

# **Peculiar COVID-19 effects in the Greater Tokyo Area revealed by spatiotemporal variabilities of tropospheric gases and light-absorbing aerosols**

Alessandro Damiani<sup>1</sup>, Hitoshi Irie<sup>1</sup>, Dmitry Belikov<sup>1</sup>, Shuei Kaizuka<sup>1</sup>, Hossain Mohammed Syedul Hoque<sup>2</sup>, Raul R. Cordero<sup>3</sup>

<sup>1</sup>Center for Environmental Remote Sensing (CEReS), Chiba University, Chiba, 2638522, Japan

<sup>2</sup>Graduate School of Environmental Studies, Nagoya University, Nagoya, 4640064, Japan

<sup>3</sup>Department of Physics, Universidad de Santiago de Chile, Santiago, 3363, Chile

*Correspondence to:* Alessandro Damiani (alecarlo.damiani@gmail.com)

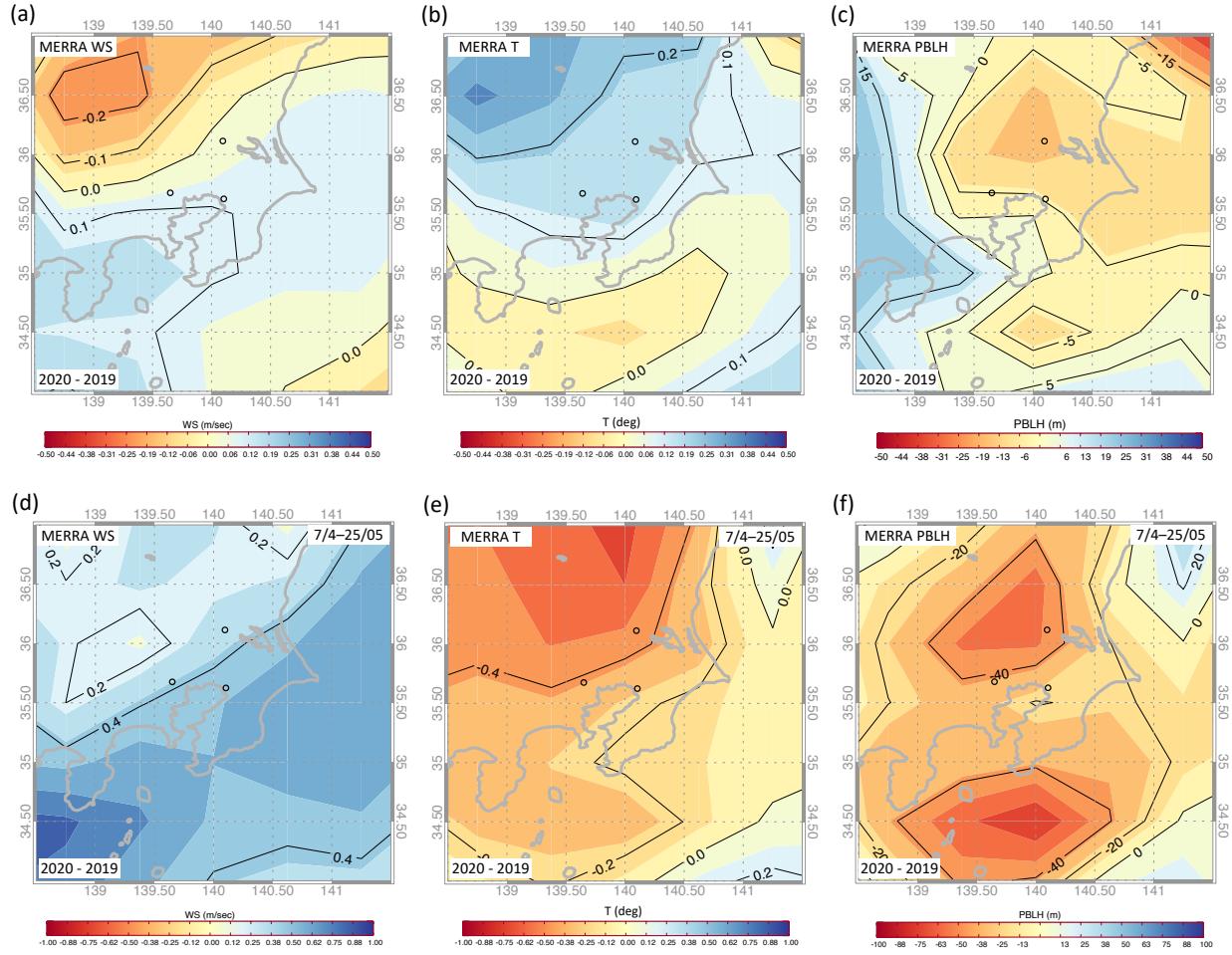


Fig. S1. Spatial distribution of the difference between 2020 and 2019 in wind speed (a), temperature (b) and PBLH (c) as simulated with MERRA-2 reanalysis data. Panels (d–f) are as described in (a–c) but limited to 7 April–25 May (i.e., the state of emergency).

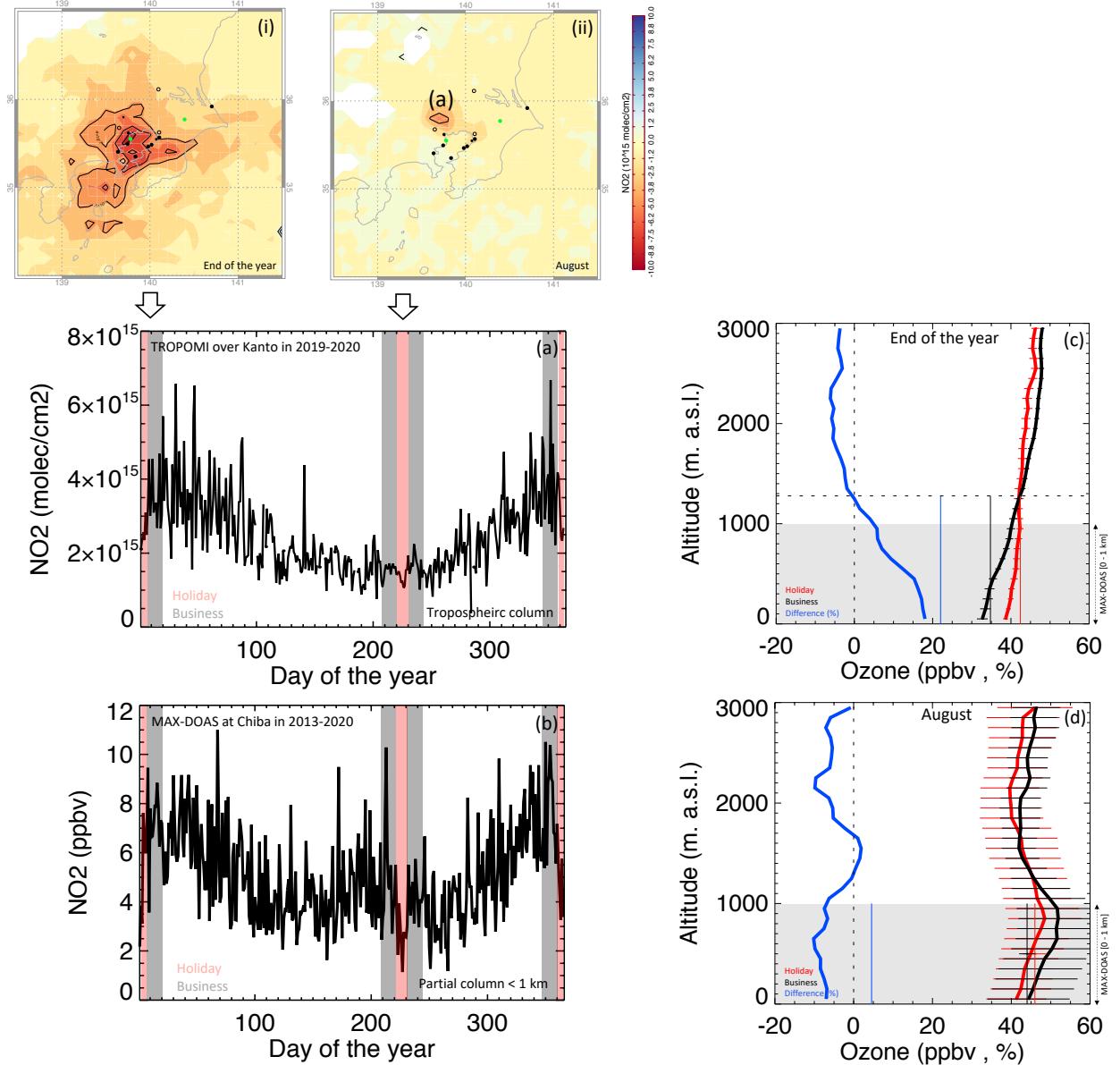


Fig. S2. TROPOMI NO<sub>2</sub> daily climatology over the investigated Kanto region for 2019–2020

