



ENSO Wrap-Up

Current state of the Pacific and Indian Ocean

El Niño strengthens but a warm Indian Ocean

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The 2015 El Niño is now the strongest El Niño since 1997–98. The tropical Pacific Ocean and atmosphere are fully coupled, with sea surface temperatures well above El Niño thresholds, consistently weak trade winds, and a strongly negative Southern Oscillation Index. Weekly tropical Pacific Ocean temperature anomalies (i.e. difference from normal) in the central Pacific are now at their highest values since 1997–98, though still remain more than half a degree below the peak observed during 1997–98.

Most international climate models surveyed by the Bureau of Meteorology indicate the tropical Pacific will continue to warm, with the largest anomalies occurring later in the year. Typically, El Niño peaks during the late austral spring or early summer, and weakens during late summer to autumn. The 2015 event has, so far, been following a normal El Niño life cycle.

While the Indian Ocean as a whole has been at near-record temperatures, the Indian Ocean Dipole (IOD) index has been at or above +0.4 °C for the past four weeks. To be considered a positive event, the IOD would need to remain at or above +0.4 °C through September. Three of the five international models surveyed by the Bureau of Meteorology indicate a positive IOD event is likely during spring.

El Niño is usually associated with below-average winter–spring rainfall over eastern Australia, and a positive IOD typically reinforces this pattern over central and southeast Australia. However, sea surface temperatures to the north of Australia and more broadly across the Indian Ocean basin, also affect Australia's climate and are likely to be moderating the influence of these two climate drivers in some locations.

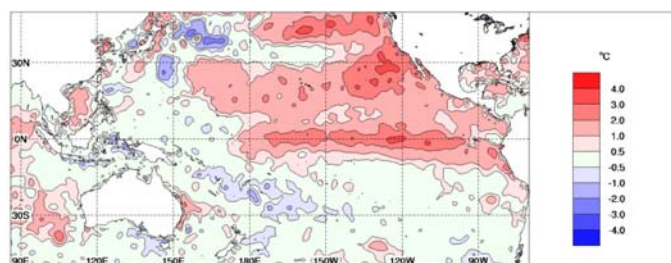
Next update expected on 15 September 2015 |

Weekly sea surface temperatures

Over the past fortnight sea surface temperature (SST) anomalies have increased along much of the equator in the eastern to central Pacific and in the northwestern Pacific. Warm anomalies persist along the equator from the South American coastline to the Date Line and across most of the Pacific Ocean east of the Date Line in the northern hemisphere.

Anomalies for the week ending 30 August exceeded +2 °C across most of the equatorial Pacific east of 170°W. The eastern half of the northern Pacific was more than one degree warmer than average, with large areas more than two degrees warmer than average. Warm anomalies were also present along parts of the east coast of Australia, in areas to Australia's west, and across large parts of the Indian Ocean.

All five NINO indices remain above +1 °C this week. Both NINO3 and NINO3.4 exceeded +2 °C for the week ending 30 August 2015. This is the first time either of these indices have exceeded +2 °C during this event, and the first time since the 1997–98 El Niño.



Index	Previous	Current	Temperature change (2 weeks)
NINO3	+1.9	+2.0	0.1 °C warmer
NINO3.4	+1.8	+2.0	0.2 °C warmer
NINO4	+1.0	+1.2	0.2 °C warmer

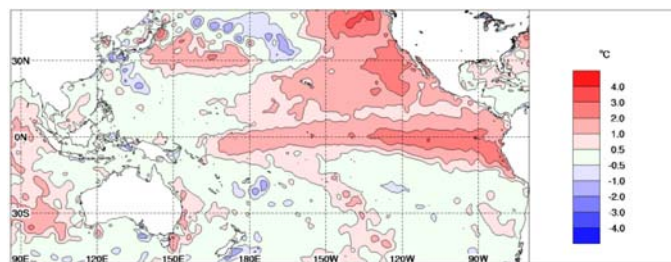
Baseline period 1961–1990.

