East Asian Seas: Hypothetical Oil Spill Trajectories

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Hypothetical oil spill trajectories are projected for each monsoon from four locations near Japan: the central and southern Sea of Japan; and the northern and southern East China Sea. Actual and possible maritime jurisdictional boundaries are superimposed on these trajectories. Spills at most sites would soon cross international jurisdictional boundaries and eventually reach a sometimes estranged neighbor's coast.

A major concern in the region is the possibility of a catastrophic spill. Oil spill trajectories are projected from four locations in East Asian Seas: a hypothetical point at 37°30'N, 131°30'E in the center of the Tsushima Basin; South Korea's Dolgorea-1 (35°25'N, 130°10'E); China's Longjing-1 (30°10'N, 126°05'E); and Taiwan's CPC YDF (26°50'N, 121°50'E) using methodology and models developed by Galt (1980), Galt and Payton (1981), and Torgrimson (1981). Actual and possible maritime jurisdictional boundaries are superimposed on these trajectories (Lee and Valencia, in press).

The trajectories indicate the distance of travel from the site in three day intervals, usually up to 30 days, or until there is little further movement expected. They include the effects of the regional currents, the circulation pattern derived from a simplified circulation model of the region, the statistical or climatological winds and a hypothetical weathering process for an intermediate weight crude oil. For each trajectory, a discrete multimillion gallon oil spill is assumed to occur on the first of each month. Spreading and evaporation is assumed to convert the spilled oil to an invisible film after one month.

These trajectories were generated for the peak phases of each monsoon: full winter northwest monsoon (January) and the full summer southeast monsoon (July). Caution should be exercised in their interpretation. The peak month for each of these phases is different at the different locations. The expected current flow patterns may not be reproducible on a monthly basis. The cases presented represent combinations of time when the winds were established in a particular pattern and the currents were either in opposition to, or in support of the wind regime. Thus the spill trajectories are useful for discerning relative numbers and characteristic values for pollutant trajectory transport but the monthly trajectories may not be indicative of the actual conditions at any particular moment. The spill location is marked with an asterisk. Each of these spills is represented by elliptical areas and within each of the elliptical areas, the solid area indicates where fairly heavy concentrations of oil would be expected. There the oil would appear in large patches and linear strings which could be identified relatively easily from the air. The lighter areas are places where trace or small quantities of hydrocarbons would be present. These would appear as thin, sheer streaks which may be difficult to observe from the air.

Experience with major spills throughout the world indicate that it is very difficult to trace spills of less than a million gallons in the open ocean for more than a week or so, and the prospects of finding concentrated pools of oil after several weeks are low. Spills in the multi-million gallon range tend to present large patches of oil for several weeks. Beyond this range, there is a tendency to show thin, disjointed streamers of oil that may be quite difficult to identify or map from the air. Detailed surface oceanographic cruises with appropriate sampling gear may still be able to identify oil in trace quantities over areas as large as those indicated in these trajectory studies.

Marine Pollution Bulletin, Vol. 23, pp. 753–757, 1991.
Printed in Great Britain
0025-326X/91 $3.00+0.00

The number along the tracks indicates the percentage of the oil which would be lost due to evaporation and accommodation processes. For a medium weight crude oil, 24 percent would be gone after only 2 days, 42 percent after 5 days, 45 percent after 8 days, up to a maximum of 48 percent after 14 days. After that time, the residual that would be moving in the slick would represent heavier fractions which would tend to have a much longer half-life, or persistence, in the marine environment. These would be less toxic than the lighter fraction which tends to evaporate and become accommodated rather quickly. Beyond the two-week period, the weathering processes proceed much more slowly and are governed by photo-oxidation and biological degradation, with some possibility of tarball or oil particles agglomerating to suspended sediments. Beyond this time horizon, the actual weathering processes and long term fate of spilled hydrocarbons is much less certain. The quantitative information on weathering is presented as fractions of the total spill so this information could actually be used to analyze a large range of spill scenarios.

Sea of Japan II (Site 1)

During winter, heavy concentrations of a spill at hypothetical point "X" would move directly southeast into undisputed Japanese waters and strike Oki Gunto in 15 days. The slick from the spill would reach southwest Honshu within 18 days and then move east along the coast. During summer, heavy concentrations of a spill at this hypothetical site would move almost due north into undisputed South Korean waters striking Uleung Do within 9 days. It would then spread laterally east and west in the open sea without reaching land.

