Salinity effects on pressure-based tide gauges in a macro-tidal estuary

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Estuarine salinity can be highly variable, resulting in significant density variability. So tide-gauges measuring pressure (either directly or as bubblers) can experience salinity-induced pressure variations of up to 1% of their range. They can therefore record depths with up to 1% variability that is not seen in other measurement systems. In most places this is a small effect compared to other sources of variability but in macro-tidal estuary such as the Severn in the UK it amounts around 10cm difference between high and low tide. This is comparable to levels of accuracy being sought by current surge forecasts.

This effect can be seen in neighbouring radar and pressure gauges in the Severn. It could result in spurious seasonal and spring-neap constituents. Elsewhere, similar errors could result related to unusual freshwater river flow in estuarine locations that are usually saline, or unusual saline storm surge in usually freshwater sites. It has implications for assessment of storm surge and multi-hazard forecasting, and accurate calibration of new gauge installations.