Reviewer 1

The authors are grateful for your comments.

Specific comments:

"Based on the small differences in latent heat fluxes calculated from different parameterization experiments (Fig 9), it is concluded that an explicit accounting for sea waves in the calculations of heat fluxes can be neglected in climatic aspect. What would be the effect of background surface temperature and humidity conditions on the calculations of heat fluxes? How the differences in heat fluxes would look if calculated in mid-latitude or say in the tropical ocean? The effect of waves on heat fluxes can be region dependent (coastal to open ocean as seen in Figs 11, 13, 14), latitudinal differences, and wind conditions (very strong winds such as in hurricane can show larger heat flux difference from these parameterizations)»

The conclusion about the small impact on waves applies exclusively to the Barents Sea. This conclusion based on long-term calculations. Indeed, there are differences inside the Barents Sea, in some areas there is no influence, but somewhere more, but the maximum of 3%.

Of course, heat fluxes depend on different parameters. The differences will be even smaller in the tropic or the equator regions, since there is a low storm activity. In the middle latitude (especially the southern hemisphere) the influence of waves on the heat fluxes probably will be more. However, we need to make a long-term calculations to show the influence of humidity or temperature in similar wave conditions. We add a comments on this topic at lines 600-602

«How good are the WWIII simulated wave parameters? Are there any in-situ measurements of wave parameters against which model results can be compared? How about wave model errors that might contribute to errors in heat flux calculations from equations 4, 5, and 6?»

The quality of our implementation corresponds to similar implementations of other authors. Correlation between model results and measurements data is 0.8–0.9, and the RMSE error is ~ 0.5 m. We compared wave model results with satellite data to show model quality. We add a Fig.2 and comments about wave modeling quality at lines 190-194.

Since the scatter index of our modeled significant wave heights is 0.28 (or 28%), then probably this value can lead to mean errors ~4-5% in the calculated heat flux values when the wave heights is ~ 5 m. We add this comments at lines 249-250.

«The number of storms per year plotted for significant wave heights (Fig 5) show a decline after 1995. Since the analysis is performed over a long time period of 1979-2017, how the sea ice changes (due to global warming) could impact the significant wave height, wave lengths? The CAO days (in Fig 6) also show somewhat declining trend»

Storms in the Barents Sea primarily come from the west with Atlantic cyclones. The Barents Sea is always open from the west side from ice. Reduction of ice slightly increases the number of storms which come from the north when the fetch in growing, but this is not visible in the long-term storm variability. Storms in the Barents Sea are more related to the Arctic Oscillation index. Cao events, on the contrary, are observed in the opposite atmospheric pressure situation – blocking of west-east transport. In theory, these graphs should not coincide. We add comments on this topic at lines 359-365 and 396-401.

«Lines 388-402: It is interesting to note that the errors in calculation of heat fluxes dropped by more than 50% when the errors in reanalysis data (wind, temperature, humidity) are excluded. It points to the need of corrected reanalysis data product for a better estimate of heat fluxes. Enhanced in-situ measurements can help reanalysis data sets to overcome these bias. Surprisingly, the sensible and latent heat fluxes from different parameterizations are almost identical, even in high wind speed (or high Hs) cases.»

Unfortunately, reanalysis errors are inevitable, especially in the Arctic, where there is little observational data to assimilate. However, we hope that these errors annihilate with a large time averaging. Small differences between parametrizations are explained by the prevalence of the developed sea state conditions, when all parametrization should behave well. For cases with young sea state difference in heat fluxes between parametrization reached 11% of the flux magnitude. Discussion of small differences between parametrizations we add in section "Discussion…"

«Section 3.3: The ship based observations must be along the cruise-track of ship. Mention how the reanalysis input data for different parameterization methods/experiments is extracted for a comparison with ship data. Any area averaging was considered?»

CFSR and wave reanalysis were bilinearly interpolated (using 4 surrounding points) to ship location on every time step. No averaging was performed, since the reanalysis already has a rather coarse resolution and the values in its cells seem to correspond to the average value over the cell area.

"Figures 3 and 4:"

Yes, it is a long-term average for complete year. "M" changed on "m".

«Figure 9: Time series of heat fluxes and significant wave heights are shown here. But, these measurements are not really continuous in time throughout. I suggest to have a break/gap in the continuous line joining data points when you jump from year 2005- 2007 (2nd to 3rd data point), 2007 to 2013, 2013 to 2015.»

We understand the remark, figure corrected.

"Line 331: Do authors mean 'criteria (7m)' instead of criteria (7)?"

It mean formula (7), we add clarification.

All technical corrections fixed. Thanks for your work!

Reviewer 2

The authors are grateful for your comments.

"What are the waves boundaries conditions used for the wave simulation? And so, as a related question how good does your wave simulation performed against observations and then if you have a bias could it also be a source of error when comparing the output of COARE against observations?"

We use calm conditions on the open boundaries. However, we use a very big unstructured grid which include all North Atlantic Ocean (waves do not come from south hemisphere to the Barents Sea, it is very far). On the North boundary the ice fields is a nature boundaries. Therefore, our grid allows us to get correct estimates of wave climate in the Barents Sea.

We compared wave model results with satellite data to show model quality. We add a Fig.2 and comments about wave modeling quality at lines 190-194.

Since the scatter index of our modeled significant wave heights is 0.28 (or 28%), then probably this value can lead to mean errors ~4-5% in the calculated heat flux values when the wave heights is ~ 5 m. Thus, the differences between the output of COARE and observations in not caused by errors in wave modeling.

« If I understood correctly the wind seen by the waves in the simulation is the same as the one input in COARE, could you confirm that? Because if not it might include some inconsistency between the wind and waves parameters...»

Yes, the wind input in the wave model and in COARE is the same: it is 10-m wind from CFSR reanalysis.

« Heat fluxes difference: *I found it interesting ….»*

Some analysis of these significant differences we add to the text at lines 539-550. Maximal differences between parametrizations are observed for the young sea state.

«Also, you recommend in the conclusion that it is better to use parametrization including wave parameters and I tend to be agreed with that...»

The choice on neglecting or not neglecting the explicit wave account depends on the application. In climate studies operating with large time-scales and spatially and temporally averaged values (for example, in future climate modeling) the difference between parametrizations is small and the Charnock parametrization (which do not involve additional wave modelling) seems to be sufficient. On smaller time scales, for example, in weather prediction, the choice of parametrization plays a greater role. However, it is impossible to determine the best parametrization because there are no in-situ measurements of heat fluxes in those areas and those times, where heat flux differences in parametrizations are big. Available measurements shown on Fig.9 corresponds to situations when differences between parametrizations were rather small. Some explanations on this topic we add at lines 628-640.

«Did you look at the momentum fluxes differences between the parametrization in the long term and for CAO and storm waves? Since those are occurring during strong wind regime one could expect impacts on the roughness length and so the drag coefficient and surface stress. It might be

worth mentioning it in the discussion or perspective since the stress is also an important factor in the air-sea processes and of COARE calculation.»

In this paper, we focused specifically on heat fluxes, since Barents Sea is a “hot spot” in terms of heat air-sea exchange. However, we add a few sentences on momentum flux at the “discussion section” of the paper.

Fig 10,11 : Do you mean “ sea ice represents more than half of the grid nodes” ?

No. It mean that the sea ice in one node was in 50% of all time of calculations.

Other Technical corrections fixed.

Thanks for your work!