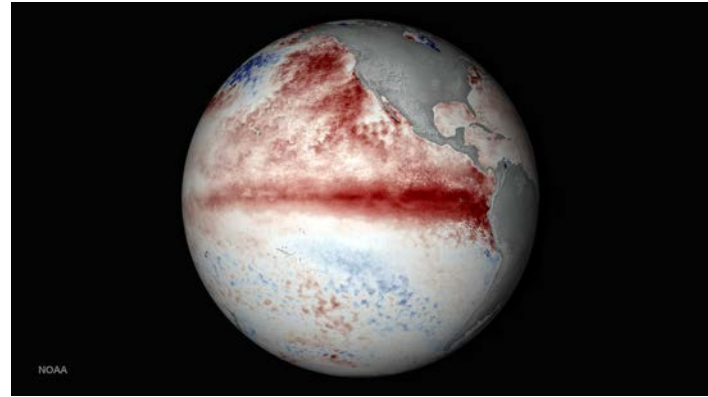


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El Niño

In 2015, El Niño (pronounced neenyō) has been in the news again. But what is it and why are its effects newsworthy? El Niño literally translates as "the boy child", because the phenomenon was first observed around Christmas time. An El Niño is a natural event that happens every few years and is a period when the waters in a specific part of the Pacific Ocean, near the equator, are warmer than the long-term average. It is not caused by climate change, but climate change may make its effects stronger than usual in the coming months.



Above: This visualisation from August 2015 shows areas of warmer waters (in red) in the Pacific Ocean. Image by Stuart Rankin.

The warmer waters affect the equatorial "trade winds", which typically blow from east to west. In an El Niño event, the trade winds are either weakened, or sometimes even reversed, blowing west to east.

Measuring El Niño - the tricky science bit

The size of an El Niño event is measured by comparing the temperature of the waters in the top two metres of an area of the Pacific called 'Niño 3.4'. The last big El Niño event happened in 1997-98, when the waters of Niño 3.4 peaked at 2.33 degrees C above the long-term average in November 1997. The current El Niño is likely to peak in December 2015.

You might think "so the water in the Pacific is a bit warmer than usual, so what?" Well, we need to consider the scale of what we're looking at. The Niño 3.4 region covers around six million square kilometres of ocean. So just the top two metres of water in the Niño 3.4 region amount to some 13.6 trillion tonnes of water! To make all that water increase in temperature by 2 degrees C requires an energy input of around 100 quadrillion kilojoules - that's roughly equivalent to the entire annual energy consumption of the USA! So the Pacific Ocean has been storing up a vast amount of heat energy and it's this that is affecting - and will continue to affect - the weather across large parts of the world.

It is quite likely at this point that the 2015-16 El Niño will either be second only to the 1997-98 El Niño, or will end up being even stronger. According to the US National Oceanographic and Atmospheric Administration (NOAA), in the week ending 16 November 2015, the waters of the Niño 3.4 region were 3 degrees C above the seasonal average. That's higher than any previous weekly reading. (2.8 degrees C above was previously the highest ever weekly reading, and was taken in the week ending 26 November 1997).

However, the strength of an El Niño is not measured by the data from one week alone. The Oceanic Niño Index (ONI) is calculated using three month averages, so we won't know until 2016 whether the current El Niño is the biggest ever or not. The World Meteorological Organisation (WMO) is currently predicting a final value of 2 degrees above average for the 2015-16 El Niño.

The World Health Organisation (WHO) has stated that with global average temperatures likely to be the hottest ever recorded in 2015, El Niño could modify the planet's weather "in ways which we have never experienced before."

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EL Niño gallery

How El Niño affects the World

More Pacific hurricanes, fewer Atlantic ones

El Niño tends to increase the number of hurricanes occurring in the Pacific Ocean while reducing the number of Atlantic hurricanes. In 2015, there have so far been 21 Category 4 and 5 storms in the north Pacific, while in 1997, there were 17. There have so far been 11 Atlantic storms, with 12 being the seasonal average, but there have only been 3 hurricanes, well below the average of 6.



Above: The warmer waters in the Pacific Ocean tend to lead to a higher number of hurricanes in the Pacific region as a result of El Niño.

So what does it mean for us in the UK?

The Met Office has predicted that we will have a wet and windy start to our winter. So far, this has held true, with flooding recently occurring in Cumbria and more rain and strong winds on the way. However, there is also an increased risk that we will see a cold snap later in the winter, possibly with the cold weather lasting longer into 2016 than usual.

El Niño's effects on crops

The effects of El Niño in other parts of the World are far more serious though and this could mean that we see prices for favourites like coffee, rice, sugar and cocoa increasing as a result of poor harvests.

