

SOUTHEAST TEXAS PHOTOCHEMICAL MODELING TECHNICAL REVIEW
COMMITTEE

Meeting Summary
February 12, 2008

H-GAC Offices
3555 Timmons Avenue
Houston, Texas

Members and Guests Present:

Steve Kilpatrick, Alex Cuclis, Jay Olaguer, Daewon Byun, Steve Smith, Susan Moore, Wei Zhou, Antara, Bruce Davis, Bernhard Rappenglueck, Barry Lefer, Ken Gathright, Graciela Lubertino, Dan Baker, Karl Pepple, Erik Snyder, Theresa Pella, Susana Hildebrand, Rebecca Rentz, Jim Smith, Mark Estes and Dick Karp, and Liz Hendler, and Tom Tesche via telephone.

SIP Planning and Implementation Update – Theresa Pella (TCEQ)

Theresa indicated that the TCEQ comments on the proposed reclassification of the HGB area are on the TCEQ web site (<http://www.tceq.state.tx.us/implementation/air/sip/Hottop.html>). In particular, Theresa mentioned that the later SIP submission date allows TCEQ to utilize the wealth of information arising from the TexAQS II study. She also mentioned that TCEQ intends to solicit stakeholder input in the SIP development and is currently planning initial stakeholder meetings, possibly in late March 2008. Theresa indicated that formal notification of the stakeholder meeting dates and times would be posted on the TCEQ web site and sent via e-mail to those who are on the e-mail list. She encouraged participants to sign up on the TCEQ web site (E-Gov) by going to:

http://service.govdelivery.com/service/multi_subscribe.html?code=TXTCEQ&origin=http://www.tceq.state.tx.us/e-services/success.html

EPA SIP Related Update – Erik Snyder (EPA)

Erik mentioned the docket number for the HGB proposed reclassification is: EPA-R06-OAR-2007-554. Erik indicated the comment period has closed (January 30, 2008), and final action is scheduled for the June to July timeframe.

The appeals court handling the litigation on the HGB 1-hour SIP heard oral arguments on January 30, 2008. This litigation, in part, involves the HECT and MECT rules in the December 2004 SIP, which EPA approved in August 2006.

Regarding the proposed ozone NAAQS review, Erik indicated that briefings at the highest levels in EPA and OMB, as well as the White House, are taking place. He also indicated that EPA has conducted new modeling using a 2002 base year and 2009 future year to project the areas of the country that would be nonattainment for the different NAAQS levels. When asked about the availability of the modeling, Erik responded that the modeling was still being reviewed internally, but may actually be used in the technical support document for the final action.

EPA is taking a couple of actions to address the litigation on phase 1 of the 8-hour ozone implementation. These actions involve contingency measures, backsliding issues such as NSR, and the 185-fees for failure to attain the 1-hour ozone NAAQS.

Erik also reported that letters for “failure to submit” an 8-hour ozone SIP by June 15, 2007, were signed and ready to be mailed out Friday February 15, 2008. Although there have been some recent submissions (e.g., New York City), there are a number of states that are expected to get letters for “failure to submit,” including some LADCO states (e.g., Indiana), and California for some of its nonattainment areas (e.g., San Joaquin).

H-GAC Update – Graciela Lubertino, PhD (H-GAC)

Dr. Graciela Lubertino gave a presentation on the recently completed portion of a fuel economy study for Harris County. (Note: Graciela’s presentation is available on the SETPMTTC web-site: http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html). The City of Houston requested the study as a part of the Mayor’s plan of reducing fuel usage 5% by 2010. Graciela’s presentation focused on the analysis technique, which used 2007 projected VMT mix data and Mobile6 fuel consumption factors. The study will also include an analysis for the year 2002 using actual VMT mix data and the year 2009, again with projected VMT mix data. Graciela was asked whether the fuel consumption factors used were the recently revised factors from EPA, and responded that she did not think so, since they were using the factors directly from Mobile6. The comment was made that the changes in the factors may not make a notable difference. Graciela also mentioned that based upon trends, the 2009 fuel usage is projected to be ~15% more than 2007. So showing a 5% decrease by 2010 from 2002 may be difficult.

As Graciela explained, the analysis technique involves an application of matrices. Three matrices are used in the analysis: a matrix of the fraction of vehicles of age zero to 24-years for each of the 28 vehicle-type categories (Reg.Dist); a matrix of the fractional VMT of the 28 vehicle-types for each of the 15 roadway-types (VMX) and a matrix of the fuel consumption factors for the 28 vehicle-types in the 25 age categories (MPG). Note that a VMX matrix is developed for each of four time periods throughout the day (6-9 am, 9-3 pm, 3-7 pm and 7-6 am). In addition to these matrices, the hourly VMT of each of the 28 vehicle-types on each of the 15 roadway categories output from the IMPSUM program is needed to get the total fuel consumed.

