With heat waves projected to increase in magnitude and frequency throughout the 21st century, the understanding of these weather events along with their interactions with large cities will become critically important. This study presents an application of the factor separation method proposed by Stein and Alpert to assess the contributions of the impervious land cover, the representation of the urban environment, and large scale heat wave conditions to temperatures over New York City. The scenario taken as case study is a heat wave event that took place during June 4-8, 2010. The WRF ARW 3.7.1 urbanized with a multilayer building parameterization and a building energy model to account for presence of buildings and for anthropogenic heat, respectively, was used as modeling tool. The simulation considers a grid size of 1 km for New York City, executed into an ensemble that consisted of; forest land, urbanized land, no-heat wave case, and heat wave case. Results of the ensemble found that while the synoptic conditions had the largest contribution to the temperature field, the surface factors could match it in magnitude in locations where wind flows encounter the urban barrier, such as along eastern Manhattan and along the southern coasts of the city. The overall effect of the land cover and urban representation held a higher relative contribution at nighttime and early morning, when calmer land breeze conditions result in a marked urban heat island effect. The contribution of the interaction between all three factors is significant and positive and during morning and night, which results in a magnification of the urban heat island during a heat wave. A vertical cross-section across part of the city where the urban canopy is densest show effects near the surface that follow the patterns observed in the 2 m air temperature field. The effects of the urban land cover and its interaction with the city during the heat wave are negative during the day, hinting at an enhancement of the wind flow through channeling between buildings.