NASA Technical Memorandum 104648

Spherical Harmonics Analysis of the ECMWF Global Wind Fields at the 10-Meter Height Level During 1985: A Collection of Figures Illustrating Results

Braulio V. Sanchez
Goddard Space Flight Center
Greenbelt, Maryland

Masahiro Nishihama
Hughes STX
Greenbelt, Maryland

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland
1997

This publication is available from the NASA Center for AeroSpace Information,
800 Elkridge Landing Road, Linthicum Heights, MD 21090-2934, 301-621-0390.

ABSTRACT

Half-daily global wind speeds in the east-west (u) and north-south (v) directions at the 10-meter height level were obtained from the European Centre for Medium Range Weather Forecasts (ECMWF) data set of global analyses. The data set covered the period 1985 January to 1995 January.

A spherical harmonic expansion to degree and order 50 was used to perform harmonic analysis of the east-west (u) and north-south (v) velocity field components.

The resulting wind field is displayed, as well as the residual of the fit, at a particular time. The contribution of particular coefficients is shown. The time variability of the coefficients up to degree and order 3 is presented. Corresponding power spectrum plots are given. Time series analyses were applied also to the power associated with degrees 0-10; the results are included.

ACKNOWLEDGMENTS

We express our appreciation to Dr. Nikolaos K. Pavlis of Hughes STX for providing the Fast Fourier Transform software. We give thanks to Dr. Andrew Y. Au of Hughes STX for facilitating access to the ECMWF data set. This work was supported by the Space Geodesy Branch at the Goddard Space Flight Center and the TOPEX/POSEIDON project.

TABLE OF CONTENTS

Introduction

The general circulation of the ocean is driven by various types of forces, including surface wind stress. The results presented in this publication were obtained as part of an investigation of the wind-driven variability of the ocean circulation. It is possible that these results might be of interest to other investigators, not only in the limited context of ocean circulation, but also from the larger perspective of geodynamics, Earth rotation, and space geodesy. With such possibility in mind, it was decided to document the results. However, the intention is only to present the results obtained in graphical form; no interpretation is attempted here.

Half-daily global wind speeds in the east-west (u) and north-south (v) directions at the 10-meter height level were obtained from the European Centre for Medium Range Weather Forecasts (ECMWF) data set of global analyses. The data set covered the period 1985 January to 1995 January. The original global grid is 2.5° latitude by 2.5° longitude, and the data set used in this investigation has been reprocessed and interpolated onto a 2° latitude by 2.5° longitude grid, as described by Schubert et al. (1990).

A spherical harmonic expansion to degree and order 50 was used to perform harmonic analysis of the east-west (u) and north-south (v) velocity field components. The formal validity of this procedure was established by Simmonds (1974). Formal developments are given in Appendix I.

The software used in the analysis implements a technique developed by O. L. Colombo (1981), based on the Fast Fourier Transform.

Global Wind Fields

Figures 1-10 show the vectors for the wind fields corresponding to various cases. With the exception of figures 7 and 8, the time epoch is January 1, 0 hour GMT, 1985. This is the time of the first data entry for 1985.

Figure 1 shows the wind field as obtained from the ECMWF data files, the maximum magnitude is 22 meters/second. This wind field was fitted by means of an expansion in spherical harmonics including coefficients up to degree and order 10. The resulting field is shown in figure 2; maximum wind speed is 12 meters/second. The difference between the data and the fit is displayed in figure 3; the largest discrepancy has a magnitude of 16 meters/second.

Figure 4 exhibits the wind field obtained by fitting the data with spherical harmonics up to degree and order 50, note the improvement as compared to the degree-10 fit; the maximum wind speed is now 20 meters/second. The residuals are shown in figure 5; the maximum error has a magnitude of 4.5 meters/second. Note that the largest discrepancies are concentrated around the poles.

Figures 6 and 7 exhibit the wind fields from the ECMWF data files at January 1, 0 hour GMT, 1985 and at July 1, 0 hour GMT, 1985; the wind vectors are plotted with equal length in order to show clearly the wind direction, the magnitudes are indicated by the shading, the lower (higher) wind speeds corresponding to the darker (brighter) shades. Figure 8 depicts the average wind field for 1985.

Figures 9 and 10 are included to display the effect of some of the coefficients in the spherical harmonic expansion. Figure 9 brings to view the wind field corresponding to the C_{10} coefficient by itself. Figure 10 makes apparent the wind field produced by the sum of the C_{11} and S_{11} coefficients.

FIGURES 1–10

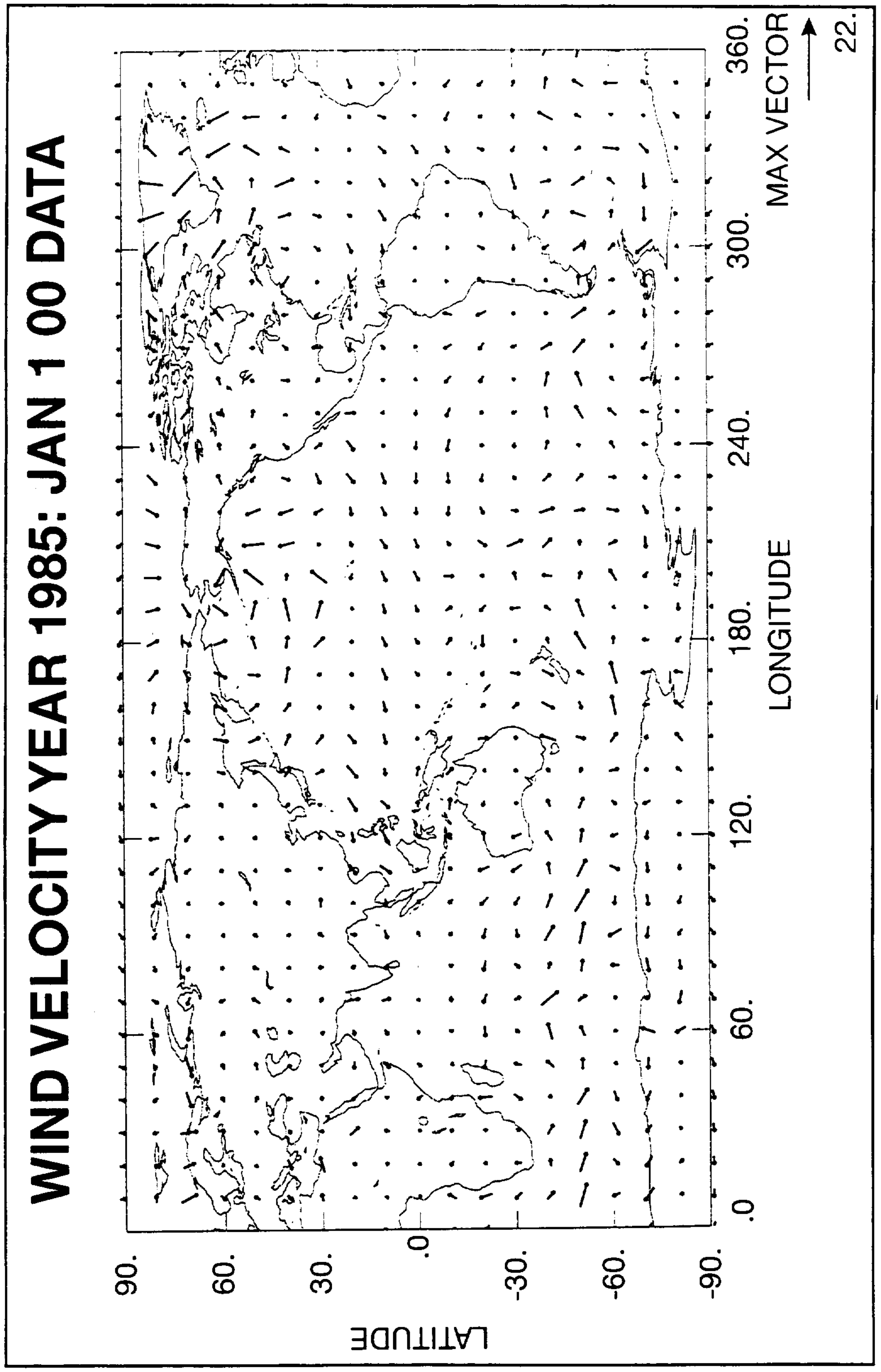

Figure 1. Wind Field at 1985, January 1, 00. As Obtained from the ECMWF Data Set.

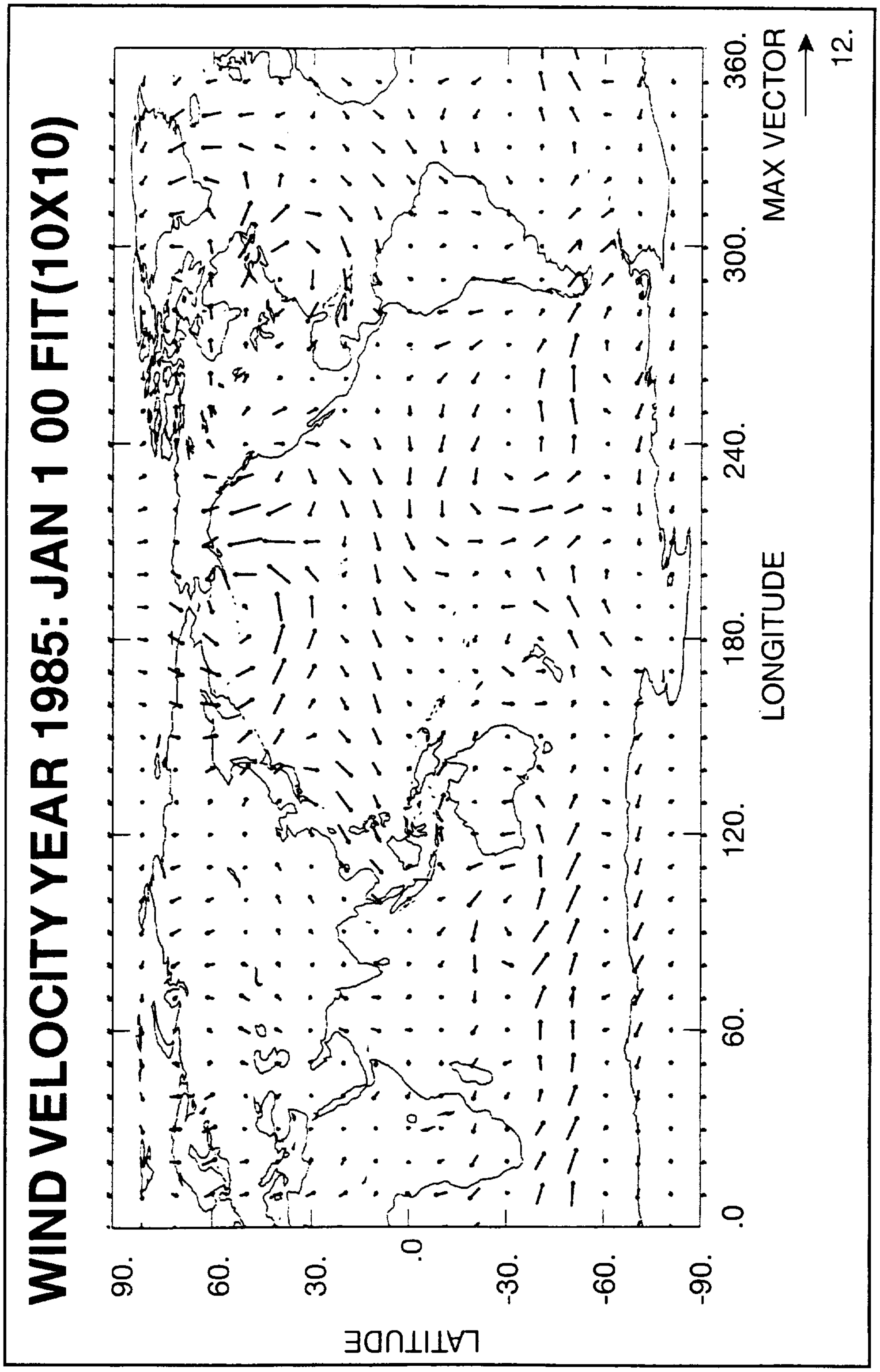

Figure 2. Wind Field at 1985, January 1, 00. As Obtained from the Spherical Harmonic Expansion to Degree and Order 10.

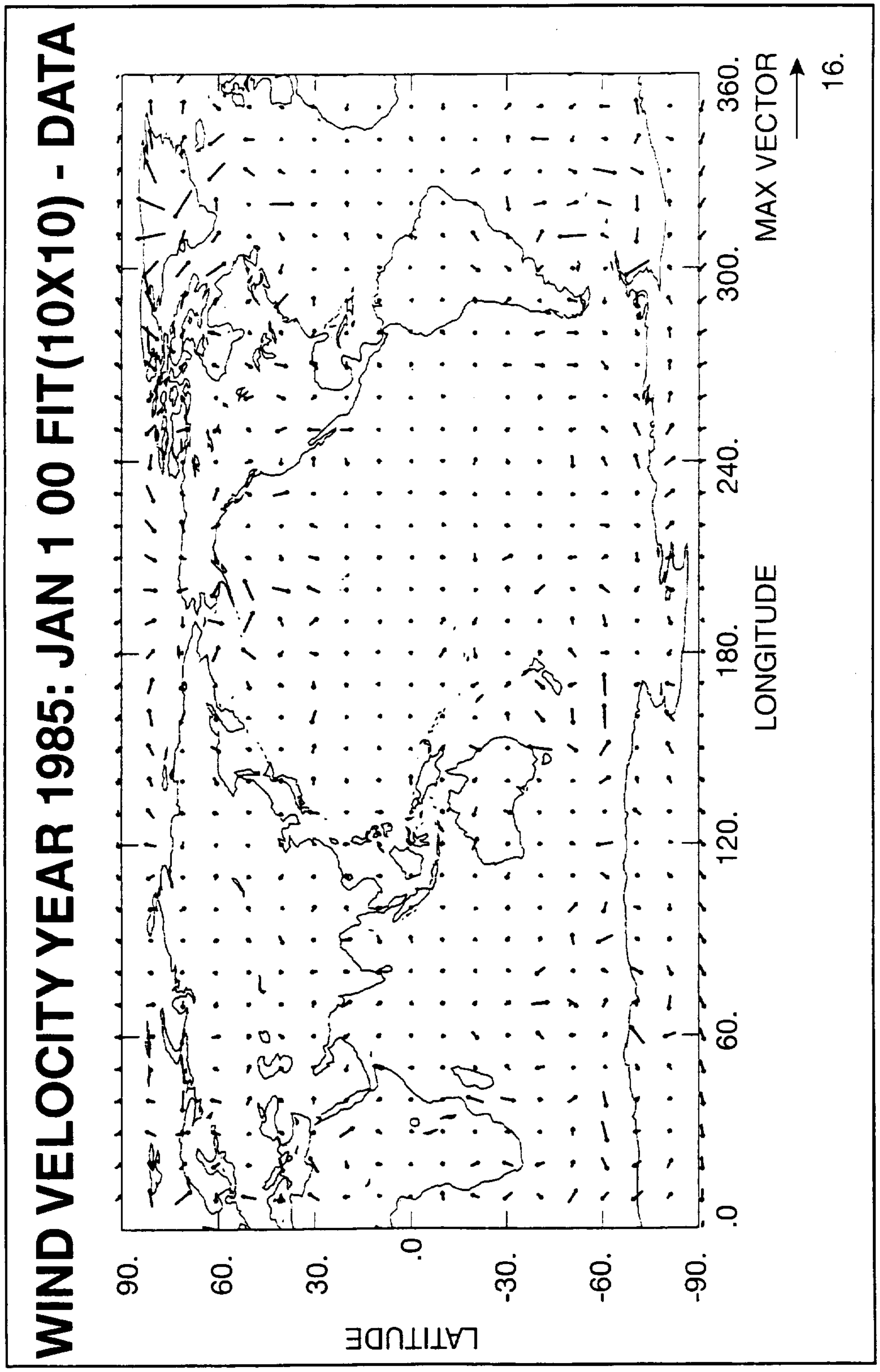

Figure 3. Vector Difference Between the ECMWF Wind Field, and the Wind Field from the Spherical Harmonic Expansion to Degree and Order 10.

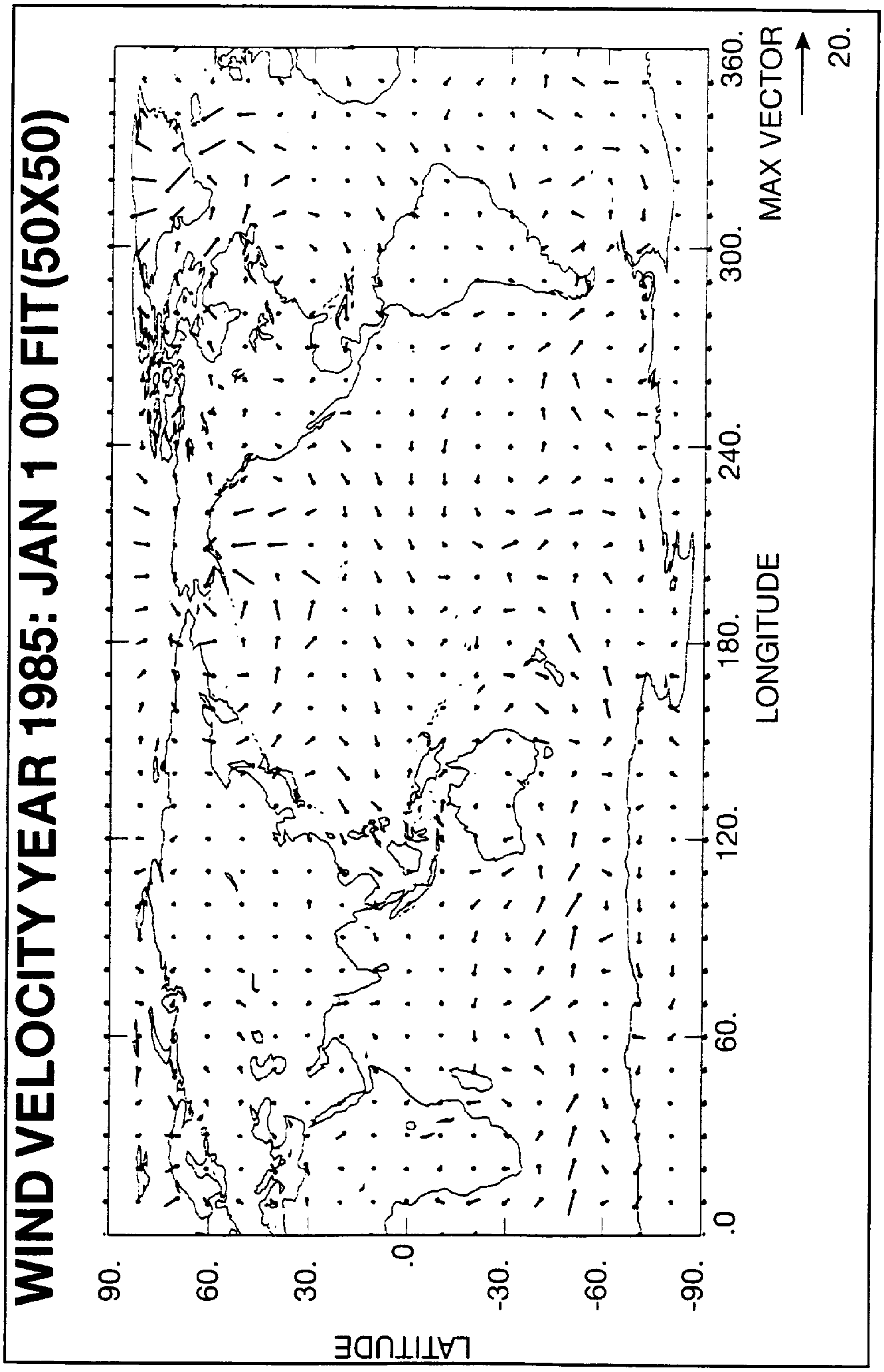

Figure 4. Wind Field at 1985, January 1, 00. As Obtained from the Spherical Harmonic Expansion to Degree and Order 50.

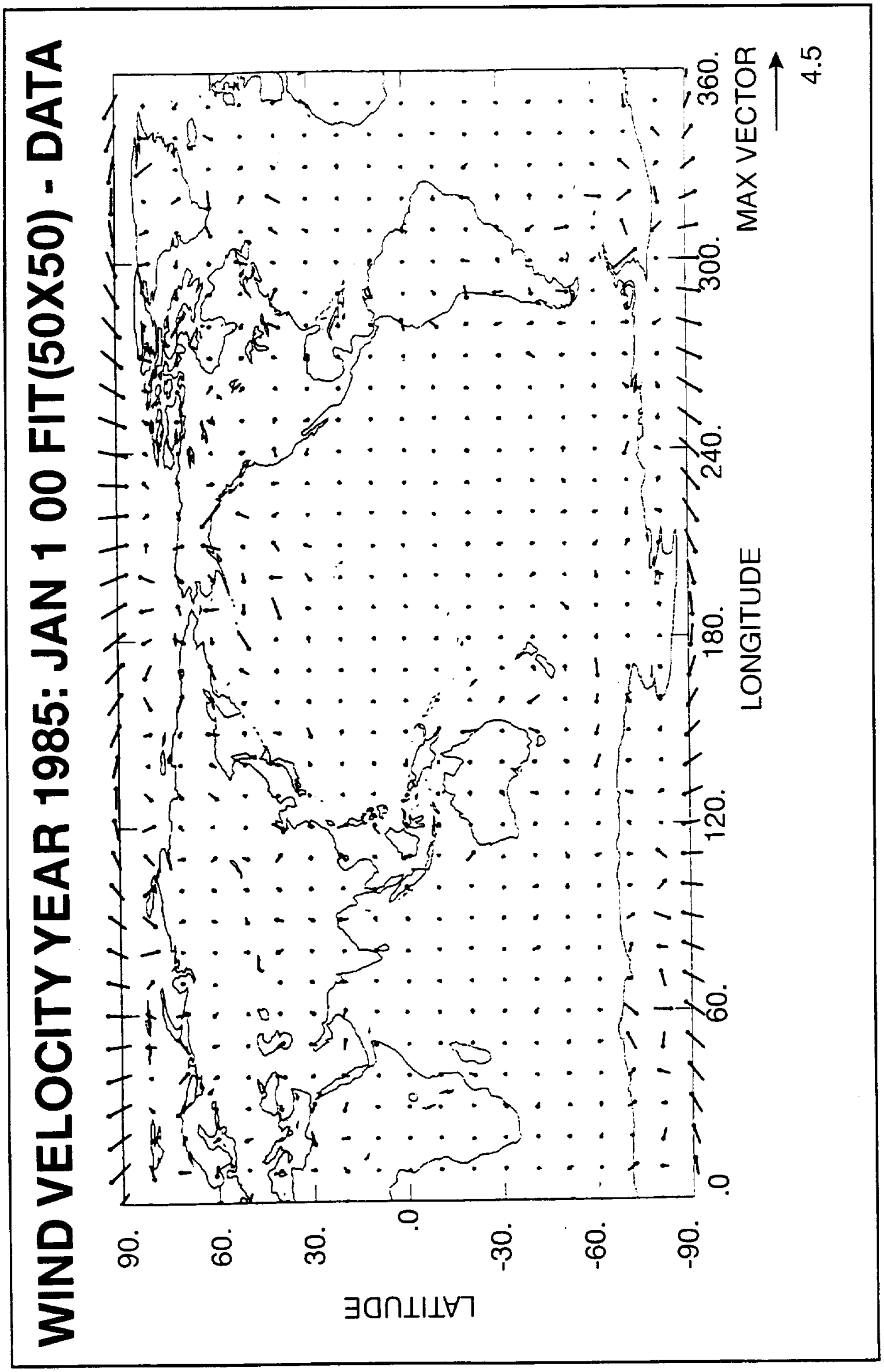

Figure 5. Vector Difference Between the ECMWF Wind Field, and the Wind Field from the Spherical Harmonic Expansion to Degree and Order 50.

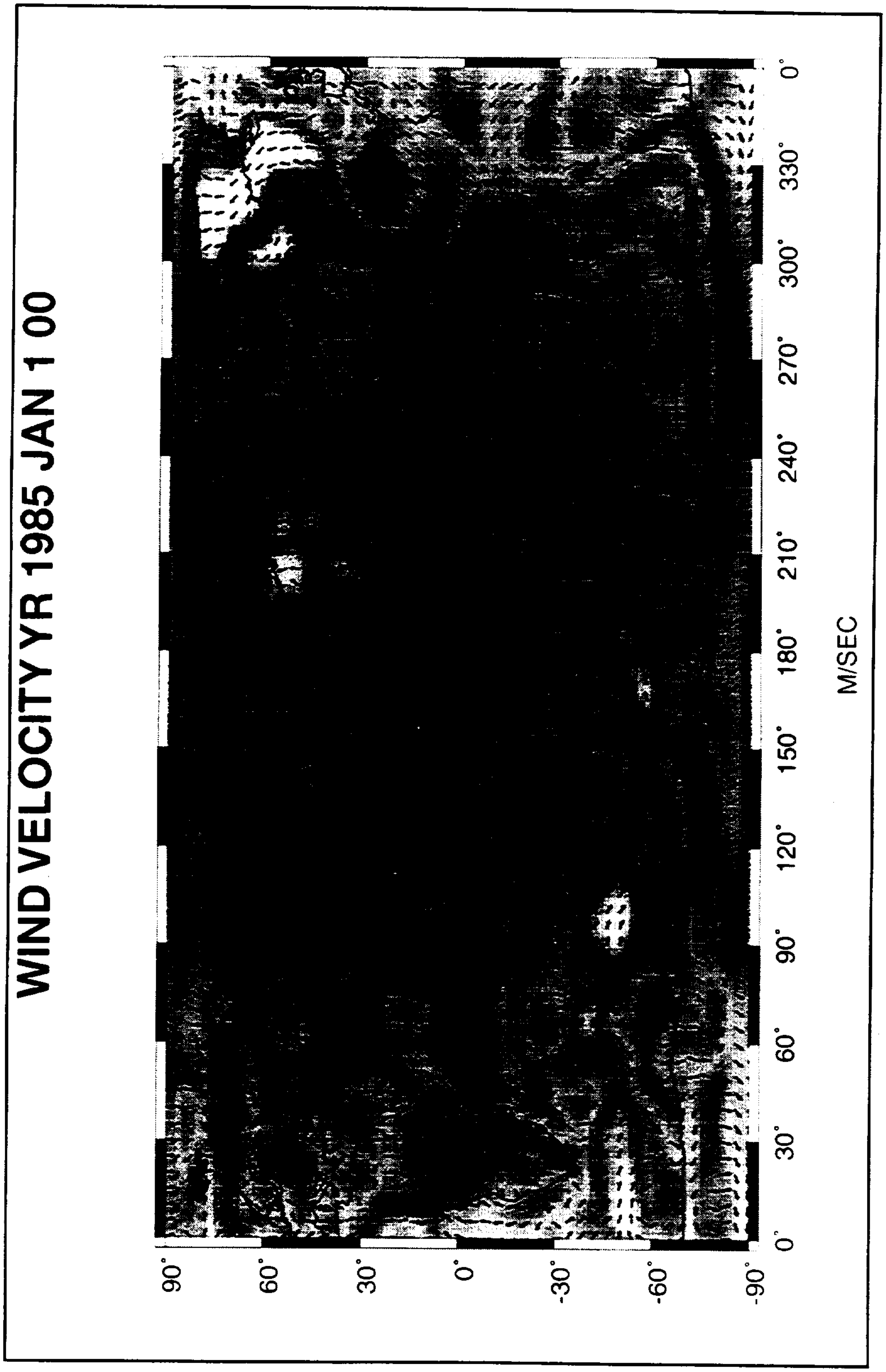

Figure 6. Wind Field Directions at 1985, January 1, 00. As Obtained from the ECMWF Data Set.

