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RAMBOLL ENVIRON

Date February 14, 2017

## MEMORANDUM

To: Marise Textor, Western Refining, and Jessica Christianson, El Paso Electric Company
From: Sue Kemball-Cook and Jeremiah Johnson, Ramboll Environ
Subject: CAMx Modeling of June 21, 2015

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**Summary:** CAMx photochemical modeling shows a clear causal connection between regional fire emissions and ozone at CAMS 12 on June 21, 2015.

We ran the CAMx photochemical model to evaluate the impact of regional fire emissions on the daily maximum 8-hour average ozone (MDA8) at the UTEP CAMS 12 monitor on June 21, 2015. We used TCEQ anthropogenic emission inventories for the year 2017 and episode-specific emissions for biogenics and electric generating units. Fire emissions for the US were provided by the US EPA and the FINN fire emission inventory was used for Mexico. We ran the WRF model to generate meteorological inputs for CAMx and used episode-specific boundary conditions from a MOZART global model run. We evaluated CAMx model performance for ozone and other species at ground level monitoring sites in Arizona, New Mexico and Texas to assess the model's ability to simulate observed ozone during June 2015.

The model performance evaluation showed that CAMx had a general tendency to underestimate ozone across the modeling domain. Model performance on June 21 was excellent at all El Paso and Dona Ana County monitors except the UTEP CAMS 12, Chamizal CAMS 44 and Desert View, NM monitors. At these three monitors, CAMx greatly underestimated peak 1-hour ozone (by ~30 ppb at CAMS 12). This suggests that the model simulated the regional background ozone entering El Paso and Doña Ana County well, but did not adequately characterize other processes affecting ozone at UTEP CAMS 12, Chamizal CAMS 44 and Desert View. Possible hypotheses for the low bias for ozone include but are not limited to: simulation of downward mixing and winds in complex terrain at the narrow mountain pass near these monitors, underestimation of fire emissions, and underestimation of Mexico emissions.

Next, we made a second CAMx run identical to the first run, except fire emissions were removed. The difference between the two CAMx runs models the impact of fire emissions. Figure 1 shows the modeled impacts on the MDA8 in the El Paso area due to fire emissions. The model estimated the impact of fire emissions on the MDA8 at the UTEP CAMS 12 monitor at 4.1 ppb and modeled impacts at other El Paso area monitors range from 2.5-4.0 ppb. Doña Ana County monitor modeled impacts range from 2.2-4.2 ppb. The model showed a steep east-west gradient in fire emission ozone impacts across this region with impacts up to 7 ppb approximately 30 km southwest of El Paso. The location of modeled ozone plumes produced downwind of the fires in Arizona and New Mexico is consistent with satellite fire and smoke products (Figure 2; Figure 3). The model results clearly show

