

Prime Meridian

(80) October 30, 2017

In South East England, nights are growing longer and the days are colder. The autumn equinox is a month behind us and the winter solstice is two months ahead. Winds and rains from the remnant of hurricane Ophelia, followed shortly by Storm Brian, have helped to pluck leaves from the trees, leaving some almost bare. At the present, however, many are holding on to their leaves and there remain large swathes of green.

Global environment:

- A remarkable hurricane season in the Atlantic has been the 7th most active in a 166 year record.
- 2017 saw an unusual, late summer episode of melting on Greenland's ice cap.
- In a warming Arctic, sea ice older than 4 years is now rare.

Right: A sign of autumn. The iconic white-spotted bright red toadstool of fly agaric (*Amanita muscaria*) appeared in silver birch (*Betula pendula*) woodland. The fungus is involved in a symbiotic association the roots of birch trees. Beacon Wood, Bean, Kent. Oct. 9, 2017.





A rogues gallery of hurricanes.

This year, a succession of impressive hurricanes has swept out of the Atlantic to batter Caribbean and American shores.

Hurricanes are intense cyclones, weather systems which rotate anti-clockwise (in the Northern Hemisphere) around centres of profound low pressure.

Most of them originate near the Cape Verde islands, off the coast of West Africa. The temperature contrast between the hot Sahara and the cooler rain forest area to the south encourages the formation of a tight, fast-moving ribbon of air, the African Easterly Jet, in the upper atmosphere.

Every two or three days, waves in the course of this jet stream produce troughs of low pressure and these have the potential to develop into storms. To qualify as a tropical storm, winds must sustain a speed of 63 km per hour for a minimum of one minute. A hurricane has winds in excess of 119 km per hour. The paths of hurricanes tend to curve towards the west, then swing back eastwards towards the mid-latitudes.

Hurricanes from upper left to : Franklin, Aug. 9 (NASA); Gert, Aug. 16 (NASA); Harvey, Aug. 25 (NOAA); Irma, Sept. 6 (NASA); Jose, Sept. 8 (NASA); Katia, Sept. 8 (NASA); Lee, Sept. 27 (NASA); Maria, Sept. 19 (NOAA); Nate, Oct. 7 (NASA); Ophelia, Oct. 14 (NASA).



Atlantic hurricane season generally runs from June to November.





Above: Three hurricanes seen by the NOAA GOES satellite on September 8, 2017. Katia is hitting Mexico, Irma is approaching Florida and Jose is out in the Atlantic. The last time that three hurricanes were active at the same time was in 2010 and, unusually, all threatened land.

This hyper-active season (which is not yet over) has earned itself a distinctive place in the annals of climate:

- It saw the greatest number of major hurricanes since 2005.
- It boasted the greatest number of consecutive hurricanes seen in the era of satellites.
- It has been one of only six recorded years with multiple Category 5 hurricanes.
- It has been the second season on record (after 2007) to feature two hurricanes making landfall at Category 5 intensity.
- It saw the strongest hurricane (Irma) ever seen gathering force in the Atlantic Ocean, beyond the Gulf of Mexico and Caribbean Sea.
- Ophelia was the easternmost hurricane and the strongest storm on record to hit Ireland.
- It has been the only hurricane season on record with three hurricanes, Irma, Jose and Maria, each having an Accumulated Cyclone Energy (ACE) exceeding 40.
- The 2017 season has seen the 7th largest ACE (over 220) in a record that began in 1851.

