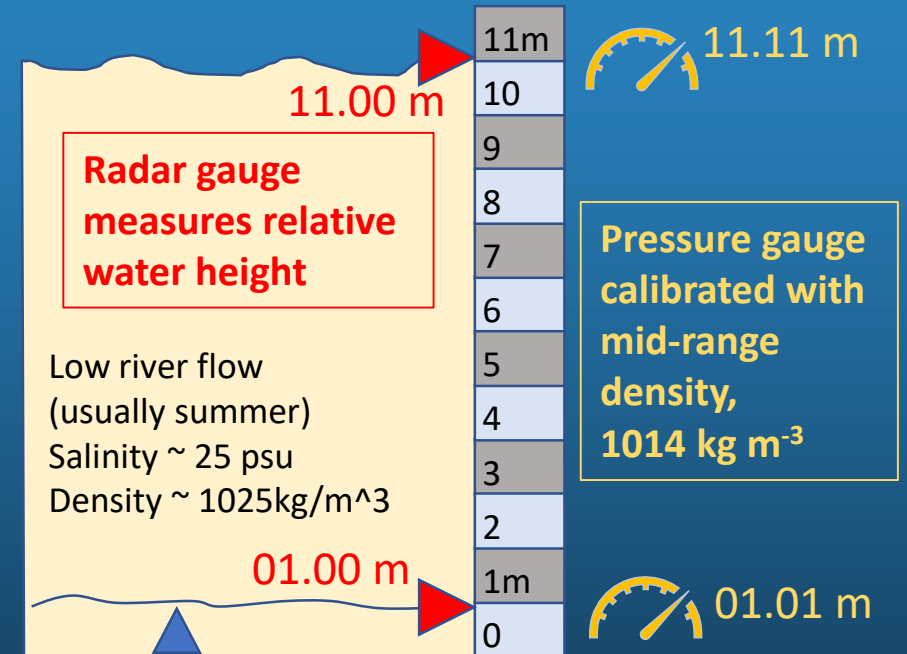
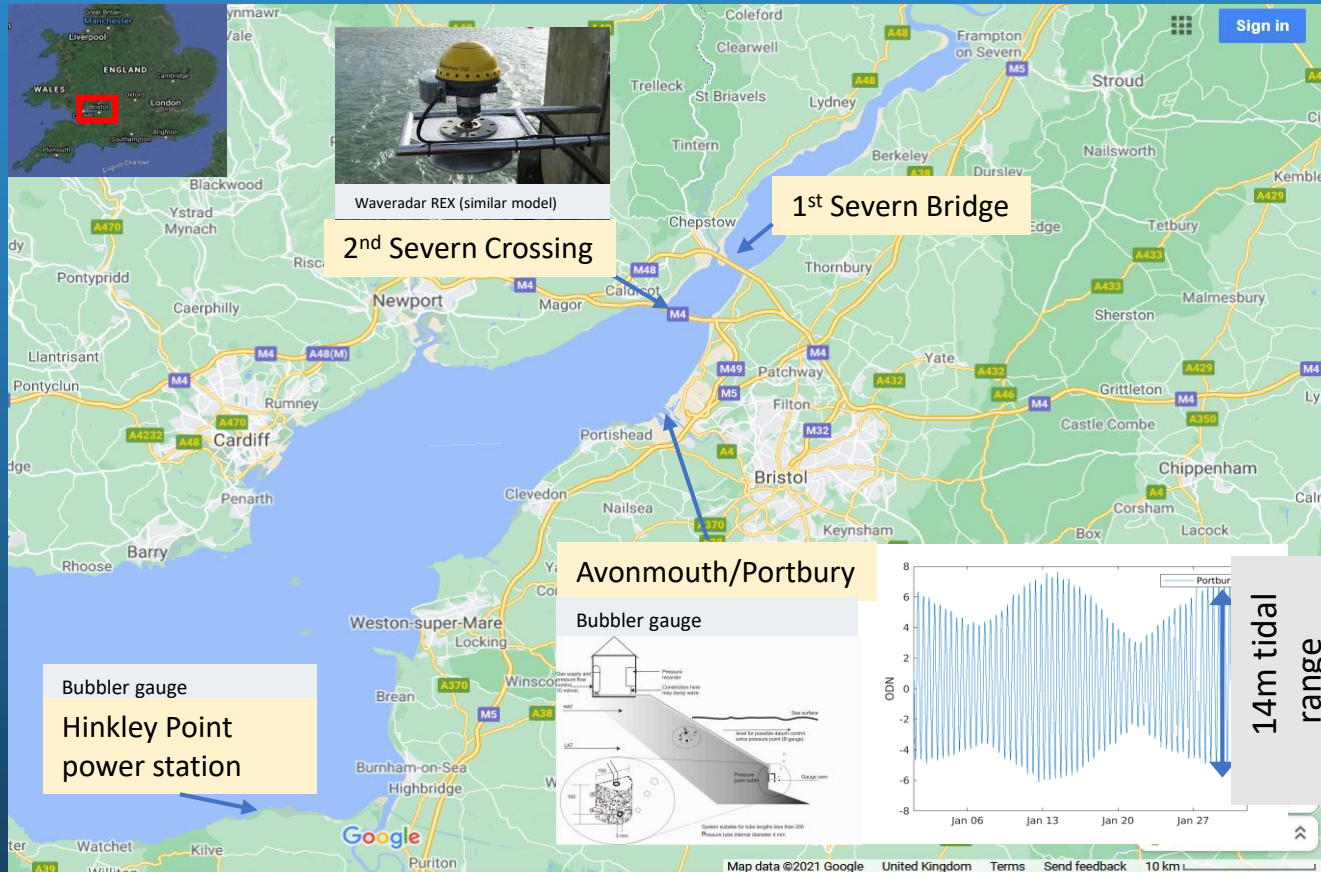




