

Future flooding of the Volta Delta caused by sea level rise and land subsidence

Abstract

The Volta Delta (Ghana, West Africa) is increasingly impacted by Sea Level Rise (SLR). SLR renders the Volta Delta mostly vulnerable to flooding, salinization of water resources and agricultural fields, and permanent loss of lands. This would potentially threaten its population, infrastructure and economy, and could be worsened by land subsidence (LS). Relative Sea Level Rise (RSLR) in this study is the rate of LS with respect to SLR. It is thus very important to precisely quantify LS rates together with SLR and plan and assess countermeasures. This study presents and discusses recent LS rates in the Volta Delta derived from satellite-based SAR-Interferometry and their impact on relative SLR. Sentinel-1 scenes acquired between 2015 and 2021 were used to quantify recent LS in the study area. The Persistent Scatter Interferometry (PS-InSAR) technique was applied, which allowed for estimating displacement rates of coherent backscatter targets with mm/yr precision. Separate analyses of time series for the Keta lagoon and Songor lagoon areas of the delta give insight into the vertical land movements, with irregularly distributed average rates of up to 4 mm/yr. LS in the Volta Delta is due to various causes, most prominently natural compaction of young deltaic sediments, but also aquifer over-exploitation and salt mining, and probably increasingly less compensated by a drop in sediment supply due to damming. Furthermore, projection of future elevation projections by RSLR was assessed by combining the observed LS rates with three IPCC representative concentration pathways (RCP) scenarios. The RSLR impact assessments computed revealed that by 2100, more than 20% of the Volta Delta districts could potentially be below MSL for all the addressed RCP scenarios, including the fragile but key sand barriers surrounded by water bodies. The study is, however, a preliminary investigation and recommends further local ground-based LS investigations to calibrate PS-InSAR outcome, thus improving our understanding of the areas driving critical present and future changes in the Volta Delta.