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Diel cycles of reduced manganese and their seasonal variability in the Marque River

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Electrolabile reduced manganese (II) has been monitored by voltammetry during two periods of one month in summer 2014 and at the end of winter 2015 in a small river (the Marque River) located in northern France and going through a suburban area with agricultural activities. Diel variations, evolution within the one-month period and seasonal differences have been observed. Taking into consideration the multiple physical, biological and chemical reactions regulating manganese speciation in aquatic systems, it has been demonstrated that manganese is probably controlled by the competition of two antagonist reactions: the photoreduction of manganese oxides (in broad sense and represented thereafter by MnOx) and the biotic oxidation of Mn(II). Depending on the season, the biological activity in the river and the amount of luminosity reaching the MnOx, the dominant process can be shifted rather toward the production of reduced labile Mn(II) or toward the precipitation of MnOx. Other punctual events such as the drop of oxygen concentration due to large inputs of biodegradable organic matter and eutrophication phenomena, rainy events and high luminosity periods can also affect the behavior of dissolved Mn(II) in the Marque River.