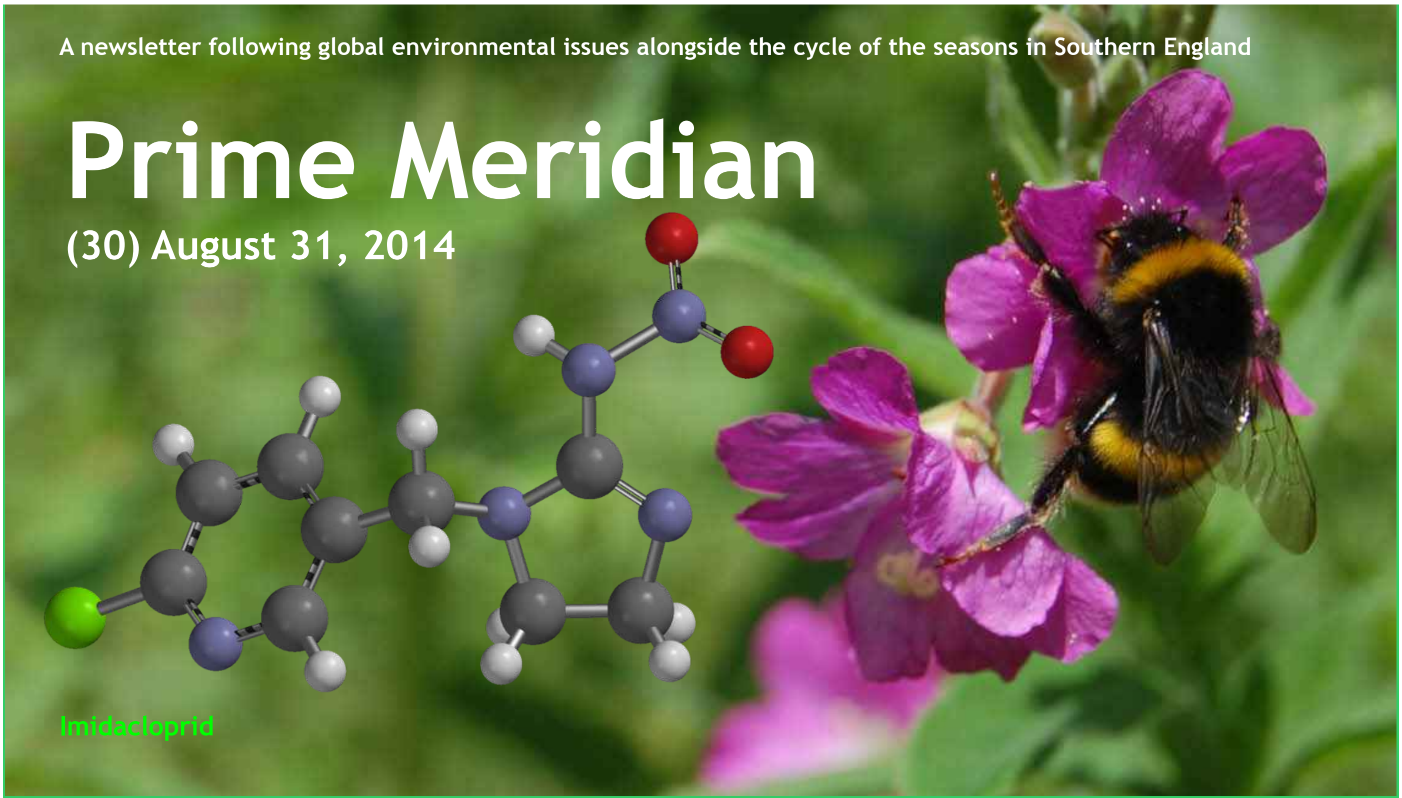
A newsletter following global environmental issues alongside the cycle of the seasons in Southern England

Prime Meridian

(30) August 31, 2014



Above right: A bumblebee alights on great hairy willowherb (***Epilobium hirsutum***) in the ecology area of Belair Park, South London. July 14, 2014. Above left: A model of imidacloprid, the first neonicotinoid pesticide, which was introduced in the early 1990s. Carbon = grey; hydrogen = white; nitrogen = blue; oxygen = red; chlorine = green.

