Air Quality Forecast Models During CalNex-2010

Stuart McKeen (NOAA/ESRL/CSD, U of Colorado/CIRES)

Jim Wilczak, Irina Djalalova (NOAA/ESRL/PSD)

Similar to ICARTT/NEAQS-2004, TexAQS-2006 field studies:

- **Collect several AQ forecasts during intensive (O_3, PM2.5, met)**
- **Provide web-site for model/obs comparisons (near real-time)**
  - **Surface Chemistry sites**
  - **Upper-air comparisons of wind-profiler and sodar data**
- **Post field-study model evaluations**
  - **U.S. EPA AIRNow Network O_3 and PM2.5**
  - **NOAA Aircraft/Ship data**
- **Forecast comparisons and ensemble forecasting during the field intensive**

For examples: http://www.etl.noaa.gov/programs/2006/texaqs/verification/

Probable Air Quality Forecast Contributors:

- **NCEP/NWS-NOAA** (operational run at surface, experimental run for upper air)
- **Environment Canada** (operational GEM-MACH)
- **NOAA/ESRL Global Systems Division** (2 or 3 configurations)

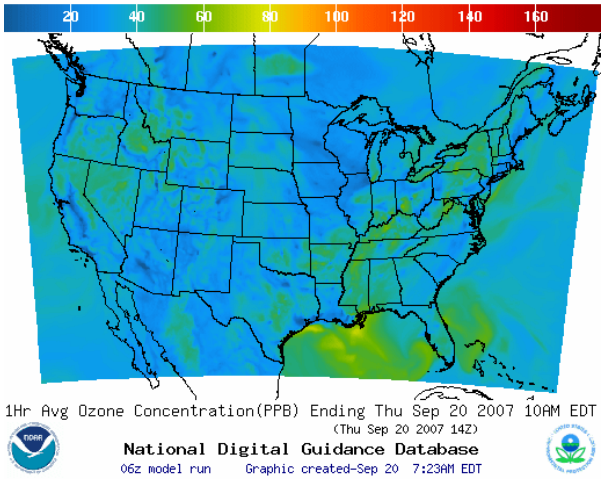
Possible Contributors:

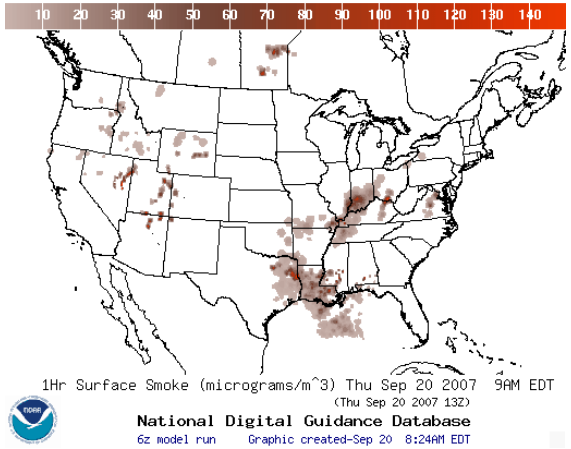
- **University of Iowa** (WRF/STEM-2K3)
- **Baron AMS Inc.** (WRF/MAQSIP-RT)
- **DOE/PNNL** (WRF/Chem)
- **NCEP/NWS-NOAA** (developmental configuration)
- **Environment Canada** (Hi resolution nest of GEM-MACH)
- **Open Welcome to any regional air quality forecast model**

AQ forecast guidance for CONUS

(Dr. Paula Davidson, NWS manager, AQF capabilites)

www.weather.gov/aq





Predictions available real-time: CONUS
Ozone NAM(WRF-NMM)-CMAQ
Operational: 2X daily, 12km/1hr res,
Experimental: 2X daily, adv capabilities

CONUS Smoke NAM-HYSPLIT
Operational predictions: 1X daily

Developmental test products: Available for development & focus group evaluation.
CONUS aerosol predictions: NAM(WRF-NMM)-CMAQ
Real-time, but not hardened: disruptions possible during high-usage : 2X daily