The results of this analysis indicate that about 4.4 million gallons of gasoline and 1.0 million gallons of diesel fuel are projected to have been consumed daily in Harris County in 2007. Graciela was asked if fuel sales for 2007 were available to check these results. Graciela answered that [apparently] Harris County only compiles the tax revenue generated from fuel sales but not the actual amount of fuel. Another interesting result was the higher fuel economy during the morning and afternoon peak VMT periods. Presumably, this is due to the lower percentage of diesel vehicles (with lower fuel economy) contributing to the VMT during these periods. However, it was noted that the range (17.0 to 18.6 mpg) over the four time periods yields a variance of only about nine percent. Graciela was asked about displaying the fuel economy by fuel type (i.e., gasoline and diesel) separately, as well as the combined. Graciela indicated the data is provided in the appendices and can readily be done. Also of interest was the higher proportion of diesel traffic on collector roads.

HGB SIP Modeling Update– Dick Karp (TCEQ)

Dick presented an update of the modeling for the 2005 episodes. (Note: Dick's presentation is available on the SETPMTC web-site:

http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html). The second interim modeling for the 2005 episodes is underway. As Dick explained, the meteorological updates and enhancements include incorporating the new UT-CSR LU/LC data for improving surface characteristics and hourly sea-surface-temperature (SST) data to include the diurnal fluctuation in SST. The emissions updates and enhancements include an adjustment for ethane, which is not considered a VOC but is used in the CB05 mechanism, and adding episode-specific emissions for wildfires and tank landing losses. Other updates and enhancements include the use of episode-specific boundary conditions extracted from output from the GEOS-CHEM global model runs.

Questions and comments that arose during Dick's presentation included how the hourly SST data is incorporated into the MM5; whether TCEQ planned to run process analysis; whether the meteorological and emissions modeling were evaluated prior to being evaluated via the CAMx base case modeling performance; concern about CB05's alleged lower sensitivity to emission reductions for mid-range 8-hour ozone design values (e.g., ~ 85ppb) as compared to CB-IV; and the relationship between the 2006 STARS and the 2006 Special Inventory (SI) emissions.

Since the University of Houston (U of H) developed the software for incorporating the hourly SST into MM5, Daewon Byun, Ph.D. responded to the first question. In general, Dr. Byun responded that MM5 is configured for SST to be a time-dependent variable, and the hourly SST is derived from NASA-JPL GOES satellite data. Dick indicated that TCEQ does plan to run process analysis and may be run on the second interim CAMx modeling, depending on the performance. With regard to the performance of the meteorological and emissions modeling, Dick responded that there is a considerable amount of evaluation conducted prior to running CAMx, especially for the meteorological modeling, including statistical and graphical evaluations. Dick further indicated that they had just completed a plume plotting routine for graphically comparing trajectories of plumes based upon modeled versus monitored winds. Dick, as well as other TCEQ staff present (e.g., mark Estes) indicated they were unaware of recent studies which showed the lower sensitivity of CB05. However, as Dick pointed out, the 8-hour ozone design values for the HGB area are generally above the mid-range, and the notable amount of emissions from petrochemical sources makes it compelling to use a mechanism that provides more discerning carbon bond species, such as OLE and IOLE. Concerning 2006 STARS and the 2006 SI, Dick explained that the 2006 STARS includes emissions for all FIN/EPN pathways, while the 2006 SI primarily focused on those pathways with continuous emissions monitoring equipment (CEMs).

Reconciling Reported VOC Emissions with Ambient Measurements, Continued –Jim Smith, Ph.D., (TCEQ)

At the previous SETPMTC meeting (December 12, 2007), Jim gave a presentation on the procedure TCEQ is investigating with regard to reconciling the reported emission of the HRVOC species with ambient measurements from the Automatic Gas Chromatographs (auto-GC's). This presentation provided additional analysis results and initial CAMx modeling with reconciled

emissions. (Note: Jim's presentation is available on the SETPMTC web-site: http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html).

Jim briefly recapped the December 2007 presentation describing how ISC modeled concentrations, based upon reported emissions, and ambient monitored concentrations were used in the Potential Source Contribution Factor (PSCF) analysis to compute an Emission Reconciliation Factor (ERF) for point sources. Subsequently, ERFs have been computed for all anthropogenic sources. In addition, Jim presented a statistical evaluation of the improvement due to the emission reconciliation and the results of preliminary CAMx modeling using reconciled emissions.

