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Adjusting Mellor-Yamada-Janjic boundary layer parametrization for offshore surface conditions

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One year of marine wind speed over North and Baltic Sea has been dynamically downscaled with the WRF-ARW model, using Mellor-Yamada-Janjic (MYJ) level 2.5 (2) boundary (surface) layer parameterization. Comparisons with the measurements show that within the first hundred meters in the atmosphere, the wind shear in stable atmosphere is too low while in the unstable atmosphere it is too high. The discrepancy between the measurements and simulation is mostly attributed to inaccurate surface/boundary layer parameterizations. The surface/boundary layer parameterization has been adjusted, by redefining the diffusive-dissipative length scale in the MYJ parameterization. In the surface layer, the stability correction has been added to previously implemented Prandtl length scale, limiting vertical exchange in the stable atmosphere and enhancing it in the unstable atmosphere. In the upper boundary layer, the most important corrections are the limiting of the length scale by the stability corrected Prandtl length and adding the nonlocal, surface forcing to the diffusive-dissipative length scale in the unstable atmosphere. The improved parameterization is shown to better describe marine wind shear near the surface. However, in the real cases the accurate knowledge of the surface forcing, e.g. the sea state and the sea surface temperature, is required in order to precisely model the wind shear conditions.