



Web-based Interactive Photochemical Model Evaluation Tools

Source Apportionment Time-Series Evaluation Tool (SATSET)

Weining Zhao and Doug Boyer – Texas Commission on Environmental Quality

Introduction

Source apportionment (SA) technology in photochemical grid models (*e.g.*, OSAT, APCA, and PSAT in CAMx) tracks contributions from various sources to model simulated pollutant concentrations at specified locations in a modeling domain.

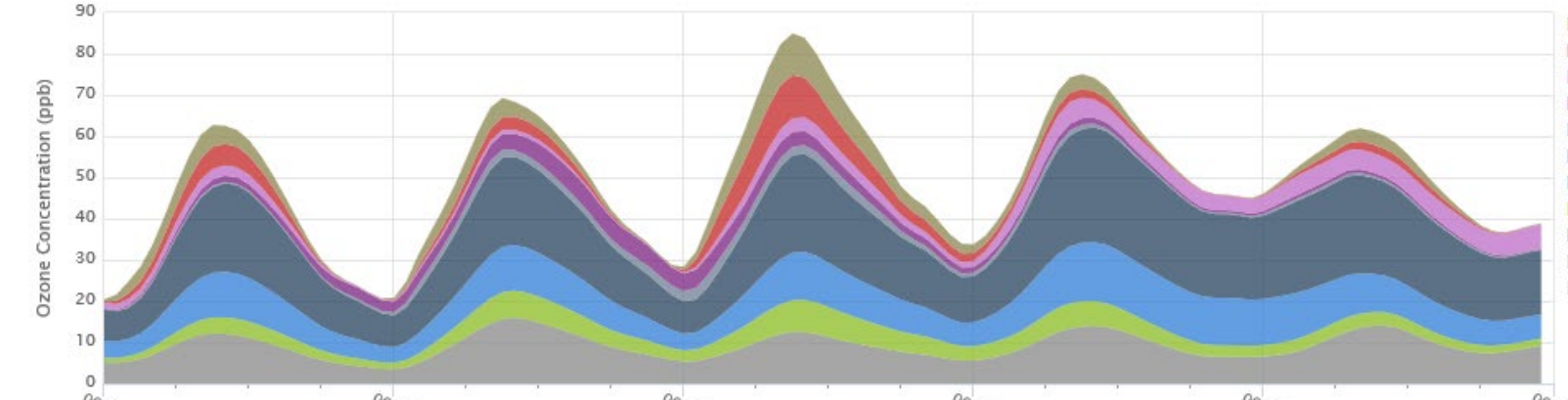
SA is typically configured by dividing a modeling domain into several emissions source regions of interest (*e.g.*, Texas, states outside Texas, *etc.*) and separating total emissions into emission components or types (*e.g.*, biogenic, on-road mobile, *etc.*). The combination of emissions regions and components, as well as contributing precursor chemicals (*e.g.*, NOx and VOC for ozone) could create a large number of individual source contributor elements.

This web-based evaluation and analysis tool provides an intuitive and highly interactive interface for users to visualize and analyze SA results. Individual source contributor elements can be easily combined into a composite source contributor via drag-and-drop of web objects.

