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Transport enhancement by the wake of an island

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Transport from nutrient-rich coastal upwellings is a key factor influencing biological activity in surrounding waters and even in the open ocean. The rich upwelling in the North-Western African coast is known to interact strongly with the wake of the Canary islands, giving rise to filaments and other mesoscale structures of increased productivity. Motivated by this scenario, we introduce a simplified two-dimensional kinematic flow describing the wake of an island in a stream, and study the conditions under which there is a net transport of substances across the wake. For small vorticity values in the wake, it acts as a barrier, but there is a transition when increasing vorticity so that for values appropriate to the Canary area, it entrains fluid and enhances cross-wake transport.