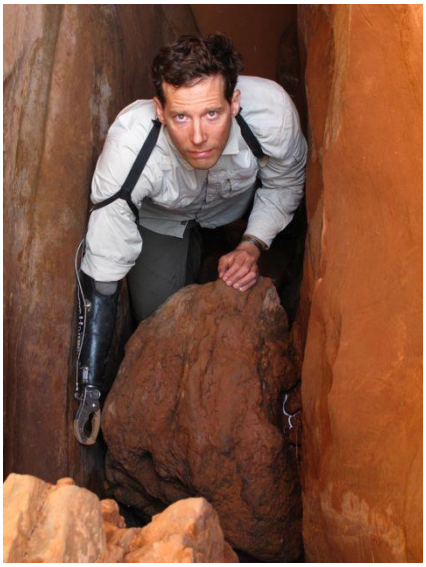
ANNEX 1: JIGSAW

JIGSAW PIECE 1: Metaphors

1

Between Rock and a Hard place: Facing the truth of global heating

Aron Ralston was out exploring in the Bluejohn Canyon in Utah in 2003 when he fell down a crevasse, just ahead of a large boulder that then literally trapped him “Between a Rock and a Hard Place” (2004). With only two burritos, 350ml of water and a blunt knife he quickly understood that there was no way that he could move the rock that crushed his lower right arm against the canyon wall. After being trapped for 5 days, he had to drink his urine and, expecting the worst, he carved his name, the date, and final messages to his family onto the sandstone wall right next to him. However, after waking up on the sixth day, he realised there was a chance that he could survive. His decomposing arm could be broken, and he could cut through the tendons and everything else with his blunt knife.



It was a simple choice. Either he was going to die there with both of his arms remaining attached to his body – or he was going to survive, but without his lower right arm. Leaving the main arteries until last, he did the self-surgery in about an hour and then, after 10km of hiking during which he lost around 25% of his blood, he found a Dutch family on vacation who gave him food, drink and everything else he needed. The extraordinary details can be seen in the movie “127 hours”.

The law of gravity which pinned the 360kg rock onto Aron Ralston’s arm is just as stubborn as the laws of physics and chemistry that determine the atmosphere and the climate. Denial does not change the situation, neither does bargaining. Either we do immediate and major surgery to the infrastructure of our societies — with unprecedented levels of focus and

investments, or we will push the climate system into a violent and unbalanced state.

2 Chasing Cheese: Running out of time

Every year, for about 600 years, many human beings gather at a small hill near Gloucester (UK) and roll a 3-4kg round block of cheese down a hill and chase it.

It is a lot of fun for those who watch. It is a lot of fun for those who chase the cheese - as long as they don't fracture their arm, dislocate a shoulder, or break their neck. Sometimes fun things can have unintended negative consequences.

Of course, if we take a sober step back from this event, we might just conclude that the people chasing the cheese are just a bit crazy or stupid. Like, really, is it worth it?

Yet, we should not laugh too loudly. The image of these people running after a bit of cheese is not unlike what we are doing when we have an economy that is so enthusiastic about acquiring products. We could call this kind of economy "**extractivist**" – because it needs us to dig up raw materials such as fossil fuels and limited minerals from the crust of the Earth to do it.

All this running around causes greenhouse gas emissions. So it is a weird truth about climate change that so many beautifully good things, fun things, happy things, have a climate change shadow to them. Every movement and gesture, every act and gift – even if they are deeply loving, carry with them a carbon cost.

3 In the velodrome

Indoor track cycling. What a sport. The Olympian demands that the athletes push themselves through on the track are astonishing. Any win in such an event takes a cyclist to the limits of what a human being can exert and endure. It is also a sport that has witnessed some truly memorable crashes, especially in the team events.

Thankfully, such carnage is not that common. The cyclists are able to sustain speeds of over 80kmh whilst jockeying to gain small pockets of slipstream with incredible skill and concentration. However, when a crash does happen, the fine margins that the athletes trade in whilst hurtling around the track, look awfully thin.

A pile-up often starts with a tiny wobble or a small miscalculation. However, because there is so much kinetic energy packed into a compact space, the effects of these small moments of imbalance have major consequences. One rider can trigger **a chain reaction** that can send numerous bikes and bodies flying into the air.

The peloton will always stretch and compress at different times in the race as the riders play out their individual tactics in a reaction to the movements of the group. No two races are the same, but there is a common **predictable pattern** of ebb and flow that plays out, with a certain amount of elasticity.

However, this predictability flies out of the window when a crash happens. One rider can be following his game plan, feeling in a strong position to win the race, and setting themselves up to make a move off the end of a bend when their back wheel suddenly gets hit by another bike. The chain reaction through the peloton will shred the race script, and it will just come down to luck if a rider survives the wreckage. The moment that the rider loses balance can be understood as **a tipping point**.

