Ocean Sci. Discuss., 12, C788–C795, 2015
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Interactive
Comment

Interactive comment on "Responses of atmospheric circulation to sea surface temperature anomalies in the South China Sea" *by* M. Zhou and G. Wang

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Received and published: 29 September 2015

Thanks for the comments and constructive suggestions of Anonymous Referee 2. The reply is listed below.

RC: According to the Aims and Scope of Ocean Science this article appears rather displaced. So an atmospheric or meteorological journal might be more appropriate.

AC: Thanks for your suggestion. In this study, we tried to investigate the South China Sea (SCS) ocean role on the atmospheric teleconnections.

RC: 1) It is clear that in a changing climate SSTs won't change solely in the SCS but

also at any other location in the world ocean. So the question should be discussed if the described teleconnections would operate in the real world. Unfortunately, no attempt was made to validate the teleconnections. On page 1700 line 20ff the authors note that in boreal winter in the northern SCS, SST anomalies are independent from the atmospheric conditions. This gives the opportunity to look in the used observational data sets find support for the described teleconnections. If on the other hand, as the authors state the SCS most of the time only responds passively responds to atmospheric forcing, then it would be better to choose another shelf sea which is less dependent for these sensitivity experiments. The article would clearly benefit from that.

AC: Thanks for your insightful suggestions. We calculate the correlation between the winter SSTA in northern SCS and the barotropic/baroclinic streamfunction. As shown in Figure R1, the correlation in (a) demonstrated two waves: one is from SCS to North America and the other is from SCS to the Southern Hemisphere; the correlation in (b) showed positive anomalies in East Asia and the Southwest Pacific and negative anomalies in the North Pacific and southern tropical Indian Ocean. These suggest that the described teleconnection between SCS SST and the global atmosphere circulation can work. The figure will be added in the revision.

RC: 2) The model basically predicts anomalies in the baroclinic and barotropic streamfunctions. It is not clear if any of these changes are of any climatic or physical relevance at all in the remote regions (Mediterranean, North America etc.). Hence, the authors should briefly introduce to the local climatic conditions in the remote regions and give hints why and how atmospheric circulation changes might be important in these regions (the frequent heavy rain events in the northern Mediterranean might be an example, etc.). The scientific relevance would benefit from that.

AC: Thanks for your practical suggestions. We calculate the correlation between the winter SSTA in northern SCS and rainfall. As shown in Figure R2, the correlation between the northern SCS SSTA and the rainfall also showed two waves: one is from SCS to North America and the other is from SCS to the Southern Hemisphere. Thus

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the described teleconnection between SCS and North America exists not only in the stream functions, but also in rainfall. This part will be discussed in the revision.

RC: Specific comments It should be introduced in more detail to the phenomenon of global teleconnections. What is the role of the ocean, the atmosphere and their interaction? And why is the SCS of special interest for this specific phenomenon. Does the SCS warm faster than other ocean regions (because it is a flat shelf sea)? Also it would be interesting to know more about the seasonal cycle of the air-sea temperature difference in order to estimate how energy is distributed in the model (either by reduced heat loss to the ocean or by increases heat flux from the ocean).

AC: Thanks for your suggestions. Yes, some global teleconnections will be discussed in the introduction.

Yes, the SCS warming is faster than the global average (Figure R3c). The SCS warming is largest in the latitudes between 0-20N globally (Figure R3b). Actually that is why we want to see the SCS role on atmosphere circulation. We will discuss it more in the revision.

We also calculate the seasonal cycle of the air-sea temperature difference (Figure R4); it suggests that atmosphere reduces heat loss to the ocean in the northern SCS during the boreal winter and increases heat flux from the ocean during the summer in the northern SCS. Thus the boreal winter SST in northern SCS can give us some opportunities to investigate the teleconnections discussed in the study.

RC: page 1695, Line 8: which positive SST anomaly are you talking of?

AC: Thanks for your suggestions. Positive SST anomaly of page 1695, Line 8 means the SST over the SCS is larger than the seasonal climatology from 1958 to 1999. Now we make it clearer in the text.

RC: page 1699, line 5: “The results support...”. Don’t understand this sentence. Be more verbose. What is meant by asymmetric heating sources? The reference to Fu et

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al. (1980) in Chinese language is not sufficient here.

AC: We will add one more reference here: Timothy J. Dunkerton, 1989: Nonlinear Hadley Circulation Driven by Asymmetric Differential Heating.

"The results support..." is changed to "The role of asymmetric heating in influencing atmosphere circulation also can be seen in many literatures such as Fu et al. (1980) and Dunkerton (1989)."

RC: page 1699, line 9: what is meant by "atmospheric circulation in the zonal direction"? Circulation is by its nature neither strictly zonal nor meridional. Or do you mean that the overwhelming wind field over the SCS is mostly in E-W direction during summer and winter? Or do you have E-W gradients in the SST anomaly applied?