Sea of Japan (Site 2)

During winter, heavy concentrations of a spill at the Dolgorea-1 well would move directly southeast and strike the extreme southwest coast of Honshu within 12 days. The slick would continue to spread both northeast and southwest along the coast. During summer, heavy concentrations of a spill at this site would move north-northeast and strike the southeast coast of South Korea within six days. The slick would continue to spread north tangential to the coast of the Korean peninsula.

East China Sea I (Site 4)

Heavy concentrations of a spill at China's Longjing-1 well site in winter would move southeast into Japanese-claimed waters brushing the Japan-South Korea joint development zone. The spill would reach islands in the Ryukyu archipelago in 21 days, and subsequently, the northern tip of Okinawa itself. In summer, heavy concentrations of a spill at China's Longjing-1 well site would move north towards Cheju, quickly entering the Japan/South Korea joint development zone. The spill would strike the south coast of Cheju within 12 days and then move mainly northeast, reaching the southeast coast of the Korean peninsula in 18 days.

East China Sea II (Site 5)

Heavy concentrations of a spill at Taiwan's YDF-1 well site in winter would spread south and east, quickly crossing Taiwan's claimed EEZ and enter waters claimed by China and Japan. The slick would continue moving southeast, eventually impacting the Tiao Yu T'ai/Senkaku islands. A spill at this site in summer would move northeast, staying almost entirely within Chinese waters without striking land.

Conclusions

Oil spilled at the selected sites would soon cross international jurisdictional boundaries. Therefore, cooperation is needed among East Asian countries regarding coordination of responses to transnational oil spills.

References

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Galt, J. and Payton, D.L. (1981). Finite element routines for the analysis and simulation of seashore circulation. NOAA, Seattle, Washington. Mimeograph.

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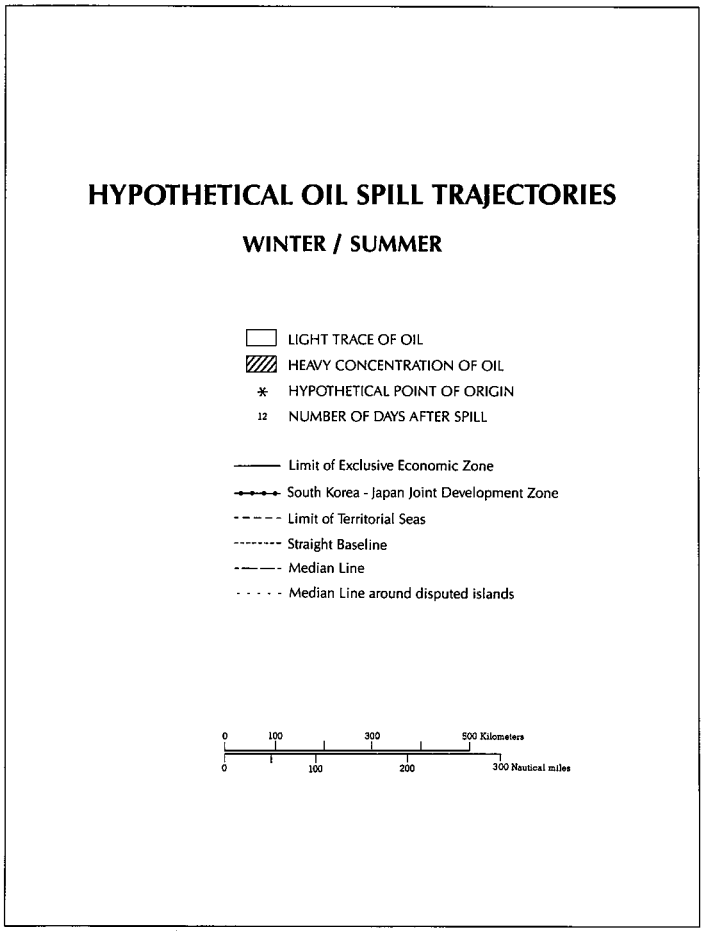

