



Australian Government
Bureau of Meteorology



**Climate and Oceans Support
Program in the Pacific**

Monthly Climate Bulletin

March 2015



Summary

Issued on 6 March 2015

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- The central tropical Pacific Ocean is likely to continue to warm, with all models monitored by the Bureau predicting El Niño thresholds will be reached or exceeded by mid-year. The accuracy of model outlooks at this time of year, the traditional El Niño Southern Oscillation (ENSO) transition period, is lower than for outlooks made at other times of the year. The Bureau's ENSO Tracker remains at El Niño WATCH status.
- The 30-day Southern-Oscillation Index (SOI) value to 31 March was -11.7 .
- Sea surface temperatures (SSTs) in March were significantly warmer than average across most of the equatorial western and central Pacific Ocean. At the same time there was a large volume of warmer-than-average water below the surface of the central equatorial Pacific. In the last fortnight, the warm sub-surface water intensified and grew in extent in both the central and eastern equatorial Pacific with the pool of warm anomalies continuing to progress eastward.
- Less weather activity is expected across the western Pacific Ocean, as an active phase of the Madden-Julian Oscillation (MJO) was located over the far western equatorial Indian Ocean at the end of the month.
- The South Pacific Convergence Zone (SPCZ) was largely enhanced in March and displaced northward between the Solomon Islands and Samoa. Beyond Samoa, the SPCZ extended further east than normal with southward displacement near the Cook Islands. The Intertropical Convergence Zone (ITCZ) was also enhanced, especially west of the Date Line and displaced northward. A second band of ITCZ activity was evident just south of the equator.
- Below normal rainfall is favoured for most of Papua New Guinea, the Solomon Islands, northern Vanuatu, southeast Fiji, Tonga and northern islands in the southern Cook Islands group and above normal rainfall for most of northern Tuvalu, southern Gilbert Islands and northern Line Islands in Kiribati and the northern Marshall Islands according to the POAMA outlook for May to July 2015.

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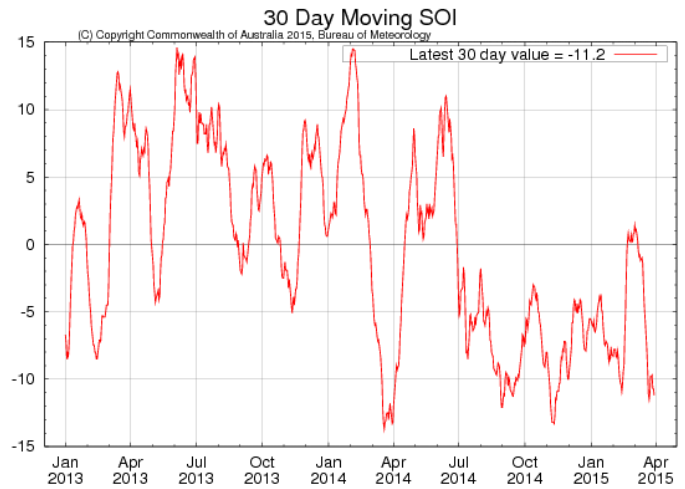
El Niño–Southern Oscillation

Recent warming of Pacific Ocean could be an early indication of El Niño

Bureau ENSO Wrap-Up issued on Tuesday 31 March 2015

Recent warming of the tropical Pacific Ocean has primed the Pacific for El Niño. However, history has shown El Niño does not always develop from the ocean trends currently observed.

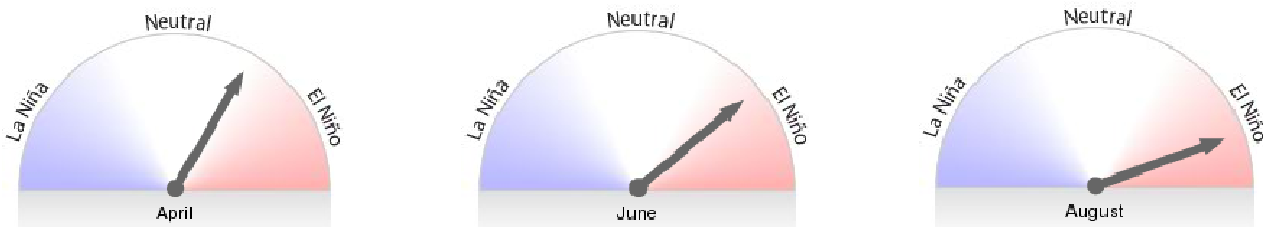
International climate models monitored by the Bureau indicate the central tropical Pacific Ocean is likely to continue to warm, with all models predicting El Niño thresholds will be reached or exceeded by mid-year. However, the accuracy of model outlooks at this time of year, the traditional El Niño Southern Oscillation (ENSO) transition period, is lower than for outlooks made at other times of the year. Hence, some caution should be exercised when using model outlooks to predict the likelihood of El Niño.



The Bureau's ENSO Tracker remains at El Niño WATCH status. This means that when current observations and model outlooks are considered together, there is about a 50% chance of El Niño developing in the coming months, which is twice the normal likelihood.

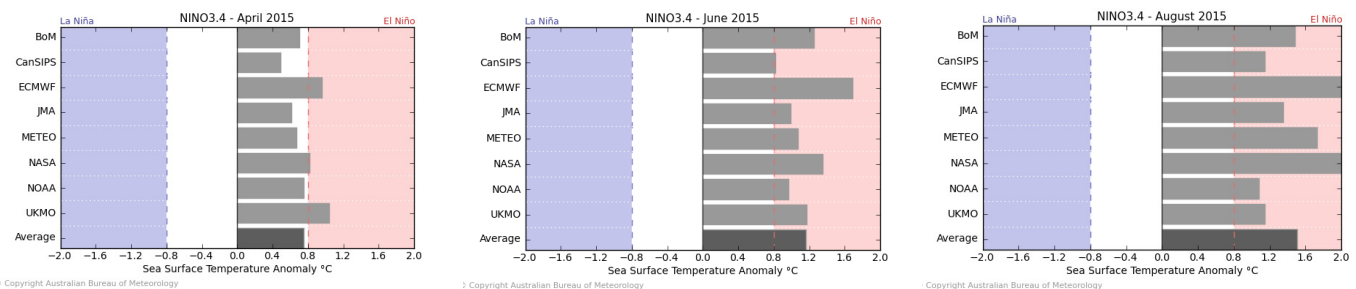
Link to the Bureau of Meteorology ENSO Wrap-Up for further information: <http://www.bom.gov.au/climate/enso/>

Bureau of Meteorology ENSO Model Outlooks for NINO3.4



Bureau of Meteorology Average of international model outlooks for NINO3.4 Link: <http://www.bom.gov.au/climate/ahead/model-summary.shtml#tabs=Overview>

Bureau of Meteorology NINO3.4 International Model Outlooks



Bureau of Meteorology Summary of international model outlooks for NINO3.4 Link: <http://www.bom.gov.au/climate/ahead/model-summary.shtml#tabs=Pacific-Ocean>



Madden-Julian Oscillation and Wind

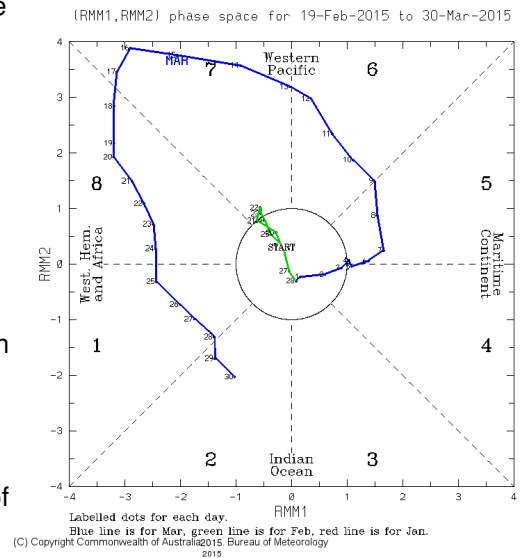
Bureau of Meteorology Weekly Tropical Note Issued on Tuesday 31 March 2015

Currently an active MJO is located over the far western equatorial Indian Ocean, enhancing tropical activity in this region. The MJO is also likely to be contributing to the lull in tropical activity currently observed across South-East Asia, northern Australia and parts of the southwest Pacific Ocean. Forecast models indicate that active convection over the western tropical Indian Ocean is likely to move slowly eastwards. However, most models suggest the MJO will weaken as it moves towards the Maritime Continent region in the week ahead. An early season tropical cyclone has formed over the northwest Pacific Ocean. Typhoon *Maysak* has already made a direct hit on the Micronesian state of Chuuk and is tracking westward. It is expected to impact the Philippines later this week.