- Estuarine salinity varies with season and spring neap cycle, as much as 25 PSU.
- Hence density varies by 1% from central estimates.
- Tide-gauges measuring pressure can experience salinity-induced pressure variations of up to 1% of their range.
- This is not seen in direct water level measurements, such as radar gauges.

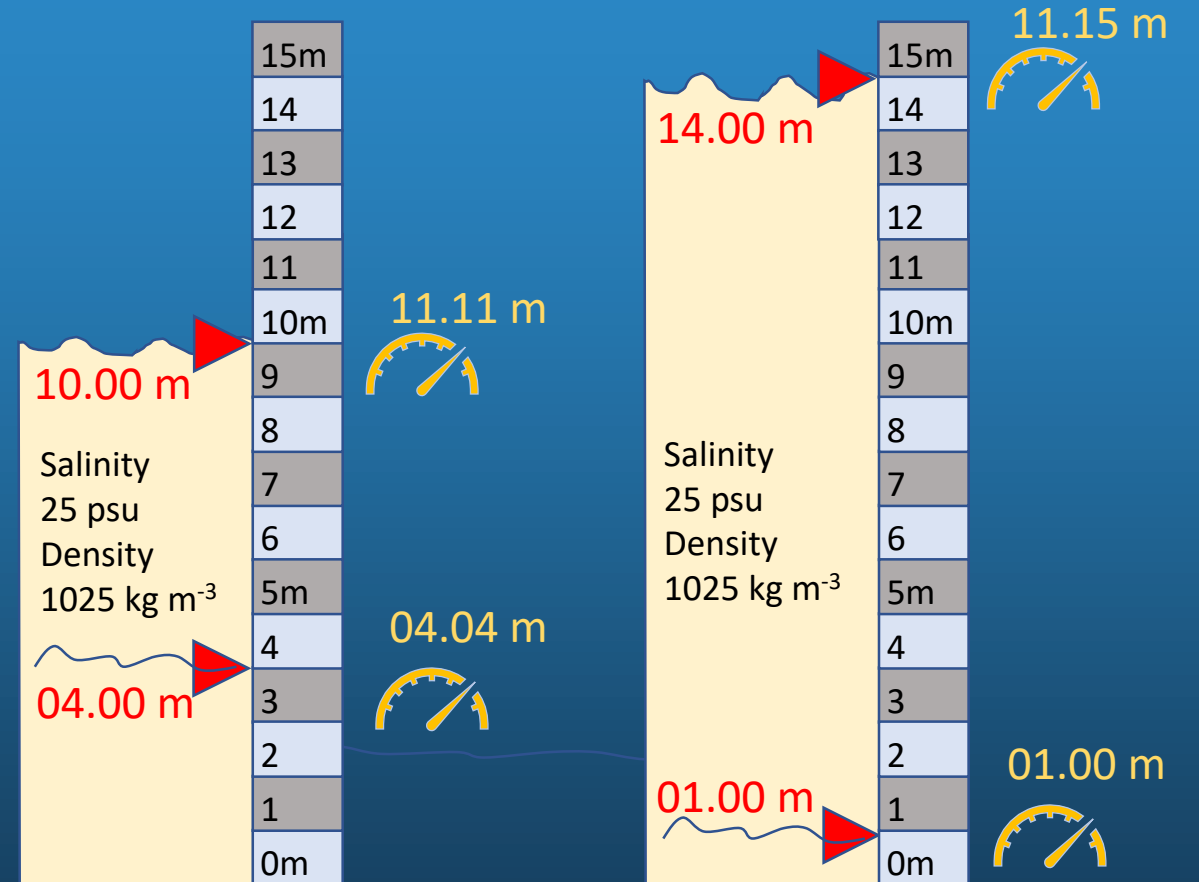
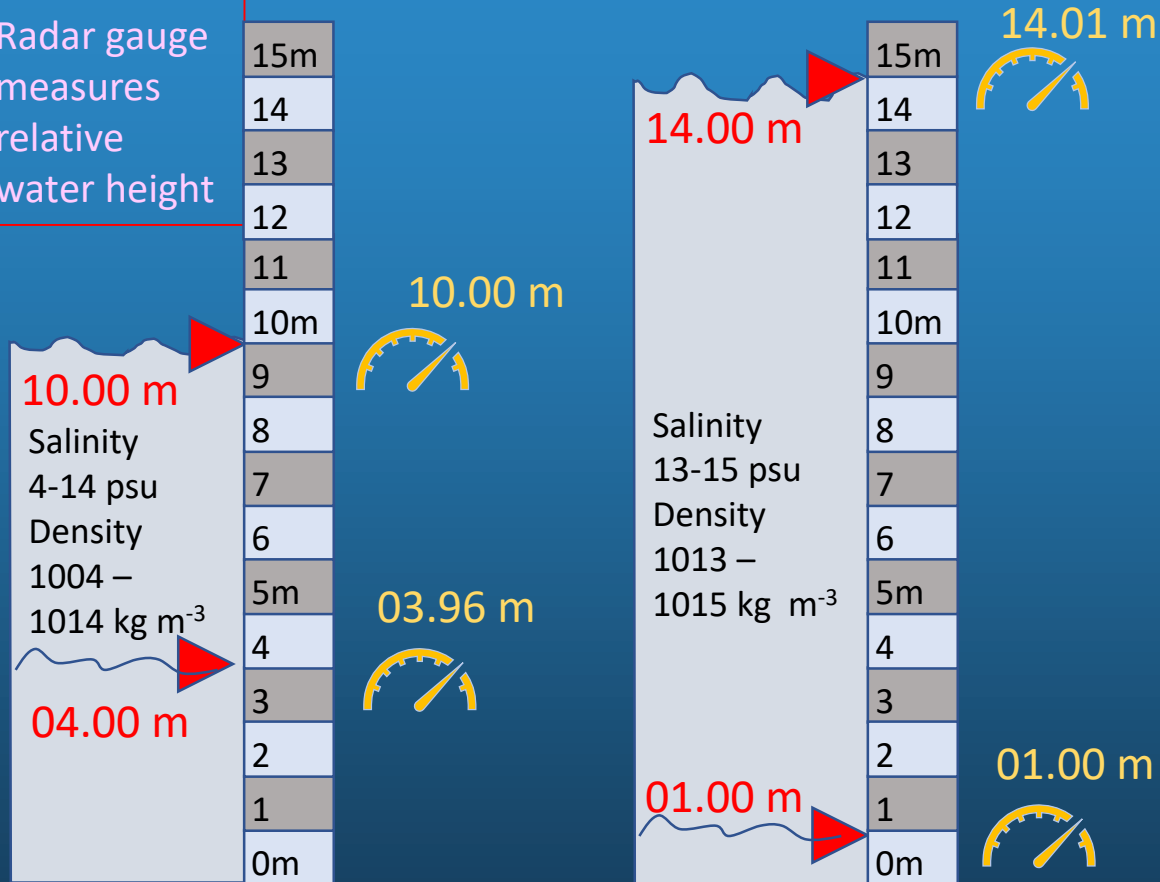
- In most places this is a small effect compared to other sources of variability.
- In a macro-tidal estuary such as the Severn in the UK it amounts around 10cm difference between high and low tide.
- This is comparable to levels of accuracy being sought by current surge forecasts. Great care must be taken in calibration and comparison of records from different instruments.



