

# TOGA Pseudo-stress Atlas

## 1985-1994

**Volume 1: Tropical Atlantic**

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**September 1996**

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**CRSI**

## *Forward*

*The TOGA programme made considerable progress in the understanding and modelling of oceanic and coupled processes in the tropics. One of the major reasons for this was the progress in analyzing and distributing a surface wind product. This volume is the first in a three part series covering the three tropical oceans. Acquiring data was but one part of the TOGA programme: creating, documenting, cataloguing and distributing the data are equally important. I thank the authors Jacques Servain, James Stricherz, and David Legler for their work in analyzing the surface wind fields for the Atlantic and creating this nice record of the mean wind field and its variations over the TOGA period.*

*As any ocean modeller knows only too well, the performance of a numerical models is a strong function of the forcing fields, particularly the wind field. The analyses for all the tropical oceans performed by David Legler, Jacques Servain, and James Stricherz will provide an excellent record of the TOGA programme in providing forcing fields for ocean modellers. They will provide a nice complement to the forcing fields being developed from the atmospheric reanalyses currently underway at NCEP and at ECMWF. Only by using these fields to force ocean models and by intercomparing results will progress be made in both improving models and the forcing fields.*

*The authors would welcome any feedback on your perceived strengths or weaknesses of the fields. Although TOGA has now ended, it is a pleasure to see projects begun under TOGA coming to fruition. As the last Chairman of the International TOGA Scientific Steering Group, I would like to thank the authors for the valuable contribution they have made. I hope you will enjoy studying these atlases.*



David Anderson  
June 1996

## DATA PROCESSING

Monthly mean and anomaly fields of pseudo wind stress (the wind component times the magnitude) of the tropical Atlantic Ocean are presented in this atlas from January 1985 through December 1994. This period coincides with the 10 years of the international Tropical Ocean Global Atmosphere (TOGA) program. This is an update of three earlier atlases covering the periods 1964-1979 (Picaut *et al.*, 1985), 1980-1984 (Servain *et al.*, 1987) and 1985-1989 (Servain & Lukas, 1990). Furthermore in this atlas, derived products (curl, divergence, variability ellipsoids) are presented for annual and monthly climatologies.

Most of the observations that have determined the fields presented here were measurements made on ships of opportunity. The rest are from fixed (very few) and drifting buoys. The data were transmitted over the Global Telecommunication System (GTS) and recorded in real time by the National Meteorological Center (NMC, Washington, DC). These real-time data and additional data that were delayed in transmission, were archived by the National Climatic Data Center (NCDC, Asheville, NC). The data, covering from 60°W to the African coast and from 30°N to 20°S are provided to us, by the Center for Ocean-Atmospheric Prediction Studies (COAPS) at Florida State University, Tallahassee, FL. Between 6,000 and 8,000 observations are received each month for the study region.

Though continuously increasing, the number of real time reports collected by NMC is of course less than that of the delayed mode data at NCDC. In 1987 for instance, the difference was about 20%. However, for the Atlantic, this difference does not affect significantly the reliability of the real time analysis: in fact 5% to 10%

of the delayed observations in the NCDC data set are redundant and most of the extra observations in the delayed data are in areas which are already well sampled. Notice that the narrowness of the tropical Atlantic basin, compared to the width of the Pacific, can explain why the space-time density of the observations is two times larger here than in the Pacific.

Details of the data processing methods to calculate the monthly pseudo wind stress fields can be found in Picaut *et al.*, 1985, Servain *et al.*, 1985a, 1985b, and 1987. Briefly summarized, this method is based on a combination of objective and subjective analysis. The data are first averaged in 2° latitude by 5° longitude boxes. All the individual values statistically unrealistic within these boxes are then discarded, corrected or kept according to the result of a climatological test and a consistency test with values of the surrounding boxes. This procedure prevents rejecting dramatic abnormal events. Then, an objective analysis method of the successive-correction type (Cressman, 1959) is used to create a 2°x2° gridded monthly data field without gaps.

The monthly anomaly fields presented in this atlas are computed using two different climatologies, one from the 1964-1994 data set, another performed from the TOGA years (1985-1994).

The same techniques are used for all the charts presented in this atlas. The data from NCDC were used to create the plots for 1985 and 1986. Since January 1987, we have used the monthly real time data from NMC (sent via COAPS-FSU).

The 1985, and from 1988 data files have been prepared in Centre ORSTOM at Brest. The 1986 and 1987 data files have been prepared in Instituto de Pesquisas Espaciais (INPE) at São José dos Campos, SP, Brazil.

The original digital form of this atlas has been generated at COAPS-FSU.

## EXPLANATION OF MAPS

The climatology charts are the overall annual and monthly mean pseudo wind stress vectors, curl of the wind stress vectors, and the divergence of the wind from the 1985-1994, and 1964-1994 objective analysis data over the tropical Atlantic on a 2° latitude-longitude grid. The contour intervals are the same for each type of map.

The wind roses were computed on an eight point compass starting at North (0°) and incremented every 45° (NNE or 45°, E or 90°, etc.). A mean for each directional bin was computed and plotted for both the climatological monthly means and overall mean for each analysis period.

Charts follow for the monthly pseudo wind stress means for all 120 months, January 1985 through December 1994. The wind stress components are given by

$$\tau_x = \rho_a C_D u |V| \quad (1)$$

$$\tau_y = \rho_a C_D v |V|$$

where  $u, v$  are the eastward, and northward components of the horizontal wind,  $|V|$  is the wind speed,  $C_D$  is the drag coefficient,  $\rho_a$  is the density of dry air, and  $\tau$  is the wind stress vector, with components  $\tau_x$  and  $\tau_y$ .  $T_x = u |V|$ ,  $T_y = v |V|$  are the eastward and northward pseudo wind stress components respectively. Vectors are plotted of the pseudo wind stress vectors. Vector magnitudes are indicated by contours. The contour interval is  $10 \text{ m}^2 \text{s}^{-2}$ .

Monthly pseudo wind stress anomalies are shown for deviations from the mean calendar month for the period 1985-1994 and also for 1964-1994. The contour interval is  $10 \text{ m}^2 \text{s}^{-2}$ .

Contoured plots of the mean wind stress curl were derived from the 2° pseudo wind stress data. The magnitude of the curl is given by

$$\zeta = \hat{k} \bullet \nabla \times \tau = \frac{\partial \tau_y}{\partial x} - \frac{\partial \tau_x}{\partial y} \quad (2)$$

where  $\tau$ ,  $\tau_x$ , and  $\tau_y$  are as defined in (1). The variation in the meridional separation was taken into account in these calculations. A single pass of a 1-2-1 smoother was applied in both the N-S and E-W directions. The contour interval is  $2 \times 10^{-8} \text{ N m}^{-3}$ .

Plots of the wind divergence are calculated from the pseudo wind stress components:

$$u' = \frac{T_x}{(T_x^2 + T_y^2)^{\frac{1}{4}}} \quad (3)$$

$$v' = \frac{T_y}{(T_x^2 + T_y^2)^{\frac{1}{4}}}$$

where  $T_x, T_y$  are the pseudo wind stress components. The divergence of the wind is then given by

$$\nabla \bullet V = \frac{\partial u'}{\partial x} + \frac{\partial v'}{\partial y} \quad (4)$$

The derivatives were computed and smoothing applied by the same methods used for calculating the curl. The contour interval is  $2 \times 10^{-6} \text{ s}^{-1}$ .

## DATA AVAILABILITY

The pseudo wind stress data are available via World-Wide-Web at <ftp://ftp.ifremer.fr/ifremer/orstom>. For additional information, please contact

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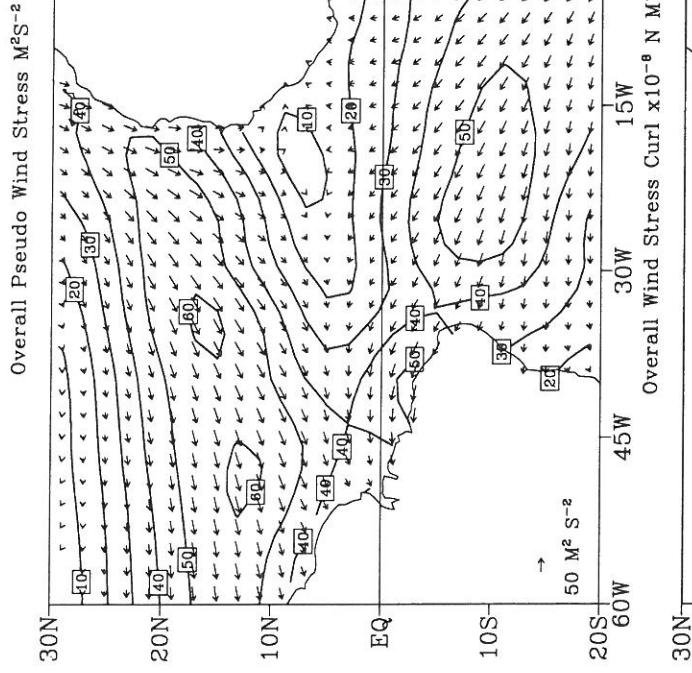
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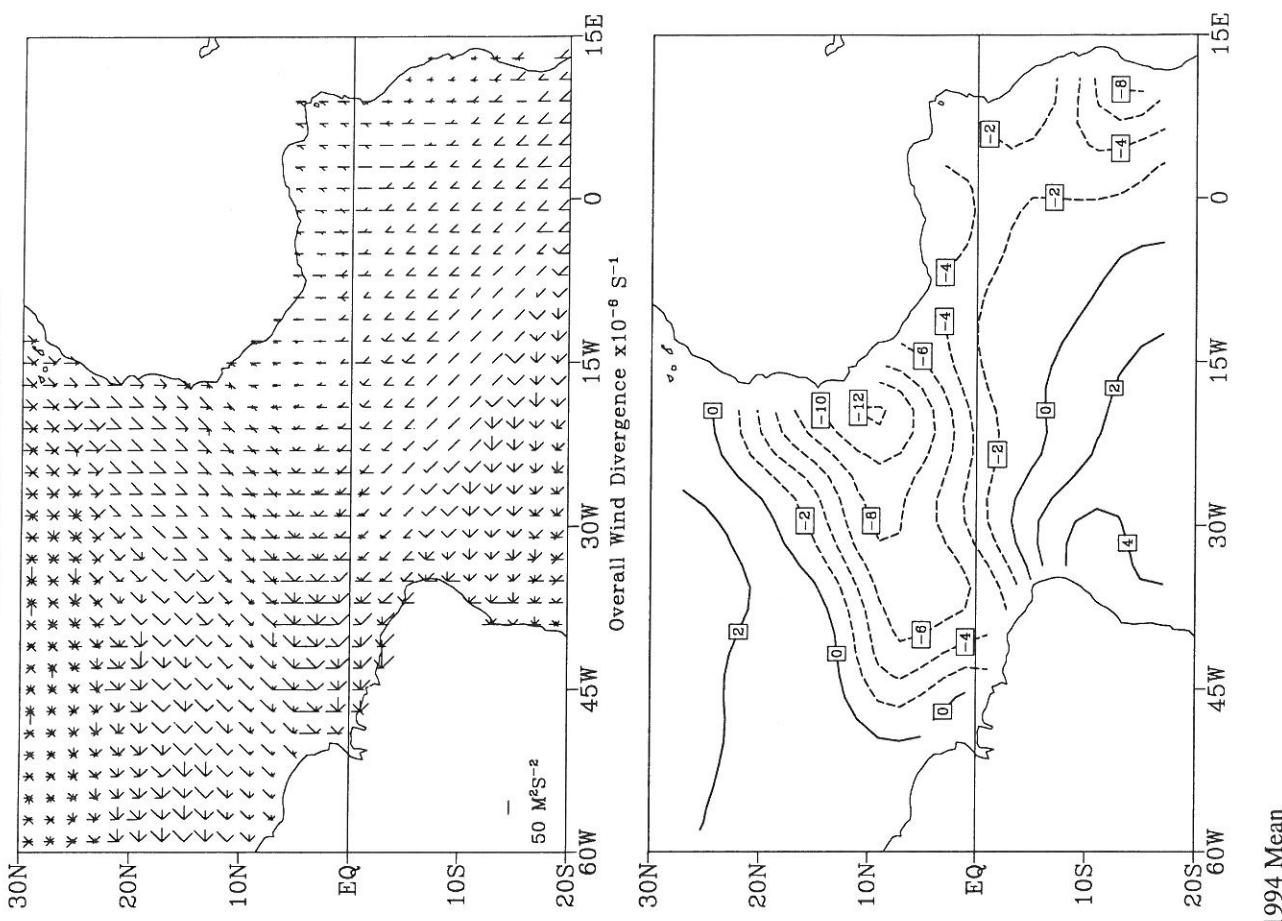
### Acknowledgments

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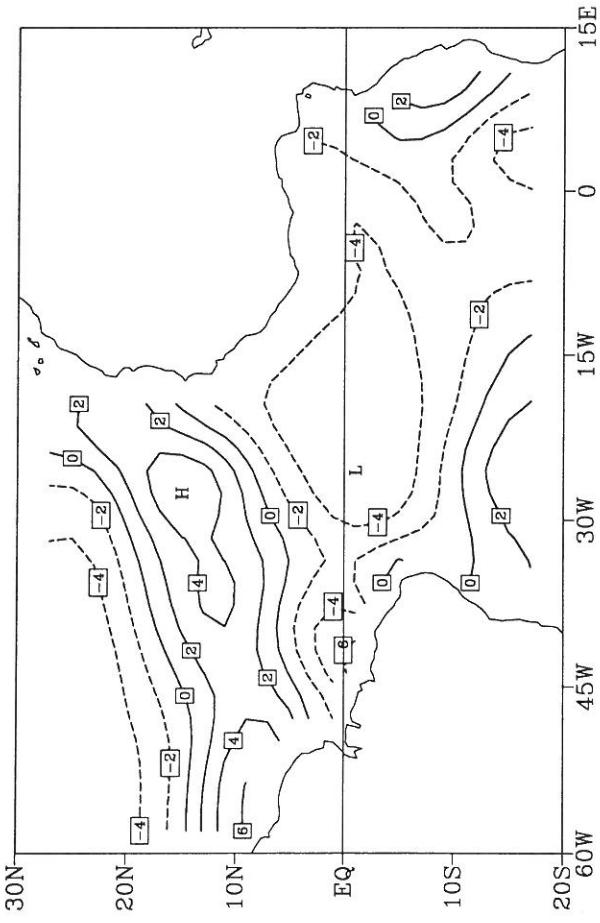
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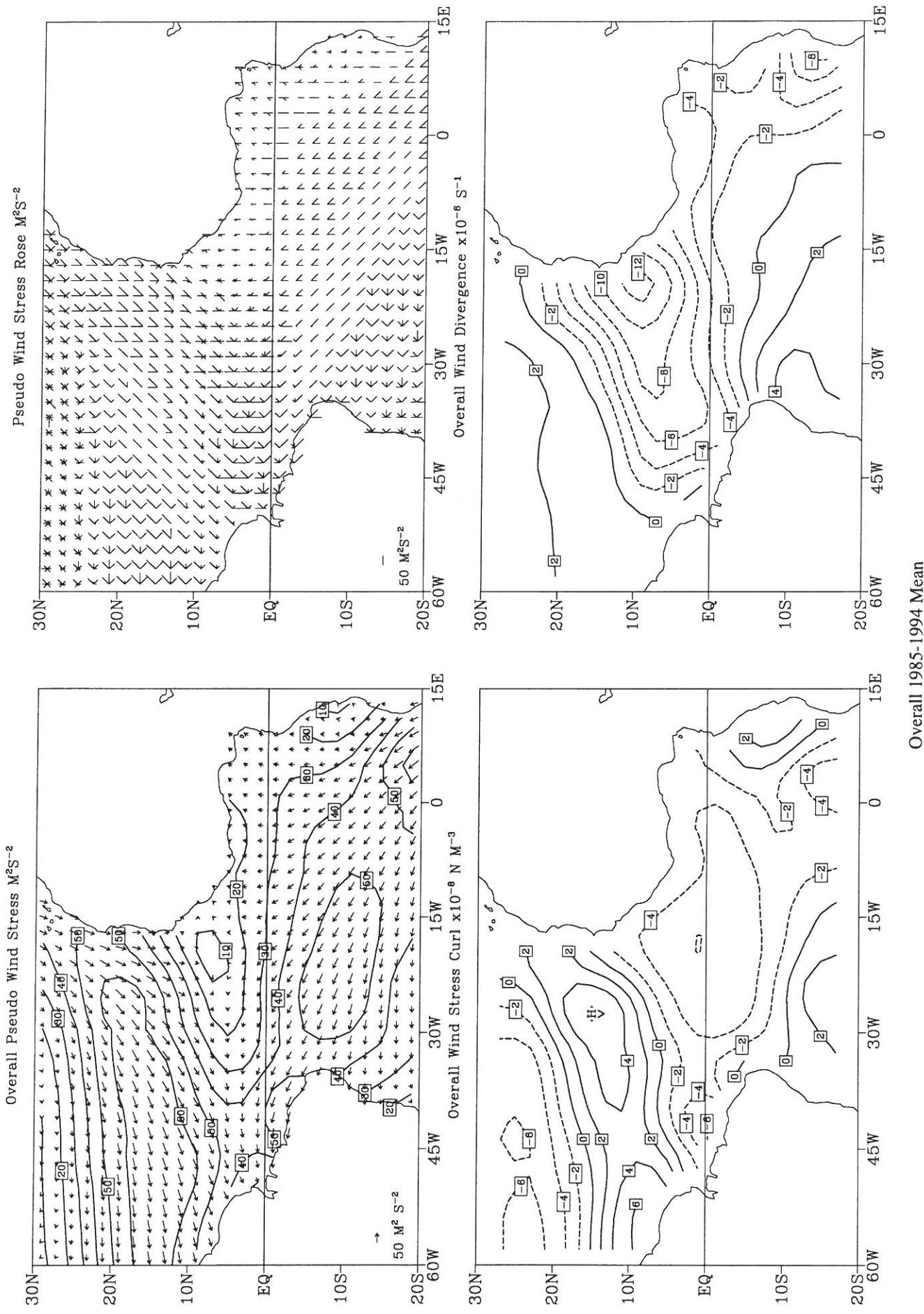


Pseudo Wind Stress Rose  $M^2S^{-2}$



Overall 1964-1994 Mean

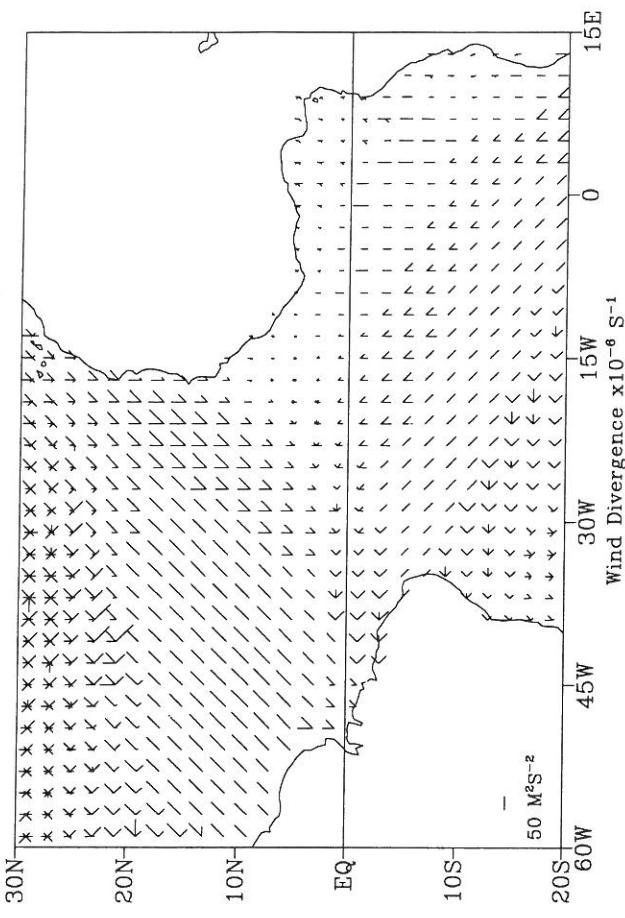




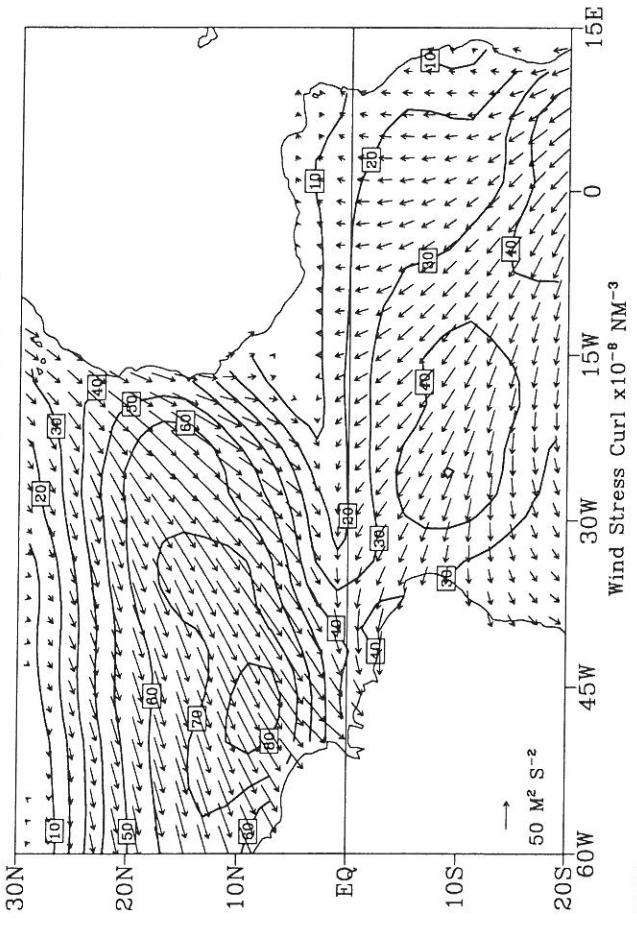
Overall 1985-1994 Mean

# Monthly Climatologies

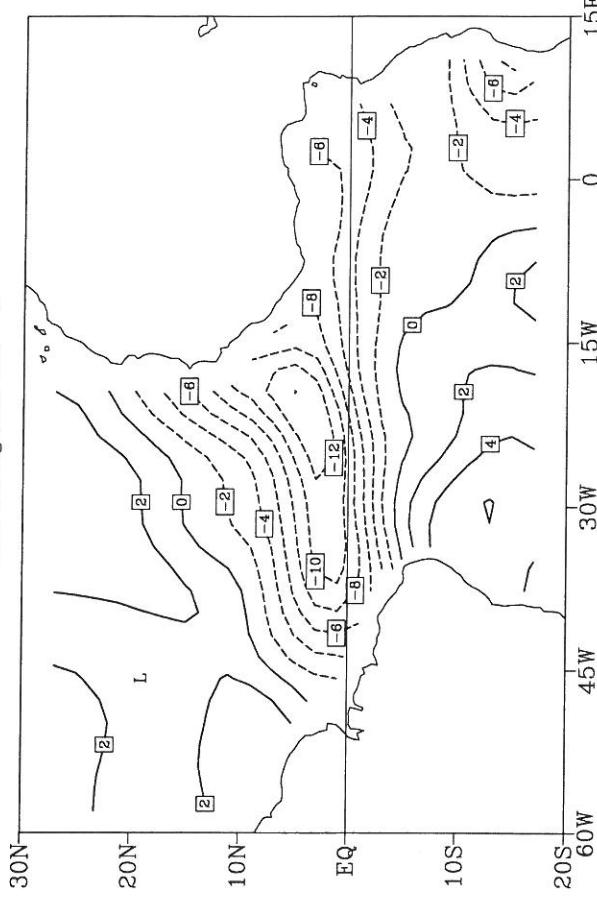
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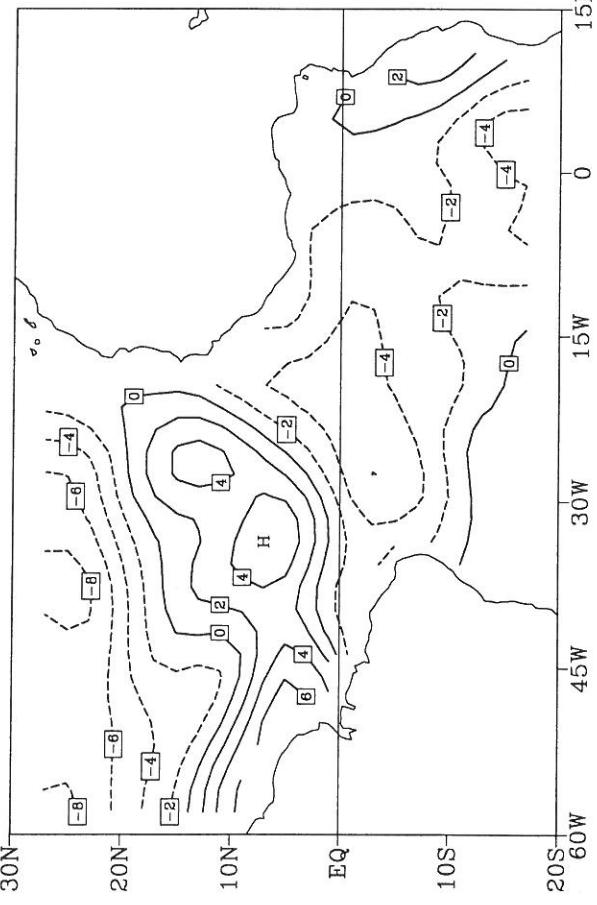
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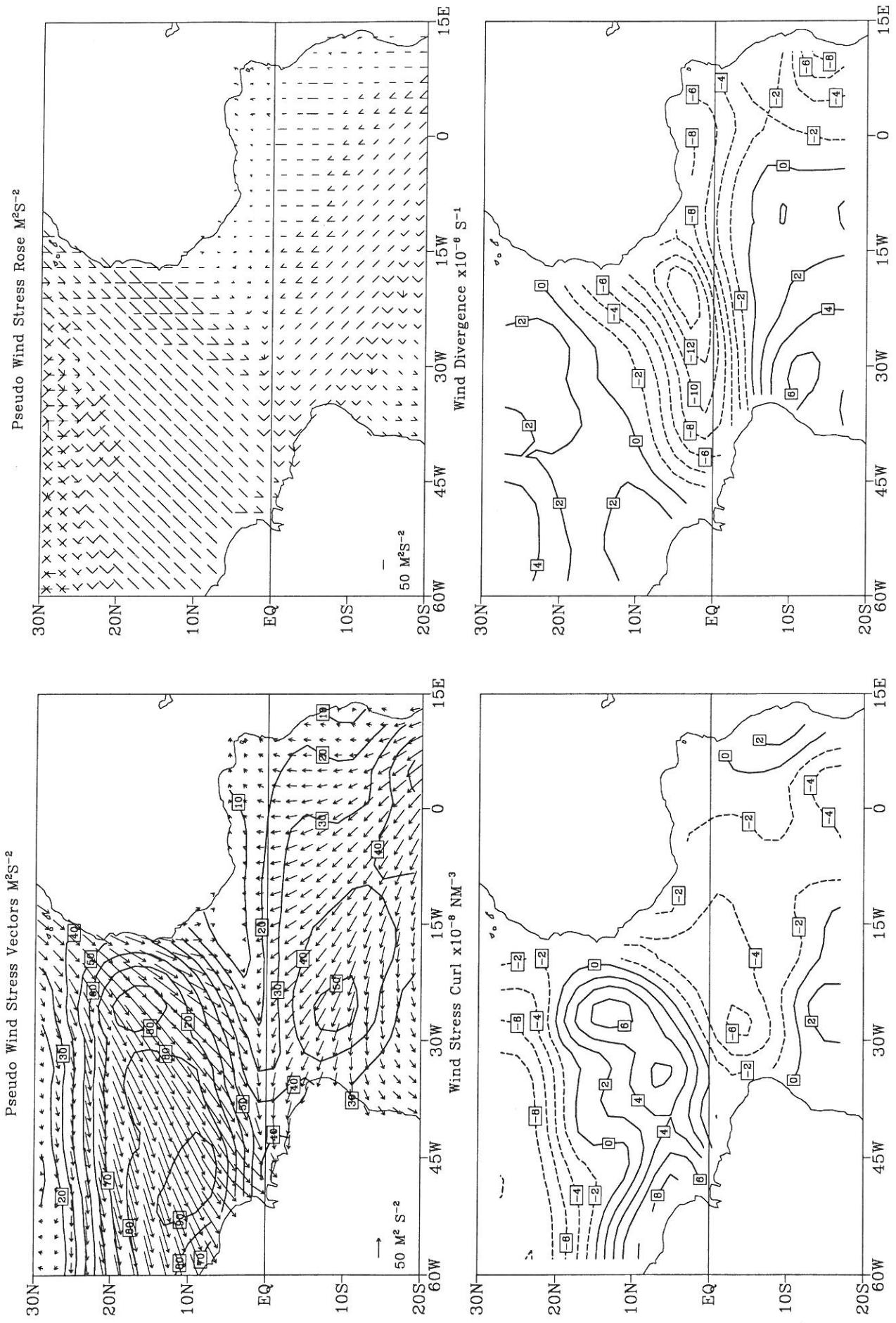
Wind Divergence  $\times 10^{-8} S^{-1}$



Wind Stress Curl  $\times 10^{-8} NM^{-3}$

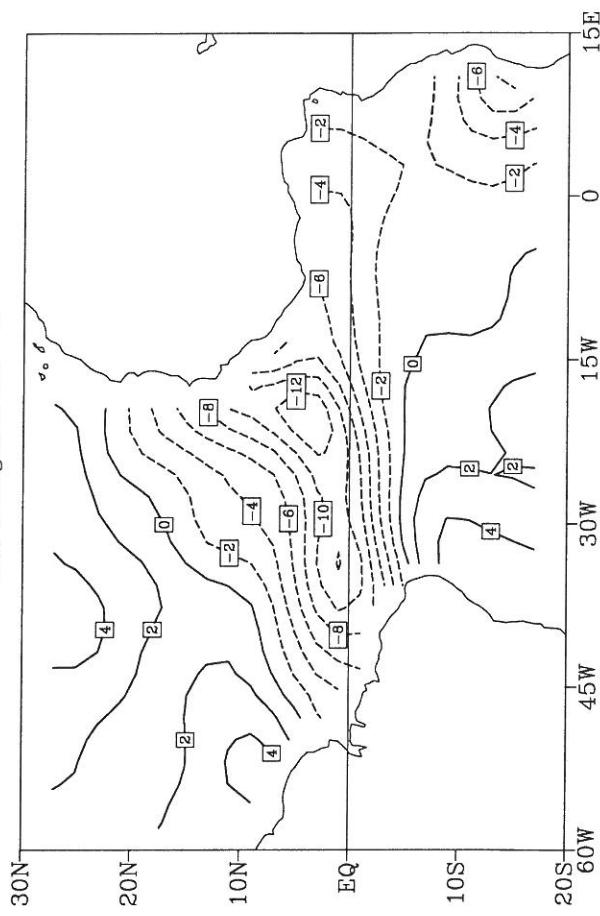
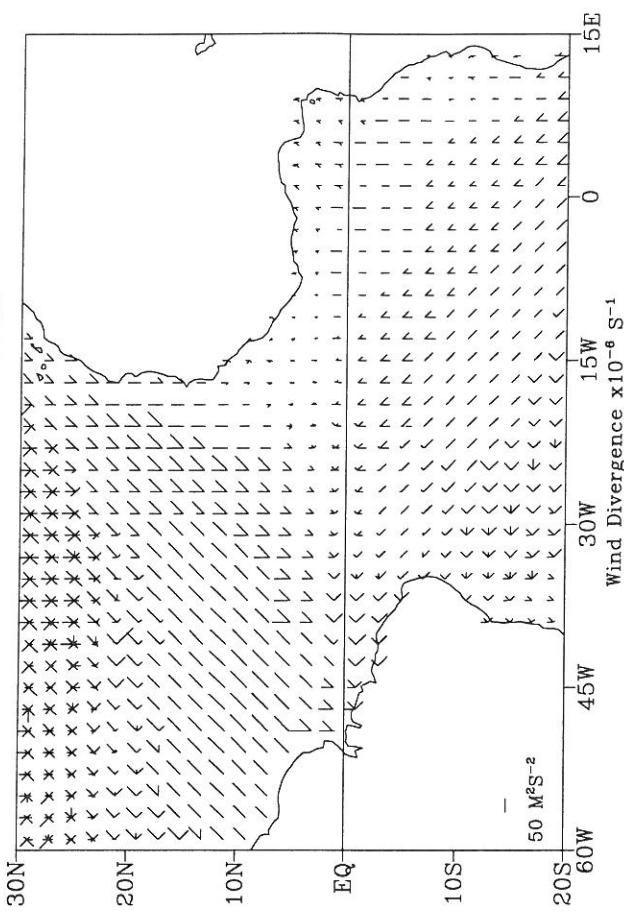


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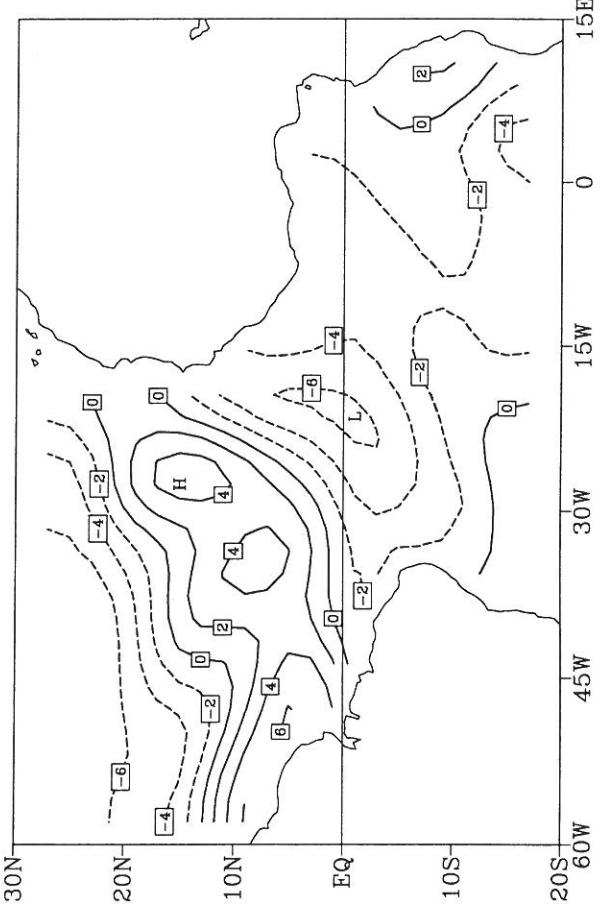
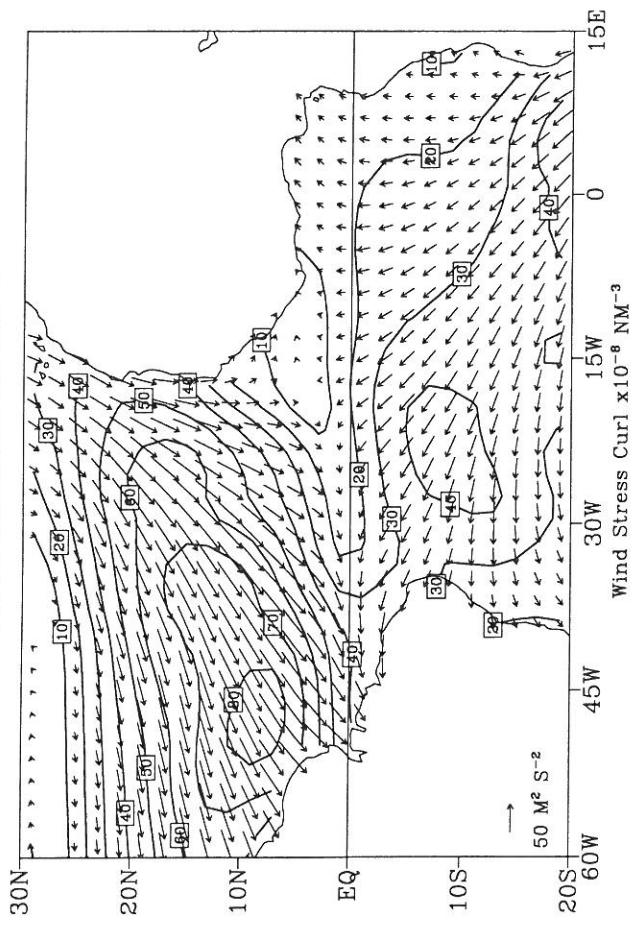


