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Estimating cross-slope exchange from drifter tracks and from glider sections

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In areas of complex topography, it can be difficult to define “along-slope” or “cross-slope” direction, yet transport estimates are sensitive to these definitions, especially as along-slope flow is favoured by geostrophy. However, if drifter positions and hence underlying water depths are recorded regularly, we know where and when depth contours are crossed by the drifters, and hence by the water assuming that the drifters follow the water. An approach is discussed for deriving statistics of contour-crossing speed, via depth changes experienced by the drifters and an effective slope.

The transport equation for (e.g.) salinity S can be reduced to an explicit equation for effective diffusivity K if we assume steady along-slope flow with known total transport Q, a salinity maximum at its “core” and effective diffusion to less saline waters to either side. Salinity gradients along the flow and to either side are needed to calculate K. Gliders provide a means of measuring salinity gradients in this context. Measurements at the continental shelf edge south-west of England and west of Scotland illustrate the calculation.

Both approaches give overall rather than process-related estimates. There is limited scope for process discrimination according to (i) how often drifter locations are recorded and (ii) the time-intervals into which estimates are “binned”. (i) Frequent recording may record more crossings owing to processes of short time scale, albeit these are less significant for slowly-evolving water contents. (ii) Sufficient samples for statistically significant estimates of exchange entail “bins” spanning some weeks or months for typically-limited numbers of drifters or gliders.