

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Average Near-Bottom Currents
in Massachusetts Bay and Cape Cod Bay
Measured with Woodhead Drifters:

Progress Report for Drifters Released Sept. 1990 through May 1991

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Any use of trade names in this report is for descriptive purposes only and does not imply endorsement by the Geological Survey.

I. Introduction

The U.S. Geological Survey is presently conducting a program of studies in Massachusetts and Cape Cod Bays designed to understand water circulation and the transport and fate of contaminated sediments. These studies are closely coordinated with the Massachusetts Bays Program of the Environmental Protection Agency. One component of the U.S.G.S. program is the use of Woodhead bottom drifters to measure the average speed and direction of the water flowing over the sea bed. This progress report presents deployment and recovery statistics for drifters released between September 1990 and May 1991, and recovered by June 7, 1991.

II. The Woodhead Drifter Project

A Woodhead bottom drifter is shaped like an open umbrella with a long handle and is made of brightly colored plastic (Figure 1). The bottom of the stem is weighted so that the drifter is slightly heavier than seawater, and it is stable with its tip on the sea floor and the cap end up. A water-proof, postage-paid postcard is threaded onto the stem; it bears an identifying number and the request that the finder fill in the time and location at which the drifter was found and then mail the card. Before release, the drifters are bundled in groups of ten or twenty and attached to salt blocks (rabbit salt licks)

large enough to pull the bundle to the sea floor before dissolving so that the drifters can move individually.

Bottom drifters are released in groups of 40 or 50 during hydrographic surveys and mooring setting operations at stations in Western Massachusetts Bay, Stellwagen Basin, Cape Cod Bay and offshore of Manomet Point (see Table I and Figure 2). The Massachusetts Bay release point is near the site of the new Boston wastewater outfall. Drifter releases through May 1991 are listed in Table II. Drifters will continue to be released monthly through 1992.

III. Results

Data from cards returned by June 7, 1991 are summarized in Table III and Figure 3. Bottom drifters were found on beaches and in the nets of fishermen. Drift paths are drawn as straight lines to emphasize the fact that we only know where the drifters were released and where they were found, and not the actual path taken. Exceptions are drift paths for which a straight line would cut across land; we assume that the drifters traveled by water. For the drifters found on beaches, we do not know the time lag between a drifter's arrival on the beach and its discovery. Thus the calculated drift times for these drifters are upper limits.

No cards have been returned from the drifters released on

April 30 and May 2 (groups 9 - 11). This represents a drift time of at least 36 or 38 days, not inconsistent with average drift times of 29 to 98 days for other releases.

In general, drifters released together were found in the same region, but drifters released at different times at the same location were often found in completely different regions. For example, drifters released in Cape Cod Bay in September (Figure 3a, D) were mostly found in Plymouth and Sandwich on the western shore of the bay, while those released at the same location in March (Figure 3c, D) were found to the east, mostly along the Atlantic beaches of the Cape Cod National Seashore.

The drifters released in Stellwagen Basin in September (Figure 3a, A) were found in an exceptionally large region extending from Gloucester to Sandwich, as well as on the Atlantic shore of Cape Cod. The actual spread of drifters from Stellwagen Basin is probably even greater, as drifters moving into deeper, offshore waters are less likely to be found than if they arrive on coasts or in heavily fished coastal areas.

IV. Discussion

The near-bottom water flow measured by a drifter is averaged over time following the unknown path of the drifter. After drifting for many days, the drifter's forward motion is the accumulated difference between flood and ebb tidal currents. The Woodhead drifters released in Massachusetts Bay and Cape Cod Bay have measured different near-bottom drifts originating at the

same locations, suggesting weekly or monthly currents caused by storm winds and seasonal changes in river discharge. More data will be necessary to determine the effects of the different processes, so that we can frame general conclusions and predictions about the movement of bottom water and suspended sediments. Correlations between drifter paths, weather, and the velocities measured by moored current meters, and between find-locations and fishing- and beach-use patterns, will be important aspects of data analysis.

Figure Captions

Figure 1. Top and side views of Woodhead drifter. The stem is 6 mm in diameter and 55 cm long, and the cap is 18 cm in diameter and has four 2-cm diameter round holes centered 3 cm from the center of the cap.

