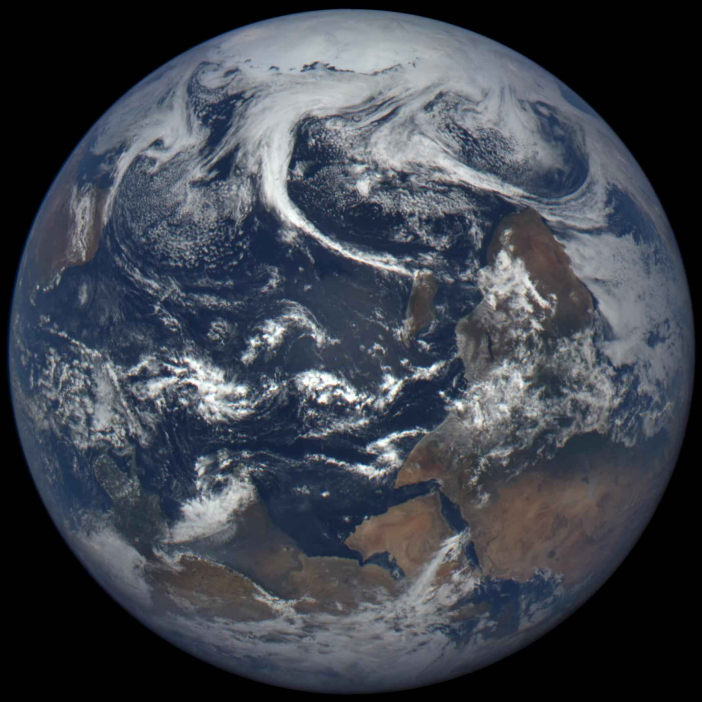
A newsletter following global environmental issues alongside the cycle of the seasons in Southern England

Prime Meridian

(47) November 30, 2015



A controversal new NASA study claims that Antarctica's ice cap is *growing*.

