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On the use of SAR Interferometry for assessing tide gauge stability for long term sea-level estimation

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One of the important consequences of climate change is the global sea level rise of 20cm since the end of the 19th century. This process is very likely to continue and accelerate in the future. Future projections of global sea level rise range from about 30cm to 80cm by 2100 with significant regional variability).
Local and regional vertical ground motions are one of the important sources of uncertainties to consider in sea level rise impact assessments. However, it is very difficult, if not impossible, to evaluate them without observations due to their complex causes and evolution in space and time. Consequently, a first motivation to accurately characterize vertical ground motions in large coastal cities is to reduce the uncertainties of sea level rise impact assessments.
A second challenge motivating a precise characterization of vertical ground motions in coastal cities is to reconcile sea level estimates for the 20th century: over this period, there is a slight disagreement between (1) observations of sea level rise obtained from the available tide gauge data sets, and (2) the sum of contributions from each process causing sea level rise. Accurate knowledge about the ground motions affecting tide gauges is thus highly desirable, especially in regions poorly covered by tide gauges. Indeed, one of the possible explanations of the 20th century sea level budget imbalance is an inappropriate spatial sampling of historical tide gauges along the oceans' coastlines, most being located in Europe and in the United States. In addition, noteworthy is the fact that Tide Gauges with long Time Series are generally located in urbanized areas. Growing of urbanizations in development during the last century can result in local changes of ground surface level (in particular: groundwater extraction produces subsidence phenomena).
In this perspective, we propose the use of Differential SAR interferometry techniques for characterizing the ground surface deformation in the neighborhood of the Tide-Gauges. The objective is therefore to qualify the relevancy of a given Tide Gauge time series over the last decades/century to contribute to the global sea-level estimation. In addition, in certain cases a correction to the Time Series can be derived from such surface deformation mapping.
This utilization of DInSAR is illustrated by three test cases that correspond to different ground surface deformation characteristics (slight regular displacements, dm/yr irregular motions, negligible motion) and data acquisition conditions (available data amount, sensors). The test areas are located in Alexandria (Egypt), Manila (Philippines) and Dakar (Senegal).