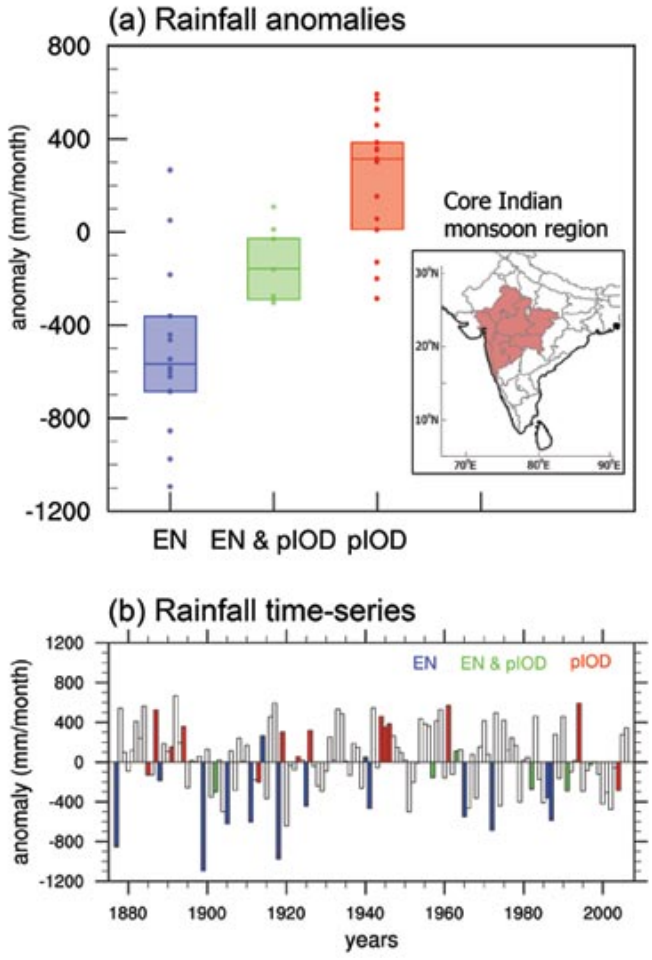
environmentalresearchweb

NEWS

Aug 12, 2011

Insight: Indian Ocean plays crucial role in supporting monsoon

A new study (http://iopscience.iop.org/1748-9326/6/3/034006/fulltext) by researchers at the University of New South Wales (UNSW), Australia, using 130 years of data, has shown how conditions in the Indian Ocean have moderated the drought-inducing effect of El Niño events over India in recent decades. With more than a third of the world's population dependent on the monsoon season, the report calls for urgent studies on the effect of climate change on the Indian Ocean and how this could impact the monsoon season in the future.



(http://images.iop.org/objects/erw/news/6/8/21/monsoon.jpg)

Rain check (http://images.iop.org/objects/erw/news/6/8/21/monsoon.jpg)

The Indian monsoon is intimately linked to conditions in the Pacific Ocean and it is well known that El Niño events often cause the monsoon to fail. Indeed, failure of the monsoon at the beginning of the 20th century (which caused widespread drought and famine in the subcontinent at this time), led to the discovery of the El Niño–Southern Oscillation (ENSO) by Sir Gilbert Walker, a British scientist. More recent studies have also shown that variability associated with the Indian Ocean Dipole (IOD) can modulate this relationship.

The IOD is an ocean–atmosphere phenomenon and is characterized by an out-of-phase relationship in sea-surface temperatures (SST) between the eastern and western part of the Indian Ocean. The tropical Indian Ocean varies between "positive", "neutral" and "negative" phases of the IOD. During the positive phase, the western Indian Ocean is warmer than average and East Africa often experiences wet conditions. In contrast, waters in the eastern Indian Ocean are cooler than average and dry conditions prevail over Indonesia and Australia. The negative phase brings about the opposite conditions – warmer water and more rainfall in the eastern Indian Ocean and cooler, drier weather in the west.

The new study has investigated the impact of the positive phase of the IOD over timescales of several decades using data from 1877–2006. For monsoonal rainfall events in key Indian agricultural regions, the work demonstrates how conditions in the Indian Ocean can explain a recent weakening in the El Niño-Indian monsoon relationship – where positive IOD events cancel out the drought-inducing effect of El Niño.

In particular, when an El Niño event occurs in the absence of a positive IOD, the Indian monsoon tends to break down. Conversely, when a positive IOD occurs in the absence of an El Niño, monsoon rainfall is significantly higher than average. When an El Niño event and a positive IOD coincide, however, normal levels of monsoonal rainfall tend to occur. A positive IOD therefore disengages the relationship between an El Niño pattern in the Pacific and monsoonal rainfall over India.

A number of previous studies have suggested explanations for the recent breakdown in the El Niño-Indian monsoon relationship. Our study offers a new simpler hypothesis: that the IOD modulation of the ENSO–Indian monsoon relationship also drives multi-decadal variations. In particular, more frequent positive IODs between 1975 and 2006 provide a consistent explanation for successful monsoon seasons despite the presence of El Niño events.

Very few El Niño events during this period have occurred independently of positive IOD conditions. As a result, there were few monsoon failures during this period and total monsoonal rainfall remained relatively steady.

The overriding impact of a positive IOD on monsoonal rainfall has also been observed over other periods. For example, from 1943–1974, few isolated El Niño events occurred, resulting in higher overall monsoon rainfall. In contrast, between 1911–1942 – a period with frequent isolated El Niño events – monsoon failure was much more common.

Large warming trends have recently been recorded in both the Indian and Pacific Oceans, which may affect their variability. This could have profound effects on India's agricultural sector and economy. It is therefore vital to improve our understanding of the Indian Ocean's role in modulating the El Niño–Indian monsoon relationship.

The research group based at UNSW is now investigating how the Asian–Australian monsoon system will be affected in a warming world.

About the author

Caroline Ummenhofer is a postdoctoral research fellow at the Climate Change Research Centre (CCRC) at the University of New South Wales, Sydney, Australia, and works on understanding links between Indo–Pacific climate variability and regional drought. The co-authors of the study were Alex Sen Gupta, Yue Li, Andrea Taschetto and Matthew England, all based at the CCRC.