Characterization of Gas-Phase Air Pollutants and their Public Health Impact

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Air pollution can have deleterious effects on human health. This study examines the role of meteorological factors on air pollution concentrations and their cumulative effects on public health in Hackensack Meadowlands, New Jersey. Ambient concentrations of nitrogen oxides (NO_x) and ground-level ozone (O_3) were measured and meteorological variables were monitored at the Meadowlands Environmental Research Institute (MERI) from June 2007 to May 2008, to characterize the temporal and seasonal variations of gas-phase air pollutants. Health records of respiratory hospital admissions were obtained from the New Jersey Department of Health and Senior Services (NJDHSS). Statistical analyses were conducted by using time series, multiple linear and principal component regression techniques. The meteorological conditions and air pollutants that may be associated with human respiratory health effects were analyzed.

The results show that ambient levels of NO_x and O_3 are influenced by certain meteorological conditions in the Meadowlands, and there is a strong relationship between hospital admission and personal exposure to NO_2. There is no direct relationship between O_3 and hospital admission (r=-0.092), whereas hospital admission and NO_x correlate (r=0.317) but more strongly with NO_2 (r=0.359) at a significance level of 0.01. Hospital admission rates are indirectly affected by relative humidity (r=-0.077). The seasonal dependence of pollutants is caused mainly by low wind speed and differences in chemical processing, making them interdependent. Seasonal variations of NO_x were less distinct with strong diurnal patterns of traffic-related peaks during the early morning rush hour. There was a strong association between NO_x and respiratory hospital admissions in the fall, winter and spring seasons. The variability of NO_x and O_3 was altered by distinct atmospheric conditions and chemical inter-conversions of the pollutants. There was an inverse relationship between concentrations of NO_x and O_3; the latter was dominant in summer and specific time of the day (early afternoon). For O_3, association with hospital admissions was strongest at 2 lag days. Both climate-induced and pollution-induced health effects of NO_x and O_3 suggest that current national standards may not adequately provide a safe threshold for air pollutants from a public health perspective.

Uranium isotopes as a novel tracer of paleo-hydrology?

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Uranium series isotopes provide unique insights into the rates and amplitude of geologic processes through their range of chemical behaviours in different environments, and their radioactive decay. In this case we use ^{234}U and ^{238}U isotopes to examine and quantify the controls of uranium input to rivers with an emphasis on watershed precipitation and discharge. First we show data from contrasting hydrological zones in two dynamic regions: New Zealand and Chile. After controlling for lithology and physical weathering caused by uplift we show that the strength of the hydrologic cycle plays a distinct role in controlling the $^{234}U/^{238}U$ ratio in river waters as they move through a water shed. Hydrothermal systems, subsurface processes and lakes may also act to affect the final ratio as rivers discharge into the ocean. The hydrologic cycle is thought to have changed markedly over millennial and glacial interglacial timescales leading to the possibility of a shift in the $^{234}U/^{238}U$ ratio of rivers, groundwater and seawater. Terrestrial speleothem $^{234}U/^{238}U$ records appear to provide supporting evidence for a lower regional hydrologic cycles during the last glacial period. By contrast, a compilation of seawater $^{234}U/^{238}U$ recorded in corals point to a shift in the opposite direction.

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