CHUKCHI SEA ICE MOTIONS 1981-82

by

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TABLE OF CONTENTS

INTRODUCTION

During the winter of 1981-1982, six ice drifting buoys were deployed off the northwest coast of Alaska in the Chukchi Sea. The purpose of the work was to determine ice motions in the mobile region within about 150 km of shore, to measure ice motions further offshore, and also to measure barometric pressures and under-ice ocean currents. These data were expected to be valuable to analysts attempting to understand the forces that drive the nearshore ice at high speeds alongshore. The ice motion observations also extend the limited data base of direct measurements of Chukchi Sea ice motions.

The buoy deployment operations were presented by Thomas and Pritchard (1982). Briefly, two buoys were deployed in December 1981, and four more buoys were deployed in February 1982. Three of the latter buoys had current meters suspended 10 m below the top surface of the ice. Two of the latter buoys also contained barometers to measure atmospheric barometric pressure.

The Argos buoys, current meters, barometers and associated hardware were described in detail by Thomas and Pritchard (1982).

This report is a brief narrative description of the observed ice motions and currents.

RESULTS

The trajectories of each buoy deployed on the ice cover are presented in Figures 1 through 6. The ice motion histories were calculated using smoothed estimates of position. The smoothed positions were determined by passing a moving 48-hour cosine-bell filter over the data and calculating a position at 0000 GMT of each day. This analysis technique was used by Thomas and Pritchard (1981) to analyze ice drift behavior in Norton Sound. The position estimates each day are indicated by an 'x' on the trajectories. The date is indicated by a number determined by counting the days consecutively throughout the year, beginning with January 1 as day 1. Days in December 1981 lie in the interval of 335-365, and days in January 1982 begin with 1. Thus, January 31, 1982 is day 31, etc.

Several basic ice motion patterns are seen. The buoys further from shore (Figures 2 and 3) tend to drift fairly steadily offshore towards the west and northwest. These buoys were deployed about 200 km away from shore. The rest of the buoys deployed nearer shore (Figures 1, 4, 5, and 6) drifted back and forth alongshore. The net motion of each nearshore buoy was much less than the total distance traveled.

The ice behavior is best viewed by breaking the time into episodic intervals. Then, at any selected time there is often a strong correlation between the motions of the buoys. For example, between days 60 and 80 all buoys, including the two further offshore, moved in a semicircular pattern to the northwest, then southwest and finally southeast.

The current meters suspended from buoys numbered 3623, 3624 and 3625 provided 9-rein average current speeds and instantaneous direction readings every two hours (see Thomas and Pritchard, 1982, for descriptions of the hardware). The results are presented as stick plots in Figures 7 through 9. Each relative current vector represents the current velocity seen by an observer moving with the ice. This is different from the measurements taken by a fixed current meter. The absolute current is found by adding the ice velocity to the relative current. For example, if the ice is drifting freely with the ocean current, then the relative current would be zero.

The relative currents can be compared only until about day 66, after which the current meters on buoys numbered 3623 and 3625 stopped working. Until this failure, the currents offshore of Pt. Hope (Figure 8) and the currents offshore of Icy Cape (Figure 9) are similar. The currents offshore of Wainwright and west of Barrow (Figure 7) are not at all similar. The ice motions at all three sites appear to be similar from Figures 4 through 6. We may not be able to estimate ice velocities from these figures, however. After two of the current meters failed, the third buoy (see Figure 5 for positions and Figure 8 for relative current) continued to move about 200 km north and south offshore of Pt. Hope and Cape Lisburne. The currents during these excursions do not appear to be strongly correlated with the ice motions. From these observations, we conclude that the ice motion was not primarily driven by the local ocean currents. This conclusion differs from that of Reimer et al. (1979), who concluded that the ice in this region was strongly driven by the currents, at least when currents were large.