Winter: high river flow, salinity varies with tide

Summer: low river flow, salinity estimated as constant 25 psu

Radar gauge
measures
relative
water height



Pressure range 4cm more than radar

Pressure range 1cm more than radar

Pressure range 7cm more than radar

Pressure range 15cm more than radar

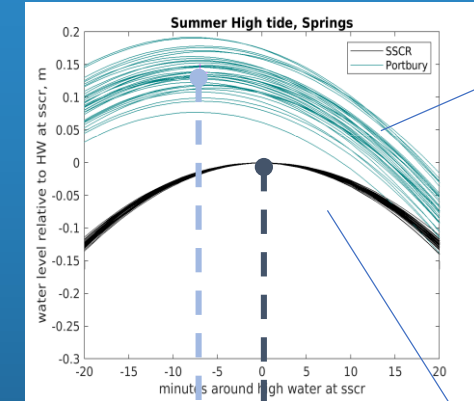
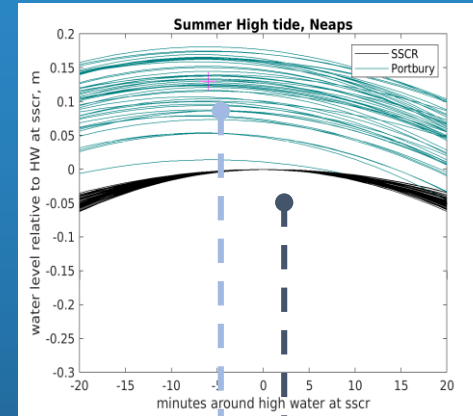
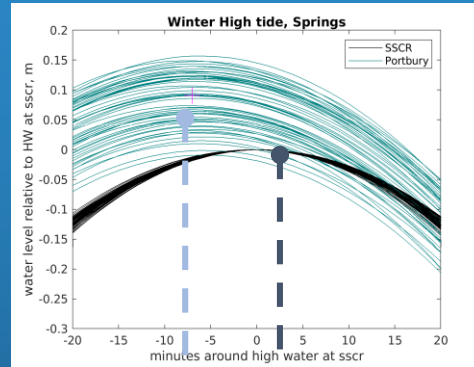
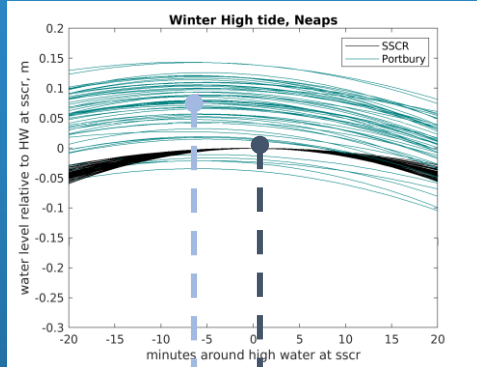
How much can we expect the pressure gauge to be affected by salinity?

