Feedbacks between biological retention of nutrients, carbon-mineral sorption, and pore space generation along an earthworm invasion chronosequence

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Partitioning and transport of chemical phases in soils are governed by the complex interactions between competing biotic and abiotic processes that are difficult to quantitatively and mechanically separate. Addressing this challenge, we study an ~200 m long earthworm invasion chronosequence in a hardwood forest in Minnesota. The forests in the Great Lakes region have evolved without native earthworms since the Last Glacial Maximum. Exotic earthworms were recently introduced due to agriculture, recreational fishing, and logging activities. The transect represents an invasion history of ~40 yrs with its invasion front proceeding at a rate of ~5 m/yr. We quantified the degree that biological retention of elements (Si, Ca, P, K), sorption of organic matter on mineral surface, and generation of pore space respond to the arrivals of different earthworm functional groups. Invasive earthworms critically and systematically impact the three key biogeochemical processes. We quantitatively and mechnistically reveal that strong feedbacks among the three processes are present, and that the feedbacks systematically evolve with ongoing earthworm invasion. We determined biomasses and species compositions of earthworms, elemental chemistry (ICP), soil mixing intensity (^{137}Cs), and carbon-mineral sorption (BET), and adopted the geochemical mass balance approach with Zr as an immobile element. This study illustrates how and to what degree invasive earthworms – by altering bioturbation and consuming particulate organic matter – cause cascading effects on the dynamics and interactions between nutrients and carbon fluxes.

Light-absorbing aerosol radiative forcing in the Kathmandu Valley during Suskat-ABC Field Campaign

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Light-absorbing aerosols, such as black carbon (BC), are major contributors to the atmospheric heating and the reduction of solar radiation reaching at the earth's surface. In this study, we investigate light-absorption properties of aerosols (i.e., BC mass concentration, aerosol solar-absorption efficiency) in the Kathmandu valley during Sustainable atmosphere for the Kathmandu valley (SusKat)-ABC campaign, from December 2012 to February 2013. Kathmandu City is among the most polluted cities in the world. However, there are only few past studies that provide basic understanding of air pollution in the Kathmandu Valley, which is not sufficient for designing effective mitigation measures (e.g., technological, financial, regulatory, legal and political measures, planning strategies). A distinct diurnal variation of BC mass concentration with two high peaks observed during wintertime dry monsoon period. BC mass concentration was found to be maximum around 09:00 and 20:00 local standard time (LST). Increased cars and cooking activities including substantial burning of wood and other biomass in the morning and in the evening contributed to high BC concentration. Low BC concentrations during the daytime can be explain by reduced vehicular movement and cooking activities. Also, the developmements of the boundary layer height and mountain-valley winds in the Kathmandu Valley paly a crucial role in the temproal variation of BC mass concentrations. Detailed radiative effects of light-absorbing aerosols will be presented.

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