but until recently have not understood how imminent this particular risk may be.

Another is psychological. Most of us are understandably reluctant to engage with climate tipping points and future scenarios which are less optimistic, but perhaps more realistic given our current trajectory. Thinking about this is frightening.

And the final reason is political. Wider awareness of the dangers of climate tipping points will increase the pressure for urgent action. Despite decades of scientific warnings about climate breakdown, we still see around the world new fossil fuel infrastructure and oil exploration, airport expansion, deforestation and more. Those invested in these rather than in alternatives like renewable energy have a strong incentive to downplay climate risks. Arguing for rapid action to cut emissions is, more often than not, portrayed as radical. But if we look beyond this decade or the next, then continuing 'business as usual' is clearly a reckless gamble.

### **What should we do?**

Major climate risks, like AMOC slowing or complete collapse, need to be taken as seriously by governments as other risks to our economy and national security such as war, pandemics or terrorism - and arguably much more seriously because of its irreversible nature.

For the AMOC and other climate tipping points, **the only action we can take to minimise the risk is to phase out fossil fuel use and stop deforestation as fast as possible.** This would of course also reduce other climate impacts such as heatwaves, floods, droughts, wildfires and sea level rise, which in themselves stand to cause increasing human suffering, economic damage and ecological devastation.

### **References**

1. Drijfhout et al. (2025) reported (with link to original paper) in the Guardian: “Collapse of critical Atlantic current is no longer low-likelihood, study finds” [rb.gy/8v81yf](https://www.rb.gy/8v81yf)
2. van Westen and Baatsen (2025) reported (with link to original paper) by Carbon Brief: “Ocean current ‘collapse’ could trigger ‘profound cooling’ in northern Europe – even with global warming” [tinyurl.com/3ejtahsb](https://tinyurl.com/3ejtahsb)
3. Ritchie et al. (2020) reported by Exeter University “Atlantic circulation collapse could cut British crop farming” [tinyurl.com/842ye7yk](https://tinyurl.com/842ye7yk) Original article (paywalled) at [tinyurl.com/36wumavu](https://tinyurl.com/36wumavu)
4. OECD (2021) “Managing Climate Risks, Facing up to Losses and Damages” [tinyurl.com/yh9624d8](https://tinyurl.com/yh9624d8) p153
5. Blog post by Prof. Stefan Rahmstorf, July 2023: “What is happening in the Atlantic Ocean to the AMOC?” [tinyurl.com/3d5e7k3v](https://tinyurl.com/3d5e7k3v)

Links to further reading at [campaigncc.org/amoc](https://campaigncc.org/amoc)