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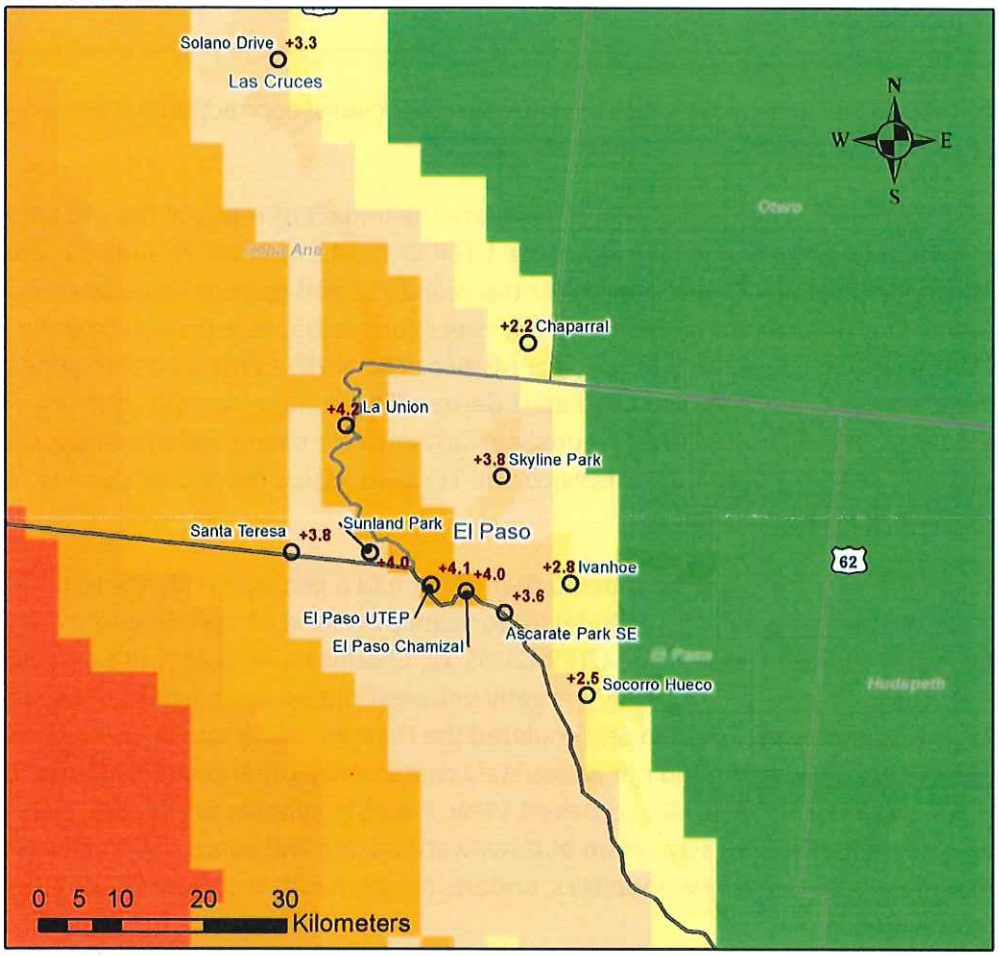
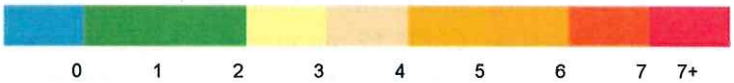
the influence of fire emissions on ozone (Figure 4) and $PM_{2.5}$ concentrations at CAMS 12 on June 21. Vertical cross sections of modeled ozone and $PM_{2.5}$ indicate that on June 21, an elevated layer of ozone and $PM_{2.5}$ was present over El Paso in the early morning and, as the morning progressed, the layer mixed downward to the surface. Given its underestimate of CAMS 12 peak 1-hour ozone on June 21, the CAMx model cannot be used make a quantitative determination of the magnitude of fire impacts at CAMS 12. However, the model results establish a clear causal relationship between regional fire emissions and ozone and particulates at CAMS 12 on June 21, 2015.



