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Impact of tidal mixing with different scales of bottom roughness on the general circulation in the ocean model MPIOM

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We implement a tidal mixing scheme that parameterizes diapycnal diffusivity depending on the location of energy dissipation over rough topography in the ocean general circulation model MPIOM. The tidal mixing scheme requires a bottom roughness map that can be calculated depending on the scales of topographic features one wants to focus on. Here, we examine the sensitivity of the modeled circulations to different spatial scales of the modeled bottom roughness. We compare three simulations that include the tidal mixing scheme using bottom roughness calculated at three different spatial scales, ranging from 15 to 200 km. We find that with decreasing spatial scales at which roughness is calculated, the roughness values increase in the deep ocean and decrease in coastal or shallow regions. The diffusivities produced by the three experiments, therefore, have not only different spatial structures but different vertical structures as well, with stronger bottom diffusivities for smaller scales of roughness. The lower limb of the Atlantic overturning and the bottom water transport in the Pacific Ocean are stronger for stronger bottom diffusivities, suggesting a 1/2 power law scaling between overturning strength and diffusivity. Such a relation does not hold for the upper limb of the Atlantic. All tidal simulations significantly increase the Indo-Pacific bottom water transport, improving the model solution in the Indo-Pacific Ocean.