*Extract, edited for JRS from “The Climate Academy Student Guide (2022)” ©

CLIMATE ACADEMY

JIGSAW PIECE 2: Carbon budget and Tipping points

1 The Carbon Budget

"How many more gigatonnes of carbon can be emitted before we commit ourselves to a 1.5°C or 2°C rise?"

We produce about 42 gigatonnes of CO_2 emissions every year that go directly into the atmosphere. A gigatonne is a billion tonnes – so that it is the same as throwing 6 billion African elephants into the air (who are made entirely out of CO_2, if that were possible). This would not be a problem, but the laws of physics and chemistry inform us that this CO_2 makes the planet hotter – and that destabilizes everything.

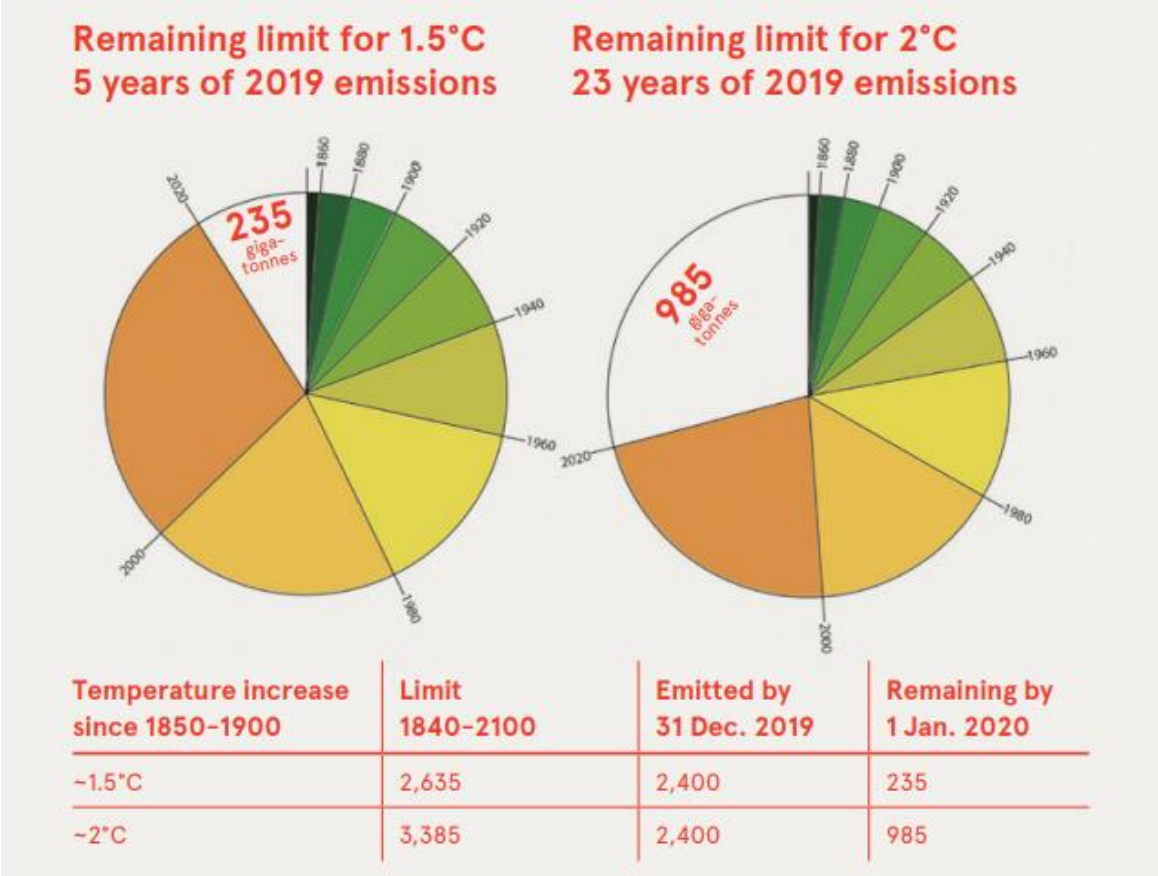
Here are a few scattered examples, from the very small, to the very big:

- The reassuring email message sent by a friend who is concerned about how you are coping with a highly pressurised day at work (**0.014 grammes of CO_2e**) and follows up later in the day with an email (**4gCO_2e**) but forgets to attach a lovely picture of a sunset (**50gCO_2e**).
- A birthday gift to a nephew: a pair of shoes, **11.5kg CO_2e**
- A £500 new Welsh gold necklace **22kg gCO_2e**
- A wedding anniversary night celebrated in an average B'n'B, including meals and drinks: **25kgCO_2e**
- A London-Glasgow return trip to attend COP26
    - By bike: **53kgCO_2e** (if you eat bananas for energy)
    - By coach: **63kgCO_2e**
    - By plane: **500kgCO_2e**
    - By large 4wD car**: 1100kgCO_2e**
- A mobile phone, used for one hour a day, per year: **1250kgCO_2e**
- The birth of a child (life expectancy 79 years, living an average UK life): **373 tonnesCO_2e**.
- The World Cup (South Africa, 2010): **2.8 million tonnesCO_2e**
- The world's data centres: **c250 million tonnes CO_2e**