1985-1994 January Climatology

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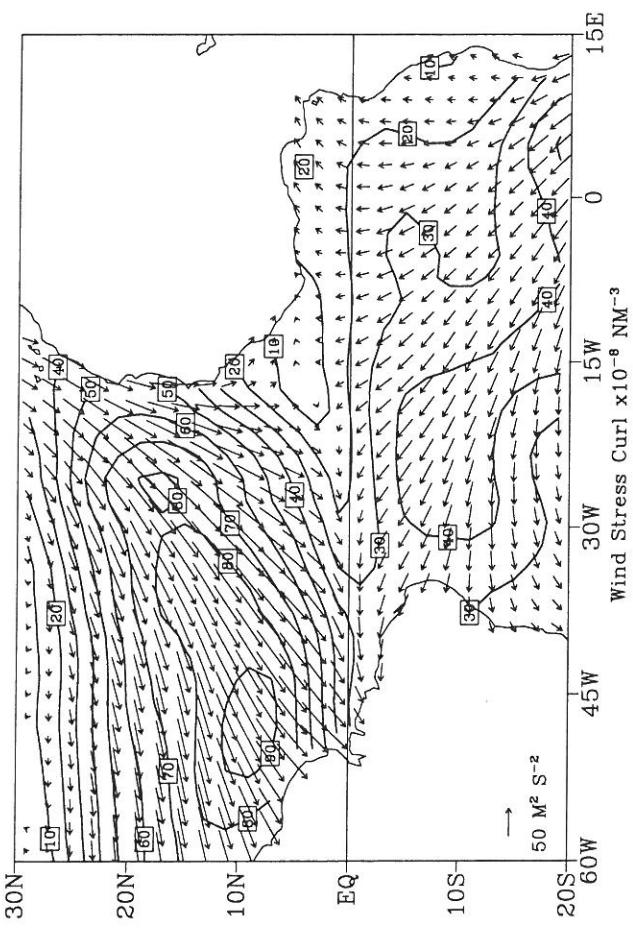


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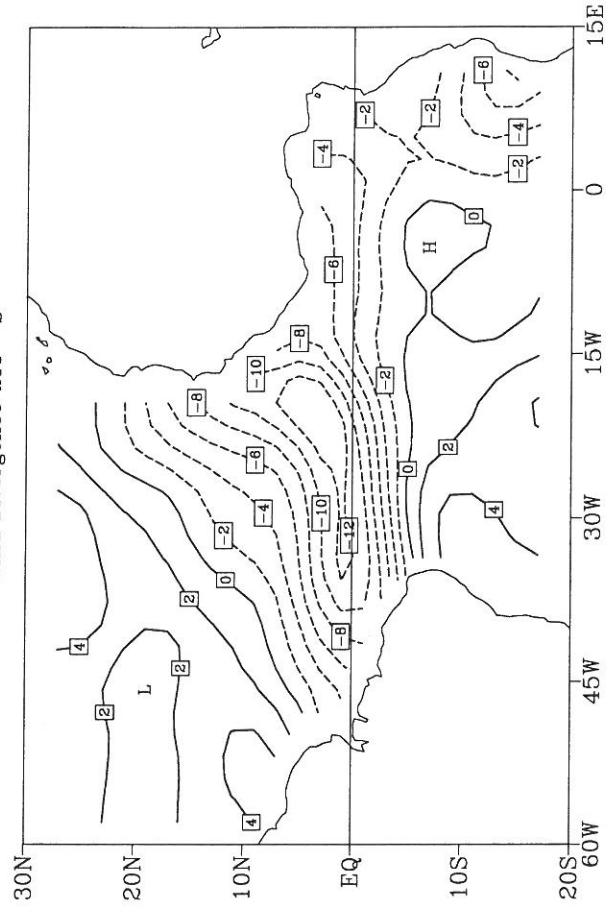
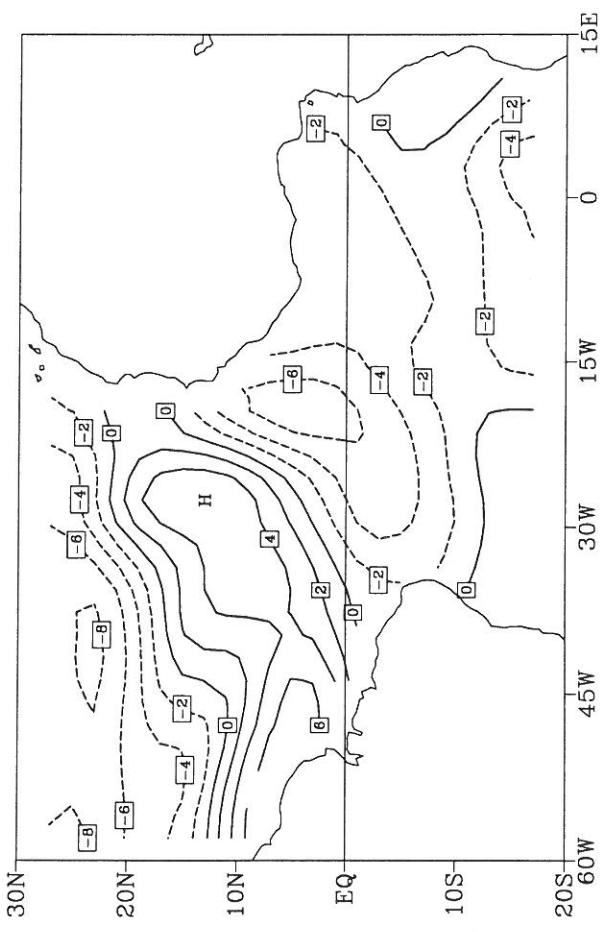
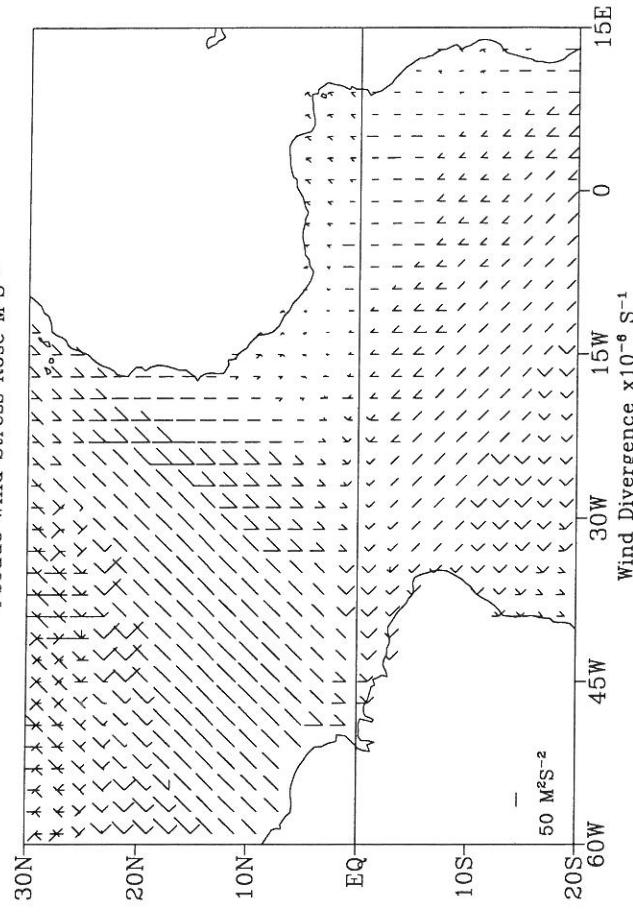


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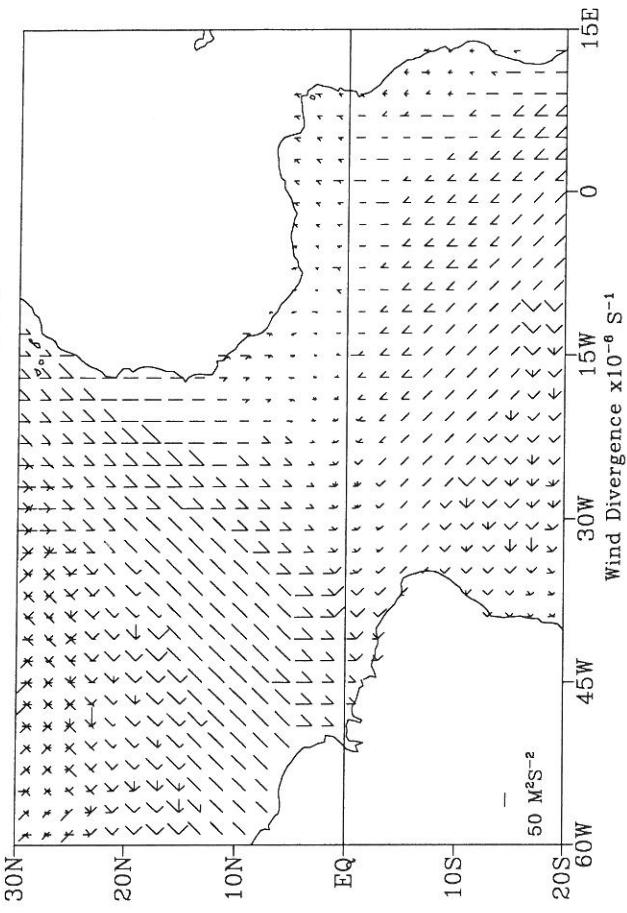
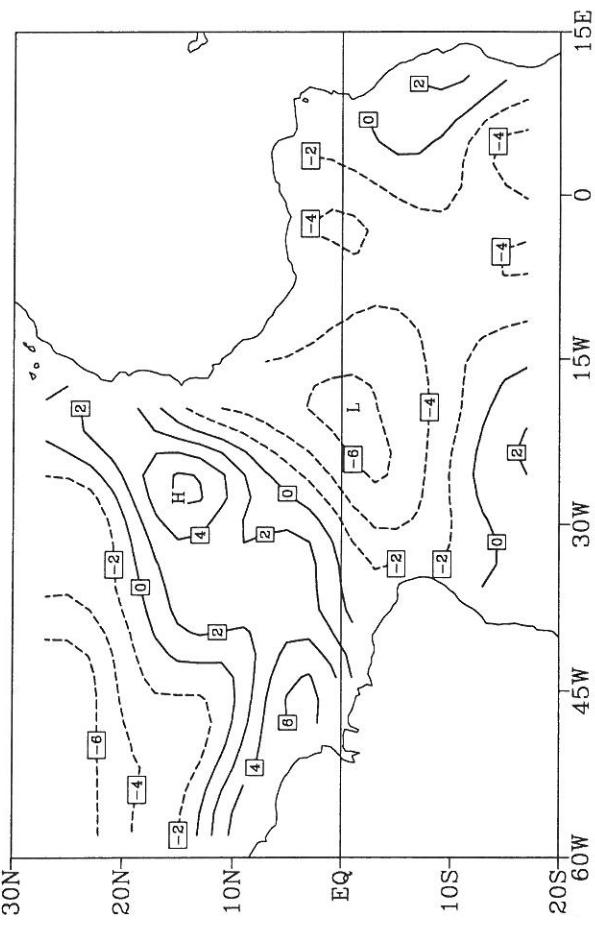
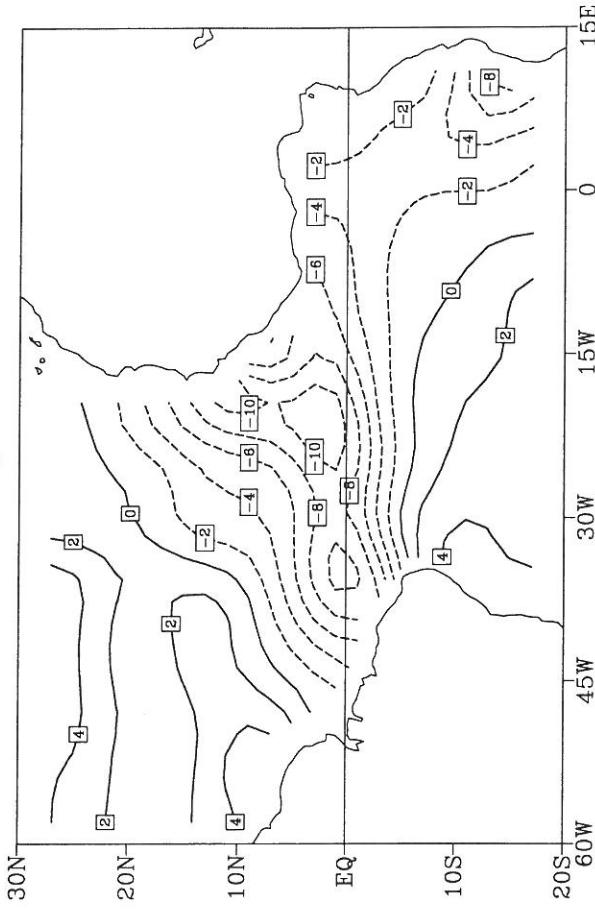
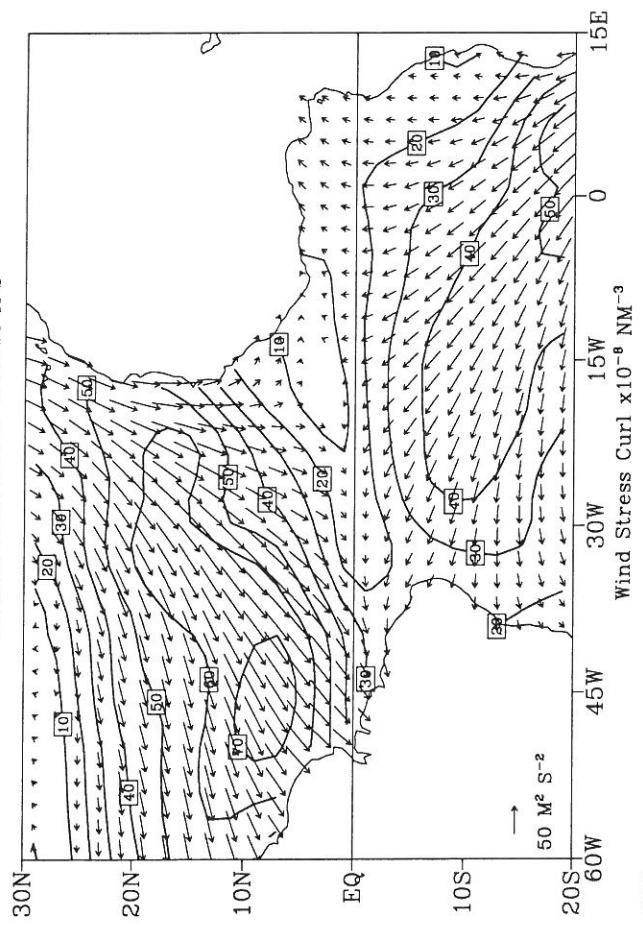
Pseudo Wind Stress Vectors  $M^2 S^{-2}$



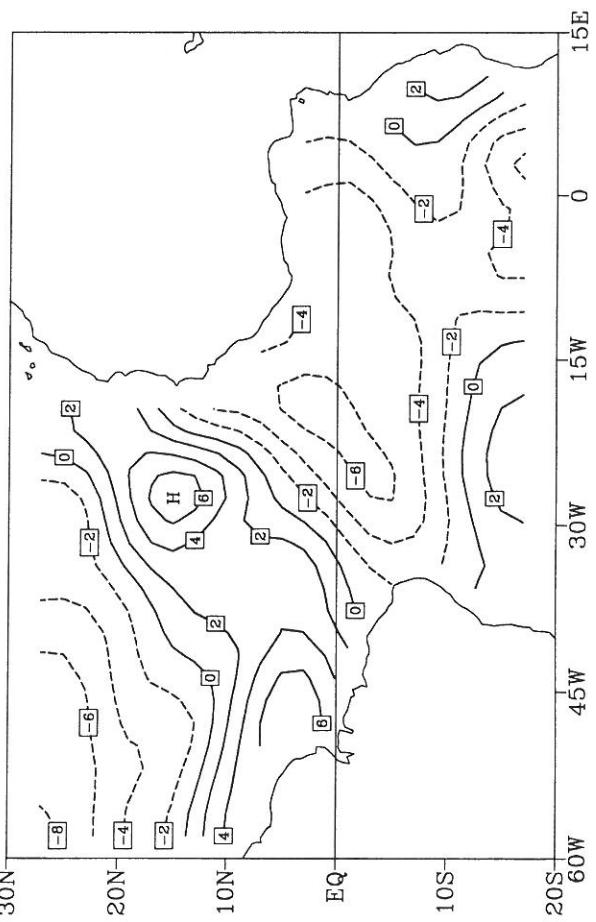
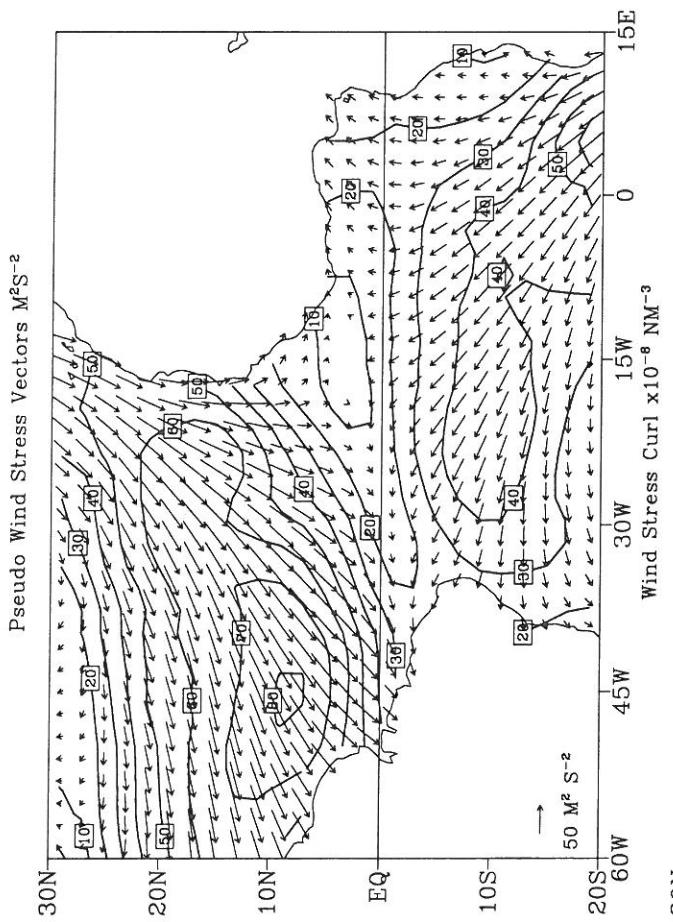
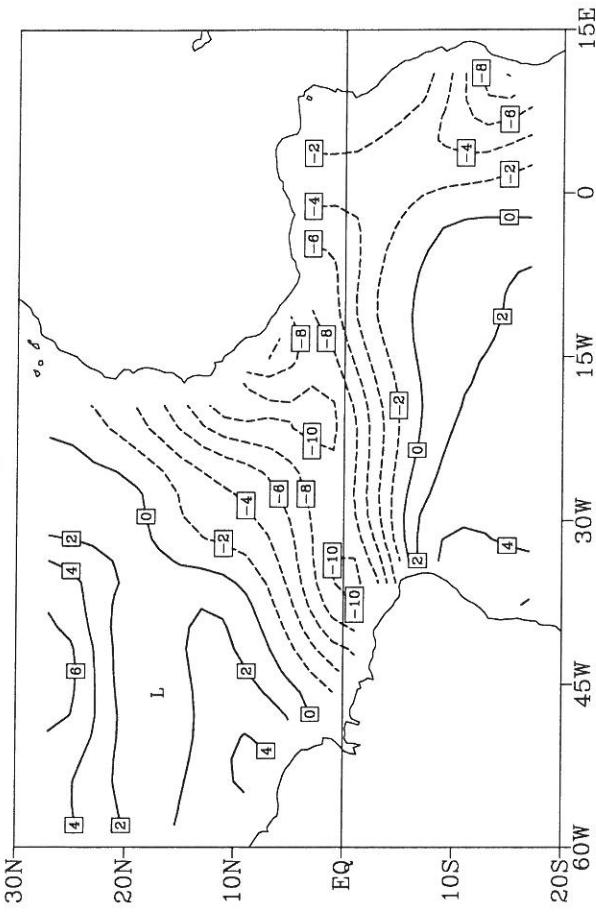
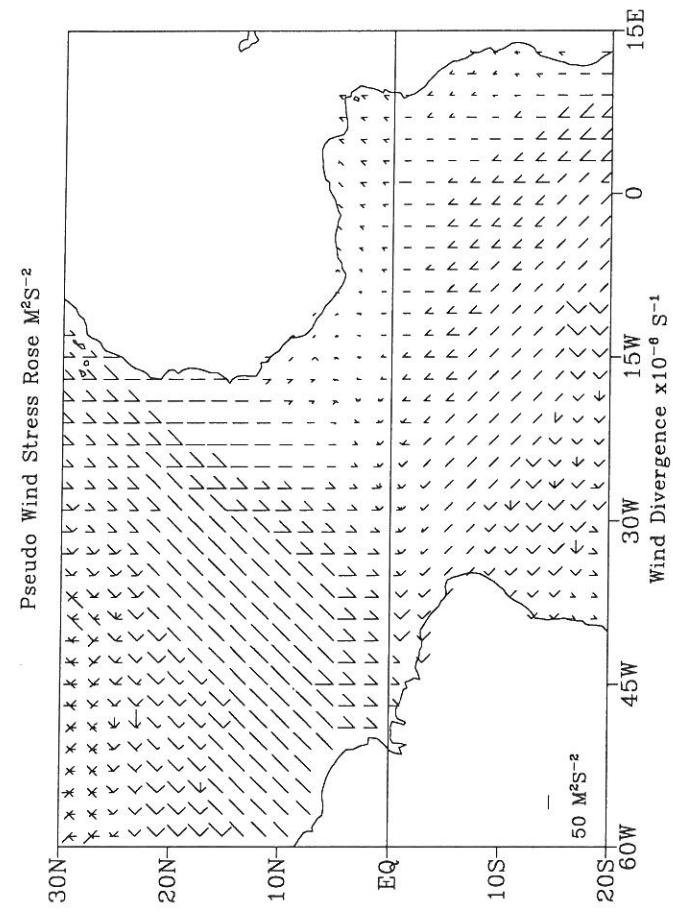
Pseudo Wind Stress Rose  $M^2 S^{-2}$



1985-1994 February Climatology

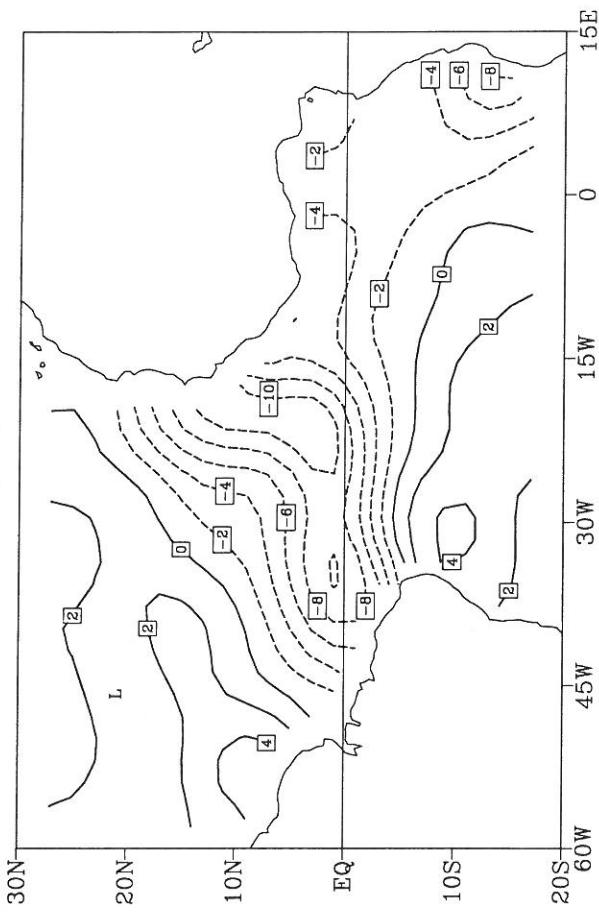
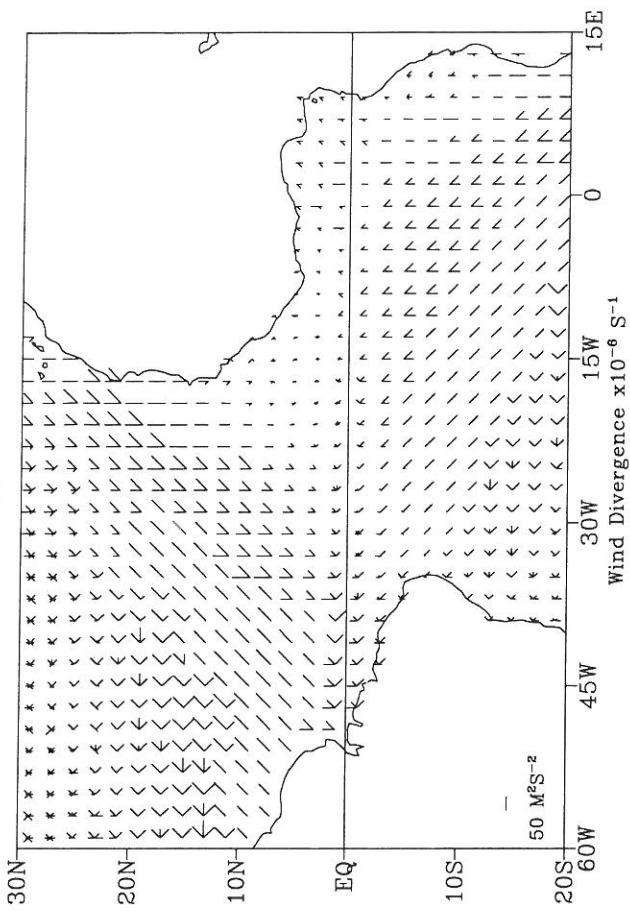
Pseudo Wind Stress Rose  $M^2 S^{-2}$ Pseudo Wind Stress Vectors  $M^2 S^{-2}$ 

1964-1994 March Climatology

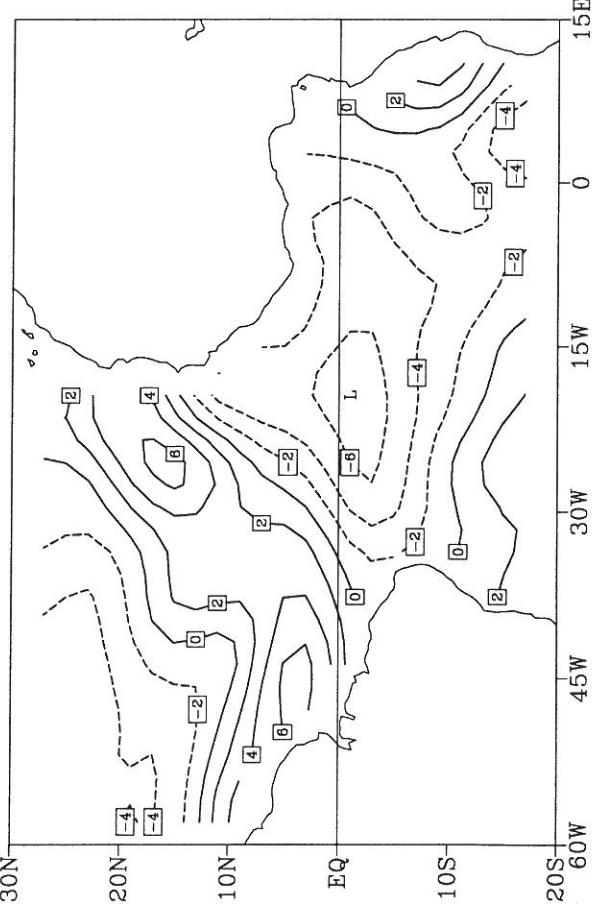
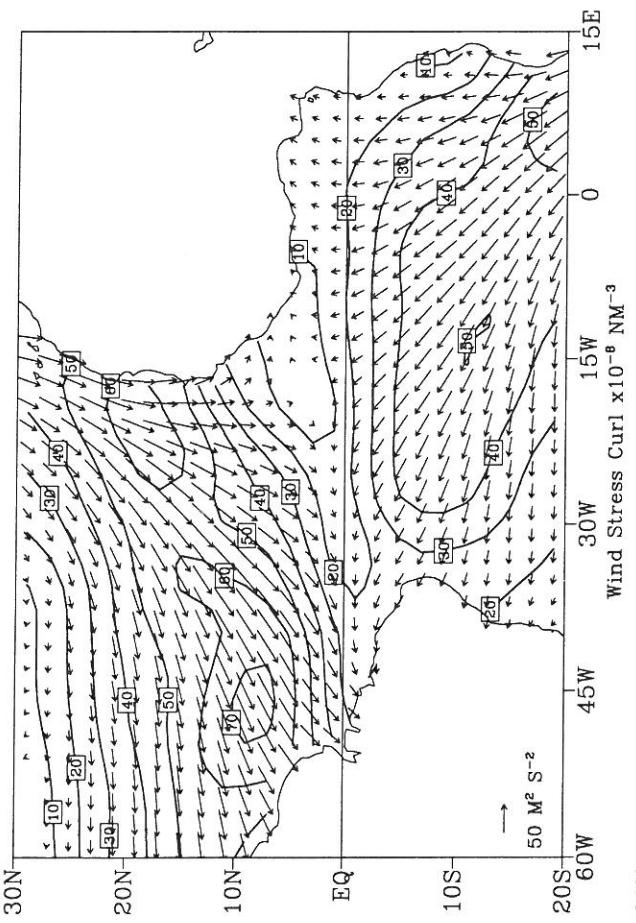


1985-1994 March Climatology

Pseudo Wind Stress Rose  $M^2 S^{-2}$

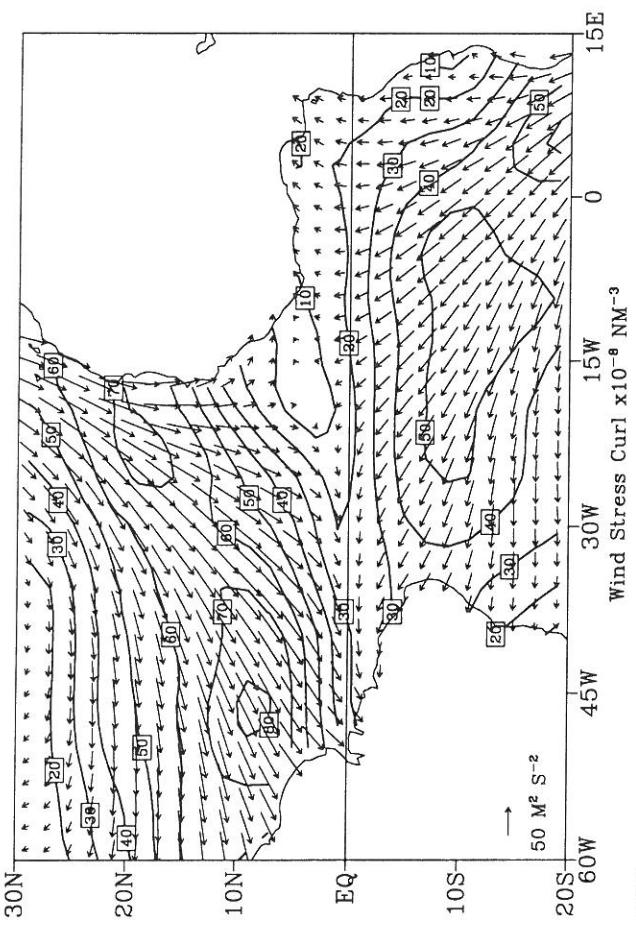


Pseudo Wind Stress Vectors  $M^2 S^{-2}$

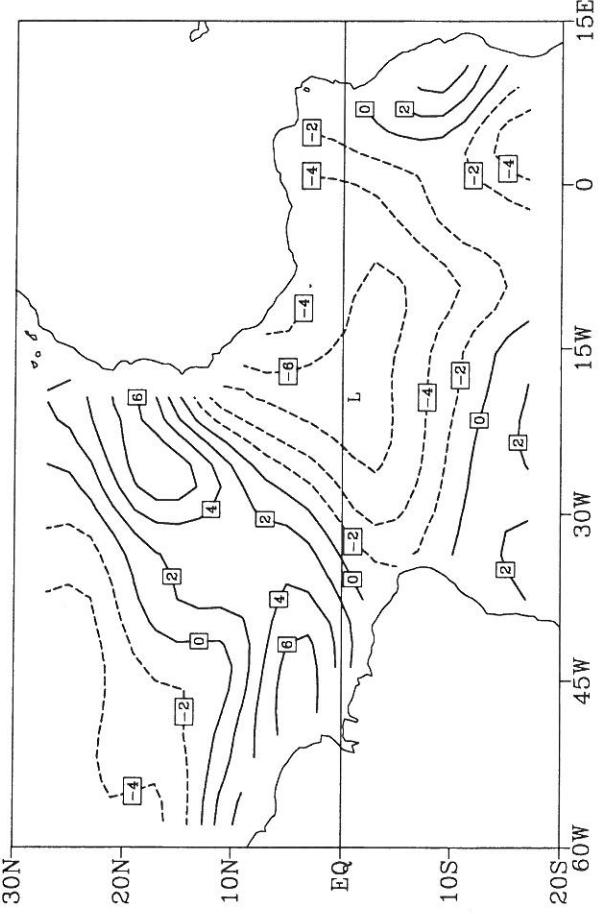
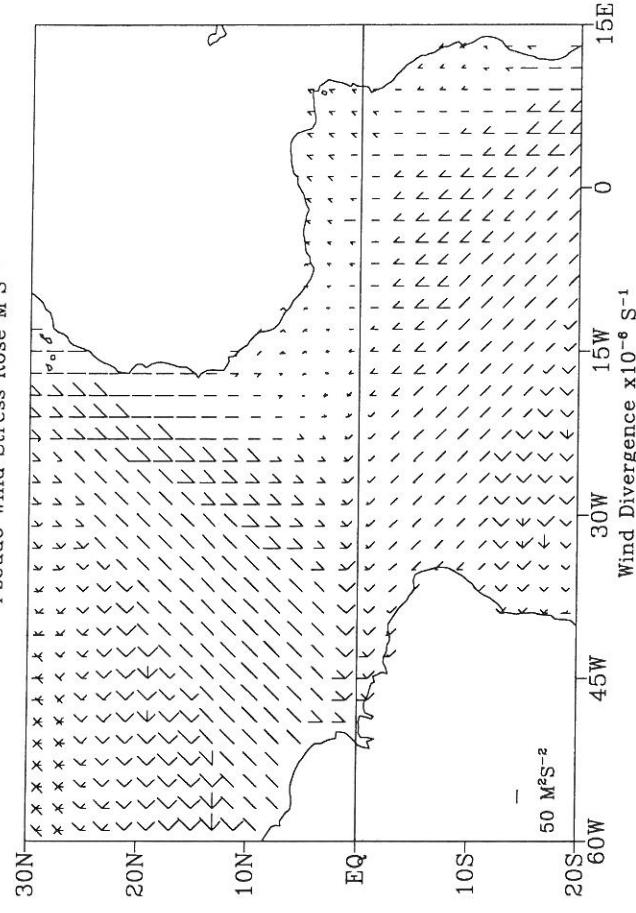


1964-1994 April Climatology

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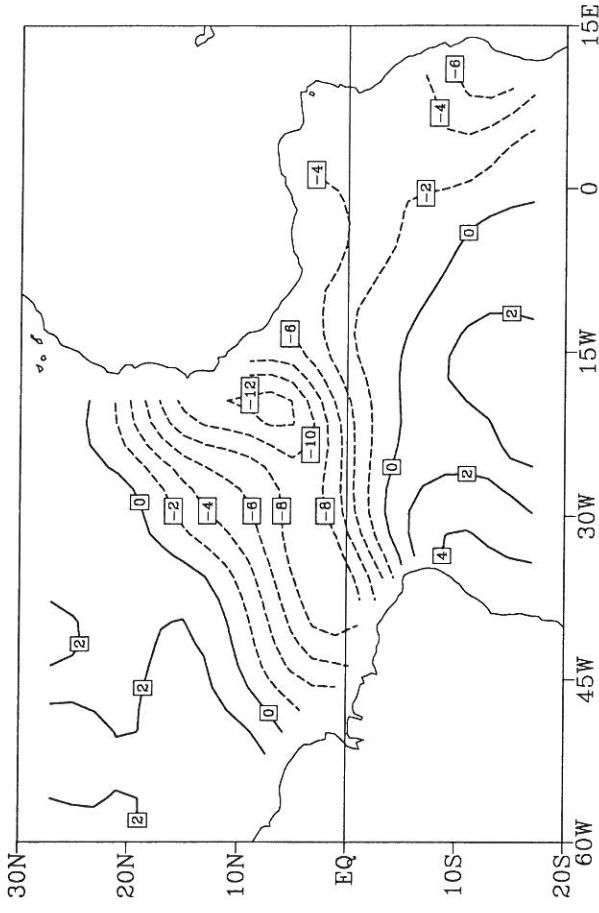
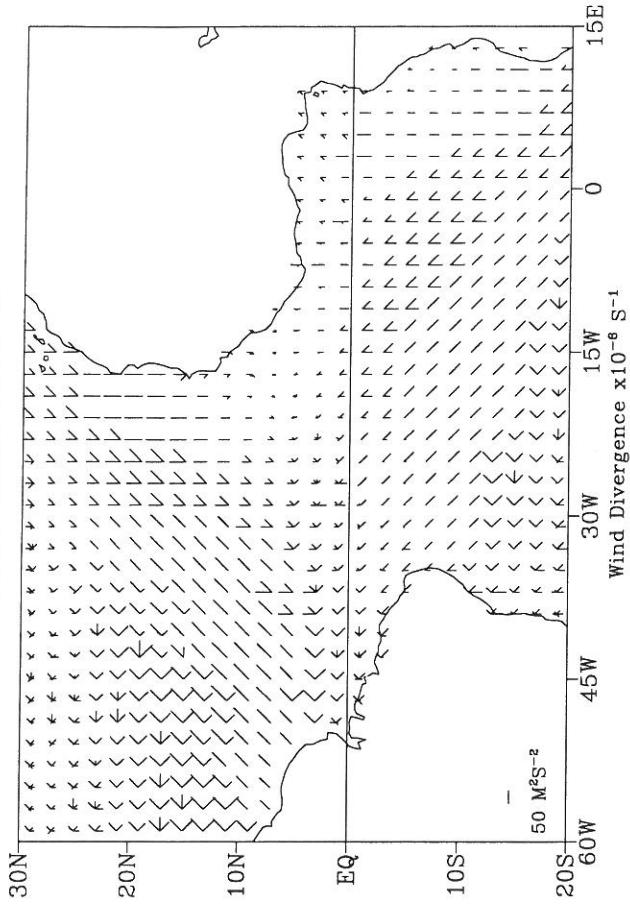