Neonicotinoid pesticides: ongoing research is confirming concerns about their harmful effects on bees and ecosystems.

A paper published in *Nature* on July 17, 2014 warned: "*Our results on the declines in bird populations suggest that neonicotinoids pose an even greater risk than has been anticipated*." Hallmann, *et al*. (2014, p. 343).

In Prime Meridian 14 (June 30, 2013), we reported a demonstration by bee keepers on Parliament Green (in front of London's Houses of Parliament) on April 26, 2013. Since then, the case for anxiety about the use of these pesticides has continued to grow.

Here is a dilemma for human communities. The protection of crops is essential to ensuring agricultural yields and feeding the world's population. However, neonicotinoids, the worlds most widely used pesticides (which work by disabling the nervous systems of insects), pose a threat, not only to wildlife in general, but in particular to bees, which are essential for carrying out pollination – and therefore to agriculture. The scale of the potential problem is daunting because 1,500 crops are insect-pollinated and neonicotinoids amount to a quarter of insecticides used (41% of neonicotinoid use involves imidacloprid). The industry has asserted that there are no obvious problems for bees and ecosystems at concentrations actually found in the field. The credibility of such optimism is evaporating as research continues.

Dave Goulson (School of Life Sciences at Sussex University) has authored useful overviews (Goulson, 2013; 2014). Neonicotinoids attack the nervous systems of insects. They are taken up by plant tissue and safeguard plants against attacks by herbivorous insects. They are used as seed dressing with the intention that they dissolve around the seed and are taken up from the soil during plant growth. In reality, only around 5% ends up in plant tissue. 80 to 90% of the active ingredients will end up in the soil and in water bodies. Some blows away. Neonicotinoids (Goulson, 2013, p. 296): "*can be taken up by the roots of hedgerow plants, where they will have the same systemic action as in crops, spreading through the leaves and flowers. Non-target herbivorous insects such as grasshoppers, beetles, shield bugs and the caterpillars of butterflies, moths and sawflies will all be exposed through this route, and these form the food supply for a broad range of predatory insects, birds and some mammals, such as shrews and bats.*" Amy H. Easton & Goulson (2013) showed that imidacloprid repels pollinating flies and beetles at field-realistic concentrations.

Pesticides in combination can have harmful effects on foraging and bee colony survival.

Richard J. Gill of University of London Royal Holloway, and co-workers looked at how pesticides in the environment may work together to produce unwelcome effects on bees. They concluded (p.105) that: "*chronic exposure of bumblebees to two pesticides (neonicotinoid and pyrethroid) at concentrations that could approximate field-level exposure impairs natural foraging behaviour and increases worker mortality leading to significant reductions in brood development and colony success. We found that worker foraging performance, particularly pollen collecting efficiency, was significantly reduced with observed knock-on effects for forager recruitment, worker losses and overall worker productivity. Moreover, we provide evidence that combinatorial exposure to pesticides increases the propensity of colonies to fail.*" Adverse effects were found to show up as long as 2 to 4 weeks after exposure, shorter term tests could have missed them.

Impairing the homing abilities of bees.

A study with Mickaël Henry of the Institut National de la Recherche Agronomique, Avignon, France as lead author concluded that the homing ability of bees could be undermined by exposure to thiamethoxam (neonicotinoid systemic pesticide) and that this would impact negatively on colony survival. The more challenging the landscape the greater the potential impacts of impaired homing. According to Henry *et al.* (2012, p. 350): "*impact studies are likely to severely underestimate sublethal pesticide effects when they are conducted on honey bee colonies placed in the immediate proximity of treated crops. This study raises important issues concerning exposed solitary bee species, whose population dynamics are probably less resilient to forager disappearance than are honey bee colonies.*"

Massive reduction in numbers of bumble bee queens.

