Changes in the global freshwater N and P cycles over the 20th century

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Dramatic world-wide changes occurred during the 20th century in both nutrient delivery and in-stream retention. In this paper, we use a combined nutrient-input, hydrology, in-stream nutrient retention model to quantitatively track the changes in the global freshwater N and P cycles over the 20th century. Global nutrient delivery almost doubled due to expanding agriculture and increasing wastewater discharge. Nutrient retention also increased by a factor of two as a result of the rapidly growing number of dams and reservoirs. This increase in nutrient retention could not balance the increase in nutrient delivery to rivers. River export to coastal seas increased during the 20th century from 19 to 37 Tg yr-1 of N and 2 to 4 Tg yr-1 of P. There are important differences in riverine N:P export ratios in various parts of the world resulting from the interplay of multiple processes and economic activities in different river basins. Increasing nutrient loading of freshwater systems is a threat to water quality. Furthermore, the global river export increase in the molar N:P ratio during recent decades may affect the ecology within both the river basins and the coastal system. This ratio change may be driven by the recent stagnation of P fertilizer use in most industrialized countries, in comparison to the ever increasing N fertilizer use.