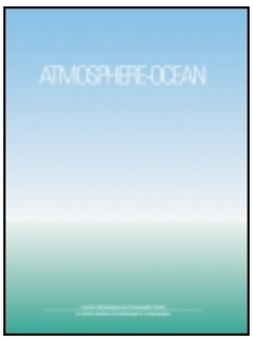

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# Ice drift in Southern Baffin Bay and Davis Strait: Research note

F. Jordan & H.J.A. Neu

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# Ice Drift in Southern Baffin Bay and Davis Strait

RESEARCH NOTE

F. Jordan and H.J.A. Neu
*Atlantic Oceanographic Laboratory*
*Ocean Science and Surveys*
*Bedford Institute of Oceanography*
*Dartmouth, Nova Scotia*

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ABSTRACT *Using satellite pictures of Baffin Bay and Davis Strait, ice-floes were tracked in order to give weekly surface velocities for 1978–1979. The approximate location of the edge of the ice sheet was also determined.*

*In winter the direction of travel was mainly southward in Davis Strait then, as the summer approached, the edge of the ice sheet retreated northward and floe motion became less clearly defined – even going north on occasion in Baffin Bay.*

*Nearshore speeds along Baffin Island exceeded 50 cm $s^{-1}$ in Davis Strait during November and February. Typical values in the winter/spring period were 10–15 cm $s^{-1}$ between Davis Strait and Hudson Strait. Wind records at nearby shore stations showed directions to be mainly from the northwest, roughly parallel to the Baffin Island coastline.*

*The study confirms the usefulness of satellite pictures as a data source for modelling surface ice movement and for selecting navigation routes in these northern waters.*

RÉSUMÉ *A l'aide d'images de la mer de Baffin et du détroit de Davis prises par satellite, des floes de glace ont été pistés afin d'obtenir leur vitesse de surface hebdomadaire en 1978 et 1979. On a aussi déterminé l'emplacement approximatif de la lisière de la nappe de glace.*

*En hiver, le déplacement s'est fait surtout en direction sud dans le détroit de Davis, puis avec l'approche de l'été, la lisière de la nappe de glace a régressé vers le nord et le mouvement des floes est devenu moins nettement défini (prenant même parfois la direction nord dans la mer de Baffin).*

*Au cours des mois de novembre et de février, la vitesse près de la côte le long de l'île de Baffin a même dépassé 50 cm $s^{-1}$ dans le détroit de Davis. Des valeurs de 10–15 cm $s^{-1}$ ont caractérisé la période hiver-printemps entre le détroit de Davis et le détroit d'Hudson. Des relevés de vent enregistrés dans des stations voisines du littoral indiquent que les vents dominants soufflaient surtout du nord-ouest, à peu près parallèlement à la côte de l'île de Baffin.*

*L'étude confirme l'utilité des images prises par satellite comme source de données permettant de simuler le mouvement de la glace à la surface de la mer et de choisir des routes maritimes dans ces eaux nordiques.*

## 1 Introduction

In the Canadian waters of the Labrador Sea and in the more northerly latitudes of

Davis Strait and Baffin Bay, ice is present for most of the year, either being formed locally during the colder seasons or being advected through Lancaster, Smith and Jones Sounds. In addition, there are the icebergs calved from glaciers along the western coast of Greenland. Initially these icebergs drift northward and westward at rates of up to 12 and 15 cm $s^{-1}$ in July and January, respectively. (Brooks, 1977; Robe et al., 1980), until they are taken by the southerly current along the east coast of Baffin Island.

Little is known about the distribution and long-term variation of surface currents in Baffin Bay and Davis Strait; with the presence of so much transient ice, current meters cannot be moored safely except in deeper wäters. The only ways to determine the movement of the surface layer are by using surface drifters that could float with the ice, or by directly following individual ice-floes.

Researchers such as Brooks (1977), Metge (1978), Osborn et al. (1978) and Spedding and Wood (1979) used surface drifters, drogued and undrogued, over limited time periods and locations. At Cape Dyer, nearshore speeds of 10 cm $s^{-1}$ and offshore speeds of 180 cm $s^{-1}$ were measured in August. Farther south through Davis Strait, average daily drift rates of up to 19 cm $s^{-1}$ were found in September. Anderson and Masterson (1977) reported that two marked ice-floes were followed by ship at the edge of the 1976–77 winter ice-pack in an area north of the Hudson Strait outlet where drift speeds reaching 100 cm $s^{-1}$ were logged during the 24-h measurement period.