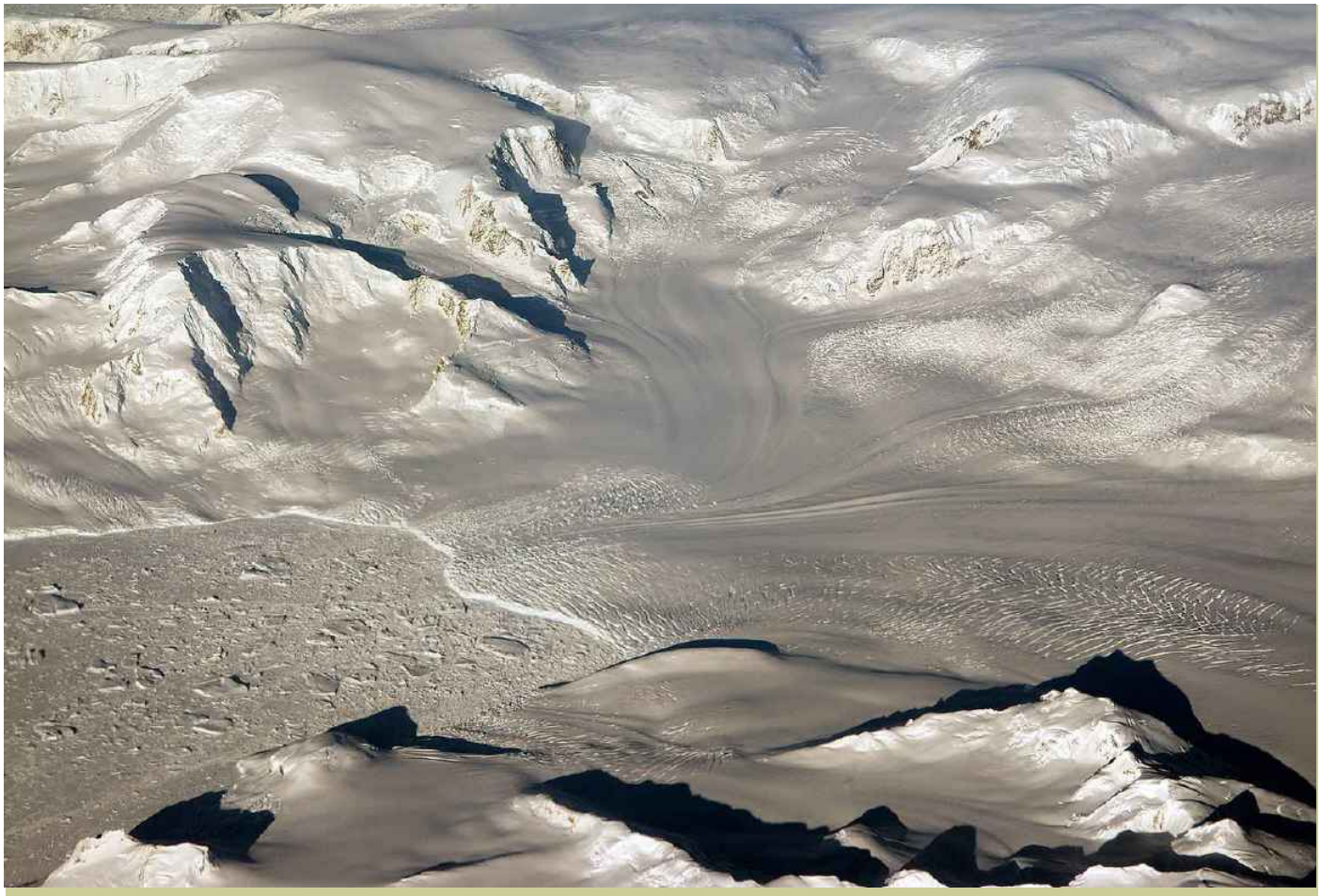
Tens of millions of people who live in low-lying areas could be displaced by rising sea levels during the coming century. Many locations of economic and/or historical importance could be inundated. Attempts to adapt will costly, but planners will be obliged to plot a course through a future that will be fraught with uncertainties. As one study follows another, estimates of how fast sea levels are going to rise continue to change, complicating the problem of how to safeguard communities and economies in the face of global disruption.

A surprising paper, whose lead author was H. Jay Zwally of the Cryospheric Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA, appeared in the October 30, 2015 issue of the *Journal of Glaciology*, with the provocative title "Mass gains of the Antarctic ice sheet exceed losses."

It has drawn fire from other researchers and it has been seized upon by politically-motivated critics of the idea that human activity can cause climate change. It leaves us with a mystery about the rate at which sea level is rising, because, overall, Antarctica has been thought to be losing ice through melting. Instead, net accumulation of snowfall would be reducing the rate of sea level rise.

Above: Earth from the NASA/NOAA DSCOVR satellite. November 17, 2015. Below: The South Pole on the same date. NOAA/NSF.

Oct. 2015: warmest October in a record beginning in 1880 and greatest departure from the 20th C mean of any month on record (page 10).



Above: An evening view of West Antarctica as seen during a return flight from one of NASA's Icebridge expeditions. Oct. 29, 2014. Credit: NASA/Michael Studinger.

"Mass changes of the Antarctic ice sheet impact sea-level rise as climate changes, but recent rates have been uncertain."

We can be certain that glaciers in West Antarctica, are melting at a disturbing rate. Zwally and co-authors explained: "*We're essentially in agreement with other studies that show an increase in ice discharge in the Antarctic Peninsula and the Thwaites and Pine Island region of West Antarctica. Our main disagreement is for East Antarctica and the interior of West Antarctica – there, we see an ice gain that exceeds the losses in the other areas.*"

The key data comes from satellite measurements of the height of the ice cap. These were carried out by radar mounted on two European Space Agency European Remote Sensing (ERS) satellites between1992 to 2001 and the laser altimeter on NASA's Ice, Cloud, and land Elevation Satellite (ICESat) between 2003 to 2008. This is more complicated than it might appear at first glance. We can't simply assume that any increase in the height of the ice cap is due to new ice being added on top from snowfall. The solid body of the Earth beneath the ice sheet will adjust its height depending upon the weight of overlying ice. It will sink as more ice is added and rise if the weight of ice decreases.

