

Near-Term Modeling Support for the 2010 HGB 8-hr Ozone SIP

prepared for
Houston 8-hr Coalition

prepared by

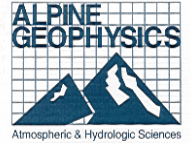
Jim G. Wilkinson
T. W. Tesche

Alpine Geophysics, LLC
Eugene, OR

11 Jun '08

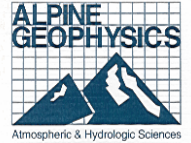


Overview



- **The purpose of this presentation is to outline ongoing modeling and analysis work funded by the Houston 8-hr Ozone Coalition to achieve three goals:**
 - **Make direct contributions to the overall modeling science foundation available to the TCEQ for developing the 2010 8-hr Ozone SIP;**
 - **Produce parallel data sets that may be helpful in other on-going science investigations in the region (e.g., H97);**
 - **Produce data sets that may be of interest to other modeling and analysis groups seeking greater participation in the 2010 HGB ozone SIP development process (e.g., EPA/OAQPS/ORD)**

Presentation-Part I

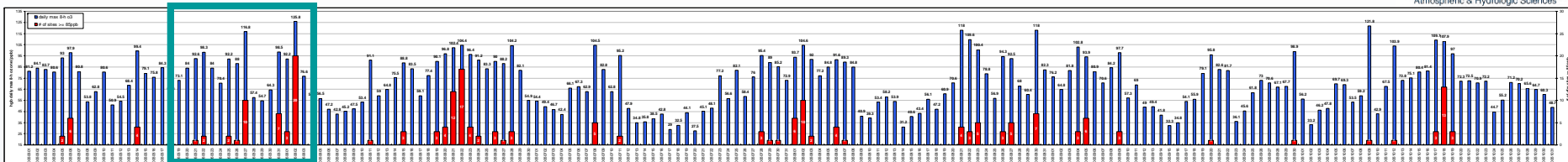
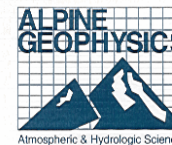


- **Overview of the 8-hr Ozone Coalition ‘Near Term’ Modeling Program**
- **Meteorological Modeling of 2006 Episodes**
- **Emissions Modeling of the 2005 & 2006 Episodes**
- **Schedule**
- **Public Access to ‘Near Term’ Data Bases and Results**

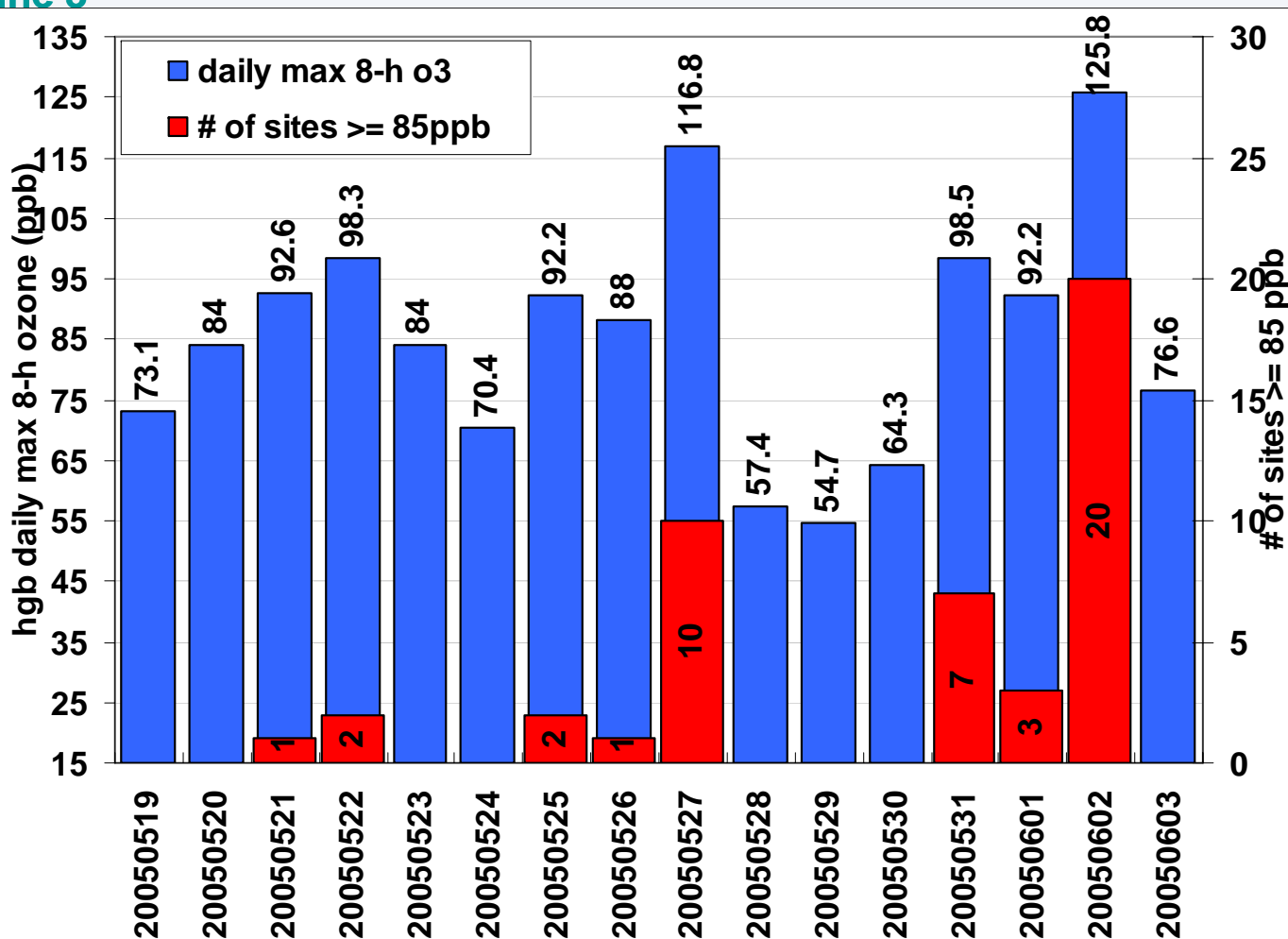
Elements of the 'Near Term' Program

- **Goal:** Provide a tested suite of models enabling an early examination precursor control options likely needed to attain the former (0.080 ppm) and new (0.075 ppm) 8-hr ozone standards by 2018.
- **Episodes:**
 - TCEQ: Ep0, Ep1, and Ep2 for '05; '06 episodes as available
 - AG: 25 May-18 June 2006, 3 Aug-16 Oct 2006 -- **main emphasis**
TCEQ 2005 episodes; TCEQ 2006 episodes as available
- **Models:**
 - Meteorology: MM5 (3.7), MCIP (3.3)
 - Emissions: SMOKE (2.4), MOBILE6.2, GLOBEIS (3.2), MEGAN (2.04)
 - Air Quality: CAMx (4.5); CMAQ (4.6)
 - Attainment Software: MATS (1.5.1), VERDI (1.03)
- **Domains:**
 - MM5: 108/36/12/4/1.33 km
 - Air Quality: 36/12/4/1.33 km

