Supplement of

Interactive Biogenic Emissions and Drought Stress Effects on Atmospheric Composition in NASA GISS ModelE

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Text S1

The figure shows the location of the MOFLUX (Missouri Ozarks) Ameriflux site located in central Missouri as a red diamond. The latitude and longitude of the MOFLUX site is 38.7441°N, 92.2000°W. The state of Missouri is displayed in green on a map of the continental United States, where state borders are shown in white.

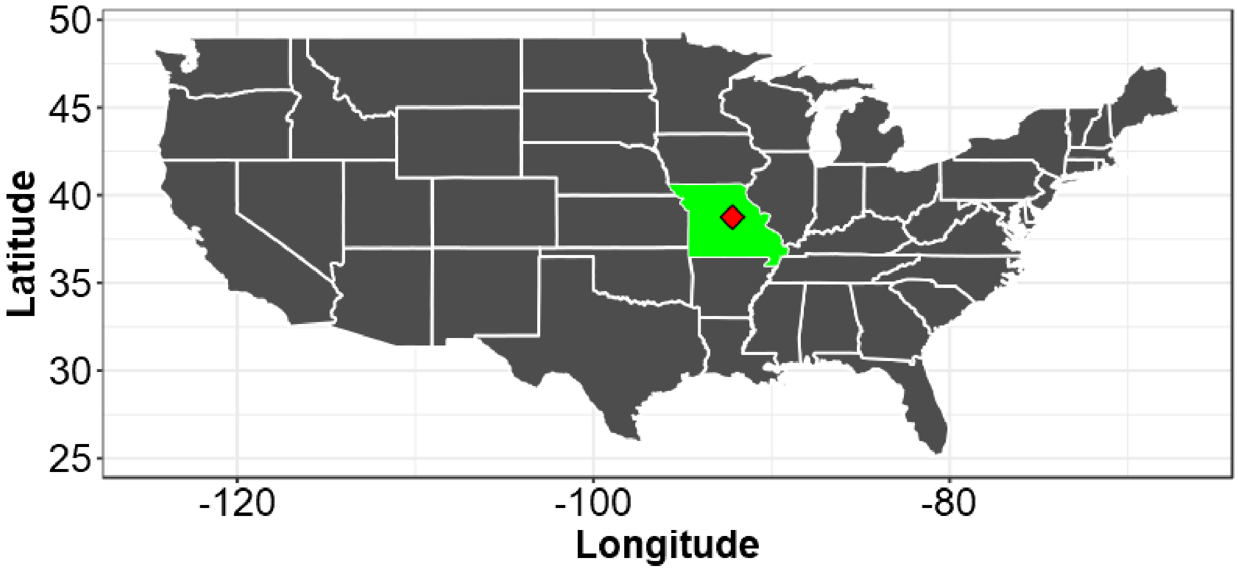

Figure S1: The figure shows the location of the state of Missouri shown in green, with a red diamond to indicate the MOFLUX Ameriflux site.

Text S2

The timeseries of daily averaged isoprene flux at the MOFLUX site (MAY-AUG 2011) top figure (a) and bottom figure (b) shows the daily biogenic isoprene flux from (MAY-SEP) 2012. Water stress is shown as a blue dotted line on the second y-axis, ranging from zero to one. A water stress value of one indicates no plant water stress and a low value indicates high plant water stress. The figure shows observations in black, the Default_ModelE simulation in red, the DroughtStress_MEGAN3_Jiang simulation in dark green, the MOFLUX_DroughtStress simulation in orange, and the DroughtStress_ModelE simulation in lime green. During 2011, it is clear all four simulations underestimate observed isoprene during a majority of the summer. During later summer the model is clearly overestimating in 2011. In 2012, the summer is broken up into three main periods MAXVOC, Severe Drought, and Drought Recovery. During the MAXVOC period the model is underestimating, during the severe drought period the isoprene drought stress parameterizations are applied, and during the drought recovery period due to rising values of water stress the drought stress parameterizations stop reducing isoprene emissions.