years (a). Top insets show the TROPOMI-based holiday effect in NO<sub>2</sub> during the end-of-year (i) and mid-August (ii) holiday periods (the holiday effect is defined as the difference between holidays and business days). Panel (b) is as described in (a) but for MAX-DOAS NO<sub>2</sub> daily climatology at Chiba for 2013–2020. In (a) and (b), holidays (pink) and business days (gray) are highlighted. The vertical ozone distributions obtained from the ozonesonde (profile) and box model simulation (vertical lines) for holidays and business days during the periods highlighted in

(a) and (b) are presented in panels (c) and (d) for the period of 2013–2020 (see Sect. 2 for details). Panel (c) is analogous to Fig. 6c and has been shown for the sake of clarity.

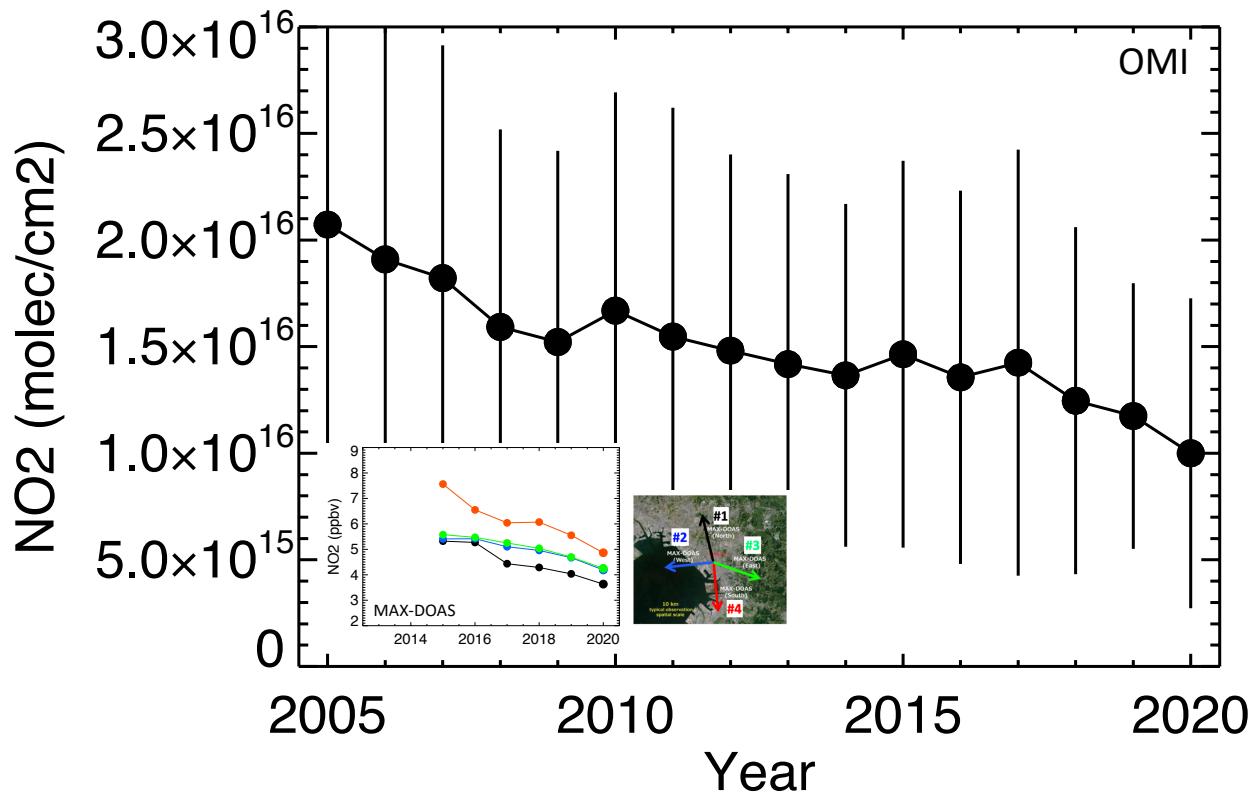


Fig. S3. Main panel: annual mean OMI NO<sub>2</sub> tropospheric column data at Chiba in 2005–2020. Insets: annual mean MAX-DOAS partial column values at Chiba in 2015–2020 for the MAX-DOAS systems pointing in four directions (north: black, south: red, west: blue, east: green; © Google Maps 2019).

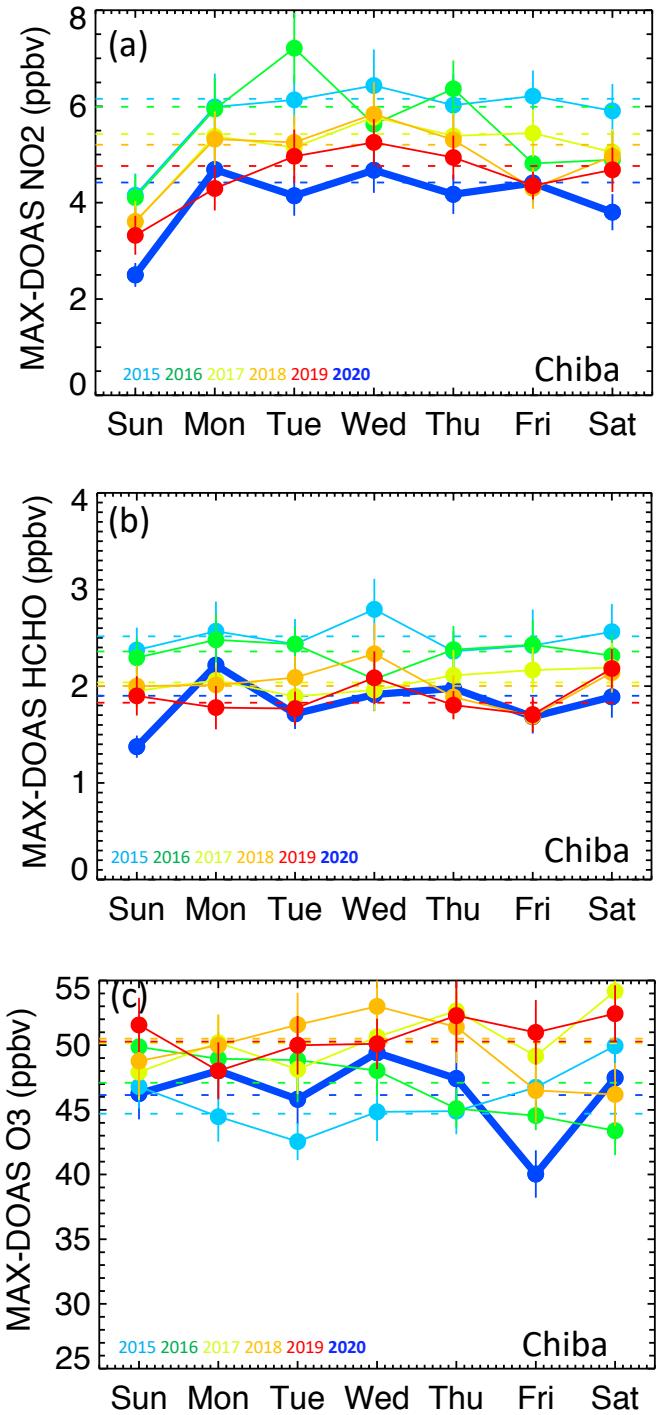


Fig. S4. Weekly cycle of MAX-DOAS partial column NO<sub>2</sub> (a), HCHO (b) and O<sub>3</sub> (c) concentrations at Chiba for 2015–2020. Error bars show 1-sigma error of the mean.

