Technical Approach for 2012 SJV $PM_{2.5}$ Plan Modeling

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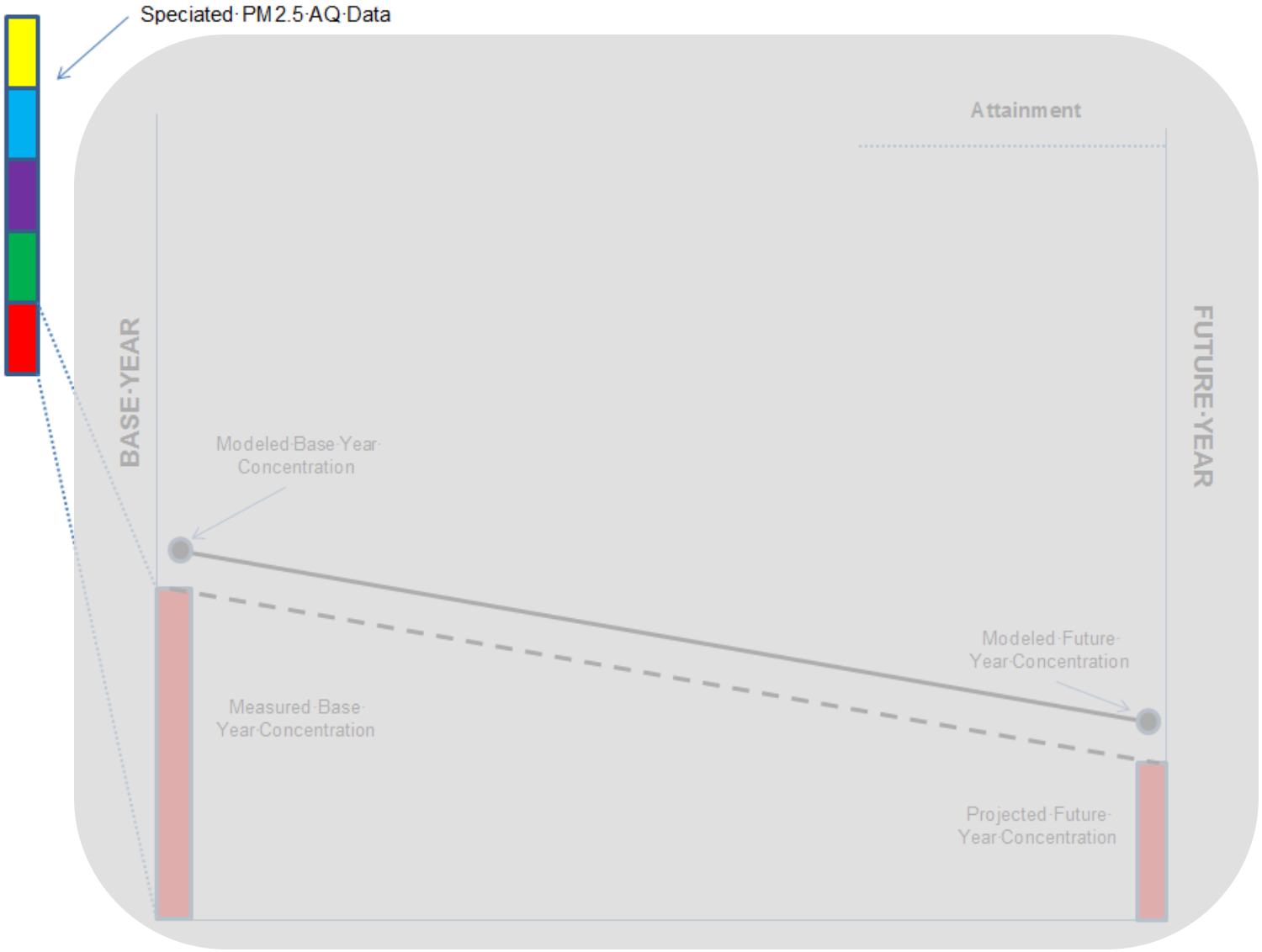
Outline of the Presentation