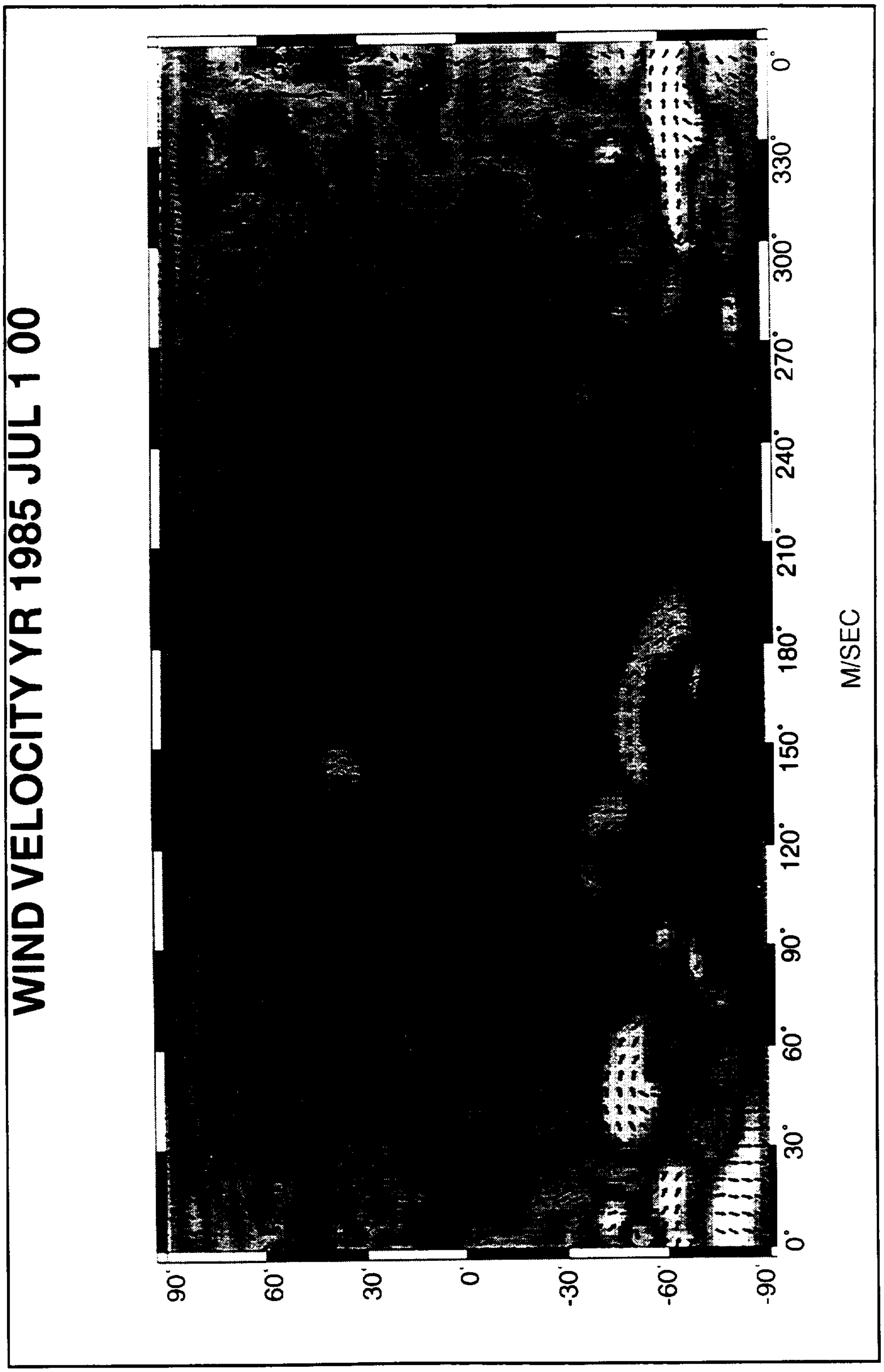

Figure 7. Wind Field Directions at 1985, July 1, 00. As Obtained from the ECMWF Data Set.

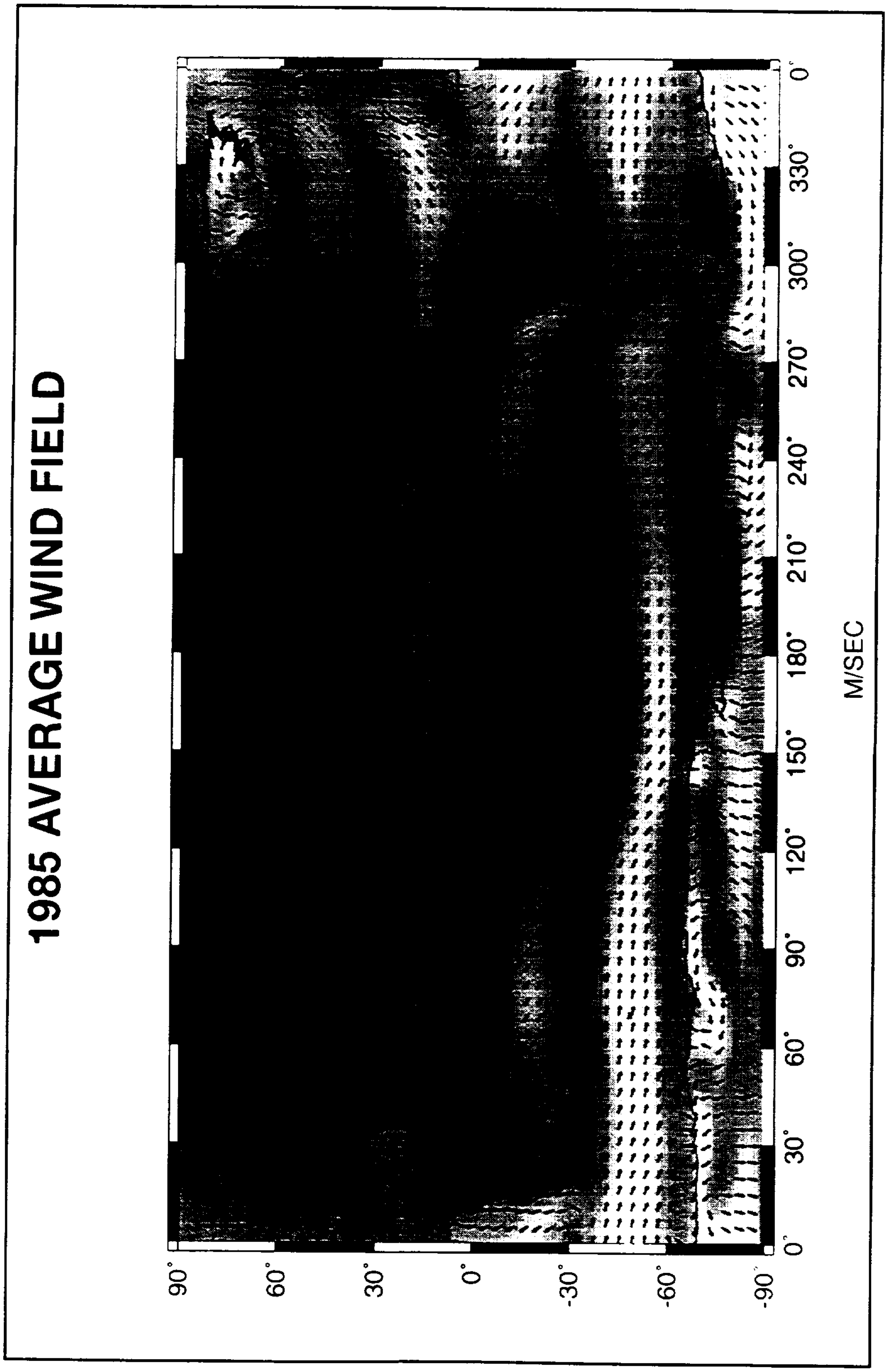

Figure 8. Average Wind Field Directions for 1985. As Obtained from the ECMWF Data Set.

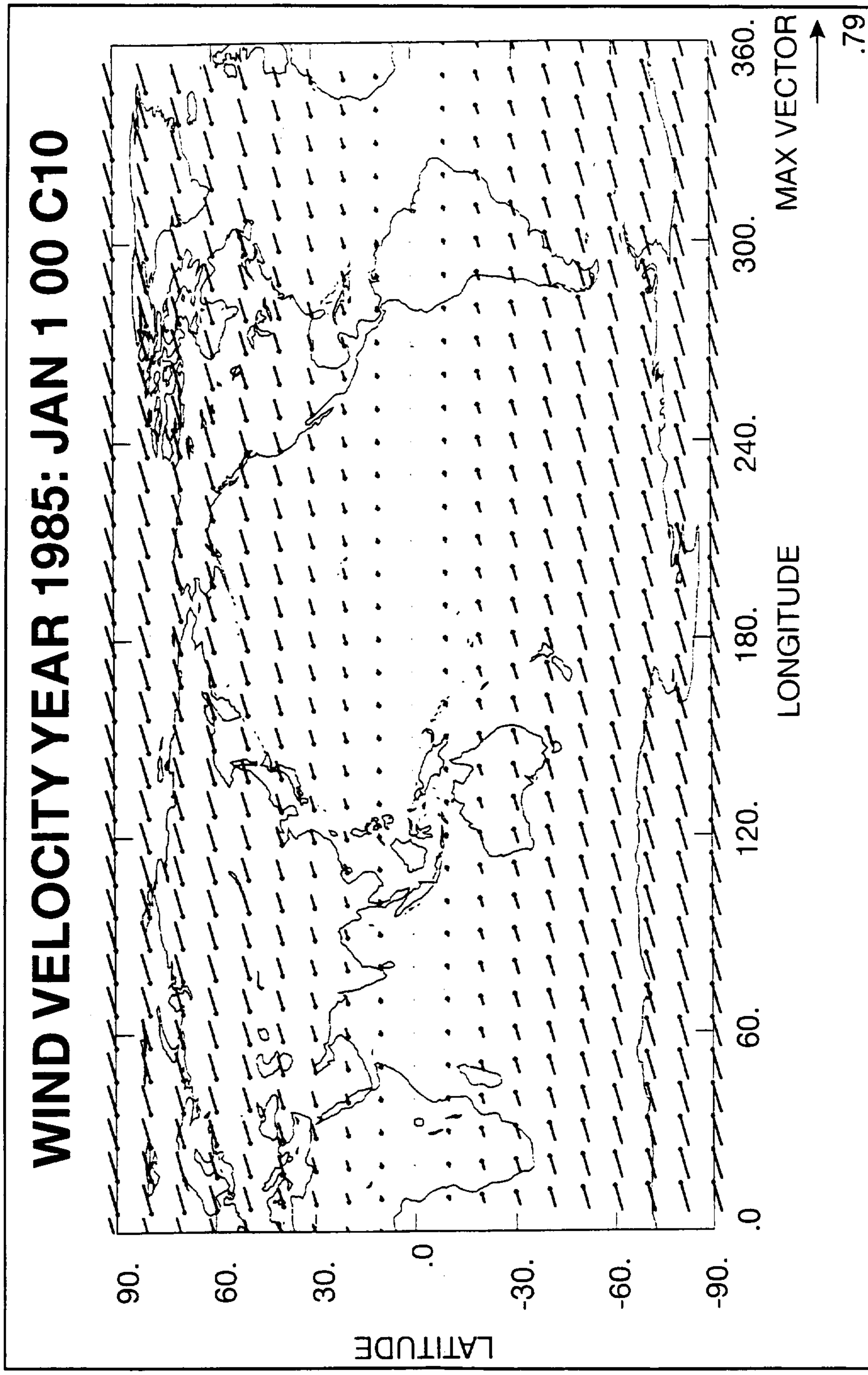

Figure 9. Wind Field at 1985, January 1, 00. As Obtained from the Spherical Harmonic Expansion, Using Only the C_{10} Coefficient.

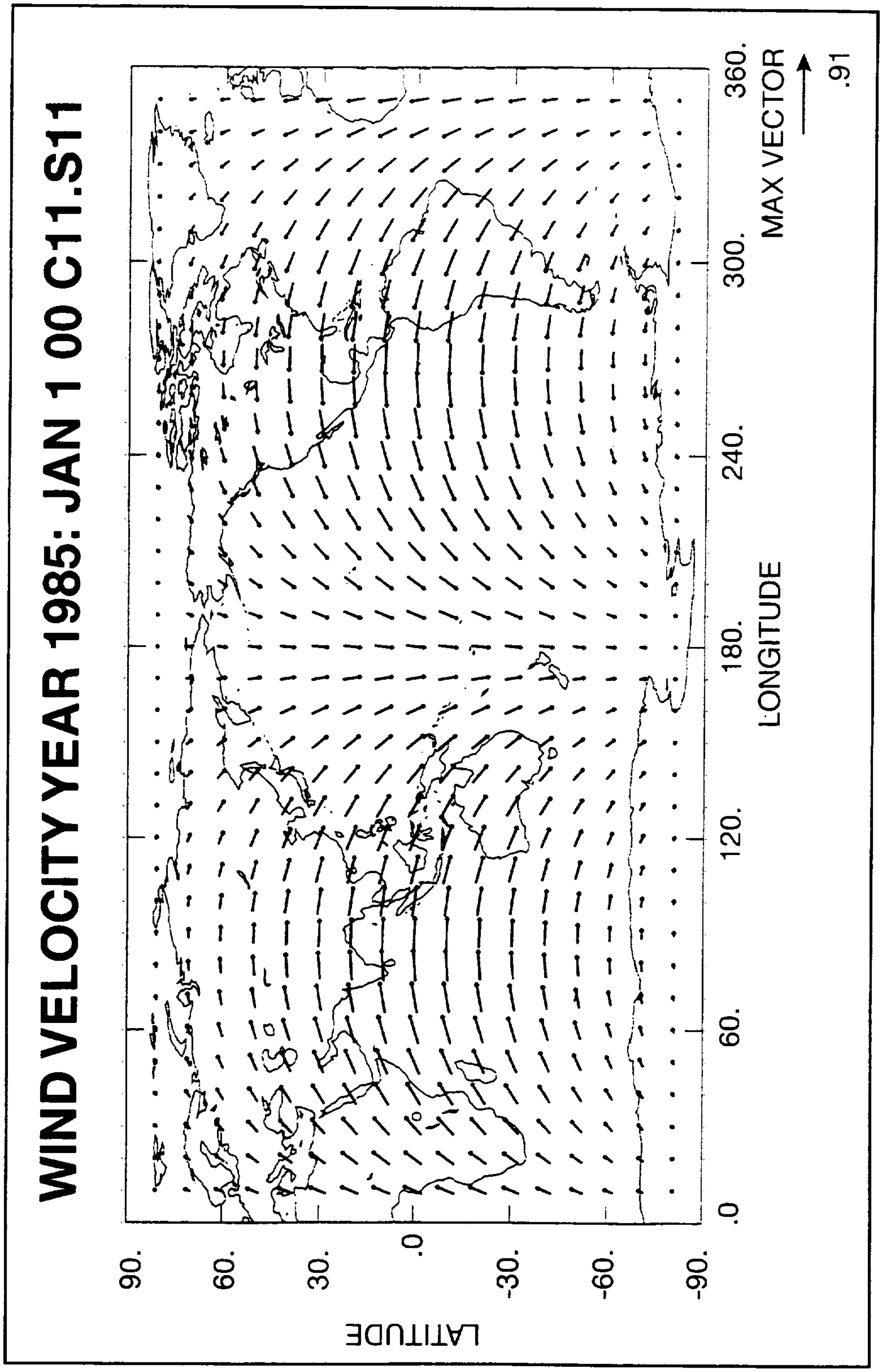

Figure 10. Wind Field at 1985, January 1, 00. As Obtained from the Spherical Harmonic Expansion, Using Only the C_{11} and S_{11} Coefficients.

TIME VARIABILITY OF SELECTED SPHERICAL HARMONIC COEFFICIENTS

Figures 11–26 portray the time variability of the spherical harmonic coefficients up to degree and order 3. Each figure shows the results for the east-west (u) and north-south (v) velocity components. There are 730 values over the course of a year for each spherical harmonic coefficient. These time series were analyzed by means of Fourier expansions in sine and cosine terms, as presented in Appendix II. Plots of power as a function of frequency are given in figures 27–34. In general, most of the power is concentrated in the low frequency terms, especially the zero frequency component. The east-west velocity component predominates over the north-south, with the exception of the coefficients C_{00}, C_{30}, and S_{32}.

The time series analysis was applied also to the power associated with degrees 0-10, as given by the last equation in Appendix I. The results are dispayed in figures 35-45. Each figure presents the results for the east-west (u) and north-south (v) velocity components. As shown in part (a) of the figures, most of the power is contained in the zero-frequency term. Part (b) makes evident the power in the other frequencies by setting the constant part equal to zero.

FIGURES 11–45

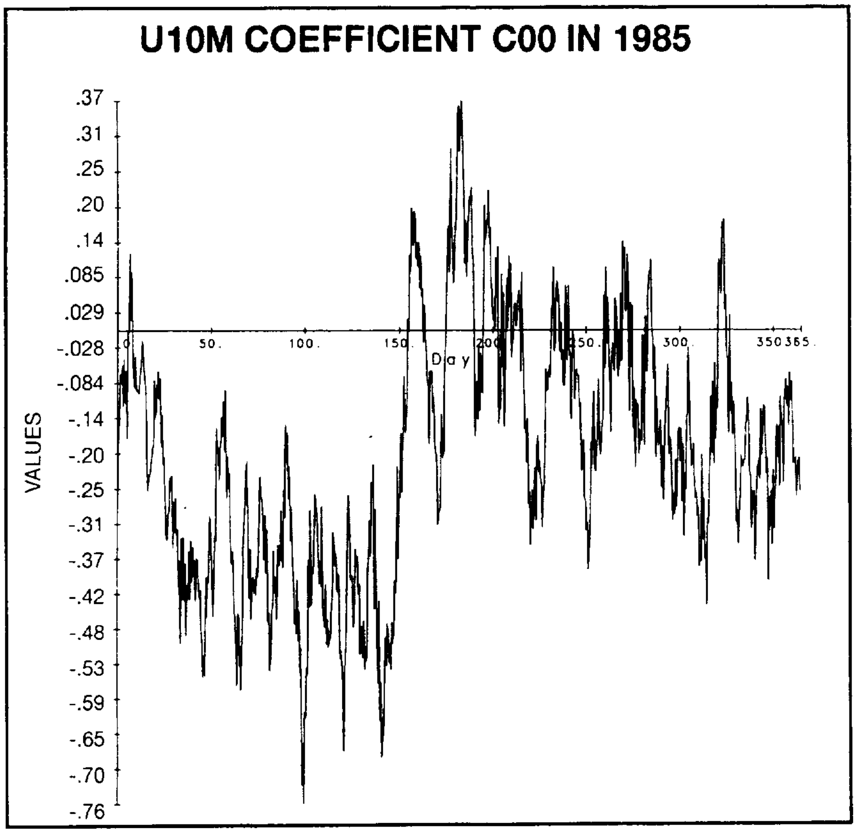

Figure 11a. The Coefficient C_{00}, Year 1985. The East-West Velocity Component (u).

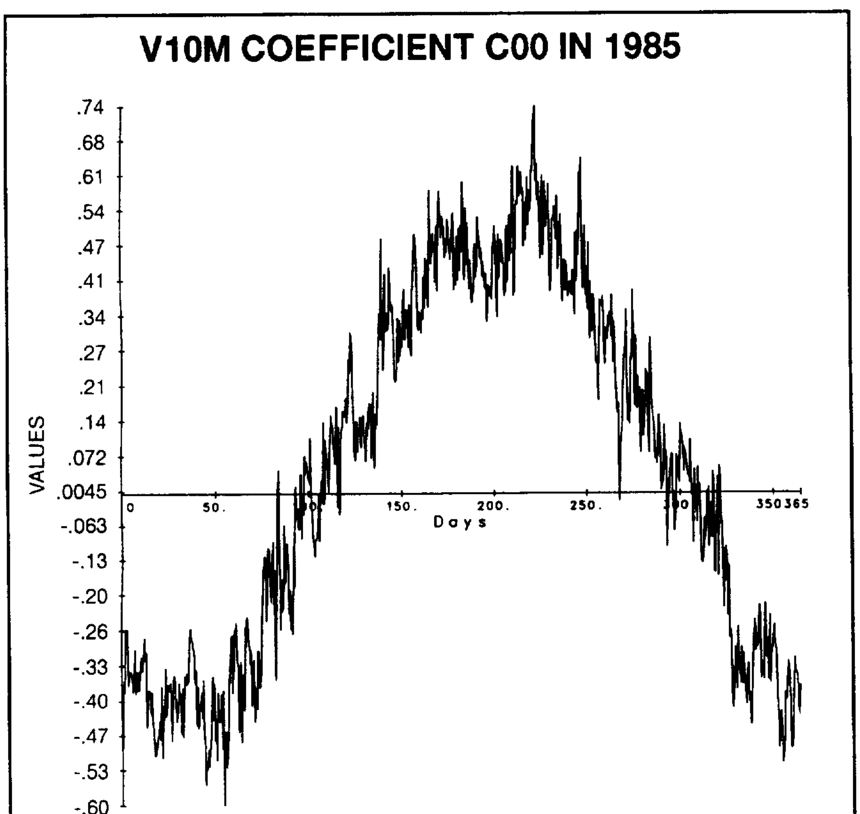

Figure 11b. The Coefficient C_{00}, Year 1985. The North-South Velocity Component (v).

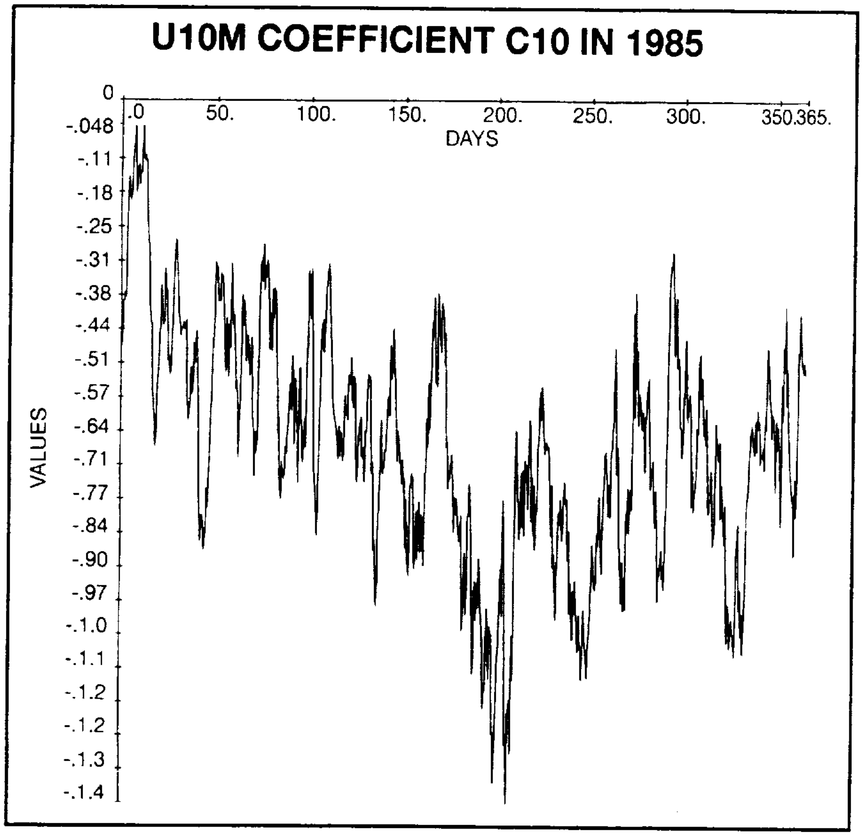

Figure 12a. The Coefficient C_{10}, Year 1985. The East-West Velocity Component (u).

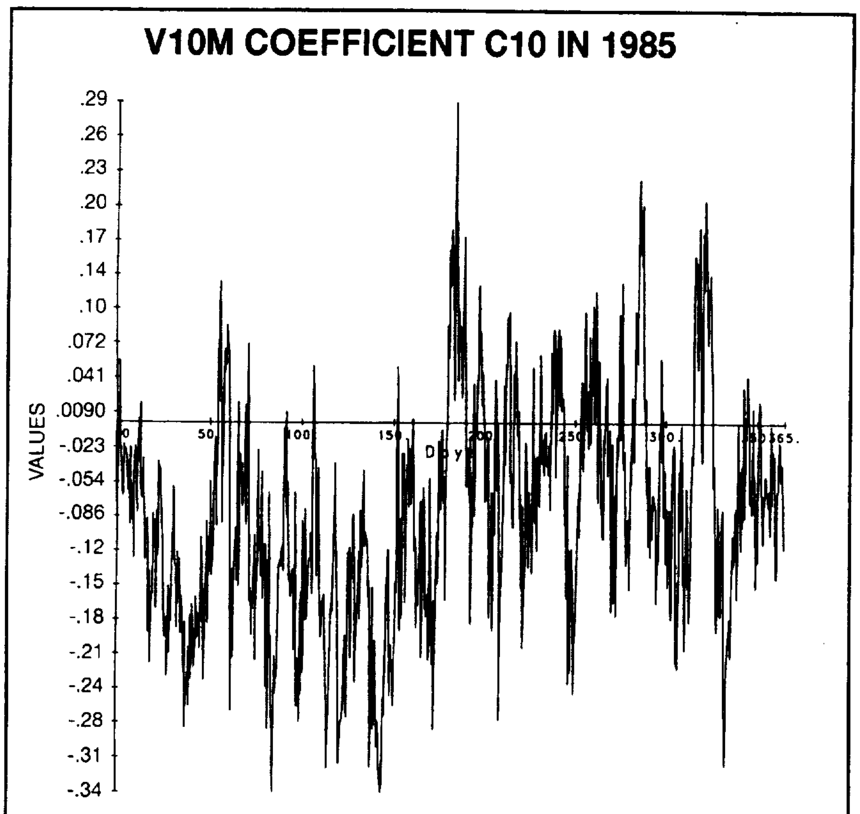

Figure 12b. The Coefficient C_{10}, Year 1985. The North-South Velocity Component (v).

