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CLOUD MODEL DATABASE COMPARISON STUDY

by

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AUGUST 1992

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13. Abstract: This report documents the results of a study that examined and compared the Air Force Global Weather Central's (AFGWC's) climatological cloud model databases: the Real-Time Nephanalysis (RTNEPH) and the Three-Dimensional Nephanalysis (3DNEPH). The study investigates their characteristics, determines the length of a climatologically sound period of record (POR), finds a year with "typical" cloud cover for use as a baseline in future studies, and weighs the advantages and disadvantages of Multipurpose Simulator (MPS) databases derived from the RTNEPH and 3DNEPH. The older 3DNEPH cloud model, first used in the 1970's, produced worldwide, layered cloud analyses on a 25-NM grid. RTNEPH replaced 3DNEPH at the beginning of 1984.

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PREFACE

This report documents work done on USAFETAC Project #900308, "The RTNEPH/3DNEPH/MPS Database Comparison Study." To complete that project, USAFETAC/DOS (USAFETAC's Special Projects Branch) compared the Air Force Global Weather Central (AFGWC) Real-Time Nephanalysis (RTNEPH) cloud model with its predecessor, the Three-Dimensional Nephanalysis (3DNEPH). It also evaluated and compared the Multipurpose Simulators (MPS) derived from the RTNEPH and 3DNEPH.

Objectives were to determine the best POR for certain kinds of data, to identify differences between the two MPS databases and recommend one of them for use. and to identify a "representative" database year for use as a standard in future studies. This study extended earlier USAFETAC project #90240, which compared the RTNEPH and 3DNEPH MPS databases.

CONTENTS

INTRODUCTION

Background and Purpose of the Study. USAFETAC conducted this study of available climatological cloud databases to examine their characteristics, determine the length of a climatologically sound period of record (POR), find a year with "typical" cloud cover for use as a baseline in future studies, and finally, weigh the advantages and disadvantages of Multipurpose Simulator (MPS) databases derived from AFGWC's Real-Time Nephalysis (RTNEPH) and Three-Dimensional Nephanalysis (3DNEPH).

The older 3DNEPH cloud model, first used in the early 1970's, produced worldwide, layered cloud analyses on a 25-NM grid. The 3DNEPH data for this study was taken from 1977-83. The RTNEPH cloud model replaced 3DNEPH at the beginning of 1984; it uses floating, rather than fixed, layers, and adds many diagnostic flags to the data. The RTNEPH data used in this study had a POR of 1984-1989. The two MPS databases are summaries, by month and hour, of either the 3DNEPH or the RTNEPH databases. The 3DNEPH-based MPS dataset has a 50-NM resolution obtained by merging the 25NM 3DNEPH raw data with 1974-1982 POR. The RTNEPH-based MPS database uses RTNEPH data at 25-NM resolution for the years 1985-89. All databases use Zulu time, unless otherwise noted.

Points and Boxes. Since processing all of the more than 500,000 points in the RTNEPH and 3DNEPH databases was impractical, we selected 48 points from 14 RTNEPH boxes. These were chosen to represent the many combinations of climatological regimes and model characteristics possible. We picked 33 points from 10 Northern Hemisphere boxes, and the other 15 from four Southern Hemisphere boxes. Calculations were performed on each of the points, and on each of the 14 boxes as a whole.

The RTNEPH Database. This is AFGWC's most current cloud database, available from 1984 through the present. It has eighth-mesh (25-NM) resolution, four floating cloud layers, time and source data flags, and total cloud amounts. Data is available in 3-hour increments. It is used as input for cloud forecasts at AFGWC, and in climatological studies at USAFETAC that require detailed information on individual points and areas.

The 3DNEPH Database. The RTNEPH's predecessor has full data available from 1977-83. It is also eighth-mesh resolution, with 15 fixed cloud layers and total cloud amounts. Data is saved at 3-hour intervals. For this study, a time flag was simulated for the individual points by comparing the cloud information from consecutive observations. If there was any change, the time flag for the point was reset to zero. If the data remained identical, the time flag was incremented by 3 hours. This database is also used for climatological studies, but the absence of source flags and the fixed layers limit its use in many areas.

The RTNEPH Multipurpose Simulator (MPS) Histogram Database. This is a compilation of RTNEPH data in the form of percent frequencies of occurrence of cloud amounts and types. Data is compiled from 1985 to 1987 RTNEPH cloud data and is available in 3-hour increments for each month.

The 3DNEPH MPS Histogram Database. This is a compilation of 3DNEPH data in the form of percent frequencies of occurrence of cloud amounts and types. Data is available from 1974 to 1982. It has quarter-mesh (50-NM) resolution and is available in 3-hour increments for each month. Because this database uses local sun time rather than GMT, its times had to be converted to GMT for comparisons with other databases.

The "10YEAR" Database. This database gives 10-year means of total cloud, by hour and month, in the form of total percent clear (rather than cloudy). Data from one box was used for comparison purposes. Data for this database is compiled as needed from 3DNEPH and RTNEPH tapes. For this study, a data file was built from 1977-86 3DNEPH and RTNEPH data.

SHARPNESS

Definition: The percent frequency of occurrence of total cloud amounts within the 0-20% and 80-100% ranges. In the MPS databases, the upper range is 81-100% because of the histogram ranges.

Sharpness Influences. The data produced in the study indicated that two things strongly affected the sharpness at a point. The first, and most widely known, is the effect of smoothing the eighth-mesh data to quarter-mesh. This is used in the 3DNEPH MPS database. Sharpness values of 3DNEPH MPS points were down 9% when compared to the same points in the seven years of 3DNEPH data available. Some of this is due to the different period of record (74-82 vs 77-83), but most is due to the smoothing. The second effect was the amount of conventional (non-satellite) data within the record for a particular point. There was an inverse correlation between the amount of conventional data and the sharpness. A large increase in the amount of conventional data usually resulted in a significant decrease in sharpness, and vice-versa. See Appendix A, Figures A-1 to A-7.

Trends. The yearly sharpness plots (Figures A-8 to A-21 in Appendix A) show two distinct trends during the period. First, there was a jump of 3-5% in the sharpness at most points from 1983-84, when the changeover to RTNEPH from 3DNEPH was made. The RTNEPH sharpness values are generally higher than the 3DNEPH values until the second trend arrives. Almost all the points show declines in sharpness after 1987, most seriously in 1989. These decreases are so widespread they must indicate changes in the model.

Other Influences. Many model changes, model tuning, and variations in the input data source can influence the total cloud and therefore the sharpness. Complete records have not been kept on what changes were made to the RTNEPH and 3DNEPH models or when changes were made. Also, no record has been kept of what satellites were used by the models and what sensors were available.

Database Problems. After this study was completed, an error in the RTNEPH database was found: during 1986, 1987, and 1988, three

Northern Hemisphere boxes (19, 46, and 53) were sometimes erroneously filled with 100% total cloud. This type of error, which was frequent enough to have an effect on sharpness, would persist until overwritten by new surface or satellite data. As can be seen in Figure A-16, there was a large sharpness jump in the two points studied in box 46 between 1986 and 1988. Most of this jump was probably due to the anomalous data, which may also exist in some Southern Hemisphere boxes. USAFETAC is studying this problem, and will attempt to identify and exclude bad box analyses from future studies.

TOTAL CLOUD

Total Cloud Calculation. Total cloud is given in all the databases except the MPS, where it must be calculated from the histogram data. In this study, total cloud was calculated using the following equation:

Total cloud *TCFREQ*(1)*0 +...+

TCFREQ(*I*)*((*I*-1)*5-2.5)/100 +...+

TCFREQ(21)*((21-1)*5)/100

where *TCFREQ(I)* = histogram total cloud frequency in percent and *I* ranges from 2 to 20. In effect, this counts the first category as clear, the last as overcast, and the rest as the midpoint of range represented.

Influences on Total Cloud. Since determining total cloud is one of the primary functions of the models, a lot of things can influence it. For example, RTNEPH is routinely tuned to correct over- or under-interpretation of cloud. However, since there is no "tuning flag" in the RTNEPH database, the effects of tuning, like the effects of other problems, cannot be measured exactly. There may be some correlation between total cloud and the frequency of conventional data used, but this relationship needs much more study to see how strong it is.

Trends. Over the period of record of both models, total cloud has been stable for both points and whole boxes. Figures A-22 to A-35 show the total cloud, sharpness, and percentage of conventional data merged for the study points in each box. Except for a small jump in the polar regions, and possibly some variation in tropical land regions, there was little visible change in total cloud when the models changed over. These variations need to be checked further to determine their cause and magnitude. However, a check on some older 3DNEPH data from 1976 showed that the older data had a much lower mean total cloud at almost every point and for most boxes (see Figure A-36). USAFETAC OL-A had identified these problems earlier; data from before 1977 should not be used. Unfortunately, the 3DNEPH MPS database was built from 1974-1982 data; it therefore contains this contaminated data.

Database Problems. As was noted in "Sharpness", there are errors in the total cloud values of boxes 19, 46, and 53 for 1986-88. USAFETAC is attempting to specifically identify the flawed analyses and boxes (including, possibly, some in the Southern Hemisphere).

DATA AGE

Definition. Data age was available in the form of time flags in the RTNEPH database; it was simulated for 3DNEPH. The time flags indicated how recently the point had received new data. For 3DNEPH, this was simulated by comparing the most recent analysis cloud data against the previous analysis cloud data. If there had been a change, new data had been added and the time flag was reset to zero. If there was no change, the program assumed that no new data had been added, and 3 hours were added to the time flag. This method worked well over areas with moderate amounts of cloud, but over very clear or cloudy areas such as deserts and icecaps it sometimes gave very high data ages. For any persisted data points, the simulated time flags would average 1 to 2 hours older than the actual data.

Results and Trends. We investigated data age because old, greatly persisted data affects the quality of the analysis cloud data. For both RTNEPH and 3DNEPH, we looked at mean data age and the frequency distribution. For surface data-rich points (points on or near surface reporting stations), RTNEPH data age averaged less than an hour old. Most surface data-sparse points averaged just over 3 hours old. The mean 3DNEPH data ages were skewed heavily by the time flag simulation algorithm and were not very useful. On the other hand, frequency distributions were revealing for both databases. The RTNEPH time flags showed that analyses were 6 hours old or less over 90% of the time for most points, and 9 hours old or less 95% of the time. The 3DNEPH time flags showed that the data was 9 hours old or less nearly 90% of the time, even with the older simulated time flags. There was no indication that the data age gets shorter or longer as the RTNEPH model evolves. AFGWC, however, recently began adding data from a third satellite to the model; this should reduce the data age slightly.

SUGGESTED PERIOD OF RECORD (POR)

Method. Finding the best POR required determining the mean total cloud for the entire POR (1977-89) and comparing it to much shorter subsets to see how much they differed. A great difference would mean that a longer data subset would be required to approximate the original full size period of record. For both box and point data, we compared 3-year and 5-year means against available PORs of RTNEPH (1984-89) and 3DNEPH (1977-83). We also studied two points in more detail, finding the 3-year, 5-year, 7-year, and 10-year means for two points over the combined 3DNEPH and RTNEPH PORs to check the variation.

Whole Box. Mean total cloud amounts for whole boxes were almost all within 2% at the 3-year point for both 3DNEPH and RTNEPH, and within 1% at the 5-year point. In these cases, the data subset for a model was compared only to the full POR for that model. For instance, the 3-year data subset for RTNEPH was compared only to the mean total cloud from 1984-89, not the full 1977-89 mean. When compared to the combined 13-year POR, the results were not as close, but they usually stayed within 4% at 3 years and 3% at 5 years. In some cases, notably the polar regions and some areas of the tropics, the means of the two models were so far apart that a short period mean was bound to be greatly different from the long-POR mean.

Point. Mean cloud amounts at individual points were generally within 6% at 3 years, and 2% at 5 years, for the same database. The whole period database did not compare as well. Many of the points had greatly different means in each model.

Detailed Point Study. The two points chosen for the more closely detailed check included a relatively cloudy point with a stable long-term mean, and a clearer point. This clearer point's mean total cloud dropped significantly when RTNEPH took over from 3DNEPH. The RTNEPH mean was 13% lower than the 3DNEPH mean. For each point, 3-, 5-, 7-, and 10-year means were computed for each possible consecutive period. The mean and standard deviations were then computed for each group of like-length mean cloud amounts. For the cloudy point, the standard deviation of the means of the various PORs was less than 5% at 3 years, less than 3% at 5 years, and less than 1% at 10 years. The clear point was less than 5% at 7 years, and less than 2% at 10 years.

Best PORs. Because of the various influences (actual year-to-year changes in cloud cover, model changes, varying input data sources), 10-year PORs are recommended at single points. For box data, 5 years is probably adequate.

BEST DATABASE

RTNEPH Vs 3DNEPH. When the sharpness of all the sample points was combined, the RTNEPH was slightly sharper than 3DNEPH (80.4% to 76.9%). The length of PORs for both models are almost the same, and the RTNEPH continues to grow. There is probably enough RTNEPH data available for whole-box studies. Any 10-year point study should use as much RTNEPH data as possible while incorporating the last few years of 3DNEPH data to fill out the 10-year POR.

RTNEPH MPS Vs 3DNEPH MPS. The RTNEPH MPS was, as expected, much sharper than the 3DNEPH MPS. The mean difference was 13.2% over the points studied: most due to the quartermesh smoothing, but we are convinced the increased sharpness of RTNEPH also contributed. In total cloud, both databases were 3-4% short of the whole-POR (1977-89) means, probably due to the smoothing involved in building the histograms and reconstituting the mean total cloud. The 3DNEPH MPS is also contaminated by early 3DNEPH data. The 3DNEPH MPS is also much more difficult to use for climatological studies. The analysis times are given in local sun time, which is difficult to use for hour-by-hour studies. The RTNEPH MPS had a very short POR (3 years) at the time of this study (spring 1990), but it is now 5 years.

BEST YEAR

When searching for the most representative year in a database, the yearly means should ideally be compared to the whole POR means, and the year with the least difference should be selected. Since there was not enough time to make a formal comparison for all cases, we scanned the yearly total cloud means and long term means. We also looked at the sharpness and the availability of conventional and diagnostic data. Based on a preliminary review, **the best year was 1989**; by then, the model had incorporated all the latest changes, the data errors affecting total cloud had been eliminated in many boxes, sharpness values were down from their 1987 peaks and had apparently stabilized near 1988 levels, and there were much better source/diagnostic flags available for study than in any other 3DNEPH database year.

RECOMMENDATIONS

Most of the work on this study involved writing programs to extract and format the cloud data, and running these programs to build the study data files. With the data now available, the main topics can be examined more closely. We recommend the following:

Total Cloud. Variations in total cloud over the poles and tropical areas need to be checked in greater detail. The magnitude of the variations should be better defined; more important, the accuracy of the 3DNEPH and RTNEPH models in these areas should be checked to see which gave the better analysis.

Surface Data. Compare surface data against model data to see if long-term climatic changes can be traced to actual changes in cloud cover.

Persisted Data. Compare old (greatly persisted) data to new to see if the persisted data is distributed the same, or if certain cloud amounts are persisted unusually often.

Satellite Data Sources. Investigate the availability of satellite data, especially the sensors on the satellites, and trace any model variations to specific satellite problems.

Sparse/Rich Sharpness Variation. Check the extent of the sharpness variation between surface data-sparse and data-rich points. Help quantify differences between conventional and satellite data.

3- and 5-Year RTNEPH MPS. Compare total cloud and sharpness of the old (3-year) and new (5-year) RTNEPH MPS databases.

Background Terrain Influences. Compare terrain to investigate scope of known RTNEPH model problems. For example, the differences between land, water, and coastal points need to be checked more closely.

Source Flags. Look at the RTNEPH source flags and isolate model inconsistencies, problems, and evolution.

Best Year. Find the most representative model data year by comparing yearly means for all boxes.

ACRINABS

AFGWC	Air Force Global Weather Central
GMT	Greenwich Mean Time (Zulu, or "Z")
MPS	Multipurpose Simulator
NM	nautical mile
POR	Period of Record
RTNEPH	Real-Time Nephanalysis
3DNEPH	Three-Dimensional Nephanalysis
USAFETAC	USAF Environmental Technical Applications Center