According to Zwally's press statements, previous studies "*didn't take into account the slow growth (in ice) at the center . . . instead of the Earth coming up because the ice went away, it's going down because of that*". When warmer conditions set in at the end of the last ice age, snowfall doubled because warmer air could carry more moisture into Antarctica. According to Zwally (NASA website): "*The extra snowfall that began 10,000 years ago has been slowly accumulating on the ice sheet and compacting into solid ice over millennia, thickening the ice in East Antarctica and the interior of West Antarctica by an average of 0.7 inches (1.7 centimeters) per year.*"

It was explained that: "*This small thickening, sustained over thousands of years and spread over the vast expanse of these sectors of Antarctica, corresponds to a very large gain of ice – enough to outweigh the losses from fast-flowing glaciers in other parts of the continent and reduce global sea level rise.*"

A mystery: melting in Antarctica is supposed to explain about 0.27 mm per year of sea level rise. However, if Antarctica is actually reducing sea level by roughly 0.23 mm per year, where is the observed sea level rise coming from?

What is causing sea level to rise and how fast is it rising? Sea level is rising firstly because increasing ocean temperature causes water to expand and secondly because melting of ice, in mountain glaciers and the Greenland and Antarctic ice caps, adds more water to the oceans. Sea level change in recent years has been attributed in roughly equal amounts to both (Dessler, 2012). Studies imply that the rate of sea level rise has been increasing in recent years. One recent study (Wenzel & Schroeter, 2010) found a sea level rise of 1.6 to 1.9 mm per year during the 20th Century. Another (Nicholls & Cazenave, 2010), estimated that sea level had been rising at an average rate of 1.7 ± 0.3 mm per year between 1950 to 2009, but 3.3 ± 0.4 mm per year from 1993 to 2009. Research published earlier this year (Hay *et al.*, 2015) concluded that sea level rose on average by 1.2 ± 0.2 mm per year for the period 1901 to 1990, but at 3.0 ± 0.7 mm per year for the period 1993 to 2010.

Zwally and his co-workers estimated that between 1992 and 2001, the net accumulation of ice from snowfall on the continent exceeded the loss by melting by 112 ± 61 billion tonnes per year. In the interval 2003 to 2008 the accumulation of ice on the 82 ± 25 billion tonnes per year. The latter was equivalent to a sea level fall of 0.23 mm per year. Zwally told NASA's website (October 30, 2015): "*The good news is that Antarctica is not currently contributing to sea level rise, but is taking 0.23 millimeters per year away," Zwally said. "But this is also bad news. If the 0.27 millimeters per year of sea level rise attributed to Antarctica in the IPCC report is not really coming from Antarctica, there must be some other contribution to sea level rise that is not accounted for.*"