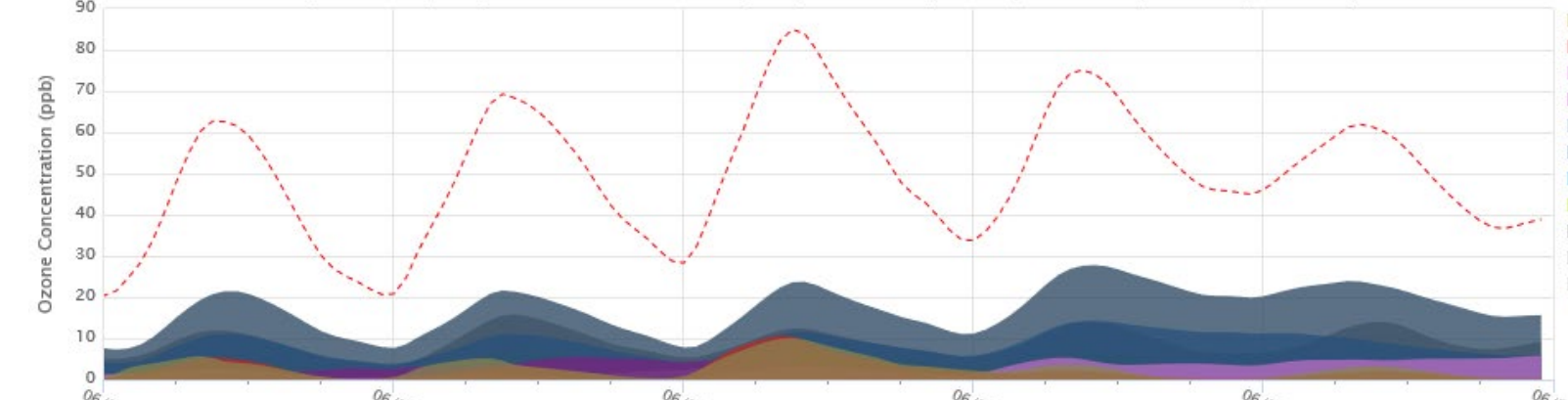
This tool is developed with HTML, CSS, PHP, MySQL, JavaScript, jQuery, Highcharts, Highstock, and Google Map JavaScript.

View from Different Perspectives

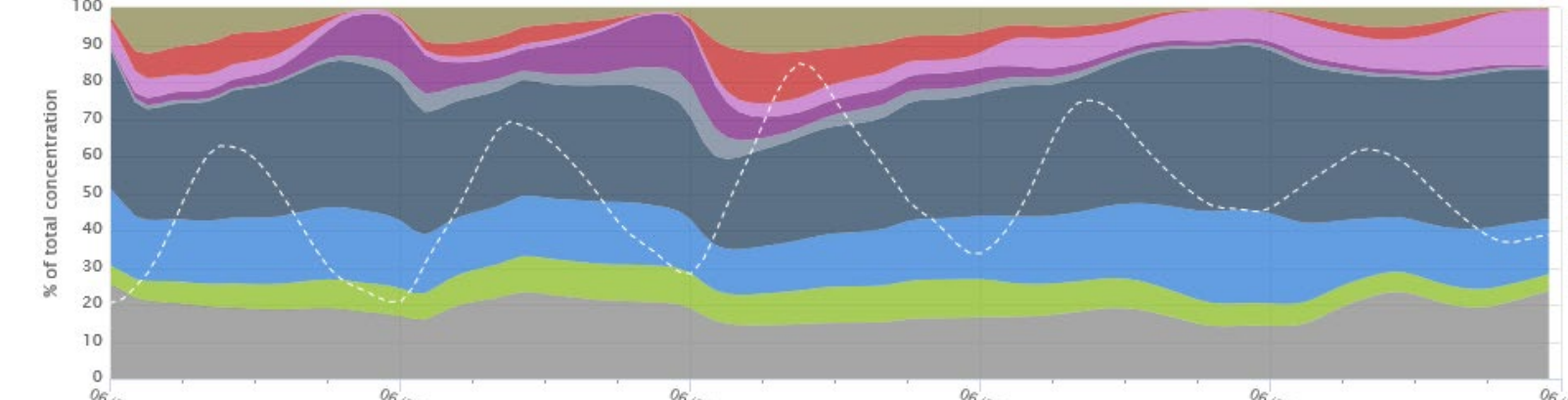
A. Stacked area plot showing accumulation of concentrations contributed from all sources.



