Geoscientific
Model Development

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Supplement of

Application of the Multi-Scale Infrastructure for Chemistry and Aerosols version 0 (MUSICAv0) for air quality research in Africa

Wenfu Tang et al.

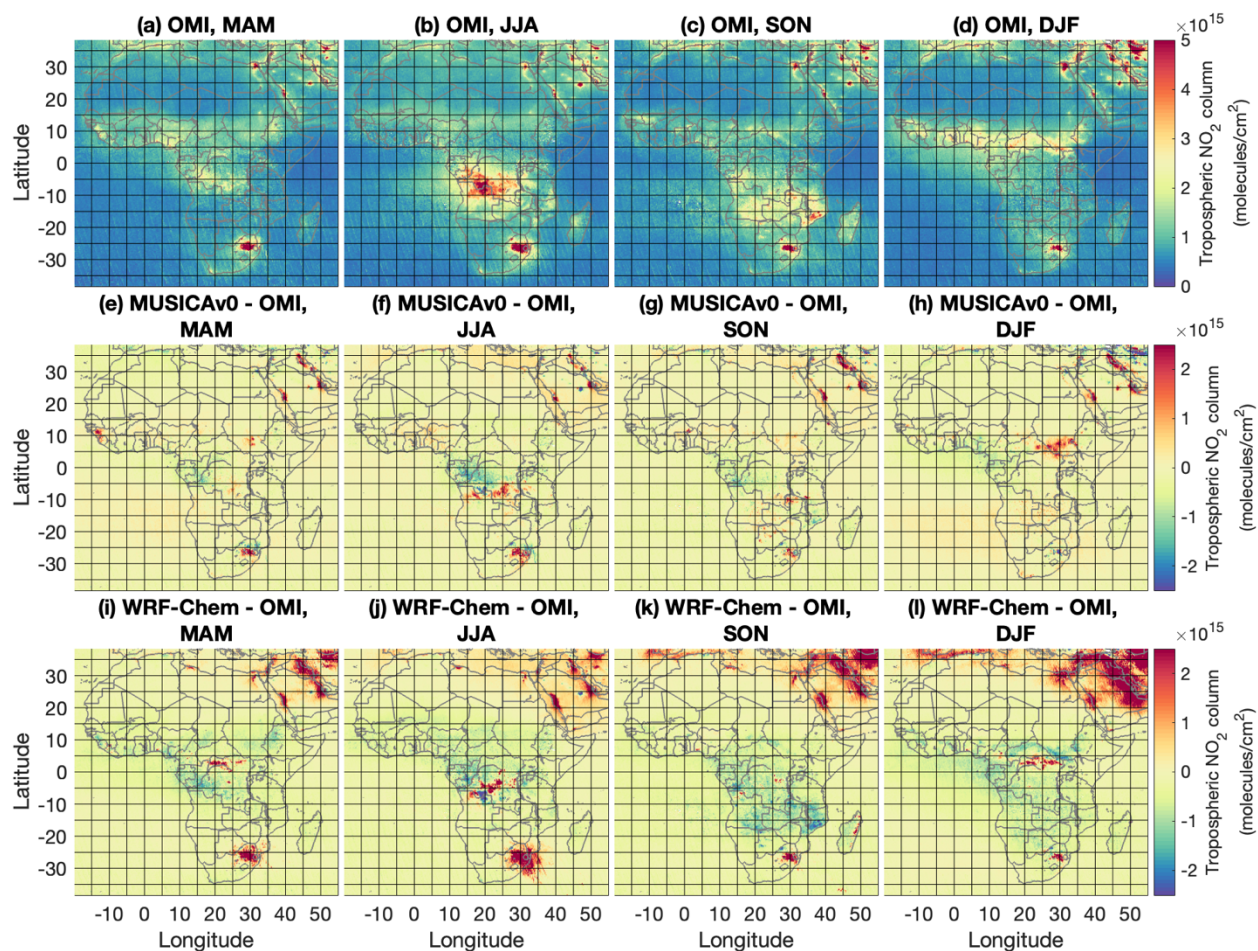*Correspondence to:* Wenfu Tang (wenfut@ucar.edu)

Figure S1. Comparisons of MUSICAv0 and WRF-Chem simulations and OMI tropospheric NO$_2$ column (molecules/cm²) in 2017. (a-d) Averaged OMI tropospheric NO$_2$ column in MAM (March, April, and May), JJA (June, July, and August), SON (September, October, and November), and DJF (December, January, and February). (e-h) MUSICAv0 model biases against OMI tropospheric NO$_2$ column in MAM, JJA, SON, and DJF. (i-l) is the same as (e-h) but for WRF-Chem. All data are gridded to 0.25 degree × 0.25 degree for plotting.
