Impacts of a shrinking Great Salt Lake on future air quality along the Wasatch Front

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Human exposure to adverse air quality is expected to continue into the foreseeable future along the Wasatch Front due to rapid population growth combined with an increase in dust production as a result of shifting climate and heightened anthropogenic activities (e.g., agriculture, energy exploration/development, recreation). In addition, the mean lake elevation for the Great Salt Lake (GSL) has been declining as a result of increased water consumption along the Wasatch Front, resulting in an increase of dust-prone land-surfaces. Wind-blown dust events often lead to elevated levels of particulate matter (PM_{10} and $PM_{2.5}$), which are regulated by the U.S. Environmental Protection Agency (EPA) through the National Ambient Air Quality Standards (NAAQS). Research has shown that prolonged exposure to elevated $PM_{2.5}$ and PM_{10} concentrations can cause significant health issues in the form of cardiovascular and respiratory diseases as well as premature death, with the young and elderly being the most sensitive to exposure. In order to estimate the impacts of a shrinking GSL on future air quality, we have developed a dust modeling framework that can quantify the impacts of wind-blown dust on $PM_{2.5}$ concentrations at major population centers. Simulations were carried out for two different GSL level scenarios: (1) the GSL after the proposed Bear River Dam Project is completed, and (2) complete desiccation of the GSL. For the Bear River Dam scenario, results showed that despite a minimal decrease in lake levels by 23 cm, $PM_{2.5}$ concentrations along the Wasatch Front during wind-blown dust events increased by ~70%, on average. For the desiccated lake scenario, $PM_{2.5}$ increased by ~110%. Here we conclude that further reducing GSL water levels could increase the risk of significant enhancements in $PM_{2.5}$ levels during wind-blown dust events, which will worsen air quality along the Wasatch Front and potentially jeopardize Utah's State Implementation Plan for reducing $PM_{2.5}$.