Ep0: 19 May-3 Jun '05

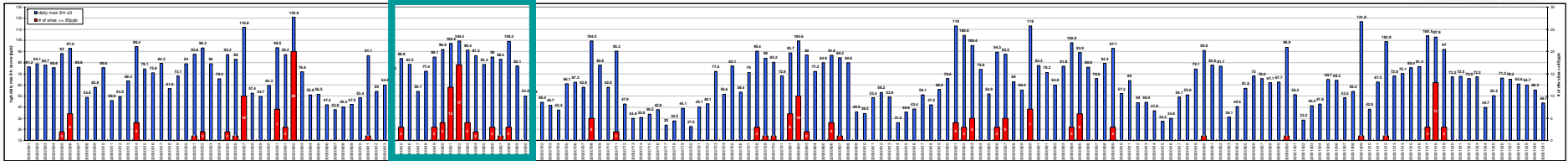


May 19-
June 3

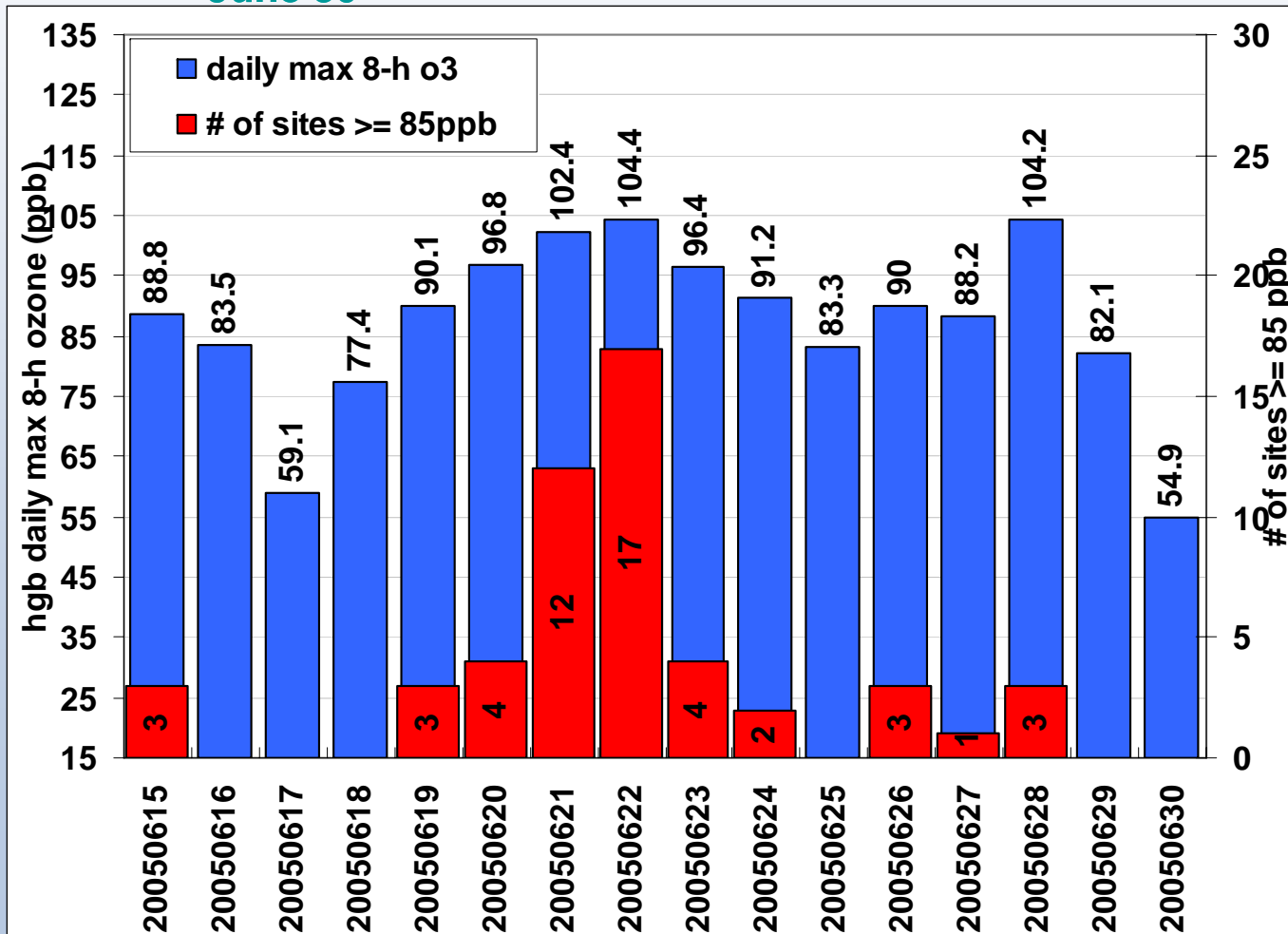


Smith, J. (2006).
Modeling Update
(page 6).
Presentation to
the SETPMTC.
Prepared by
TCEQ Air
Quality Division.
08-Nov.

Ep1: 15-30 Jun '05

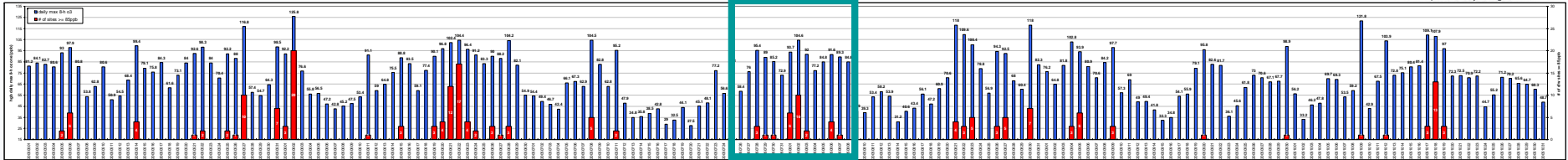
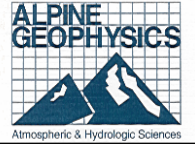


June 15-
June 30

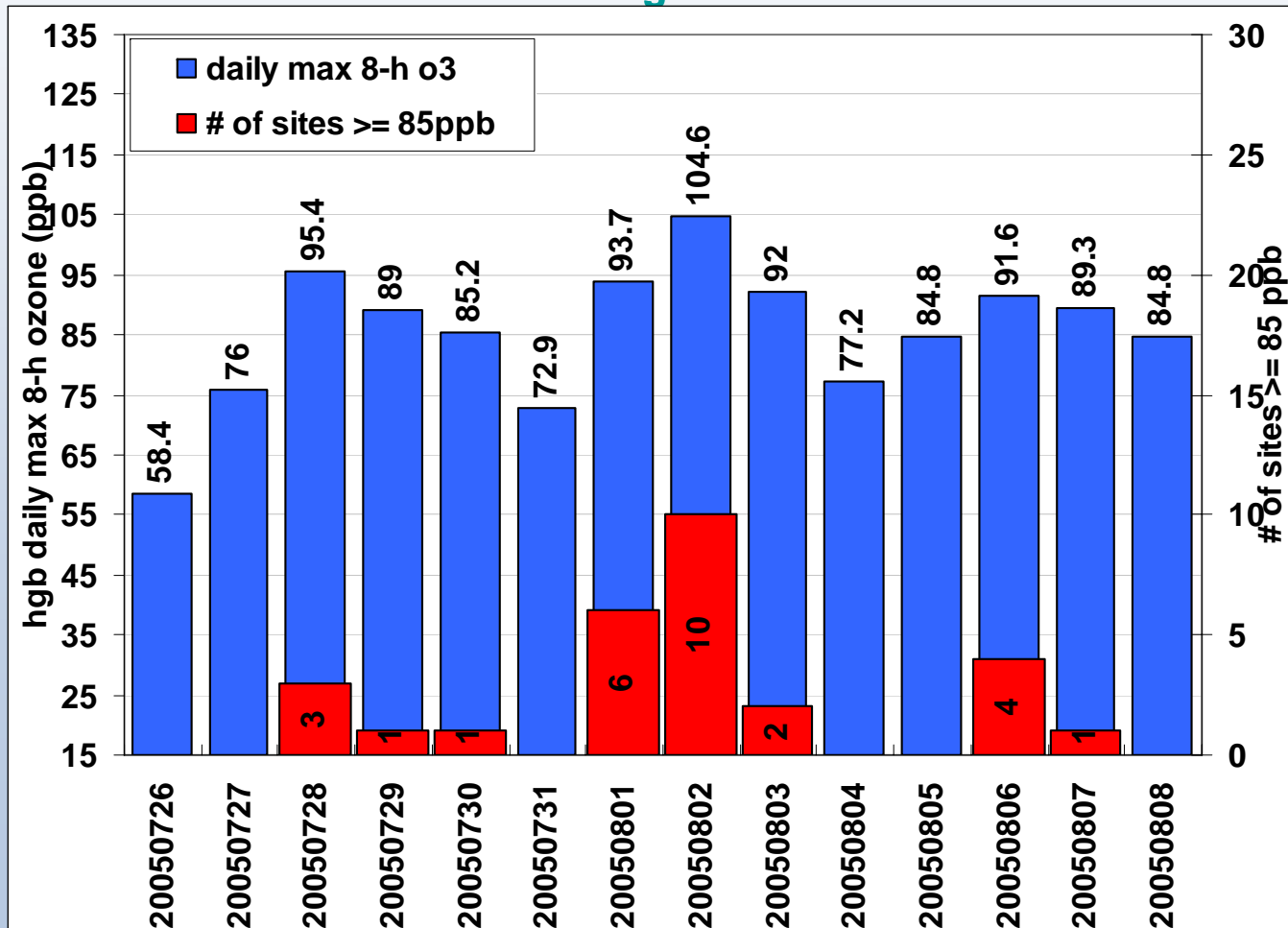


Smith, J. (2006).
Modeling Update
(page 8).
Presentation to
the SETPMTC.
Prepared by
TCEQ Air
Quality Division.
08-Nov.

Ep2: 26 Jul-8 Aug '05

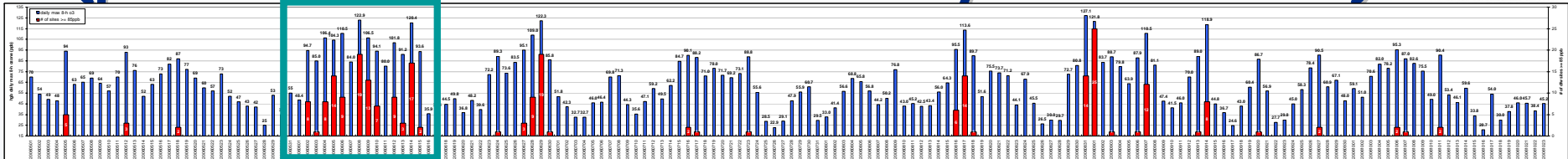
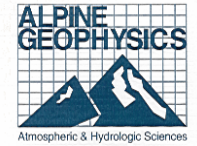