Penelope R. Whitehorn of the School of Natural Sciences, University of Stirling, UK and fellow researchers reported (2012, p. 352) that: "*We exposed colonies of the bumble bee **Bombus terrestris** in the laboratory to field-realistic levels of the neonicotinoid imidacloprid, then allowed them to develop naturally under field conditions. Treated colonies had a significantly reduced growth rate and suffered an 85% reduction in production of new queens compared with control colonies. Given the scale of use of neonicotinoids, we suggest that they may be having a considerable negative impact on wild bumble bee populations across the developed world.*"

Contamination harms freshwater life.

A team at Utrecht University with Tessa C. Van Dijk as lead author reported reduction in the numbers of macro-invertebrates living in bodies of surface water which had been polluted with Imidacloprid. Using 8 years of data for the Netherlands, this was the first study of this problem on a national scale. It involved 680,147 species abundance measurements at 7,380 locations and 9,037 measurements of imidacloprid concentrations at 801 locations. It was reported: "*Imidacloprid is one of the most widely used insecticides in the world. Its concentration in surface water exceeds the water quality norms in many parts of the Netherlands. Several studies have demonstrated harmful effects of this neonicotinoid to a wide range of non-target species.*" They discovered a sharp decline of macro-invertebrates between 13 and 67 nano gm per litre. "*our study, based on data from large-scale field monitoring during multiple years, shows that serious concern about the far-reaching consequences of the abundant use of imidacloprid for aquatic ecosystems is justified.*"

Ivo Roessink (Wageningen University and Research Centre, Wageningen, The Netherlands) and co-workers reported that mayfly nymphs and caddis fly larvae were particularly sensitive to imidacloprid in the short term, and that mayfly nymphs were the most sensitive to long-term exposure of the 7 invertebrate species tested.

Below: July 17, 2014, South London.

Impacts higher up the food chain – neonicatinoids can undermine bird populations.

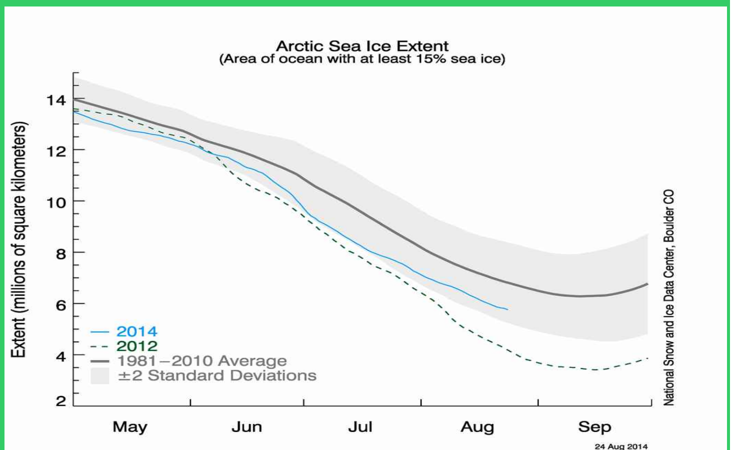
Within the last few weeks study implicating neonicotinoids in the declines of insectivorous birds has been carried out by a team led by Caspar A. Hallmann of the Radboud University, Institute of Water and Wetland Research, Departments of Experimental Plant Ecology & Animal Ecology and Ecophysiology, in the Netherlands. As noted by Hallman and colleagues (2014, p. 343): *"Farmland birds have experienced tremendous population declines in Europe in the past three decades, with agricultural intensification as the primary causal factor* [Chamberlain & Fuller , 2000; Fuller, 2000; Newton, 2004; Gregory *et al.*, 2005]. *Among aspects of intensification, pesticides are known to be a major threat to farmland birds* [Boatman *et al.*, 2004; Geiger *et al.*, 2010; Mineau & Whiteside, 2013]." *"Invertebrates constitute a substantial part of the diet of many bird species during the breeding season and are indispensable for raising offspring* [Cramp & Perrins, 1994]. . . . *we show that, in the Netherlands, local population trends were significantly more negative in areas with higher surface-water concentrations of imidacloprid. At imidacloprid concentrations of more than 20 nanograms per litre, bird populations tended to decline by 3.5 per cent on average annually. Additional analyses revealed that this spatial pattern of decline appeared only after the introduction of imidacloprid to the Netherlands, in the mid-1990s."*

The scientific evidence for the negative impact of neonicotinoids is growing. The examples of recent papers quoted above illustrate this point, but are by no means a comprehensive review of current publications. The reviews by Goulson are a good starting point for exploring the literature.