Additional AQF products in testing for AK, HI

Further information: www.nws.noaa.gov/ost/air_quality

Comparative Performance, O3

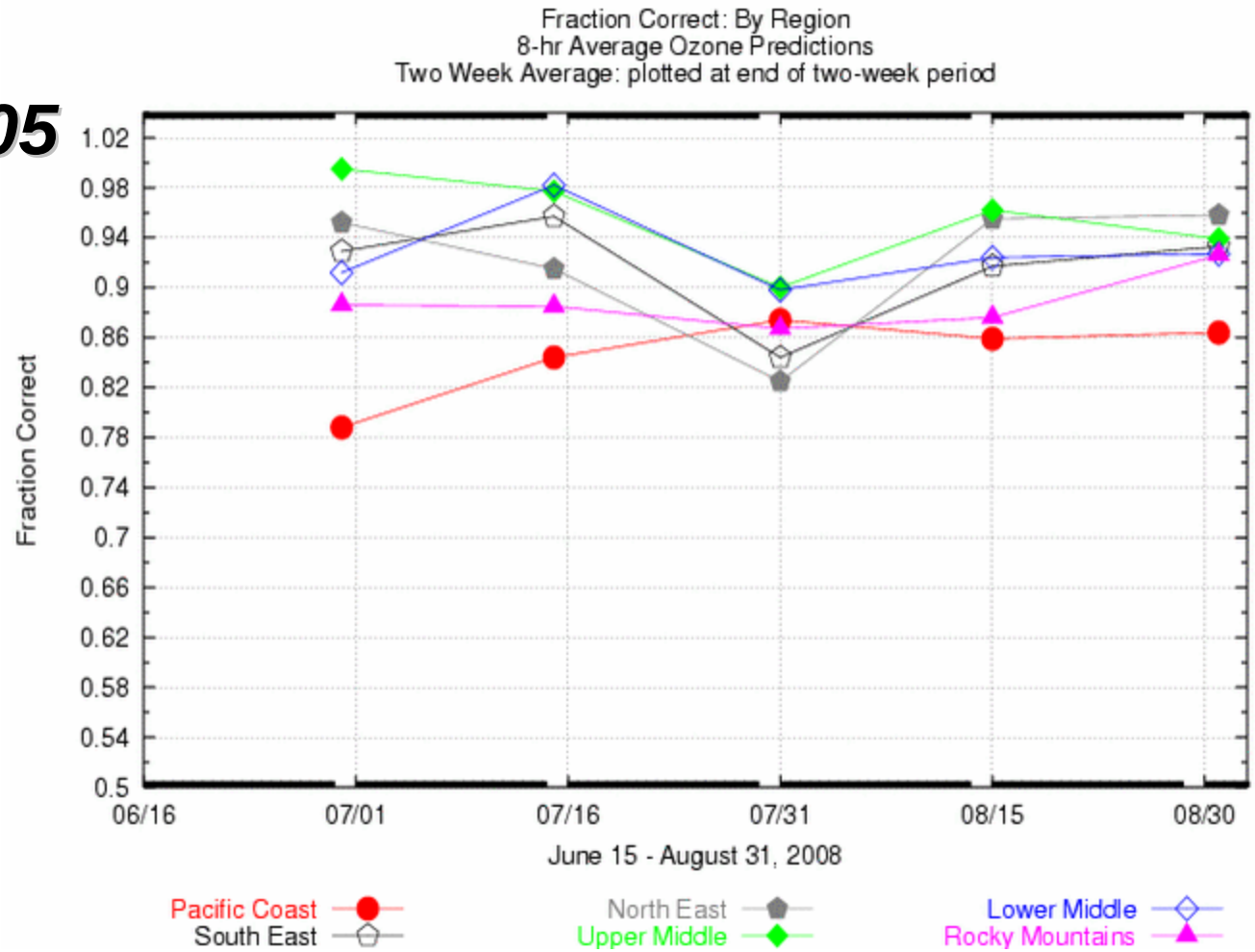
Exp Tests, CB05

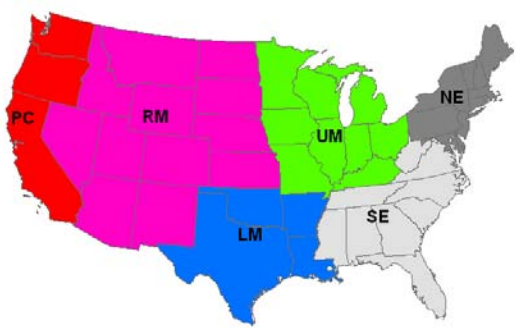
West Coast:

Red Circles

Courtesy

J.Gorline





Challenges for AQ Forecasts in California

- **Ozone predictions in southern CA: accuracy significantly lower than for CONUS; peak concentrations often predicted for areas displaced too far eastward (2007-2008)**
- **Aerosol predictions not quantitative. Summer wildfire outbreaks significant, e.g. 2008: northern CA**
- **Potential measurements to assist diagnostic evaluations:**
  - *At high spatial/temporal resolution, ground-level and where possible vertical information*
  - *Ozone (and precursor) measurements in southern CA*
  - *PM2.5 total measurements in conjunction with aerosol components*
  - *During wildfire outbreaks, total PM2.5, aerosol species, OC & EC totals, CO, O3 (and precursors)*

Environment Canada Environnement Canada

Canada