Monthly sea surface temperatures

The SST anomaly map for July 2015 shows positive anomalies extended from the South American coastline, across the equatorial Pacific, past the Date Line to around 160°E. Compared to June, the strength of these anomalies have increased in the eastern Pacific. Strong warm anomalies also persisted across much of the northeast of the Pacific Basin, with weak warm anomalies to Australia's east, and moderate to strong warm anomalies across much of the Indian Ocean.

NINO3 measured its warmest monthly anomaly since the 1997–98 El Niño, with an anomaly of +1.9 °C for July 2015, ahead of +1.7 °C in June 2015 and +1.6 °C December 2009. The July 2015 value of NINO3.4 was +1.5 °C.

In the coming weeks, the NINO3.4 region may exceed the peak anomaly values reached during the 2002 (+1.6 °C) and 2009 (+1.7 °C) El Niño. The current El Niño has already exceeded the 2006 peak of +1.2 °C, but current anomalies still remain well short of the 1982 and 1997 peaks (+2.8 °C and +2.7 °C respectively). Note: peak values are typically recorded



Index	June	July	Temperature change
NINO3	+1.6	+1.9	0.3 °C warmer
NINO3.4	+1.3	+1.5	0.2 °C warmer
NINO4	+1.1	+1.1	no change

Baseline period 1961–1990.

late in the year.

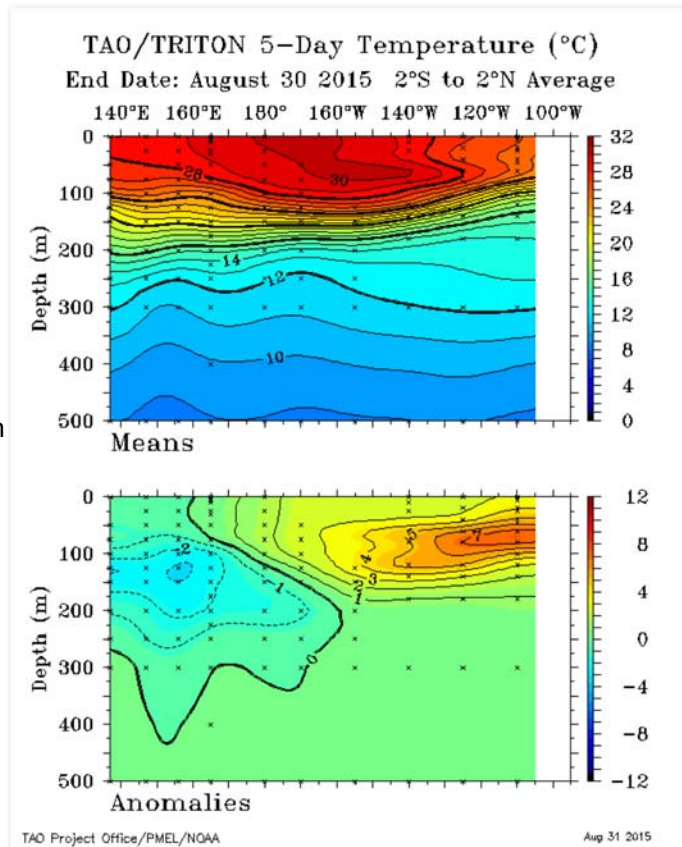
5-day sub-surface temperatures

The sub-surface temperature map for the 5 days ending 30 August shows temperatures were warmer than average in the top 150 m of the central to eastern equatorial Pacific and cooler than average below the surface of the ocean in the western equatorial Pacific. Water in far eastern Pacific sub-surface was very much warmer than average, with a large area of anomalies around 75 m depth more than 7 °C warmer than average. Anomalies in this area have strengthened and increased in area compared to two weeks ago.

Cool anomalies in the western equatorial Pacific remain generally similar compared to two weeks ago. A broad area of anomalies more than 2 °C cooler than average persists between around 100 m and 200 m depth.

