

Climate Change – Macro Scale

What is the Walker Cell?

This is the **normal atmospheric conditions** in the Pacific Ocean. The great NE and SE trade wind belts blow equatorward and westward across the width of the Pacific towards the warm water of the west. A convectional uplift occurs as the water heats up. **Pressure rises over the eastern Pacific Ocean**, off the coast of South America, and **falls over the western Pacific Ocean**, toward Indonesia and the Philippines. **The descending air in the east gives the clear, dry conditions** that create the Atacama Desert in Peru, whilst the **warm, moist air ascending in the west gives heavy convectional rainfall**.

What are the atmospheric conditions in an El Nino year?

During an El Nino year the normal conditions are **reversed** in the equatorial Pacific region, in pressure, precipitation and often in winds and ocean currents. **Pressure rises over the western Pacific** and **falls over the eastern Pacific** causing the region of **rising air to move east** with the associated convectional uplift. This allows the **ITCZ to migrate southwards** and cause the **trade winds to weaken** in strength, or even to be reversed in direction. The **descending air gives much drier conditions** in South-east Asia, than it usually experiences and on extreme conditions even causing drought. In the **eastern Pacific air is now rising, giving much wetter conditions** in places like Peru, that normally experience desert like conditions. The change in direction of the **trade winds means that: surface water tend to be pushed eastwards so that sea-level in South-east Asia falls**, whilst rises in South America; and **surface water temperatures in excess of 28°C extend much further eastwards** and the upwelling of cold water off South America is reduced allowing sea temperatures to rise by 6°C. This warmer water in the eastern Pacific lacks oxygen, nutrients and therefore plankton, having an adverse affect on Peru's fishing industry.

What do the “normal” trade winds do for the area?

In the Walker Cell they: **push water westwards** so that the level in the Philippines is normally 60sm higher than Panama and Columbia; **allow water, flowing westward as the equatorial current, to remain near to the ocean surface where it can gradually heat** (giving the world's highest ocean temperatures - 28°C). In contrast, as warm water is pushed away from South America it is replaced by an upwelling of colder, nutrient -rich water. Although this water lowers temperatures below 20°C, it does provide a plentiful supply of plankton, which forms the basis of Peru's fishing industry.

What changes in an El Nino Year?

The whole system **relaxes**.

What effect does an El Nino event have on the global climatic pattern?

El Nino has a major effect on places far beyond the Pacific margins as well as on those bordering the ocean itself in its low latitudes. This is because the **upper air disturbances distort the path of the jet streams**, which can lead to teleconnections all around the world. Between 1997 and 1998 the largest El Nino event occurred.

- **Severe droughts** were experienced in the **Sahel and southern Africa** as well as across the **Indian subcontinent**
- There **were extremely cold winters** in central **North America**
- **Stormy** conditions with floods in **California**
- **Exceptional wet, mild and windy winters** were experienced in **Britain** and north-west Europe
- In Peru for 12 days in early March, Peru received the equivalent of six months of normal rain. Over several months, flash flooding caused 292 deaths, injured more than 16000 people, left 400 missing, destroyed 13200 houses, wrecked 250000km of roads, swept away bridges, damaged crops, and schools, and disrupted the lives of up to half a million Peruvian.
- In parts of Kenya over 1000mm of rain fell during six months (up to 50 times more than the average) at a time normally considered to be the “dry” season. Roads and the mainline railway were swept away, the latter causing the derailment of the Nairobi -Mombasa train. Later, more than 500 people died of Malaria as the receding floodwater created mosquito - spawning pools.

Consider three climatic regions, how would El Nino affect each of these systems?

Tropical maritime climate – e.g. India.

El Nino disrupts the normal monsoon climate bringing drought and very high temperatures to areas unexpectedly and torrential rainstorms, causing mudslides to other areas.

What is La Nina and how does it differ from El Nino?

La Nina has the **reversed climatic conditions of El Nino**. However when La Nina does occur it is usually **just before or after El Nino**, however its occurrence has been less frequent and therefore harder to predict. In a La Nina event, in contrast to the normal conditions in the Pacific Ocean the **low pressure over the western Pacific becomes even lower** and the **high pressure over the eastern Pacific even higher**. This means that **rainfall increases over South-east Asia**, there are **drought conditions in South America** and due to the increased difference in pressure between the two places, the **trade winds strengthen**. The stronger trade winds: **push large amounts of water westwards**, giving a higher sea-level in Indonesia and Philippines: and **increases the equatorial under-current** and significantly enhance the upwelling of cold water off the Peruvian coast.

What global consequences are experienced when La Nina occurs?

Globally La Niña in very general terms will mean that those parts of the world who normally experience **dry weather will be drier** and those with **wet weather will be wetter**. The Atlantic and Pacific **hurricane activity will increase** with La Niña and the effects of severe droughts are now being considered for those parts of the world who are already suffering.

Broadly speaking, the La Niña event could give drier conditions in Central East Africa, SW USA, Northern Mexico, South America etc. Wetter conditions could be experienced in North/North East Australia, South Africa (which may cause further floodings similar to that in Mozambique and other countries in the region), Southern Asia (during the monsoon) and the northern half of South America, Central America and the Hawaiian Islands.

Whilst historically these are the effects of a La Niña event, as we have seen with El Niño, nothing is certain and the global impact is still to be fully understood.