AC: Thanks for your suggestions. "To test the effects of the SST warming patterns in the SCS on atmospheric circulation in the zonal direction" is changed to "To test the effects of the SST warming differences in the zonal direction on atmospheric circulation".

Yes, we applied E-W gradients in the SST anomaly.

RC: page 1700, line 18: "For example, we may forecast climate related events based on SCS SST anomalies". This is a zero statement. Please give examples for the kind of events you might forecast or remove the sentence.

AC: Thanks for your suggestions. "For example, we may forecast climate related events based on SCS SST anomalies" is changed to "For example, we calculate the correlation between the northern SCS SSTA and the rainfall. The correlation pattern is quiet similar to Figure 4a, which also showed two waves: one is from SCS to North America and the other is from SCS to the Southern Hemisphere (Figures not shown here), thus this study may help to forecast climate-related events like rainfall in the North America based on the SCS SST anomalies."

Interactive comment on Ocean Sci. Discuss., 12, 1693, 2015.

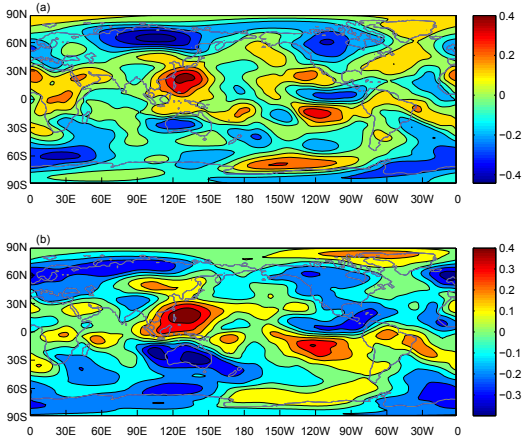

Figure R1. Lag correlation maps (lag day=15 day) of the northern SCS (12 − 23° N, 110 − 121° E) SSTA in the winter (October 2003 to March 2004) with global barotropic stream function (a) and baroclinic stream function.

Fig. 1.

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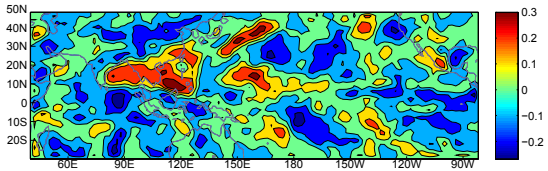

Figure R2. Lag correlation maps (Lag days=15d) of the northern SCS (12 − 23° N, 110 − 121° E) SSTA in the winter (October 2003 to March 2004) with global rainfall.

Fig. 2.

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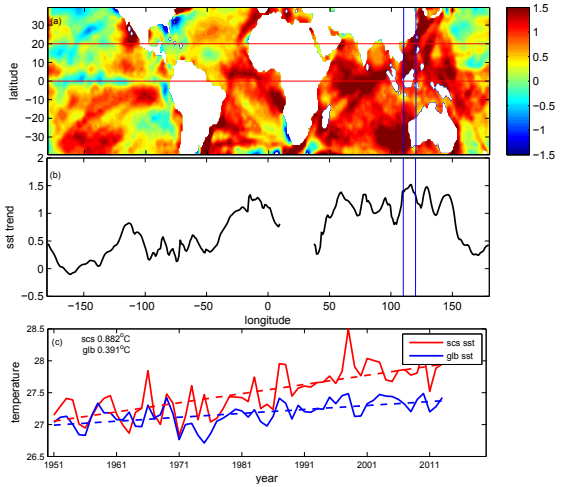

Figure R3. Linear trends (1951-2013) of the SST anomalies (color shaded unit: ℃ /100 year) obtained from the HadISST (a). The Linear trends (1951-2013, 0-20˚ N meridional mean) of the SST anomalies (unit: ℃ /100 year, b). The time series (1951-2013) of the SST in the SCS (red) and global mean (blue) obtained from the HadISST (c).

Fig. 3.

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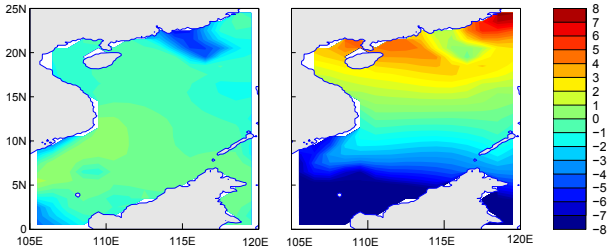

Figure R4. The summer- (a) and winter-mean (b) air-sea temperature difference (2 meter air temperature minus SST, units: C) in the SCS from 1982 to 2011, the 2 meter air temperature is from ECWMF ERA-Interim and the OISST is from NOAA.

Fig. 4.

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