Appendix A

FIGURES

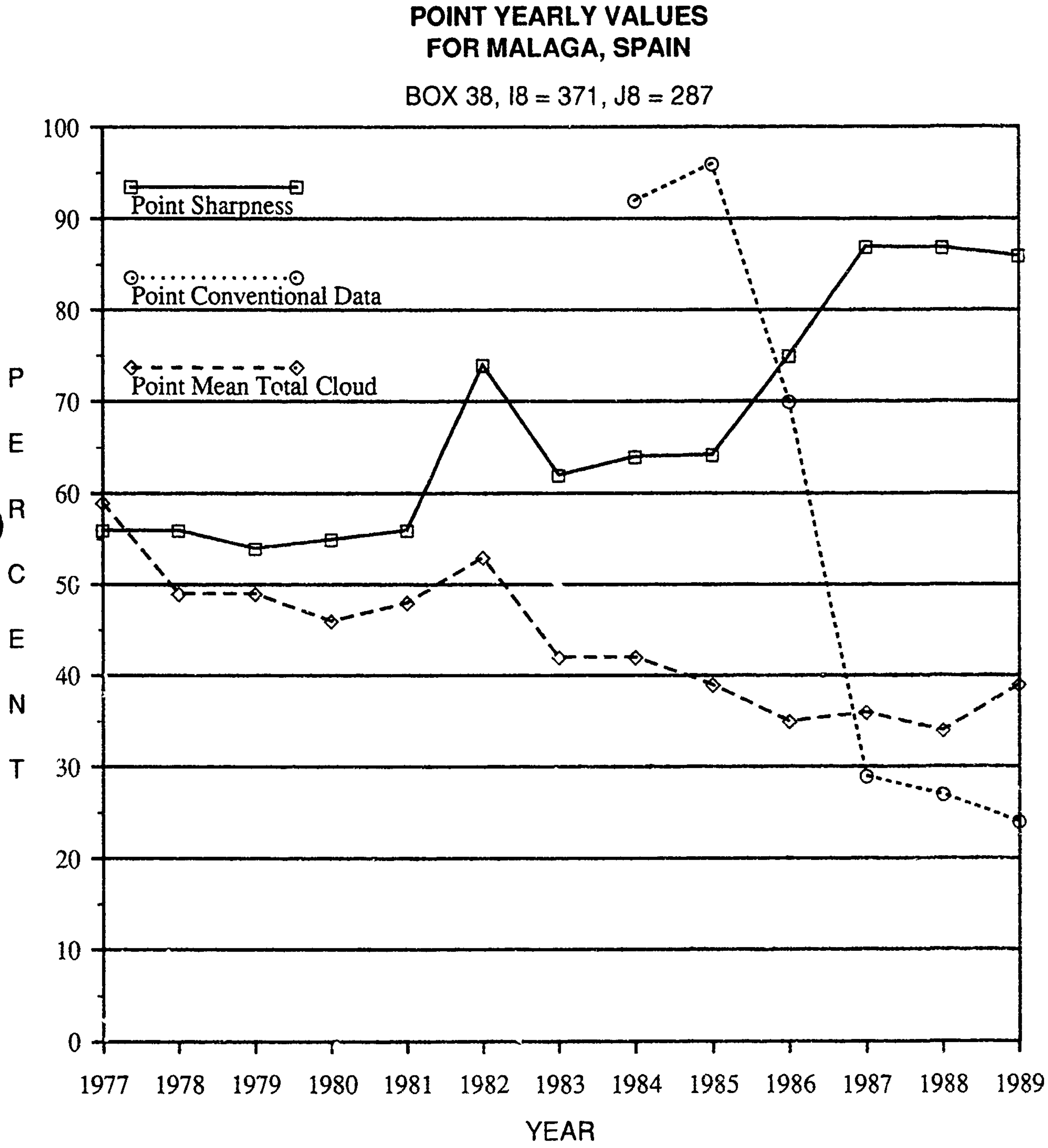


FIGURE A-1

POINT YEARLY VALUES
FOR PO, UPPER VOLTA

BOX 40, I8 = 460, J8 = 297

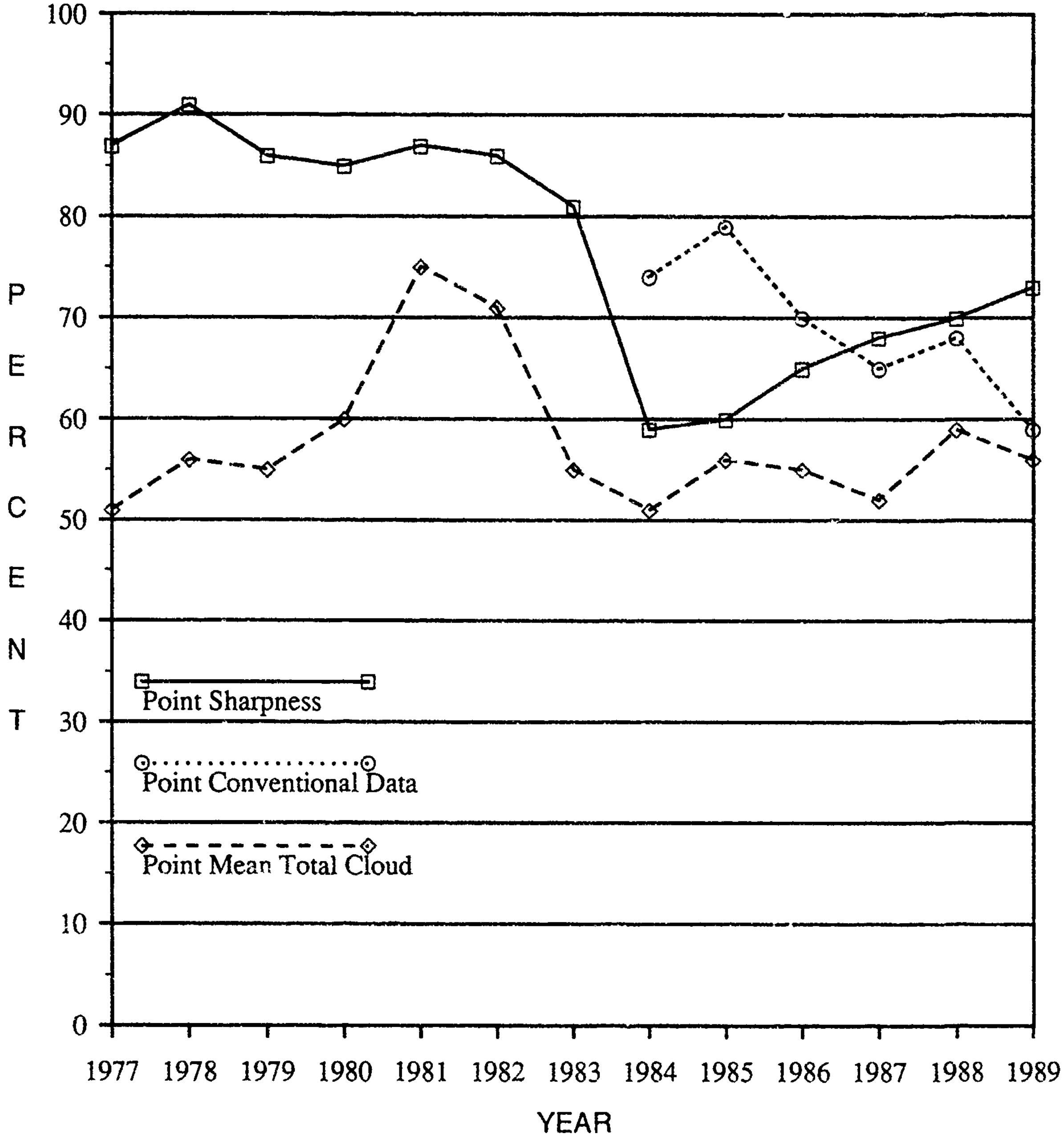


FIGURE A-2

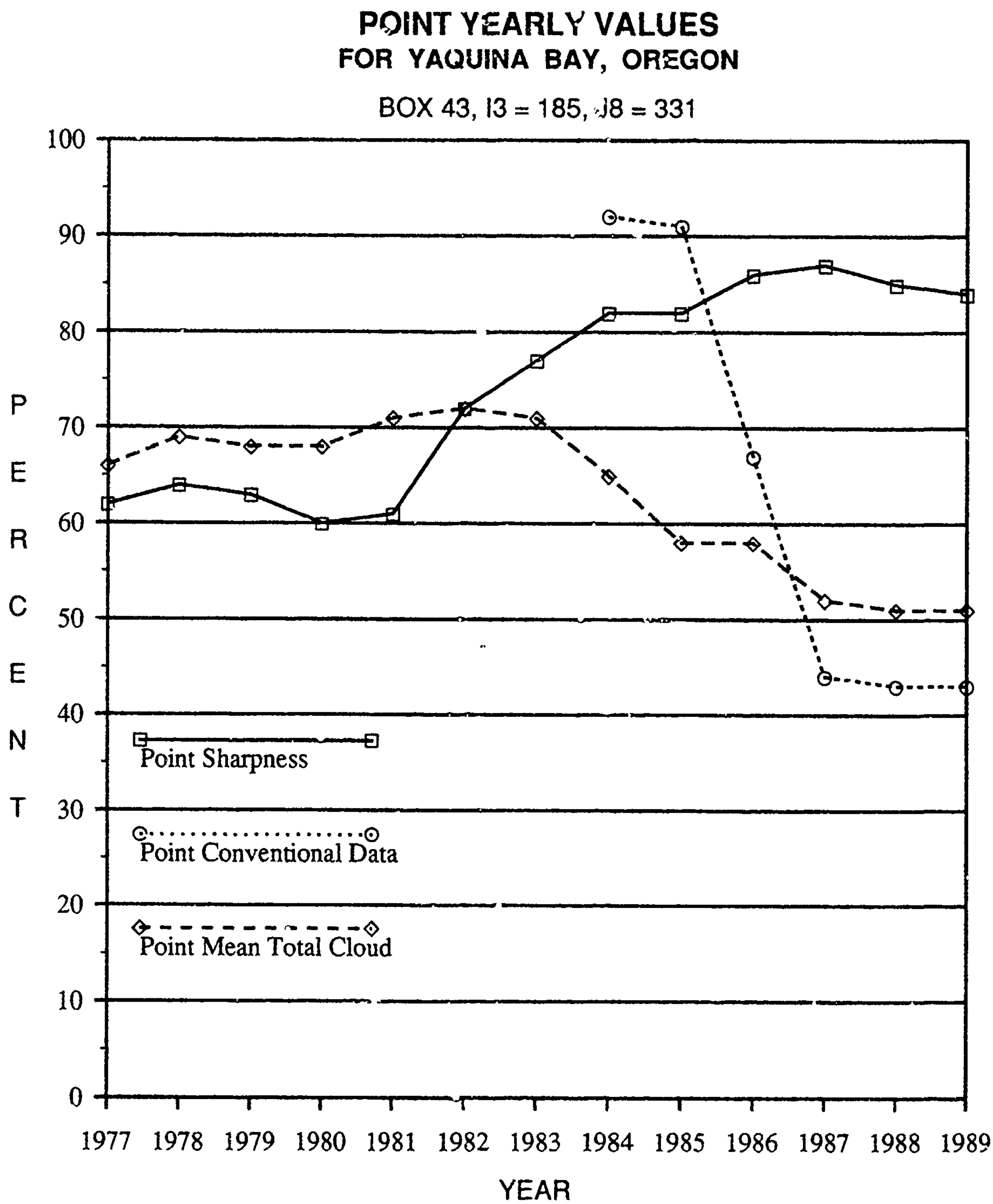

POINT YEARLY VALUES
FOR YAQUINA BAY, OREGON
BOX 43, I3 = 185, J8 = 331
100
90
80
70
60
50
40
30
20
10
0
PERCENT
Point Sharpness
Point Conventional Data
Point Mean Total Cloud
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-3

POINT YEARLY VALUES
FOR FORT CHAFFEE, ARKANSAS

BOX 44, I8 = 227, J8 = 383

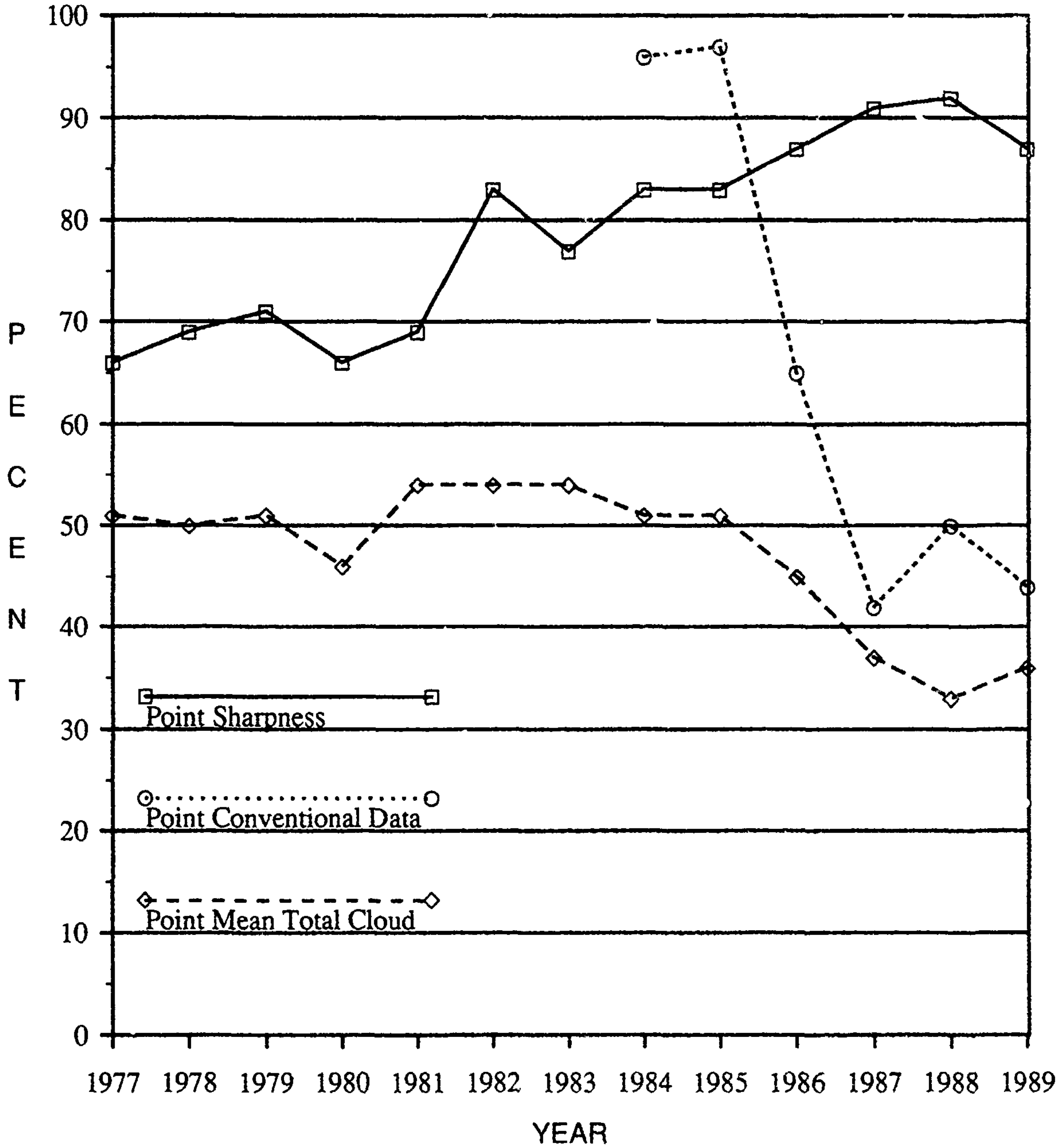
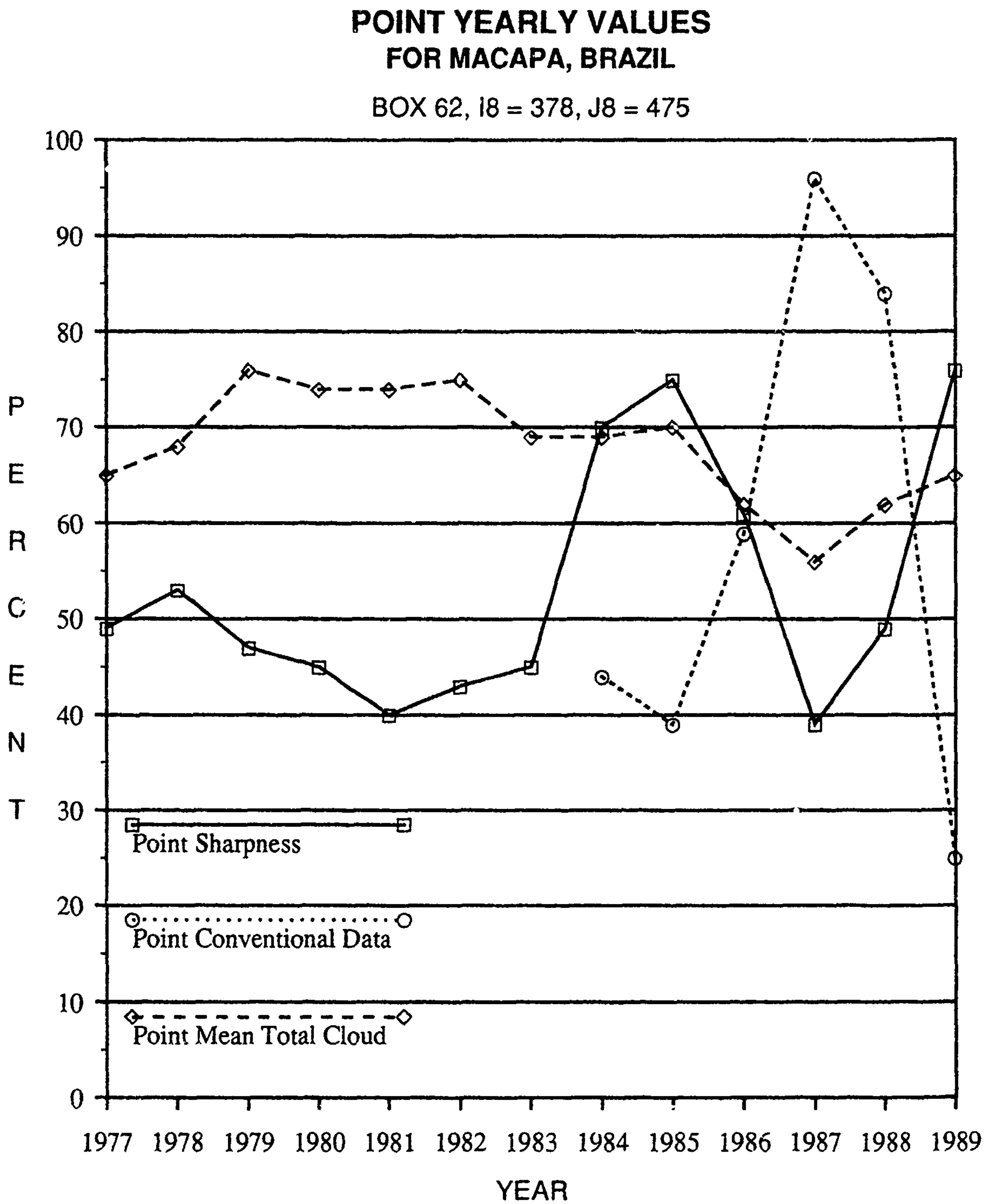


FIGURE A-4



POINT YEARLY VALUES
FOR MACAPA, BRAZIL
BOX 62, I8 = 378, J8 = 475
100
90
80
70
60
50
40
30
20
10
0
PERCENT
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR
Point Sharpness
Point Conventional Data
Point Mean Total Cloud

FIGURE A-5

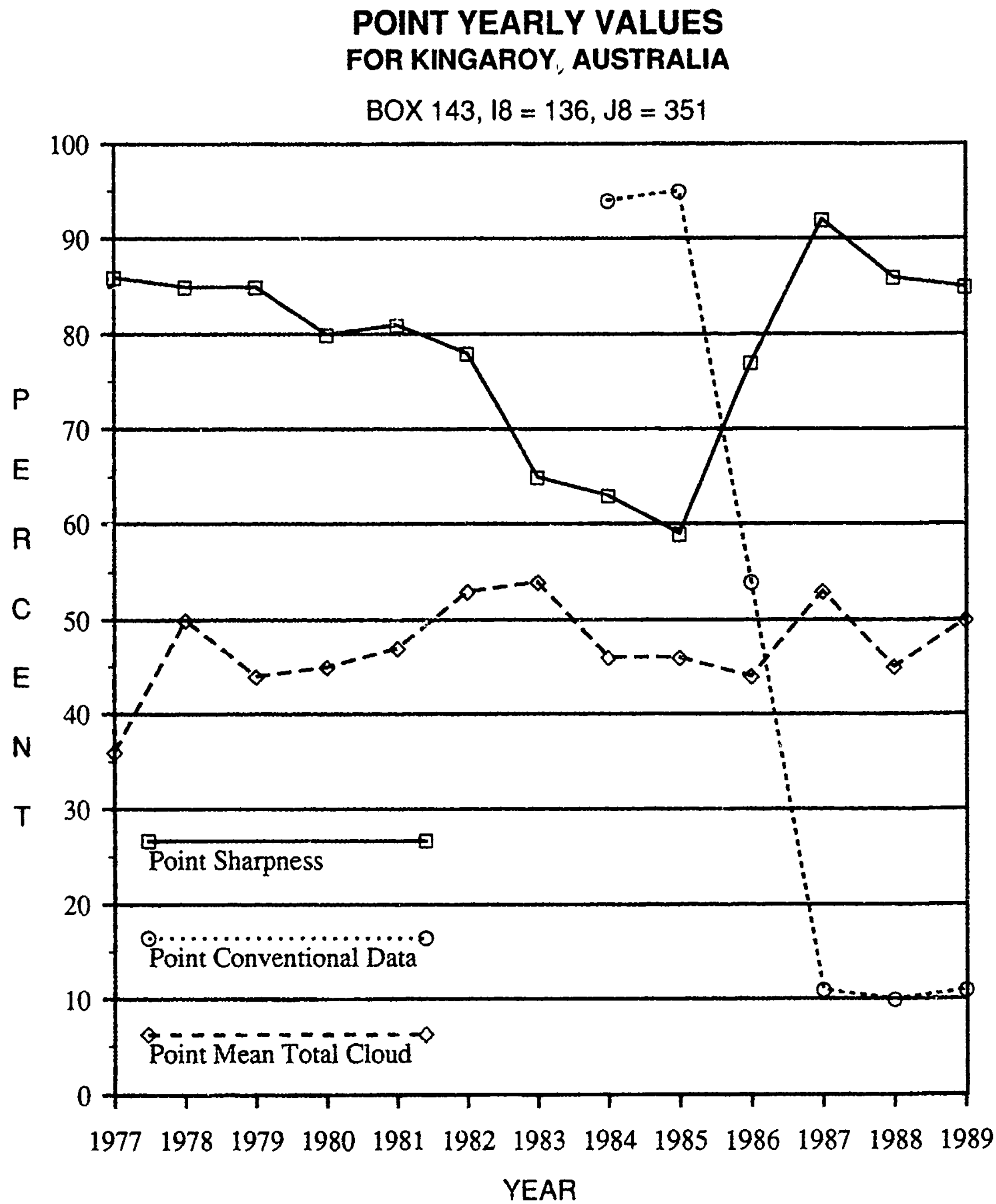

POINT YEARLY VALUES
FOR KINGAROY, AUSTRALIA
BOX 143, I8 = 136, J8 = 351
PERCENT
YEAR
Point Sharpness
Point Conventional Data
Point Mean Total Cloud
100
90
80
70
60
50
40
30
20
10
0
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989

