Lateral mixing of passive scalars around porous obstacles in tidal flows

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Abstract. In this study, we use high-resolution two-dimensional numerical simulations to study mixing and transport of passive scalars around porous cylindrical obstacles in tidal flows. A submerged obstacle blocks the flow (partially or fully depending on its porosity) causing deceleration of the flow, shedding of vortices and the formation of a downstream wake. The lateral distribution of the passive scalar is quantitatively examined by calculating the lateral mixing coefficient as a function of three non-dimensional parameters namely; the non-dimensional drag coefficient, C_D (imparted by the obstacle); the ratio of the tidal to mean flow velocity amplitudes, $\eta = U_T/U_M$; and an tidal excursion parameters, $K = 2U_T/\omega D$, where ω is the forcing frequency and D is the diameter of an obstacle. The simulation results show that the lateral mixing is substantially enhanced due to the combined effect of the drag exerted by the obstacle and the oscillatory flow compared to the classical dispersion in a uni-directional flow without drag. The results also highlight the complex dispersion patterns around submerged obstacles in oscillatory flows.