Houston 8-hr Ozone Coalition Modeling Research Plan

presented to

Southeast Texas Photochemical Modeling Technical Committee (SETPMTC)

TW Tesche
CARA

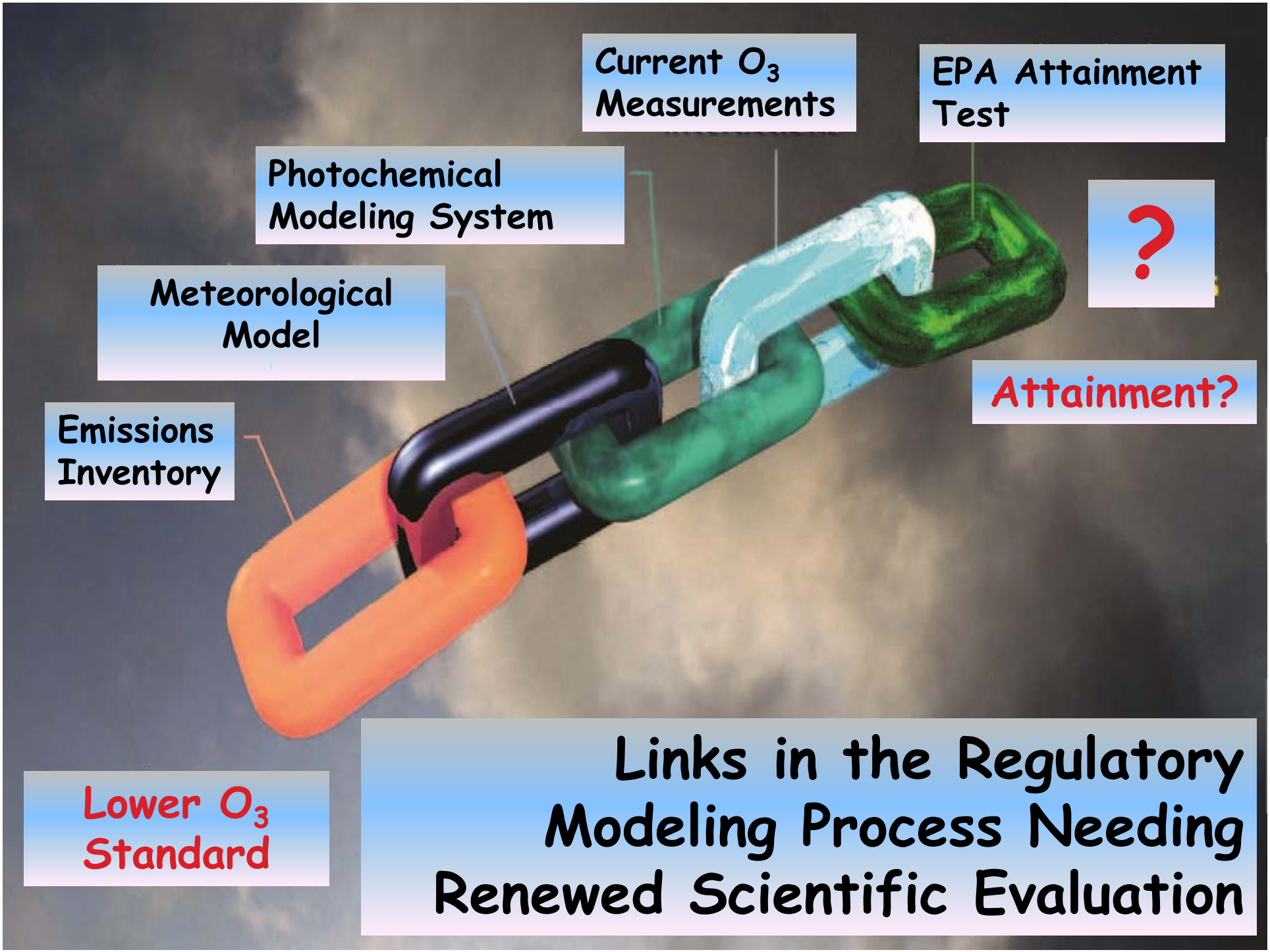
Jim Wilkinson
Alpine Geophysics

26 Jan 2010

Recent 8-hr SIP Experience

- Current ozone measurements show attainment of the 0.080 ppm NAAQS, but
- Regulatory SIP modeling exercises have tended to show that additional emissions controls are needed.
- Thus, present ozone measurements and future modeling projections seem disconnected.