As Jim explained, to test the efficacy of the ISC/PSCF emission reconciliation, an analysis was conducted to evaluate the difference between just uniformly reconciling the emissions using a scaling factor equal to the ratio:

$$\left\{ \frac{\text{Mean (over sites) Median Measured Concentrations}}{\text{Mean (over sites) Median ISC-Modeled Concentrations}} \right\}$$

and using the ISC/PSCF ERFs to reconcile the emissions. Since the ISC modeled concentrations are linearly related to the emissions, uniformly reconciling the emissions was simply accomplished by multiplying the unreconciled ISC modeled concentrations by the scaling factor. For the ISC/PSCF emission reconciliation, the ISC was rerun using the reconciled emissions, as per the ERFs. Both the uniformly scaled and the ISC/PSCF emission reconciliation concentrations were compared with the unreconciled ISC modeled concentrations and the ambient measured concentrations. Differences varied by monitoring site and HRVOC specie. However, the mean relative error (over sites) was less for the ISC/PSCF emission reconciliation than the uniformly scaled reconciliation for all HRVOC species, indicating the ISC/PSCF emission reconciliation does a better job of reconciling the emissions. As an additional evaluation of the ISC/PSCF emission reconciliation, a revised set of ERFs was computed using the reconciled ISC modeled concentrations and the ambient measured concentrations. If the ISC/PSCF emission reconciliation is a suitable approach, the revised set of ERFs should be close to or trend toward unity (i.e., ERF ~ 1.0), which is what Jim showed.

Jim showed some preliminary CAMx modeling results using the ISC/PSCF emission reconciliation. Based upon the ERFs, a ground level source (i.e., source X) was established for each pertinent 2km X 2km grid cell. (note: based upon criteria set forth previously, an ERF is not computed for all 2km X 2km grid cells.) As might be expected, the inclusion of the reconciled emissions increased the amount of ozone modeled in each of the episodes, although, typically, the increased ozone did not coincide with the location of the daily maximum ozone. As Jim showed, the relative bias was slightly improved for episode0 (May/June 2005) and episode1 (June 2005), but was mixed for episode2 (July/Aug 2005).

In addition, Jim showed time series, scatter plots and Q-Q plots of hourly modeled and monitored CB05 species of ETH and OLE (primarily propene) at selected monitoring sites. Again the results were mixed. At some sites for one or the other, ethene or olefins, the reconciled emissions were an improvement, especially at the higher concentrations but for others

it was not. However, as Dick explained, the ISC/PSCF emission reconciliation is not episode-specific, because it is based upon modeled versus monitored concentrations throughout 2005.

Jim indicated he plans to conduct a second iteration of the ISC/PSCF analysis, starting with the reconciled emissions, consider a seasonal and/or diurnal aspect for the ERFs, and investigate including reactivity via the decay feature in ISC. In addition, Jim indicated that once the 2006 STARS emissions are processed, he plans to apply the ISC/PSCF analysis to the 2006 data. Further, Jim will be documenting the methodology and exploring the possibility of publishing this work in a journal.

Questions and comments that arose during Jim's presentation included how the ISC model handles vertical mixing and whether ISC is mass conserving, and would the reconciled emissions be included in the current baseline and future baseline emissions. It was also commented that high monitored concentrations included in the ISC/PSCF analysis that are due to upsets (reported in the upset database) should be excluded.

Jim responded that for the ISC modeling mixing height, data was obtained from NOAA-ARL and a comparison with the PBLs estimated from the 2005 La Port radar profiler data showed fairly good agreement. In addition, the ISC model does conserve mass. With regard to including the reconciled emissions in the current and future year baseline emissions, Jim indicated that was the plan, although at present, none of the reconciled emissions have been assigned to existing FIN/EPN pathways. Jim indicated that the CCEDS database has been examined for each of the 2005 episodes, so it may be possible to cross check the CCEDS with the ISC/PSCF data set. However, since the ISC/PSCF analysis uses the ratio of median values, excluding a few high monitored concentrations may not change the median values all that much.

TexAQS II Findings from December 2007 American Geophysical Union Meeting – Mark Estes, TCEQ

Mark presented some of the pertinent finding from papers and presentations made at the recent American Geophysical Union meeting. (Note: Mark's presentation is available on the SETPMTC web-site:

http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html).

One of the pertinent issues for the HGB area is whether there are more primary emissions of formaldehyde (HCHO) than reported in the inventory. And if there are more primary emissions of HCHO what are the sources. Mark presented some graphical results from the work of Gillman et al., which investigated various groups of VOC species (e.g., alkanes, alkenes, oxygenates) and the hydroxide [OH] radical reactivity. This study indicates that most of the oxygenated VOCs (e.g., HCHO) are secondary products, i.e., reaction products, occurring during the daylight hours, and that the nighttime concentrations are relatively small, constituting a background of likely primary emissions.

