Domestic wastewater inputs of phosphorus and nitrogen to the Mediterranean Sea

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Sources of phosphorus (P) and nitrogen (N) associated with wastewater discharges may contribute to eutrophication of aquatic systems. In the Mediterranean Sea (MS), both treated and untreated wastewater is discharged directly into coastal areas. Wastewater inputs pose a threat to the vulnerable ecosystems of the MS and are likely to increase in the near future. Of particular concern are algal blooms within the coastal zone of the MS linked to discharges of wastewater [1]. Nonetheless, current nutrient budgets for the MS do not include direct wastewater discharges of P and N. Here, we use an empirical modeling approach to quantify P and N associated with household wastewater discharged directly into the MS for cities with a population of more than 2000 inhabitants. We further determine the relative importance of direct wastewater discharges to riverine inputs of P and N into the MS. In 2003, 0.93 (0.52-1.46) x 10^9 mol P yr^{-1} and 14.6 (10.5-22.7) x 10^9 mol N yr^{-1} from domestic sewage were discharged directly into the MS. These values are on the same order of magnitude as the P and N inputs from rivers [2] and therefore should be included in nutrient budgets. Inputs from wastewater may become increasingly important in the future as river loads of P and N decrease due to drier climate and best management practices. Scenario analyses indicate that by 2050, P inputs along the African coast are projected to increase by 147% in response to population growth if no mitigation strategies are implemented, compared to only an increase of 14% in north Mediterranean countries. Improvements in sewerage systems and treatment facilities should therefore be a priority in the southern region of the MS basin.

[1] Diaz, et al. (2011). Global Eutrophic and Hypoxic Coastal Systems. *World Resources Institute*. [2] Ludwig, et al. (2009) *Global Biogeochem. Cy* **80,** (199-217)