2012 summer Arctic sea-ice minimum will set a new record

Summary of issue

Arctic summer sea-ice extent, thickness (where estimated) and thus volume, have been declining over recent decades and most rapidly in the past five years. This summer, Arctic sea-ice extent is already lower than the previous record minimum, set in 2007, and is attracting much media interest. The disappearance of Arctic sea-ice results in a positive climate feedback; sunlight-reflecting ice is replaced by darker seawater which absorbs more of the sun's energy, resulting in further warming and therefore melting.

There is concern that increased warming may destabilise deposits of methane gas in the Arctic seabed and result in increased release of greenhouse gases from thawing permafrost. Arctic sea-ice also affects Northern Hemisphere weather patterns, and should the sea-ice continue to thin and disappear during the summer as predicted, it could lead to changes in the UK summer, autumn and winter weather.

Lines to take

- Note that this summer's Arctic sea-ice extent is already lower than the previous record minimum of 4.17 million km^2, which was set in 2007. The minimum usually occurs around mid-September.
- Understand that Arctic sea-ice decline has accelerated over recent years as global warming continues to increase Arctic temperatures at a faster rate than the global average.
- Aware that climate models currently suggest that the Arctic could be seasonally ice-free sometime after 2030, although some experts suggest a more rapid rate of decline, based on recent summer conditions.
- Note that a positive climate feedback means that decreasing sea-ice causes further warming in the Arctic, which in turn leads to more sea-ice melting. Increasing warming in the Arctic is leading to the possibility of a release of greenhouse gases (especially methane) that are currently trapped in the frozen sea-bed and in permafrost in the Arctic.
- Also note that there is some evidence that the decreasing amount of Arctic sea-ice could lead to an increase in the frequency of spells of cold weather during winter, and possibly also wetter summers, over Europe.

Key Points

- Sea-ice in the Arctic has a seasonal cycle; growing during the winter, and melting during the summer. Sea-ice extent normally reaches its minimum value during September.
- This year, Arctic sea-ice extent has not yet reached its minimum but is already below the previous record low of 4.17 million km^2, set in 2007. This summer's rapid decline was in part due to extreme weather conditions in July and August.
- Summer Arctic minima for 2007 to 2012 will be the six lowest recorded during the satellite era (since 1979).
- Preliminary satellite measurements indicate that Arctic sea-ice volume has also rapidly declined over the last decade. Estimates of ice thickness suggest that, where estimated, winter ice has thinned from 3.6m in 1980 to 1.9m in 2008.

- The recent rapid decline has occurred as thicker, 'multi-year' ice (ice that survives at least one melt season) disappears, to be replaced with thinner ice which melts quickly the following summer.
- Melting Arctic sea-ice results in a climate system feedback – darker sea water revealed by the melted ice absorbs more of the Sun's energy which leads to more heating and therefore further melting.
- Current climate model projections suggest that an essentially ice-free summer Arctic will occur between 2030 and 2080, with the earlier part now being considered more likely. It is possible that this projection may be revised as understanding of sea-ice processes progresses and models are improved.
- However, recent observations show that many previous climate model projections of sea-ice decline, such as those reported by the IPCC in its 2007 Fourth Assessment report, have not reproduced rapid declines in ice extent and thickness, as seen most recently.
- Reduced Arctic sea-ice extent means that the ocean releases more heat. The resulting increases in Arctic temperatures, together with additional changes in the Atlantic Ocean, could potentially affect the strength and position of the jet stream, which strongly influences northwest European and UK weather.
- Some studies have suggested increased occurrence of cold, easterly winds across northern Europe in winter, associated with the sea-ice decline. Other studies have suggested the potential change in the jet stream might result in more summer rainfall over the UK and northwest Europe.
- However, there is no consensus yet over possible impacts and it is not yet known whether it is the sea ice directly affecting the jet stream or whether it is changes in the Atlantic Ocean that are most important factor. A run of wet UK summers in the 1950s coincided with Atlantic Ocean conditions similar to today's, which suggests that ocean conditions are likely to be implicated in the recent wet UK summers.
- There is concern that increased sea-ice melt and warming in the Arctic could lead to the release of significant amounts of the greenhouse gases which are trapped below the ice in the sea bed, as well as methane and carbon dioxide from melting permafrost. However, there is much uncertainty surrounding both the quantity of methane which could be released. Nonetheless, potential rapid release of methane is a danger which requires further study.
- The NERC Arctic Research Programme (ARP) is planning significant new research into the impacts of sea-ice reductions and crucially on Arctic methane budgets and methane release from hydrates and permafrost thaw. DECC already funds a significant research effort on these topics through the Climate Programme at the Met Office Hadley Centre and is intending to provide some additional funding support through the ARP.