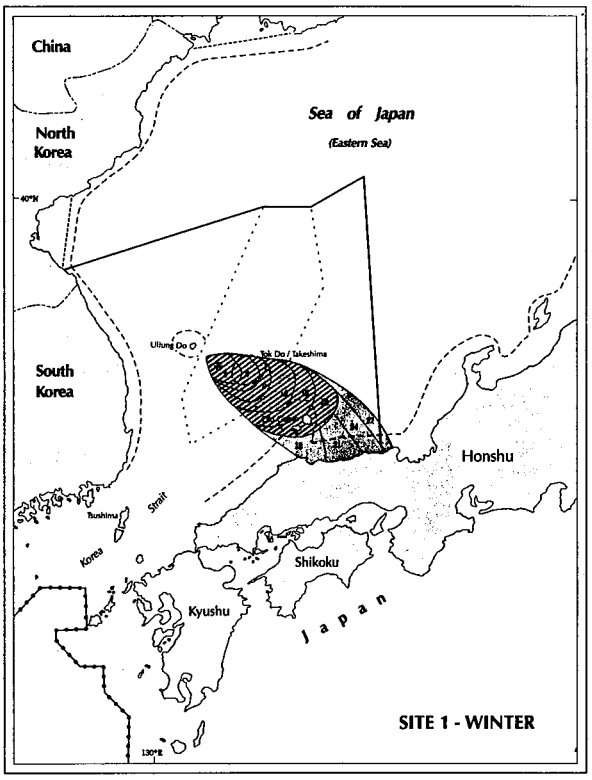
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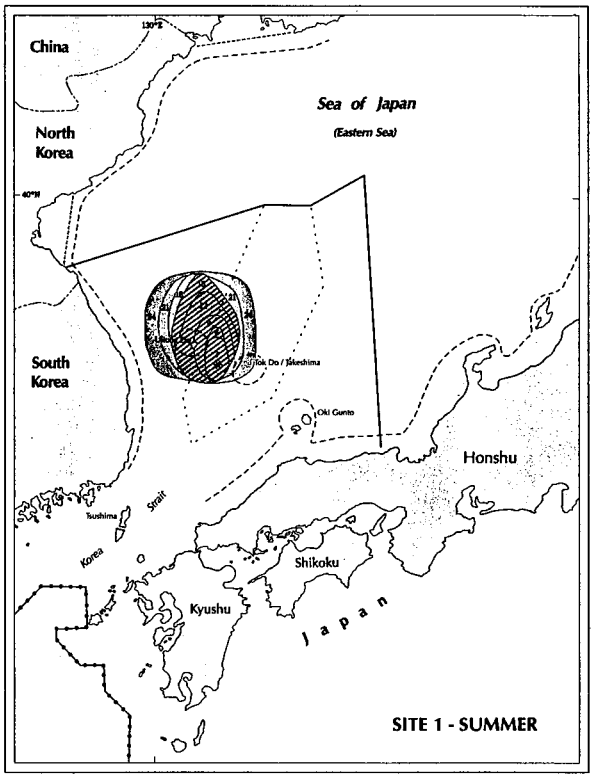
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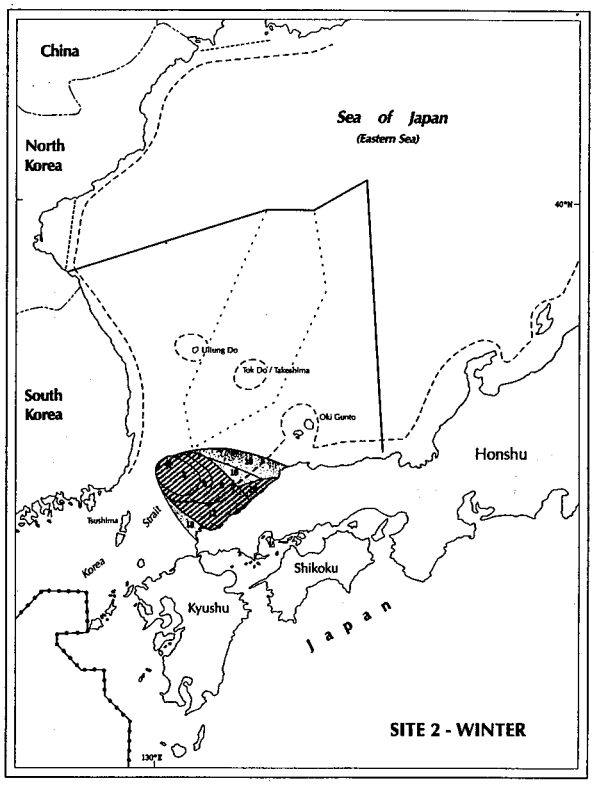
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