**Processes driving carbon, nitrogen and phosphorus balance in mangrove creeks with varying anthropogenic influence.**

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The main objective of this study was to investigate the processes driving dissolved gases (carbon and oxygen) and nutrients (nitrogen and phosphorus) balance in Mtoni and Ras Dege mangrove forests. This was achieved by comparing: i) creek waters physicochemical characteristics between the two sites (Mtoni and Ras Dege) within wet and dry seasons, ii) forests benthic sediment characteristics, anaerobic organic matter mineralization and fluxes of dissolved gasses (CO2 and O2) between Mtoni and Ras Dege mangrove forests, iii) water column processes governing concentration of dissolved gases (O2 and CO2), nutrients (N and P) and organic carbon (particulate and dissolved) and iv) the processes happening in the natural forest (Mtoni and Ras Dege) and those happening in the experimental mesocosms planted with Avicennia marina and Rhizophora mucronata seedlings and experimentally exposed to domestic sewage of varying strength. DIC studied in the water column was higher in Mtoni than Ras Dege creeks ANOVA test: $p=0.0138$ and generally higher in wet season than in dry season while turbidity was generally higher in Mtoni than in Ras Dege (student's- t-test, $p < 0.05$). Generally Ras Dege creek water had higher pH than Mtoni water (one way ANOVA: $Fs=5.585$, $df=1$, $p=0.039$). Wet season samples from Mtoni creek waters, had significantly higher particulate organic carbon (POC) and nitrogen (PON) than the waters from Ras Dege creek(one-way ANOVA: $df= 1$, $Fs= 4.43$, $p= 0.04$ and one-way ANOVA: $df= 1$, $Fs= 10.25$, $p= 0.012$)respectively. On general account, sediment samples from Ras Dege had higher SRR's than those from Mtoni regardless of the season ( one-way ANOVA: $df =7$, $Fs = 13.77$, $p= 0.00001$)and outer boundary sites(R1 and M1)had higher FeR than inner sites t-test: $t = -3.596$, $df=3$, $p= 0.036$ and sample t-test: $t= -5.109$, $df=3$ , $p= 0.015$) respectively. CO2 fluxes during the wet season for both stations were significantly higher (one-way ANOVA: $df =7$, $Fs =37.999$, $p =0.002$ ) than that of the dry in Ras Dege indicating that Mtoni is more polluted than Ras Dege. There was also higher CO2 fluxes in wet season than in dry season for both sites indicating the effect of the wet season in controlling the benthic metabolism. Anaerobic carbon oxidation was dominated by FeR irrespective of anthropogenic influence in sediments in natural

mangrove forests. In the Mesocosm study the microbial mineralization in the water column reduced organic pollutants by > 90% while anaerobic carbon mineralization in the sediment was dominated by SRR and increased with sewage dose. The study proved the resilience nature of mangrove forest by sinking most of organic pollutants which could cause eutrophication in adjacent coastal waters. Anaerobic mineralization higher GPP in Mtoni (4.5-5.2 μM O2 h−1 ) than RasDege(3.4-3.9 μM O2 h−1 as evidenced by Mesocosm study: (cells receiving higher sewage dose (60%) revealed higher GPP than the cells receiving low dose) indicate that anthropogenic activities in Mtoni are main drivers of the balance in nutrients and dissolved gases in mangrove forests. Higher DOC and NH4+ production in both stations in neap waters indicate the influence of tidal waves and season in general water column metabolism.