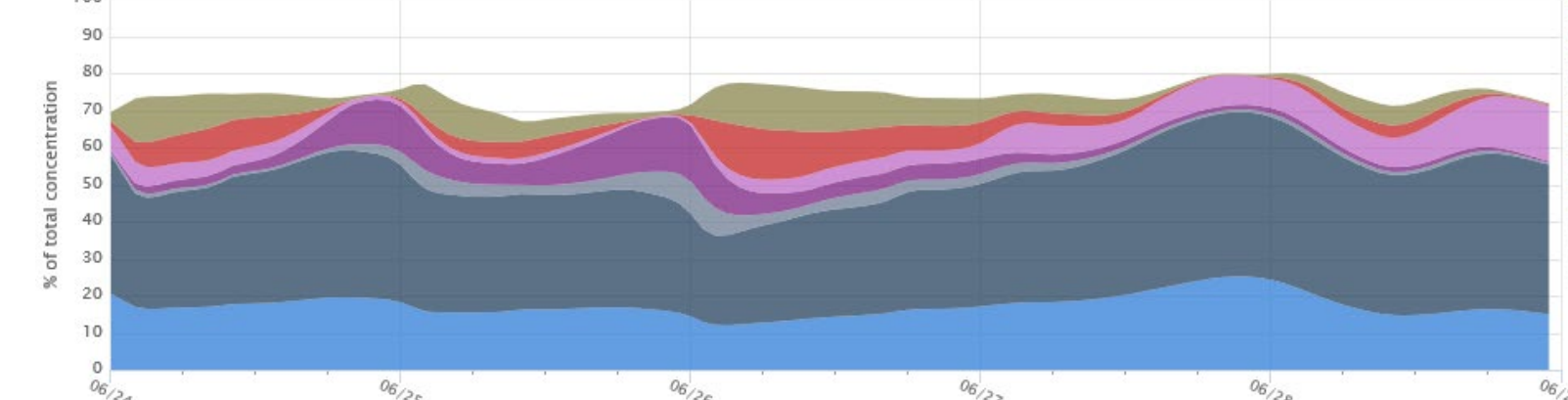
B. Non-stacked area plot showing concentrations contributed from various sources. Also shown is the total concentration in a red dashed line.



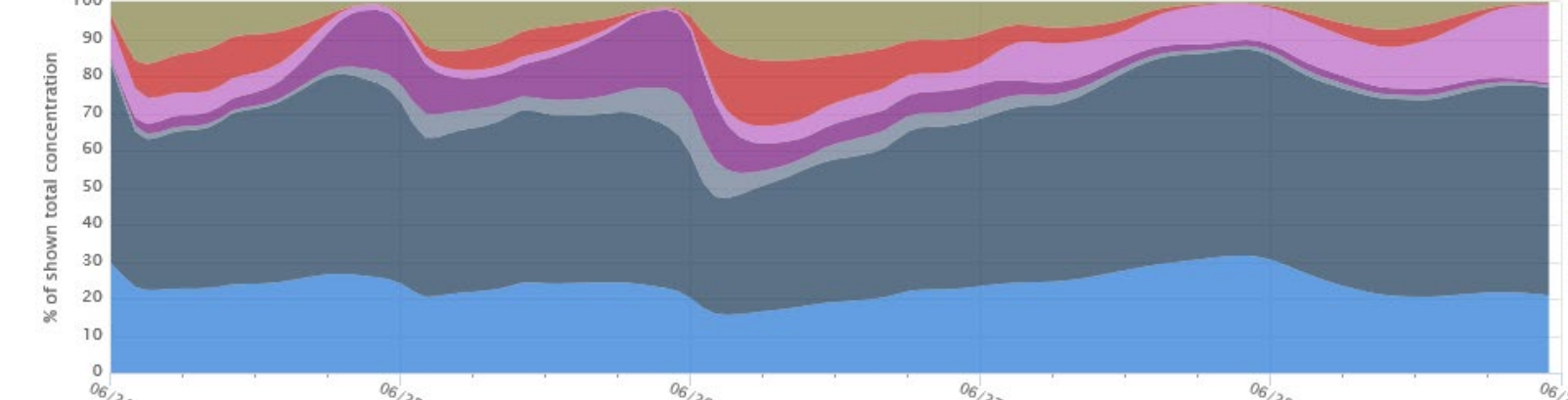
C. Stacked area plot showing fractional contributions to the total concentration from all sources. Also shown is the total concentration in a white dashed line.



D. Stacked area plot showing fractional contributions of selected sources (*e.g.*, anthropogenic emissions) to the total concentration from all sources.



E. Similar to D, but showing fractional contributions to the total concentration from only selected sources (*e.g.*, anthropogenic emissions).



