

Interactive comment on “Joint effect of the western and eastern Pacific warm pools on ENSO cycle” by Q. Qi et al.

Q. Qi et al.

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We have carefully read the referee8217;s comments on our manuscript and now give the explanations below (embedded into the referee3’s comments for convenience).

"The authors present two metrics for the state of the tropical Pacific, namely the position of the 2861616;C isotherm of the western and eastern warm pools, and a combined index involving both. I see nothing new in terms of providing a better understanding of ENSO or providing an index that is better or complementary to those already used. I recommend the paper is rejected".

Response: The aim of our article is to study the joint effect of the zonal variation of the western Pacific warm pool (WPWP) zonal and meridional variation of the veast-ern Pacific warm pool (EPWP) on ENSO. As both of the two warm pools are oc-

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cupied by high-temperature water mass, it is feasible to study their movements using the 28C isotherm as a margin. In fact, the position of the 28C isotherm represents the front edge of warm pool water. We found that during the weak El Niños, eastern edge of the WPWP does not reach the Nino3 region, i.e. the WPWP warm water stays away from the Nino3 region. Yet southern edge of the EPWP reaches the Nino3 region, this indicates that the EPWP also plays an important role in ENSO development. However no previous study has noticed this and no study has been conducted for the joint effect of WPWP and EPWP on ENSO, it is obviously a very interesting issue to understand the mechanism of the ENSO formation.

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"In order to differentiate between the two measures (the eastern edge of the western warm pool and the southern edge of the eastern warm pool) the authors divide the tropical Pacific into two rather contived areas. It is not surprising the two measures are highly correlated with each other and with Nino3 SST since a warming in the latter will mean a shift in the position of the 28C isotherm both eastwards and southwards. Since the two measures are highly correlated, combining them to make an index offers no new information".

Response: In previous studies on warm pool and ENSO, only the effect of WPWP was considered (please ref. Maes et al GRL 2006), and it was suggested that the abnormal warming in equatorial central and eastern Pacific was due to the anomalous eastwards shift of the WPWP. Our analyses indicated that the abnormal WPWP eastward extension and EPWP southward extension are corresponding to a strong El Nino event, while the weak WPWP eastward shift and strong southward expanding to weak El Niños. So we consider that it is unreasonable to overlook the EPWP's effect on ENSO. Dividing the tropical pacific into two areas is meaningful because the adjacency and separation of the two warm pools denoted by the 28C isotherm is close to 130o W in the ITCZ (Inter-Tropical Convergence Zone) region. We analyzed the joint effect of the WPWP and EPWP on ENSO, not only due to the high correlations between

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the two warm pools and SSTA in the Nino3 region, but also explain reasonably where the warm water in Nino3 comes from, and then help to understand the mechanism of ENSO development. =====

"The authors talk of an invasion of the eastern warm pool into the Nino3 region. This gives a totally misleading impression of the reason for the shift in isotherms. The change in the position of isotherms comes about because of a warming/cooling of the equatorial waters".

We believe that the equatorial Pacific warming/cooling is likely to impact to some extent on the temperature of the EPWP, however, it cannot change the EPWP meridional movement impacted primarily by the meridional wind anomaly. =====

"The authors also say the eastward shift in the western warm pool triggers El Niño events. Again this is misleading. The eastward shift is part of the build up of an event, and is caused by westly wind anomalies (see e.g.Maes et al GRL 2006)"

Base on analysis of the relativity of the eastern edge of the WPWP and southern edge of the EPWP with SSTA in Nino3, the new idea that the two warm pools effect jointly on ENSO, and the joint effect index is introduced. This is a significant work that not only provides a new recognition of the role of the EPWP in the formation of ENSO, but also promotes the understanding of the effect of meridional wind anomaly on ENSO.

In all, due to its complexity, the mechanism of ENSO formation hasn't been figured out yet, though it has been considered as the redistribution of the mass and heat in the tropical Pacific upper-ocean under the condition of strong interaction of air and sea. Both the WPWP and EPWP are important warmest seawater regions where covers most typical region of air-sea interaction in tropical Pacific. Their movements associated with wind anomalous variation are the essential properties of the ENSO. So how the two warm pools move and what the role they take in the air-sea interaction has become one of the most important themes of ENSO research. In our manuscript, we

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found that, not only the WPWP zonal variation (e.g. WPWP eastward shift) associated with zonal wind anomaly (e.g. westly wind anomalies) is closely related to ENSO, but the EPWP meridional variation associated with meridional wind anomaly is closely related to ENSO as well. Then, the idea of joint effect of the two warm pools on ENSO was put forward.

Our results would provide new clues to the research of the ENSO mechanism, it is obviously very significant.

Interactive comment on Ocean Sci. Discuss., 5, 163, 2008.

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