Weather news

Second warmest September in UK

The Met Office reports that September 2021 was the second warmest on record across the UK, with a mean temperature of 14.7 °C. Individually, Scotland recorded its second warmest September (13.0°C), Wales its third warmest (14.8°C), England its joint third warmest (15.8°C), and Northern Ireland its joint warmest (14.2°C). Despite the warmth, Northern Ireland was also remarkably dull, with only a spatial average of 74.3h of sunshine, the lowest value for September since 1962, and the third dullest September on record. Western Scotland also saw below average sunshine (Figure 1). (Source: Met Office, *Warm September marks start of Autumn*, press release, 1 October 2021.)

Arctic sea ice in 2021– twelfth lowest in 43 years

Scientists at the US National Snow and Ice Data Center (NSIDC) have reported that Arctic sea ice extent decreased to 4.72 million km^2 on 16 September, which is considered to be the annual minimum this year. Overall, the Arctic summer was relatively cool and cloudy, due to the dominant weather patterns. This was the largest extent of ice since 2014, but also the twelfth lowest in 43 years of satellite measurements. The extent in 2021 was more than 1 million km^2 greater than the 3.82 million km^2 reported in 2020, but the long-term trend is still towards a significant reduction in ice cover. (Sources: NSIDC.org; and Thompson, T. 2021. Arctic sea ice hits 2021 minimum, *Nature*, (News), 29 September 2021, doi: 10.1038/d41586-021-02649-6.)

Growing ozone hole, and cold winter in Antarctica

A significant ozone hole opened up in 2021 in the stratosphere above southern polar regions (*Financial Times,* 1 October 2021). This year's hole is reported to be similar to that of 2020, which was one of the deepest and longest-lasting on record. However, in 2019 it was small due to the onset of a rare, disrupting sudden stratospheric warming event. The Director of the Copernicus Atmosphere Monitoring Service, Vincent-Henri Peuch, said that the scale of the 2021 ozone hole was within the top 25 percent of those recorded to date.

The scientific consensus is that the hole is undergoing a slow recovery following the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted by the UN on 15 September 1987. However, illegal use of chlorofluorocarbons (CFCs) in China is thought to have slowed progress, although unlawful use in Asia is now declining. Other causes of ozone loss are being looked at which might explain why there is slow progress in reducing the hole – for example an increase in iodine pollution is one possible factor. (Koenig TK *et al.*, 2020. Quantitative detection of iodine in the stratosphere. *PNAS*, 2020; 201916828, doi: 10.1073/pnas.1916828117.)

The winter months in Antarctica (April to September) have been especially cold during 2021, particularly at the South Pole, according to the *Washington Post* (1 October 2021). The US Amundsen–Scott South Pole Station reported a mean low of –61°C, which was the lowest since records began in 1957. The cold conditions led to an increase in sea ice around the southern continent, the areal extent becoming the fifth largest on record. The cause of this has been put down to a strong polar vortex, which prevented the cold air from escaping to lower latitudes.

Assessment of ERA5 in the Antarctic

A group of scientists have assessed the ECMWF reanalysis near-surface dataset (ERA5) for its performance over the Antarctic. Both ERA5 and ERA-Interim were compared against data from 41 weather stations. The study found some regional differences, with good correlations in the west of the continent, but lower in the east. Overall, the temperature trend from ERA5 was found to be broadly consistent with observations, with a cooling trend dominant in East and West Antarctica, while a warming trend has been evident in the Antarctic Peninsula during most months of the year. Overall, ERA5 was found to provide an important tool for assessing climate