Current meter data in this area are rare, but one mooring at 154-m depth in the centre of Davis Strait recorded up to 40 cm $s^{-1}$ during August to October (Osborn et al., 1978). Dey (1978) used Landsat and NOAA imagery for May 1975 and June 1975, 1976 and 1977, to detect floe motions of 17 cm $s^{-1}$ in the centre of Baffin Bay.

These observations are either too short-term or too local to adequately describe the movement of the surface layer through Davis Strait. The aim of the present project is to enlarge on this earlier work by showing the variation of the movement of ice through Davis Strait during the course of nearly a year.

A consecutive series of 1978–79 NOAA-5 weather satellite pictures clearly showed that large floes could be re-identified from day to day; thus the pictures could serve as a suitable data base for the study. It was found that floes 20-km long could be tracked with ease as long as clouds did not interfere. Velocity vectors were drawn and horizontal velocity distributions developed, one for each week, but based sometimes on as little as two days of tracks.

## 2 Wind

The motion of ice and surface water are both greatly influenced by wind. In northern regions the wind can persist strongly for a considerable time particularly in winter. In order to assess the general level of impact that the wind might have on our observations, predominant wind directions and weekly average strengths were obtained from four weather stations along the coast of Baffin Island, one at Cape Dyer in Davis Strait and the other three – Broughton Is., Cape Hooper and Clyde – farther north along the island (Fig. 1). Although these stations are coastal and do not necessarily represent the true conditions over the ice in Baffin Bay and Davis Strait, they at least provide a useful guide for deciding when basic currents are being

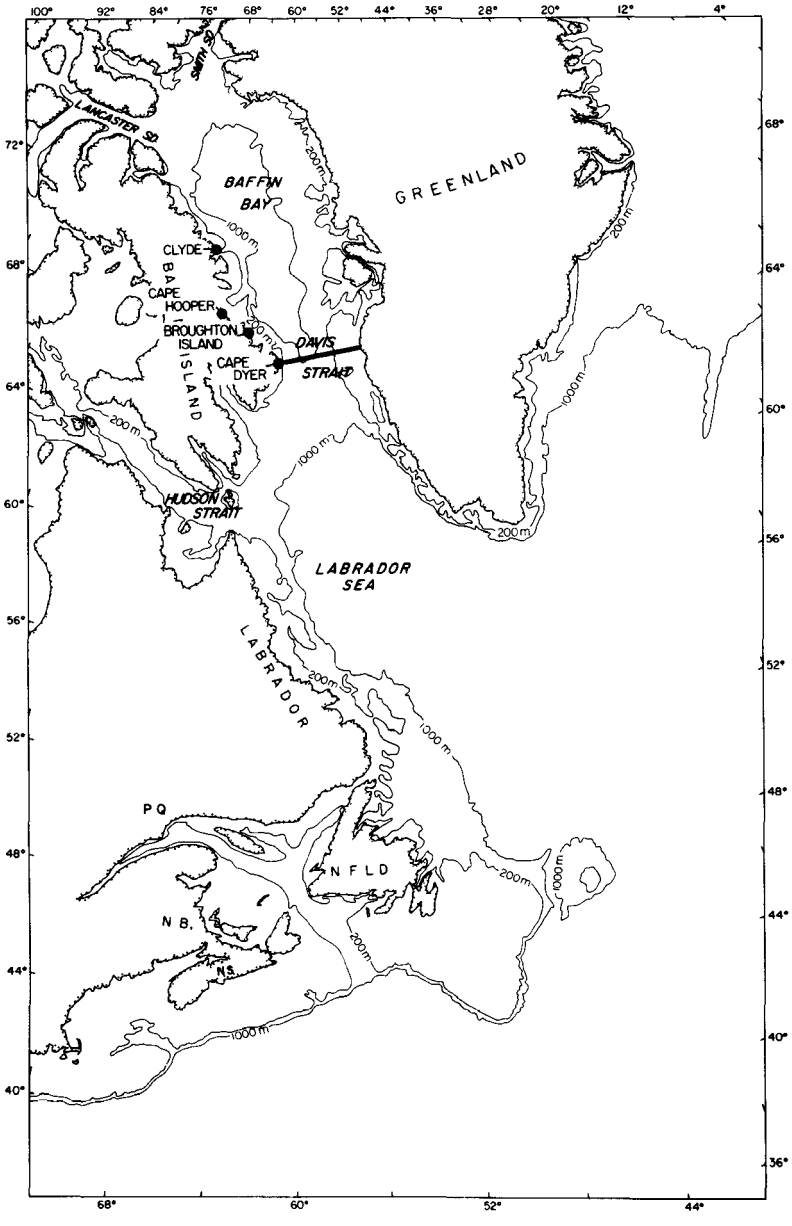


Fig. 1 Map of Baffin Bay and Labrador Sea area.

observed. The geostrophic wind would have been more representative, but observations were too scarce to obtain reliable pressure gradients.

