Climate Change & Idaho's Treasure Valley Air Quality

Potential Impact on Community Health

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The Boise metropolitan area is growing rapidly, with new housing developments, new shopping centers, and new roads. Automobile traffic is increasing and air quality declining as more people move into this region, long called the Treasure Valley for its natural riches.

International epidemiological studies have shown a strong correlation between ambient air pollution and respiratory illnesses. Such conditions appear to disproportionately harm children and elderly people who suffer from asthma and other respiratory illnesses, and anyone with chronic cardiovascular disease.

Because the Treasure Valley now accounts for about 60 percent of Idaho's population, it is a focus of state concern about air quality, overall environmental quality, and public health. Environmental changes could restrict the region's potential for future growth and development because the Clean Air Act requires that the Treasure Valley meet national air quality standards. Air quality conditions associated with winter inversions have already placed the Valley near noncompliance limits.

How air pollution forms

Two factors determine the ambient concentrations of air pollution: Emissions and weather. If there are no emissions (man-made or natural), air pollution problems are not expected. Depending on weather conditions, however, even a moderate amount of emission can create potentially serious air quality problems.

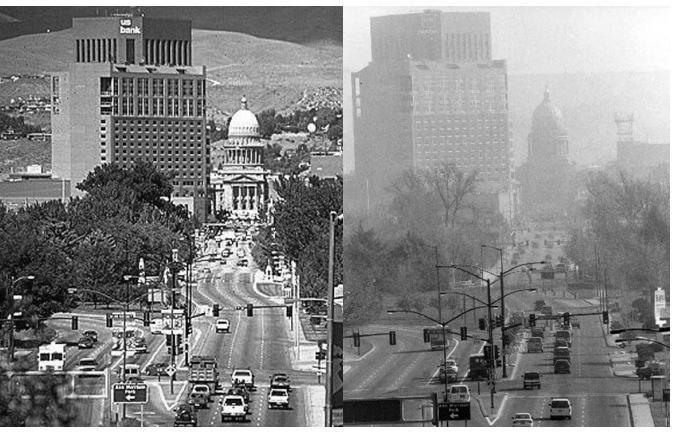

Photo: Idaho Department of Environmental Quality

Downtown Boise on a clear day (left) and during a winter inversion period (right).

As changing climate conditions in the Pacific Northwest influence seasonal weather patterns, we can extrapolate how different climate regimes may affect air quality in the Treasure Valley, and how this can affect the health of our population.

Because of our topography (a perfect bowl) the Treasure Valley can experience some of the most severe wintertime inversions in the intermountain west. Inversions occur when heavier, colder air settles into the valley while warm air sits above it. This causes the air to stagnate and trap pollutants until another weather system moves through and mixes the air mass. Particulate matter is the pollutant of primary concern during such episodes, and concentrations in our region frequently exceed national health standards.

In the summer, the valley experiences problems with ground-level ozone concentrations. Stagnant air conditions combine with high heat and intense sunlight to produce unhealthy levels of ozone from volatile organic compounds (VOC) and nitrogen oxides (including NO and NO_2) Over the past decade, the number of "Good" air quality days, as rated by EPA's Air Quality Index or AQI system, has been steadily decreasing in the Treasure Valley, from a high of 300 days rated as "good" in 2001 to fewer than 170 in 2007. Concentrations of ozone and particulate matter in the Valley occasionally exceed national health criteria, and barely meet the National Ambient Air Quality Standards.

Computer models allow us to project current patterns of weather and air pollutant concentrations, and extrapolate them according to various scenarios of climate change. The Community Multi-scale Air Quality (CMAQ) modeling system is used by the Idaho Department of Environmental Quality (IDEQ) to model ozone and fine particulate concentrations in the Treasure Valley, and can be used to evaluate both long-term (annual to multi-year) as well as short-term climate changes. We can vary the scenario to assume the climate is warmer and more humid, warmer and less humid, colder and more humid, or colder and drier. Each of these scenarios produces a different pattern for summer and winter.