Wind Summary

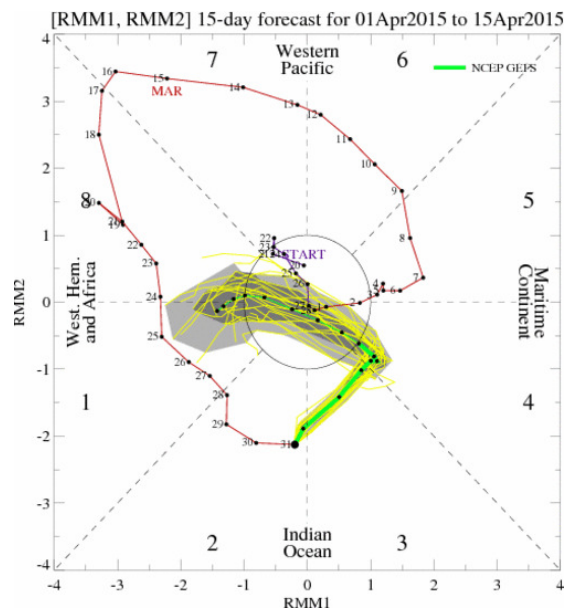
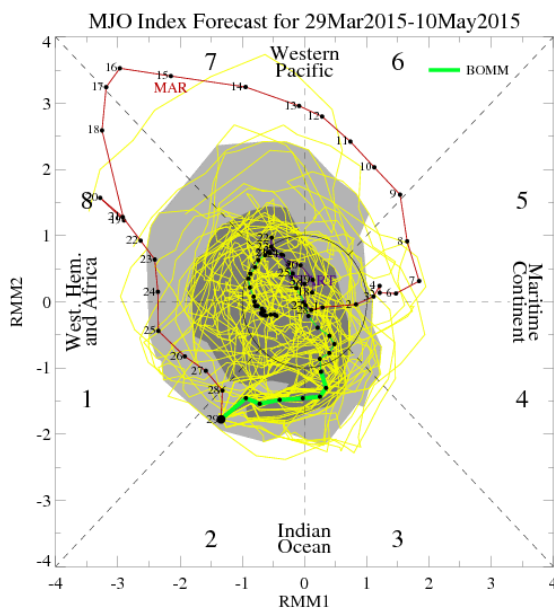
The wind plots show weaker than average trade winds in the western half of the tropical Pacific for both the last 30- and 7-days to 29 March. A persistent reversal of wind direction (i.e. from southeasterlies to westerlies) has been observed in parts of the western equatorial Pacific for about seven weeks now. Trade winds in the eastern half of the tropical Pacific were near average. Bursts of westerly winds over the equatorial Pacific can induce warming of the ocean below by driving downwelling Kelvin waves, which travel eastward as a 'pulse' of warmer-than-average water. These Kelvin waves often warm the surface of the ocean in the eastern and central Pacific. During La Niña, there is a sustained strengthening of the trade winds across much of the tropical Pacific, while during El Niño there is a sustained weakening of the trade winds.

40-Day MJO Phase Plot:



Link to the Bureau of Meteorology: Madden-Julian Oscillation for further information :<http://www.bom.gov.au/climate/mjo/>

MJO Phase Forecasts



Bureau of Meteorology MJO Forecast Link: <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/bomm.shtml>

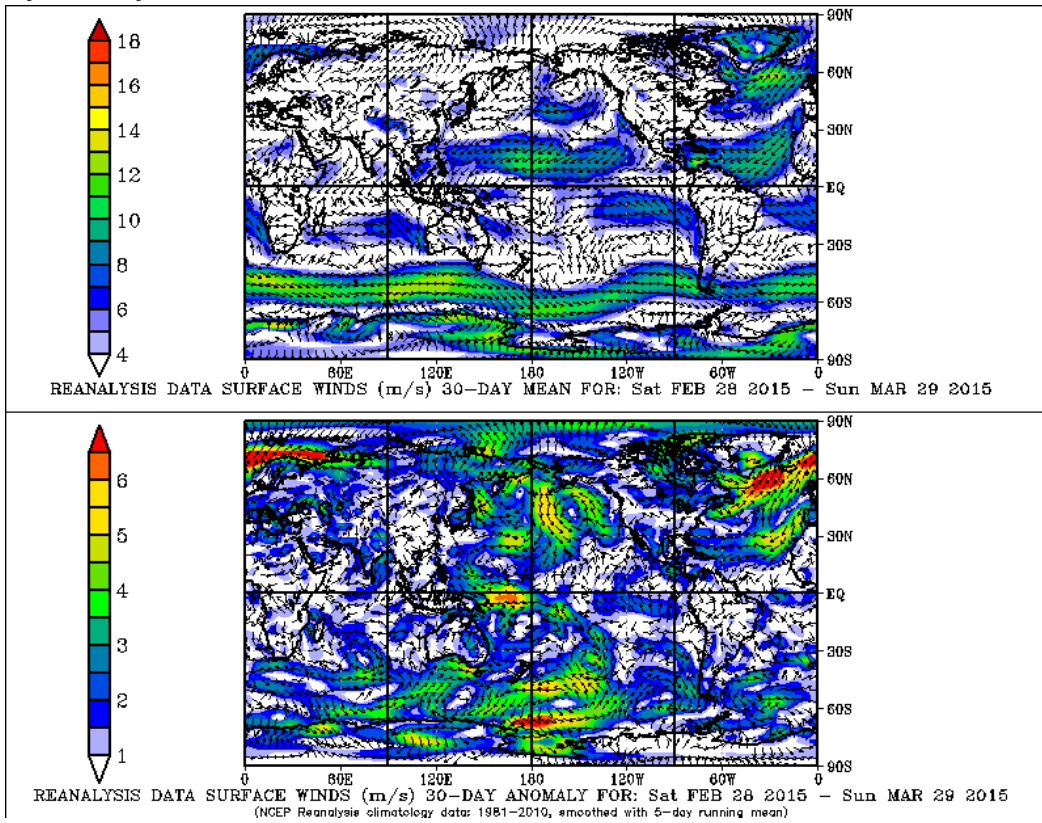
NOAA: MJO Model Forecasts Link: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/clivar_wh.shtml

