State of the Arctic heightens focus on climate policy

The deterioration of the Arctic ice cap and its climate has continued apace. Vanessa Spedding provides an update on recent developments.

Since the previous article in the *SGR Newsletter*[1] in 2013 on melt conditions and predictions for the Arctic ice cap, the decline of sea ice cover has continued with a clear and consistent trend, albeit with significant year-to-year variability.

Examining the latest Arctic observations

Latest figures from the National Snow and Ice Data Center (NSIDC) in the USA[2] show that the Arctic sea ice extent for September 2017 — the end of this year's Arctic summer — was, at 4.87 million square km, not a record low but the eighth lowest minimum of summer sea-ice cover. However the summer was characterised by localised weather conditions in the form of storms and low-pressure areas, both of which have cooling effects, and which produced a temporary rally. Conversely, winter 2016-7 *did* break a record, with measurements registering an all-time low for winter sea ice extent.[3]

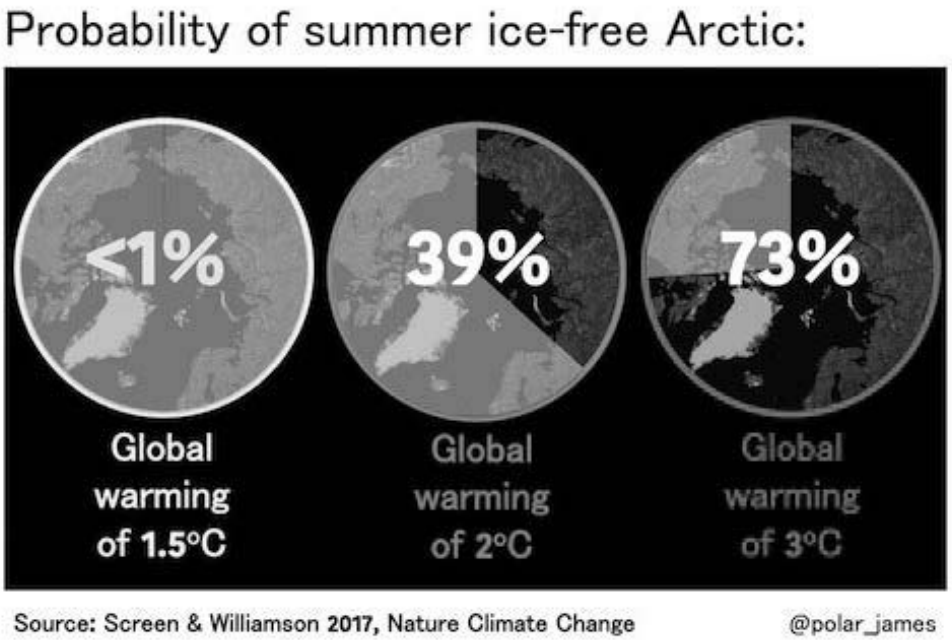
The rate of sea ice decline per decade provides a useful, longer view. For September 2017, NSIDC calculations give this figure as 13.2% per decade (relative to the period 1981 to 2010) – little changed since 2012.

Further insight into the prospects for Arctic ice is provided by assessments of its thickness, or total volume, which give indications of its quality and resilience. A rare (and dangerous) winter expedition, undertaken by Norwegian researchers in 2015, showed that winter sea ice is thinner and weaker than they expected. The scientists observed[4] that much of the older, thicker, multi-year ice is being replaced by younger ice that is thinner, more vulnerable to storms and winds, more prone to breaking up, and more likely to experience accelerating degradation, as Prof Peter Wadhams warned in our 2013 article.[1]

Overall the trends are clear and offer little comfort. A report for policy-makers published in 2017 by The Arctic Monitoring and Assessment Programme (AMAP)[5] of the Arctic Council[6] provides a comprehensive and disturbing overview of the state of the Arctic region and its prospects. The report, titled *Snow, Water, Ice and Permafrost in the Arctic* (SWIPA), is based on assessments undertaken between 2010 and 2016 and concludes that the Arctic's climate is shifting to a new state, which is warmer, wetter and more variable.

Its survey of the most recent predictions for an ice-free Arctic summer suggests this could occur as early as the late 2030s, fitting with the range of predictions made by Prof James Overland[7] and Prof Tim Lenton (referenced previously[1]) in 2013.

The SWIPA report notes that Arctic temperatures have been rising more than twice as fast as the global average for the past 50 years, that snow cover has declined steadily and that sea temperatures are also increasing.



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These observations align with recent findings by a Japanese team of researchers that include Prof Kay Ohshima and Haruhiko Kashiwase, of Hokkaido University and the Japan National Institute of Polar Research respectively, which show clear evidence of the albedo effect in action.[8] This is a positive feedback loop in which reduced reflectivity resulting from receding white ice giving way to dark water causes more of the sun's energy to be absorbed as heat, in turn causing more melting. "This study was the first to quantitatively elucidate that ice-ocean albedo feedback is a primary driver of seasonal and yearly variations in Arctic sea ice retreat," Prof Ohshima said.