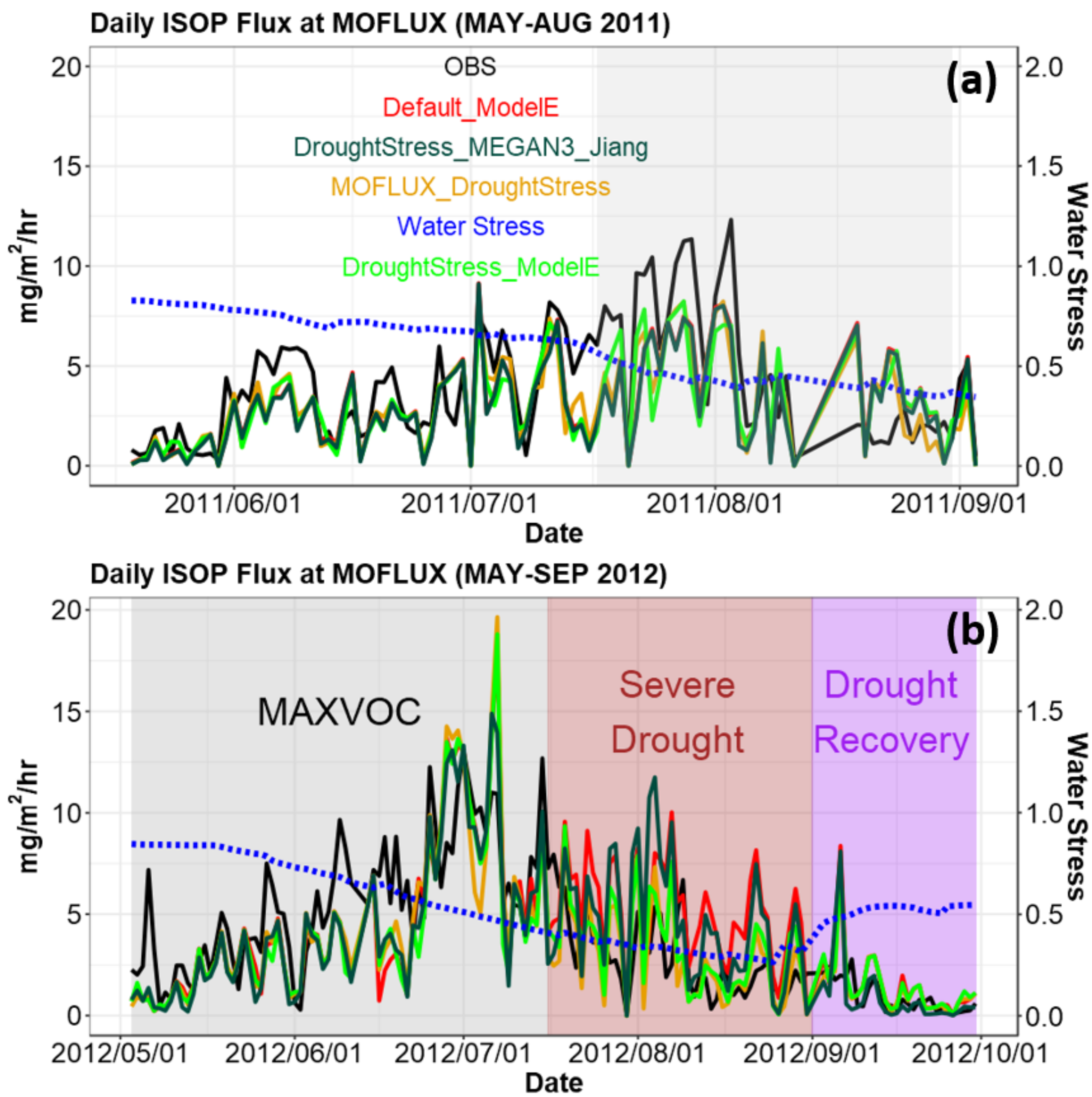

Figure S2: The timeseries of daily averaged isoprene flux at the MOFLUX site (MAY-AUG 2011) top figure (a) and bottom figure (b) shows the daily biogenic isoprene flux from (MAY-SEP) 2012. This figure shows all four simulations described by Table 1 in the main text. This figure includes the timeseries for DroughtStress_MEGAN3_Jiang which is not included in the main text. The left axis indicates isoprene emissions in mg/m^2/hr of isoprene and the second y-axis indicates water stress which ranges from zero to one.