Changes in weather patterns brought about by El Niño are likely to have serious effects on crops around the world. In Asia, a drought in July and August of 2016 would badly affect the rice harvest. Corn, a crop which needs lots of water to grow, is likely to grow less well than usual in China in the event of an El Niño-induced drought. Soybean production will also lessen, which might cause countries like India to need to import more palm oil. Finally, the Australian wheat crop, which accounts for 14% of world exports could be reduced by as much of 50% because of drought. However, high temperatures in the waters of the Indian Ocean mean that drought conditions may not affect eastern Australia as badly as first thought.

Meanwhile, in South America, increased rainfall will help coffee plantations in drier areas. However, with too much water, coffee beans become bitterer to taste. Sugar cane may also benefit from increased rainfall, but too much water will lead to a reduction in the cane's sucrose content, making it less sweet.

India

As mentioned in the previous section, relatively high temperatures in the waters of the Indian Ocean may prevent El Niño from producing a serious drought affecting eastern Australia. But those high water temperatures, combined with the strength of the current El Niño have brought unusually high rainfall to the Tamil Nadu region of southern India and have caused dramatic flooding in Chennai, India's fourth largest city. In just 72 hours, starting on 29 November 2015, Chennai received 436mm of rain, having already had 623mm of rain from 8 to 22 November. Many parts of Chennai and its suburbs were submerged.



Above: Much of Chennai was flooded by unusually heavy rainfall in late November/ early December 2015. Photo by Karthik Pasupathy Ramachandran.

East Africa

El Niño tends to cause increased rainfall between October and December in countries like Ethiopia, Somalia, Kenya, Tanzania, Burundi and Rwanda. There has already been some flooding in Somalia.

Southern Africa

Many parts of southern Africa are already experiencing drier than normal conditions and El Niño is only likely to make this worse from December through until the end of February 2016. Countries likely to be affected by reduced rainfall include Zimbabwe, Botswana, Namibia, Angola, South Africa, Lesotho, Swaziland and southern Mozambique.



Above: Droughts can be caused by El Niño, which affects rainfall in many parts of the world.

The United States

El Niño will hopefully bring some rainfall to the parched state of California, which has been enduring drought conditions for the last four years. Three storms arrived in a week in December 2015, bringing much needed rainwater. However, the NOAA says that the state will need to see double its usual annual rainfall to get out of drought conditions. The warmer waters of the Pacific caused by El Niño have already carried pelagic red crabs up to the California coast from Mexico, turning beaches red! The warmer waters have also resulted in increasing numbers of sharks being spotted off the California coast.



Above: This 'No Fishing' sign at the dried up Folsom Lake Marina shows how desperately California needs the rainfall El Niño may bring. Photo by Robert Couse-Baker

South America

2015 has been an exceptional year for forest fires in the Brazilian Amazon. In fact, according to satellite data, there were some 18,716 fires in November 2015 alone!

Many of the fires are caused by farmers, who deliberately set fire to the forest to clear the land ready for planting with crops or for grazing cattle. This land clearance technique is known as 'slash and burn'. Fires made by humans kill up to half of the large trees and most of the small ones. Where big trees die, they open up gaps in the canopy, making the forest floor hotter, drier and more prone to burning.



Above: Slash and burn in the Amazon rainforest leaves the land badly damaged. It can take years for the forest to recover. Photo by Matt Zimmerman

The drought that the Amazon region is suffering as a result of El Niño means that the forest has kept on burning, with small fires growing bigger and burning for much longer than usual. The smoke cloud resulting from the fires was so bad that 12

Amazonian cities declared states of emergency in October 2015. Droughts in the Amazon region are currently forecast to triple by 2100.

Meanwhile, in Peru, they are bracing themselves for flooding caused by El Niño. Trujillo, a city with a population of a million people, usually sees less than 50mm of rain per year. From November 1996 to March 1997, as a result of the last major El Niño event, 3,000mm of rain fell, destroying homes and flooding people out for extended periods of time.

Peru has the world's largest stock of anchovy. But in 2015, the anchovy catch has halved to 2.5 million tonnes and fishermen are expecting it to get worse still in 2016. The anchovy fishery runs into difficulty because the warmer waters in the Pacific cause the anchovies to swim further south and dive deeper in search of colder water.



Above: Peru's anchovy fishermen have had poor catches in 2015 and they expect worse to come in 2016. Photo by Hector de Pereda.

Indonesia

The situation in the Amazon is bad, but in parts of southeast Asia, it is even worse. Fires have been burning continuously since July 2015, resulting in a cloud of smoke that has been steadily spreading across Malaysia, Singapore, southern Thailand, Vietnam, Cambodia and the Philippines. The smoke cloud is disrupting transport, schools and businesses. In Singapore, 300km from the fires, people are keeping their children indoors and have stopped exercising outdoors because of the smoke.

In some areas the smoke has been so dense that people haven't seen the sun for more than two and a half months, while visibility is down to between 50 and 200 metres. Around 500,000 people in the smoke-affected areas have already suffered from respiratory illnesses as a result of the smoke and some 40 million people have been exposed to the toxic smoke haze, especially in Borneo and Sumatra. A mass evacuation of endangered orang-utans from affected forest areas is also being considered.