Pressure gauge calibrated with mid-range
density, 1014 kg m^{-3}

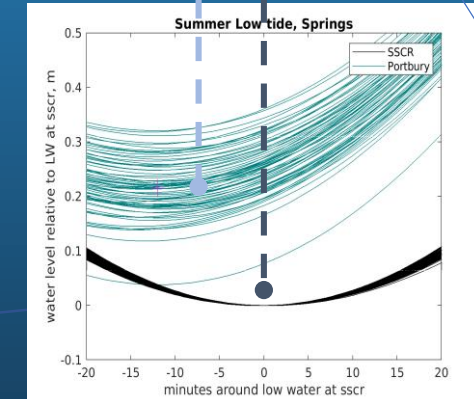
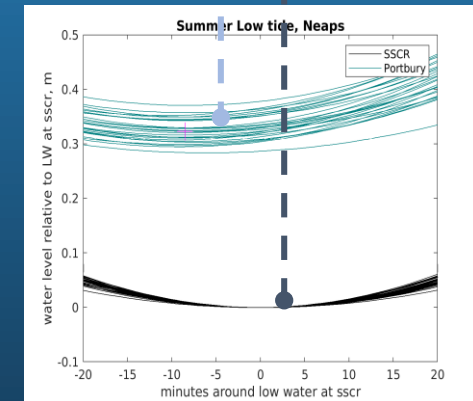
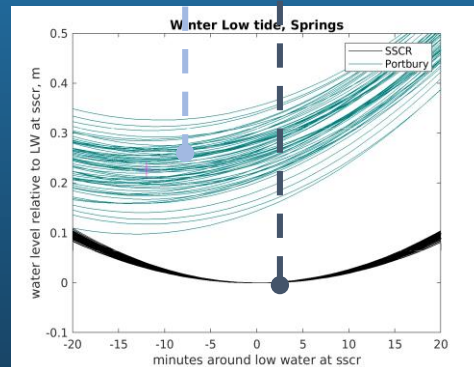
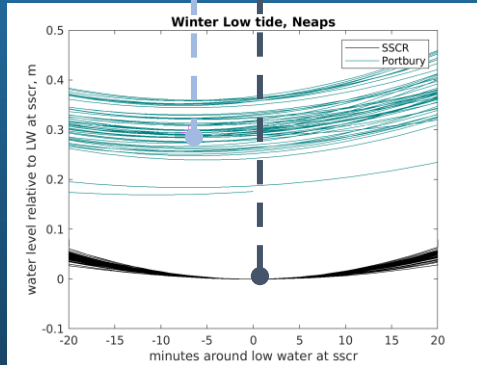


Winter: high river flow, salinity varies with tide

Summer: low river flow, estimated salinity constant 25 psu



Portbury,
bubbler
gauge,
aligned
relative to
high water
at SSCR



SSCR
(second
Severn
crossing)
radar
gauge

Portbury range 21cm less than SSCR
Neap Tide

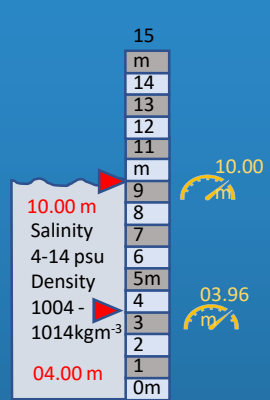
Portbury range 14cm less than SSCR
Spring Tide

Portbury range 19cm less than SSCR
Neap Tide

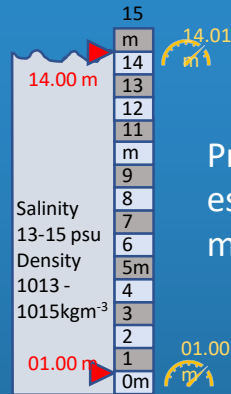
Portbury range 8cm less than SSCR
Spring Tide