Mark also presented some graphical results from the work of Rappenglueck et al. (University of Houston), which shows the diurnal profile of HCHO concentrations at the Moody Tower (MT) for different wind directions and also at the Lynchburg Ferry (LYNF) and HRM3 monitoring sites. These results seem to suggest that primary HCHO emissions are higher in the Houston

Ship Channel (HSC) and that secondary HCHO production in the HSC may be quite rapid during the daytime, with peak values occurring before 12 noon CST.

Next, Mark presented several sets of scatter plots of HCHO versus CO taken from the work of Rappenglueck et al., at the MT site, and De Gouw et al. from the Ron H. Brown (RHB) research vessel at the HSC turning basin on August 2, 2006, and from the WP-3D research aircraft at Montgomery Airport north of the Houston urban area during a nighttime missed approach. The HCHO and CO data in the scatter plots was identified as daytime and nighttime. Since both CO and primary HCHO could be expected to arise from incomplete combustion and therefore be emitted from the same sources, a notable correlation would be expected between CO and primary HCHO, especially at night. These results seem to suggest that nighttime correlations are typically better than daytime, although even nighttime correlations in the HSC are poor.

Next Mark presented some graphical results from the work of Alvarez et al., using data collected by the Baylor aircraft on August 31, 2006, which was a very high ozone day in Houston (8-hour ozone daily maximum = 127 ppb). During the morning portion of the flight (8-10 am CDT), the aircraft flew from east to west just south of the HSC, turning north at the western end of the HSC. Because HCHO concentrations were not expected to be much greater than 10 ppbv, the HCHO monitor on the Baylor aircraft “pegged” at approximately 12ppbv. Therefore the magnitude of the HCHO concentration in the various plumes encountered during the morning flight is not known. Mark showed time-series plots of 5-second CO, O₃, NO, NO₂, NO_Y, SO₂, HCHO and RAD (rapid alkene detector) data collected as the aircraft flew through various plumes. Mark also presented scatter plots of O₃ versus NO_Z for the morning portion of the flight along the HSC and for the afternoon portion of the flight downwind of the HSC and the Houston urban area. These results seem to indicate that in a few of the plumes, HCHO may be correlated with emissions of other primary constituents (e.g., NO, CO, SO₂) suggesting that there are additional primary emissions of HCHO or that the reactivity is high enough to be rapidly producing secondary HCHO. The high correlation of O₃ and NO_Z for the downwind afternoon portion of the flight is typical for an aged air parcel. The lack of any correlation for the morning portion of the flight along the HSC may be indicative of the high degree of reactivity going on in the HSC in the morning.

Another pertinent issue for the HGB area is the relationship between the planetary boundary layer (PBL) depth and peak ozone. Mark presented some graphical results from the work of Hardesty et al., and Banta et al., using ozone and LIDAR data collected by the NOAA Twin Otter research aircraft, and ozone and wind data collected from a variety of platforms (e.g., surface network, DIAL), respectively. These results seemed to indicate that peak ozone concentrations are correlated more with wind speed than the PBL. However, as Mark pointed out, the analyses did not address the role of nocturnal or morning PBL dynamics within the Houston urban area.

Next Mark presented some graphical results from the work of Washenfelder et al., and Peischl et al., using the 2004 TCEQ point source emissions inventory and data collected from various platforms (e.g., RHB vessel, WP-3D aircraft) during the 2000 TexAQS and 2006 TexAQS II field studies. These results seem to indicate a notable reduction has occurred in NO_x emissions from point sources in the eastern portion of the HSC. However, since the western portion of the

HSC is probably impacted by notable emissions from non-point sources (e.g., mobile sources), this analysis was not able to discern a reduction in point source emissions.

Finally, Mark presented results from the work of Williams et al., using the 1999 NEI with updated 2004 CEMS data and ship activity data (ERG, 2004), which compares marine vessel (i.e., large ocean-going) and point source emissions. These results indicate the much larger emission factors for ships versus power plants (e.g., NO₂ approximately 100 times greater for ships) and the notable estimate of ship emissions (approximately 25 tpd) in the HSC.

Adjourn

The meeting adjourned with a brief discussion of the scheduling of subsequent meetings. Dick indicated he thought the next meeting was scheduled for Wednesday, April 16, 2008. However, subsequent to this meeting, Dick checked the scheduling and noted that the next meeting is actually scheduled for Wednesday, April 23, 2008, because Wednesday, April 16, 2008 is a TCEQ Commissioner Agenda Meeting.