RESULTS FROM THE NOAA COLLABORATIVE TALL TOWER NETWORK FOR MONITORING CARBON DIOXIDE AND RELATED GASES


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CO₂ Sampling in North America

Legend: Sampling Platform
- Green: Surface-layer tower
- Blue: Mixed-layer (tall) tower
- Red: Complex terrain
- Orange: Aircraft Profile
- Gray: Weekly Surface Flask
- Yellow: Ameriflux tower

Blue: NOAA ESRL & Collaborators
Green: Canadian Carbon Program
Red: Other (PSU, ORST, Harvard, NCAR)
Yellow: MCI Ring of Towers 2 (PSU)
Gray: Weekly or Infrequent Sampling

Slide courtesy of Scott Denning
CO$_2$ Sampling in North America

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**Notes:**
- 6 Calibrated, Continuous Sites Operating in 2001
- Network has grown to ~40 by 2008!
NOAA ESRL Collaborative Tall Tower Network

ITN (1992-1999)  Active Sites
Focal point for NACP Mid-Continent Intensive. Local support from U of Iowa (Prof Charles Stanier)
CALGEM pilot project joint with LBNL funded by California Energy Commission's Public Interest Energy Research Program (Marc Fischer PI)
Mountain ridge site in Shenandoah National Park Collaboration with Prof Stephan de Wekker (UVA).
Collaborative effort with US Department of Energy Savannah River National Laboratory (Matt Parker).
Brand new flask sampling site on Mt Wilson, CA!

April 2010!
New Tower Image Viewer Software for daily QA/QC:

By Dan Chao
Mike Trudeau and Dan Chao
New Tower Image Viewer Software for daily QA/QC:
New “intercomparison” website provides quick look plots of flask/in situ data agreement:

LEF tower Flask – In Situ
0.01  0.33 ppm
Oct 2006 - present

Ken Masarie and Dan Chao
### Results - Statistics

#### Test file: p2d1_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchsummary

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### Results - Data

- p2d1_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchsummary
- p2d2_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchsummary
- p3d1_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchsummary
- p3d2_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchsummary
- p2d1_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchdiffsummary
- p2d2_laf_co2_esrl_flask_laf_co2_esrl_in situ_comp_matchdiffsummary
Estimating CO2, CO and CH4 background concentrations using ensemble trajectory analysis combined with Globalview-like background reference surfaces:
Multiple trajectory analysis combined with Globalview-like background reference surfaces for \( \text{CO}_2 \), \( \text{CO} \) and \( \text{CH}_4 \) provides estimate of background concentration:
Argyle, Maine Tower (AMT) – Midday Observations

Background Smooth Curve
Long-term Trend: 12-month running average of mid-afternoon data
Long-term Trend: 12-month running average of mid-afternoon data

- OBS - BG

**CO₂, ppm**

**CO, ppb**

- NH: Wisconsin
- GL: Texas
- **Maine**
- **Colorado**
- **Iowa**
- **California**
- **South Carolina**
- Virginia
CO₂ Seasonal Cycle

BACKGROUND

OBS - BKG

- --- NH Wisconsin
- --- GL Texas
- Maine Colorado
- Iowa California
- South Carolina Virginia
Wintertime CO: CO$_2$ Correlations

West Branch, Iowa
January and February (2008-2009)

$R^2 = 0.78$

ODR Slope:
6.5 ppb/ppm
6.6 ppb/ppm
**CO$_2$ vs CO Correlations (Enhancement over Background):**

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<tr>
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<th>R$^2$</th>
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<td>0.76</td>
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<td><strong>TX</strong></td>
<td>0.66</td>
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<td>0.93</td>
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<td><strong>VA</strong></td>
<td>0.78</td>
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Highlights

• CarbonTracker 2010 will be the first release with strong surface data constraints in the Southeastern US (SC and VA sites online Aug 2008).

• New Web-based tools facilitate quality control and flask/in situ comparison.

• Automated flask samples are now collected at all tall tower sites and analyzed for >40 species. Routine graphite extraction for radiocarbon analysis began in 2009 for several sites.

• Trajectory analysis allows separation of continental influence from background – new look at seasonal cycle and trends.

• CO$_2$ and CO co-vary strongly in winter with nearly constant slope across the US, reflecting a broad-area mixture of combustion and biological sources.
Cumulative $\Delta$ppm CO$_2$ for each site versus distance from tower
22-31 July 2008
CarbonTracker 2008 Fossil Fluxes

East Coast

West/Mid-west: note WGC proximity to pollution sources

Rural upper/mid-west: reflects original intention of network to focus on biological fluxes