July 26-
Aug. 8

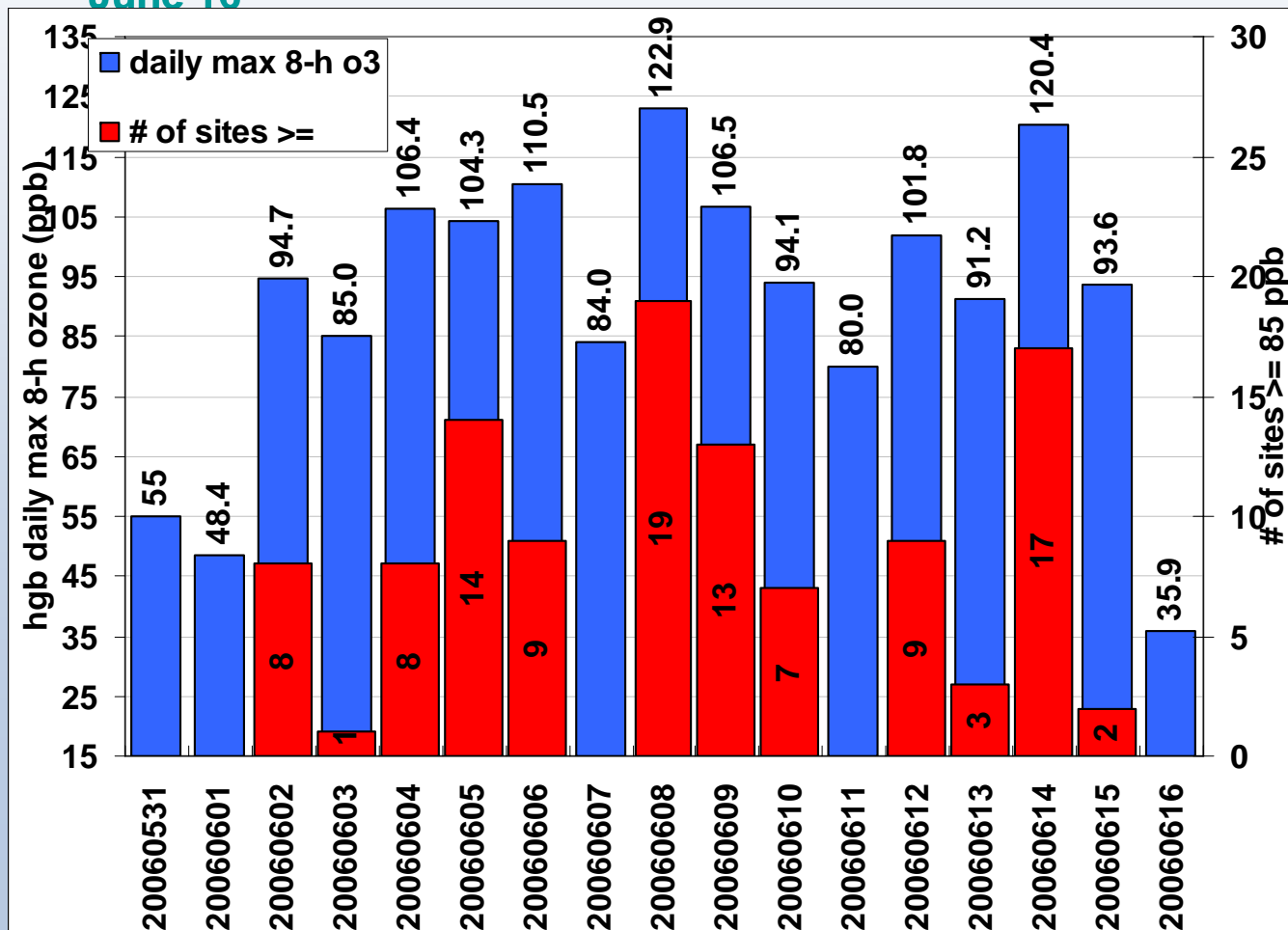


Smith, J. (2006).
Modeling Update
(page 10).
Presentation to
the SETPMTC.
Prepared by
TCEQ Air
Quality Division.
08-Nov.

31 May-16 June 2006 Episode (possibly extend from 25 May to 18 June)

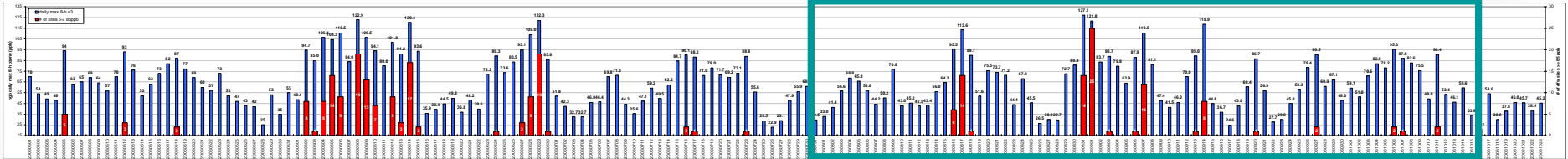
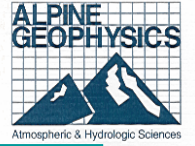


May 31-
June 16

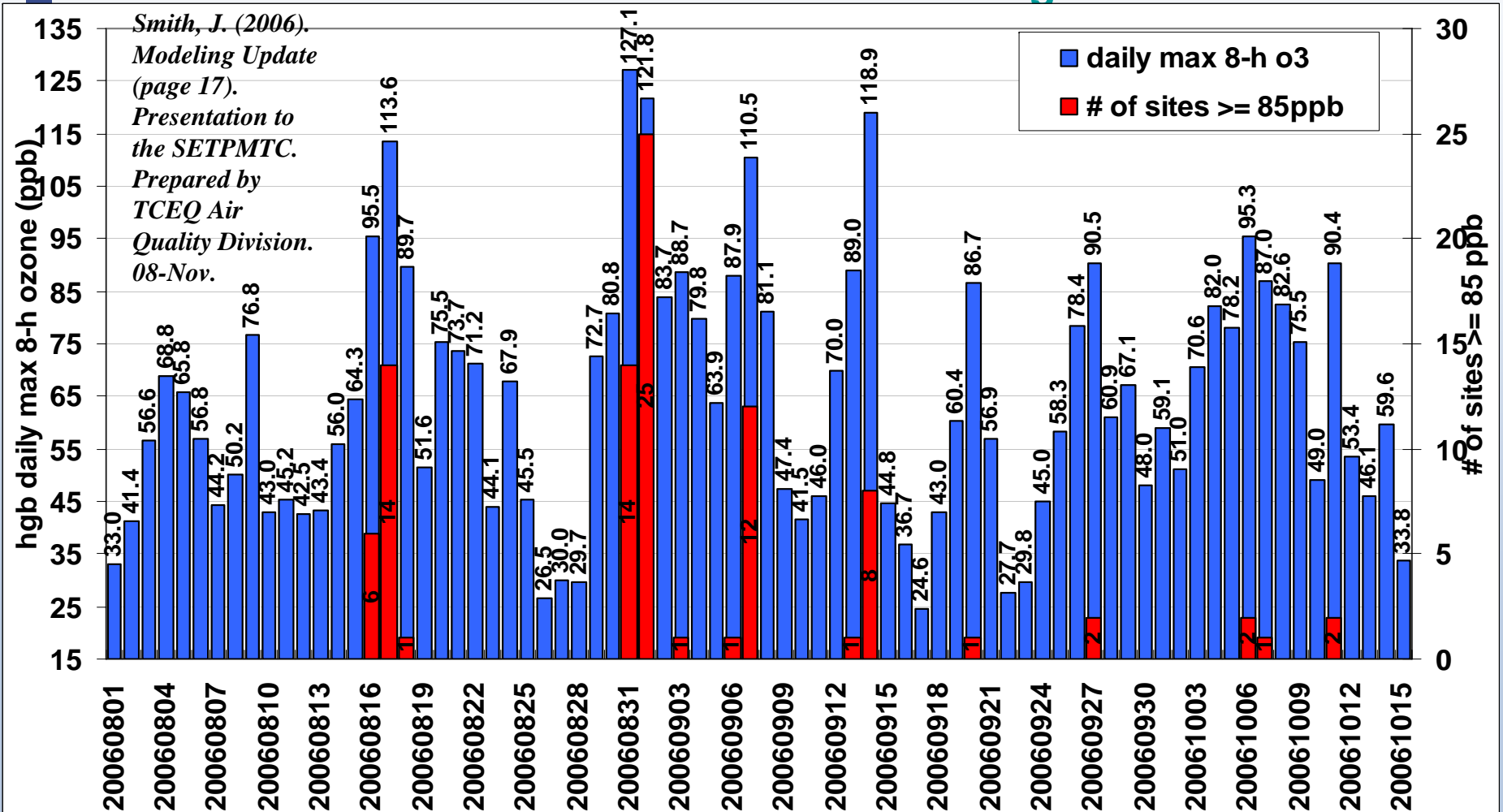


Smith, J. (2006).
Modeling Update
(page 15).
Presentation to
the SETPMTTC.
Prepared by
TCEQ Air
Quality Division.
08-Nov.