Pressure gauge calibrated with mid-range
density, 1014 kg m^{-3}

Winter: high river flow, salinity varies with tide

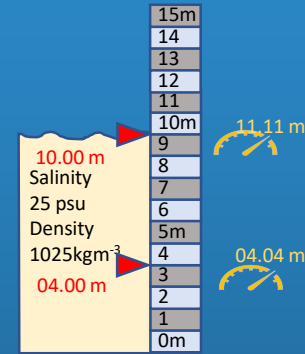


Pressure range estimated 4cm more than radar

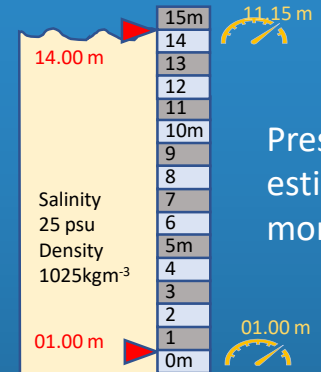


Pressure range estimated 1cm more than radar

Summer: low river flow, estimated salinity constant 25 psu



Pressure range estimated 7cm more than radar



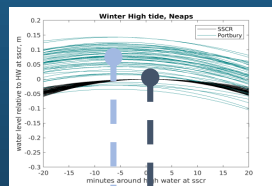
Pressure range estimated 15cm more than radar

Portbury neap range -4cm is 25cm less than SSCR

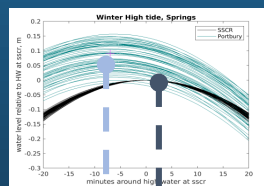
Portbury spring range -1cm is 15cm less than SSCR

Portbury neap range -7cm is 26cm less than SSCR

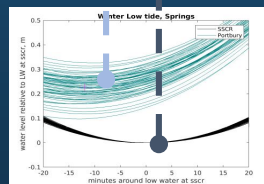
Portbury spring range -15cm is 23cm less than SSCR



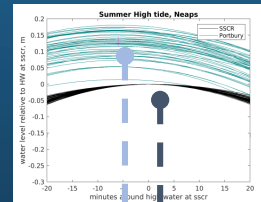
Portbury bubbler range measured 21cm less than SSCR radar



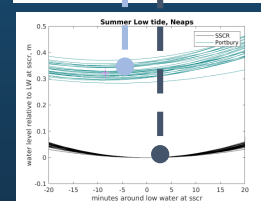
Portbury bubbler range measured 14cm less than SSCR radar



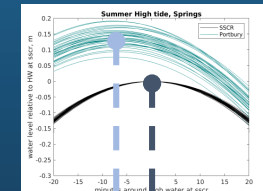
Spring Tide



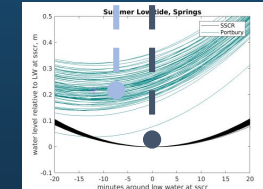
Portbury bubbler range measured 19cm less than SSCR radar