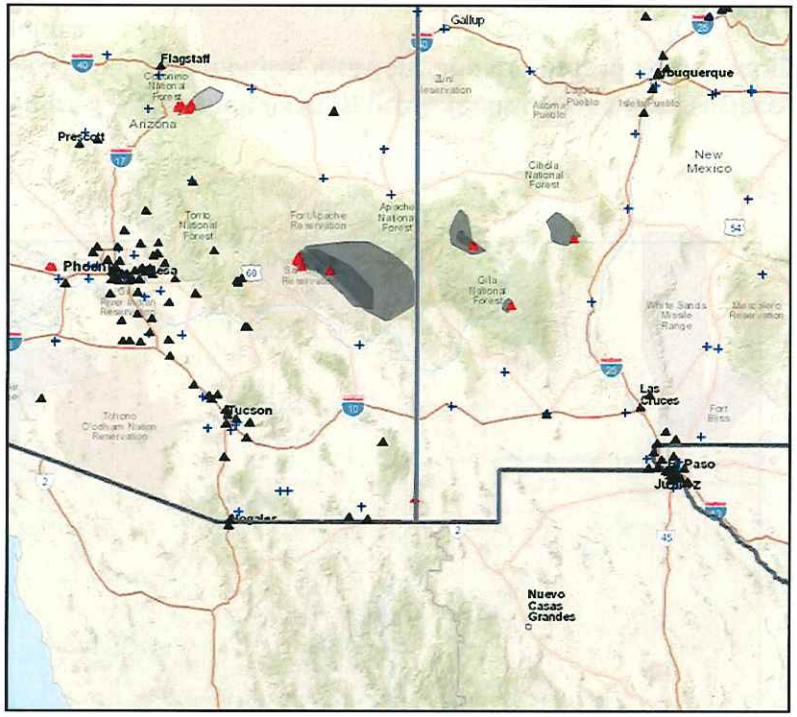

**Surface MDA8 Ozone Fire Impacts (ppb)**




O AQS Monitoring Sites

**Figure 1. June 21, 2015 CAMx surface layer MDA8 ozone impacts in the El Paso area and southern Doña Ana County due to fire emissions.**

## HMS Fire and Smoke: June 21




## CAMx: 4 km Grid

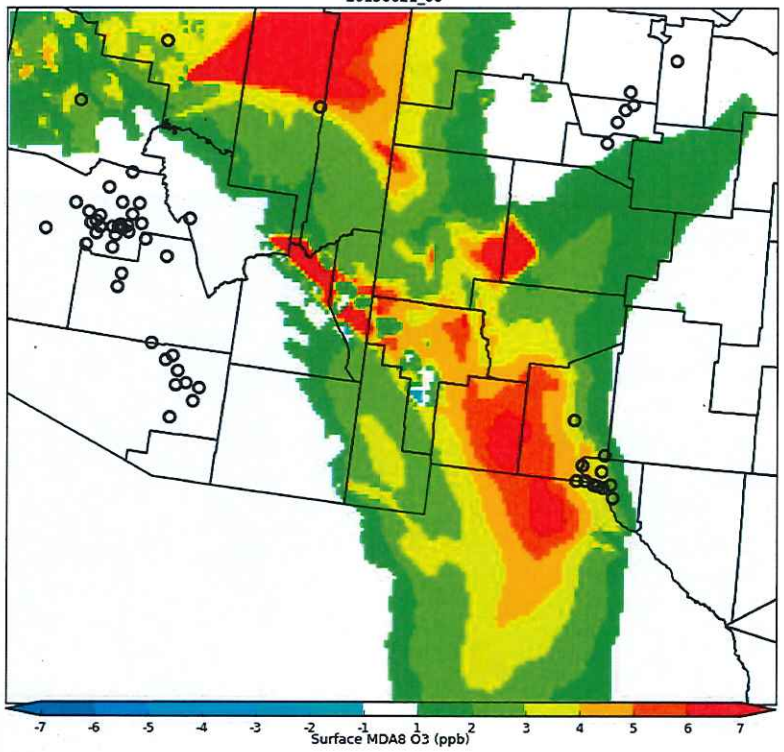
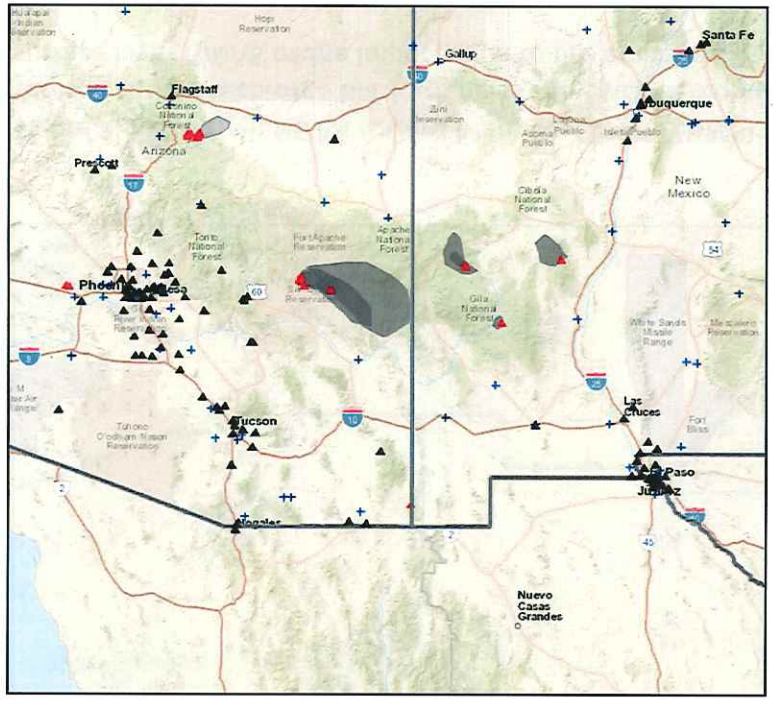