Text S3

Figure shows the scatterplots (a-c) hourly and daily (d-f) averaged simulated isoprene emissions compared to observed for MAY-AUG 2011 at the MOFLUX site and the units are mg/m^2/hr of isoprene. Default_ModelE's hourly correlation coefficient was 0.77, DroughtStress_MEGAN3_Jiang was 0.76, and DroughtStress_ModelE showed improvements with a correlation coefficient of 0.78. For all three online simulations there were only minor changes in slope and y-intercept. The daily correlation coefficient showed the largest change from 0.66 in the Default_ModelE to 0.68 in DroughtStress_ModelE. With 2011 being a less severe drought year, there was not expected to be large improvements in the relationship of simulated to observed.

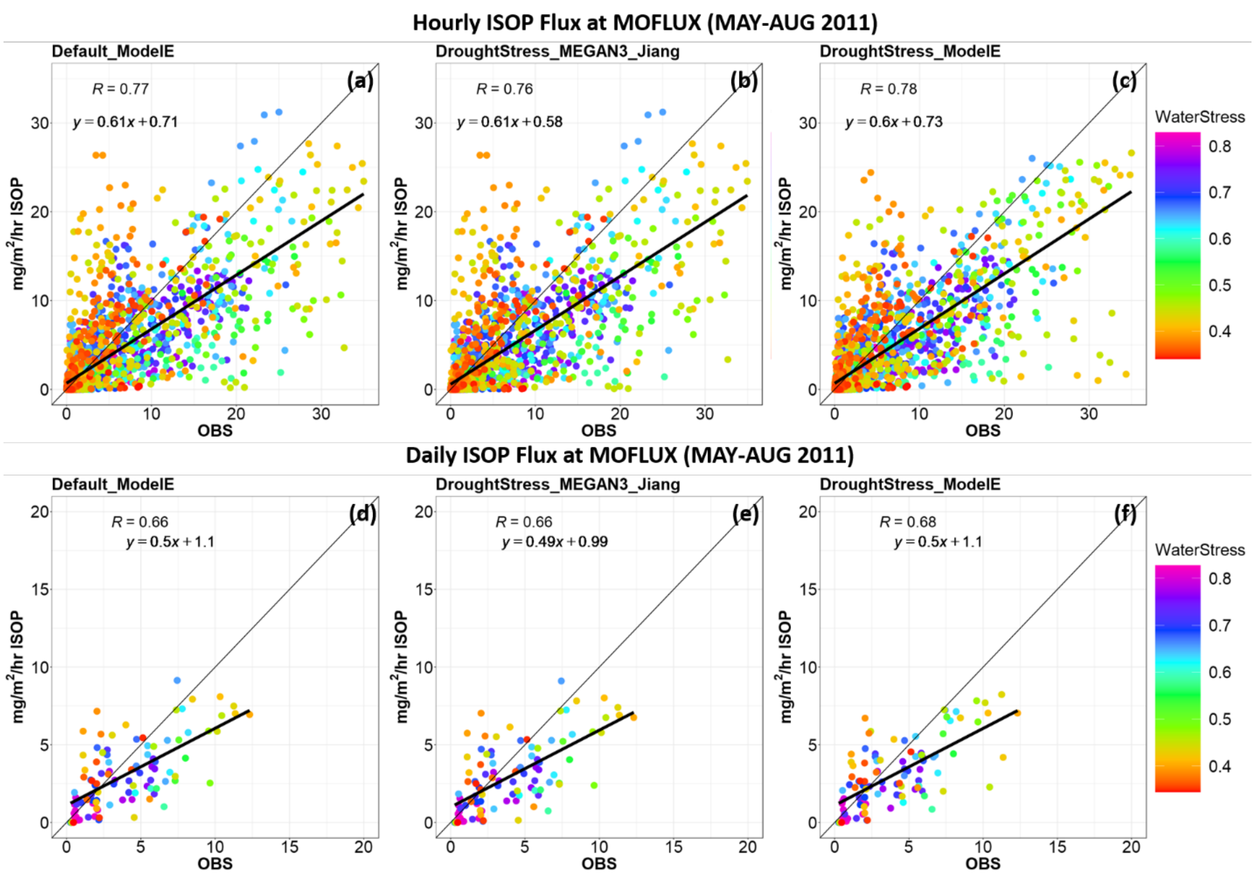

Figure S3: Figure shows the scatterplots (a-c) hourly and daily (d-f) averaged simulated isoprene emissions compared to observed for MAY-AUG 2011 at the MOFLUX site and the units are $mg/m^2/hr$ of isoprene. The points are color coded by water stress. The first column indicates Default_ModelE, the second column indicates DroughtStress_MEGAN3_Jiang, and the third column indicates the simulation DroughtStress_ModelE.

Text S4

The figure shows the diurnal cycle at the MOFLUX site for observed, Default_ModelE, MOFLUX_DroughtStress, and DroughtStress_ModelE. The top panel (a) shows the diurnal cycle from MAY-AUG 2011 and the bottom panel (b) shows the diurnal cycle from MAY-SEP 2012. For 2011, all simulations underestimate the diurnal cycle. For 2012, Default_ModelE overestimates the diurnal cycle, while shown in panel (b) DroughtStress_ModelE overlaps with observations during peak hours. ModelE does well in reproducing the diurnal cycle for 2012, but misses some characteristics of the shape in 2011.