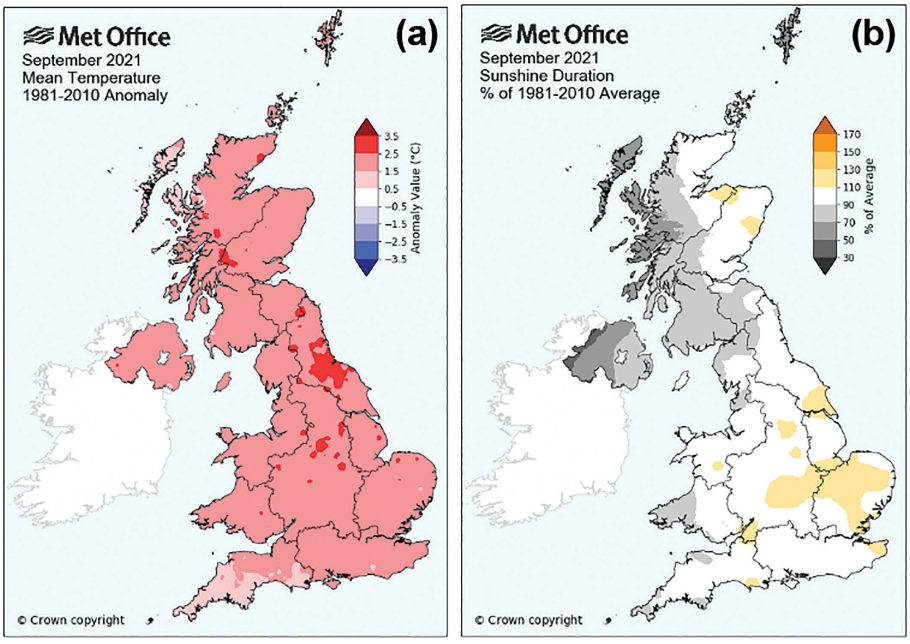

Figure 1. September 2021: (a) mean temperature and (b) hours of sunshine.

change in the Antarctic, where observations are limited. (Zhu *et al*. 2021. An assessment of ERA5 reanalysis for Antarctic near-surface air temperature, *Atmosphere* 12: 217, doi: 10.3390/atmos12020217.)

La Niña forecast to return this winter

NOAAs Climate Prediction Center (CPC) in its weekly report *ENSO: Recent Evolution, Current Status and Predictions* (20 September 2021) has forecast that there is a 70–80 percent chance that La Niña conditions will return during the Northern Hemisphere winter of 2021–22. In the summer (May to August) sea-surface temperatures were below average across much of the equatorial Pacific Ocean. As a result, the reports suggests that the southwest states of the USA may experience below average rainfall, and above average temperatures between October and December this year.

European average wind speed is weakening

The *Financial Times* has reported that average surface wind speeds across many parts of Europe are declining. This is having an impact on power generation from wind farms. The fall in average wind speeds over land this year is of the order of 15 percent, according to data from weather modelling group *Vortex*.

Some meteorologists have confirmed this trend, which has been described as 'global stilling', and suggest it is possibly related to climate change. Paul Williams, Professor of Atmospheric Science at the University of Reading commented that *'…the phenomenon is part of a genuine long-term trend, rather than cyclic variability.'* A decreasing temperature gradient between the Arctic and the tropics is expected to reduce the thermal wind near to the continental surface. This trend in weakening surface wind speeds is consistent with long-term modelling and projections from the IPCC. For the European summer months, the international panel forecasts a further drop of 10 percent by 2100, given 1.5°C warming above the pre-industrial level. (Source: Bernard S. 2021. Europe's electricity generation from wind blown off course, *ft.com*, 8 October.) Other studies have noted decadal changes in wind speeds related to the North Atlantic Oscillation: Laurila TK, Sinclair VA, Gregow H. 2020. Climatology, variability, and trends in near-surface wind speeds over the North Atlantic and Europe during 1979–2018 based on ERA5, *Int. J. Clim*. 41: 2253–2278, doi: 10.1002/joc.6957.

Tropical cyclones in September and early October

In the North Atlantic and East Pacific most hurricanes of note remained over the open ocean during September and early October, although Hurricane *Nicholas* reached category 1 status before making landfall over Texas on 14 September.

