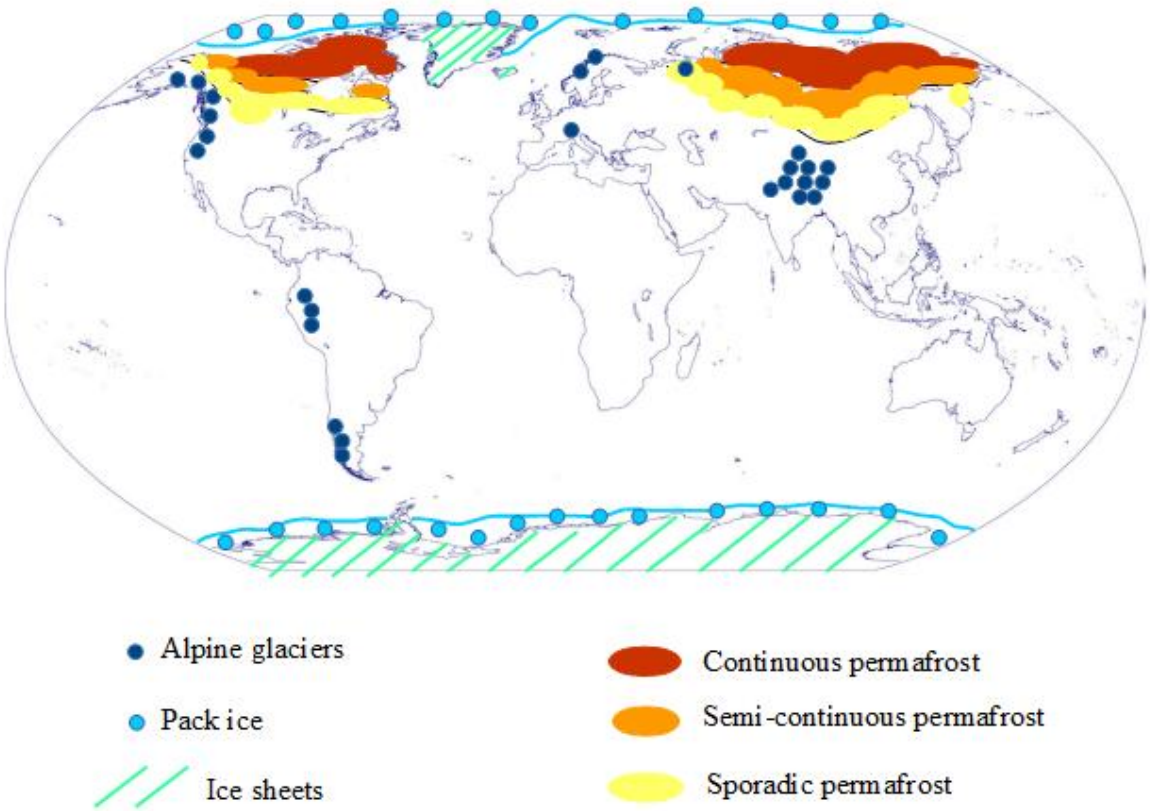
The Distribution of Cold Environments

Over 25% of the surface of our planet can be said to have a cold environment, but defining what we actually mean by that can be very challenging. This is because cold environments vary so much across the globe in nature and are subject to change over time.

Northern parts of Britain such as the Uplands of Scotland can be defined as having a cold environment during the winter months. At extreme latitudes (the very north and south of our planet) there is constant ice but this is subject to fluctuation (change). In Antarctica (the south) ice sheets which are up to 2000m in depth cover the continent. In the summer months this ice will retreat away from the coast to reveal land but in the winter months the sea ice around Antarctica grows and doubles the size of the continent.

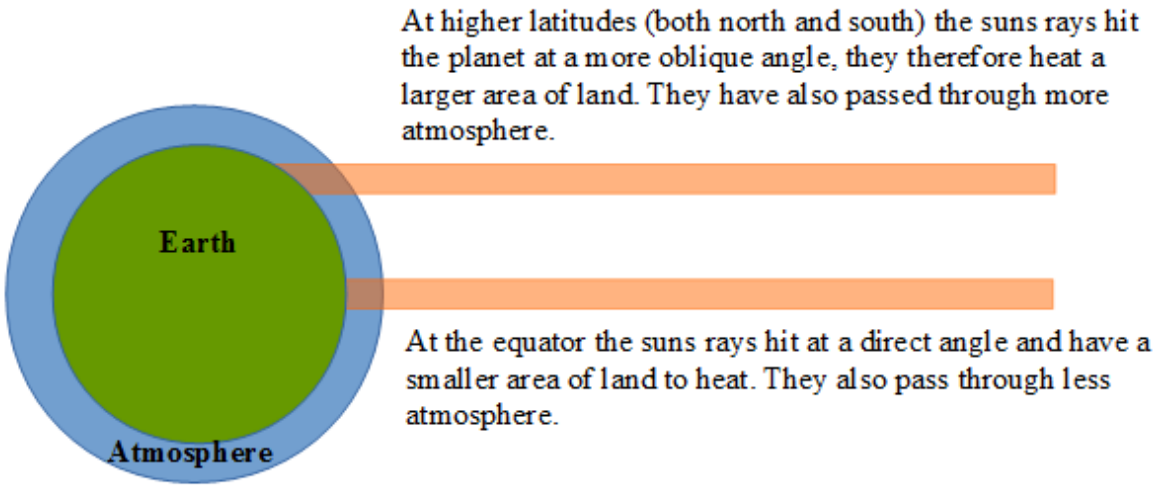
In the Arctic (the north) there is no land mass, but the sea ice grows and shrinks in both area covered and thickness, depending upon the season. Over the land in northern latitudes we see areas of continuous permafrost (land which is permanently frozen), for example in Siberia, Northern Canada and Northern Alaska. As we move south from the Arctic circle (66° 33' north) this changes to discontinuous and then sporadic permafrost by approximately 55° – 50° north. In Greenland there are year round ice sheets which retreat to reveal the coast in the summer and then grow outwards to become sea ice in the winter.

I. Global distribution of cold environments



1. Latitude

One of the main controlling factors for the distribution of these cold environments is latitude. At the equator the suns rays hit the earth at a direct angle, as we move north and south this angle becomes more oblique meaning the rays are heating up a larger area of land. Added to this is the greater thickness of atmosphere caused by this oblique angle; more of the suns rays will be bounced back to space by particles in the atmosphere.



2. Continentiality

If you look at the world map showing areas of cold environment you will notice that the UK and areas of western Europe do not have permafrost even though they are at the same latitude as places in Siberia or North America which do. Also, in central Asia and central North America the permafrost extends further south. This is due to an effect known as continentiality. The further inland you go into a continent the more extreme the temperature will become. This is because of the temperature modifying effects of the oceans. Land heats up and cools down far more quickly than the sea does. Therefore in winter months at higher latitudes the ocean has the effect of heating coastal areas by a small amount as the ocean has not yet lost the heat created by the summer sun. The difference is enough to keep the permafrost at bay.

3. Altitude

Away from higher latitudes we have areas of cold environments in mountainous areas such as the Alps in Europe, the Himalaya in Asia, the Andes in South America, the Coast Range in North America. These areas are high altitude, another controlling factor in the location of cold

environments. As altitude increases the air becomes thinner and contains less gasses. This means that it can not store heat in the same way and the temperature falls.

4. Albedo

Albedo is how reflective different parts of the planet are, the higher the albedo the more reflective the surface. Dark colours absorb heat whereas lighter colours reflect it. Therefore white areas such as the Arctic, Antarctica, mountain areas with snow, have a higher albedo and reflect heat and light from the sun away creating a colder environment.

5. Glacials and Interglacials

As well as changing seasonally the extent and location of cold environments changes over a far longer time scale. The Earth has gone through many periods of warmer and colder temperatures and some have been very extreme. From times when there has been no ice at all with sea levels so high as to leave a much reduced land mass to periods when the whole surface of the planet was covered in ice (a phase known as “snow ball Earth”. Colder periods are known as glacials and warmer periods as interglacials, they last for many thousands of years. Fluctuations happen within these periods, interstadials are short, warmer fluctuations within a glacial period that cause the ice to retreat. Stadials are short, colder fluctuations within an interglacial period that result in the ice advancing.

Over the last 1 million years the glacials have lasted for a longer time than the interglacials. The glacials have also been more extreme; they see a larger drop in temperature than the interglacials see as a rise. The difference in the mean global air temperature only needs to be two or three degrees to mark the change from a glacial to an interglacial.

Many scientists believe we are beginning to come to the end of our current interglacial period and what will happen to world temperatures and the distribution of cold environments is a matter of much scientific debate. This is because for the first time we see a human influence in climate change with the release of greenhouse gasses.

II. The Most Recent Glacial

The last glacial period began about 30 000 years ago, reached its maximum at about 18 000 years ago and ended approximately 10 000 years ago. At its most advanced the ice in the UK came as far south as Bristol.

III. Reasons for Changes in Climate

There are many different theories to explain changes in climate throughout the Earth's history.

- Changes in the amount of carbon dioxide and methane in the atmosphere – e.g. gases being trapped in tundra and then released as the tundra melts.
- Changes in the amount of dust and particles in the atmosphere after volcanic eruptions (sunlight can be blocked out by large amounts of dust).
- Milankovitch cycles – changes in the tilt of the axis of the earth and the shape of our orbit around the sun. These change in cycles that last thousands of years.
- Changes in the shape of the land – e.g. the uprising of the Himalaya and Tibetan plateaux.

Multiple Choice Questions

1. Approximately how much of the Earths surface can be defined as a cold environment?

    a) 10%

    b) 5%

    c) 40%

    d) 25%

2. Cold environments are difficult to define because...

    a) the definition changes from place to place

    b) some places are colder than others

    c) temperatures change over space and time

    d) it doesn't snow every winter?

3. In the Arctic...

    a) there is no northern land mass but the sea ice grows and shrinks with the seasons

    b) the ice retreats back from the coast in the summer

    c) the sea ice grows up around the continent in the winter

d) the sea ice completely melts away in the summer?

4. At high latitudes the suns rays hit the Earth's surface...

   a) at a faster rate

   b) in a more direct line

   c) at a more oblique angle

   d) at a slower rate?

5. Areas of high altitude can be cold environments because...

   a) it snows more

   b) the air becomes thinner with altitude so it can not hold as much heat

   c) at high altitude you are closer to the sun

   d) you are further from the sea?

6. A glacial period is...

   a) a period of colder temperatures that lasts about a hundred years

   b) a period of colder temperatures that lasts many thousands of years

   c) a period of warmer temperatures that lasts many thousands of years

   d) a brief period of colder temperatures within an interglacial?

7. A stadial is...

    a) a brief colder period within an interglacial

    b) a brief colder period within a glacial

    c) a brief warmer period within an interglacial

    d) a brief warmer period within a glacial?

8. The most recent glacial ended...

    a) 100 000 years ago

    b) 1000 years ago

    c) 10 000 years ago

    d) 100 years ago?

9. A possible cause of change to world climate over time is...

    a) our sun becoming weaker

    b) our planet is moving away from the sun

    c) our planet is moving towards the sun

    d) changing amounts of gases such as carbon dioxide and methane in our atmosphere?

10. Milankovitch cycles are...

a) changes to world ocean currents

b) changes to the Earth's axis tilt and orbit shape

c) changes to wind currents

d) changes in the shape of the Earth's land masses?

Answer

1 = d, 2 = c, 3 = a, 4 = c, 5 = b, 6 = b, 7 = a, 8 = c, 9 = d, 10 = b.