Neap Tide

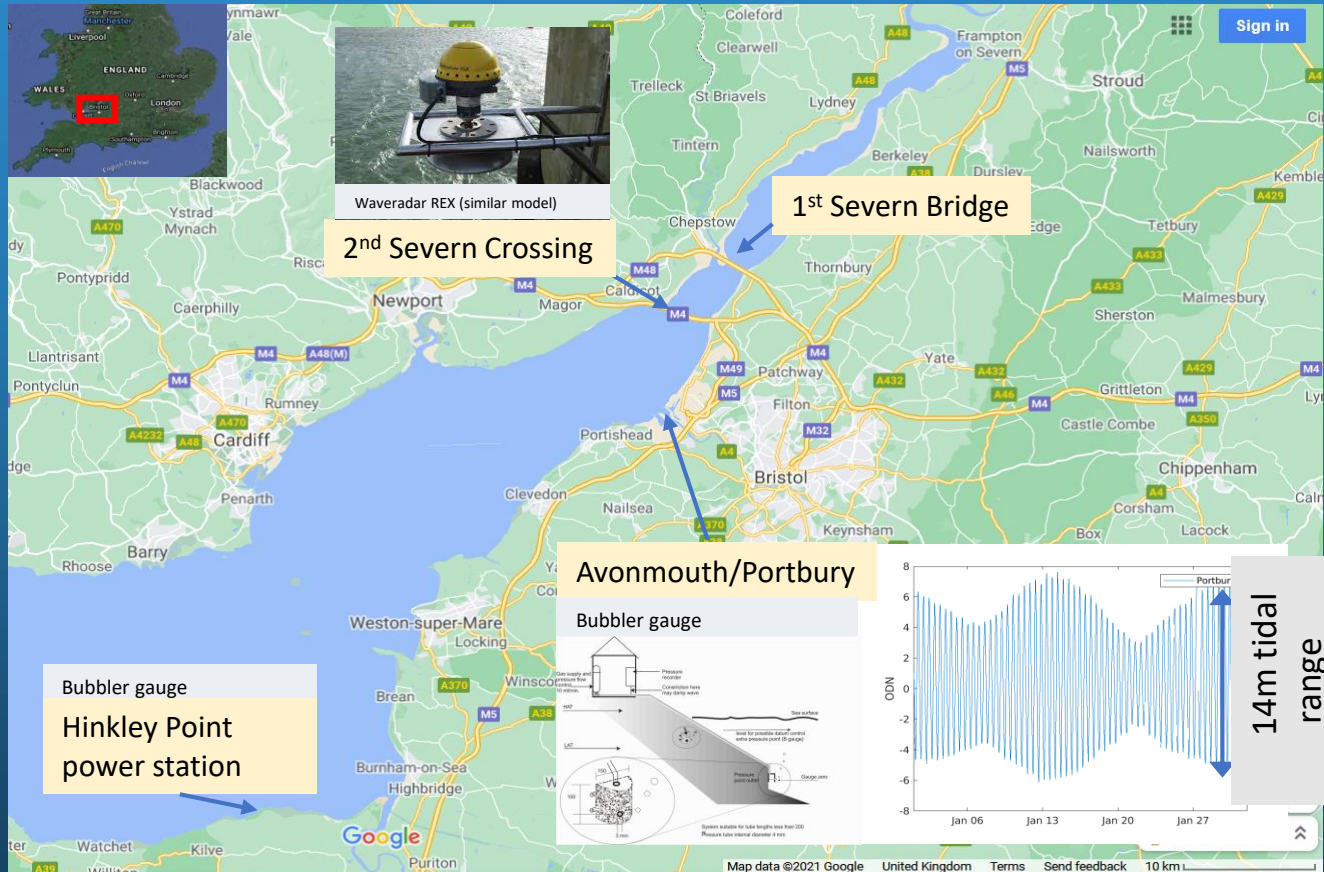


Portbury bubbler range measured 8cm less than SSCR radar



Spring Tide

Neap Tide



- Radar or float gauges measure distance to the water.
- The bubbler at Portbury is calibrated to a constant mid-range density of 1014 kg m^{-3}
- Crude time-variable recalibration of the pressure gauge at Avonmouth/Portbury based simply on seasonal salinity estimates gives broadly consistent comparison to nearby radar gauge.
- Further work on time-variable calibration – using more accurate salinity estimates or based on measured river flow levels is recommended.
- Potential correction is of about 1% of tidal range. At this extremely macro-tidal site, over 10cm. This is of significance for surge model calibration as well as for longer term sea-level studies.

Portbury neap range -4cm
is 25cm less than SSCR

Portbury spring range -1cm
is 15cm less than SSCR

Portbury neap range -7cm
is 26cm less than SSCR

Portbury spring range -15cm
is 23cm less than SSCR

Winter: high river flow, salinity varies with tide

Summer: low river flow, estimated salinity constant 25 psu