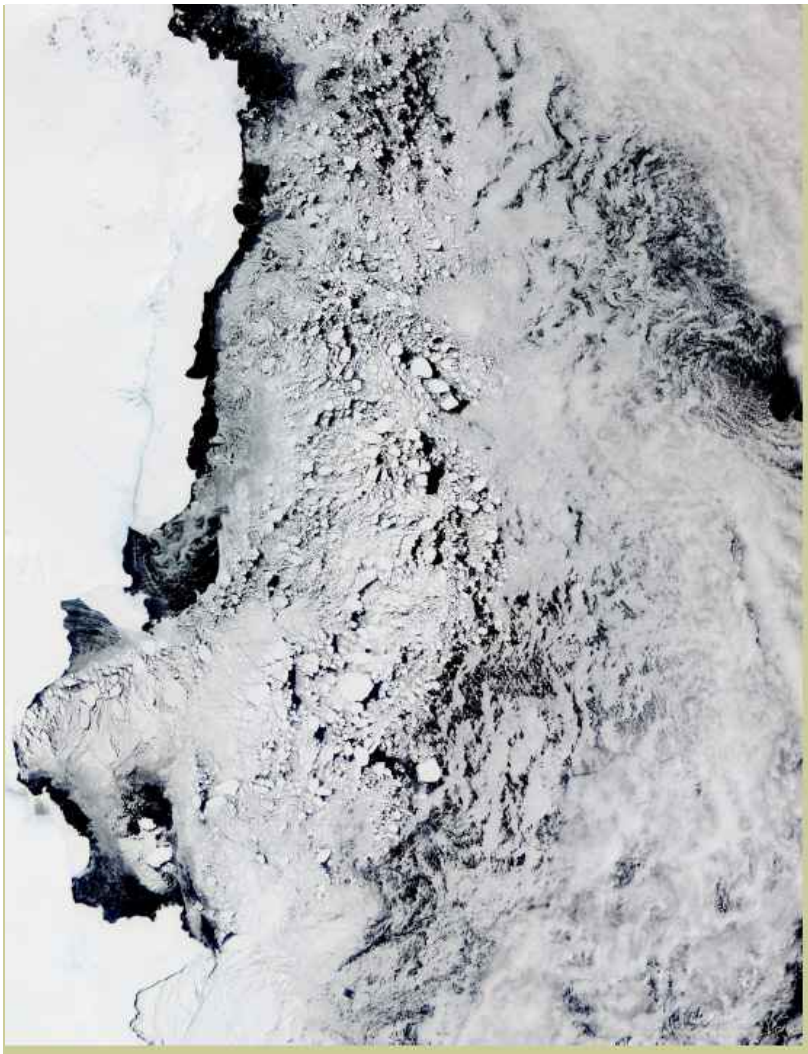
Among the unconvinced is Eric Rignot, principle scientist for the Radar Science and Engineering Section at NASA's Jet Propulsion Laboratory. He responded (quoted by Al Jazeera): "*There is no quality data to support the claims made by the authors of [ice] growth in East Antarctica*". There are plans for scientists to measure the height of the ice cap from the ground, rather than by satellite, and these investigations, it is hoped, will clarify the discrepancies between the Zwally paper and previous research.

Dessler, A. E. (2012). *Introduction to Modern Climate Change*. Cambridge Universtity Press. Cambridge, UK. **Hay, C. C. *et al*. (2015).** *Nature* 517: 481-484. **Nicholls, R. J. & Cazenave, A. (2010).** *Science Magazine* 328: 1517-1520. Bibcode:2010Sci...328,1517N. doi:10.1126/science.1185782. **Wenzel, M. & Schroeter, J. (2010).** *J. Geophys. Res.* 115: C08013. **Zwally, H. J. *et al*. (2015).** *Journal of Glaciology* 61: 1019-1036. doi: 10.3189/2015JoG15J071

Editor: M. J. Heath.
Editorial assistance: Penelope Stanford.

