We examine three methods for reducing memories and computational times in large- and multi-scale interplate earthquake cycle simulations including slow slips based on a rate and state friction law; Fast Fourier Transform Method (FFT), Fast Multipole Method (FMM) and Hierarchical (H)-matrices Method. For computing the product of slip response function matrix (SRFM) and the slip deficit rate vector in simulations with the number of divided cells $N$, the memory and the computational time are reduced from $O(N^2N)$ to $O(N)$ and $O(N\log N)$ with FFT, $O(N)$ and $O(N)$ with FMM, and $O(N)$ and $O(N)-O(N\log N)$ with H-matrices. FFT requires cyclic boundary conditions. At subduction zones, such conditions cannot be assigned in the dip directions because of the free surface. FMM was developed for rapid evaluation of the long-ranged forces in N-body problem in astrophysics and has been widely applied to a variety of problems. It does not require any cyclic boundary conditions but the functional forms suitable for multipole expansion. However, no suitable forms have been obtained for the dip-slip-faulting in a semi-infinite homogeneous elastic medium (Ohtani et al., 2010). H-matrices, which are efficient low-rank compressed representations of dense matrices, enable rapid arithmetic operations with less memory (Hackbusch, 1999). H-matrices require only the slip response function decays with the distances between source and receiver cells, and Ohtani et al. (2011) use slip response function in a semi-infinite homogeneous elastic medium. H-matrices would enable us to simulate earthquake cycles in a more realistic heterogeneous medium at subduction zones, by constructing SRFM with FEM.