

AQA Geography GCSE

3.1.2.4: Cold Environments

Detailed Notes

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Cold Environments

What is Classed as a Cold Environment?

Cold environments are **regions** that experience **sustained below freezing (0°C) temperatures**, resulting in a **short growing season** and **highly adapted wildlife**.

They are located at **high latitudes** (surrounding polar regions) that experience less intense sunlight, or at **high altitudes** (on mountains).

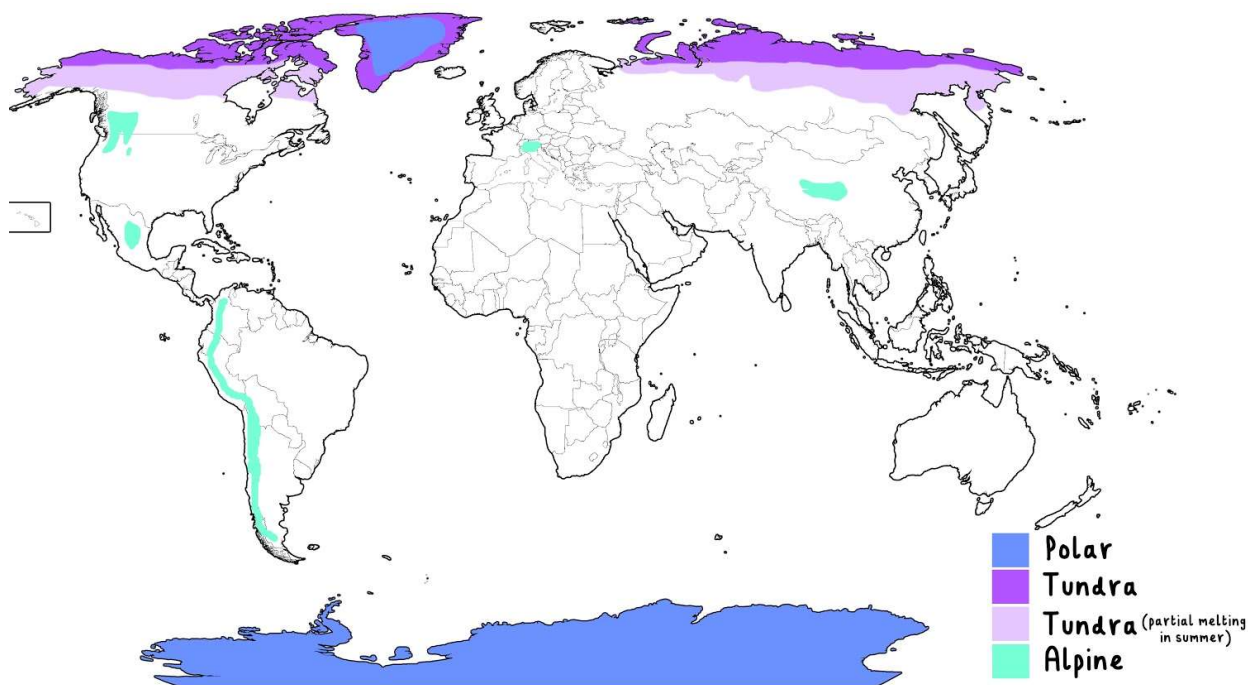


Nuuk, Greenland. (Source: <https://www.silentia.eu>)

There are different types of cold environments depending on their **location** and **characteristics**:

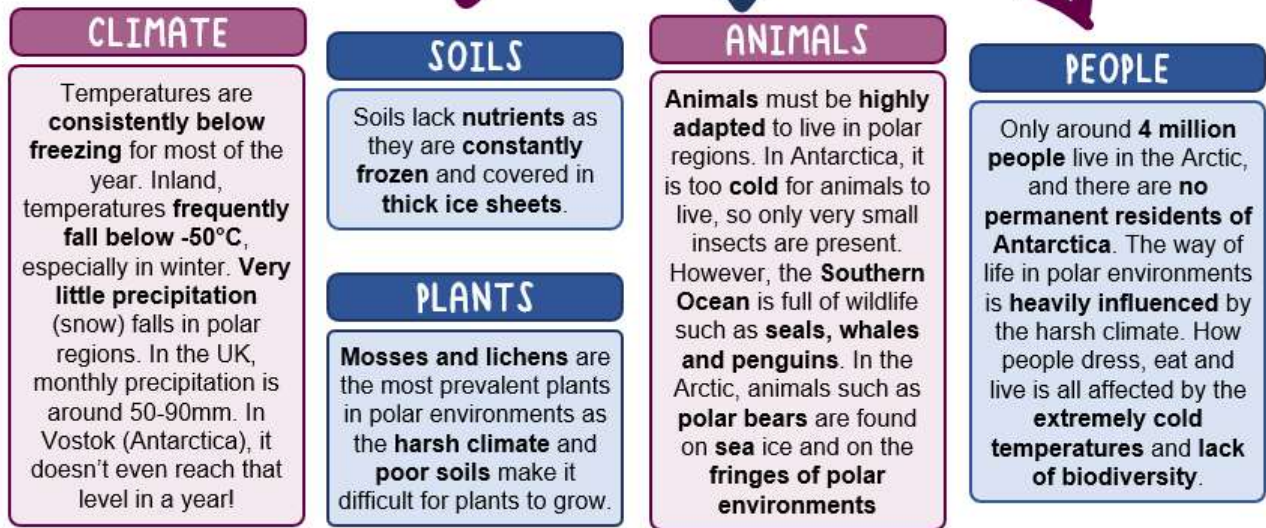
- **Polar** - areas surrounding the **poles** (90°N and 90°S), such as Antarctica or Greenland.
- **Tundra** - Areas at **high latitudes** with **low temperatures** and **short growing seasons**. Tundra is characterised by **consistently frozen ground (permafrost)**, which can **thaw seasonally** in lower latitude regions. E.g. areas of Canada and Russia.
- **Alpine** - Cold, **mountainous** regions with snowy conditions and warmer summers, such as the Himalayas and the Alps.

The **distribution** of these environments can be seen below:

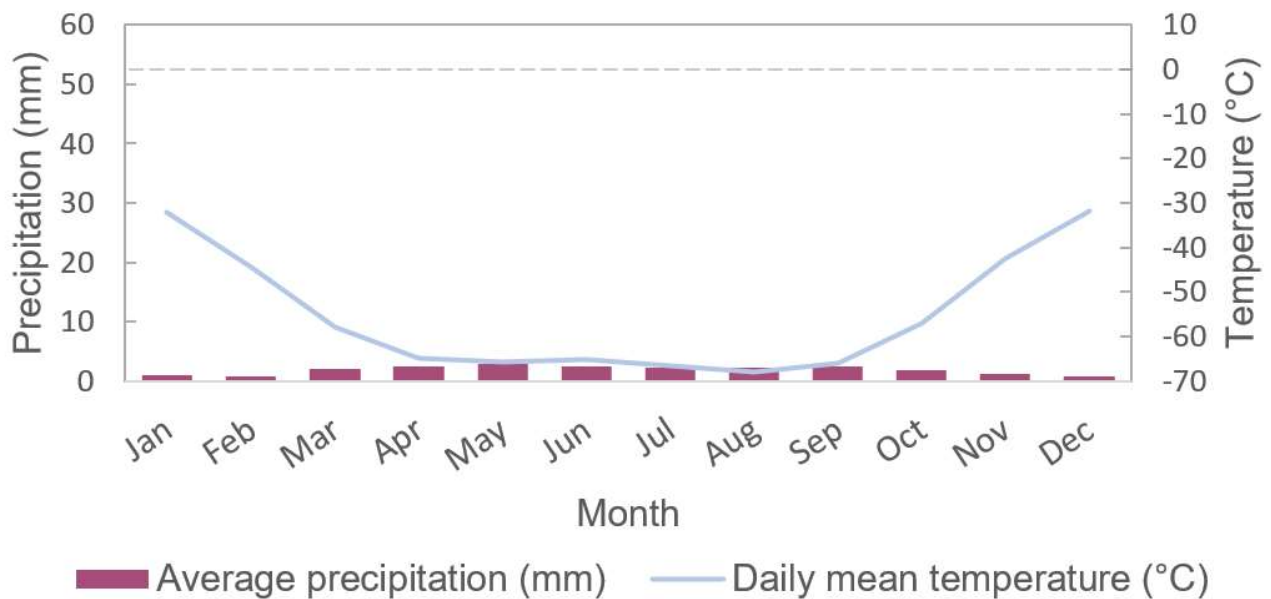


Characteristics of Cold Environments

Polar Environments



Polar Climate (Vostok, Central Antarctica)



Remember the Antarctic is in the Southern Hemisphere, so winter is July – August here!





Tundra Environments



CLIMATE

Tundra climates are **less extreme** than polar environments. Temperatures are usually well below freezing in winter, but may reach **above freezing temperatures in the summer months**. The growing season is short.

Precipitation may be high, especially in coastal regions. This falls as mainly **snow** but can fall as **rain** also.

SOILS

Soils are **nutrient poor** and are **frozen permanently** (known as **permafrost**). In summer, warmer temperatures can **thaw** the surface of the permafrost, making them **waterlogged** and **boggy**.

PEOPLE

More people live in **tundra** environments, but their lives are still influenced by the **cold temperatures**.

ANIMALS

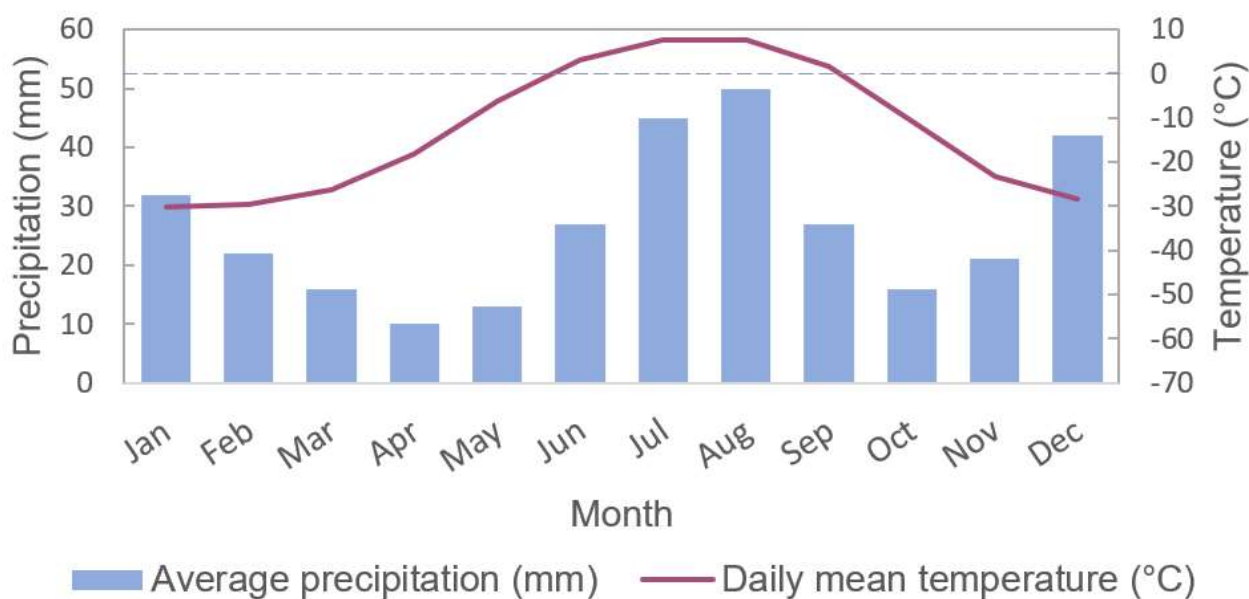
There is **greater biodiversity** in tundra environments, with more **diverse wildlife** living on **land**. There are more plants and developed **food chains** meaning there are **food options** for carnivores and herbivores.

Foxes, hares, birds and insects are present.

PLANTS

Plants are mainly **low-growing** flowering plants and hardy mosses/grasses. It is generally **too cold for trees** to grow aside from in the warmest regions where the **permafrost** is **discontinuous**. Plant-life is not **nutrient rich**, which results in the **soils** also lacking nutrients (as soils get their nutrients from the plants when they decompose).

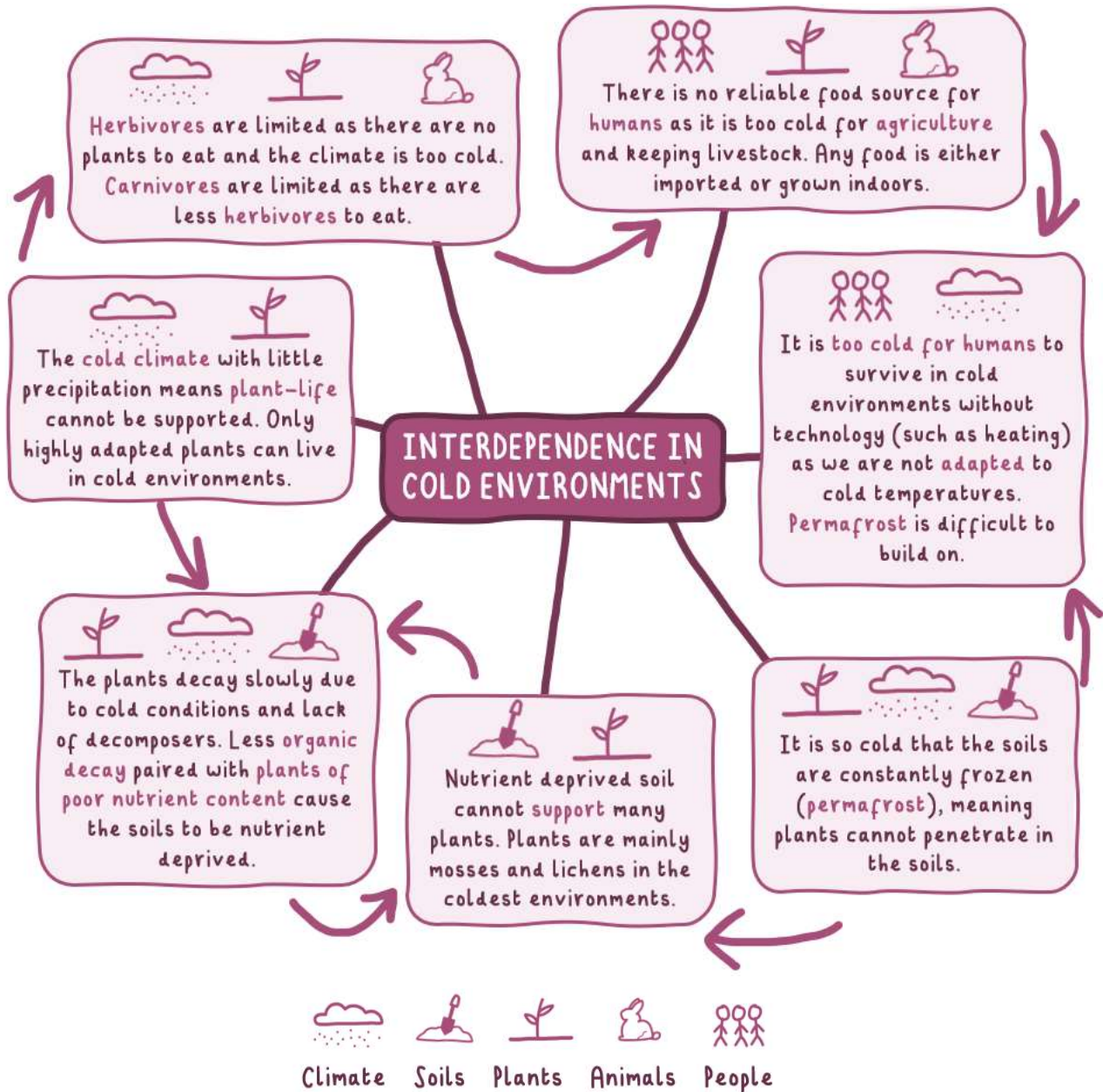
Tundra Climate (Tiksi, Russia)



Interdependence in Cold Environments

The **climate** of cold environments drives the **physical processes** that take place within these environments. Furthermore, different aspects of the environment **interact with each other** and **influence each other**.

Some examples of these interactions are outlined below.



Adaptations

Plants and animals have had to **adapt** to the **severe conditions** within cold environments. Some of these adaptations include:

- Thick, insulating **fur** and layers of **fat** to keep animals **warm**. Polar bear's fur is **hollow** to increase **insulation**.
- Animals may alter **behaviour** to limit the exposure to cold environments. For example, many animals that live in the **tundra hibernate** in burrows until the harsh winter is over. Some birds **migrate** in winter to stay away from the cold.
- Plants grow **low to the ground** and in tightly compact structures (sometimes cushion-shaped) to reduce exposure to **strong, harsh winds** and to insulate the plant.
- **Flowering and seeding** usually happens in short time periods so reproduction can take place within the **very short summers**.
- **Water loss** is reduced by thick, waxy leaves and **hairy stems** can insulate plants.



(Source: oceanwide-expeditions.com)

The Fragility of Cold Environments

Cold environments are **environmentally fragile**, which means any **small changes within the ecosystem** can have **large** and potentially **destructive** impacts on the environment.

Cold environments are fragile because the ecosystem is **highly adapted** to the harsh **climate and physical characteristics**. The environment can take a **long time to recover** from **disruption**, and in some cases, **may never recover**. Cold environments are fragile due to:

The highly adapted ecosystem - Plants and animals must be highly adapted to the **extreme weather conditions** around them in order to survive. Especially in polar regions, plants and animals have adaptations that allow them to **survive in the cold temperatures**. Therefore, when something in the ecosystem changes, e.g. the temperature becomes higher, these highly adapted species find it more **difficult to cope with the changes**.

Its slow nutrient cycle - Due to the **cold temperatures** and **nutrient deprived environment**, cold environments' **nutrient cycles** are slow. This means that things will take **longer to break down**, and longer to restore if they are damaged. For example, plants **do not grow as quickly** in cold environments compared to elsewhere in the world. Litter etc. will take a **long time to decompose**, which can affect plant and animal behaviour.

The lack of biodiversity - Due to the cold and unforgiving climate, only certain plants and animals thrive, meaning **food chains are limited and species depend on each other**. If a species is removed or damaged, this can spread throughout the **entire** food chain, affecting every aspect of the ecosystem. For example, **species of krill** is declining in the Antarctic, which is causing **penguins** to migrate to different areas, affecting **seal** populations.



Thinking Further: How Development Damages Cold Environments

Cold environments are **valuable resources to humans**. Many cold environments have reserves in **mineral resources** and **other natural resources** (gold, silver, coal, oil and gas to name a few). Furthermore, there are opportunities in **tourism**, **fishing** and **scientific research**, and infrastructure/homes need to be built for those who actually **live and work in cold environments**.

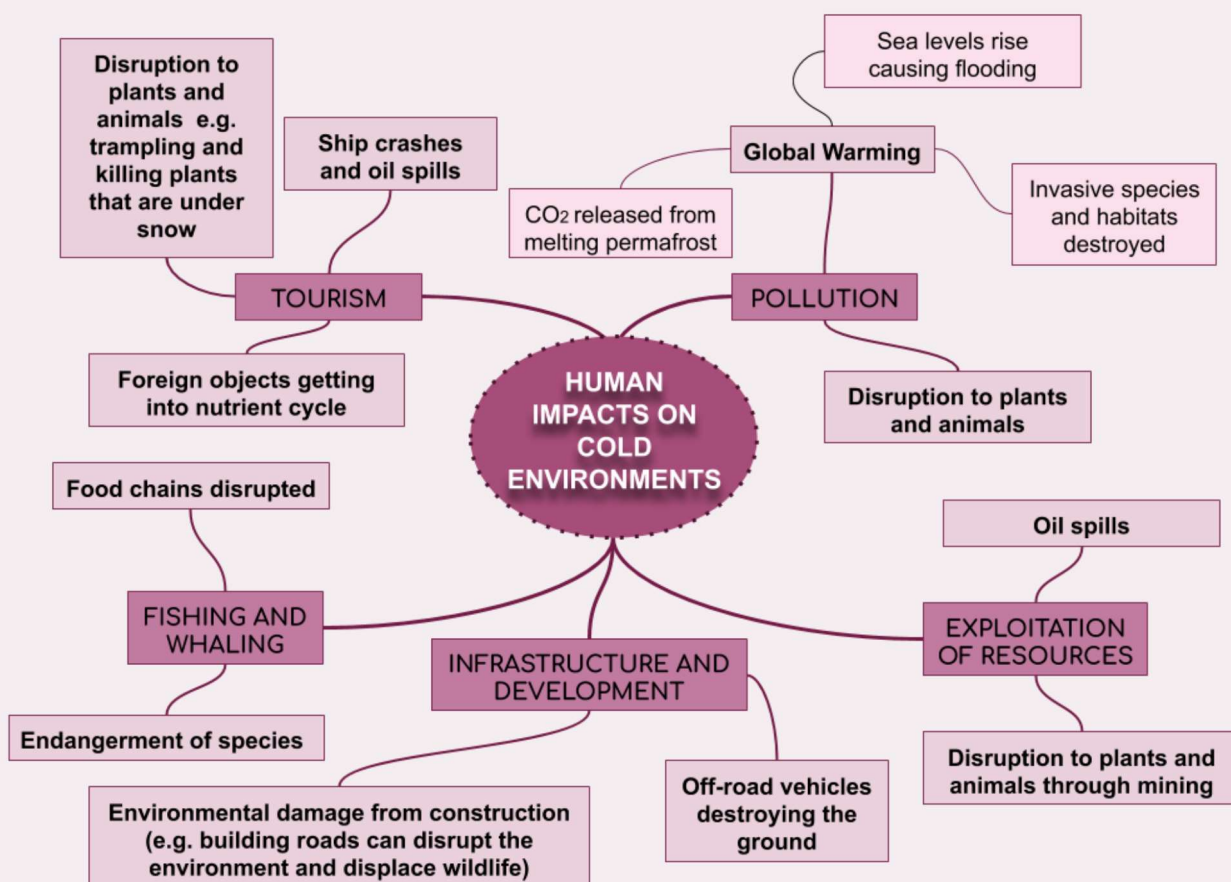
These **developments** have put cold environments under threat, especially because the cold environment ecosystem is so **fragile**.