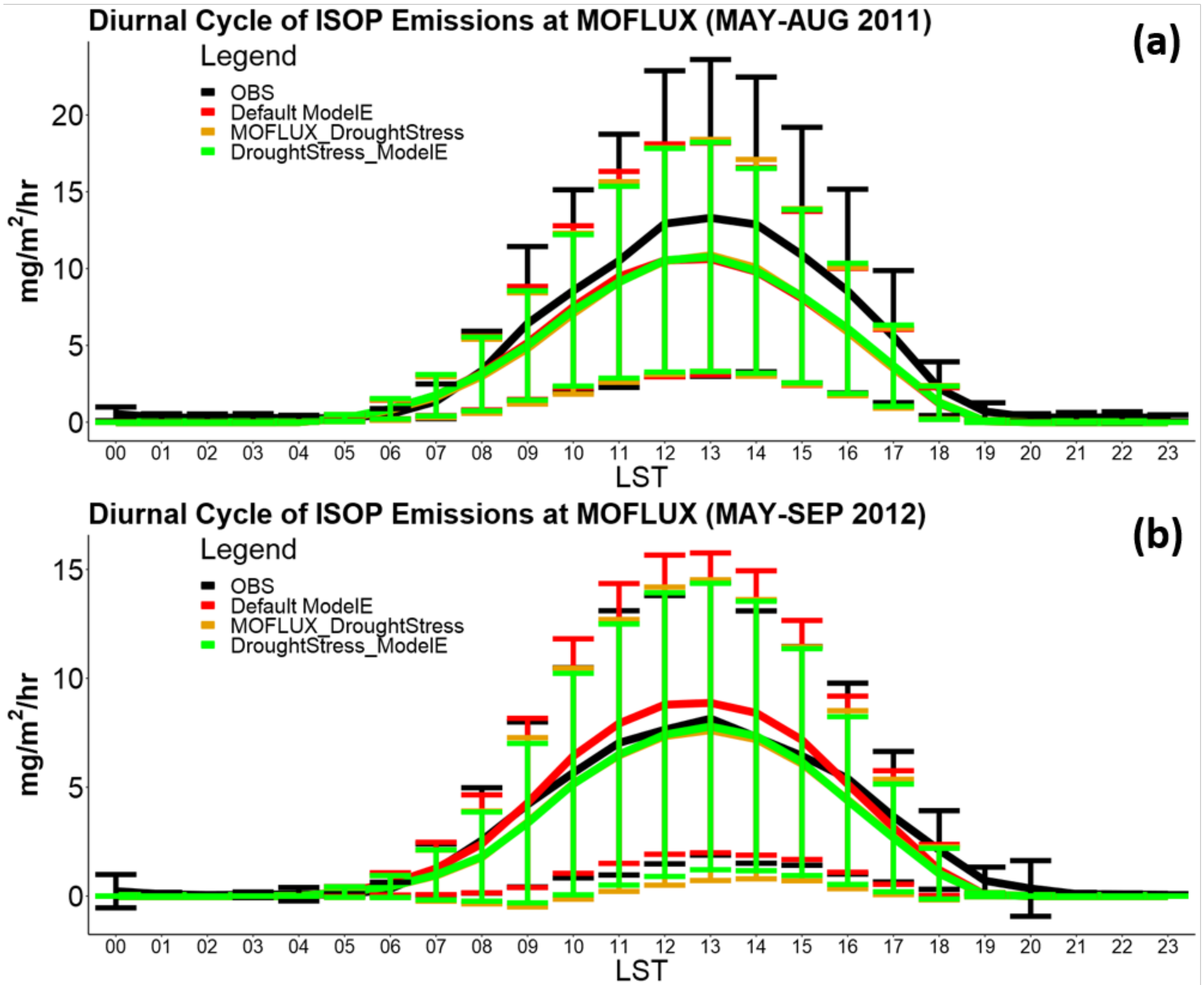

Figure S4: Diurnal cycle for MAY-AUG 2011 shown in (a) and diurnal cycle of isoprene emissions for MAY-SEP 2012 shown in (b). Black line indicates observations of isoprene emissions, red line is Default_ModelE without isoprene drought stress, orange line indicates MOFLUX_DroughtStress, and green indicates DroughtStress_ModelE. Full description of simulations in main text Table 1.

Text S5

Figure S5 shows the daily isoprene flux at MOFLUX from MAY-SEP 2012 for the simulations (a) Default_ModelE, (b) DroughtStress_MEGAN3_Jiang, and (C) DroughtStress_ModelE. In Default_ModelE the correlation coefficient is 0.64 and increases to 0.73 in DroughtStress_ModelE. Shown