Why is this? Is it important?


Current O_3 Measurements
EPA Attainment Test
Photochemical Modeling System
?
Meteorological Model
Attainment?
Emissions Inventory
Lower O_3 Standard
Links in the Regulatory Modeling Process Needing Renewed Scientific Evaluation

Implications of Lower Standard

A 'step-function' decrease in the O_3 NAAQS can only be met in Houston by a corresponding 'step-function' increase in the rigor of new ozone modeling

- The 'foundational' cause-effect assumptions underpinning regulatory applications of O_3 models for Houston warrant vigorous probing and evaluation.

- Hypotheses regarding preferred regulatory modeling methods and application procedures should:
  - Be compared, tested and recommended based on their individual scientific merits.
  - Reflect the consensus view of a diverse peer-review engaging science and policy-making experts.

Three Research Questions

In the draft 2010 SIP, TCEQ affirms the agency's plan to invest resources in technological research and in improving the science of ozone modeling & analysis.

- How can the most scientifically-credible and 'EPA-approvable' O_3 formation & control approach be identified and implemented for Houston?
- What are the challenges in incorporating emergent modeling science and emissions technology into future HGB ozone SIPs?
- How can the Coalition's 2010-2013 activities contribute most effectively and cooperatively with ongoing research efforts of the TCEQ, EPA and others?

Policy & Science Research Improvement Themes

In Science Team's 2010 research plan covers activities in five areas

- Evaluation of O_3 formation and control explanations
- Improved science in regulatory ozone models
- Improved procedures for applying and interpreting models and their databases
- Enhanced attainment demonstration tools for planners and public decision-makers
- Improved data bases for control strategy evaluation

Rethink O_3 Formation Paradigms

Choice of the most scientifically plausible explanation of peak ozone formation and control has a profound influence on future attainment outcome(s)

- **Traditional understanding.** Regulatory guidance assumes that the full range of O_3 levels can be modeled adequately with existing tools (CMAQ, CAMx) and inventories.

- **Dual-ozone paradigm.** Holds that peak regulatory O_3 levels best explained and controlled by separation of cause/effect into 'traditional' and 'non-Typical' processes. Modeling application strategies have key differences.

- **Other.** Research may reveal other approaches/options.

Improve Modeling Science

Attaining a lower NAAQS will impose a far greater demand for scientifically-sound, well-tested, and comprehensive modeling tools than <u>any</u> previous SIP exercise