Figure 2. Massachusetts and Cape Cod Bays. Release points for bottom drifters are: A, Stellwagen Basin; B, Massachusetts Bay; C, Manomet Point; D, Cape Cod Bay.

Figure 3. Minimum length drifter paths. (a) Groups 1-4, released Sept. and Oct. 1990. (b) Group 5, released Feb. 1991. (c) Groups 6-8, released March 1991. Release stations: A, Stellwagen Basin; B, Massachusetts Bay; C, Manomet Point; D, Cape Cod Bay.

Table I. Release points for bottom drifters in Massachusetts and Cape Cod Bays.

	<u>Station Name</u>	<u>Latitude North</u>		<u>Longitude West</u>	
A	Stellwagen Basin	42	21.3'	70	24.0'
B	Massachusetts Bay	42	22.6'	70	46.99'
C	Manomet Point	41	56.06'	70	27.6'
D	Cape Cod Bay	41	57.0'	70	19.8'

Table II. Time and location of Woodhead Drifter releases in Massachusetts and Cape Cod Bays.

<u>No.</u>	<u>Release Group</u>		<u>Number Released</u>	<u>Card Numbers</u>
	<u>Date</u>	<u>Location</u>		
1	9/13/90	Stellwagen Basin	50	1001 - 1050
2	9/13/90	Cape Cod Bay	50	1051 - 1100
3	9/13/90	Manomet Point	40	1101 - 1140
4	10/23/90	Massachusetts Bay	50	1141 - 1190
5	2/ 5/91	Massachusetts Bay	50	1427 - 1451 1477 - 1502
6	3/13/91	Massachusetts Bay	50	1401 - 1426 1452 - 1476
7	3/22/91	Stellwagen Basin	50	1503 - 1552
8	3/23/91	Cape Cod Bay	50	1553 - 1599 1201 - 1203
9	4/30/91	Massachusetts Bay	50	1204 - 1207 1209 - 1254
10	4/30/91	Stellwagen Basin	50	1255 - 1304
11	5/ 2/91	Cape Cod Bay	50	1305 - 1355

Table III. Return percentage and average drift rate by release group.

<u>No.</u>	<u>Release Group</u>		<u>Percent Returned</u>	<u>Group Average</u>	
	<u>Month</u>	<u>Location</u>		<u>Drift Time</u>	<u>Drift Speed</u>
1	9/90	Stellwagen Basin	46	98 days	.57 km/day
2	9/90	Cape Cod Bay	74	52 days	.66 km/day
3	9/90	Manomet Point	75	50 days	.35 km/day
4	10/90	Massachusetts Bay	74	59 days	.74 km/day
5	2/91	Massachusetts Bay	22	38 days	.44 km/day
6	3/91	Massachusetts Bay	4	48 days	.29 km/day
7	3/91	Stellwagen Basin	10	29 days	.61 km/day
8	3/91	Cape Cod Bay	70	39 days	.82 km/day
9	4/91	Massachusetts Bay	0		
10	4/91	Stellwagen Basin	0		
11	5/91	Cape Cod Bay	0		

Figure 1

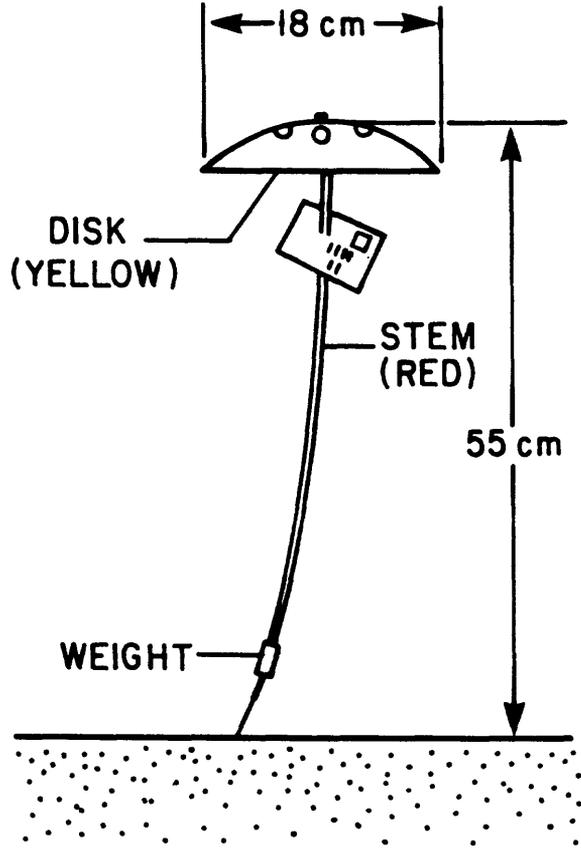
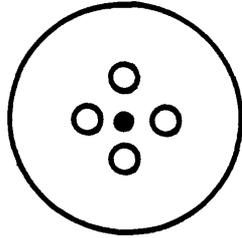


