Major comments:

The meridional overturning in the South China Sea has a three-dimensional structure, for example, the upwelling mainly occurs near the Vietnam coast. In Section 3, the authors only described the zonal mean structure. I understand that the purpose of this paper focuses on the meridional circulation. Since the SODA data can provide the three-dimensional information, it would be better to give a complete picture of the overturning in the South China Sea, for example the path of the subducted water. Does the west boundary current proposed by Stommal and Arons' (1959) exist?

Reply: We thank Dr. Li for his comments and suggestions. In this paper, we mainly focus on the two-dimensional structure and the driving mechanisms of the meridional overturning circulation. We mention that the subducted water flows southward along the isopycnals in the following months (Fig. 5c and d, line 11, page 1197). Details on the three-dimensional structure will be given in a future study. And we can tell from Fig.7 (b), which is the velocity field at the bottom of the mixed layer in January, that strong west boundary current definitely exists in the SCS. In review of progress in studies of the SCS circulation, Liu et al. (2008) pointed out that a northward western boundary current existed in summer and a southward western boundary current existed in winter.

New Reference:

Liu Q. Y. , Kaneko A., and Su J. L.: Recent progress in studies of the South China Sea circulation, Journal of Oceanography, 64, 753-762, 2008.

What is the purpose to use the OFES output? The difference between the SODA and the OFES is apparent in Figure 1, but the authors did not explain it. If the OFES output is used for validation, it is not convincing to validate one model result with another.

Reply: Indeed, the values of meridional streamfunction obtained from SODA and OFES are different. But the OFES data is used only for validation of the existence of the shallow meridional overturning circulation in the SCS. And Fig. 1b dose show a weaker meridional overturning structure limited to a shallower depth compared to what obtained form the SODA data. And in the second paragraph of section 3 (line 5, page 1195), some previous studies can prove that SODA data have been widely used in the study of the SCS and meridional overturning circulation in the Indian Ocean (Schott et al., 2002; Liu et al., 2008). Besides, in the assimilation of SODA, it is continuously corrected by contemporaneous observations with corrections estimated every 10 days (Carton et al., 2007), which makes it more credible. So we believe that the meridional overturning structure of the SCS obtained from the SODA data is credible. And OFES data are not used except for section 3.

New Reference:

Carton J. A., Giese B. S.: A reanalysis of ocean climate using Simple Ocean Data Assimilation (SODA), Monthly Weather Review, 136 (8), 2999-3017, 2008.

The total upwelling near the Vietnam coast is 7.3-4.4=2.9 Sv, doubled of the subducted water in the northern South China Sea. May the authors explain the reason?

Reply: It's mainly because the upwelling rate obtained off the Vietnam coast (7.3 Sv) is a high estimate. It is obtained on the hypothesis that all the Ekman pumping water will be upwelled into the mixed layer and becomes permanently transformed, which is unlikely in fact. Besides, not all

the upwelled water will be transported northward, part of it will be transported southward south of 8° N (Fig.1 a in our paper).

The comparison between the South China Sea and the Indian Ocean is vague. I cannot get the direct connection between them. More descriptions are needed.

Reply: In fact, we add this section to increase interest of our paper, or our results are entirely confined to the SCS according to the Editor's kind suggestion. So maybe this part is a little disconnected from the rest of the paper. We did not discuss their internal connections such as their impacts on each other, instead we made some comparisons between their strengths, characteristics of structures, and formation mechanisms. The strength in the Indian Ocean is stronger. They have similar structures and driving mechanisms. They are both in the monsoon area and have coastal upwelling, with subduction and Ekman transport playing important roles in their formations. Indian Ocean upwelling occurs off Somalia, Oman and off Indian, and only during the summer monsoon. SCS upwelling occurs off Vietnam coast and mainly in summer. They embrace similar structures and different characteristics at the same time.

About the discussion of the upwelling near the Vietnam coast, there are two mechanisms: one is the Ekman transport caused by the alongshore wind, the other is the Ekman pumping caused by offshore increasing wind. The paper paid more attention on the latter one. The paper also pointed that the former one is dominant (Line 10 on page 1199). This confused me. Are they related?