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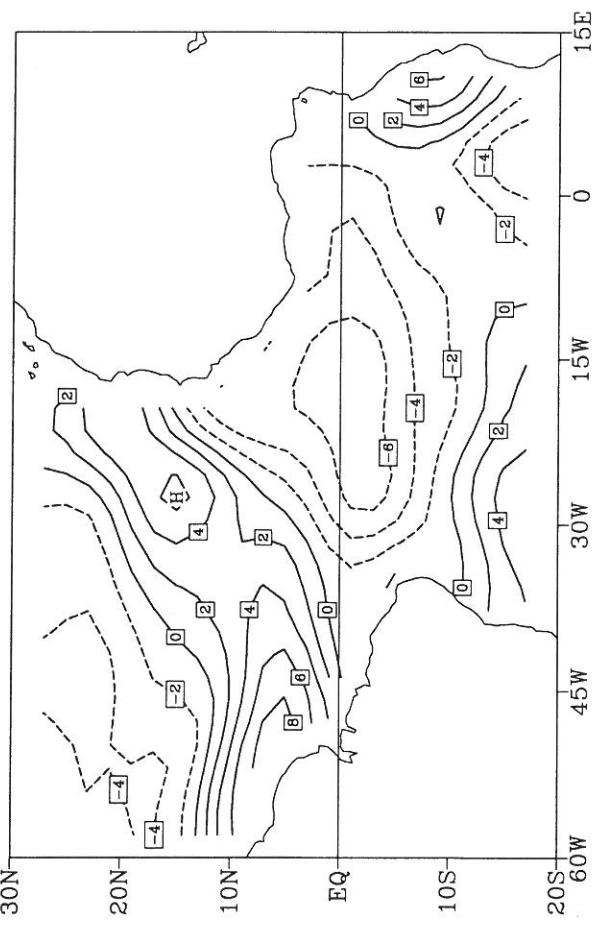
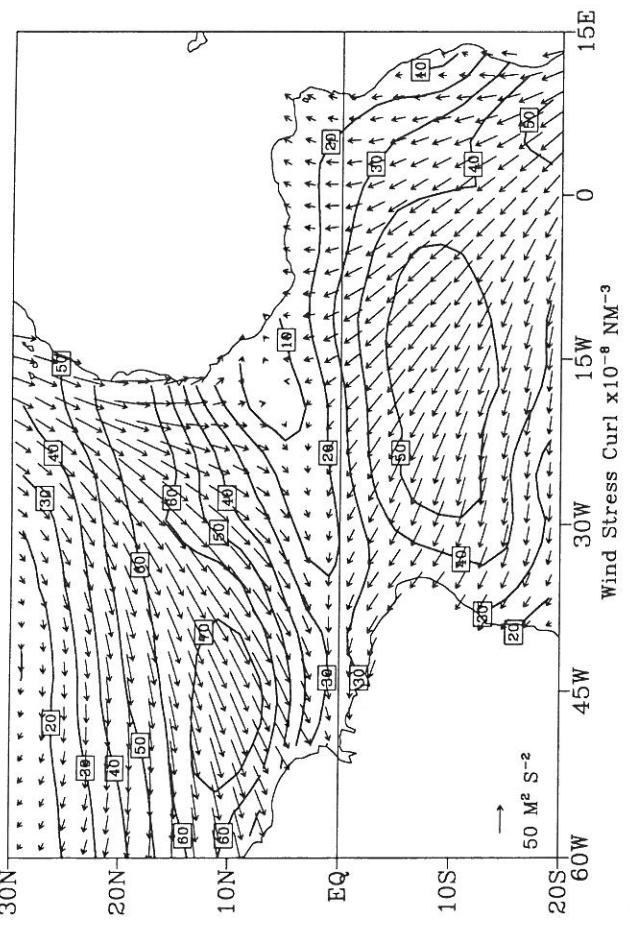


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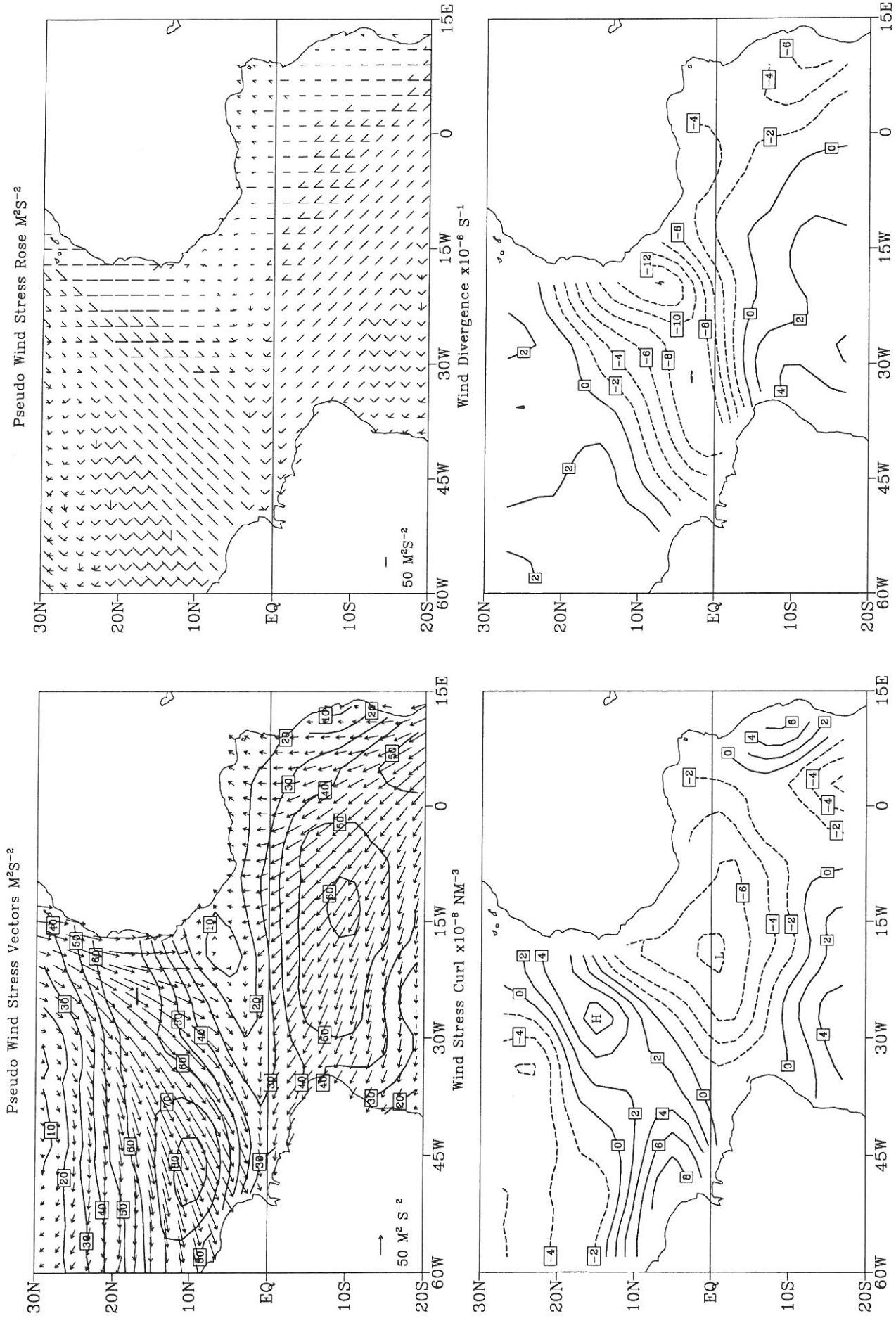
Pseudo Wind Stress Rose  $M^2 S^{-2}$



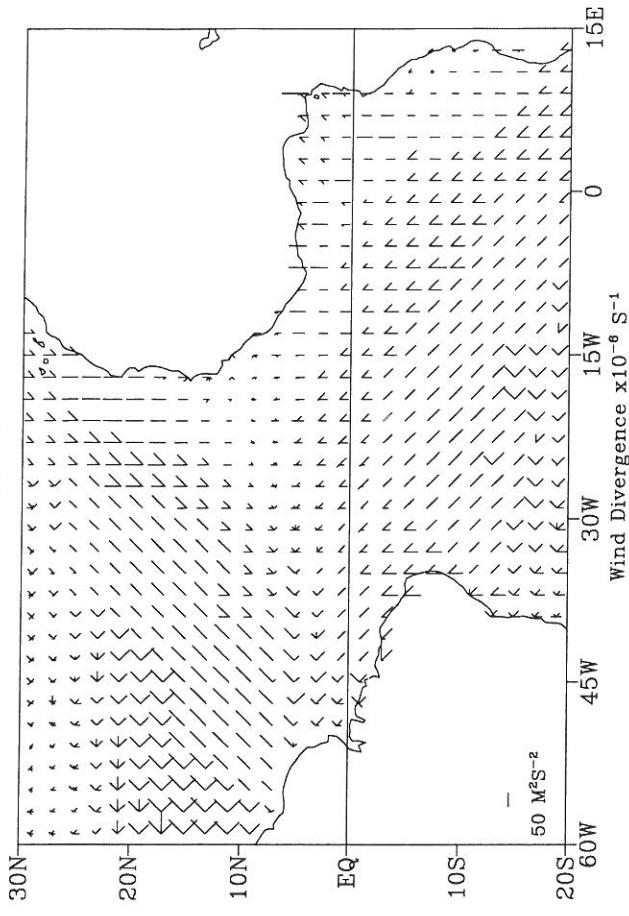
Pseudo Wind Stress Vectors  $M^2 S^{-2}$



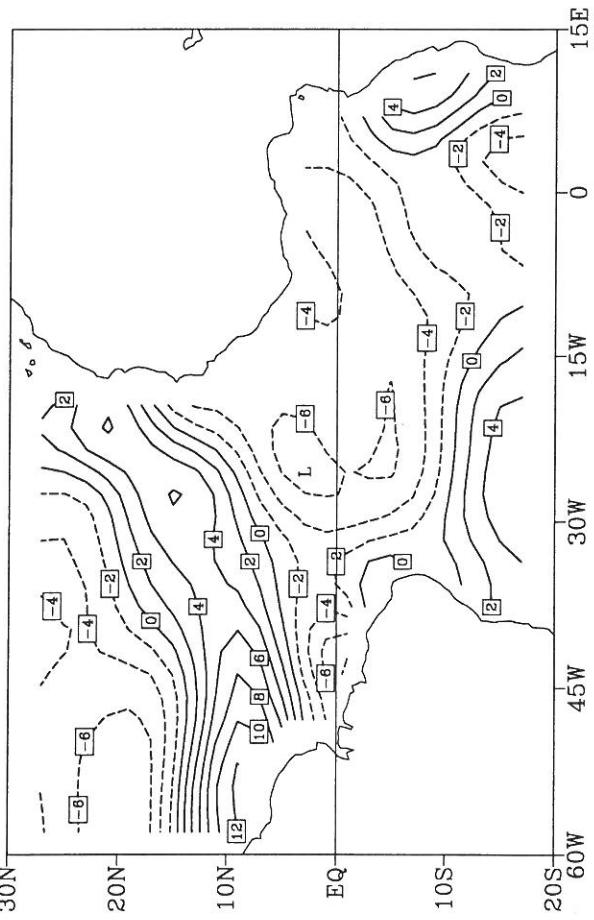
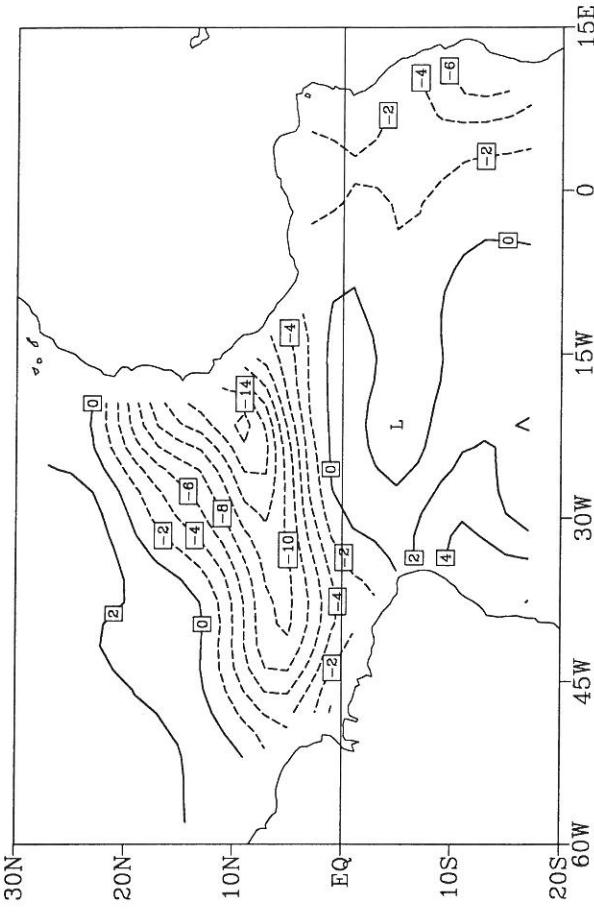
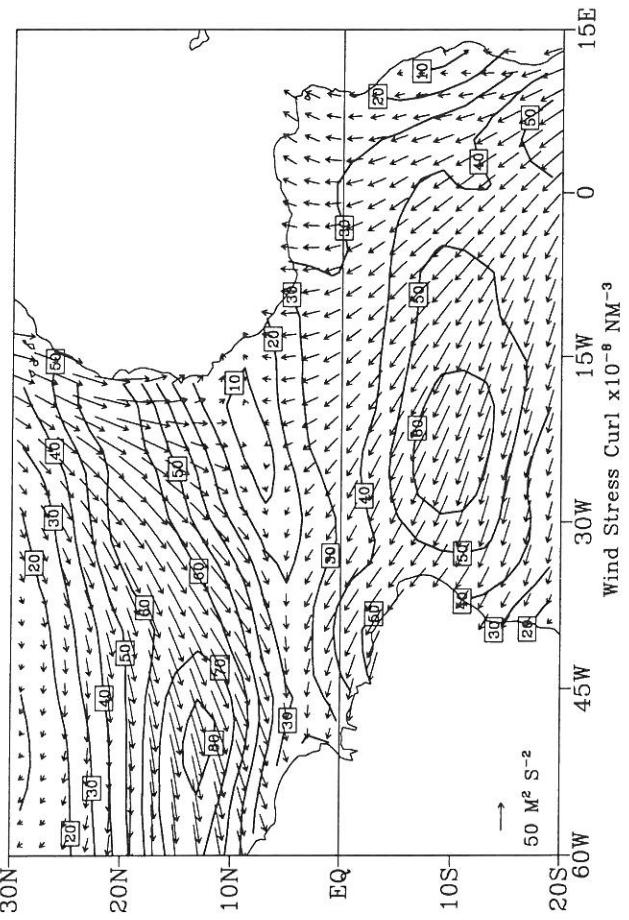
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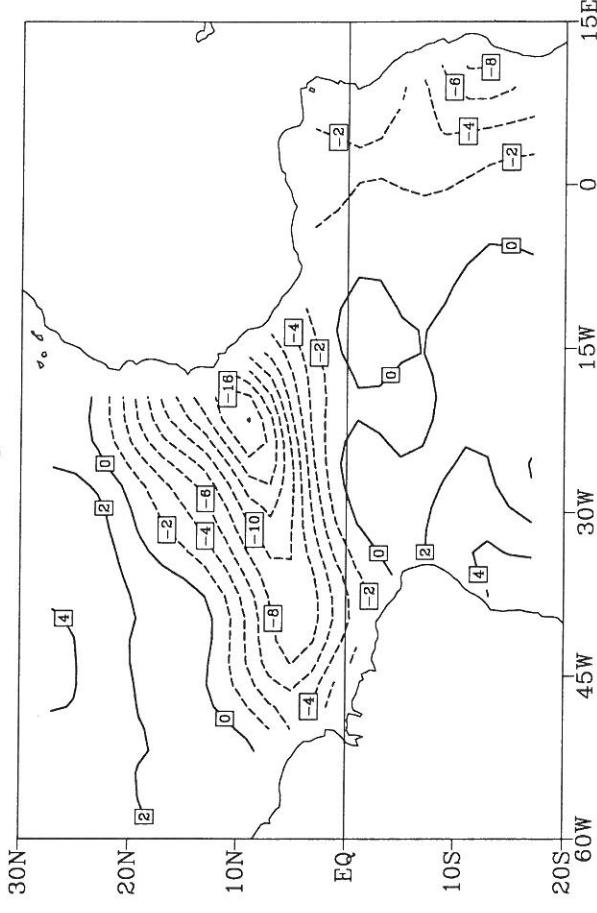
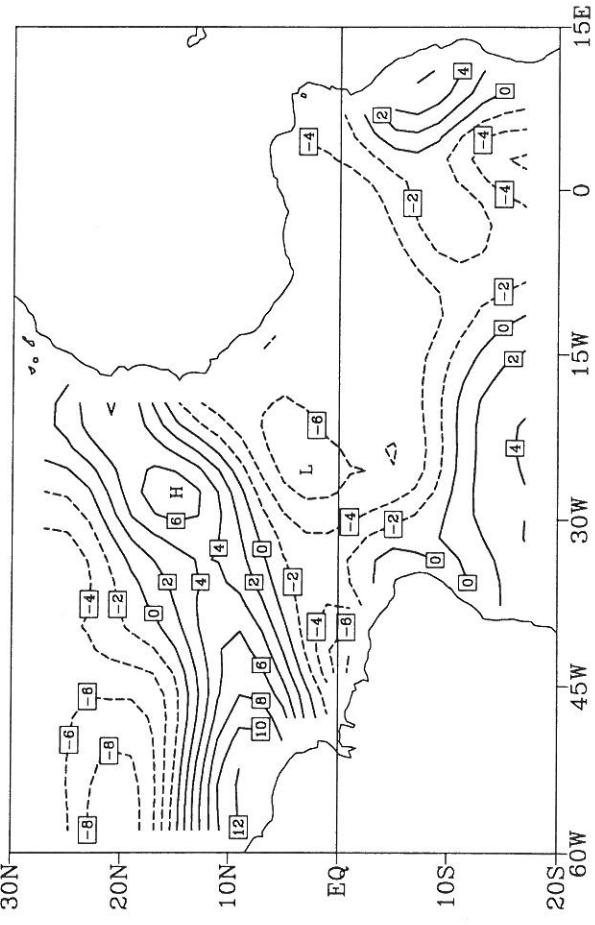
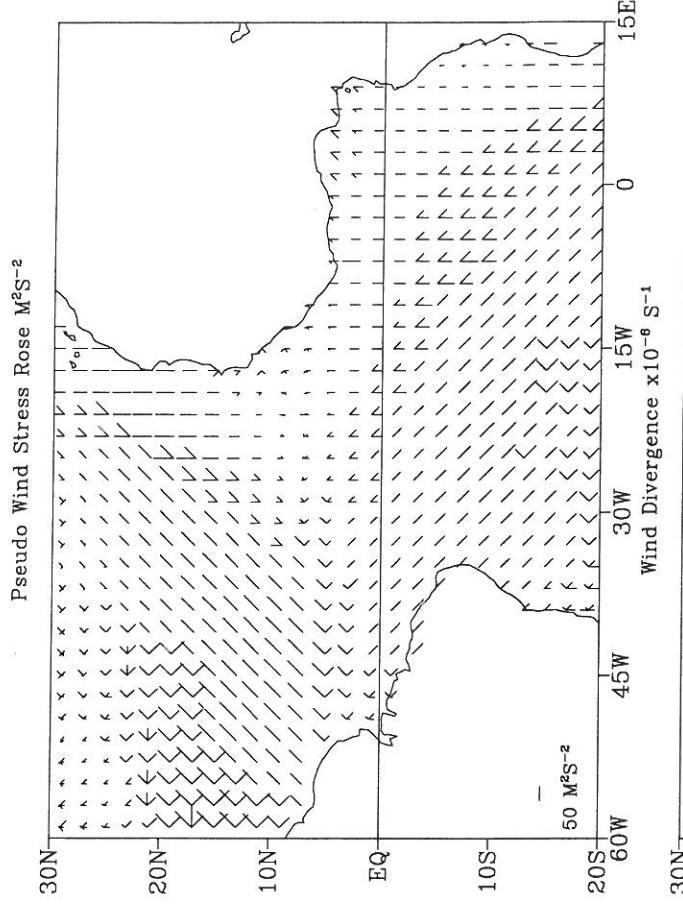
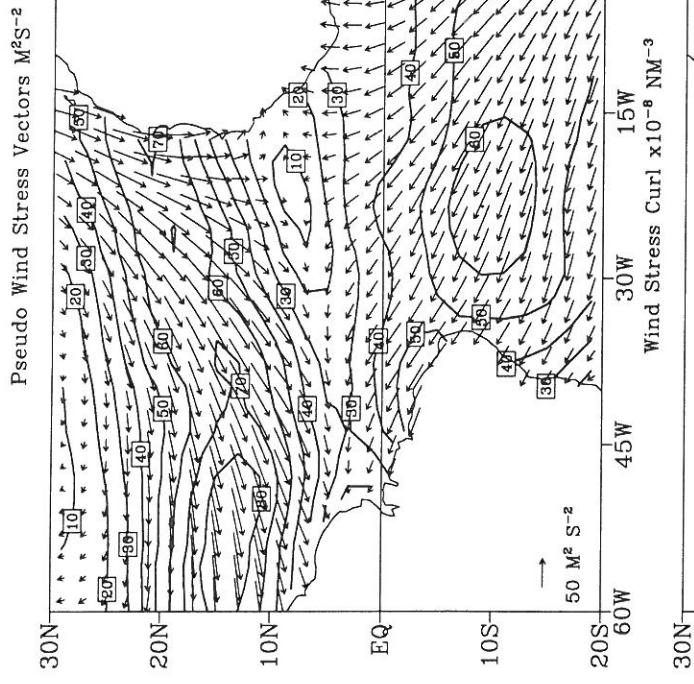
Pseudo Wind Stress Rose  $M^2 S^{-2}$



Pseudo Wind Stress Vectors  $M^2 S^{-2}$

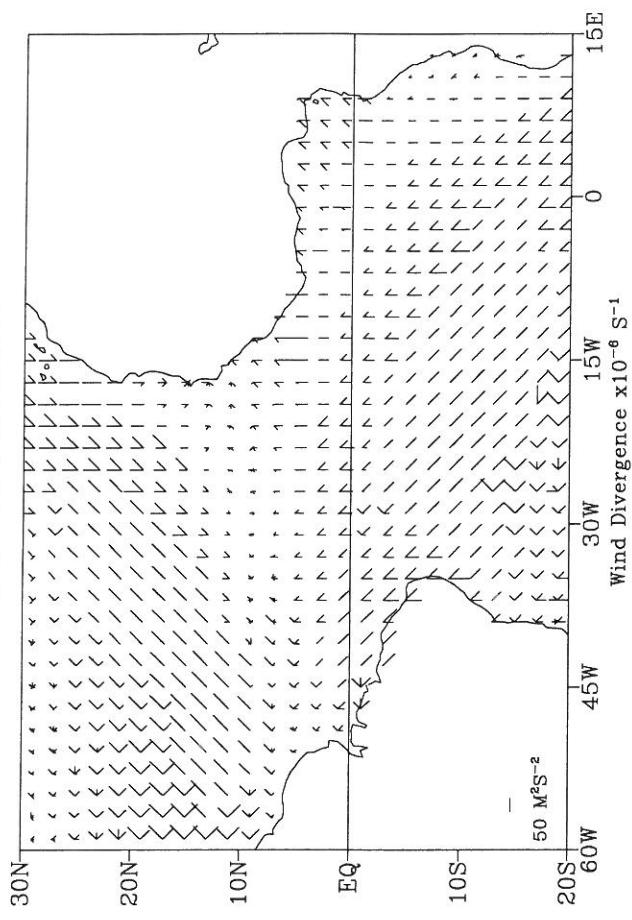


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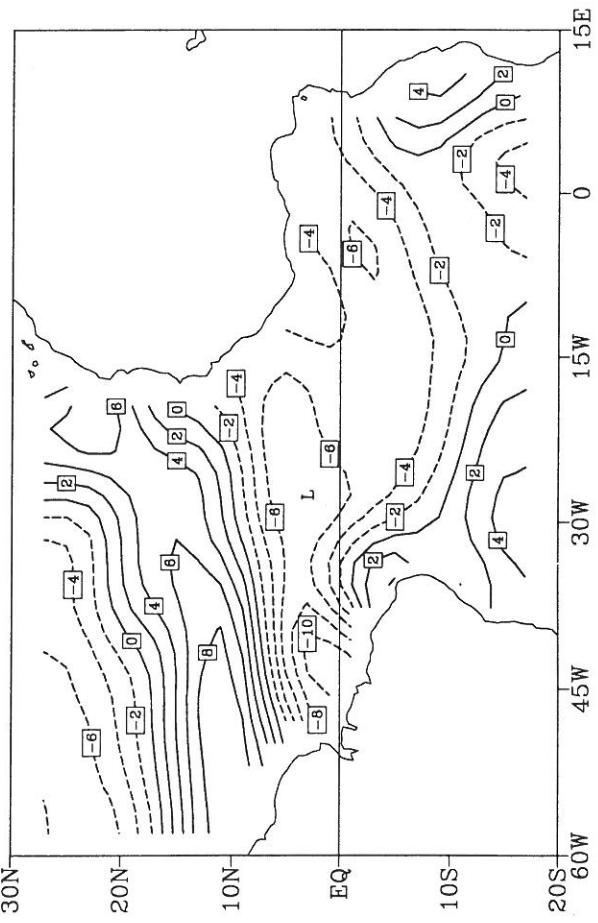
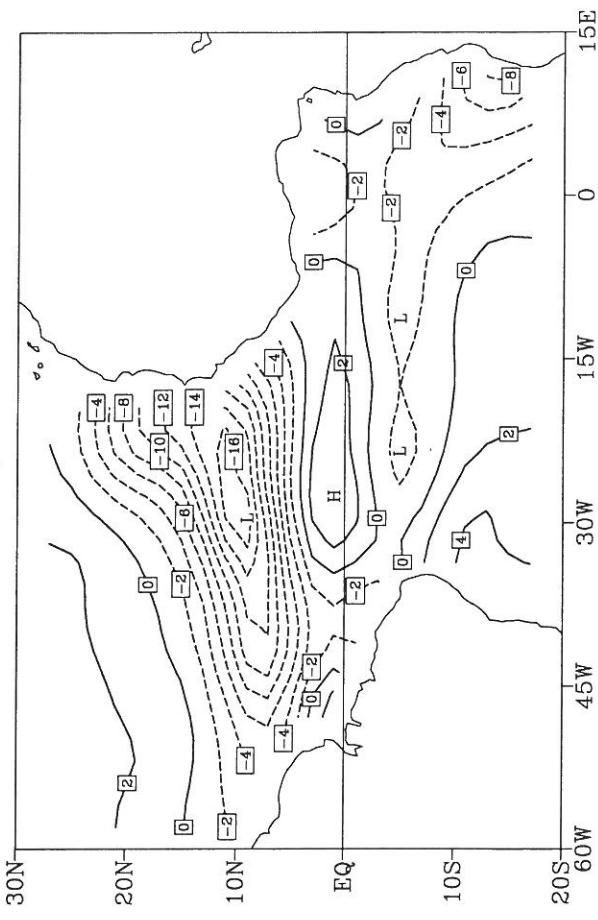
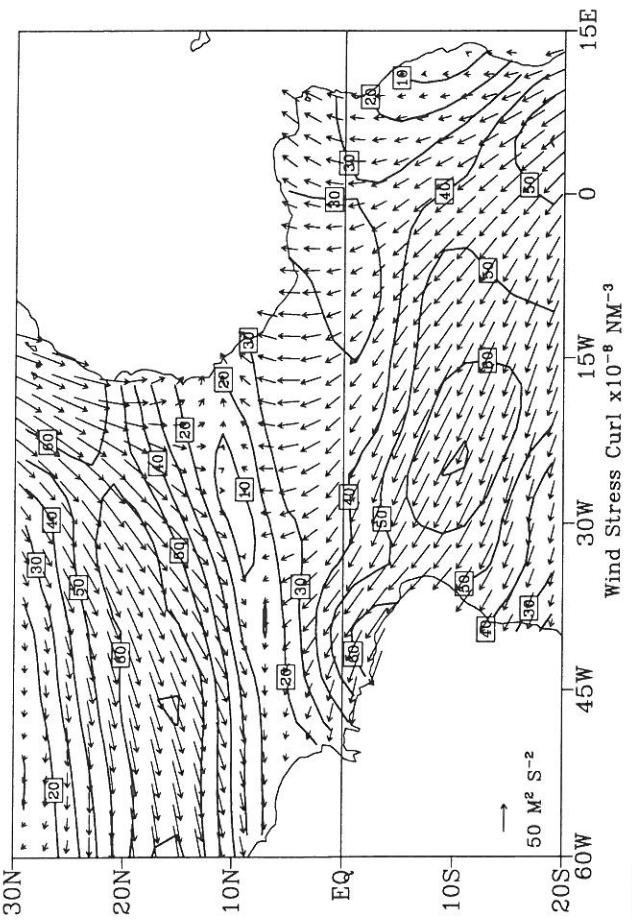


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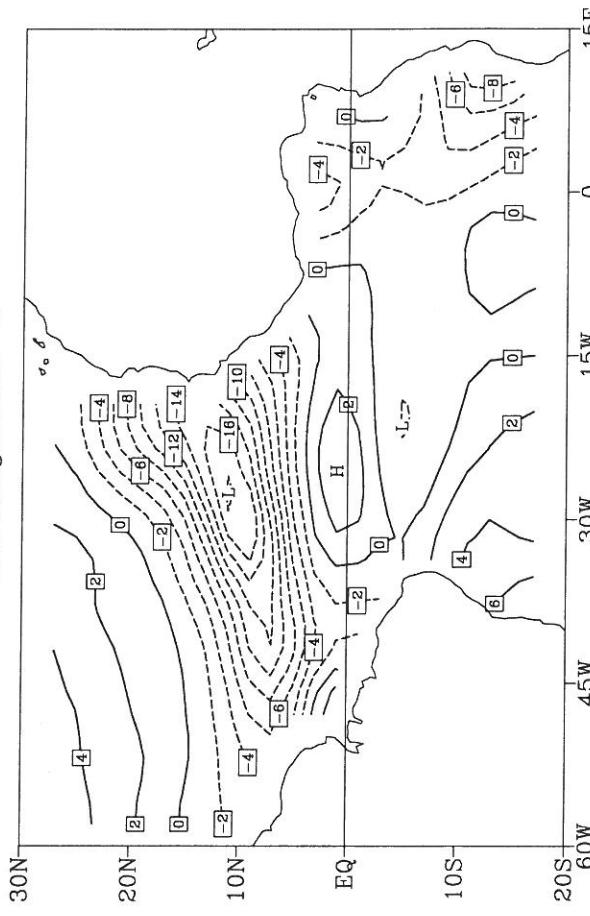
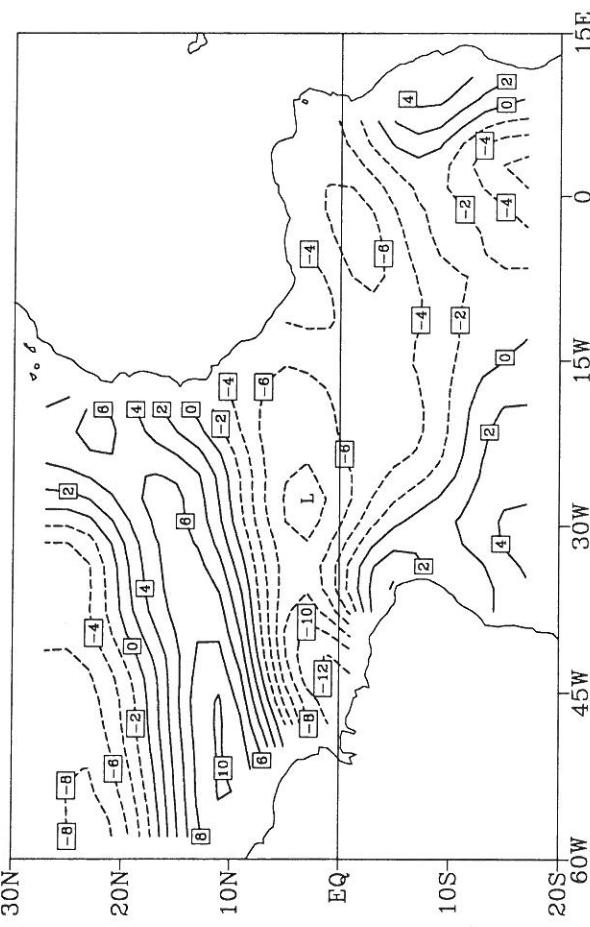
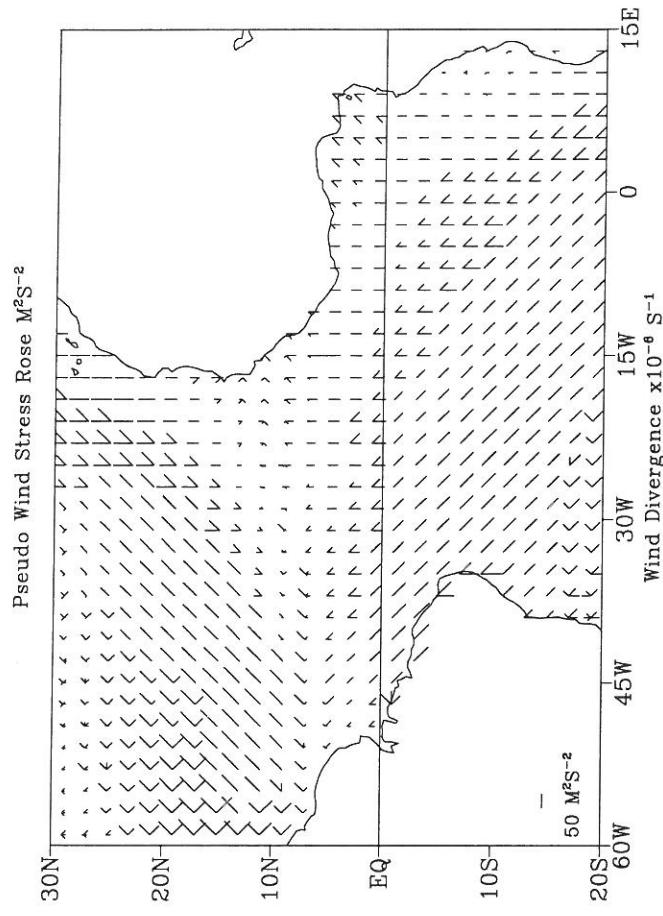
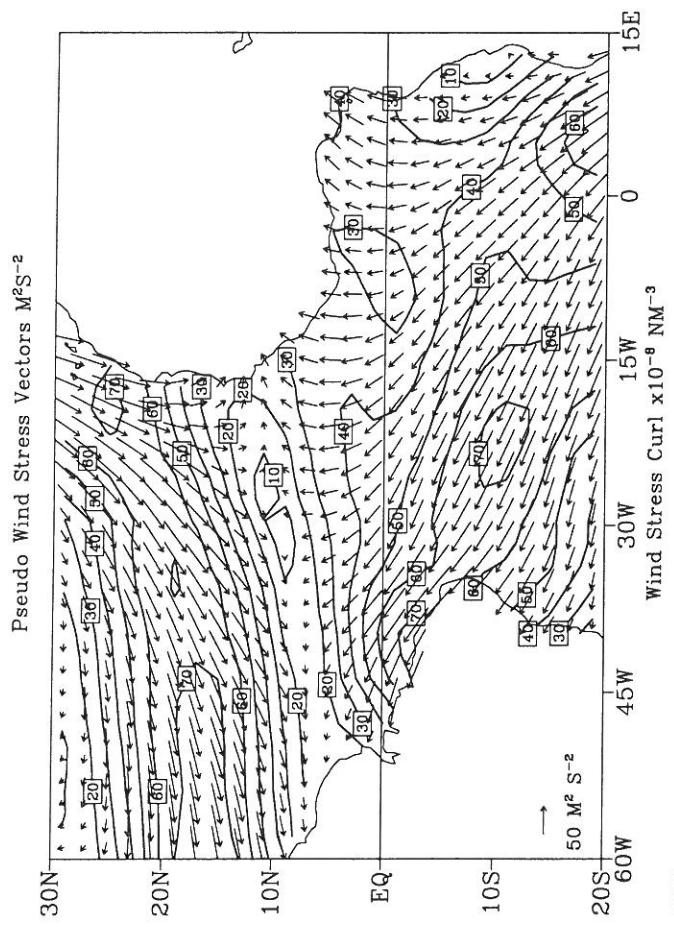
Pseudo Wind Stress Rose  $M^2 S^{-2}$



