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Short-term changes of anthropogenic eutrophication with precipitation in tropical coastal waters (Guanabara Bay, Rio de Janeiro, Brazil)

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Eutrophication in coastal waters caused by non-treated urban discharges has been considered one of the most important effects of global change. At tropical latitudes, nutrient dynamics may be especially intense due to increased metabolic responses supported by high temperatures and solar incidence throughout the year. In addition, short-term variations, such as in rainfall and the tidal regime, may determine important changes in nutrient concentrations and the subsequent trophic status of coastal waters, which are still neglected especially during nocturnal periods due to common logistical constraints. Here, we assessed 24-h variations of water quality during the winter season in a tropical eutrophic bay that receives large inputs of nutrients from non-treated urban effluents (Guanabara Bay, RJ, Brazil). We measured concentrations of dissolved forms of nutrients (nitrate, nitrite, N-ammoniacal, phosphate, and silicate) and carbon (DOC), and oxygen (DO) associated with temperature, salinity, and pH in surface waters each 2h over two daily cycles (July and August 2018). Water samples for nutrients and DOC were preserved for later analysis, while other variables were measured in the field. A biomonitoring system with a submersible pump was used to collect surface coastal waters without bubbling, and along a 70 m pipe from the beach to the field lab. In turn, meteorological data were obtained from a city weather station located ~6 Km from the sampling area. The monthly accumulated precipitation with respect to the 24-h cycle in July was ~70% lower than in August (58 and 16 mm, respectively), although only that in July has showed a rainfall event during the sampling period. As a result, average DOC and N-ammoniacal concentrations in surface waters were ~50% lower, while nitrate, silicate and DO concentrations ~56, 164 and 50 % higher, respectively, during the 24-h cycle in August compared

to July. Also, waters were slightly more basic and less saltier in August, contrasting with similar average values of phosphate concentrations and temperature between both sampling periods. Finally, DO concentrations indicated an intense metabolism, varying from a peak of supersaturation with high solar incidence to net autotrophy (2 pm) to undersaturation values as a proxy of net heterotrophy after the nocturnal period (6 am). In conclusion, this short-term study showed that higher monthly accumulated precipitation may dilute high DOC and N-ammoniacal concentrations in coastal aquatic ecosystems undergoing anthropogenic eutrophication. On the other hand, silicate and nitrate concentrations might be related to higher runoff inputs from the watershed. The event of precipitation in July also confirmed a drastic increase in nitrate concentrations, likely due to inputs from the watershed. Therefore, our findings reveal the complexity of accumulated and immediate effects of rainfall on nutrient levels in tropical coastal waters, which highlight the importance of biomonitoring studies specially in urban areas.