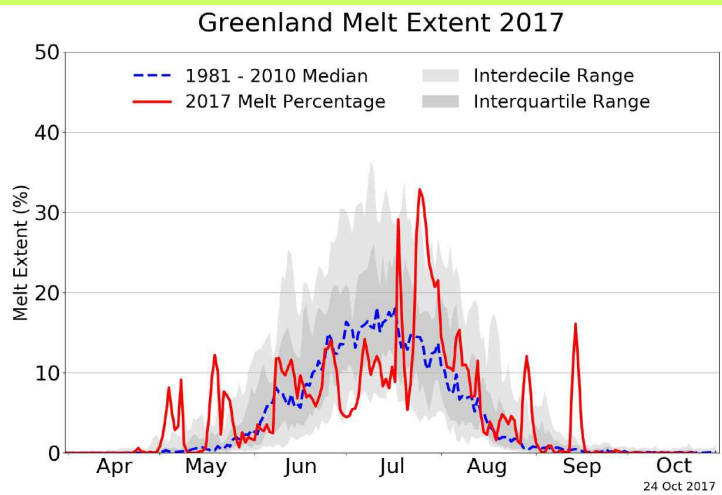
Meteorologists calculate the ACE using:

$$ACE = 10^{-4} \sum v_{\max}^2$$

The ACE for any season is based on the maximum sustained wind velocity (v_{\max}) of every cyclonic storm. Kinetic energy depends on the square of the velocity and v_{\max} is measured in knots (nautical miles per hour; nautical mile = 1.852 km). ACE is the sum of energies calculated every 6 hours for all the season's storms. The result is divided by 10,000 to reduce it to a more convenient figure. The record to date was 258.57 for 1933.



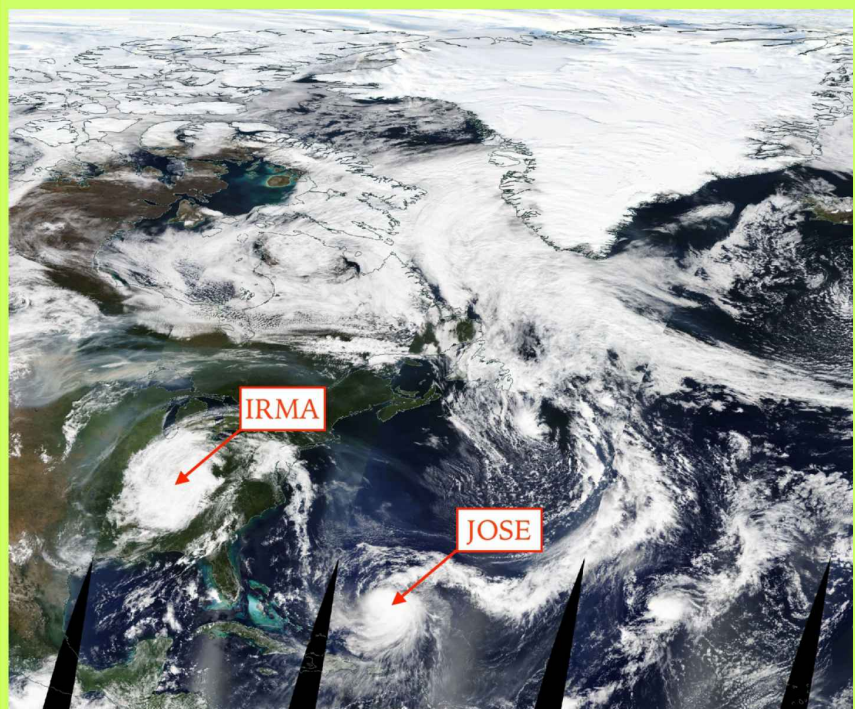
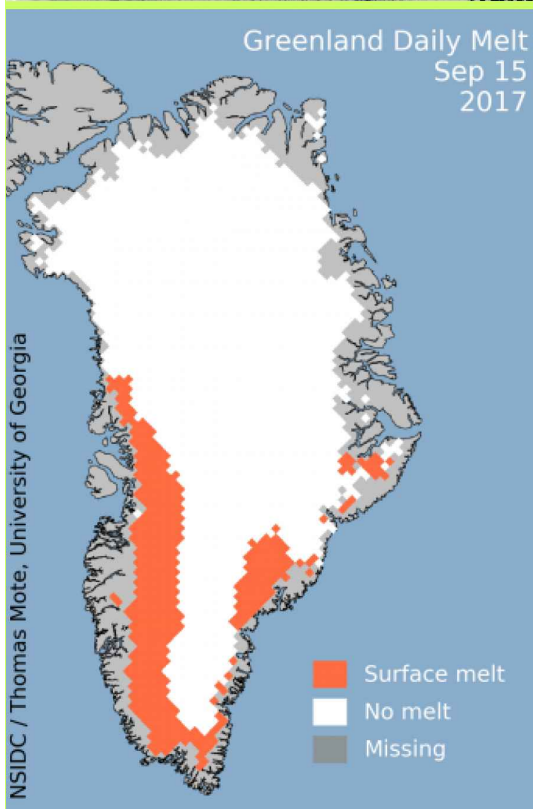
Port Arthur Texas, flooded in the wake of Hurricane Harvey. Aug. 31, 2017. Image credit: U.S. Air National Guard. Staff Sgt. Daniel J. Martinez.