Pseudo Wind Stress Vectors  $M^2 S^{-2}$

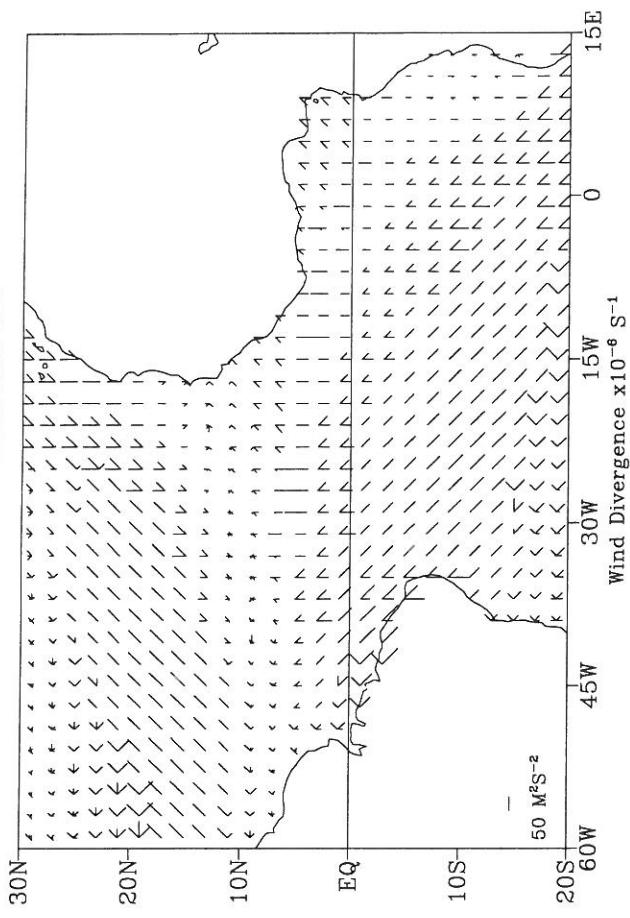


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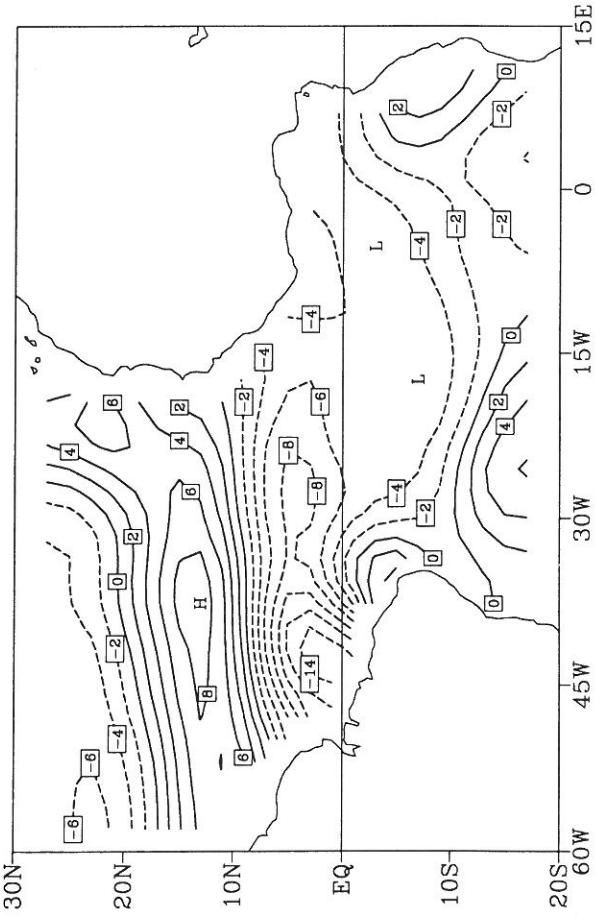
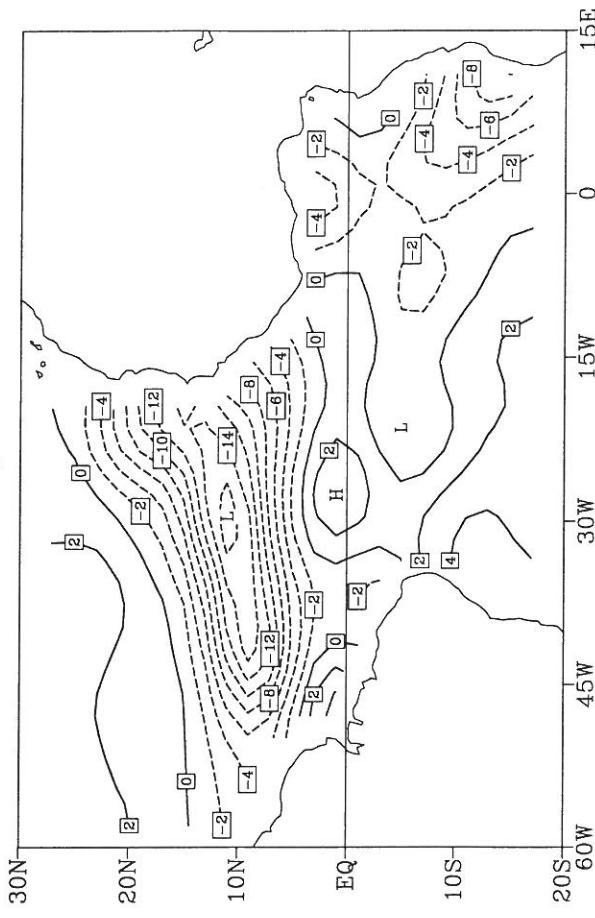
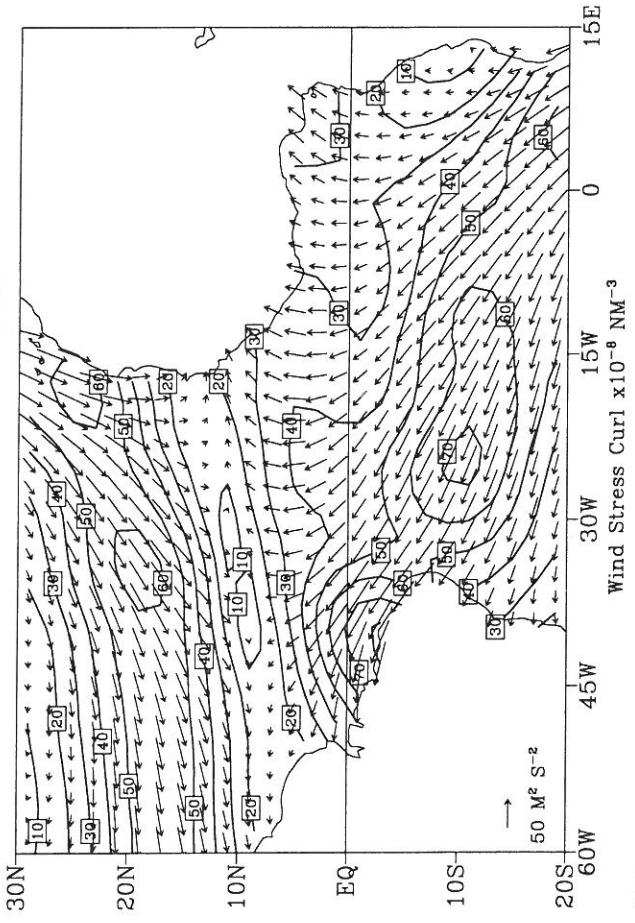


1985-1994 July Climatology

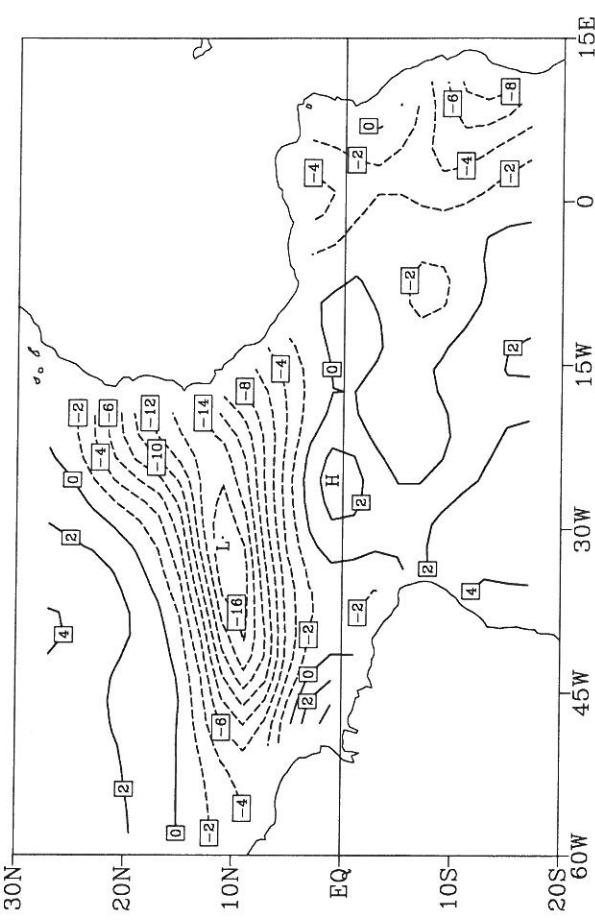
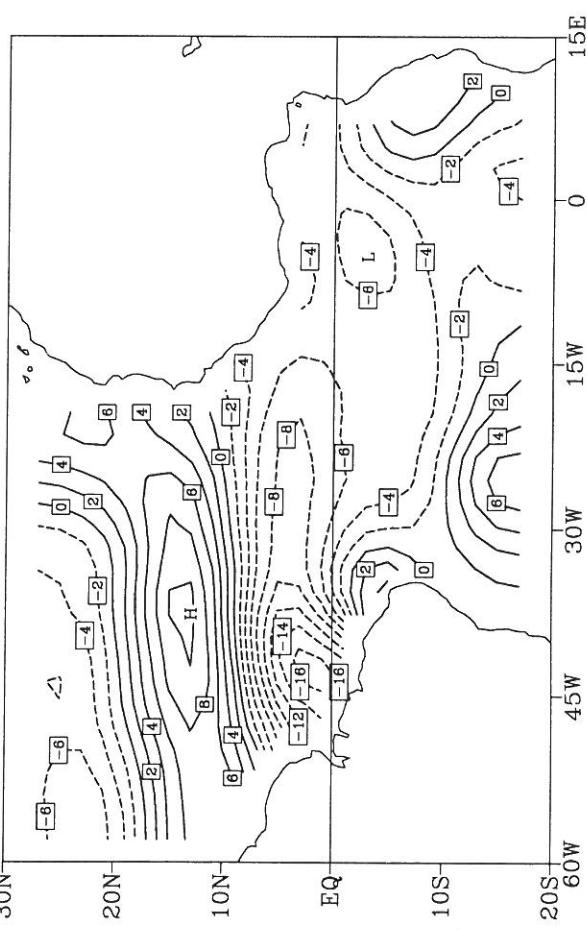
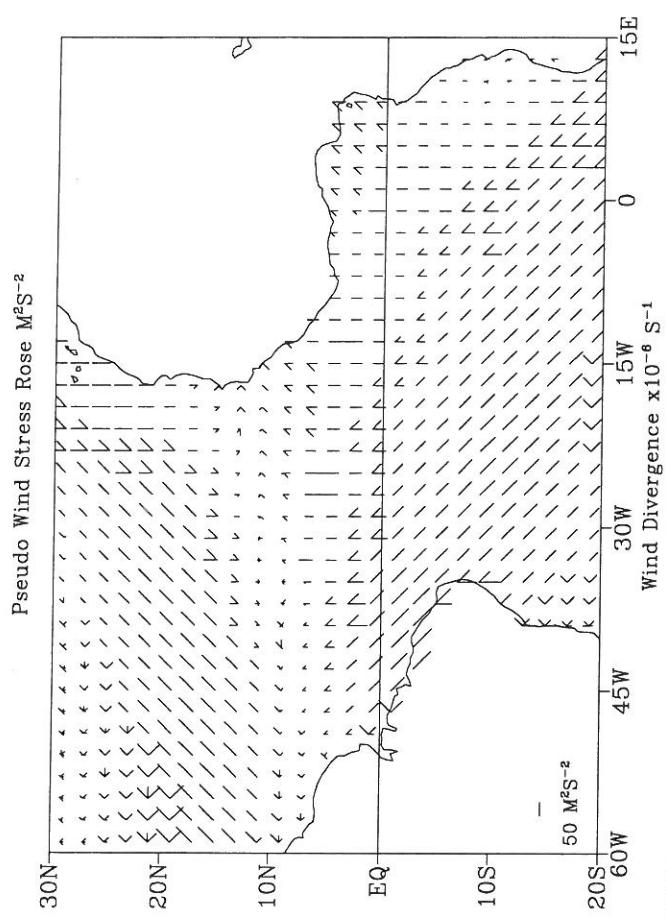
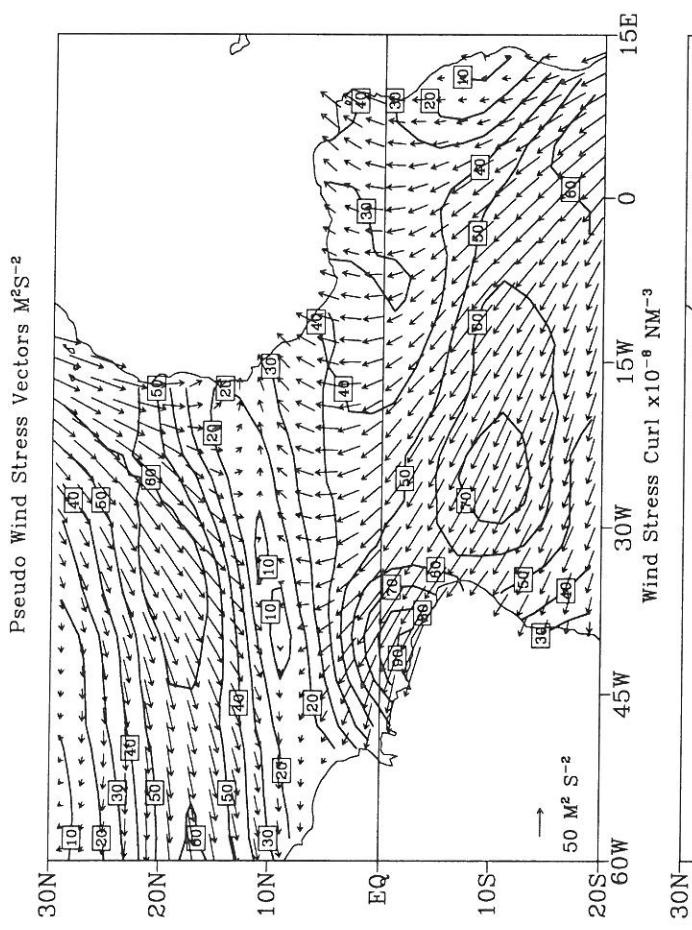
Pseudo Wind Stress Rose  $M^2 S^{-2}$



Pseudo Wind Stress Vectors  $M^2 S^{-2}$

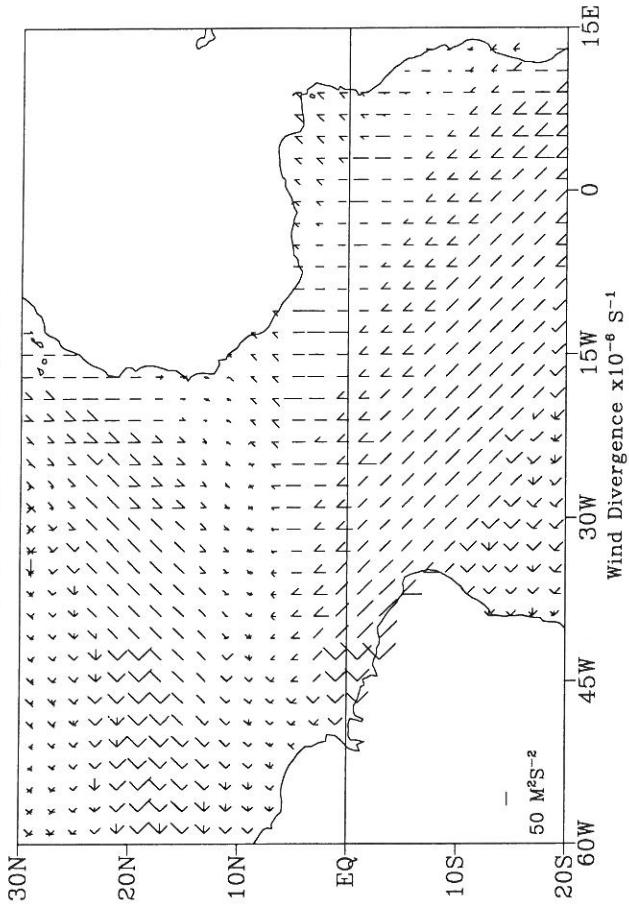


1964-1994 August Climatology

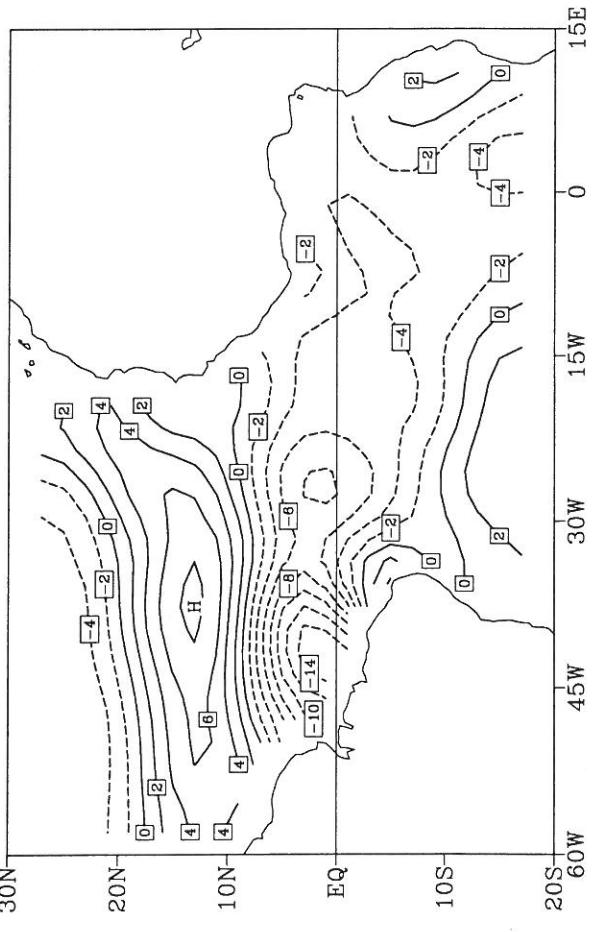
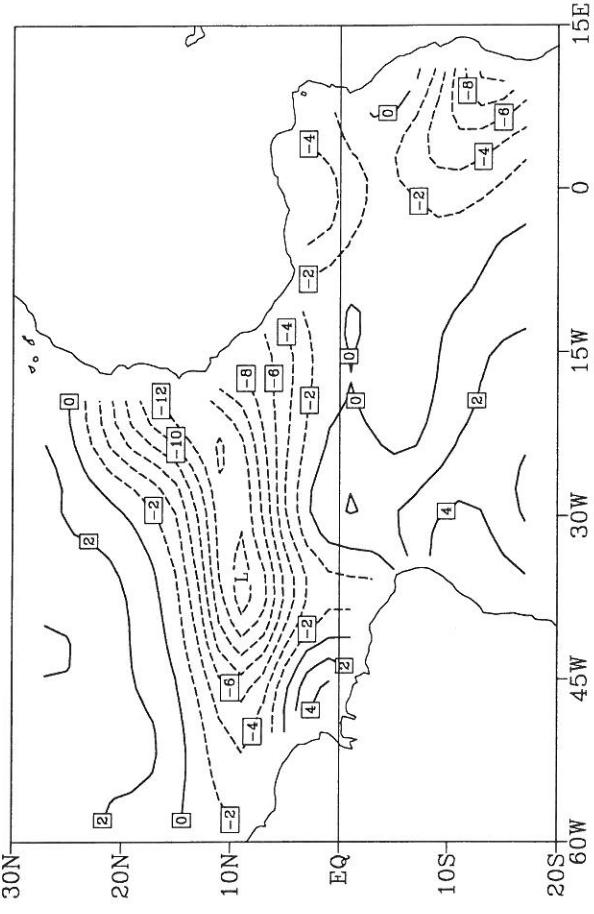
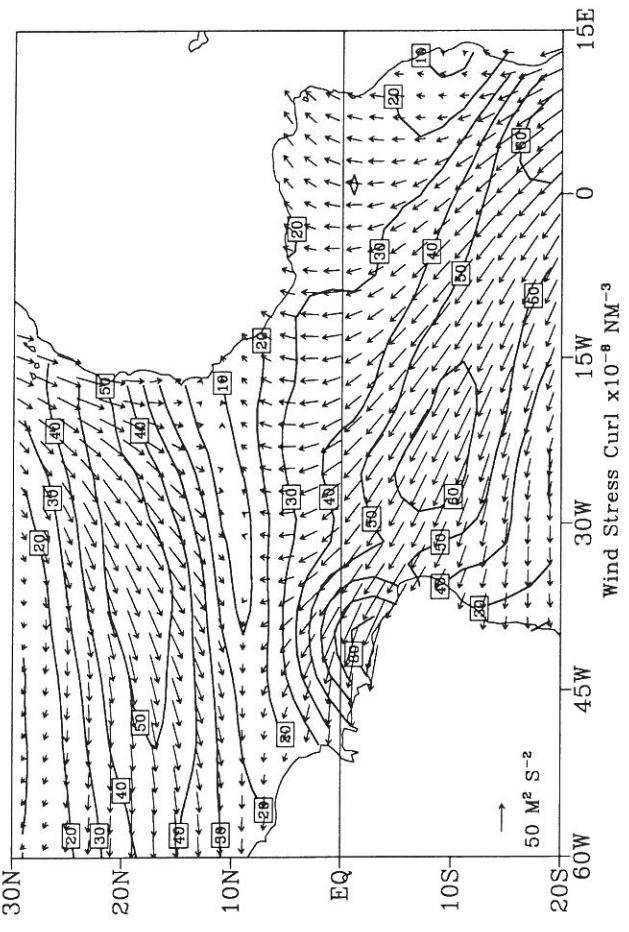


1985-1994 August Climatology

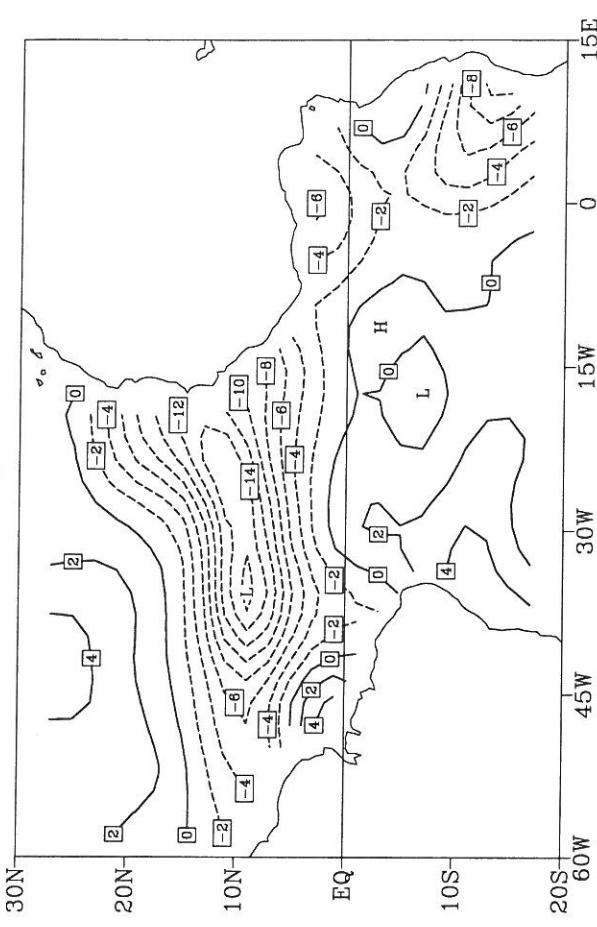
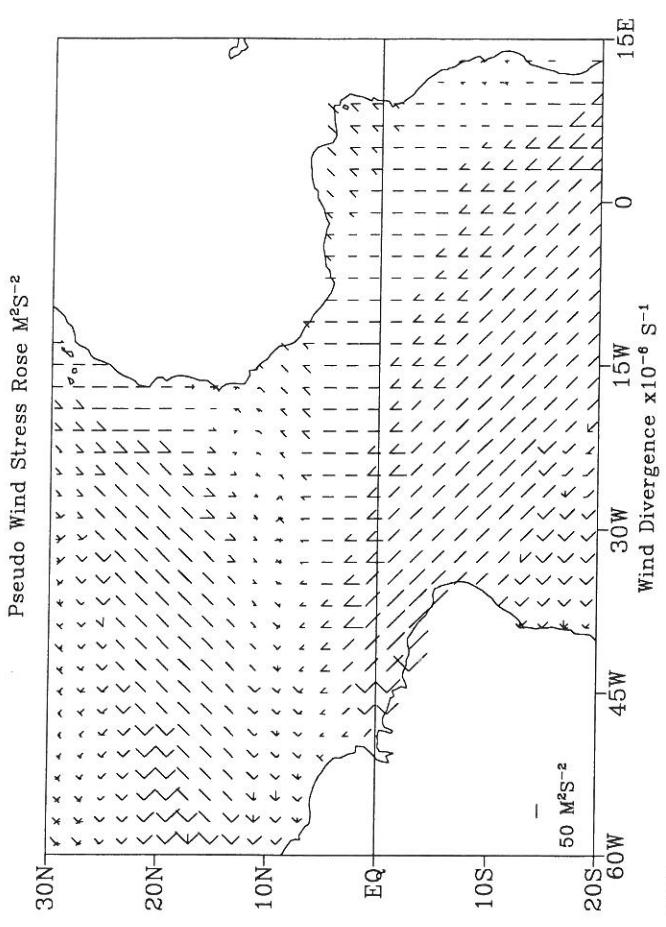
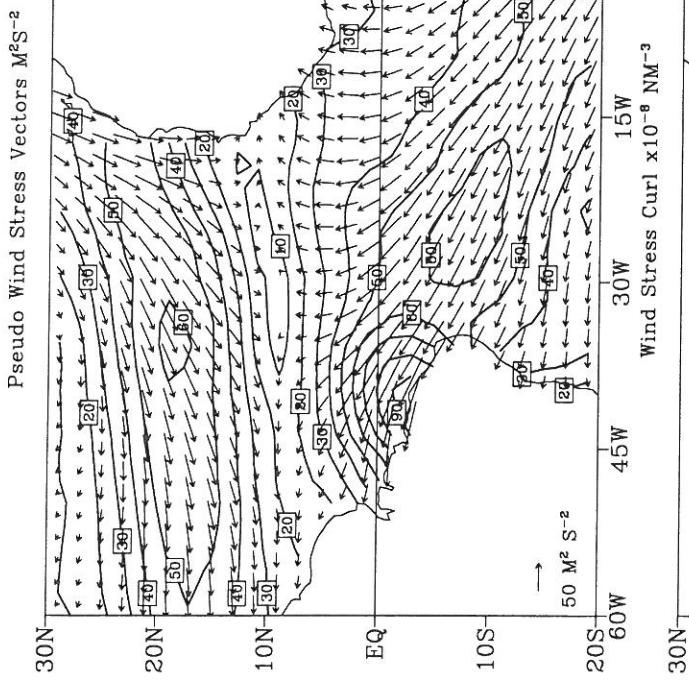
Pseudo Wind Stress Rose  $M^2 S^{-2}$



Pseudo Wind Stress Vectors  $M^2 S^{-2}$

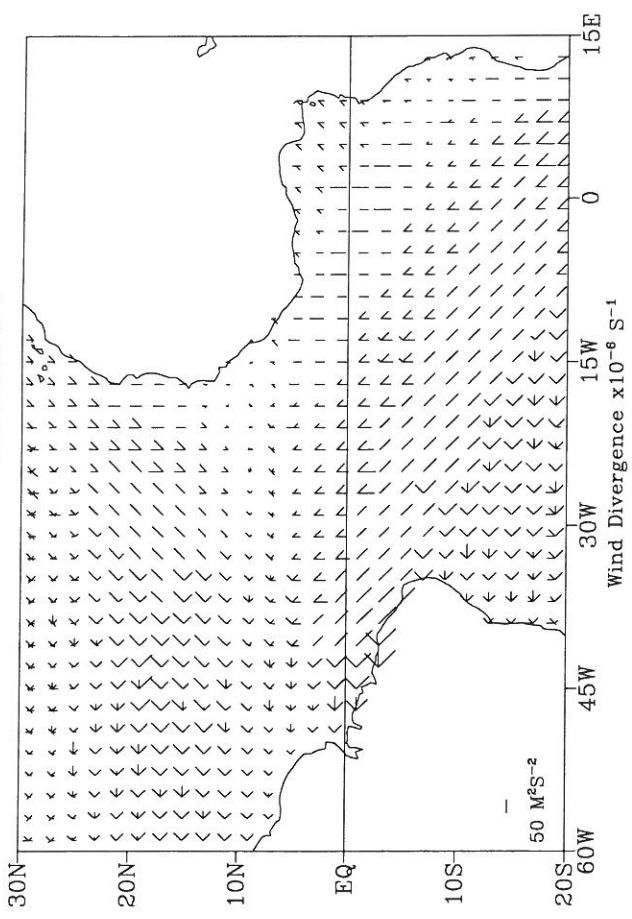


1964-1994 September Climatology

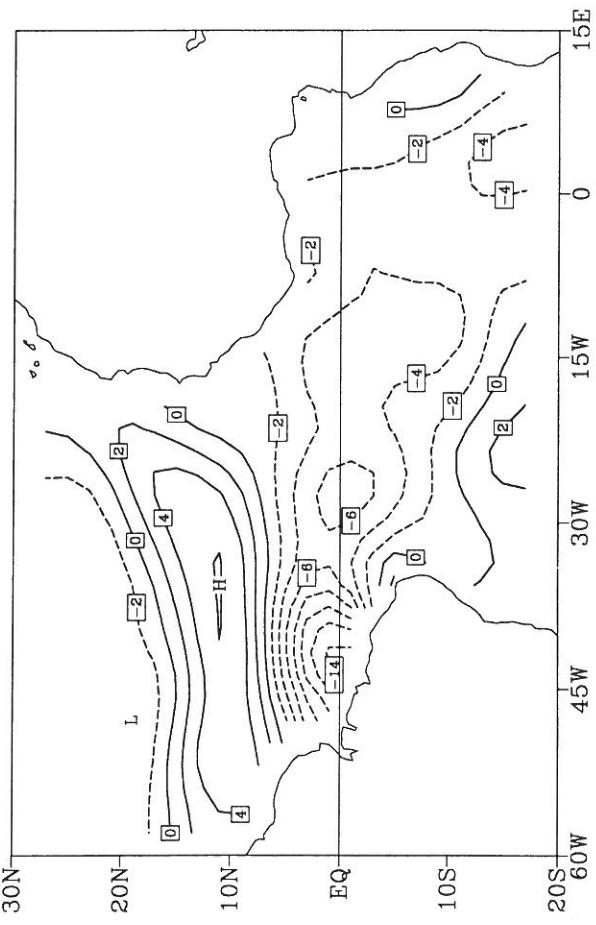
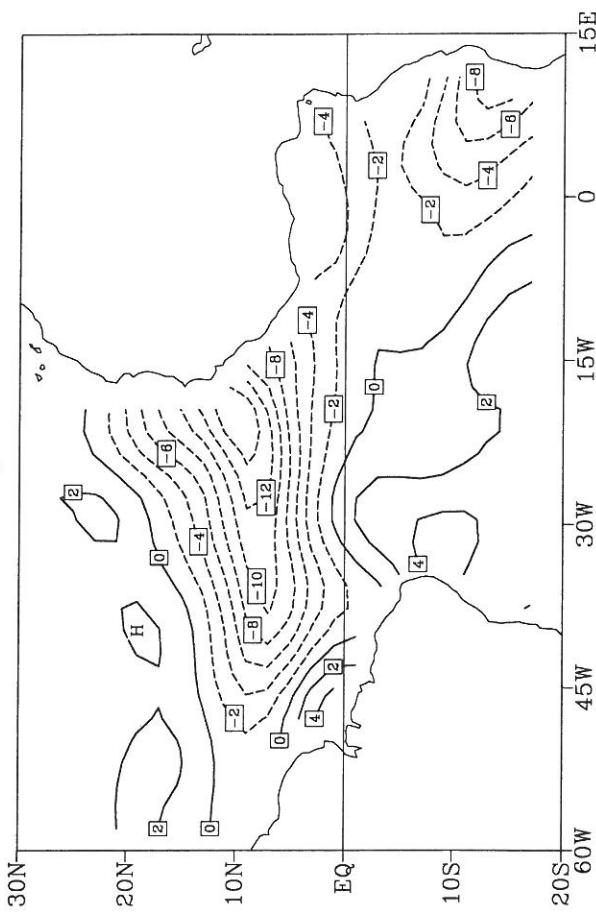
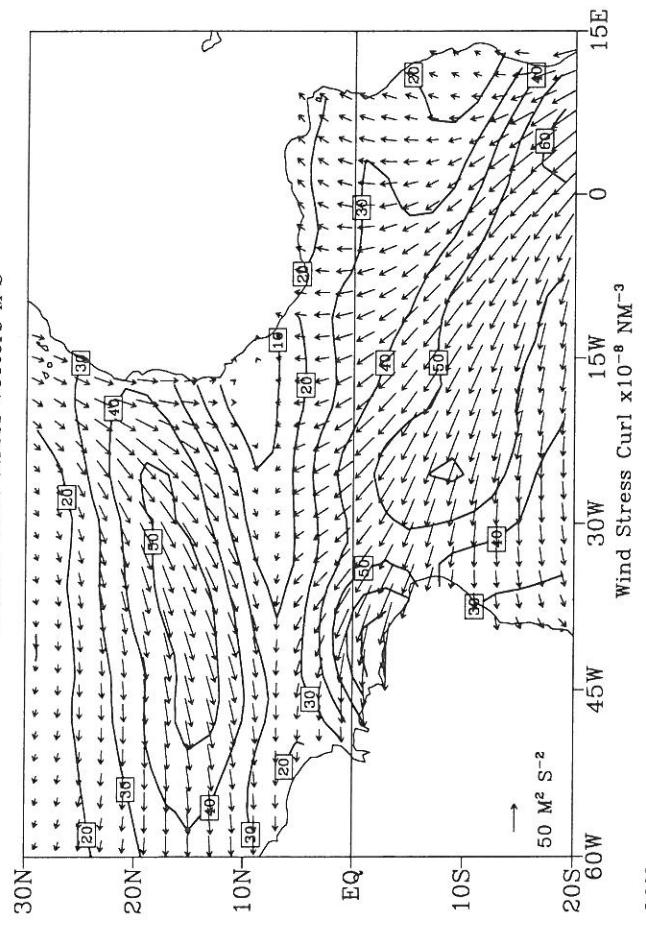


