CLIMATOLOGY

A NOTE ON THE CLIMATOLOGY OF BACKDOOR COLD FRONTS

Timothy P. Eichler (1) and Mark D. Shulman (2)
Department of Meteorology and Physical Oceanography
Cook College—New Jersey Agricultural Experiment Station
Rutgers—The State University of New Jersey
New Brunswick, NJ 08903

ABSTRACT

Backdoor cold fronts along the United States East Coast were analyzed for the period April, 1968 to March, 1985 to determine southward penetration, direction of 500 mb flow at the front's maximum southward extent, and seasonal occurrence. Backdoor cold fronts were stratified according to origin as maritime (type 1) or continental (type 2). Both types were most frequent during the warm half of the year, with no distinct maximum. The average maximum southward extent of backdoor cold fronts occurred between 40 and 43° N for type one and 37–40° N for type two. In addition, 500 mb winds concurrent with maximum southern extent of the surface backdoor cold fronts occurred most frequently between 300 and 330 degrees for all backdoor cold fronts.

1. INTRODUCTION

Backdoor cold fronts are synoptic events common to the east coast of the United States. They differ from other cold fronts in that they move from a North or Northeasterly direction instead of from a westerly or northwesterly direction. After passage, Northeasterly surface winds occur along the coast causing cool damp weather. This phenomenon occasionally extends to 30 degrees N. affecting much of the coastal plain and piedmont and is often associated with southward surface ridging along the coast known as damming. From a forecsting perspective, backdoor cold fronts are important, since they often separate warm dry weather from the cool and damp weather. Knowledge of the climatology of backdoor cold fronts may provide a valuable forecasting tool.

2. LITERATURE REVIEW

Research on backdoor cold fronts has been limited. Carr (3) did a case study of a backdoor cold front and suggested that the east slope of the Appalachian Mountains often limit their westward progression. The mountains channel cold air southward progression. The mountains channel cold air southward along the piedmont and coastal plain and result in cold air damming. This event is often associated with the movement of a sharp "V-shaped" 500 mb trough off the Atlantic Coast, resulting in upper level northerly flow along the coast allowing backdoor cold fronts to move south with the upper air flow.

Hovey et al. (4) studied backdoor cold fronts over a nine year period (1958–1966). A total of thirty-nine cases were found, with maximum occurrence in June and September. The upper level flow with backdoor cold fronts described by Hovey et al. (4) differed from Carr's results in that 30 of 39 events had 500 mb winds between 300 and 330 degrees, with only one event with winds from 360 degrees. These upper level winds occurred in conjunction with a 500 mb closed high or a sharp ridge over the lower Ohio Valley, possibly extending northward to Hudson Bay.

Bosart et al. (5) studied backdoor cold fronts for the months of April through October, 1964–1971. Their study showed maximum frequency in October, with greatest southward extent in June and August. Maximum southward penetration occurred east of the Appalachians, coincident with the effects of cold air damming. A short-wave trough at 850 and 500 mb east of Hudson Bay often preceded backdoor cold fronts. As this short-wave trough moved towards the maritime provinces and intensified, anti-cyclogenesis occurred upstream. The resulting northerly flow on the eastern side of the amplifying ridge thus forced the backdoor cold front southward.

3. DATA

The data consisted of the Daily Weather Map Series, which contained the 1200 GMT surface maps and 500 mb charts (U.S. Department of Commerce, 6). Backdoor cold fronts were identified and month of occurrence, maximum southward extent, and 500 mb flow were extracted from these maps. Orientation was found by measuring the angle between the intersection of the front with an east-west latitude line at the point of southernmost penetration. Hovey et al. (4) considered only those fronts which had a westerly component of movement, while Bosart et al. (5) considered only those fronts with an east-west orientation north of 45 degrees north persisting for more than 24 hours. This study expands these definitions by including fronts of continental origin which changed orientation with time to resemble fronts of maritime origin. This resulted in a classification of backdoor cold fronts into two categories. Fronts with a maritime origin and movement toward the south or south-west were designated as type one. These were the "traditional" backdoor cold fronts and were associated with surface ridging from the North-East. Fronts with a continental origin associated with a surface high pressure system originating in interior Canada were designated as type two. As this high moves east, the front changes orientation from northeast-southwest to east-west. Finally, the high moves into Northern New England, with the eastern portion of the front assuming the characteristic backdoor cold front configuration.