A late and intense melting episode across 15% of the surface of Greenland's ice sheet.

The USA's National Snow and Ice Data Center has confirmed that: *"The late season spike is one of the largest to occur in September on satellite record (since 1978)."* The event, which lasted from Sept. 13 to 18 and peaked on Sept. 15, was caused by the arrival of air from the central Atlantic. It affected the SW and SE coastal areas and amounted to 263,000 km². NSIDC clarified that the warm air was associated with a mid-latitude frontal system further south: *"The cyclone's warm sector brought surface air temperatures well above freezing for Greenland's southern coast in addition to steady rainfall."*

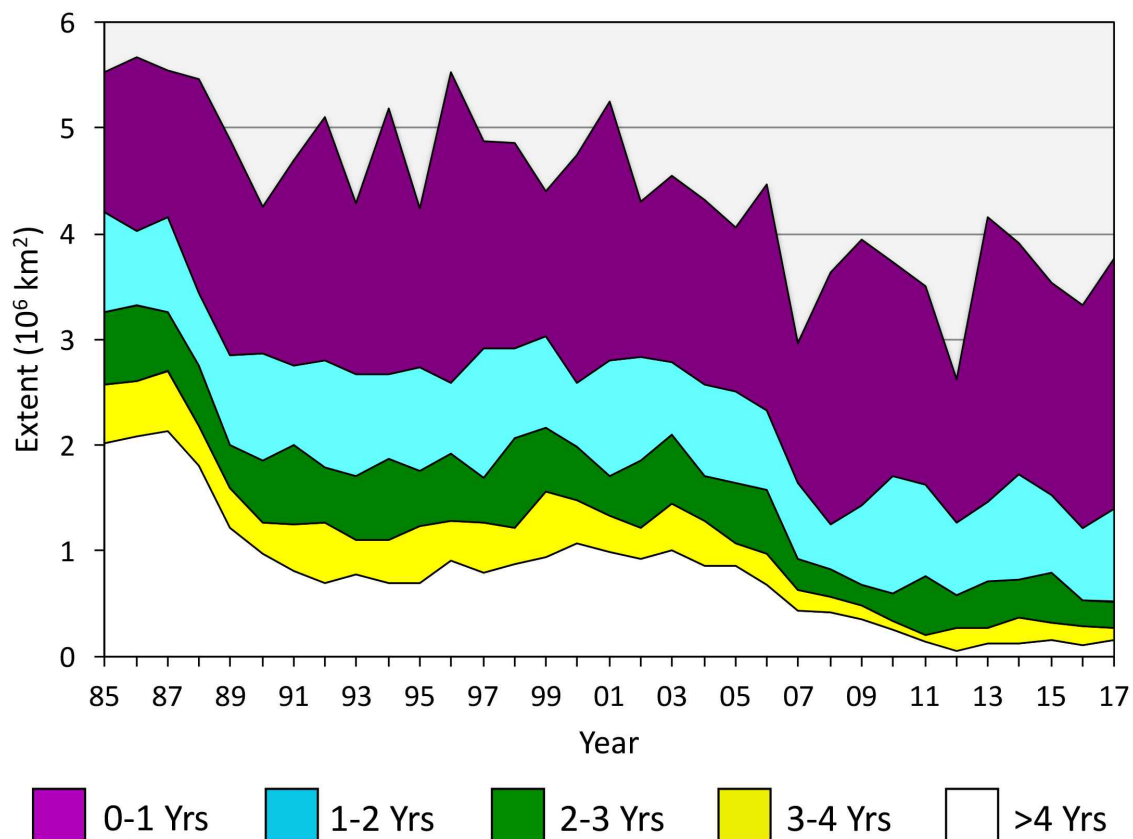
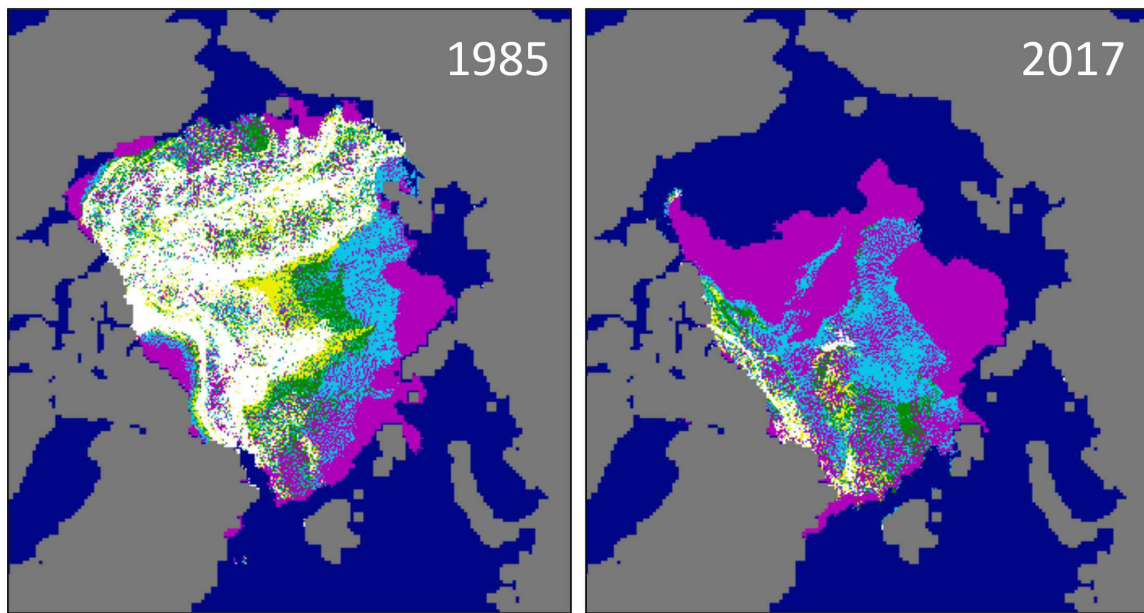
Top left: The Earth on Sept. 14, 2017 at 15:19:40 GMT (NASA/NOAA DSCOVR satellite). Top right: Greenland's 2017 melt history. Left: A true colour image of Greenland on Oct. 14, 2017. Taken with the Moderate Resolution Imaging Spectrometer (MODIS) aboard NASA's Aqua satellite. By this date, melting had essentially ceased. Below: Map of Greenland showing ice melt on Sept. 15. A NASA Worldview showing Greenland and further south, Hurricane Jose and the remains of Hurricane Irma.



Bad news for old ice.