References. Boatman, N. D. *et al.* (2004). *Ibis* 146: 131-143. **Chamberlain, D. E. & Fuller, R. J. (2000).** *Agric. Ecosyst. Environ.* 78: 1–17. **Cramp, S. & Perrins, C. M. (1994).** *The Birds of the Western Palearctic*. Oxford, UK: Oxford University Press. **Easton, A. H. & Goulson, D. (2013).** *PLOS ONE* **8:** e54819. Fuller, R. J. (2000). In *Ecology and Conservation of Lowland Farmland Birds* (Eds. N . J. Aebischer *et al.* pp. 5-16. British Ornithologists' Union. **Geiger, F. *et al.* (2010).** *Basic Appl. Ecol.* 11: 97–105. **Gill, R. J. *et al.* (2012).** Nature 491: 105-109. **Goulson, D. (2013).** *Journal of Applied Ecology* 50: 977-987. **Goulson, D. (2014).** *Nature* 511: 295-296. **Gregory, R. D. *et al.* (2005).** *Phil. Trans. R. Soc.Lond. B* 360: 269–288. **Hallmann, C. A. *et al.* (2014).** *Nature* 511: 341-344. **Henry, M. *et al.* (2012).** *Science* 336: 348-350. **Mineau, P. & Whiteside, M. (2013).** *PLoS ONE* 8: e57457. **Newton, I. (2004).** *Ibis* 146: 579-600. **Roessink, I, *et al.* (2013).** *Environmental Toxicology and Chemistry* 32: 1096-1100. **Van Dijk, T.C. *et al.* (2013).** PLoS ONE 8: e62374. **Whitehorn, P. R. *et al.* (2012).** Science 336: 352-353.

Arctic sea ice continues to shrink towards its annual summer minimum, but 2014 will probably not see the smallest extent ever recorded.

The USA's National Snow & Ice Data Center noted that sea ice extent on August 17 was 1.03 million km^2 below the 1981 to 2010 mean and "*large areas of low concentration ice are observed in the Beaufort Sea and along the Siberian coast.*" However, this was 1.42 million km^2 greater than on the same date in 2012 (the year that saw the record minimum).



Summer in S.E. England. A field of ripe wheat beside St. Peter's and St. Paul's Church, Ash, Kent. July 23, 2014.

Finding our Sun's long lost sibling in the night skies of late summer

Above: Re-labelled *Stellarium* chart of the areas of Hercules. Left: Our Sun blazes down on Gravesend, Kent on July 5, 2014 (P. Stanford), around aphelion, when Earth is furthest from the Sun (101.67 %. its mean distance). *Safety tip: do not look at the Sun through camera, telescope or binoculars.*

The northern hemisphere summer wears on and the autumn equinox approaches on September 23. The constellation of Hercules (near the bright bluish star Vega in Lyra) is on view in the evening sky. Earlier this year, astronomers flagged up a nondescript star in Hercules, slightly too faint to be seen by the unaided eye, as a possible long lost sibling of our own Sun. Binoculars will reveal it easily.

Our Sun is the source of the light and heat which keeps our atmosphere gaseous and our ocean liquid. An unknown mass of bacteria live at depth in the Earth's crust. However, it is sunlight in the range 4000 to 7000 Å that powers photosynthesis, the process whereby plants manufacture their own foodstuffs from water and carbon dioxide, and which enables plants to have built up a huge biomass at the Earth's surface. 70 % of that biomass (usually quoted in terms of the amount of carbon it contains) resides in forest ecosystems (including C in the soil; see for example the figures in Solomon & Kirilenko, 1997). Could it be that our Sun's possible sibling is shining down on a life-bearing planet of its own?

