



## Coastal-Ocean Processes and their Influence on the Oil Spilled off San Francisco by the M/V *Puerto Rican*†

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### ABSTRACT

*The oil tanker M/V Puerto Rican exploded on 31 October 1984 and later broke apart to produce a major oil spill in the coastal waters off San Francisco, California, USA. Oil from this spill initially moved to the SSW until 5 November, when it abruptly reversed direction and began moving rapidly to the north and then to the NNW during the following week.*

*The oceanic processes that most likely contributed to the displacement of the oil spilled by the Puerto Rican are examined within the framework of a simple, empirical-hindcasting model. A large-scale flow component, wind drift, and tidal currents are included in the model. Wind drift, inferred by using a simple linear formulation, was the single most important factor in determining the over-all displacement of the oil. Residuals from the model, however, indicate that the winds alone could not fully account for the sudden and dramatic reversal in oil movement that occurred on 5 November 1984. This reversal was surge-like and coincided with an increase in sea level along the central California coast. Finally, the close agreement between the local and advective changes in sea-surface temperature in the Gulf of the Farallones at the time of the Puerto Rican oil spill indicate, although not conclusively, that this reversal could have been related to the onset of the Davidson Current or other larger-scale flow phenomena.*

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## INTRODUCTION

On 31 October 1984, the oil tanker M/V *Puerto Rican* exploded about 30 km west of the Golden Gate Bridge, San Francisco (Fig. 1). Three days later, the *Puerto Rican* broke in two while under tow. The stern section sank and produced a major oil spill in the Gulf of the Farallones. An estimated 1.5 million gallons of oil were spilled into the ocean as a result of this accident (Herz & Kopec, 1985). The resulting spill gradually spread south over the next three days. However, on 5 November, the oil-spill

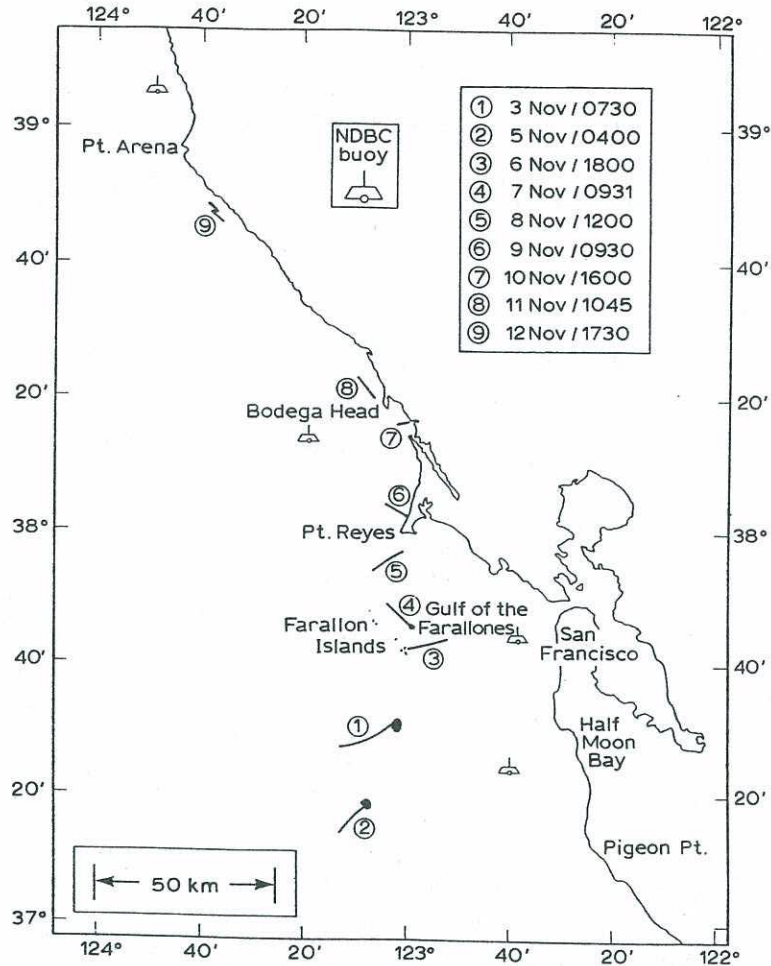


Fig. 1. Oil-slick locations at different times along the central California coast during the period of the *Puerto Rican* tanker oil spill between 3 and 12 November 1984. Approximate shapes of the oil-slick pattern are also indicated; hence the bulbous extremities associated with the oil slicks at locations 1 and 2.