FIGURE A-6

POINT YEARLY VALUES
FOR COOKTOWN, AUSTRALIA

BOX 150, I8 = 122, J8 = 391

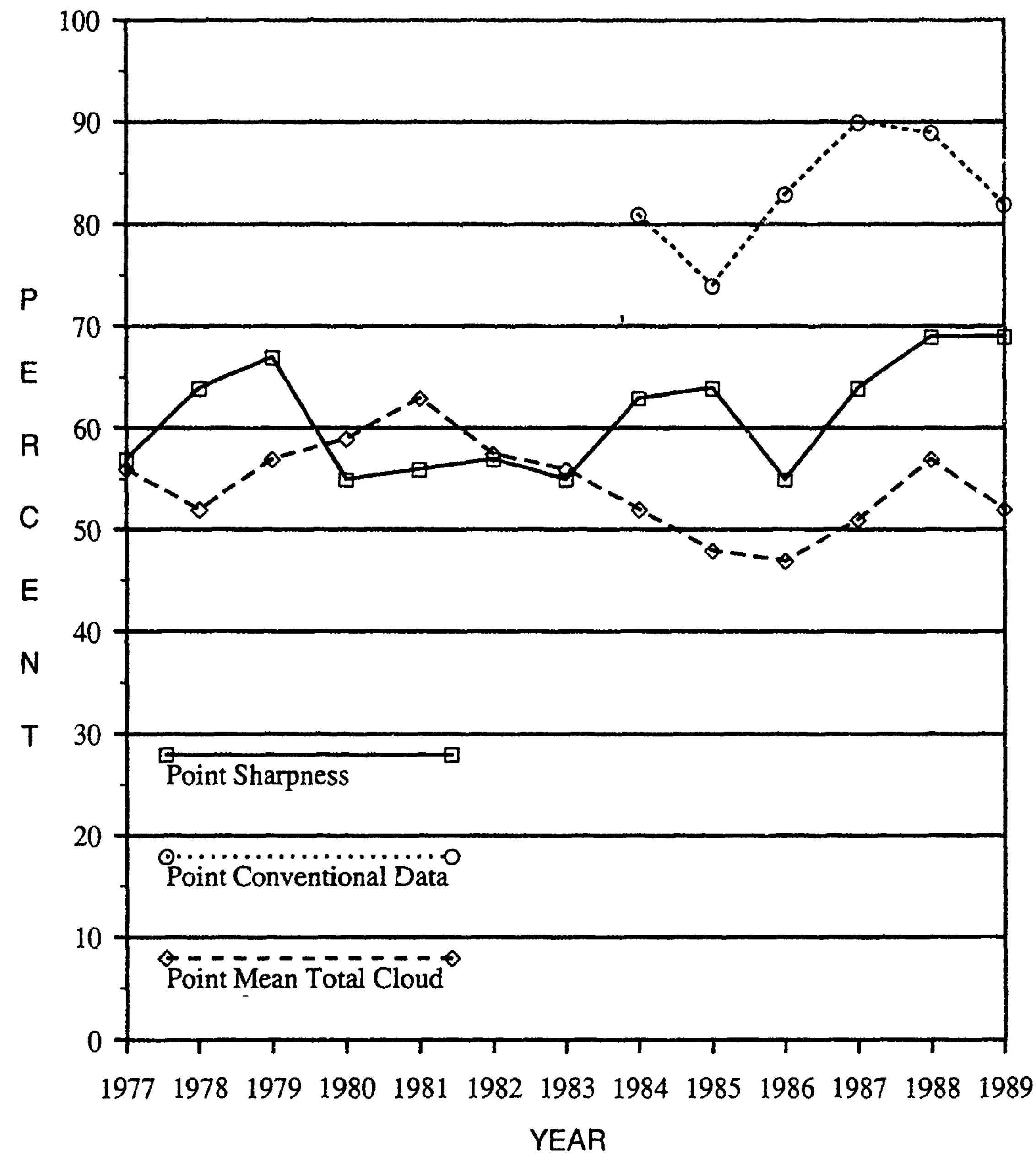


FIGURE A-7

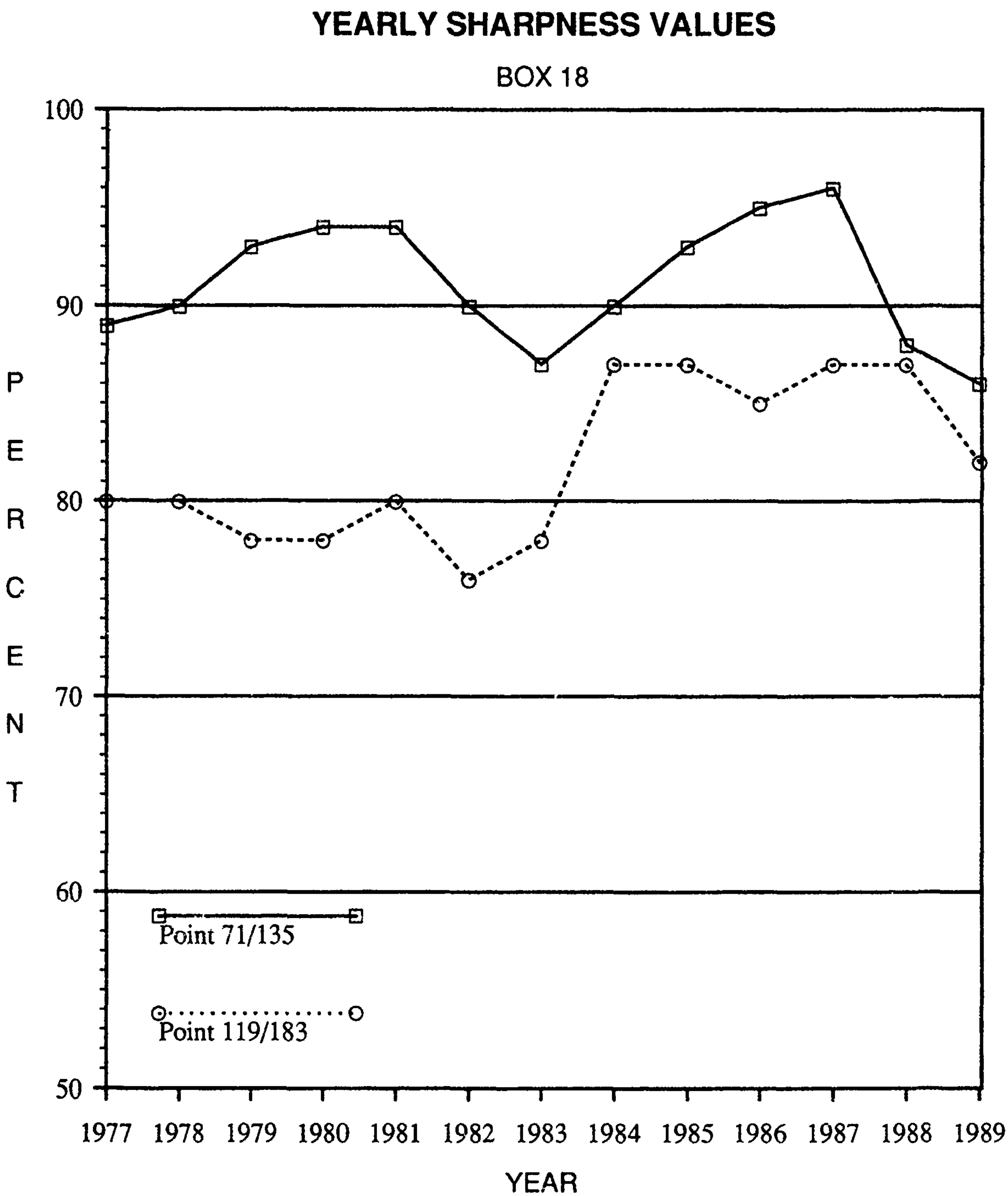

YEARLY SHARPNESS VALUES
BOX 18
100
90
80
70
60
50
PERCENT
Point 71/135
Point 119/183
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

FIGURE A-8

YEARLY SHARPNESS VALUES

BOX 21

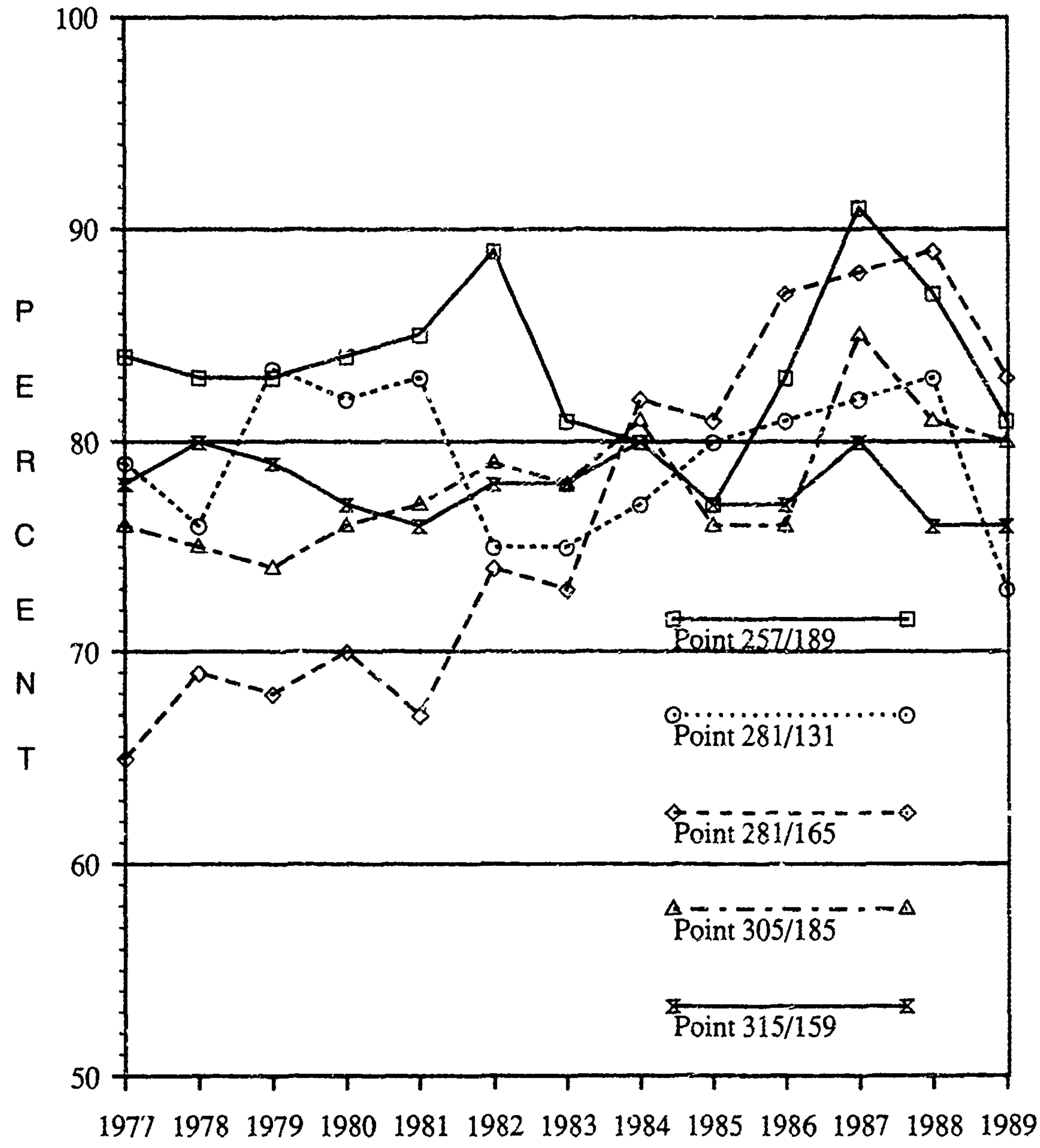
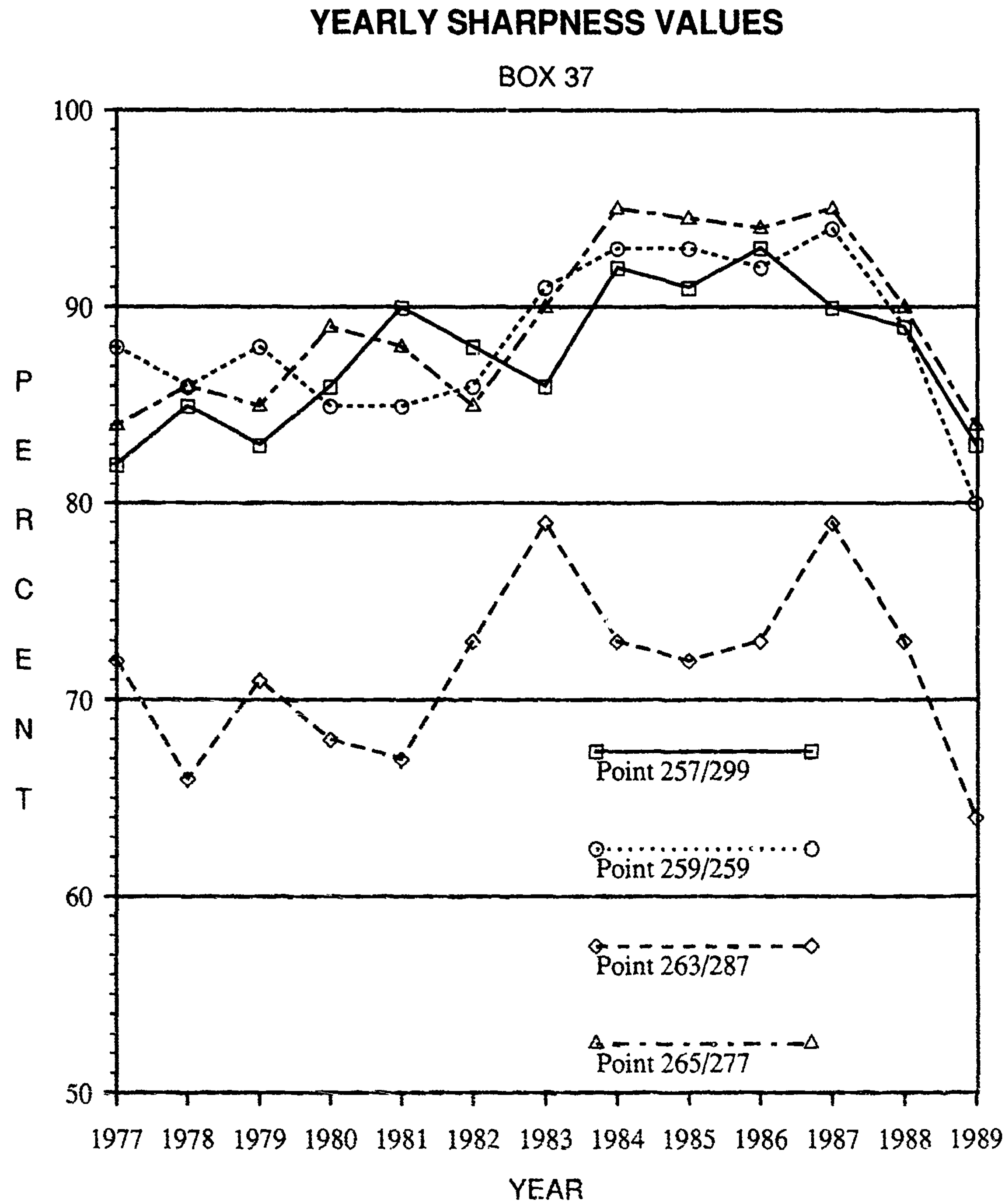


FIGURE A-9



YEARLY SHARPNESS VALUES
BOX 37
100
90
80
70
60
50
PERCENT
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR
Point 257/299
Point 259/259
Point 263/287
Point 265/277

