



Patterns of Hits to the Nearshore from a Major Fairway in the Gulf of Finland

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The Baltic Sea hosts one of the heaviest ship traffic in the world. Although relatively small in size, still up to 15% of the world's cargo is transported along its numerous fairways. The largest threat to the environment is oil transportation that has increased more than by a factor of two in 2000–2008 and a 40% increase is expected by the year 2015. One of the major marine highways in the European waters enters the Baltic Sea through the Danish Straits, crosses the Baltic Proper and stretches through the Gulf of Finland to Saint Petersburg.

An area that is highly vulnerable to ship pollution is the nearshore that usually has the largest ecological value. While the probability of coastal pollution for open ocean coasts can be reduced by shifting ship routes farther offshore, the problem for narrow bays, like the Gulf of Finland, is how to minimize the probability of hitting any of the coasts. To a certain extent, light can be shed to this problem by means of quantification of the offshore areas in terms of their ability to serve a danger to coastal environment if pollution would happen in these areas. A convenient way to address this problem is to use statistical analysis of a large number of Lagrangian trajectories of test particles representing the potential pollution and passively carried by surface currents.

In this paper, we make an attempt to quantify the link between potential sources of pollution along an existing fairway and the sections of the coast reached by current-driven pollution. The problem is analysed by means of considering hits to the nearshore from a major fairway in the Gulf of Finland and by making sure whether certain parts of the coast are hit by pollution particles most frequently and whether or not these pollution particles stem from certain specific parts of the fairway. Trajectories are simulated in the Gulf of Finland by placing tracers along a line that follows one of the major fairways from the Baltic Proper to Saint Petersburg.

The probabilities for the hit to different parts of the nearshore and the ability of different sections of the fairway to provide coastal pollution have extensive seasonal variability. The potential impact of the fairway is roughly proportional to its distance from the nearest coast. A short section of the fairway to the south of Vyborg and a segment to the west of Tallinn are the most probable sources of coastal pollution. The most frequently hit coastal areas are short fragments between Hanko and Helsinki, the NE coast of the gulf to the south of Vyborg, and longer segments from Tallinn to Hiiumaa on the southern coast of the gulf.