

## ***Interactive comment on “Benefits of assimilating thin sea-ice thickness from SMOS-Ice into the TOPAZ system” by J. Xie et al.***

### **Anonymous Referee #2**

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#### General Comments

The paper investigates the impacts of assimilating SMOS sea ice thickness into the TOPAZ system. The DA experiment of assimilating SMOS sea ice thickness is compared with the experiment without SMOS thickness. It shows that assimilating SMOS thickness can reduce the thin sea ice thickness errors (as expected), slightly improve the sea ice concentration, but does not degrade other ocean variables. Further, the DFS method is used to quantify the impact of SMOS ice thickness on the model data. Overall, the result is encouraging, and would be helpful for future sea ice prediction and reanalysis efforts. However, some issues need to be further addressed. I recommend that this manuscript be accepted after a major revision. The following comments/suggestions are provided for the authors to consider.

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## Specific Comments/suggestions:

- (1) Page 2, line 6: “winter season” should be “cold season”.
- (2) Page 2, line 13, the full name of TOPAZ should be given in the Abstract.
- (3) Page 2, line 20, should “contents” be corrected to “contains” ?
- (4) Page 2, line 28, the “Keywords” should be revised, e.g., a lot of readers do not know “OSE” and “DFS”.
- (5) Page 3, line 22, “draft” should be “freeboard”.
- (6) Page 4, line 13: Yang et al. (2015) should be (2014).
- (7) Page 4, line 14: “LSEIK” should be defined.
- (8) Page 4, line 26, “Xie et al., 2016” is frequently referred in this MS, this should be corrected, as it has not been accepted, the authors even have not tell us the journal they submitted to.
- (9) Page 7, line 15, is “TOPAZ equivalent ice thickness” “TOPAZ model mean ice thickness”?
- (10) Page 7, line 17, “RMSD” is not defined here.
- (11) Page 7, line 29, you only assimilate the SMOS data less than 0.40 m, why not 0.50 m? As you referred, “the penetration depth into sea ice is about 0.5 m”. Although you mentioned that “the effect of ice melting may lead to a saturation thickness of less than 0.4 m”, but for this paper, you run the experiments in the cold season, basically there is no melting in the sea ice surface. If you increase the upper limit, more SMOS observation data is available, thus stronger influence/correction to the TOPAZ system is expected. In Yang et al. (2014), they use an upper limit of 1.0 m.
- (12) Page 8, line 3, 4, 7: “thick” should be “thickness”?
- (13) Page 8, line 19, ysmos is not defined.

(14) Page 9, line 10: “SMOS-Ice” is forgotten in Table 1.

(15) Page 11, line 1: In the Beaufort Sea, there are some sea ice draft measurements from Beaufort Gyre Exploration Project (BGEP) by upward-looking sonar (ULS) moorings located in the Beaufort Sea (<http://www.who.edu/beaufortgyre>). Also, there are some sea ice thickness data obtained from autonomous ice mass balance (IMB; <http://imb.erd.c.dren.mil> ). I would suggest the authors to use these data as the independent ice thickness observations in the evaluation of their model results.

(16) Page 12, line 32, an “a” is missing before “slight”.

(17) Page 13, line 24, should be “In addition”.

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