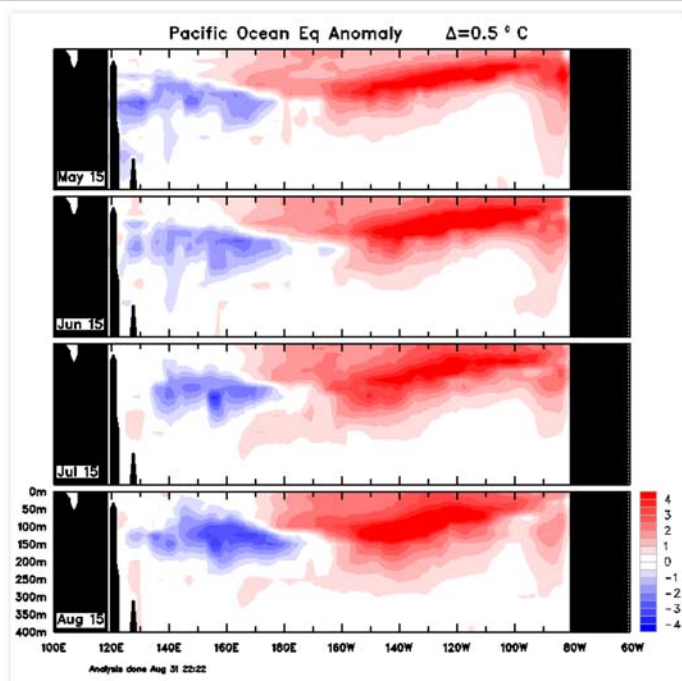
The pattern of warm anomalies in the eastern sub-surface and cool anomalies in the west is consistent with a well-established El Niño.

In the mean 5-day values (upper panel), the thermocline is almost flat. The thermocline sits around the 20 °C region, and is considered mid-point between the warmer surface waters, and cooler subsurface waters. This tends to only occur during strong El Niño events.



Monthly sub-surface temperatures

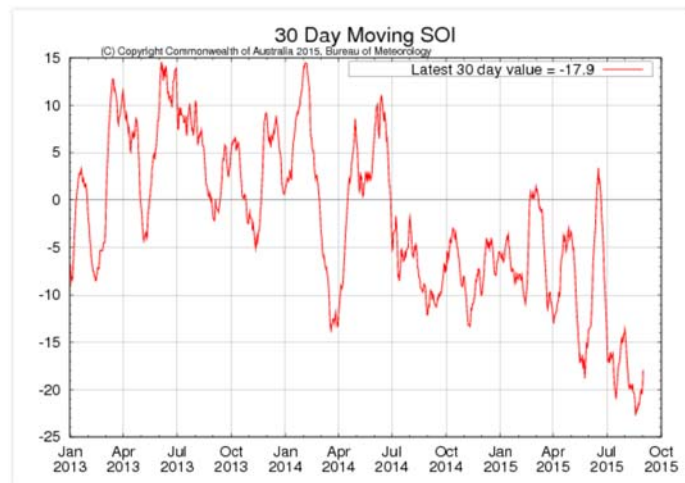
The four-month sequence of sub-surface temperature anomalies (to August) shows a generally consistent pattern of anomalies throughout the past four months. Warm anomalies were evident for August in the top 200 m of the equatorial Pacific sub-surface between about 170°E and the South American coast. Monthly anomalies across large areas of the eastern half of the equatorial Pacific reached more than +4 °C. An area of cool anomalies persisted in the sub-surface of the western equatorial Pacific.



Southern Oscillation Index

The Southern Oscillation Index (SOI) dipped slightly during the past two weeks, before stabilising at values similar to two weeks ago. The 30-day SOI value to 30 August was -20.4.

Sustained positive values of the SOI above +7 may indicate La Niña, while sustained negative values below -7 may indicate El Niño. Values of between about +7 and -7 generally indicate neutral conditions.