***Prime Meridian* is published as part of the outreach programme of the Ecospheres Project's Earth Campaign.**

Email: prime-meridian01@hotmail.com Website: www.ecospheresproject.org



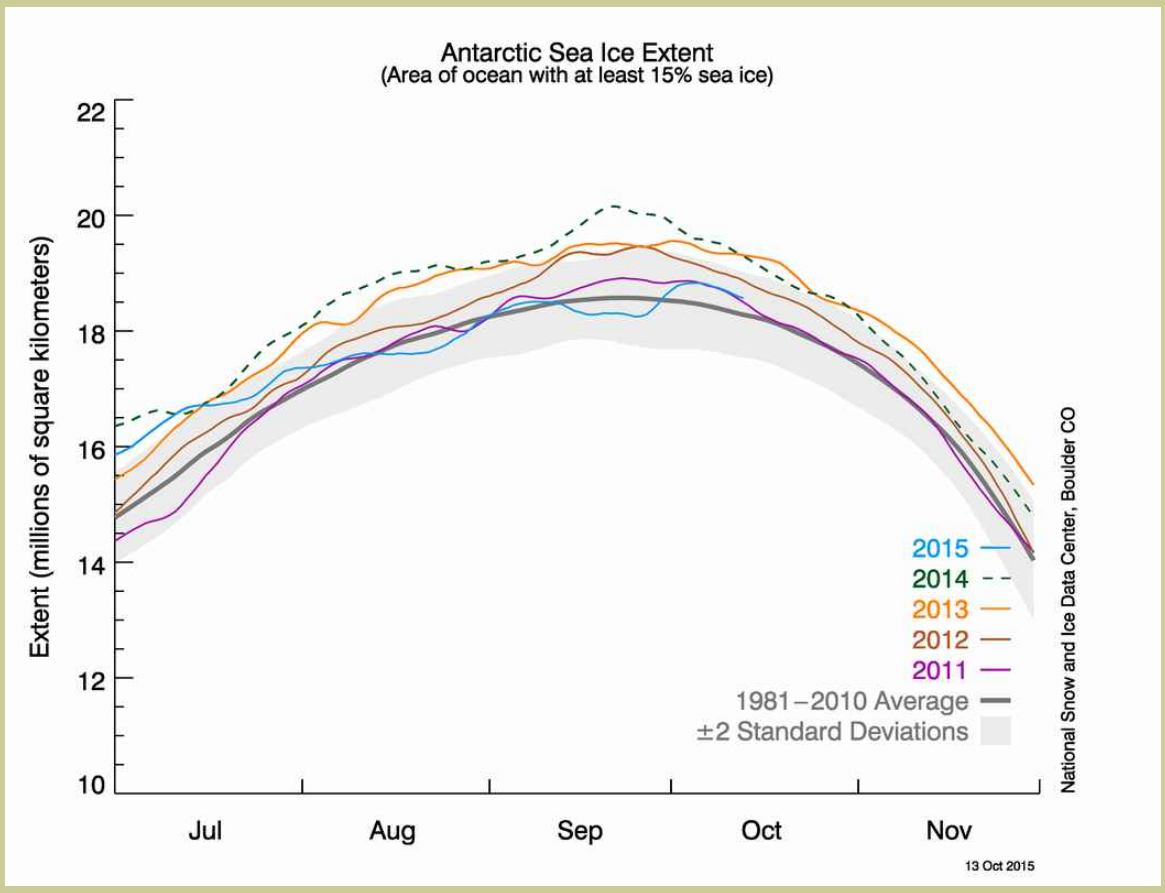
Spring in the Antarctic – autumn in the northern hemisphere.

Left: November 11, 2015. Mawson and Ingrid Christensen Coasts of East Antarctica as seen from NASA's Terra satellite. Imaged obtained by its Moderate Resolution Imaging Spectroradiometer (MODIS).

North is at the right. The continent is smothered by ice and snow. The ice clinging to the coastline is known as "fast" ice. Outwards from the coast are found icebergs and in the zone beyond, filigree patterns represent thin sea ice.

Below: A hedgerow, near West Kingsdown, Kent, on October 31, 2015 As the Sun fell towards the horizon on Halloween, it cast a mellow glow highlighting yellowing foliage. Fruits, rosehips, brambles and clematis had been ripening at the feet of beech trees.

Antarctica's sea ice expanded to an unremarkable annual maximum.



The claim that ice is accumulating on the land mass of Antarctica must be distinguished from the fact that in recent years, the sea ice around the continent has expanded. Because the sea ice is floating, it is already displacing its own weight of water and so its melting or re-freezing, unlike that of ice on land, will not affect sea level. Also, the sea ice is not an unbroken mass. Its *extent* is defined as the area over which it covers at least 15% of the ocean surface and this will be affected by currents and winds.