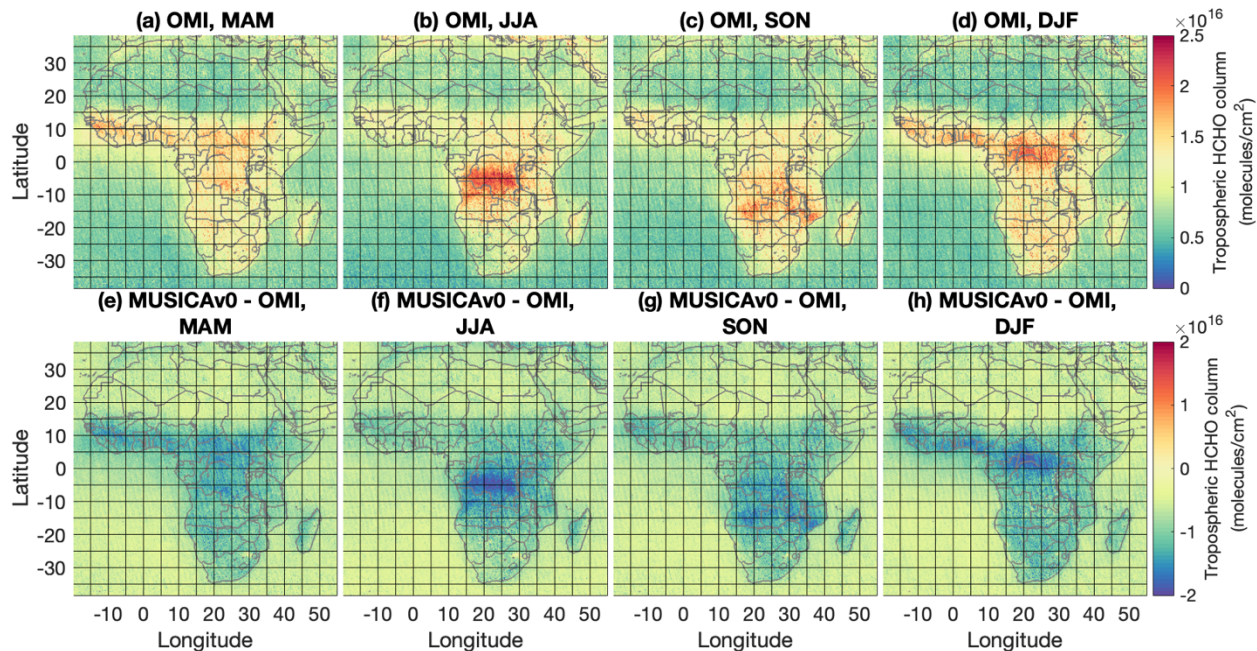
Figure S2. Comparisons of MUSICAv0 and WRF-Chem simulations and OMI tropospheric CH$_2$O column (molecules/cm^2) in 2017. (a-d) Averaged OMI tropospheric CH$_2$O column in MAM (March, April, and May), JJA (June, July, and August), SON (September, October, and November), and DJF (December, January, and February). (e-h) MUSICAv0 model biases against OMI tropospheric CH$_2$O column in MAM, JJA, SON, and DJF. All data are gridded to 0.25 degree × 0.25 degree for plotting.
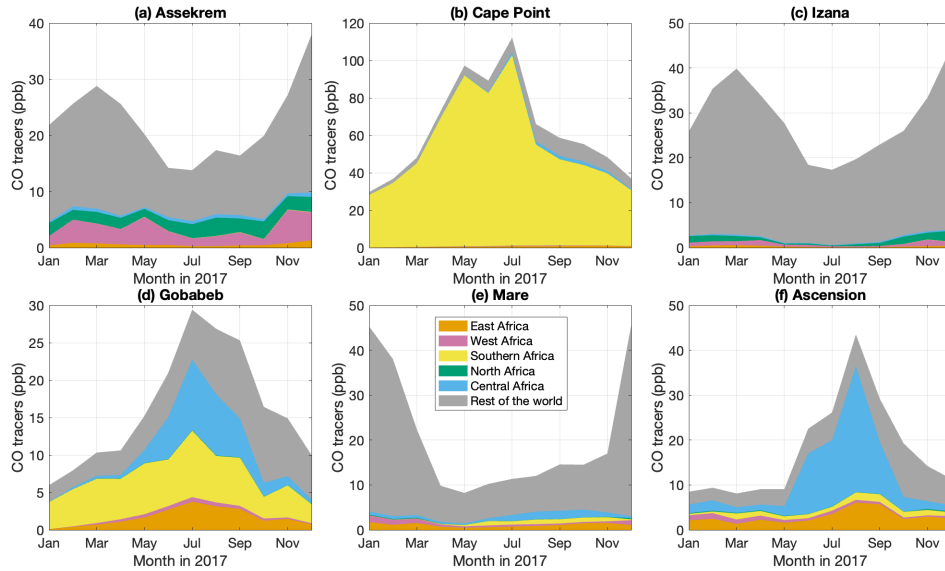
Figure S3. Monthly time series of CO tracers of emissions from North Africa (green), West Africa (pink), East Africa (orange), Central Africa (blue), Southern Africa (yellow), and the rest of the world (grey) at (a) Assekrem, (b) Cape Point, (c) Izana, (d) Gobabeb, (e) Mare and (f) Ascension. The locations of the sites and the definition of the regions can be found in Figure 1.