1985-1994 September Climatology

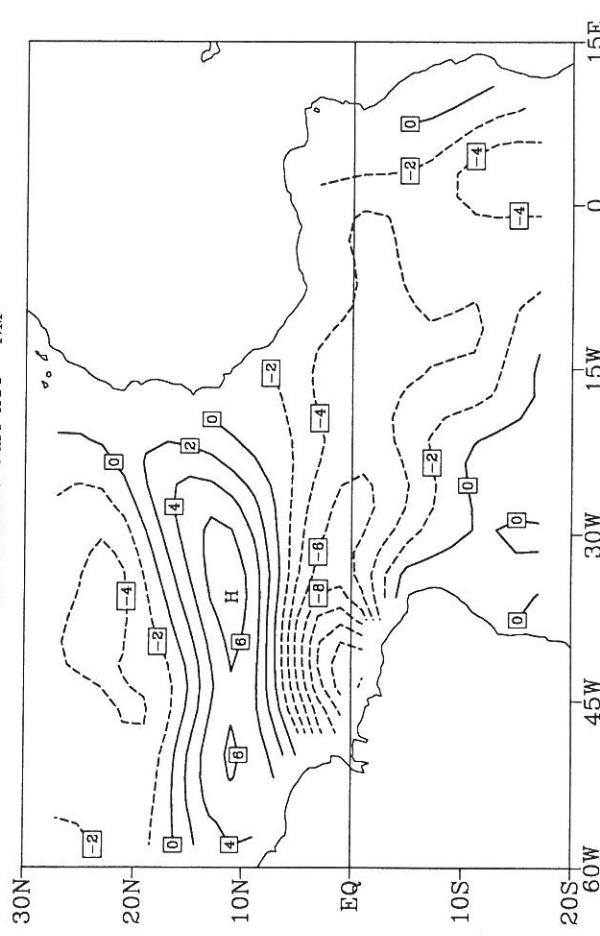
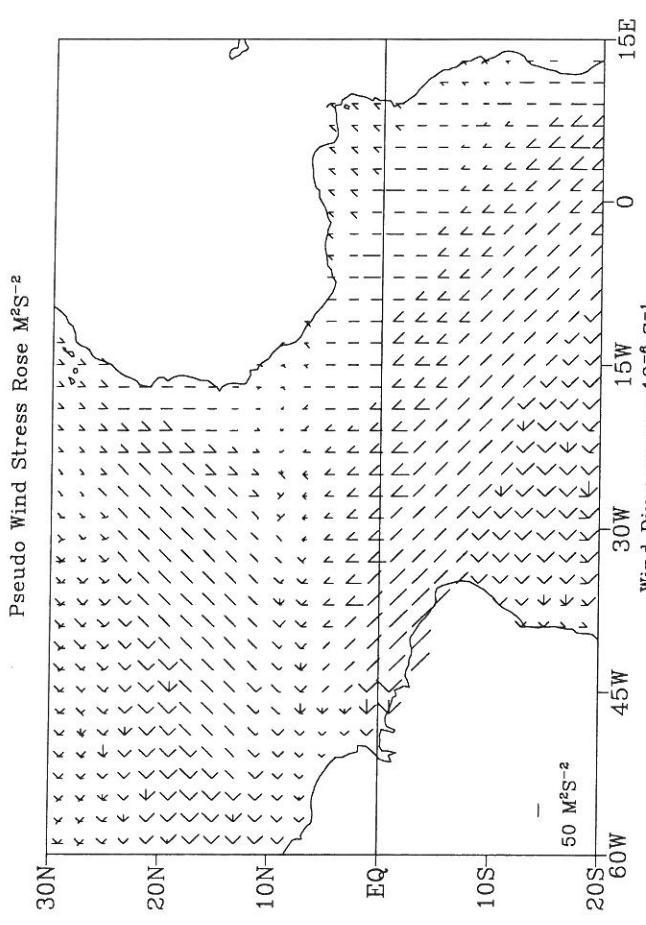
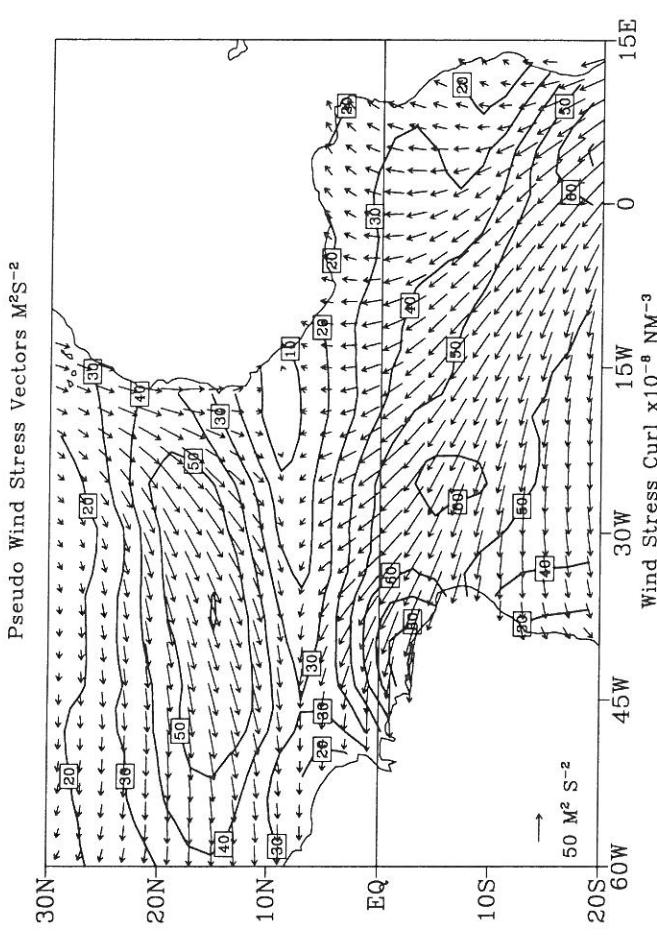
Pseudo Wind Stress Rose  $M^2 S^{-2}$



Pseudo Wind Stress Vectors  $M^2 S^{-2}$

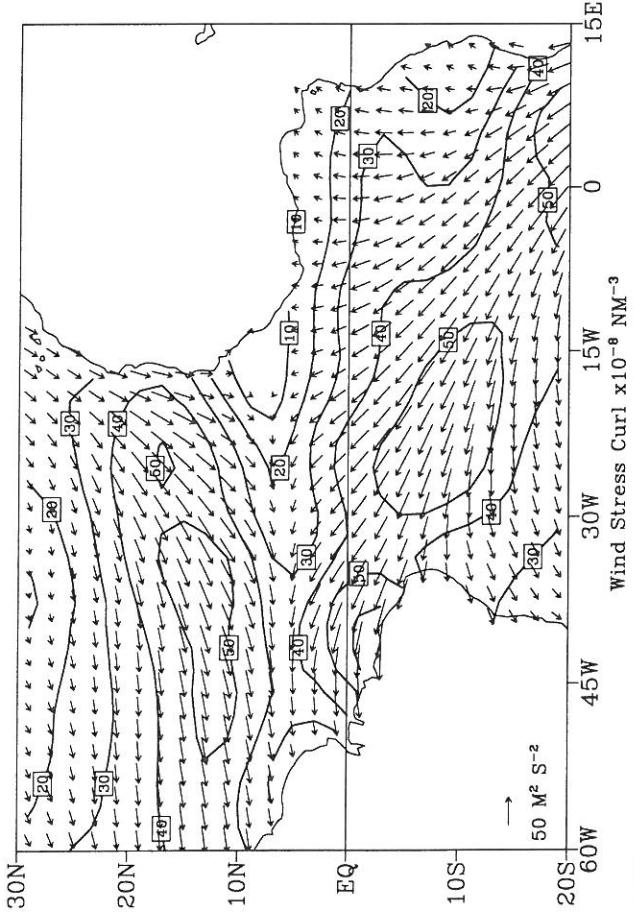


1964-1994 October Climatology

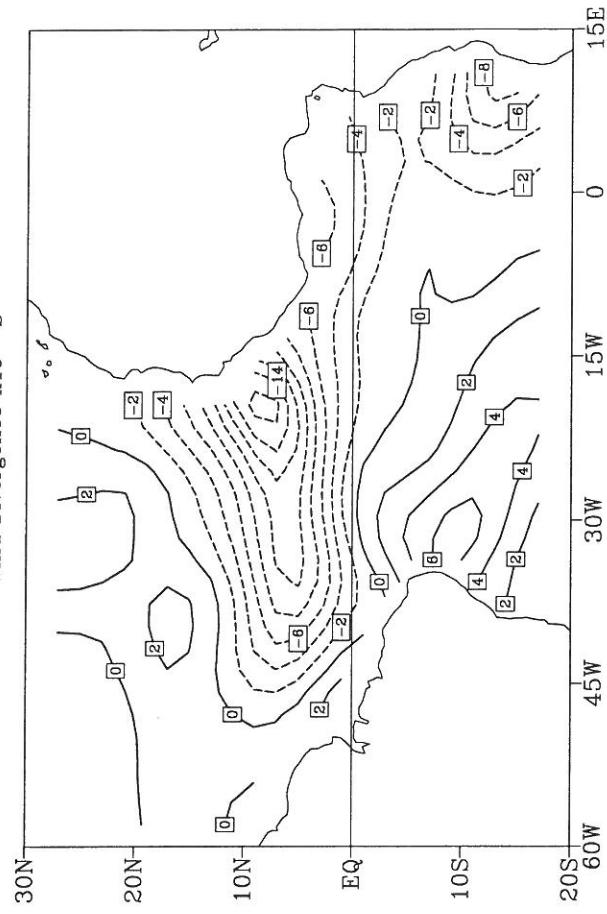
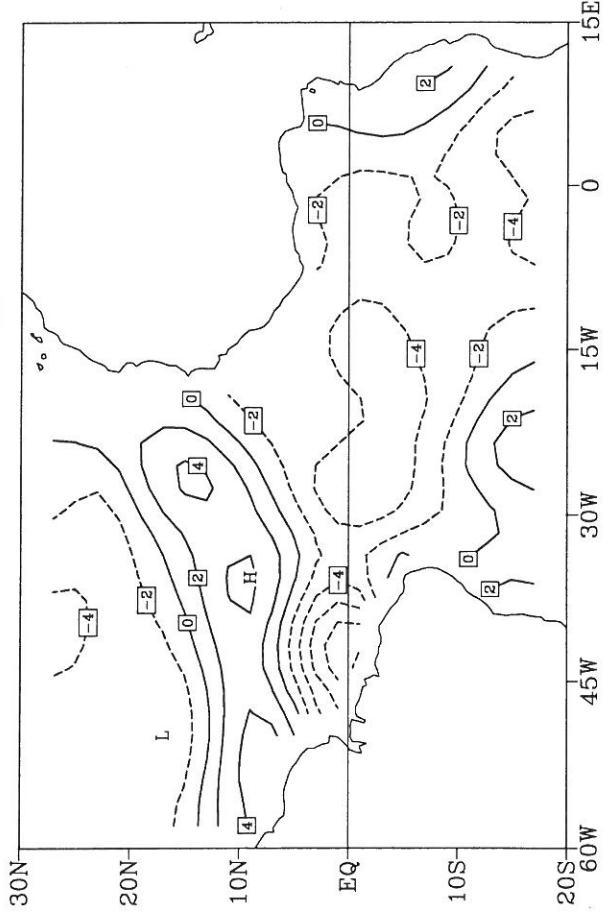
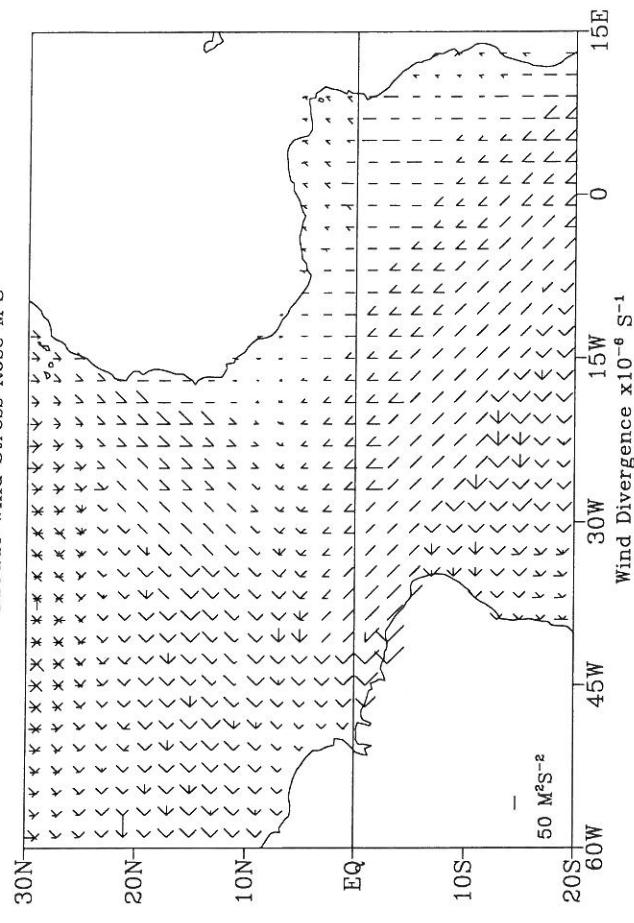


1985-1994 October Climatology

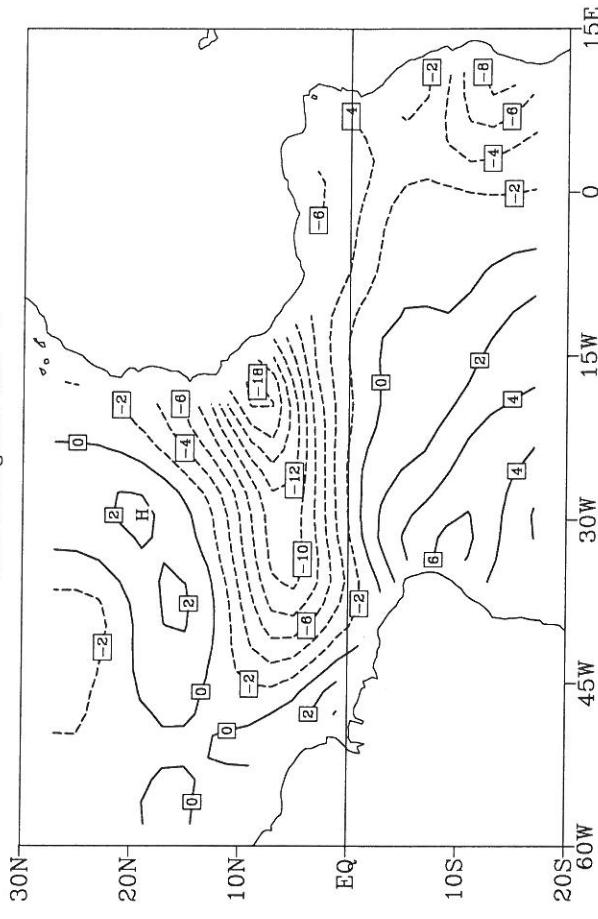
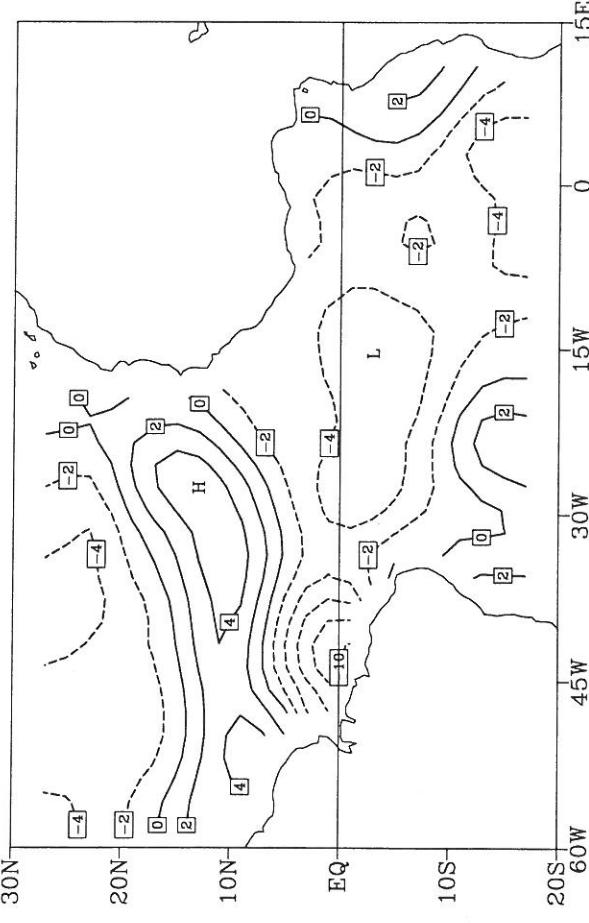
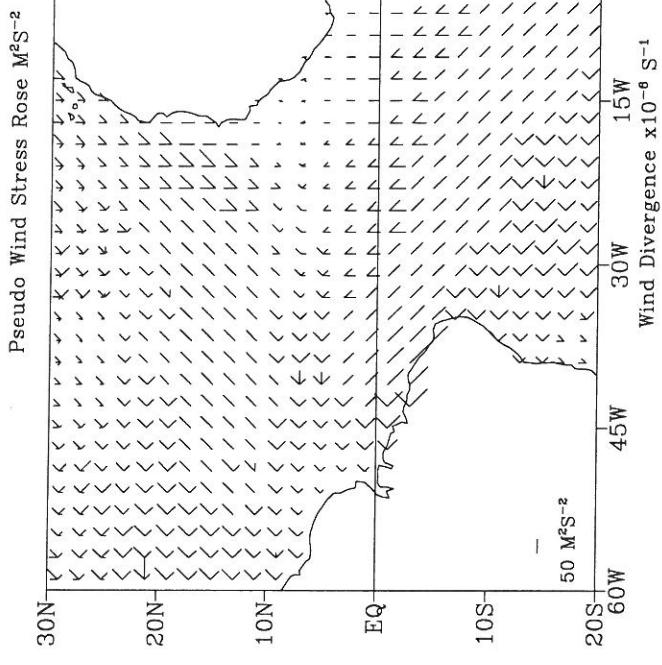
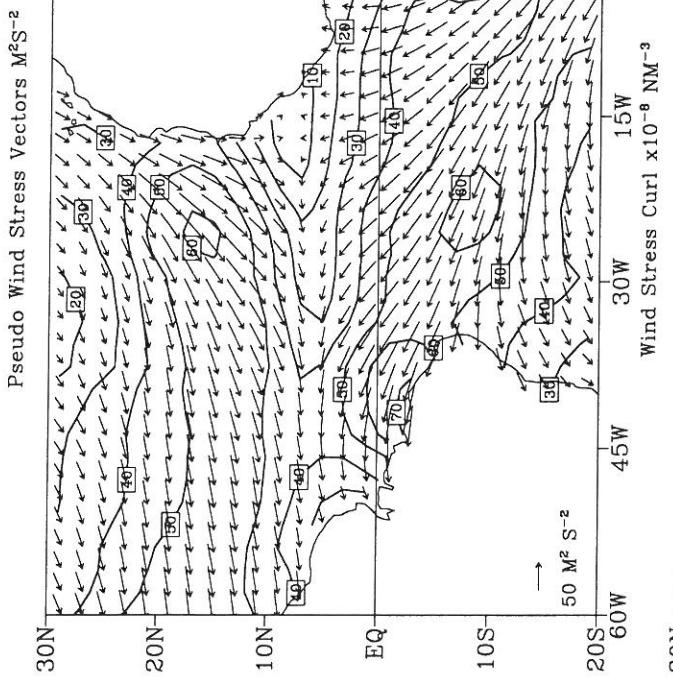
Pseudo Wind Stress Vectors  $M^2 S^{-2}$



Pseudo Wind Stress Rose  $M^2 S^{-2}$

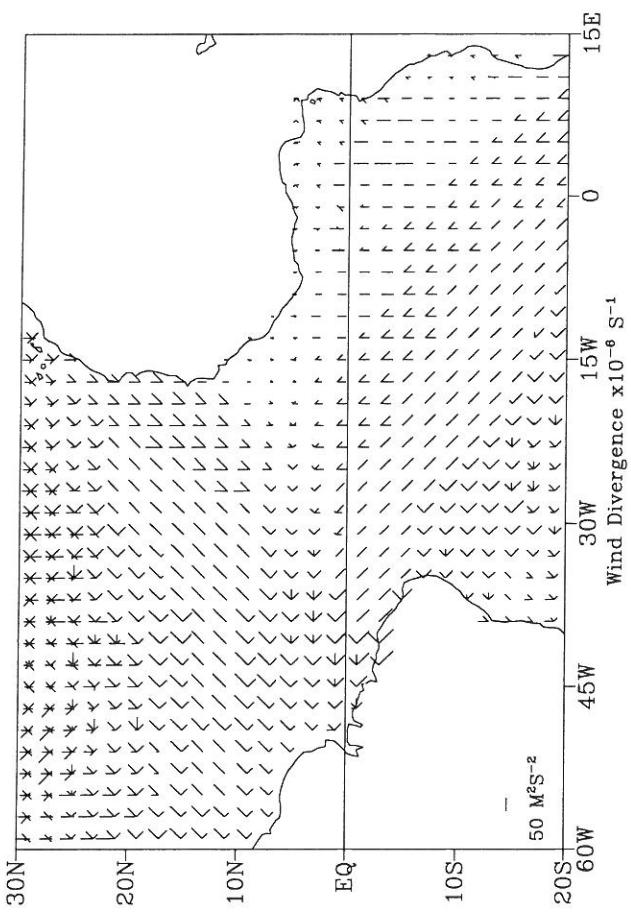


1964-1994 November Climatology

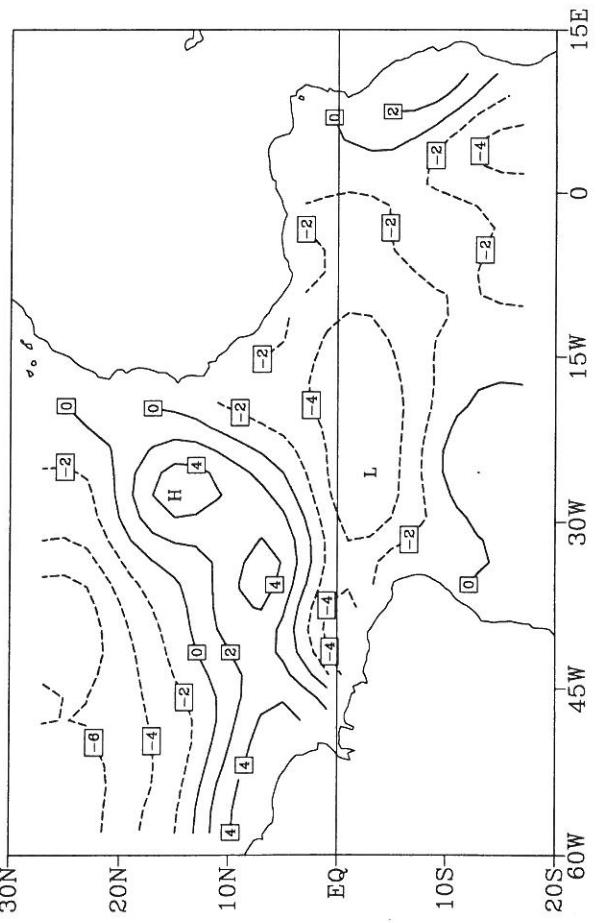
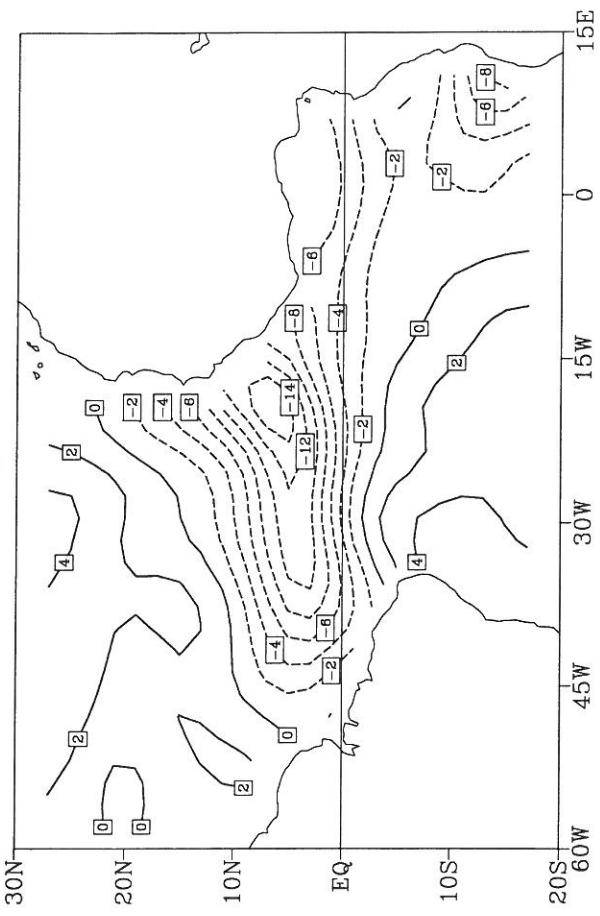
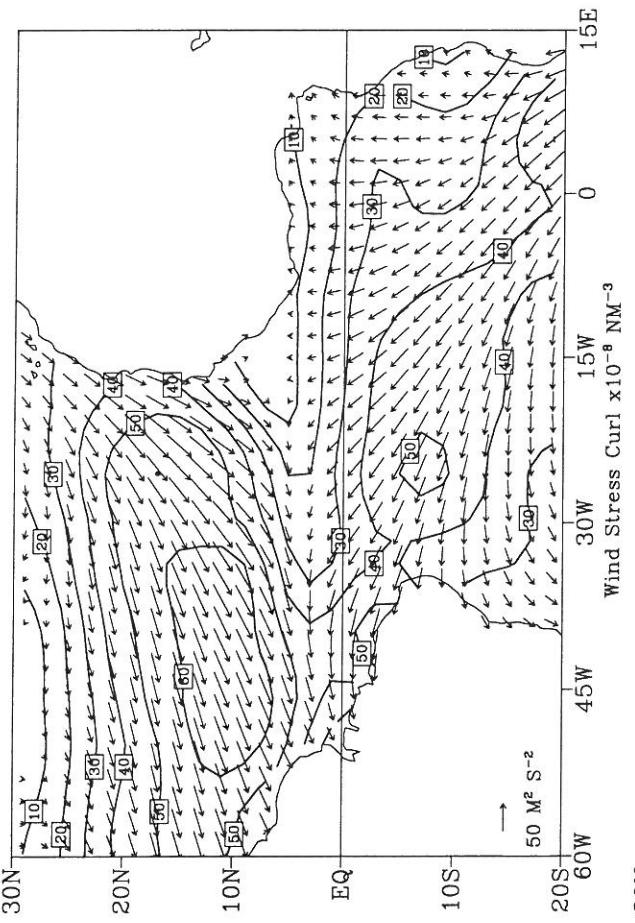


1985-1994 November Climatology

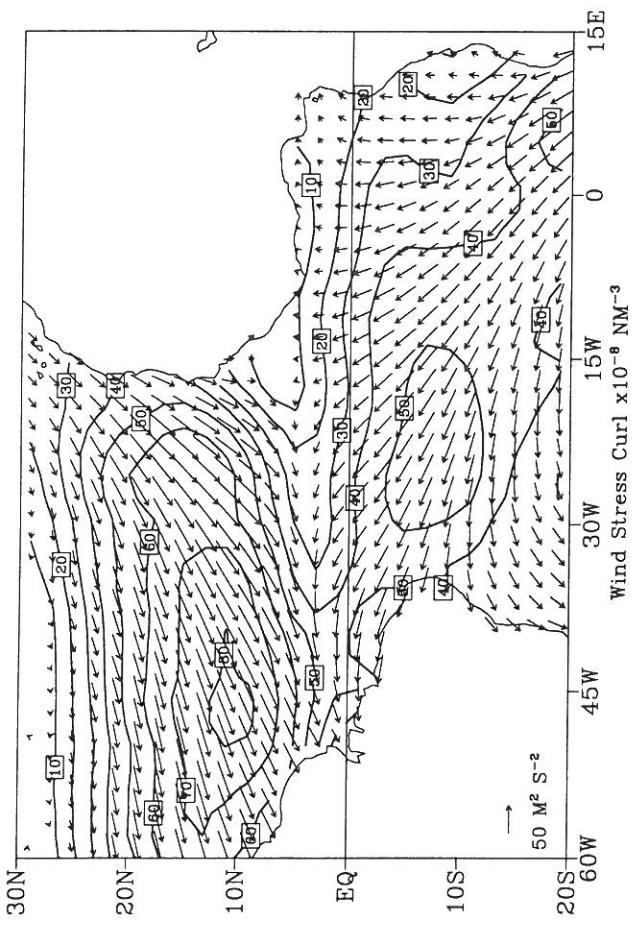
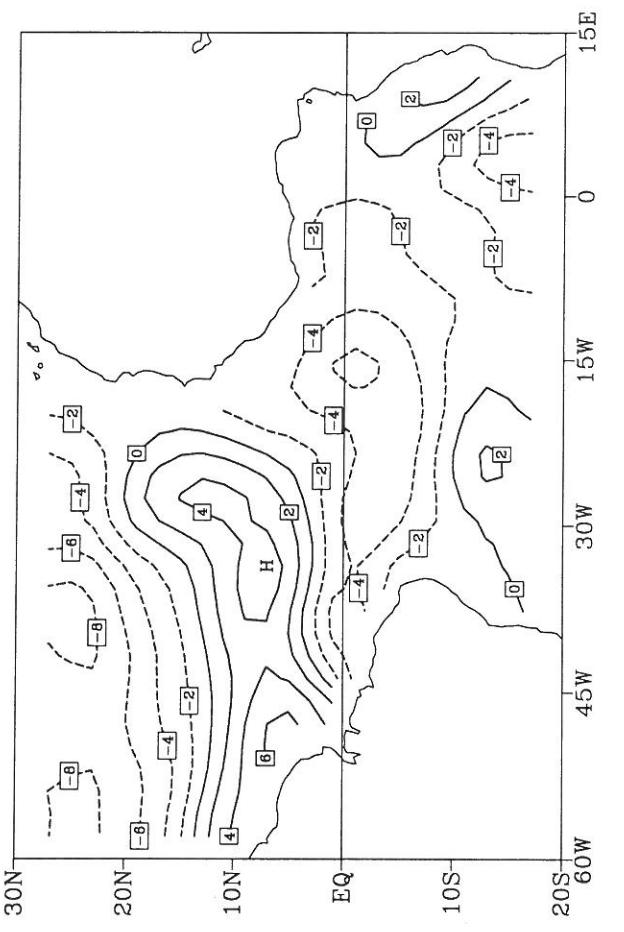
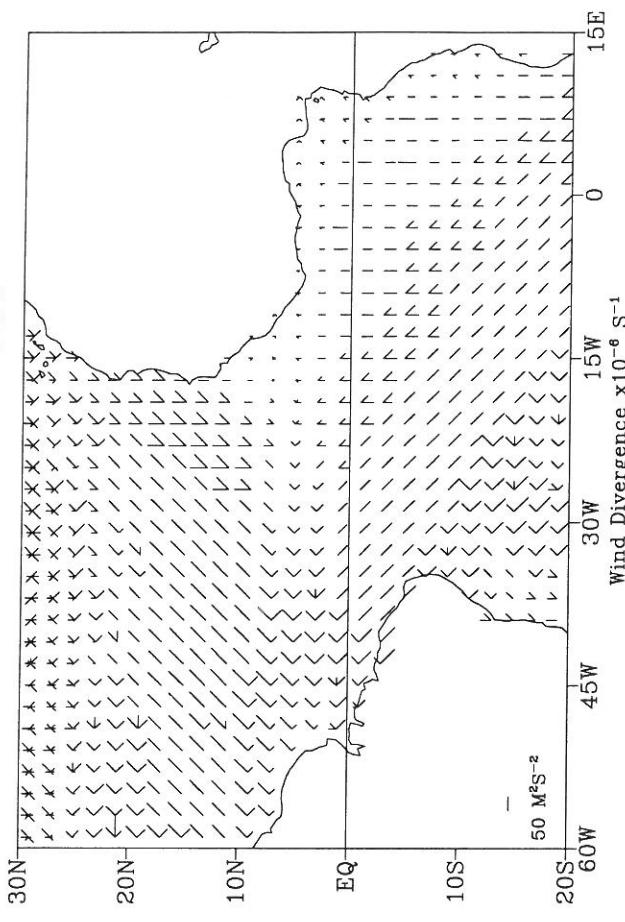
Pseudo Wind Stress Rose  $M^2 S^{-2}$



Pseudo Wind Stress Vectors  $M^2 S^{-2}$

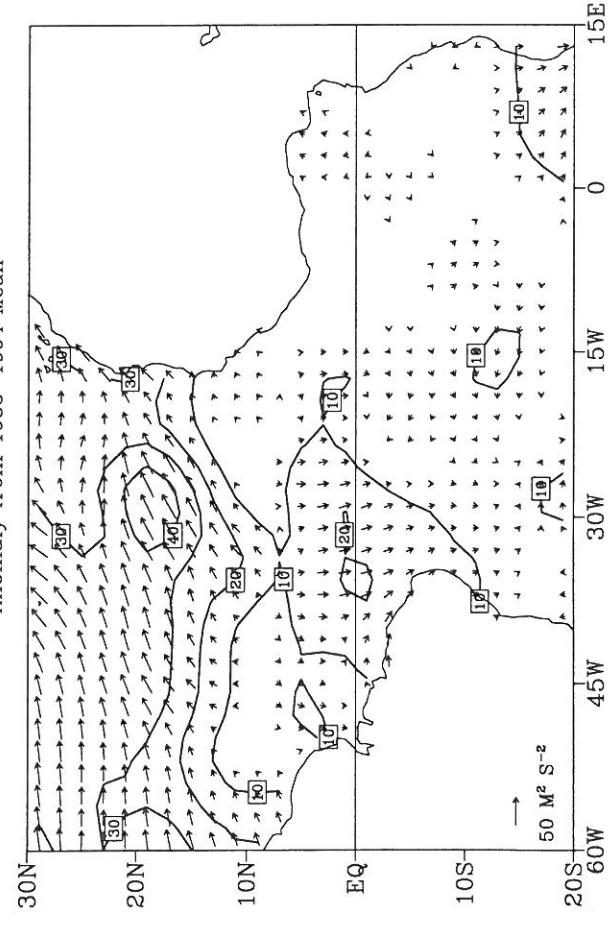
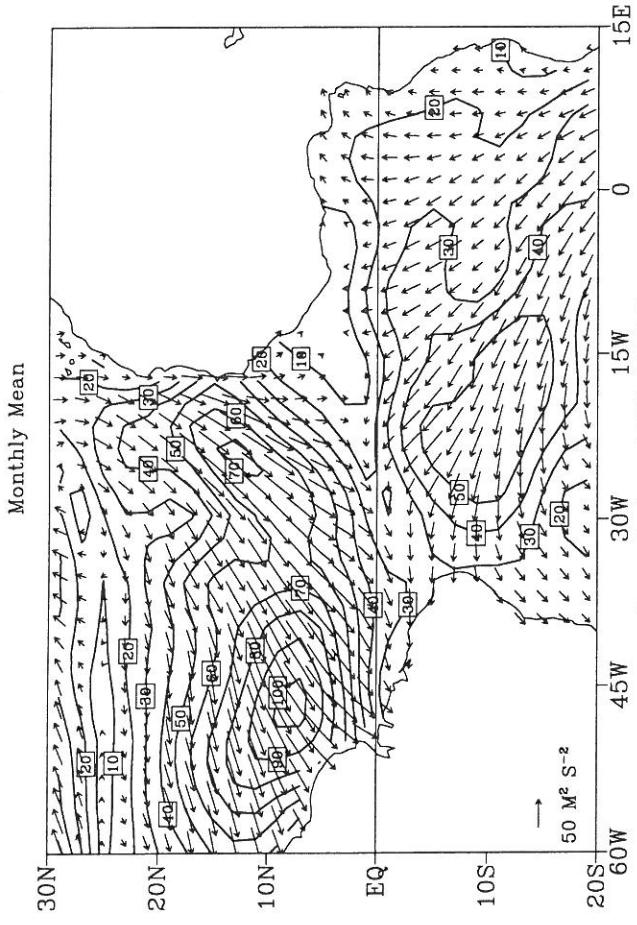


1964-1994 December Climatology

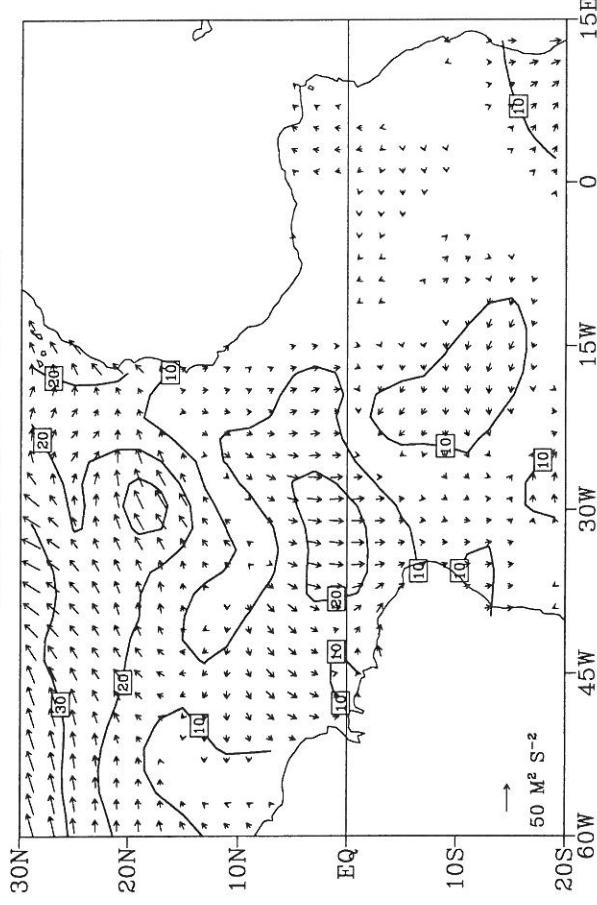
Pseudo Wind Stress Vectors  $M^2 S^{-2}$ Pseudo Wind Stress Rose  $M^2 S^{-2}$ 