Most stars are born in well-defined star clusters (or looser associations) formed through the collapse of clouds of gas and dust, so our Sun could have numerous sibling stars of the same age. Over billions of years, as a cluster continues to orbit the centre of our Galaxy, many stars will escape because of gravitational tugs from other stars and interstellar clouds and, like our Sun will then orbit the Milky Way Galaxy alone. Ivan Ramírez of the University of Texas at Austin and co-workers have argued that a star catalogued as HIP 87382 (another of its catalogue names is HD 162826) has very similar abundances of elements to the Sun. It also has an orbit around the Galaxy compatible with it being a sibling of our star, born in the same cluster nearly 4.6 billion yeas ago. Former members of the cluster, the Sun's siblings, will have been spread themselves out around the Galaxy, but by chance, HIP 87382 presently lies a mere 109 light years away. Like the Sun, it produces energy through nuclear fusion reactions in its core that convert hydrogen to helium. This is how a star spends most of its life. Eventually, when hydrogen in its core is used up, it will begin to burn hydrogen to helium in a shell around its core - which will cause it to expand into a vast, brilliant, red giant. HIP 87382 is about 15% more massive than our Sun, however, and the more massive a star is the hotter, brighter and more short lived it will be (because fusion reactions run much faster in its core). Rather larger than the Sun and with an estimated surface temperature of 6101 ± 32 K as against 5777 K for the Sun, it is actually more luminous, but it appears in our sky as a star of visual magnitude 6.56 - which could only be seen by the keenest sighted person on a very clear night.

The Sun's planets went through an early intense bombardment from smaller Solar System bodies and Ramírez *et al.* (2014) suggested that because 5 % of the debris hurled up from giant impacts on the early Earth may have been moving fast enough to escape from the gravitational clutches not only of the Earth, but even of the Solar System (Worth *et al.*, 2013), it's far from impossible that lumps of rock containing primitive life were exchanged amongst the stars of the Sun's cluster during the time that they were close neighbours. That intriguing point of light that we can see through our binoculars may not only be sibling star of our Sun, but it might also be orbited by worlds on which our sibling life-forms are thriving.

References. Solomon A. M. & Kirilenko, A. P. (1997). *Global Ecology and Biogeography Letters* **6**: 139-148. **Ramírez, I.** ***et al.*** **(2014).** arXiv:1405.1723v1 [astro-ph.SR] 7 May 2014. **Worth, R. J.** ***et al.*** **(2013).** *Astrobiology* 13: 1155-1165.

A neglected tsunami risk for the British Isles.

". . . the tsunami associated with the 1755 Lisbon earthquake killed thousands and was observed from England to Brazil. An event of comparable magnitude today would have a much more devastating impact on the North Atlantic seaboard . . ."

Despite large populations and the economic importance of coastal areas bordering the North Atlantic, there is inadequate preparation for the possibility of tsunamis. That is the warning from Matthew J. Owen and Mark A. Maslin (Department of Geography, University College London) in the correspondence section of August 2014's *Nature Geoscience*. Tsunamis in the Atlantic are eight times less likely to occur than those in the Pacific, but their impact on human populations should not be ignored.

Left: The infamous tsunami which struck Lisbon in 1755 was generated by movement along the Azores-Gibraltar fault zone. The well-known drawing left was by an unknown artist (from Earthquake Engineering Online Archive – Jan Kozak Collection KZ128).

Both the Indian Ocean 2004 and Japan 2011 tsunamis struck within 20 minutes of the earthquake which raised them, travelled several kilometres inland and the onshore surge was as high as 30 m.

A report *Tsunamis — Assessing the Hazard for the UK and Irish Coasts*, was prepared for the UK's Department for Environment, Food and Rural Affairs in 2006.

