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STUDY TITLE: Lagrangian Surface Current Measurements in Alaska.

REPORT TITLE: Lagrangian Surface Current Measurements on the Outer Continental Shelf.

CONTRACT NUMBER(S): BLM: IA7-41; MMS: 14-12-0001-29160; Research Unit No. 217.

SPONSORING OCS REGION: Alaska.

APPLICABLE PLANNING AREA(S): Gulf of Alaska; Kodiak; North Aleutian Basin; St. George Basin; St. Matthew Hall; Bowers Basin.

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COST(S): FY 1976: \$168,410; FY 1977: \$71,952; FY 1978: \$152,211; CUMULATIVE PROJECT COST: \$392,573.

PROJECT MANAGER(S): Outer Continental Shelf Environmental Assessment Program (OCSEAP). The OCSEAP office is no longer in operation. For further information, contact the MMS, Alaska OCS Region, at the address below.

AFFILIATION: National Oceanic and Atmospheric Administration.

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KEY WORDS: Pribilof Islands; physical oceanography; currents; surface drifters; eddy; satellite tracking; Lagrangian; Gulf of Alaska; Kodiak; North Aleutian Basin; St. George Basin; St. Matthew Hall; Bowers Basin.

BACKGROUND: With potential development of offshore oil reserves along the outer continental shelf of the Gulf of Alaska and the Bering Sea, there was concern over the fate of a possible hydrocarbon spill. Of particular interest were indications that the northern Gulf of Alaska may be an accumulation point for surface materials. Lagrangian drifter data collected as part of the North Pacific Experiment (NORPAX) and numerical models covering large areas of the North Pacific suggested that surface materials tend to be swept into the Gulf of Alaska where they impinge and ground along the coast. Of particular concern were the sensitive biological habitats along the Aleutian Islands.

This report summarizes deployments of Lagrangian surface drifter deployments along the Alaskan outer continental shelf. The resulting Lagrangian current statistics were to form the basis for input to advanced surface contaminant dispersion models. Initially, in the spring and summer of 1976, near-surface Lagrangian current data were collected within the northeast Gulf of Alaska from Yakutat Bay to Prince William Sound. During 1976, but principally with the drifter deployment in 1977, the region of interest was expanded to include the southeast Bering Sea.

OBJECTIVES: (1) To obtain Lagrangian current data for assessment of probable trajectories of oil spills in the Gulf of Alaska and the southeast Bering Sea using drogued free-drifting buoys located by a satellite positioning

system; and (2) To provide a series of maps depicting characteristic flow trajectories that provide an easily-understood visualization of surface currents for use by decisionmakers involved in hydrocarbon resources development offshore Alaska.

DESCRIPTION: Six buoys were deployed southeast of the Pribilof Islands in the southeast Bering Sea in May 1977. The longest surviving buoy terminated transmission after 7.5 months. Average longevity exceeded 135 days. Buoy failure was largely due to entrainment within seasonal ice cover. Two short-lived buoys failed due to grounding on the Pribilof Islands. One of these failed two months after deployment as a result of grounding on St. George Island. More than 820 days of surface drift data were obtained within a region bounded meridionally by 54°N and 59°N and zonally by 163°W and 178°W.

In 1976, two types of expendable free-drifting buoys were deployed in the Gulf of Alaska. A high endurance buoy was drogued at depth of 30 m and carried sensors for sea surface temperature, wind speed, and drogue loss. A smaller, more economical buoy was also deployed. It carried a drogue set at a depth of 10 m to reduce the risk of grounding and an instrument package with fewer sensors. In 1977, buoys deployed in the southeast Bering Sea were of the second smaller type and contained only a drogue-loss sensor. Buoys were located from three to five times each day using the Random Access Measurement System aboard the NIMBUS-6 satellite. The buoy identification, time, and other parameters were telemetered to the Goddard Space Flight Center operated by NASA.

The six buoys were deployed in two lines across the continental slope north of Unimak Pass in the southeastern reaches of the St. George Basin. The prevailing surface current flows northward from the Gulf of Alaska, through a gap in the Aleutian Island arc and into the St. George Basin. The deployment positions were selected so that the drifters would be on the upstream edge of this influx into the St. George Basin.

SIGNIFICANT CONCLUSIONS: On basin-wide scales, floating material from a sizable portion of the North Pacific Ocean tends to be transported by the Alaskan Current northward into the Gulf of Alaska. There, flotsam is trapped within the Alaskan subpolar gyre and much of it grounds along the northern Gulf of Alaska. The Lagrangian circulation within the southeast Bering Sea departs significantly from that of the Gulf. Specifically, net mean displacements are much smaller and are superimposed on an energetic mesoscale field of eddies. As a consequence of these differences, steady state circulation modelling is of much less utility for determining oil-spill trajectories in the southeast Bering Sea.

STUDY RESULTS: All six buoys deployed in St. George Basin exhibited generally similar behavior characterized by extensive eddy recirculation superimposed on a weak net displacement. For the most part, the net drift of the buoys was toward the Pribilof Islands, northwest of the deployment site. Further interpretation of buoy trajectories indicated that surface currents in the southeast Bering Sea during the summer and fall of 1977 had significant kinetic energy at periods of days to weeks. Current speeds averaged over several days were on the order of 20 cm/sec or less. Sustained current speeds rarely exceeded 30 cm/sec. Long term displacement of surface water masses was sluggish, on the order of 400 km in 100 days.

STUDY PRODUCT(S): D. Hansen. 1977. Lagrangian Surface Current Measurements on the Outer Continental Shelf. An annual report for the U.S. Department of the Interior, Bureau of Land Management, Alaska OCS Office, Anchorage, AK and the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, OCS Environmental Assessment Program, Anchorage, AK. Contract No. IA7-41 and 14-12-0001-29160; Research Unit No. 217. 13 pp.

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