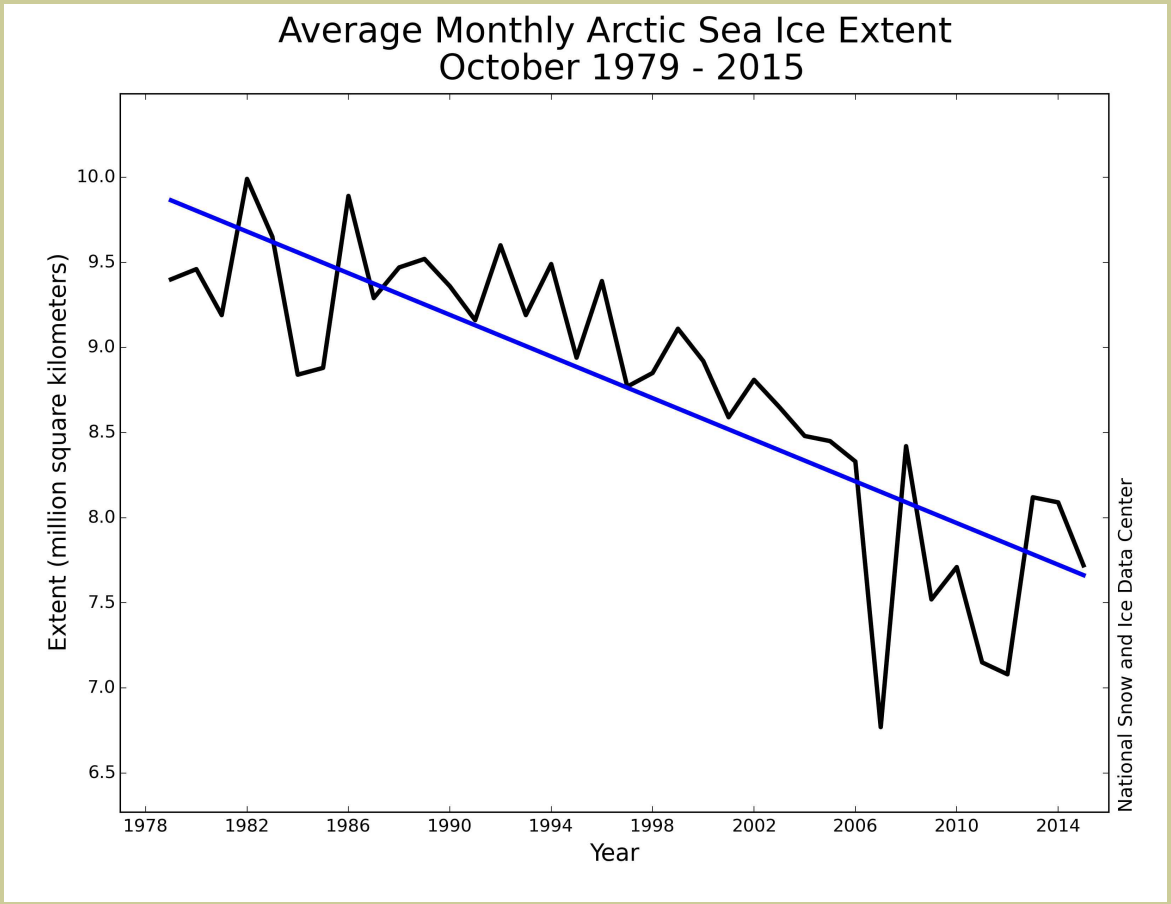
The Antarctic's sea ice reached its annual maximum extent on October 6, 2015, somewhat late in the season. Only 2002 was later (October 12). With an area of 18.83 million km^2, this maximum set no records. In fact, it came a nondescript 16th in the 35-year satellite record, only slightly above the 1981 to 2010 average.

UK's Met Office has warned ahead of December's Paris climate summit: "*The warmth of 2015 represents an important marker where global annual average surface temperature is set to reach approximately 1°C above pre-industrial levels for the first time.*"

The Intergovernmental Panel on Climate Change has adopted a rise in the mean global temperature of 2°C above the pre-industrial level as the threshold for dangerous climate change. In order to keep the temperature below this limit, (IPCC, 2014), it would be necessary to limit the total amount of CO_2 released by our civilisation to below 3,670 billion tonnes, below 2,900 billion tonnes when the release of other greenhouse gases is taken into account. Since the Industrial Revolution, we have emitted an estimated 2,000 billion tonnes (Le Quéré *et al.*, 2015) - over two thirds of this budget.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp. Le Quere, et al. (2015). **Le Quéré, C. *et al.* (2015).** *Earth Syst. Sci. Data* 7: 47-85, 2015.