**Figure 2. Left panel: NOAA Hazard Mapping System (HMS) fire and smoke locations for June 21. Figure developed using on-line tools at Airnowtech.org. Black triangles show active monitoring sites and crosses are inactive monitors. Right panel: CAMx surface layer MDA8 ozone impacts due to fire emissions in the 4 km domain. Circles indicate monitor locations.**

## June 21 HMS Fire and Smoke



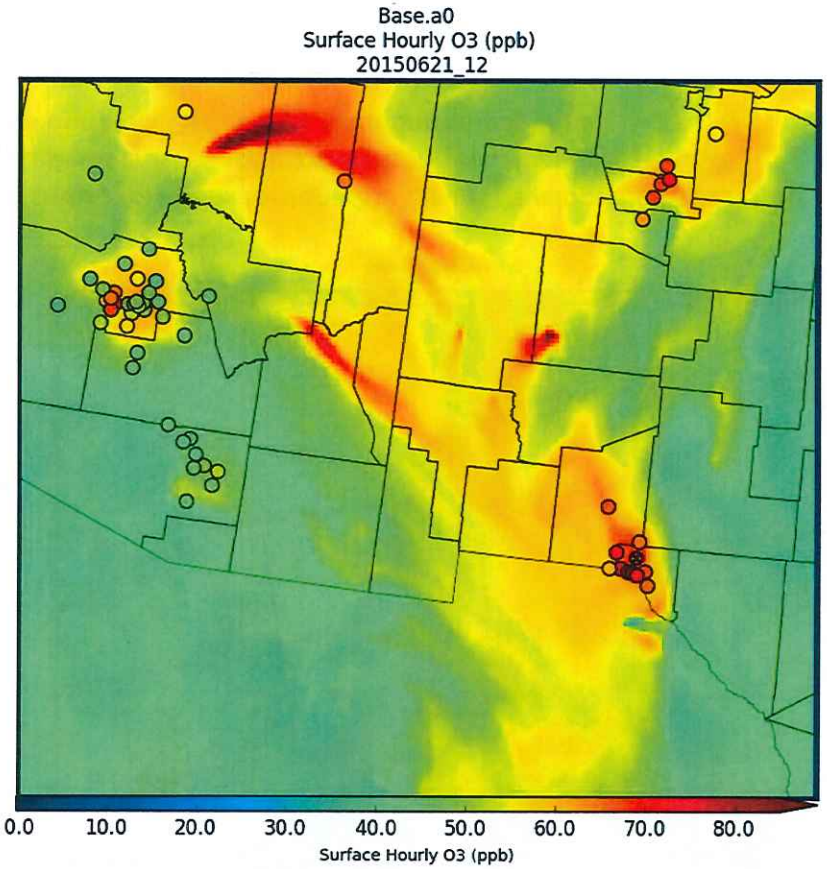




**Figure 3. Left panel: As in Figure 2. Right panel: CAMx surface layer 1-hour average ozone at 12 pm local time on June 21, 2015. Circles indicate monitor locations and monitored 1-hour ozone values are shown within the circle for comparison to the modeled values.**

