

Visual geoanalytics of the ecological vulnerability of the Finnish shores of Gulf of Finland to oil accidents

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Oil transportation in the Gulf of Finland is increasing significantly, thus increasing the risk of large accidents in the area. The effect of an oil spill upon the ecology and recreational value of the shore would potentially be disastrous. When oil is spilled onto sea as a result of an accident, it spreads and moves with waves and currents and is affected by weather, passing time, and other factors. Heavy oil may sink or drift onto shores and cause damage to the ecology of seabed and shoreline. Cleaning up an oil-contaminated area is time-consuming, difficult, and very costly. After an accident oil contamination can be combatted with, e.g., mechanical tools, booms, and chemical dispersants.

With these tools it is also possible to have some control over which areas become polluted.

In this paper we present geoanalytical procedures for producing information for preparing for and management of oil spills. The procedures combine geocomputation and visualization in a novel software environment. The initial data for the procedures include, besides common geospatial data like shorelines and land-cover classification, accident simulation data, habitat data, and distance to the opposite shore data.

The accident simulation data contains simulated, hypothetical trajectories of oil slicks under varying but common weather conditions.

The oil slicks are computed based on assumed accidents in two locations in the Gulf of Finland. The habitat data contains polygons of varying sizes (usually less than one square km) with information about the species living in that area, and, in the case of species living in the littoral, the elevations at which it lives. The species have differing ecological values due to their abundance and role in the ecosystem. The distance to the opposite shore data contains the lengths of open water in different directions from points at the shores.

Being prepared for and, if an accident happens, management of oil spills and slicks requires operational, tactic, and strategic activities, thus the end results that are expected from the analysis and tool development must be able to support all these activities. In the OilEco project, which conducts the analysis and develops the support tools, geovisual analysis is conducted in parallel with ecological analysis, especially development of ecological indicators, and the development of management support tools, i.e., visual, interactive geospatial applications and datasets.

The software environment in which the computations and visualizations are conducted is a geospatial software stack that consists of free and open source components. The stack consists of geospatial software components, of a high-level programming language (Perl) component, of a GUI toolkit component, and of integrative components. The core visualization component is a small C library, which links to data access and analytical libraries and contains code for rendering geospatial data on a pixel buffer. The environment combines a Perl interface to the geospatial data library with a Perl interface to the GTK GUI toolkit. We present a bottom-up approach for geovisualization, which is implemented with generic geospatial data access software that provides access to a wide variety of existing datasets and sources. The environment facilitates combination of high-level programming with interactive graphics.

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