Arctic sea ice continues long-term shrinking trend.

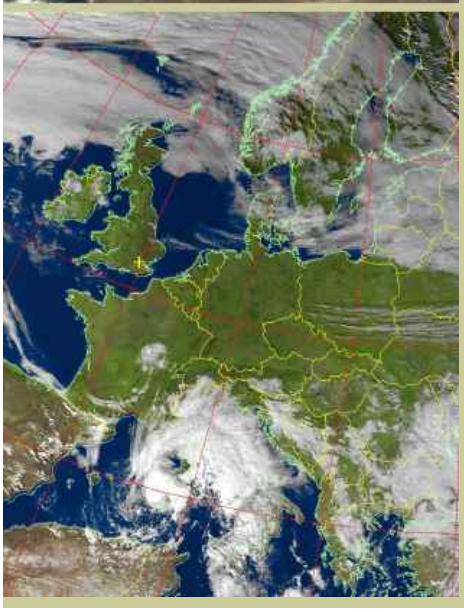


The Arctic ocean is freezing once again and the northern cap of floating ice is expanding as the Northern Hemisphere's cold season deepens. The average sea ice extent for October 2015 was 7.72 million km^2. This, reported the USA's National Snow and Ice Data Center, was the sixth lowest Arctic sea ice extent in the satellite record, some 1.19 million km^2 smaller than the 1981 to 2010 average. Looking at the data since the late 1970s, it is evident that there has been a distinct long-term trend for a reduction in the areal extent of sea ice.

Below: October 24, 2015. London planes and limes in autumnal colours, Crystal Palace Park, South London. October 27. A blue tit pecks at nuts in a back garden dispenser. New Ash Green, Kent (Penelope Stanford).

Seasons in South East England

October, 2015



Above: Rosehips and clematis had gone to seed along a hedgerow near West Kingsdown in Kent. October 10, 2015.

October was warmer and drier, but also cloudier than average.

According to the UK's Met Office: *"For much of October the weather was influenced by high pressure bringing periods of dry, settled weather and some good spells of sunshine, but with some overnight frost and fog. However, it was more unsettled with spells of rain from 5th to the 7th, and it was unsettled again for the last third of the month, but generally mild in a mostly westerly or southerly flow."*

The month opened with high pressure conditions. Clear skies and sunny conditions prevailed over the UK as can be seen in the views from space at left. They were taken on October 1 at 12:31:42 GMT by the DSCOVR satellite (NASA/NOAA) and at 12:54 GMT (lower) by NOAA-19 (courtesy Geoff Hamilton).

Right, from top: Ash (*Fraxinus excelsior*) "keys" in the vicinity of New Ash Green (Oct. 4, 2015). A fallen beech nut has been caught in ripening blackberries. Hedgerow near Near West Kingsdown, Kent (Oct. 10). Michaelmas daisies (*Aster amellus*) West Norwood. Oct.11).

Above: Field boundary trees around Ash, Kent, are yellowing. October10, 2015.

The mean temperature for the UK as a whole was 10.0°C (0.5°C above the 1981-2010 mean) and for England 10.7°C (0.4°C above the mean). The UK's highest temperature for October 2015 (22.7°C) was recorded on the first day of the month, not in the SE, but far to the north at Braemar, in Aberdeenshire.