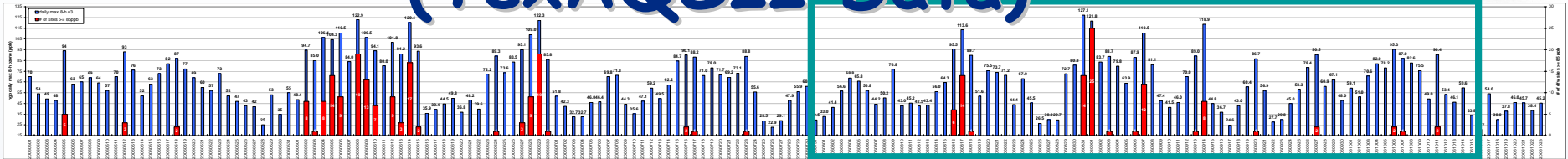
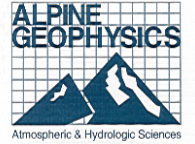
1 Aug-16 Oct 2006 Episode



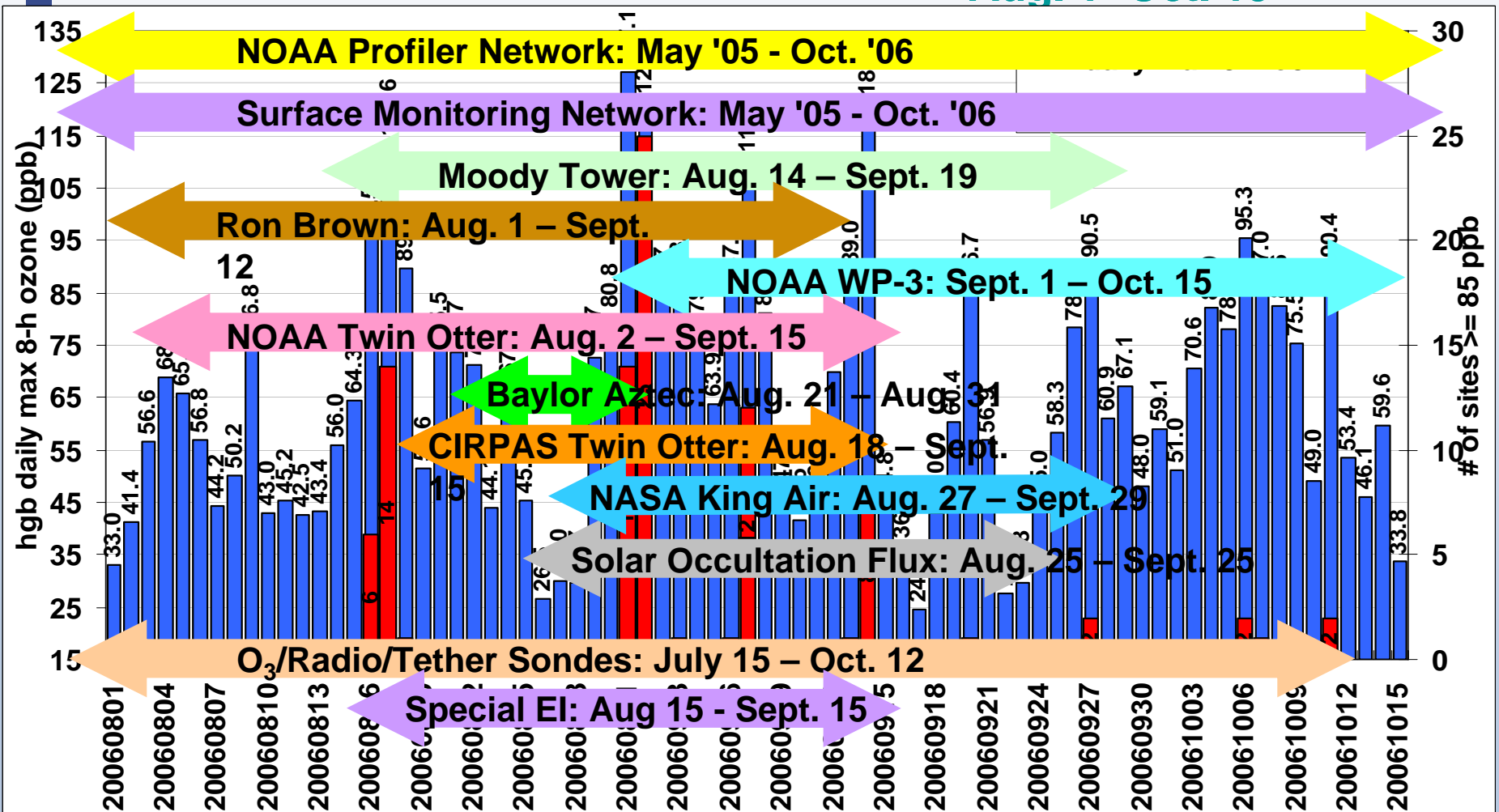
Aug. 1- Oct. 15



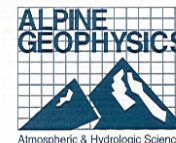
1 Aug-16 Oct 2006 Episode (TexAQSI Data)