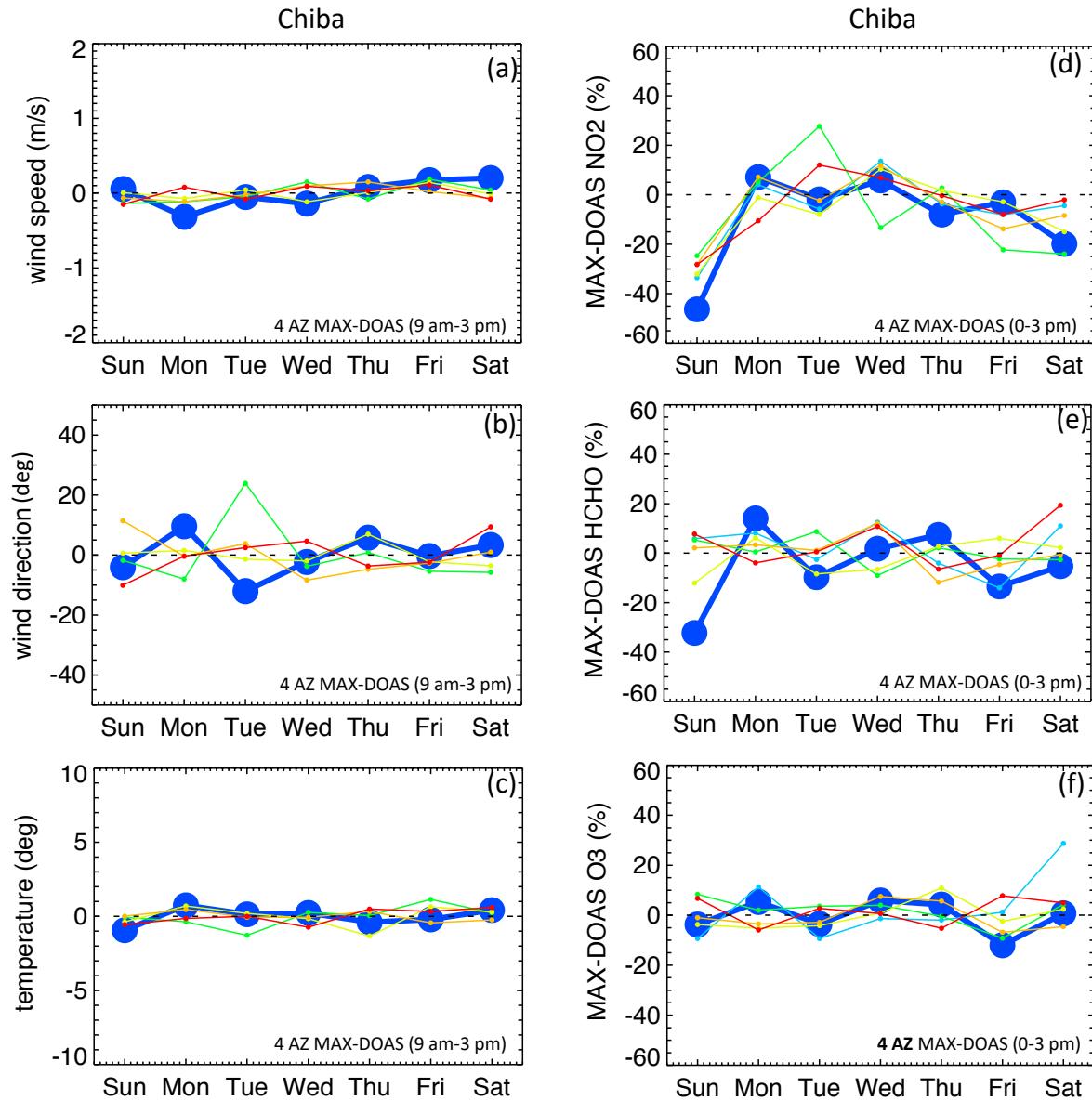


Fig. S5. Left panels: Weekly cycles of wind speed (a), wind direction (b) and temperature (c) as observed at the weather station of Chiba University at 9 am–3 pm. Right panels: Weekly cycles of MAX-DOAS partial column NO<sub>2</sub> (d), HCHO (e) and O<sub>3</sub> (f) at Chiba University in the afternoon (0–3 pm). Period: 2015–2020.