The chart below, showing the age of sea ice in the Arctic Basin, has been published by the National Snow and Ice Data Center. In 1985, about 24% of the sea ice's extent was accounted for by first year ice. Roughly 37% was ice older than 4 years. This year, the floating ice cap was smaller and the percentages were around 63% for first year ice and less than 4% for the ice over 4 years old. The predominance of younger, thinner ice means that the Arctic is becoming more vulnerable as the climate warms.

Arctic Sea Ice Age



W. Meier/National Snow and Ice Data Center, M. Tschudi et al.



Seasons in South East England September, 2017

Above: A rural lane at Ash, Kent, two days after the autumnal equinox. Sept. 24, 2017.

Slightly cooler & wetter.

The month of the autumn equinox took a chilly turn, a premonition of colder months to come. Last year, we had a warm September, with East Anglia 2.6°C and England South East and Central South (containing London) 2.3°C above the 1981-2010 norm. In 2017, Scotland and N England managed to be warmer than normal, but most regions, were cooler. The UK's overall mean was 12.6°C (0.1°C below the norm). England's mean was 13.4°C (-0.3°C). Of all the Met Office regions, East Anglia saw the highest mean, 14.1°C, but this was 0.4°C cooler than normal. Close behind was Met Office region England South East and Central South, second warmest at 14.0°C. This was 0.5°C cooler than the September norm.

Left: The first day of the month opened with sunshine, but the end of August was wet, as was early September. Heathrow received 4 mm of rain on Sept. 3 and 3 mm on Sept. 4. The top picture was taken at Ash, and the lower at Hartley Bottom, Kent on Sept. 3.





The UK's Met Office reported that: "*September started with a weak ridge of high pressure which brought dry sunny weather to many parts, although there were some sharp showers in the east. However, the rest of the month was unsettled, with an unusually high number of rain days across England in particular.*"

The UK's warmest day (24.0°C) came early in the month (Sept. 4) and well beyond our region at Hawarden (county Clwyd, NE Wales). Early next day, the Met Office reported, the temperature fell no lower than 17°C at Shoeburyness in Essex and Bognor Regis in West Sussex. At Heathrow, the lowest temperature was not quite as low as 16°C.

September 8 and 9 both saw 7 mm of rain at Heathrow, with thundery showers widespread in the south. Tibenham in Norfolk received 42.8 mm on Sept. 8. On September 12 and 13, Storm Aileen (the first named storm of the season) swept across Britain. On September 12, the Needles on the Isle of Wight felt a gust of over 133 km per hour. The next day saw a mixture of sunny and thundery intervals, intervals, but also episodes of thunder over the South East.

On the day of the Autumnal Equinox, September 22, this year, the weather marked the occasion with a cold spell. The UK's lowest temperature for the month (-1.2°C) was recorded at that notably cold location, the hamlet of Altnaharra in Sutherland (Scotland). Meanwhile, in our region, Heathrow in Greater London also experienced its lowest temperature that day, namely 7°C. Heathrow's warmest day, however, was shortly afterwards on Sept. 24 (23°C). Rains amounted to 5 mm on Sept. 25 and 12 mm on Sept. 27.

Left: An early appearance of autumn (Sept. 2, 2017) in the churchyard of St Leonard's Church, Streatham, S. London was caused by a widespread disease of horse chestnut (*Aesculus hippocastanum*) trees. Leaves develop normally in the spring, but, by June, begin to show white blotches, which later turn brown. This is due to an infestation by caterpillars of the leaf-mining moth *Cameraria ohridella*. Leaves are heavily mined by August and drop early. On Sept. 3, puddles and yellowing hedgerow trees imparted the sense of an approaching autumn. Below: A mass of dark cloud loomed overhead at sunset. Dartford, Kent. Sept. 8. Later that evening, rain pelted down over this area, the street lights catching raindrops as streaks.





Above: A rainbow seen from the fields of Ash, Kent on September 9, 2017. Flowers of chicory (*Cichorium intybus*) at Green Street Green, Kent. Sept. 8.