4. RESULTS

The monthly frequency for types one, two, and their sum appear in table and are plotted in figure one. Both type one and type two were most frequent during the warm half of the year. A sea breeze mechanism, resulting from a positive land/sea temperature gradient, contributes to the propogation of such fronts.

Although backdoor cold fronts tend to occur more requently in the warm half of the year, a minimum of both types one and two occurred in July. This may be due to the contraction of the circumpolar vortex, coupled with a relatively small land-sea temperature difference.

The southward extent of backdoor cold fronts is shown in table two, with the fronts extending most frequently to between

Table 1: Frequency of Backdoor Cold Fronts by Month and Type for the Period 1968–1985.

MONTH	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Type 1	0	1	0	2	6	7	2	7	5	3	3	0
Type 2	1	3	2	8	10	10	6	12	12	13	4	5
Sum	1	4	2	10	16	17	8	19	17	16	7	5

Table 2: Maximum Southward Penetration of Backdoor Cold Fronts by Type for the Period 1968–1985 in Degrees Latitude.

Lat	43°+	40–43°	37–40°	34–37°	31–34°
Type 1	2	13	12	6	3
Type 2	3	22	32	15	13
Sum	5	35	44	21	16

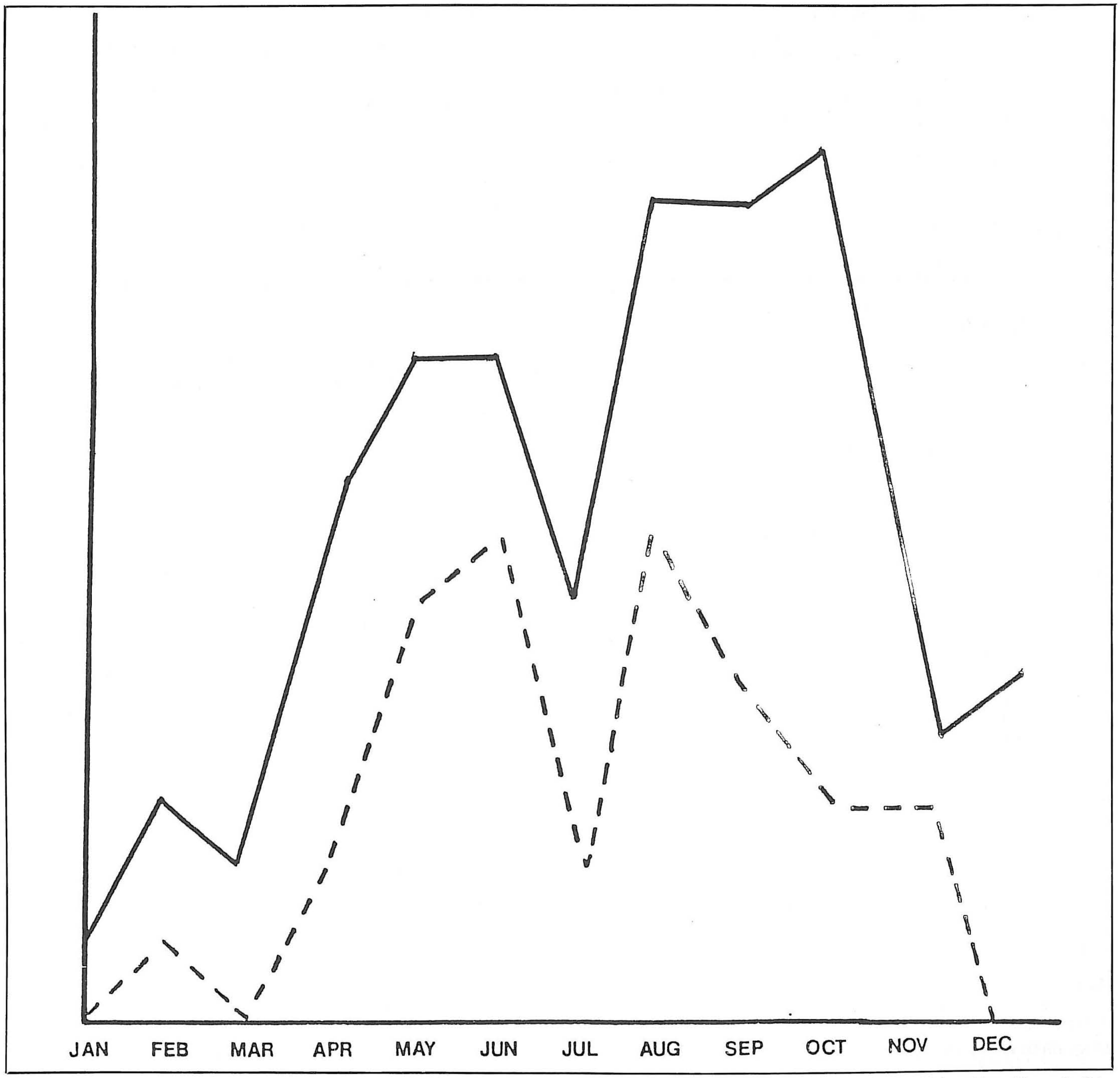

Fig. 1. Monthly Frequency of Backdoor Cold Fronts by Type for the Period 1968–1985 Where Type One is the Dashed Line, Type Two, Solid

Table 3: Frequency of 500 mb Wind Direction at the Front's Southernmost Extent for the Period 1968–1985.

0–30°	30–60°	60–90°	90–120°	120–150°	150–180°
1	1	1	0	1	1
180–210°	210–240°	240–270°	270–300°	300–330°	330–360°
1	11	17	22	35	13

37 and 40° N. It appears that backdoor cold fronts originating in New England or further north are likely to reach the Mid-Atlantic Coast.

