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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sea waves impact on turbulent heat fluxes in the Barents Sea according to numerical modeling" *by* Stanislav Myslenkov et al.

Anonymous Referee #1

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Comments on the manuscript "Sea waves impact on turbulent heat fluxes in the Barents 1 Sea according to numerical modeling" by Myslenkov et al.

General comments: This paper presents calculations of turbulent heat flux over the Barents Sea using the COARE algorithm, meteorological data from reanalysis and sea-wave data from wave model WWIII. Different parameterization schemes used to calculate heat fluxes Charnock (C55), Taylor and Yelland (T1), Oost et al. (O2) and Drennan et al. (D3). Spatial variations of latent and sensible heat fluxes as calculated from these methods are inter-compared for periods of storms and cold-air outbreaks (CAO) in the Barents Sea during winter season (November-April) of 1979-2017. The

ship-based observations (eddy-covariance method) are used to assess the derived heat fluxes. Based on the high correlation between the number of CAO days and turbulent fluxes of sensible and latent heat, it is concluded that the interannual variability of the frequency of occurrence of CAOs largely determines the interannual variability of heat loss from the ice-free surface of the Barents Sea in winter season. The differences in heat fluxes calculated from different parameterizations found to be small on average (1-3 % of the magnitude of flux). It also highlights errors in meteorological parameters in the reanalysis data which results into errors in calculation of turbulent heat fluxes.

The paper provides a comprehensive analysis of wave climate and spatial variations of latent and sensible heat fluxes in the winter-time ice-free regions of the Barents Sea. Further, the differences in heat fluxes (spatial maps in Barents Sea) during normal days, storm days, and CAO days calculated from different parameterization experiments are provided. In general, the paper is well-written. It contributes new knowledge to the field. The paper needs a revision in view of the following 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).

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 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.

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.

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?

Figures 3 and 4: Are the significant wave heights and spectral peak wavelengths are shown for winter season or complete year during 1979-2017? Use color bar unit as 'm' in place of '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.

Technical corrections: Line 16: '. . . .in the energy exchange of the Barents Sea and the atmosphere is. . .. . .' to be replaced with '. . .. .in the energy exchange between the Barents Sea and atmosphere is. . .. . .'.

Line 73: Delete word 'also'.

Lines 77-80: 'The turbulent heat transfer . . .. Brunke et al. 2011)'. Lengthy sentence difficult to read. Split the sentence into two.

Lines 80-81: '. . .. . .used in the main reanalyses. . ..' – Replace with '. . .. . ..used in different reanalyses. . ..'

Lines 96-98: Rephrase the sentence 'According to studies . . ..Barents Sea.' as 'According to studies of the wave climate of the Barents Sea (Wind and Wave. . ., 2003; Stopa et al., 2016; Liu Q. et al., 2016), stormy weather prevails during significant part of the year'. Also, check and correct the reference 'Wind and Wave. . ., 2003;' if mis-spelled.

Line 147: To be consistent with the acronym use 'WWIII' in place of 'WW3'.

Line 160: Add a reference to the Discrete Interaction Approximation (DIA) model or studies using it.

Define w' in equation 2.

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

Lines 409-410: 'The mean . . .. on Figure 10, 11'. Check grammar and correct the sentence.

Line 423: Correct typo '-3 Ãů 2'.

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