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Refinements to harmonic tidal predictions in estuaries and shallow water.

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Harmonic analysis is used to predict tidal heights from observations or model data. The usual method is to fit tidal constituents, at frequencies informed by astronomical cycles. In most cases the higher harmonics of these frequencies are sufficient to provide a good model of the tide to within observational accuracy, and successfully predict tides for decades outside the observational period, even including double high and low water and seasonal variations.

In shallow bays or estuaries the propagation of the tidal wave slows, leading to very slow draining of the water and much faster rise. The tidal waveform is closer to a saw-tooth shape than sinusoidal. So least-square fit of harmonics leads to Gibbs ringing artefacts around the discontinuity in slope just before the tide rises. These are often several tens of cm in the macrotidal regime of the UK, and complicate the assessment of surge modelling.

Though the problem is not new, we are still seeking a consistent and universally applicable solution. In practice manual corrections are often applied at individual sites. Or with enough data, more harmonics can be fitted to minimise the false peaks, but at the risk of over-fitting. In this presentation we quantify the severity of this problem in UK estuarine sites, improvements using the response method, and the subsequent effect on total water level for operational storm surge forecasting.