Figure 2

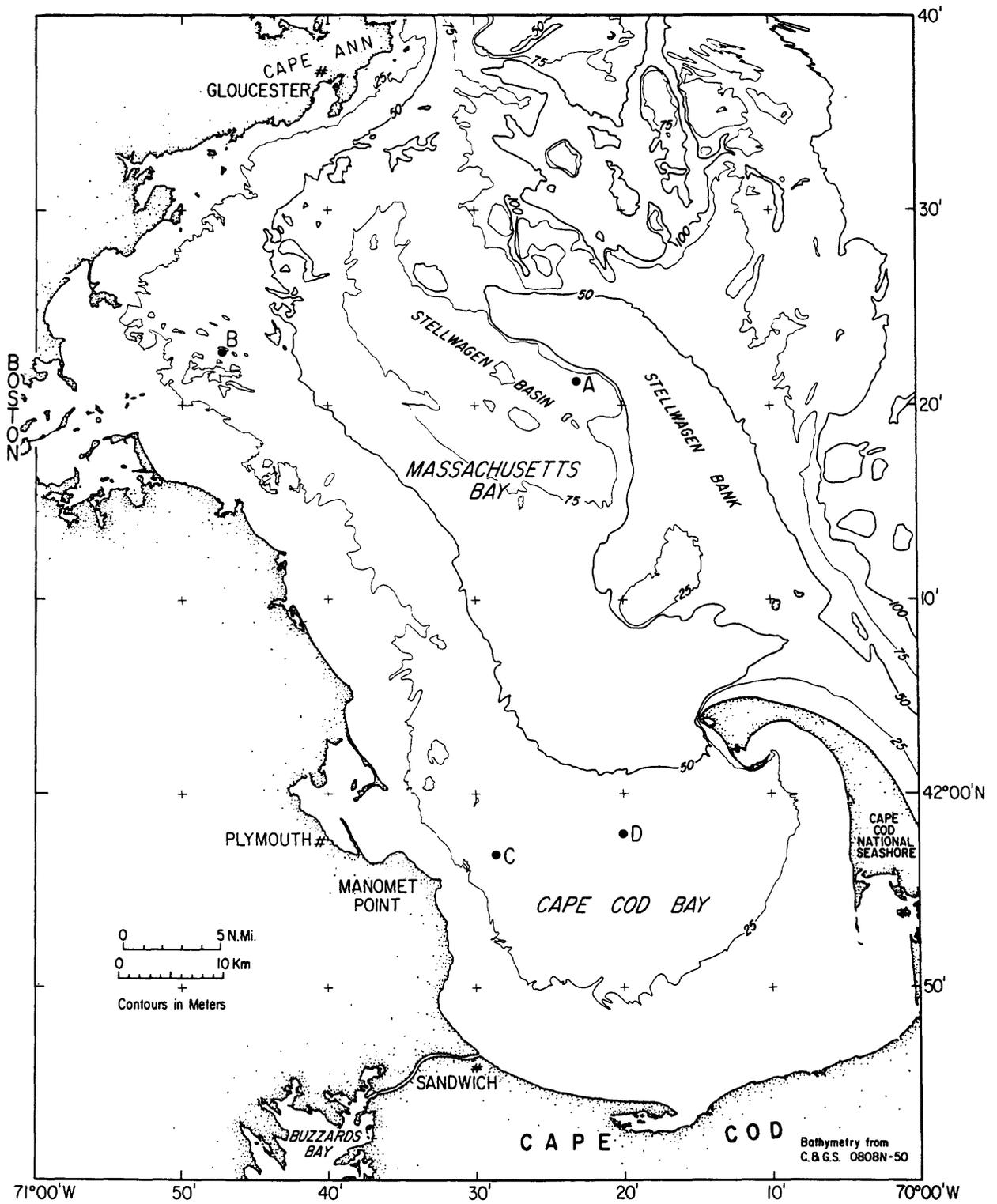


Figure 3 (a)

