Supplement of Atmos. Chem. Phys., 20, 671–682, 2020
https://doi.org/10.5194/acp-20-671-2020-supplement

Atmospheric Chemistry and Physics
Open Access
EGU

Supplement of

Evidence for impacts on surface-level air quality in the northeastern US from long-distance transport of smoke from North American fires during the Long Island Sound Tropospheric Ozone Study (LISTOS) 2018

Haley M. Rogers et al.

Correspondence to: Drew R. Gentner (drew.gentner@yale.edu)

S1 Elevated CO at the Yale Coastal Field Station and Data From Additional Urban Sites

CO data from the urban site located in Queens, NY were also compared to measurements made at the other less urban sites (YCFS, New Haven, Bridgeport, Figure S1). Despite the additional urban sources of CO present at the Queens site, a multi-day peak during the two event periods is consistent across all sites (Figure S1).

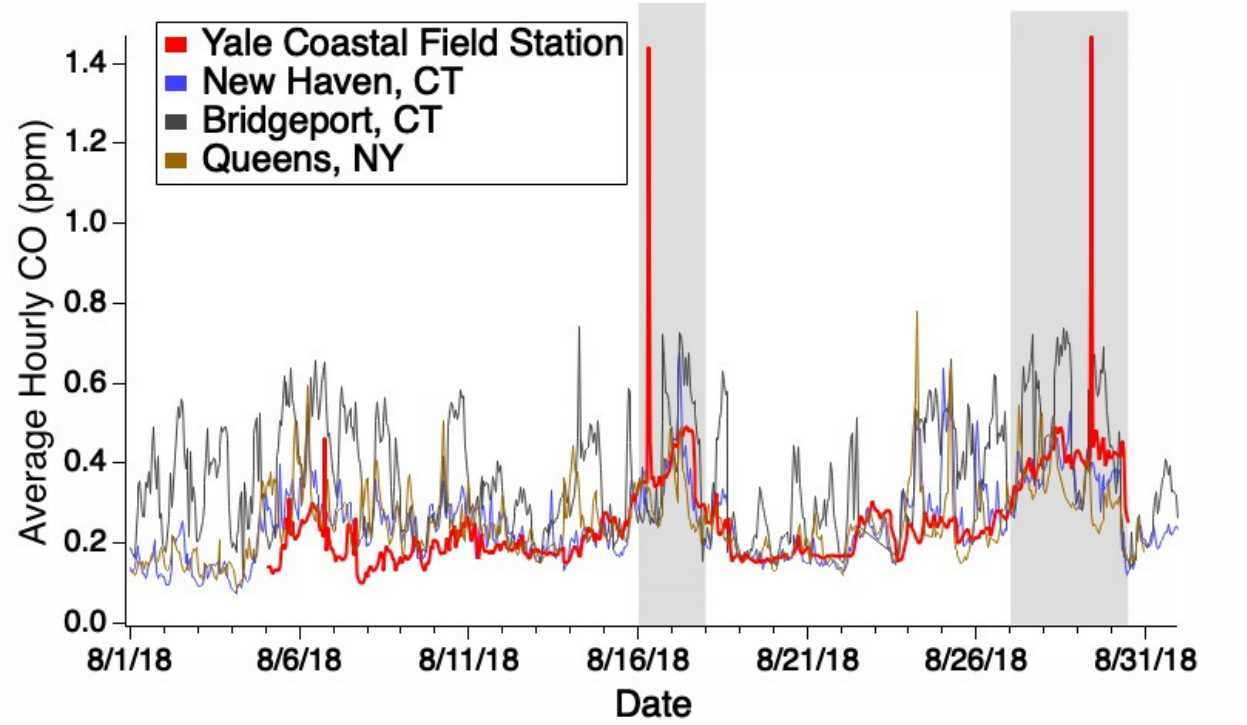

Figure S1: Average hourly surface-level CO. Data from the Queens, NY urban monitoring site have been included. While there are additional urban sources at the Queens site, the trend in increasing CO during the two event periods remains the same. Grey shading indicates the identified event periods.