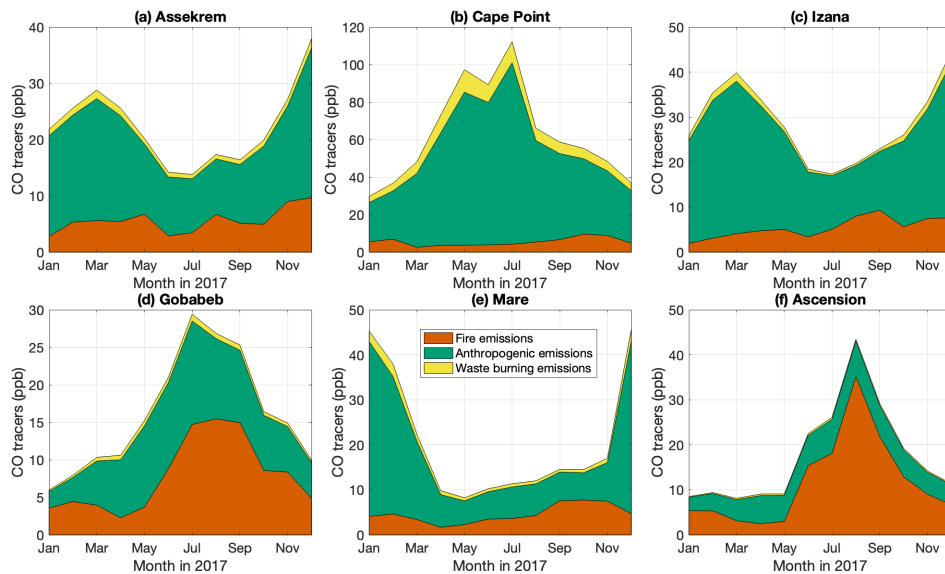

Figure S4. Monthly time series of CO tracers of fire emissions (red), anthropogenic emissions (green), and waste burning emissions (yellow) at (a) Assekrem, (b) Cape Point, (c) Izana, (d) Gobabeb, (e) Mare and (f) Ascension. The locations of the sites can be found in Figure 1.
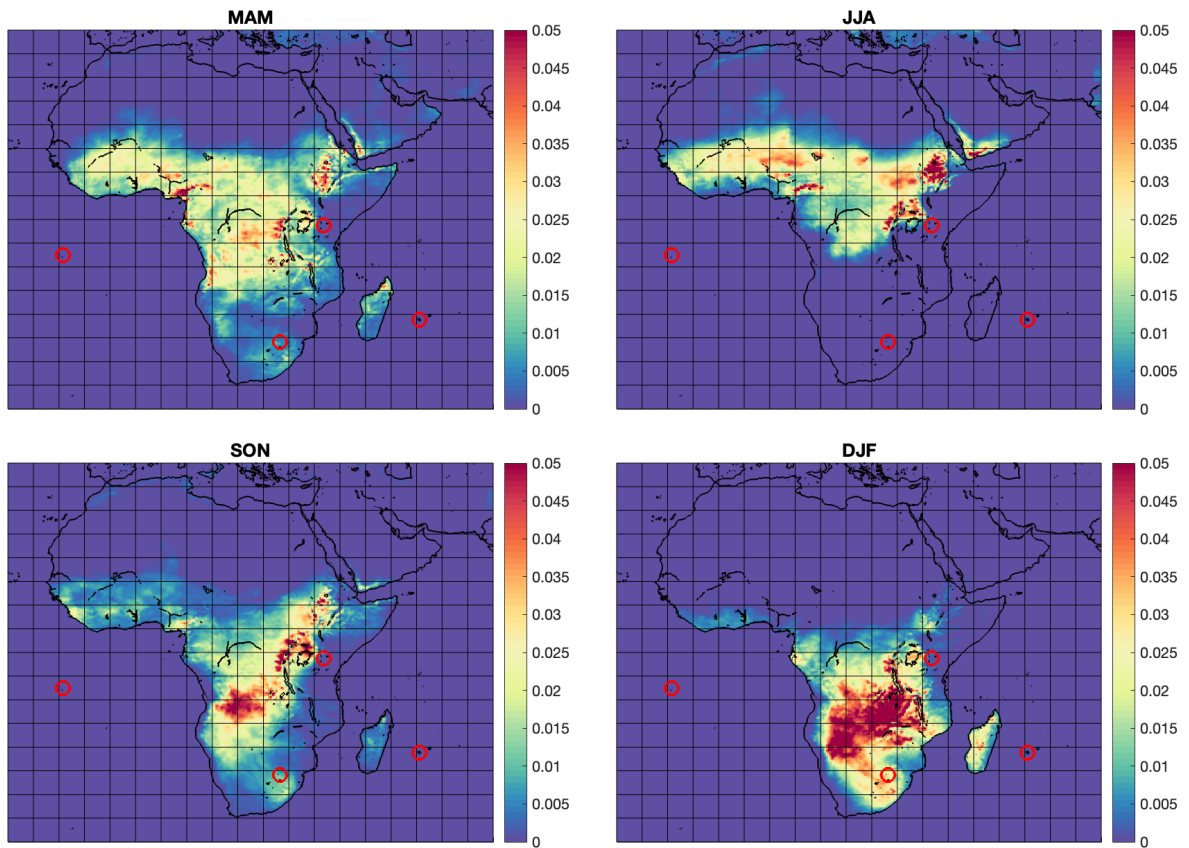
Figure S5. Modeled lightning NO emissions (g N/month/m^2) from the MUSICAv0 simulation in MAM (March, April, and May), JJA (June, July, and August), SON (September, October, and November), and DJF (December, January, and February). Four ozonesonde sites are shown by red circles (Ascension, Irene, Nairobi, and La Reunion).
