Prime Meridian

(7) November 27, 2012

Above: The light of a setting Sun streams into woodland under the tree canopy. Nov. 5, 2012; near Ash, Kent, England.

About the Earth Campaign.

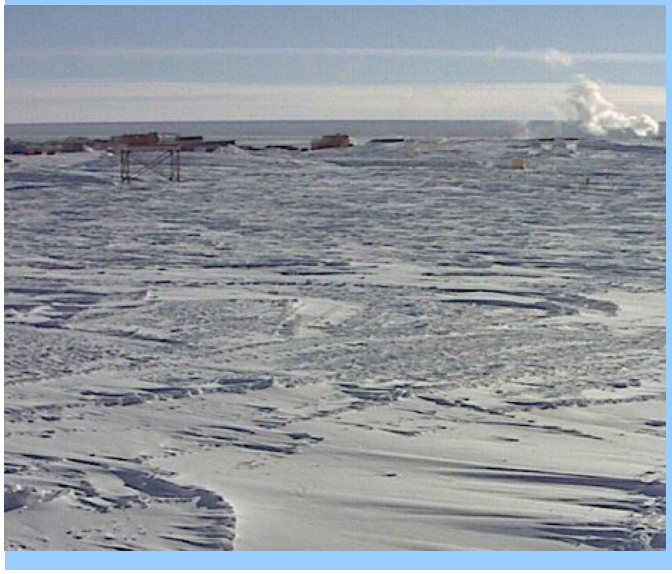
Martin Heath, Editor.

Our civilisation has brought many benefits unimaginable to earlier generations. At the same time, we face a dilemma, because many of the activities which keep it running are harming the world upon which it depends for its existence. Many campaigns are mounting heroic efforts to remind governments of the danger of doing too little too late to tackle environmental damage.

My colleagues and I are emphasising the other half of the problem: it will be impossible to achieve responsible planetary stewardship without determined, effective and continuing programmes of research into the awesomely complex planet upon which we live, into our impact upon it, and into the implications for human communities.

Anyone who believed that their desire to help the sick amounted, in itself, to a medical qualification, would be dismissed as dangerously deluded. In the same way, a desire to be planetary stewards does not qualify us to manage a planet. Governments are not uniformly failing to fund relevant research, even in this time of austerity. However, (see future issues of *Prime Meridian*) there are astonishing instances of neglect, whilst history shows us that actions taken with the best of declared intentions, but with inadequate knowledge, can fail disastrously. This is a major social justice issue; in the face of a deepening, many-sided environmental crisis, we must support a growing population, now over 7 billion. Crops, water availability and soil quality are key issues. We have limited time in which to serve our apprenticeship, graduate into competent Earth stewards and achieve long-term security for our civilisation. This may well be *Homo sapiens*' toughest challenge for the 21st Century.

The Earth Campaign arose through the Ecospheres Project, a collaboration between myself and Dr. Laurance Doyle of the SETI Institute, USA. Its focus is the search for other habitable planets. Last year, Laurance, who works with NASA's Kepler mission, led the team which discovered the first planet orbiting around two suns (but, a giant world, very different from Earth). We are presently preparing a re-assessment of what it takes for an Earth-like planet to support complex life. Exciting as this work is, we recognise that our first and most urgent priority is to safeguard the beautiful planet upon which we live: the Earth Campaign is the vehicle through which we contribute to this effort. See: http://www.ecospheresproject.moonfruit.com



Our autumn – Antarctica's spring.

On September 22, 2012, we passed through the northern hemisphere's autumn equinox. Shortly before, this summer's remarkable shrinkage of the Arctic sea ice reversed, although the new ice now forming will be thin and vulnerable to warming next summer. Meanwhile, in South East England, the weather grew colder and the trees, put on unusually colourful displays, reminiscent of the Fall in North America. As the Sun set at the North Pole, it rose at the South Pole.

Upper left: Hedgerow near Ash, Kent, England (September 29, 2012). Centre left: Brilliant colours seen on the edge of a small patch of woodland, near West Kingsdown, Kent (November 11, 2012). Lower left: Close to the South Pole, the Amundsen-Scott Station from the USA's National Oceanic and Atmospheric Administration web cam (November 19, 2012).

Antarctica & sea level rise.