FIGURE A-10

YEARLY SHARPNESS VALUES

BOX 38

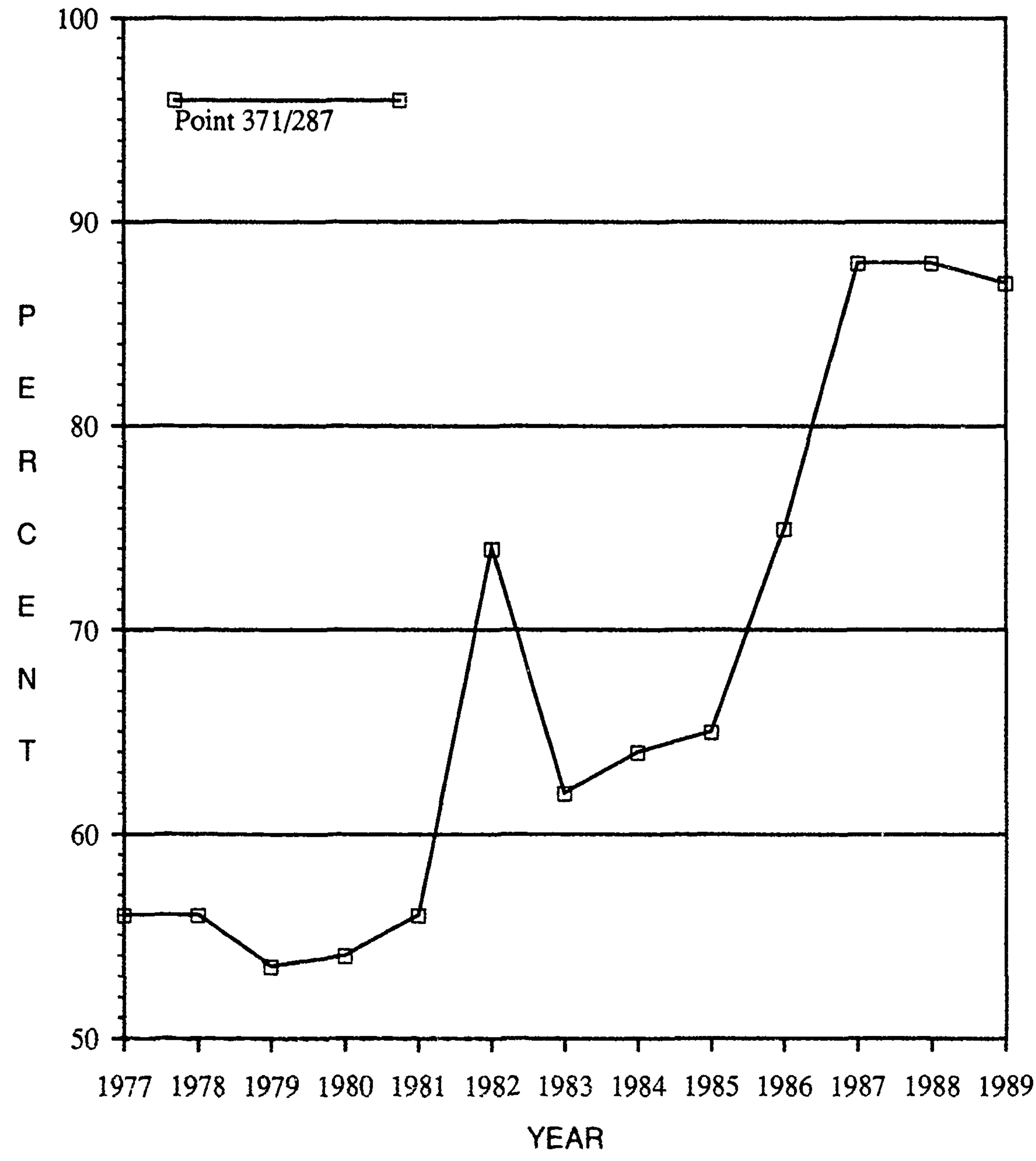


FIGURE A-11

YEARLY SHARPNESS VALUES

BOX = 39

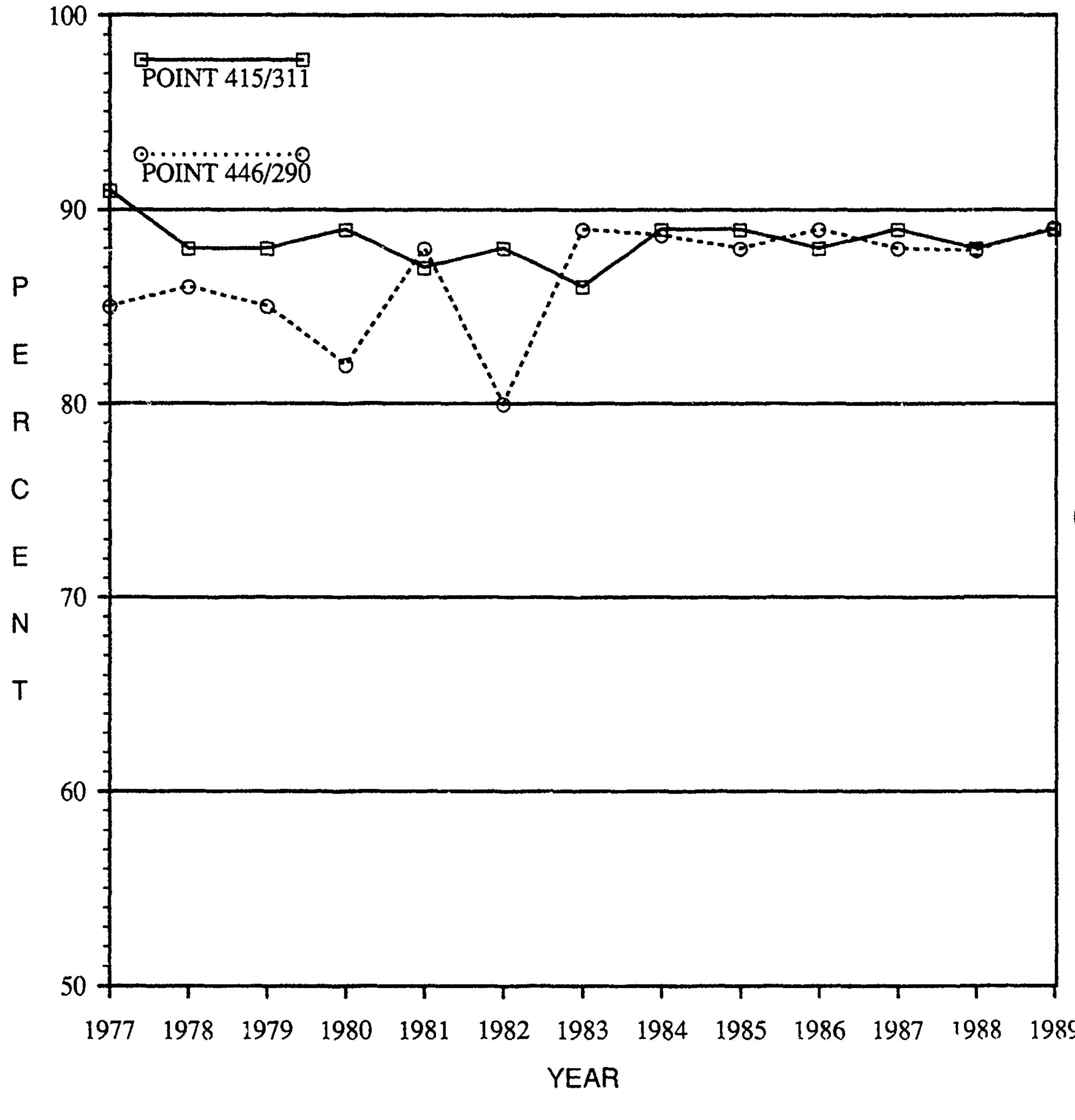


FIGURE A-12

YEARLY SHARPNESS VALUES

BOX = 40

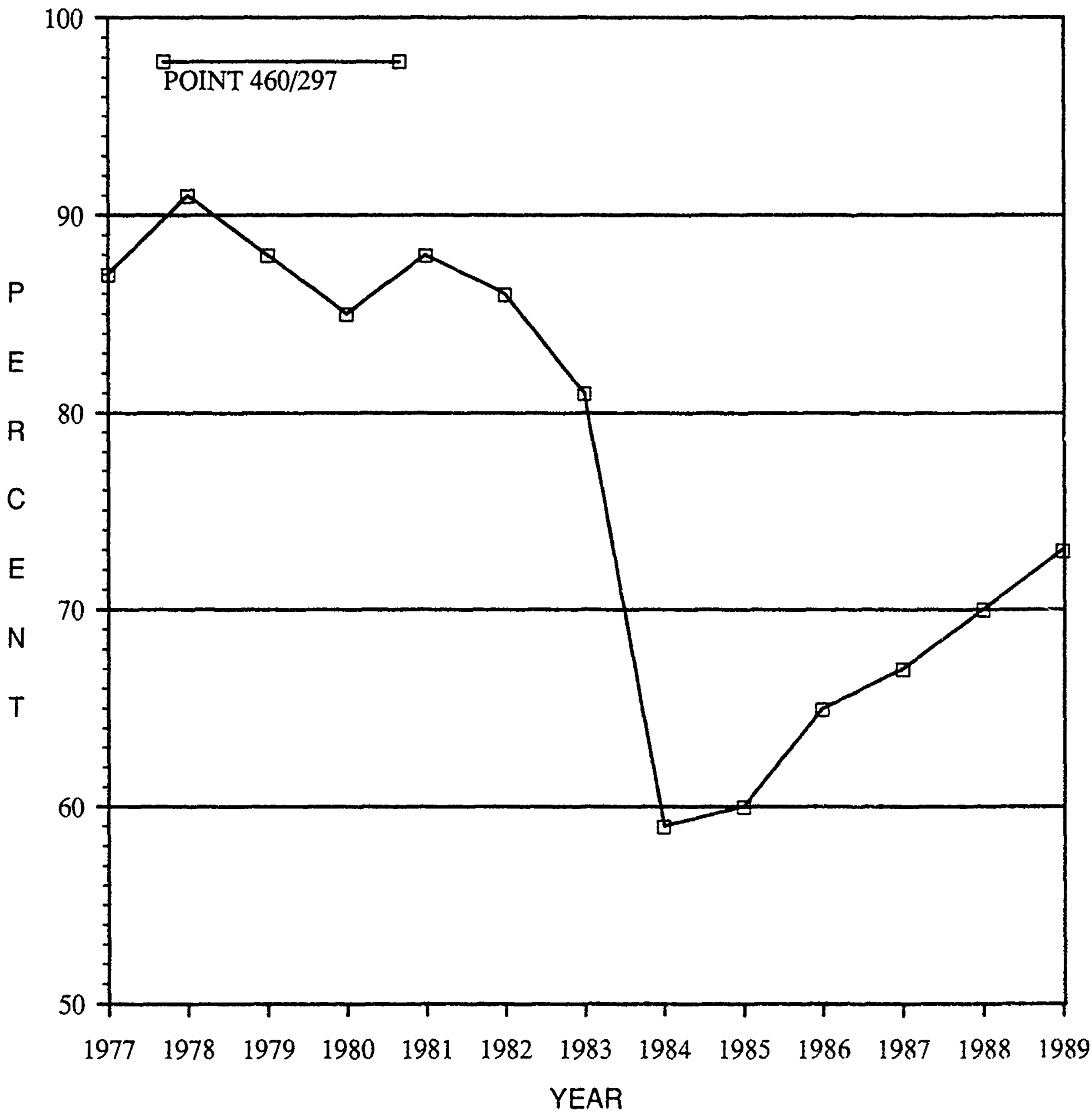


FIGURE A-13

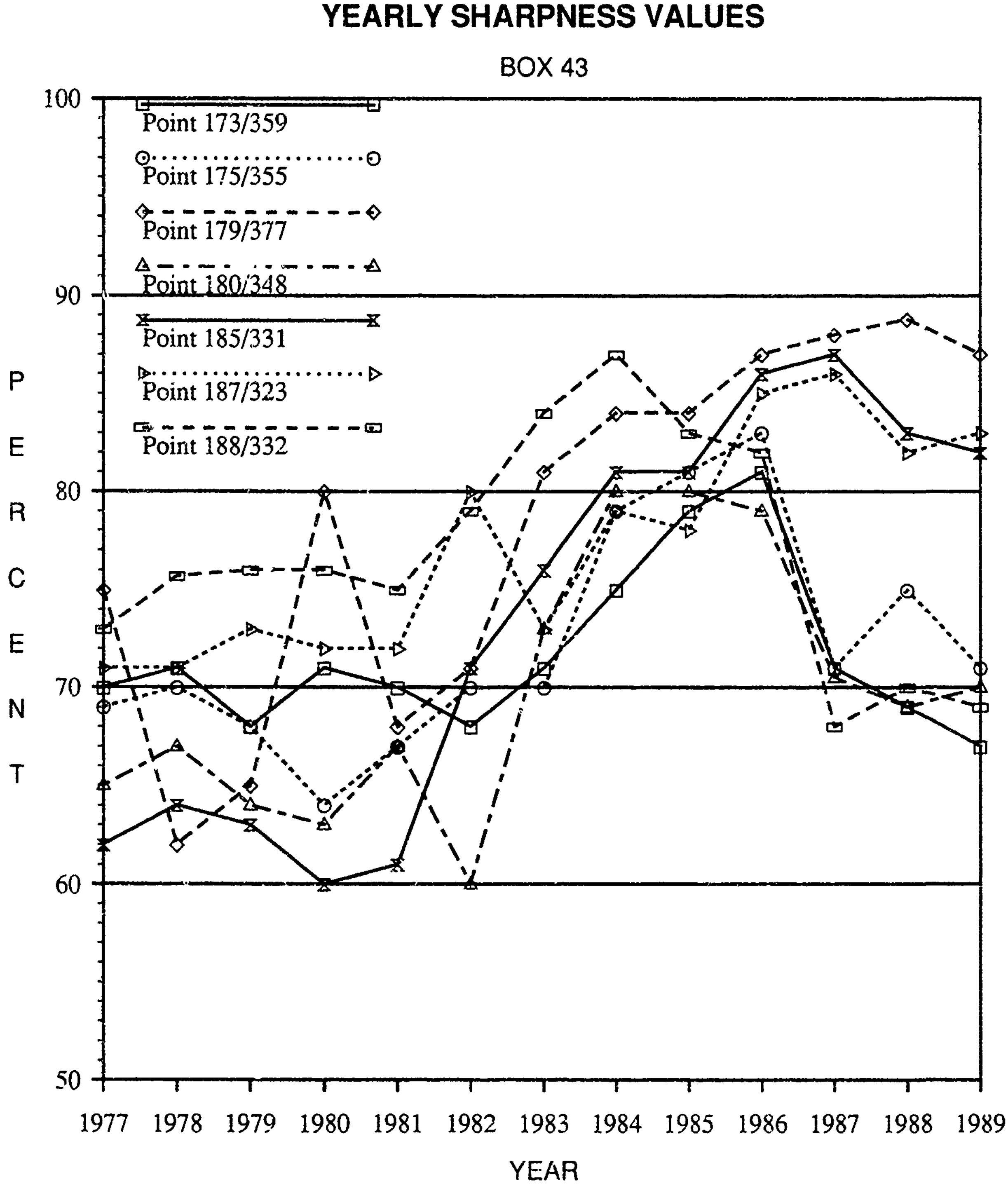

YEARLY SHARPNESS VALUES
BOX 43
Point 173/359
Point 175/355
Point 179/377
Point 180/348
Point 185/331
Point 187/323
Point 188/332
PERCENT
100
90
80
70
60
50
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

FIGURE A-14

YEARLY SHARPNESS VALUES

BOX 44

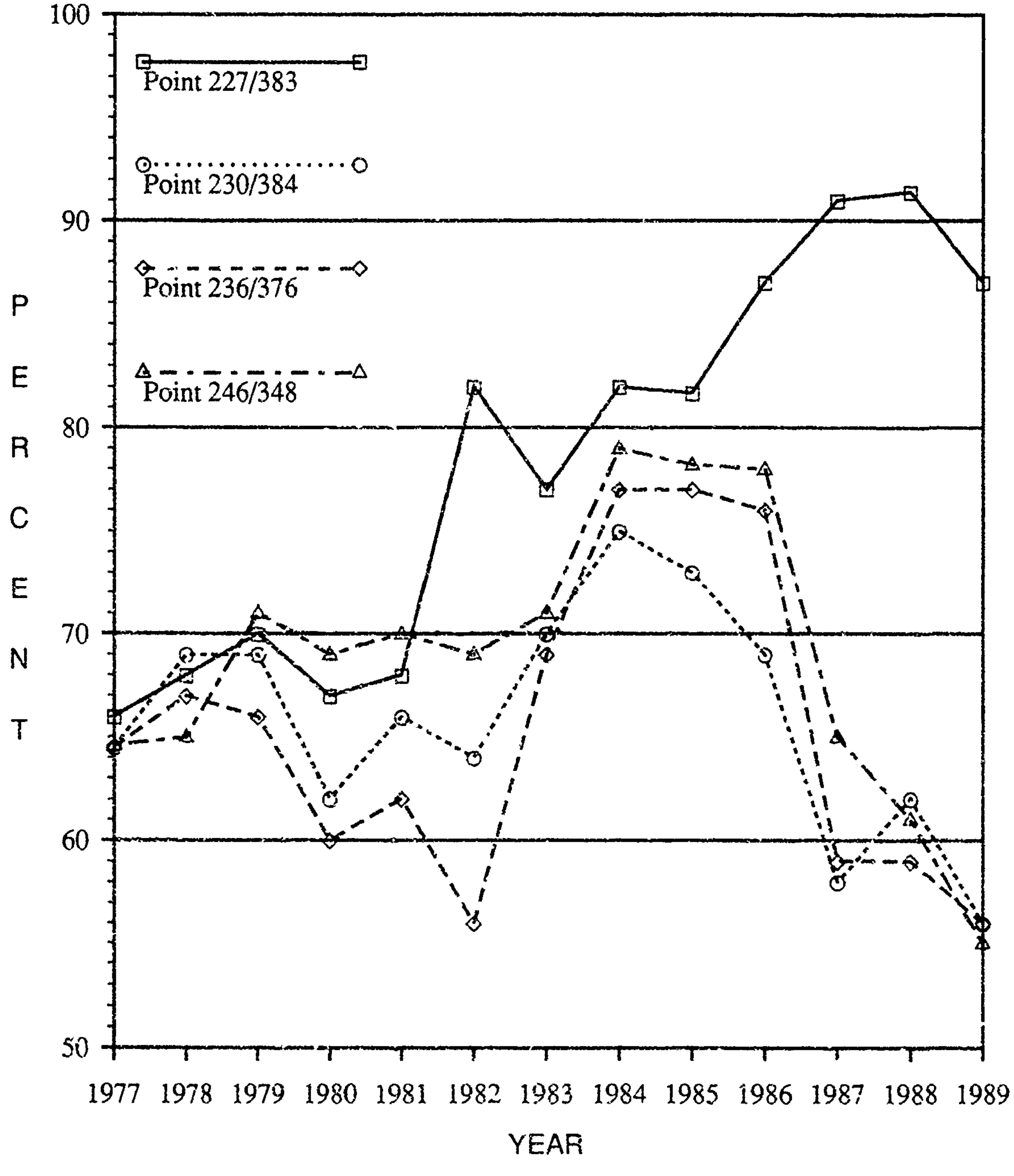


FIGURE A-15

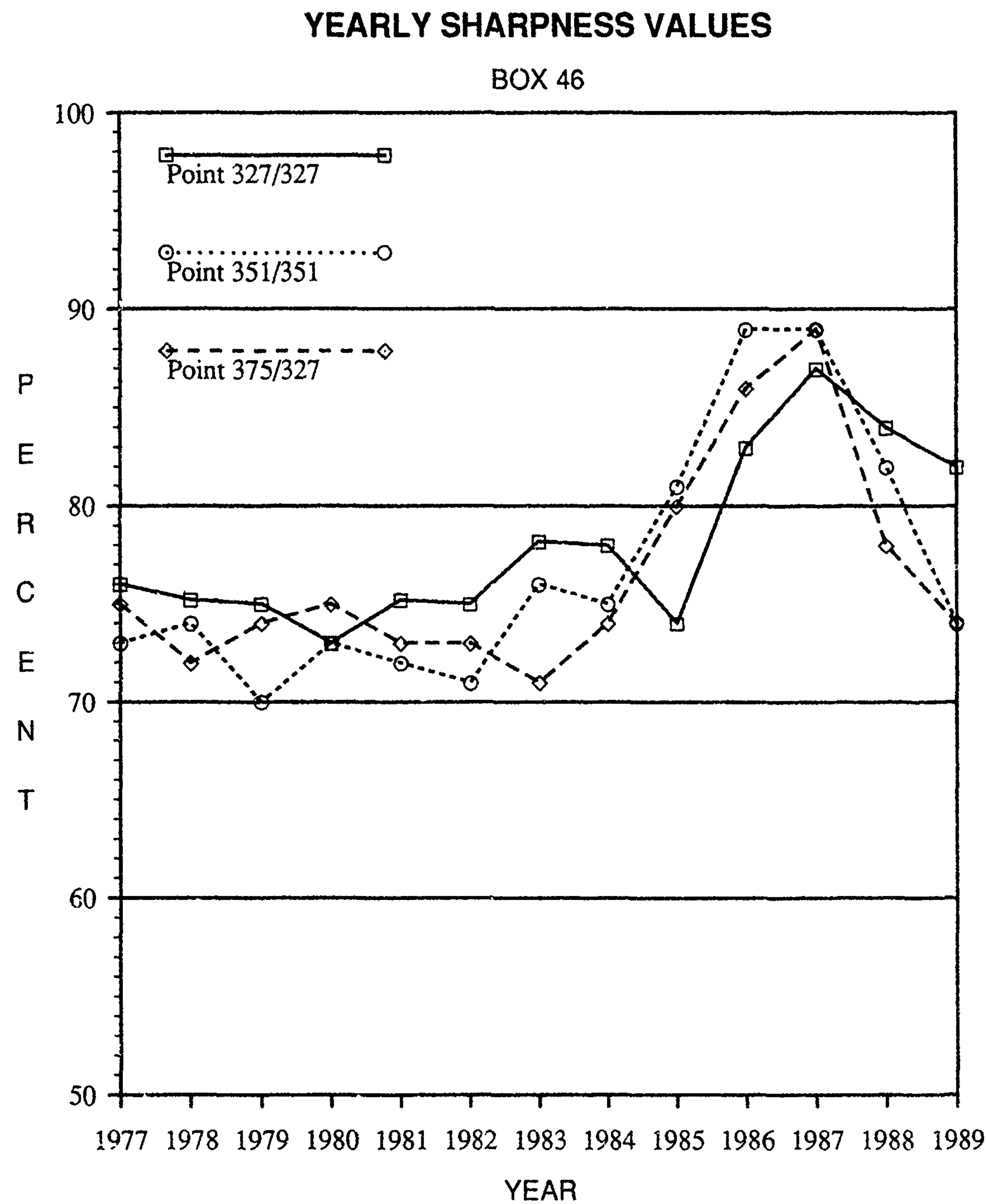
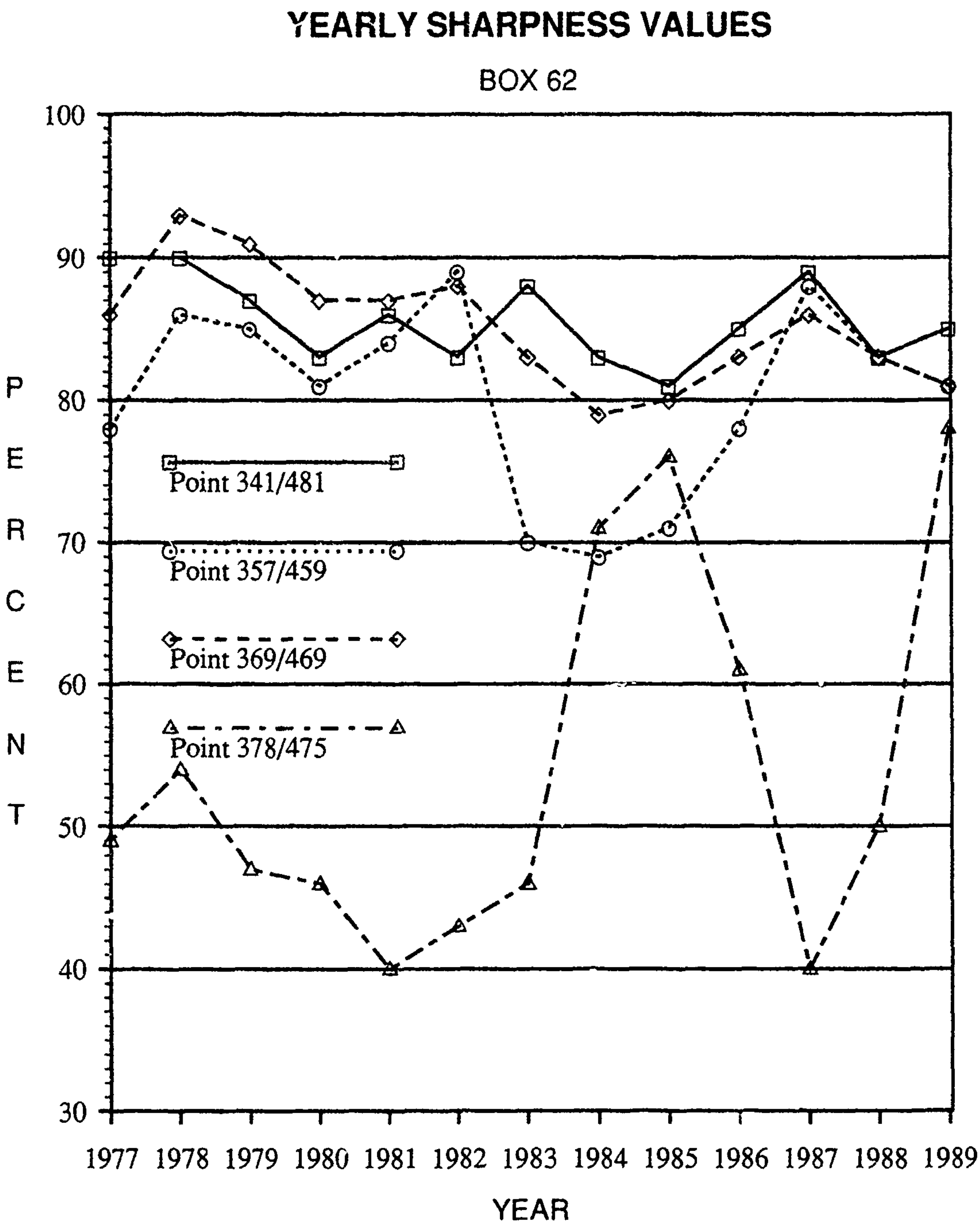

