Sedimentation in response to sea level rise in mangroves of Mwache Creek, Mombasa-Kenya: a field and modeling study

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The stability of mangrove ecosystem in the face of rising sea level highly depends on their ability to maintain their surface elevations relative to sea level. This ability is a function of mineral and organic sedimentation and compaction rates. In Kenya, there is little information regarding the magnitude and interaction of the above biophysical processes that cumulatively control accretion and elevation changes. This study carried out a field study in Mwache Creek, Kenya to examine the prevailing rates of accretion and elevation changes. Variation in accretion rates, suspended sediment concentrations (SSC) and elevation changes were measured in the densely and less vegetated parts of Mwache Creek. Suspended sediment concentrations varied between 0.076g/L in less vegetated site to 0.128g/L in the densely vegetated site. Elevation change rates ($mmyr^{-1}$) measured using sedimentation-erosion tables (SETs) varied between 1.33$mmyr^{-1}$ in the less vegetated to 2.48$mmyr^{-1}$ in the densely vegetated sites and this correlated to average accretion rates measured by the sediment traps ranging between 0.6$mmyr^{-1}$ in the less vegetated to 1.05$mmyr^{-1}$ in the densely vegetated sites. There was a positive correlation between accretion rates and suspended sediment concentrations (R^2 = 0.60). The sea level in Mombasa was found to be rising at a rate of 3.1$mmyr^{-1}$ which correlates well with projected global rates of 3.0$mmyr^{-1}$. The model simulations showed that the growth of mangrove surface elevation is influenced by mangrove surface elevation (which controls inundation), mineral sedimentation, compaction rates and amount of sediments in suspension (assist in accretion) but rates of organic sedimentation and low settling velocities caused minimal effect. This study showed that biophysical processes in such ecosystems interact and their magnitudes moderate the accretion and elevation changes. Quantification of these biophysical processes provides an understanding of the integrity and sustainability of mangrove ecosystems in the face of global threats including relative sea level rise.

Keywords: Mangroves; Suspended sediment concentration; Accretion; Sea level rise; Modeling.