S2 Satellite Imagery on Non-Event Days

Surface-level concentrations of $PM_{2.5}$, BC, and CO indicated possible biomass burning pollution events on August 6-7 and August 10, as evident by the periods of slight pollutant enhancement in Figure 2 on these days. NOAA Smoke Maps show minimal smoke plume influence in the NYC Metro area, therefore these two periods in early August were not examined further (Figure S2).

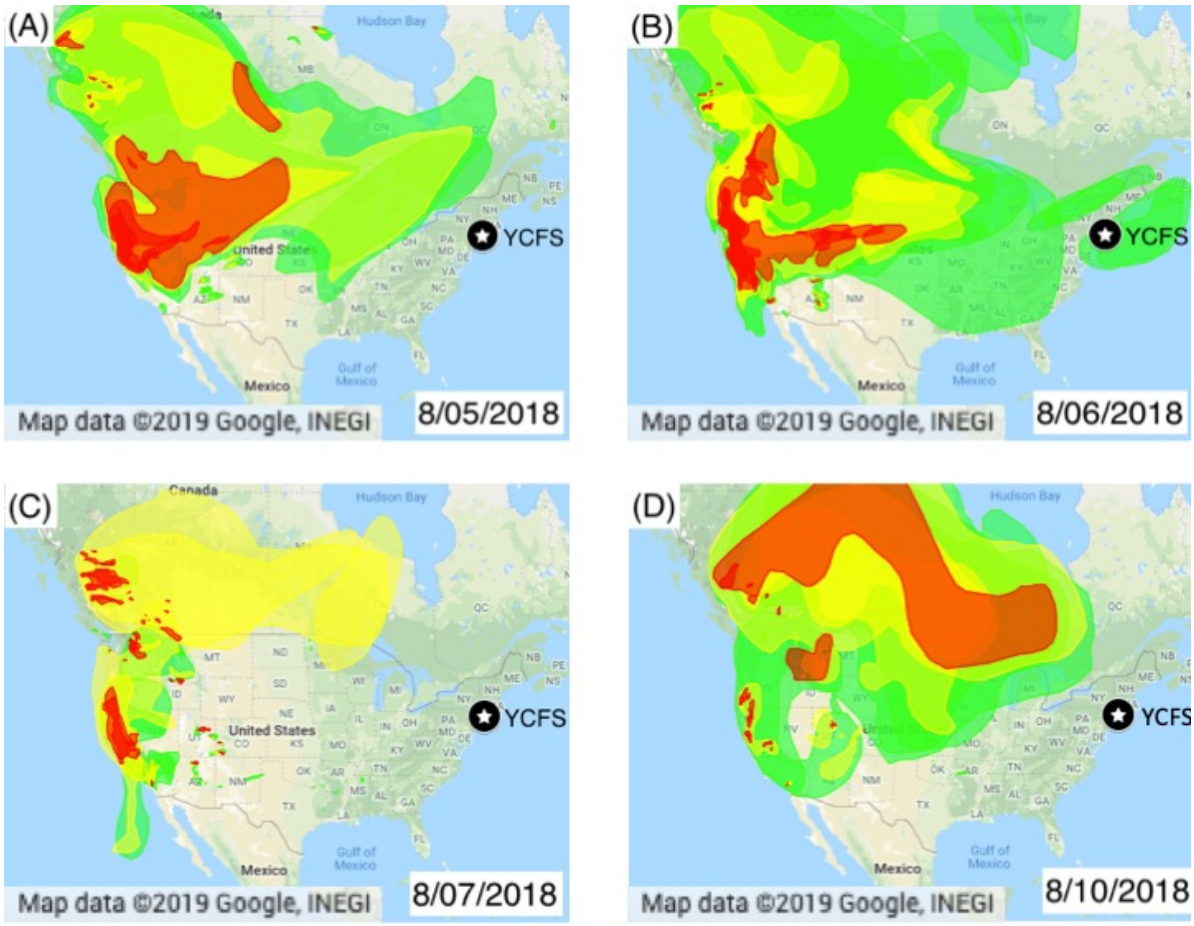

Figure S2: Smoke Maps (NOAA) based on satellite imagery for total column measurements for August 5-7 (panels A-C) and August 10 (panel D) during relatively smaller increases in $PM_{2.5}$, BC, and CO. The YCFS is marked by the black star. Colors indicate the density of the smoke cloud, with red being the most dense smoke, yellow being intermediate, and green being the least dense. This figure is provided as a supplement to Figures 2-4.