in panel (a) and (c) there is improvements in correlation slope and reductions in y-intercept indicating the isoprene drought stress parameterization improve daily simulations at the MOFLUX site.

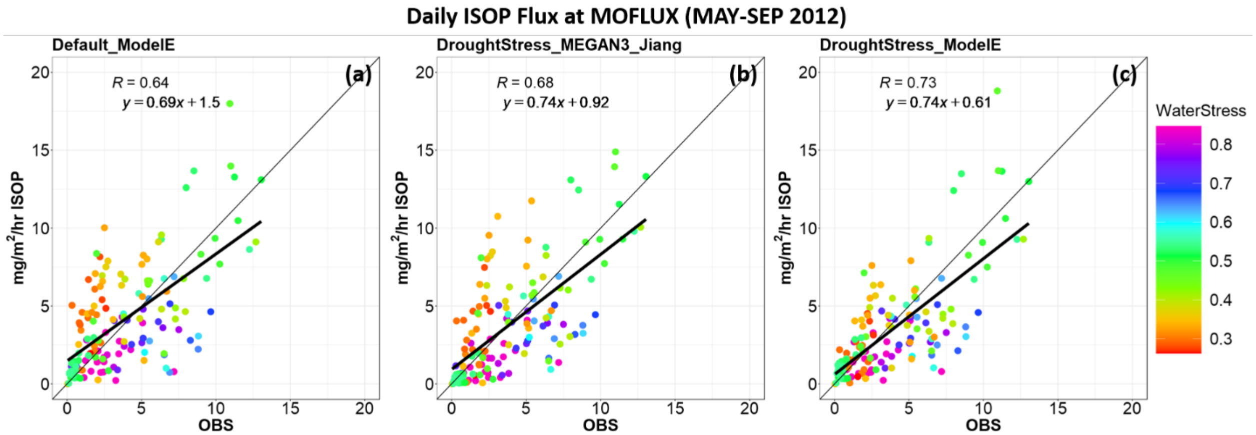

Figure S5: Shown are three scatterplots indicating the daily isoprene flux of simulated compared to observed at the MOFLUX site from MAY-SEP 2012. The first panel (a) indicates the Default_ModelE simulation, panel (b) indicates DroughtStress_MEGAN3_Jiang, and panel (c) indicates DroughtStress_ModelE. The points are color coded by simulated water stress. A zero to one line is also indicated on the plot as light grey while the regression is shown as a bolded black line.