*(From **"How Bad are Bananas? – The carbon cost of everything"** (2010) by Mike Berners-Lee)*

Scientists know how much CO_2 (and other greenhouse gases) we can put into the atmosphere before things get really serious, and we are in danger of breaking a neck. This is known as **The Carbon Budget**. For 1.5°C it is about 200 gigatonnes and for 2°C it is about 750 gigatonnes (these numbers were true in June 2022). The further we go beyond these limits of the budget, the further we go into a minefield of tipping points.

Therefore, if we are producing an average of 42 gigatonnes per year as a global population – that means that we will have committed ourselves to a 1.5°C temperature rise in about 5 years from now.



Temperature increase since 1850-1900	Limit 1840-2100	Emitted by 31 Dec. 2019	Remaining by 1 Jan. 2020
~1.5°C	2,635	2,400	235
~2°C	3,385	2,400	985

If we take the Paris Agreement at face value, and assume that all of the nations of the world actually want to limit climate change to well below 2°C, then this carbon budget would be the starting point and the end point of the

commitments and the negotiations that follow. The fact that this simple budget does not define either the political or public debate about tackling climate change indicates that we are not yet really serious about the crisis.

2 Tipping points

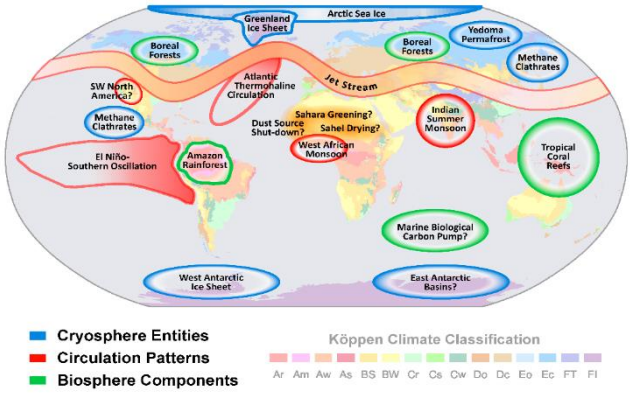
A tipping point is critical moment in a situation or system beyond which a major, often unstoppable change takes place.

Here you can see a graphic of the major cogs that determine life on planet Earth. They all exist and change in an interconnected balance with each other. It could be called the 'meta' map of natural world. These cogs can be classified into groups. At the broadest scale, there are three.

The planetary systems that relate to ice, such as the permafrost areas in the polar north and the massive ice sheets in the polar south, are known to science as the Cryosphere (the 'ice-sphere'). There are also major biological systems: with components such as the vast Boreal Forests, Amazon Rainforest and tropical coral reefs. And there are energy flows like the Jet Stream.

Put all these components together into a map, and the major **controlling hubs of life on Earth** become clear. These blocks of energy, these flows and patterns are what determine everything else that goes on. These are the underlying cogs that have been locked in place with each other, in a settled equilibrium and pattern, for thousands of years.

When many people think about climate change, they think about storms and floods... individual weather events. These are of course very serious and destructive. However, the reason why climate change is talked about in such strong language by people who understand it, is because **what is *truly* dangerous is the collapse of the whole system** after a tipping point.



*Extract, edited for JRS from "The Climate Academy Student Guide (2022)" ©

JIGSAW PIECE 3: Climatic migrations

1 A few important definitions before we start:

Refugees are people fleeing conflict or persecution. Refugees are by definition outside of their own country. They have crossed at least one international border. Refugees are forcibly displaced. This means they had no choice but to leave, otherwise they would continue to be exposed to danger. International law says that refugees cannot be sent back to their own country if this puts them at risk of war, violence, or persecution. They have a right to remain in the host country.

Migrants have moved to another country because of other reasons than war, violence, or persecution. They have crossed at least one international border. Migrants could in principle return to their own countries without being in immediate danger. However, they may have very good reasons to leave, such as poverty or famine. Most States and some regional organizations regulate movements of migrants under their own migration laws.

Internally displaced people have moved from their homes because they were in danger as a result of war, violence or persecution. Like refugees, this means they had no choice but to leave, otherwise they would continue to be exposed to danger. Internally displaced people (also called 'IDPs') are by definition still inside their own country. Internally displaced people stay within their own country and remain under the protection and laws of their country's government even if that government is the reason for their displacement, for example because the government is persecuting certain groups in the country.