Understanding what is happening in our planet's polar regions is essential if we are going to predict details of climate change. One of the key issues on which researchers are focussing is how fast ice is melting over Antarctica in response to global warming, and its contribution to rising sea levels. In the period 1993 to 2008, sea levels may have been rising by 2.61 ± 0.55 mm per year (or 3.22 ± 0.41 mm if satellite data is used as well as tide gauges). This may not seem much, but it adds up over time, increasing the risk of flooding in low lying areas, with implications for loss of life, for property and for the economy.

Data from Church, J. A. *et. al* (2011). *Geophys. Res. Lett.* **38**: L18601 (8 pages).

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Research into rising sea levels will help to reduce the human cost of more frequent floods.

In the minds of many people, social justice and the science of rising sea levels belong in separate compartments. This is understandable. The plight of refugees hit by natural or human-made disasters, particularly when brought into our homes through TV news reports, has urgency and immediacy. It calls for practical action that can be measured in terms of the numbers of tents, quantity of fuel, lorry loads of food, bottles of clean water, or crates of medical supplies that can be rushed to the area and how quickly aid workers can arrive on the scene. Often, the individual really can make a difference, even if small, and it can be as simple as making a donation.

Discussions about techniques of climate modelling, about how much more mass ice caps lose by melting rather than they gain by snowfall, or about how we should interpret gravity measurements made by satellites as they orbit over the world's great ice masses do not generate the same sense of urgency, and yet they are, even so, of direct and vital relevance. We can appreciate this, when we recall that killer floods appear regularly amongst the disasters which cross our TV screens. No less than a quarter of a million lives were lost through flooding in Bangladesh in November, 1970 and 1988's record flood level affected 80% of the country (Houghton, 2009). Around half of the world's population live in coastal areas and the economic impacts of flooding can be devastating.

NASA's Cynthia Rosenzweig is Director of the NOAA-sponsored Consortium for Climate Risk in the Urban Northeast and co-chair of the New York City Panel on Climate Change. Interviewed by Climate.gov's Brian Kahn (November 5, 2012) in the wake of Hurricane Sandy (seen right on Oct. 29, 2012; NASA image), she stressed that:

"*sea level rise is a big issue for millions of people in the U.S., not just New Yorkers. Twenty-three of the 25 most densely populated U.S. counties are on the coast. In New York, the full brunt of Hurricane Sandy has shown how powerful and damaging the effects of coastal flooding can be for infrastructure and communities.*

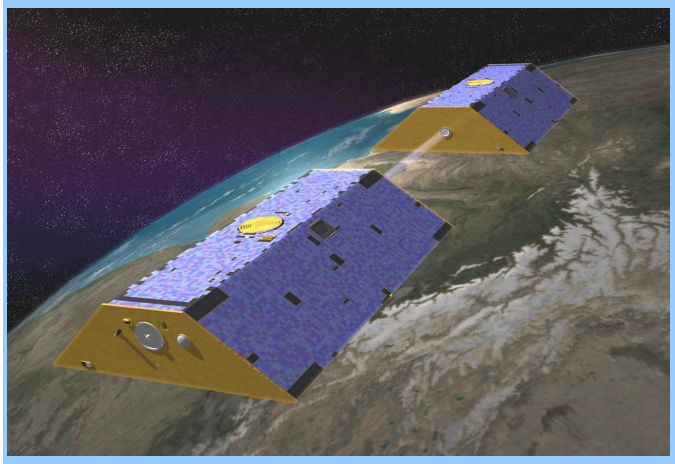
The storm itself we can't immediately link to climate change, but the flooding damage we can. As sea levels continue to rise, a storm of the same magnitude will cause even greater damages due to storm surges coming in on top of a higher "baseline" water level."

The two main causes of sea level rise are warming oceans (water expands as it heats) and melting ice sheets and glaciers. So, how does Antarctica fit into the picture? It is important, first of all, not to confuse melting of the on-land Antarctic ice cap with a recent modest expansion of *floating* sea ice surrounding Antarctica; this can form or melt without changing sea levels. Concern focusses on glacier ice which has been lost from the continent itself. This may emerge onto the sea as a floating ice tongue, but it represents ice lost from the continent and it did not form on the sea by freezing of sea water. Antarctica's average surface temperature appears to have risen by more than 0.1°C in the decade 1957 to 2006 (Steig *et al.*, 2009), with perhaps 0.17 ± 0.07°C warming in West Antarctica.