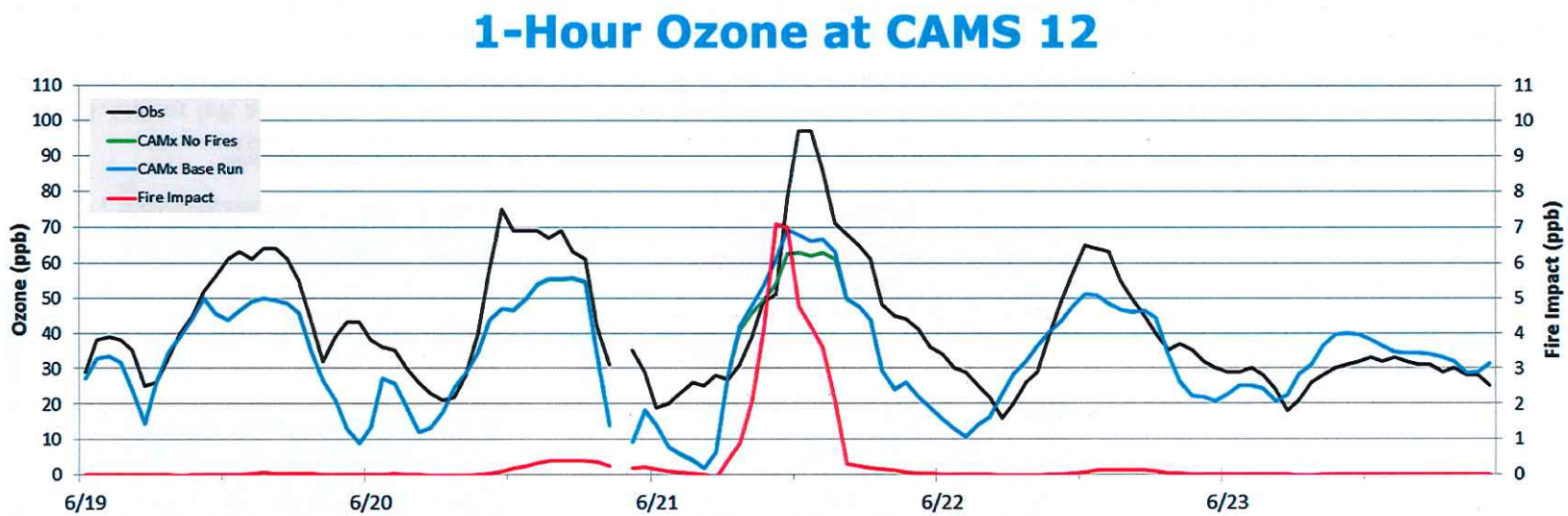



**Figure 4. Upper panel: observed ground level ozone at UTEP CAMS 12 (black) and CAMx surface layer ozone for the CAMx Base Run with fire emissions (blue) and the CAMx run without fire emissions (No Fires; green). The fire impact (red) is the difference between the CAMx runs with and without fires and is plotted using the scale on the right axis.**