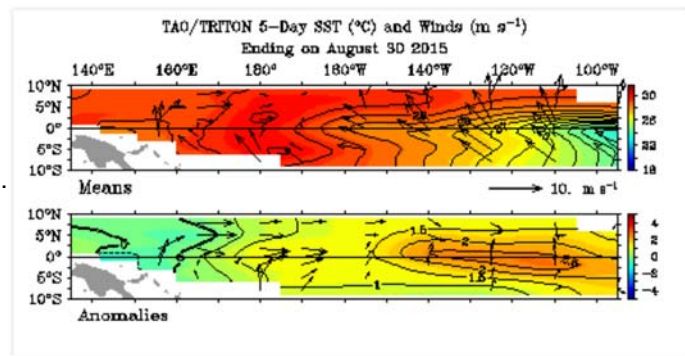


Trade winds

Trade winds for the 5 days ending 30 August show westerly anomalies were present over the western to central equatorial Pacific, remaining similar to two weeks ago. Trade winds were reversed (i.e. westerly winds) to the north of the equator west of the Date Line.

Trade winds have been consistently weaker than average, and on occasion reversed in direction (i.e. westerly rather than easterly), since the start of 2015.

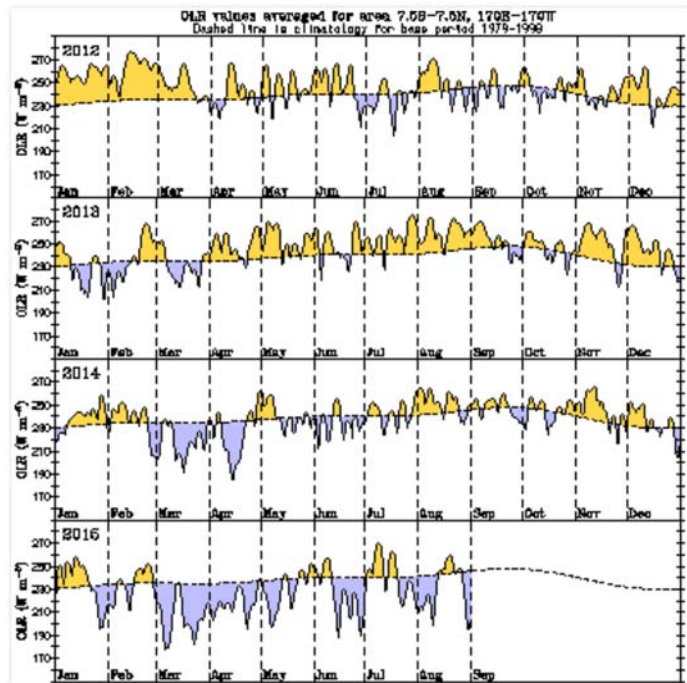
During La Niña events, there is a sustained strengthening of the trade winds across much of the tropical Pacific, while during El Niño events there is a sustained weakening of the trade winds.



Cloudiness near the Date Line

Cloudiness near the Date Line returned to above-average values at the end of August after a brief period of values slightly lower than average.