1985-1994 December Climatology

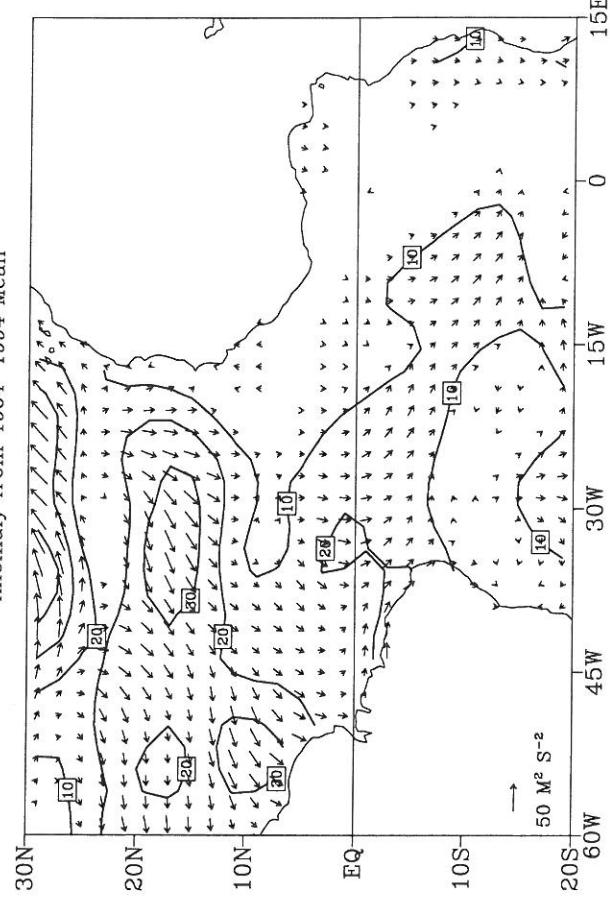
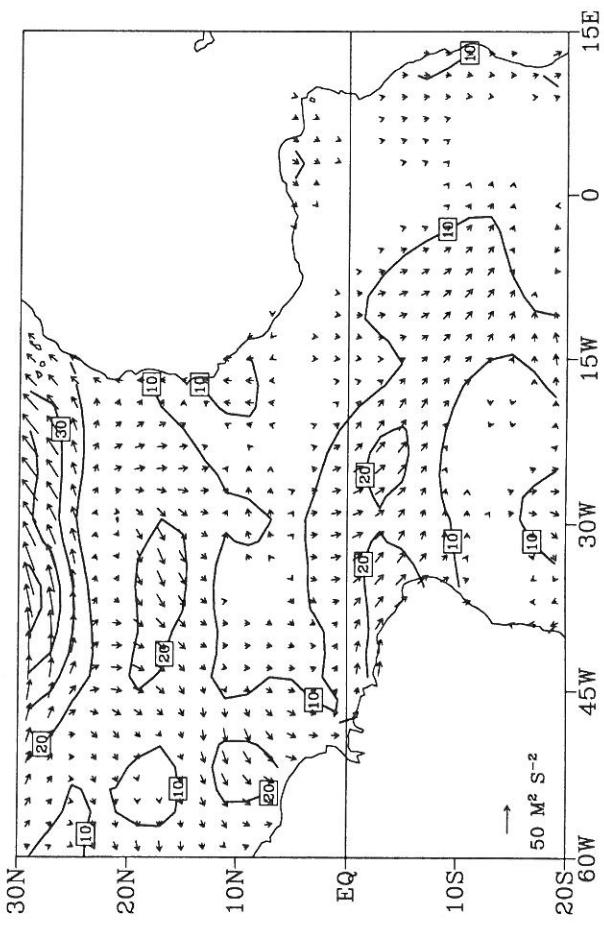
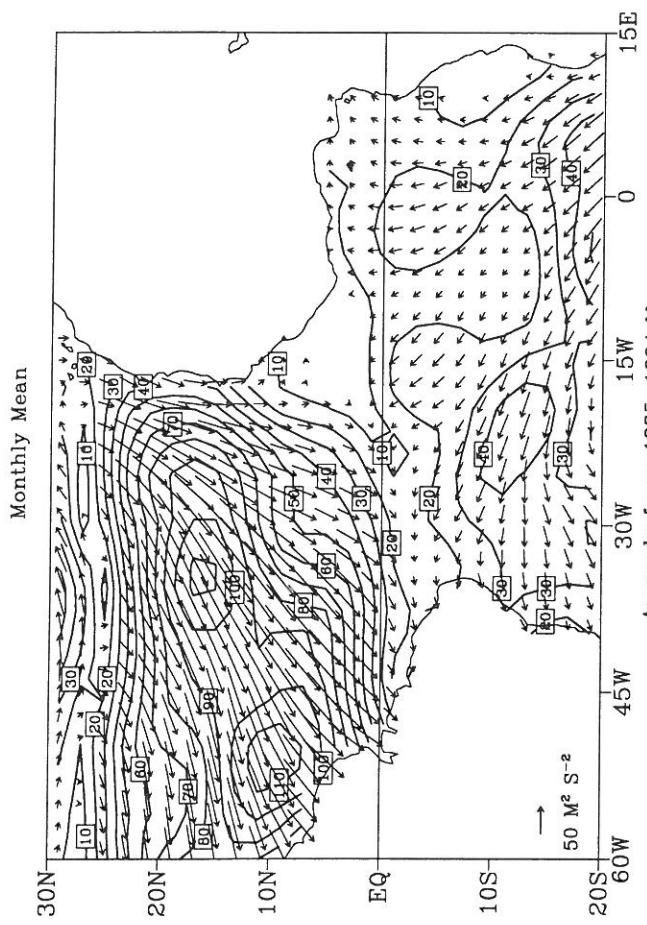
# **1985-1994 Monthly Fields**

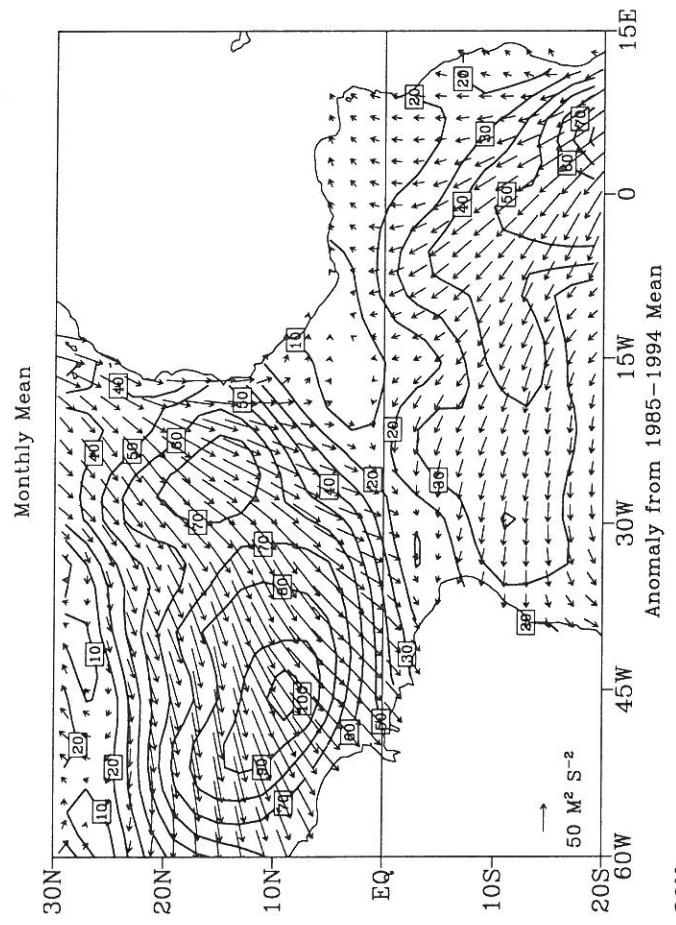


Anomaly from 1964–1994 Mean

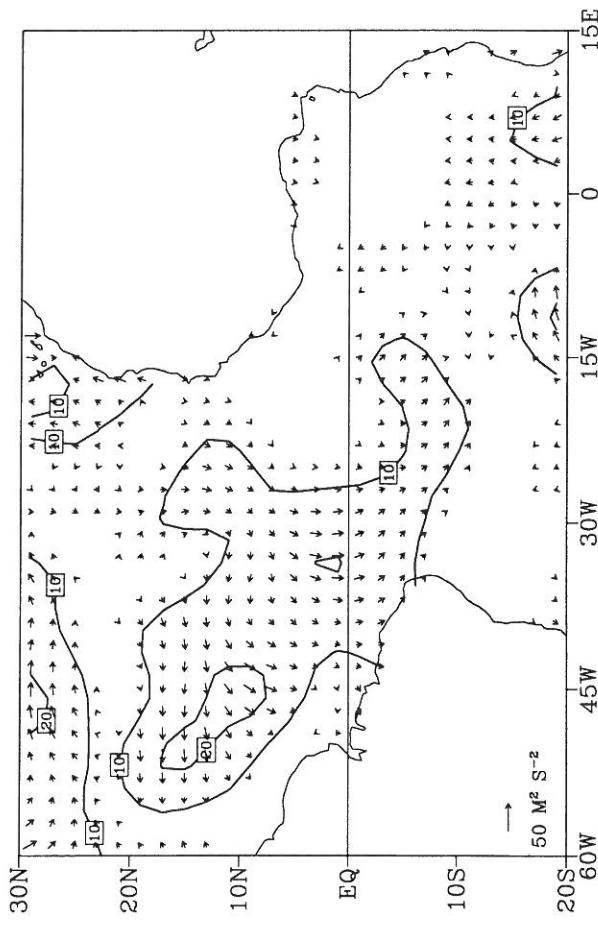


January 1985  
Pseudostress Vectors

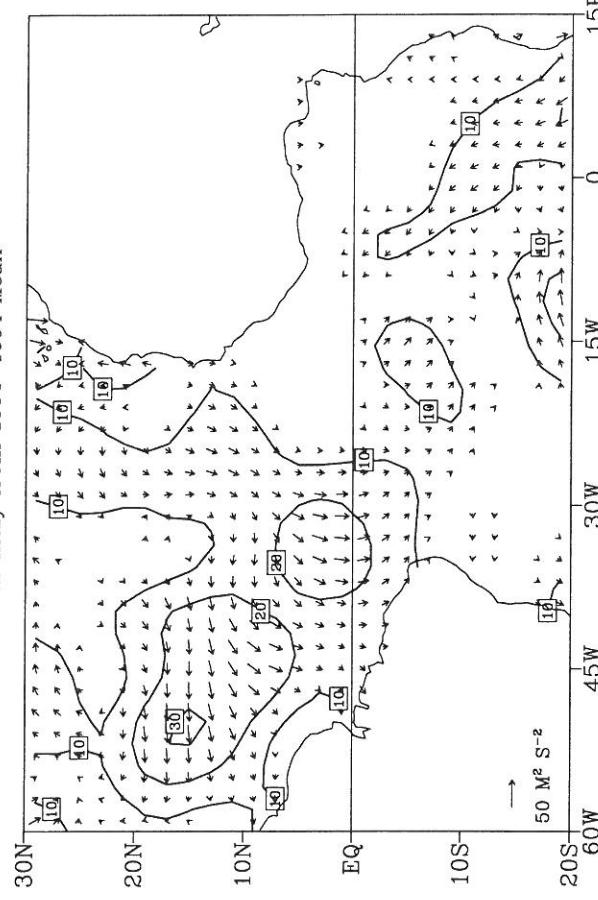




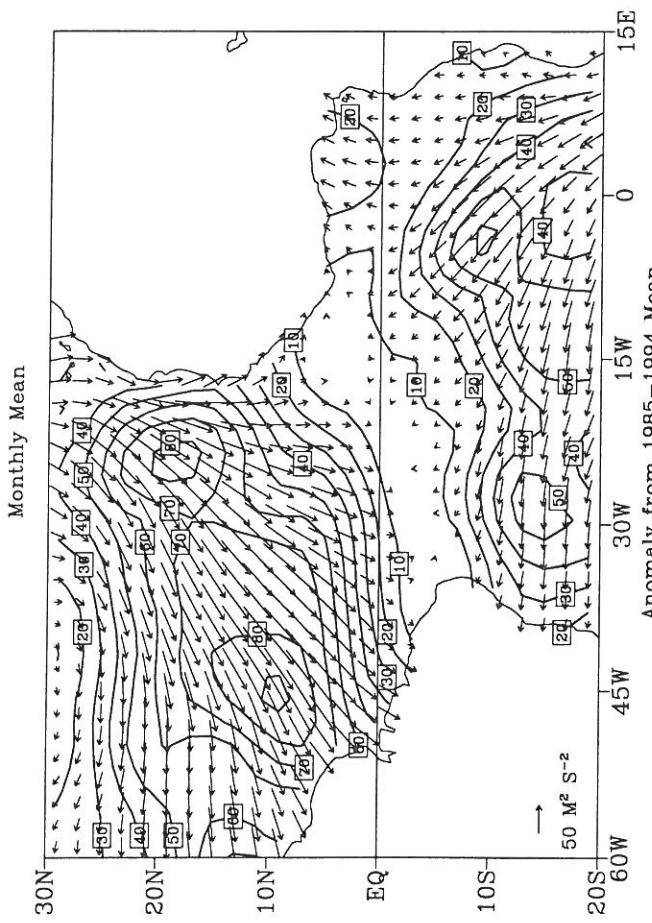
March 1985  
Pseudostress Vectors



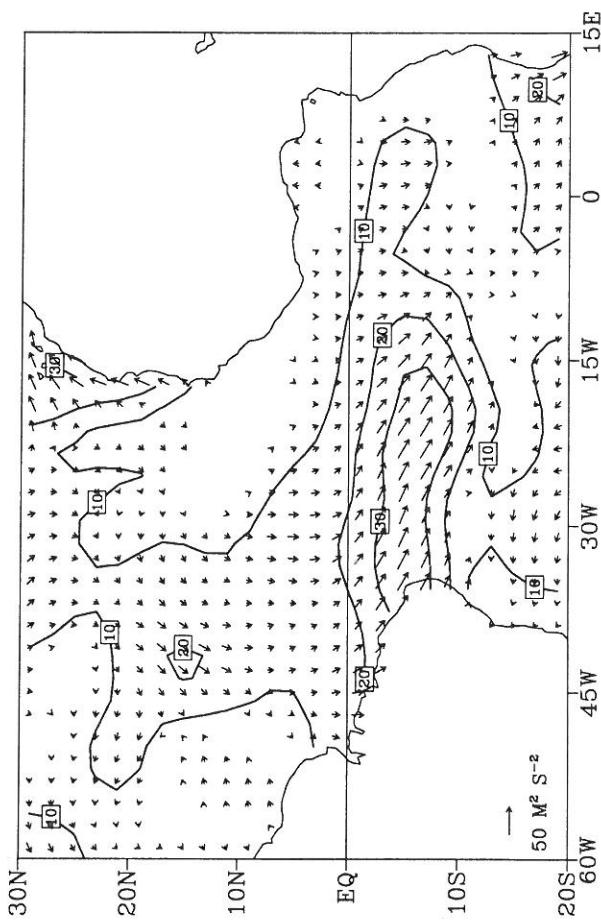
Anomaly from 1964–1994 Mean



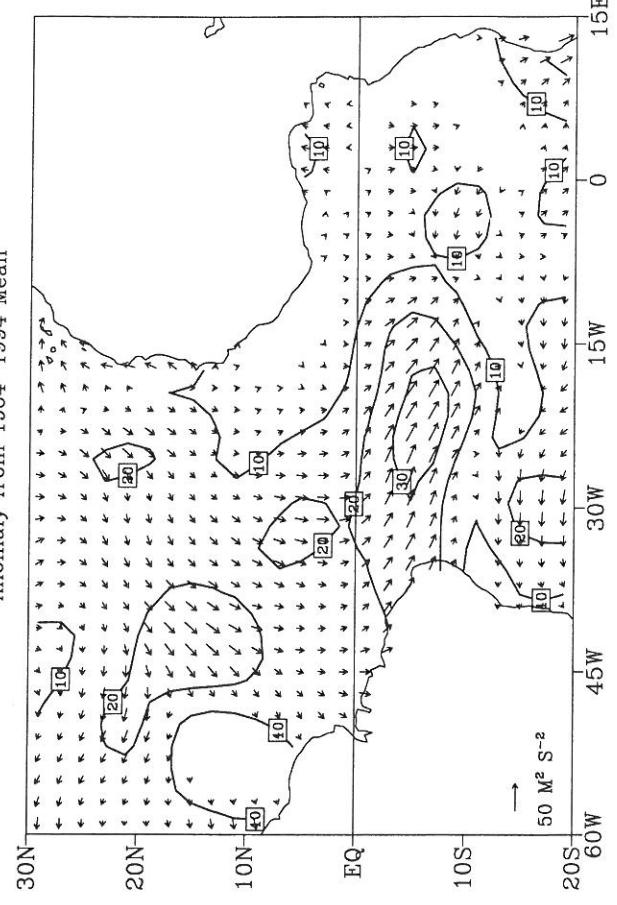
Anomaly from 1964–1994 Mean

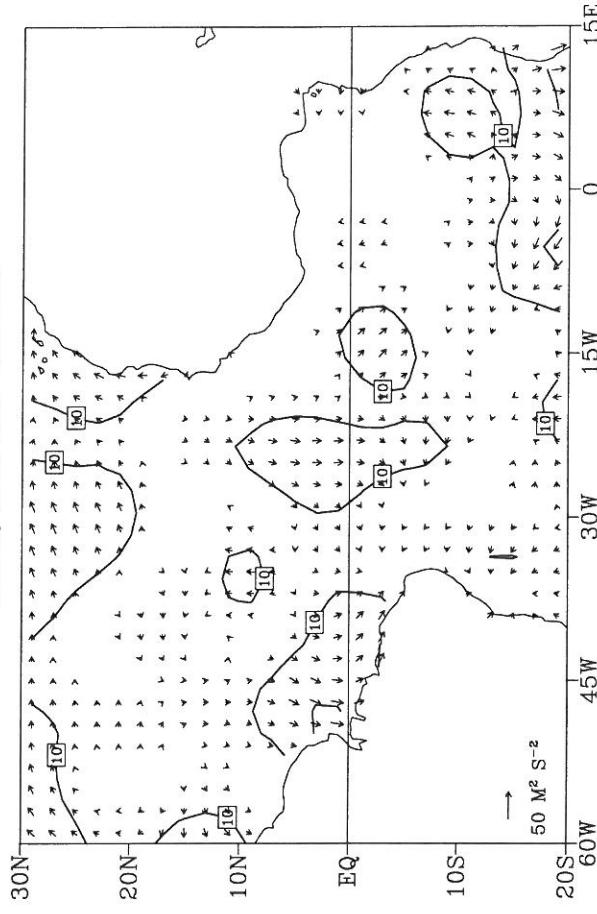
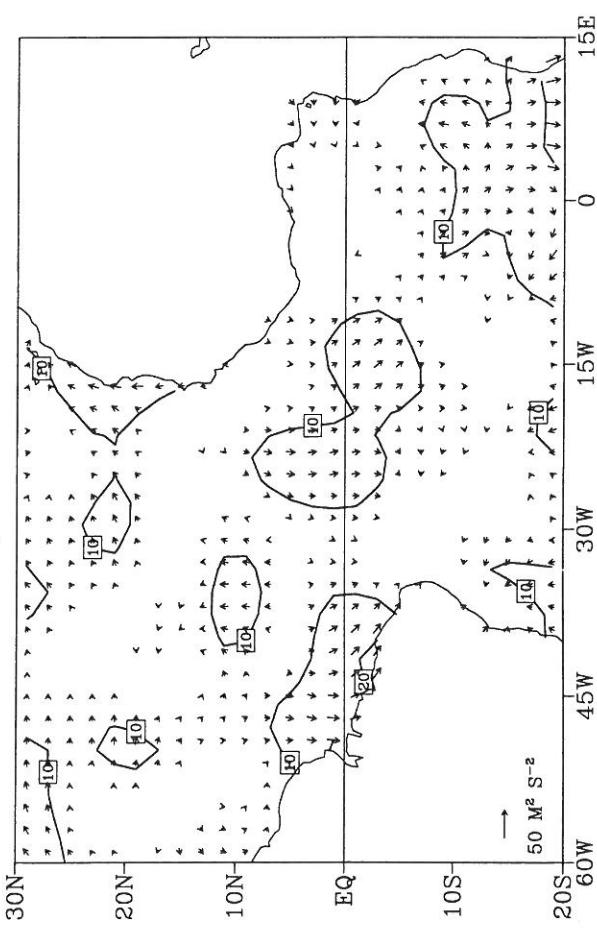
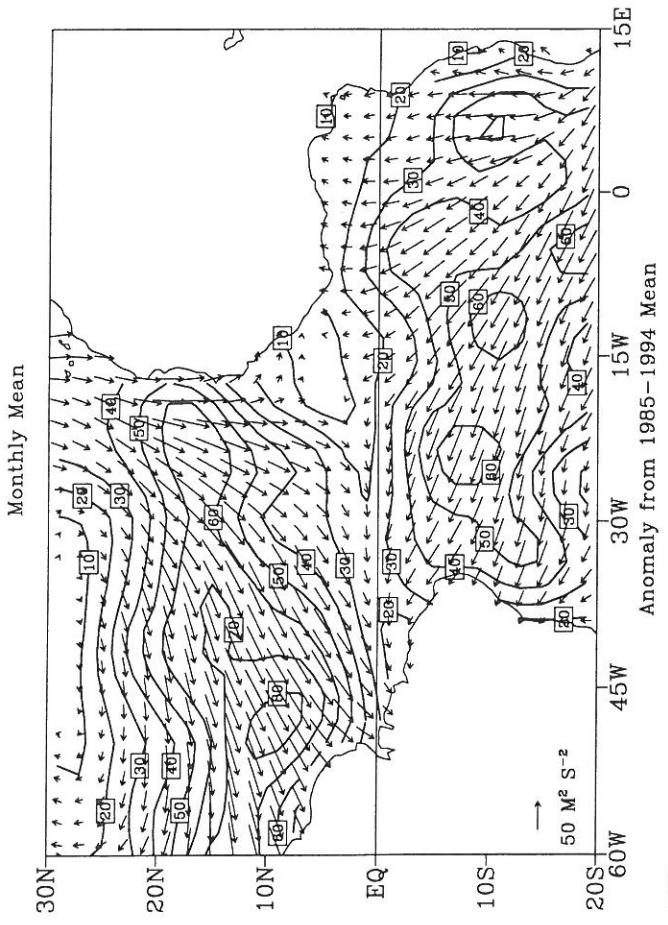


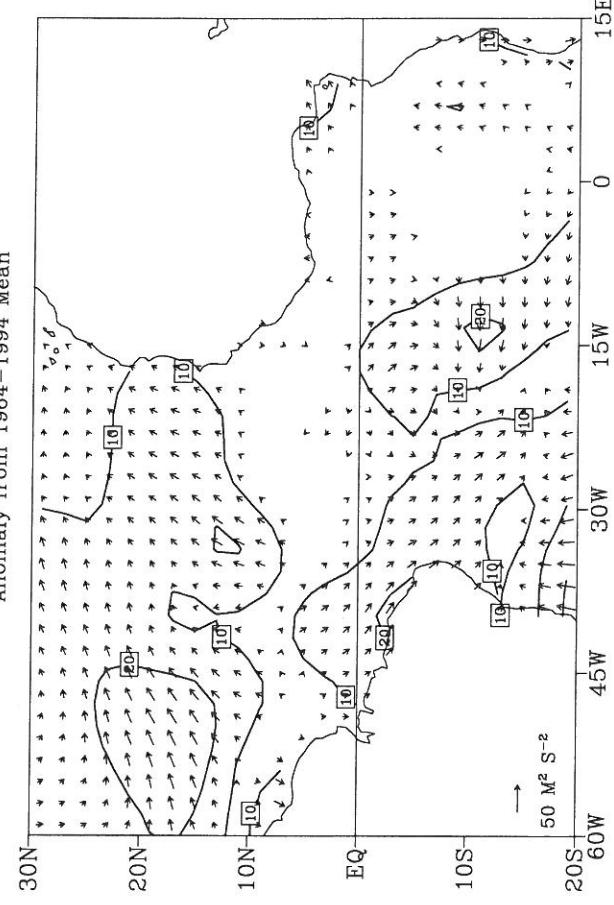
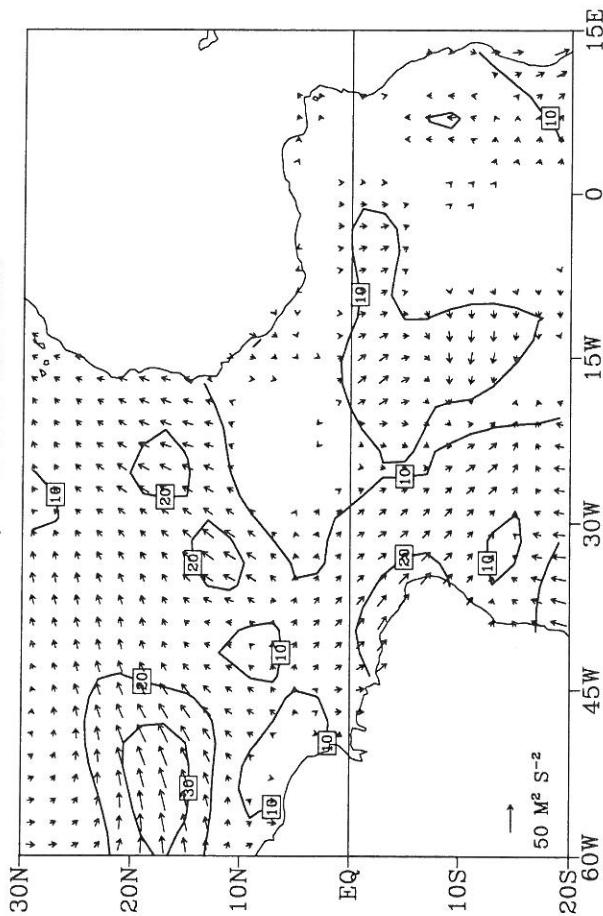
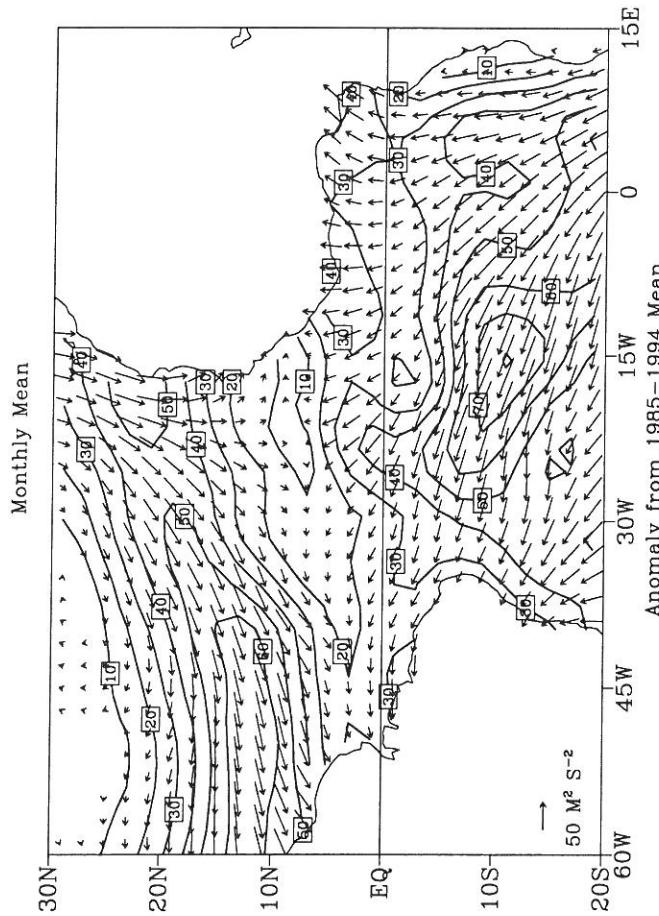
April 1985  
Pseudostress Vectors



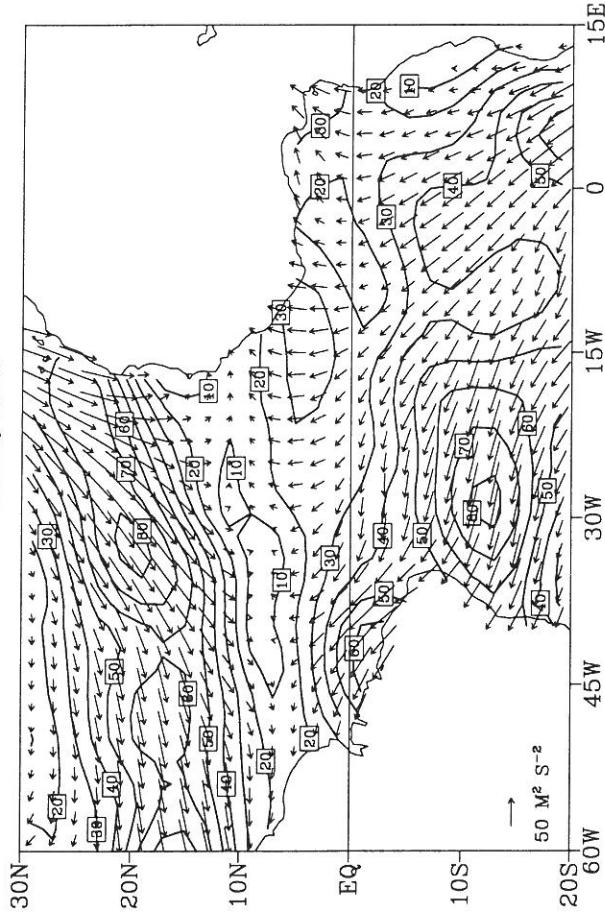
Anomaly from 1964–1994 Mean





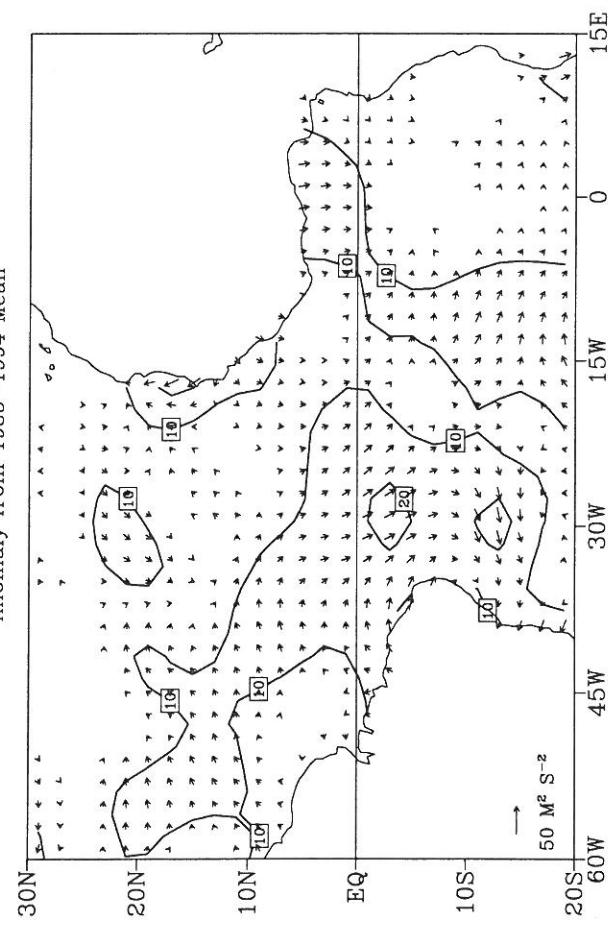


Monthly Mean

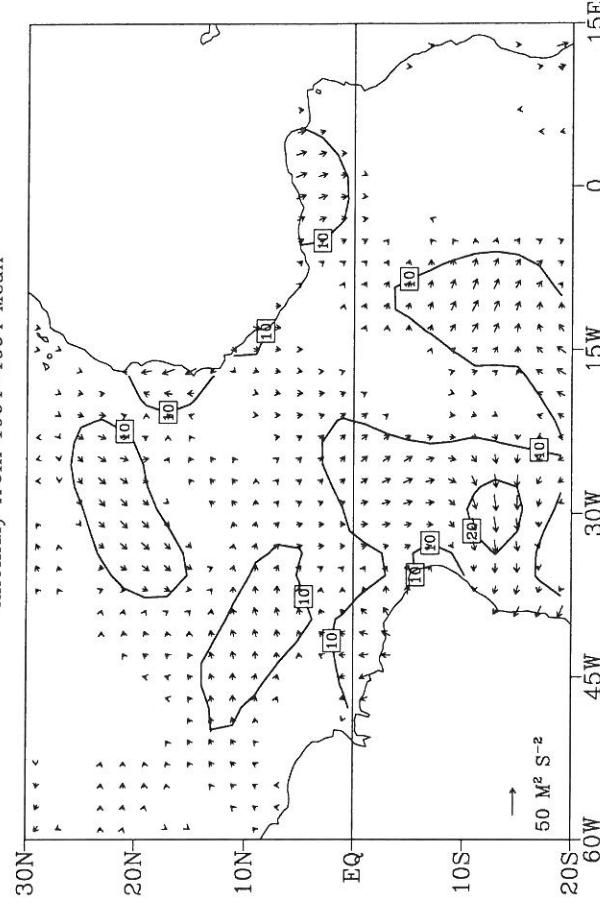


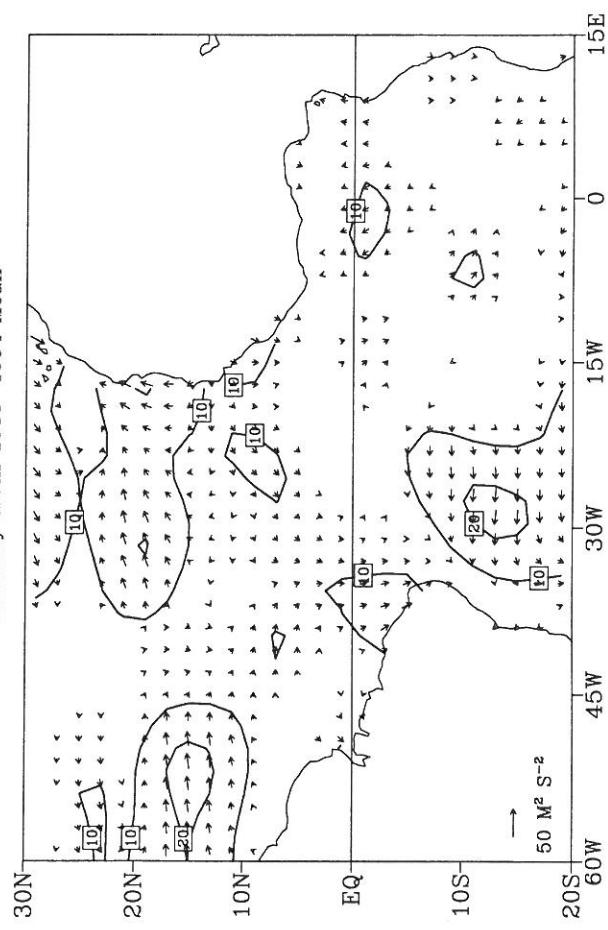
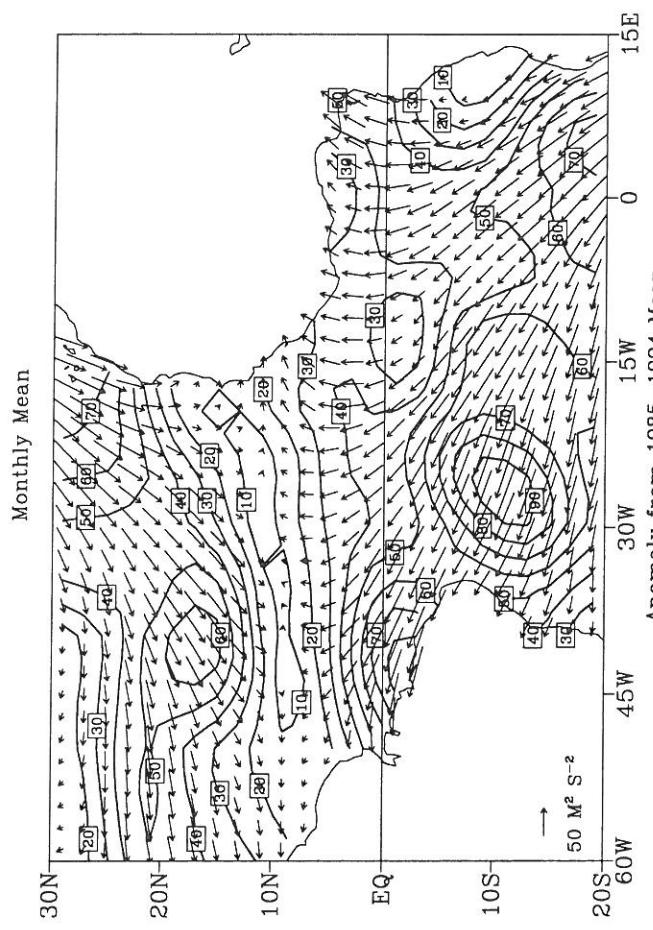
July 1985  
Pseudostress Vectors