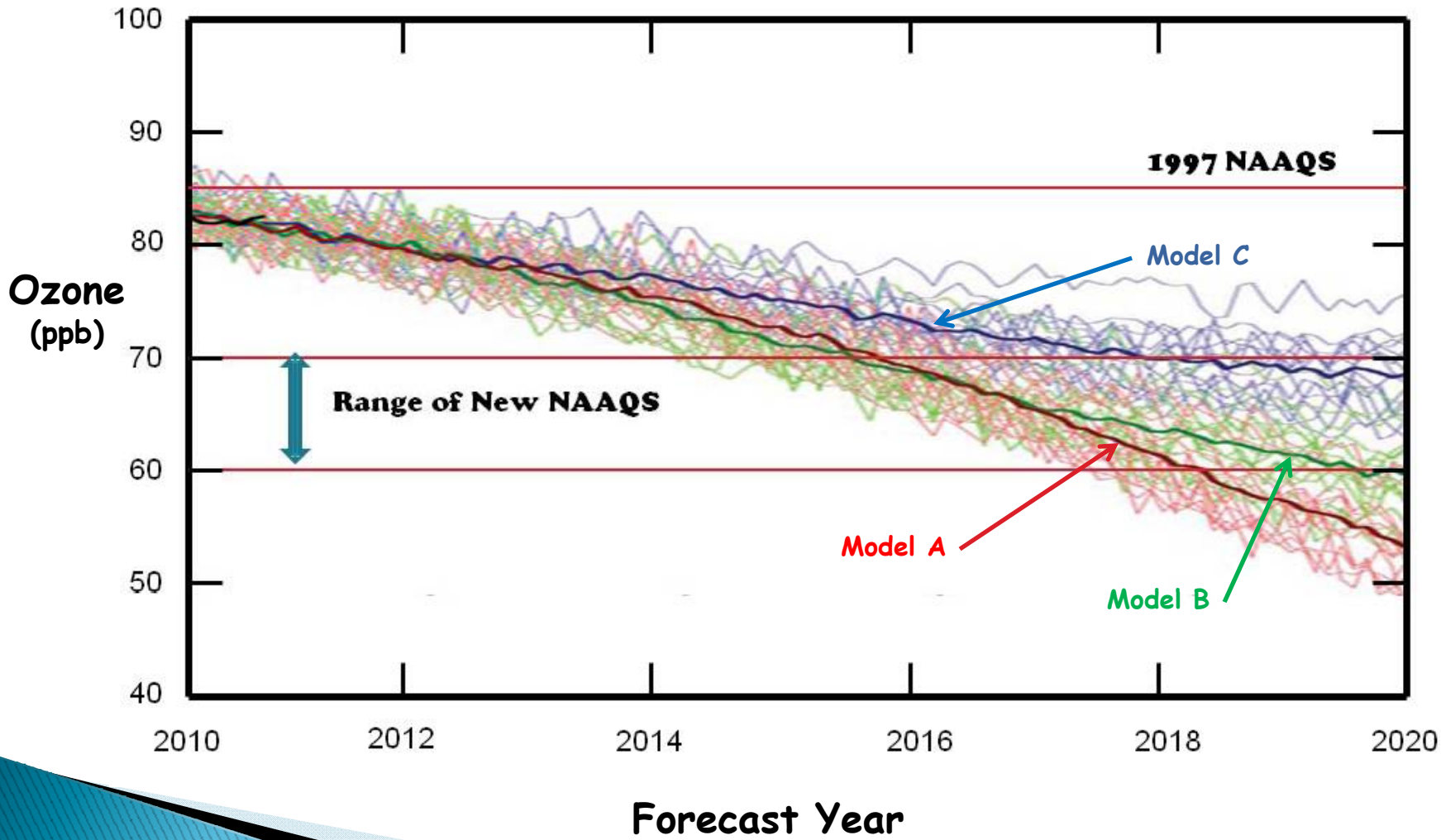
- Evaluate of merits new science developments for inclusion in HGB regulatory modeling approach
- International Transport of O_3 Precursors into Texas
- Chemical mechanism updates, e.g., toluene, radical species, isoprene nitrate, Halogen-NOx reactions
- 'Seamless' use of alternative modeling codes with common input data bases
- Improved model evaluation methods and useful metrics

Improve Model Applications

Reliance one model should be assessed carefully; replaced with a tailored ensemble modeling system and application methodology may offer improved reliability

- Ensemble modeling
  - What is it? (see next page)
  - Base case episode simulations with ensemble models
  - Ensemble modeling to develop future O_3 attainment estimates
- Bias-correction methods for future ozone projections
- Process analysis experiments (Henderson, 2008; TCEQ, 2009; Jeffries and Vizuete, 2009)
- Quantifying emissions controls
  - Brute force, subregional, station-specific, OSAT, PA, DDM (Cohan and Digar, 2009)

Conceptualization of O_3 Ensemble Estimates at a Monitor from Three Modeling Systems



Improve Data Bases

A 'step function' increase in SIP modeling rigor will necessitate more comprehensive emissions , satellite data bases and additional, recent O_3 modeling episodes

- Emissions Modeling and Databases
  - Adjoint (inverse) modeling for CO, NOx
  - Stochastic inventory construction (Webster et al., 2007)
  - Corroborative on-road MV procedures
  - Projection of future industrial source emissions
  - Refined characterization of flares, fugitives, etc
  - Examination of marine biomass and sea-salt contributions
  - Inclusion of relevant halogen and other biogenic sources
  - Forensic analysis of inventory data sets

- Satellites
  - NASA's Atmospheric InfraRed Sounder

- New Modeling Episodes
  - One or more from 2010-2011 summertime periods

Enhance Decision-Making Tools

To capitalize on significantly advanced O_3 modeling tools, their outputs must be directly useful and understandable to regulatory decision-makers and the public

- Direct incorporation of modeling and observational data uncertainty into decision-making process

- Probabilistic attainment demonstration
  - Includes, but not limited to, traditional deterministic (one-outcome) regulatory method (Timin, 2009)
  - Supplies information on individual model mean and spread & ensemble model mean and spread across all credible model runs

- Incorporation of optimal control-cost analysis
  - Based on optimal, subregional precursor control-ozone response
  - Augmented with current data on precursor control costs by source category
  - Applied by subregion across Texas and adjoining states.