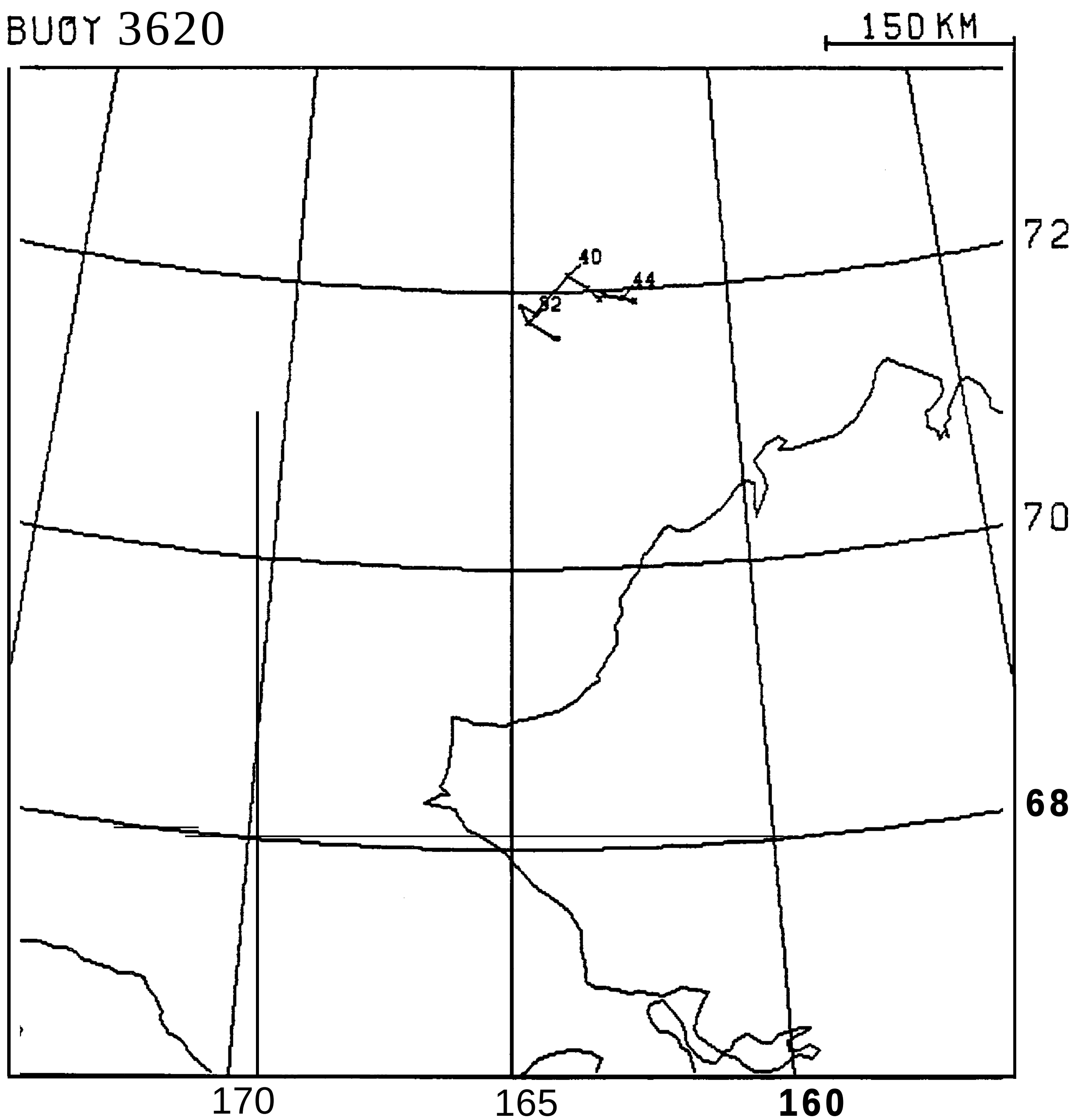

Figure 1. **Trajectory** for Buoy Number 3620

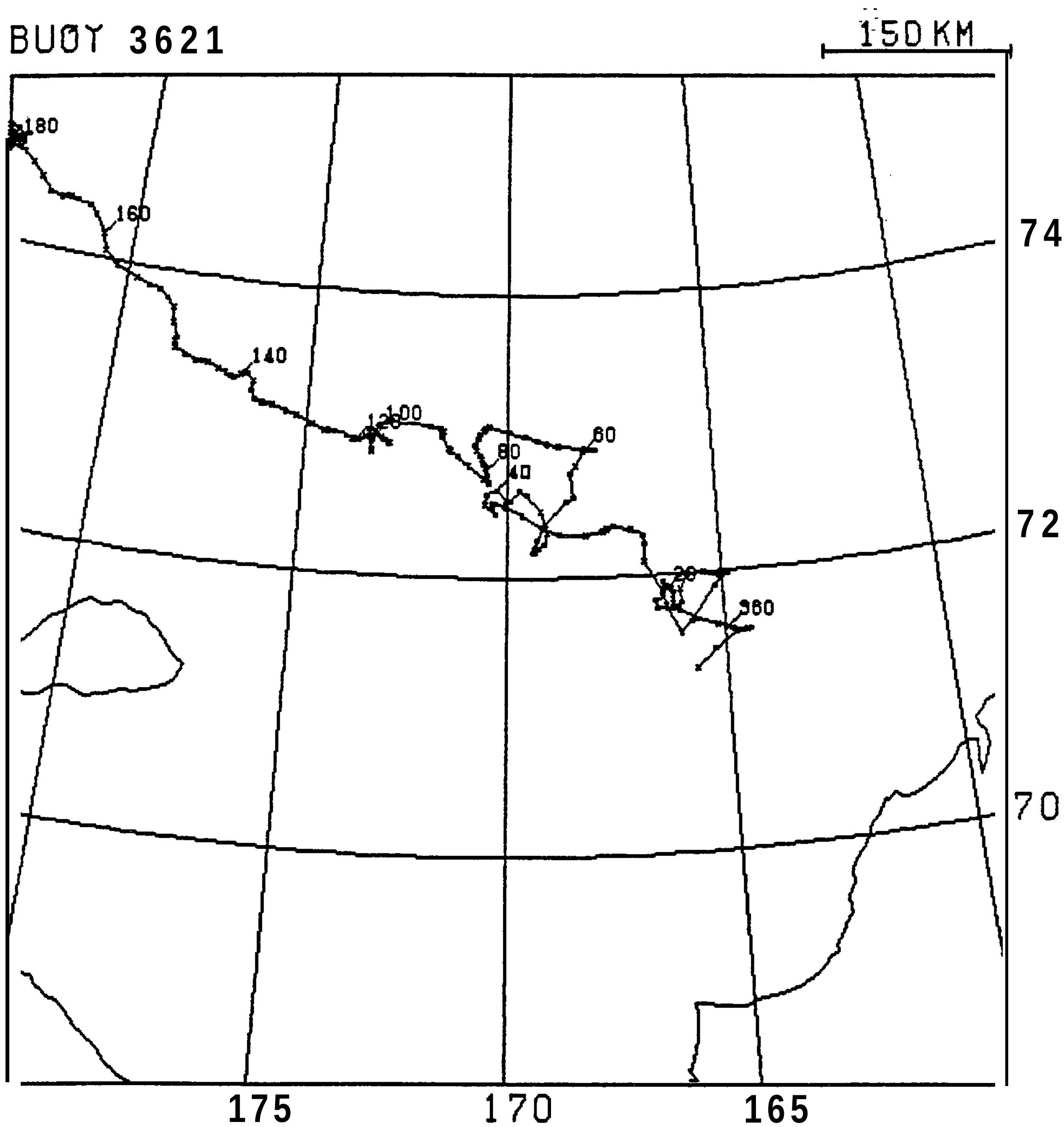

Figure 2. Trajectory for **Buoy Number 3621**

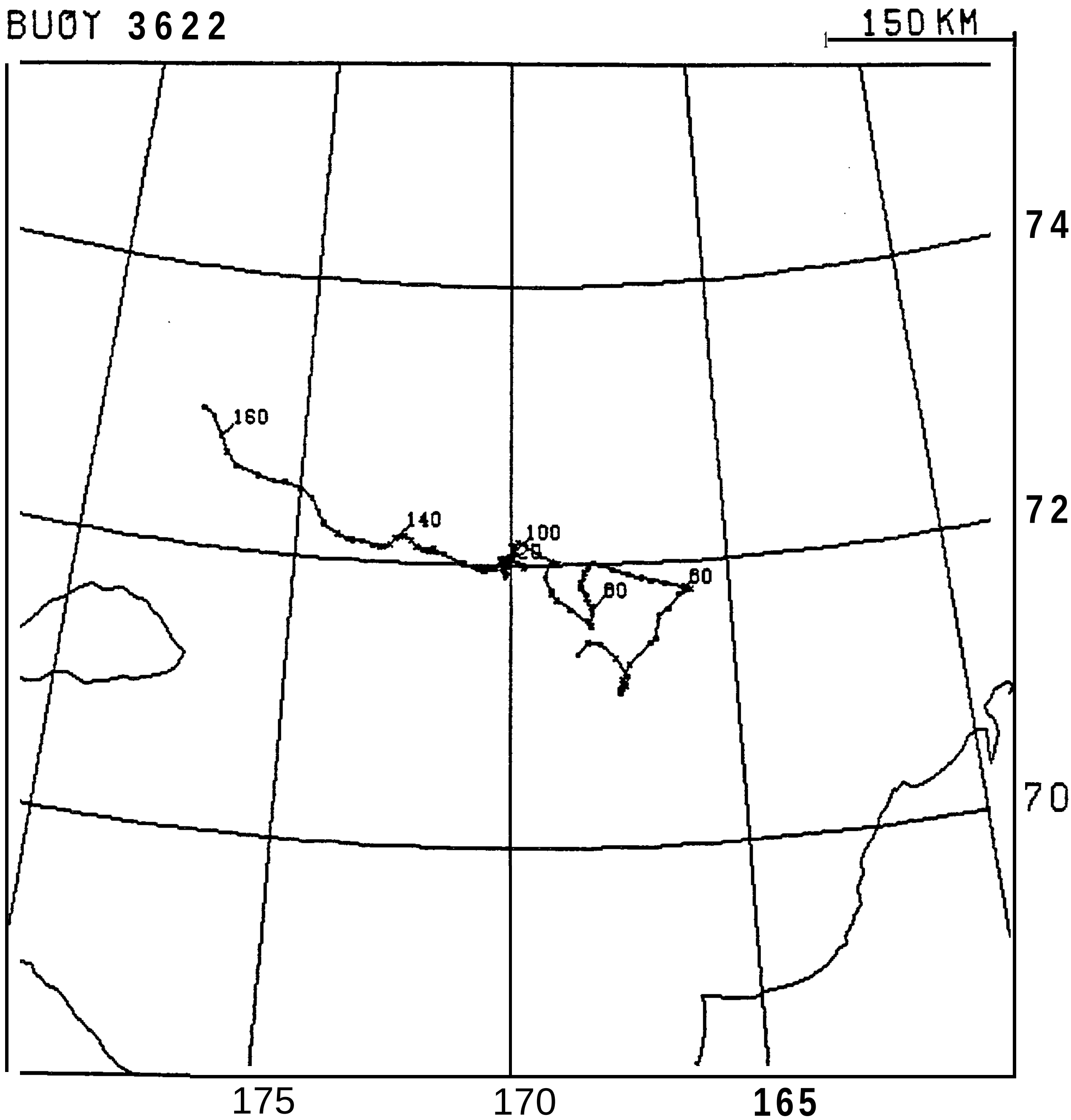

Figure 3. Trajectory for Buoy Number 3622

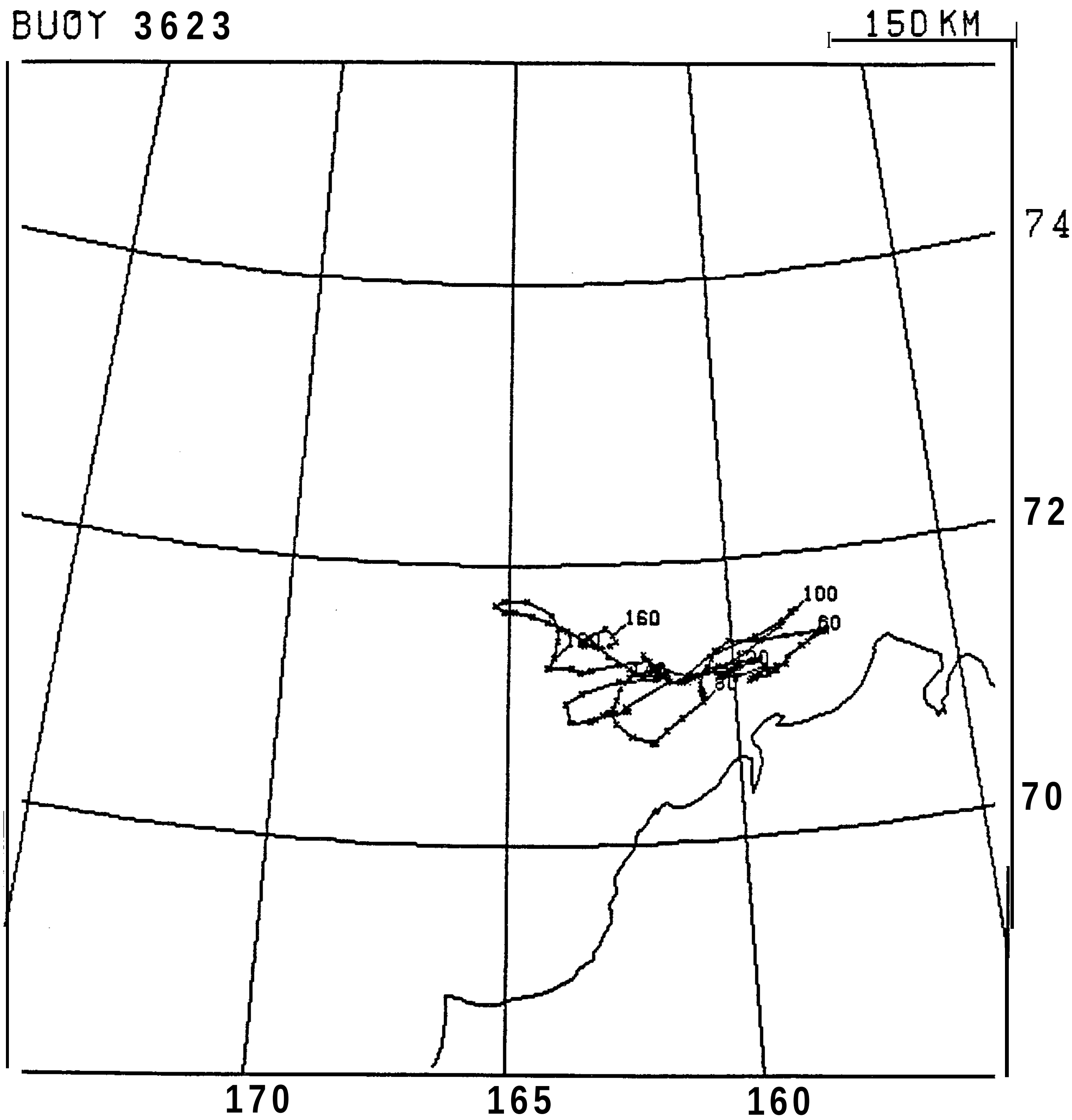

Figure 4. Trajectory for Buoy Number 3623

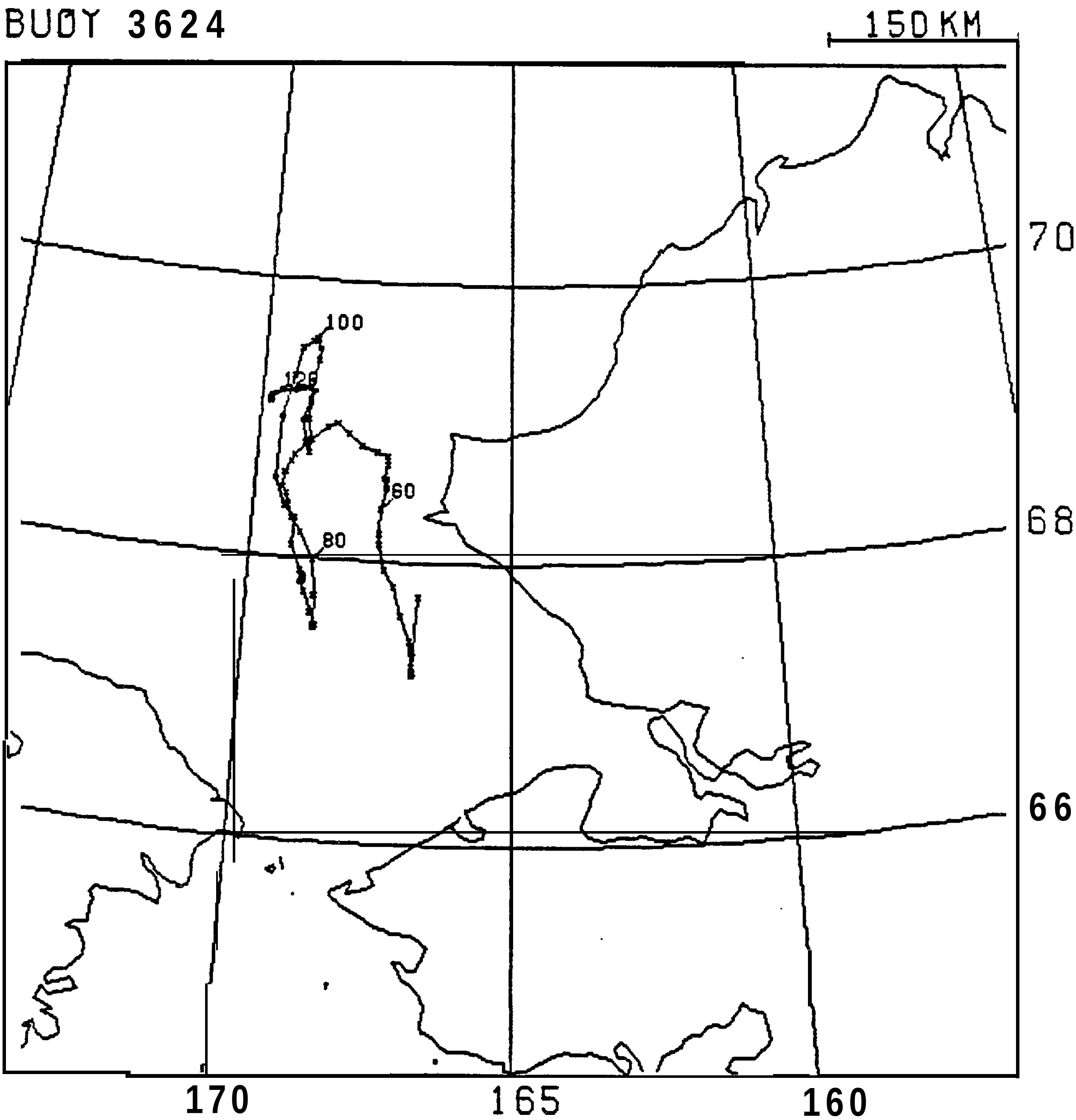