Reply: In fact, the first paragraph in section 4.3 (page 1199) is a review of studies on summer upwelling off the Vietnam coast. The sentence saying that offshore Ekman transport is a dominant mechanism to pump cold water in Line 10 on page 1199 actually is a conclusion from Kuo et al. (2000), and this conclusion in not based on comparison between the two mechanisms, because they didn't mention the increase in southwestly winds. In our paper, we only calculate the upwelling resulted from the wind stress curl, because we want to make a primary estimate of upwelling caused by Ekman pumping, in correspondence with the subduction in northern SCS which is also mainly caused by Ekman pumping. We think the two mechanisms resulting in upwelling are independent. If there is no wind stress curl, the alongshore winds can still cause offshore Ekman transport and then cold water can be pumped up off the Vietnam coast. Likewise, if there is only wind stress curl, it can also pump water into the mixed layer, in the open ocean off Vietnam.

Other comments:

In the abstract, the SODA data should be mentioned.

Reply: Thank you for your suggestion, contents should be added to the paper:"In this paper, the structure and formation mechanism of the annual-mean shallow meridional overturning circulation of the South China Sea (SCS) are investigated, using the Simple Ocean Data Assimilation (SODA) data."

In Section 2, the model configuration should be clearly presented. Especially for the SODA data, what kind of wind forcing is used?

Reply: The SODA system begins with a state forecast produced by an ocean general circulation model based on Parallel Ocean Program numerics (POP; Smith et al., 1992), with an average

resolution of 0.25°×0.4° and 40 levels. Daily surface winds are provided by the ECMWF ERA-40 reanalysis (Uppala et al., 2005). Surface freshwater flux is provided by the Global Precipitation Climatology Project monthly satellite-gauge merged product (Adler et al., 2003) combined with evaporation obtained from the same bulk formula used to calculate latent heat loss. The model also includes a relaxation to *World Ocean Atlas 2001* climatological sea surface salinity. The monthly-averaged output are remapped onto a uniform global 0.5°×0.5° horizontal grid and saved in netcdf format (Carton et al., 2007).

New References:

Adler, R. F., and Coauthors: The Version-2 Global Precipitation Climatology Project (GPCP) monthly precipitation analysis (1979-present), J. Hydrometeor., 4, 1147-1167, 2003.

Carton J. A., Giese B. S.: A reanalysis of ocean climate using Simple Ocean Data Assimilation (SODA), Monthly Weather Review, 136 (8), 2999-3017, 2008.

Smith, R. D., Dukowicz, J. K., and Malone, R. C.: Parallel ocean general circulation modeling, Phys. D: Nonlinear Phenomena, 60, 38–61, 1992.

Uppala, S. M., and Coauthors: The ERA-40 re-analysis. Quat. J. Roy. Meteor. Soc., 131, 2961-3012, 2005.

Line 24 on page 1196: Directly from Figure 6, the mixed layer is deep in the north while shallow in the South.

Reply: Maybe we didn't express us clearly. The contours of mixed layer depth are mostly in northeast-southwest direction. So it is deeper in the northwest and shallower in the southeast.

Line 7 on page 1198: "It should be noted that the estimate of annual subduction rate is subject to substantial error but it can be used to investigate the distribution pattern qualitatively." This will confuse readers.

Reply: This sentence means errors can not be avoided when using Marshall's equation to estimate annual subduction rate. Mashall (1993) mentioned that assuming the errors in w_H and $u_H \cdot \nabla H$ are 40% of their absolute values, then the error in S_{annual} is typically ± 15 myr^{-1} in the interior gyre or ~30% of the absolute value.

Line 14-16 on page 1200: Be careful of the unit of density. And these two sentences are not clear to me.

Reply: Karstensen and Quadfasel (2002) investigated the densities of subducted water to follow their paths and upwelling zones.

The language and writing styles needs to be improved.

Reply: Thank you for your kind suggetstion, we will improve them.