- Construction of the speciation for Federal Reference Method (FRM) filters
- Calculation of the future Design Value
- Meteorological and photochemical modeling
- Limiting precursors and their efficacies
- Resource requirements
- Current status of modeling

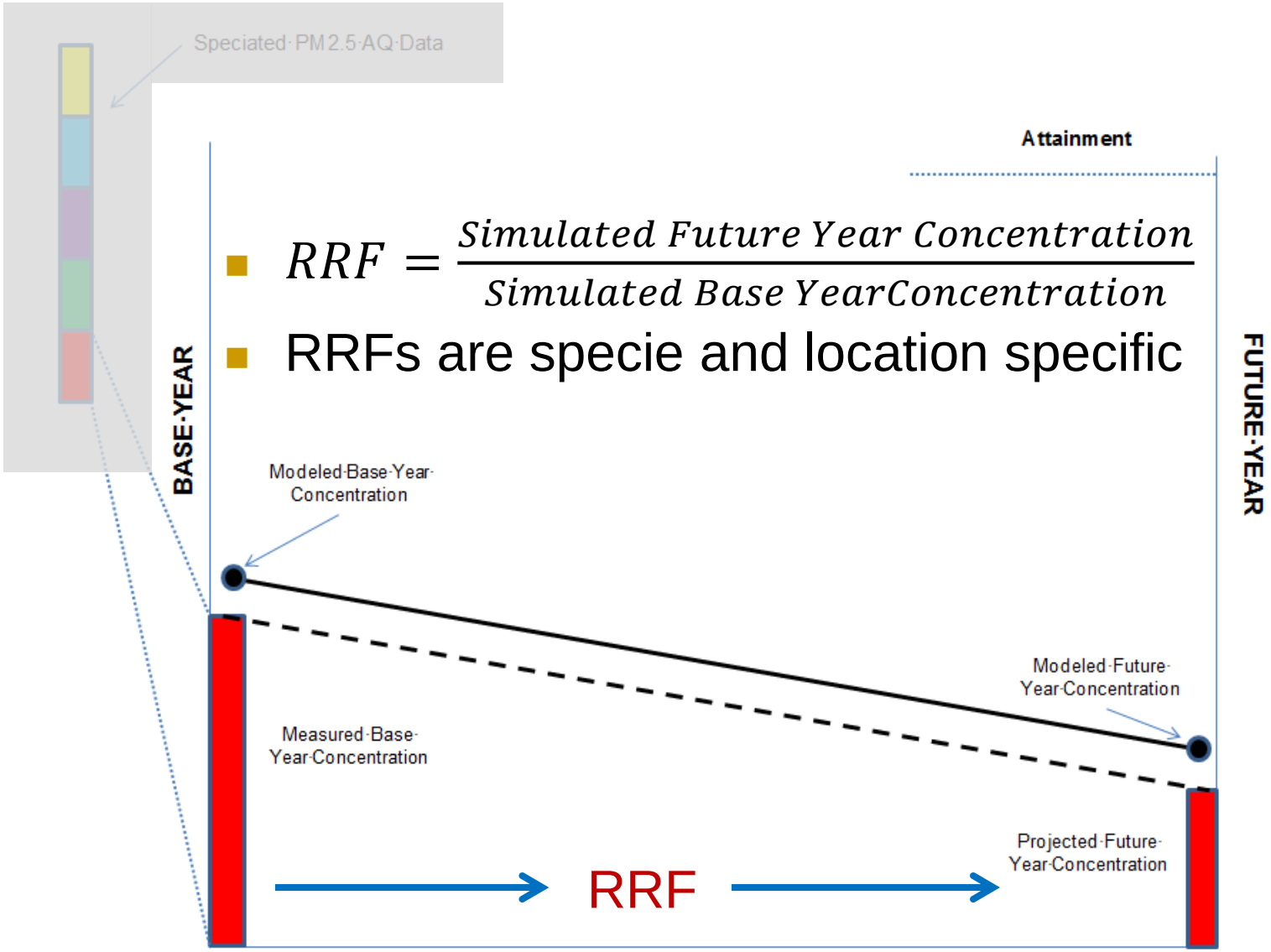

Speciated PM2.5 AQ Data
Attainment
BASE YEAR
FUTURE YEAR
Modeled Base Year Concentration
Modeled Future Year Concentration
Measured Base Year Concentration
Projected Future Year Concentration