Web Interface and Contributor Group Builder

Data Selections:

- Different model runs
- Hourly or eight-hour average values
- Cell or 3x3-cell average values

Model Run
2016-10-21: camx631APCA_cb6r2h.tx.bl12_12
2016-10-21: camx631APCA_cb6r2h.tx.bl12_12jun.r6a.r4
2016-10-13: camx631APCA_cb6r2h.tx.fy17_12jun.c0m.c0

Temporal Option
hourly average
hourly average
8-hour average

Spatial Option
3x3-cell mean
3x3-cell mean
cell value

Different ways to display data.

Layer Stacking Option
stacked concentrations
stacked concentrations
non-stacked concentrations
stacked % of total sources
stacked % of total displayed sources

Show the **total concentration line** and set line color and style.

Show Total Concentration Line
line color line style
line color line style
line color line style
line color line style

Export the chart to an image file or download chart data to a CSV file.

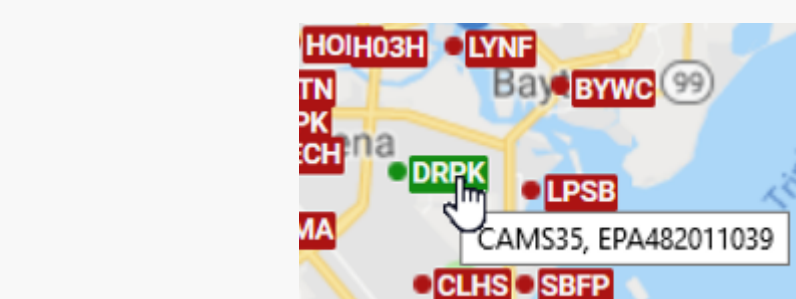
Hide or show a data series via a legend label.

Change date and time range

Select a monitoring site from the site list dropdown menu ...

Site DRPK, 482011039, C35, Houston Deer Park 2 CDeer Park, Harris Co., TX
DNGC, 480390618, C618, Dancig, Brazoria
DRPK, 482011039, C35, Houston Deer Park 2 C35r, Harris Co., TX
FWCB, 482010570, C570, Clear Brook High SchoolX

... or click a site marker on the map.



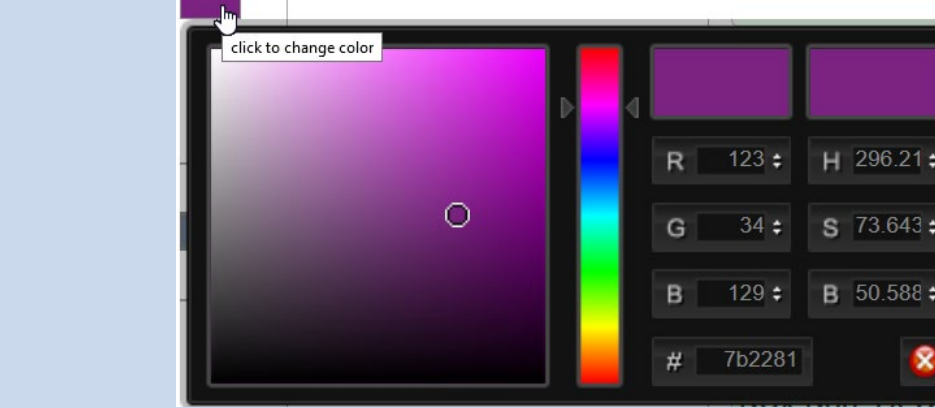
Drag and drop a group definition file here to load predefined groups.

drag and drop a group definition file here

Group Label can be edited on the spot.

