Prime Meridian (88) May 23, 2018

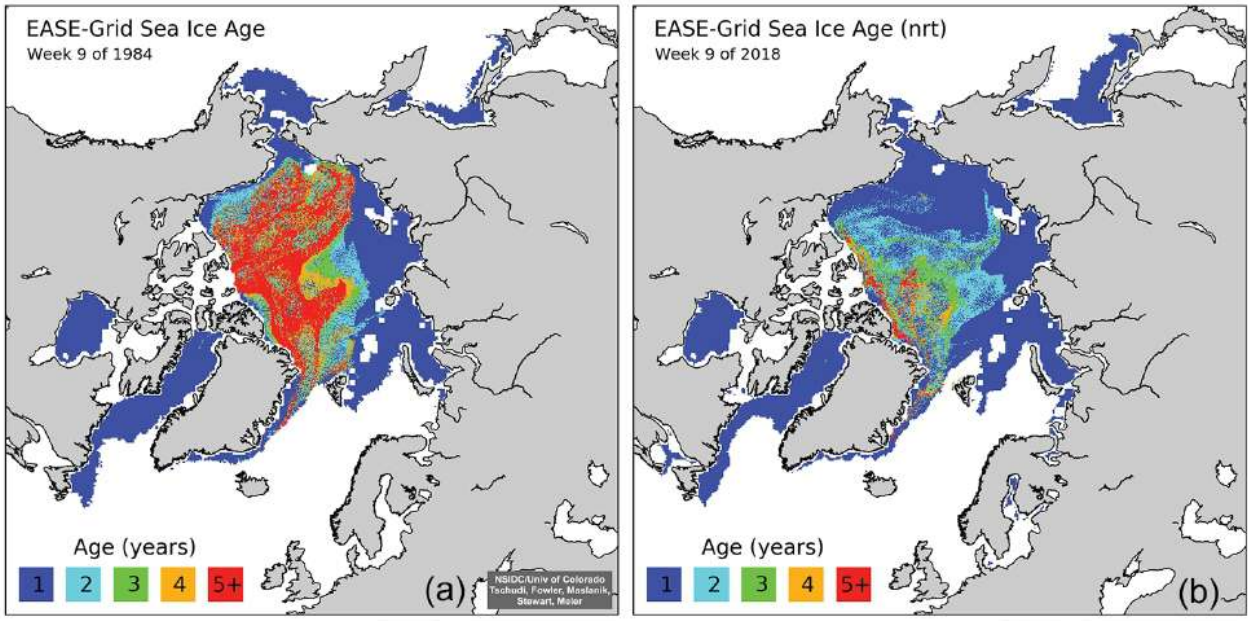
A view of the Earth from the Deep Space Climate Observatory lying 1.5 million km closer to the Sun. May 18, 2018.

In May 2018, the northern polar regions are revealing their shrinking caps of sea ice in the perpetual daylight. To the south, the prime meridian in England has baked in a string of sunny days, sometimes with almost cloudless sky. After sunset, our nearest world Venus, almost the size of the Earth, emerges in the western sky. Meanwhile, low in the east, the distant giant planet Jupiter appears into the evening sky.

Snatching a free gift from an alien ocean? Part III.

Our horizon scanning paper in 1996, argued that if plumes of water were emerging through the icy surface of Jupiter's moon Europa, space probes could explore them. This might allow astrobiologists to seek clues for possible life-forms in Europa's deep oceans. A new paper from USA researchers has adds further evidence for the reality of plumes.