S3 Additional Backward-Trajectory Model Results

The second identified pollution event occurred on August 27-29, based on surface level data. Backward-trajectories for August 27 (Figure S3) show similar travel paths to those on August 28 and 29 (Figure 6), with circulation in the southeastern US over areas of biomass burning. The earliest trajectories on August 27 pass through central and Northern Canada without major interaction with active fires. However, starting around 6:00 am backward-trajectories begin to circulate in the southeastern United States where they pass over areas of biomass burning. This change in backward-trajectory path on the morning of the 27th aligns with the increase in surface level concentrations on the morning of the 27th.

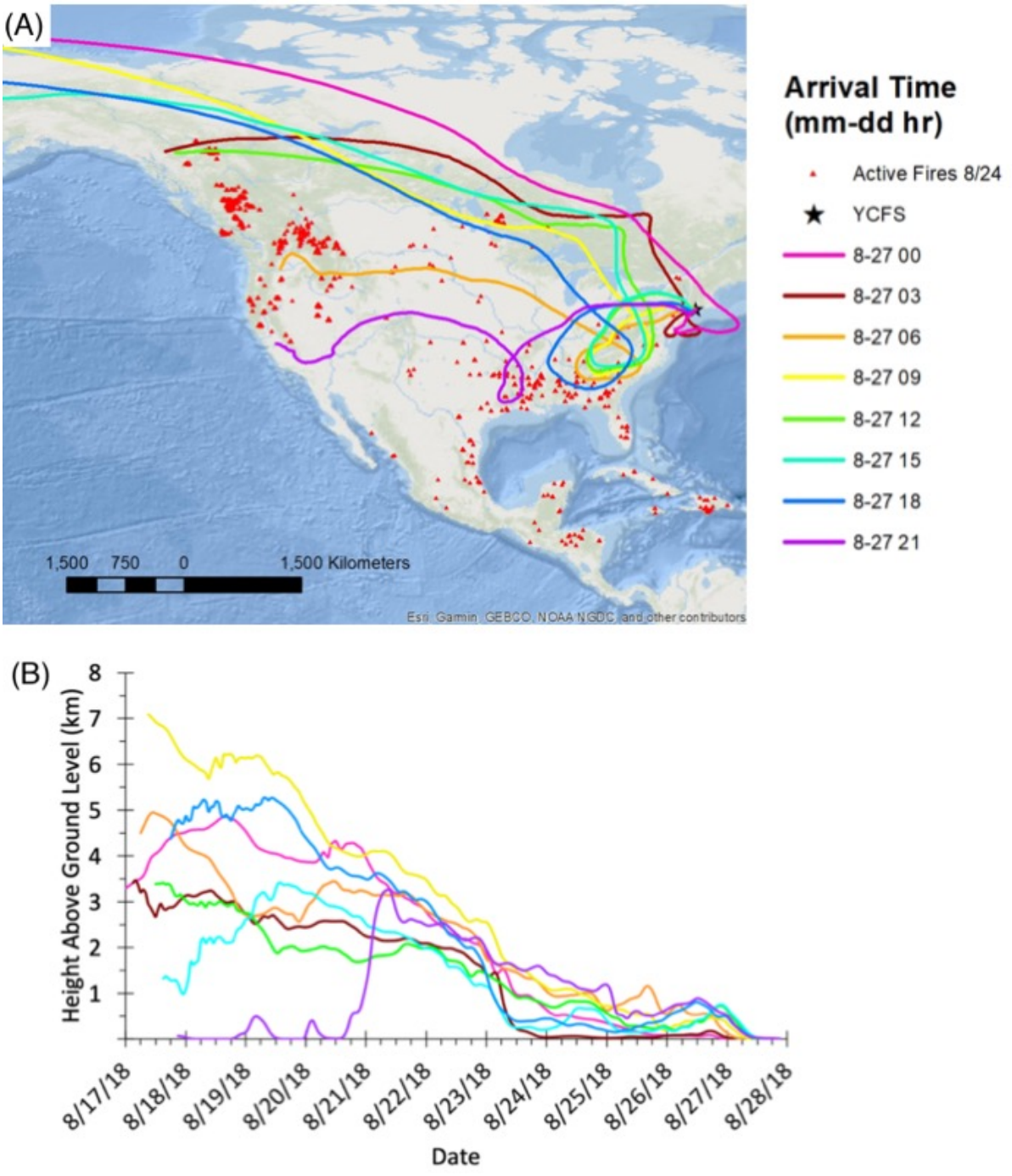

Figure S3: NOAA HYSPLIT Backward-trajectory model results for air parcels arriving on August 27, 2018 to surface-level YCFS site. Each color represents the backward-trajectory for an air parcel arriving every three hours throughout the course of the day. The location of fires on August 24 (when most trajectories intersect the fire zone in the southeast) is depicted with red triangles (from NOAA HMS fire maps). The top map (A) shows the full 10-day trajectory and the bottom figure (B) shows the vertical height of each air parcel along its trajectory. Backward-trajectory patters shift to circulation in the south east at approximately the same time as surface level concentrations of biomass burning markers increase (Figure 2).

S4 Example Non-Event Days

To contrast the patterns observed on the identified event days with those of non-event days, the same analysis across platforms (Smoke Maps, backward-trajectory modelling) was performed for a subset of non-event days. August 4th, 5th, 13th, and 21st were selected as non-event days because low concentrations of biomass burning tracers were observed at the YCFS, and these dates were outside the two identified event periods. On August 4th, 5th, and 21st, NOAA Smoke Maps showed no smoke in the Long Island Sound region and backward trajectories had minimal interaction with fires despite considerable fire activity in several areas of the U.S. (Figure S4-S7). This supports our other comparisons showing that high surface-level concentrations at the YCFS during the transport events are coincident with Smoke Maps showing smoke aloft over the NYC metropolitan region and backward trajectories passing through areas of biomass burning. This is different from these results showing that on non-event days there are no nearby smoke plumes in the satellite data outputs and backward-trajectories travel through air that has not been exposed to major biomass burning events, In the case of August 13th, which shows some smoke aloft and has a few backward trajectories that could have encountered fires, regional rain in the late morning to afternoon and 1-2 days of transport at the water's surface in the marine boundary layer before arriving at the YCFS would have reduced any potential biomass burning-related particle concentrations via deposition, leading to the cleaner conditions observed at the surface-level sites.