NOAA: MJO Page Link: <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml>

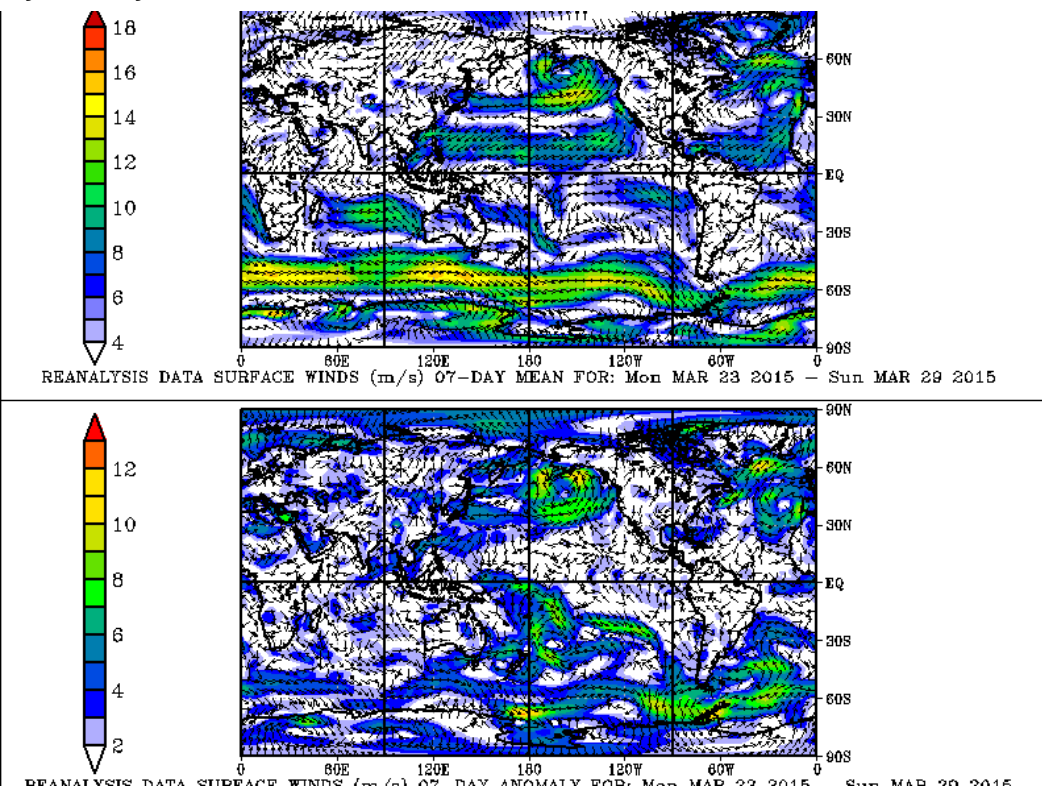


Madden-Julian Oscillation and Wind

30-Day Reanalysis Data Surface



7-Day Reanalysis Data Surface



7-Day ACCESS Model Prognostic Chart Link: <http://www.bom.gov.au/australia/charts/viewer/index.shtml?type=windbarb&level=10m&tz=AEDT&area=SWP&model=G&chartSubmit=Refresh+View>

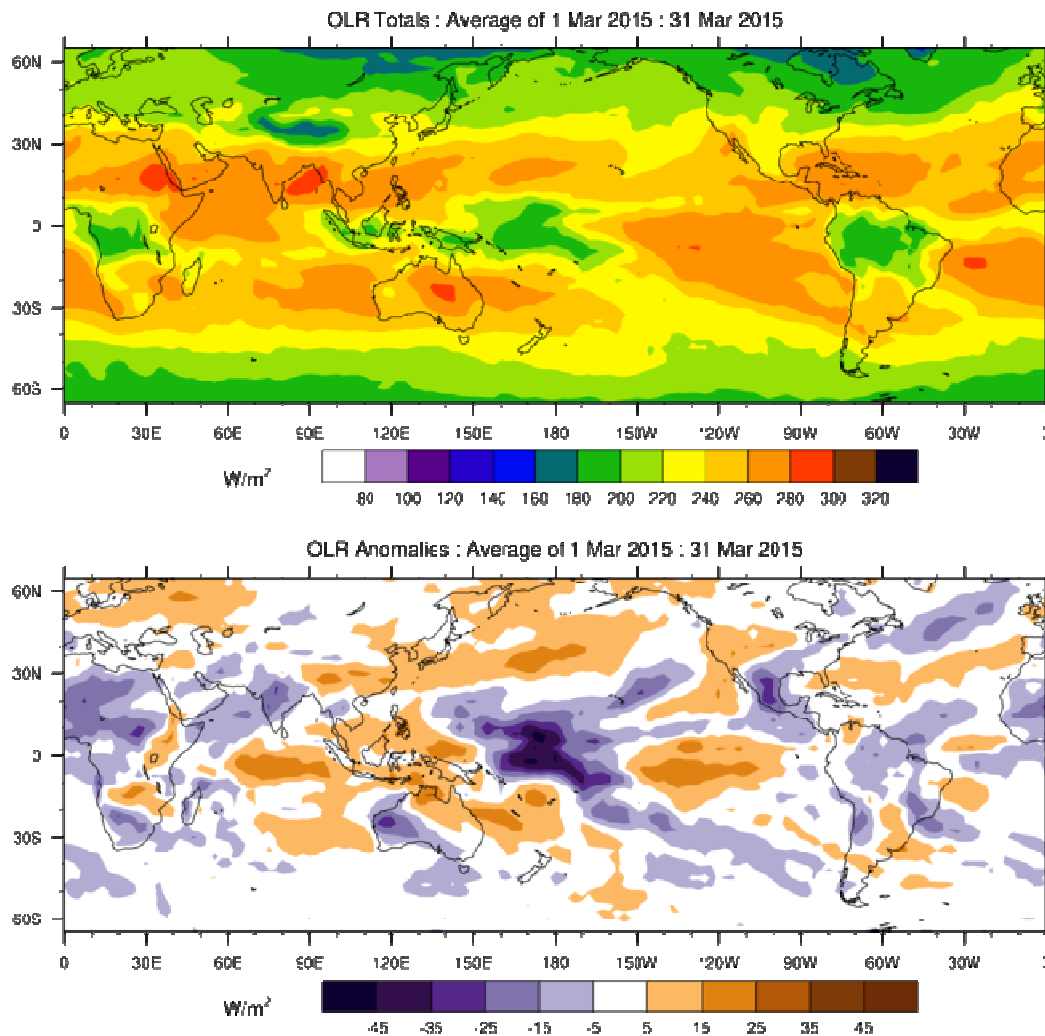


Cloud and Rainfall

The TRMM 30-day rainfall anomaly map to 30 March 2015 shows a double ITCZ (common in the austral autumn) consisting of a strong positive anomaly band north of the equator and weak positive anomaly band just to the south of the equator. In the south Pacific, SPCZ activity was enhanced and displaced northward between the Solomon Islands and Samoa. Beyond Samoa, the SPCZ extended further east than normal with southward displacement near the Cook Islands. The monthly climatology map shows the ITCZ and SPCZ merging over the Warm Pool. In March 2015, the ITCZ and SPCZ merged close to the Date Line which was most likely due to the strong warm SST anomalies in this region. The TRMM 7-day rainfall map shows the SPCZ merging with the ITCZ over the Date Line and the SPCZ significantly displaced northeastward west of Samoa.

Note: Negative OLR anomalies indicate increased cloudiness and more rain; positive anomalies indicate reduced cloudiness and less rainfall.

