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Coastal sea level variability in the eastern English Channel: Potentialities for future SWOT applicability

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Scientists and engineers need to understand the sea level variability in order to provide better estimates of the sea level rise for coastal defense using tide gauges and radar altimetry missions. The natural limitation of the tide gauge records is their geographical sparsity and confinement to coastlines. The future Surface Water and Ocean Topography (SWOT) mission will be launched in 2015 over a period of 5 years and will be designated to address this issue. This research was carried out in the framework of the program Surface Water and Ocean Topography (SWOT) which is a partnership between NASA and CNES. Using a series of statistical analyses, we point to characterize the sea level variability in the eastern English Channel (western France) from four tide gauges in Dunkirk, Dieppe, Le Havre and Cherbourg for the period 1964-2012. To assess the extent to which tide gauge point observations represent tide gauge data, we compare tide gauge records to SWOT measurements in their vicinity. Results have shown that the bimodality of the sea level, provided by the distribution analysis, can be reproduced by SWOT measurements with an overestimation of both modes and also the extreme values. The rate of the linear regression was also overestimated from 1.7-4 mm/yr to 2.6-5.4 mm/yr. The continuous wavelet transform of sea level records has shown the large-scale variability of annual (1-year band) and interannual cycles (2-6- and 6-12-year bands) in sea level, which can be explained by oceanographic and hydrological factors. High frequency dynamics of the sea level variability at short time-scales were extracted from SWOT measurements. They provide a good survey of the surge events (band of 3-4 months) and the spring-neap tidal cycle (band of 28 days). Then, tide gauges should be used in conjunction with satellite data to infer the full time-scale variability. Further studies are needed to refine the SWOT applicability in coastal areas.
Key words: coastal zone, sea level variability, tide gauges, virtual SWOT measurements