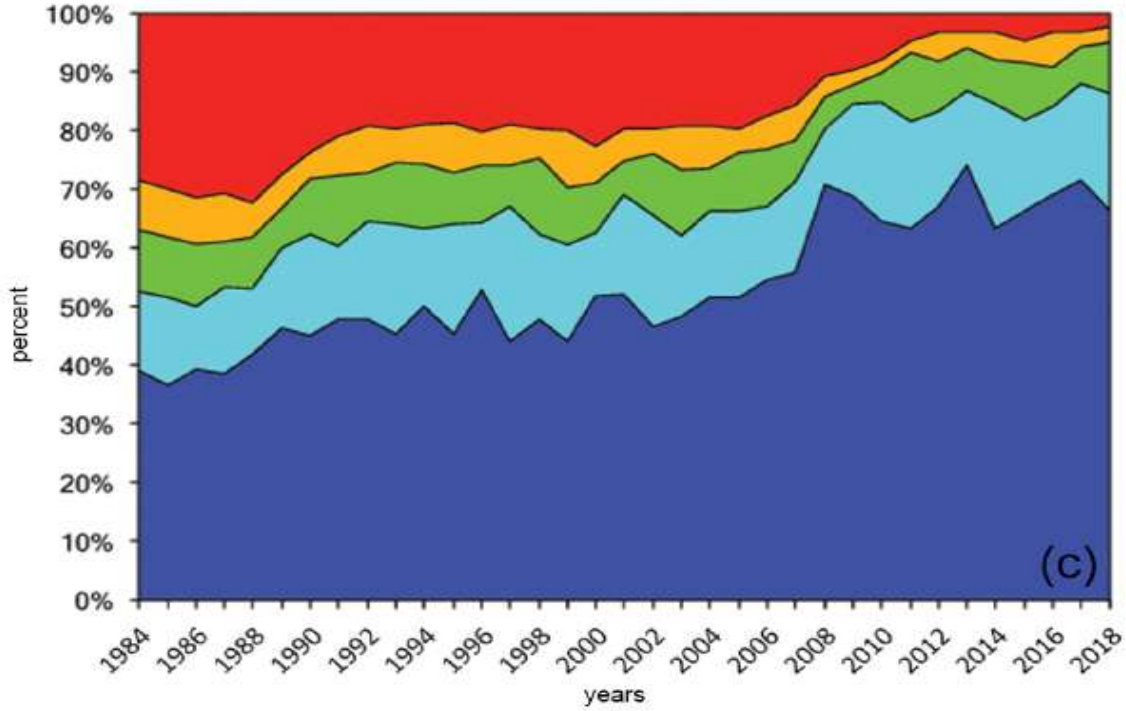
Ice Age Distribution During Week Nine in 1984 and 2018



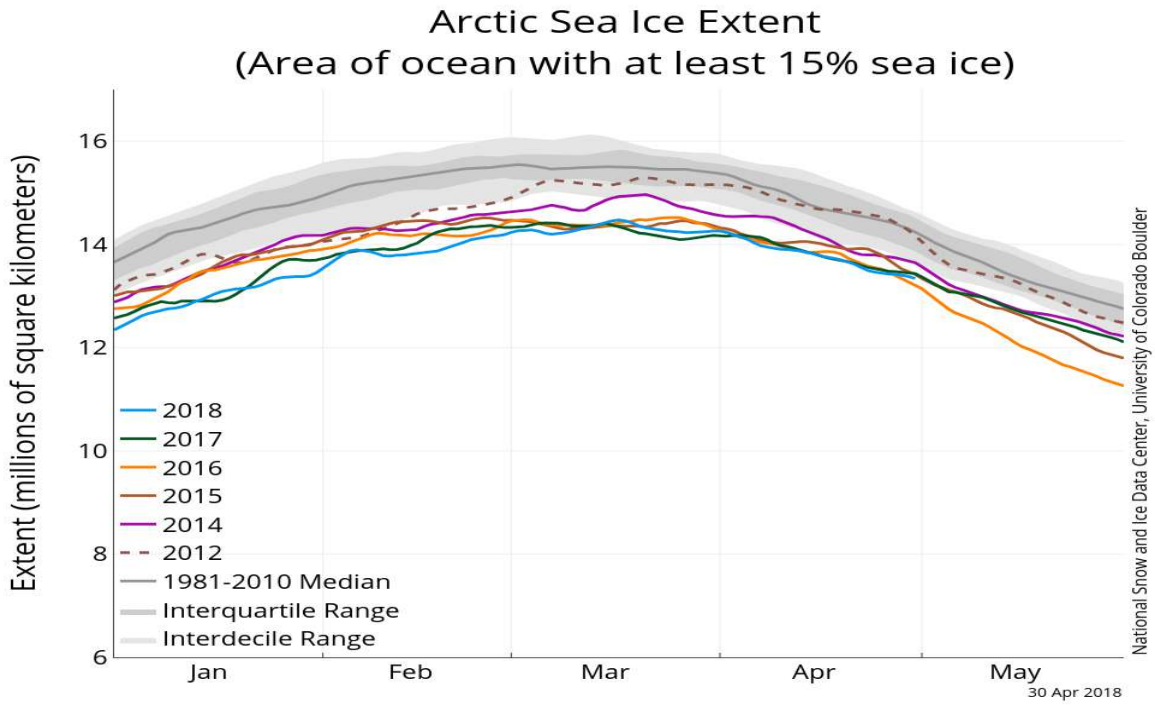
2018 continues the long-term threat to sea ice: politicians and planners

This time of year brings in images of long daylight in the northern polar regions, taken from the ground, ships, place and satellites. The DSCOVR images from the front page, provide a timely reminder to check out the latest data from the USA's Snow and Ice Data Center. The message from the Arctic is clear, unequivocal and disturbing. The Arctic is a key issue, and we, as eco-campaigners, can only keep reminding politicians that they should, themselves, continue to watch this data. There is no room for complacency. The diagrams above and below show how the decrease of the extent of sea ice over time and also has the age of Arctic sea ice has been lost. Older ice is thick and able to surface during the summer, but new ice is thinner and more likely to be melted during the warmer months. This increases the danger of near-ice loss, with summer warming of the the Arctic Ocean and major climate changes. Images by M. Ttschud, S. Stewart University of Colorado Boulder and W. Meier, J. Stroeve, NSIDC.

