**Title**: **Estimates of global erosional sediment, carbon, nitrogen and phosphorus fluxes**

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Soil erosion yields enormous amounts of sediment, carbon (C), nitrogen (N) and phosphorus (P) that are transported from land to rivers and oceans, which has significant impacts on both geomorphology and biogeochemistry of aquatic and coastal ecosystems. However, large-scale estimates of erosional biogeochemical fluxes under climate and land cover changes are lacking. In this study, we calibrate the soil erosion module of the DOE Energy Exascale Earth System Model (E3SM) using the global 25-km resolution RUSLE-based soil erosion estimate and the WBMSed basin-level sediment yield estimate as benchmarks. Using the calibrated model, we estimate the fluxes of erosional sediment, C, N and P globally and evaluate their dynamics in large river basins under climate and land use and land cover changes from 1990 to 2010. Importantly, we find that for many river basins, sediment production in river channels is a substantial sediment source that cannot be ignored, because sediment yields in these river basins are much larger than the levels of soil erosion. This result shows the importance to represent sediment production in rivers in E3SM’s river model, MOSART, to reasonably predict the riverine transport of sediment, C, N and P to the global coasts.