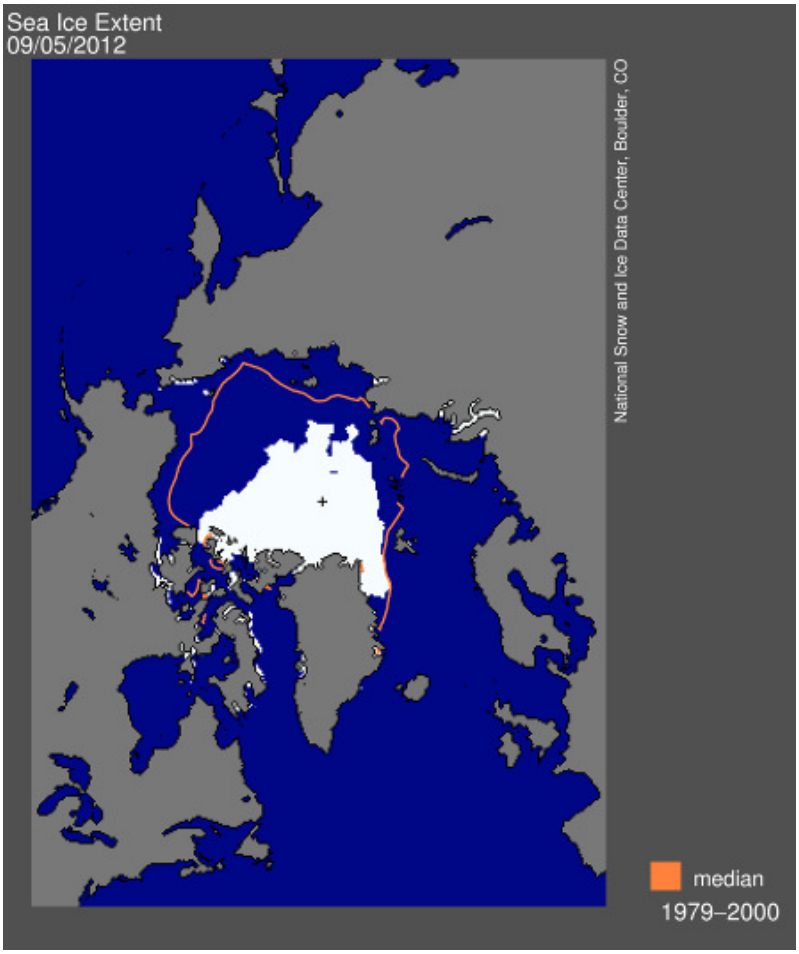

Figure 1. Sea Ice Extent on 5th September 2012.

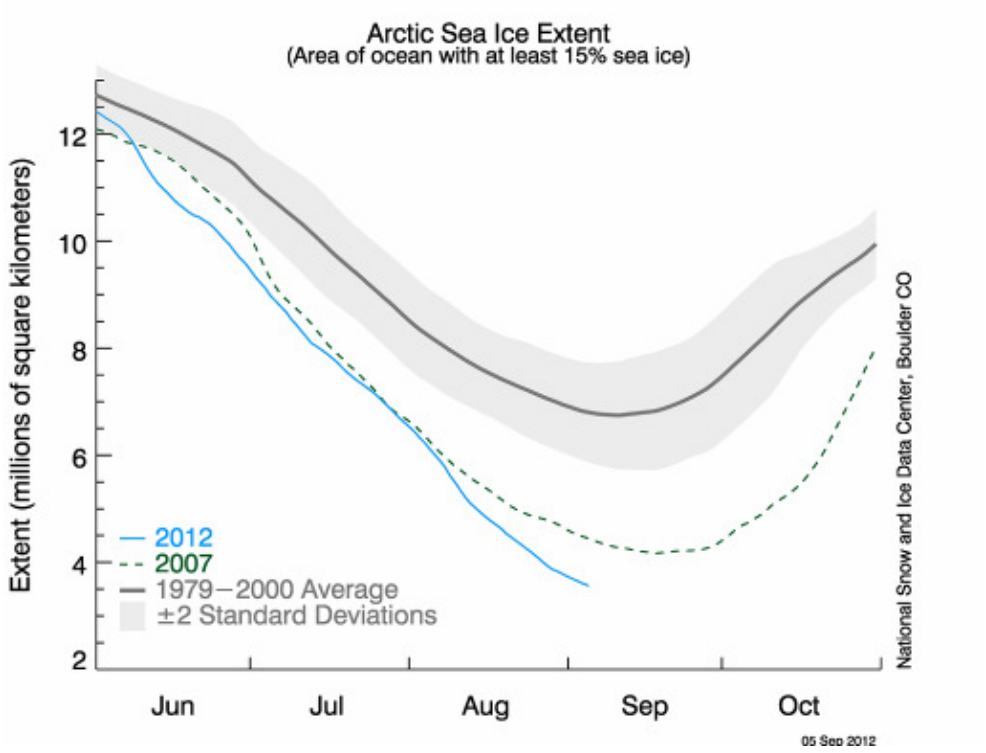

Figure 2. Arctic Sea Ice Extent Decline since June 2012.