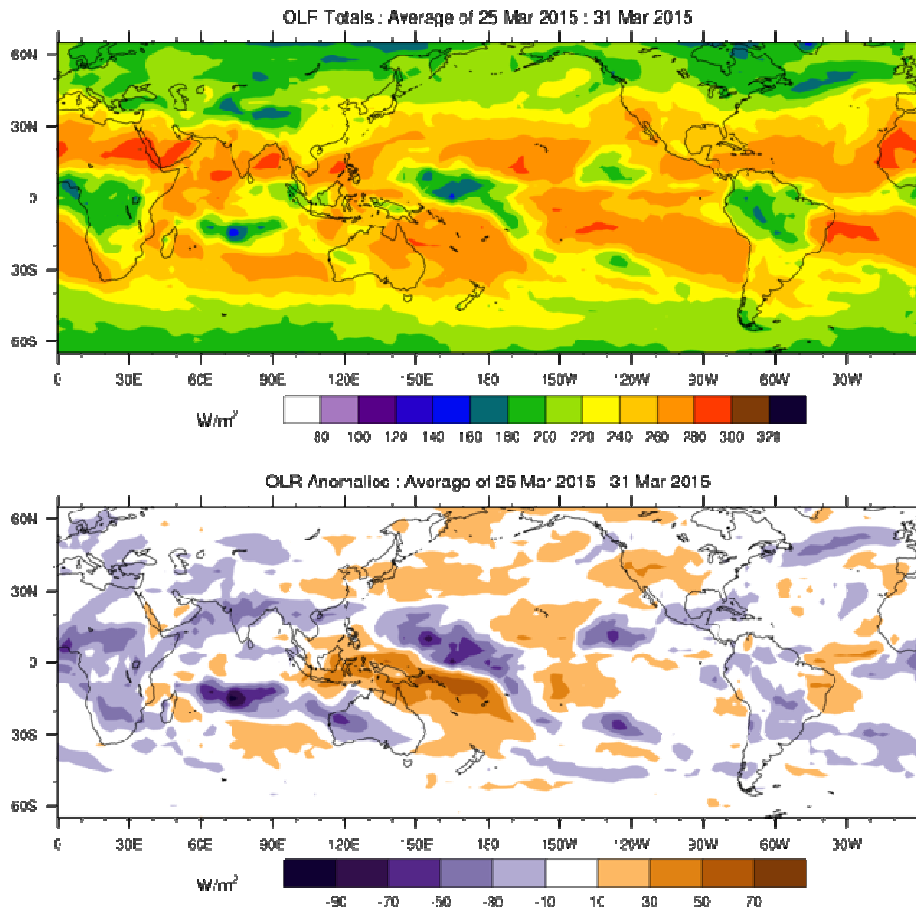
OLR Totals and Anomalies, 30 Day OLR





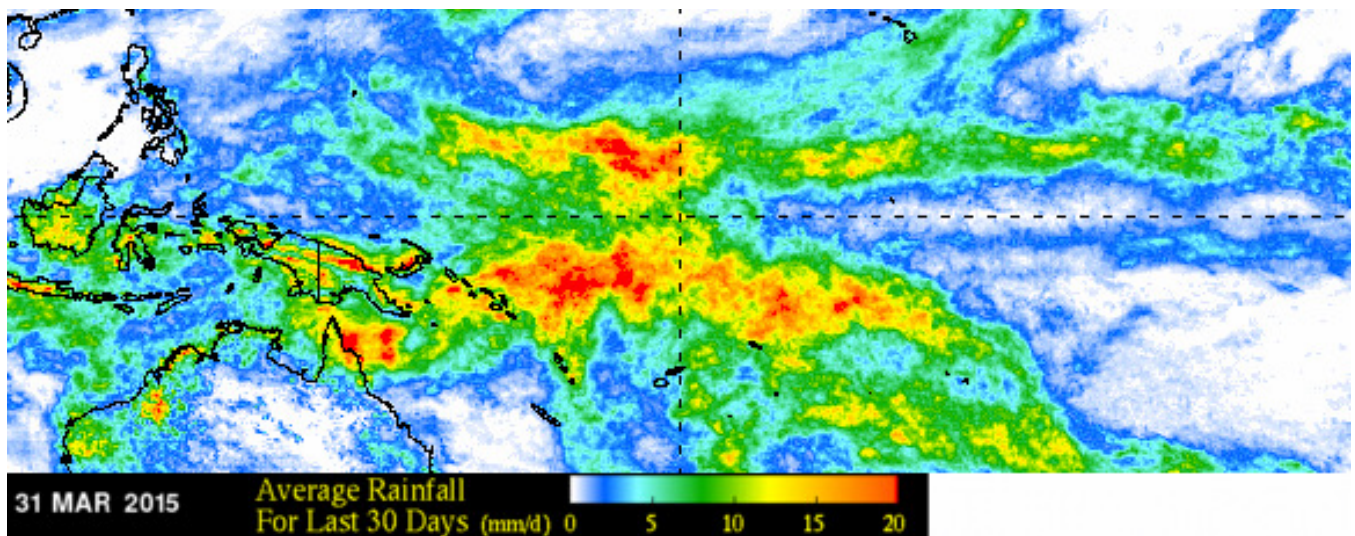
Cloud and Rainfall continued

OLR Totals and Anomalies, 7 Day OLR



Bureau of Meteorology: Madden-Julian Oscillation - Cloudiness Link: <http://www.bom.gov.au/climate/mjo/#tabs=Cloudiness>

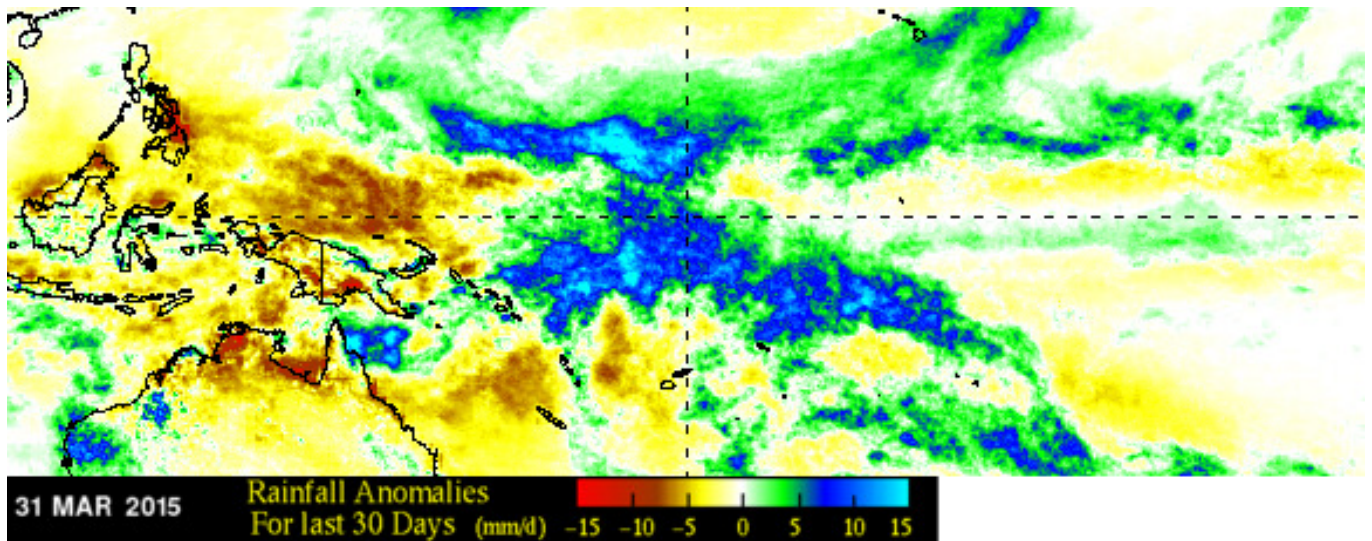
TRMM 30-Day Rainfall Averages



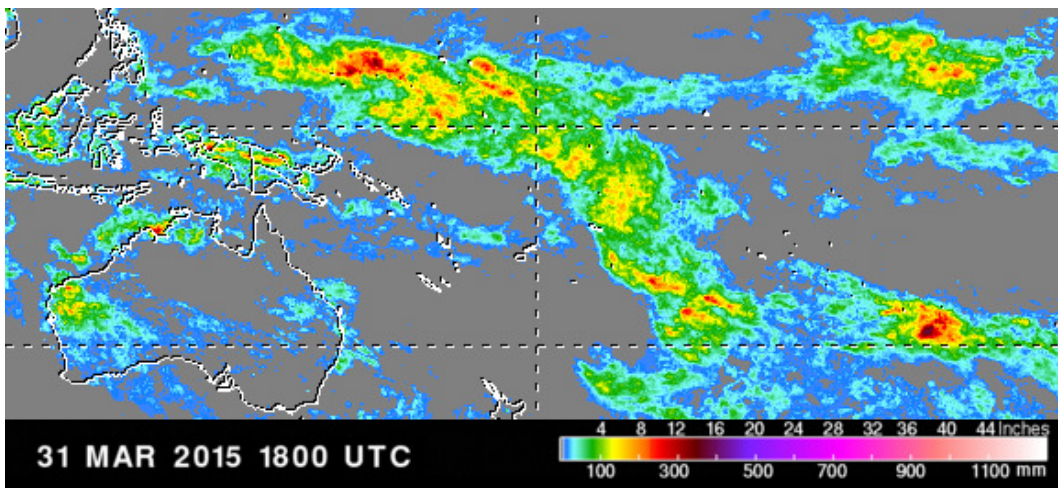


Cloud and Rainfall continued

30-Day Rainfall Anomalies

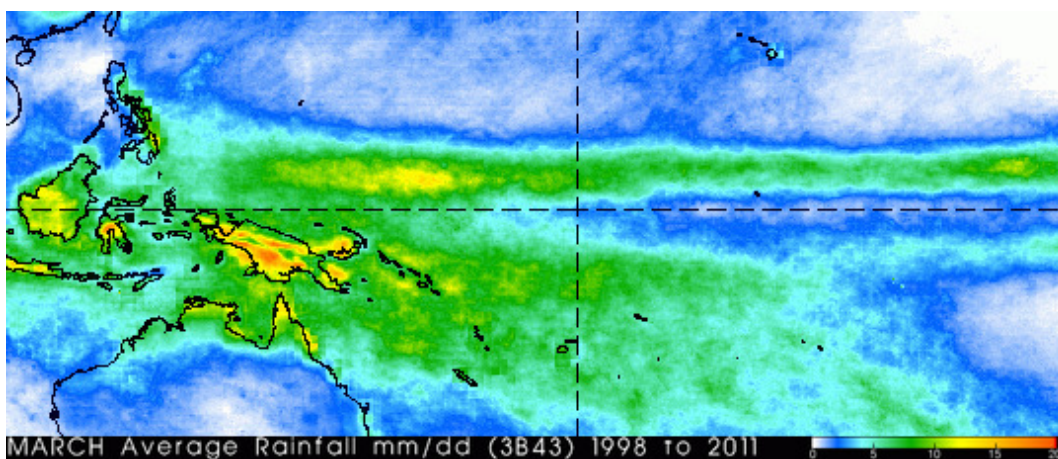


7-Day Rainfall Accumulation



Link to NASA Tropical Rainfall Measuring Mission - TRMM for further information: http://trmm.gsfc.nasa.gov/trmm_rain/Events/thirty_day.html

