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The impact of Eurasian dust storms and anthropogenic emissions on atmospheric nutrient deposition rates in forested Japanese catchments and adjacent regional seas

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Bulk precipitation and stream water chemistry data from 1993 to 2005 are used to analyze the relationship between Eurasian dust storms and nutrient deposition rates in the Kutsuki experimental forest (near Lake Biwa). From 2000 to 2005, atmospheric deposition, total nitrogen (TN), total phosphorus (TP) and dissolved silica (DSi) deposition rates increased by 26%, 132%, and 38%, respectively in the Kutsuki experimental forest. These TN and TP increases are associated with three seasonal factors: the increasing frequency and intensity of Eurasian spring dust events (March/April); the annual typhoon period (late August/September); and autumn/early winter (October to December) monsoons. The annual typhoon and monsoon winter periods are drivers for atmospheric TP and DSi deposition due to the correlation between the deposition and precipitation. In addition, increased spring dust deposition is a primarily driver for TN deposition changes. Increased emissions from urbanized areas in China (and likely Korea) affect the chemical properties of aerosols reaching downwind Japanese regions. Aerosol processes are responsible for increasing TN in aerosols, which are affected primarily by anthropogenic emissions. From 2000 to 2005, coal burning emissions from East Asia have contributed to an increase in TP (and possibly DSi) deposition rates. The observed increase in nutrient deposition did not noticeably impact short-term (5 year) stream water fluxes in the Kutsuki experimental forest. Due to plant uptake, the forest ecosystem retained atmospherically deposited N and P. Finally, the observed increases in nutrient deposition rates over the East China Sea and the Sea of Japan may significantly influence intra-annual net primary production. It is recommended that earth system modeling incorporate changes in atmospheric nutrient deposition rates and their impacts on the regional carbon cycle as well as aquatic and terrestrial ecosystems.