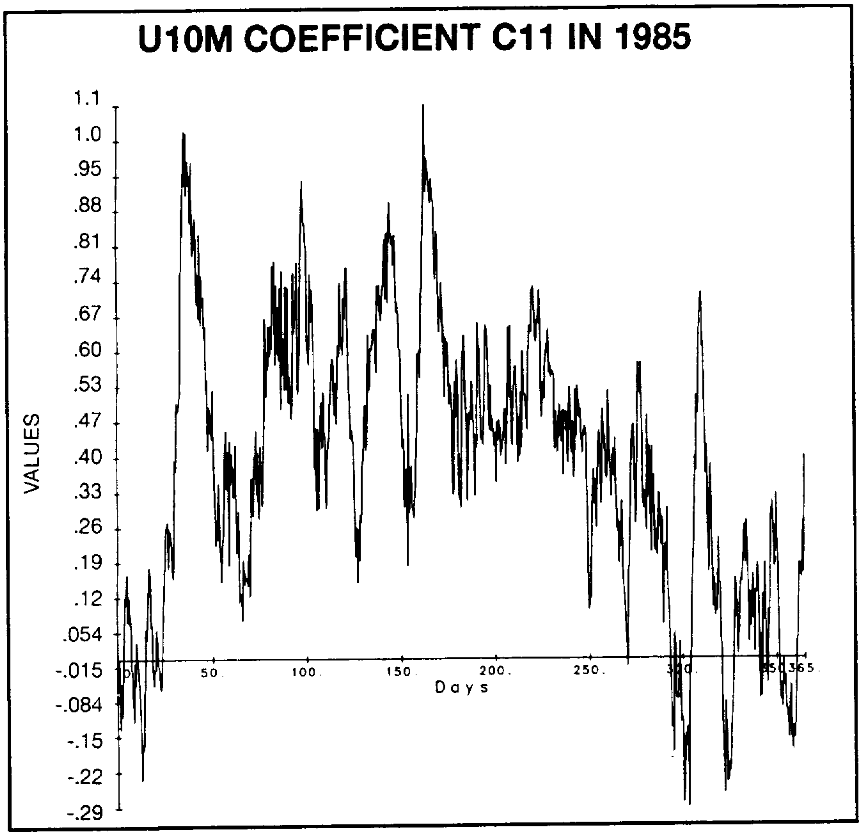

Figure 13a. The Coefficient C_{11}, Year 1985. The East-West Velocity Component (u).

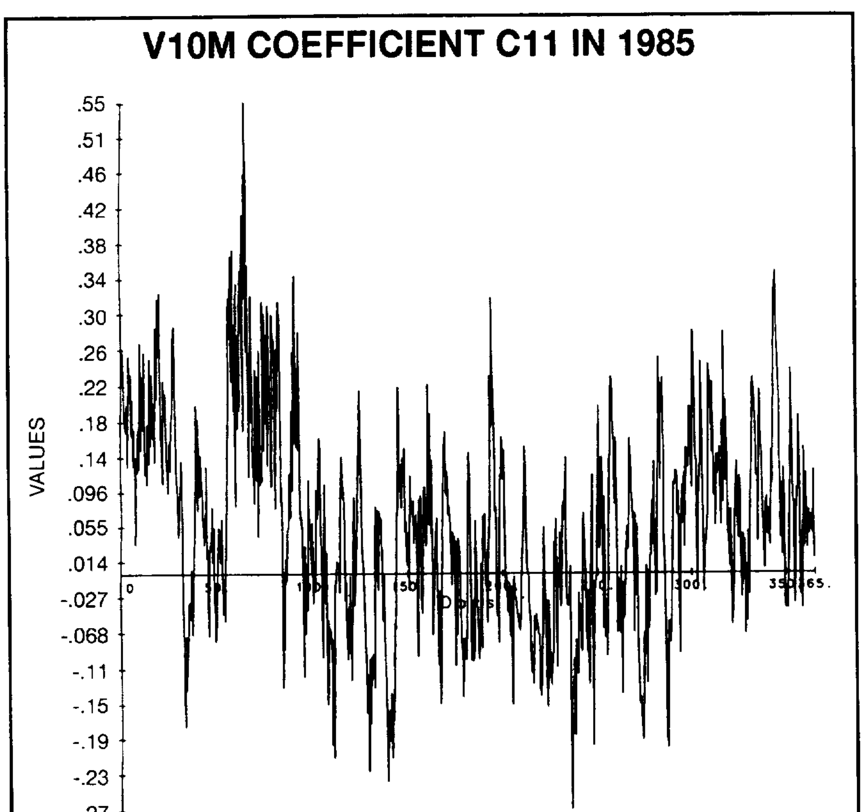

Figure 13b. The Coefficient C_{11}, Year 1985. The North-South Velocity Component (v).

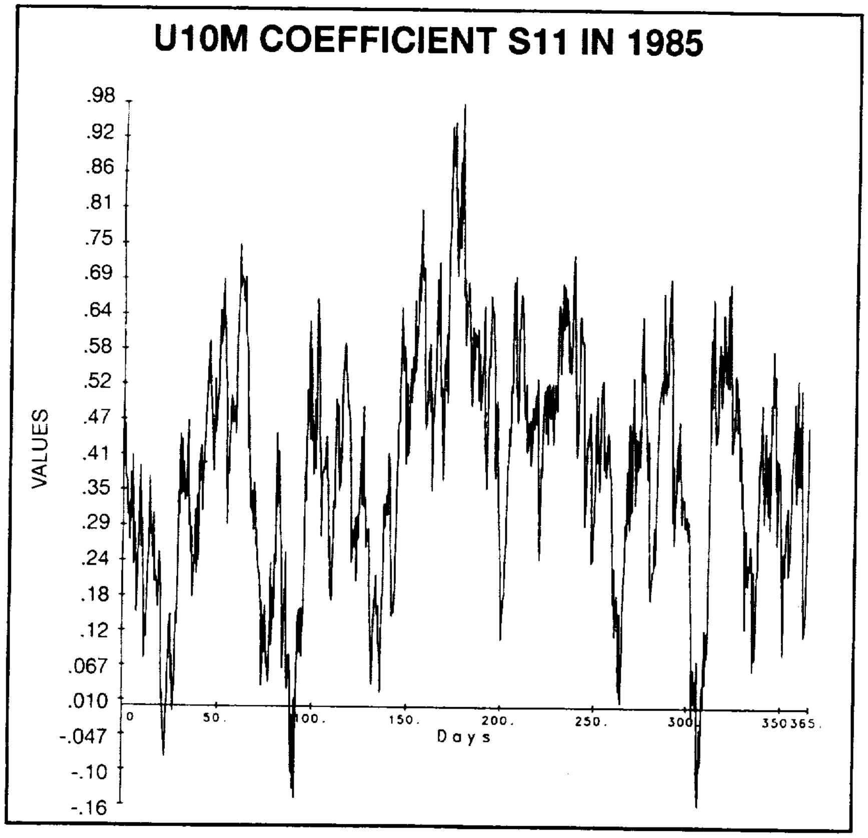

Figure 14a. The Coefficient S_{11}, Year 1985. The East-West Velocity Component (u).

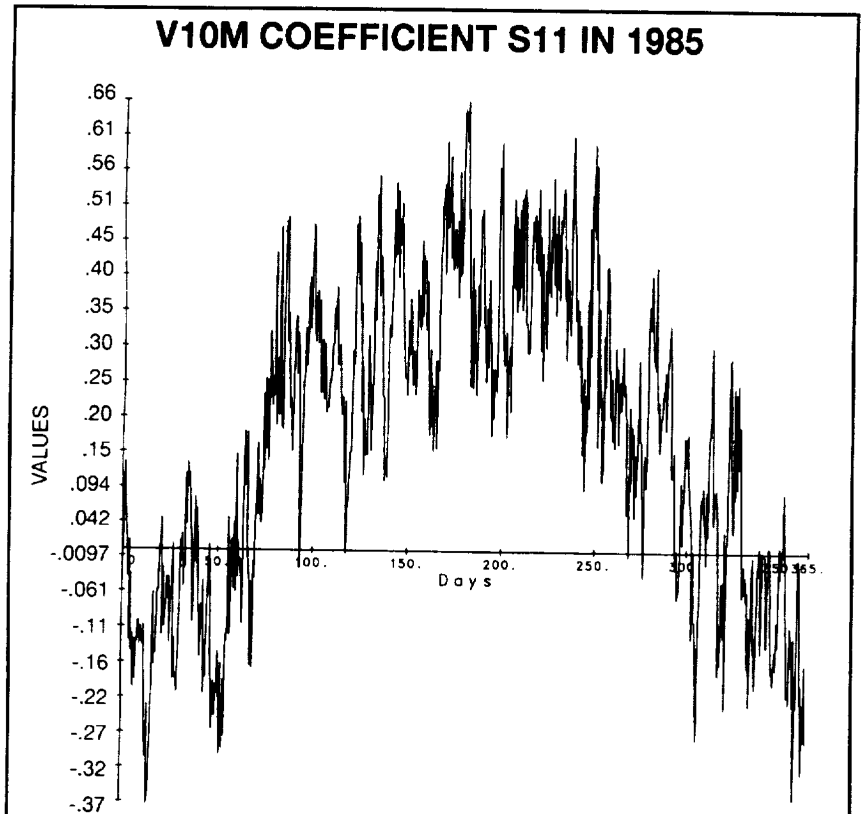

Figure 14b. The Coefficient S_{11}, Year 1985. The North-South Velocity Component (v).

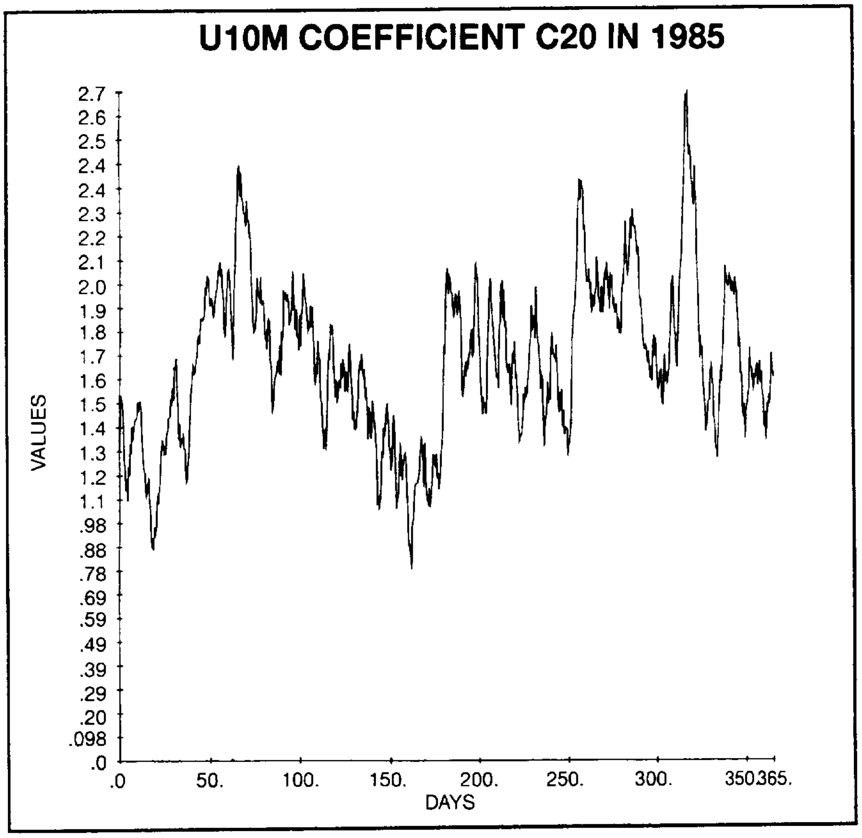

Figure 15a. The Coefficient C_{20}, Year 1985. The East-West Velocity Component (u).

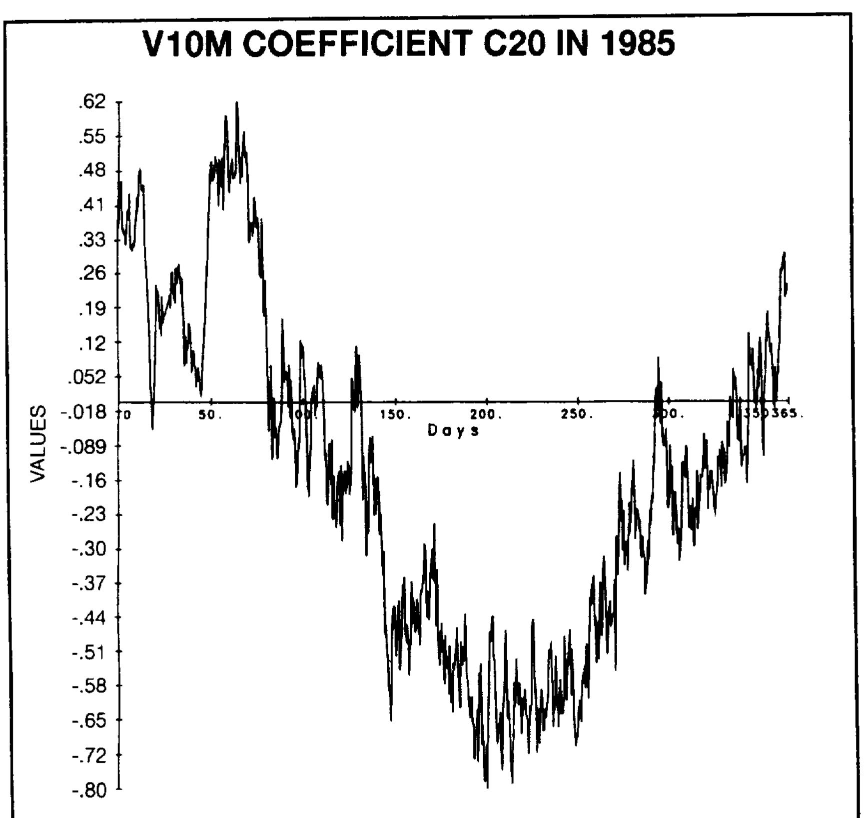

Figure 15b. The Coefficient C_{20}, Year 1985. The North-South Velocity Component (v).

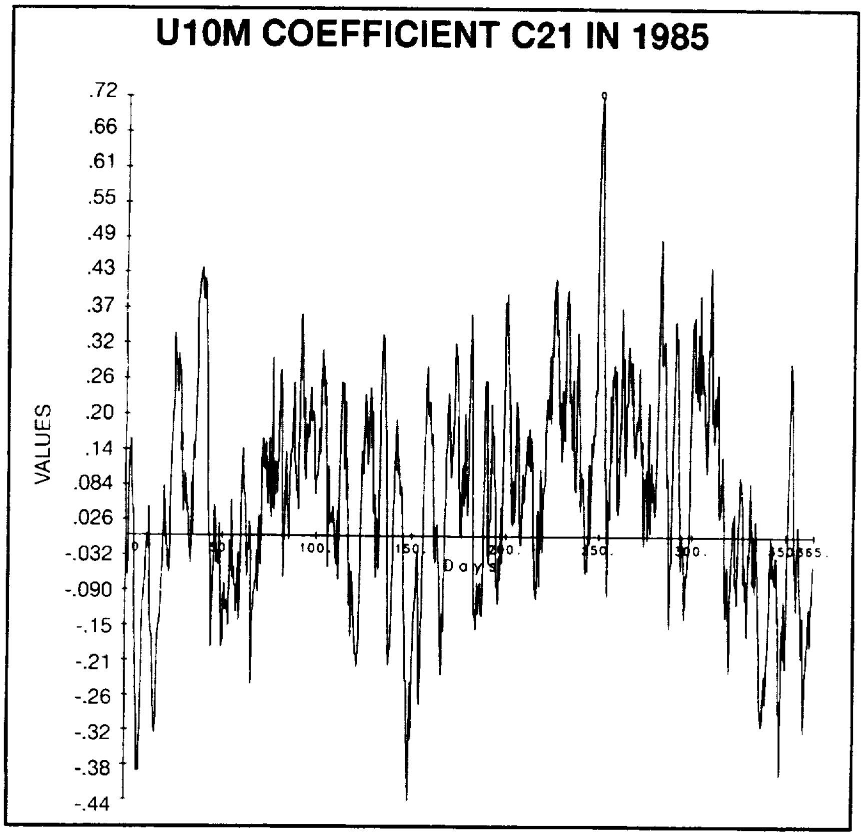

Figure 16a. The Coefficient C_{21}, Year 1985. The East-West Velocity Component (u).

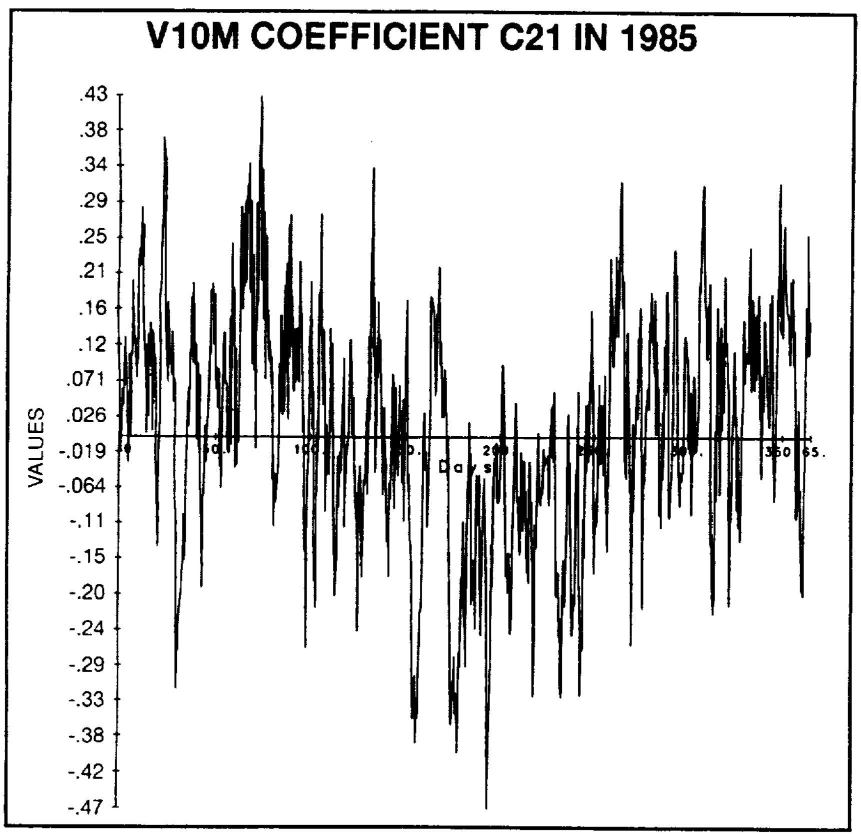

Figure 16b. The Coefficient C_{21}, Year 1985. The North-South Velocity Component (v).

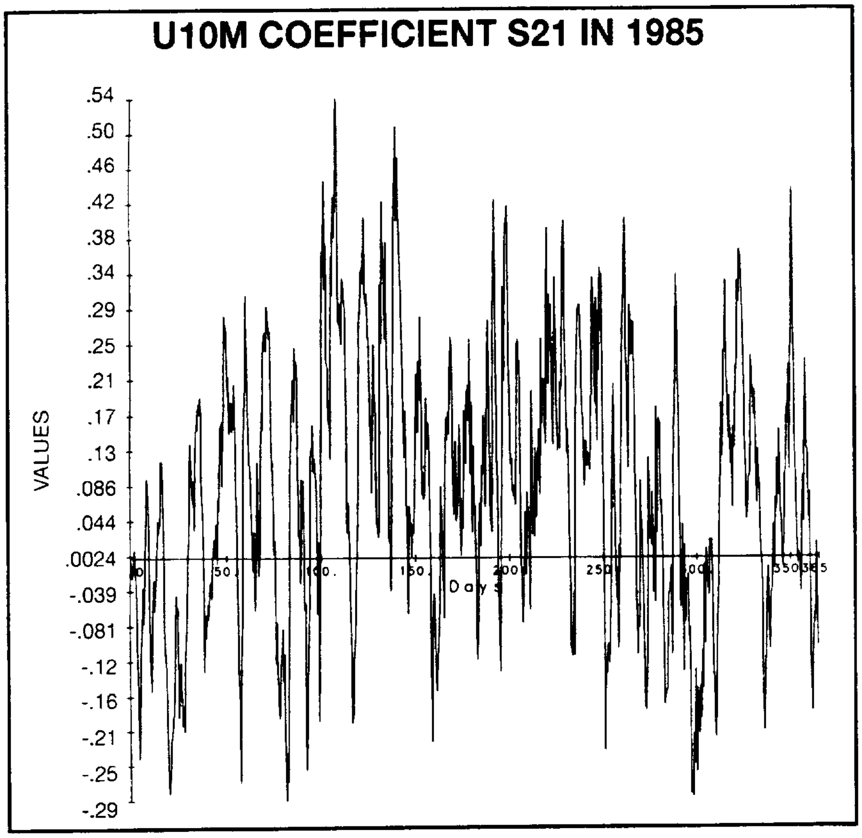

Figure 17a. The Coefficient S_{21}, Year 1985. The East-West Velocity Component (u).

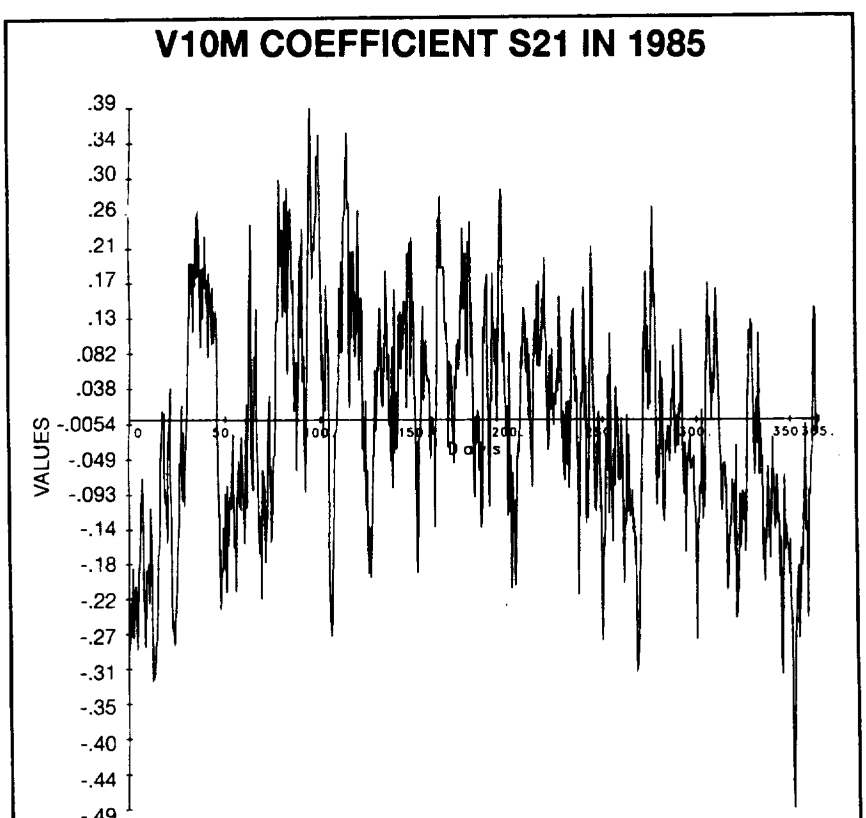

Figure 17b. The Coefficient S_{21}, Year 1985. The North-South Velocity Component (v).

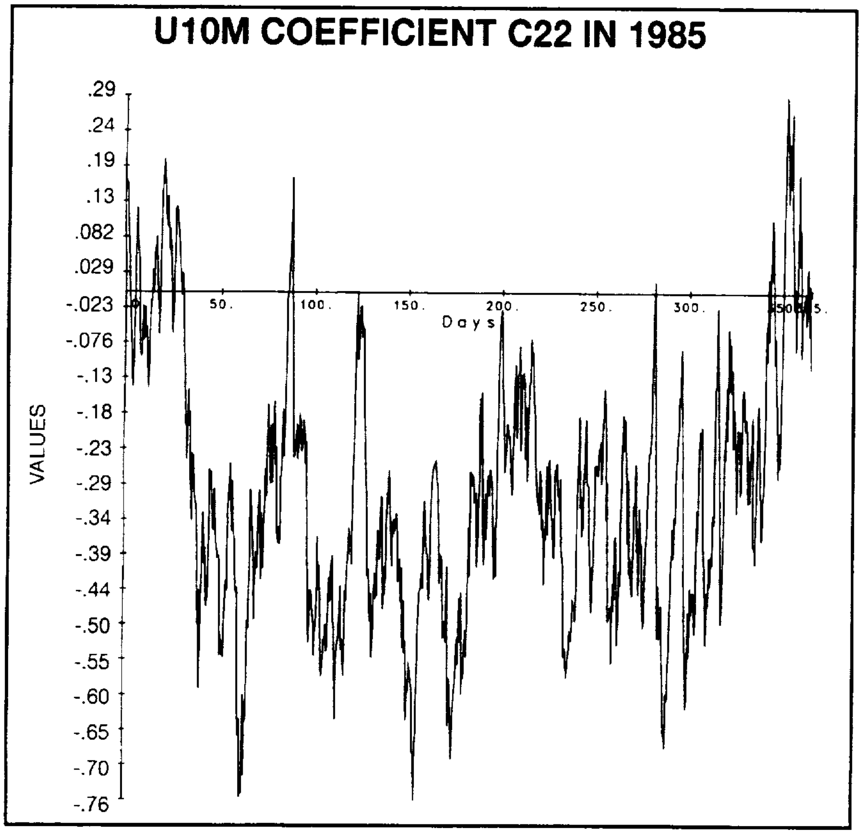

Figure 18a. The Coefficient C_{22}, Year 1985. The East-West Velocity Component (u).

