Spatial patterns of atmospheric carbon

Jim Ehleringer, John Lin, Dave Bowling, Diane Pataki, and Court Strong
Susan Bush, Ryan Bares, Carolyn Stwertka, and Andy Schauer

Global Change & Sustainability Center
THE UNIVERSITY OF UTAH
Fossil fuel

Dust

CO₂ → Climate impact

CO → Climate impact

NO → Health impact

PM → Climate impact

Health impact

Trace gas compositions correlated

Air quality

Source
Quantify
Predict
Link
What research is needed to improve our quality of life?
95% of all human growth will occur in urban locations, such as here in the Salt Lake Valley.
How can air quality research

• provide link with human health at appropriate scales

• provide explanatory power

• provide predictive power

What UU research is ongoing?
What UU research is needed?
Trace gas network

http://co2.utah.edu
What are the dynamics of urban CO$_2$?

Midday CO$_2$ levels are always higher than global or regional averages.
A history of increasing $CO_2$ values for Josh Ehleringer. What will $CO_2$ rise to when your children attend college?
CO₂ levels are impacted by

- location in dome
- time of day
- season of year

Hour of day

Murray

Urban central

Hour of day

Kennecott

Rural

Ehleringer et al.
Human choice affects urban CO$_2$, CO, NO, PM
Murray site, 1500 – 1700 hours

2.3 ppm CO$_2$ increase for every 1,000 vehicles

$y = 0.0023x + 383$

$r^2 = 0.953$

Ehleringer et al.
Relocatable and mobile gas sampling

Capability

Carbon dioxide
Carbon monoxide
Methane
Ozone
Flask – trace gases
Flask – isotopes
Flask – VOCs
PM (soon)
GPS
Temperature
Humidity
Wind
Note the net emissions structure at intersections.
CO$_2$ morning transect during January 2013 inversion

[CO$_2$] above background, ppm
Stable isotopes are used to partition CO$_2$ into fossil fuel sources

$^{14}$C isotopes are used to quantify local variations in CO$_2$
Extending predictability down to the neighborhood level

Spatial heterogeneity
Combining satellite, monitoring, and forecasting, we should be capable to
• predict spatial structure of air quality
• link spatial air quality and health
• source attribute through stable isotopes
UU faculty are working on opportunities to
• design better transportation systems
• redevelop walkable and livable neighborhoods
• coupling human activity and environment
• think, design, and plan better
Research that contributes to a better future:

- predictive air quality capacity to meet the needs of health
- coordinated research in the natural-, social-, and physical sciences
- smarter growth and transportation solutions that improve quality of life

This is our past.