Current Month Rainfall Climatology





Oceanic Conditions

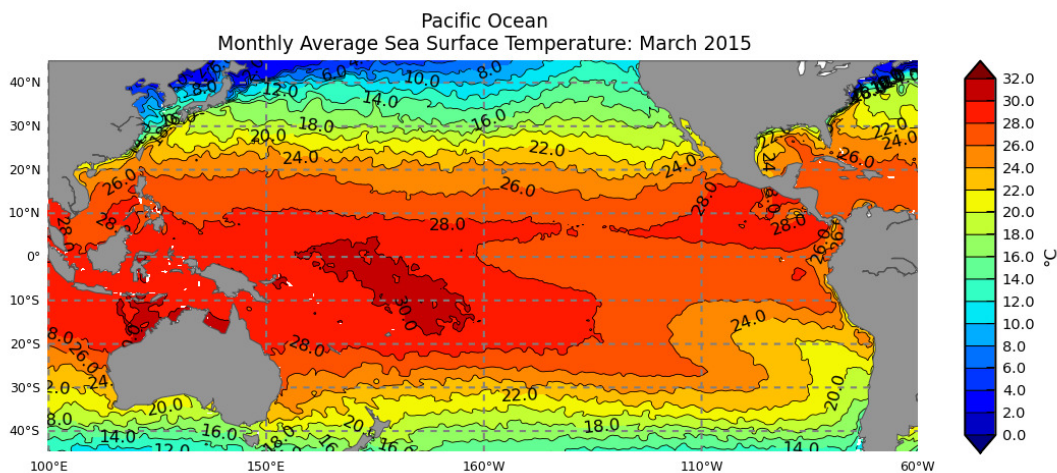
The SST anomaly map for March shows significant warm anomalies across the western and central equatorial Pacific Ocean. At the Date Line warm anomalies exceed +1.5 °C. Cool anomalies remain in the Coral Sea and around parts of New Guinea, in the south Pacific subtropics east of New Zealand and in the eastern Pacific Ocean. Warm anomalies remained across a large part of the northeast Pacific Basin, in the south Pacific on both sides of the Date Line and in the Tasman Sea between Australia and New Zealand. The final two weeks of March saw significant increases in SST anomalies across the eastern half of the tropical Pacific, especially along the coast of South America.

The March decile map shows SSTs in the above average to highest-on-record range (deciles 8-10) across most of the northeast, tropical north and southwest Pacific and the Tasman Sea. Sea surface temperatures in the below average to lowest-on-record range (deciles 1-3) were present in the central north Pacific and cover a large area in the eastern Pacific.

The Bureau of Meteorology's four-month sequence of equatorial sub-surface water temperature anomalies plot to March shows cool anomalies in the eastern Pacific have weakened since their peak in January. In contrast, warm anomalies in the western and central Pacific have strengthened throughout the last three months. March saw warm anomalies in the top 100 m between about 150°E and 130°W contracting between the Date Line and 130°W at 150 m depth. Anomalies in small parts of this region reached more than +3 °C. A small area of weak cool anomalies remains between 50 m and 150 m, east of about 130°W.

The TAO/TRITON 5-day sub-surface water temperature anomalies plot to 31 March shows warm anomalies across most of the sub-surface of the equatorial Pacific, with cool anomalies in the far western Pacific. When compared the situation a fortnight beforehand, the sub-surface warmed in both the central and eastern equatorial Pacific. This pool of warmer-than-average water progressed eastward (this is known as a downwelling Kelvin wave) with warm anomalies greater than 2 °C in the central Pacific between 100 m and 200 m depth, rising to the top 100 m in the eastern Pacific. The strongest warm anomalies in the central Pacific exceeded +4-5 °C.

Monthly Mean SST



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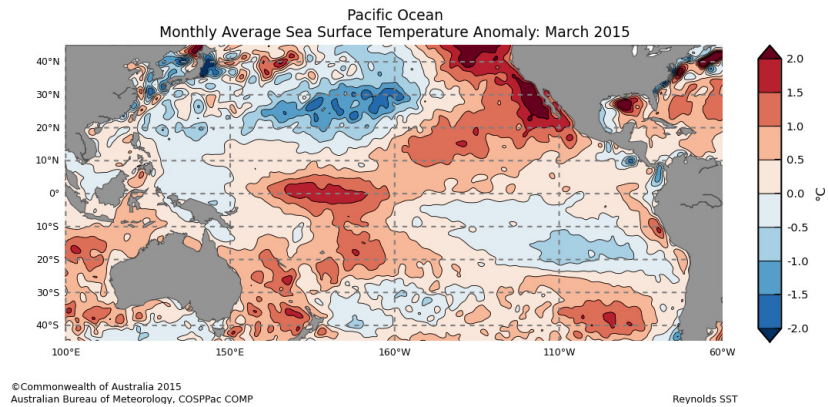
Reynolds SST

Reynolds Data 'About' file Link: http://www.bom.gov.au/cosppac/comp/ocean-portal/about_reynolds.pdf