Left: Rain clouds and showers seen from Ash in Kent on Sept. 9. On Sept. 11, cumulus piled high into the air above the River Thames and Houses of Parliament in central London.

Below: Sept. 11, 2017. Two views of rainbows over South London. Left is across an ornamental planting in Dulwich Park and centre looks across the leafy suburbs to the chalk North Downs, from a vantage point on Sydenham Hill.



Below right: The brown leaves of horse chestnut, broken seed cases and fruits (conkers) clog a road-side gutter in South London. Not only are horse chestnuts being assailed by leaf mining caterpillars, but also by bleeding canker. This was originally attributed to *Phytophthora*, which belongs to the fungus-like oomycetes (sometimes called "egg fungi"). Since 2000, however, a bacterium, infection *Pseudomonas syringae* pv *aesculi*, has been seen as the general cause. The future of our familiar horse chestnut is a matter of concern.





Above left: A view from the DSCOVR on September 13, 2017 at 12:32:05 GMT, when Storm Aileen was passing over Britain. Above right: Apples were ripening on the trees and fallen fruit was rotting on the ground. Sept. 12. NW Kent.

Left: Cows grazing beneath a blue sky and cumulus. Hartley Bottom. Sept. 12. Bright red ripe berries on a rowan tree (*Sorbus aucuparia*) growing on the fringes of a playing field at New Ash Green, Kent. Sept. 13. The River Thames and wind turbines at Gravesend, Kent, beneath a grey overcast. Sept. 14.



Below: A family of mute swans (*Cygnus olor*), the UK's resident swan, on the Brooklands Lake, Dartford, Kent. Sept. 17, 2017.





Autumn equinox, September 22, 2017.

In the fields around Ash, Kent, a low mist hung over the ground, in the early hours, but the sky above was clear and bright stars were visible.

The Earth's closest neighbours, the rocky terrestrial planets, were all present in the dawn twilight. Venus stood the highest, with Mars below it and Mercury closest to the horizon. Mars was the faintest and unseen, but the two other planets could be made out.

Above left. The brilliant planet Venus sat in the sky above farmlands.

Above right: Mercury above the tree on the left) rose shortly before dawn and could be glimpsed if one knew where to look.

Below: The Sun rising over a mist-filled valley.

Right: North field, near New Ash Green is managed for wildlife and as a public amenity. In the afternoon, tractors were collecting bales of hay.





As the month drew to a close, tractors were busy preparing fields for the next cycle of crops and the yellowing of the woods and hedgerows was well underway.

Looking back, we can be wise in hindsight about the predictions made by various meteorologists and eagerly taken up in some British newspaper articles, that September was set to be warm.

Monthly means for SE and central S England. Max. temp.: 18.2°C (-0.7°C); min. temp.: 9.9°C (-0.2°C). Hours of sunshine: 138.1 (93%). Rain: 71.6 mm (115%). Anomalies re. 1981-2010 norm in brackets. Date obtained from Met Office on-line monthly reports. Heathrow data from WeatherOnline.

Above: Yellowing hedgerows and narrow woodland fringing a field at Ash, Kent on September 24, 2017. Right: A patch of hawthorn (*Crataegus monogyna*) was looking autumnal while the rest of the hedge remained mostly green. Ash, Kent. Sept. 24. In hedgerows near West Kingsdown, Kent, the leaves of the roses remained green, although all that remained of the summer's flowers were rose hips. Sept. 30, 2017. Below: Looking along a hedgerow near West Kingsdown towards London, with a flock of pigeons taken to the air. Sept. 30, 2017.