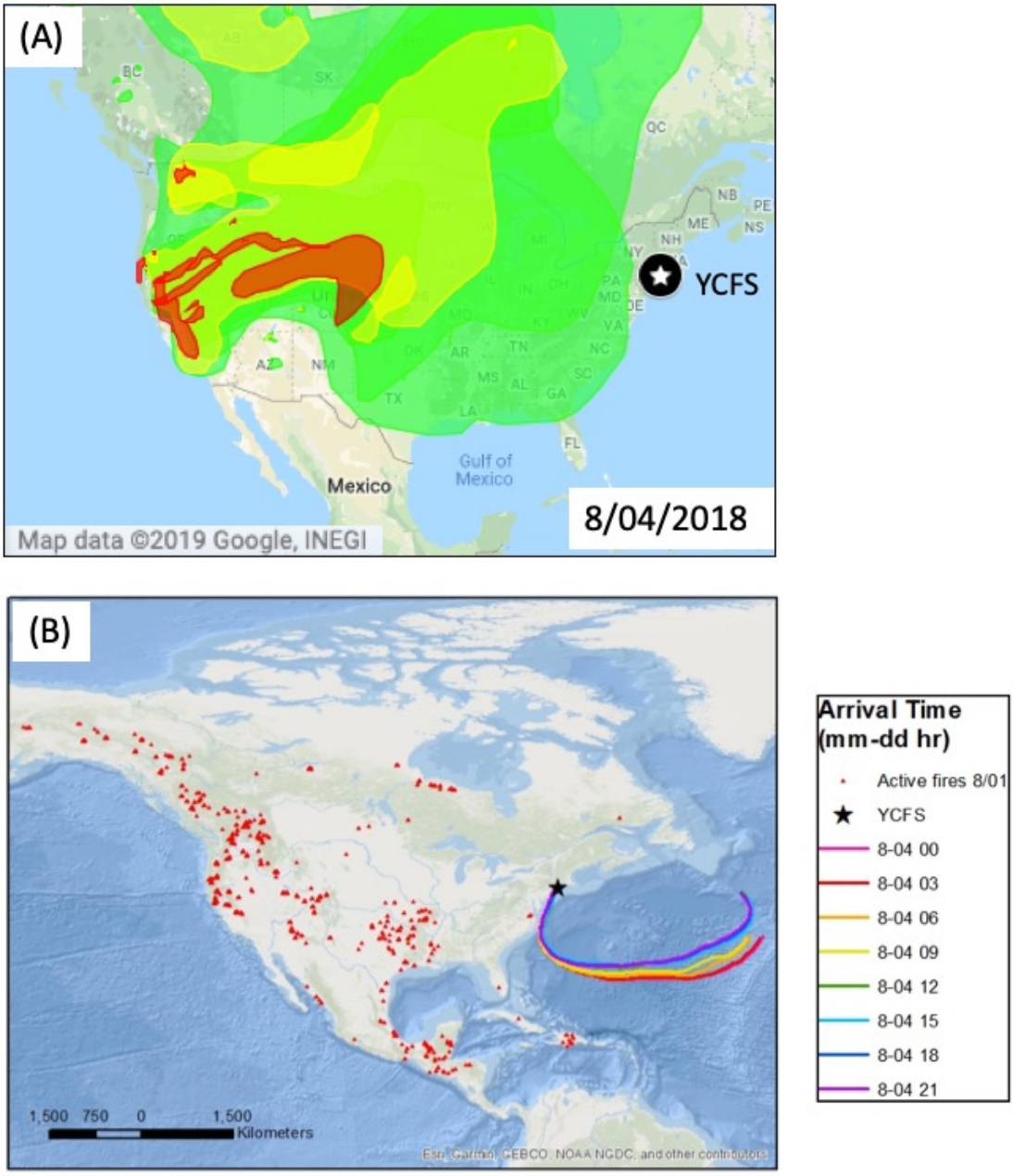

Figure S4: NOAA Smoke Map (A) and HYSPLIT backward-trajectory model (B) for August 4, 2018, a non-event day when surface level concentrations at the YCFS were lower. On this day, NOAA Smoke Maps show no visible smoke plumes in the NYC metropolitan area and 10-day backward trajectories show minimal interaction with active fires, despite the presence of active fires and fire plumes elsewhere in the U.S. This serves as an example to contrast the patterns observed on event days, where NOAA Smoke Maps show smoke influence in the NYC metropolitan area and backward trajectories pass through regions with active fires.