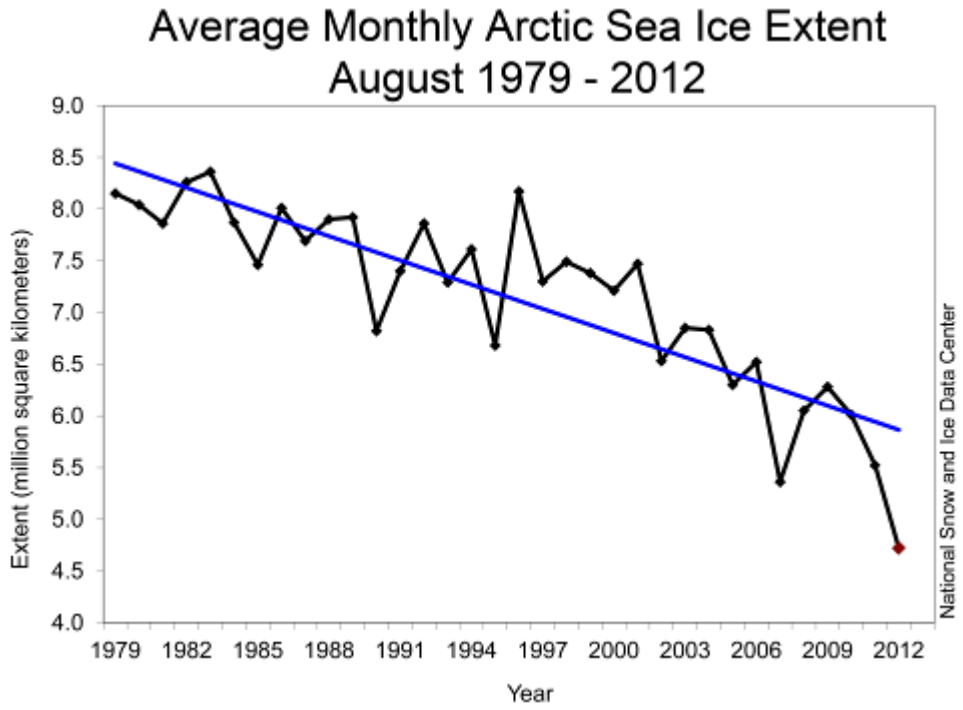

Figure 3. August Sea Ice Extents since 1979.

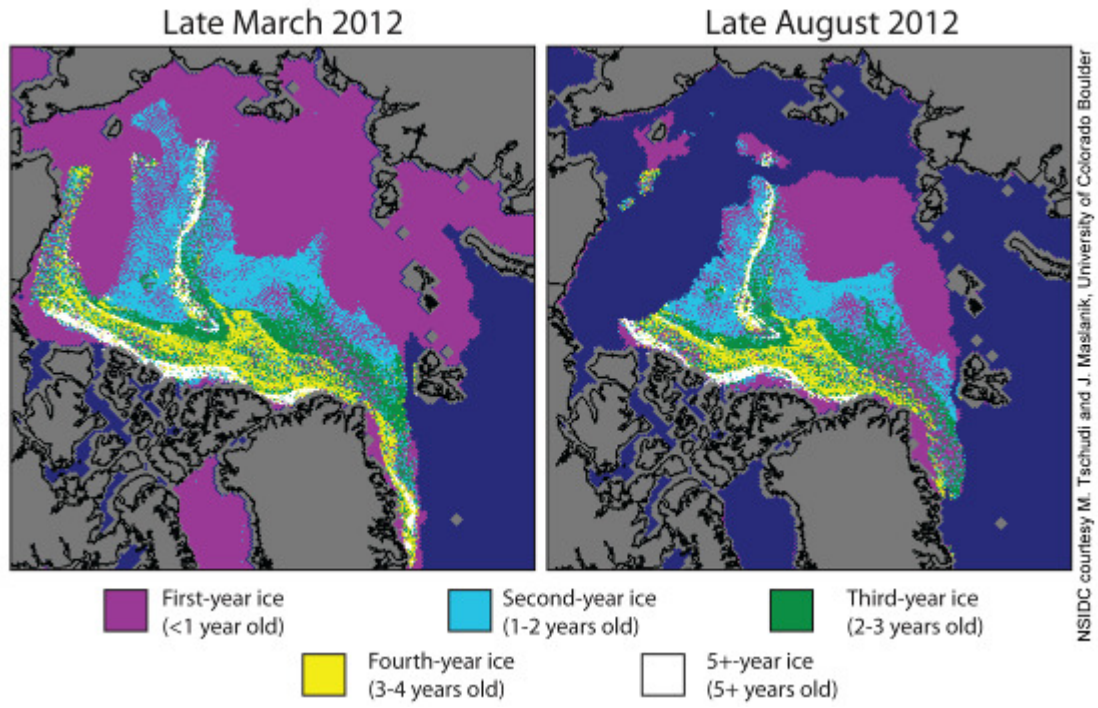

Figure 4. Extent of first year Sea-ice and Multiyear Sea-ice at maximum (March 2012) and in Late August 2012.