Text S6

The map shows the location of four global isoprene emission hotspots. These four regions are selected to showcase the changes in isoprene emissions due to implementation of isoprene drought stress. The geographic regions are defined as East U.S. (Eastern U.S.) (65-105°W, 25-50°N), SA (Amazon) (40-80°W, 30°S-7°N), AF (Central Africa) (10-40°E, 15°S-10°N), and SE Asia (Southeast Asia) (100-150°E, 11°S-38°N).

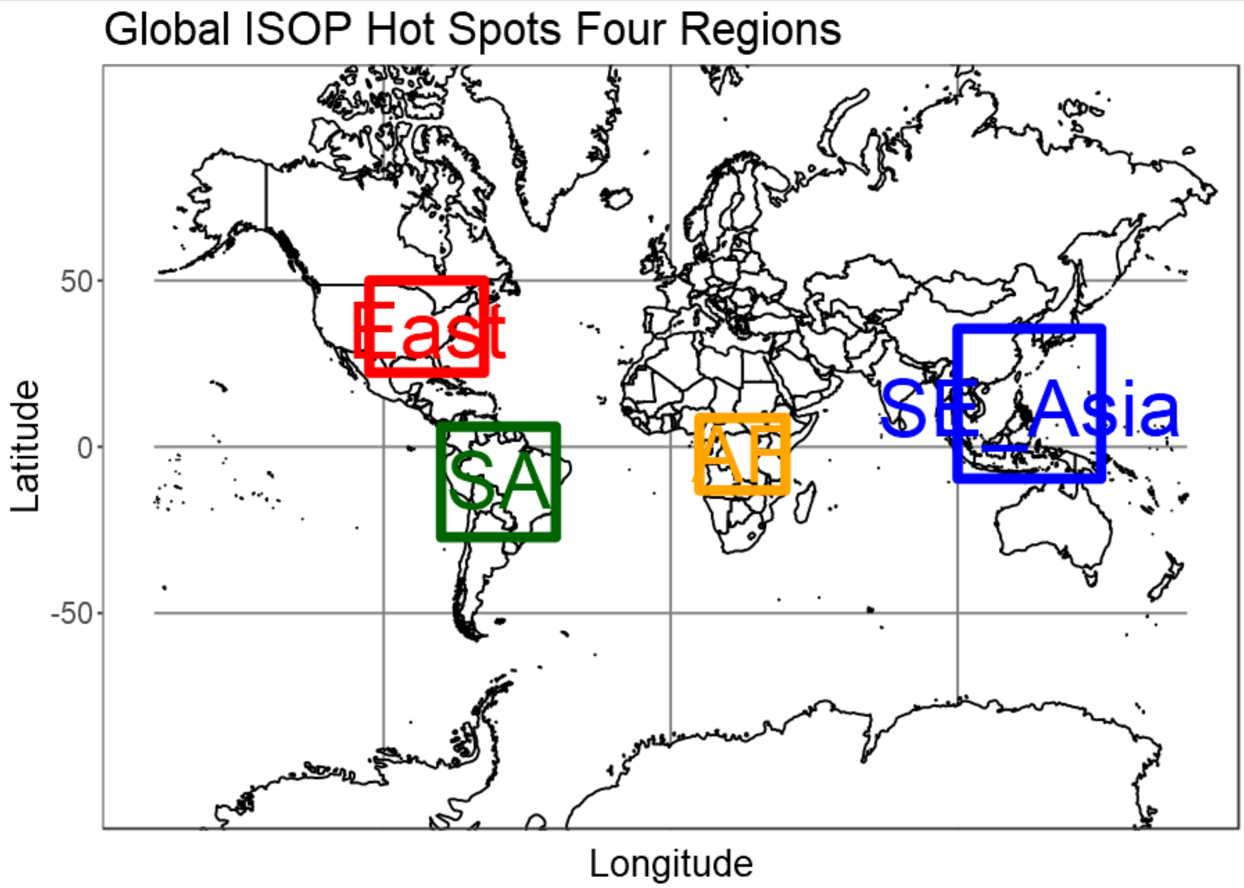

Figure S6: The four isoprene hotspots are depicted on the global map are Eastern U.S (East) shown by a red rectangle, Amazon (SA) shown by a green rectangle, Central Africa (AF) shown by an orange rectangle, and Southeast Asia (SE_Asia) shown by a blue rectangle.