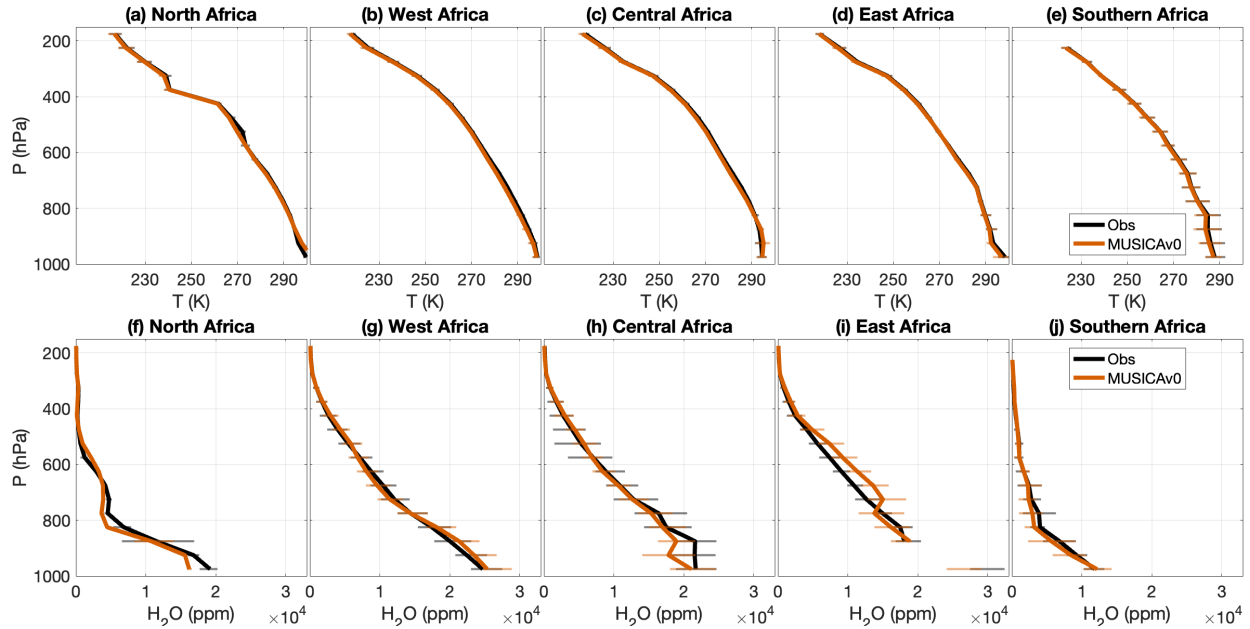
Figure S6. Vertical profiles of air temperature (T; K) and water vapor mixing ratio (H_2O; ppm) from the In-service Aircraft for a Global Observing System (IAGOS) measurements (black) and corresponding model output from MUSICAv0 (red), and WRF-Chem (blue) during 2017. Annual mean T profiles with the variation of the data in the pressure layer (25% quantile to 75% quantile) over (a) North Africa, (b) West Africa, (c) Central Africa, (d) East Africa, and (e) Southern Africa are shown. (f-j) are the same as (a-e) but for H_2O.