Links between Arctic effects and wider climate patterns

The implications of all these trends for disruptions to wider climate stability are also growing clearer. Research by Prof Florian Sévellec at Southampton University in the UK and colleagues at Yale University in USA[9] indicates that the ongoing decline of Arctic sea ice has a slowing effect on the Atlantic Meridional Overturning Circulation (AMOC). Their climate model found the AMOC to be especially sensitive to these effects in the Arctic over multi-decadal timescales (longer than 20 years).

Prof Jennifer Francis of the Institute of Marine and Coastal Sciences at Rutgers University in the USA maintains her position[10] (as described in our previous article[1]) that there is a link between a warming Arctic and a disrupted jet stream, with effects on Northern hemisphere weather patterns.

Given the importance of Arctic sea ice to maintaining stable climate patterns elsewhere, together with the enhanced sensitivity of the region to global warming, a concerted focus on preventing further degradation of the ice would seem judicious.

According to a project earlier this year, which modelled the sensitivity of Arctic sea ice to temperature increases, there may be a clear and familiar signpost to achieving that.

Reporting in *Nature* on their study into Arctic ice melt,[11] James Screen, Associate Professor in Climate Science, and Daniel Williamson, Senior Lecturer in Mathematics, both at Exeter University in the UK, conclude that summer ice cover is "virtually certain" to survive if average global warming does not rise more than 1.5°C above pre-industrial era levels. "We estimate there is a less than 1-in-100,000 chance of

an ice-free Arctic if global warming stays below 1.5°C," said Prof Screen.[12]

However, if global warming heads to 2°C (the current target maximum stipulated by the 2015 Paris climate agreement[13]), the chances of an ice-free Arctic summer rise perilously to 39% in their model.

Answering a question on the implications of the potentially inadequate 2°C target, Prof Screen commented by email, "Are we condemning sea ice to oblivion? I would say no. I would counter such a pessimistic view by saying that our work shows that the odds of ice-free summers can be significantly reduced through strong mitigation."

"We find very low chances of an ice-free Arctic for 1.5°C," he continued. "Some may say that 1.5°C is impossible and maybe it is. But the Paris Agreement text says we should pursue efforts to limit warming to 1.5°. Even if we miss that target, limiting to 1.7° or 1.8° could still pay dividends in terms of reducing the risk of a summer ice-free Arctic, compared to 2°C, or our current pathway to roughly 3°C."

If his model is correct, the difference between the current climate target of 2°C and the "stretch" target of 1.5°C is therefore far from academic.

Even accounting for ambiguity about precisely what those targets mean (in the words of Prof Screen: "Does the 1.5°C target mean we never reach 1.5°C, or stabilise at 1.5°C, or even overshoot and come back down to 1.5°?"), and allowing for the model's restriction to only one interpretation (warming to then stabilising at the target temperature), as well as other caveats that put their estimated probabilities "likely on the low side," Prof Screen is confident that "one basic message holds true […]: 1.5°C gives us a much better chance of avoiding an ice-free summer Arctic than 2°C."

In the light of that conclusion, it is encouraging that the Intergovernmental Panel on Climate Change (IPCC) is working on a special report, due for publication in September 2018, on "the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change".[14]

Thinking about public communication

It is worth noting that to date, however, targets have made little difference to global greenhouse gas emissions. Dr Christopher Shaw, researcher[15] and author of *The Two Degrees Dangerous Limit for Climate Change*[16] — despite acknowledging the great debt owed to climate researchers and modellers for their work — countered the tendency to hang all hopes on target figures, saying, "Climate change always has been and always will be a political problem. In democratic societies politicians are not likely to move far ahead of public opinion. Rather than trying to effect change through a top-down, numbers-driven approach, the momentum for ambitious climate action needs to be built from the bottom up, grounded in the values, world views and aspirations of the people."

Calling for a climate conversation that branches out beyond "the preserve of technical experts and political elites", Dr Shaw suggested that an "inclusive peer-to-peer network of dialogues" might offer the hope of sustained buy-in from the public, which could provide "a human counterweight to what is fast becoming a terminal search for the magic number that will save us."

While the IPCC teams work through the latest numbers, scientists augment their assessments, and modellers refine their predictions of how a changing Arctic ice cap will impinge on society, life in the Arctic itself is already suffering substantial challenges and depredations. The SWIPA report identifies, among other impacts, changes to the ranges of a number Arctic species, increased occurrences of algal blooms, changes in diet among marine mammals; and altered predator-prey relationships, habitat uses and migration patterns. Terrestrial ecosystems are also feeling the effects with grazing animals such as caribou, reindeer, and musk ox struggling to meet their nutritional needs, while indigenous communities experience deleterious impacts on their livelihoods.

The reality on the ground — and the ice — calls for immediate mitigation efforts, regardless of the targets. Whether this comes thanks to an upswell of coordinated public protest or to the connection being made between a particular temperature and the prospects for civilisation, or both, the Arctic sea ice remains a bellwether, or perhaps a harbinger, of profound change.

In offering "an example of a climate threshold that is highly sensitive to the amount of warming in the 1.5 - 2°C range" (to quote Prof Screen once more), Arctic sea ice provides a critical focal point for calls to act with urgency on limiting warming.

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