Conflict, violence, and disasters triggered **38 million internal displacements** across 141 countries and territories in 2021, the second highest annual figure in a decade after 2020's record-breaking year for disaster displacement. From these 38 million internal displacements, 14.4 million are caused by conflict and violence and 23.7 million by disasters.

From Internal Displacement Monitoring Centre https://www.internal-displacement.org/global-report/grid2022/

What about **climate refugees, environmental or climate migrants or persons displaced in the context of disasters and climate change?**

There are a great number of different definitions of the term "climate refugee". However, it is worth noting that there is no official definition. Neither the United Nations or any international agency that works with refugees or on climate change recognises any particular definition. As a result, climate displaced persons are often stuck in legal limbo because they are not protected under international refugee law.

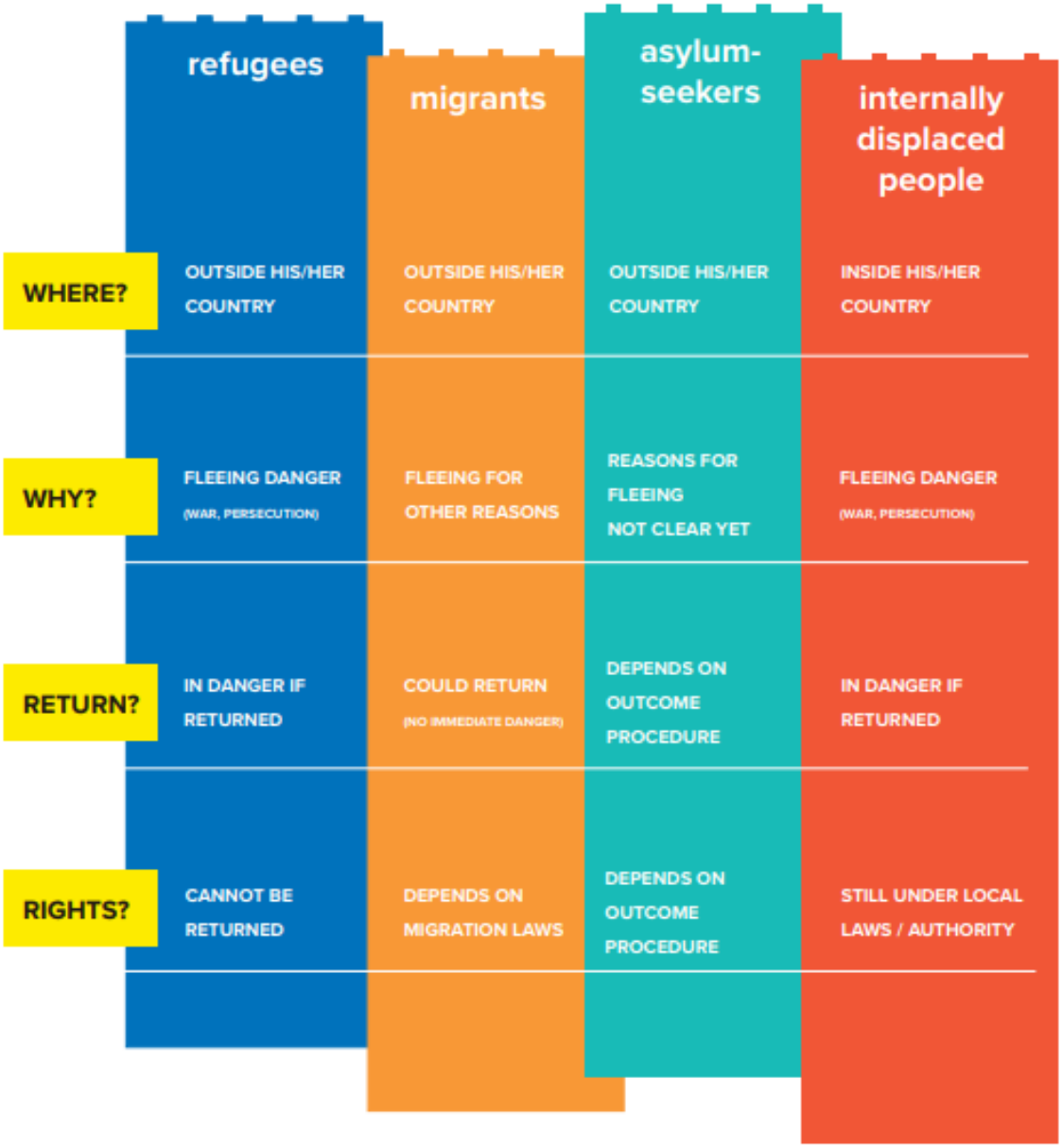
The Environmental Justice Foundation proposes the following definition

Persons or groups of persons who, for reasons of sudden or progressive climate-related change in the environment that adversely affects their lives or living conditions, are obliged to leave their homes either temporarily or permanently, and who move either within their country or abroad.