According to this report, a repeat of the Lisbon 1755 earthquake could see tsunamis 2 to 4 m high arrive in Cornwall, possibly reaching heights of 12 m onshore (Richardson, 2006). The report concluded that after a North Sea event: "*the wave would reach the coast in approximately 30 minutes, probably too short a time to issue a warning. This said, the level of hazard on the beaches for such an event could be classified as low. For the Lisbon-type tsunami, travel times are approximately four and a half hours to the Cornish coast, allowing enough time for the general public to be notified of the potential hazard providing a suitable mechanism were in place.*" Another class of tsunamis, the meteotsunamis are created by weather conditions, namely travelling air pressure disturbances. In 1992, a water surge 3 m high struck Florida. Tsunamis risks will be exacerbated by rising sea levels associated with global warming – an estimated 1 metre by 2100. Owen and Maslin stressed the necessity of long-term funding, flood warning systems and participatory evacuation exercises, and pointed out that the Japan 2011 tsunami had a smaller human impact than the Indian Ocean 2004 event, because of the greater level of preparation and education in Japan combined with coastal defences.

References: Owen, M. J. & Maslin, M. A. (2014). *Nature Geoscience* 7: 550. **Richardson, S. (2006).** *Tsunamis — Assessing the Hazard for the UK and Irish Coasts* (Defra).

Seasons in South East England

July, 2014

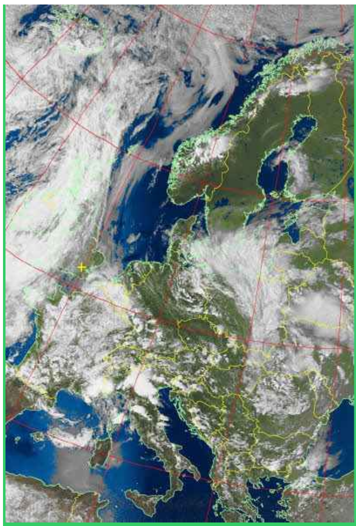
Above: Ripening fruits of guelder rose (*Viburnum opulus*) in a field margin near West Kingsdown, Kent. July 29, 2014.

Reduced rain, but thunder & downpours.

This was a warm July. According to provisional Met Office data, the average temperature was 16.3ºC, which was 1.2ºC higher than the 1981-2010 mean and unusual warmth was most pronounced during the daylight hours. The UK as a whole received 133% its usual July sunshine and this was the 8^{th} warmest July since records began in 1910. Despite lower rainfall than average (82%) for the UK, *"There was plenty of warm, dry, sunny weather, but with the warmth leading to thunderstorms and localised downpours at times; the heaviest rain was generally across the south-east and East Anglia."* Dry and bright conditions, July 3 27.3ºC at Writtle in Essex. July 5 SE saw scattered showers in the SE, whilst the east coast experienced persistent rain on July 6. this day also saw the UK's lowest temperature of 1.2ºC on Braemar (Aberdeenshire). July 7 saw showers concentrated on the SE, whilst on July 8, thunderstorms heaviest in the east. Despite sunnier conditions on July 9 it was coolest on the east coast. On July 10, rain arrived in the east from Humberside to Kent. On July 11 there were scattered showers over the South East during the morning and on the afternoon of July 12 thunderstorms broke out in the east from Humberside to Kent, although central London experienced 27ºC. The Met Office reported that: *"The showers and thunderstorms stretched down the east coast on the 13th with the heaviest in Suffolk and Norfolk; Wattisham (Suffolk) recorded 36.2 mm, with 30 mm of this falling within 1 hour during the afternoon, but it was another warm day for most places."* On July 16, there was rain in the NW, but the South East saw sunnier weather and a temperature of 27.9ºC was recorded at Writtle, Essex.

July 18, which was warmer than any previous day of 2014, saw the UK's maximum temperature of 32.3ºC at Gravesend in Kent. On July 20 the South East, Yorkshire and Lincolnshire took the brunt of thunderstorms and experienced the UK's most intense rainfall. A total of 49 mm was recorded at Norwich (46 mm of which came down in just one hour).

Left top to bottom: Skipper (*Thymelicus*) on great hairy willow herb (*Epilobium hirsutum)* in the ecology area of Belair Park (July 14, 2014). Glow worm (*Lampyris noctiluca*) in Beacon Wood, Bean, Kent (July 23). Numbers glimpsed during an informal trip appeared smaller than usual for this time of year. Honey bee on knapweed (*Centaurea nigra*, rayed version). Beacon Wood. (July, 29).