"Speciating" the FRM Filter

- Speciated Model Attainment Test (SMAT), which uses RRF, requires speciated $PM_{2.5}$
- Federal Reference Method (FRM) filters are not speciated
- Four FRM sites have co-located speciation monitors
- Use Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous material balance approacH (SANDWICH) to estimate FRM speciation

Five things about SANDWICH

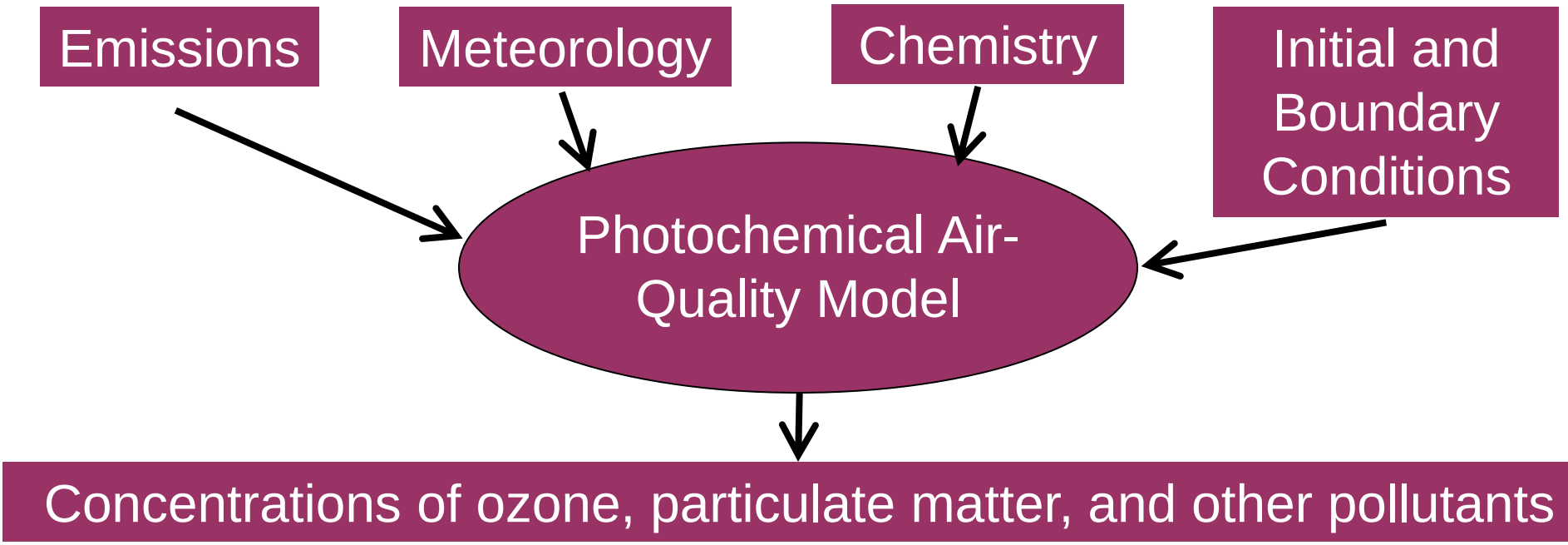
- Sulfate, EC, geologic – no adjustments
- Nitrate – use a thermodynamic equation to account for different nitrate collection efficiencies of speciation and FRM filters
- Water – use another thermodynamic equation to calculate particle-bound water
- Ammonium ion – calculated using ion balance of sulfates and nitrates
- Carbonaceous Material – use species mass balance to infer the mass of organic carbon


