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Interactive comment on "Comparison of the simulated upper-ocean vertical structure using 1-dimensional mixed-layer models" *by* Sonaljit Mukherjee and Amit Tandon

Anonymous Referee #1

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This paper compares simulations of three1-dimensional ocean mixed layer models: PWP, KPP and κ-ε models (CA), with observed data. The difference of SST and vertical structure of temperature and velocity between three models are primarily discussed. The model results are compared with two in-situ datasets: SWAPP and MLML. The results show some significant differences between the models such as structure of shear, inertial variations, and SST evolution. Although these in-situ data have not been compared with simulations of multiple 1-dimensional models previously, some of the interpretation of the model results are not clearly explained. Therefore I suggest major revisions. My concerns as well as minor comments are described in the following:

Major points: 1. Abstract "The inertial maximum extends over a substantial range of

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depths, and is continuous for the κ-ε model but discontinuous for the KPP and PWP models."

This is the major difference for the SWAPP case, and it is discussed in Section 4.1. But the reason of the difference is not explained clearly enough. Lines 30-31, "While the local mixing in CA reduces the intensity of vertical shear below the ML at all frequencies, the corresponding shear in KPP and PWP are stronger since both these simulations do not have a parameterization for vertical mixing below the ML". This sentence seems to be the explanation of the difference described above. But it is not quite clear and confusing. For example, the mixing parameterization below the ML in PWP is gradient Richardson number adjustment, and KPP is (5) (page 5, Lines4-5). Does the sentence above imply that the shear cannot be reduced by mixing in KPP and PWP? More explanations are needed.

2. Abstract "the net warming of SST at the end of the diurnal cycle is stronger for the PWP compared to κ-ε and KPP". The authors argue that this different mixing process for the diurnal warming is responsible for the difference in SST warming during R phase (Section 4.2). PWP results show larger SST warming during R phase than other models. Isn't it simply because PWP ML is shallower, and thus absorbed heat is concentrated in the thin layer? Is ML in PWP shallower than other models during this period? If so, isn't such simple explanation acceptable? Section 4.2 discusses the heat content and SST relation. Discussion on ML depth in each model and its relation to SST evolution should be included.

3. The authors discussed why PWP model generate SST changes larger than other models during R phase for the MLML case. But they did not discuss why PWP model agrees best with the observations. Are there any model deficiencies in κ-ε and KPP, which makes this SST simulation worse than PWP?

Minor points: 1. Page 2, Line 2, Typo. Should be "Pinkel" 2. Year of SWAPP and MLML should be indicated somewhere (e.g., captions). 3. Fig. 1 is not referred in the text.

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4. Figure 3 caption. Arrows should be explained. 5. Page 9, Line 11 “a similar diurnal amplitude (Figure 6)” A diurnal amplitude of M phase cannot be seen in Figure 6. 6. Page 10, (7) What value of zb is used in the calculation? 7. Does this study contribute to the improvement of mixing parameterization? If so, how could the results be used?

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