HEI Research Planning Workshop

Understanding Population-Level Exposures Related to the Development of Oil and Natural Gas from Unconventional Resources

Denver, CO
July 11-12, 2018

POSTER PRESENTATIONS

Emissions of volatile organic compounds (VOCs) from oil and natural gas activities in several U.S. shale basins

Gilman JB, Lerner B, Aikin K, Isaacman-VanWertz G, Koss A, Peischl J, Ryerson TB, Sueper D, Tokarek T, Yuan B, Warneke C, de Gouw J.
Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado at Boulder

Abstract: During the NOAA Shale Oil and Natural Gas Nexus mission (SONGNEX), the NOAA WP-3D "flying laboratory" made measurements of methane, criteria pollutants and several air toxics over oil and gas extraction regions in 7 states ranging from North Dakota to Texas. We will summarize the composition of hydrocarbon emissions in these basins. While in some production regions (Barnett, San Juan) the hydrocarbon emissions are dominated by methane, non-methane hydrocarbons represented over 20-40% of the hydrocarbon emissions in the Denver-Julesburg, Permian and Bakken regions. Emission fluxes of ethane, propane and butane are reported for the Bakken region and represent 1-3% of the estimated global emissions of these compounds. Emission fluxes of other hydrocarbons, nitrogen oxides and air toxics are determined for several regions by the same methods and can be used as inputs for 3-dimensional chemistry-transport models that calculate regional exposure to different pollutants.

An energizing new program to address public health concerns of oil and gas development in Colorado

McMullin T, Bamber A, Flores J, Vigil D, Van Dyke M.
Oil and Gas Health Information and Response Program, Colorado Department of Public Health and Environment

Abstract: Colorado's rapidly growing population in parallel with increased oil and gas (O&G) operations in populated areas has created a situation in which many Coloradans now live and work in close proximity to O&G. In 2015, the Colorado Oil and Gas Task Force developed a set of recommendations to help foster responsible development of oil and gas in Colorado. As part of their assessment, the Task Force stated that they "heard from many citizens who expressed concern and uncertainty about potential human health risks associated with exposure to emissions from oil and gas activities. The Task Force believes citizens deserve and need accurate, credible, peer-reviewed scientific information to help them evaluate risk." In response to these concerns, the Task Force made several recommendations to be addressed by the Colorado Department of Public Health and Environment (CDPHE). CDPHE established the Oil and Gas Health Information and Response Program (OGHIR) which implemented three main goals that align with the Task Force's recommendations: (1) Track and deliver a rapid response to citizen health concerns, (2) Provide objective health information related to oil and gas operations, and (3) Establish and maintain credibility with stakeholders.

Assessment of potential public health effects from oil and gas operations in Colorado

Bamber A, McMullin T, Flores J, Vigil D, Van Dyke M.
Oil and Gas Health Information and Response Program, Colorado Department of Public Health and Environment

Abstract: Colorado's rapidly growing population in parallel with increased oil and gas (O&G) operations in populated areas has created a situation in which many Coloradans now live and work in close proximity to O&G. Over the last several years, multiple published papers have outlined the potential chemical and non-chemical hazards from O&G operations. In addition, studies specifically evaluating the relationship between living near oil and gas operations and the potential for certain adverse health effects have been widely publicized. This information led to heightened public and policy-maker concerns about whether or not harmful health effects occur in people living near oil and gas operations. In 2015, the Colorado Oil and Gas Task Force made several recommendations to the Colorado Department of Public Health and the Environment (CDPHE). Among them was a recommendation to review existing scientific literature and compile a summary of useful findings.

Quantifying the relationship between reported health symptoms and air exposures across multiple communities near Oil and Gas Operations in Colorado

Bamber A, McMullin T, Bon D, Van Dyke M
Colorado Department of Public Health and Environment

