Sources, sinks, and transport of nutrients across a mixed-use headwater catchment in north-central Ohio

Ozeas Costa Jr
School of Earth Sciences, The Ohio State University, Mansfield, Ohio, United States of America (costa.47@osu.edu)

In many ecosystems on land and sea, the supply of nutrients is a key factor controlling the nature and diversity of plant life, the population dynamics of both grazing animals and their predators, and vital ecological processes such as plant productivity and the cycling of carbon and soil minerals. Over the last century, runoff from farms and cities, along with land cover and land use changes, have drastically altered the mass balance of nutrients in aquatic systems, affecting both their ecological functioning and the living communities they support. Here we present the results of a multi-year nutrient assessment of streams and lakes from the Mohican Watershed, in North-Central Ohio, which drains to the Ohio River and into the Gulf of Mexico. A total of 64 streams and 8 lakes/reservoirs have been sampled periodically since the summer of 2008. A GIS-based landscape model was used to examine the relationships between streams and their catchments. Land use data from NLCD was used to select representative reach-catchment areas in one of four categories: forested, developed, cropland, and pasture. Nutrient concentrations (NO$_2$; NO$_3$; NH$_4$; PO$_4$) were measured and used for calculation of nutrient fluxes within the watershed. Sampling was undertaken during both baseflow and stormflow conditions in order to evaluate the effects of precipitation on nutrient transport. In order to assess nutrient contribution from atmospheric deposition, rainwater samples were also analyzed. Our results show that nutrient fluxes are highly controlled by the land use of the reach-catchment and by precipitation events. In addition, there is a marked shift between local and external controls on biogeochemical processes under baseflow and stormflow conditions. During stormflow, nutrient input is primarily hydrologically controlled. During baseflow, biological processes dominate both the production and removal of nutrient ions from the stream. This short-term hydrological variability is compounded by the effects of long-term geomorphic and climatic changes, and an increase of over 15% in nutrient export was observed during wetter years.