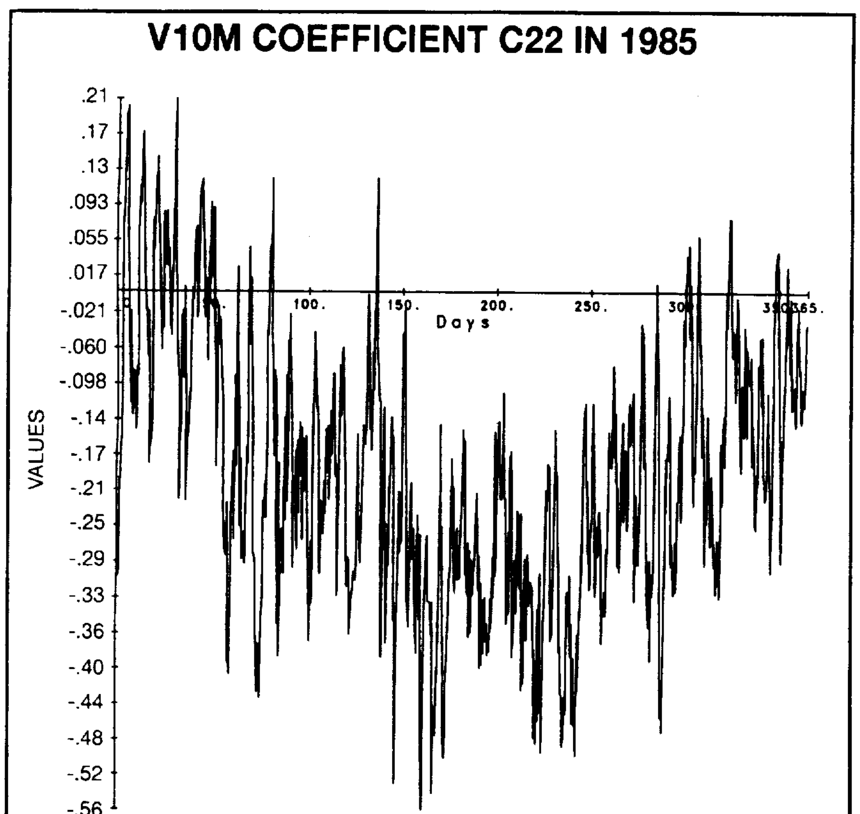

Figure 18b. The Coefficient C_{22}, Year 1985. The North-South Velocity Component (v).

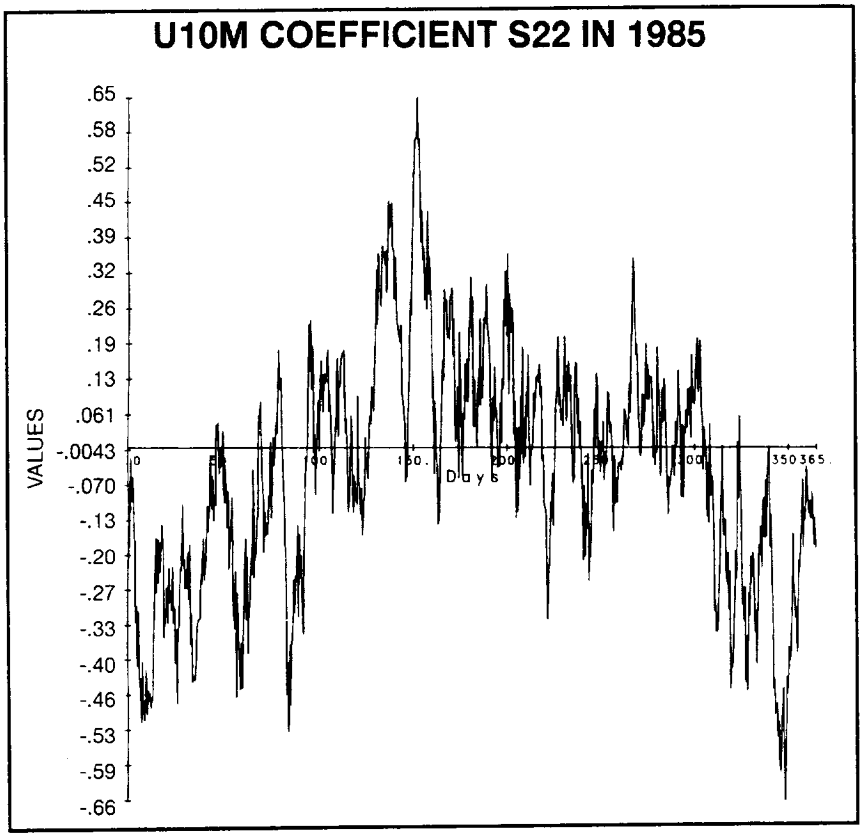

Figure 19a. The Coefficient S_{22}, Year 1985. The East-West Velocity Component (u).

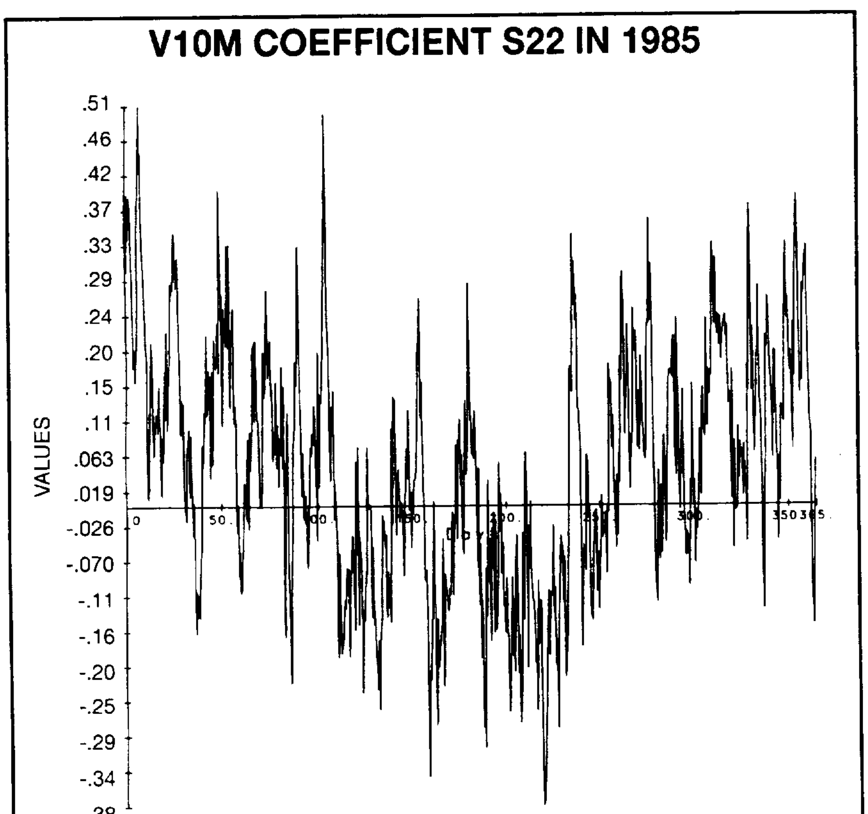

Figure 19b. The Coefficient S_{22}, Year 1985. The North-South Velocity Component (v).

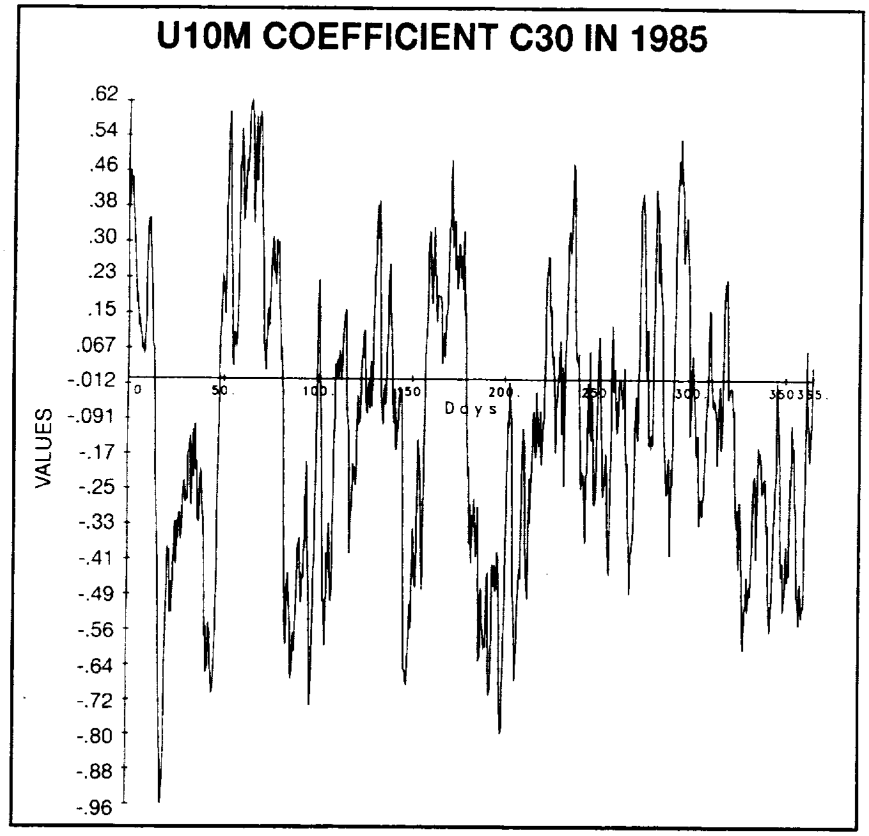

Figure 20a. The Coefficient C_{30}, Year 1985. The East-West Velocity Component (u).

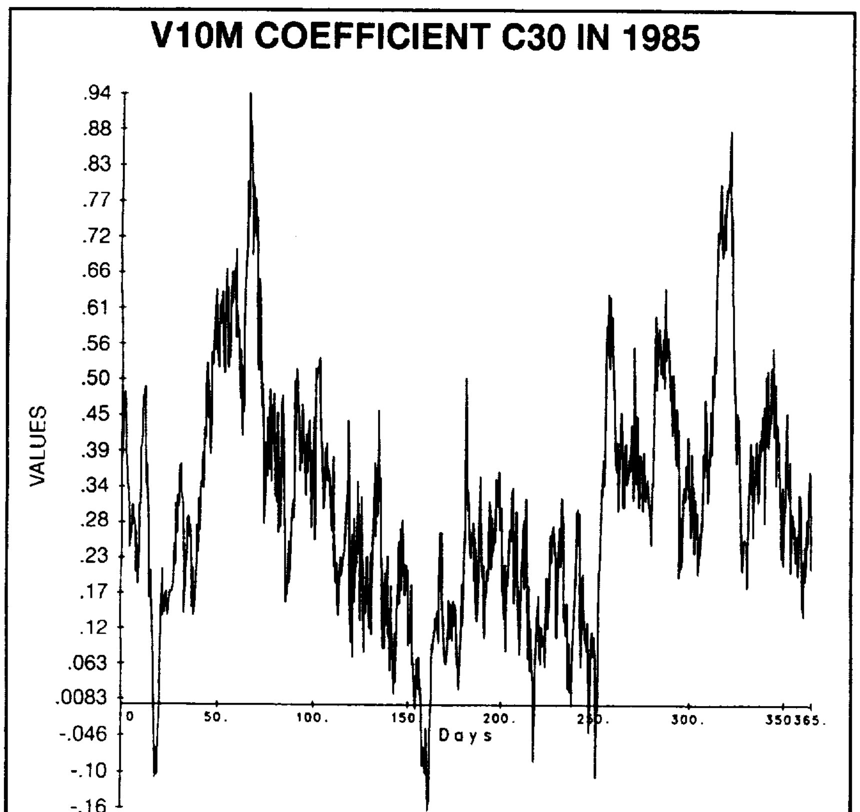

Figure 20b. The Coefficient C_{30}, Year 1985. The North-South Velocity Component (v).

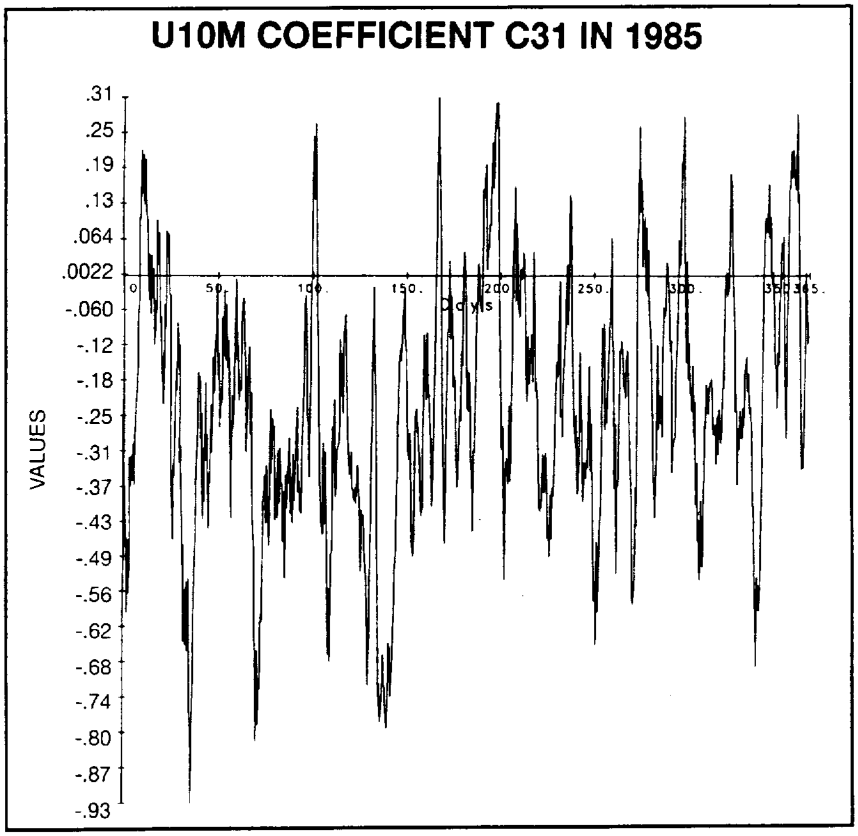

Figure 21a. The Coefficient C_{31}, Year 1985. The East-West Velocity Component (u).

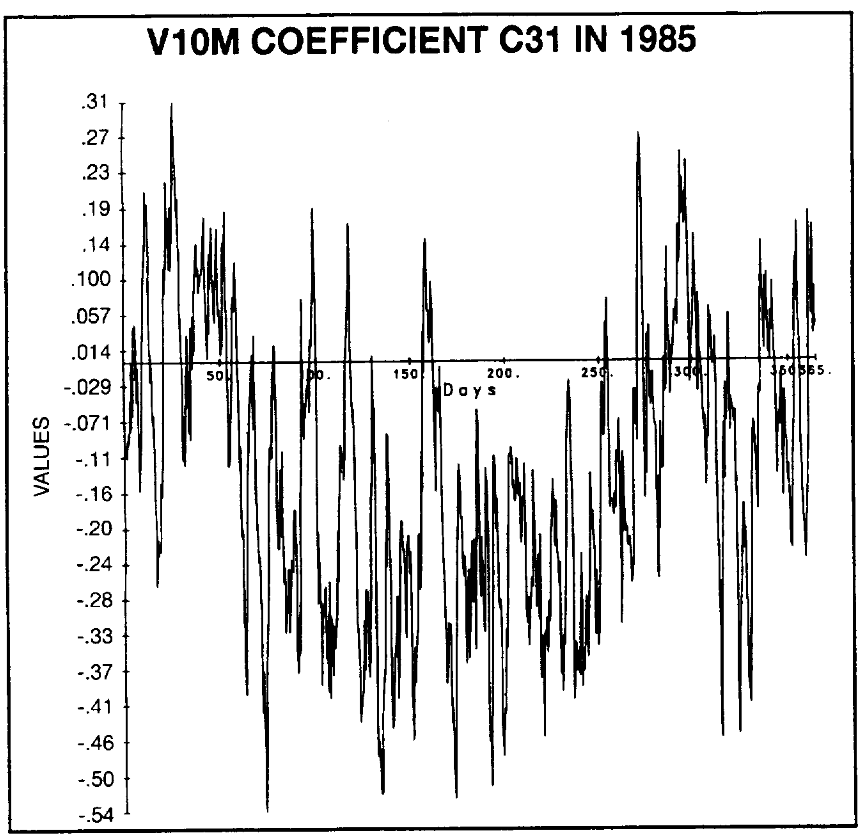

Figure 21b. The Coefficient C_{31}, Year 1985. The North-South Velocity Component (v).

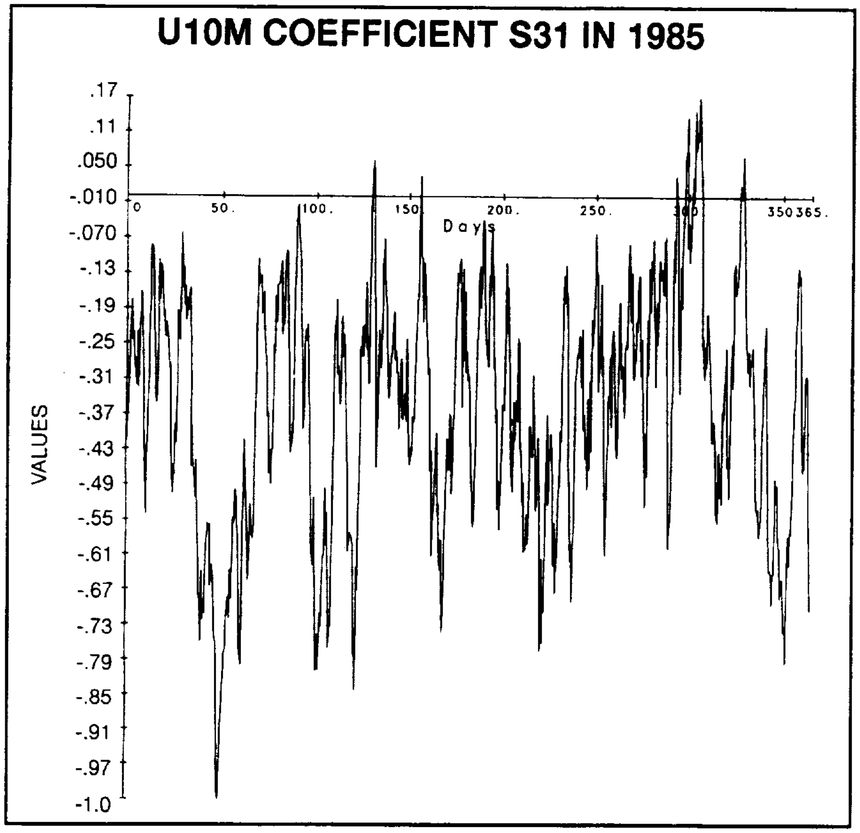

Figure 22a. The Coefficient S_{31}, Year 1985. The East-West Velocity Component (u).

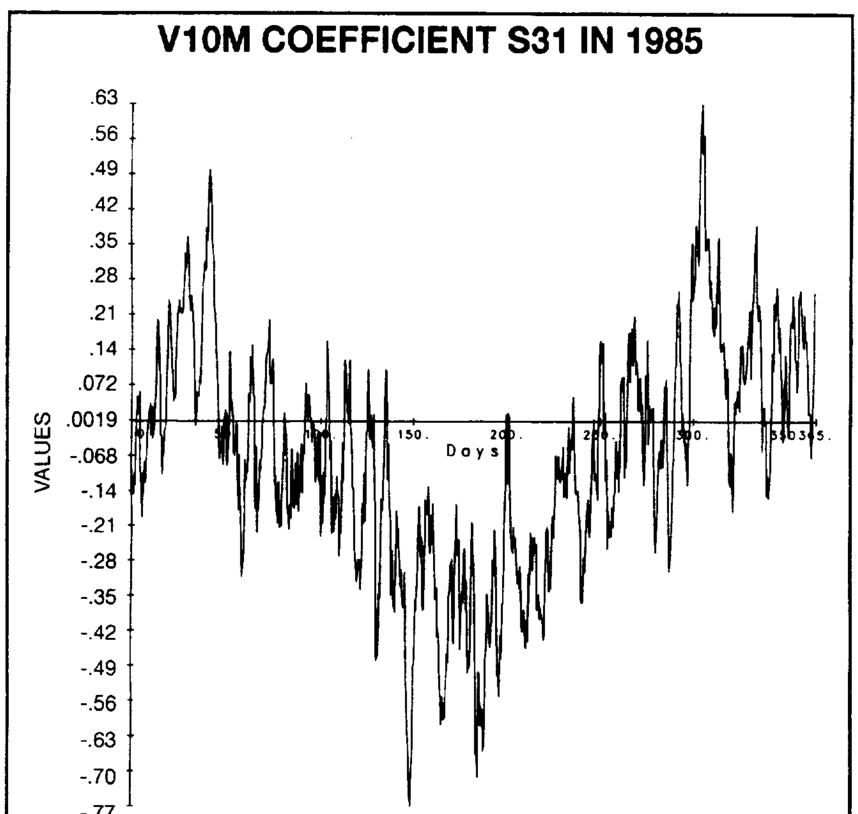

Figure 22b. The Coefficient S_{31}, Year 1985. The North-South Velocity Component (v).

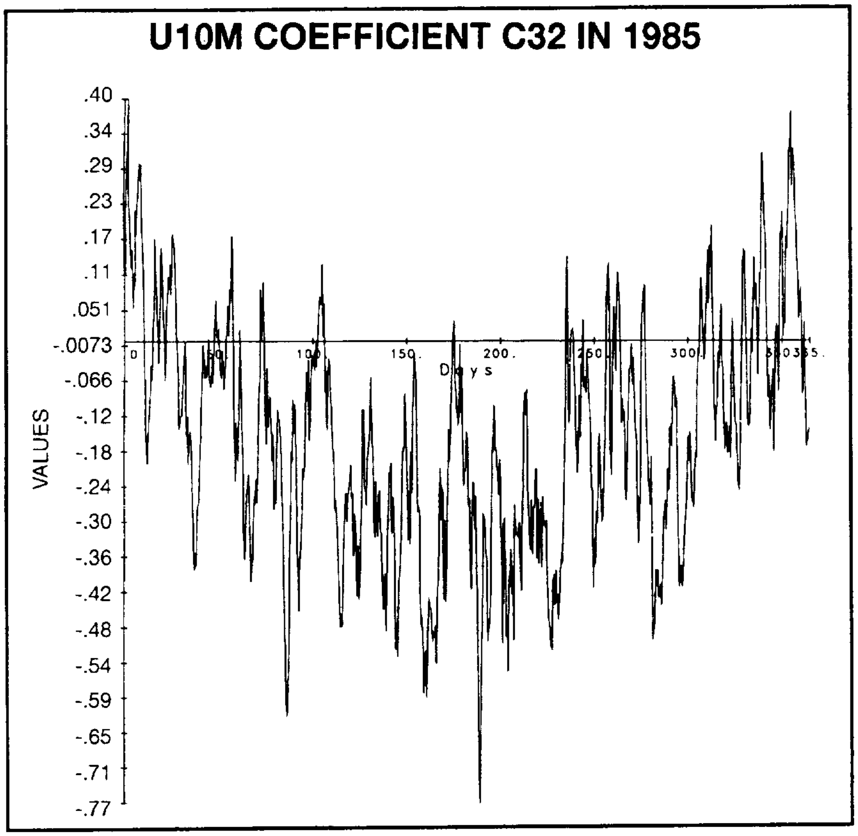

Figure 23a. The Coefficient C_{32}, Year 1985. The East-West Velocity Component (u).

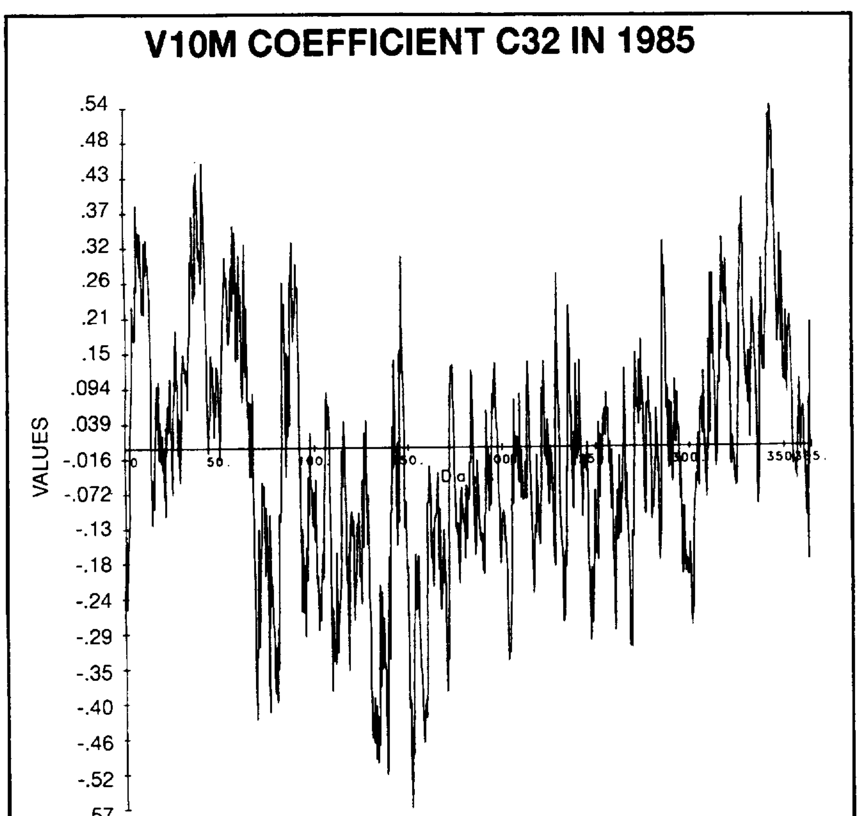

Figure 23b. The Coefficient C_{32}, Year 1985. The North-South Velocity Component (v).

