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Interactive comment on "The shallow meridional overturning circulation of the South China Sea" *by* N. Zhang et al.

Anonymous Referee #4

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This manuscript confused me. There are several different components to the work and I had difficulty with each part. I recommend that the authors submit a new manuscript "discussing the ... driving mechanisms ... in different seasons" (as they indicate in the last sentence that this will be their next study) and include the results from this manuscript in the new manuscript as averages over the seasonal (or monthly) analyses.

The manuscript is an analysis of the annual mean circulation in the South China Sea where the seasonal variations associated with the monsoons may be very large. It is primarily an analysis of SODA model data. To my eye, the comparison in circulation between SODA and OFES models (in Figure 1) is not very good, raising questions about the reliability of SODA. The circulation on which the authors focus is an "interior"

pattern from 8N to 18N but most of the action in the model circulations is north of 18N. The shallow annual mean circulation turns out to be primarily associated with annual mean Ekman transport and is quite small, though the monthly variations are likely to be large. It was not clear to me whether the authors use the same wind stress climatology for Ekman transport calculations as SODA uses to drive the model circulation. The subduction rate is estimated using annual mean vertical velocity and annual mean horizontal velocity times annual mean slope of the mixed layer depth. I thought the point of Stommel's "Ekman demon" papers was that the subduction primarily happened in late winter so the late winter structure was core to the vertical transfer. Since the equations are nonlinear, should the authors be doing monthly (or daily) subduction calculations and then time averaging the time series of subduction analyses to produce an annual mean?

Toward the end of the manuscript, upwelling (Section 4.3) is discussed on a monthly basis which led me to conclude that the shallow circulation and subduction would also be much better presented in terms of monthly variability. The comparison with the Indian Ocean subduction (Section 5) seemed out of place in this manuscript on the shallow overturning in the South China Sea.

In conclusion, I think the authors need to map out exactly what the topic of this manuscript is. The last sentence says "there may be different driving mechanisms when discussing them in different seasons. We will discuss this in a further study." For me this "further study" would represent a better way forward for discussing the meridional overturning circulation of the South China Sea, possibly including an annual average of the seasonal (or monthly) circulations to properly address the topics presented here in this manuscript.

Interactive comment on Ocean Sci. Discuss., 11, 1191, 2014.