Aug. 1- Oct. 15

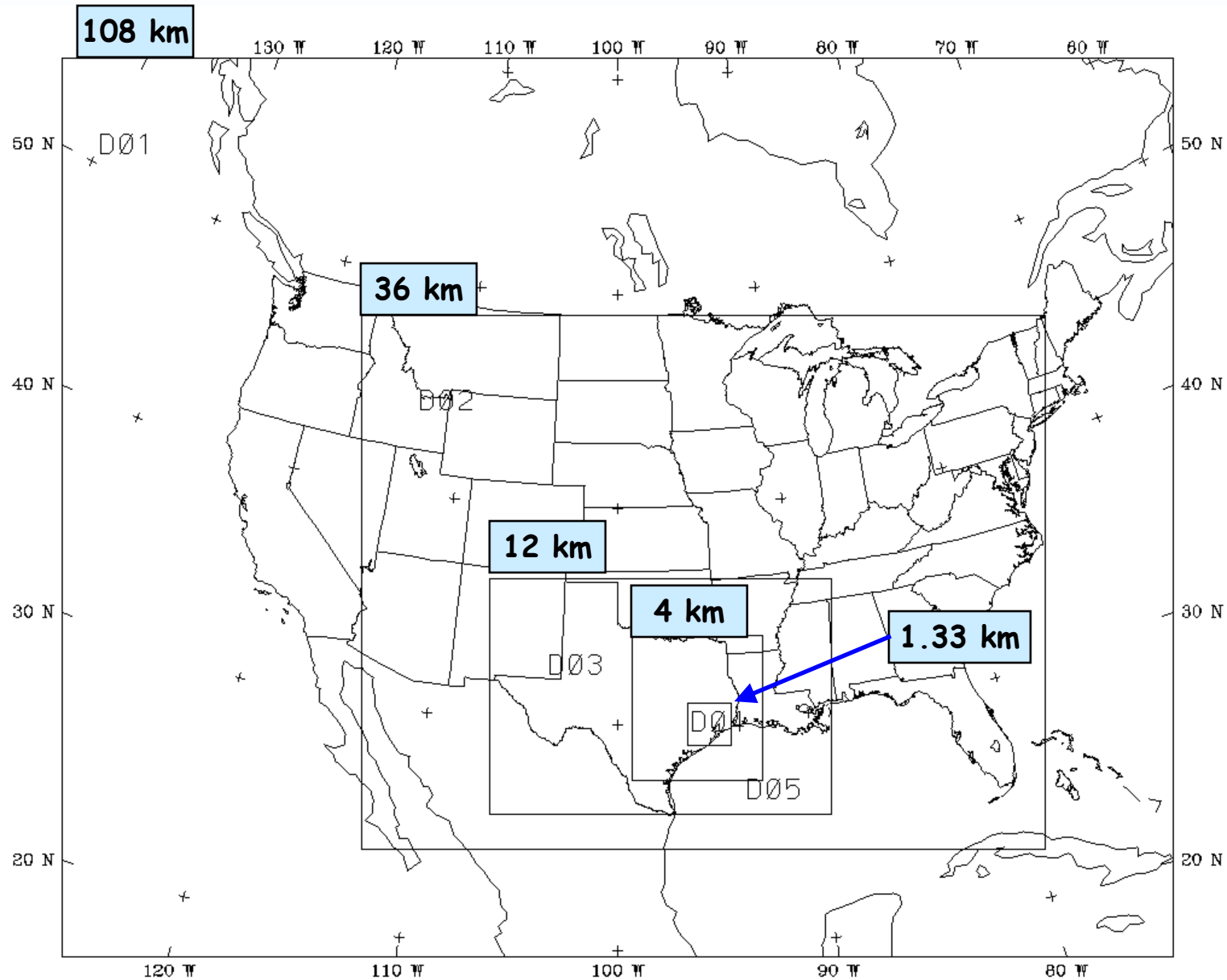


Meteorological Modeling

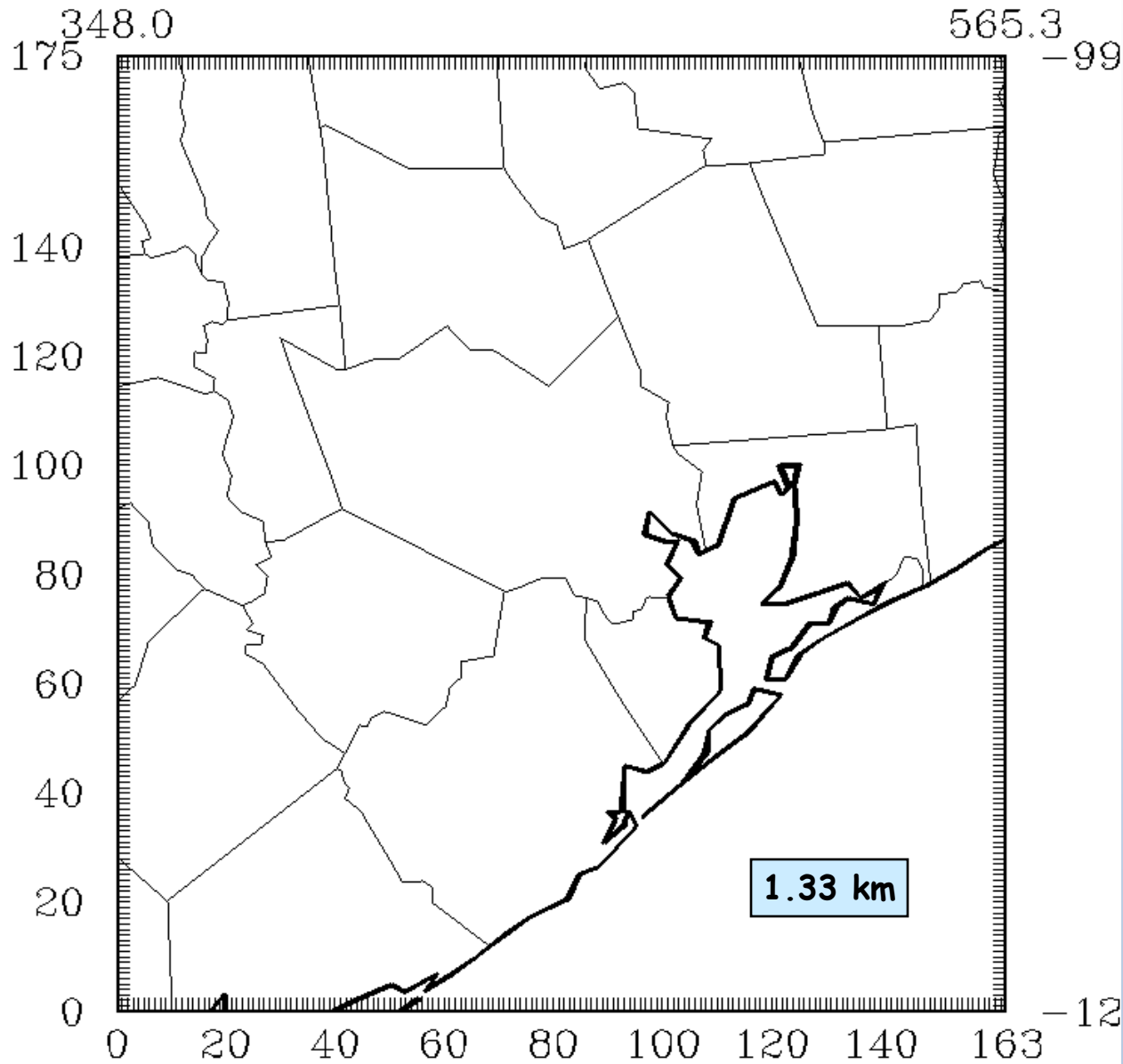


- Latest versions of MM5 (3.7), MM52CAMx (21feb08), and MCIP 3.3 software
- MM5 run on 108/36/12/4/1.33km grids
- Western boundary of 36 km grid moved from west-central Texas to western Idaho
- Vertical layer structure and model physics options same as TCEQ '05 MM5 modeling
- Two FDDA nudging schemes:
 - Standard NWS/NCEP nudging,
 - Enhanced nudging with supplemental FDDA files provided by TAMU.
- MM5 runs of both '06 episodes initiated in early March '08
- MM5 runs completed. Post-processing, performance evaluation, and formatting for SMOKE, CAMx and CMAQ underway.

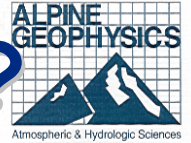
MM5 Meteorological Modeling Domain



MM5 Modeling: 1.33 km Domain

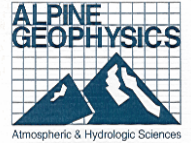


Why 1.33 km instead of 1 km or 2 km?



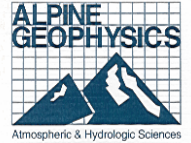
- **Grid nesting in MM5 and CAMx allows two-way interactive grids provided the grid nest scale is a 3:1 ratio.**
- **Use of 1.33 km nesting allows *both* the meteorological and CAMx air quality model to use two-way nesting at each integration time step.**
- **CMAQ allows only 1-way nesting**
- **Use of 1 km or 2 km inner nests allow 1-way nesting only for MM5, CAMx and CMAQ**
- **Given the length of Gulf coastline and perimeter of near shore embayments (e.g., Galveston Bay), there are technical concerns about the adequacy of ‘flexi-nesting’ (i.e., straight interpolation down from the 4 km grid) to represent local the land-gulf winds and thermodynamic structures.**

Emissions Modeling



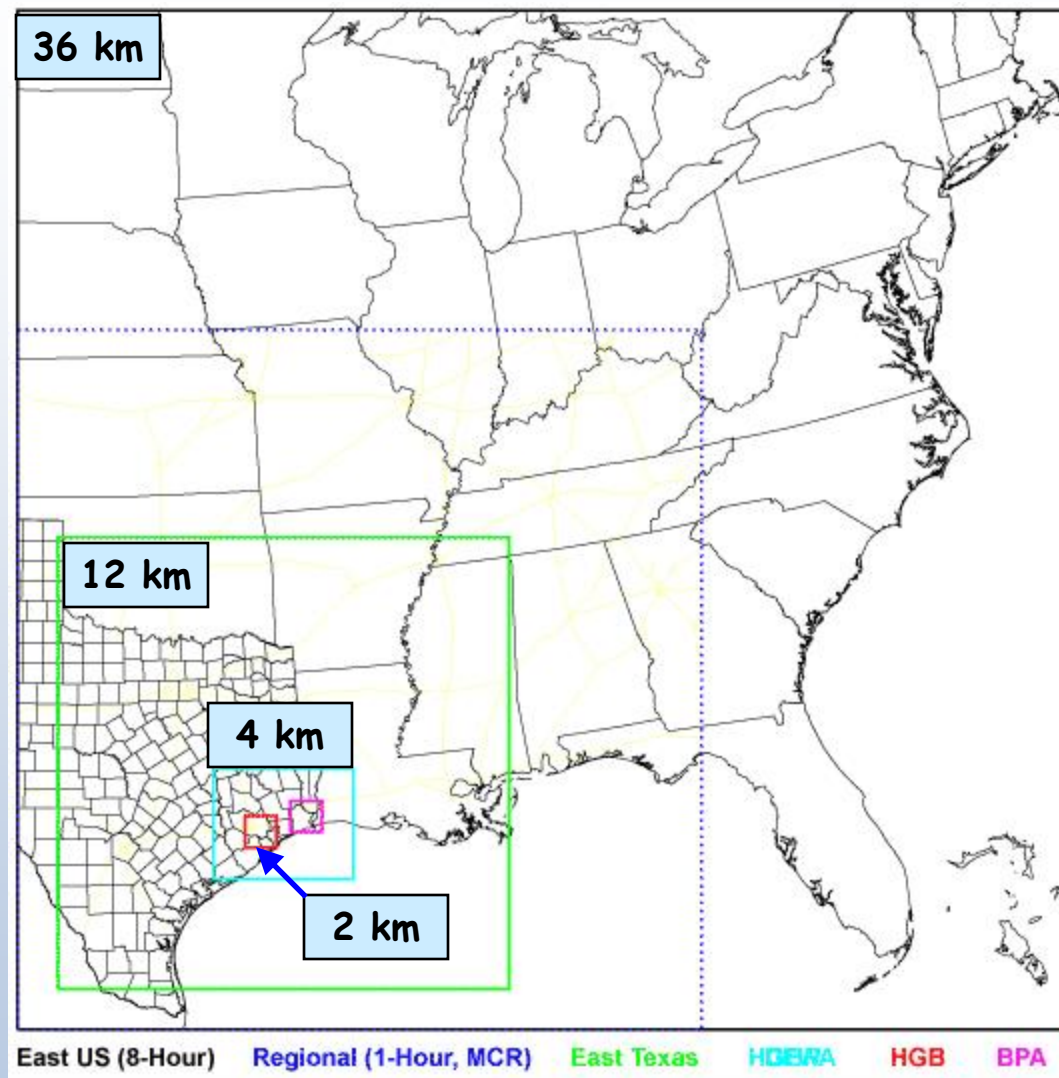
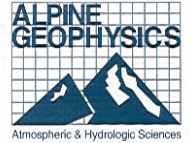
- **Task begun in early Jan '06**
- **Goal: set up latest version of EPA SMOKE emissions system utilizing, wherever possible, emissions input files available from TCEQ 2005 and 2006 modeling**
- **Include the 2006 TexAQS II Special Inventory study data for the two '06 episodes.**
- **Create independent SMOKE emissions modeling framework to support base year and future year (e.g., 2018) modeling as well as future emissions sensitivity and targeted VOC and/or NOx control runs**
- **Wherever possible, corroborate SMOKE baseline ('05, '06) emissions and those produced by TCEQ's EPS processors.**
- **SMOKE inventories completed for the three 2005 episodes and both 2006 episodes (except MM5-dependent biogenics and motor vehicles – to be generated very shortly).**