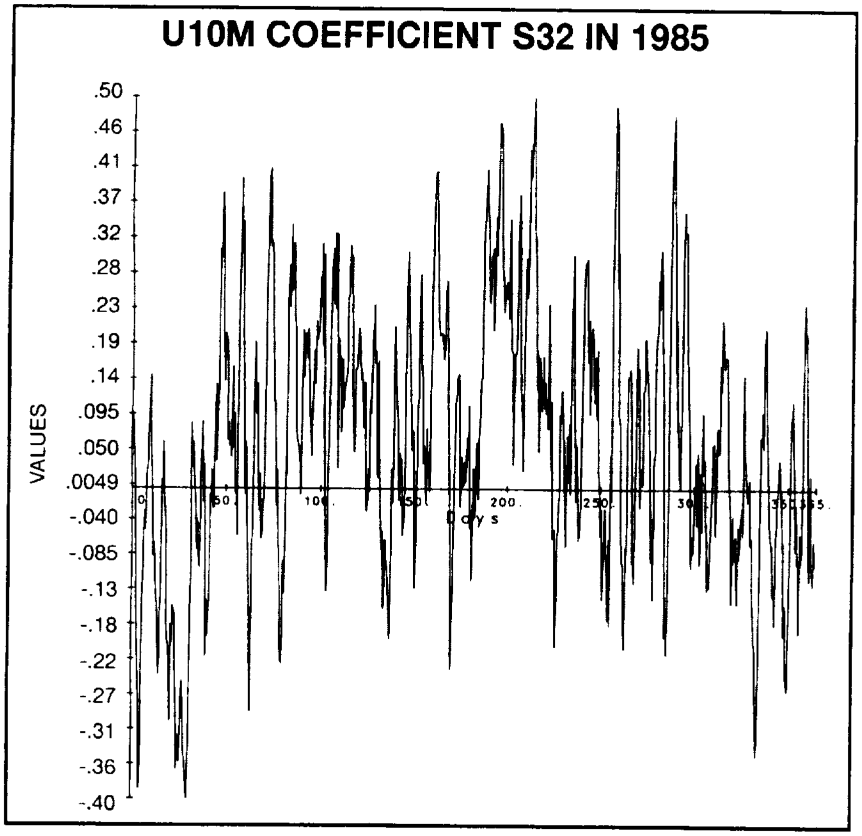

Figure 24a. The Coefficient S_{32}, Year 1985. The East-West Velocity Component (u).

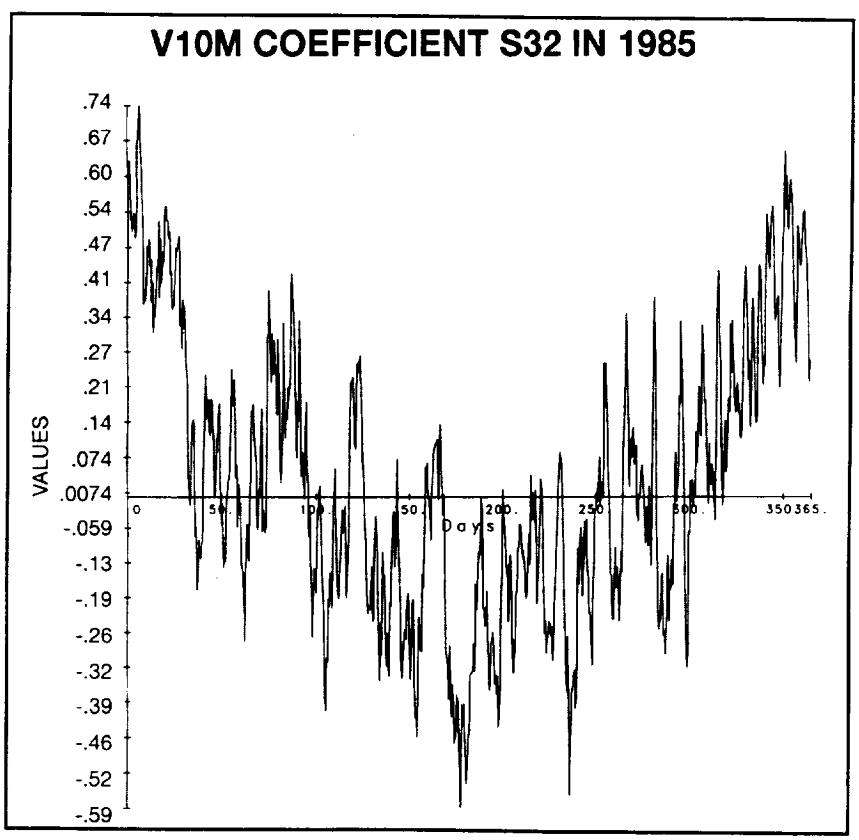

Figure 24b. The Coefficient S_{32}, Year 1985. The North-South Velocity Component (v).

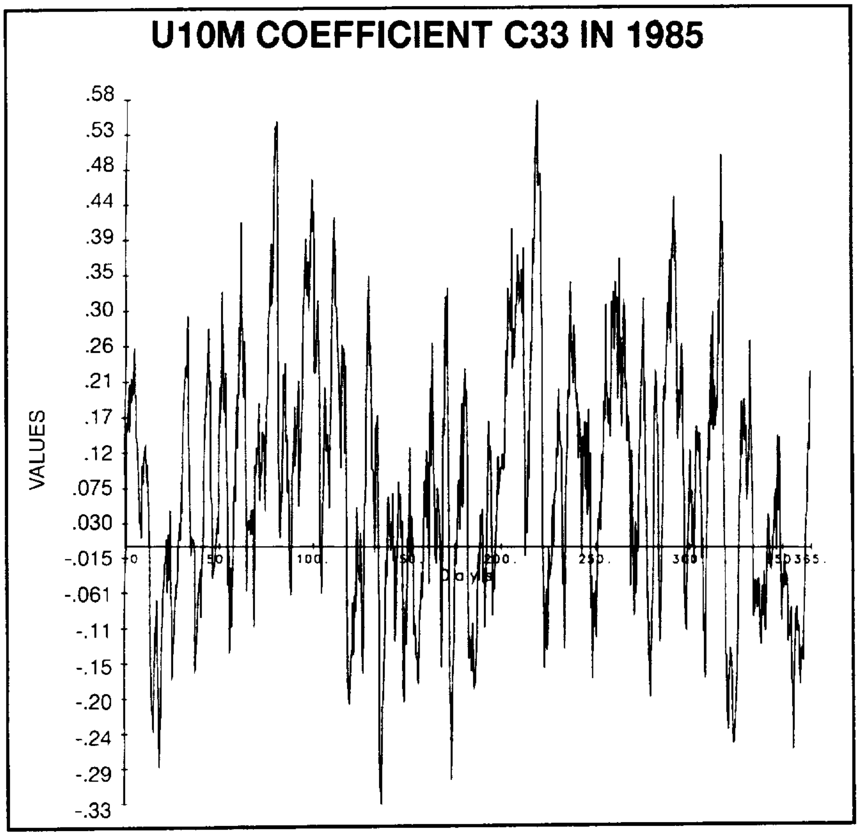

Figure 25a. The Coefficient C_{33}, Year 1985. The East-West Velocity Component (u).

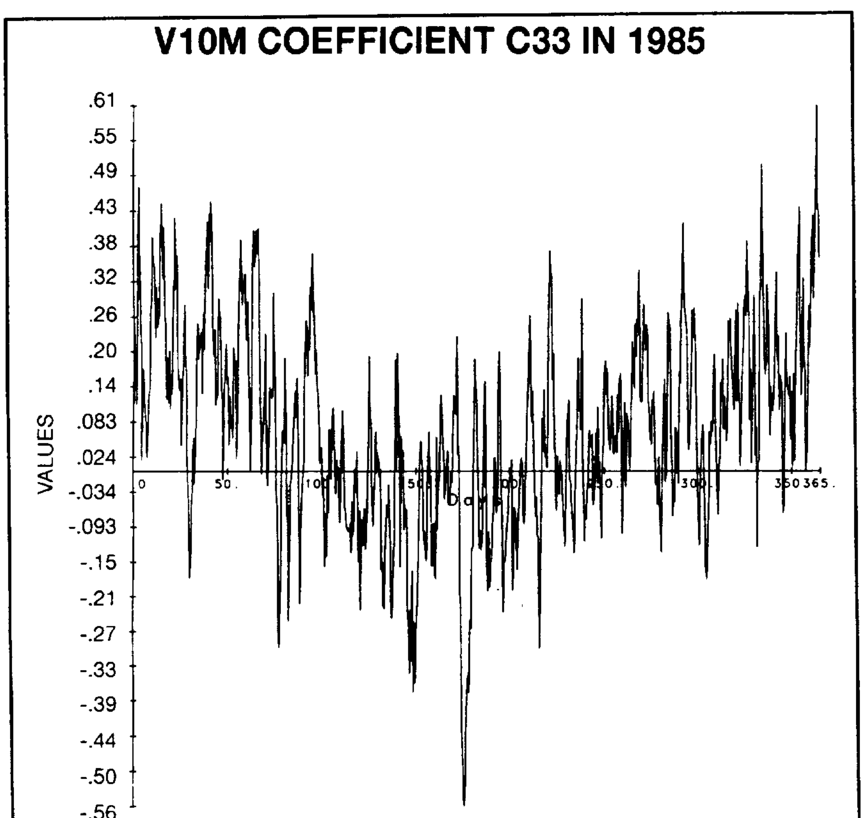

Figure 25b. The Coefficient C_{33}, Year 1985. The North-South Velocity Component (v).

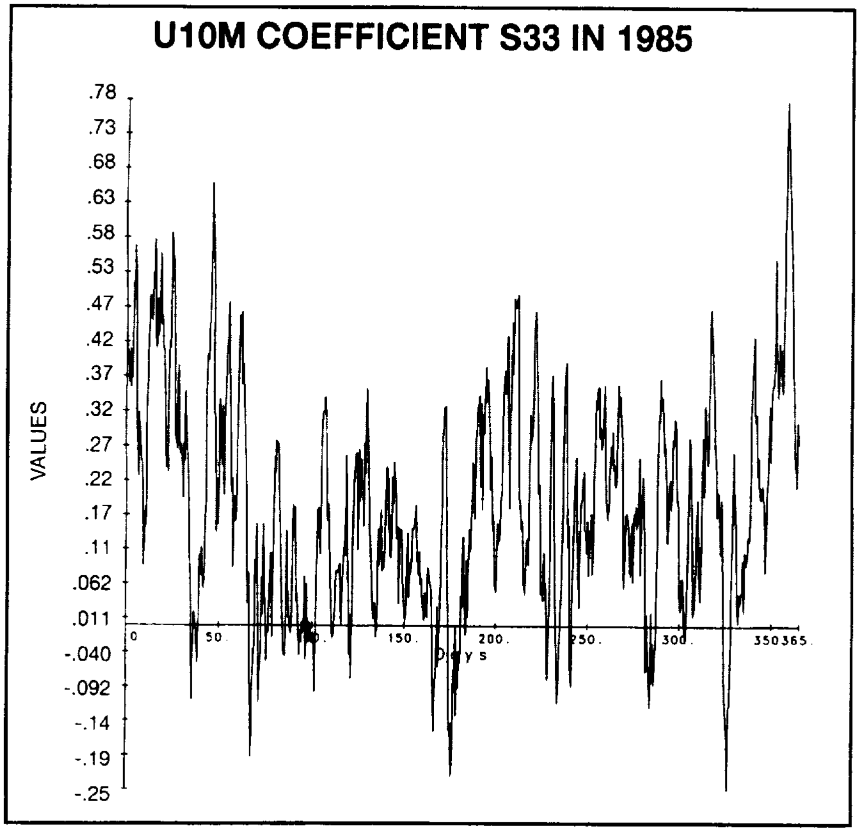

Figure 26a. The Coefficient S_{33}, Year 1985. The East-West Velocity Component (u).

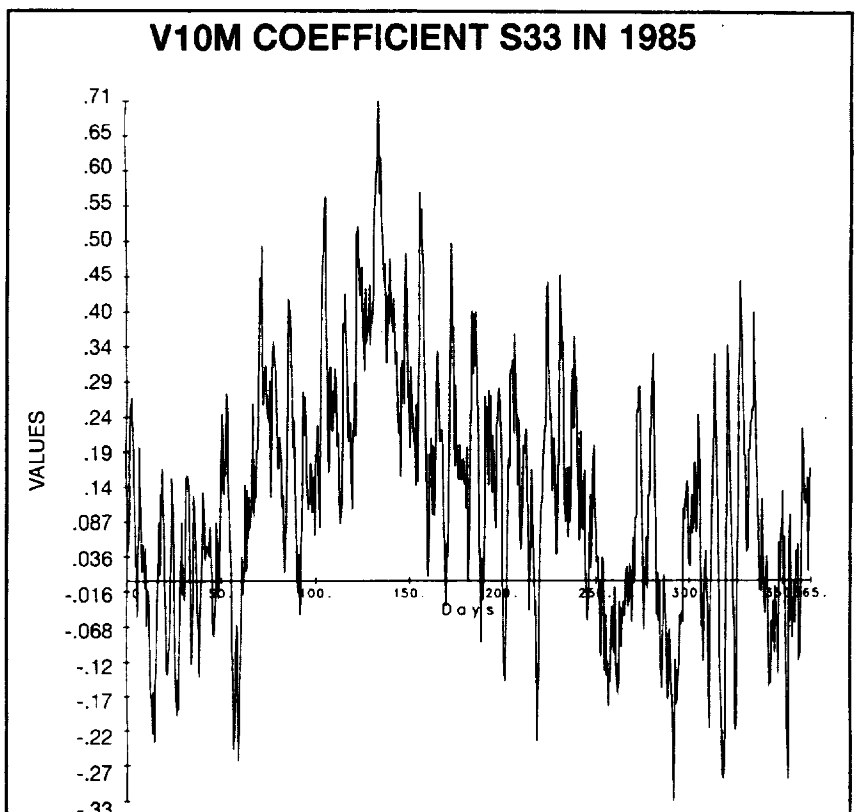

Figure 26b. The Coefficient S_{33}, Year 1985. The North-South Velocity Component (v).

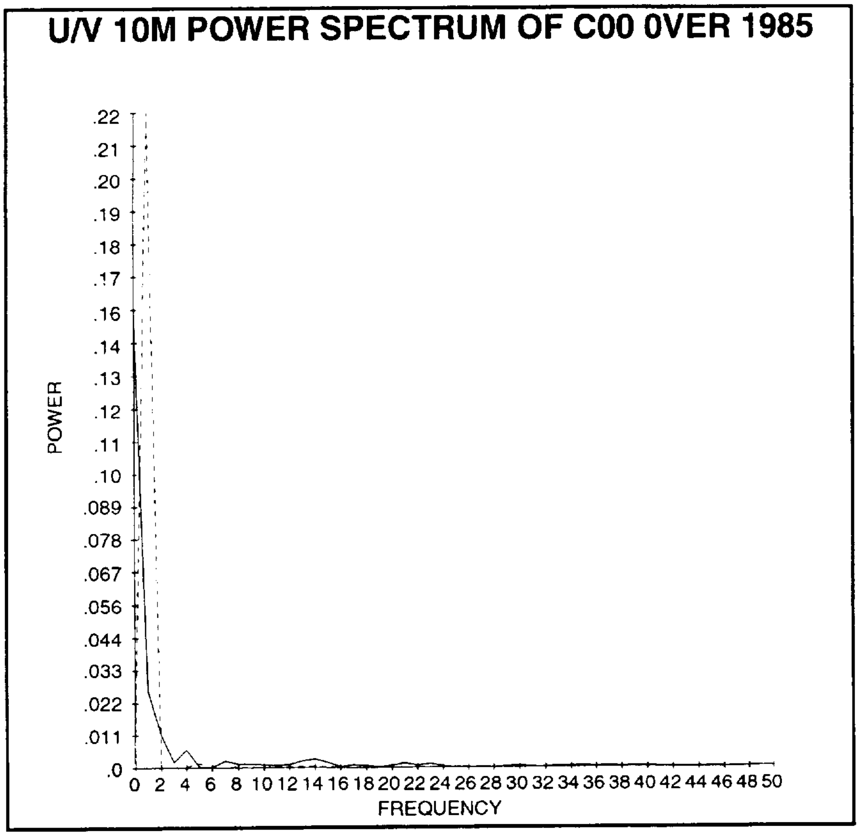

Figure 27a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{00}.

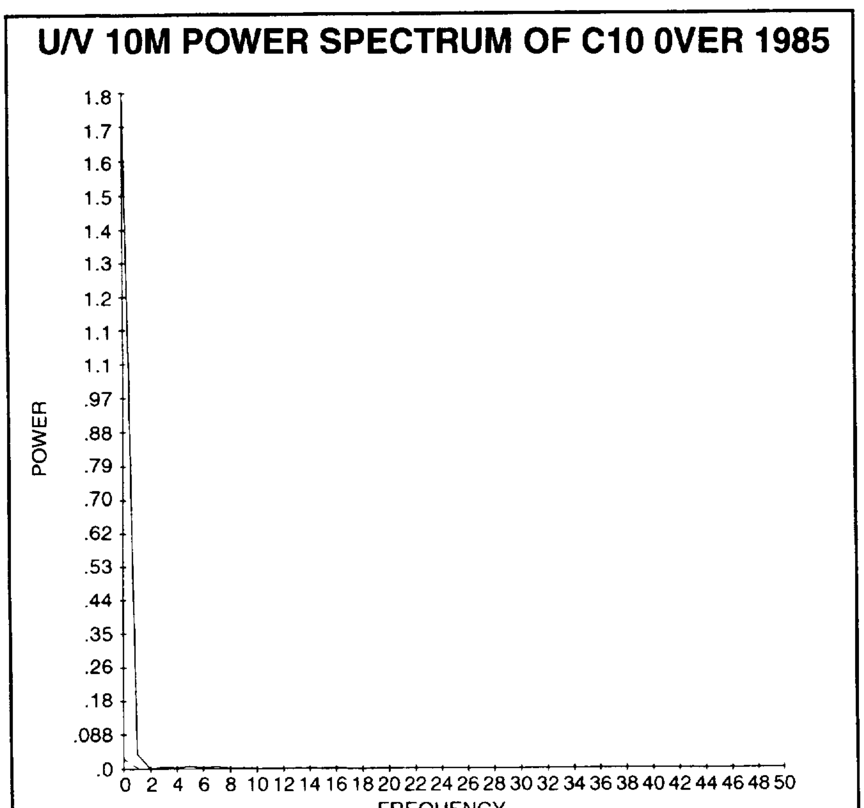

Figure 27b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{10}.

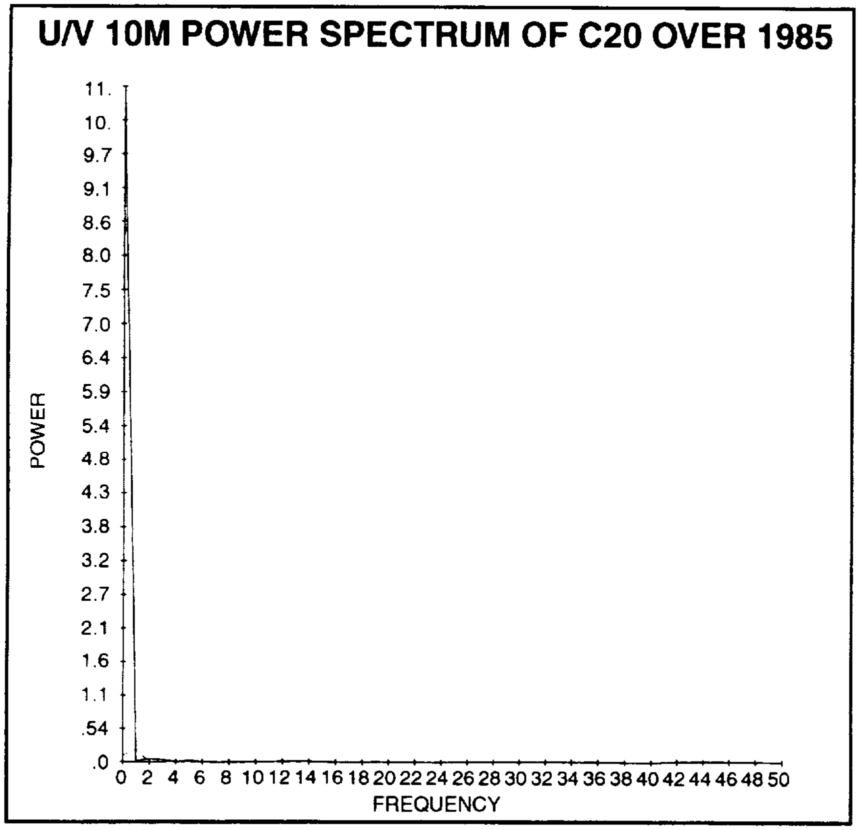

Figure 28a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{20}.

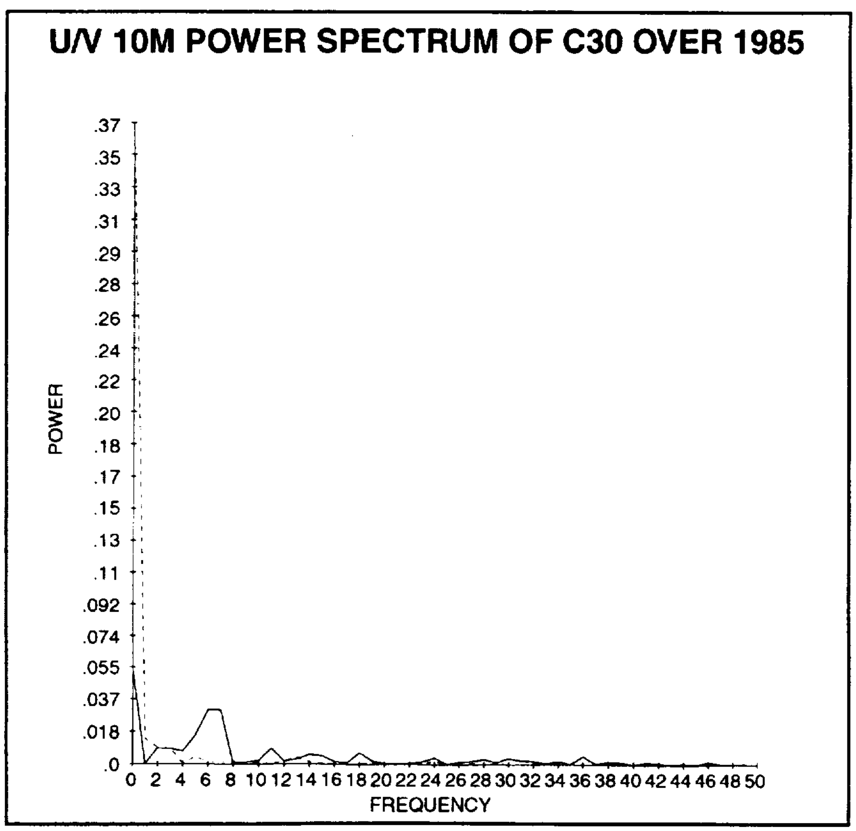

Figure 28b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{30}.

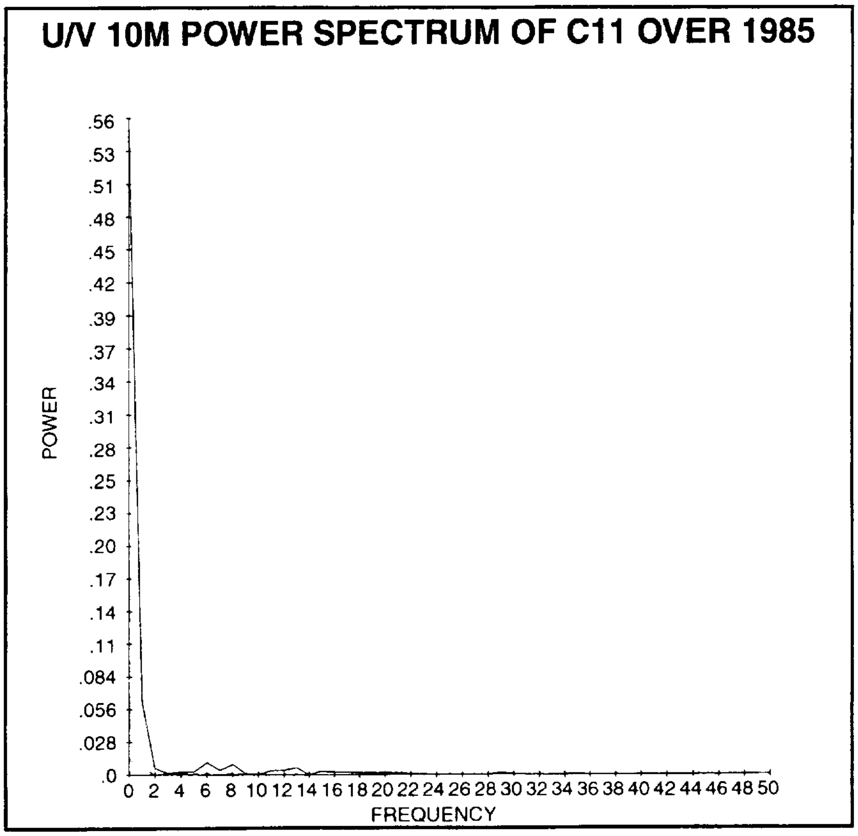

Figure 29a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{11}.

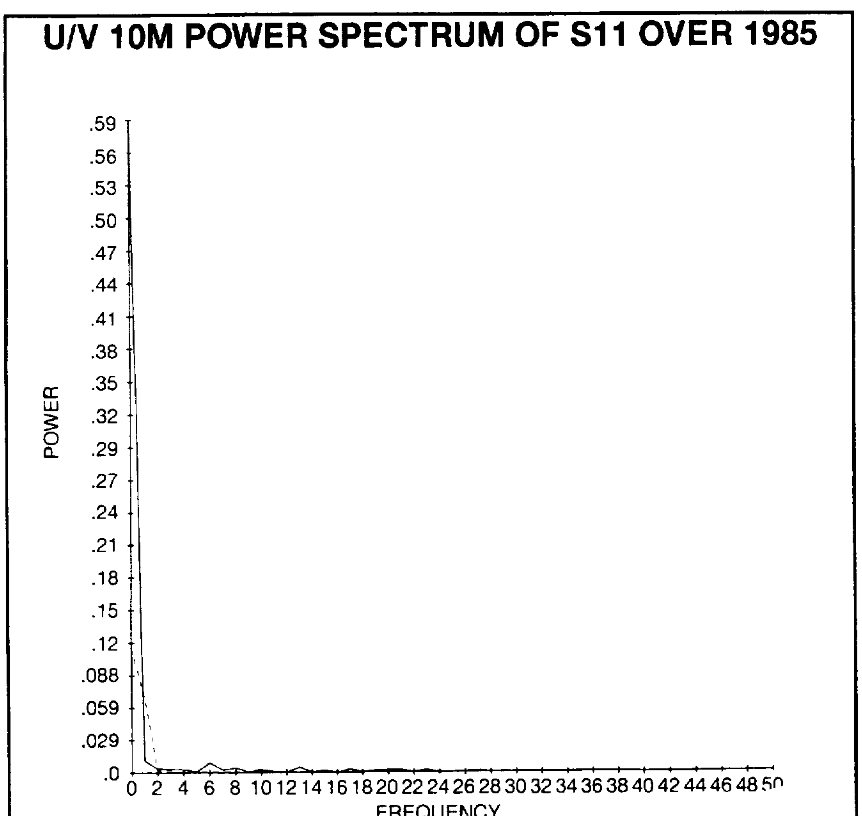

Figure 29b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient S_{11}.