Speciated PM2.5 AQ Data
Attainment
$RRF = \frac{Simulated\ Future\ Year\ Concentration}{Simulated\ Base\ YearConcentration}$
RRFs are specie and location specific
BASE YEAR
FUTURE YEAR
Modeled Base Year Concentration
Modeled Future Year Concentration
Measured Base Year Concentration
Projected Future Year Concentration
RRF

Future Mass → Future Design Value

- Select the highest eight FRM $PM_{2.5}$ days per quarter for 2005-2007 and SANDWICH them
- Project each component specie for each day into the future (There is an app for that!)
- Add components to get the total mass for each day
- Find the 98th percentile for each year
- Average 98th percentiles for three years to get the future Design Values

Photochemical Models → RRF



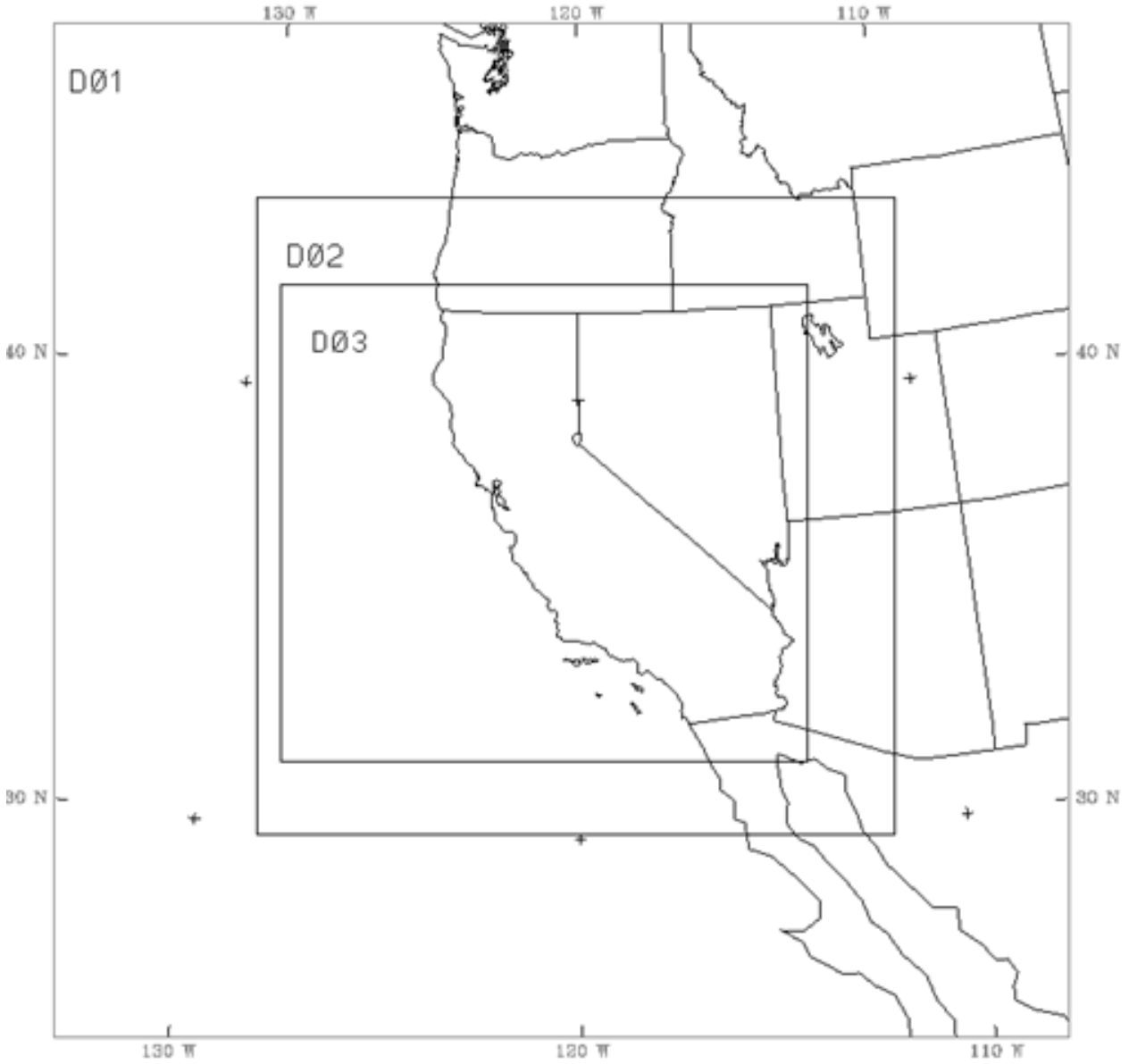
Models are mathematical representations of our best knowledge of atmospheric processes