Figure 5. Trajectory for Buoy Number 3624

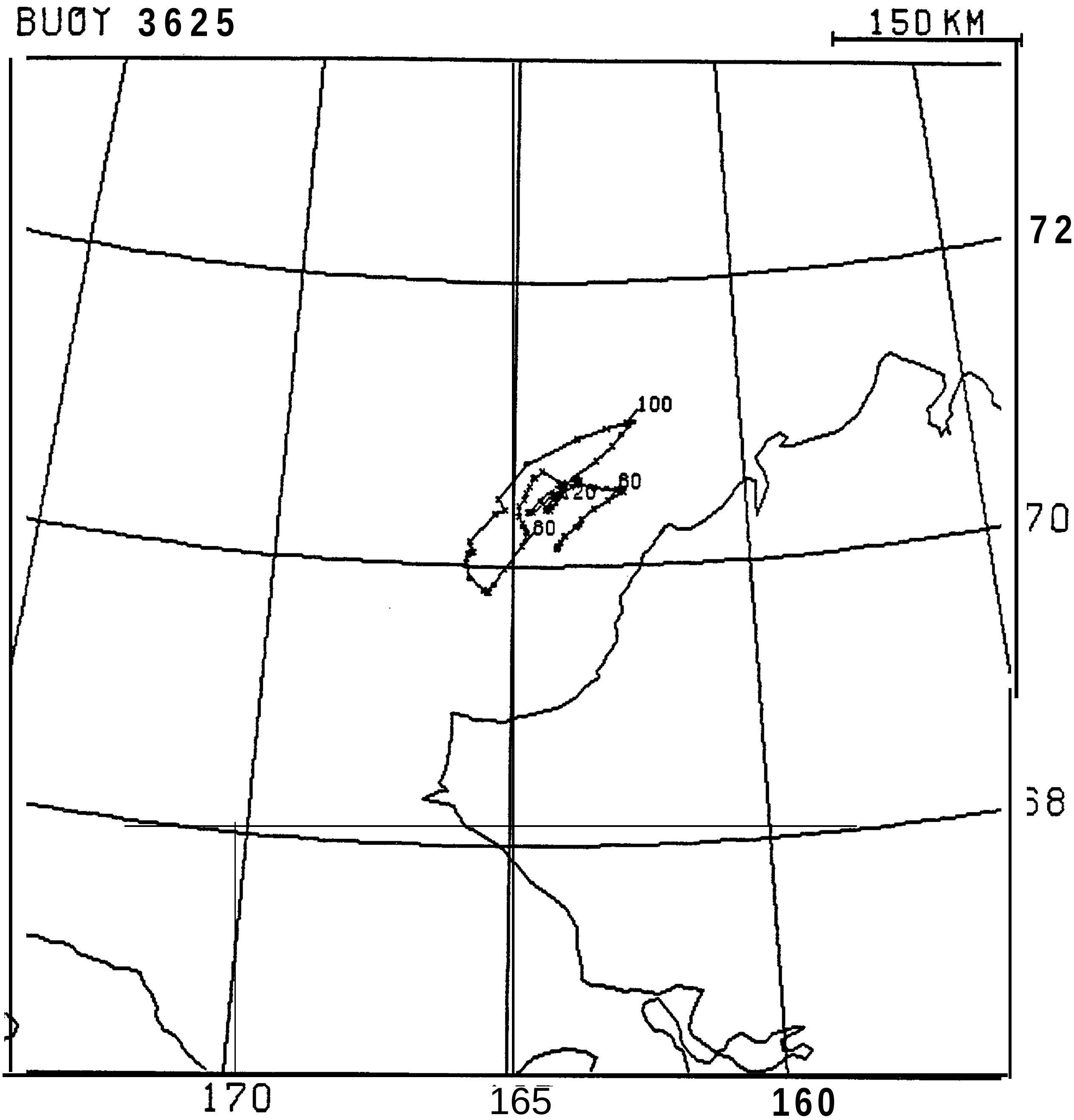

Figure 6. Trajectory for Buoy **Number 3625**

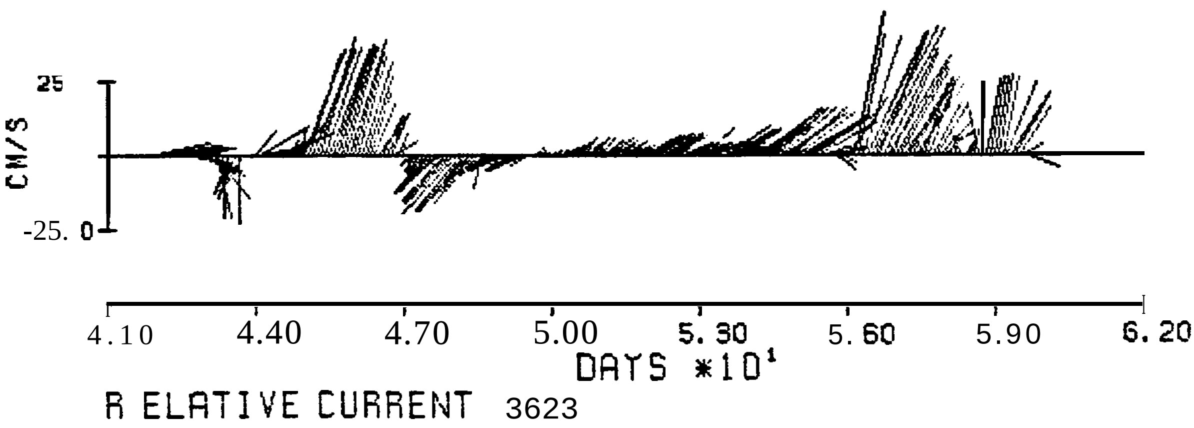

Figure 7. Relative Current Measurements for Buoy Number 3623

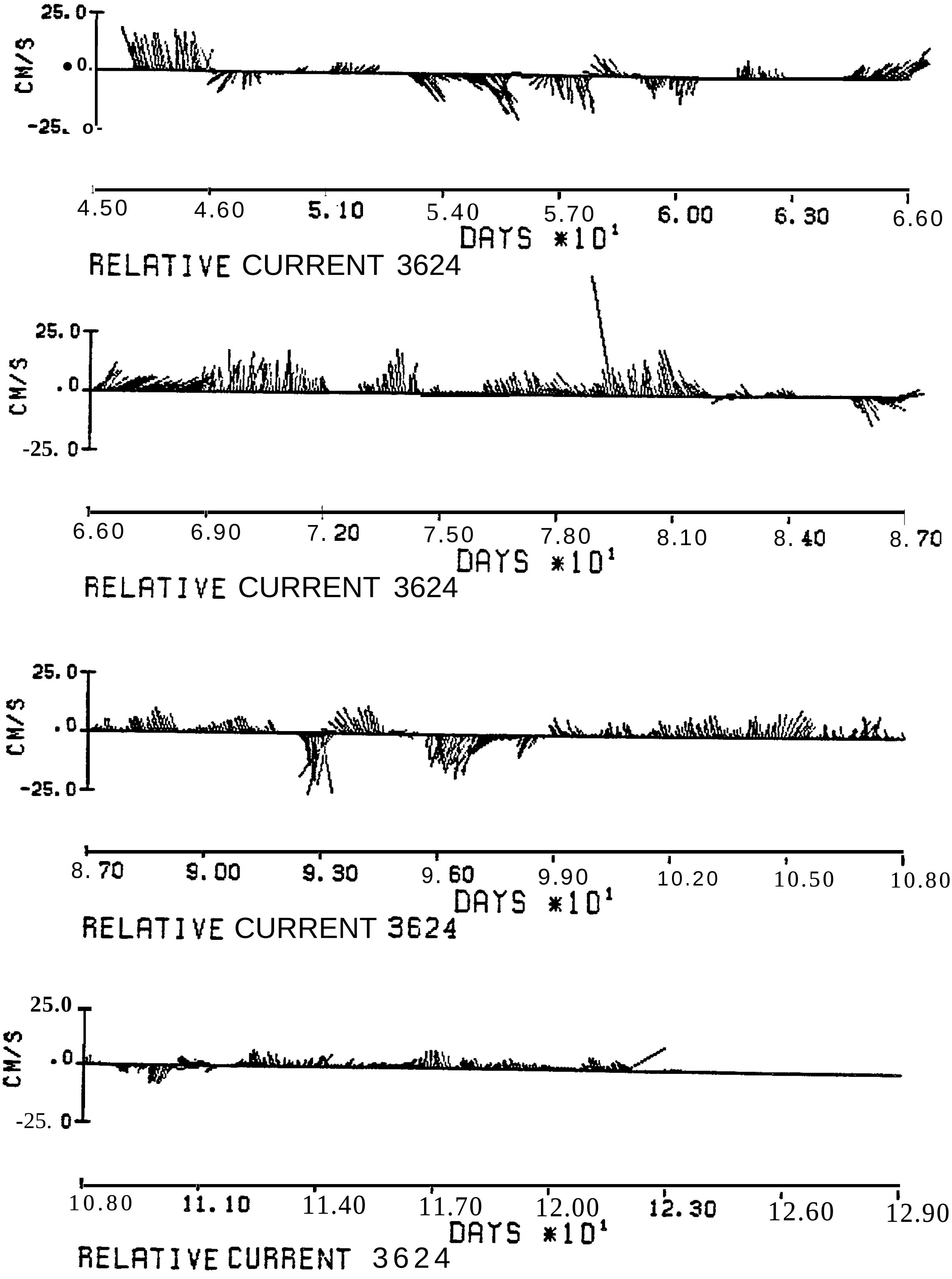

Figure 8. Relative Current Measurements for Buoy Number 3624

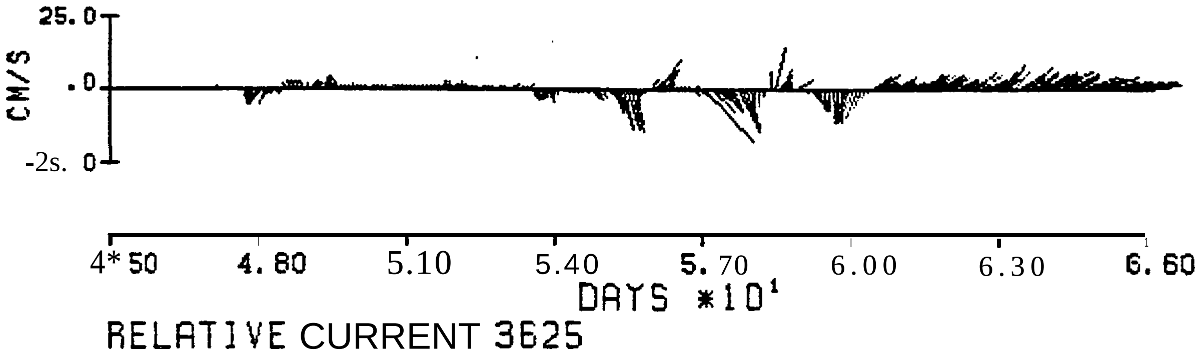

