IEAGHG Information Paper: 2017-IP15; WMO Statement on the State of the Global Climate

The World Meteorological Organisation (WMO) issued its annual statement on the State of the Global Climate ahead of World Meteorological Day on 23 March 2017[1]. The WMO has issued annual climate reports for more than 20 years and submits them to the Conference of the Parties of the Framework Convention on Climate Change. The annual statements complement the assessments reports that the Intergovernmental Panel on Climate Change (IPCC) produces every six to seven years.

Key headlines from the report are:

- The report confirms that the year 2016 was the warmest on record – a remarkable 1.1°C above the pre-industrial period, which is 0.06 °C above the previous record set in 2015.
- Globally averaged sea surface temperatures were also the warmest on record, global sea levels continued to rise, and Arctic sea-ice extent was well below average for most of the year.
- With levels of CO_2 in the atmosphere consistently breaking new records, the influence of human activities on the climate system has become more and more evident the WMO conclude.

The report states that the increased power of computing tools and the availability of long term climate data have made it possible today, through attribution studies, to demonstrate clearly the existence of links between man-made climate change and many cases of high impact extreme events in particular heatwaves.

Each of the 16 years since 2001 has been at least 0.4 °C above the long-term average for the 1961-1990 base period, used by WMO as a reference for climate change monitoring. Global temperatures continue to be consistent with a warming trend of 0.1 °C to 0.2 °C per decade, according to the WMO report.

The powerful 2015/2016 El Niño event boosted warming in 2016, on top of long-term climate change caused by greenhouse gas emissions. Temperatures in strong El Niño years, such as 1973, 1983 and 1998, are typically 0.1 °C to 0.2 °C warmer than background levels, and 2016's temperatures are consistent with that pattern.

Global sea levels rose very strongly during the El Niño event, with the early 2016 values reaching new record highs. Global sea ice extent dropped more than 4 million square kilometres below average in November, an unprecedented anomaly for that month.

The very warm ocean temperatures contributed to significant coral bleaching and mortality was reported in many tropical waters, with important impacts on marine food chains, ecosystems and fisheries.

CO_2 levels in the atmosphere reached the symbolic benchmark of 400 parts per millions in 2015 – the latest year for which WMO global figures are available – and will not fall below that level for many generations to come because of the long-lasting nature of CO_2.

Noteworthy extreme events in 2016 included:

- severe droughts that brought food insecurity to millions in southern and eastern Africa and Central America.
- Hurricane Matthew caused widespread suffering in Haiti as the first category 4 storm to make landfall since 1963, and inflicted significant economic losses in the United States of America,
- Heavy rains and floods affected eastern and southern Asia.

[1] https://public.wmo.int/en/media/press-release/climate-breaks-multiple-records-2016-global-impacts

Other highlights of the 2016 Statement

Global Temperatures:
2016's warmth extended almost worldwide. Temperatures were above the 1961-90 average over the vast majority of the world's land areas, the only significant exceptions being an area of South America centred on central Argentina, and parts of south-western Australia.

Mean annual temperatures at least 3°C above the 1961-1990 average occurred in various high-latitude locations, particularly along the Russian coast and in Alaska and far north-western Canada, and on islands in the Barents and Norwegian Seas. In the high Arctic, Svalbard (Norway) Airport's 2016 mean annual temperature of −0.1 °C was 6.5 °C above the 1961-1990 average, and 1.6 °C above the previous record.

Outside the Arctic, 2016's warmth was more notable for its consistency across the globe than for its extreme nature in individual locations.

Oceans
Globally averaged sea surface temperatures in 2016 were the warmest on record. The anomalies were strongest in the early months of 2016.

Global ocean heat content was the second-highest on record after 2015. It reached new record highs in the northern hemisphere, but was cooler in the southern hemisphere.

Globally, sea level has risen by 20 cm since the start of the twentieth century, mostly due to thermal expansion of the oceans and melting of glaciers and ice caps. Global sea levels rose very strongly during the 2015/2016 El Niño, rising about 15 millimetres between November 2014 to a new record high in February 2016. This was well above the post-1993 trend of 3 to 3.5 mm per year. From February to August, sea levels remained fairly stable as the influence of the El Niño declined. Final 2016 sea level data are not yet available at the time of writing.

Arctic sea ice
The seasonal maximum, of 14.52 million square kilometres on 24 March, was the lowest in the 1979-2016 satellite record. The 2016 autumn freeze-up was exceptionally slow – with sea ice extent even contracting for a few days in mid-November.

Precipitation
Much of southern Africa began the year in severe drought. For the second year in succession, rainfall was widely 20 to 60% below average for the summer rainy season (October to April) in 2015/2016.

The World Food Programme estimating that 18.2 million people would require emergency assistance by early 2017.

Provisional figures showed 2016 was the driest on record over the Amazon Basin, and there was also significant drought in north-east Brazil. El Niño brought drought conditions elsewhere in Central America and northern South America.

The Yangtze basin in China experienced, overall, its most significant flood season since 1999, with some tributaries experiencing record flood levels. Averaged over China as a whole, it was the wettest year on record, with national mean rainfall of 730 mm being 16% above the long-term average.

Heatwaves

The year started with an extreme heatwave in southern Africa in the first week of January. On 7 January, it reached 42.7°C at Pretoria and 38.9°C at Johannesburg, both of which were 3 °C or more above the all-time records at those sites.

Extreme heat also affected South and South-East Asia in April and May, prior to the start of the summer monsoon. South-East Asia was badly affected in April. A national record of 44.6°C was set at Mae Hong Son, Thailand, on 28 April, and 51.0°C was observed on 19 May at Phalodi, the highest temperature on record for India.

Record or near-record temperatures occurred in parts of the Middle East and north Africa. The highest temperature observed was 54.0°C at Mitribah (Kuwait) on 21 July which (subject to ratification) will be the highest temperature on record for Asia. Other extremely high temperatures included 53.9°C at Basra (Iraq) and 53.0°C at Delhoran (Islamic Republic of Iran – a national record), both on 22 July, whilst significant high temperatures were also reported in Morocco, Tunisia, Libya and the United Arab Emirates.

A late-season heatwave affected many parts of western and central Europe in the first half of September. In southern Spain, 45.4°C was recorded at Cordoba on 6 September.

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Evaluating technology options to
mitigate greenhouse gas emissions