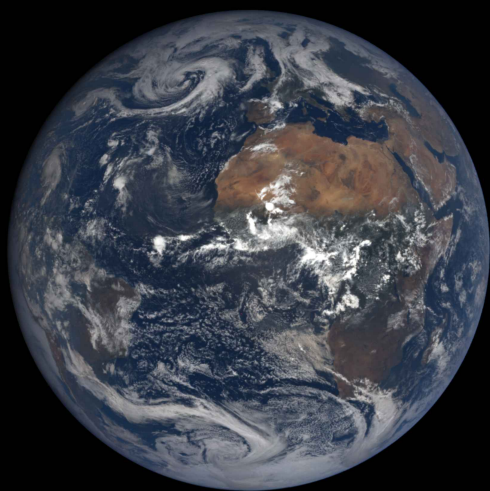
Global climate: Not a record-breaker, but the fourth warmest September.

September 2017 was another month near the top of the chart for warmth in a data series that began in 1880.

The USA's National Oceanic and Atmospheric Administration has reported that the global mean temperature for September was 0.78°C higher than the 20th Century mean of 15.0°C .

NOAA stated: *"Warmer-than-average conditions engulfed much of the world's land and ocean surfaces during September 2017, with record warmth observed across parts of central and southern Africa, southern Asia, and scattered across the western, northern, and southern Pacific Ocean, the Atlantic Ocean (specifically off the southeastern coast of South America), the Norwegian Sea, Greenland Sea, and Barents Sea, and across parts of the Indian Ocean. Near to cooler-than-average conditions across the globe were limited to western and central Russia, central Europe, the Sea of Okhotsk, the central and eastern tropical Pacific Ocean and along the western coast of South America, the northern Pacific Ocean, and across parts of western and eastern Indian Ocean. No land or ocean areas experienced record cold September temperatures."* All the anomalies quoted below are positive.

Globally, land plus oceans were $0.78 \pm 0.15^{\circ}\text{C}$ above the mean, (4th warmest, with 2015 as warmest) oceans were $0.63 \pm 0.14^{\circ}\text{C}$ above the mean (4th warmest; warmest was 2015), whilst the land areas at $1.17 \pm 0.24^{\circ}\text{C}$, were the 3rd warmest on record (2016 was warmest).



In the Northern Hemisphere, land plus ocean was $0.93 \pm 0.16^{\circ}\text{C}$ above the mean, the 3rd highest on record with 2015 as warmest. The oceans were $0.81 \pm 0.15^{\circ}\text{C}$ above the norm (4th warmest; 2015 was warmest), while the land ($1.12 \pm 0.20^{\circ}\text{C}$ above the mean), was its 5th warmest (2016 was warmest).

In the Southern Hemisphere, the combined land and ocean temperature was $0.63 \pm 0.15^{\circ}\text{C}$ above the mean (4th warmest; 2015 was warmest). The oceans were 0.50 ± 0.15 above the mean (8th warmest, with 2015 as warmest). Temperatures on land were record-breaking, however, at $1.30 \pm 0.13^{\circ}\text{C}$ above the norm, the warmest ever recorded for September.

Source: NOAA National Climatic Data Center, *State of the Climate: Global Analysis for September 2017*. Published online. Data is provisional.

Above left: Planet Earth on the day of the Autumnal Equinox, September 22, 2017, at 11:52:55 GMT. DSCOVR mission. NASA/NOAA.



A misty valley shortly before dawn on the day of the Autumn Equinox. Ash, Kent.



Above: At around solar noon, the low October sun shines through the branches of a lime tree that has already lost most of its yellowed leaves. October 21, 2017. Ash, Kent.

Prime Meridian

This newsletter is published by the Ecospheres Project, a trans-Atlantic research and media collaboration.

Prime Meridian 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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During the last couple of years, we have been grateful to Belair House Ltd (UK) for generous provision of internet facilities and to Laura Elworthy, Angus Swanson, Palash Dave, Narahari Dave and Tanim Dave (1941-2016), Helen O'Connell, Vinnie O'Connell, Sam Bentley-Toon, Dave Clark and Daniel Greenwood for valuable assistance.

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