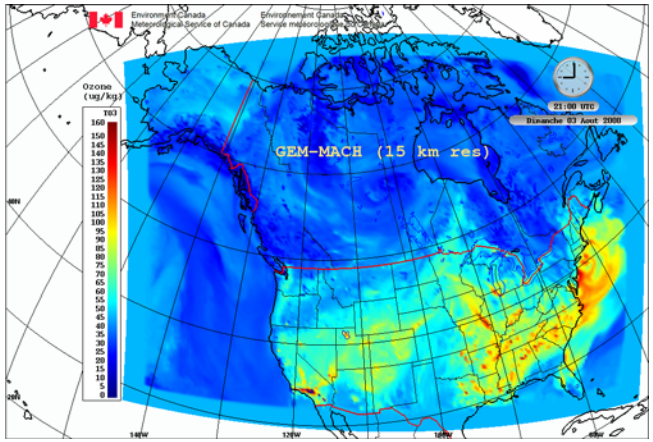
EC plans for participation in CalNex – AQ forecasting component

V. Bouchet, Wanmin Gong

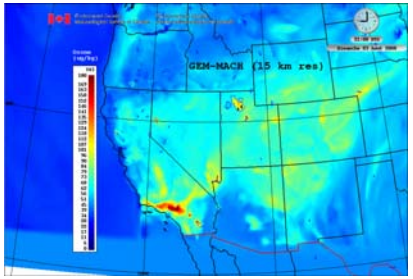
Air quality modelling – Environment Canada

Canadian participation – Environment Canada

- **Plans to date (Feb. 2009)**
  - Operational GEM-MACH15 forecasts
    - GEM with in-line chemistry and aerosol from AURAMS
    - Twice a day, 15 km resolution
    - O_3, $PM_{2.5}$, NO_2
    - Additional output possible based on needs
  - Emission input comparison (pre-campaign?)
  - Objectives:
    - evaluation over California
    - assessment of western boundary conditions



GEM-MACH15 domain (top) and zoom over California (bottom)



- **Additional plans being considered**
  - Experimental window at 2.5km resolution over California
  - Experimental global/regional cascade (Boundary conditions from global GEM-MACH version)
  - post-event study: interest in ensemble emission scenarios study
  - Post-event activity: interest in maintaining ensemble forecast beyond study

