## Air Quality / Atmospheric Sciences

Climate & Health Workshop May 9, 2017 CU Boulder, SEEC Building



University of Colorado Boulder

### Front range air quality researchers

#### **CU Boulder**

- Engineering Air CIRES / NOAA **Quality Group** 
  - Owen Cooper

• Joost de

Gouw

- Shelly Miller
- Jana Milford
- Marina Vance Chemistry
- Daven Henze
- Mike Hannigan
- Lupita Montoya

- 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





TOPOSPHERIC ozone assessment report

## IGAC FURSHERIC CHEMISTER

#### Stakeholders





#### **Tropospheric Ozone Assessment Report**

*Global metrics for climate change, human health and crop/ecosystem research* 

Days per year that maximum daily 8-hr average ozone exceeds 70 ppb

#### Mission:

To provide the research community with an up-todate 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



# 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 produ
- 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)

Daily Fire Emissions for the Western US



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)







### Global health impacts of $PM_{2,5}$ and $O_3$ – Daven K. Henze

Associate Professor, Mechanical Engineering, CU Boulder

### Global modeling and satellite data used to evaluate health, climate and ecosystem impacts of air pollution and climate mitigation strategies

Malley et al., EHP, in press



Revised estimates of global O<sub>3</sub> health impacts of >2 million premature deaths annually, significantly greater than previous estimates (~500k), and now similar in magnitude to premature deaths from ambient  $PM_{2.5}$  exposure (1.6-4.2 million).



Per Cookstove Contribution to 2050 Global Temperature Impact (per mln households using solid fuels)

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.

### Linking Energy Systems & Air Quality – Jana Milford

Professor Mechanical Engineering, Environmental Engineering Program, CU Boulder



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

#### Energy-Air Quality Nexus in Developing Communities – Lupita Montoya

Assistant Professor, Civil, Environmental and Architectural Engineering, Environmental Engineering Program, CU Boulder



### Wildfire smoke and health – Colleen E. Reid

Assistant Professor, Geography and Institute of Behavioral Sciences, CU Boulder

**MODIS Visible Image** 



#### 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

#### **Epidemiological analyses**

- **Respiratory morbidity**
- cardiovascular morbidity
- Maternal and birth outcomes

#### Identification of vulnerable populations

Sex, age, socio-economic groups





SCHOOL OF

PUBLIC HEALTH



### Indoor Air Quality – Shelly L. Miller

Professor Mechanical Engineering, Environmental Engineering Program, CU Boulder



#### Indoor Air Quality in Immigrant Housing in Commerce City



Mechanical Engineering IVERSITY OF COLORADO BOULDER

#### Home Tightness, Energy Efficiency and Respiratory Health colorado school of public health

THE OHIO STATE INIVERSITY











**Bacterial Diversity and Abundance Inside Single-Family Residences** 





### Wildfires – Shelly L. Miller

Professor Mechanical Engineering, Environmental Engineering Program, CU Boulder



### 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.







Mechanical Engineering UNIVERSITY OF COLORADO BOULDER

### 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

### Chemistry of Indoor Air - Jose Jimenez

Professor of Chemistry, CU Boulder

#### Aircraft Aerosol Measurements

#### Chamber Studies of Atmospheric Chemistry





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 Inititiatives**

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.

![](_page_15_Picture_6.jpeg)

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/