Sea level rise within the west of Arabian Gulf using tide gauge and continuous GPS measurements

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Arabian Gulf is connected to Indian Ocean and located in the south-west of the Zagros Trust Belt. To investigate sea level variations within the west of Arabian Gulf, monthly means of sea level at 13 tide gauges along the coast of Saudi Arabia and Bahrain, available in the database of the Permanent Service for Mean Sea Level (PSMSL), are studied. We analyzed individually the monthly means at each station, and estimated secular sea level rate by a robust linear trend fitting. We computed the average relative sea level rise rate of 1.96 ± 0.21 mm/yr within the west of Arabian Gulf based on 4 stations spanning longer than 19 years. Vertical land motions are included into the relative sea level measurements at the tide gauges. Therefore sea level rates at the stations are corrected for vertical land motions using the ICE-5G v1.2 VM4 Glacial Isostatic Adjustment (GIA) model then we found the average sea level rise rate of 2.27 mm/yr. Bahrain International GPS Service (IGS) GPS station, which is close to the Mina Sulman tide gauge station in Bahrain, is the only continuous GPS station accessible in the region. The weekly GPS time series of vertical component at Bahrain IGS-GPS station referring to the ITRF97 from 1999.2 to 2008.6 are downloaded from http://www-gps.mit.edu/~tah/. We fitted a linear trend with an annual signal and one break to the GPS vertical time series and found a vertical land motion rate of 0.48 ± 0.11 mm/yr. Assuming the vertical rate at Bahrain IGS-GPS station represents the vertical rate at each of the other tide gauge stations studied here in the region, we computed average sea level rise rate of 2.44 ± 0.21 mm/yr within the west of Arabian Gulf.