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Recent measurements of subsidence in the Ganges-Brahmaputra Delta, Bangladesh

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Deltas, the low-lying land at rivers mouths, are sensitive to the delicate balance between sea level rise, land subsidence and sedimentation. Bangladesh and the Ganges-Brahmaputra Delta (GBD) have been highlighted as a region at risk from sea level rise, but reliable estimates of land subsidence have been limited. While early studies in the GBD suggested high rates of relative sea level rise, recent papers estimate more modest rates. Our objective is to better quantify the magnitude, spatial variability, and depth variation of compaction and subsidence in the GBD in order to better evaluate the processes controlling it and the pattern of relative sea level rise in this vulnerable region.

With support from the Bangladesh Water Development Board, we have rehabilitated previously installed GNSS and installed new GNSS co-located with Rod Surface Elevation Tables (RSET) to better understand the balance of subsidence and sedimentation in the coastal zone in SW Bangladesh, which is less affected by the active tectonic boundaries to the north and the east. The continuous GNSSs installed in 2003 and 2012 were mounted on reinforced concrete building roofs. GPS stations in the area yield subsidence rate estimates of 3-7 mm/y. To densify the subsidence data, in early 2020 we resurveyed 48 concrete Survey of Bangladesh geodetic monuments in SW Bangladesh that were installed in 2002. Although only measured at the start and end of the period, the time span between the two measurements is ~18 years enabling us to estimate subsidence over this timespan.

Preliminary results show that about ½ the sites yielded very high subsidence rates; repeat measurements confirm the suspicion that the monuments at these sites are unstable and have undergone localized subsidence from settling or anthropogenic activity. The remaining sites show an increase in subsidence from the NW to the SE, consistent with estimates of average Holocene subsidence (Grall et al., 2018). However, rates from the campaign stations are much higher than those from continuous GNSS sites, but only slightly higher than an RSET site. We interpret that the continuous building GNSS omit very shallow compaction-related subsidence, while RSETs neglect deep subsidence. This is further reinforced by results from a compaction meter consisting of 6 wells from 20 to 300 m depth with vertical optical fiber strainmeters in each well. They show a decrease in compaction with depth. While initial results require further investigation, we highlight the importance of multiple methodologies for interpreting subsidence rates--deep, shallow, natural, anthropogenic--in vulnerable delta regions.