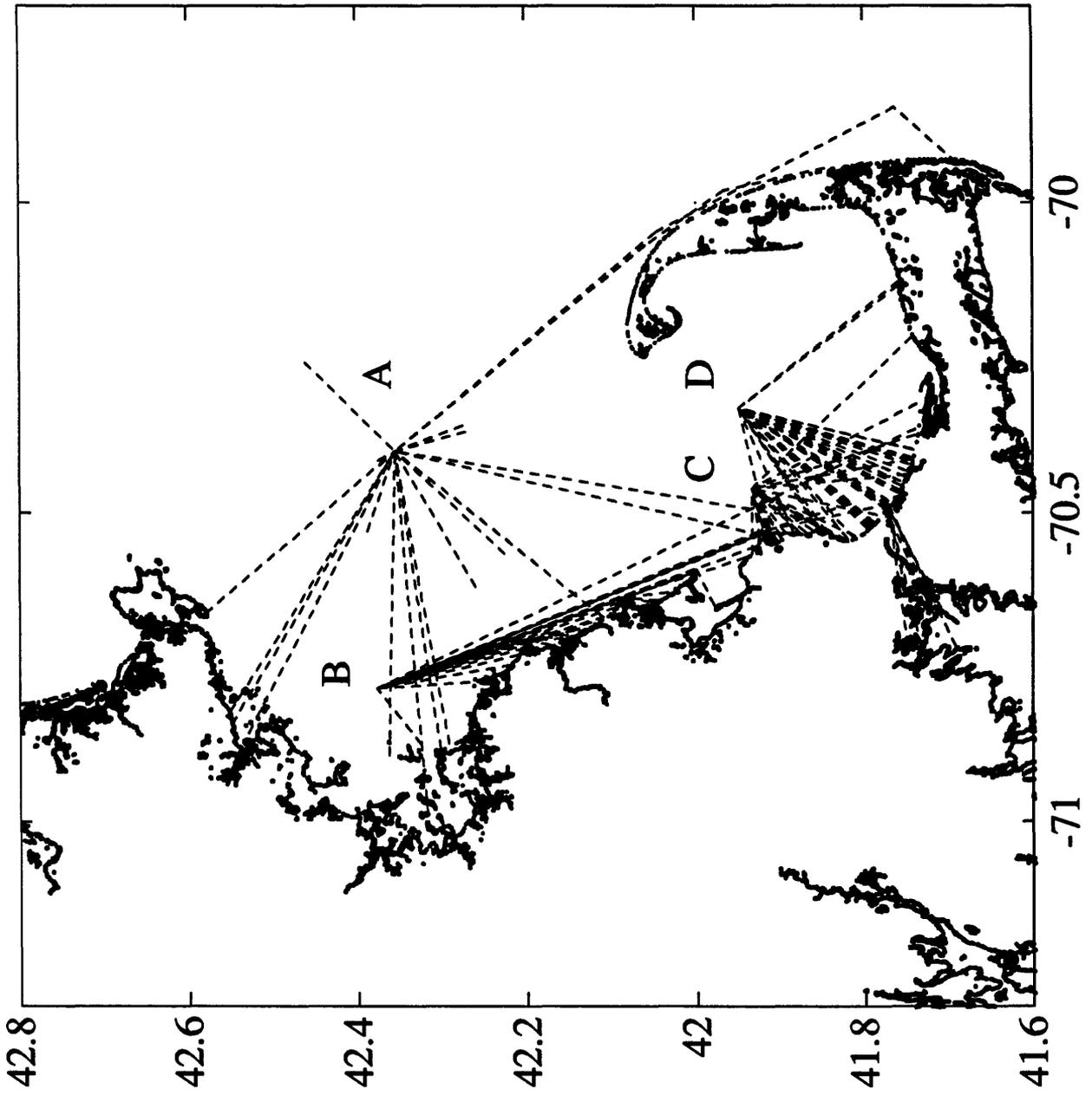


Figure 3 (b)