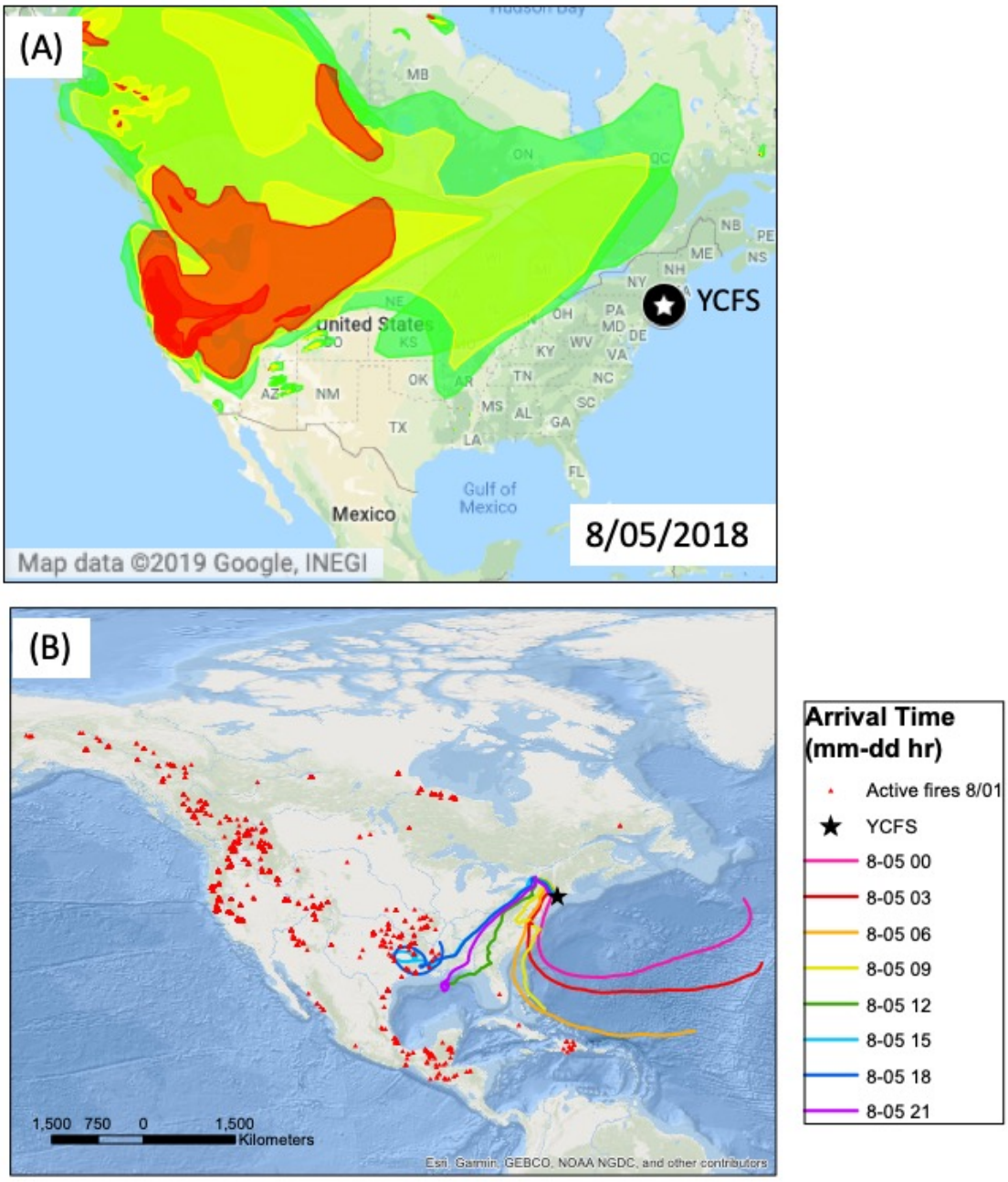

Figure S5: NOAA Smoke Map (A) and HYSPLIT backward-trajectory model (B) for August 5, 2018, a non-event day when surface level concentrations at the YCFS were lower. On this day, NOAA Smoke Maps show no visible smoke plumes in the NYC metropolitan area and 10-day backward trajectories show minimal interaction with active fires, despite the presence of active fires and fire plumes elsewhere in the U.S. This serves as an example to contrast the patterns observed on event days, where NOAA Smoke Maps show smoke influence in the NYC metropolitan area and backward trajectories pass through regions with active fires. Note that some interaction with fires is possible for 2 trajectories later in the day, consistent with slightly higher tracer concentrations at YCFS in the later hours of the day, which is the time period leading up to a potential biomass burning transport event on August 6th-7th in metro NYC (Figures 2, S2), which was smaller in magnitude compared to the other 2 events.

