Air Quality / Atmospheric Sciences

Climate & Health Workshop
May 9, 2017
CU Boulder, SEEC Building
Front range air quality researchers

CU Boulder
• Engineering Air Quality Group
  • Shelly Miller
  • Jana Milford
  • Marina Vance
  • Daven Henze
  • Mike Hannigan
  • Lupita Montoya

• CIRES / NOAA
  • Owen Cooper
  • Joost de Gouw

• Chemistry
  • Jose Jimenez
  • Paul Ziemann

• Geography
  • Colleen Reid

Other Institutions
• NCAR
  • Christine Wiedinmyer, Gabi Pfister and many others

• CSU
  • Jennifer Peel, Sheryl Magzamen, Brooke Anderson, Ander Wilson, John Volckens, Jeff Pierce, Shantanu Jathar, Maggie Clark and others

• CU Anschutz
  • John Adgate and others
Framing for this talk...

Society’s Responses to Climate Change

Climate Change

Air Quality

Human Health
Tropospheric Ozone Assessment Report
Global metrics for climate change, human health and crop/ecosystem research

Mission:
To provide the research community with an up-to-date scientific assessment of tropospheric ozone’s global distribution and trends.

World’s largest database of ozone observations
TOAR’s database contains ozone exposure metrics at thousands of measurement sites around the world, freely accessible for research on the impact of ozone on climate, human health and crop production.

TOAR is designed to facilitate research on the impact of ozone on human health.

For more information contact:
Owen Cooper
CIRES Senior Research Scientist, CU Boulder
owen.r.cooper@noaa.gov

Days per year that maximum daily 8-hr average ozone exceeds 70 ppb
Volatile Organic Compounds in the Atmosphere – Joost de Gouw, CIRES Senior Scientist & Fellow of CIRES

Two decades of experience measuring VOCs by mass spectrometry and gas chromatography

- Urban air quality studies, LA, Mexico City, northeast US, southeast US, Houston
- Emissions from biosphere, Sierra Nevada, Alabama, Colorado
- Emissions from Deepwater Horizon oil spill, 2010
- Emissions from oil and natural gas production in Colorado, Utah, North Dakota, Wyoming, New Mexico, Oklahoma, Texas, Arkansas, Louisiana and Pennsylvania
- Emissions from bioethanol production and use, e.g. corn production, bio-refining
- Emissions from biomass burning
- Emissions from petrochemical industry in Texas

Direct health effects, e.g. BTEX, formaldehyde
Contributes to surface ozone formation
Contributes to aerosol formation
Pollutant emissions and impacts – Christine Wiedinmyer
Scientist, Atmospheric Chemistry Observations & Modeling Lab, NCAR

Estimating air pollutant emissions from Wildfires with the Fire Inventory from NCAR (FINN)

Quantifying emissions and impacts from traditional and improved cooking technologies in Africa with M. Hannigan (CU)

Assessing climate and health impacts from changing emissions in Africa (with Hannigan, Lacey, and Henze)
Revised estimates of global O₃ health impacts of >2 million premature deaths annually, significantly greater than previous estimates (~500k), and now similar in magnitude to premature deaths from ambient PM₂.₅ exposure (1.6-4.2 million).

Climate (x-axis) and ambient health (y-axis) impacts from national scale per-cookstove phase-out of emissions (by 2020) of aerosols and GHG’s, identifying where mitigation efforts would have co-benefits beyond indoor air quality.
Least cost energy system modeling to develop future emissions scenarios with contrasting policy and technology assumptions

Comparing scenario impacts for air quality and health effects using atmospheric chemistry and transport models

Emissions downscaling with utility dispatch models
Energy-Air Quality Nexus in Developing Communities – Lupita Montoya
Assistant Professor, Civil, Environmental and Architectural Engineering, Environmental Engineering Program, CU Boulder

Coupling of source apportionment and indoor air quality models (Chile)

Home heating practices, indoor air quality and human health and a framework for sustainable solutions (Navajo Nation)

Waste-to-Energy systems for developing countries (Ghana)
Wildfire smoke and health – Colleen E. Reid
Assistant Professor, Geography and Institute of Behavioral Sciences, CU Boulder

MODIS Visible Image  GBM predicted surface

Epidemiological analyses
- Respiratory morbidity
- Cardiovascular morbidity
- Maternal and birth outcomes

Identification of vulnerable populations
- Sex, age, socio-economic groups

Spatiotemporal air pollution (PM2.5 and ozone) exposure modeling
- Machine Learning
- Combines satellite data, CTMs, monitoring, meteorological and land use data to predict air pollutants of health concern
Indoor Air Quality – Shelly L. Miller
Professor Mechanical Engineering, Environmental Engineering Program, CU Boulder

Indoor Air Quality in Immigrant Housing in Commerce City

Ultrafine and Fine Particulate Matter Inside and Outside of Mechanically Ventilated Buildings

Bacterial Diversity and Abundance Inside Single-Family Residences

Home Tightness, Energy Efficiency and Respiratory Health
Wildfires – Shelly L. Miller
Professor Mechanical Engineering, Environmental Engineering Program, CU Boulder

Mitigation Measures During Prescribed Burns and Wildfires

Indoor Air Quality During Wildfires and Home Tightness

Air Cleaners

Windows Closed
Ultrafine aerosol exposures – Marina Vance
Assistant Professor, Mechanical Engineering, Environmental Engineering Program, CU Boulder

**Exposure Science:**
• Understanding emissions of ultrafine aerosols and engineered nanoparticles from novel and everyday sources.

**Ultrafine Aerosol Detection:**
• Using material science and nanotechnology to develop sensors for ultrafine aerosol detection.

**Chemistry of Indoor Environments:**
• Developing a community of scientists in the field of indoor chemistry.
Chemistry of Indoor Air - Paul Ziemann and Jose Jimenez
Professors in the Department of Chemistry & Biochemistry
Cooperative Institute for Research in Environmental Sciences

- Studies of the chemical and physical processes that affect the composition of indoor air
- Real-time and offline chemical analyses of organic and inorganic gases, particles, and surfaces using mass spectrometry and spectroscopy
- Controlled experiments to investigate emissions and reactions of oxidants, acids, and water with indoor materials and human skin surfaces as sources and sinks of indoor chemicals
- Studies conducted in CU-Boulder classroom, art museum, athletic facilities, food venues, and residences
Remote aerosol is very acidic (pH < 0)
Partnership for Air Quality, Climate, and Health
Colorado State University

**Our Vision**
A CSU Partnership, reaching inward and outward, that provides comprehensive science-vetted information in useful form to stakeholders in air quality, climate, and health issues. The Partnership envisions implementing a structure and support facility that integrates CSU-wide capabilities in air quality, climate, and health in a comprehensive and synergistic way, and that focuses on communicating to stakeholders scientific findings relevant to their unique challenges. The Partnership will enable and foster policy-relevant research aimed at filling knowledge gaps identified jointly with our stakeholders, and will focus on effective partnering to formulate, plan, conduct and disseminate our knowledge in useful formats.

**Current Initiatives**
The Partnership for Air Quality, Climate and Health began with three initial focuses in mind – the effects of wildland fires, cookstoves, and oil and gas on individuals, local communities, and our world.

**Researchers**
A.R. (Ravi) Ravishankar, Chemistry & Atmospheric Science
Sonia Kreidenweis, Atmospheric Science
Marilee Long, Journalism & Media Communication
Jennifer Peel, Epidemiology
John Volckens, Mechanical Engineering & Environmental Health Sciences

https://vpr.colostate.edu/pach/