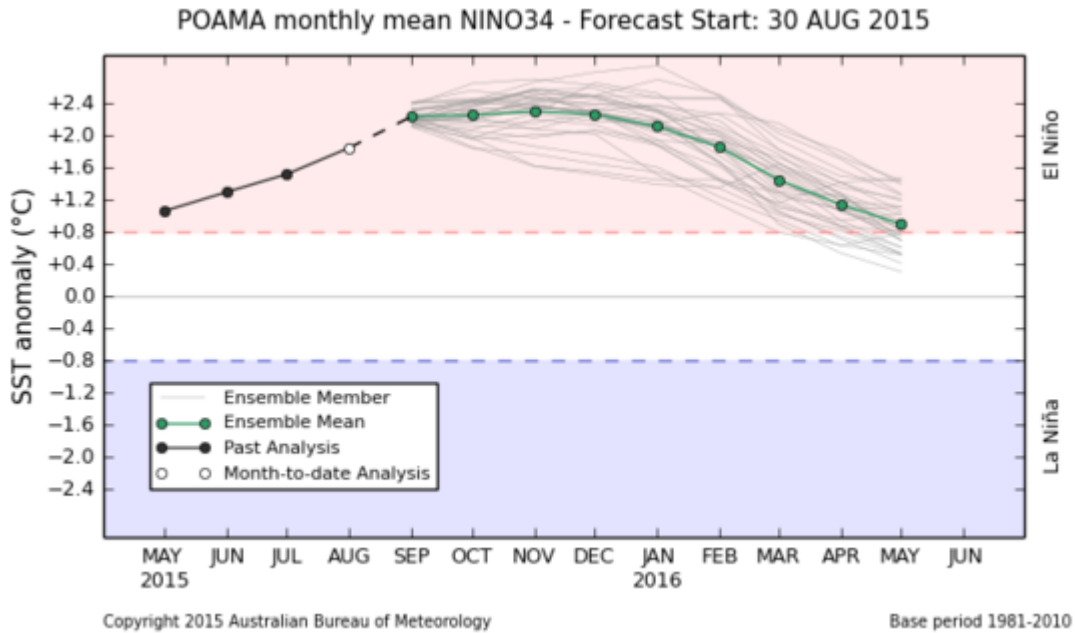
Cloudiness along the equator, near the Date Line, is an important indicator of ENSO, as it typically increases (negative OLR anomalies) near and to the east of the Date Line during El Niño and decreases (positive OLR anomalies) during La Niña.



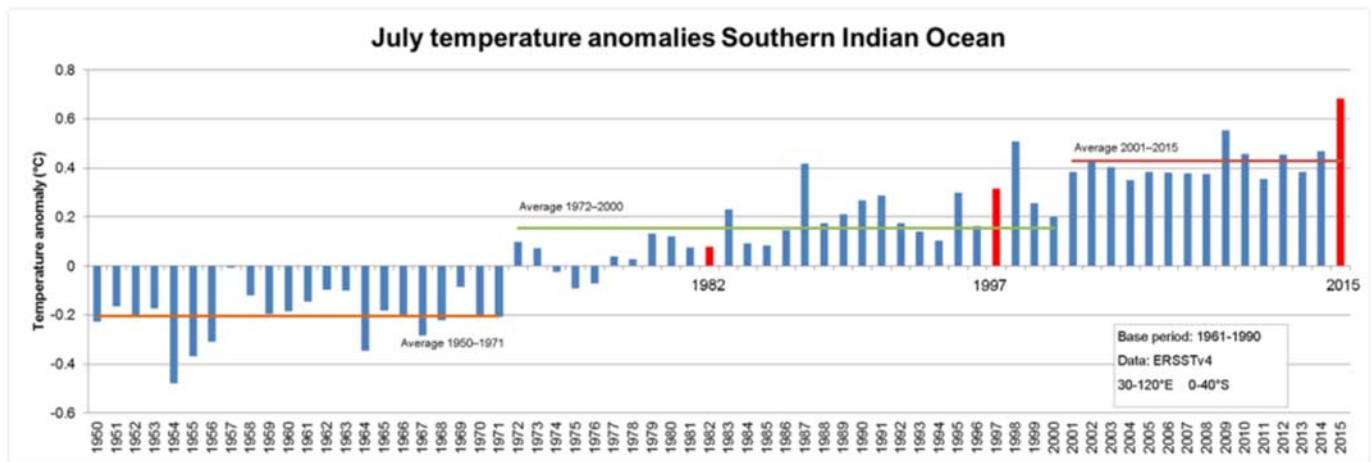
Model outlooks

Most of the eight international [climate models](#) surveyed by the Bureau indicate there is likely to be some further warming of central Pacific Ocean during the coming months. About half the models indicate the event may begin to plateau during spring to early summer.