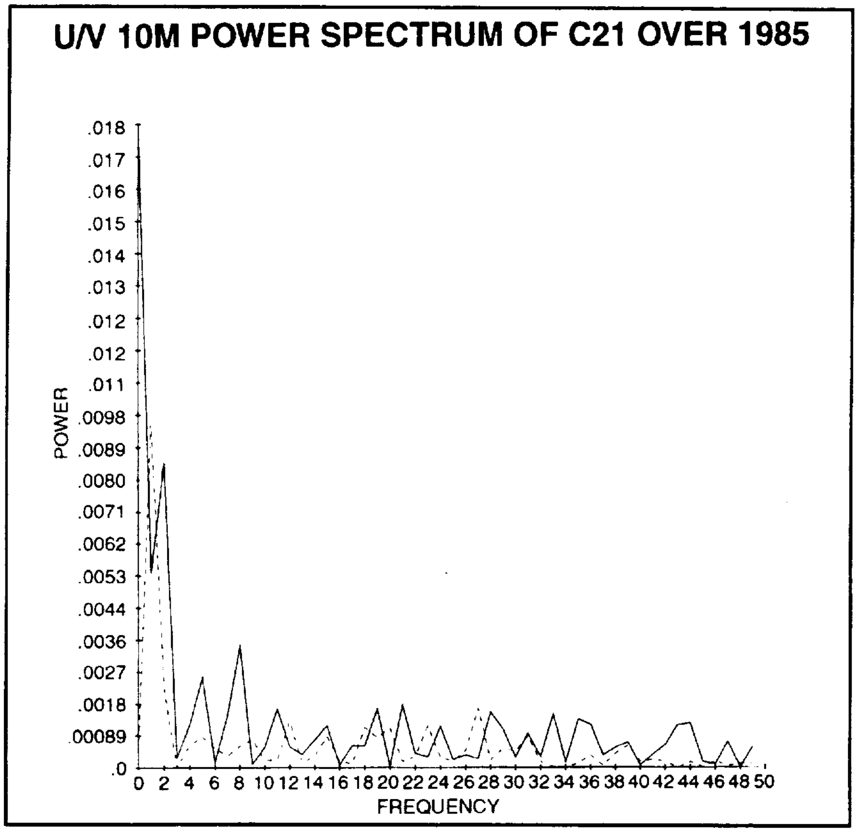

Figure 30a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{21}.

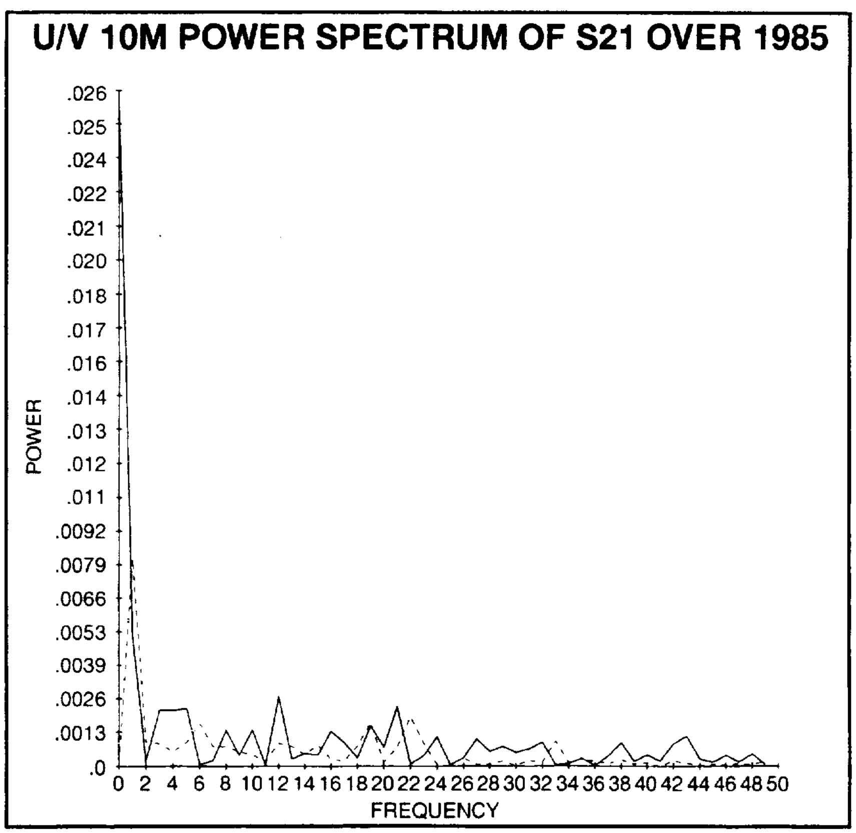

Figure 30b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient S_{21}.

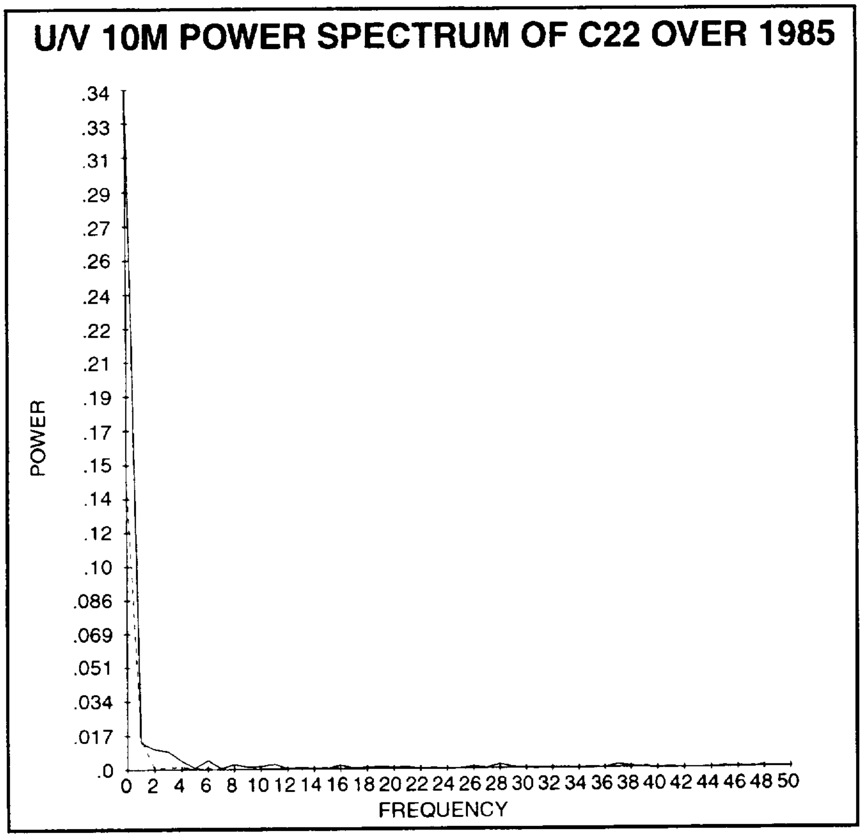

Figure 31a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{22}.

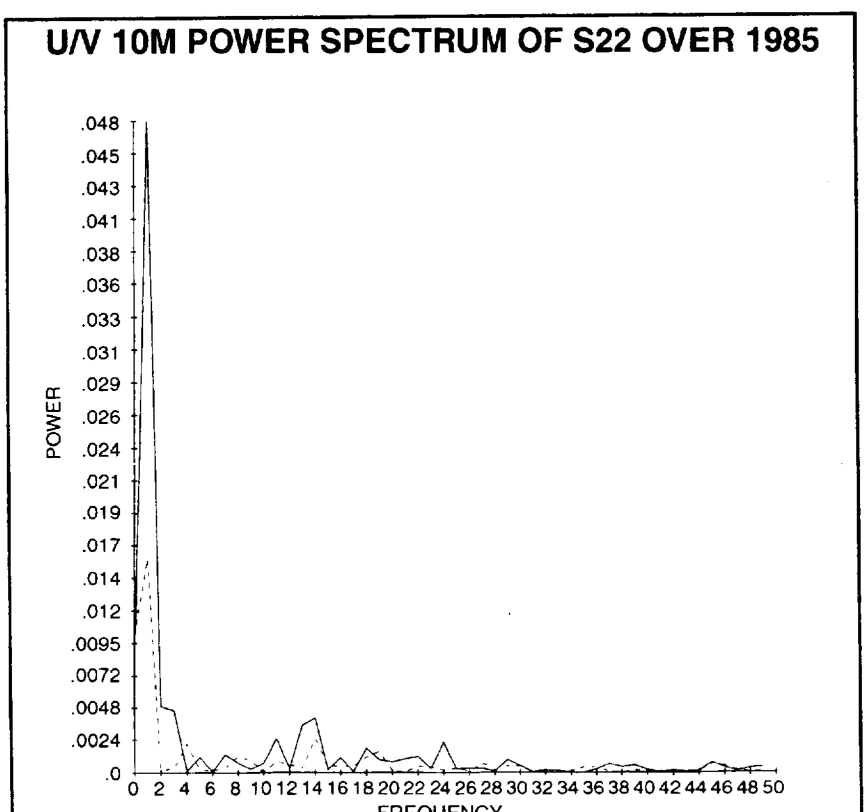

Figure 31b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient S_{22}.

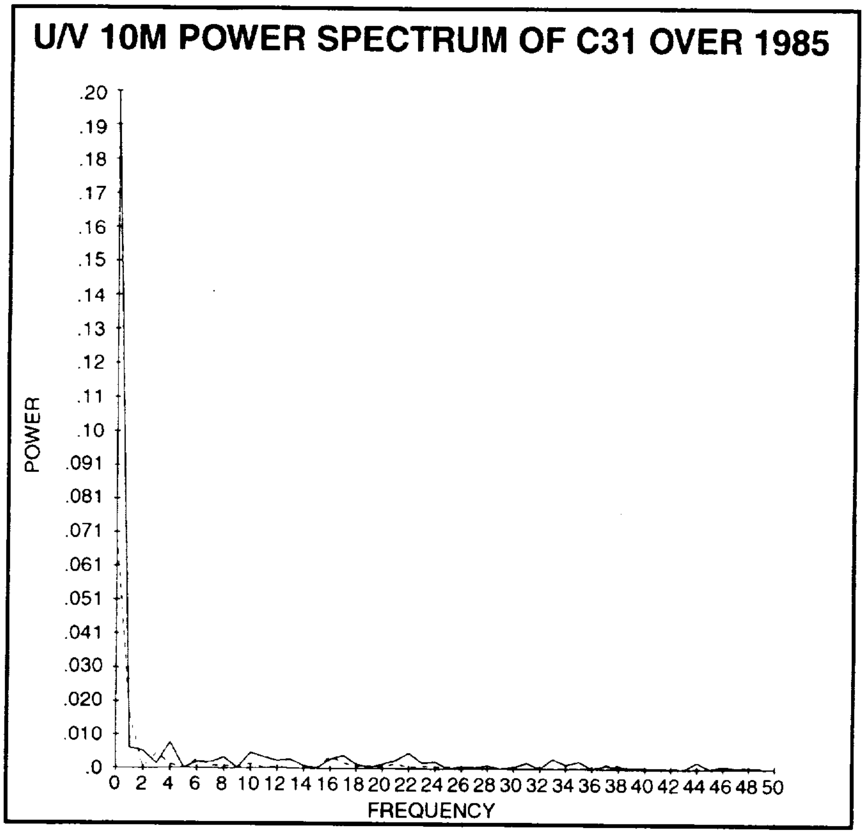

Figure 32a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{31}.

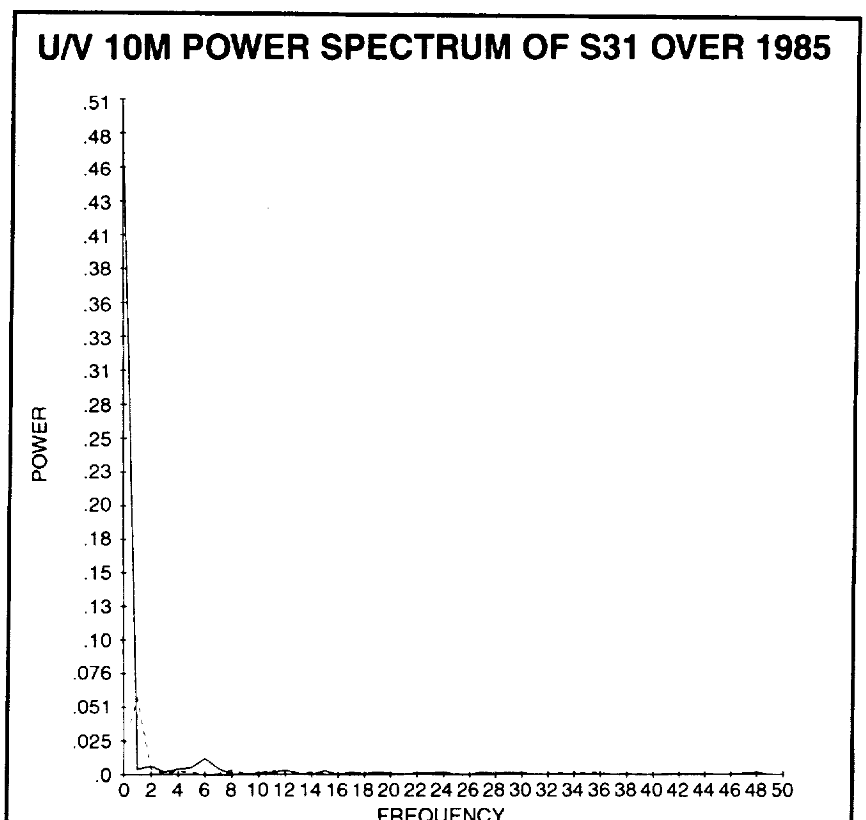

Figure 32b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient S_{31}.

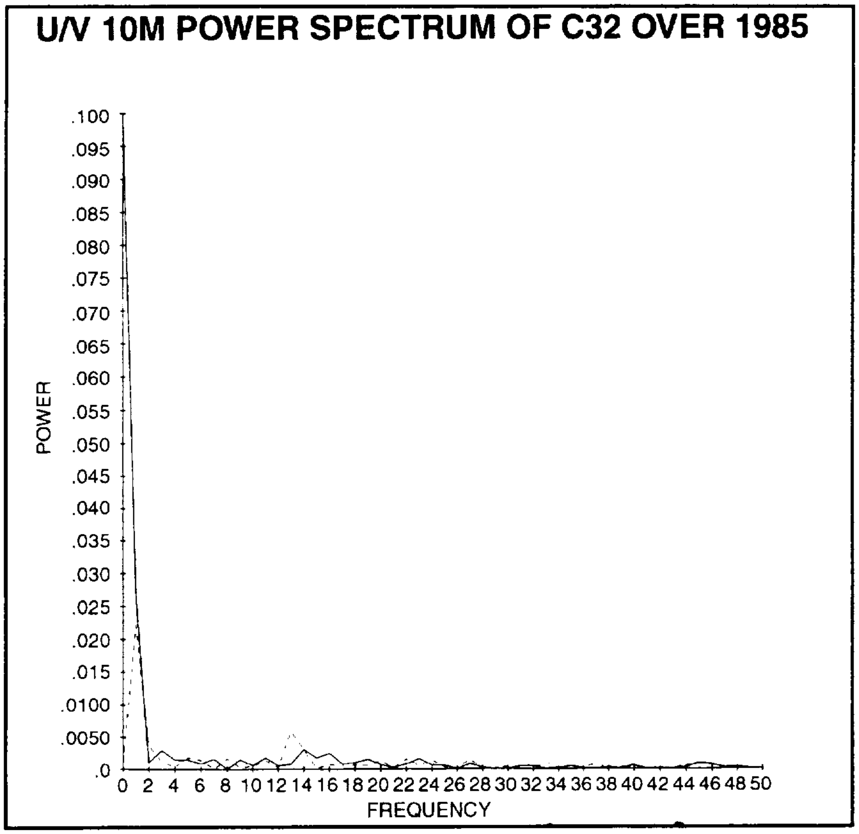

Figure 33a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{32}.

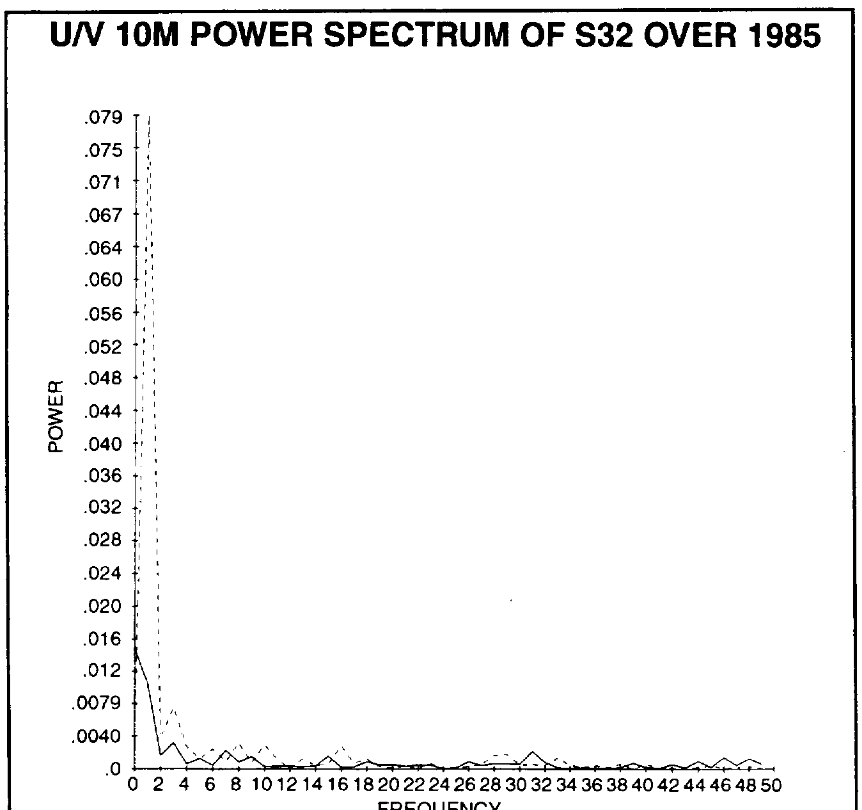

Figure 33b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient S_{32}.

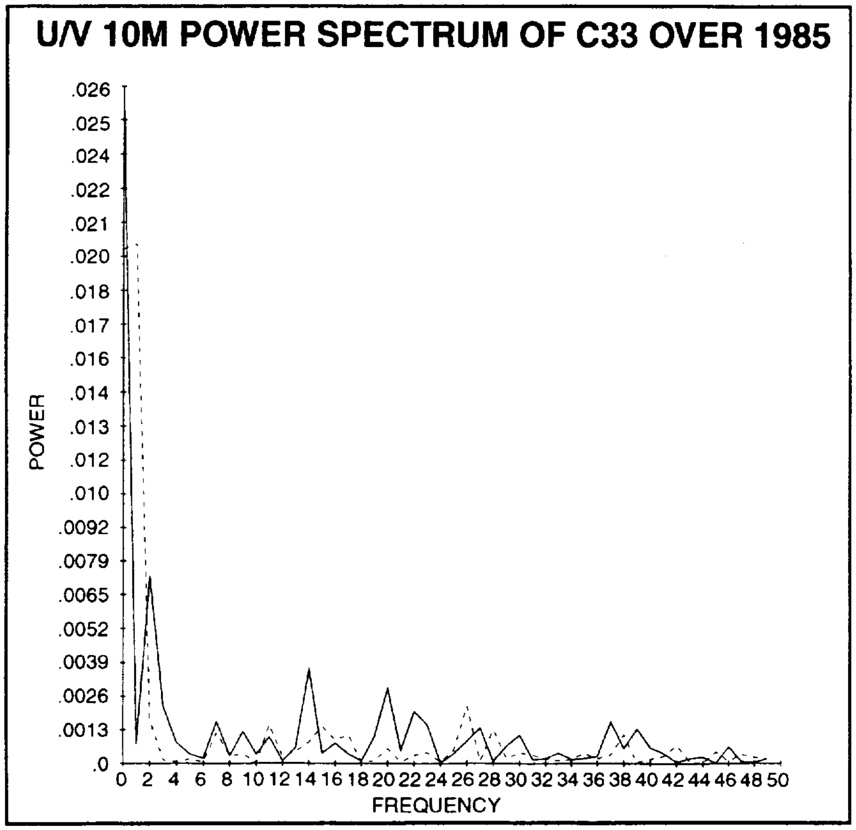

Figure 34a. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient C_{33}.

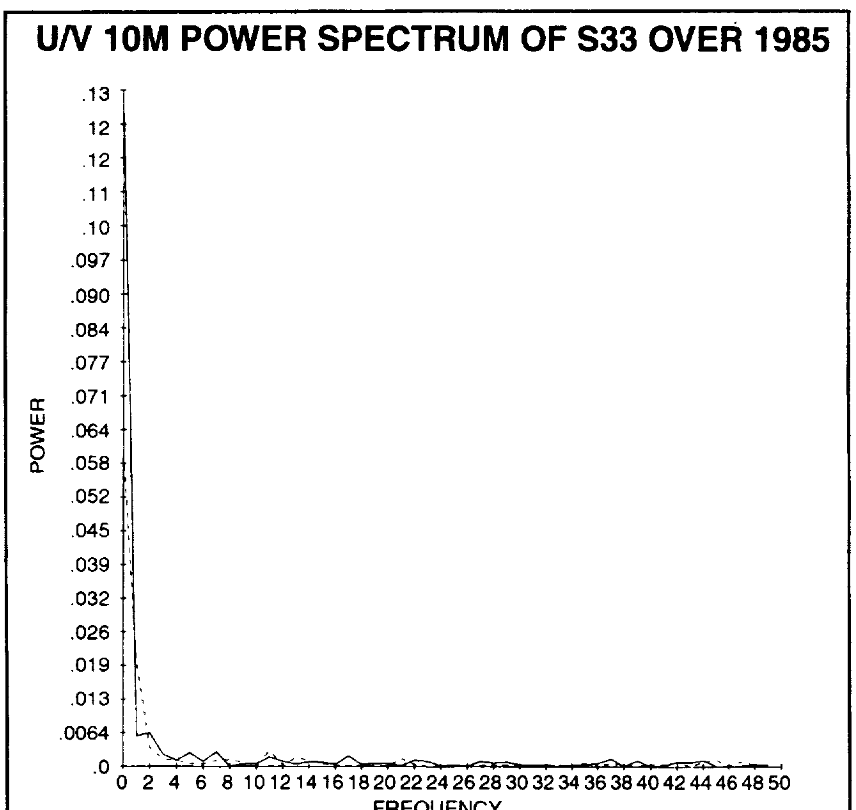

Figure 34b. Power Spectrum. Frequencies: 0–50. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). The Coefficient S_{33}.