YEARLY SHARPNESS VALUES
BOX 46
100
90
80
70
60
50
Point 327/327
Point 351/351
Point 375/327
PERCENT
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

FIGURE A-16



YEARLY SHARPNESS VALUES
BOX 62
100
90
80
70
60
50
40
30
P
E
R
C
E
N
T
Point 341/481
Point 357/459
Point 369/469
Point 378/475
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-17

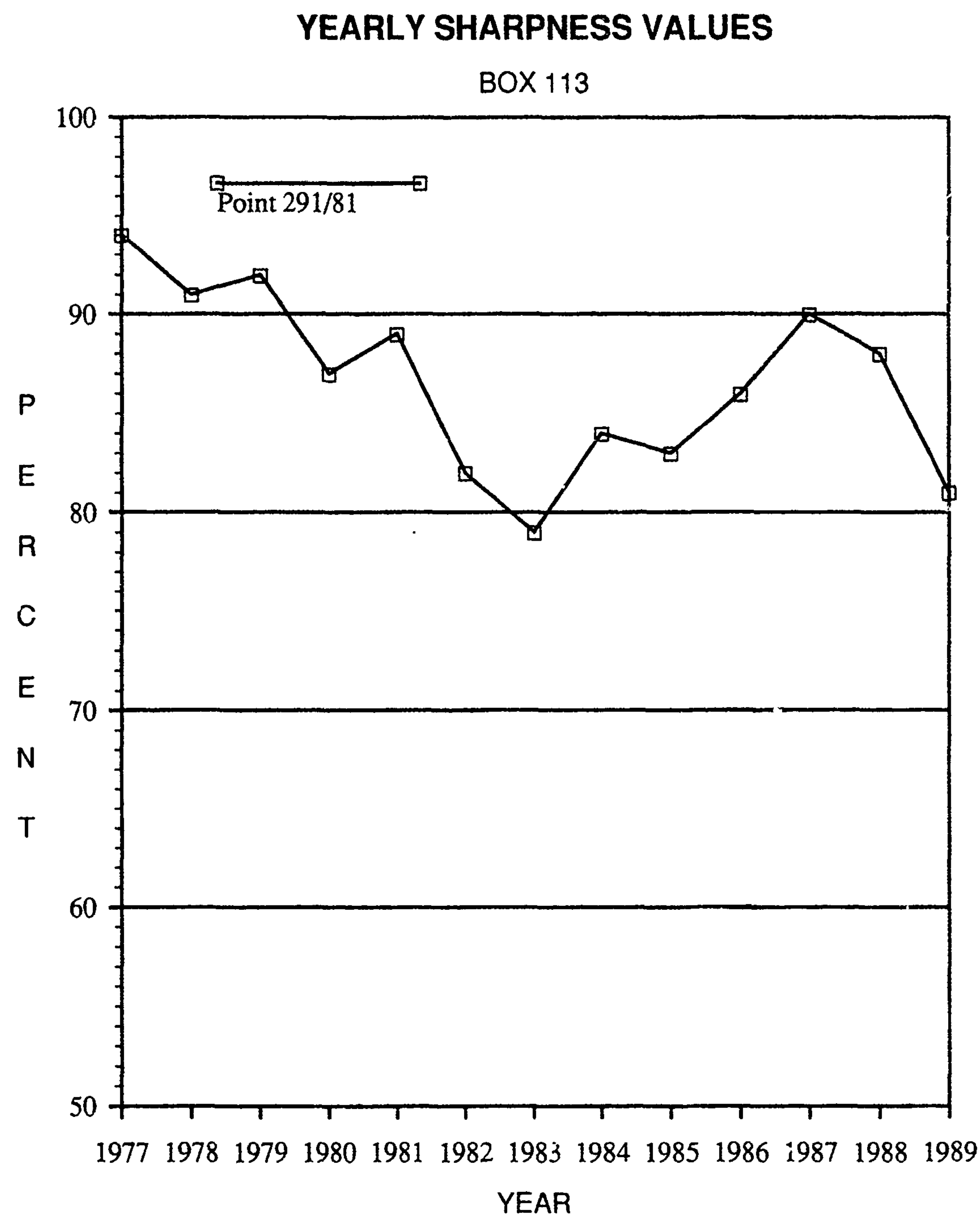

YEARLY SHARPNESS VALUES
BOX 113
Point 291/81
P E R C E N T
100
90
80
70
60
50
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-18

YEARLY SHARPNESS VALUES

BOX 129

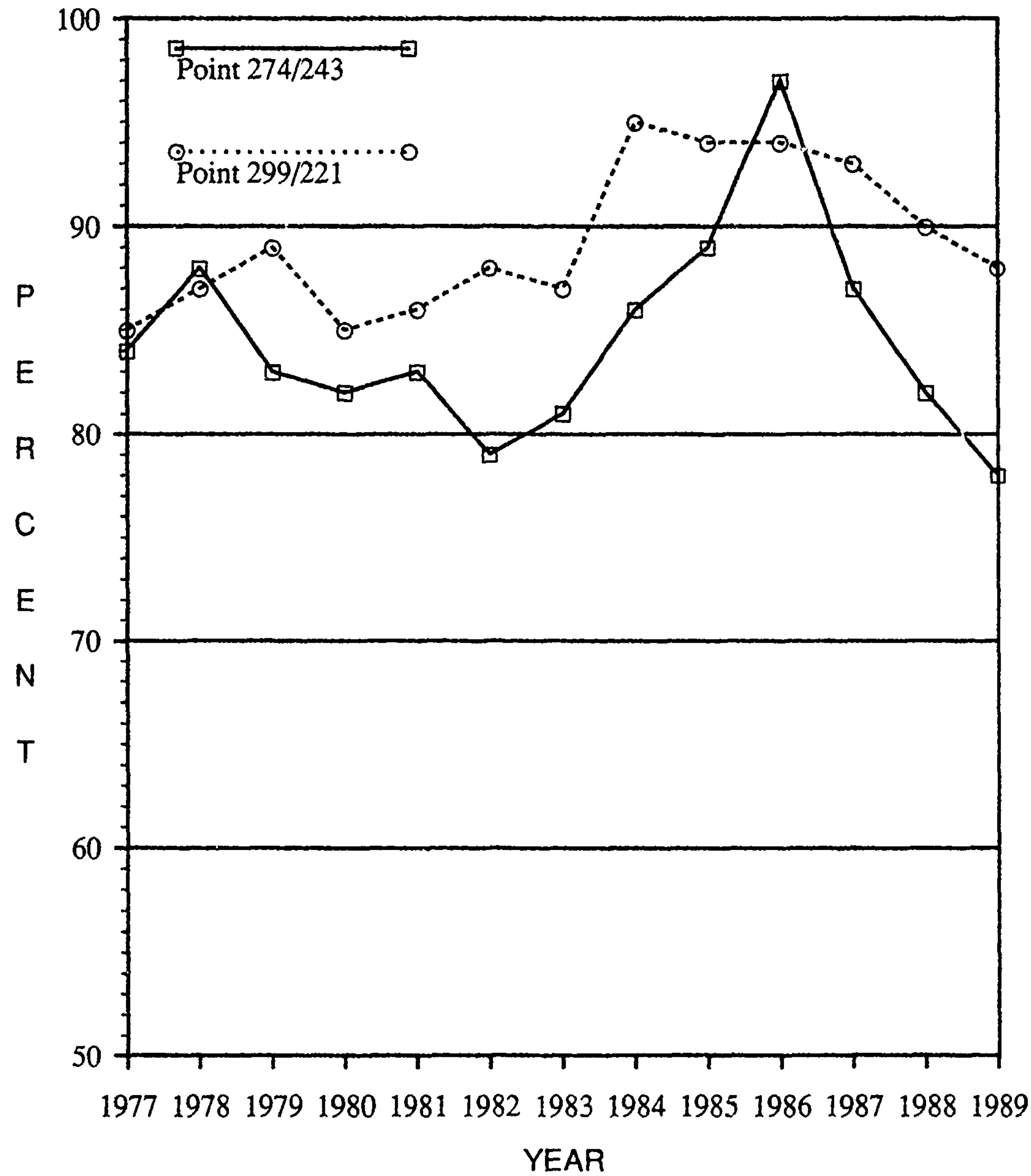


FIGURE A-19

YEARLY SHARPNESS VALUES

BOX 143

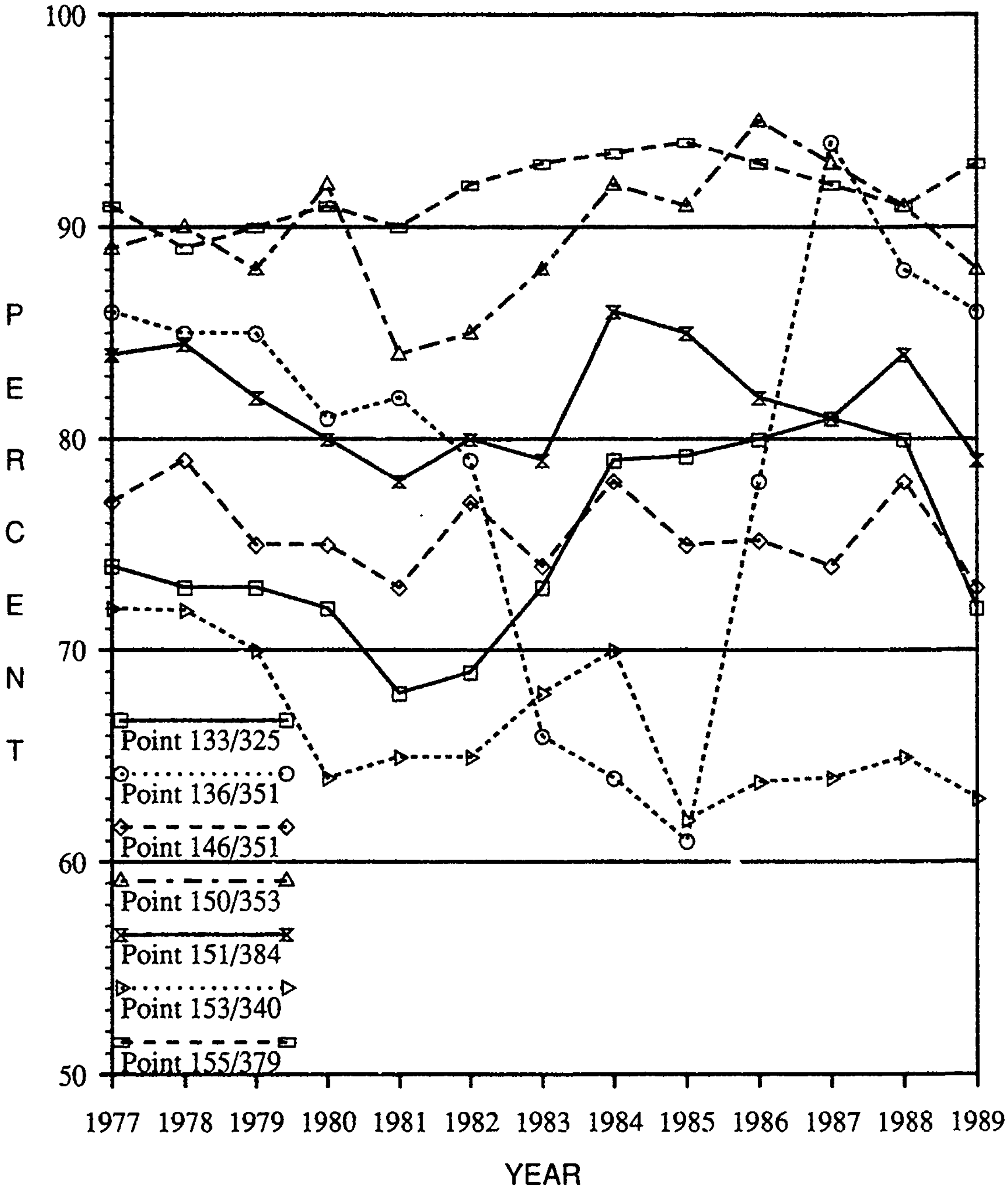


FIGURE A-20

YEARLY SHARPNESS VALUES

BOX 150

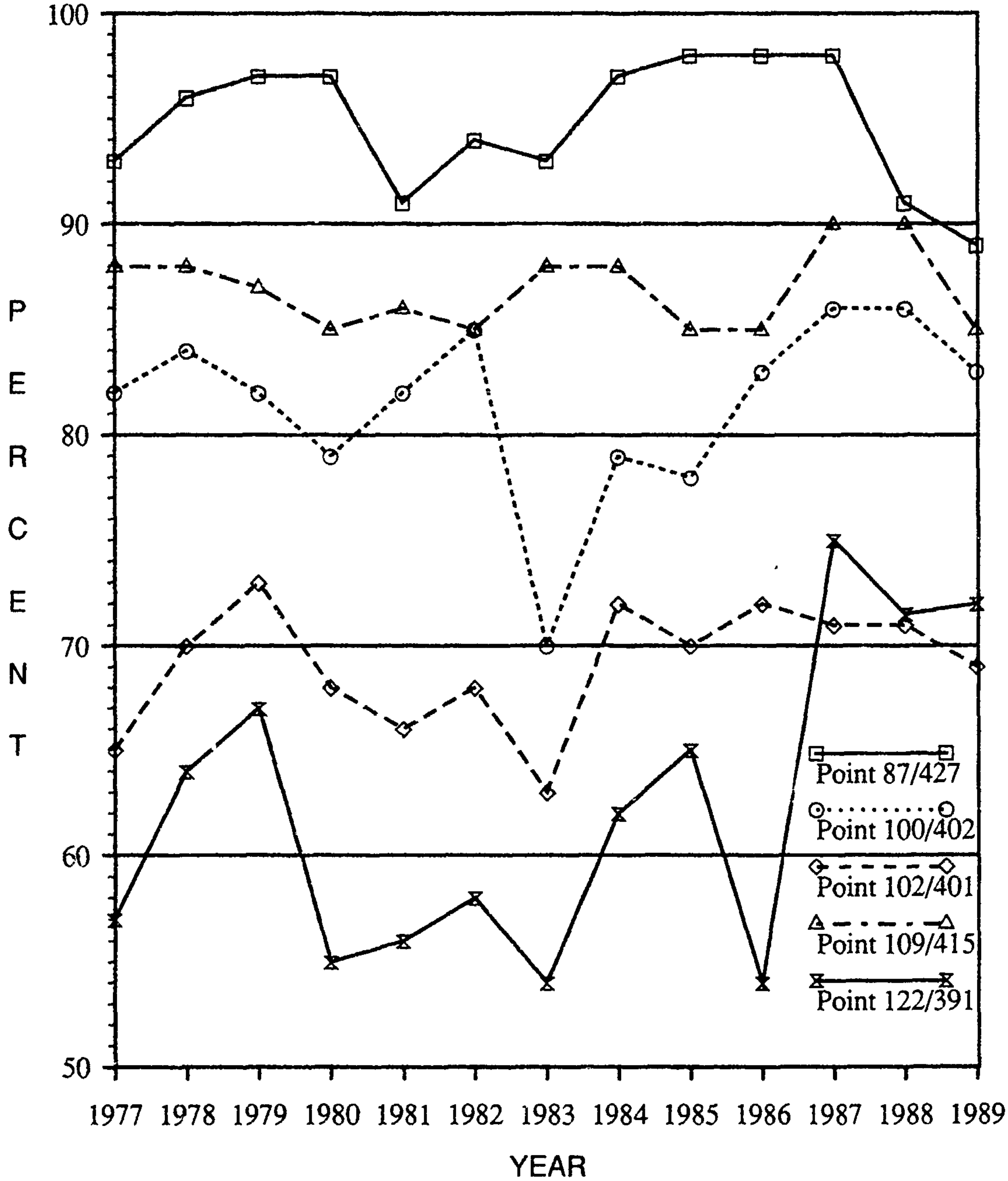


FIGURE A-21

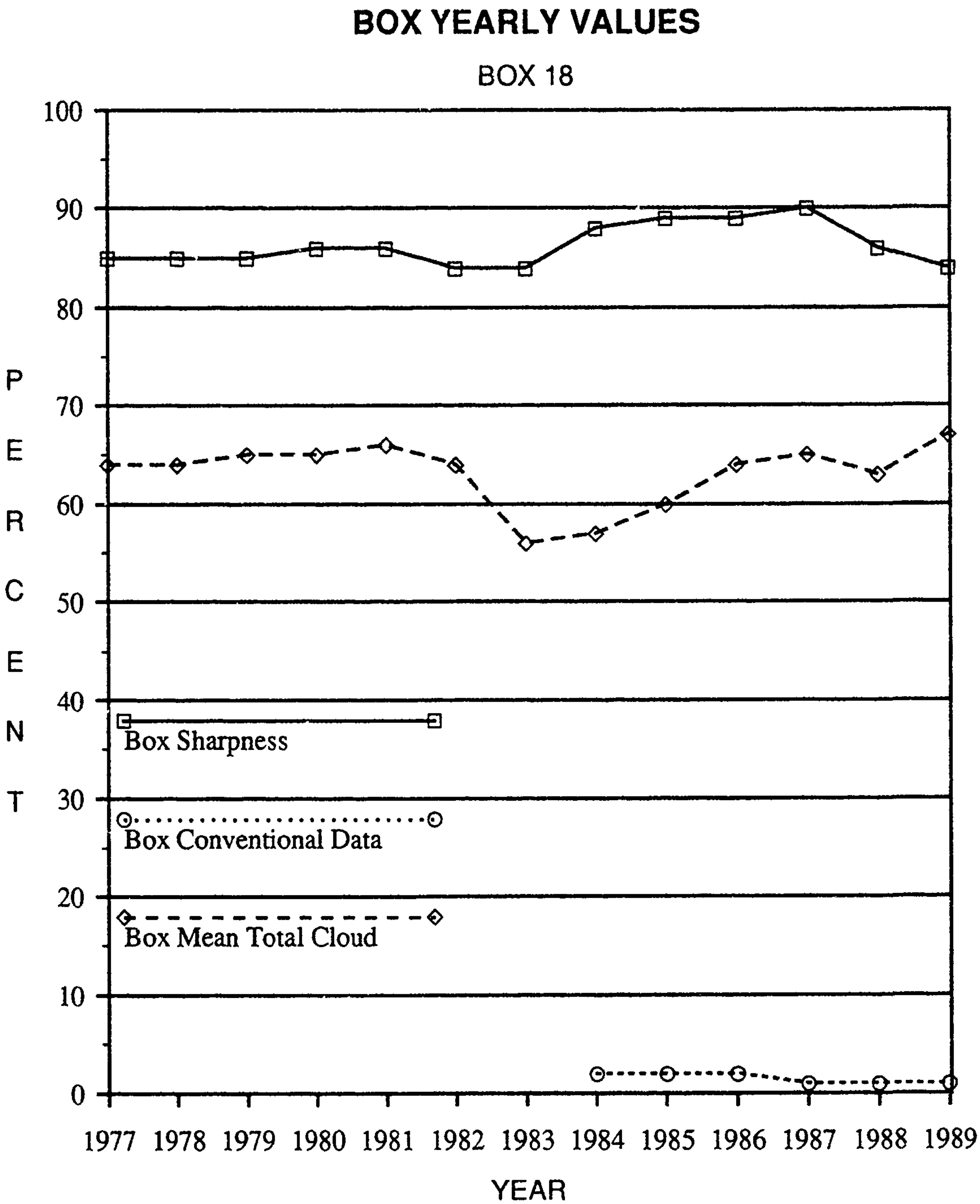

BOX YEARLY VALUES
BOX 18
100
90
80
70
60
50
40
30
20
10
0
P
E
R
C
E
N
T
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