In the West Pacific several typhoons formed during September: Typhoon *Chanthu* (PAGASA *Kiko*), and *Mindulle*, but these too remained largely over the ocean. Several tropical storms affected the Philippines, China and Vietnam with strong winds, heavy rain and flooding, including Tropical Storm *Lionrock* (PAGASA *Lannie*) in early October. Severe Tropical Storm *Kompasu* (PAGASA *Maring*) passed north of Luzon Island and crossed into the South China Sea in mid-October.

An Indian Ocean Cyclonic Storm *Gulab* formed in the Bay of Bengal bringing heavy rain and strong winds to east India, particularly Andhra Pradesh upon landfall on 26 September. The storm weakened to a depression as it crossed India, returning to the Indian Ocean by 1 October, where it regained tropical storm strength, and was renamed *Shaheen*. It was classified as a category 1 tropical cyclone before making landfall on the coast of northern Oman on 3 October (Figure 2). Major flooding occurred in the region around Muscat. This is thought to have been the first such storm to affect this location since June 1890 (Sources: NOAA NHC, JTWC, MEI.edu.)

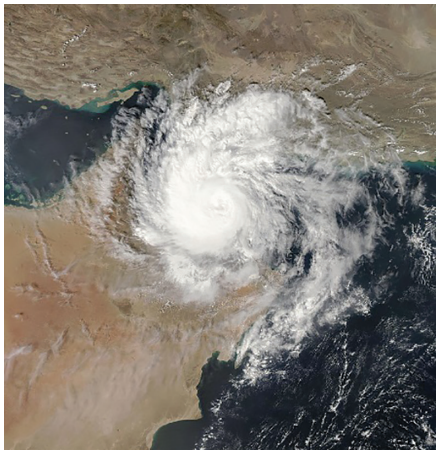

Figure 2. Severe Cyclonic Storm Gulab-Shaheen 3 October, 2021, just prior to landfall.

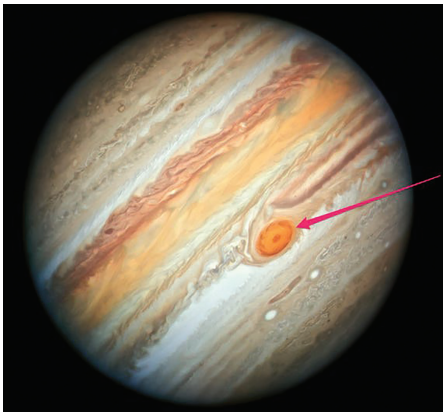

Figure 3. Image of Jupiter from the Hubble Space Telescope 27 June 2019. NASA, ESA, A. Simon (Goddard Space Flight Center) and M.H. Wong (University of California, Berkeley).

Jupiter's Great Red Spot is slowly changing

Scientists have been utilising the Hubble Space Telescope to monitor changes in Jupiter's Great Red Spot over a period of over a decade – from 2009 to 2020. This spot, which is a giant cyclonic storm 16 000km across, and larger than the Earth, has been observed for over 150 years. The storm is trapped between two jet streams moving in opposite directions. During that time, it has been shrinking in size and has become more circular. Quantifying the changes has now been possible through analysis of images from the Hubble Space Telescope's WFC3/UVIS instrument. Storm wind speeds in the outer cloud-ring, that can reach 640kmh^{-1}, have increased by 4 to 8 percent over a decade as the storm increases its vorticity. Lightning has also been detected within the storm system, confirmed by high-resolution imagery from Hubble, the Juno probe, and the Gemini ground-based instrument (Figure 3). (Sources: Wong *et al*. 2021. Evolution of the Horizontal Winds in Jupiter's Great Red Spot From One Jovian Year of HST/WFC3 Maps, *GRL*, 48: 18, 29 August 2021, doi: 10.1029/2021GL093982 and Wong *et al*. 2020, High-resolution UV/optical/IR imaging of Jupiter in 2016–2019, *ApJS* 247; 58, doi: 10.3847/1538-4365/ab775f.)

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