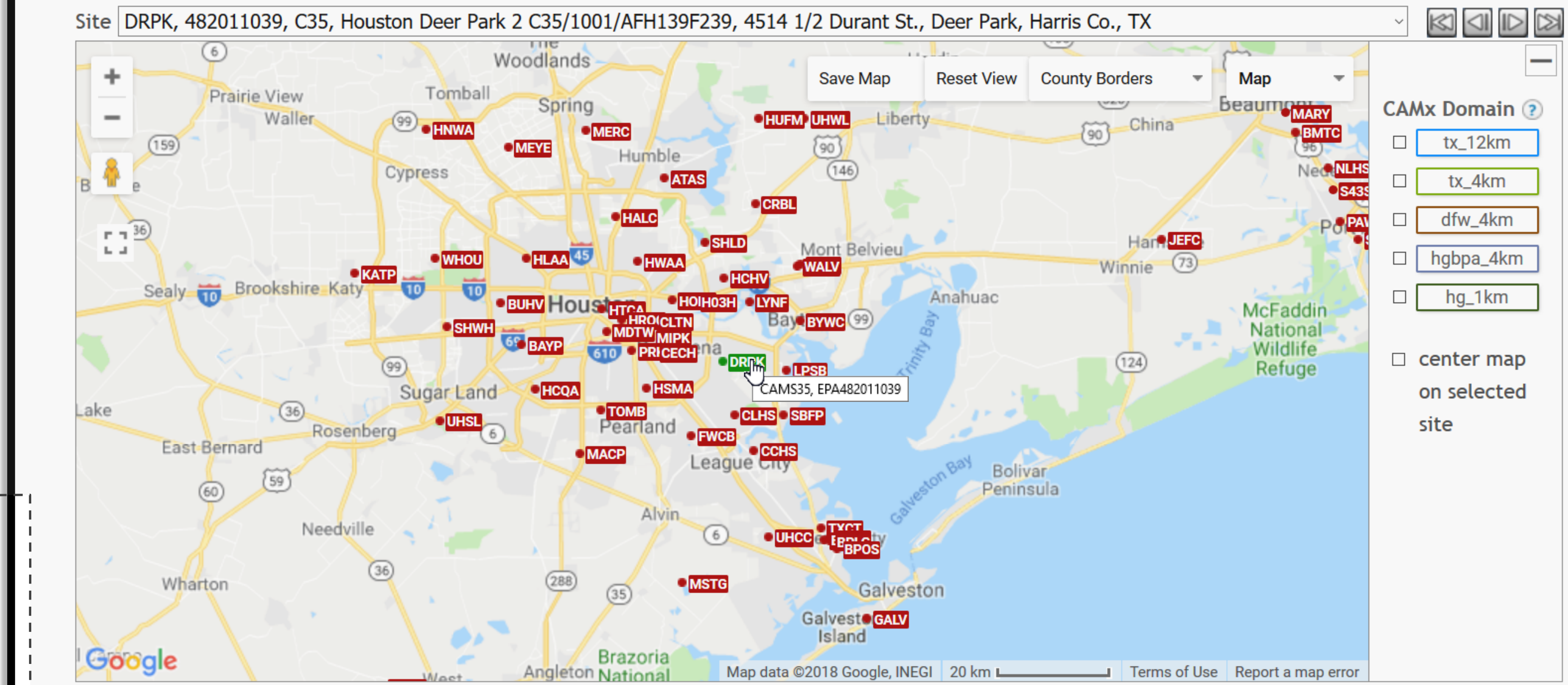
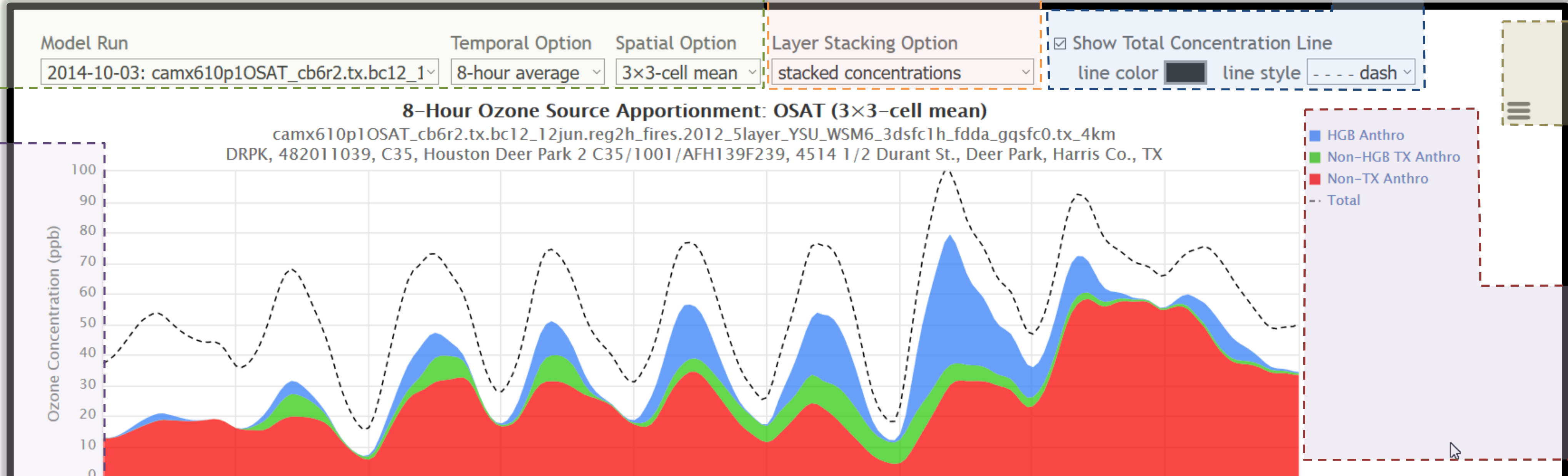
HGB Anthro