Mean vector winds were developed for the weekly sets of satellite photographs, and are presented in Fig. 2 as stick plots (with direction being shown as going from the baseline towards the end of each stick), and in Fig. 3 on the current velocity plots.

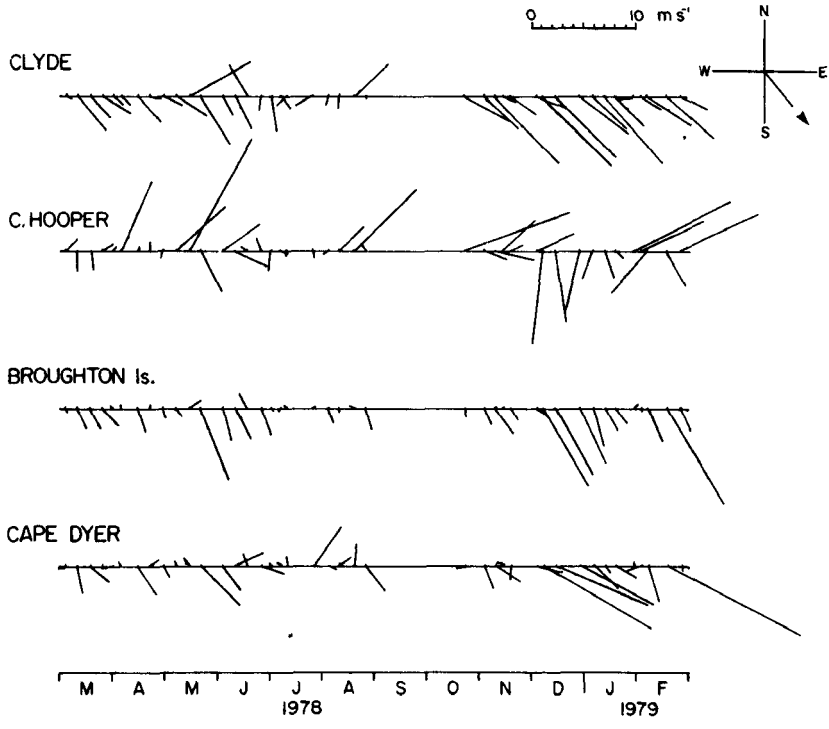


Fig. 2 Mean vector winds at four shore stations in Baffin Bay.

## 3 Results and discussion

The visible edge of the ice-field was determined for each week. Its average location for four particular periods is shown by a dotted line in Fig. 3. Only in late winter and early spring was Baffin Bay completely covered with ice. For the rest of the year the ice front retreated northward and westward, leaving open water along the coast of Greenland into Baffin Bay. The size of this lead varied with season and was maintained by warmer water in the West Greenland Current from the south. Floe ice that drifts into this water quickly disappears and cannot be used as a tracer. The entire ice-field of Baffin Bay appeared to be slowly moving southward to maintain the edge of the ice sheet at Davis Strait where floes were continuously breaking off and travelling south. The boundary of the West Greenland Current and the edge of the ice sheet may possibly coincide during the winter and early spring, but this is not necessarily the case at other times when atmospheric warming can control the position of the ice edge.

For the period 27 February to 27 August 1978, vectors were drawn between the first and last positions in each week for several freely drifting ice-floes. By this time the shrinking ice front had retreated out of the range of our pictures and the summer weather had brought increasing cloud cover to such an extent that the few ice-floes that could be seen were quickly lost. On 23 October individual ice-floes were again