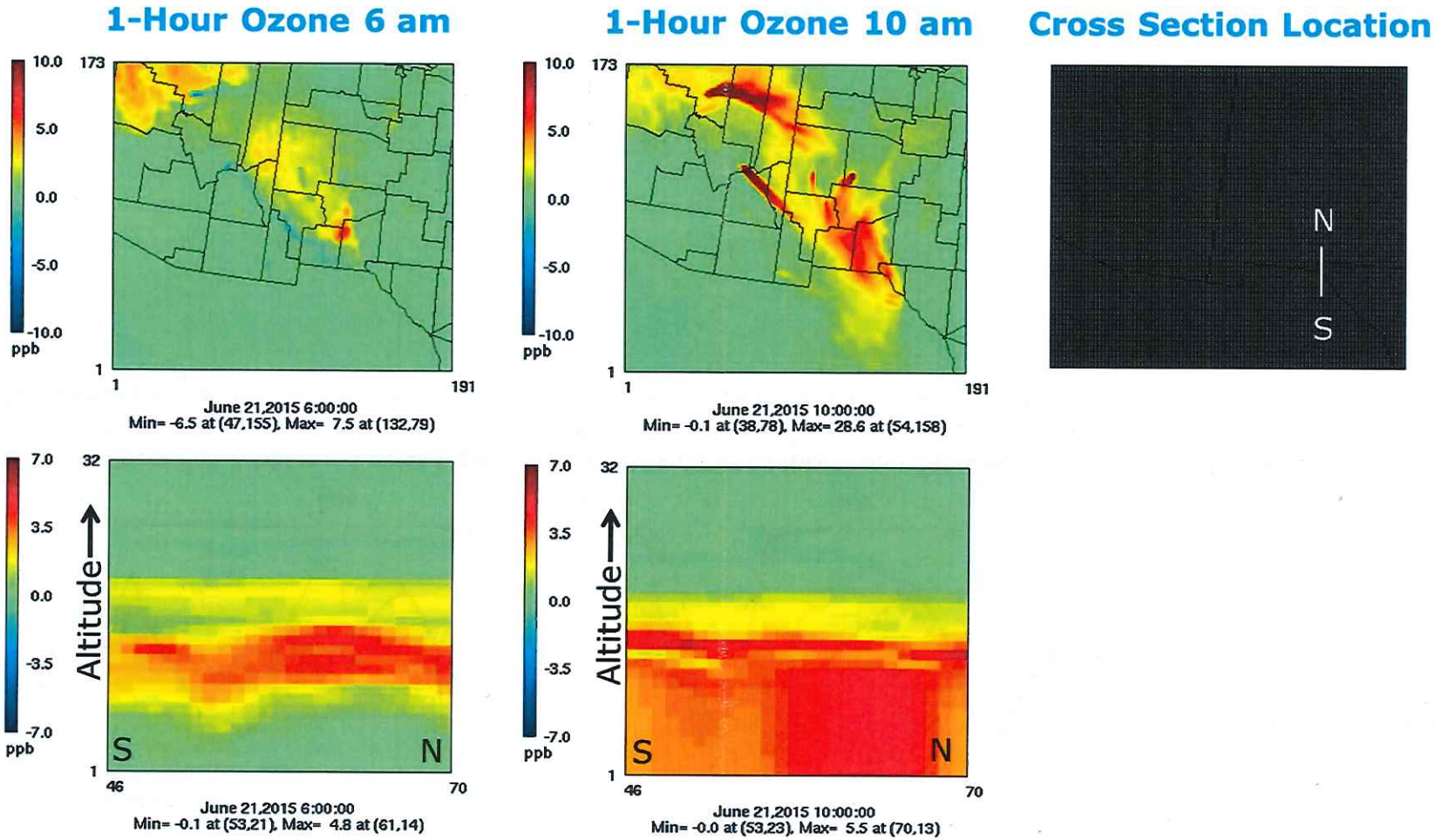



**Figure 5. Upper left and center panels: CAMx surface layer 1-hour average ozone due to fire emissions at 6 am and 10 am local time on June 21, 2015. Upper right panel: Map of 4 km modeling domain with white line showing location of the north-south cross section displayed in the lower panels. Lower panels: vertical cross section of ozone due to fire emissions along the white line at 6 am and 10 am. Cross sections show a layer of ozone aloft at 6 am that mixes down to the surface by 10 am.**