FIGURE A-22

BOX YEARLY VALUES

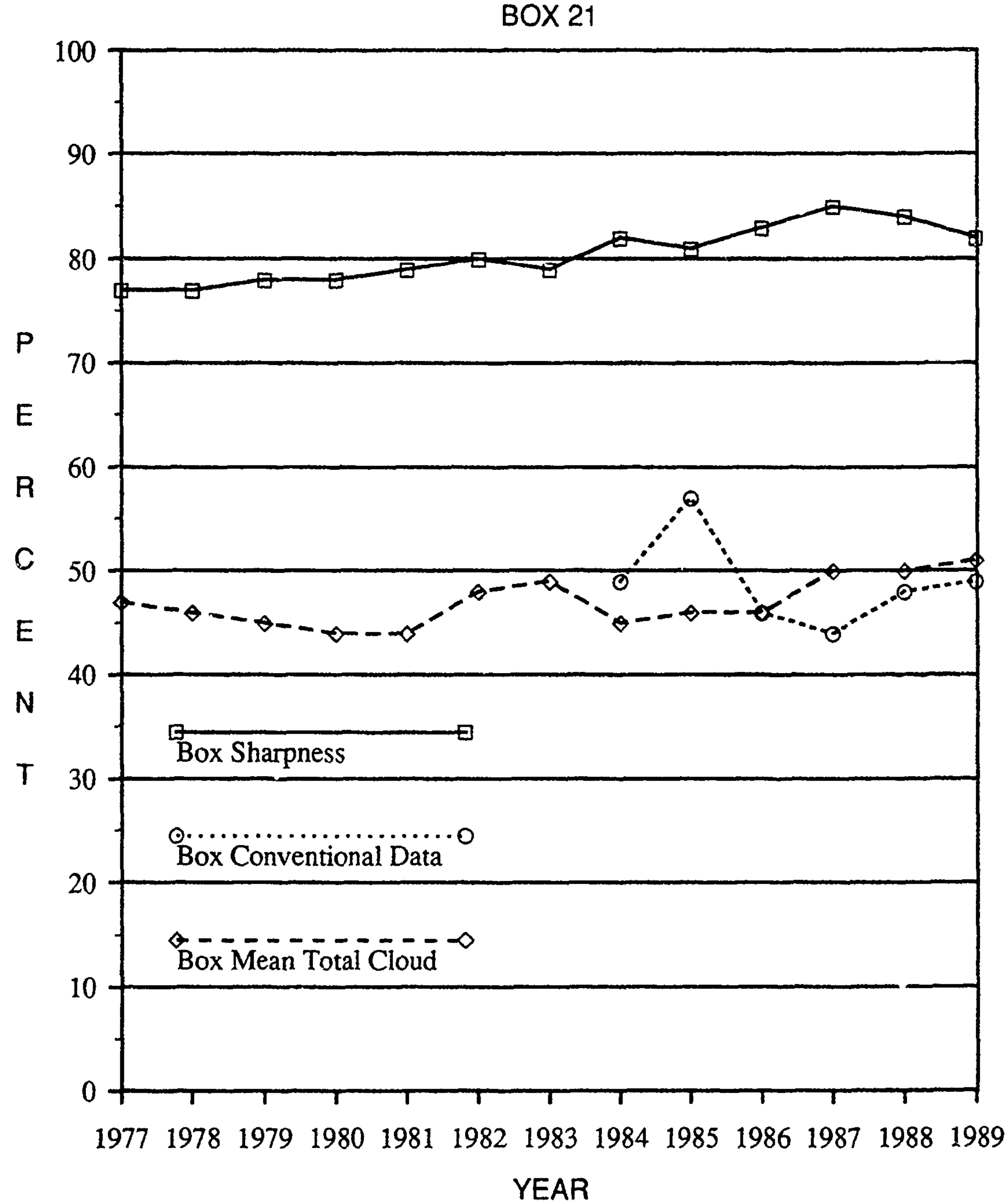


FIGURE A-23

BOX YEARLY VALUES

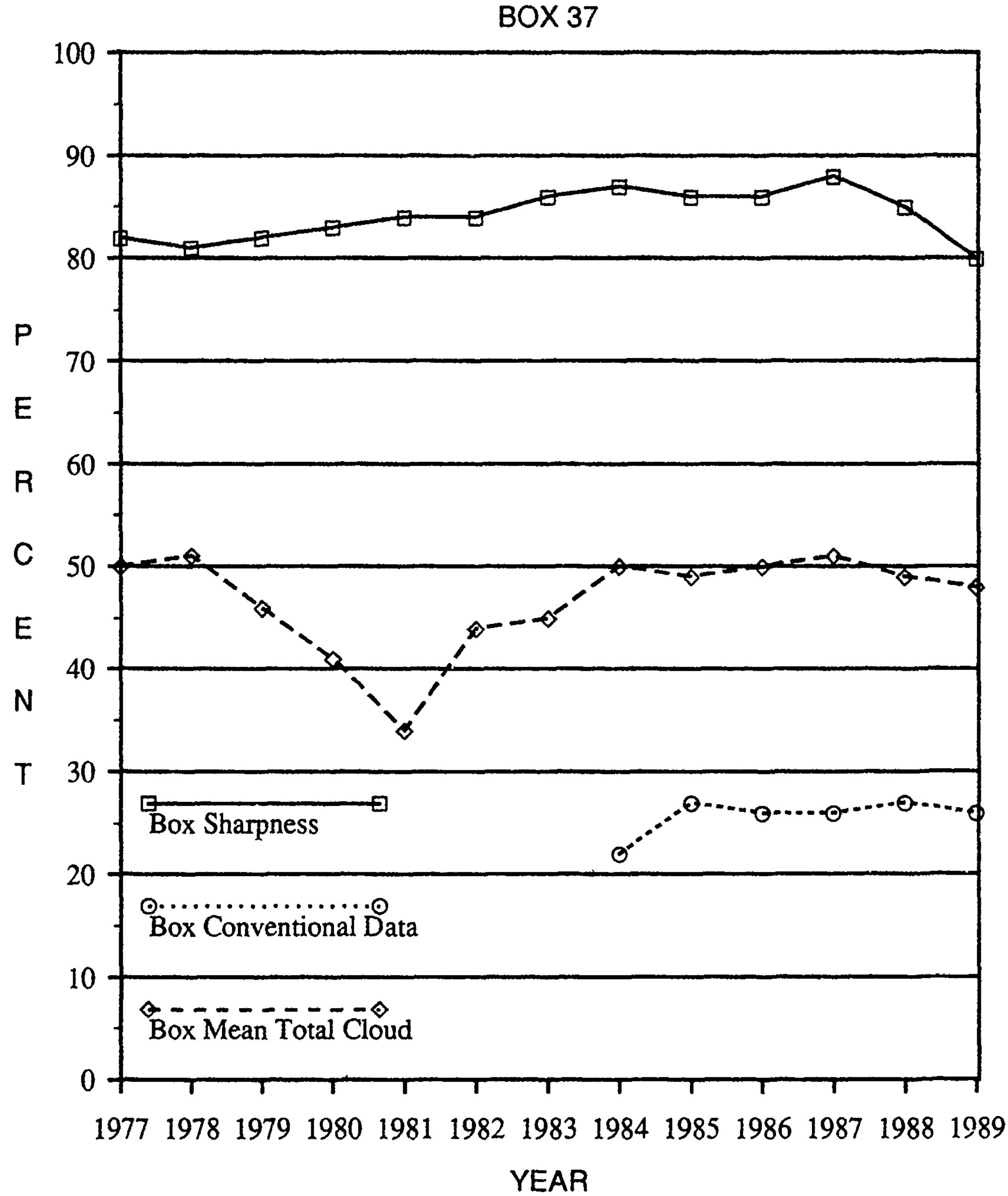


FIGURE A-24

BOX YEARLY VALUES

BOX 38

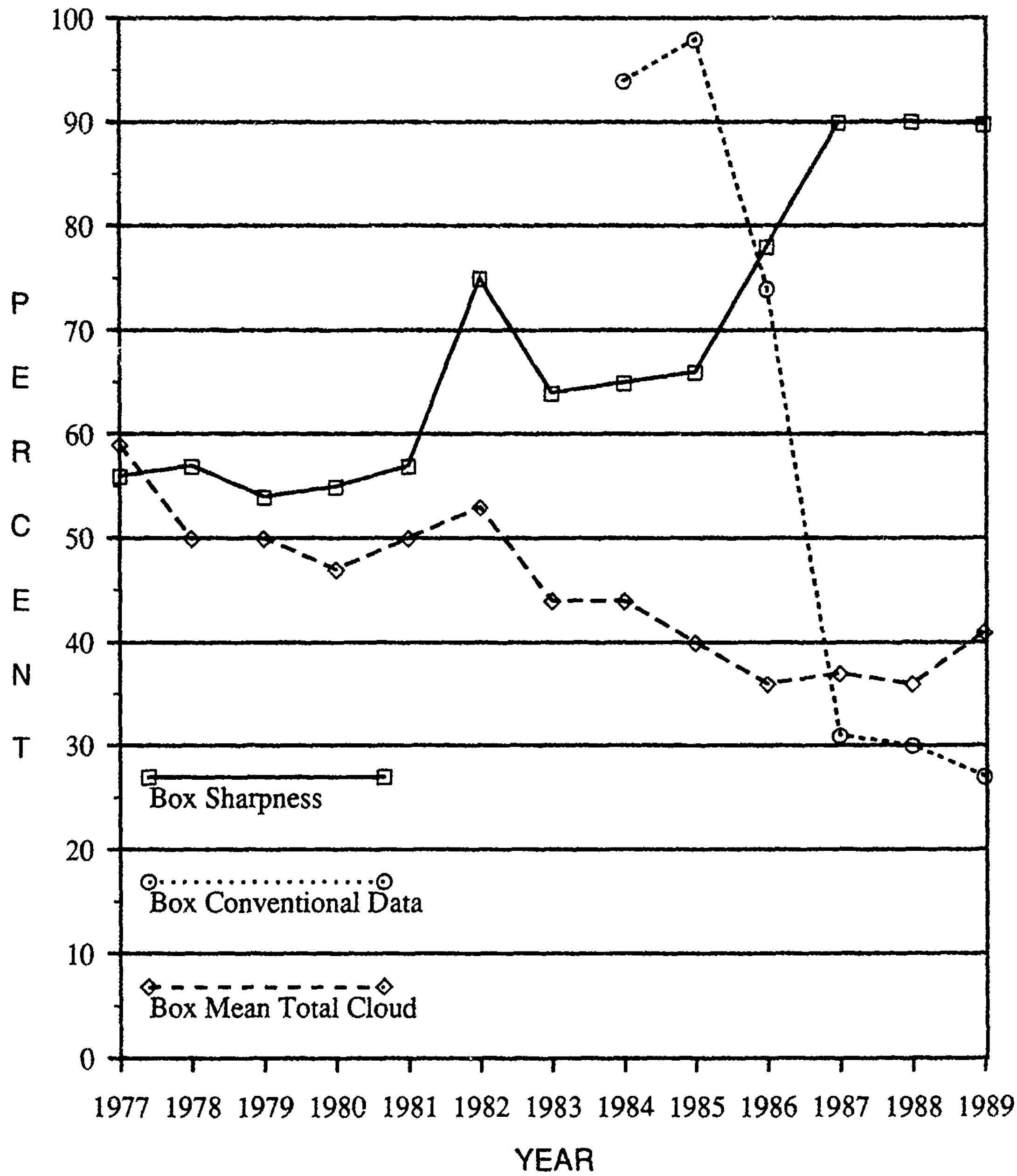
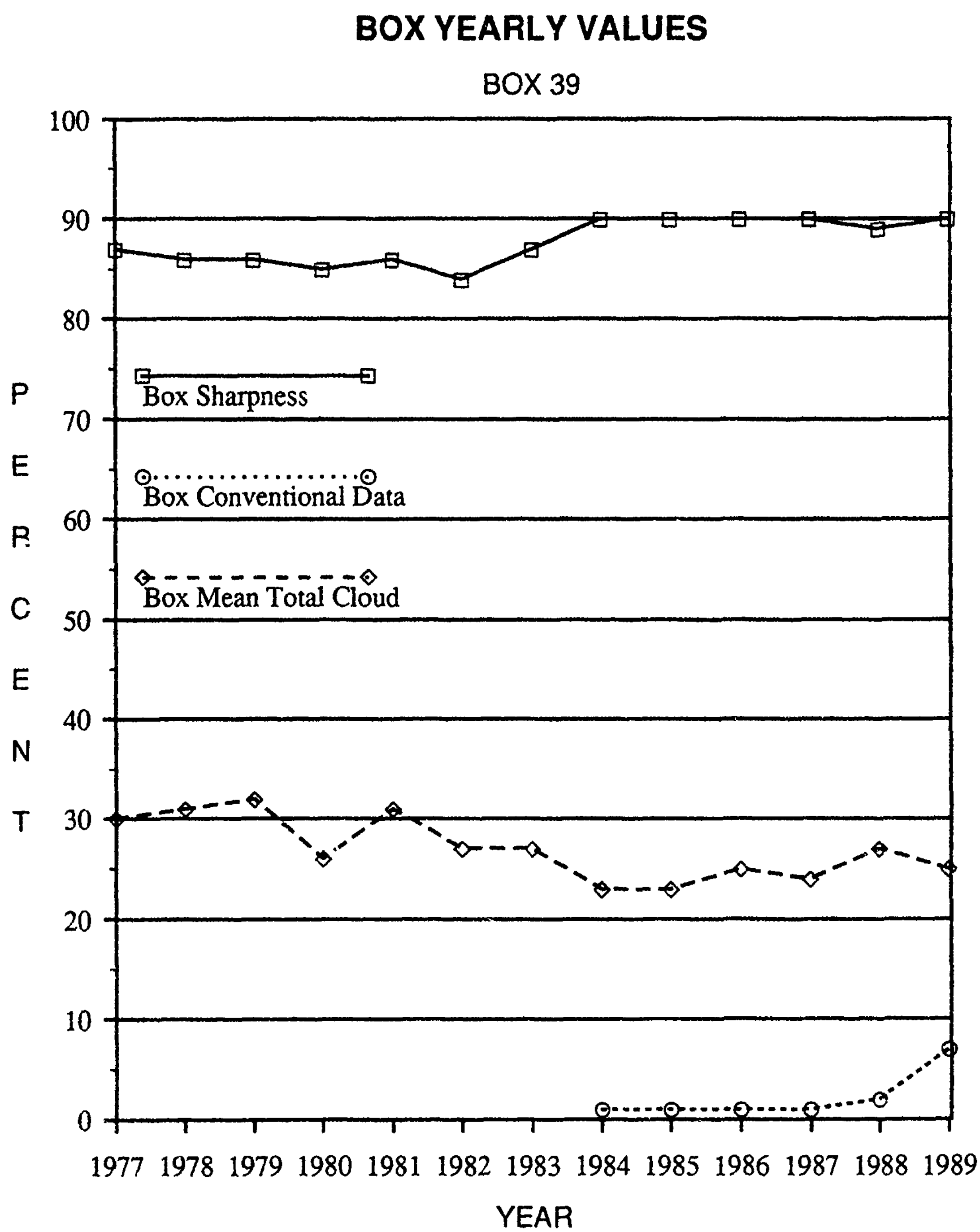


FIGURE A-25



BOX YEARLY VALUES
BOX 39
100
90
80
70
60
50
40
30
20
10
0
P E R C E N T
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-26