To go further What should we call people who migrate because of climate-related reasons? - YouTube

NOTE TO TEACHERS

It is important to state that environmental and climate issues have caused displacement for thousands of years – famine caused by drought or disease/pests for instance. But as climate crisis hits these events become much more common and more severe. For example, famine in horn of Africa rapidly approaching following 4 consecutive failed rainy seasons. These also overlap more and more with other displacements which might be considered 'conflict' displacements – e.g., conflicts over resources in the horn of Africa, and conflict in turn worsening the effects of environmental crisis by destroying crops, blocking aid, etc.


refugees
migrants
asylum-seekers
internally displaced people
WHERE?
OUTSIDE HIS/HER COUNTRY
OUTSIDE HIS/HER COUNTRY
OUTSIDE HIS/HER COUNTRY
INSIDE HIS/HER COUNTRY
WHY?
FLEEING DANGER (WAR, PERSECUTION)
FLEEING FOR OTHER REASONS
REASONS FOR FLEEING NOT CLEAR YET
FLEEING DANGER (WAR, PERSECUTION)
RETURN?
IN DANGER IF RETURNED
COULD RETURN (NO IMMEDIATE DANGER)
DEPENDS ON OUTCOME PROCEDURE
IN DANGER IF RETURNED
RIGHTS?
CANNOT BE RETURNED
DEPENDS ON MIGRATION LAWS
DEPENDS ON OUTCOME PROCEDURE
STILL UNDER LOCAL LAWS / AUTHORITY

2 Reading 1: Refugees from a changing climate

A Global Challenge: 'Climate Refugees' | Morningside Center for Teaching Social Responsibility (https://www.morningsidecenter.org/teachable-moment/lessons/global-challenge-climate-refugees)

Refugee. The word conjures images of people running from persecution and war, clinging to rafts, sleeping in tents. Under international law, refugees are people fleeing conflict or persecution. There are 20 million people classified as refugees in the world today, according to the UNHCR, the United Nations Refugee Agency. They include Syrians running from their country's devastating conflict, members of Myanmar's Rohingya ethnic minority escaping persecution, and South Sudanese fleeing civil war. All told, there are more refugees in the world today than at any time since the end of World War II. To organizations that help refugees, such as the UNHCR, the world is already suffering from a catastrophic refugee crisis. But today's refugee population may be just a fraction of what the world could see in coming decades. As the planet warms and polar ice melts, changing weather patterns and rising seas will force millions of people to leave their homes.

By 2060, there could be about 1.4 billion climate refugees, estimates Charles Geisler, professor emeritus of development sociology at Cornell University. By 2100, the number might be as high as 2 billion — about one–fifth of the world's anticipated population. Geisler cites a variety of factors contributing to the expected tsunami of refugees, including "war, exhausted natural resources, declining productivity desertification, urban sprawl, 'paving the planet' with roads."

A refuge is a safe shelter. Where can people find refuge when the climate in their home countries can no longer support farming, fishing, hunting, and other activities that have sustained human life for centuries, if not millennia? People who fit the legal definition of "refugee" are entitled to certain types of protection under international law. But people fleeing climate chaos do not meet the current legal definition of "refugees," even when government policy is responsible for uninhabitable conditions. The current migration system "makes climate refugees particularly disposable," says Zygmunt Bauman, a professor emeritus of sociology at the University of Leeds, leading to "a lack of protection for these people."

"Ironically," writes reporter Bruna Kadletz, climate refugees " often come from countries with low carbon dioxide emissions and few resources to respond to climate change." Kadletz describes the precarious life of 11–year–old Melina, who left her home in southern Malawi when she was three to move with her parents to South Africa. Since the late 1990s, Malawi has cycled between extreme flood and drought conditions. This severe weather made it impossible to grow the staple crop, maize, that had sustained Melina's family for generations. In South Africa, the family is living in limbo, without the legal status that would allow Melina to go to school and the family to have access to health care.

Climate change doesn't happen in a vacuum. Typically, a combination of factors forces people to leave their homes. Excessive drought, heat, or flooding intertwine with famine, unemployment, inequality, and conflict. Climate change acts as a "threat multiplier" — a factor that can push simmering social, political, and economic problems into full–blown crisis.

Syria is a clear example of a climate disaster that that catapulted a political crisis into catastrophe. A three–year drought, the worst in the region's recorded history, led to crop failures and livestock deaths. Scientists say the drought's length and intensity could only be explained as a result of a changing climate. More than a million people, mostly farmers who could no longer live on the land, sought work in overcrowded cities where food prices soared, fuelling existing dissatisfaction with the authoritarian Assad regime. By March 2017, more than 5 million people had left the country and 6.3 million were displaced within the country.

On the other hand, there are places where climate change is the clear single cause of displacement. A report by the Lancet, a British medical journal, found that at least 4,400 people have been forced to leave their homes in Alaska, Papua New Guinea, and Louisiana because of rising seas, coastal erosion, and disintegrating coastlines.