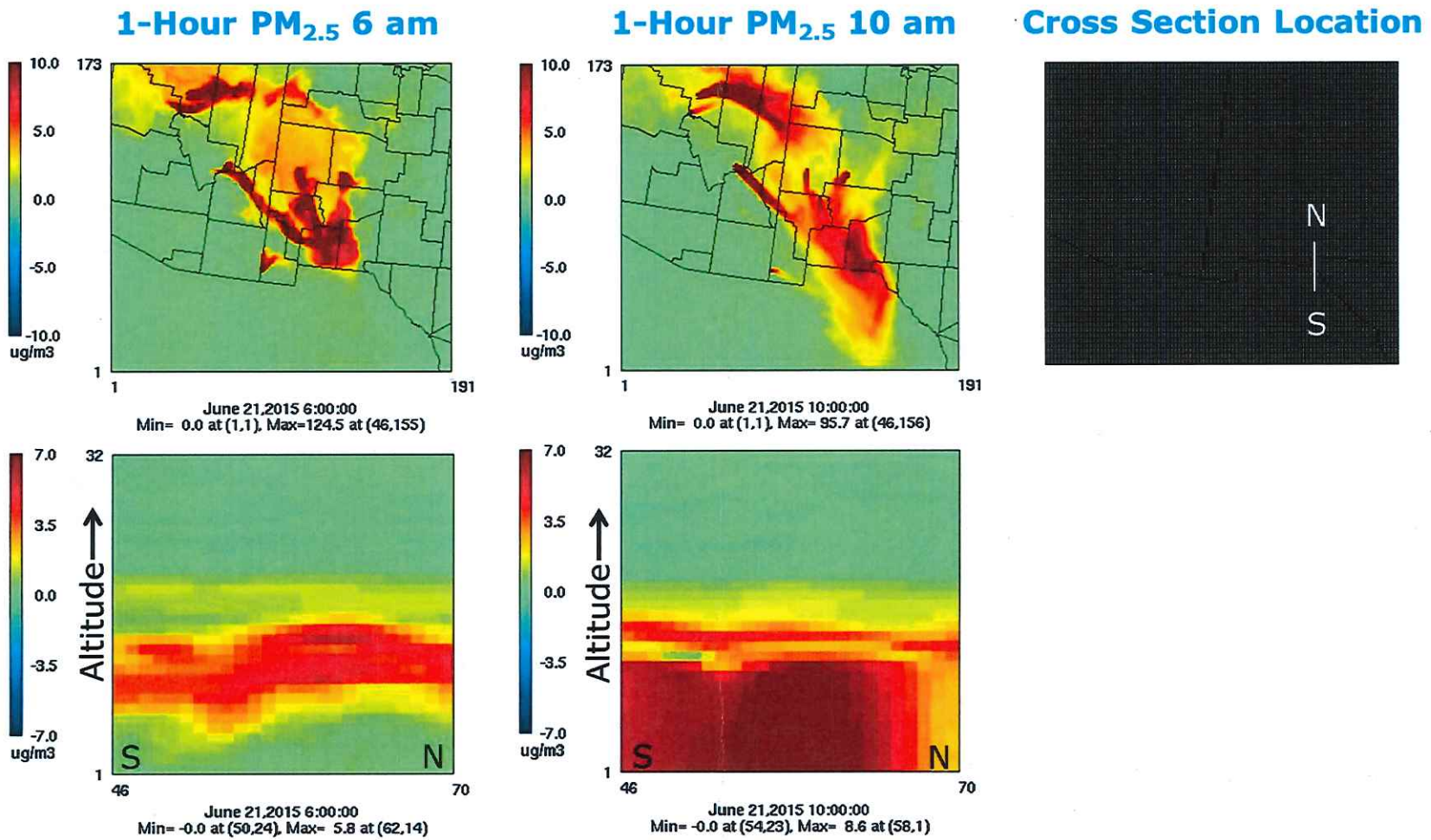



**Figure 6. Upper left and center panels: CAMx surface layer 1-hour average $PM_{2.5}$ due to fire emissions at 6 am and 10 am local time on June 21, 2015. Upper right panel: Map of 4 km modeling domain with white line showing location of the north-south cross section shown in the lower panels. Lower panels: vertical cross section of $PM_{2.5}$ due to fire emissions along the white line at 6 am and 10 am. Cross sections show a layer of $PM_{2.5}$ aloft at 6 am that mixes down to the surface by 10 am.**