BOX YEARLY VALUES

BOX 40

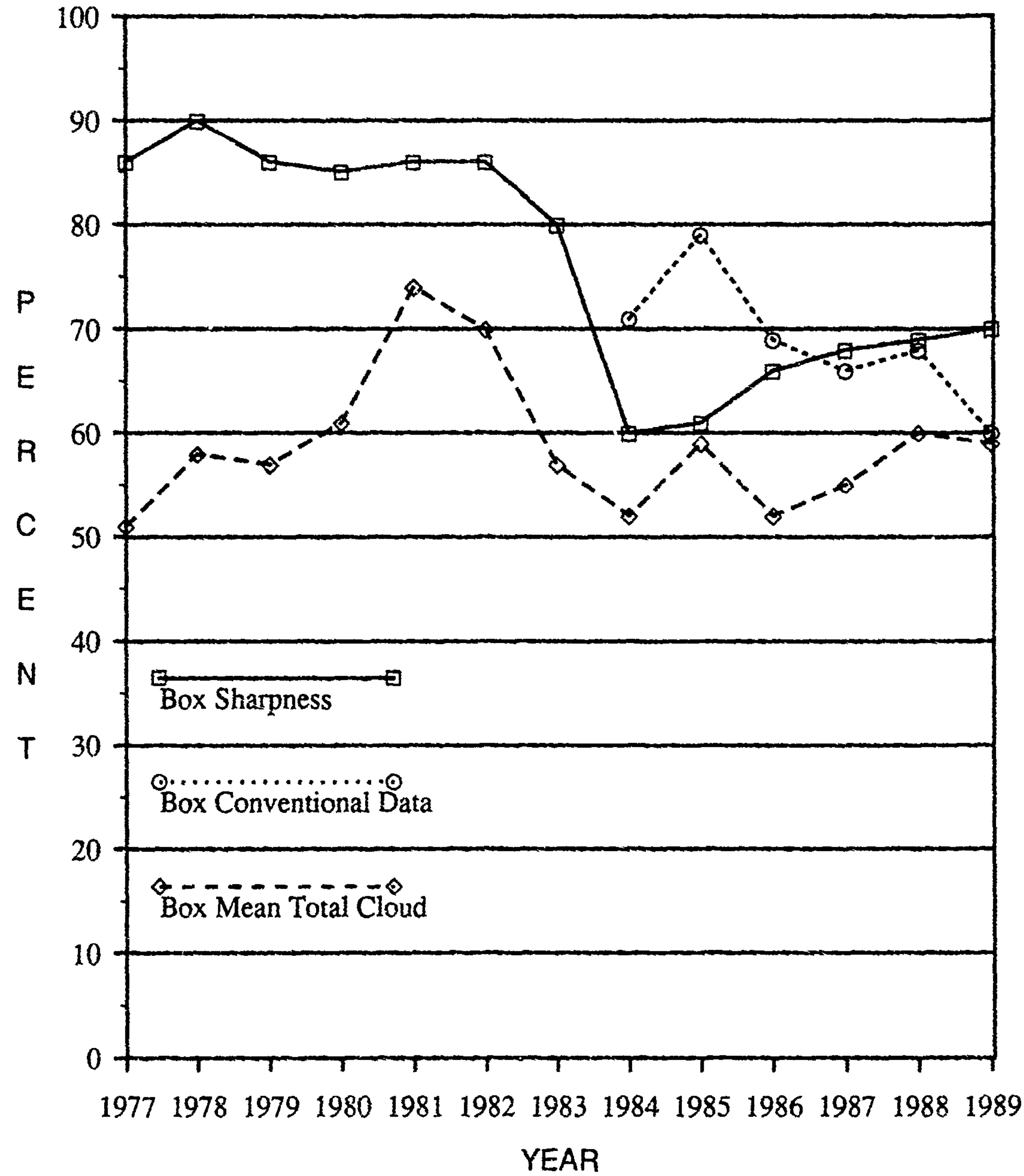


FIGURE A-27

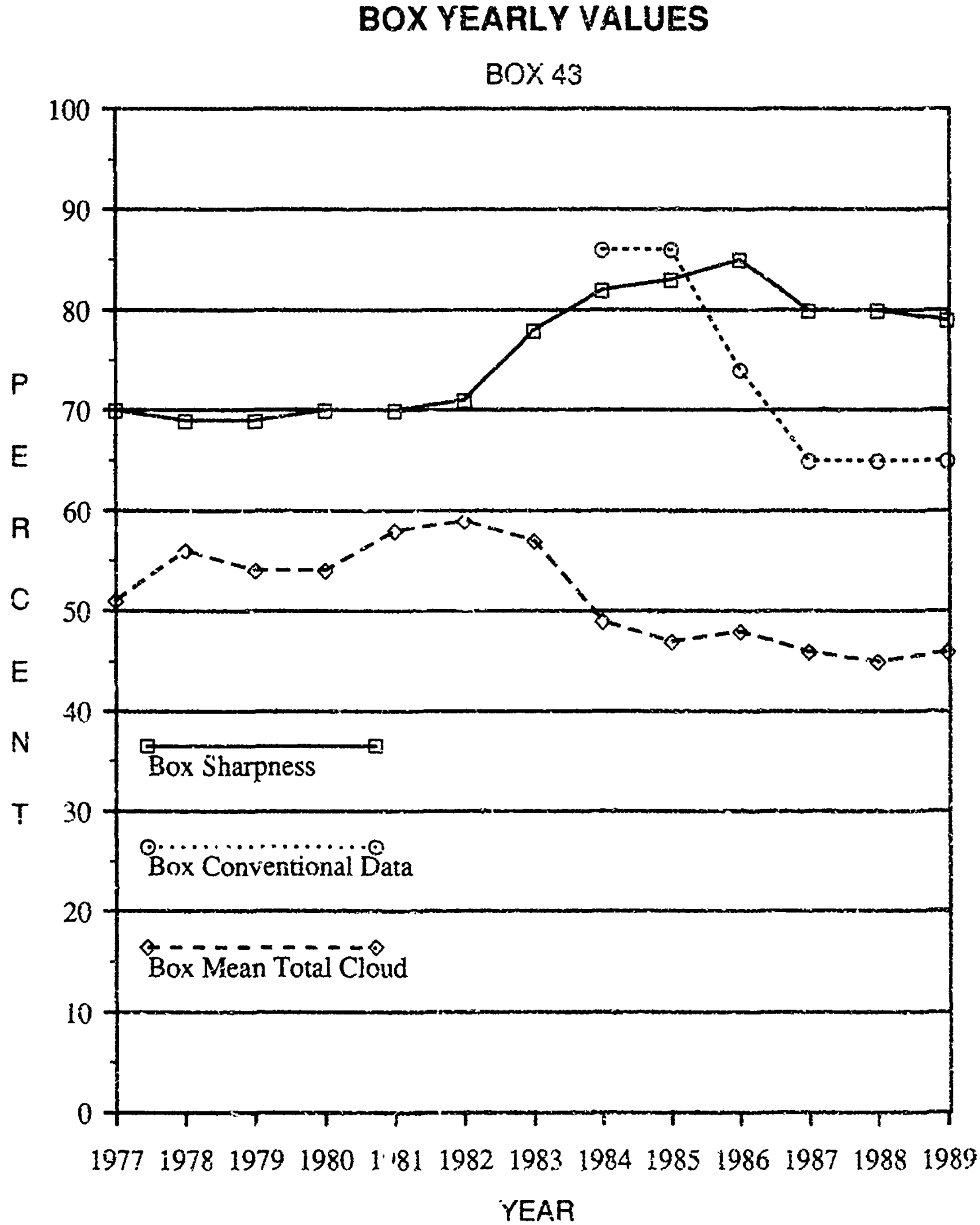

BOX YEARLY VALUES
BOX 43
100
90
80
70
60
50
40
30
20
10
0
PERCENT
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-28

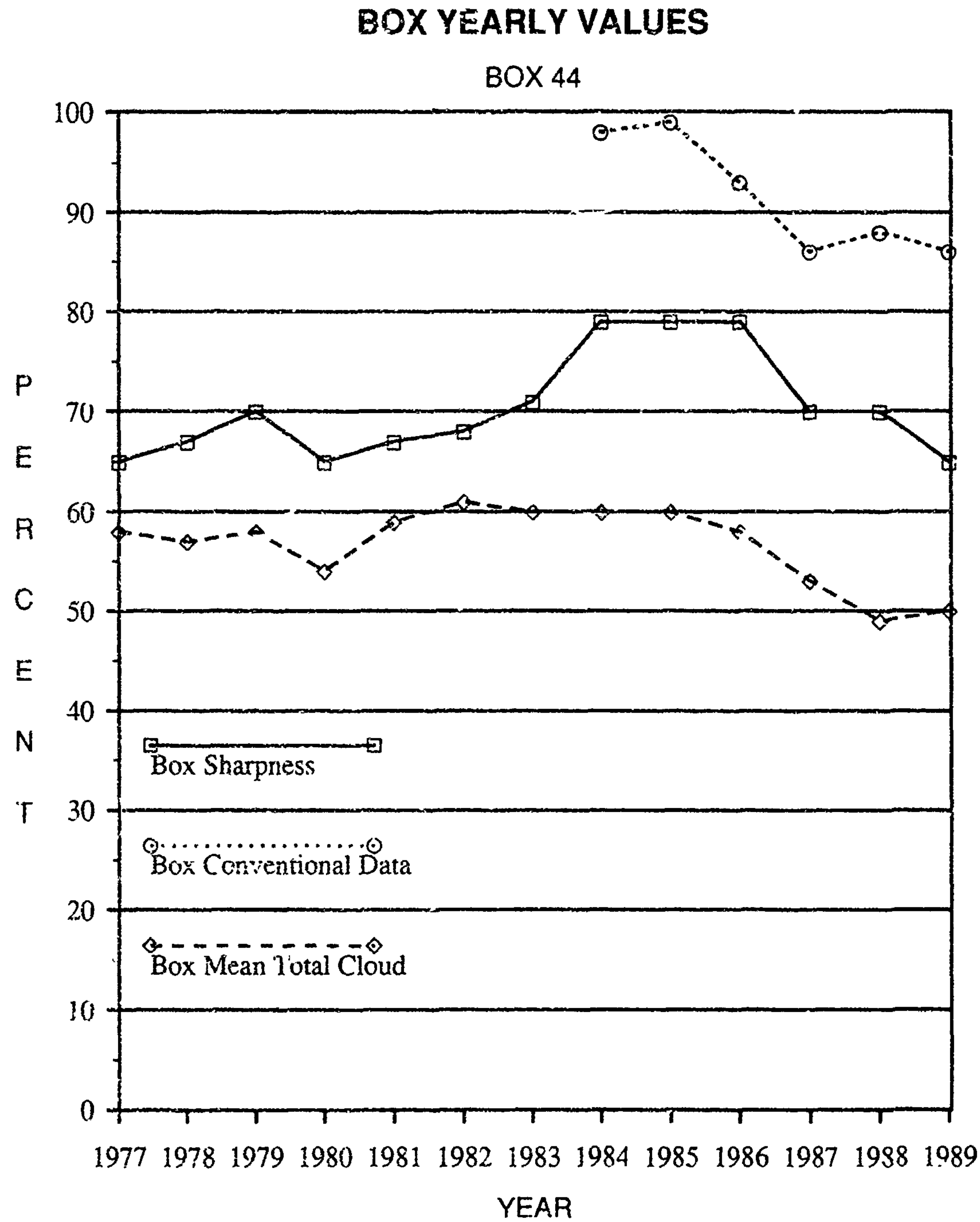
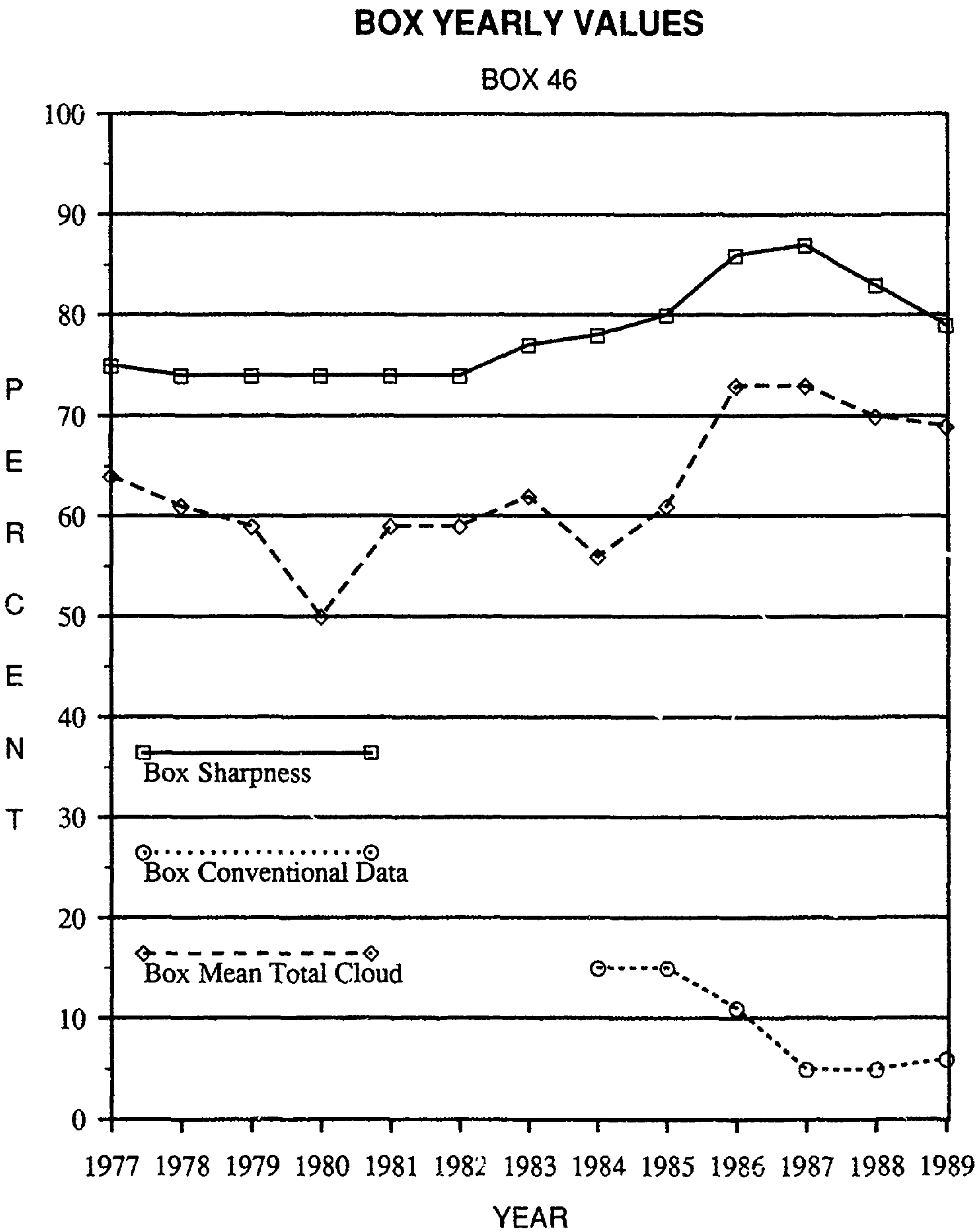

BOX YEARLY VALUES
BOX 44
100
90
80
70
60
50
40
30
20
10
0
PERCENT
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

FIGURE A-29



BOX YEARLY VALUES
BOX 46
100
90
80
70
60
50
40
30
20
10
0
PERCENT
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

FIGURE A-30

BOX YEARLY VALUES

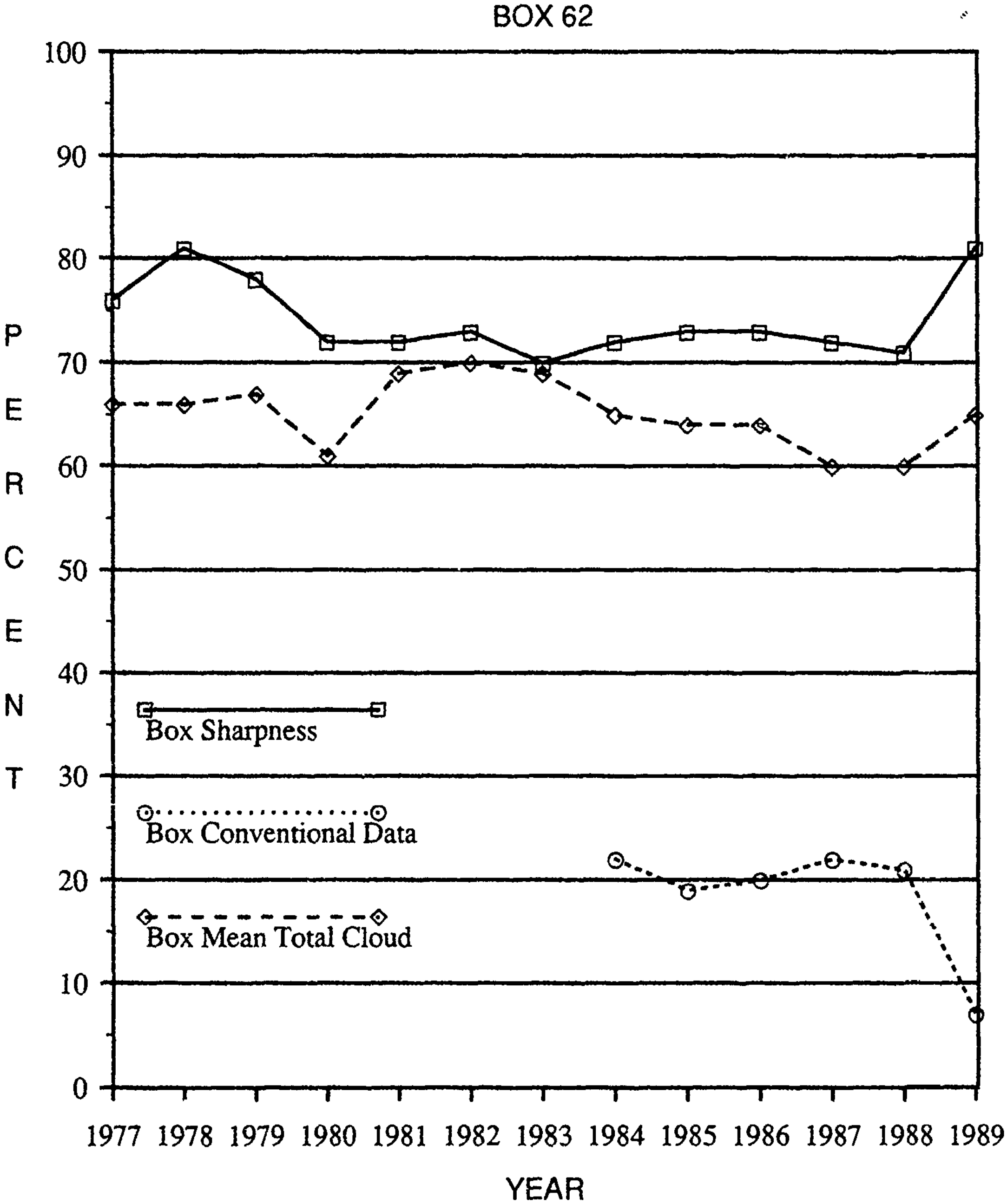


FIGURE A-31

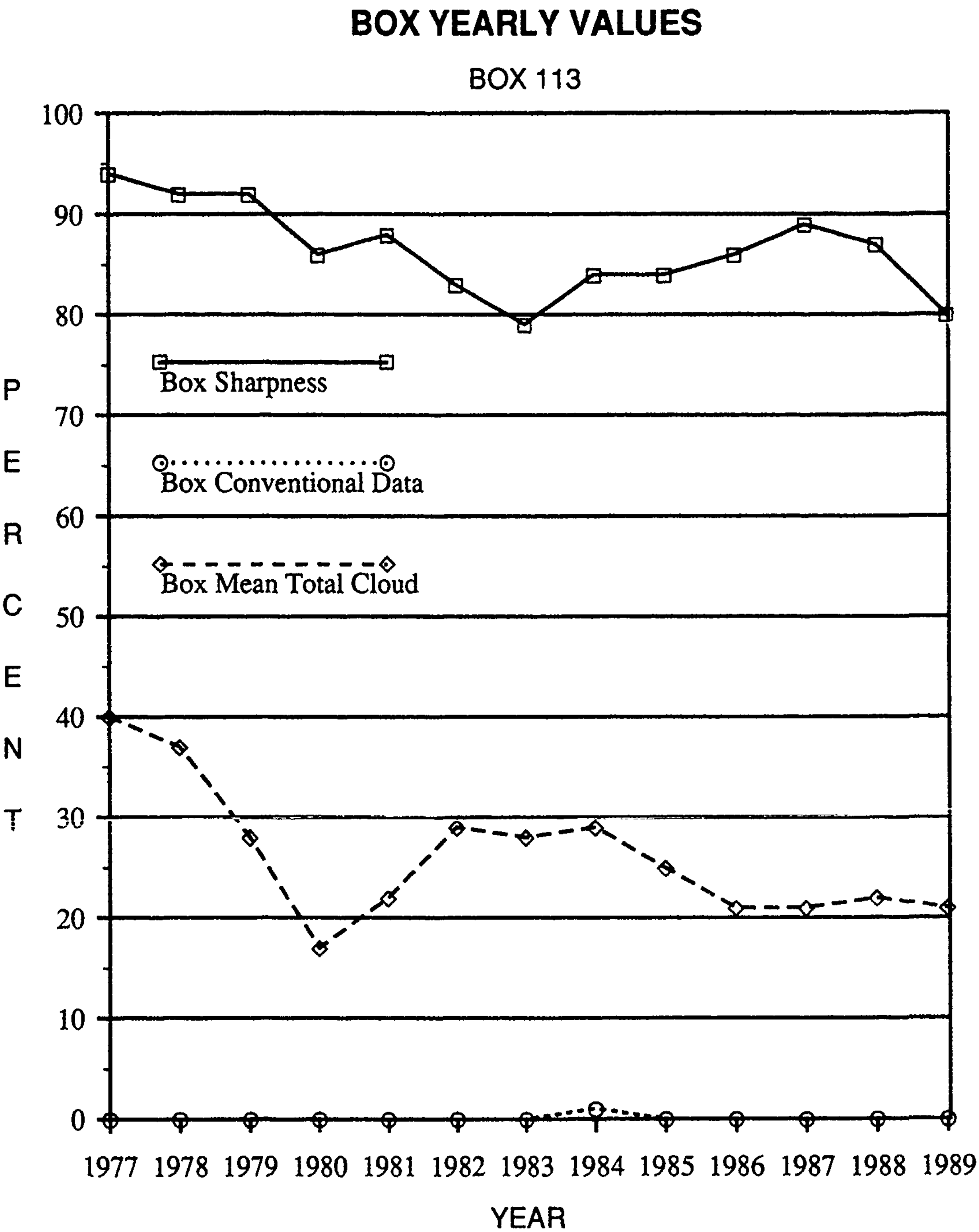

BOX YEARLY VALUES
BOX 113
100
90
80
70
60
50
40
30
20
10
0
P E R C E N T
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-32