Group Color can be changed with a pop-up color editor.



Group Display Order can be changed by dragging and dropping a table row to a different place.

10	HGB Point Sources
9	All Elevated Ships



OSAT/APCA Contributor Group Builder
☐ category code info ☐ group builder instruction

Load predefined groups into the Group Definition Table:

drag and drop a group definition file here sa.group.2012.1a.txt

#	Color	Group Label	Contributor List
3		group name	
3		HGB Anthro	NOx HGB El-Point NOx HGB Lo-Anthro VOC HGB El-Point VOC HGB Lo-Anthro
2		Non-HGB TX Anthro	NOx Non-DFW/HGB TX Lo-Anthro VOC Non-DFW/HGB TX Lo-Anthro NOx Non-DFW/HGB TX El-Point VOC Non-DFW/HGB TX El-Point
1		Non-TX Anthro	NOx Non-TX El-Point VOC Non-TX El-Point VOC Non-TX Lo-Anthro NOx Non-TX Lo-Anthro

Ungrouped Contributors:
NOx IC NOx BC West NOx BC East NOx BC South NOx BC North NOx BC Top NOx DFW Bio NOx Non-DFW/HGB TX Bio NOx Non-TX Bio NOx HGB Bio
VOC IC VOC BC West VOC BC East VOC BC South VOC BC North VOC BC Top VOC DFW Bio VOC Non-DFW/HGB TX Bio VOC Non-TX Bio VOC HGB Bio

Ungrouped Contributors – This block holds individual source contributor items. When the SA data are first loaded, all items are shown in this block.