Text S7

This map shows the geographic regions of the U.S. known as West (105-125°W, 25-50°N) and East (65-105°W, 25-50°N). The two regions are divided based on the demarcation line between when the magnitude of isoprene emissions and ΩHCHO rapidly decrease between Western and Eastern U.S.

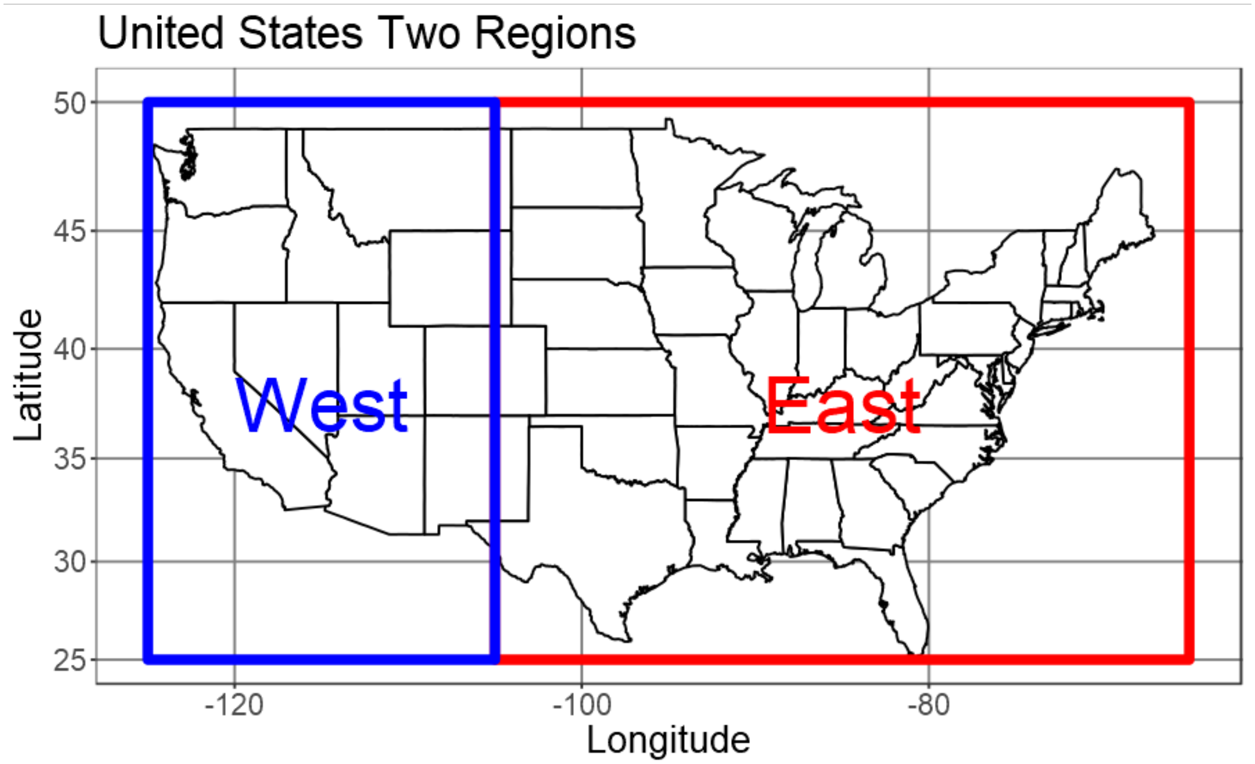

Figure S7: The map shows the region of West U.S. as a blue rectangle and East. U.S. as a red rectangle. The East geographic region includes the MOFLUX site.