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On the length and time scales of the power supply to the ocean between the meso-scale and the synoptic-scale

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The input of mechanical power to the ocean due to the surface wind-stress, in regions which correspond to different regimes of ocean dynamics, is considered using data from satellites observations. Its dependence on the coarse-graining range of the atmospheric and oceanic velocity in space from 0.5° to 10° and time from 6h to 40 days is determined. In the area of the Gulf Stream and the Kuroshio extensions the dependence of the power-input on space-time coarse-graining varies over tenfold for the coarse-graining considered. It decreases over twofold for the Gulf Stream extension and threefold for the Kuroshio extension, when the coarse-graining length-scale passes from a few degrees to 0.5° at a temporal coarse-graining scale of a few days. It increases over threefold in the Gulf Stream and the Kuroshio extensions when the coarse-graining passes from several days to 6h at a spatial coarse graining of a few degrees. The power input is found to increase monotonically with shorter coarse-graining in time. Its variation with coarse graining in space has no definite sign. Results show that including the dynamics at scales below a few degrees reduces considerably the power input by air-sea interaction in regions of strongly non-linear ocean currents.

When the ocean velocities are not considered in the shear calculation the power-input is considerably (up to threefold) increased. The dependence of the power input on coarse graining in space and time is close to being multiplicatively separable in all regions and for most of the coarse-graining domain considered.