Percent of Sea Ice Extent During Week Nine for Different Age Classes

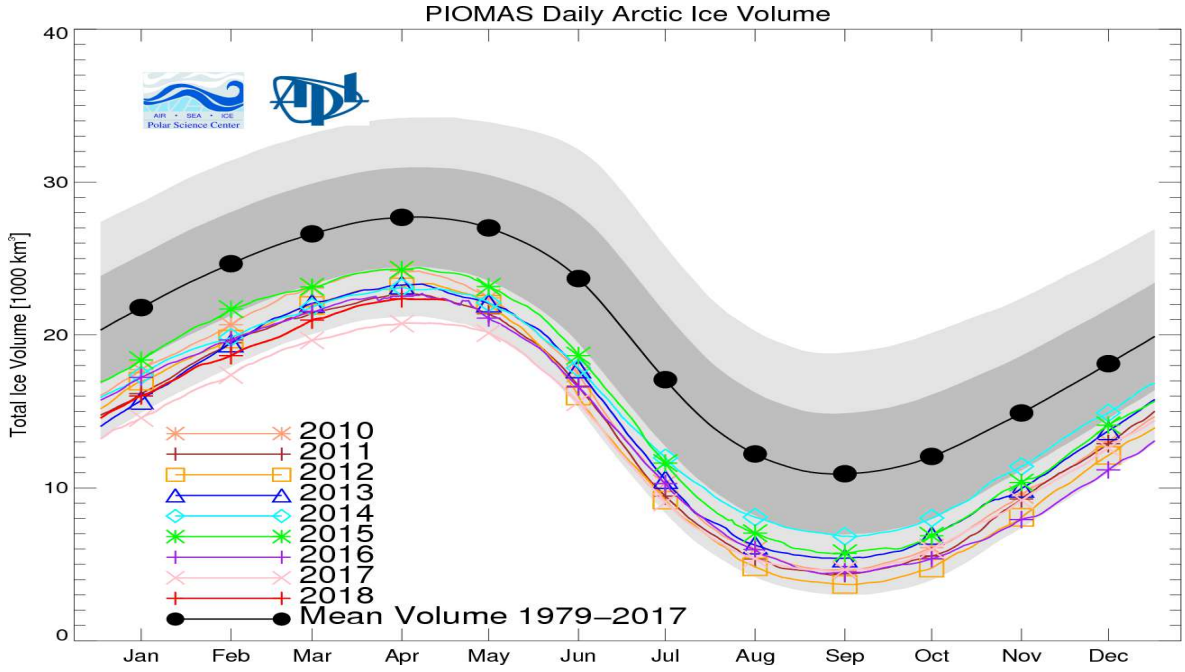


Latest estimates: 2 different measures of Arctic sea ice; they are very low.



The USA's NSIDC provides estimates of extent, which is based on the amount of sea ice covering at least 15 % of the sea; above. Winds and of ocean currents contribute to its range. During the winter months of 2018, despite the growth of Arctic sea ice during the dark, cold time of the year, long parts of the time saw the smallest extent during the period of satellite observations.

Meanwhile, the Pan-Arctic Ice Ocean Modeling and Assimilation System (PIOMAS). This looks at the ice *volume*. PIOMAS noted that the ice volume in April 2018 was 22,250 km^3. "Ice thickness anomalies anomalies 2018 relative to 2011-2017 . . . are positive in the East Siberian Sea and negative in much of the rest of the Arctic." From February to March, the volume of sea ice in 2018 was not as low as in 2017. In April, it was stated that "the second lowest on record tied with 2016 and about 1500 km^3 above the previous April record that was set in 2017 with 22,600 km^3. Ice volume was 32% below the maximum in 1979 and 19% below the mean value for 1979-2017."



Snatching a free gift from an alien ocean? Part III.