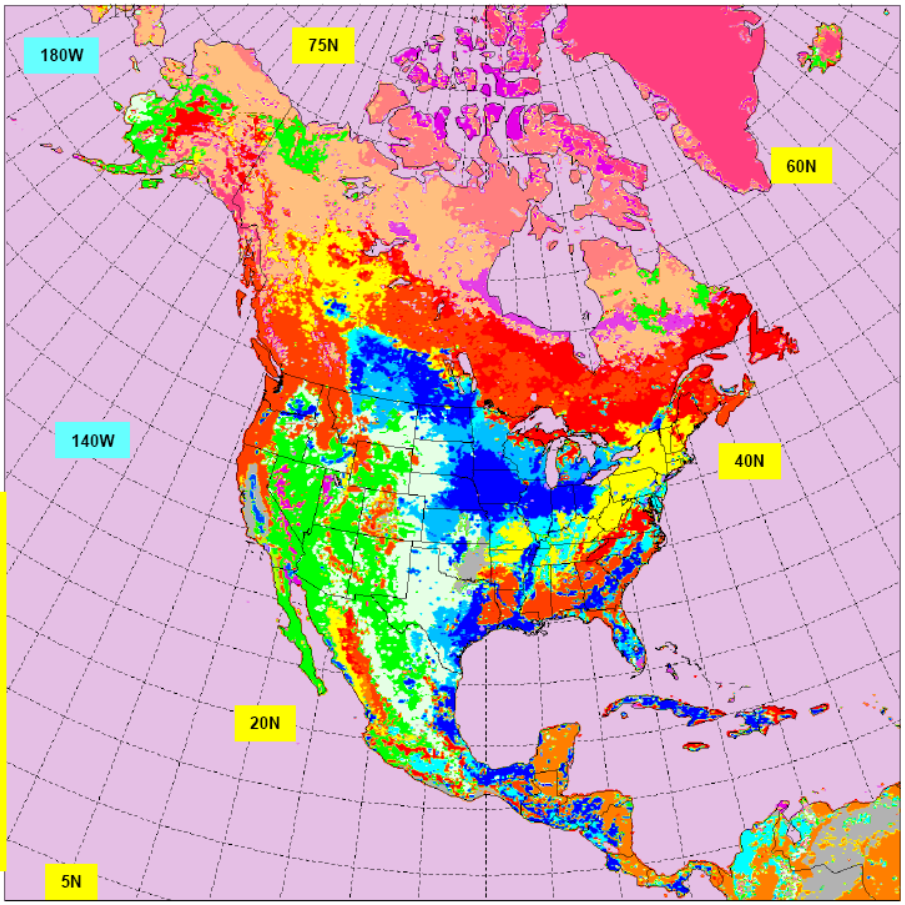
Proposed ESRL Runs

Georg Grell, Steven Peckham (NOAA/ESRL/GSD)

1. FIM-Chem
   - Global Icosahedral model, hybrid isentropic vertical grid (approx dx=50km)
   - 5 day forecasts using simple GOCART aerosols (including dust and wildfires)
2. Rapid Refresh (RR)
   - North American Grid (dx=13km)
   - Aerosols/Chemistry as in (1)
   - 6-hourly chemical and meteorological data assimilation cycle. ***Forecast length to be determined at later stage***
   - RR without chemistry will replace the operational RUC at NCEP
3. High Resolution RR (HRRR3)
   - 3km horizontal resolution version of RR, but with full chemistry (O_3 and PM2.5) over western part of USA
   - Data assimilation and forecast length as in (2)

