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Studying effects of daily surface flux anomalies on the time-mean ocean circulation using an empirical flux model

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The effect of daily flux anomalies at the sea surface on the time-mean oceanic circulation is studied using an empirical flux model. The model produces fluctuating fluxes resulting from the oceanic feedbacks on the fluxes and from the atmospheric turbulence. Various experiments are carried out by driving an ocean general circulation model with different terms in the empirical model. It is found that daily flux anomalies significantly alter the meridional overturning circulation (MOC) and the Antarctic Circumpolar Current (ACC). Flux anomalies lead to an increase in the MOC of about 4 Sv and a decrease in the ACC of about 65 Sv. The changes are approximately 30% of the MOC and ACC obtained without daily flux anomalies. They are caused partly by setting a realistic 3-dimensional density distribution via the SST-feedback, and partly by providing additional vertical mixing via fluctuating buoyancy forcing. The latter effect is novel. Due to the non-linear nature of convection, fluctuating buoyancy anomalies tend to increase convective mixing in mostly stable regions and to decrease convective mixing in mostly unstable regions. As a result, global-scale changes in the mixing structure are found.