Anomaly from  
1985–1994 Mean

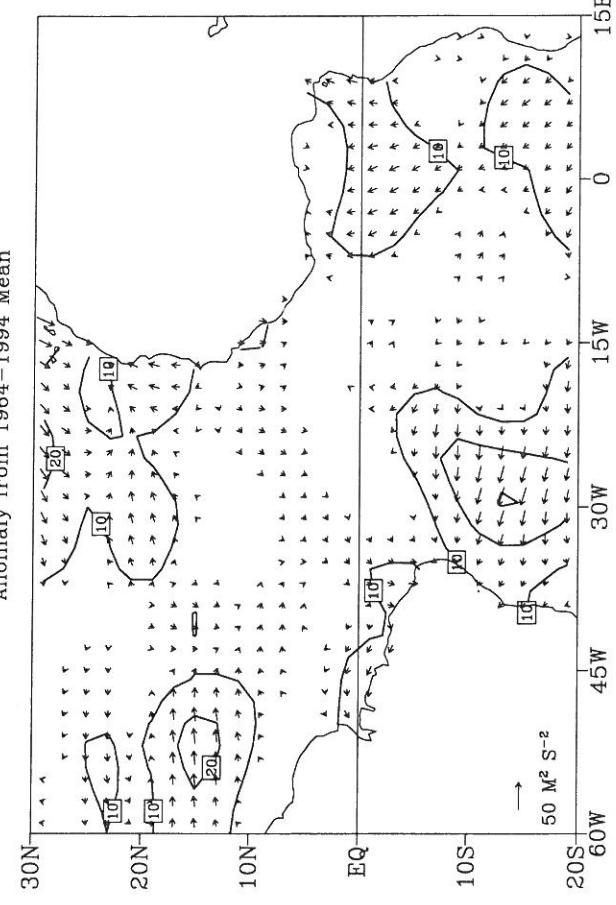


Anomaly from 1964–1994 Mean

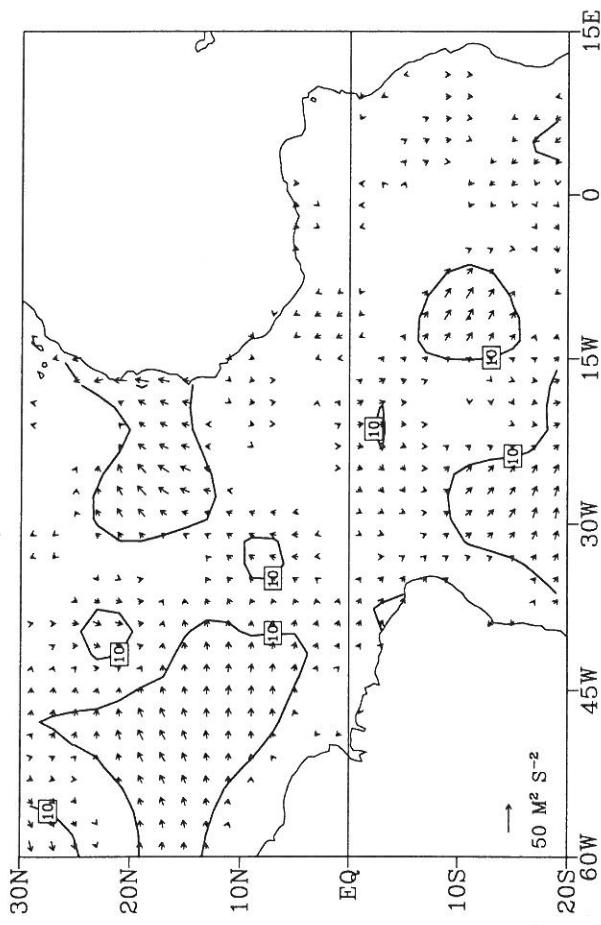
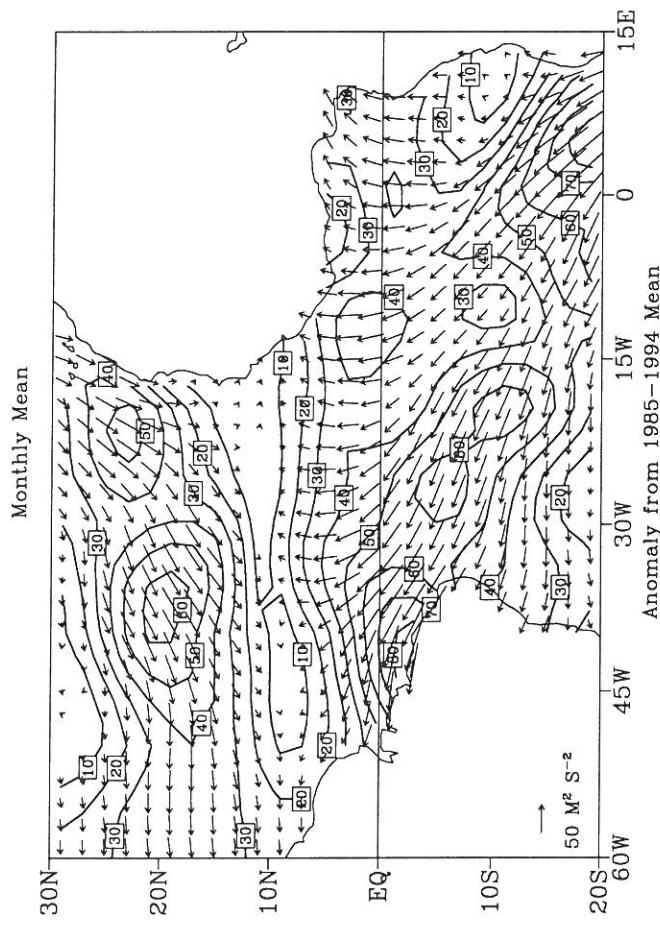




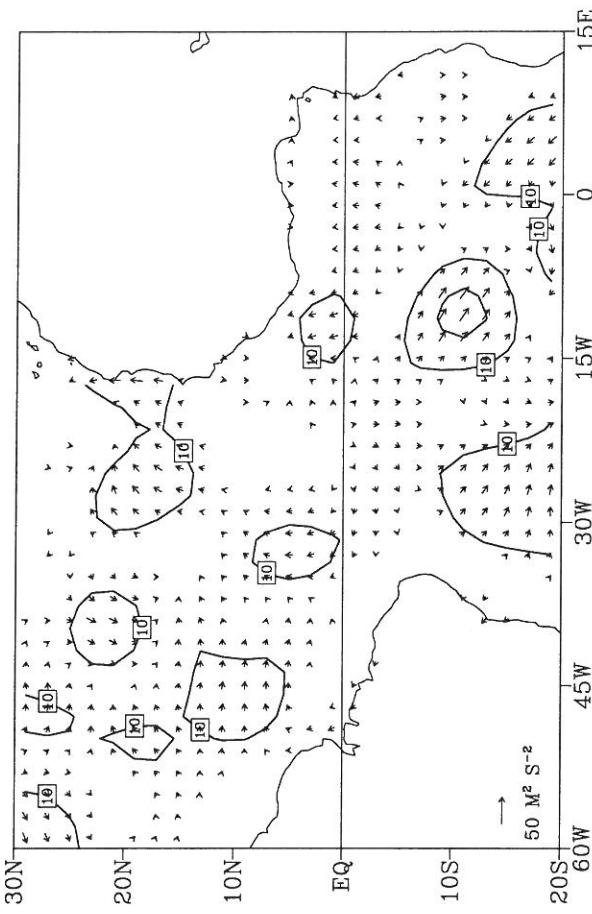
Anomaly from 1964–1994 Mean

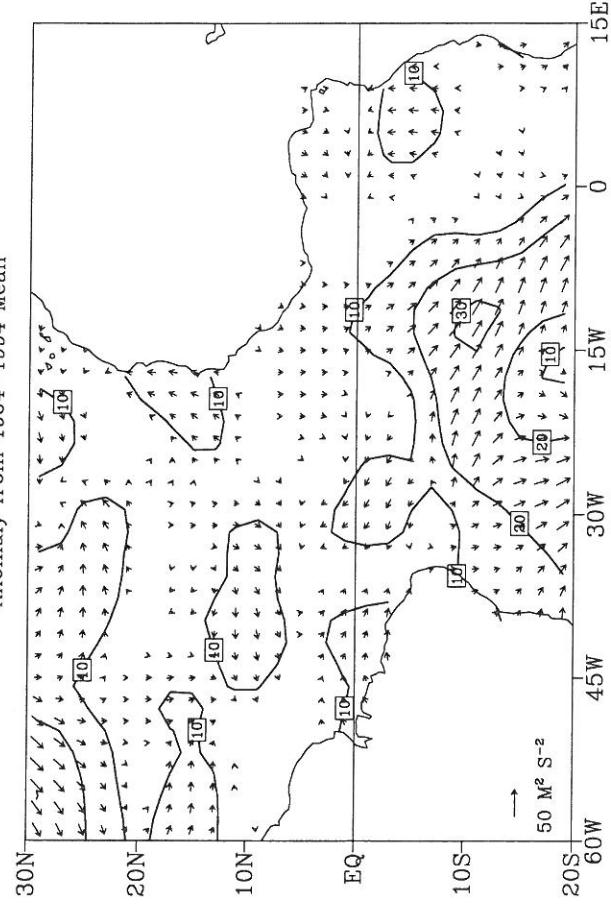
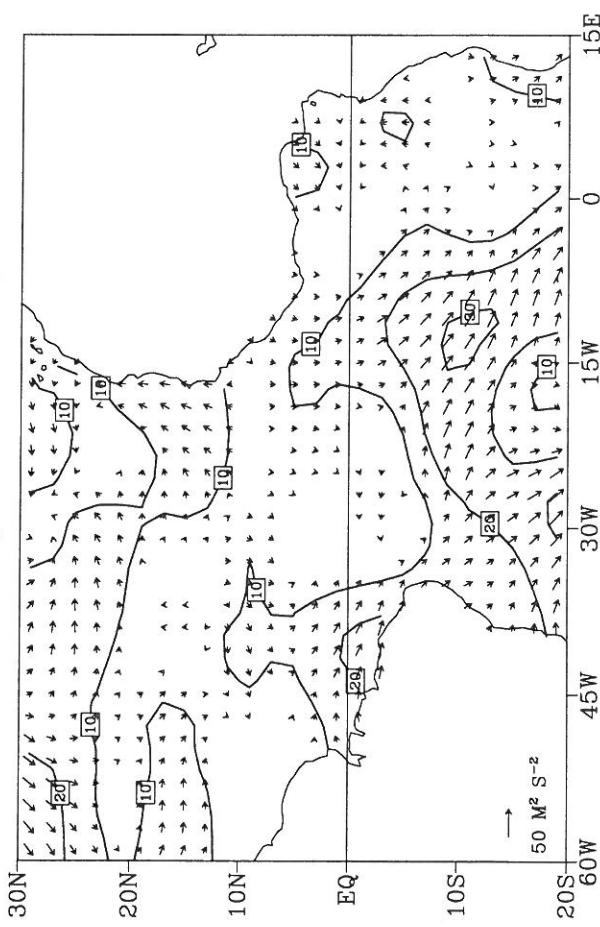
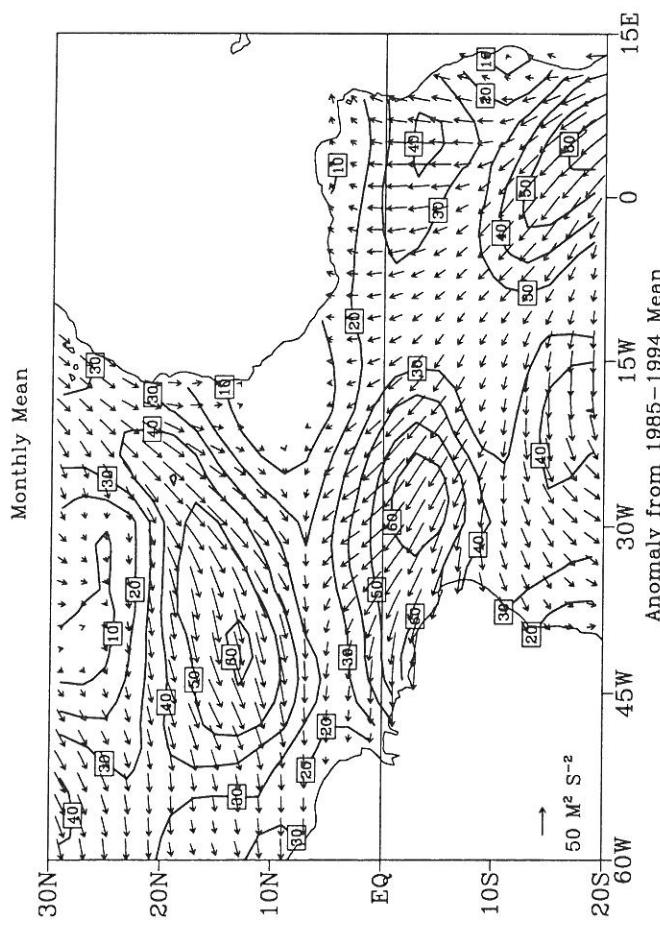


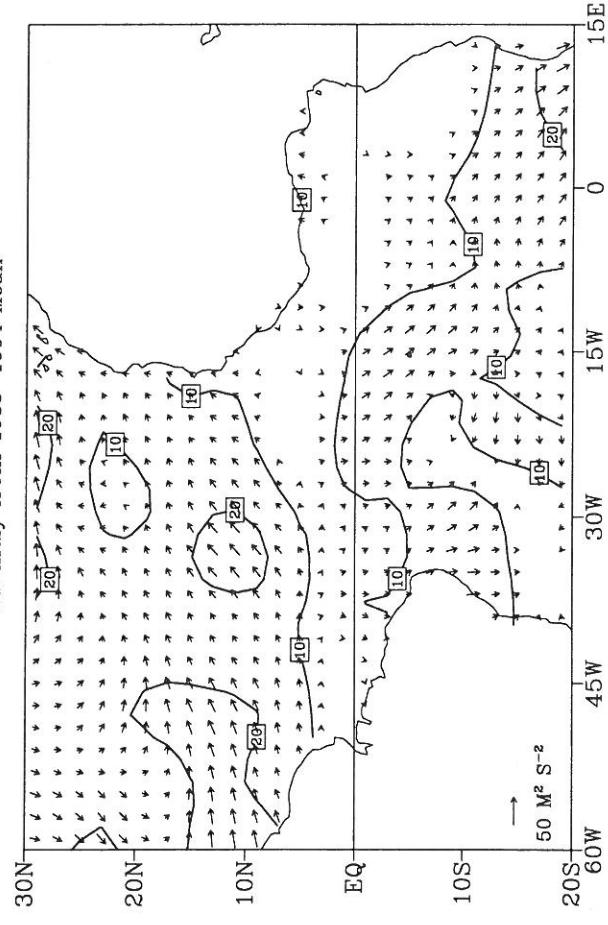
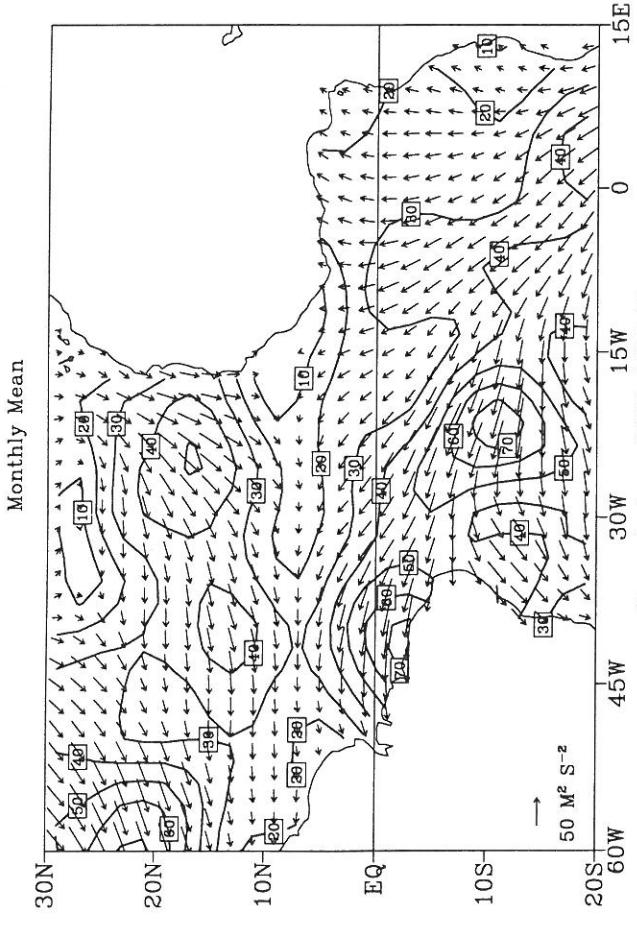
August 1985  
Pseudostress Vectors



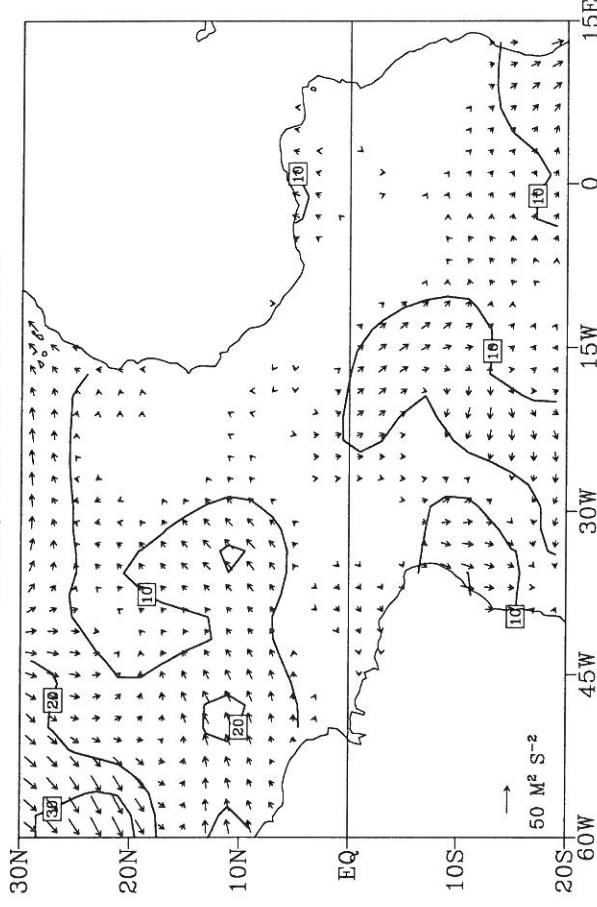
Anomaly from 1964–1994 Mean

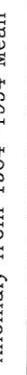
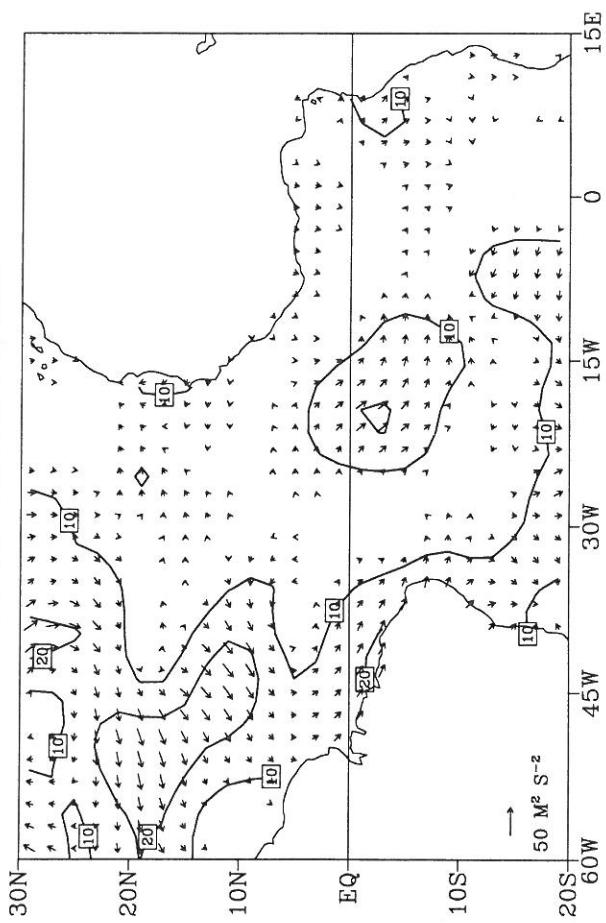
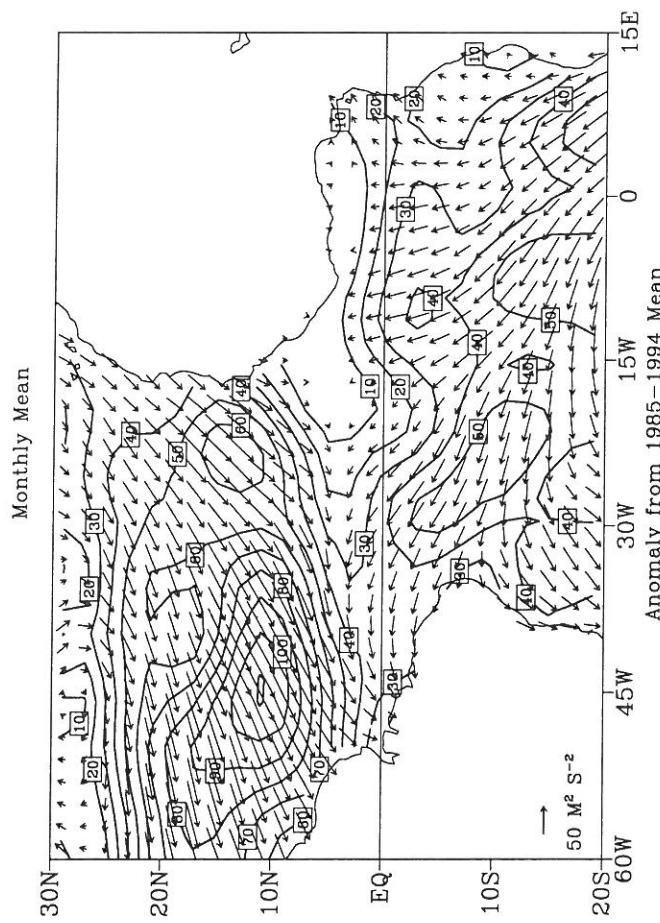


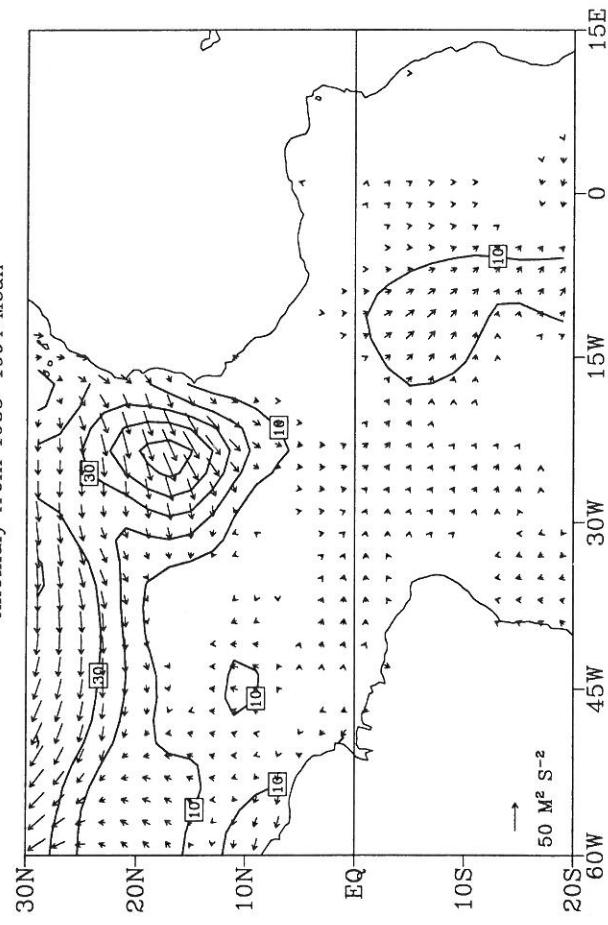
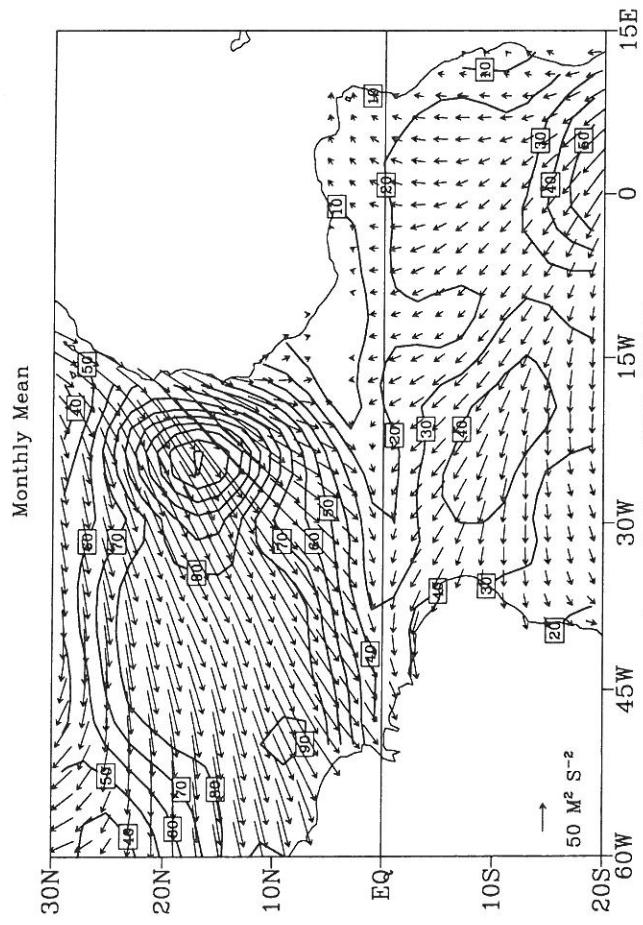




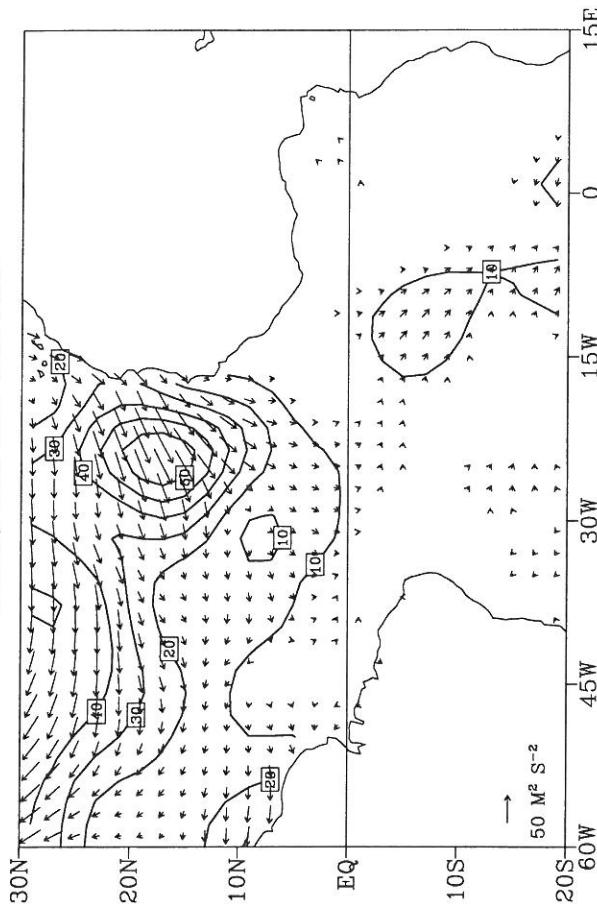
Anomaly from 1964–1994 Mean

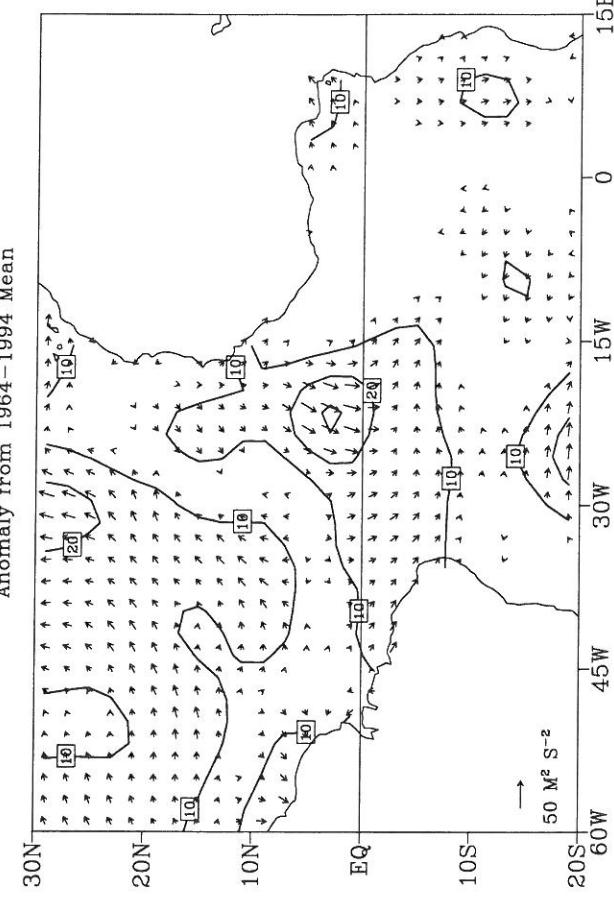
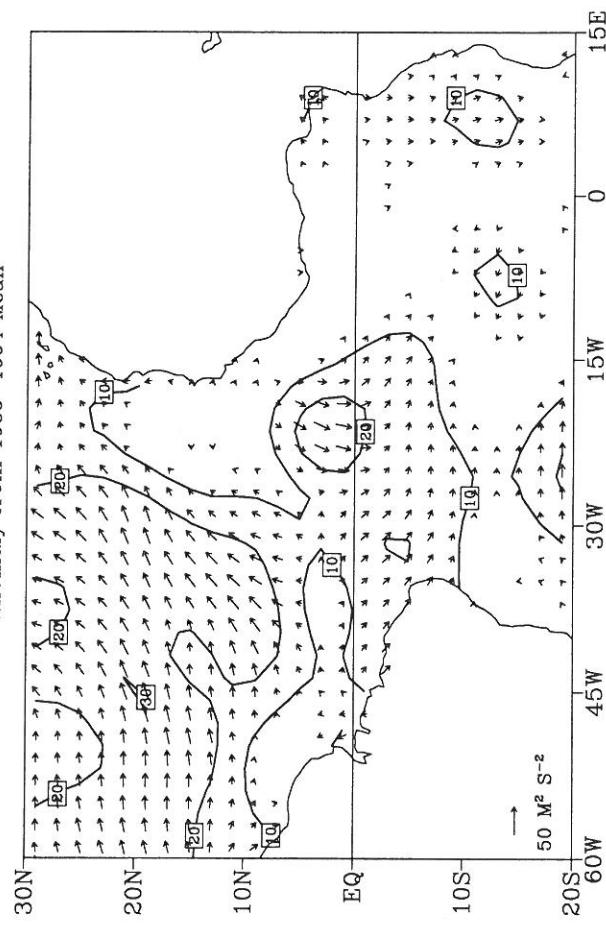
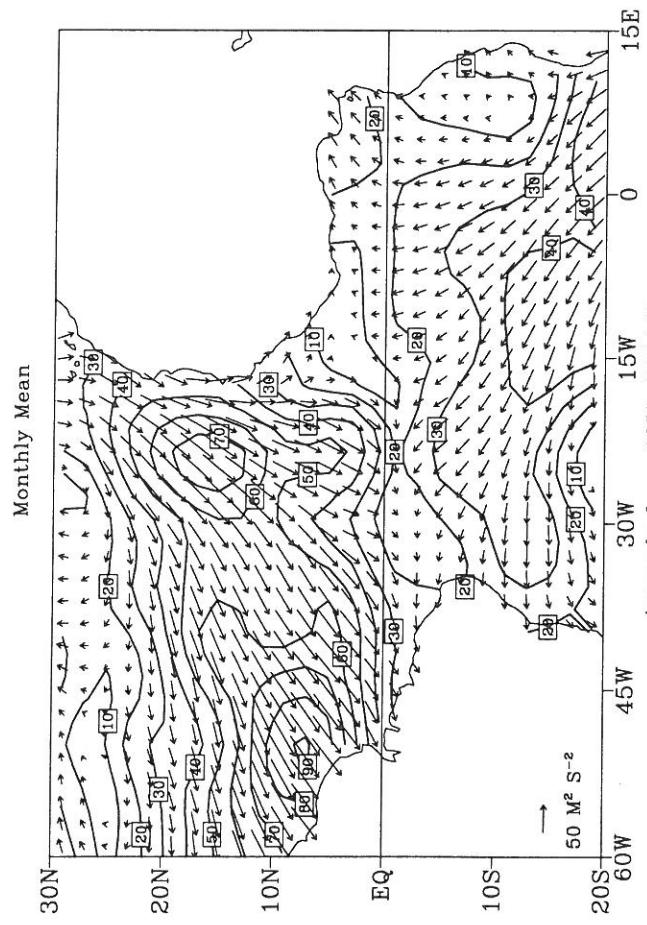


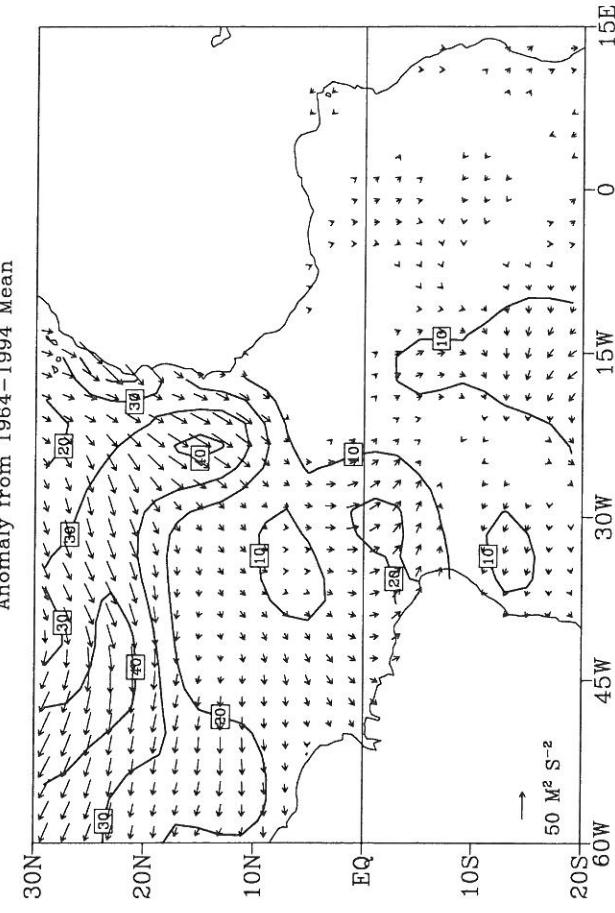
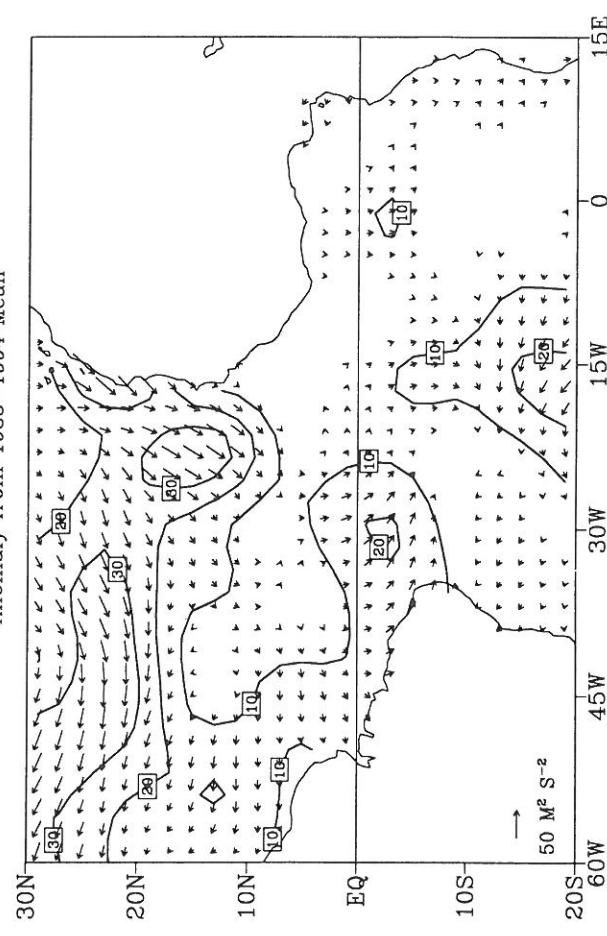
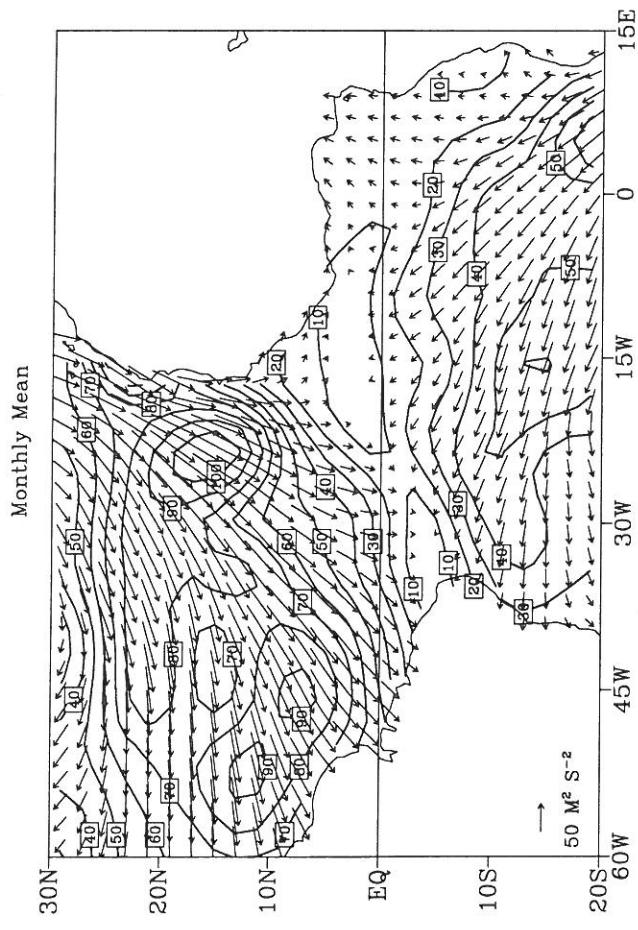