BOX YEARLY VALUES

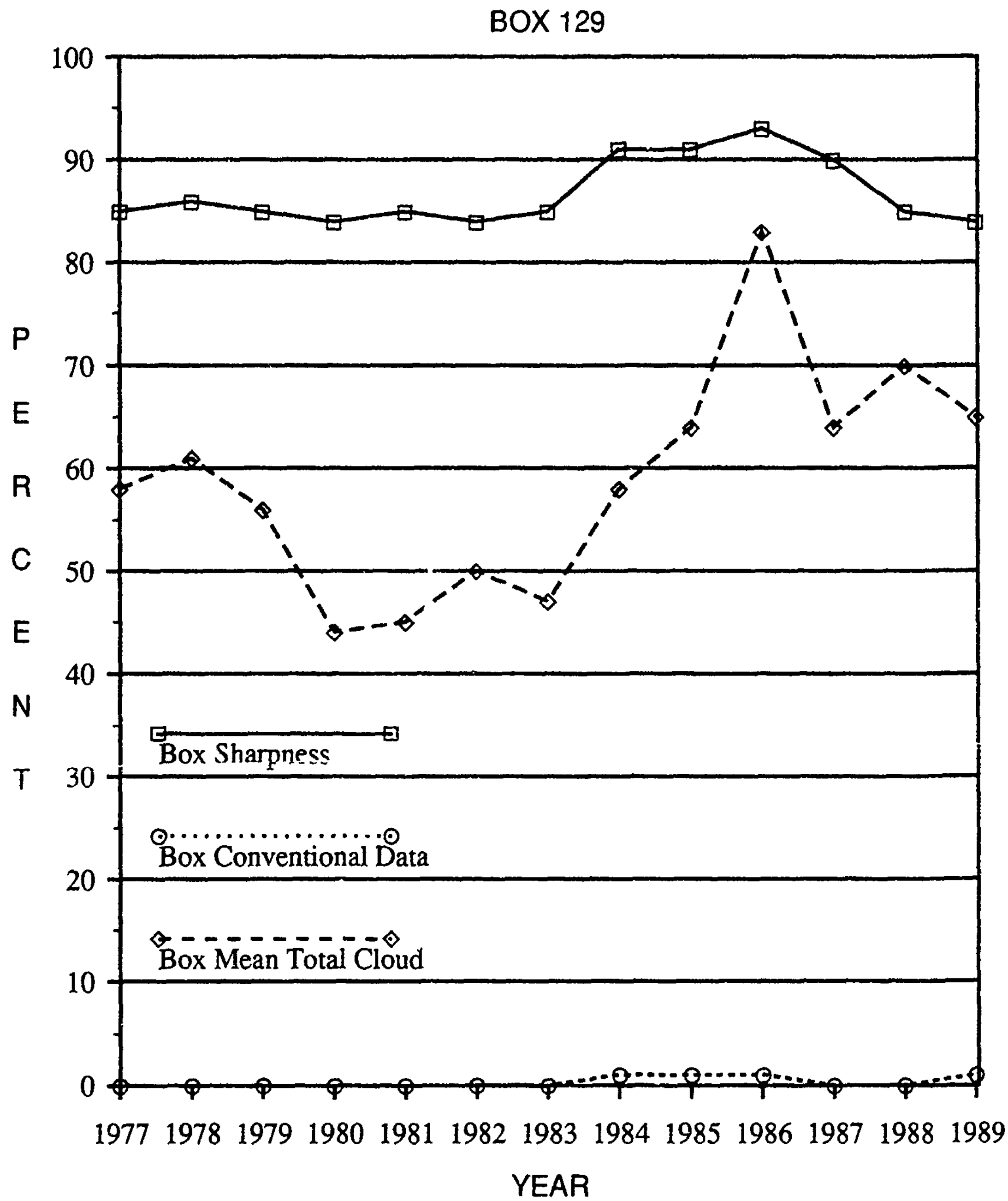


FIGURE A-33

BOX YEARLY VALUES

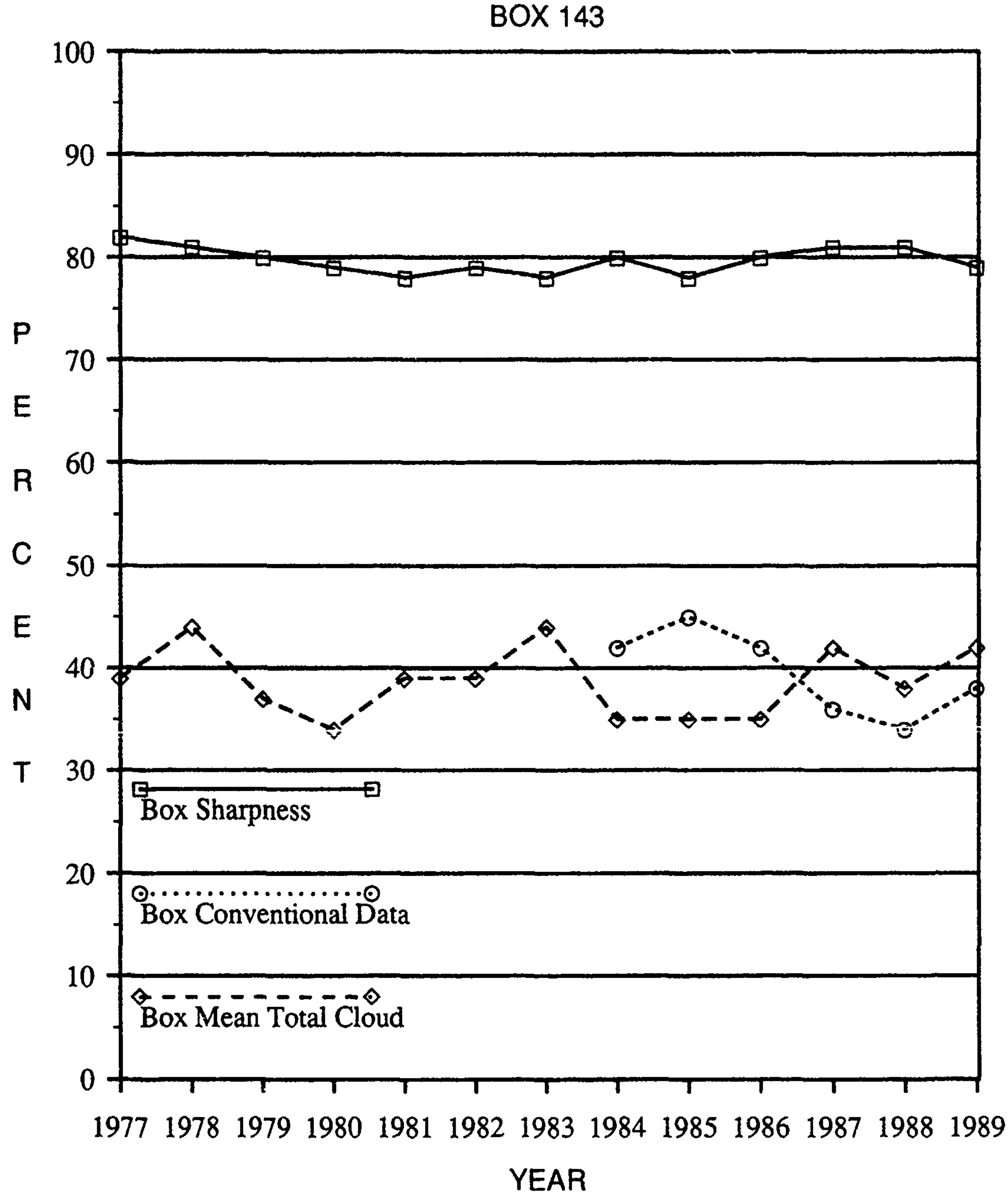


FIGURE A-34

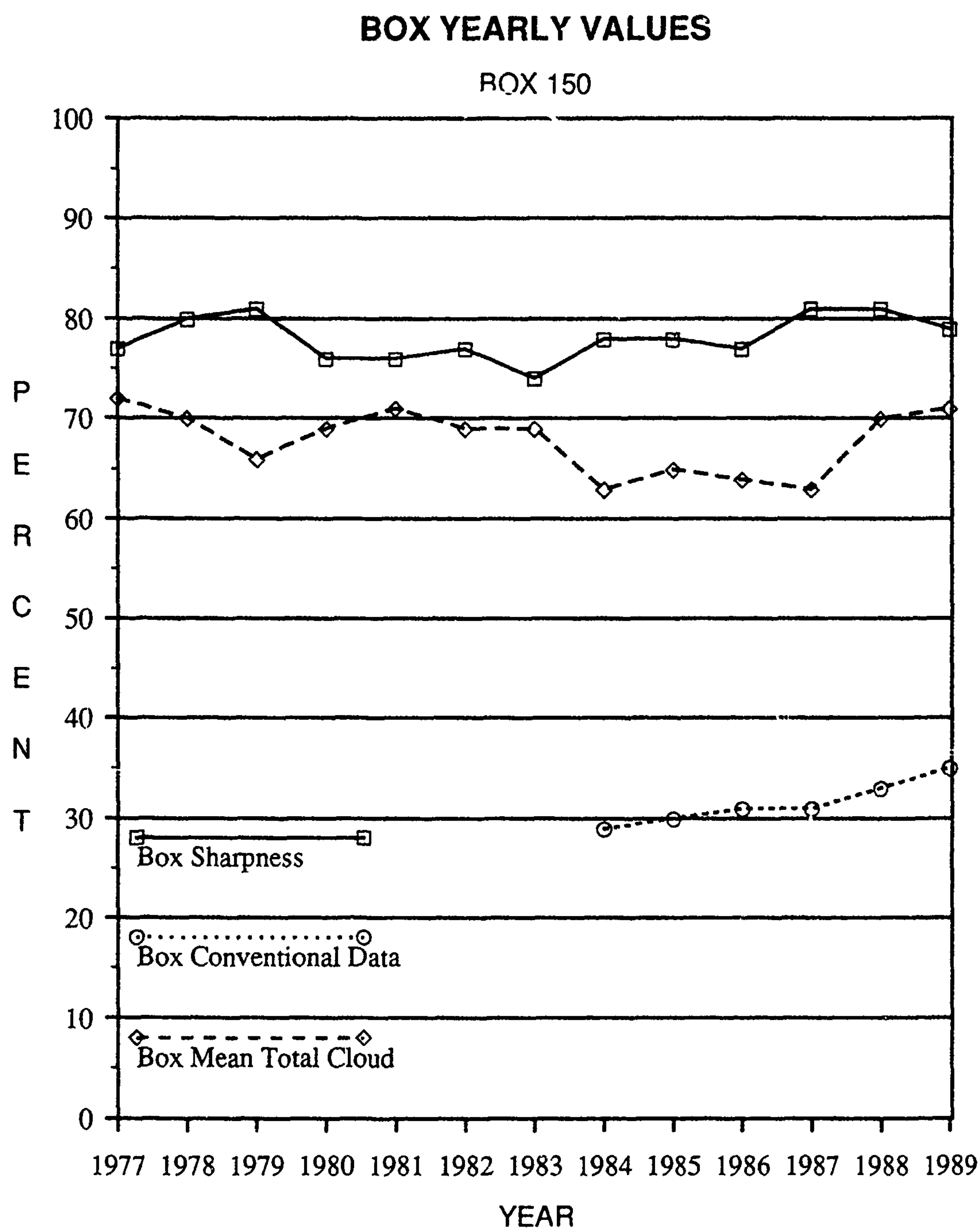

BOX YEARLY VALUES
BOX 150
PERCENT
100
90
80
70
60
50
40
30
20
10
0
Box Sharpness
Box Conventional Data
Box Mean Total Cloud
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
YEAR

FIGURE A-35

ALL POINT YEARLY VALUES

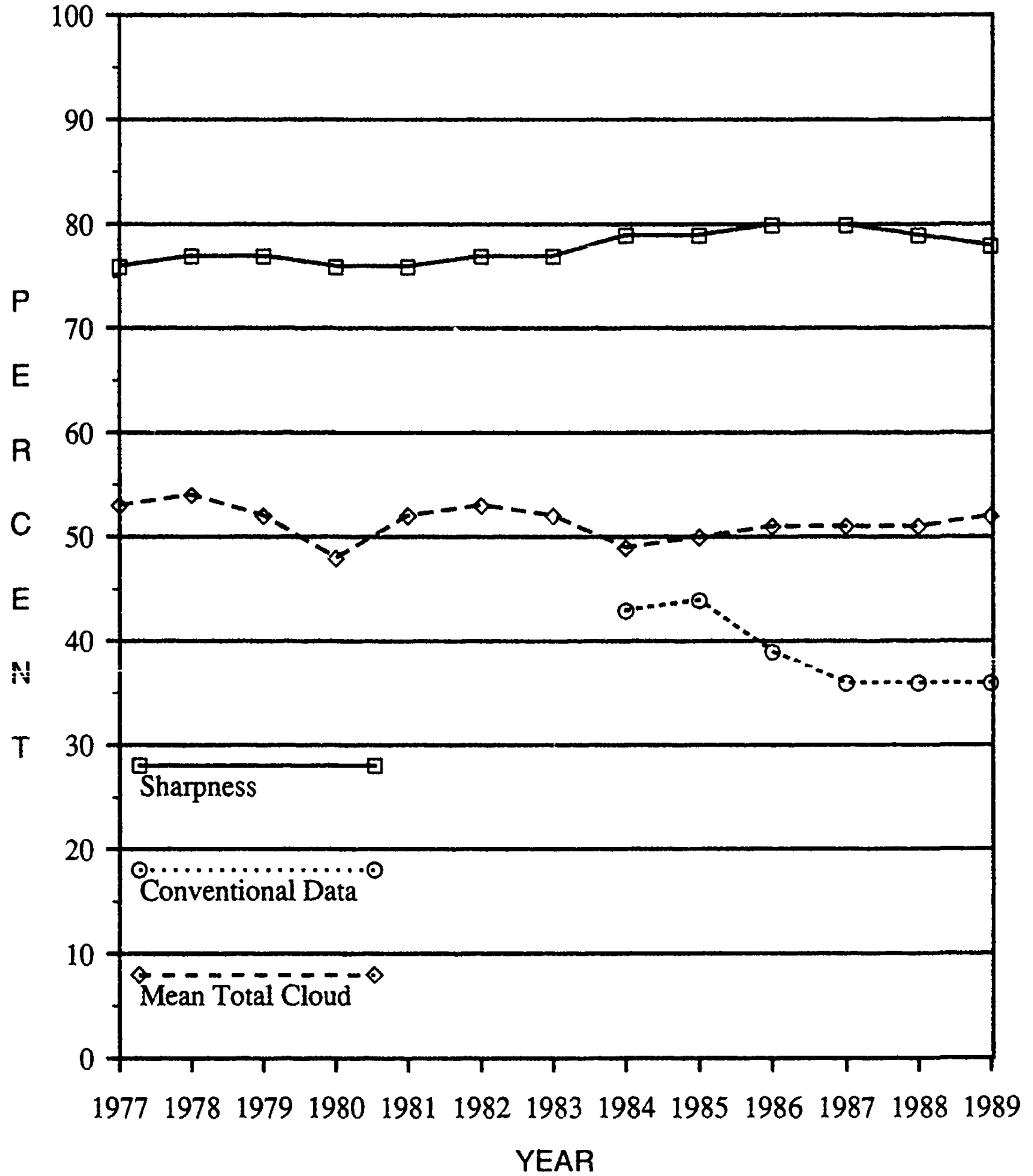


FIGURE A-36

Appendix B

CLIMATOLOGICAL STUDY POINTS

Appendix B lists the data points used in the study; they were chosen to represent many general climatic types; water, land, or coastal points (because of problems with each type of terrain); amount of surface data available at the point; and, to minimize processing, from as few RTNEPH boxes as possible. The climatic group and type were determined using a modified Koppen classification from Trewartha's *An Introduction to Climate.*

NORTHERN HEMISPHERE

Group	Climate Type	Point Type	Sfc Data	Box/I,J	1/8 Mesh
Tropical		Water	Sparse	18/7,7	71,135
		Water	Sparse	46/31,31	351,351
	Wet	Land	Sparse	62/49,21	369,469
		Land	Rich	62/58,27	378,475
		Coastal	Sparse	62/37,11	357,459
	Wet and Dry	Land	Sparse	62/21,33	341,481
		Land	Rich	40/12,41	460,297
Dry	Desert or Arid	Land	Sparse	39/31,55	415,311
		Land	Rich	21/59,31	315,159
		Coastal	Sparse	43/51,57	179,377
	Steppe/Semi-Arid	Land	Sparse	39/62,34	446,290
		Land	Rich	21/25,37	281,165
Subtropical		Water	Sparse	18/55,55	119,183
		Water	Sparse	46/55,7	375,327
	Humid	Land	Sparse	44/35,63	227,383
		Land	Rich	44/38,64	230,384
	Dry Summer	Coastal	Rich	43/45,39	173,359
		Land	Sparse	38/51,31	371,287
		Land	Rich	43/47,35	175,355
Temperate		Water	Sparse	43/59,3	187,323
		Water	Sparse	46/7,7	327,327
	Oceanic	Coastal	Rich	43/57,11	185,331
		Land	Rich	43/60,12	188,332
	Continental	Land	Sparse	21/49,57	305,185
		Land	Rich	44/44,56	236,376
Boreal		Land	Sparse	21/1,61	257,189
		Land	Rich	44/54,28	246,348
Polar		Water (Ice Cap)	Sparse	37/3,3	259,259
	Tundra	Coastal	Rich	37/7,31	263,287
		Land	Sparse	37/1,43	257,299
	Ice Cap	Land	Sparse	37/9,21	265,277
Highland		Land	Sparse	21/25,3	281,131

SOUTHERN HEMISPHERE

Group	Climate Type	Point Type	Sfc Data	Box/I,J	1/8 Mesh
Tropical		Water	Sparse	150/23,43	87,427
	Wet	Land	Sparse	150/36,18	100,402
		Coastal	Rich	150/38,17	102,401
	Wet and Dry	Land	Sparse	150/45,31	109,415
		Coastal	Rich	150/58,7	122,391
Dry	Desert or Arid	Land	Sparse	143/27,59	155,379
		Land	Rich	143/23,64	151,384
	Steppe/Semi-Arid	Land	Sparse	143/22,33	150,353
		Land	Rich	143/18,31	146,351
Subtropical		Water	Sparse	143/5,5	133,325
	Humid	Coastal	Rich	143/25,20	153,340
		Land	Sparse	143/8,31	136,351
Polar		Water	Sparse	129/43,29	299,221
	Icecap	Land	Sparse	129/18,51	274,243
Highland		Land	Sparse	113/35,17	291,81

NORTHERN HEMISPHERE

RTNEPH CLIMATOLOGICAL STUDY POINTS SORTED BY BOX

Box/I8,J8	Point Type	Sfc Data	Group	Climate Type
18/71,135	Water	Sparse		Tropical
18/119,183	Water	Sparse	Subtropical	
21/257,189	Land	Sparse	Boreal	
21/281,131	Land	Sparse	Highland	
21/281,165	Land	Rich	Dry	Steppe/Semi-Arid
21/305,185	Land	Rich	Temperate	Continental
21/315,159	Land	Rich	Dry	Desert or Arid
37/259,259	Water	Sparse	Polar	Ice Cap
37/257,299	Land	Sparse	Polar	Tundra
37/263,287	Coastal	Rich	Polar	Tundra
37/265,277	Land	Sparse	Polar	Ice Cap
38/371,287	Land	Sparse	Subtropical	Dry Summer
39/415,311	Land	Sparse	Dry	Desert or Arid
39/446,290	Land	Sparse	Dry	Steppe/Semi-Arid
40/460,297	Land	Rich	Tropical	Wet and Dry
43/173,359	Coastal	Rich	Subtropical	Dry Summer
43/175,355	Land	Rich	Subtropical	Dry Summer
43/179,377	Coastal	Sparse	Dry	Desert or Arid
43/180,348	Land	Rich	Highland	
43/185,331	Coastal	Rich	Temperate	Oceanic
43/187,323	Water	Sparse	Temperate	
43/188,332	Land	Rich	Temperate	Oceanic
44/227,383	Land	Sparse	Subtropical	Humid
44/230,384	Land	Rich	Subtropical	Humid
44/236,376	Land	Rich	Temperate	Continental
44/246,348	Land	Rich	Boreal	
46/327,327	Water	Sparse	Temperate	
46/351,351	Water	Sparse	Tropical	
46/375,327	Water	Sparse	Subtropical	
62/341,481	Land	Sparse	Tropical	Wet and Dry
62/357,459	Coastal	Sparse	Tropical	Wet
62/369,469	Land	Sparse	Tropical	Wet
62/378,475	Land	Rich	Tropical	Wet

SOUTHERN HEMISPHERE

RTNEPH CLIMATOLOGICAL STUDY POINTS SORTED BY BOX

Box/I8,J8	Point Type	Sfc Data	Group	Climate Type
113/291/81	Land	Sparse	Highland	
129/274,243	Land	Sparse	Polar	Icecap
129/299,221	Water	Sparse	Polar	
143/133,325	Water	Sparse	Subtropical	
143/136,351	Land	Sparse	Subtropical	Humid
143/146,351	Land	Rich	Dry	Steppe/Semi-Arid
143/150,353	Land	Sparse	Dry	Steppe/Semi-Arid
143/151,384	Land	Rich	Dry	Desert or Arid
143/153,340	Coastal	Rich	Subtropical	Humid
143/155,379	Land	Sparse	Dry	Desert or Arid
150/87,427	Water	Sparse	Tropical	
150/100,402	Land	Sparse	Tropical	Wet
150/102,401	Coastal	Rich	Tropical	Wet
150/109,415	Land	Sparse	Tropical	Wet and Dry
150/122,391	Coastal	Rich	Tropical	Wet and Dry

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