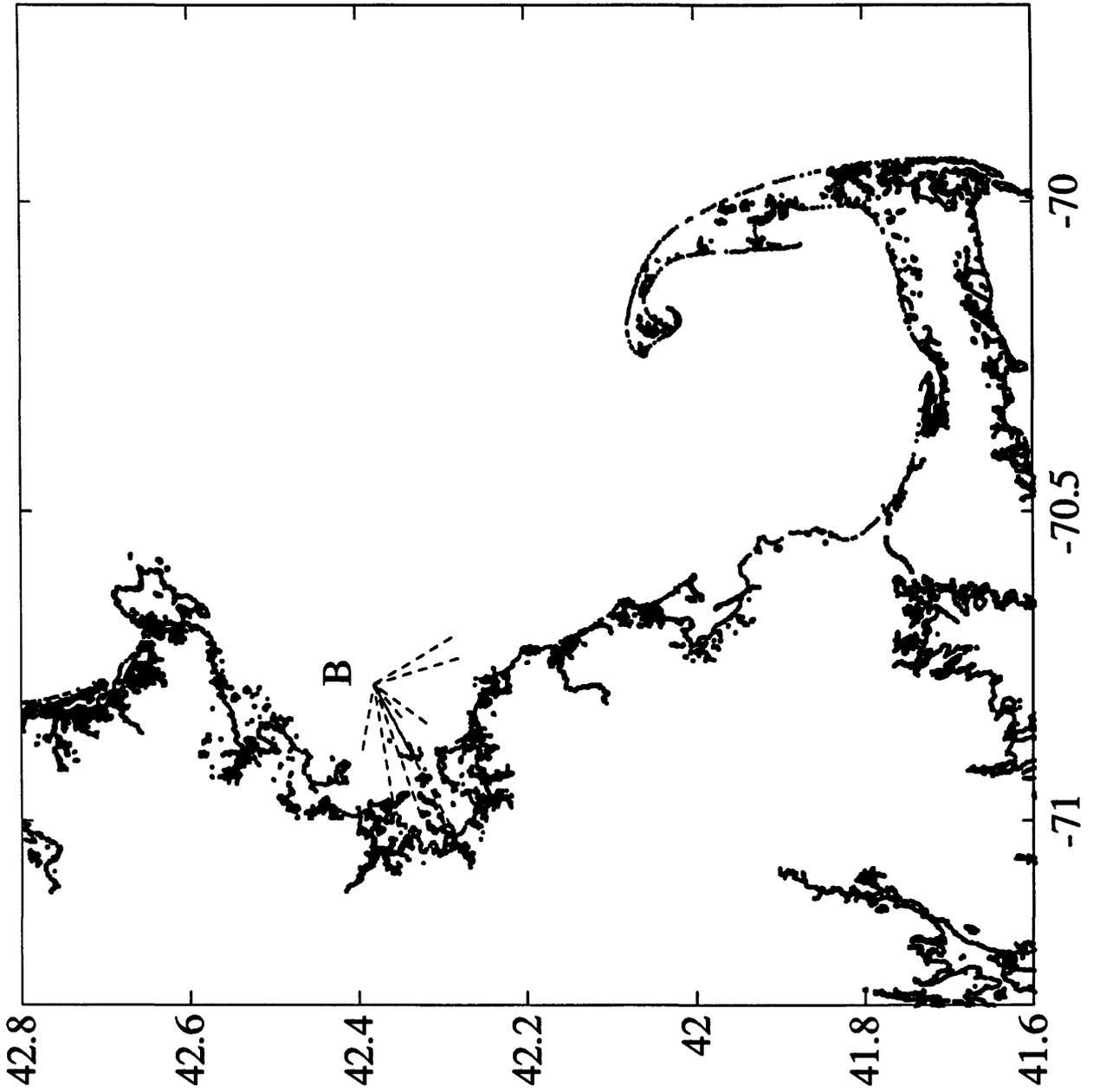


Figure 3 (c)