Above: Weather systems across Western Europe at 14:32 GMT. July 12, 2014. From the NOAA-18 satellite. Courtesy Geoff Hamilton. July 28: Flooding on the A40 and abandoned car, Uxbridge, Greater London (Albert Chau). Published online. Flooding in Ruislip, Souvik Das. Published online. Right, top to bottom: Strawberries ripen in a garden in New Ash Green, Kent (July 5). Chicory (*Chichorium intybus*) flowers in small meadow area in Belair Park (July 6). An inquisitive young robin (*Erithacus rubecula*), which approached the photographer in Sydenham Hill Wood, South London and posed unconcerned whilst a set of pictures were taken with flash (July 18).

It was mostly dry and sunny between July 21 and 24, with temperatures reaching 30ºC along the south coast, and on July 25 thunderstorms occurred in the south. The SE saw showers on the afternoon of July 27, and heavy thunderstorms took place in East Anglia on July 28, with 28, 51.2 mm falling at Santon Downham (Suffolk). Drier weather closed the month.

SE and central S England, mean max. temp.: 24.0ºC (2.0ºC); mean min. temp.: 13.2ºC (0.9ºC). Hours of sunshine: 274.4 (128%). Rain: 42.0 mm (81%). Anomalies re. 1981-2010 norm in brackets.

Source: online Met Office data.

Global climate: World's 4th hottest July since records began in 1880.

The run of hot months continues, but although July was up there amongst the hottest, it didn't break the record.

According to the monthly analysis of global climate published by the USA's National Oceanic and Atmospheric Administration (USA), July 2014 was, with a mean temperature of for both land and sea of 16.44ºC, 0.64°C ± 0.13ºC above the 20th Century average of 15.5ºC. This was the 4th warmest July on record, with 1998 holding the record.

For all land surfaces, the temperature was 0.74 ± 0.18ºC warmer than the average, the 10th warmest June on record (with 1998 as the warmest). In the oceans, however, the decisive warming trend evident during April, May and June 2014 continued and July 2014 tied with July 2009 as warmest in the record. The mean ocean temperature was 0.59 ± 0.06ºC above the average.

Left: Leaves of English oak (*Quercus robur*) against the summer sky in Belair Park, South London (July 13, 2014). Berries of rowan (*Sorbus aucuparia* variety) ripen on street tree, West Norwood, London (July 14). Silage harvested from a field near West Kingsdown, Kent is ready for collection (July 17). Old Man's Beard (*Clematis vitalba*) flowers on the edge of a playing field, West Dulwich, South London (July 18). Fruit of brambles (*Rubus fruticosus*) (July 18).

In the Northern Hemisphere, the temperature for the land and ocean together was 0.73 ± 0.16ºC above the mean, which was the 4th hottest on record (2010 was hottest). Land in the Northern Hemisphere was overall 0.74 ± 0.16ºC above the norm (10th warmest; warmest was 2012), however, the ocean, at 0.72 ± 0.06ºC, above the average, was the hottest on record.

In the Southern Hemisphere, the combined land and ocean temperature was 0.54 ± 0.136, which made it the 5th hottest July (hottest was 1998). The ocean, at 0.50 ± 0.06ºC above the average, the 5th highest July temperature on record, behind 1998. As for the land, with a positive temperature anomaly of 0.74 ± 0.12ºC, it this was the 8th hottest July behind 1998.

As with June, "*Neither El Niño* [warmer] *nor La Niña conditions* [cooler] *were present across the central and eastern equatorial Pacific Ocean during July 2014. Temperature departures from average in this region, a major indicator of the conditions, cooled slightly compared with the previous month. NOAA's Climate Prediction Center estimates that there is about a 65 percent change that El Niño conditions will develop during the Northern Hemisphere fall and early winter.*"

Source: NOAA National Climatic Data Center, *State of the Climate: Global Analysis for July, 2014,* published online. Data provisional.

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Email: prime-meridian01@hotmail.com

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