Above: An evacuation of endangered orang-utans from the burning forests of Borneo and Sumatra is being considered by the Indonesian government. Photo by Abdul Rahman.



Above: A smoky haze caused by the fires burning in Indonesia hangs over the city of Kuala Lumpur, Malaysia. Photo by Naz Amir.

The Indonesian government has sent eleven warships and two passenger ships to the worst affected areas to act as shelters and to transport children to safer locations. Meanwhile, some 22,000 soldiers and 30 aircraft are engaged in fighting the fires.

Many of the fires are set by slash and burn farmers, while others are thought to have been started by large companies producing palm oil on an industrial scale. Some companies are already being prosecuted for deliberately starting fires.



Above: Fires are blazing in Indonesia's rainforests. Photo by CIFOR.

El Niño means there's no rain to put out the fires

Normally, the fires are put out by the monsoon rains, but because of El Niño, the rains are not likely to arrive until January 2016 at the earliest. In the meantime, it's not just the forests that are burning. More than half of the burning forests lie on peatlands. When dry, peat burns readily and because the monsoon has not yet arrived, the peat continues to burn even when the trees have been burnt down. Peat stores some of the highest amounts of carbon on earth, and when it burns, carbon dioxide is released into the atmosphere. Peat fires also emit ten times more methane (an even more powerful greenhouse gas) than fires on other types of land.

The World Resources Institute has said "Taken together, the impact of peat fires on global warming may be more than 200 times greater than fires on other lands.

Greenhouse gas emissions

So far this season an estimated 600,000,000 tonnes of greenhouse gas have been emitted into the atmosphere by the Indonesian forest fires. That's equal to the total annual greenhouse gas emissions of Germany. For 26 days between 1 September and 14 October, the fires in Indonesia emitted more greenhouse gases than the whole of the United States!

Yet fires are still being lit by poor farmers looking to claim the land they clear through slash and burn. In 1997, the last time there was a major El Niño event that caused Indonesia's forests to go on burning, the cost of the forest fires was put at \$12 billion. This time, it is estimated that the cost could run to \$47 billion!



Above: Smoke from the fires in Sumatra is visible from space. Photo by NASA Goddard Space Flight Center

Stopping the fires

A big problem in Indonesia is that 80% of the available budget is spent by the Indonesian government on fighting fires, whilst only 20% is spent on preventing them from happening in the first place. It seems almost unbelievable that fires are still being lit when people know now that the monsoon will not arrive until much later than usual this year because of El Niño, but that is what's happening.

A further issue is that at the moment, precisely who owns land is often unclear. That means that slash and burn farmers are able to claim ownership of land that they have cleared by setting fire to it. In future, preventing people from being able to lay claim to land just because they have burned down the forest that stood there would create a very effective barrier to deliberately starting fires in the forests. A proper Land Registry and strong protection and enforcement for the forests seem like the best solutions, but they won't stop the fires from burning this time round.

Coral bleaching

In October 2015, the National Oceanic and Atmospheric Administration (NOAA) declared the third ever global coral bleaching event. The bleaching is caused when sea waters are abnormally warm, killing the coral and leaving it white and lifeless. This event began in the north Pacific in the Summer of 2014 and expanded to the south Pacific and Indian Oceans in 2015, with El Niño likely to be responsible for considerable impacts on coral in these waters. The first global bleaching event was recorded in 1998, when a strong El Niño was followed by an equally powerful La Niña. The second was in 2010. Coral reefs support a huge range of marine species, so it's a serious problem that so much coral is being affected by warmer sea temperatures.

So what is La Niña?

La Niña, (pronounced 'neenya') is the girl-child and is the opposite of El Niño. During La Niña, the surface waters of the equatorial Pacific are 3-5 degrees C cooler than usual. La Niña events help to keep global average temperatures down. 2011 was the second coolest year of the 21st century to date as a result of La Niña. Also in that year, La Niña caused severe drought in east Africa and caused the third wettest year in Australia's 112 year period of weather records.

Is the 2015-16 El Niño the most powerful ever?

We won't know the answer to this question until the Spring of 2016. However, it's clear that the current El Niño is a very strong one, which is certainly likely to make it into the top three ever recorded. It is possible that this El Niño will record the highest ever Oceanic Niño Index (the three month mean surface temperature increase in the Niño 3.4 region). Its effects are being felt - and will continue to be felt for some time yet - in many parts of the world.



El Nino gallery - clockwise from top left:

Lake Oroville in northern California is at just 29% capacity because of the drought. El Niño might change this for the better. Photo by Ray Bouknight.
Haze from Indonesia's forest fires hangs over Marina Bay, Singapore. Photo by Eco Business Singapore.
Global coral bleaching is causing coral reefs around the world to die, leaving them white and lifeless. Photo by Jorge Láscar.
Red crabs on a California beach. Photo by Dirk Dallas.



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