Mesoscale organization of convection is typically not represented in global circulation models, and hence the influence of such organization on the global circulation is not accounted for. A parameterization aiming at representing the dynamical and physical effects of the circulation associated with organized convection, referred to as multiscale coherent structure parameterization (MCSP), is implemented in the Energy Exascale Earth System Model version 1 (E3SMv1). Simulations are conducted to assess its impact on the simulated climate. In addition, high resolution (1 km) simulations using the Weather Research and Forecasting (WRF) model were performed  to determine the temperature tendencies induced by mesoscale convective systems (MCSs) embedded in deep convection. The free parameters in the MCSP were tuned based on the findings from WRF simulations. It is found that the MCSP enhances Kevin wave spectra in E3SMv1 and improves the simulation of the Madden-Julian Oscillation (MJO). The MCSP also reduces model precipitation biases in the tropical Pacific.