

Tidal Bore detection in the Garonne River using high frequency GNSS data

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A tidal bore is a positive surge propagating upstream that may form when a rising tide with significant amplitude enters shallow, gently sloping and narrowing rivers. Tidal bores have a significant impact on the river ecosystem behavior, especially in terms of sediment transport. Most of the existing field studies were limited to visual observations. Only a few field experiments have been devoted to a quantitative study of the tidal bore dynamics. We carried out a field study in August, 2015, using a GNSS buoy to measure the tidal bore in the Garonne River (France) at Podensac located 140 km upstream of the estuary mouth. Precise Point Positioning and Differential GNSS techniques were used to determine the river surface height variations with a 20 Hz sampling rate. This site was selected owing to the presence of well-developed undular tidal bores and also because of the absence of any significant curvature of the river at this location, which limits the complexity of the tidal bore structure. The Gironde estuary is located in the Bay of Biscay, on the southwest coast of France, and is formed from the meeting of the rivers Dordogne and Garonne. In the Gironde mouth, the mean neap tidal range and mean spring tidal range is 2.5 m and 5 m, respectively. As the tide propagates upstream a marked ebbflood asymmetry occurs in the upper reaches of the estuary and the wave is amplified. This large amplitude tidal wave propagates in the Garonne and Dordogne rivers up to 160 km from the estuary mouth. Both GNSS buoy and reference station use a Leica AR10 antenna and GR25 receiver. Both stations (reference and buoy) acquired data with a 20 Hz sampling rate. GNSS data were processed using RTKLib. Results allowed to detect the the wave train of the tidal bore that caused an elevation of the surface of around 1.5 m. Comparisons were performed using acoustic data showing a good agreement between both sources of data.