GRACE mission provides valuable insights into the state of Antarctica's ice cover.

Launched in 2002, the Gravity Recovery and Climate Experiment - a joint venture between NASA and Deutsche Forschungsanstait für Luft und Raumfahrt (DLR) - uses two satellites, one following the other with a gap of 220 km in a polar orbit some 500 km above the Earth's surface. The distance between them is measured with an accurately of 10 micrometers, and the way in which each satellite accelerates or decelerates provides detailed information about the gravity field, hence mass beneath it. There is a complication, illustrating the intricate problems with which scientists must wrestle as they learn about the Earth's environment. The weight of ice causes the ground beneath it to sink, and as an ice sheet melts, the ground will rise again. This must be taken into account when interpreting GRACE data, but there is uncertainty about the history of Antarctica's ice cover.

Below: Artist's impression of the two satellites of the GRACE mission (much closer than their real separation); NASA.



Despite the importance of nailing down the exact amount of ice that melts and accumulates every year over the continent of Antarctica, there have been huge differences in estimates. One recent study led to a figure of 246 billion tonnes, but another gave a figure nearly ten times smaller at just 31 billion tonnes. The first estimate would contribute 0.68 mm a year to sea level rise and the second, 0.09 mm a year (see references in King *et al.*, 2012). Another study (Chen *et al.*, 2009), indicated that Antarctica was losing 190 ± 77 billion tonnes of ice per year, with 132 ± 26 billion tonnes supplied by West Antarctica alone. East Antarctica appeared to be losing ice mass at 57 ± 52 billion tonnes per year.

In a new study, published in *Nature*, on November 22, 2012, Matt King (Newcastle University and University of Tasmania) and his co-workers argued that the rate at which the ground was uplifting was much slower than assumed in previous studies. Using GRACE data from August 2002 to December 2010, they came to the conclusion that East Antarctica appeared to be accumulating ice, and much of West Antarctica was close to equilibrium, but the continent's ice budget was negative overall, thanks to rapid ice loss from the area of West Antarctica facing the Amundsen Sea. King and co-workers set broad constraints on their estimates: West Antarctica lost mass at a rate between 103 and 128 billion tonnes per year, whilst East Antarctica gained ice at a rate of 7 to 89 billion tonnes per year. The overall rate of ice loss from Antarctica lay in the range 29 to 126 billion tonnes per year, but their best estimate was 69 ± 18 billion tonnes a year – contributing 0.19 ± 0.05 mm per year to rising sea levels. Ultimately, these dry figures (and uncertainties) translate into our capability to foresee threats and to adapt, protecting lives, livelihoods and agriculture from coastal flooding.

References: Chen, J. L. *et al.* (2009). *Nature Geoscience* **2**: *859-862;* Houghton, J. (2009). *Global Warming. The Complete Briefing.* 4th Edition. Cambridge, UK: Cambridge University Press. King, M. A. *et al. (2012). Nature* **491**: 586-590*;* Steig, E. J. *et al.* (2009). *Nature* 457: 459-462.

Global climate; September to October 2012 – long-term warming continues.

Preliminary data published in NOAA's monthly *State of the Climate Global Analysis.*

A pronounced and unequivocal trend for global warming was evident in data analysed by the USA's National Oceanic and Atmospheric Administration. In globally-averaged terms, the last time that a month fell below the average temperature was in February, 1985, and the last cooler than average October was in 1976.

September was one of the warmest since records began in 1880, and taking land and sea together, 2012 actually saw the warmest September on record (it tied with 2005), at 0.67 ± 0.11°C above the 20th Century average of 15.0ºC. In the Northern Hemisphere, the warming over land and ocean taken together was +0.77 ± 0.15ºC. The average combined global land and ocean surface temperature for October, 2012 tied with 2008 as the 5th warmest October on record, at 0.63°C above the 20th Century average of 14.0°C. The land plus ocean anomaly was +0.68 ± 0.09ºC for the N. Hemisphere, making it the 7th warmest October on record (2003 was the warmest).

It is a misconception that with global warming all regions must grow hotter uniformly and in step. Some regions were actually cooler than average, despite the clear overall trend. In September and October, 2012, the United Kingdom illustrated the complexities of climate, failing to follow the global trend. The first half of September was warm, but a strong low pressure system brought cooler temperatures, so that the average UK temperature was 0.7ºC below the 1981-2010 average (coolest September since 1994). This was followed by the coldest October since 2003, 1.3°C below the 1981-2010 average. Scotland actually experienced the 7th coolest October since 1910.