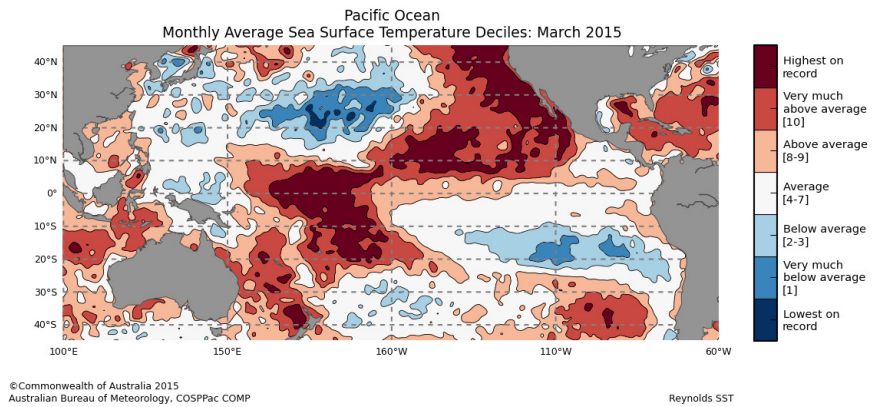


Oceanic Conditions Continued

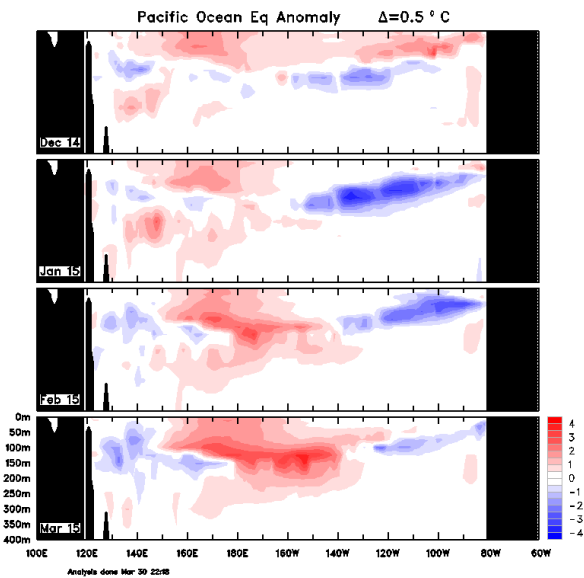
Monthly Average SST Anomaly



Monthly Average SST Deciles



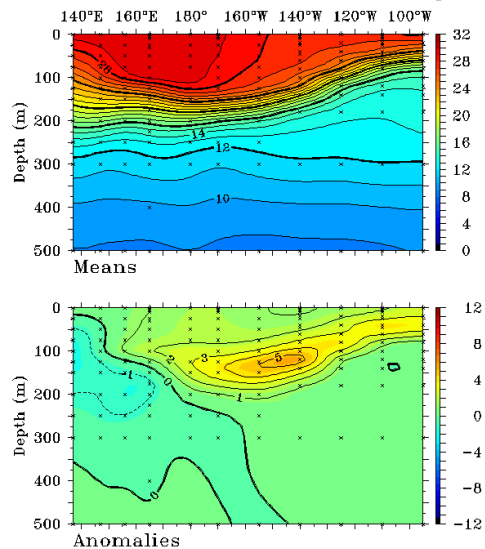
Ocean Sub-surface temperatures



Monthly Temperature Anomalies Link: http://www.bom.gov.au/climate/enso/sub_surf_mon.gif

TAO/TRITON 5-Day Temperature ($^\circ\text{C}$)

End Date: March 31 2015 2°S to 2°N Average



Weekly Temperatures Link: http://www.pmel.noaa.gov/tao/jsdisplay/plots/gif/Dep_Sec_EQ_5d.gif

Pacific Sea Level Monitoring Information

Sea level data products, including tide prediction calendars and archives of quality-controlled weather and ocean measurements, are available from the Pacific Sea Level Monitoring page at: <http://www.bom.gov.au/pacific/projects/pslm/>

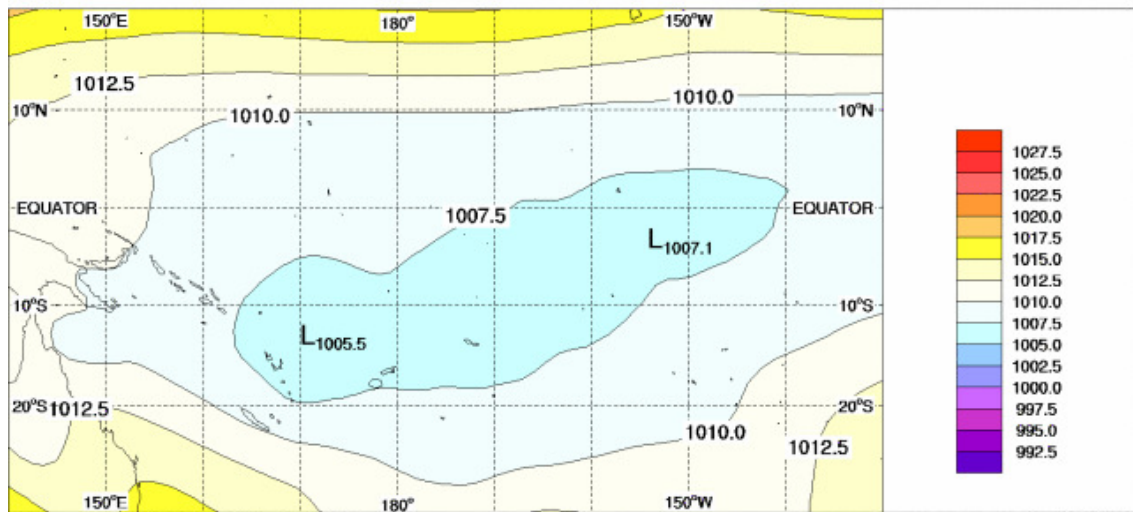


Mean Sea Level Pressure (MSLP)

The Mean Sea Level Pressure (MSLP) anomaly map for March shows anomalies greater than +1 hPa over parts of the far west tropical Pacific both north and south of the equator. Negative anomalies below -1 hPa extended eastwards from the Date Line along the equator, deepening to below -3 hPa by 155°W. Further south along the 20th parallel, negative anomalies below -1 hPa extend eastwards from about 165°E, deepening to below -1 hPa from the Date Line, and further deepening to below -3 hPa from 170°W. A region of negative MSLP anomalies between -2 and -3 hPa to the east of Vanuatu were consistent with tropical cyclone activity in March. Areas of above/below average MSLP usually coincide with areas of suppressed/enhanced convection and rain.

Monthly Mean

MSLP 2.5X2.5 ACCESS OP. ANAL. (hPa) 20150301 0000 20150329 0000

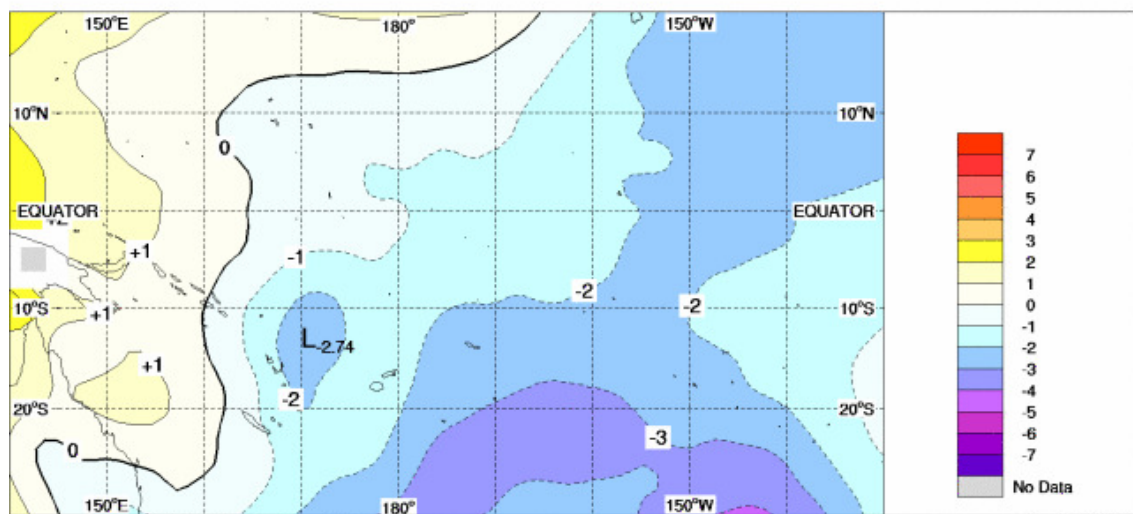


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Issued: 31/03/2015

Monthly Anomalous [with respect to a 1979-2000 mean]

MSLP 2.5X2.5 ACCESS OP. ANAL.-NCEP2 (hPa) 20150301 0000 20150329 0000



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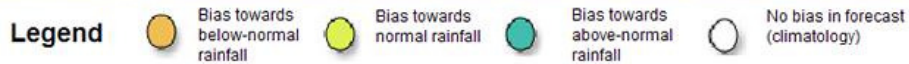
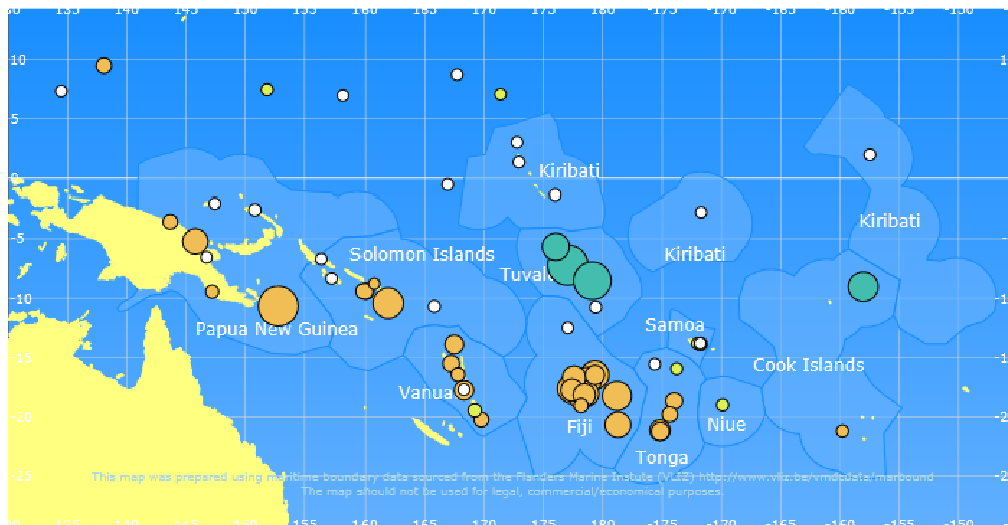
Issued: 31/03/2015