Meteorology Modeling

- Modeling is conducted on a grid system
- A meteorology model is needed to provide meteorological parameters in each grid cell
- We use prognostic meteorology models (MM5 and WRF model) to generate 2007
- A coupled set of differential equations describing gradients in meteorological parameters solved
- NARR provides global-scale input
- 30 vertical layers up to 100 mb

MM5 – Mesoscale Model 5, WRF – Weather Research Forecast,
NARR – North American Regional Reanalysis

Meteorology Domains

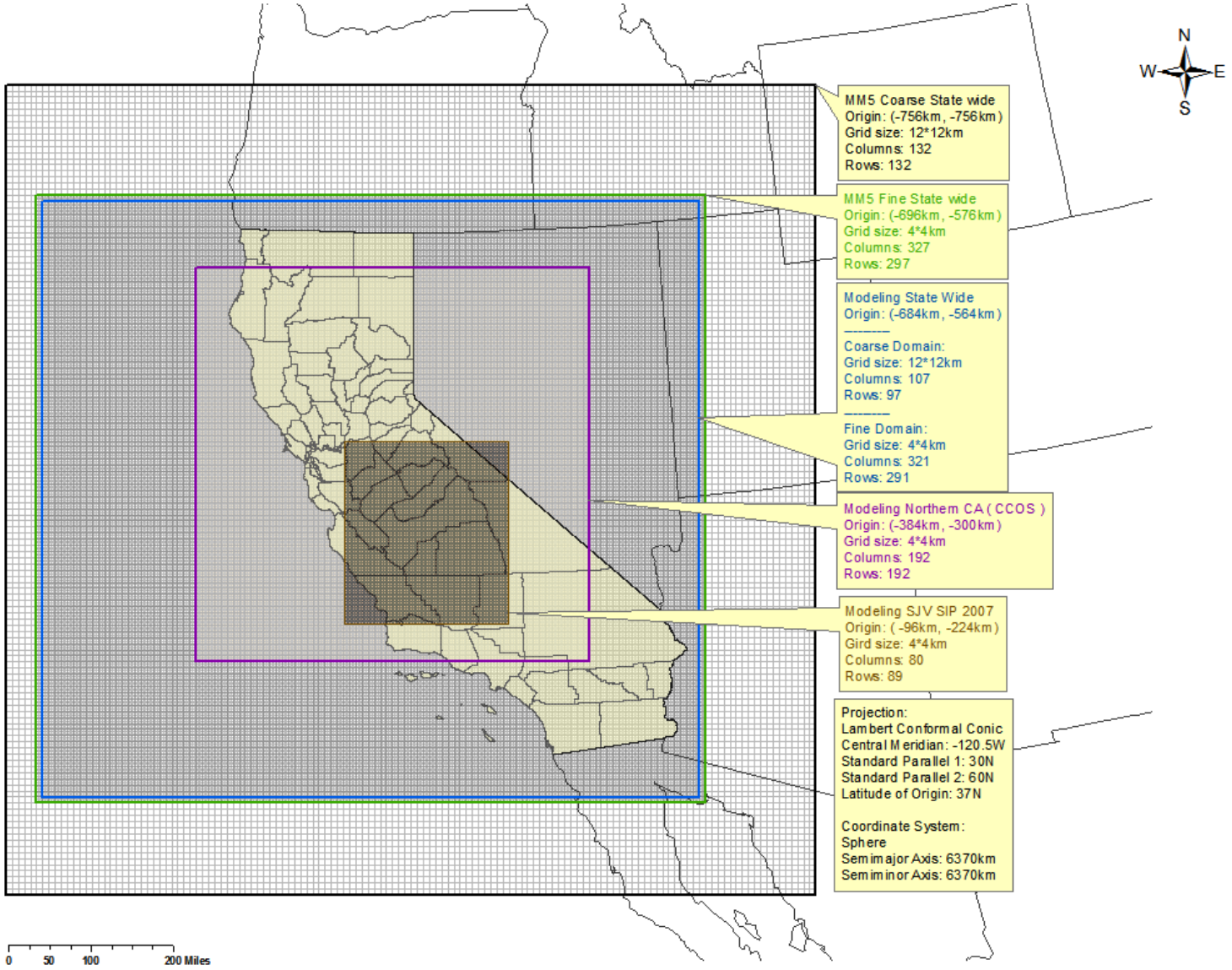


Air-Quality Modeling

- US EPA's CMAQ model
- SAPRC-97 chemistry
- Solves coupled sets of differential equations for advection, diffusion, and chemistry
- MOZART global model provides Initial and boundary conditions
- 15 vertical layers up to 100 mb

CMAQ – Community Multi-scale Air Quality
SAPRC – Statewide Air Pollution Research Center
MOZART – Model of Ozone and Related Trace Species

Air-Quality Domains



Model Performance Evaluation

- Operational (quantitative) – Ability to reproduce observed temporal and spatial patterns for meteorological parameters and pollutants
- phenomenological (qualitative) – General comparisons of observed features
- Diagnostic (semi-quantitative) – How accurate is the model in characterizing the sensitivity of $PM_{2.5}$ (and species) to changes in emissions?
- Corroborative (qualitative) – Model consistent with other analyses?

Limiting Precursors and Efficacies

- Precursors of interest are primary $PM_{2.5}$, NO_x, SO_x, VOC, and NH_3
- Last SIP simulations for the annual standard indicated that primary $PM_{2.5}$ and NO_x to be the most limiting precursors (in that order)