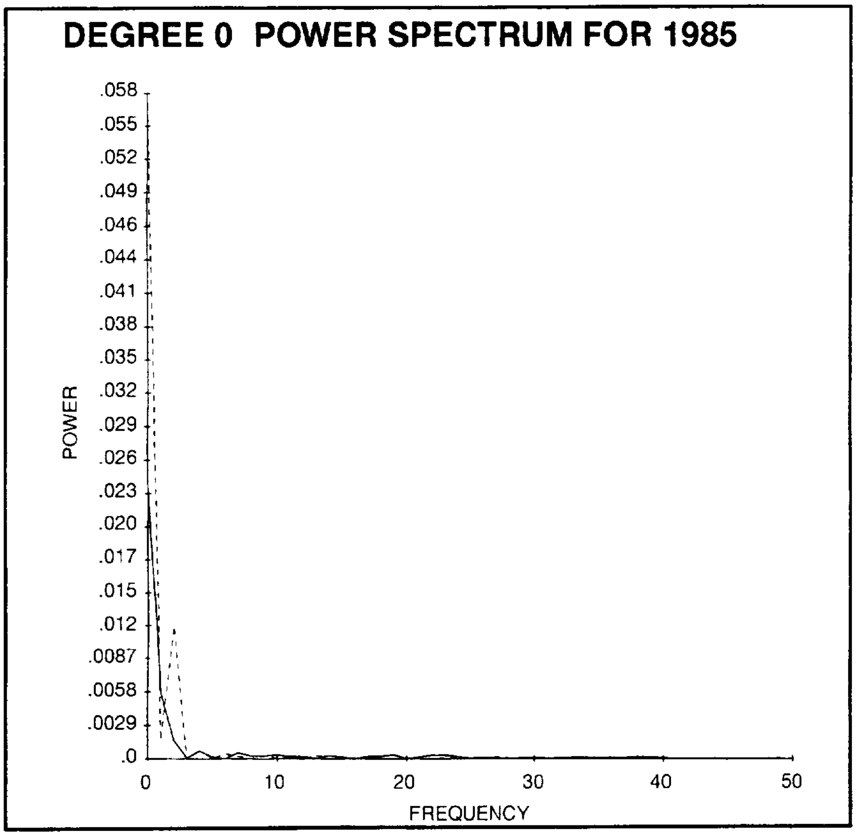

Figure 35a. Degree 0, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

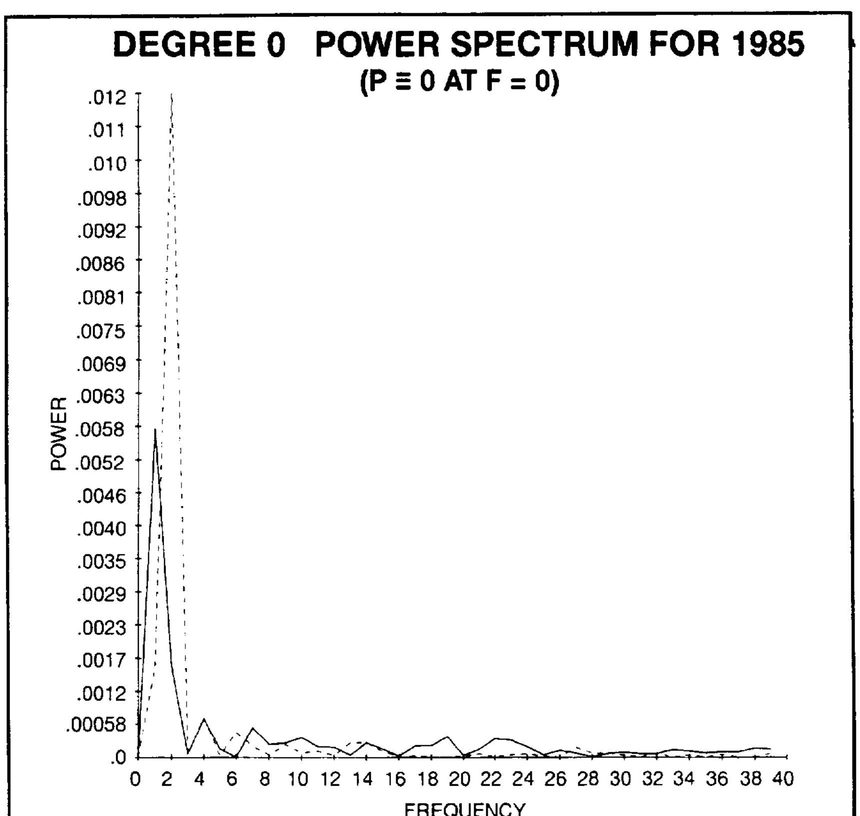

Figure 35b. Degree 0, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

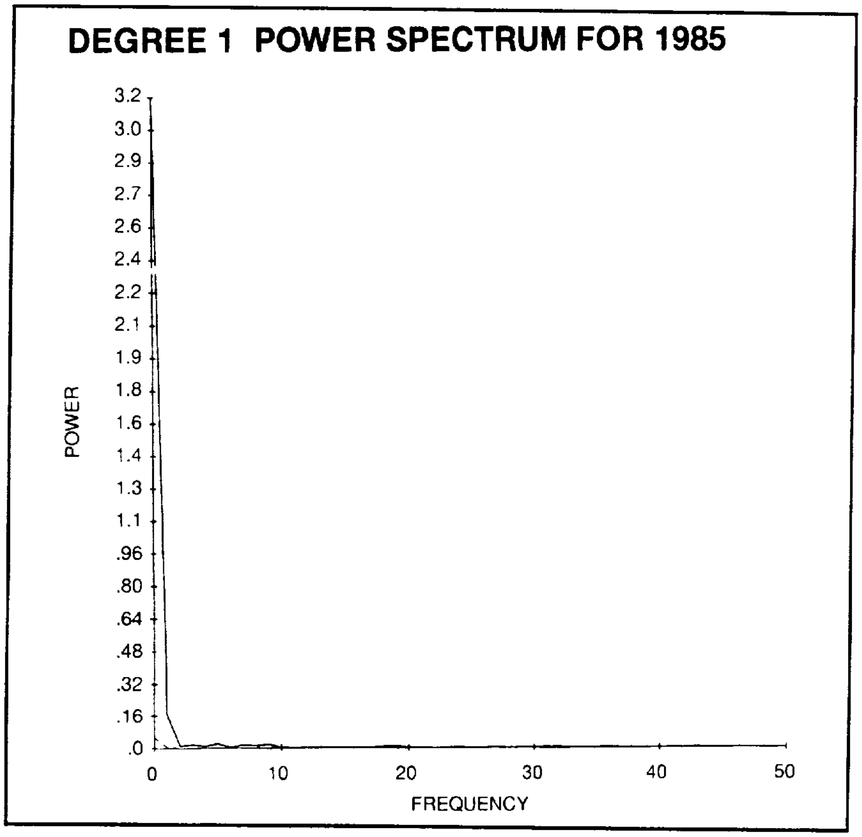

Figure 36a. Degree 1, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

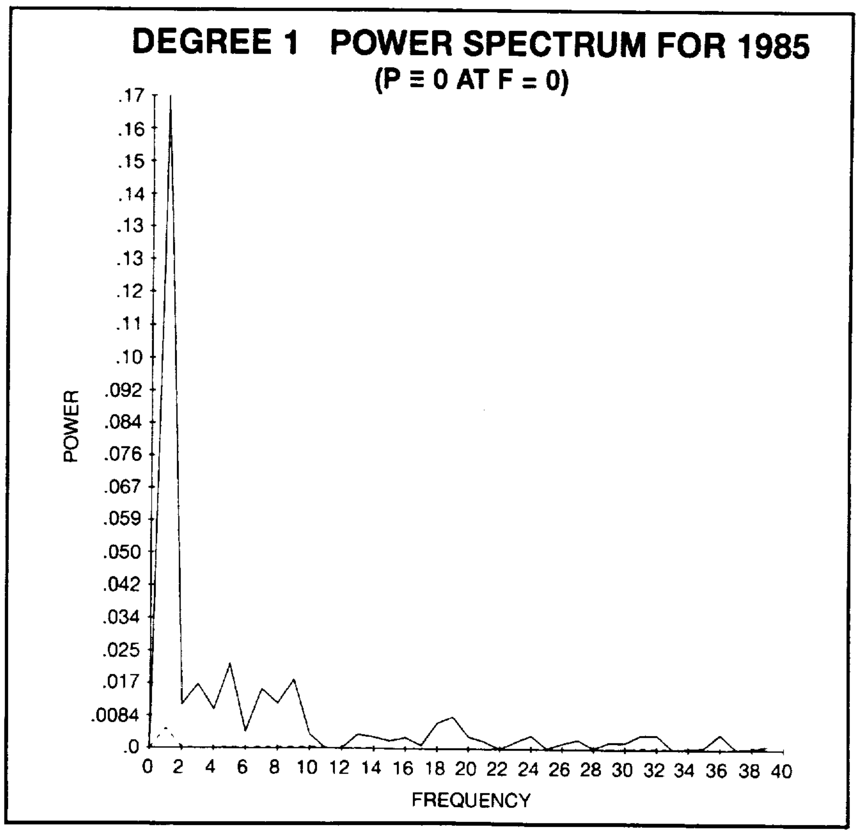

Figure 36b. Degree 1, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

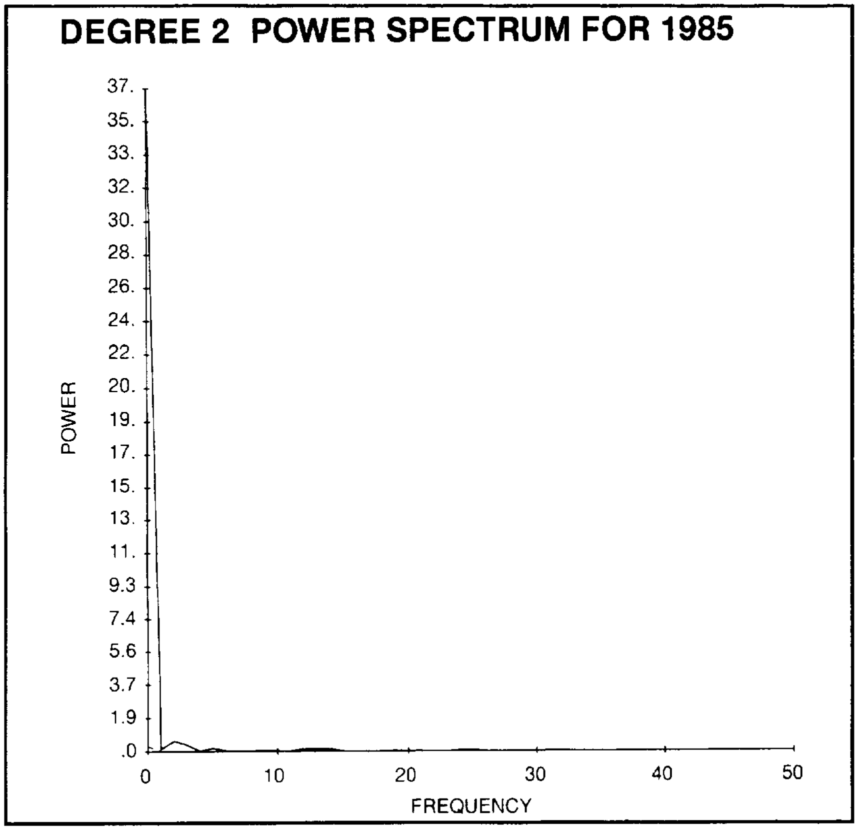

Figure 37a. Degree 2, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

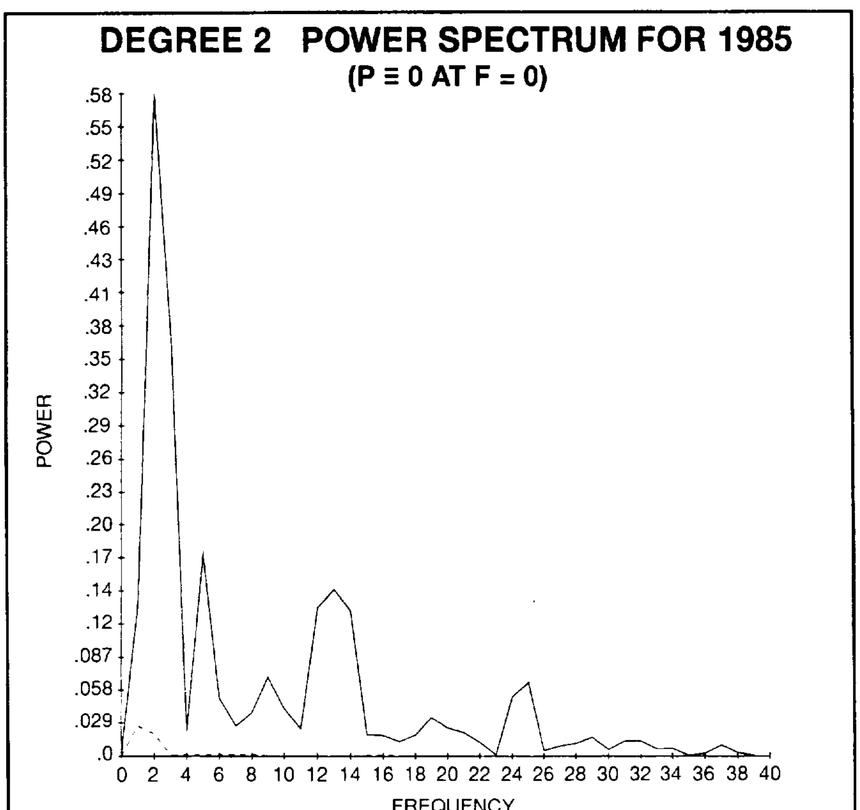

Figure 37b. Degree 2, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

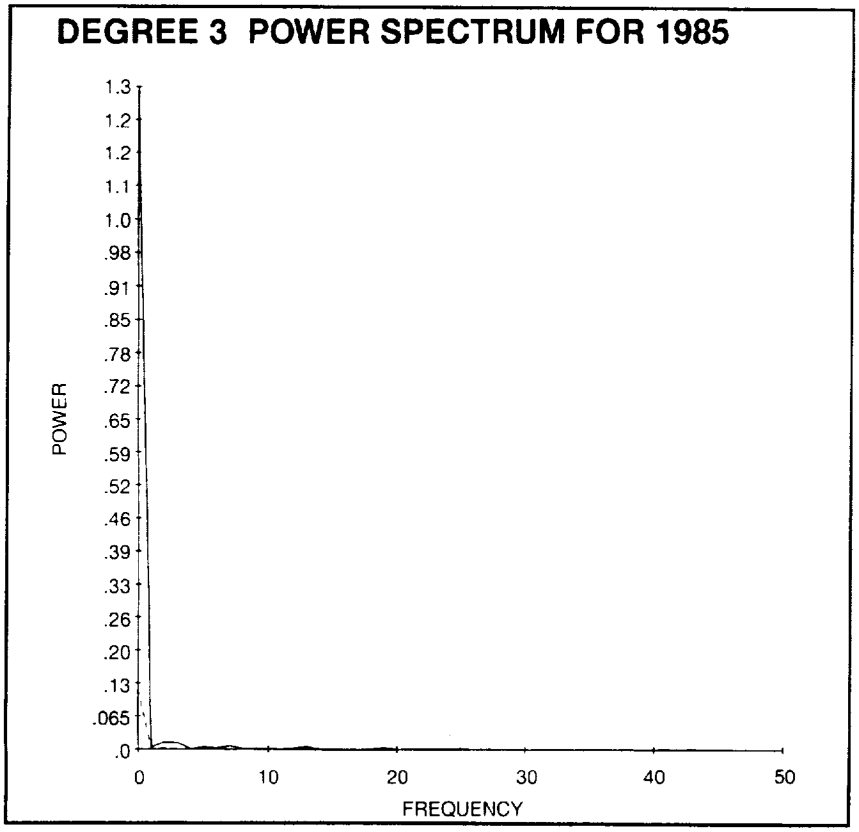

Figure 38a. Degree 3, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

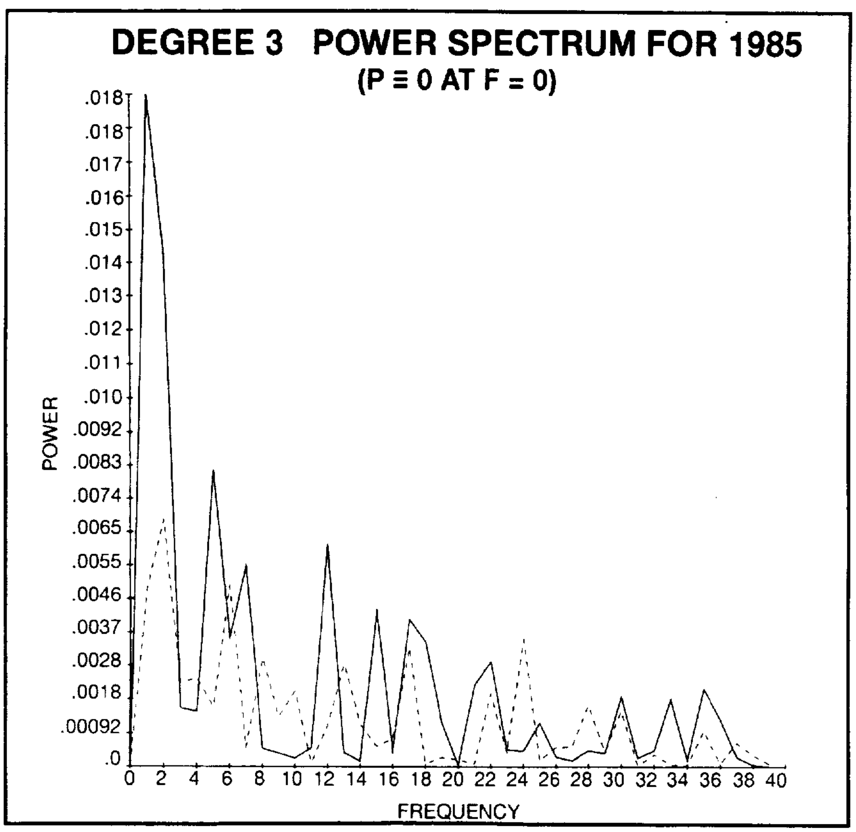

Figure 38b. Degree 3, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

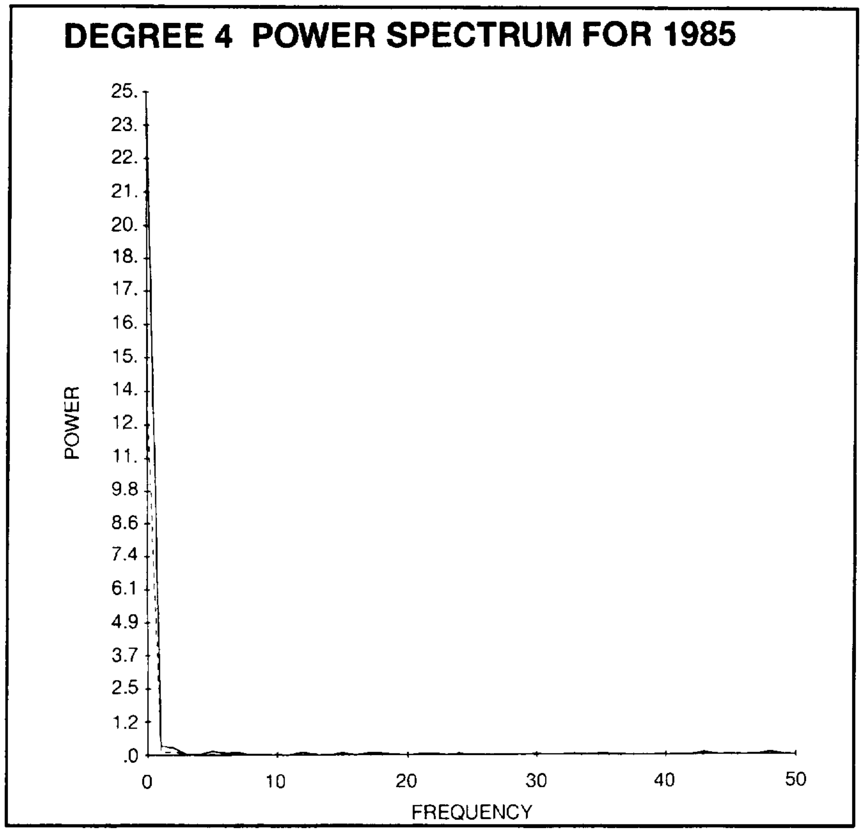

Figure 39a. Degree 4, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

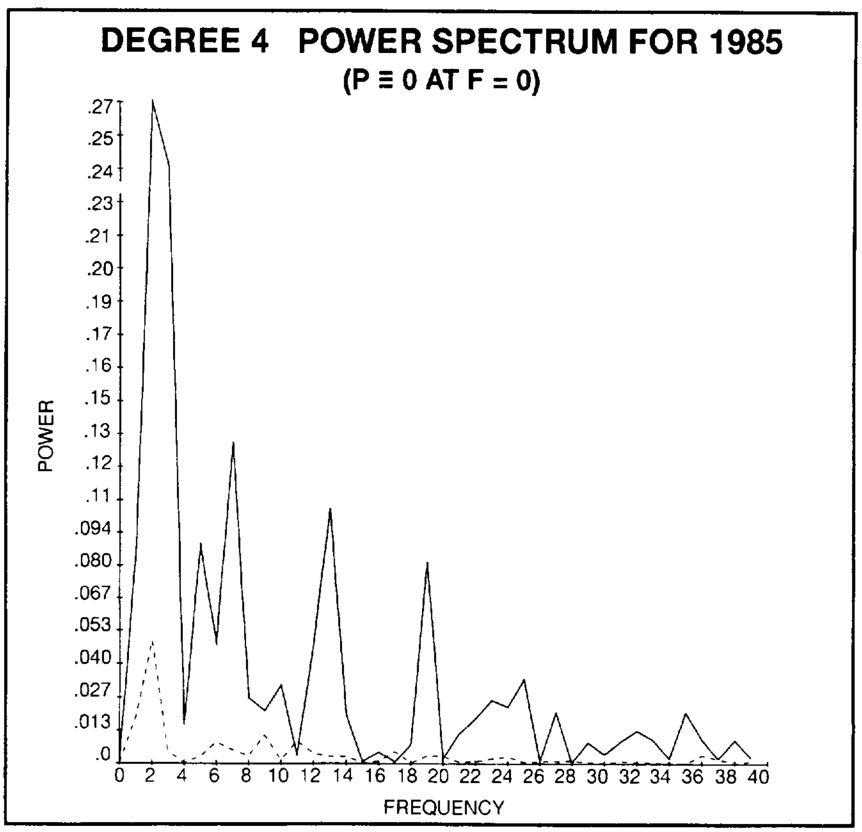

Figure 39b. Degree 4, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

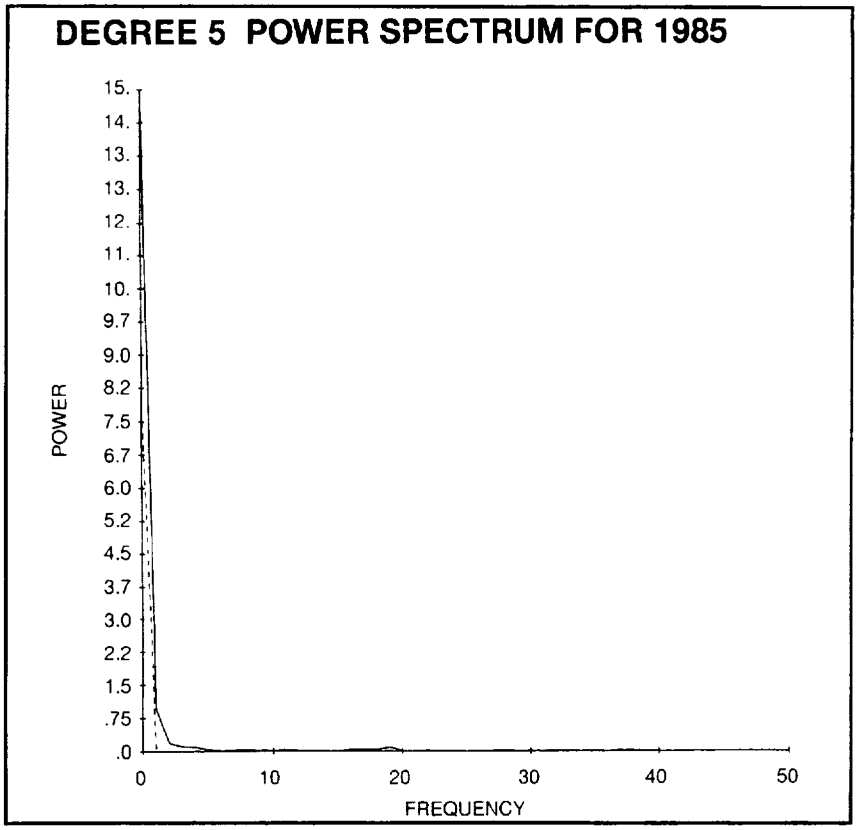

Figure 40a. Degree 5, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

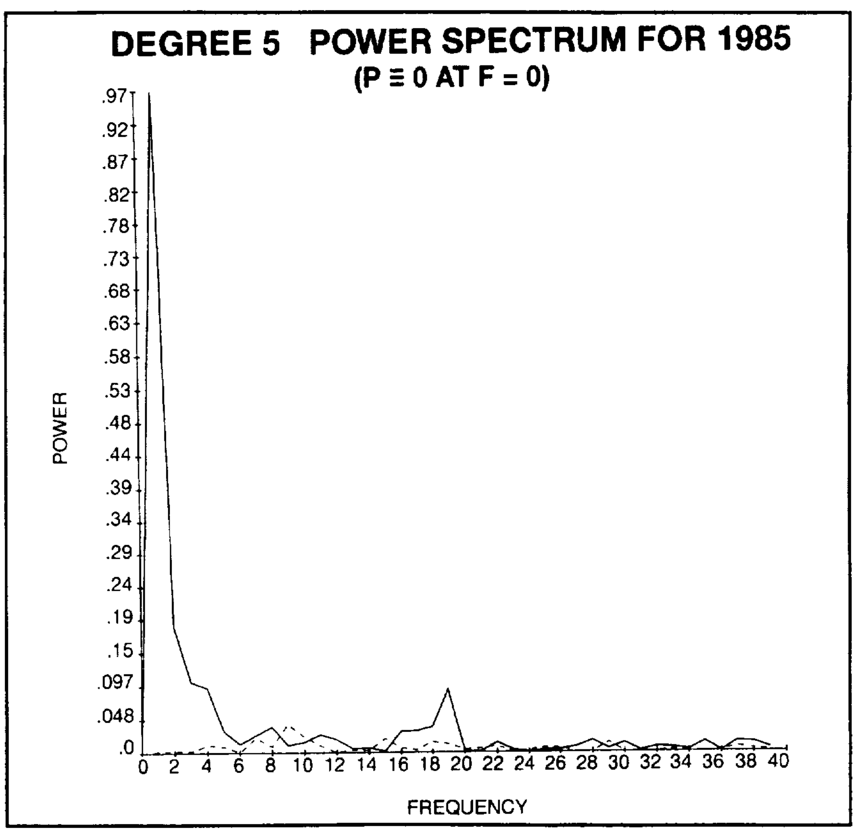

Figure 40b. Degree 5, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

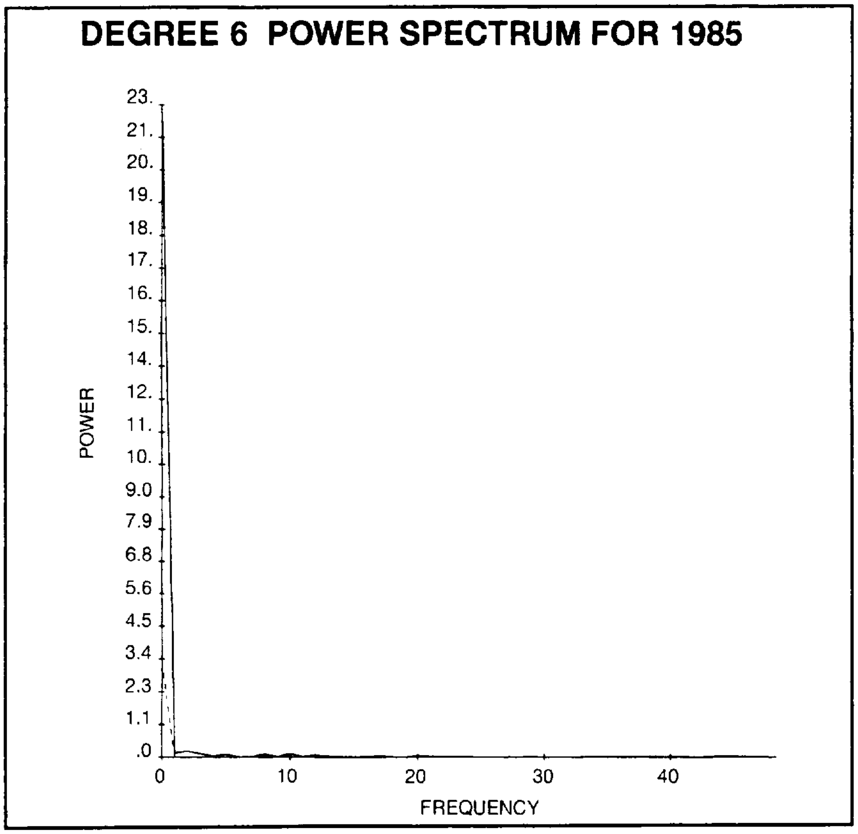

Figure 41a. Degree 6, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

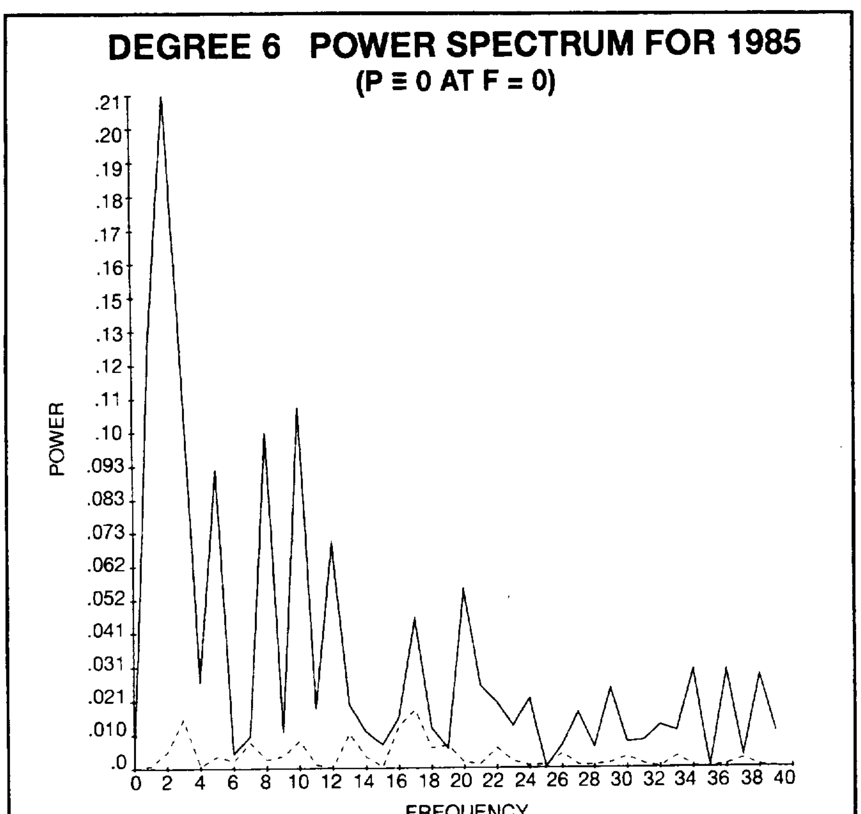

Figure 41b. Degree 6, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

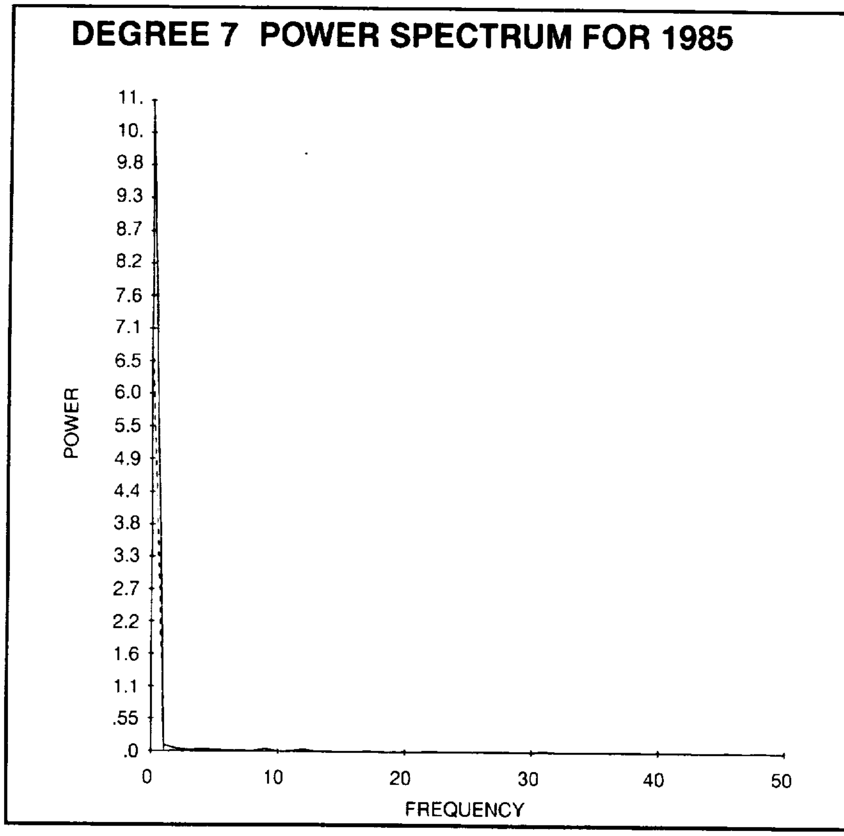

Figure 42a. Degree 7, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

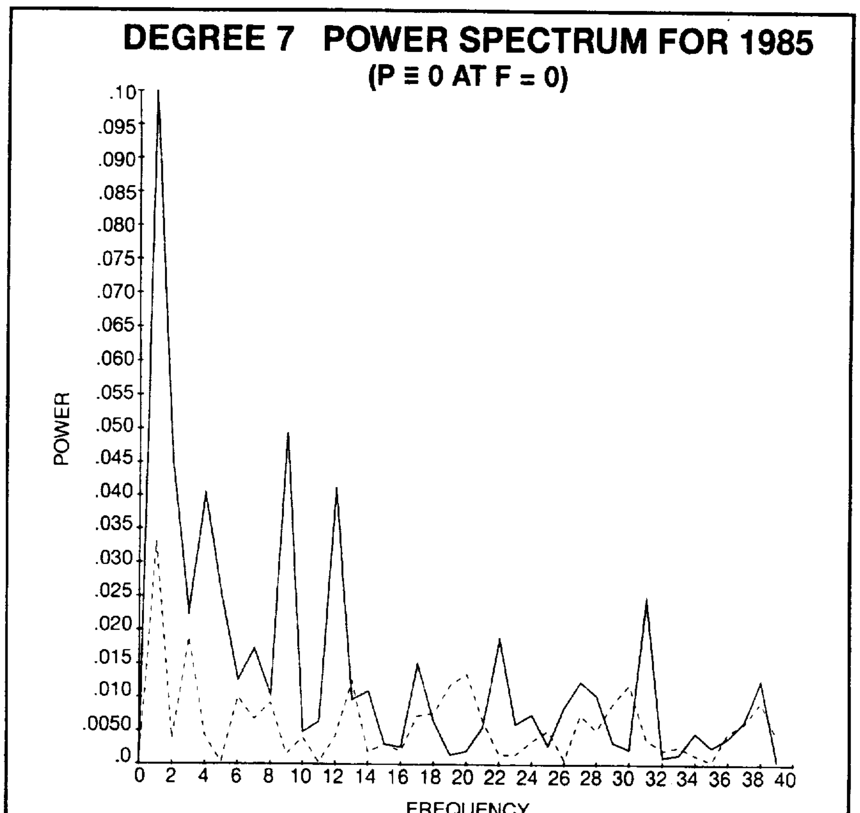

Figure 42b. Degree 7, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

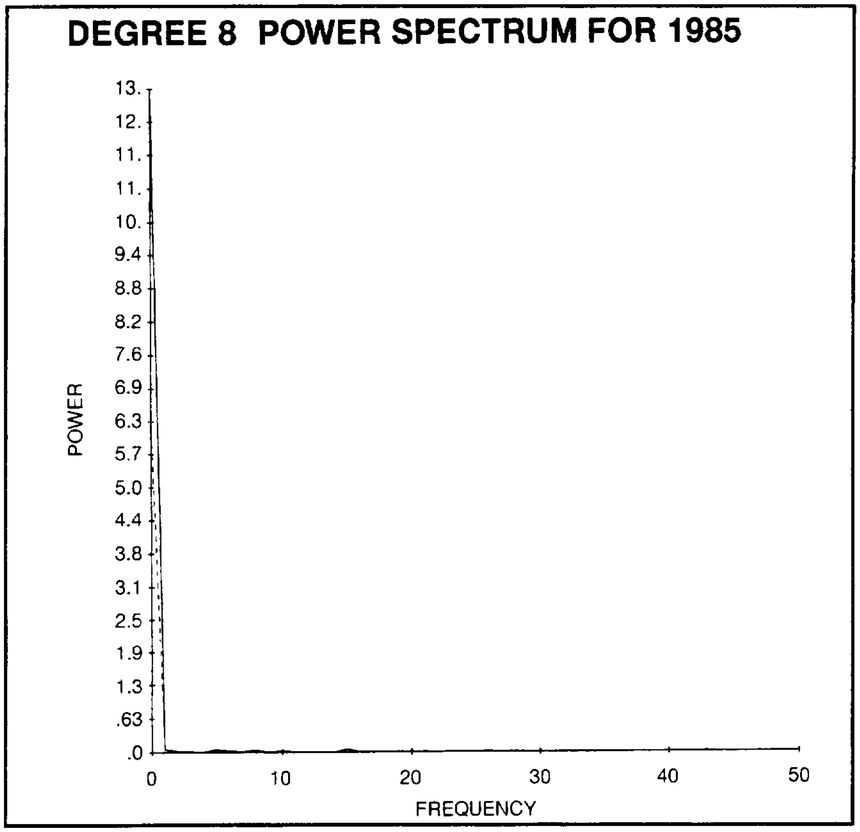

Figure 43a. Degree 8, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

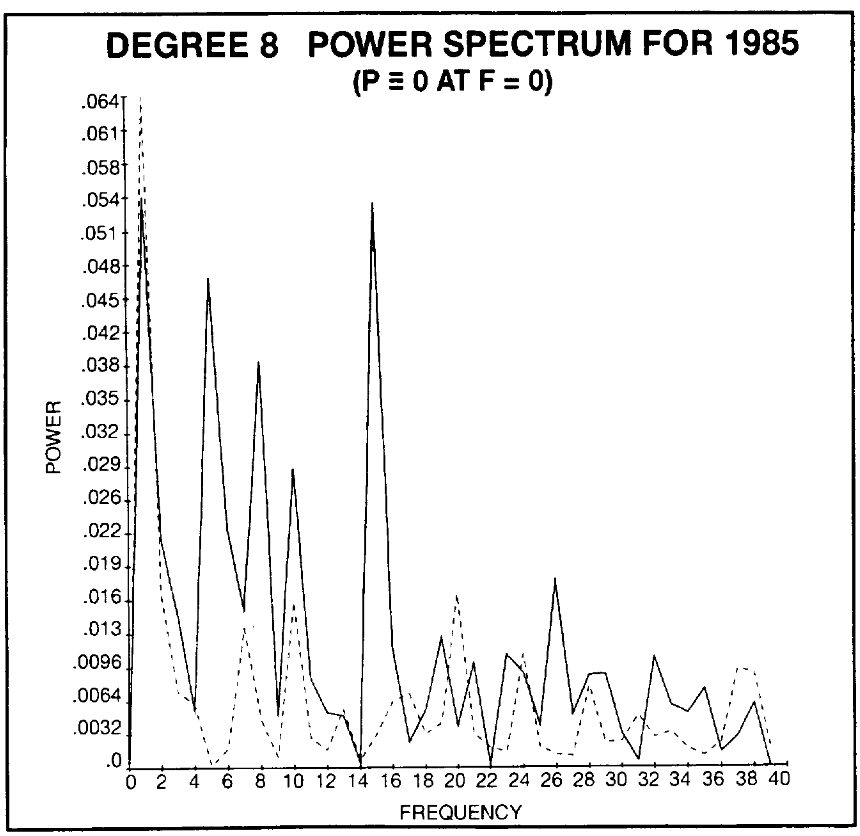

Figure 43b. Degree 8, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

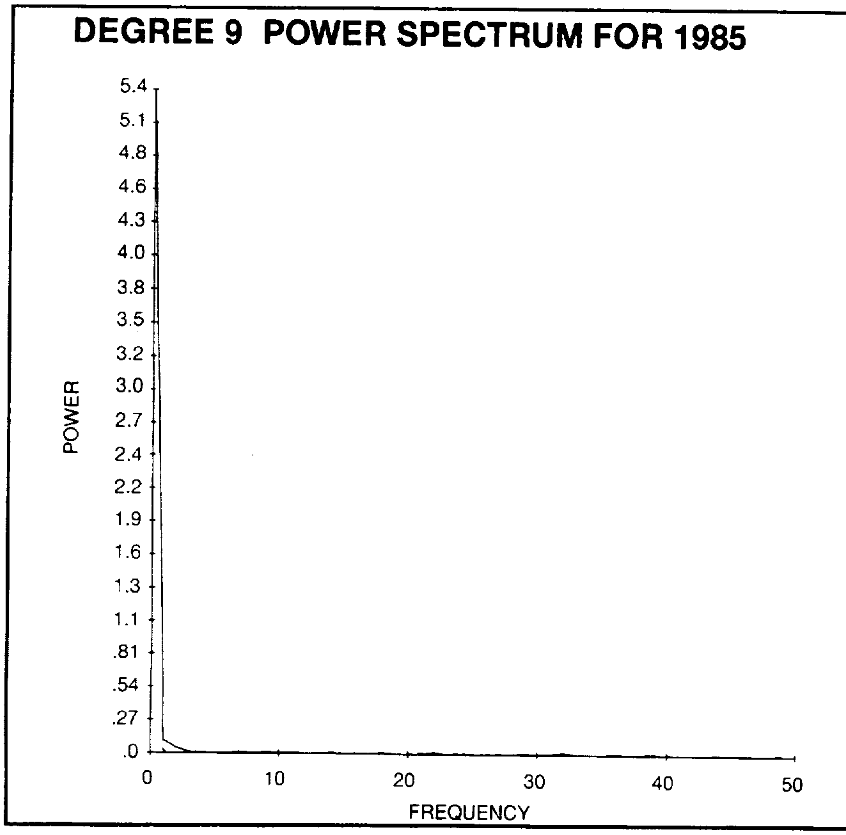

Figure 44a. Degree 9, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

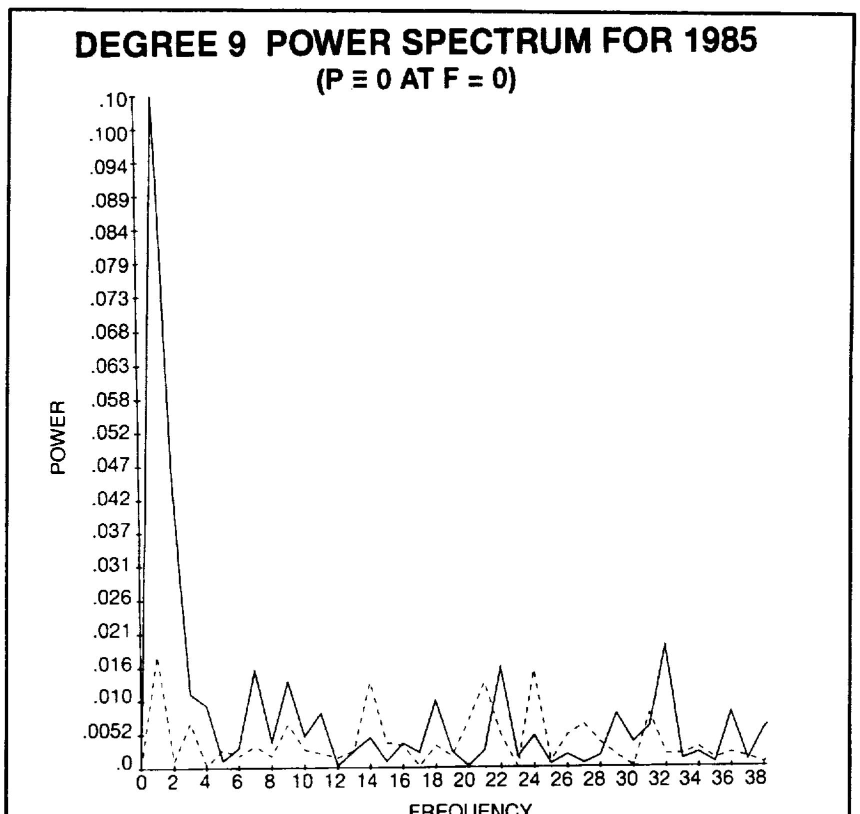

Figure 44b. Degree 9, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

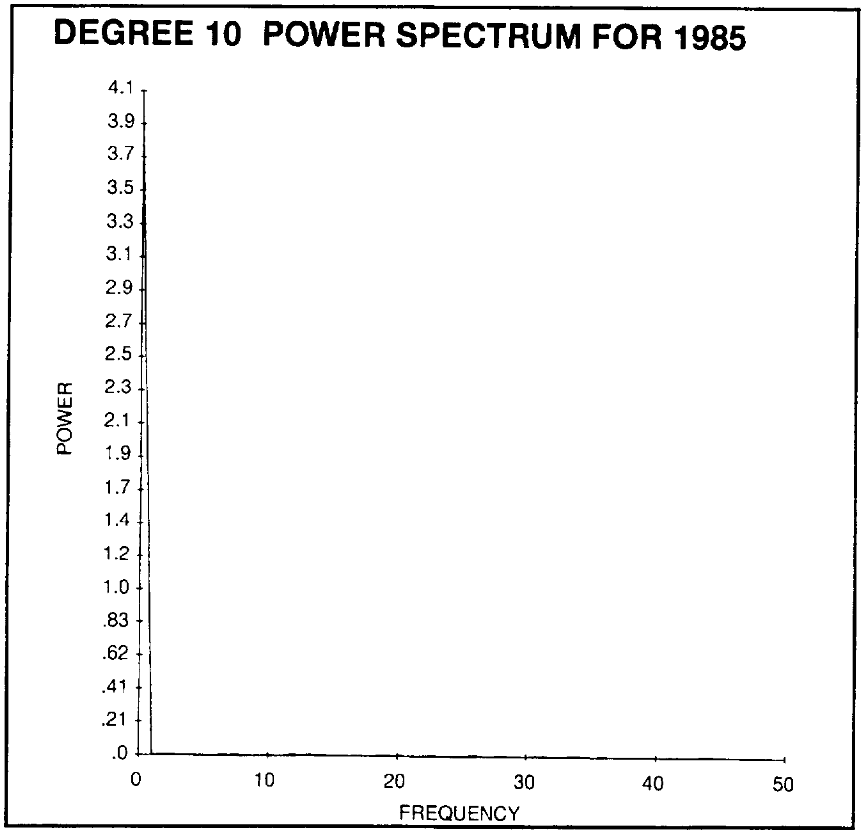

Figure 45a. Degree 10, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–50.

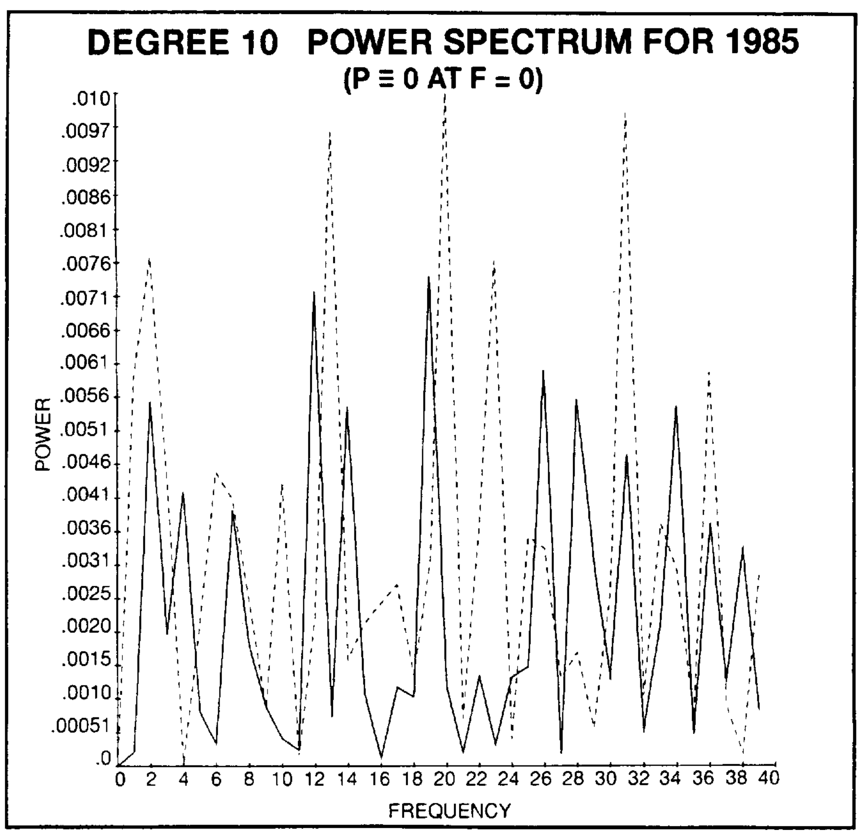

Figure 45b. Degree 10, Power Spectrum. Year 1985. Solid Line: East-West Velocity Component (u). Dashed Line: North-South Velocity Component (v). Frequencies: 0–40, Power Set to Zero at Zero Frequency.

References

Colombo, O. L., "Numerical Methods for Harmonic Analysis on the Sphere," Dept. of Geodetic Science and Surveying, Report 310, The Ohio State University, Columbus, Ohio, 1981.

Schubert, S., C. K. Park, W. Higgins, S. Moorthi, and M. Suarez, "An Atlas of ECMWF Analysis," NASA Tech. Memo., TM-100747, 1990.

Simmonds, I., "Spectral Representation of Horizontal Wind in Numerical Models of the Atmosphere," Journal of Applied Meteorology, Vol. 13, pp. 221-226, March 1974.

APPENDIX I

HARMONIC ANALYSIS OF FUNCTIONS DEFINED ON THE GLOBE

Let $f(\theta, \lambda)$ represent a function defined globally at a set of discrete points, that is,

$$f(\theta, \lambda) = f(\theta_i, \lambda_j)$$

$$i = 0, 1, \ldots, n\text{-}1$$
$$j = 0, 1, \ldots, m\text{-}1$$

λ_j : longitude $\qquad \lambda_{j+1} - \lambda_j = 2\pi/m$

θ_i : colatitude $\qquad \theta_{i+1} - \theta_i = \pi/n$

