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# Impact of fluvial sediment input to tidal amplification in an estuary

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Water level records at two stations in the Guadalquivir Estuary (Spain), one near the estuary mouth (Bonanza) and one about 70 km upstream (Seville), have been analysed to study the amplification of the tide in the estuary. The amplification factor, defined as the ratio between the amplitudes of the semi-diurnal tide at the two stations, show interesting temporal variations (See Figure 1). Firstly, a spring-neap variation is present showing that the tide is less amplified during spring tide than during neap tide. This can be explained by the stronger damping during spring tide due to the bottom resistance which increases non-linearly with the tidal flow velocity, indicating that bottom resistance is an important factor influencing the tidal amplification in the estuary. Secondly, the variation shows some spikes of extreme lows, which appear to be related to river floods causing a large difference between the mean water levels at the two stations. Thirdly, it is interesting to see that the amplification factor has a larger value during a number of periods, also after smoothing out the spring-neap variation. Further analysis of the data together with the data of turbidity and river discharges in combination with the results from various sediment transport modelling studies for the estuary reveals that this phenomenon is caused by the non-linear interaction between the tidal flow and suspended sediment transport, initiated by high sediment input from the river during a river flood. The high sediment concentration, up to more than 10 g/l, causes a reduction of the bottom resistance to the flow resulting in stronger tidal amplification in the estuary. The larger tidal amplitude causes higher tidal flow velocity which in turn keeps the suspended sediment concentration high.

Figure 1. *Amplification factor of the semi-diurnal tide between Seville and Bonanza, daily data as well as the smoothed data after filtering out the spring-neap variation*