Photochemical Modeling

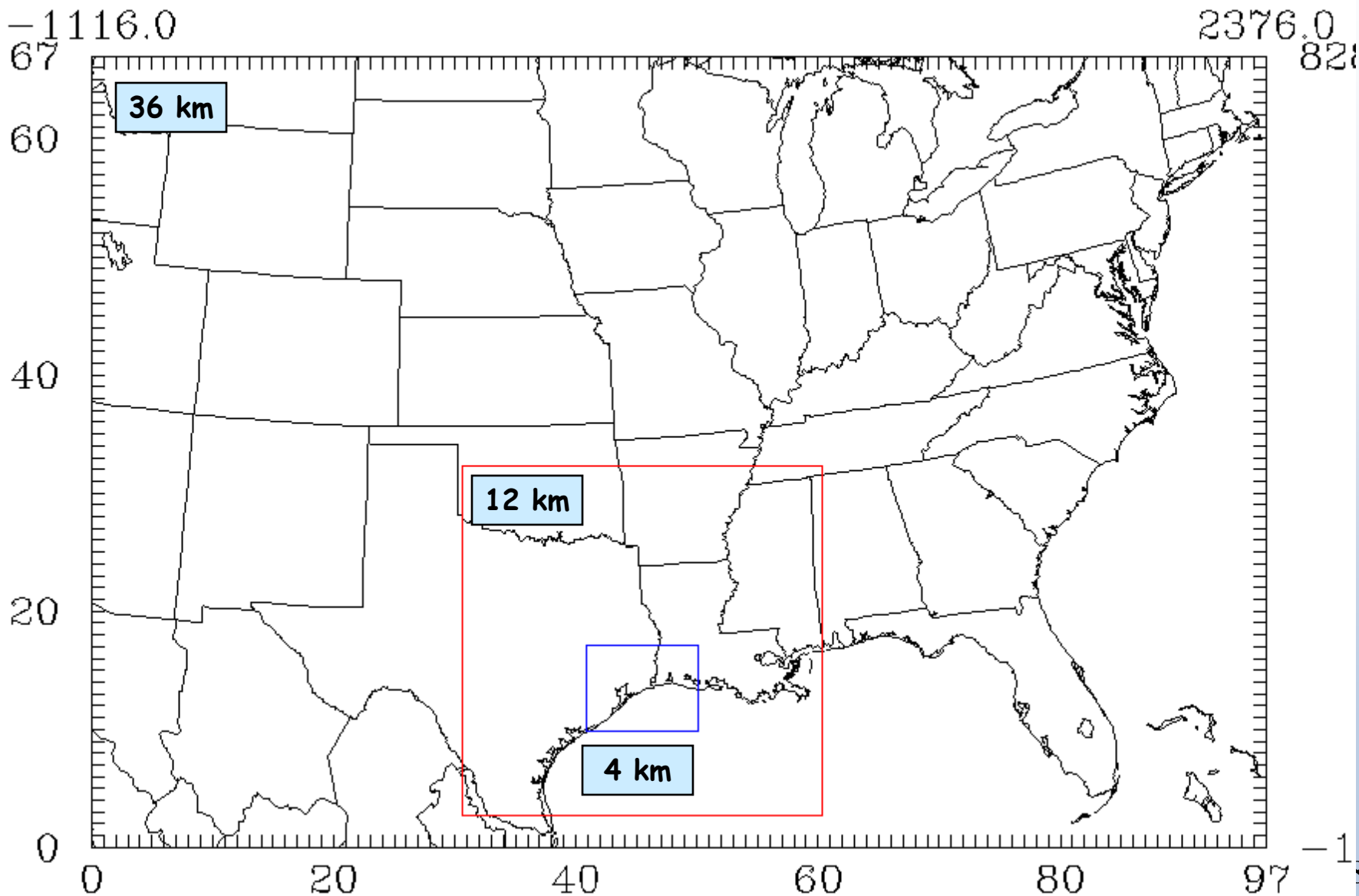
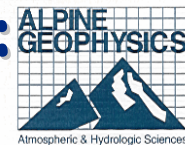


- **Two State-of-Science One Atmosphere models are being applied: CAMx (4.5) and CMAQ (4.6)**
- **Air quality models exercised on nested 36/12/4/1.33 km grid domains, consistent with outer MM5 nests**
- **Aim is to carry both models through the base case testing, future year baseline simulations, and emissions control sensitivity simulations.**
- **Diagnostic tools will be examined as appropriate for their utility**
 - **CAMx: OSAT, 3D-DDM, Process Analysis**
 - **CMAQ: 3D-DDM, Process Analysis**
- **One or both models will be used in simulating 2018 focused VOC and NOx emissions changes.**

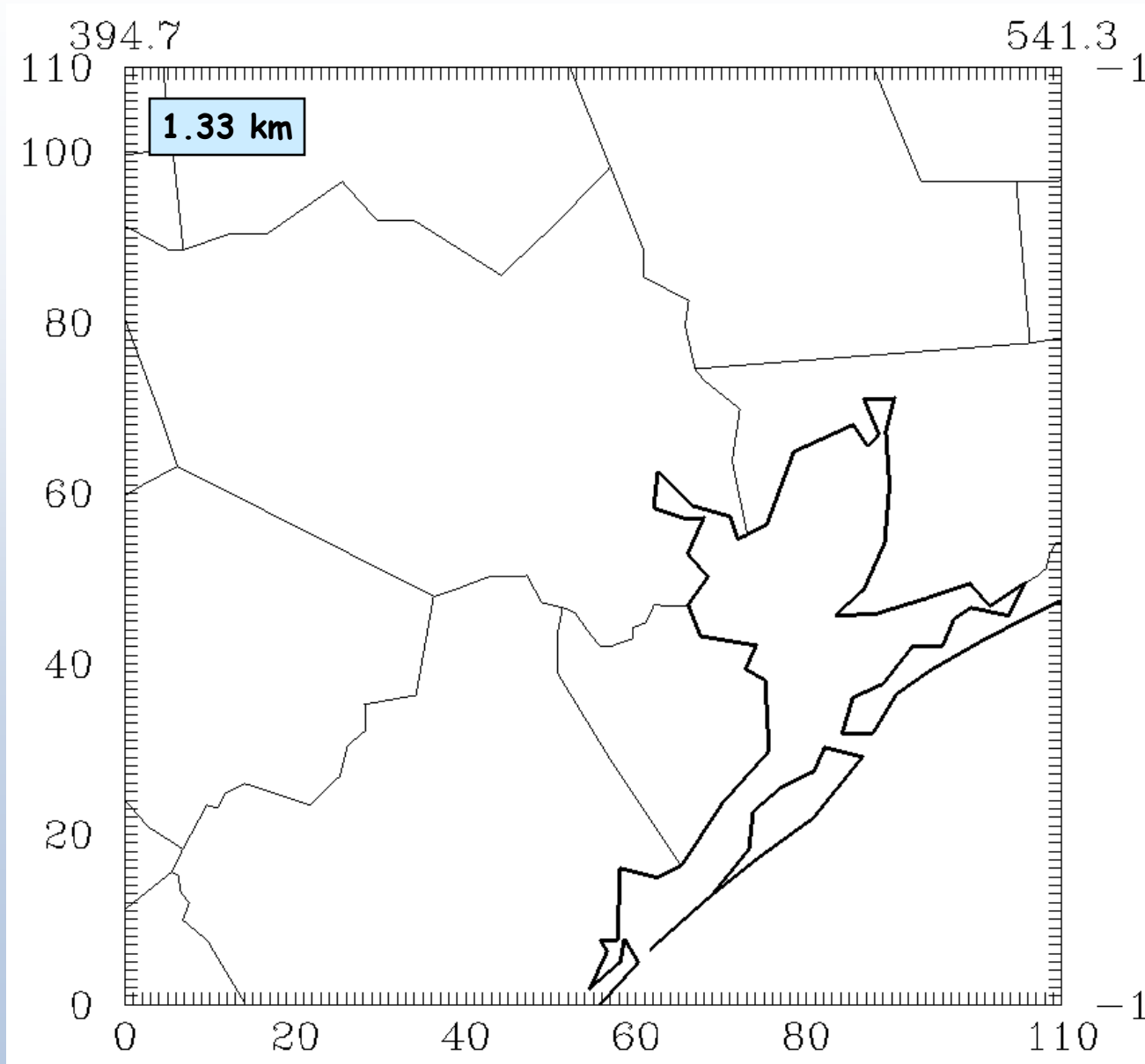
TCEQ CAMx Modeling 36/12/4/2 km Domain



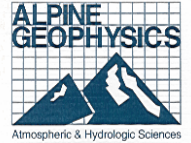
Alpine CAMx/CMAQ Ozone Modeling Domain: 36/12/4/1.33 km (1.33 km next page)



Alpine CAMx/CMAQ Ozone Modeling Domain: 1.33 km

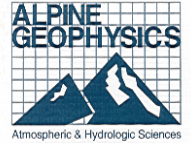


Future Year Modeling Analyses



- Development of 2018 baseline inventory reflecting all available, pertinent information on growth and controls in HGB, Texas, and the U.S.
- Run CAMx and CMAQ to assess residual 8-hr ozone nonattainment (85 ppb and 75 ppb) at each monitor in Texas;
- Perform CAMx/OSAT modeling for both 2018 episodes (OSAT runs for 2005 and 2006 episodes will be performed by AG/UNC under H97).
- Run several emissions sensitivity scenarios with CAMx/CAMQ to examine 2018 control responsiveness to precursor changes
- Run focused precursor emissions reductions in 2018 to examine effectiveness of different control strategies aimed at attainment of both levels of the 8-hr ozone NAAQS.

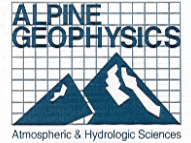
Schedule



- **Base year emissions and MM5 inputs – 30 Jun '08**
- **Base case model evaluation for both '06 episodes – 1 Aug '08**
- **Future year (2018) SMOKE EI development – 1 Oct '08**
- **Future year baseline and attainment estimate – 1 Nov '08**
- **OSAT modeling for two 2018 episodes – 31 Dec '08**
- **Emissions Sensitivity Simulations – 31 Jan '09**
- **Focused 2018 Emissions Control Effectiveness – 15 Feb '09**

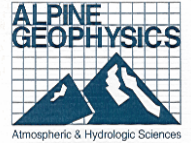
Note: many of these program elements run concurrently.

