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Remobilization of hazardous contaminants caused by climate-induced flood events in (sub-)tropical river systems (Chennai, India)

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An alarming rise of sea level is the most prominent but by far not the only hazardous phenomenon caused by climatic change. Extreme weather events with increasing frequency, such as droughts or contrasting heavy rainfalls, cause severe harm to local populations. This holds true especially for fast-growing urban centers, such as Chennai (India) with a missing or unmaintained waste and drainage management. These large coastal population centers face an increasing vulnerability to frequently reoccurring monsoon-induced floods (e.g., Chennai flood 2015; Kochi flood 2018, 2019), intensified by the advancing urbanization along the urban landscape crossing river systems and adjacent floodplains. Accompanied with these extreme floods are the increased release, re-localization and distribution of toxic xenobiotics and other pollutants (e.g., PAHs, LABs, DEHA, Mesamoll®, NBFA, and pesticides) causing harm to adjacent communities and the environment along the river's pathway. In order to endeavor the unknown risk posed by toxic river floods, to assess the flood and associated pollution history the preserved pollution signature from sedimentary records needs to be considered.

This investigation evaluates the inorganic and organic pollutant assemblage in nine sediment profiles along the Adyar and Cooum rivers (Chennai, India). Thereby heavy metals (Cr, Ni, Cu, Zn, Pb) show a continuous concentration decrease downstream towards the coast with their specific sources remaining unsolved. Based on GC-MS analysis, four main groups of organic pollutants have been detected: petrogenic pollutants (hopanes, PAHs), urban wastewater compounds (LABs, DEHA, methyl-triclosan, octocrylene), technical compounds (Mesamoll®, DPE, NBFA, PCBs) and pesticides (DDX). Organic compounds show a distinctly differing distribution pattern compared to the heavy metals. Some compounds (e.g., PAHs, LABs, DEHA, NBFA, Mesamoll®) were detected in high concentrations deriving from nearby point sources (e.g., tributaries, canals). While most organic compounds show high source specific properties, the definite sources for other compounds remain vague as the result of large scale and diffusiveness of anthropogenic emissions, such as air pollution or (untreated) industrial and municipal wastewaters. The chosen approaches have shown that urban wastewater pollutants and several technical compounds are suitable markers to assess the anthropogenic induced pollution and event history in sedimentary archives. However, the given sedimentary archives in these fast-growing and urbanized population

centers might not always allow a full reconstruction of past events, as anthropogenic alterations on the rivers course and floodplains effect the archive's preservation potential. For Chennai, advantages and disadvantages regarding the chemostratigraphic preservation are delicately balanced. However, increasing urbanization and anthropogenic overprinting causes the disruption of sedimentary archives and redistribution of contaminated material (e.g., through dredging), this favors remobilization and relocation of hazardous contaminants, thus endangering the local population due to the high mobility of these pollutants.