Climate change: hot & humid

With warmer average winter weather, more precipitation would fall as rain instead of snow, and

inversions would be unlikely. Higher rainfall and more frequent storm fronts would keep the air well mixed and would wash out particles. Also, roads would be sanded less often and residential wood stoves would be used less often.

A wetter than normal summer would lower ozone concentrations as weather fronts mix the air.

Climate change: warm & dry

Fewer weather fronts could lead to long periods of stagnant air. While inversions would not be exceptionally strong in this type of weather pattern, average particulate levels could be high.

Warm, dry summers are a recipe for high ozone concentrations in the Treasure Valley because of high evaporative VOC emissions. Without weather fronts, pollutants would build up rapidly to unhealthy levels. Dust and wildfires could increase ambient concentrations of particulate matter. Ozone concentrations would be expected the worst under this scenario because temperature and ozone formation are linked.

Climate change: cold & humid

Cold, wet winters would bring large amounts of snow to the Treasure Valley. A heavy snow pack on the valley floor can worsen temperature inversions, but weather fronts would result in a net reduction of particulate concentrations in the ambient air.

Just as hot, dry summers are ideal for ozone formation, a cooler and wetter summer would likely lower ozone concentrations, particularly with substantial cloud cover.

Climate change: cold & dry

Cold, dry winters typically are associated with extensive inversions in the Treasure Valley. Snow on the ground amplifies the cooling effect. This scenario has been associated with the worst air quality in the Treasure Valley and high particulate matter levels.

A summer that is cool but dry would likely improve ozone concentrations by inhibiting evaporative VOC emissions.

Health Issues

Data from clinical, epidemiological, and animal studies indicate that exposure to ambient ozone is an important risk factor for short and long-term health effects. These can include chest discomfort, cough, and shortness of breath in healthy people as well as those with lung disease; asthma attacks in people with asthma; the possible development of new cases of asthma and other respiratory disease in people exposed to ozone over many years; and possibly mortality in people with lung disease. For example, when ozone levels are high, people with asthma may experience worsening respiratory symptoms, need more medication, and be more likely to go to emergency rooms or be admitted to the hospital. Of course, as with most triggers, some people may be more severely affected than others. In general, people suffering from chronic obstructive pulmonary disease (COPD), including emphysema, chronic bronchitis, and asthma, are at increased risk.

Exposure to particle pollution occurs when people inhale a mixture of microscopic solids and aerosols or liquid droplets suspended in air. Components include acids, organic chemicals, metals, soil or dust particles, and allergens. The size of particles is directly linked to their potential for causing health problems. Small particles less than 2.5 microns in diameter pose the greatest problems because they can be inhaled deeply into the lungs. Larger particles are of less concern, although they can irritate the eyes, nose, and throat. The health effects associated with the exposure to particulate air pollutants can include inflammation of lung tissue in young, healthy adults; increased numbers of heart attacks, especially among the elderly and in people with heart conditions; increased severity of asthma attacks in children; and increased emergency room visits for patients suffering from acute respiratory ailments.

Pollution and climate change scenarios for Idaho's Treasure Valley

Climate Change Scenario	Meteorological Conditions	Ozone	Particulate Pollutants	Air Quality Conditions
Warm and wet	Unstable	Low	Low	Good
Warm and dry	Stable	High	High	Poor
Cold and wet	Unstable	Low	Low	Good
Cold and dry	Stable	Low	High	Poor

Such evidence is found, for example, in a review of daily hospital admission rates constructed from the Medicare National Claims History files for cardiovascular and respiratory outcomes (11.5 million Medicare enrollees in 204 US urban counties between 1999 and 2002). The study revealed a short-term increase in hospital admission rates during times of high particulate pollution. Admissions increased for all health outcomes except injuries, with the largest association for heart failure.

Authors

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