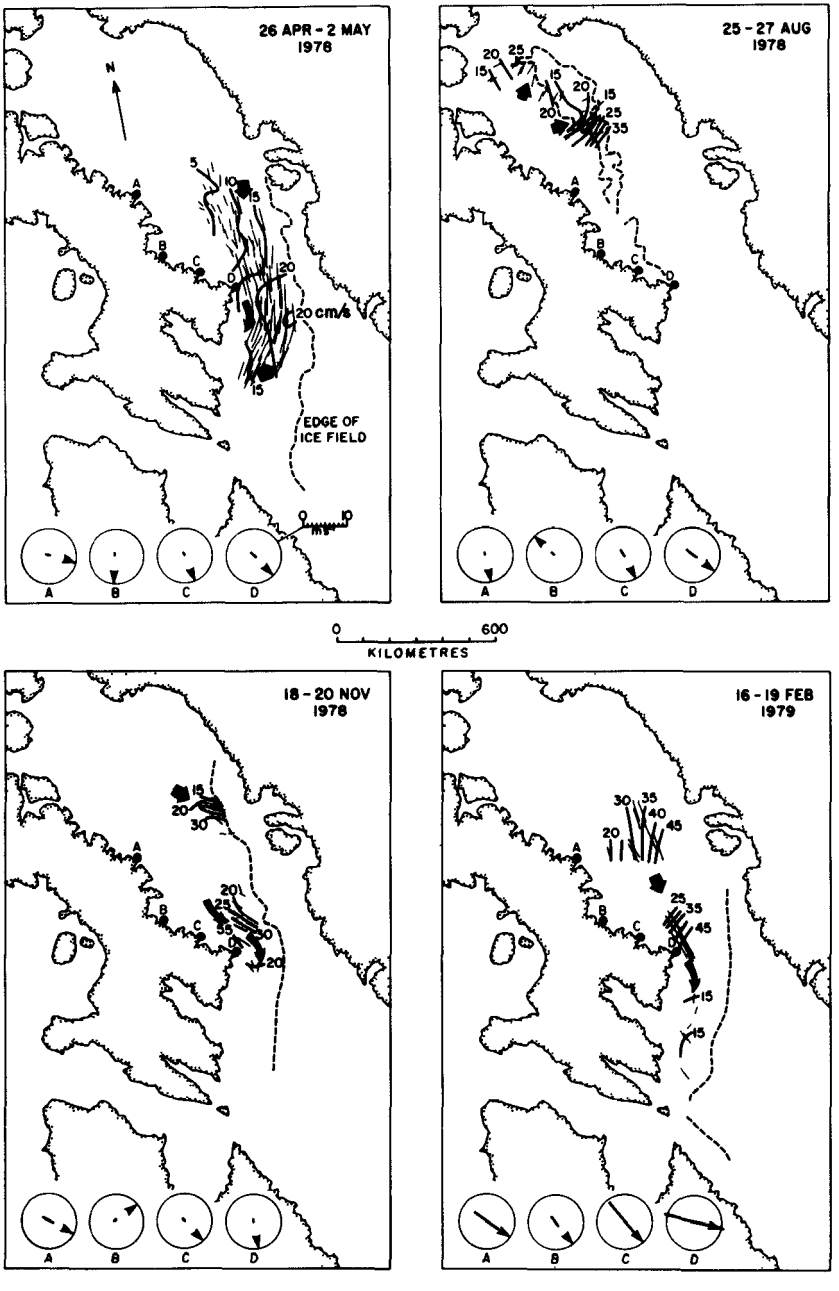


Fig 3 Four examples of data plots for various times of the year, showing ice-floe tracks (short straight lines), isovels, edge of ice-field and mean wind vectors in Baffin Bay and Davis Strait