Seasons in South East England

September, 2012

Above: Blackberries ripening in a hedgerow near Ash, Kent. Sept. 15, 2012.

This was the UK's coolest September since 1994, but E, central and S England enjoyed above average sunshine. After contrasting weather, began with sun on Sept. 1, high pressure conditions set in from Sept. 5 to 8, with dry, fine weather. Sept. 9 to 20 was more unsettled, with rain in NW England, while the SE was drier and brighter. Sept. 9: Writtle (Essex) and Cambridge saw 29.3 °C (the UK max. temp). Then, rain, heavy in places, moved S, but Sept. 22 was generally bright. Rain and strong winds accompanied a vigorous low pressure area, which moved north across the UK from Sept. 23 (with a UK min. temp. of -4.1 °C at Braemar in Aberdeenshire). They first effected the S, but Sept. 24 to 26 saw localised flooding in N England. After sun and showers on Sept. 27, a disintegrating belt of cloud and rain moved S on Sept. 28, followed by fine weather on Sept. 29, then rain and strong winds on Sept. 30.

For SE and central S England, mean max. temp.: 18.6°C (+0.1°C); mean min. temp.: 8.8°C (-1.0°C). Hours of sunshine: 187.6 (127%). Rain: 64.1 mm (91%). Anomalies re. 1971-2000 norm in brackets. Respective figs. re. 1981-2010 norm are -0.3°C; -1.2°C; 126%; 103%.

Upper left: Old Man's Beard (*Clematis vitalba*) and hawthorn (*Cretagus monogyna*) in a hedgerow near West Kingsdown, Kent. (Sept. 29). Lower left: Elder berries (*Sambucus nigra*), near Ash, Kent (Sept. 29). Weather systems on Sept. 23, 2012 (NOAA satellite; courtesy of Geoff Hamilton). Below – a quintessentially English scene – cricket on a green near Ash, Kent (Sept. 15). Weather reviews are based on Met Office summaries published online.

October, 2012

Above: View across Dulwich woods towards London. The 309.6 m Shard is at right.

The Met Office described "*a typical autumnal mix of showers and rain for much of the time, but with a couple of short settled spells*" and first widespread frost of the season. It was the UK's coldest October since 2003, with rather wetter and duller conditions in the SE. Oct. 1 saw the month's highest UK temperature of 18.8ºC at Holbeach (Lincolnshire). Between Oct. 1 and 6, there were spells of rain associated with a low pressure area, and a gust of 125.5 km per hour was recorded at the Needles Old Battery (Isle of Wight). Oct. 7 to 10 was cloudy and mild, due to high pressure systems, then low pressure areas arrived from the Atlantic until Oct 18. An active front brought intense rain in the S and W. Mist and fog formed overnight and temperatures were close to freezing. A ridge of high pressure brought more settled conditions until Oct. 24, although the SE was cloudy with spells of rain and drizzle. Oct. 22 was mild with 18.6ºC at Bognor Regis in West Sussex. Arctic air then moved S, with sleet, snow and hail in NE England and all parts of England suffered cold and strong winds. Temperatures rose on Oct. 28 and 29, whilst rain and showers alternated with sunshine, before an active cold front arrived on Oct, 31, bringing more rain and strong winds. Met Office online data.

For SE and central S England, mean max. temp.: 13.7ºC (-0.8ºC); mean min. temp.: 7.2ºC (-0.2ºC). Hours of sunshine: 87 (77%). Rain: 129.9 mm (155%). Anomalies re. 1971-2000 norm in brackets. Respective figs. re. 1981-2010 norm are -1.2ºC; -0.2ºC; 77%; 140%.

Top left: Apples ripening on the east-facing hillside of the Rosendale Allotments Association, South London (Oct. 12, 2012). Centre left: Pumpkin ripening on the allotments (Oct, 12, 2012) and pre-Christian tradition of Halloween (Oct. 31, 2012). Lower left: Trees colouring up for autumn beside St. Peter & St. Paul's Church, Ash, Kent (Oct. 13, 2012). Right: Weather systems over Britain on Oct. 15, 2012 at 13:29 GMT. (NOAA; courtesy G. Hamilton).