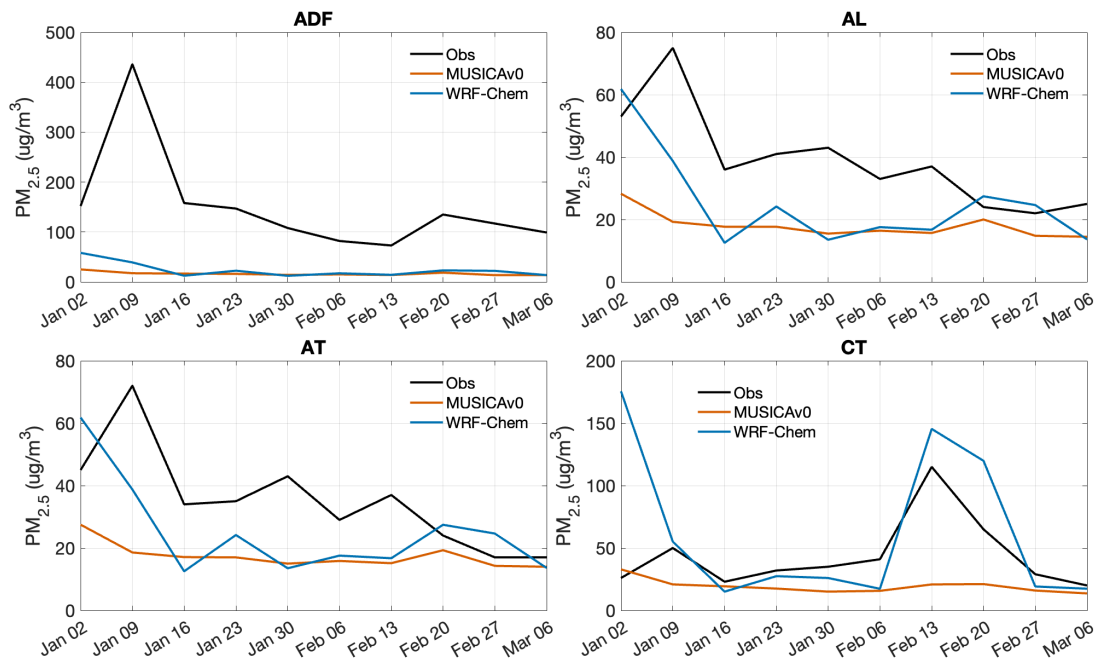

Figure S7. Weekly mean $PM_{2.5}$ from in situ observations (black), MUSICAv0 (red), and WRF-Chem (blue) during 2017 at Abidjan site representing domestic fires (ADF) emissions, Abidjan site representing waste burning at landfill (AL), Abidjan site representing traffic (AT), and Cotonou site representing traffic (CT). The three sites in Abidjan are close in space.
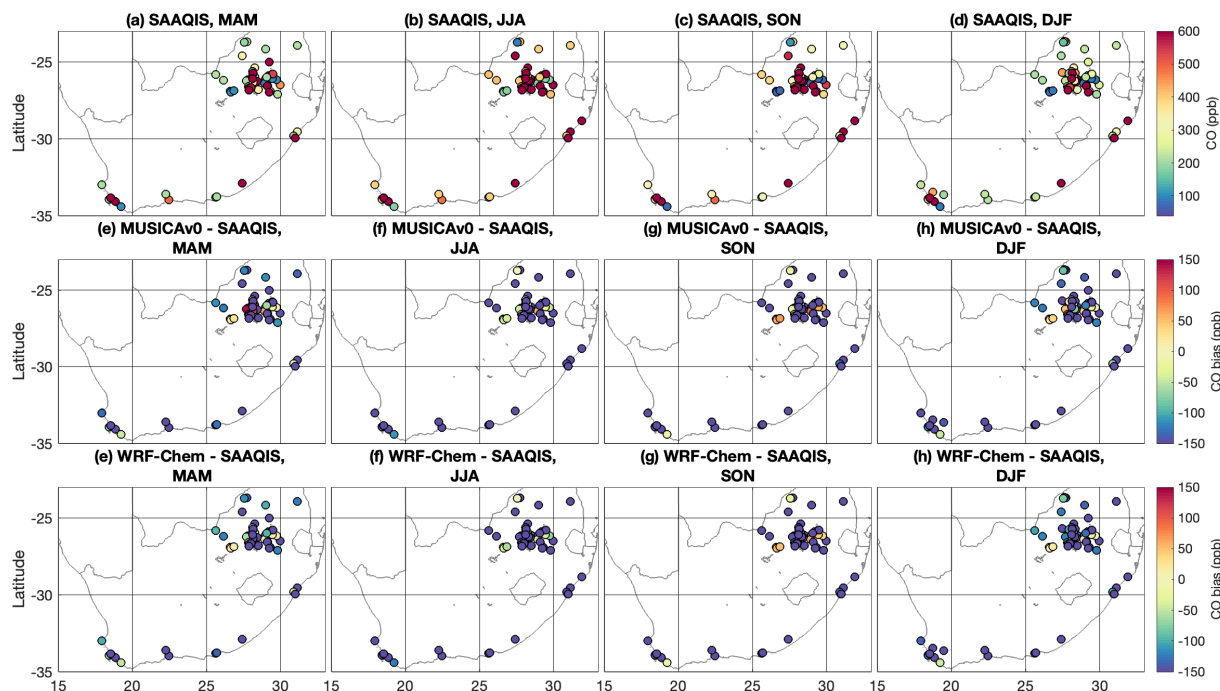
Figure S8. Comparisons of MUSICAv0 and WRF-Chem simulations and with SAAQIS CO measurements in 2017. (a-d) Averaged SAAQIS CO measurements in MAM (March, April, and May), JJA (June, July, and August), SON (September, October, and November), and DJF (December, January, and February). (e-h) MUSICAv0 model biases against SAAQIS CO measurements in MAM, JJA, SON, and DJF. (i-l) is the same as (e-h) but for WRF-Chem.