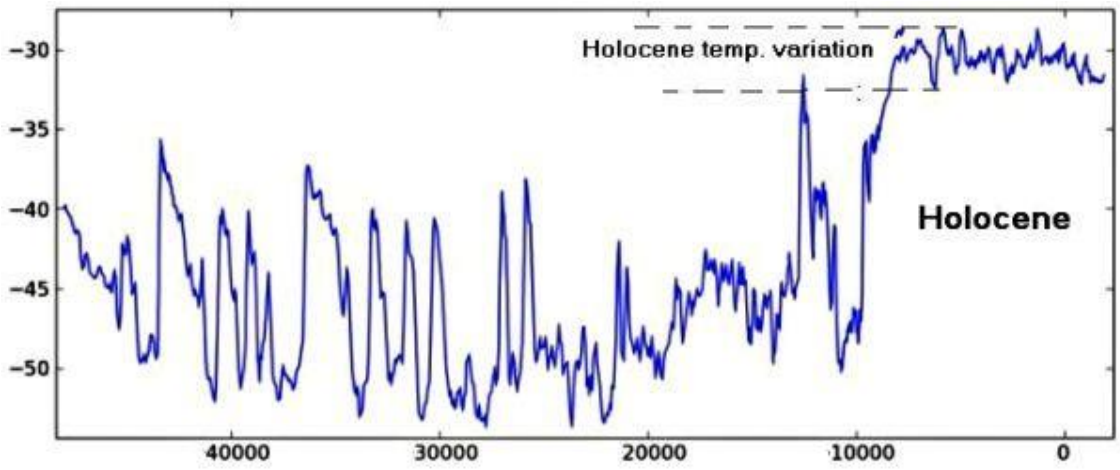
Kiribati is another example of a country that expects climate change to drive migration. The Pacific Island nation, located midway between Australia and Hawaii, may be entirely underwater in 30 to 50 years. So, it is planning for "Migration with Dignity" by training its citizens in high–tech skills that, the government hopes, will win them a welcome in other countries. New Zealand, for its part, is discussing whether to offer asylum to people fleeing climate change, which could open the door for Kiribati's climate refugees.

But it seems unlikely that Kiribati's strategy could provide a solution for the millions if not billions of people who eventually may be displaced. "Humanity is in crisis," warns sociologist Zygmunt Bauman, "and there is no exit from that crisis other than the solidarity of humans."

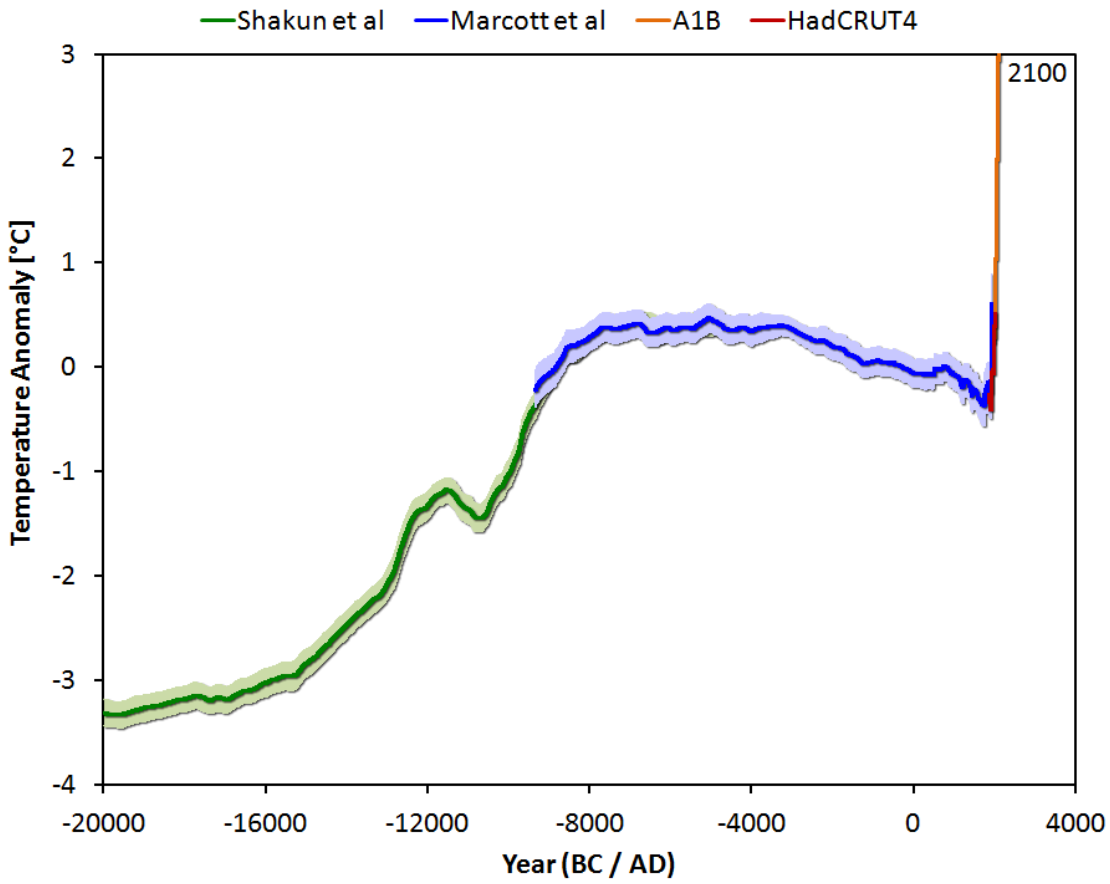
JIGSAW PIECE 4: Human (in)action: Anthropocene and Psychic Numbing

