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The impact of inter-annual variability in hydrodynamic conditions on plaice settlement success

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Using a hydrodynamic model coupled to a particle tracking routine, the impact of variability in hydrodynamic conditions on drifting plaice eggs and larvae and their successful settlement in nursery areas was studied.

The life cycle of many marine fish species consists of various life stages: Spawning at open sea, pelagic egg and larval stages and often a juvenile stage bound to shallow water nursery grounds. Numerous studies have demonstrated that pelagic stages appear to be the most critical in determining ultimate year-class success, which holds true, for example, for European plaice (*Pleuronectes platessa*). Plaice spawning grounds in the middle of the North Sea and in the English Channel are connected to juvenile nursery areas (such as the Wadden Sea) via (semi-)passive drift governed by residual currents. Field data from especially the Balgzand nursery area have shown a strong variability in the number of plaice juveniles settling there over the years. Changes to current patterns and water temperatures are expected to strongly contribute to this inter-annual variability in settlement success.

Here, we investigate these effects on pelagic plaice drift and settlement using a coupled numerical model: A 3D hydrodynamic model (GETM) was used to produce hydrodynamic data at a high spatial and temporal resolution, for the years 1994 - 2005. This data was subsequently fed into a particle tracking routine (GITM), that computed the trajectories for a million particles (representing pelagic plaice) for each year. In order to focus on the physical processes, several biological contributions such as behaviour (vertical migration) and mortality were excluded from the simulations. Spawning periods and locations, drift durations, and settlement requirements were selected around known plaice characteristics.

Results showed a strong inter-annual variability in the drift direction, drift duration and settlement success of the particles, as well as in the absolute number of settling particles and the relative importance of different nursery areas. These results can be ascribed to changes in the dominant wind direction and water temperature. Additionally, settlement in the western Wadden Sea showed seasonal changes in the origin of settling particles: During winter, stronger currents and lower temperatures result both in longer drift durations and larger displacements of particles.