Addressing management implication of loss of sea-ice

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Summary

There are indications of a significant change in the sea-ice extent around Antarctica. Between 2017 and the present, the four lowest annual minimum extents have been recorded, with both 2022 and 2023 setting new records for minimum extent. The sea ice loss is not spread uniformly around the continent, it varies between regions. The SCAR Decadal Update to the Antarctic Climate Change and the Environment (ACCE) report notes that loss of sea ice is one of the ongoing changes that will present new challenges for the management of areas of high human activity in the Antarctic. **Norway and the United Kingdom recommend that the ATCM request the CEP, with the support of SCAR, to provide advice on how human activity can avoid or mitigate unintended or unforeseen negative impacts on vulnerable species or habitats affected by local or regional sea-ice loss.**

ACCE report recommendation

The ACCE report notes that the loss of sea ice is one of the ongoing changes that will present new challenges for the management of areas of high human activity in the Antarctic (including where infrastructure and other NAP assets are deployed), and underscores that the associated challenges should be urgently addressed by Parties.

Antarctic sea-ice

Antarctic sea ice plays a controlling role in the regional and global climate, and its summer melt-back is one of the most dramatic seasonal events on Earth. At its maximum extent it occupies around 18 x 106 km2, whilst at its minimum it reduces to less than 3 x 106 km2 , with most of the remaining sea ice being located in the Weddell and Ross seas. Sea ice provides an important ecological niche for many species, and it forms a barrier between the atmosphere and the ocean, modulating the exchanges of heat, momentum, fresh-water, and gases such as CO2. Sea ice is recognised by the World Meteorological Organisation as one of seven headline Global Climate Indicators which are key to describing the changing climate.

*Recent changes*

Over the last few years there are indications of a significant reduction in the sea-ice extent around Antarctica. However, loss of sea ice is not spread uniformly around the continent, it varies between regions. For example in summer 2023, the Pacific, Ross and Amundsen-Bellingshausen seas had little sea ice remaining, while the Weddell Sea and Indian sector had less substantial change.

This year Antarctica reached its minimum extent for the year, at 1.79 million square kilometers on February 21, 2023. The 2023 minimum is the lowest in the 45-year satellite record. This year’s minimum extent is lower than the previous record low set in 2022 by 136,000 square kilometers. The four lowest annual minimum extents have been recorded between 2017 and the present (2023).

Changes in the timing (phase) of sea-ice advance and retreat might be driving contemporary trends in Antarctic sea-ice. The anomalous decay of sea ice in 2016 was associated largely with a change in when sea-ice retreated (phase) rather than the amount of retreat (amplitude), with an earlier (August rather than at the end of September) and faster than usual seasonal retreat. More generally, the loss of sea ice early in the spring allows more solar radiation to be absorbed by the ocean, which can hasten the melt. The subsequently longer ice-free season leads to increased shortwave absorption in the ocean during summer months that delays sea-ice formation the following autumn.

*Long-term regional sea ice trends*

Despite global warming, Antarctic sea ice expanded slightly during most of the first four decades of satellite observations. However, in 2016 the Antarctic sea ice area plummeted, in a change far outside the range of previously observed variability. Since this time, the Antarctic sea ice extent has not recovered. Before the major sea-ice shift around 2016 it was already recorded that sea ice extent to the west of the Antarctic Peninsula had decreased 6–10% per decade with the greatest changes in autumn and summer and that the length of the sea ice season on the west of the Peninsula had reduced by ~4 days between 1979 and 2010

*The future*

In the information summary on sea-ice trends and future projections on the Antarctic Environments Portal it is noted that model projections generally agree that over the next 50 to 100 years, Antarctic sea-ice will decrease, with significant physical and biological implications for the polar region and beyond (e.g., for global climate, indirectly sea-level rise, and ecosystems). There is currently substantial uncertainty as to the magnitude, regionality, seasonality, and timing of future change in Antarctic sea-ice coverage and properties. The latest IPCC assessment report (IPCC AR6 WG1) noted that there remains low confidence in existing future projections of Antarctic sea ice extent.

Interestingly, there are indications that the western Antarctic Peninsula region is seemingly and potentially moving towards (i) lower minimum sea-ice extent, (ii) a later sea-ice advance, and (iii) earlier retreat. Taken together, the consequence is a shorter sea-ice season with more areas experiencing extended ice-free periods.

Changes in sea-ice extent increases access to (new) areas over a longer time period

While there are few data available to assess trends at this stage, experience elsewhere indicates that when new areas are made available in space and time due to decline in sea-ice extent, human activity will follow. Examples are provided below:

1. In northern Canada, between 1990 and 2012, statistically significant increases in vessel traffic were observed on monthly and annual time-scales coincident with declines in sea ice area. Ship activity also increased during the start and end of the summer season corresponding to the increasing melt season length.
2. In the Norwegian high Arctic - a major hotspot of maritime activity and retreating sea ice cover – a study has revealed a slight overall increase in fisheries and cruise activity, as well as notable trends of stretching operational seasons and expanding navigational areas in these sectors between 2012 and 2019.
3. There is anecdotal information that indicates a potential increase in activity in the southern parts of the western Antarctic Peninsula area in seasons that now experience less sea-ice obstacles than before. It is, however, too early to determine whether sea-ice cover is a cause, or part of the cause, as aspects such as ship construction and design could also be a player; as could the search for new or less used landing sites, due to the expansion of the tourism industry.

Locations, habitats or species vulnerability at the start and end of the tourist season

The examples provided above suggest that a longer ice-free period has the potential to lead to an expanded visitation season in Antarctica i.e. visitation taking place earlier in the austral summer and visitors departing later (thus extending the so-called ‘shoulder season’). This will/can expose new areas or species/habitats to increased human disturbance, including during more vulnerable periods. Some examples include, but are not limited to:

* Earlier access to penguin and other seabird colonies may contribute to a higher level of visitation and thereby higher level of stress in one of the more vulnerable periods in their life-cycle.
* Earlier access to areas previously inaccessible during the early summer season may lead to additional pressures on species that are also having to adapt to changes in their breeding and feeding area as a result of reduced sea ice extent.
* Earlier access to landing sites may contribute to a higher level of pressure on existing vegetation communities at a point when snow melt and the resulting high moisture availability make plants, mosses and lichens more vulnerable to trampling impacts.
* Periglacial features may be more vulnerable to trampling damage during wetter times earlier in the season when snow is melting.
* Expanded and longer shipping routes could have implications for marine ecosystems at the start and end of the season, for example through marine noise, whale strikes etc.

Conclusion and proposal

Under the Protocol on Environmental Protection to the Antarctic Treaty, Parties should take steps to avoid or minimise the risk of human activity leading to unintended or unforeseen negative impact on vulnerable species or habitats. Parties may therefore find it useful to have a clear general understanding of what areas and what species/habitats may be particularly vulnerable to temporal and spatial changes in human activities resulting from on-going and potential future changes in sea ice extent. Such information may be particularly relevant to discussions relating to management of human activities in the Antarctic Peninsula region; the region which already experiences the highest level and diversity of human activities, and which is experiencing the highest level of growth.

Norway and the United Kingdom recommend that the ATCM request the CEP, with the support of SCAR, to provide advice on how human activity can avoid or mitigate unintended or unforeseen negative impacts on vulnerable species or habitats affected by local or regional sea-ice loss. In the first instance:

1. SCAR could be invited to provide a first level assessment of vulnerabilities in space and time, exposed by changing sea-ice extent in the Antarctic Peninsula region; and
2. the CEP could be asked to consider potential management implications for this region, noting that it experiences high and increasing levels of human activity.