1 The Earth and the impact of humans

For several thousands of years, the Earth has enjoyed a very stable and fairly warm climate. These very nice conditions have made it easy for humans to grow crops and develop cities and technology. The temperatures from year to year, from decade to decade and from millennium to millennium have been predictable. Scientists call this period "**The Holocene**".



However, something very dramatic happened. The Holocene finished. The calm, stable environment was thrown into the air. Look at the red line in the graph below – global warming has happened, fast. By 2100 we are on course to have not only a planet that is hotter, but one that is much more unstable.



This is not the Holocene anymore. We now live in what scientists call '**The Anthropocene'**. The Anthropocene is the current geological age, defined as the period where human beings have been the dominant influence on climate and the environment. (It is humans who have shoved the planet into a new, volatile state&'*Anthropos*' is the Greek word for human being ('ἄνθρωπος')).

2 Psychic Numbing

The global metadata of Instagram is a probably one of the best guides to human psychology that there is. Any alien visitation to the planet would be smart to start with their survey of human kind by looking at it. Essentially, we like cute and happy, we like smiling and laughing. We like cuddly and funny, sunny and yummy stuff.

And by its omission, there is one thing that is clearly not popular: Mass human suffering. In fact, we cannot even wrap our heads around it. This is known as "psychophysical numbing".

The term, was coined by Prof. Paul Slovic to capture the fact that people cannot connect on an emotional level when they are shown big numbers. Psychic numbing was undoubtedly in play when the BBC reported on the fact that two thirds of the giant ice fields in the Himalayan and Hindu Kush mountain ranges would disappear if rapid reductions in CO_2 emissions were not achieved. This outcome would critically endanger 250million people living across eight different countries. Indeed, *half* the ice fields would be turned into bare rock by 2100 if temperatures reached 2°C by the 2100. Given that we are on track for about 3°C, this is a big deal for the lives of a further 2.56 billion humans who depend on the rivers that flow from these glaciers for their food and water.

If our emotions are so quickly enflamed on Instagram for a furry kitten that is sat in a box, and if we are caught by a sharp flash of concern for someone who is about to land very badly from a short flight off a skateboard, how do explain our dull emotional reaction to this piece of scientific research about the fate of billions? Absurdly, it only briefly made it into the Top 10 "Most Read" articles on the BBC website that day.

Professor Slavic would remind us that a significant part of the explanation for our lack of response is that such numbers are, literally, unimaginably catastrophic. We are psychically numbed by them.

Yes, we all need to have fun, watch pointless Quiz shows, take breaks, take holidays, laze and muck about with our friends etc.

But do we not also sometimes need to take a reality check? Even if it is painful.

*Extract, edited for JRS from "The Climate Academy Student Guide (2022)" ©

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JIGSAW PIECE 5: Stories of Climate Displacement

1

Muiris Ó Súilleabháin, Ireland 1927

In 1927, a young man named Muiris Ó Súilleabháin left his home, a tiny island off the West coast of Ireland. He later remembered his pain at leaving, when he thought that 'if I go... I will never see my family again'. He came from the Irish-language speaking area of Ireland, and his journey was driven by environmental change.

Figure 1: The Island which was home to Muiris, 1933

As a result of a number of factors, Irish-speaking communities like Muiris' existed only in Ireland's most isolated, westerly areas by 1900. These areas were rugged and mountainous, with very high rainfall and harsh winds from the Atlantic. This harsh climate and poor soil quality meant that farming was difficult and often failed to feed people. There was little industry, and the average household here had just 1/3rd of the resources needed to live. Because of this, people needed their environment to survive: they caught fish, ate seabirds, and hunted wildlife. Because of this lack of resources and reliance on nature, these communities were vulnerable to short-term climatic events – like drought– or long-term changes.