Figure 9. Relative Current Measurements for Buoy Number 3625

CONCLUSIONS

This narrative report briefly discusses the Chukchi Sea ice motions and ocean currents observed by a set of Argos buoys during the winter of 1981-82. Some of the buoys were equipped with current meters suspended 10 meters below the ice to determine ocean currents and also with barometers to determine atmospheric barometric pressure. These instruments were added so we could gain some understanding of the forces that drive the ice motion. It is essential in future experiments to include current meters in order to gain this understanding.

The buoy trajectories and current velocity data are presented in the figures in this report. The driving forces are not evaluated here.

During this experiment, the ice in the central Chukchi Sea drifted toward the west and northwest. The ice within about 200 km of the northwest coast of Alaska, on the other hand, tended to drift alongshore. It drifted back and forth, moving up to 200 km with each excursion.

At a depth of about 10 meters, the ocean currents relative to the ice did not show any strong correlations that would indicate that currents were driving the ice motion. The relative currents offshore Wainwright and Barrow differed from those offshore of Pt. Hope and Icy Cape, which were similar.

The results presented here do not attempt to explain what caused the ice motions, only to report what was observed. A cursory look at the relationship between ice velocity and ocean current showed little correlation, a result that appears to contradict conclusions of other investigators who have studied the breakout of ice through the Bering Strait. Although a more thorough study of the data should be made, the best understanding will come from using an ice dynamics model to estimate the forces exerted on the ice by the current and wind and by the internal ice *stress*,

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