The direction of the 500 mb wind as determined from extrapolation of the Daily Weather Map Series is shown in table 3, and was measured at the time and location of the most southern penetration of the backdoor cold fronts. The most frequent wind direction is from 300–330 degrees and is similar to the findings of Hovey et al. (4). This flow results from the establishment of a 500 mb ridge in the Ohio Valley, which enables backdoor cold fronts to move southward. Onshore flow from the Atlantic Ocean restricted on the west by the Appalachian Mountains produces cool, damp weather over a large portion of the East Coast rather than the fair weather expected with a surface ridge.

5. CONCLUSIONS

Backdoor cold fronts of both continental and maritime in origin were most frequent during the warm half of the year. Their southward progression along the Mid-Atlantic Coast extended most frequently to between 37 and 40° N for type 1 and to between 40 and 43° N for type two. Winds aloft at 500 mb at the time and location of southernmost extent were from 300 to 330 degrees. This was often the result of northerly flow around the eastern portion of a 500 mb ridge located over the Ohio Valley.

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NOTES AND REFERENCES

1. Mr. Eichler received his B.S. in Physics from St. Peter's College, Jersey City and is currently pursuing his M.S. at Rutgers University Department of Meteorology and Physical Oceanography, doing research in Ocean Modeling.

2. Dr. Shulman received the B.S. in Meteorology from City College of New York, and the M.S. and Ph.D. from the University of Wisconsin. He is presently Professor and Chairman of the Department of Meteorology and Physical Oceanography, Cook College, Rutgers University, New Brunswick, New Jersey, and teaches graduate and undergraduate courses in applied meteorology and applied climatology. He is a Councilor and President-elect of the National Weather Association and serves on the editorial staff of the Digest as the Climatology Features Editor.

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