Recent observational and modeling studies have revealed that the energy input from the lower atmosphere produces significant spatial and temporal variations in the thermosphere/ionosphere. For example, the distributions of the neutral temperature and electron density in the equatorial thermosphere/ionosphere show wave-4 longitudinal structure. This wave-4 pattern is considered to originate from non-migrating diurnal tide (DE3) that is excited in the troposphere. However, the physical mechanism of spatial and temporal variations in the thermosphere/ionosphere caused by upward propagating atmospheric waves is not fully understood. In order to investigate the physical mechanism of these variations, we developed an atmosphere-ionosphere coupled model, in which a whole atmosphere general circulation model, an ionosphere model and an electrodynamics model are integrated. The coupled model, which is called Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy (GAIA), is useful for investigating effects of upward propagating atmospheric waves on the upper atmospheric behaviors. Using the coupled model, we examine effects of tides and planetary wave from the lower atmosphere on latitudinal and temporal variations in the thermosphere/ionosphere. We also discuss further development of the coupled model in the near future.