Bureau of Meteorology: South Pacific Circulation Patterns Link: <http://www.bom.gov.au/cgi-bin/climate/cmb.cgi?page=indexa&area=spac>



Model Outlooks

SCOPIC Seasonal Climate Outlook—**Preliminary** Spatial Summary for May to July 2015



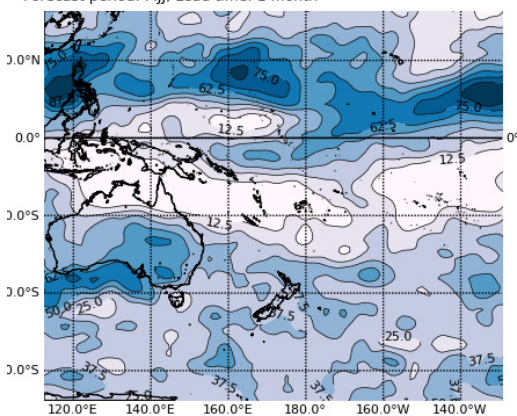
Larger "bubbles" represent higher forecast skill (based on LEPS scores)

Link to COSPPac Online Climate Outlook Forum for further information: <http://www.bom.gov.au/cosppac/comp/ocof/index.shtml>

POAMA Pacific Seasonal Rainfall Outlook

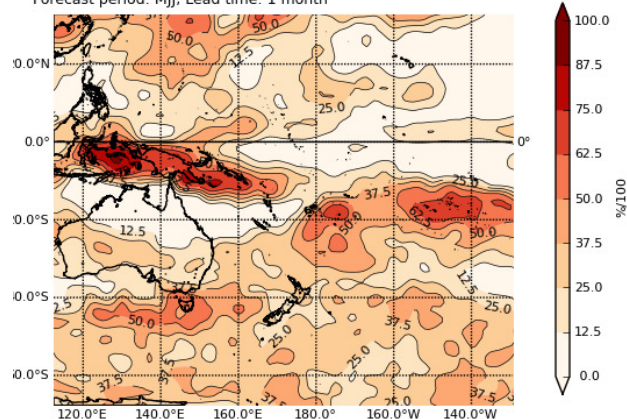
Spatial Map of POAMA Probabilities for Wetter than Normal Season

PACCSAP: Dynamical Seasonal Outlooks for the Pacific.
 Outlook based on POAMA 2 CGCM adjusted for historical skill.
 Experimental outlook for demonstration and research only.
 Variable: hr24_prpc_pt3(%/100)
 Model initialised: 20150401
 Forecast period: MJJ, Lead time: 1 month



Spatial Map of POAMA Probabilities for Drier than Normal Season

PACCSAP: Dynamical Seasonal Outlooks for the Pacific.
 Outlook based on POAMA 2 CGCM adjusted for historical skill.
 Experimental outlook for demonstration and research only.
 Variable: hr24_prpc_pt1(%/100)
 Model initialised: 20150401
 Forecast period: MJJ, Lead time: 1 month



Other Model Outlook Links:

European Centre for Medium-Range Weather Forecasts (ECMWF) Link: <http://www.ecmwf.int/en/forecasts/charts/seasonal/rain-public-charts-long-range-forecast>

United Kingdom Meteorological Office Global Long-Range Probability Maps Link: <http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/gpc-outlooks/glob-seas-prob>

National Centers for Environmental Prediction(NCEP) Coupled Model Seasonal Outlook Link: <http://www.cpc.ncep.noaa.gov/pacdir/COU1.html>

The International Research Institute for Climate and Society (IRI) Pacific Islands Precipitation Probability Forecast Link: <http://portal.iri.columbia.edu/portal/server.pt?open=512&objID=944&PageID=7868&mode=2&cached=false>



Model Outlooks Continued

Table of POAMA2.4 Rainfall % Outlooks for May to July 2015

Station	Country	Lower Tercile	Middle Tercile	Upper Tercile
Aitutaki	Cook Islands	46%	30%	24%
Rarotonga	Cook Islands	36%	40%	24%
Penrhyn	Cook Islands	12%	83%	5%
Chuuk	Federated States of Micronesia	21%	52%	27%
Pohnpei	Federated States of Micronesia	15%	79%	6%
Yap	Federated States of Micronesia	24%	40%	36%
Nadi Airport	Fiji	42%	46%	12%
Rotuma	Fiji	12%	79%	9%
Suva	Fiji	42%	46%	12%
Udu Point	Fiji	21%	70%	9%
Lakeba	Fiji	67%	28%	5%
Nabouwalu	Fiji	15%	80%	5%
Vunisea	Fiji	42%	46%	12%
Arorae	Kiribati	5%	37%	58%
Butaritari	Kiribati	30%	58%	12%
Tabuaeran	Kiribati	15%	15%	70%
Tarawa	Kiribati	12%	55%	33%
Kanton	Kiribati	6%	49%	45%
Kiritimati	Kiribati	21%	27%	52%
Nauru	Nauru	5%	56%	39%
Hanan Airport	Niue	45%	50%	5%
Koror	Palau	18%	58%	24%
Daru	Papua New Guinea	15%	80%	5%
Port Moresby	Papua New Guinea	79%	12%	9%
Madang	Papua New Guinea	73%	9%	18%
Misima	Papua New Guinea	82%	13%	5%
Momote	Papua New Guinea	40%	33%	27%
Kavieng	Papua New Guinea	43%	36%	21%
Wewak W.O	Papua New Guinea	76%	12%	12%
Nadzab	Papua New Guinea	70%	18%	12%

Link to POAMA Pacific Seasonal Prediction Portal for further information: <http://poama.bom.gov.au/experimental/pasap/index.shtml>



Model Outlooks Continued

Table of POAMA2.4 Rainfall % Outlooks for May to July 2015

Station	Country	Lower Tercile	Middle Tercile	Upper Tercile
Kwajalein	Republic of Marshall Islands	18%	36%	46%
Majuro	Republic of Marshall Islands	21%	61%	18%
Apia	Samoa	27%	55%	18%
Faleolo	Samoa	27%	55%	18%
Honiara	Solomon Islands	64%	15%	21%
Munda	Solomon Islands	64%	15%	21%
Santa Cruz	Solomon Islands	58%	30%	12%
Taro	Solomon Islands	55%	9%	36%
Kira kira	Solomon Islands	76%	12%	12%
Nuku'alofa	Tonga	49%	42%	9%
Keppel	Tonga	70%	21%	9%
Haapai	Tonga	79%	16%	5%
Lupepau'u	Tonga	79%	16%	5%
Niuafoou	Tonga	70%	21%	9%
Funafuti	Tuvalu	21%	46%	33%
Nanumea	Tuvalu	9%	42%	49%
Nui	Tuvalu	9%	39%	51%
Niulakita	Tuvalu	21%	61%	18%
Aneityum	Vanuatu	5%	90%	5%
Bauerfield (Efate)	Vanuatu	5%	90%	5%
Lamap (Malekula)	Vanuatu	5%	90%	5%
Pekoa	Vanuatu	5%	90%	5%
Port Vila	Vanuatu	5%	90%	5%
Sola	Vanuatu	64%	27%	9%
White Grass	Vanuatu	5%	90%	5%

Link to POAMA Pacific Seasonal Prediction Portal for further information: <http://poama.bom.gov.au/experimental/pasap/index.shtml>