Assume that $f(\theta, \lambda)$ can be expanded in a series of spherical harmonics,

$$f(\theta, \lambda) = \Sigma_n \Sigma_m \{ (C_{nm} \cos(m\lambda) + S_{nm} \sin(m\lambda) \} P_{nm}(\theta)$$

where,

$P_{nm}(\theta)$: fully normalized Legendre functions of degree n, order m, i.e.

$$\int\int P_{nm}(\theta) \{ \cos(m\lambda), \sin(m\lambda) \} P_{kl}(\theta) \{ \cos(l\lambda), \sin(l\lambda) \} \sin(\theta)\, d\theta\, d\lambda$$
$$= (4\pi)\, \delta_{nk}\, \delta_{ml}$$

Then,

$$C_{nm} = (1/4\pi) \int\int f(\theta, \lambda) P_{nm}(\theta) \cos(m\lambda) \sin\theta\, d\theta\, d\lambda$$

$$S_{nm} = (1/4\pi) \int\int f(\theta, \lambda) P_{nm}(\theta) \sin(m\lambda) \sin\theta\, d\theta\, d\lambda$$

The power associated with the terms of degree n is given by,

$$W_n = \Sigma_m (C_{nm})^2 + (S_{nm})^2$$

APPENDIX II

POWER SPECTRUM OF FUNCTIONS DEFINED ON THE GLOBE

Let F denote a function such as C_{nm} , S_{nm} , or W_n , as defined in Appendix I. If certain basic conditions are satisfied, then F can be expanded in a Fourier series:

$$F = a_0 + a_1 \cos(t) + b_1 \sin(t) + a_2 \cos(2t) + b_2 \sin(2t) + \ldots + a_{365} \cos(365t) + b_{365} \sin(365t).$$

for $0 \leq t \leq 2\pi$

If the data covers a time span of one year, then the zero frequency term corresponds to the average over the year, frequency 1 corresponds to a periodicity of one year, frequency 2 corresponds to a periodicity of 6 months, and so on. The power corresponding to each frequency is given by:

$$P_i = (a_i)^2 + (b_i)^2$$

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
July 1997

3. REPORT TYPE AND DATES COVERED
Technical Memorandum

4. TITLE AND SUBTITLE
Spherical Harmonics Analysis of the ECMWF Global Winds Fields at the 10-Meter Height Level During 1985: A Collection of Figures Illustrating Results

5. FUNDING NUMBERS
Code 926

6. AUTHOR(S)
Braulio V. Sanchez and Masahiro Nishihama

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES)
Goddard Space Flight Center
Greenbelt, Maryland

8. PEFORMING ORGANIZATION REPORT NUMBER
97B00064

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES)
National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
TM–104648

11. SUPPLEMENTARY NOTES
Braulio V. Sanchez, email: g5bvs@charney.gsfc.nasa.gov
Masahiro Nishihama: Hughes STX, 7701 Greenbelt Road, Suite 400, Greenbelt, Maryland

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unclassified - Unlimited
Subject Category: 46
This report is available from the NASA Center for AeroSpace Information, 800 Elkridge Landing Road, Linthicum Heights, MD 21090;301-621-0390

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Half-daily global wind speeds in the east-west (u) and north-south (v) directions at the 10-meter height level were obtained from the European Centre for Medium Range Weather Forecasts (ECMWF) data set of global analyses. The data set covered the period 1985 January to 1995 January.

A spherical harmonic expansion to degree and order 50 was used to perform harmonic analysis of the east-west (u) and north-south (v) velocity field components.

The resulting wind field is displayed, as well as the residual of the fit, at a particular time. The contribution of particular coefficients is shown. The time variability of the coefficients up to degree and order 3 is presented. Corresponding power spectrum plots are given. Time series analyses were applied also to the power associated with degrees 0-10; the results are included.

14. SUBJECT TERMS
Spherical Harmonics, Wind Fields, ECMWF

15. NUMBER OF PAGES
62

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL