Environmental Studies
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Retreat of Arctic Sea Ice

As of November 2014 Arctic sea ice covered a region of 10.36 million square kilometers. This expanse of ice plays several roles within the global climate and underpins the entire Artcic marine ecosystem.

Since 1979 the global trend for Arctic sea ice decline is approximately 3-4% per decade.

Fig. 1 Arctic sea extent standardized anomalies january 1953 - december 2012

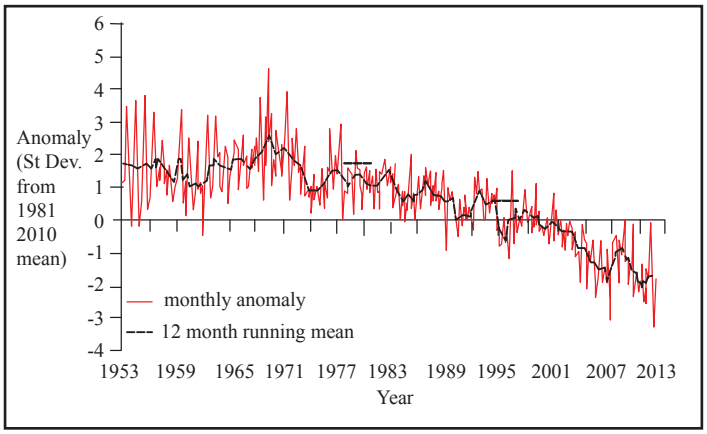
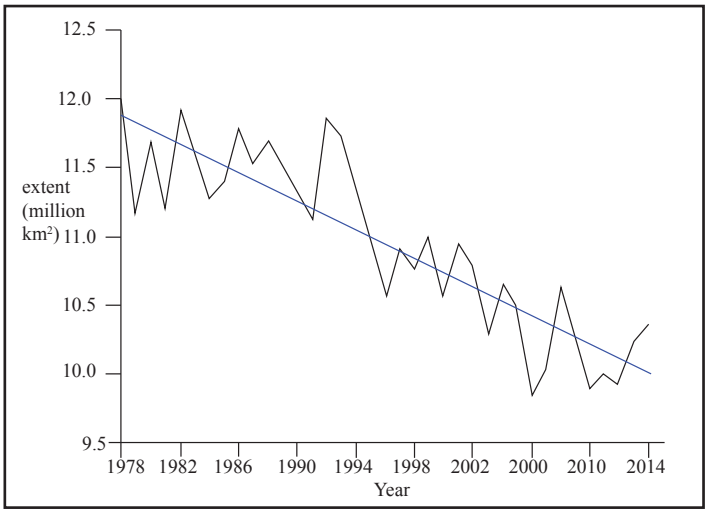


Fig. 2 Average monthly Arctic sea ice extent november 1978 -



Causes of Artic Sea ice decline

- The key driver is increased global mean temperature due to greenhouse gas emission, largely from anthropogenic sources
- The Arctic Oscillation was in a strong positive phase between 1989-1995
- Warmer summers led to more extensive summer melts north of Alaska and Siberia
- Wind patterns since the late 1990's has led to more ice moving out of the Arctic circle, where it warms and melts

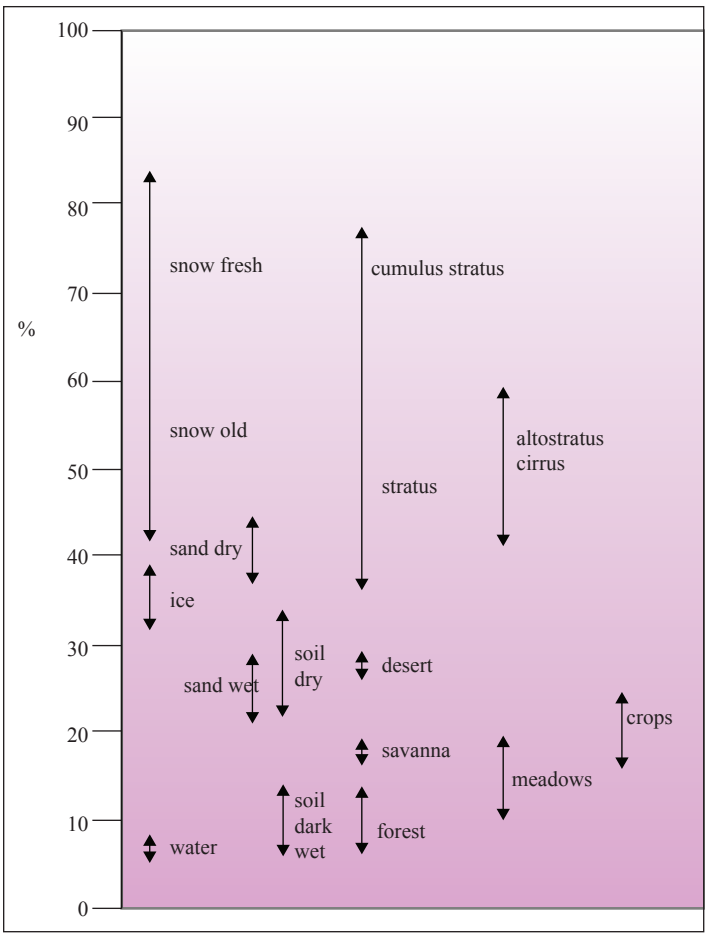
Arctic Oscillation – is a seesaw pattern of alternating atmospheric pressure. The positive phase produces a strong polar vortex, with the mid-latitude jet stream shifted northward. The negative phase produces the opposite conditions

Why is Arctic Sea ice important?

Albedo

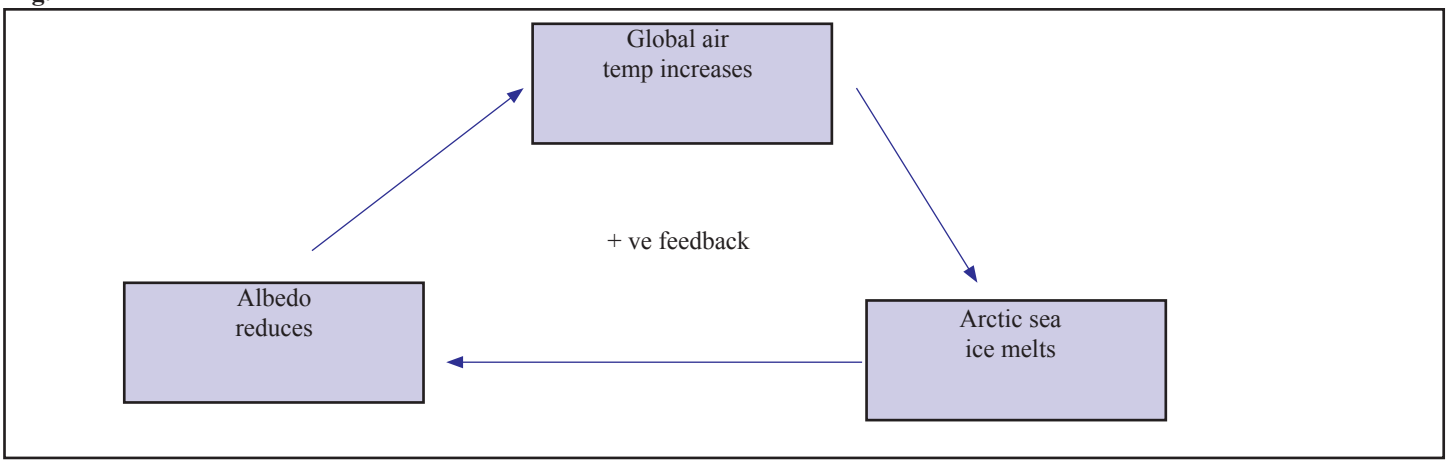
Albedo is the reflecting power of a surface. The albedo percentage reading of a surface shows how well it reflects ultraviolet radiation (sunlight).

Fig 3.



As shown in the image above ice has a relatively high albedo rating and is responsible for reflecting a significant amount of UV rays globally. With the loss of sea ice rather than being reflected more UV rays are absorbed by darker surfaces that replace sea ice i.e. open ocean water. This results in a 'positive feedback loop' where warming creates more warming.

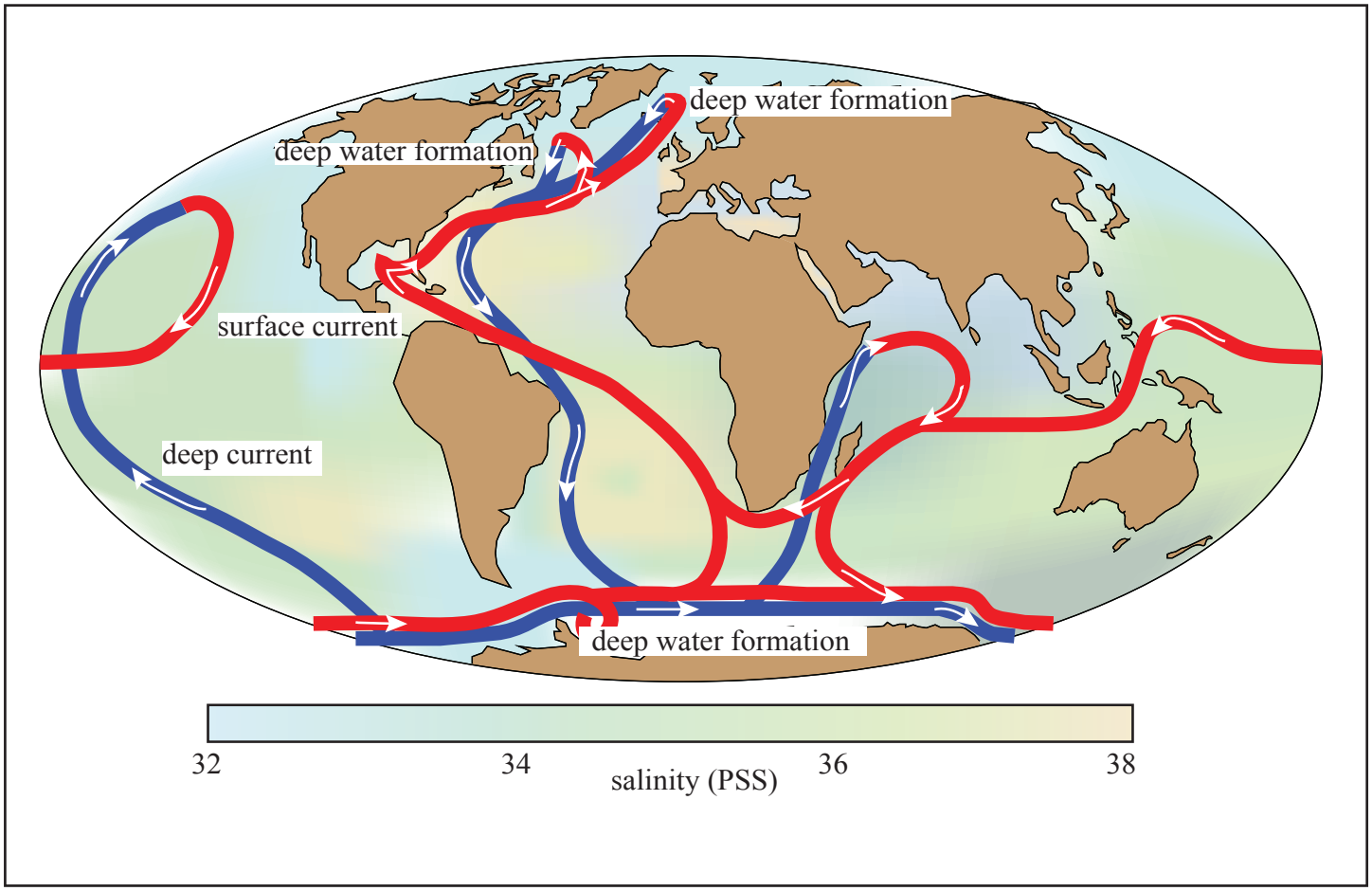
Fig. 4



Thermohaline cycle influence

The thermohaline cycle is a large scale ocean circulation system. It is commnoly refered to as a 'converyor belt' in the movement of water globablly. North Atlantic Deep Water formation (NADWF)– This process occurs in the THC in the Arctic region. Warm salty Atlantic water-cools at it approaches the Arctic. As this water-cools and become denser it overturns and sinks to the depths of the Arctic Ocean to begin flowing south again

Fig. 5 Thermohaline cycle



As the Arctic environment changes and more sea ice melts there is a rising level of fresh water. This leads to warmer surface temperatures in the Arctic Sea. This change may interrupt the driving and sinking mechanism such as the NADWF. This could result in change in climate and weather patterns throughout the globe.

Methane insulation

It is been documented for a long time that the Arctic tundra and marine sediments contain large amounts of frozen methane deposits.

Research from NASA's jet propulsion laboratory found new sources of methane within the Arctic. Exposed Arctic seawater itself has been found to e a source of methane. Melting sea ice leads to more exposed Arctic seawater and melting of frozen methane deposits. This results in a higher amount of potent methane being projected into the earth's atmosphere again creating a positive feedback loop

Limitation of severe weather

Unbroken expanses of sea ice can limit how much moisture moves from the ocean to atmosphere. This process limits the likely formation of strong storms. However with sea ice melt the amount of moisture transfer increases, leading to stronger weather systems and larger ocean waves.

Shishmaref, Alaska – Loss of ice has led to increased wave action on softened shorelines. The Arctic Sea has invaded drinking water source, threatening fuel stores and many residents have begun to relocate away from the area.

Supports Native people and Wildlife

Approximately 180 native Alaskan communities have been identified as vulnerable to sea ice melt. 12 communities have already relocated to higher ground. The loss of sea ice makes pursuit of certain species such as seals much harder. Flooding and storms also pose a risk to these extreme communities. Wildlife also suffers with the loss of sea ice.

Polar Bears – Lose their ice rafts that they use to hunt seals
Arctic Seals – Rely on heavily on sea ice for everything, including a place to raise pups and as cover from predation
Walruses- Rely on sea ice as a place to rest, loss of sea ice results in them having to travel further to overcrowded shorelines
Caribou- have reportedly fallen through thinning sea ice during migration

Further effects of Arctic Sea ice loss – exploitation

Shipping routes open security

- As Arctic Sea ice retreats new shipping routes become accessible such as the Northwest Passage, this decreasing transport times and cost
- More ship traffic brings potential new harm such as underwater noise and potential fuel spillage
- Arctic oil and gas have also become more accessible- several nations and companies are already staking their claim to the largest untapped gas reserves in the world
- Oil spills from these new developments pose a significant risk. Off shore drilling can also interrupt marine mammal communication due to increased noise
- Increased use of fossil fuels leads to more CO_2 emission. Creating another positive feedback loop

Summary

- Arctic Sea ice extent has been declining steadily since accurate recorded date in the 1950's
- Global warming due to greenhouse gases are the main contributing effect, but some natural processes are also responsible
- The effects of losing sea ice results in several positive feedback loops, where the loss of sea ice leads to the loss of more sea ice
- As Arctic Sea ice retreats further the effects amplify
  - Loss of diverse habitats
  - Loss of indigenous species
  - Loss breeding grounds
  - Loss of native Alaskan communities unless they are relocated
- Loss of Arctic Sea Ice also leads to increased exploitation. This decreases regional security and has compiling factors that increase Sea ice loss
- Arctic Sea ice loss is a classic example of a positive feedback loop. As more sea ice is lost more compounding effects occur that leads to more Sea Ice loss
- If this positive feedback continues the resulting effects will worsen and spread globally

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