All surveyed models indicate that NINO3.4 will remain above El Niño thresholds until at least the start of 2016, with most models indicating the peak NINO3.4 values of the event are likely to occur during early to mid-summer.



Indian Ocean Dipole



Timeseries graph of July monthly anomalies

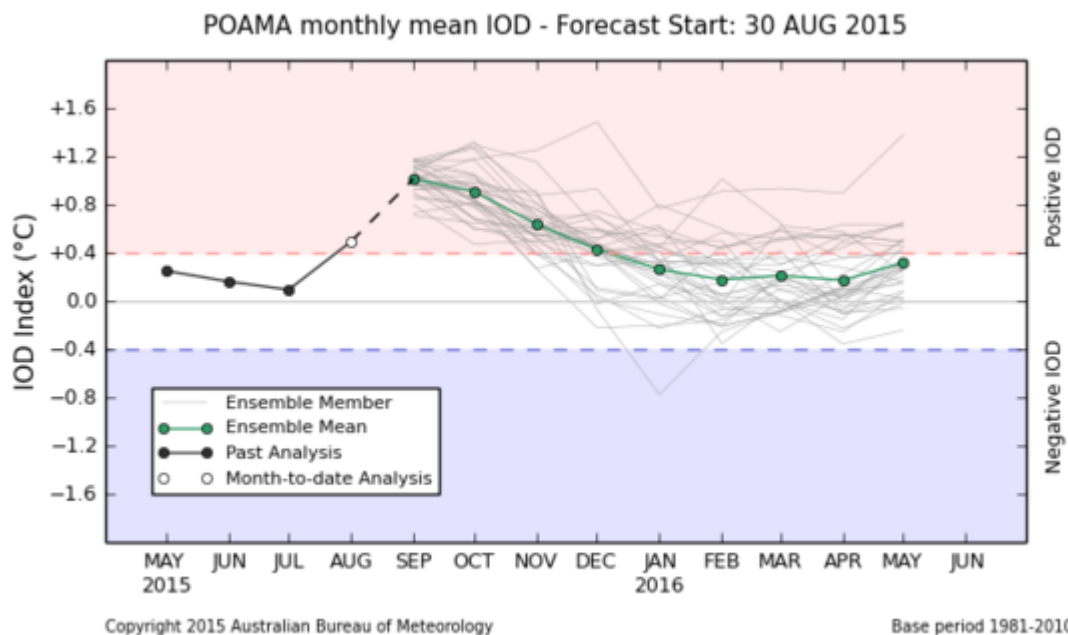
Values of the Indian Ocean Dipole (IOD) index have been at or above the threshold level of $+0.4\text{ }^{\circ}\text{C}$ for four weeks. The weekly value of the IOD index to 30 August was $+0.57\text{ }^{\circ}\text{C}$.

Sea surface temperatures (SSTs) in the Indian Ocean are warmer than average over much of the basin, and the Indian Ocean as a whole has been at near-record temperatures in recent months (see timeseries of July monthly anomalies). Typically, a positive IOD event is characterised by cooler-than-average water off the coast of the Indonesian island of Sumatra (see [About the Indian Ocean Dipole](#)).

Positive IOD events are often associated with lower rainfall in parts of central and southeastern Australia. Positive IOD events are more likely to occur during El Niño, which also is typically associated with a reduction in winter–spring rainfall in eastern Australia.

However, sea surface temperatures in the Indian Ocean basin also affect Australia's climate—it's likely that the widespread warm anomalies have moderated the influence of these two climate drivers (see Climate Outlook).

Three of the five surveyed international [climate models](#) indicate a positive IOD event is likely during the southern hemisphere spring. If the current values of the IOD index above $+0.4\text{ }^{\circ}\text{C}$ are maintained until late September, 2015 will be considered a positive IOD year.



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Base period 1981-2010

See also: [IOD forecasts](#)

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