

Interactive comment on “Roles of initial ocean surface and subsurface states on successfully predicting 2006–2007 El Niño” by F. Zheng and J. Zhu

F. Zheng and J. Zhu

zhengfei@mail.iap.ac.cn

Received and published: 2 July 2014

Answers to Karthik Balaguru, "This is a very nice paper in which the authors"

We thank Karthik Balaguru for his useful comments on our manuscript and answer all of them below.

1. In figure 1, it is seen that for the initial conditions the strongest positive SST anomalies are more or less co-located with strong positive SL anomalies in the western Pacific. However, in the eastern Pacific, while the strongest negative SST anomalies are at the equator, the strongest negative SL anomalies occur off-equator between 10°N and 15°N. What is the cause for this?

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Answer: Over the tropical Pacific, the interannual variations in SL can definitely reveal the fluctuation of the thermocline and the subsurface warm/cold conditions (e.g., Fisher et al., 1997; Chen et al., 1998), thus the locations of largest SST and SL signals are not consistent in some regions. As shown by the GODAS products of SSH and the average temperature in the upper 300 meters (Fig.1 in this comment), the water mass of upper 300 meters over the Northeastern tropical Pacific is obviously colder than that around the equator. The strongest subsurface cold condition over the Northeastern tropical Pacific is significantly correlated with the interannual variation in SSH, but cannot be reflected by the SST anomalies.

Moreover, as indicated in Kessler (2002), the variations in the upper ocean over the northeast tropical Pacific are strongly influenced by wind jets blowing through gaps in the Central American cordillera, and the existence of the subsurface cold water can be related to the persisted easterly zonal wind stress over that region.

References:

Fischer, M., M. Latif, M. Flügel, and M. Ji, 1997: On the benefit of sea level assimilation in the tropical Pacific. *Mon. Wea. Rev.*, 125, 819–829.

Chen, D., M. A. Cane, S. E. Zebiak, and A. Kaplan, 1998: The impact of sea level data assimilation on the Lamont model prediction of the 1997/98 El Niño. *Geophys. Res. Lett.*, 25(15), 2837–2840, doi: 10.1029/98GL52186.

Kessler, W. S., 2002: Mean Three-Dimensional Circulation in the Northeast Tropical Pacific. *J. Phys. Oceanogr.*, 32, 2457–2471.

2. On page 1549 (line 25), it is mentioned that the warm anomaly develops more slowly in the SST assimilation experiment when compared to the SL assimilation experiment. But when you consider the forecasted SST anomalies in figure 1 (bottom row), the SST anomalies in the west Pacific, near 160°E, for the SL assimilation case begin to develop in February 2006, while in the other two experiments they begin to develop a

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mont earlier in January.

Answer: Our previous statements on this phenomenon are not clear when comparing the development of the 2006/07 El Niño event initialized by the three different schemes. We think that the warm anomaly develops more slowly in the SST assimilation experiment, because it takes 12 months for the forecasted SST anomalies increasing from 0.2°C to 1.0°C. While in the SL assimilation case, it takes 11 months for the forecasted SST anomalies increasing from 0.2°C to 1.3°C, and in the SST+SL assimilation case, it also takes 12 months for the forecasted SST anomalies increasing from 0.2°C to 2.0°C. In this sense, we concluded that “the warm anomaly develops more slowly in the SST assimilation experiment when compared to the SL assimilation experiment” due to the developing speed of forecasted SST anomalies in the SST assimilation case is the slowest among these three cases.

Generally, the developing phase of an El Niño event is defined as from the month when the Niño3.4 SST anomalies become larger than 0.5°C (i.e., beginning of the event) to the end of the calendar year (i.e., peak of the event). From Fig. 4a in the discussion paper, we also can evaluate the tendency of the forecast Niño3.4 index in the SST assimilation experiment is weaker than those in the SL or SST+SL assimilation experiments.

We will further clarify the statements with more details in the revised manuscript when describing the different developing speed of the 2006/07 El Niño event initialized by the three different schemes.

Interactive comment on Ocean Sci. Discuss., 11, 1543, 2014.

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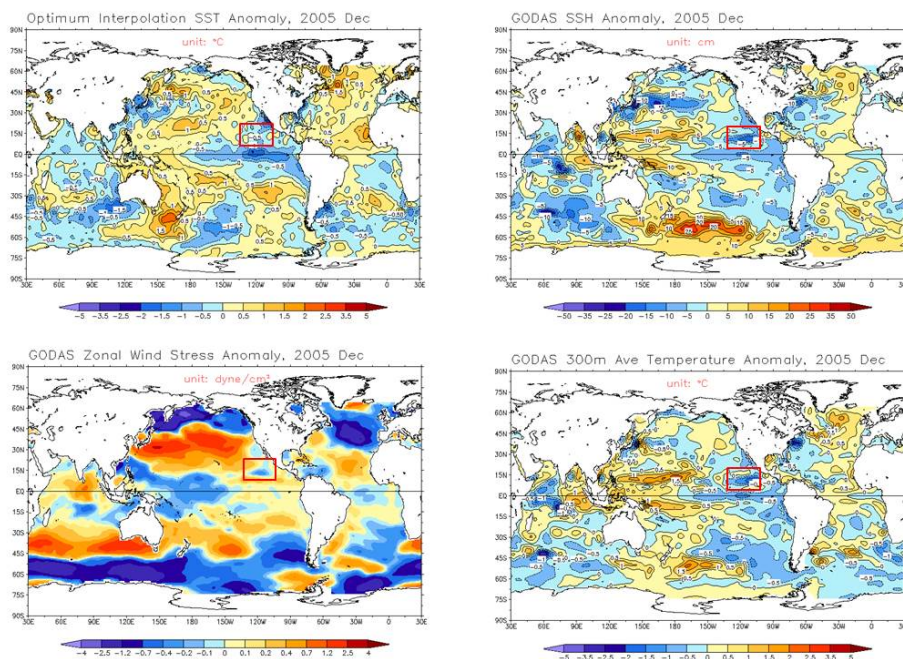


Fig. 1. Observed SST anomalies from OISST v2 and analyzed SSH, zonal wind stress, and 300m averaged temperature anomalies from GODAS products in Dec. 2005.

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