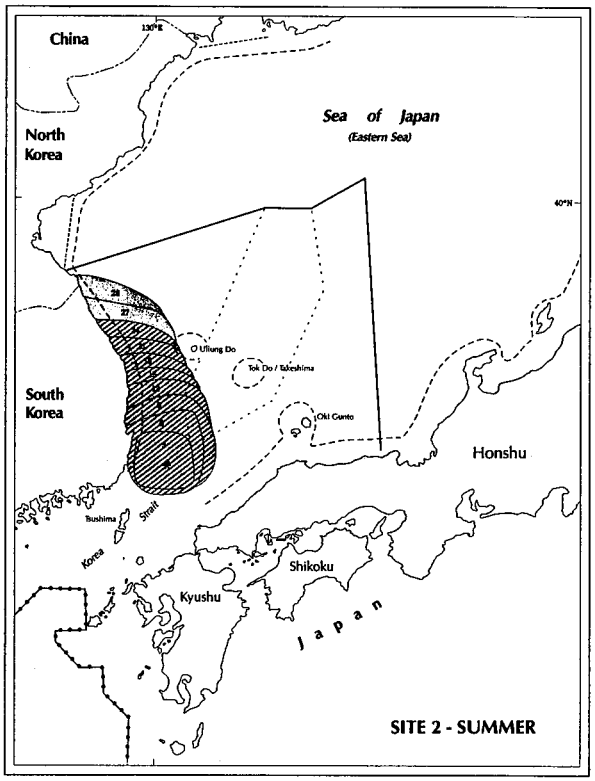
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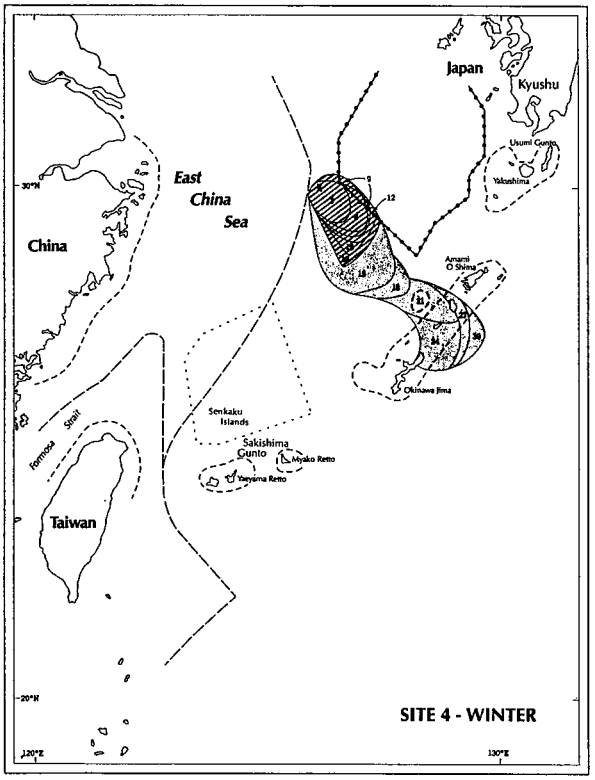
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Usumi Gunto
Yakushima
Formosa
Strait
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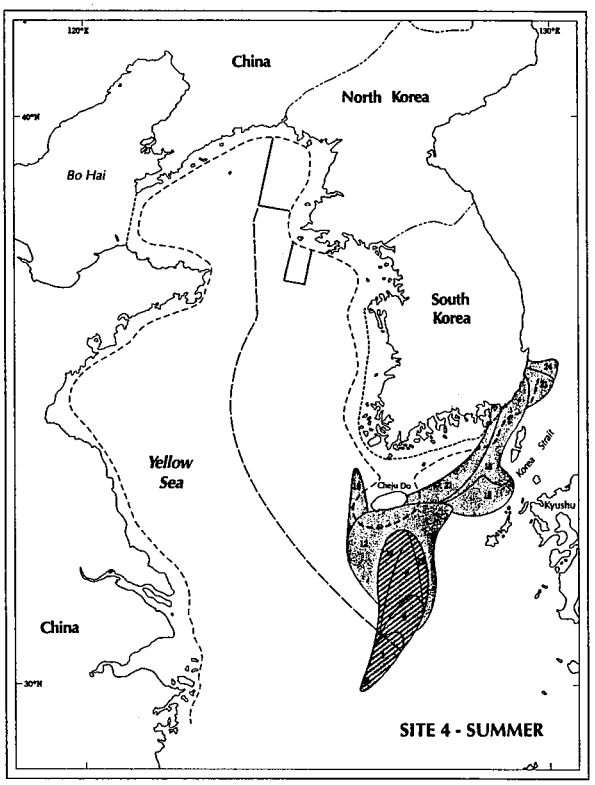
