The role of moist soil in land-atmosphere interactions is universal and fundamental, so the thermal convective way, due to water and vapour in the soil, is also important and not ignored. In this paper, we applied an improved restore-force method to substitute the old one in Simple Biosphere Model 2 (SiB2), which included the soil heterogeneity with depth and the occurrence of convective heat transfer. And the overestimation of ground temperature in daytime was reduced evidently by the new method. Based on the new method, several algorithms of soil thermal conductivity, all considering water content of the soil, were given and compared. First of all, these five algorithms all had relation to more detailed fractions of soil than the primitive parameterization in SiB2, such as the texture, the particle-size distribution, the components of the solid, etc. Secondly, among the simulations of radiant fluxes, ground temperature and wetness in surface layer, results of three algorithms, which were proposed by Balland, Côté and Becker, respectively, were relatively better than the rest in general. However, it seems that all these algorithms have little effect on the improvement of water content simulation, and the sensitivity of water content to soil thermal conductivity parameterization also requires more evidences in future. Besides, similar analyses from more sites are very needed in order to generalization.