Supplementary information to paper 'The effect of changing sea ice on nearshore wave climate trends Alaska's Central Beaufort coast'

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Wind speeds

ERA5 (Hersbach et al., 2020) modeled wind speed were compared to observed wind speeds at Prudhoe Bay (#9497645) for the time period 1993-2017. Observed data was corrected for declination based on the International Geomagnetic Reference Field (IGRF) model and corrected to 10-meter height assuming a constant power law wind a wind shear exponent of 0.16. Figure S1 presents the scatter density plot of the ERA5 modeled wind speeds compared to the observed wind speeds at the station. RMSE of the wind speed magnitude was 1.76 m/s, but differences between the modeled and observed wind speeds tend to increase for higher wind speeds of ~20 m/s and up. This underestimation of the extremes does not result in an overall wind speed bias, however, model bias for wind speeds larger than 20 m/s the bias is -4.4 m/s (underestimation). Validation of eastward and northward wind speeds (u and v respectively) result in RMSE of 1.98 and 1.90 m/s respectively.

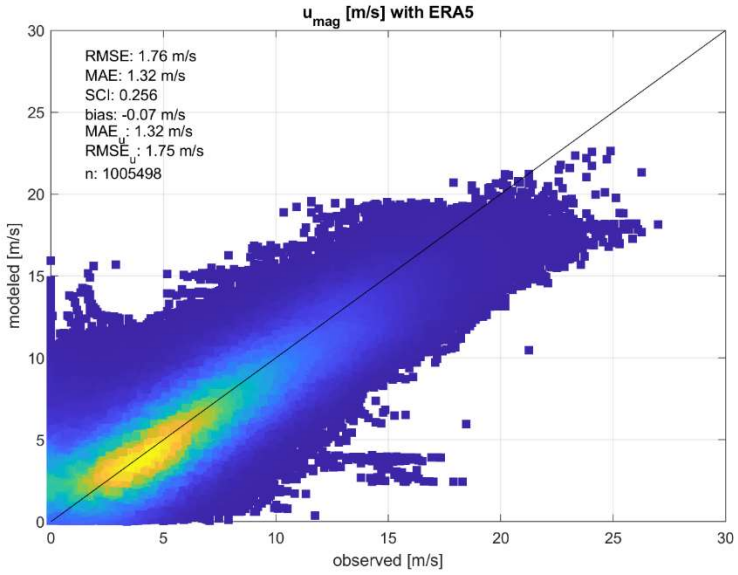

Figure S1. Observed versus modeled wind speed at Prudhoe Bay (#9497645)

Le Roux

Le Roux (2009) presented a derivation that shows the drag coefficient is also a function of air-water temperature difference and wind speed. When the water is cooler than the air, momentum transfer is less effective (relative effect smaller than 1.0) and vice-versa when water is warmer than the air. Figure S2 presents the average variation in wave heights based on ERA5 estimates for wind speed and temperature and the analytical relationships of Le Roux. The

different colors present the different quantiles and the grayed area is the time period with a median daily ice concentration of 95% or higher (i.e., closed season). A positive value means that air-sea temperature difference result in more drag and thus higher wave heights while a negative value means the opposite. From this figure one can conclude that during the Months June-September the water is generally cooler than the air resulting in less drag and wave heights ~10% lower than without this affect. In the months October-November, water is generally warmer than the air resulting in ~5% higher wave heights.

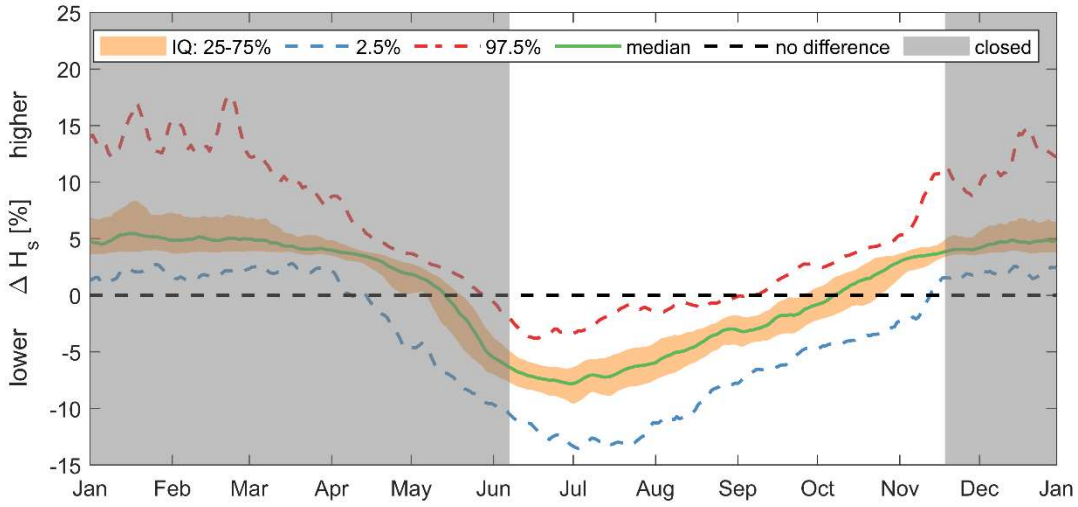

Figure S2. Relative difference in drag coefficient based on Le Roux (2009) as function of wind speed and temperature difference between air and sea.

References

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