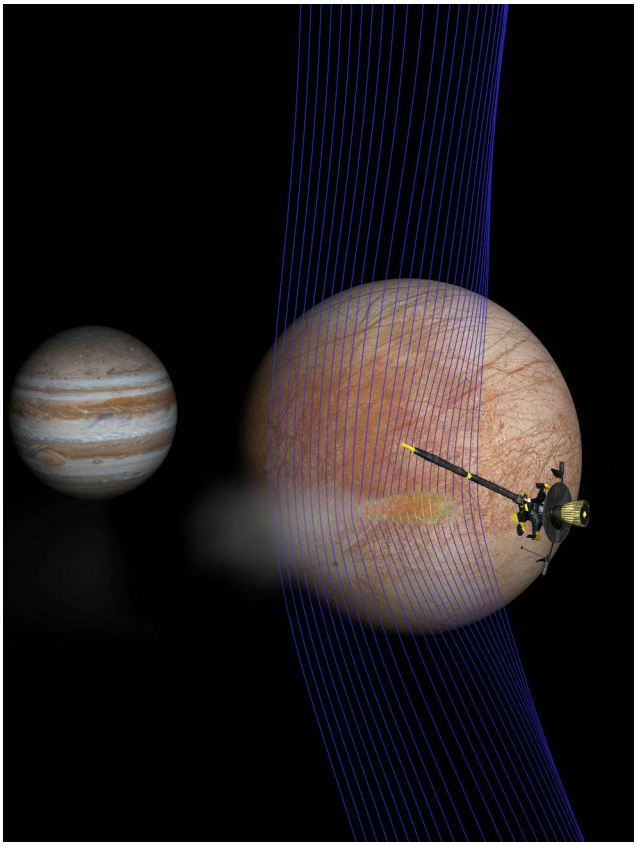
Now we can finally say (with cautious optimism): "Told you so!"

Researchers have now announced: "These results provide strong independent evidence of the presence of plumes at Europa."

Jupiter's moon Europa has a cold, icy surface about an ocean far below. In 1996, I attended the Europa Ocean Conference in San Juan Capistrano, Orange County, California (my co-author Laurance Doyle contributed text). I posed a simple possibility. If water could escape from the interior (as some had wondered), it would throw up plumes into space. We suggested that if these might carry evidence of life, they might be sampled by a future space craft. This was a way of looking for life which having, at least until we might think about ways to minimise contamination from Earth. As we have explained before, this was the kind of idea that we sometimes explore as an exercise in what is known as *horizon scanning*, simply that. I did not claimed *observation evidence* of plumes, nor *explored the physics of how plumes might escape from the ice*. I did, however, think that the idea was worth a discussion and if plumes did exist, they are were going to become a major issue.

It was a long wait to hear actual claims of plumes emerging from Europa. We explored the this evident for Europa in PM (62) November 25, 2016 and (63) December 20, 2016, and promised that we would come back for a close look. I thank my college Penelope Stanford for alerting me to a new report of plumes being discovered on Europa.

In 2014, a study which had using the Hubble Space Telescope, had find possible evidence of plumes (in the form of line emission from hydrogen and oxygen, Roth *et al*. 2014). In 2016, a different study used the Hubble Space Telescope (in the far-ultraviolet, Sparks *et al*. 2016). This possibility became yet more exciting in 2017. Spanks and co-workers now claimed to have found new evidence, not recognised at the time, but based on NASA's Galileo probe. This had been launched from space by the shuttle *Atlantis* on October 18, 1989 and entered orbit with Jupiter on December 8, 1995. The probe was finally destroyed by sending it into the atmosphere of Jupiter on September 21, 2003. They published: "a second event at the same location as a previous plume candidate from Sparks *et al*.."



This month has seen a dramatic publication from US scientists, Xianzhe Jia, Margaret G. Kivelson, Krishan K. Khurana and William S. Kurth. They provide another observation dating back to the *Galileo* probe, which approached Europa at lower than below 400 km.

In a May 14, 2018 release, NASA quoted one of the key Europa researchers: "There now seem to be too many lines of evidence to dismiss plumes at Europa," said Robert Pappalardo, Europa Clipper project scientist at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. "This result makes the plumes seem to be much more real and, for me, is a tipping point. These are no longer uncertain blips on a faraway image."

Dwayne Brown & JoAnna Wendel Headquarters, Washington and Gretchen McCartney Jet Propulsion Laboratory, Pasadena, California. RELEASE18-034. **Ji, Xianzhe *et al*. (2018).** ***Nature Astronomy*** https://doi.org/10.1038/s41550-018-0450-z. **Roth, L. *et al*. (2014).** *Science* 343: 171-174. **Sparks, W. B. *et al*. (2016).** *Astrophys. J.* 829:, 121. **Sparks, W. B. *et al*. (2017).** *The Astrophysical Journal Letters* 839:L18.

Left: From NASA. Artist's illustration of Jupiter and Europa (foreground) with the Galileo spacecraft after its pass through a plume erupting from Europa's surface.

Above: The Sun sets over the fields at Ash, Kent, after an clear day. May 22, 2018. Right (near top, look carefully): As the day ended, the planet Venus became visible in the western sky at New Ash Green, Kent.

During the summer, we will be discussing recent suggestions from planetary scientists that life may surviving even today in the high altitude clouds that shroud our closest planetary neighbour.

Prime Meridian is published by the Ecospheres Project, a trans-Atlantic research and media collaboration. It follows global environmental issues alongside the cycle of the seasons in South East England. It steps back to look at the Earth in its astronomical context and it pursues the search for other habitable worlds.

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