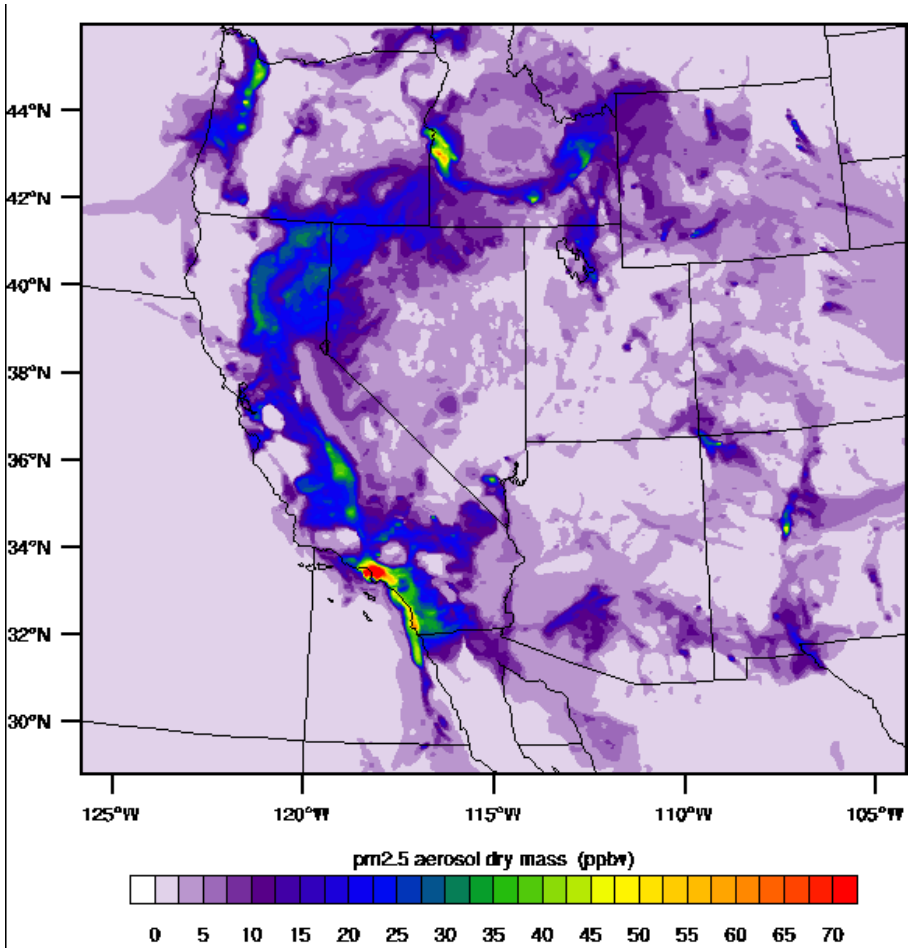
Rapid Refresh

Δx=13km, most likely aerosols only (but including effect of fires)