For example, oil spills are a **common issue** in cold environments due to the exploitation of oil in the Arctic. Pipelines can crack and equipment can fail in the ocean or on the land, which has **catastrophic consequences for the environment**. The oil can stay in the ecosystem for a very long time unless it is cleaned up, which can be very **toxic** to wildlife.

The **image to the left** was taken after an oil spill in the Arctic Ocean. The black in the image is oil, not the sea!

(Source: <https://unearthed.greenpeace.org>)



Cold Environments as Wilderness Areas

Some cold environments are important areas of **wilderness**, which means they are **untouched by humans** and therefore remain unaffected by human activity (aside from passive contributions like the influence of human-induced **climate change**).

There are some who argue that developments **should take place in cold environments** as the natural resources they hold are **valuable for human development**. However, there are many reasons why people argue for keeping cold environments as protected **wilderness areas**:

- Cold environments are **very important areas of scientific research**. A lot of climate research takes place within cold environments as the area has been **untouched by humans**, so the effects of **pollution, construction** and **exploitation** are relatively unfelt here.

This allows scientists like **climate scientists** to take accurate readings of temperature, cloud cover etc. without the **influences of human activity**. Also, cold environments hold a lot of **evidence for past climate change** (scientists drill down deep into ice sheets to extract ice from hundreds of thousands of years ago).



(Source: <https://www.nasa.gov/centers/wallops/news/story106>)

- The **ecosystem and food chains** in cold environments are **delicate and fragile**, so human intervention may throw off the **complicated balance**.
- There are many **rare and endangered species** native to cold environments that need to be protected, and human intervention may put this at risk.
- Developments would be **complicated, high risk**, and **expensive to operate**. Due to the severe weather, fragile wildlife and frozen ground, it would cause too much disruption and may not be **economically viable** to develop in some areas (e.g. drilling and transporting oil in the Antarctic is not considered economically viable right now because it would cost too much to transport it across the huge continent).



(Source: <https://globalriskinsights.com/>)



Balancing Development with Conservation

In regions where development has been taking place, organisations and governments are working to ensure that the **economic needs** of the population are being **carefully balanced** with the need to **protect** and **conserve these fragile cold environments**. This has been done through different strategies:

- Using **technology** to **minimise environmental impact**
- **Government intervention**, such as the implementation of environmental **laws**
- **International agreements** to regulate the actions of **many countries**
- **Conservation groups** who campaign and research to protect the environments

The Use of Technology

Technology has been used in cold environments to ensure that **economic development** does not come at the expense of **environmental conservation**.