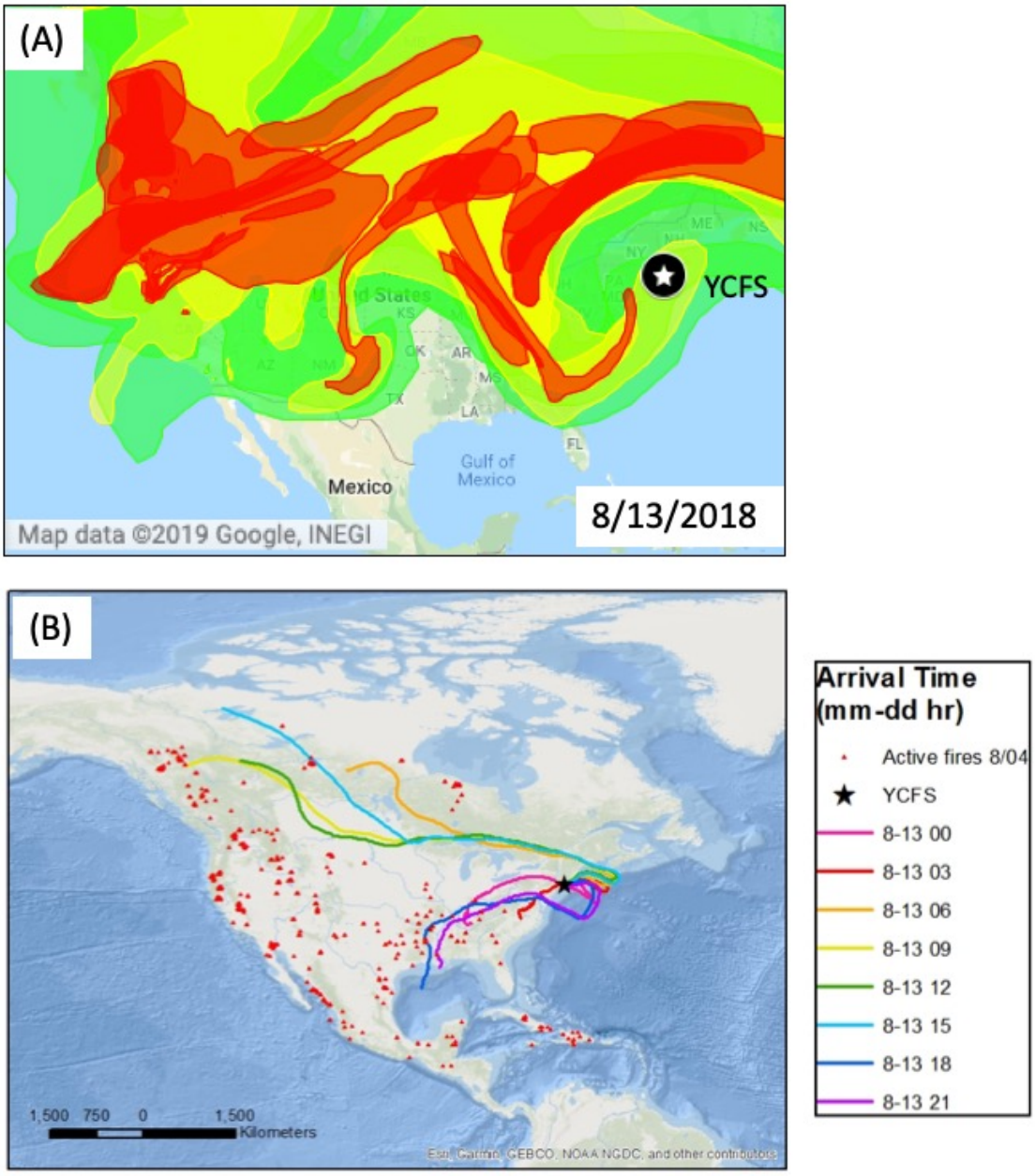

Figure S6: NOAA Smoke Map (A) and HYSPLIT backward-trajectory model (B) for August 13, 2018, a non-event day when surface level concentrations at the YCFS were lower. On this day, NOAA Smoke Maps do show visible smoke plumes aloft in the NYC metropolitan area and a few of the 10-day backward trajectories show some potential interaction with active fires. However, surface level concentrations at the YCFS remain low due to regional rain in the late morning and afternoon (leading to wet deposition of PM) and additionally air parcel backward trajectories were at immediate surface level over-water for a period of 1-2 days prior to arrival, which would have also enhanced surface deposition of PM.