Availability of Near Term Datasets



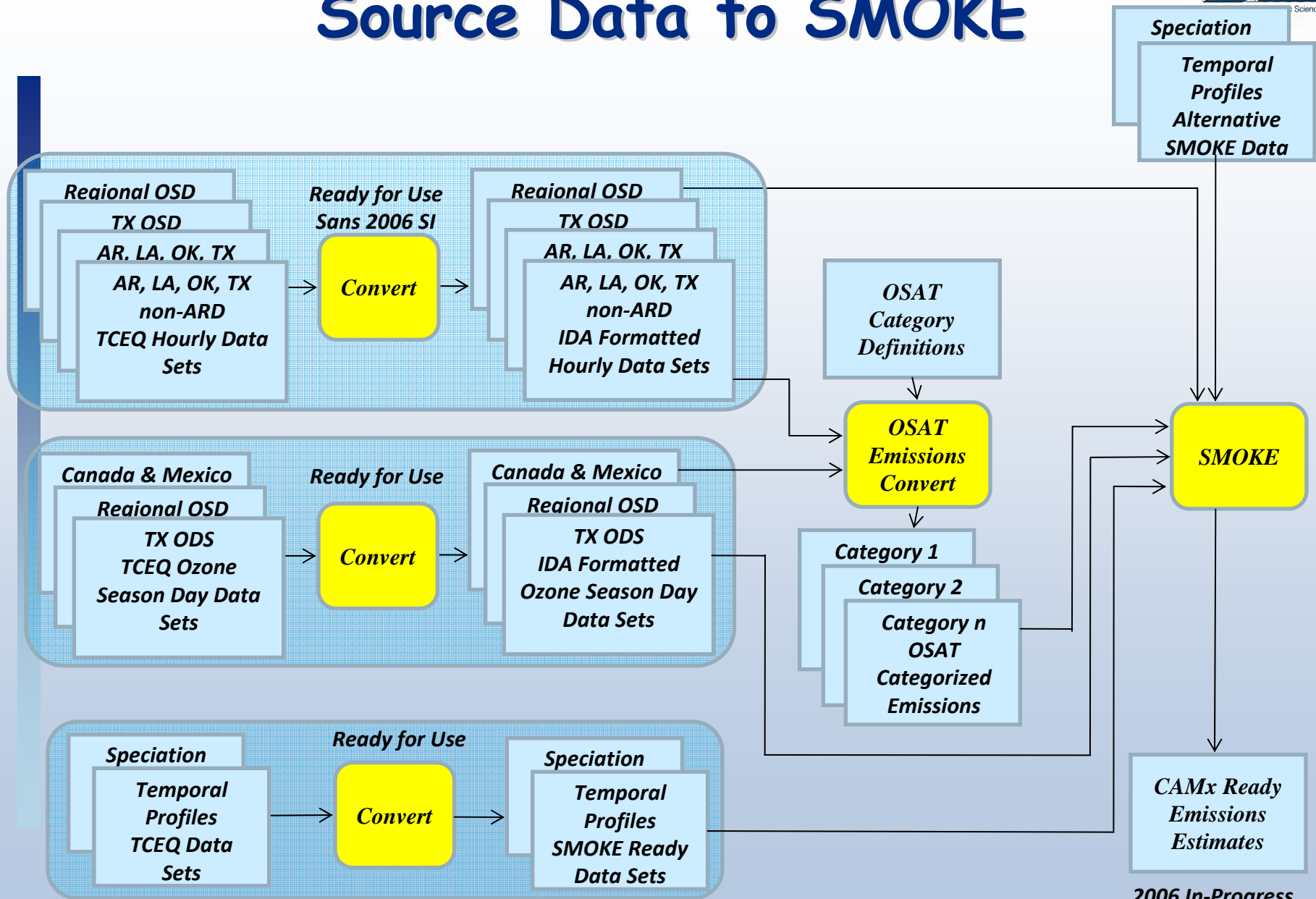
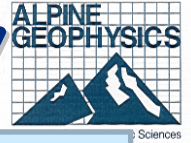
- **An important element of the Near Term Modeling Study is to transfer data sets upon request to other modeling groups involved in the 2010 HGB ozone SIP development process (e.g., HARC contractors, EPA OAQPS & ORD)**
- **Upon internal QC of data and modeling files, data sets will be transferred on requestor-supplied high capacity external disk drives. Smaller sets can be transferred by ftp.**

Presentation-Part II

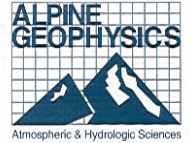


- **Development of 2006 Emissions Inventories for CAMx/CMAQ Modeling Program**
- **Continued Review and Inter-comparisons between SMOKE and TCEQ EPS Emissions Outputs for 2006 episodes**
- **Requested a piece to the puzzle from TCEQ – file to map discrete chemical species in 2006 Special Inventory to Carbon Bond chemical species**

Steps to Convert TCEQ Stationary Source Data to SMOKE

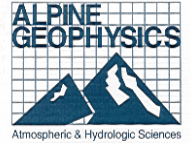


Problems Resolved (selected examples)



- Point source coordinates were based on a projection of Lambert Conformal (meters) and needed to be in decimal degrees for SMOKE - **resolved; used PostgreSQL-PostGIS**
- afs.gwei2000.20000801.3pol.lcp has illegal data for CEQEFF (pollutant [e.g., CO] is placed there instead of a real number), RULEFF (characters instead of real number), and RULPEN (characters instead of real number) - **resolved; additional format added to EPS-to-SMOKE conversion system**
- Duplicate emissions records in many of the hour-specific data sets - **resolved; TCEQ stated that duplicate records needed to be summed to a single record**
- Numerous EGUs with missing or invalid stack parameters - **resolved; TCEQ corrected and reposted new data sets**
- Missing SCCs for EGU sources in LA, AR, and OK - **resolved; TCEQ corrected and reposted new data sets**

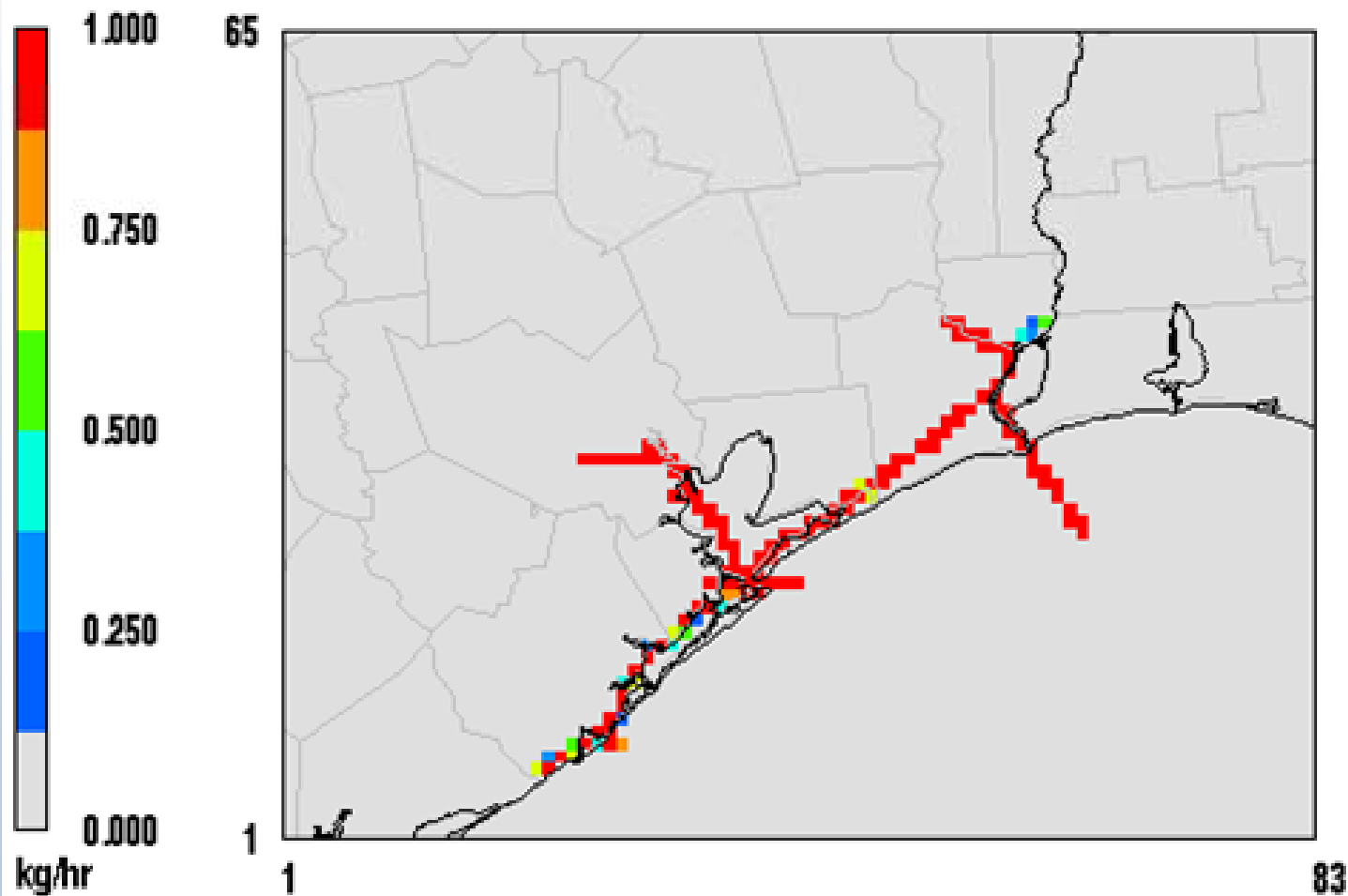
TCEQ 2006 Emissions Converted to SMOKE-ready Data Sets



- Hourly Point for 31-May through 16-June 2006
- Hourly Point 01-August through 15-October 2006 sans Special Inventory (will wait on missing speciation file)
- Common ozone season day point emissions estimates for Canada, Mexico, and states other than TX, LA, AR, and OK
- Area sources
- Nonroad (sans aircraft, CMV, railroad) & Offroad (aircraft, CMV, railroad)
- Offshore & Ship
- Mobile Sources (conversion in progress)
- Alternate biogenics (such as MEGAN)?