Trans-Alaska Pipeline

The **Trans-Alaska Pipeline System** is an **800-mile-long pipe** that **transports oil across Alaska**, from Prudhoe Bay to Valdez. The pipeline was built to allow oil to be transported across Alaska, rather than use ships which are **obstructed by Arctic sea ice in the winter**. The pipeline is constructed to ensure its environmental effects are somewhat reduced:

- Half of the pipeline is built on **stilts** to ensure the **permafrost below** is not melted by the **hot oil**. This also reduces the risk of the pipe freezing and cracking as it is away from the ground and insulated.
- Migrating animals such as the **caribou** can pass underneath the pipeline, so their **migration patterns** are not interrupted.
- The **oil flow can be blocked** at multiple points in the pipeline if there is a **leak**.



(Source: Margaret Kriz Hobson/E&E News)

Government Action

National governments can protect cold environments within their region by creating **laws** and **regulations** that citizens and companies must follow. Governments can enforce these laws and regulations by **issuing fines** or even **prosecuting** those who break the law. For example:

- **Environmental protection laws** to ensure any activity is done with **minimal impact**.
- Creating **quotas** (i.e. limits) for **fishing, hunting** or resource **extraction** in cold environments to minimise food chain and wildlife disruption.
- Creating **nature reserves** and designated areas of **wilderness** where oil drilling and development is **banned** in order to protect the wildlife.
- **Investments** into the environmental science sector, e.g. the **National Oceanic and Atmospheric Administration** in the USA works to protect marine habitats and oversees fisheries to check the activity is **sustainable**.



International Agreements

International agreements can be useful for ensuring multiple countries abide by regulations, especially in places like Antarctica which is not owned by any country.

The Antarctic Treaty System (ATS) is a **collection of international agreements** that work to protect the Antarctic from **damage** by **humans**. Below are **two** of the main agreements summarised:



The Antarctic Treaty (1959)

- 53 countries signed the treaty.
- Treaty states Antarctica should only be used for **peaceful means**.
- Antarctica can be used for **scientific research**, but **all** research has a right to be shared and cooperated on.
- All stations and operations can be **inspected** at any time.
- Antarctica is not any country's **territory**, it is a global common.
- Nuclear activity is **banned**.

The Protocol on Environmental Protection to the Antarctic Treaty (1991)

- **Bans** all activities relating to **mineral resources**, aside from for scientific purposes. This means there can be no mining or fuel extraction on the continent.
- Established the **Committee for Environmental Protection**, an advisory body that provides advice and recommendations to members.
- Created and added to regulations that were set out in the original treaty, including additions to **waste management** and **marine pollution**.

Conservation Groups

Conservation groups have less **power** than governments, but can be very useful organisations as they can incorporate **public interest** and are usually considered politically **unbiased** as they usually do not belong to a particular government.

ASOC

ASOC was formed in **1978** after concerns over **secret negotiations** between parties of the **Antarctic Treaty**. Some parties were secretly negotiating a framework for **mineral and gas prospecting** in Antarctica, which would obviously have **detrimental environmental effects on the continent**.

Originally, ASOC's purpose was to **convince governments to prevent this mineral exploitation**, as well as **allowing NGOs to participate** in the protection and **governance** of Antarctica. ASOC did this by bringing these secret negotiations into the public eye.



ASOC was **granted 'observer status' in 1991**, meaning the organisation can go to annual meetings for the Antarctic Treaty System. ASOC presents a strong **voice** for the Non-governmental organisations (NGOs) alongside conducting **campaigns and projects** to ensure Antarctica is protected.

ASOC's main focuses are:

- Overall environmental protection in Antarctica
- Monitoring and extending marine protected areas
- Wildlife conservation
- Krill conservation (a small crustacean which is very important food source for marine life)
- Climate change and the Antarctic
- Antarctic governance

Charities

Charities such as **Greenpeace and WWF** work to enhance the conservation of cold environments by:

- Collecting data and information **independent of governments**, to monitor the reliability and accuracy of other data.
- **Reporting** on issues, and releasing findings to the public and governments. This can **spread awareness** on issues in cold environments (e.g. writing articles and social media campaigns) and **boost donations**.
- Creating **petitions, lobbying, and campaigning** for change. These petitions must be discussed by governments once they have reached a certain number of signatures.



Pictured to the left is Greenpeace's ice-breaker ship 'Arctic Sunrise', which originally voyaged to the North Sea to **document marine pollution by oil from offshore installations**. Now it is used to conduct **scientific research** everywhere, including the Antarctic.

(Source: www.greenpeace.org/international/tag/arctic-sunrise/)

