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Relations between common geographic descriptors and discharge nutrient concentrations across regions and at multiple scales

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Most river basins and coastal regions worldwide are not monitored adequately to support direct data based nutrient load computations to receiving waters. Therefore, there is continued need to investigate basic relationships between upstream conditions and downstream nutrient discharges. Much work has been done in the past to identify land use based nutrient yield coefficients, however yield coefficients disconnect load estimation from the hydrological cycle and thus expected changes. Here, we investigate relationships between recent multi-year flow-averaged riverine total nitrogen (TN) and phosphorus (TP) concentrations as a function of upstream population density, percent crop and total agricultural cover, and fertilisation load over a wide range of scale (5E0-1.8E6 km2) and characteristics (e.g., 0-95% crop cover). We developed two new and utilised four previously published datasets (n=150 basins in total) to bridge understanding across three major drainage areas: the Baltic Sea, the Mississippi River basin and eastern seaboard, U.S.A. Significant positive correlations were observed in most cases between TN and TP concentrations and the geographic variables. Most noteworthy were strong and consistent relationships across the six datasets and three regions for TN concentration as a function of both percent crop cover and basin fertilisation load. In comparison, TP relationships indicated scale and region dependence. Simple empirical models for TN and TP prediction were calibrated and tested against independent data (n=113). These results are relevant to understanding how nutrient export functions across regions, and can also be useful for first order load estimation (provided complimentary flow data) in other less-well monitored non-arid regions.