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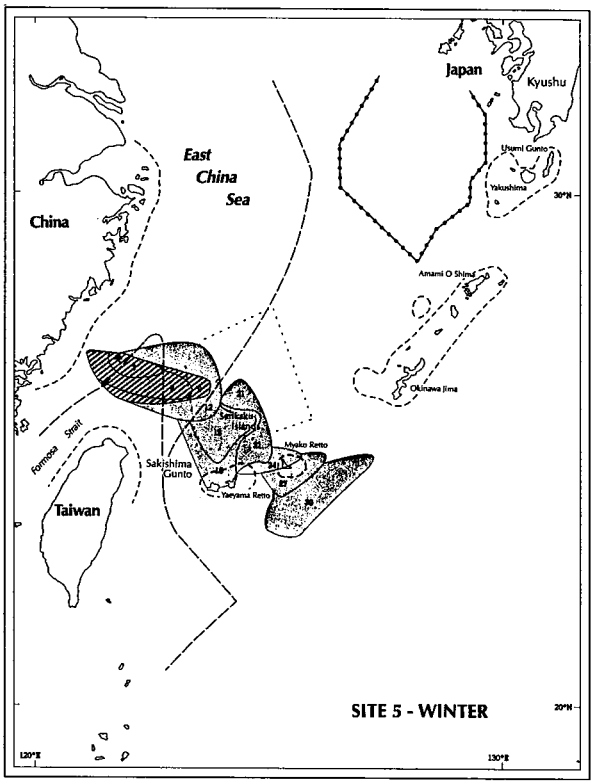
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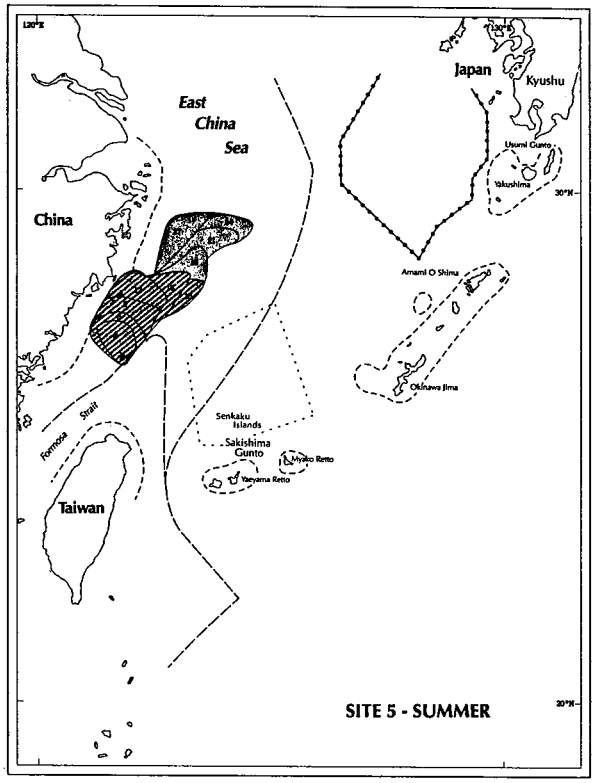
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