Figure S1. Observed hourly accumulated rainfall (color fill, mm) from rain gauges from 0100 to 0700 LST on 7 May 2017. The gray fill indicates the elevation. The solid black lines represent city borders.
Figure S2. Half-hourly wind profile from (a) Nansha station from 1500 on 6 May to 0000 on 7 May, and (b) Huadu station from 1800 on 6 May to 0300 on 7 May in LST. The colors of wind barbs indicate the vertical velocity. The blue colors represent updraft and the red colors represent downdraft.
Figure S3. Observed hourly temperature field at 2 meters AGL (color dots, °C) from 2000 on 6 May to 0100 on 7 May in LST. The dashed black lines represent the leading edge of the southeasterly flows derived in Figure 4, where the southerly component is almost zero. The black circle roughly denotes the urban areas of Guangzhou city.
Figure S4. The ageostrophic wind fields (vectors, m s$^{-1}$) at 950-hPa levels from the model results of domain at (a) 2200 LST 6 May, (b) 0300 LST 7 May. The color of wind vectors denotes wind direction.
Figure S5. Observed composite radar reflectivity (color fill, dBZ) over the Guangzhou region on 7 May 2017. The solid black lines represent city borders. The thin black contours indicate the elevation (contours: 100, 200, 300, 400 meters).
Figure S6. (a-b) The distributions of specific humidity (color, g kg\(^{-1}\)) and horizontal transport of mixing ratio (g m kg\(^{-1}\) s\(^{-1}\)) at 2200 LST on 6 May 2017 at 975-hPa levels from (a) the ERA5 reanalysis, (b) the model results of domain D03. (c-d) The distributions of specific humidity (color, g kg\(^{-1}\)) at 2 m AGL and wind fields (wind barb, m s\(^{-1}\)) at 10 m AGL from (c) the surface observations and (d) the model results of domain D03. The Qingyuan sounding station is marked with triangles in (c-d), where the specific humidity is observed 16.27 g kg\(^{-1}\) at 1004 hPa (about 19 m) at 2000 LST. The pink circle roughly denote the locations of the Huadu hills.
Figure S7. The spatial distribution of convective inhibition (CIN, filled color, J kg$^{-1}$) at 250 meters AGL at 0030 LST on 7 May 2017. The dot fill patterns in yellow indicate the convective available potential energy (CAPE) larger than 1200 J kg$^{-1}$. The dashed circles in red roughly denote the locations of the convective system “A” and “B”. The thin black contours indicate the elevation (contours: 150, 300, 450 meters).