Cyclones and Other Information

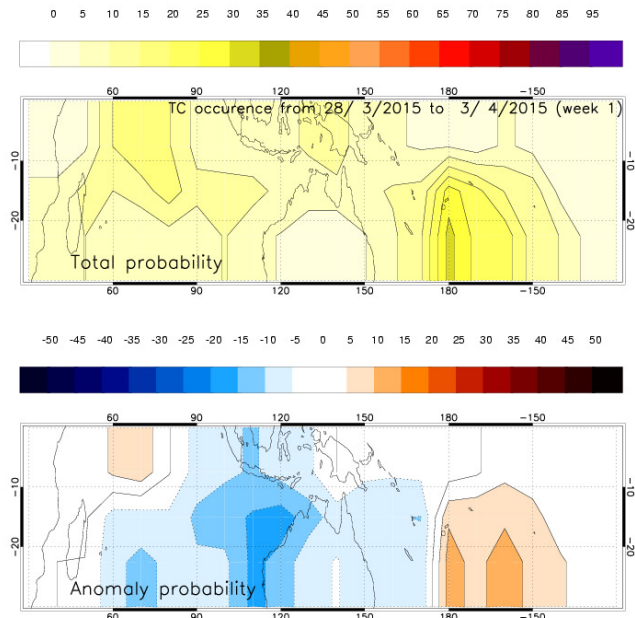
Tropical Cyclone Information

The southern hemisphere tropical cyclone season runs between 1 November and 30 April. As of 1 April 2015, six tropical cyclones have developed in the southwest Pacific region. Namely, Marcia, Niko, Ola, Pam, Reuben and Nathan.

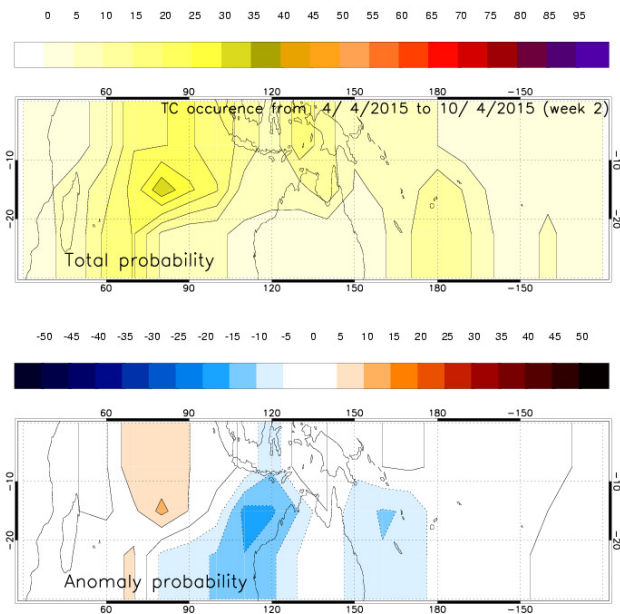
MeteoFrance Tropical Cyclone Outlook Link: <http://www.meteo.nc/cyclone/coin-des-experts>

MeteoFrance Tropical Cyclone Weekly Forecasts

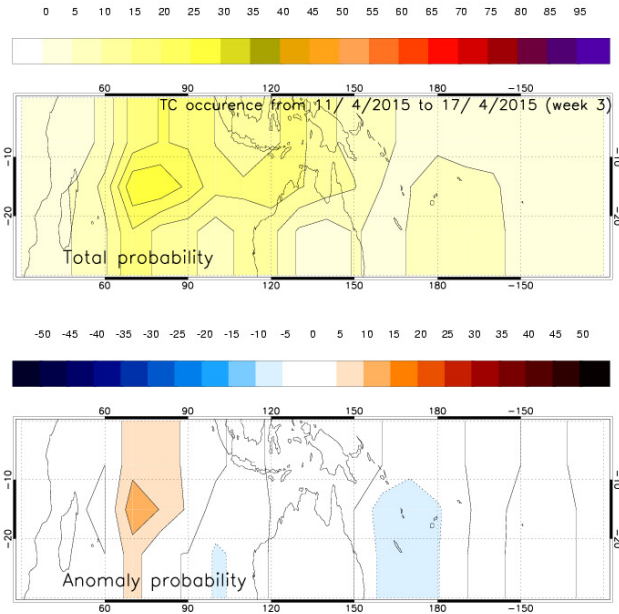
Week 1



Week 2



Week 3



Bureau of Meteorology South Pacific Tropical Cyclone Outlook Link: <http://www.bom.gov.au/climate/ahead/south-pacific/tc.shtml>

Bureau of Meteorology Tropical Cyclone Climatologies Link: http://www.bom.gov.au/jsp/ncc/climate_averages/tropical-cyclones/index.jsp

PACCSAP Tropical Cyclone Data Portal Link: <http://www.bom.gov.au/cyclone/history/tracks/>

RSMC - Fiji Meteorological Service Tropical Cyclone Warnings Link: http://www.met.gov.fj/current_warnings.php

RSMC - Japan Meteorological Agency Tropical Cyclone Warnings Link: <http://www.jma.go.jp/en/typh/>

TCWC - Australian Bureau of Meteorology Tropical Cyclone Warnings Link: <http://www.wmo.int/pages/prog/www/tcp/RSMC-TCWC.html>

Tropical Cyclone warnings and information from the Joint Typhoon Warning Center Link: <http://www.usno.navy.mil/JTWC/>

New Zealand Meteorological Service Weather Warning Link: <http://www.metservice.com/warnings/home>



Other Information

Further Information:

Southern Oscillation Index

The Southern Oscillation Index, or SOI, gives an indication of the development and intensity of El Niño and La Niña events across the Pacific Basin. The SOI is calculated using the difference in air pressure between Tahiti and Darwin. Sustained negative values of the SOI below -8 often indicate El Niño episodes. These negative values are usually accompanied by sustained warming of the central and/or eastern tropical Pacific Ocean, and a decrease in the strength of the Pacific Trade Winds. Sustained positive values of the SOI greater than $+8$ are typical of La Niña episodes. They are associated with stronger Pacific Trade Winds and sustained cooling of the central and eastern tropical Pacific Ocean. In contrast, ocean temperatures to the north of Australia usually become warmer than normal. <http://www.bom.gov.au/climate/glossary/soi.shtml>

Multivariate ENSO Index (MEI)

The Climate Diagnostics Center Multivariate ENSO Index (MEI) is derived from a number of parameters typically associated with El Niño and La Niña. Sustained negative values indicate La Niña, and sustained positive values indicate El Niño. http://www.cdc.noaa.gov/ENSO/enso.mei_index.html

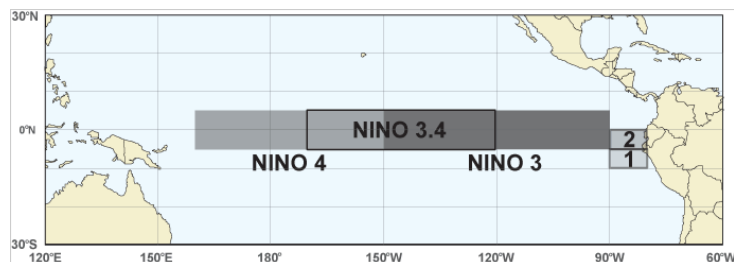
20 degrees Celsius Isotherm Depth

The 20°C Isotherm Depth is the depth at which the water temperature is 20°C. This measurement is important, as the 20°C isotherm usually occurs close to the thermocline, the region of most rapid change of temperature with depth, or the division between the mixed surface layer and deep ocean. A deeper than normal 20°C isotherm (positive anomaly) implies a greater heat content in the upper ocean, whilst a shallower 20°C isotherm (negative anomaly) implies a lower than normal heat content in the upper ocean. http://www.pbs.org/wgbh/nova/el_nino/anatomy/origins.html

Regions

SST measurements may refer to the NINO1, 2, 1+2, 3, 3.4 or 4 regions. These descriptions simply refer to the spatially averaged SST for the region described. The NINO regions (shown in the figure below) cover the following areas:

Region	Latitude	Longitude
NINO1	5-10°S	80-90°W
NINO2	0-5°S	80-90°W
NINO3	5°N to 5°S	150-90°W
NINO3.4	5°N to 5°S	120-170°W
NINO4	5°N to 5°S	160°E to 150°W



NOTE: NINO1+2 is the combined areas 1 and 2