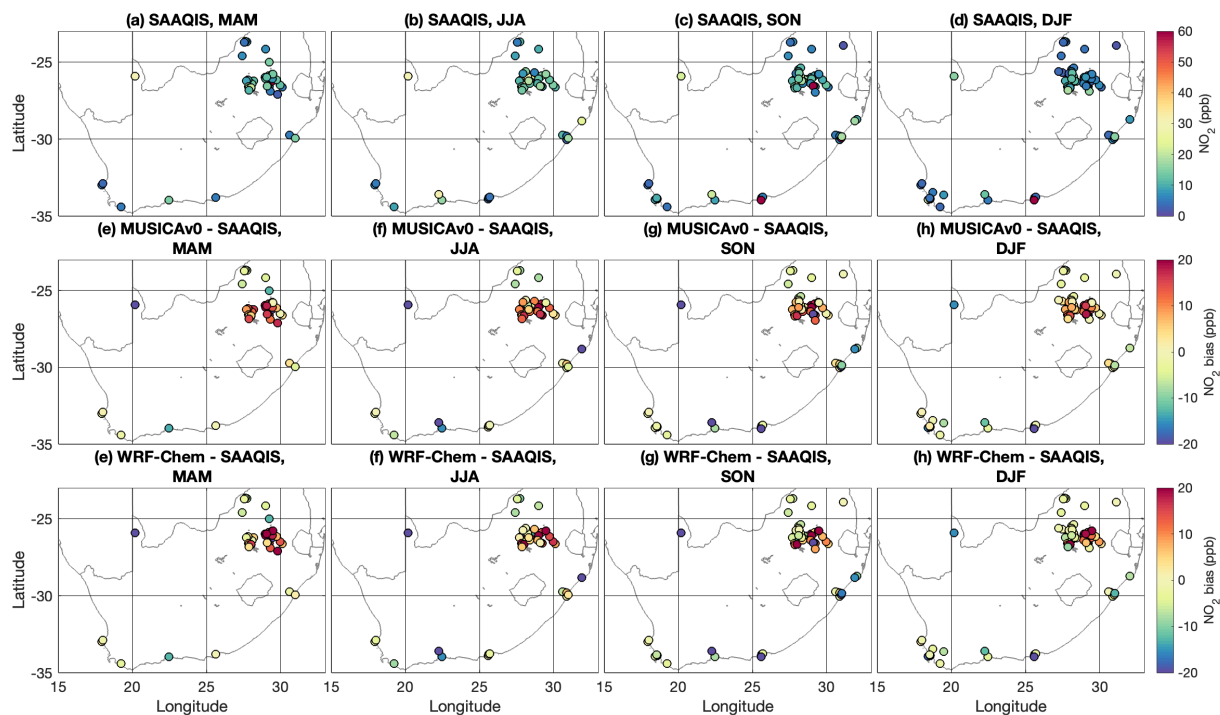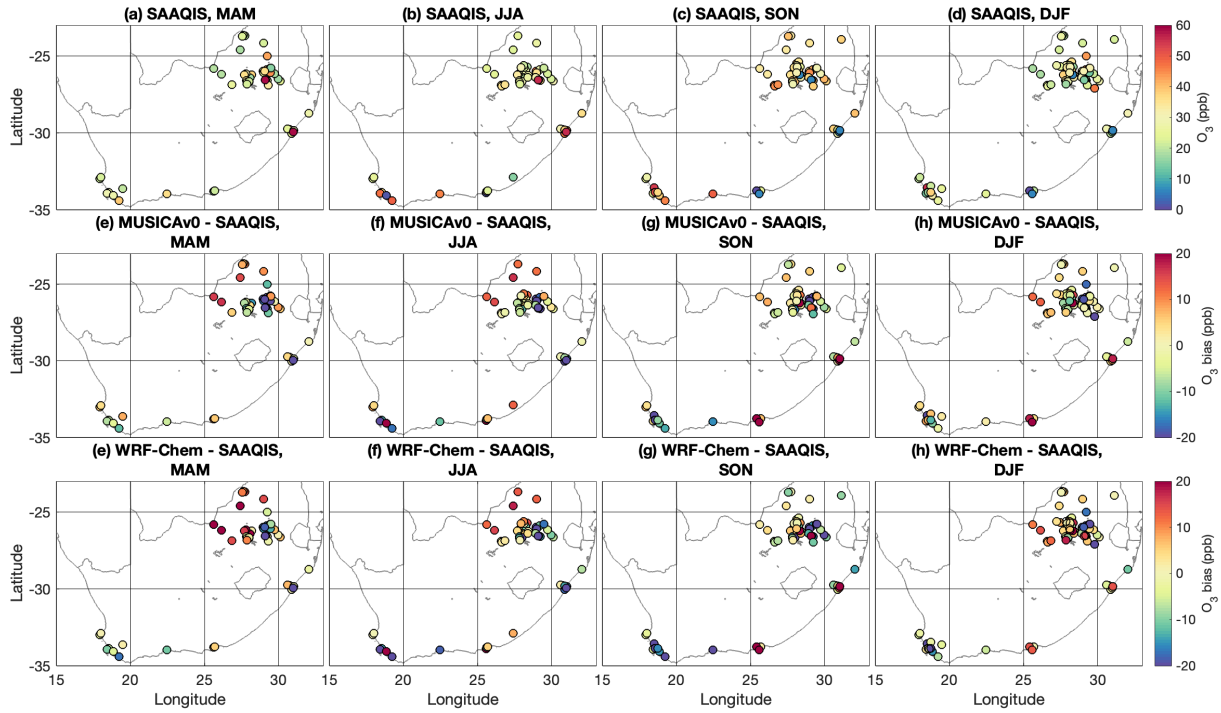

Figure S9. Same as Figure