Cloudiness increased over the UK from Oct. 3 to 4 and Oct. 5 saw persistent rain in the SE, with heavy showers in central and southern areas on Oct. 6. Oct. 5 was decidedly the rainiest day of the month at Heathrow, London, seeing 10 mm, and Oct. 6 saw 6 mm. The latter date saw Heathrow's highest temperature of roughly 19.5°C. Sunny conditions returned and on Oct. 9, the SE enjoyed the greatest benefit of sunshine. Oct. 14 saw showers persist over eastern areas and they were described as frequent and heavy in East Anglia. On Oct. 16 Norfolk and Kent were the main recipients of showers. Next day, Braemar (Aberdeenshire) witnessed the UK's lowest temperature for the month (-5.0°C). 5 mm of rain fell at Heathrow on Oct. 21. Heathrow's lowest temperature (4°C) was recorded on Oct. 25; its highest, about 19°C, on Oct. 27. The Met Office reported that:

"On the 28th, persistent heavy rain caused some flooding on road and rail networks across the southeast, with problems reported in parts of Kent, Essex, London and Cambridgeshire."

Left: Hedgerow near West Kingsdown. Oct. 10. Apple (*Malus* sp.) and sloes on a blackthorn (*Prunus spinosa*) on woodland margin, West Kingsdown. Hawthorn (*Crataegus monogyna*) along a hedgerow. Yellowing oak foliage, Belair Park, South London.

Above left: Hedgerows flanking a narrow and muddy lane near Ash, Kent. Oct. 17, 2015. Right: Field maple (*Acer campestre*) in hedgerow near West Kingsdown catches light of the setting Sun on the last day of the month.

At Heathrow, this date saw 5 mm of rain Rain continued with 3 mm on Oct. 29 and 5 mm on Oct. 30. Oct. 31 was warm, but did not break the record set last year, when Gravesend, Kent and Kew Gardens, Greater London recorded 23.6°C. The previous record had been 20.0°C. This year, at Heathrow, Halloween saw a temperature approaching 18.5°C. Sources: Met Office. Heathrow data from WeatherOnline.

SE and central S England, mean max. temp.: 14.9°C (0.1°C); mean min. temp.: 7.7°C (0.3°C). Hours of sunshine: 96.7 (85%). Rain: 58.8 mm (63%). Anomalies re. 1981-2010 norm in brackets. Source: UK Met Office.

Left: Looking across Dulwich Woods, S. London. Oct. 24. Hedgerow, near West Kingsdown. Oct. 31.Below left: View from West Kingsdown. The last day of the month draws to a close and mist gathers in the valleys. Halloween night and the first day of November 2015 were foggy in London and the nearby countryside. Below right: The light of the setting Sun catches a beech tree (*Fagus sylvatica*) in its autumnal colours.

Above: On the last day of October, 2015, a yellow tinge was spreading through the foliage of beech trees in Saxten's & Cage's Wood, Kent.

Global climate: October 2015 was another record-breaker; warmest since 1880.

The USA's National Oceanic and Atmospheric Administration reported that: "*This marked the sixth consecutive month a monthly global temperature record has been broken and was also the greatest departure from average for any month in the 1630 months of recordkeeping*". The 20th C average global temperature was 14ºC, but in October 2015, the world's land and ocean combined were 0.98 ± 0.07ºC higher. Land areas were a notable 1.33 ± 0.15ºC and oceans 0.85 ± 0.03ºC above the mean; in both cases, these were the highest departures from the mean on record. El Niño warm conditions in the central and equatorial Pacific played a large part in this and may peak during coming months.

In the N. Hemisphere, the combined mean temperature for land and ocean was 1.13 ± 0.10ºC, land areas 1.27 ± 0.12 ºC and the oceans 1.05 ± 0.03ºC above the norm. Apart from the land, which was 2nd warmest after 2011, temperatures in the ocean and land plus ocean were the highest on record. In the S. Hemisphere, the mean combined land and ocean temperature was 0.83 ± 0.06ºC, the land 1.50 ± 0.22ºC and the ocean 0.71 ± 0.03ºC above the norm; all the warmest on record.

Source: *NOAA National Climatic Data Center, State of the Climate: Global Analysis for October, 2015.* Published online. Data provisional.

The DSCOVR image of the Earth was taken on October 24, 2015 at 13:08:06 GMT. NASA/NOAA.