High Resolution Rapid Refresh-3

Δx=3km, full Chemistry



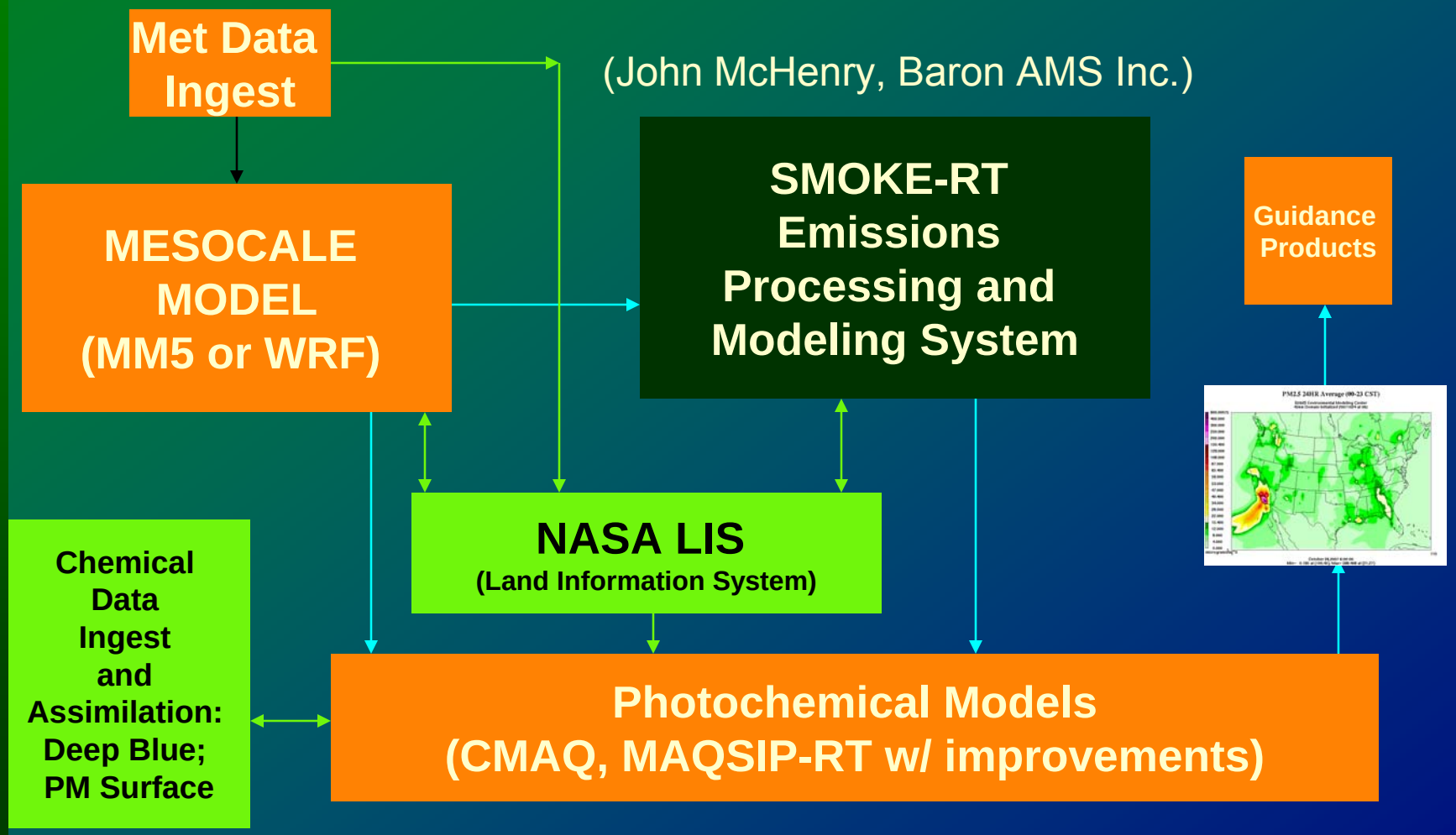
DOE Forecasting for CARES 2010

Jerome Fast, Rahul Zaveri, Bill Gustafson (DOE, PNL, Richland, WA)

- *Objective:* Support aircraft and intensive operation periods during CARES in the Sacremento-Bloggett Forest Corridor
- Operational Dispersion Forecasts:
  - *Couple WRF (Δx ~3 km) with FLEXPART dispersion model*
  - *Track plumes from key sources (e.g. Sacramento, other urban areas, biogenic) and determine relative contribution (e.g. local vs background)*
  - *Need 1-3 day forecasts to determine whether upslope /downslope flows dominate the local circulations to define intensive sampling periods*
  - *Will utilize forecasts from operational air quality models as well*
- PNNL WRF-Chem simulations:
  - *Still discussing whether these will be made operationally*
  - *Will want these simulations to be different than other chemical forecasts*
- PNNL will use WRF-chem primarily for post-field campaign analysis
  - *Improve the understanding of SOA processes, aerosol optical properties, and aerosol mixing state and their representation in models*
  - *Determine the performance of simulated regional-scale aerosol direct and indirect radiative forcing and their impact on meteorology*

High-Level Dataflow for Operational NAQP System Planned for CalNex-2010

(John McHenry, Baron AMS Inc.)



High-level AQFCST model dataflow planned for CalNex-2010

Air Quality Forecast Modelers' Wish List:

- **Updated Emissions**

  pre-campaign inventory comparisons

- **Near real-time Data**

  - **Surface data from Super sites and Intensive Sites**
  - **Tower/Elevated Site data**

- **Accurate surface NO2 (to compliment surface O_3)**