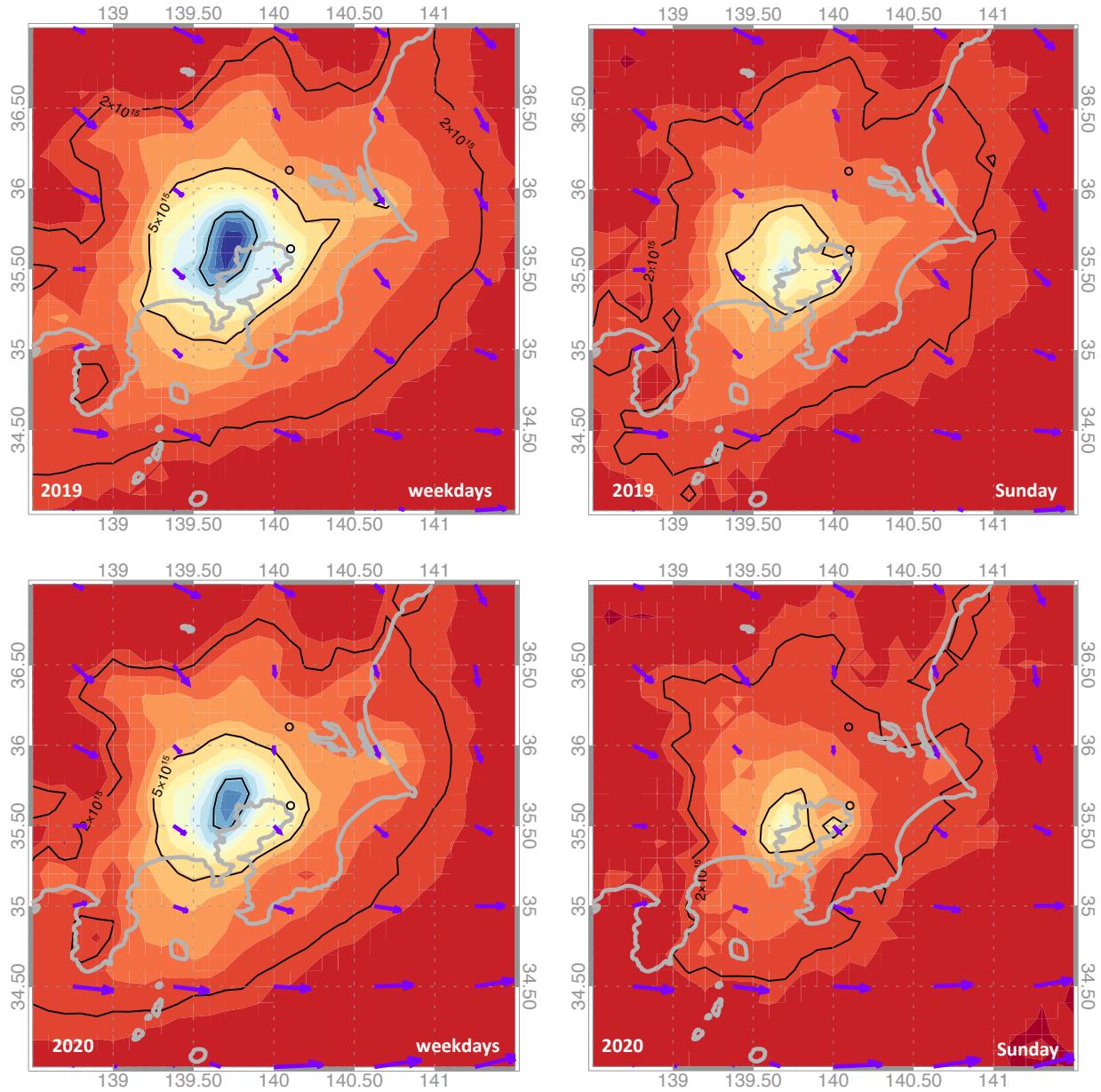


Fig. S6. Spatial distribution of TROPOMI NO<sub>2</sub> for January–December 2019 (top panels) and 2020 (bottom panels) during weekdays (left column) and Sundays (right column). The area enclosed within the  $5 \times 10^{15}$  molec/cm<sup>2</sup> isoline was reduced by an average of about –27% on weekdays and –67% on Sundays between 2020 and 2019. Arrows show the 10-m wind speed and direction climatology from MERRA-2 dataset.