Abstract: Unconventional oil and gas (OG) activity is growing in Colorado, primarily in areas with rapidly growing suburban populations, and it is estimated that approximately 10% of Colorado residents live within one mile of an active oil/and or gas well. Those living near OG sites have reported multiple acute health symptoms and odors during the development phases of drilling, fracking, and flowback. Colorado has developed some of the most stringent OG air emission regulations and extensive regional ambient air quality monitoring programs in these areas, however, community level air data on OG related air toxics near active development sites are limited. This information is critical to adequately characterize potential health risks from OG related air toxics exposures, especially during times when communities report intermittent symptoms/odors during the various phases of development. In response to over 200 citizen reports of symptoms/ odors potentially related to OG emissions, we completed 6 community level investigations and collected over 800 hours of air samples during different phases of OG operations for 64 OG related volatile organic compounds (VOCs) and select criteria air pollutants. We collected air data during the drilling, fracking, and flowback phases, and from a CO2 production facility based on citizen reports. Investigations included a total of 15 grab samples collected by either citizens or staff, downwind of the OG site, and during times of reported symptoms/odors in attempt to quantify maximum exposures. To capture the site/phase of operations variability over a longer time period, we deployed the Colorado Air Monitoring Mobile Laboratory (CAMML) four times to two different communities to collect continuous air quality data and meteorology. Based on our evaluation of the continuous air monitoring, there is no clear evidence that airborne VOCs from OG operations result in potentially harmful long-term exposures to those living nearby. Although limited, our analysis of grab samples also suggests a low risk of harm from short-term acute exposures. More extensive site and OG-activity specific community level air monitoring is needed to fully understand the relationship between reported health symptoms and OG air exposures in Colorado.

Air Toxics Inhalation – Screening Level Health Hazard Assessment in Area with High Concentration of Natural Gas Production

Roger O. McClellan RO[1] and Snipes MB[2]
[1] Advisor, Inhalation Toxicology and Risk Assessment, Albuquerque, NM 87111
[2] Consultant, Inhalation Toxicology, Tijeras, NM 87059

Abstract: The Pinedale Anticline, Sublette County, WY, has in recent decades been a site of major development and production activity for gas and oil making extensive use of hydraulic fracturing and directional drilling. In response to local concerns for air quality impacts, the Sublette County Human Health Risk Assessment Air Toxics Project was conducted by Sublette County and the Wyoming Department of Environmental Quality in 2009-2010. The concentrations of 49 chemicals were measured at 14 locations over a one-year period using vacuum canisters or sorbent samplers with samples taken for 24 hours every 6 days. The samples were analyzed using EPA recommended methods. The ambient air concentrations measured represented contributions from multiple sources, including gas and oil production activities, diesel engines and forest fires. The Air Toxics Project data were made available to the public. The authors were engaged by Shell Exploration and Production to conduct a screening level Health Hazard Assessment using EPA recommended methodology. The average ambient air concentration data for each of the 14 sites was compared to human chronic health hazard indicators obtained from public sources to yield a Hazard Quotient. All of the calculated Hazard Quotients were less than 1.0. Of the 49 chemicals identified, 3 have been categorized as human carcinogens (benzene, butadiene and vinyl chloride), 8 as probable human carcinogens, and 3 as possible human carcinogens. The calculated excess cancer risks for each of the chemicals at each site were less than 1 in 10,000. These results suggested that additional investigation, focusing on potential health hazard from exposure to mixtures of chemicals in the ambient air, were not warranted. The results of this very extensive monitoring campaign should be considered in planning any potential monitoring, risk assessment or epidemiological investigations related to gas and oil production, including use of so-called "unconventional methods."

A Semi-Quantitative Geospatial Pollutant-Specific Exposure Metric for Use in Health Studies Associated with Unconventional Natural Gas Development in Pennsylvania.

James P. Fabisiak[1], Erica Jackson[1], and Shaina Stacy[2],
[1] Dept. of Environmental & Occupational Health, Graduate School of Public Health, University of Pittsburgh
[2] Dept. of Epidemiology, Graduate School of Public Health, University of Pittsburgh, and Hillman Cancer Institute (UPMC), Pittsburgh, PA.

Abstract: Unconventional natural gas development (UNGD) within the Marcellus Shale gas play is a rapidly expanding industrial process currently impacting many areas in Pennsylvania (PA) and often occurs in close proximity to residential areas. Concerns have been raised about whether such activities represent a hazard to human health, and several epidemiologic studies have associated residential proximity to adverse birth outcomes, asthma exacerbations, cancer risk, and other untoward health effects. Emission of various air pollutants during UNGD is one possible factor in these effects; however most, if not all, of these studies have gauged exposure indirectly based on distance from and density of nearby facilities or have made limited measurements in only a few locations. Thus, establishing associations to specific chemical exposures and dose-response relationships have proved problematic. It is currently impractical to measure individual exposure to specific chemicals over long periods of time in enough locations for use in large population health endpoint studies. We are utilizing pollutant- and facility-specific emission inventories available from the PA-DEP to create semi-quantitative geo-spatial