In the 1920s, multiple environmental changes hit Muiris' community. Local populations of seabirds and shellfish declined, perhaps driven by over-exploitation. Most importantly, the mackerel shoals moved away from the coast, driven by changes in ocean temperature and currents. With this, Muiris and thousands of others were left with no choice but to leave their homes – as Muiris remembered 'from the time the fishing declined, all the young people were heading over to America'. Women and girls were particularly affected. A popular song at the time described a mother speaking to a daughter about her opportunities: with no industry for employment, and diminishing fishing, her choice was to marry into poverty or 'go over the sea'. This migration had a devastating emotional impact on those who had to leave and those who remained– one Islander remembered a mother whose 'children are all in America… alone looking at her empty house in which her grand-children should be playing. She knows that she will never see her dear ones again'. It also contributed to the loss of a culture and a language: by the 1950s, the island that Muiris had called home was abandoned, and its traditions, folklore, and culture were lost. By 1956, there were only 85000 Irish-speakers left, compared to 641000 in 1901. We cannot say that environmental change was the only factor driving this: a lack of development, food insecurity, government policy, and systems of landownership all played their part, too. However, for vulnerable communities who relied on their environments to survive, these changes were a major factor in displacing people.

2 Ardo and Abdullahi Gedi, Ethiopia 2022

In 2022, a woman called Ardo lives with 500 internally-displaced families at the makeshift Maragaajo site in Kebribeyah, Ethiopia. Ardo and the other families fled their homes in search of water. According to Ardo, 'we have never seen drought like this, it has affected everyone. We have named it 'the unseen''. Another person at the site, Abdullahi Gedi, was displaced with his animals to search for water and pasture. Because of the dangers of the journey, he was forced to leave his wife and seven children behind. He has not heard from them in 100 days – 'I don't know what happened to them and to the others who stayed: children, women, the old, and other vulnerable people' he says.

Figure 2: AbdullahiGedi

Millions in the Horn of Africa rely on their environment for pasture, water, or crops. As temperatures rise and desertification in the region continues, Ethiopia and its neighbours are experiencing one of the worst La Niña-induced droughts in 40 years, following 4 consecutive failed rainy seasons since late 2020.

Drought is a major factor driving displacement here, but there are others. Conflicts – sometimes fought over declining resources, like water –have caused devastation and displaced millions. Again, women and children are disproportionately affected. Women and girls are walking longer distances to access water, leaving them vulnerable to sexual and gender-based violence. Women are also often left to provide for their families. In 3 months in 2022, the number of children at risk of leaving school due to drought tripled, from 1.1 million to 3.3 million. In addition to disrupting education, this puts girls in greater danger of child marriage and Female Genital Mutilation: in Ethiopia, child marriage increased by 119% in three regions from 2021-2022. This happens because parents are marrying girls to secure dowries,or to help the child to enter a better-off household.

In the region, more than 18 million are food insecure as of July 2022, largely due to drought. Roughly the same number are displaced in the region. In parts of Somalia, conditions are at famine levels, and over 100000 were displaced by drought there in June 2022. Drought is not unusual in this region, but it is becoming more frequent, and another failed rainy season is anticipated in October 2022. As the environmental crisis continues, this situation is likely to get worse, as drought and desertification cause displacement and drive conflict. In Somalia, for example, temperatures are predicted to rise between 1.4-1.9 degrees by 2030, and water availability could halve by 2080.

NOTE TO TEACHERS

Just like for Muiris, Ardo, and Abdullahi, environmental changes have been forcing people to leave their homes for centuries, through drought, decline in species, or other developments. As in the case of all three, it disproportionately affects people with fewer resources and those who rely on their environments, like fisherfolk or farmers. In 1900, this included Muiris' community in Ireland, but today environmental change disproportionately hurts people in the 'Global South'. As for Muiris, Ardo, and Abdullahi, displacement is a traumatic and tragic event, affecting individuals, families, and

communities. And as in the case of all three, it is difficult to separate environmental change from other factors driving displacement – such as conflict. Although there are common themes in environmentally-driven displacement which have been present throughout history, the future will not match the past. Today, we see a crucial change. As we cross the tipping point for environmental crisis, climate-driven displacement is becoming more severe, more frequent, and more widespread. While the environmental changes in Muiris' community lasted roughly a decade, and nature recovered, forecasts indicate that environmental degradation is set to get worse in the Horn of Africa and elsewhere.

NOTE TO TEACHERS

While environmental changes affected a few thousand people in Ireland in the 1920s, drought is affecting tens of millions in the Horn of Africa today. And most importantly, while the environmental change which affected Muiris' community was local, affecting a small area, the phenomenon we see today is global. Climate and environmental change does not affect everybody – in the 'Global North' or 'Global South' – equally. However, a huge number of areas, largely in the 'Global South', are suffering from the effects of environmental crisis; from drought in the Horn of Africa to desertification in the Sahel, to flooding in Bangladesh and the Pacific. These effects – and environment-driven displacement – will continue to worsen, unless we take action.'.

NOTE TO TEACHERS