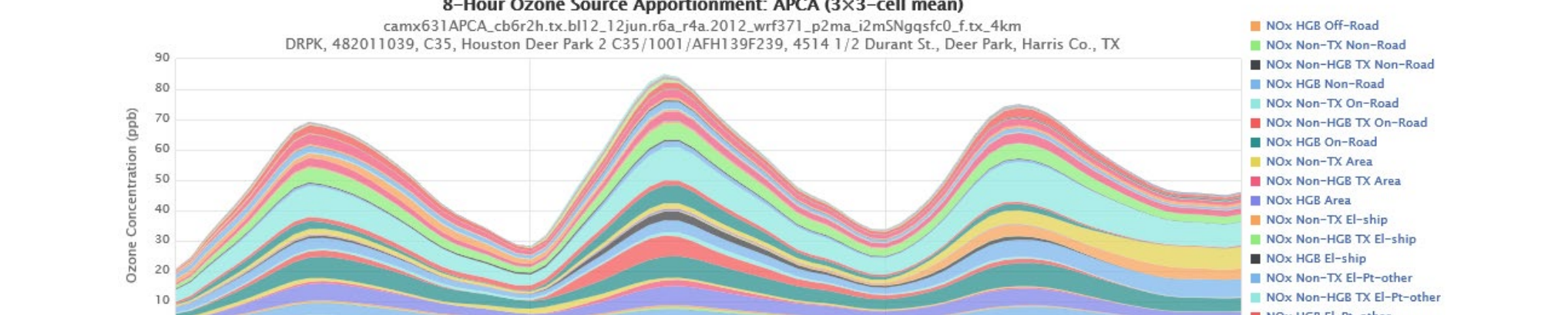
Example Case

As part of a Texas Ozone State Implementation Plan (SIP) modeling project, the TCEQ conducted a CAMx model simulation of the May through September 2012 ozone episode with the source apportionment tool Anthropogenic Precursor Culpability Assessment (APCA). The APCA configuration included:

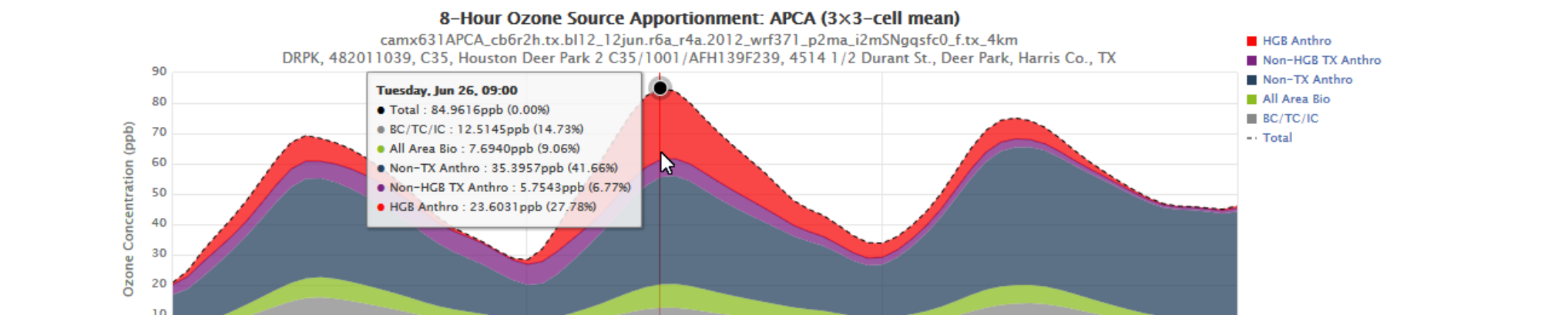
- Three emissions regions:** Houston-Galveston-Brazoria eight-county area (HGB), non-HGB Texas (non-HGB TX), and areas outside Texas (non-TX).
- 14 emissions components:** biogenic, Electric Generating Units (EGU) elevated point sources, non-EGU elevated point sources, low-level point sources, area sources, on-road mobile, non-road mobile, off-road mobile (airports, locomotives, *etc.*), elevated ships, and oil and gas drilling and production in various areas.

Combined with the initial condition (IC), four lateral boundary conditions (BC), top boundary condition (TC), and two ozone-contributing chemical precursors, NOx and VOC, the total number of individual source contributors tracked in the CAMx APCA simulation is (3x14+1+4+1)x2=96.