exposure maps relating to gas development for the entire state of PA over the years 2012 – 2016. First, the latitude and longitude for all reported Marcellus-related facilities were obtained and geo-located using Arc-GIS. Three concentric buffer zones of expanding diameter of 1, 2, and 3 miles were created around each facility. Volatile organic compounds (VOC) emission values were initially chosen as the pollutant of interest since they have high specificity for oil and gas activities, but we have also begun to similarly consider emission levels of additional contaminants such PM2.5 and NO2. The total reported annual VOC emission value (X) for a given year was arbitrarily assigned to the inner-most buffer zone of each facility. Pollutant values assigned to areas progressively more distant from the facility were adjusted based on presumed dilution as a function of surface area (d = 2-mile, X/4; d = 3-mile, X/9). When overlap occurred between buffers corresponding to different facilities the pollutant value assigned to the overlapped shape was a function of the sum of the pollutant values from each corresponding zone contributing to the overlap. For comparative purposes, when possible, UNGD facilities were designated as single well pad, multi-well pads, and downstream processing facilities such as compressor stations. The top ten industrial point emitters of VOCs from non-Marcellus sources in each county were also similarly analyzed. Exposure maps for VOCs for each year of Marcellus inventory reporting were obtained. We have noted that considerable variability exists between different facility types. For example, compressor stations can emit substantially more VOCs, PM2.5, and NO2 than UNGD wells. Moreover, even within a single facility type considerable heterogeneity exists and is often manifest as non-normal distribution characterized by a minority of high emitting facilities. Thus, simple proximity distance-weighting of a residence in relation to UNGD facilities without consideration of emission differences is likely a poor surrogate for specific chemical exposure. It is anticipated that this approach can yield a useful tool which can then be applied to environmental epidemiologic studies along with geo-coded patient/subject residential addresses in order to more specifically assign a chemical- and temporal-specific semi-quantitative exposure metric and evaluate exposure-response relationship to various disease endpoints.

Overview of Oil and Natural Gas Exploration and Production Industry Standards

Uni Blake
American Petroleum Institute

Abstract: To ensure consistency in risk management strategies, the American Petroleum Institute (API), a trade association of the oil and natural gas industry, has developed standards, guidelines and recommended practices for the industry to follow that ensure that exposures during normal industry activities are minimized and that operations under upset conditions are designed to protect human health and the environment. API is a leader in standard setting for the oil and natural gas industry and is accredited by the American National Standards Institute (ANSI). Over the years API has developed over 700 consensus standards, guidelines and recommended practices that govern all the oil and natural gas industry segments. Many API standards are incorporated into federal and state oil and natural gas regulations. The standards are also widely cited by international regulators. This presentation provides an overview of API's industry standards and recommended practices that relate specifically to exploration and production operations ensuring they are continuously improving and that risks to worker and community health are effectively managed.

Engaging Agencies and the Public in Atmospheric Monitoring Observations through Real-Time Data Posting

D. Helmig[1], B. Blanchard[1], J. Hueber[1], P. Milmoe[2], C. Copeland[2]
[1]Institute of Arctic and Alpine Research, University of Colorado, Boulder, USA;
[2]Boulder County Public Health, Boulder, USA

Abstract: The influx of oil and natural gas development into densely populated areas has raised citizen's concerns about air quality and resulting health impacts of emissions from these operations. This has prompted local governments to seek help in monitoring oil and gas pollutants for assessing citizen's exposures and associated risks. Sponsored by Boulder County Public Health, we developed and installed high time resolution monitoring of methane, volatile organic compounds, and nitrogen oxides at the Boulder Reservoir. Automated chromatogram integration, calibration, and data processing routines were implemented, and data are posted in near real-time on a public website (http://instaar.colorado.edu/arl/boulder_reservoir.html), with additional educational information on the monitored gases and interpretation of results. Methane and light alkane VOC show a strong influence from oil and natural gas sources in the north to southeast of the site. Transport events with elevated levels of VOC, exceeding background levels by 20-100 times, are frequently observed. Mean annual concentrations for many VOCs exceed those of large U.S. urban areas. This monitoring and sharing of real-time results has been instrumental in raising the interest of citizens and making this monitoring a viable source of information for use by agencies, citizen groups and the media. This is further evidenced by the close to 12,000 visits to the public website during the first year of operation.