S8 but for NO$_2$.

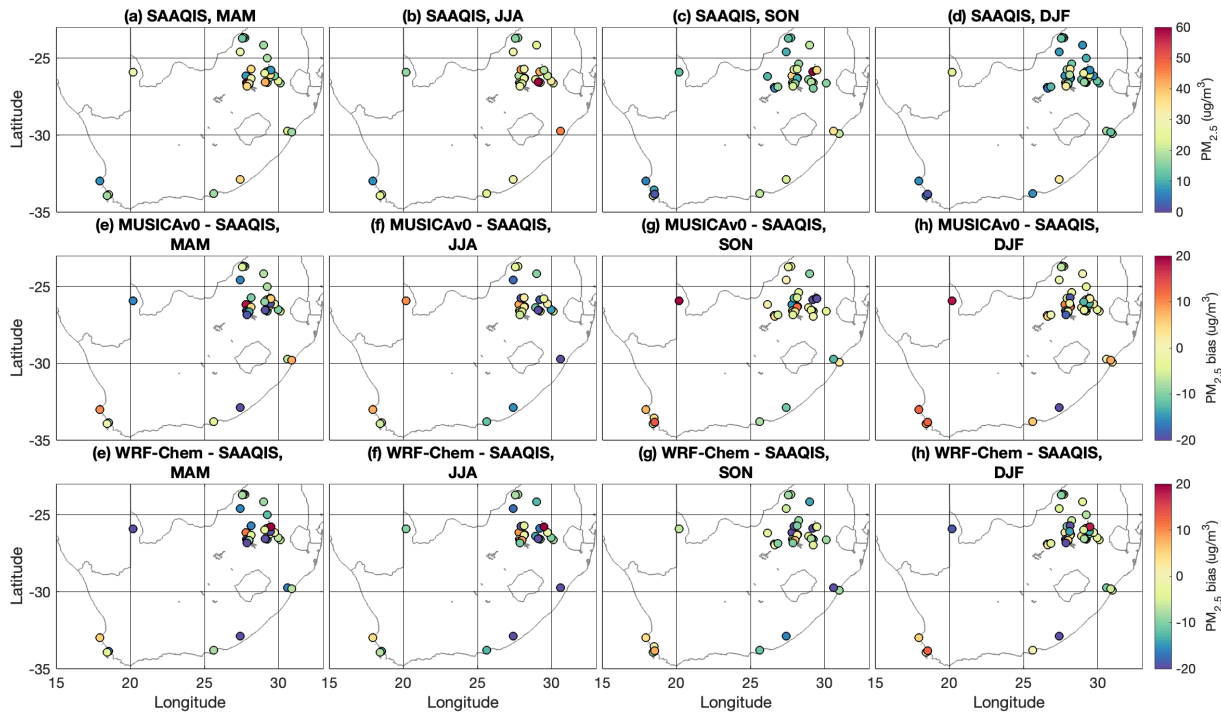**Figure S10**. Same as Figure S8 but for O_3.