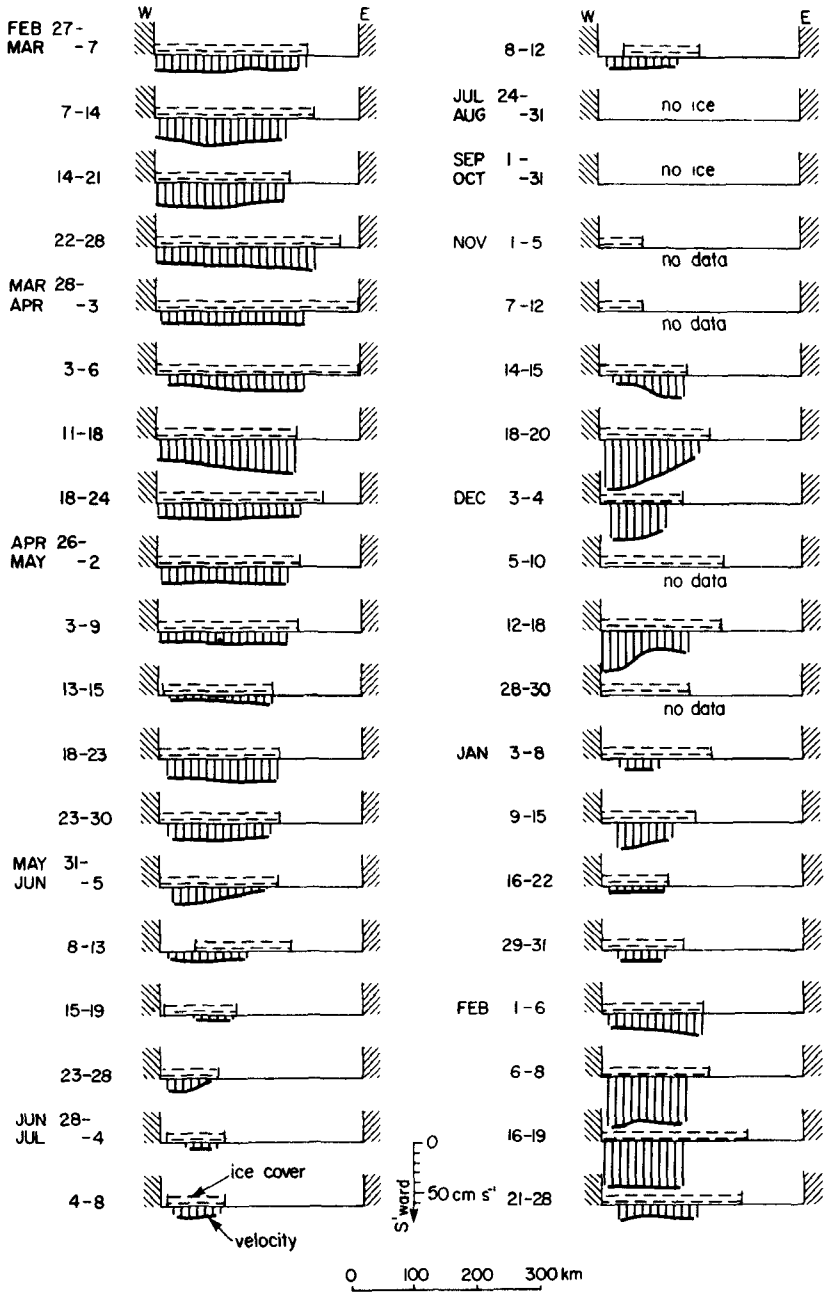


Fig. 4 Ice velocity through Davis Strait, 1978 to 1979.

consistently visible, although the main ice-field had been growing southward through Baffin Bay for some time before this.

Forty-two separate plots of velocity vectors were made and fully reported in Jordan and Neu (1981); four are shown in Fig. 3. The short, faint solid lines are the vectors; the heavy solid lines (isovels) connect vectors of equal velocity (in $cm\,s^{-1}$); the dashed line denotes the approximate edge of the ice-field. Heavy arrows indicate only general directions of travel. Nearly all ice movement visible in the western region of Davis Strait was southward, but farther north in Baffin Bay, movement was also in other directions during the summer and fall. Speeds ranged from less than 5 to more than $50\,cm\,s^{-1}$, with one 24-h observation of $59\,cm\,s^{-1}$ on 19 November 1979 in Davis Strait. During the low wind speed periods the average drift velocities were in the order of $20\,cm\,s^{-1}$ with typical values in winter and early spring being $10–15\,cm\,s^{-1}$ in the southern part of Baffin Bay, increasing to $20–30\,cm\,s^{-1}$ in Davis Strait and decreasing to $15\,cm\,s^{-1}$ along the Baffin Island coast toward Hudson Strait. These basic values are frequently modified by atmospheric effects arising from pressure changes (Crane, 1978), wind and seasonal effects.

In Fig. 4, the southward velocity components and the extent of the ice cover across Davis Strait are shown during the course of the year. Speeds vary across the strait, sometimes by as much as 50%, with more of the higher values being on the western side. Seasonally, winter speeds are on average twice as high as in the summer. The most persistent high velocity period occurred during the first half of February 1979 with values close to $50\,cm\,s^{-1}$ over nearly half of the strait. This current was associated with a strong wind field that prevailed over Baffin Bay and Davis Strait at the time. The highest speed occurred toward the end of November 1978, also in association with a developing wind field. In both cases the wind at Cape Dyer was from the northwest while the ice movement was to the southsouthwest, the latter possibly as a consequence of coastal configuration and earth rotation. The extent of the ice changed greatly, covering the western half of the strait during autumn and most of the winter, and increasing in the late winter and early spring to extend from coast to coast. From mid-April, the open water lead along the coast of Greenland started to develop and the edge of the ice-floes retreated.

## Acknowledgements

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