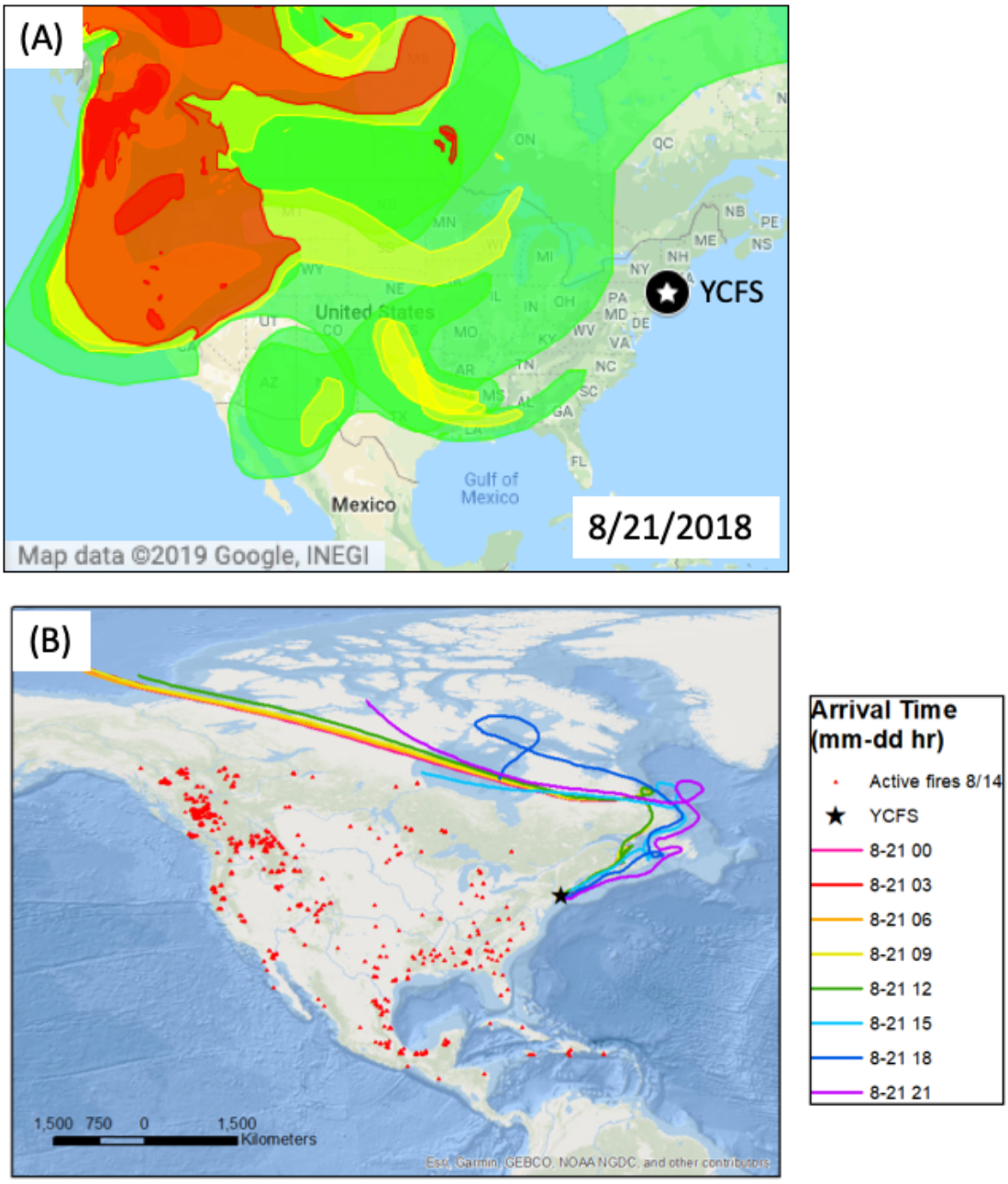

Figure S7: NOAA Smoke Map (A) and HYSPLIT backward-trajectory model (B) for August 21, 2018, a non-event day, when surface level concentrations at the YCFS were lower. On this day, NOAA Smoke Maps show no visible smoke plumes in the NYC metropolitan area and 10-day backward trajectories do not pass over areas of active fires, despite the presence of active fires and fire plumes elsewhere in the U.S. This serves as an example to contrast the patterns observed on event days, where NOAA Smoke Maps show smoke influence in the NYC metropolitan area and backward trajectories pass through regions with active fires.