- Precursor equivalencies will be calculated based on current 24-hr SIP modeling
  - Can be thought of as “trading ratios” for precursors based on their effect on Design Values

Resource Requirements

- “Super” computer systems – Clustered PCs and workstations
- Highly technical staff with extensive training in mathematical modeling

The Core Modeling Team

- Project Lead:
  - Ajith Kaduwela – Ph.D. in Chemical Physics
- Meteorology Modeling:
  - Daniel Chau – Ph.D. in Civil and Environmental Engineering
  - Kemal Gürer – Ph.D. in Atmospheric Sciences
  - Zhao Zhan – Ph.D. in Atmospheric Sciences
- Air-Quality Modeling:
  - Jin Lu – Ph.D. in Chemical Engineering
  - Jeremy Avise – Ph.D. in Civil and Environmental Engineering
  - James Chen – Ph.D. in Earth Sciences/Engineering

The Modeling Support Team

Managers
- Sylvia Zulawnick
- Vernon Hughes
- Gabe Ruiz
- Steve Zelinka
- Mena Shah
- Pingkuan Di, Ph.D.

Emissions Inventory
- Kevin Eslinger
- Janet Spencer
- Charanya Varadarajan, Ph.D.

Emissions Forecasting
- Martin Johnson
- Adrian Griffin, Ph.D.

Emissions Gridding
- Cheryl Taylor
- Leo Ramirez, Ph.D.
- Wenli Yang, Ph.D.
- Anne Lin
- Don Johnson

Air Quality Analysis
- Patricia Velasco, Ph.D.
- Kasia Turkiewicz
- Jin Xu, Ph.D.
- Eugene Kim, Ph.D.
- Larry Larsen

Met Analysis
- Adam Gerber
- Elena Hanrahan

Current Status

- Emission gridding complete. QA/QC in progress.
- Meteorology modeling complete. Model performance analyses in progress.
- Air-Quality modeling in progress.
- Results to be presented in the summer.

Photochemical modeling is part of the Weight of Evidence that determines the attainment status.

Thank you very much for your attention!