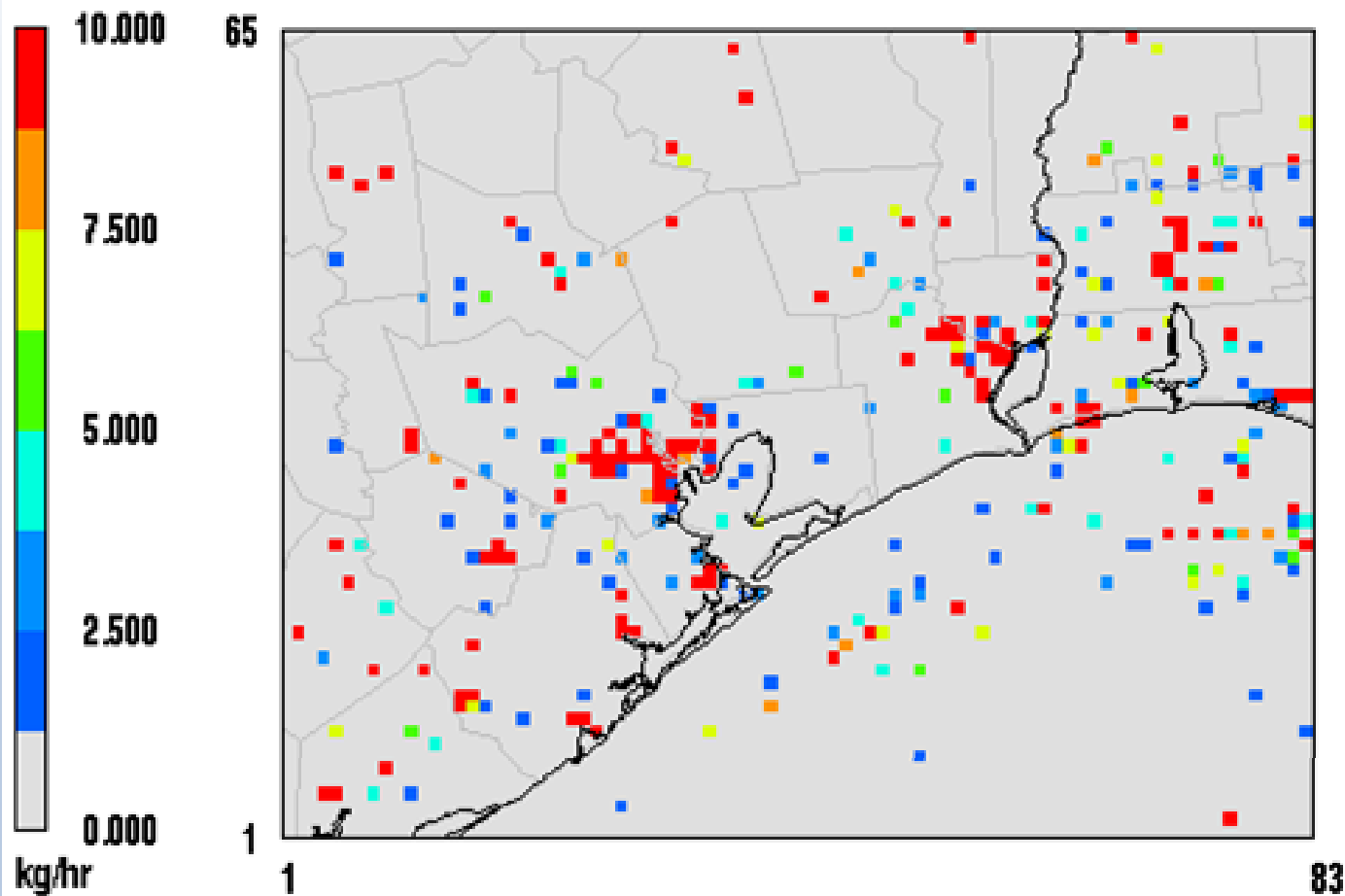
August 2006 NOX Emissions from Ships

Layer 1 (NO_v+NO_{2v})/1000



August 2006 NO_x Emissions from Stationary Sources

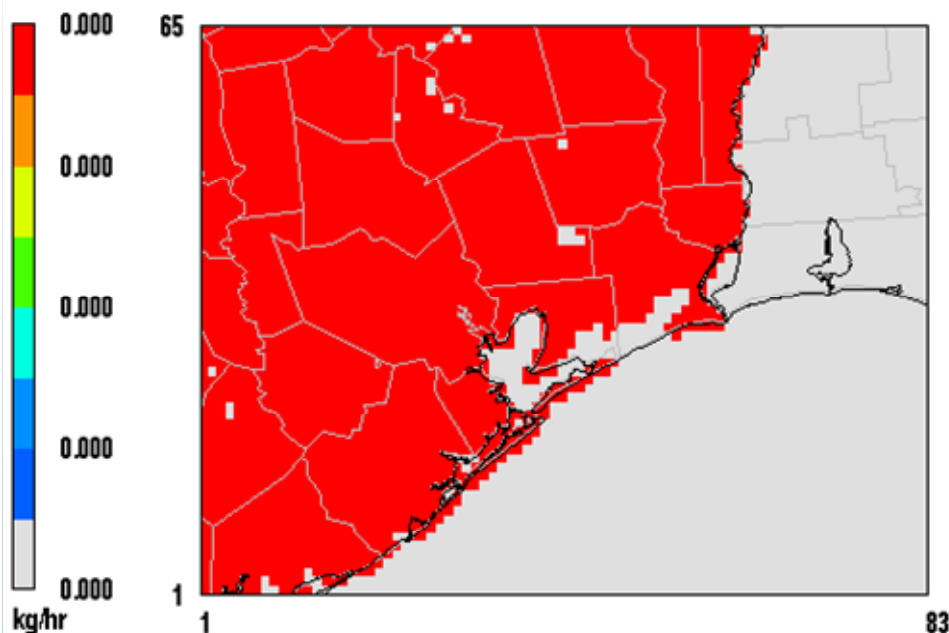
Layer 1 (NO_u+NO_{2u})/1000



August 2006 NO_x Emissions from Nonroad Sources

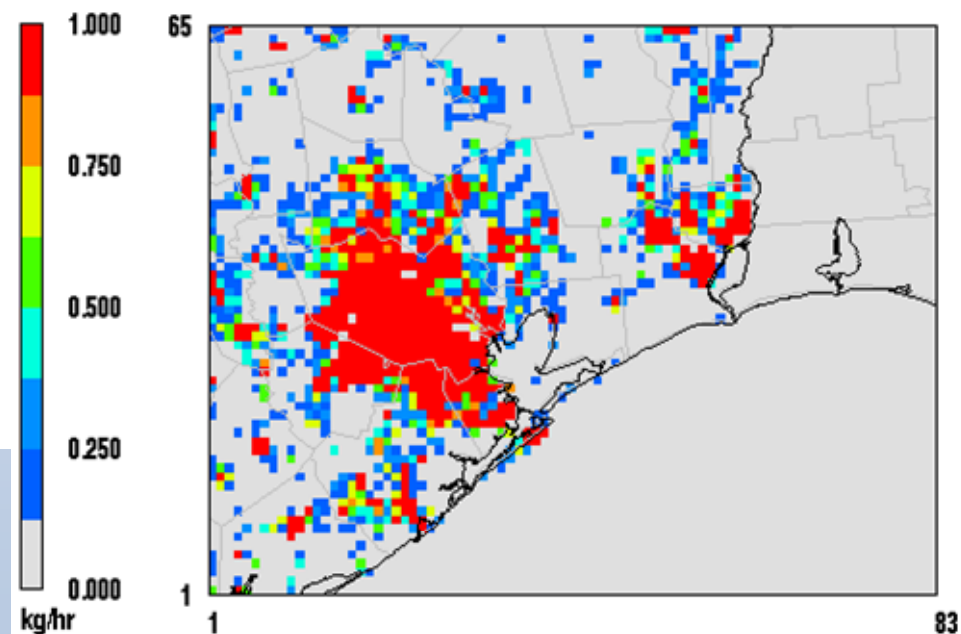
Spatial Extent

Layer 1 (NO_y+NO_{2y})/1000



Emission Density

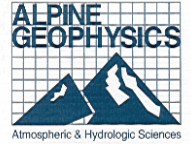
Layer 1 (NO_y+NO_{2y})/1000



Questions?



References



Tesche, T. W., J. G. Wilkinson, and Dennis McNally, 2008. “Work Plan for 8-hr Coalition Near Term HGB SIP Modeling Support Study”, prepared for the Houston 8-hr Ozone Coalition, prepared by Alpine Geophysics, LLC Ft. Wright, KY