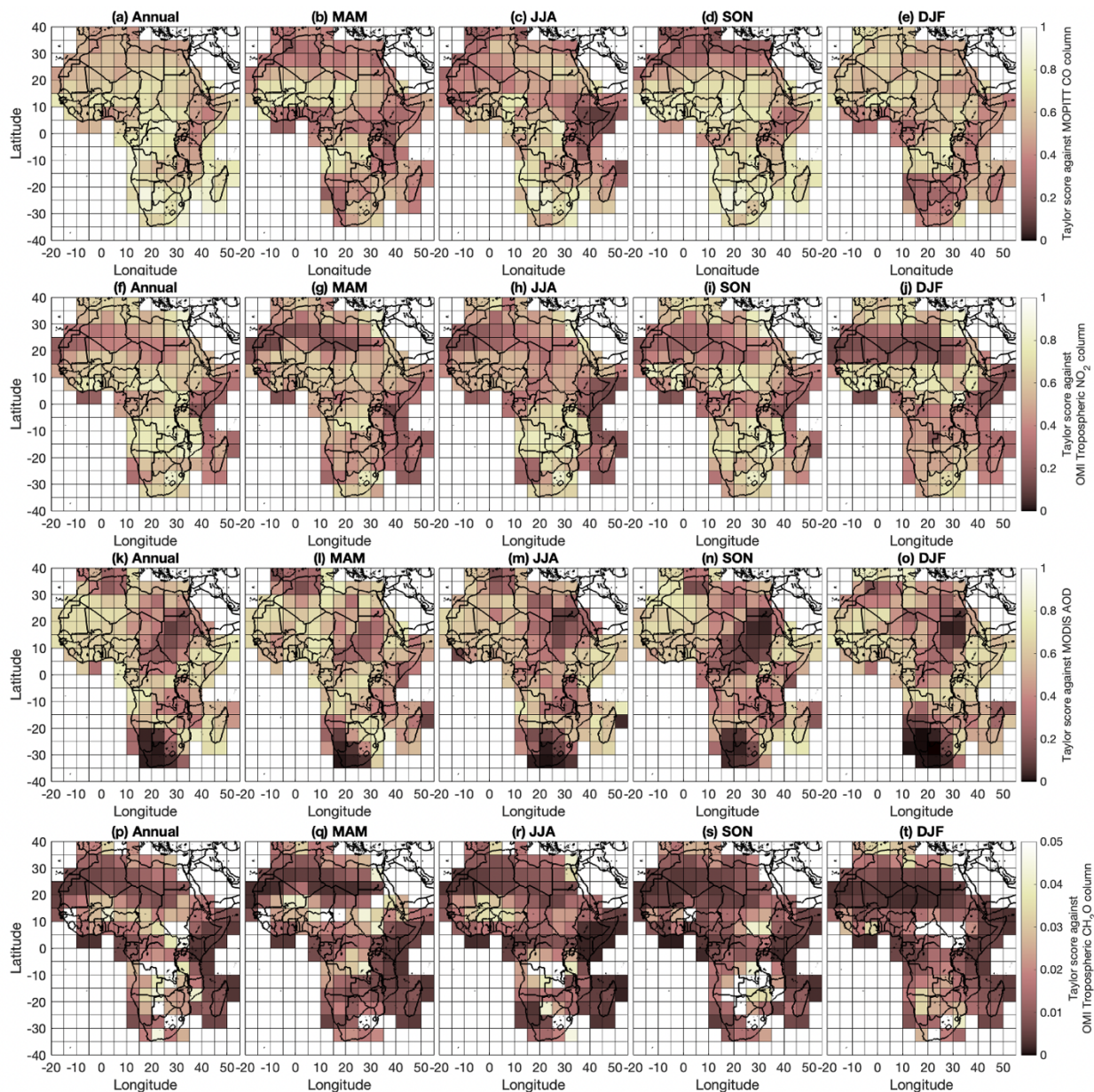

Figure S11. Same as Figure S8 but for $PM_{2.5}$.

Figure S12. Spatial distribution of Taylor score of MUSICAv0 compared to satellite retrievals in each 5 degree × 5 degree (latitude × longitude) pixels. Taylor score of MUSICAv0 compared to MOPITT CO column retrievals for (a) 2017, (b) MAM (March, April, and May), (c) JJA (June, July, and August), (d) SON (September, October, and November), and (e) DJF (December, January, and February) are shown. (f-j) are the same as (a-e) but for Taylor score of MUSICAv0 compared to OMI tropospheric NO_2 column retrievals; (k-o) are the same as (a-e) but for Taylor score of MUSICAv0 compared to MODIS AOD; (p-t) are the same as (a-e) but for Taylor score of MUSICAv0 compared to OMI tropospheric HCHO column retrievals.