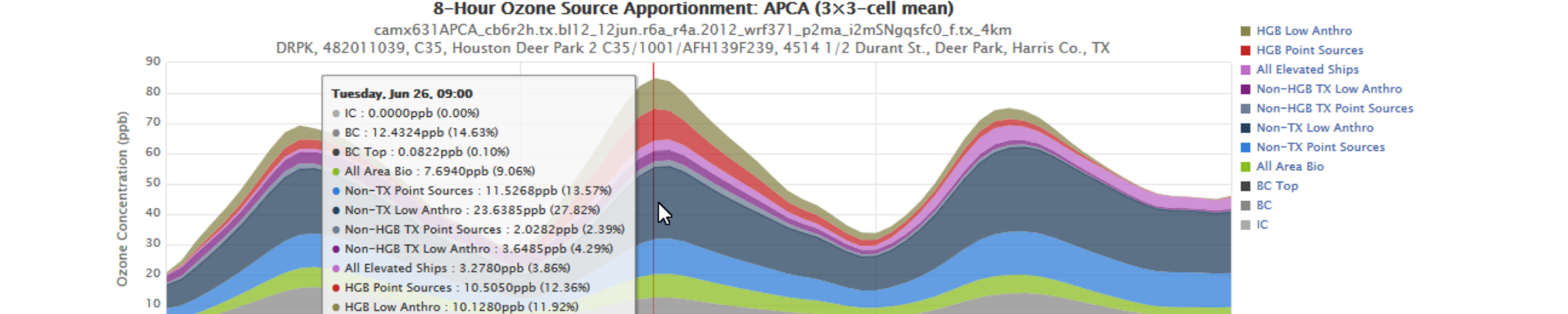
The following charts illustrate ozone contributions from various sources for June 25 through 27, 2012 at the Houston Deer Park ozone monitoring site.



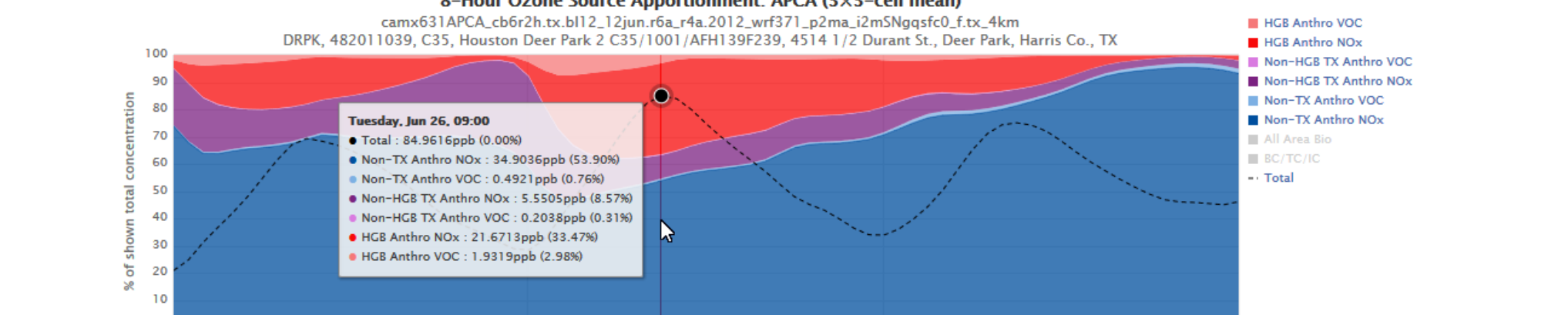
(A) Contributions from all 96 individual source contributors. Only some of the contributor labels are shown in the legend; the rest can be viewed by clicking the arrow below the list. By default the area plot uses 10 random colors, which repeat when the total number of source contributors is greater than 10.



(B) The 96 individual sources are grouped into five categories: BC/TC/IC, biogenic emissions from all areas, and anthropogenic emissions from HGB, non-HGB TX, and outside TX. The pop-up tooltip shows concentrations and percentages attributed to each of these categories at the peak ozone concentration on June 26, 2012.



(C) In this case, the sources are grouped into more refined categories showing more detail.



(D) This chart shows ozone formed from emissions from three source regions under anthropogenic NOx and VOC-limiting conditions. The pop-up tooltip shows the concentrations from each of these categories and their fractions of the total anthropogenic emissions contributions to the peak ozone concentration on June 26, 2012.

Code Sharing

We will share the source code of simplified and client-only version (no web server is needed) of this tool soon on our FTP site: <ftp://amdaftp.tceq.texas.gov/pub/tools/>.

Acknowledgements

The following JavaScript programs are used to develop this tool:

- TableDnD – a jQuery plugin by Denis Howlett
- ColorPicker – a jQuery plugin by Stefan Petre
- Scalable Y-Axis – a Highcharts plugin by Roland Banguiran
- Export-CSV – a Highcharts plugin by Torstein Honsi

Items can also be moved among “Contributor List” cells.