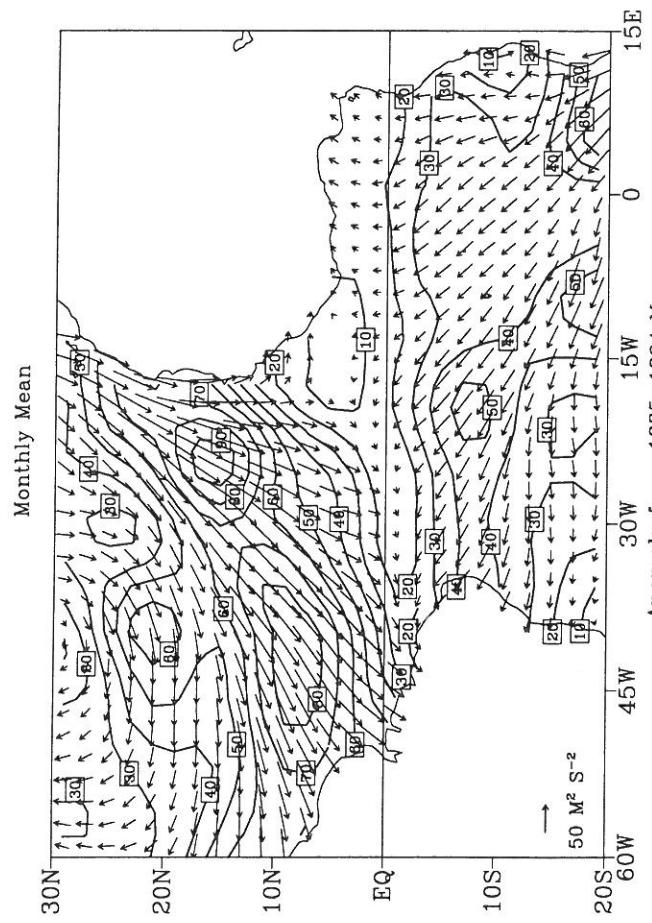


Anomaly from 1964–1994 Mean

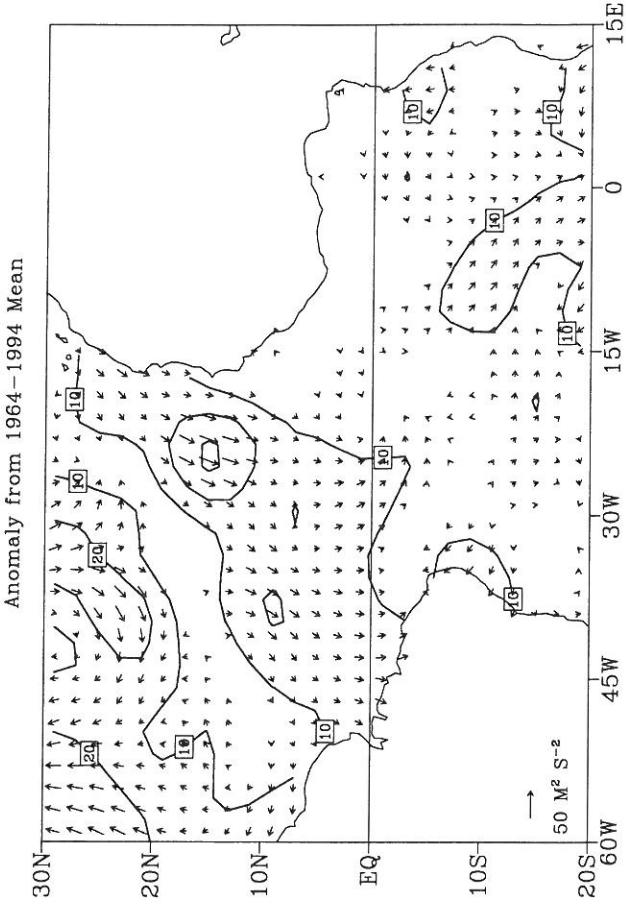
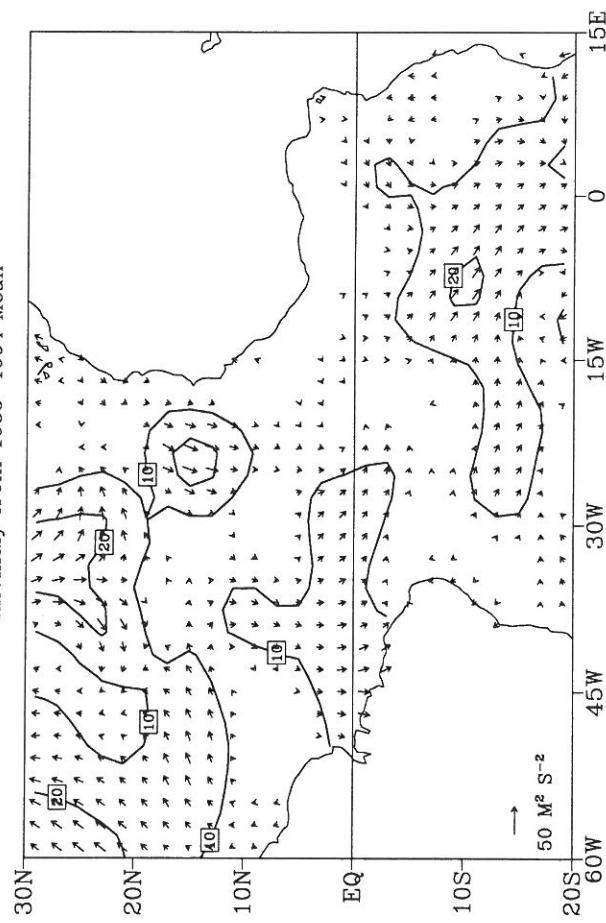


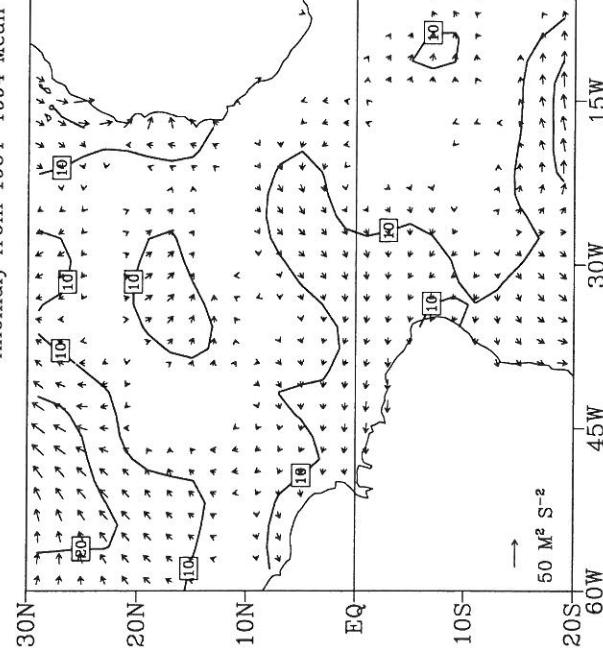
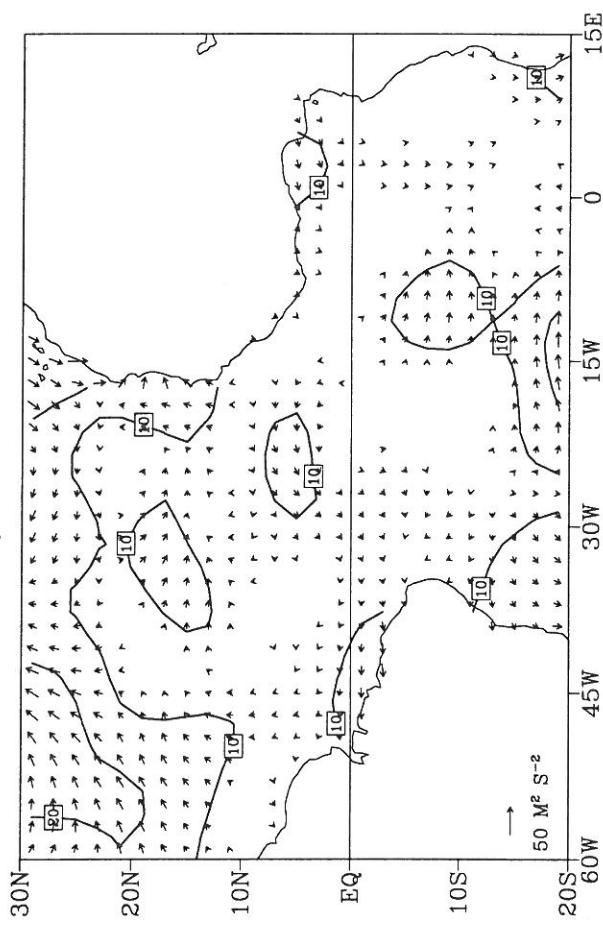
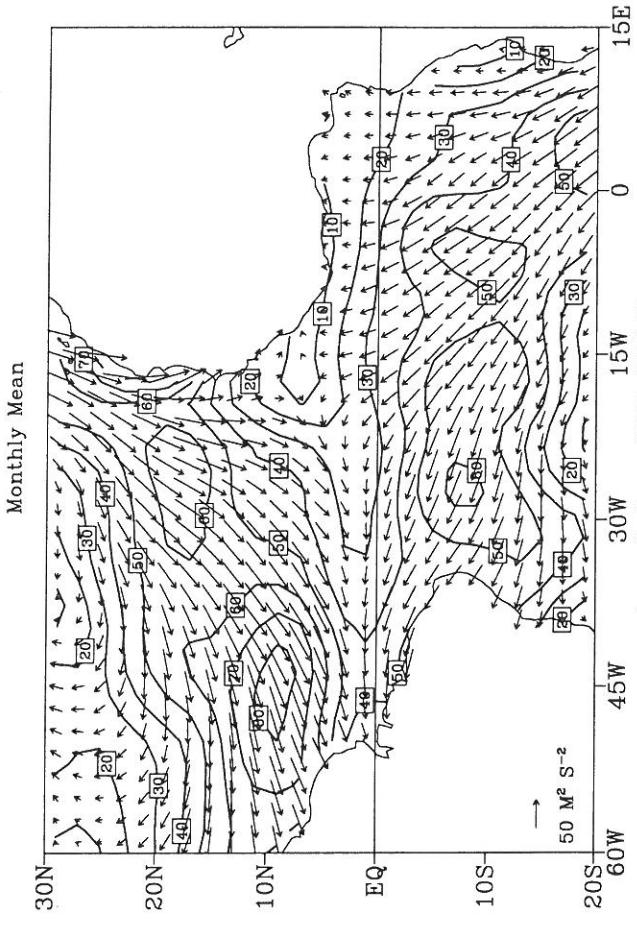


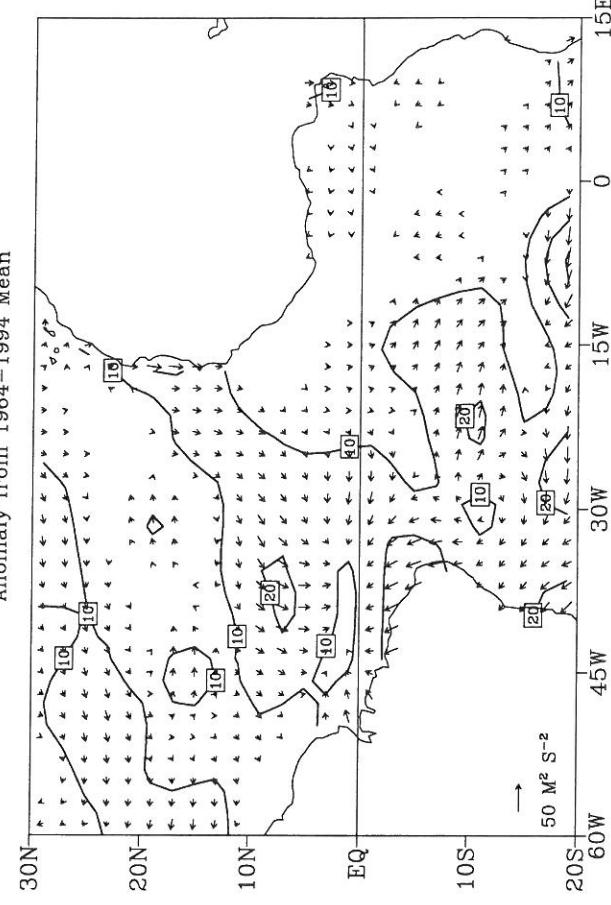
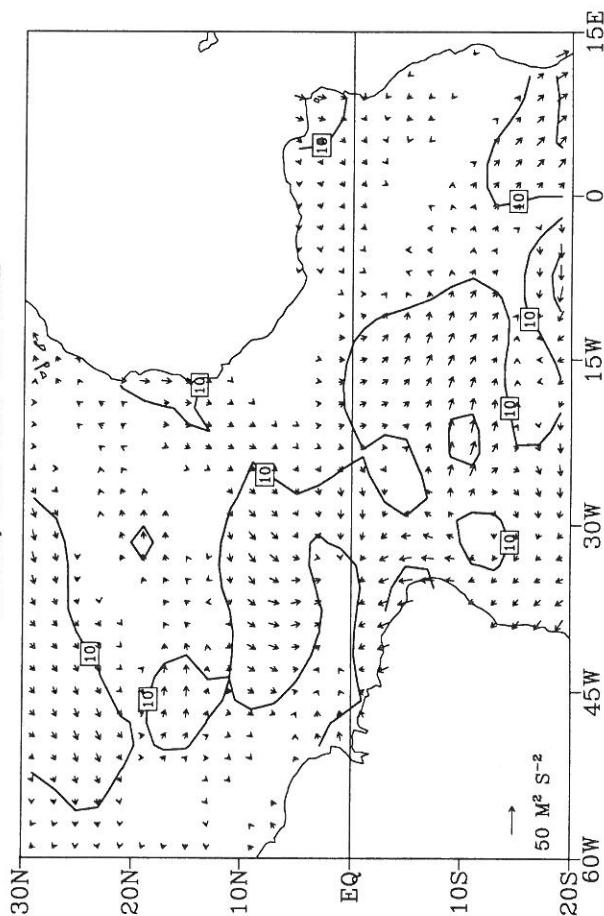
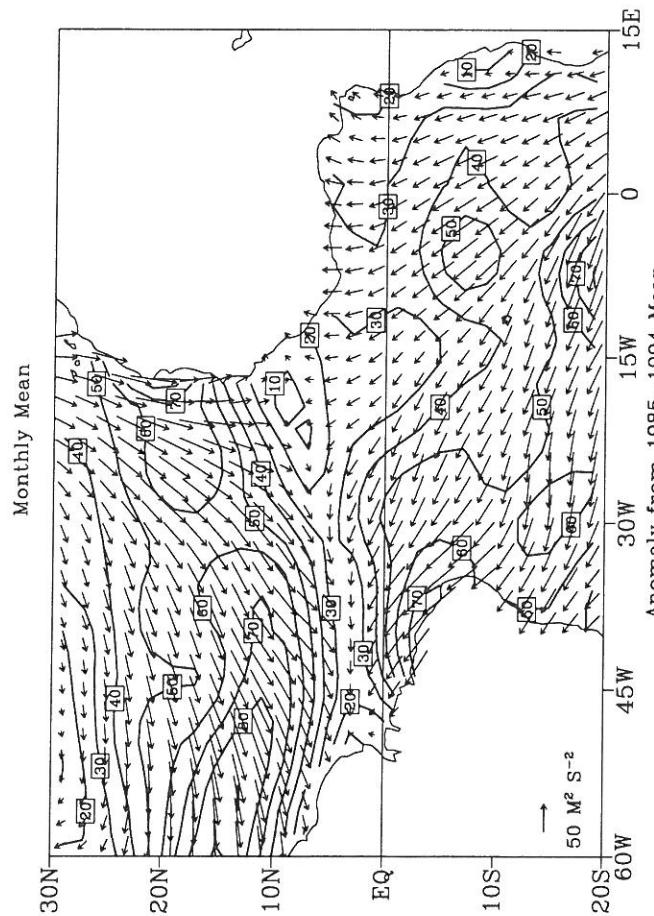


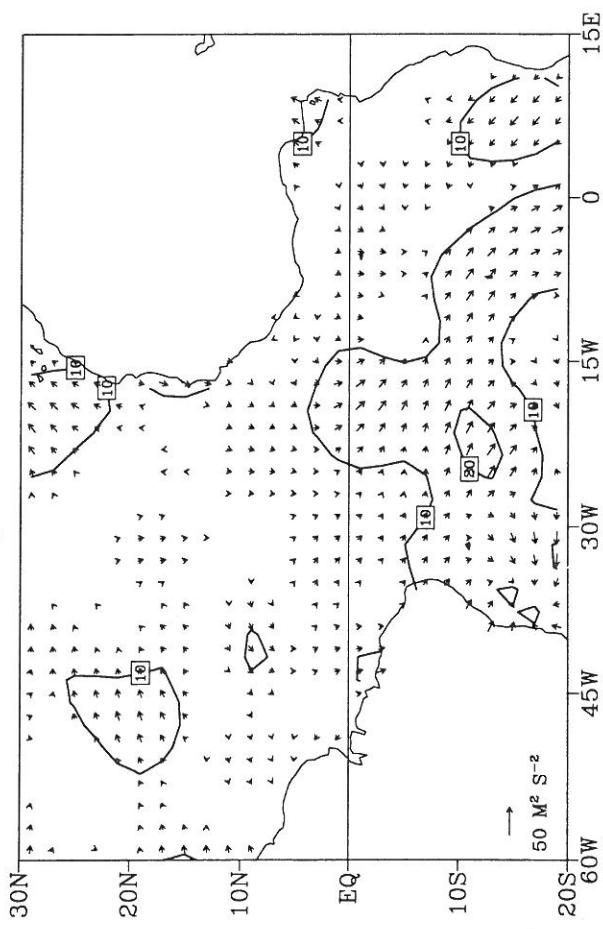
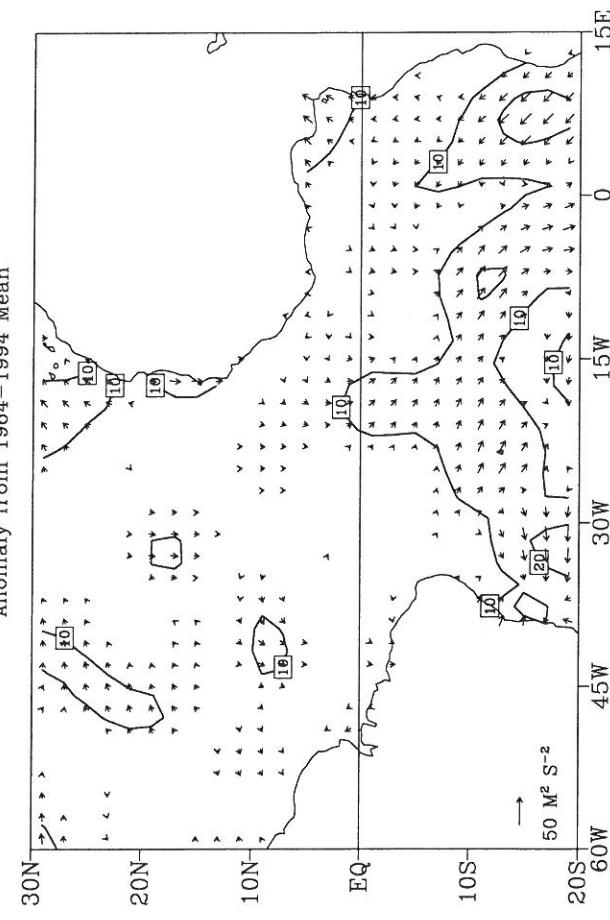
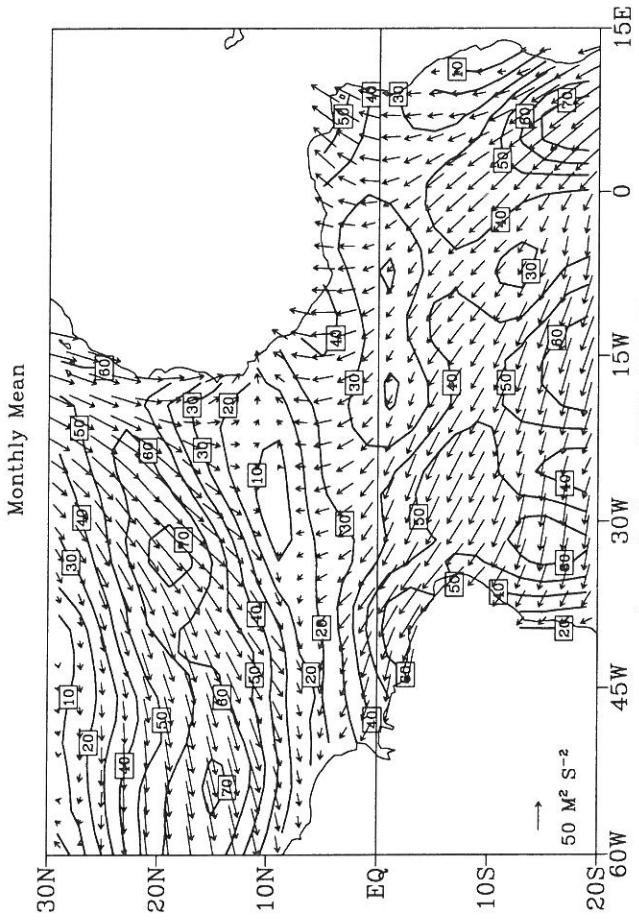


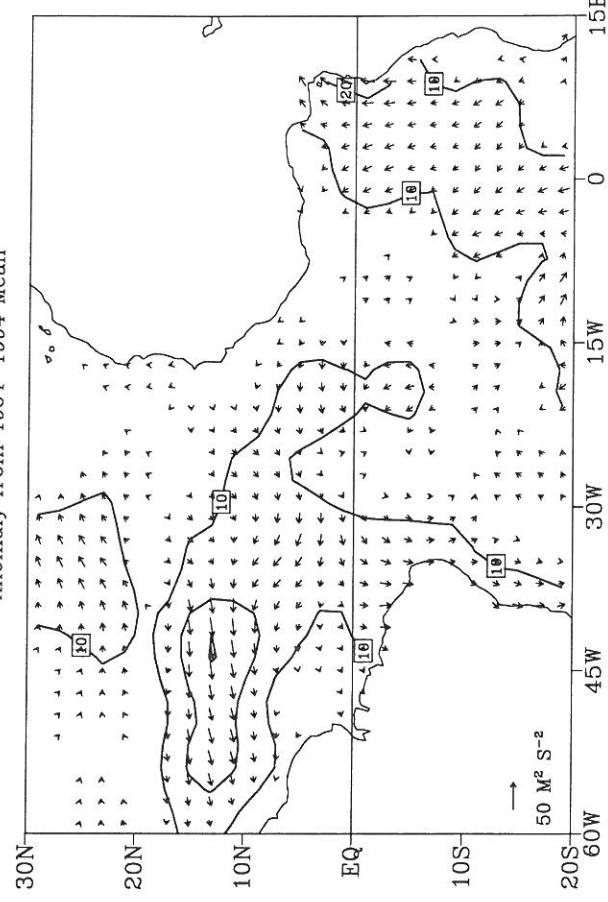
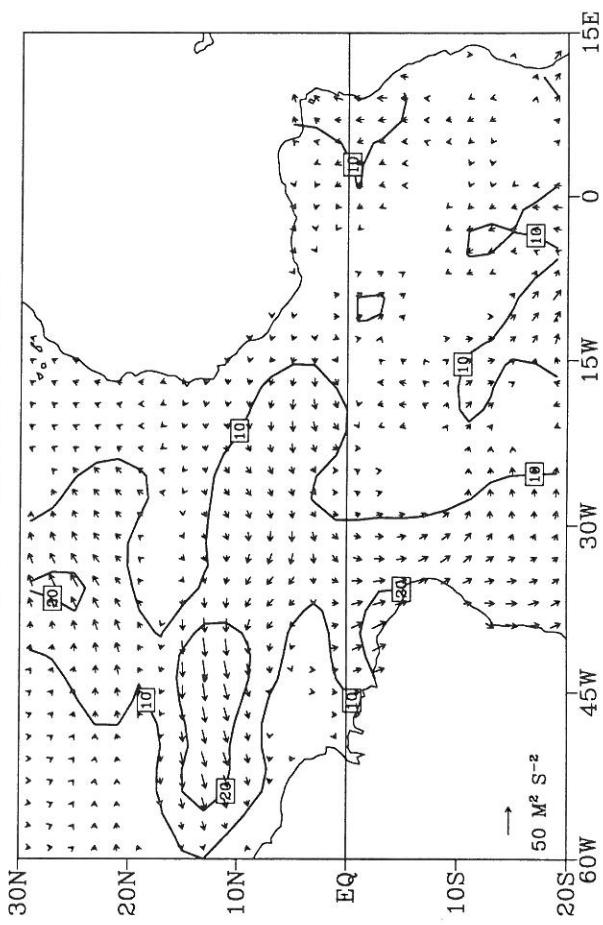
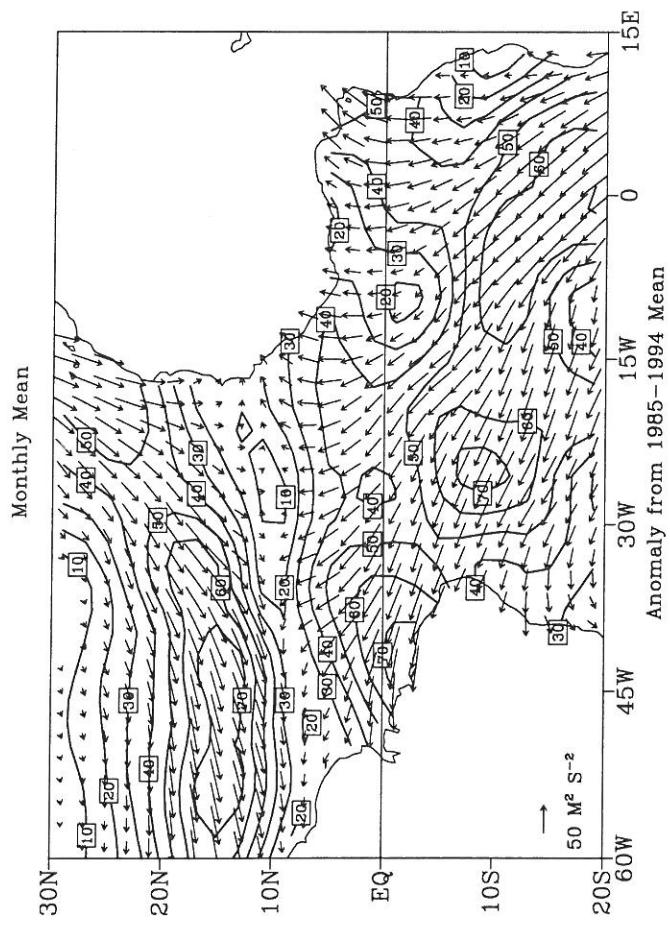
April 1986  
Pseudostress Vectors

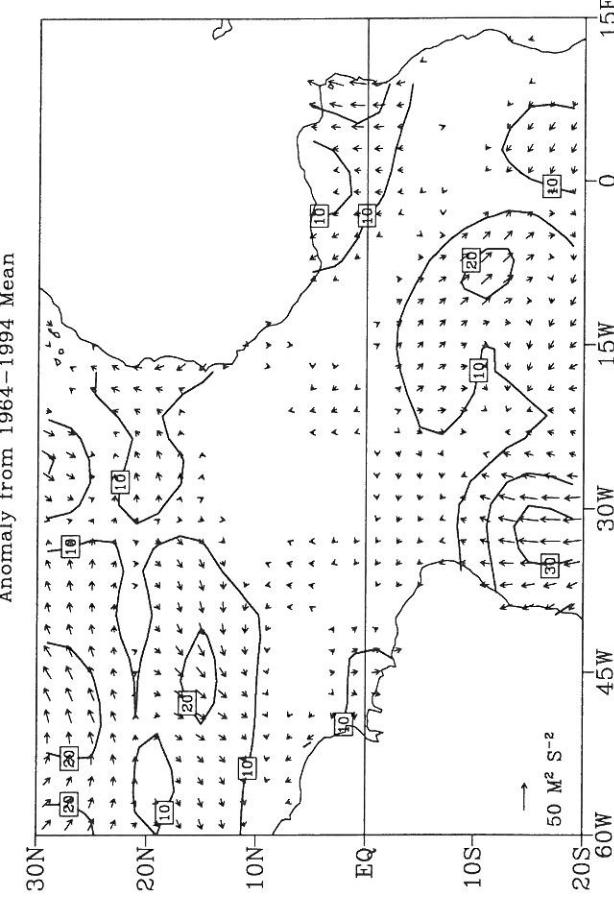
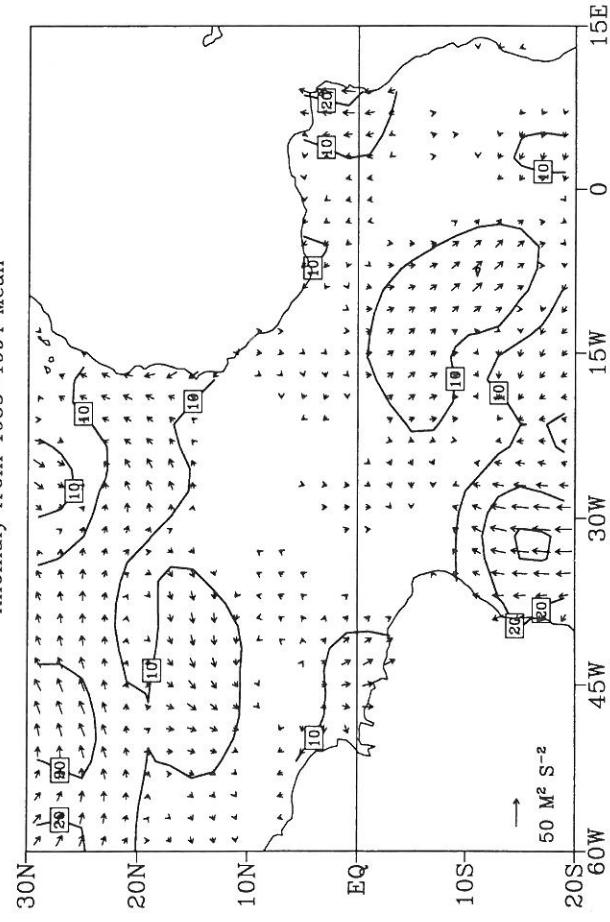
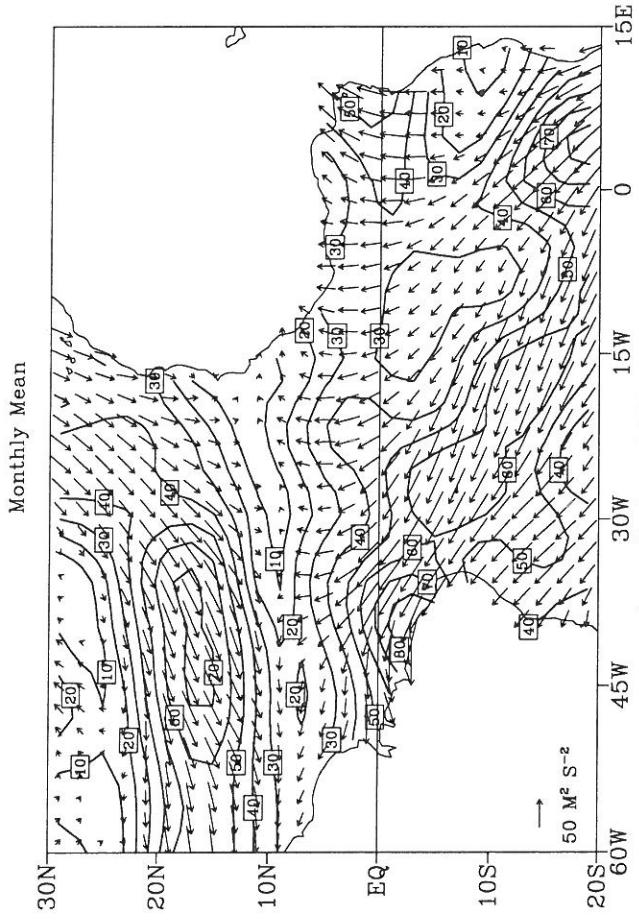


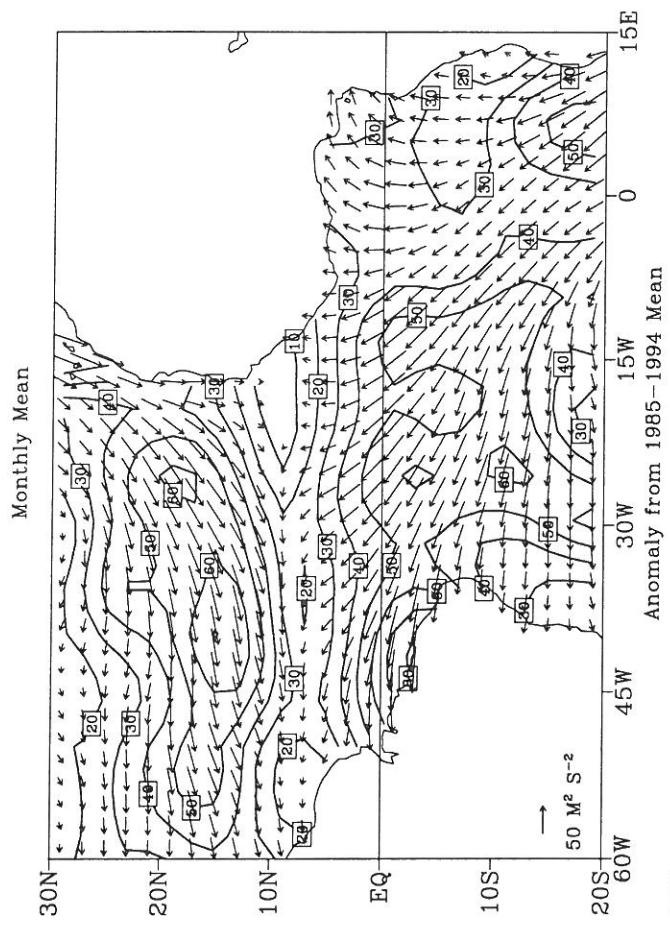




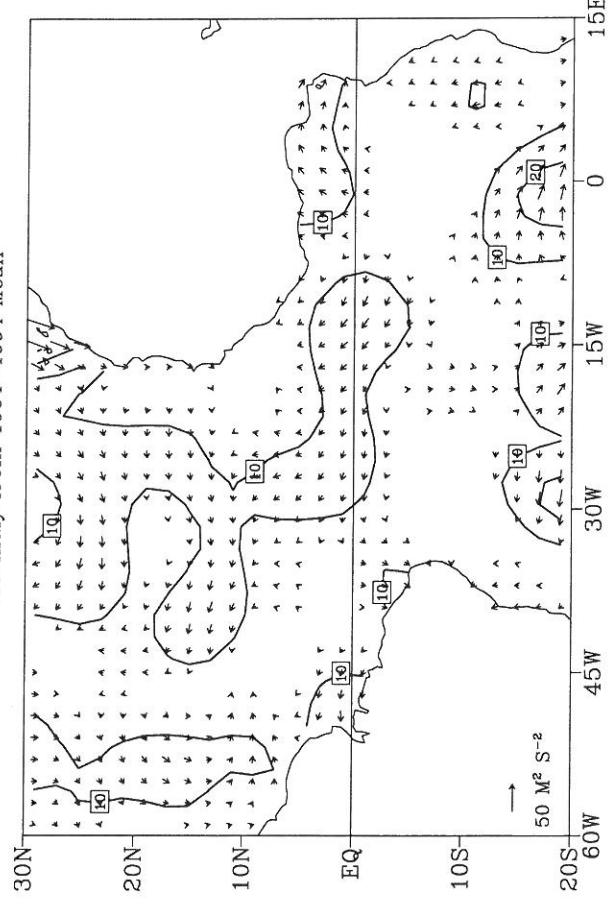
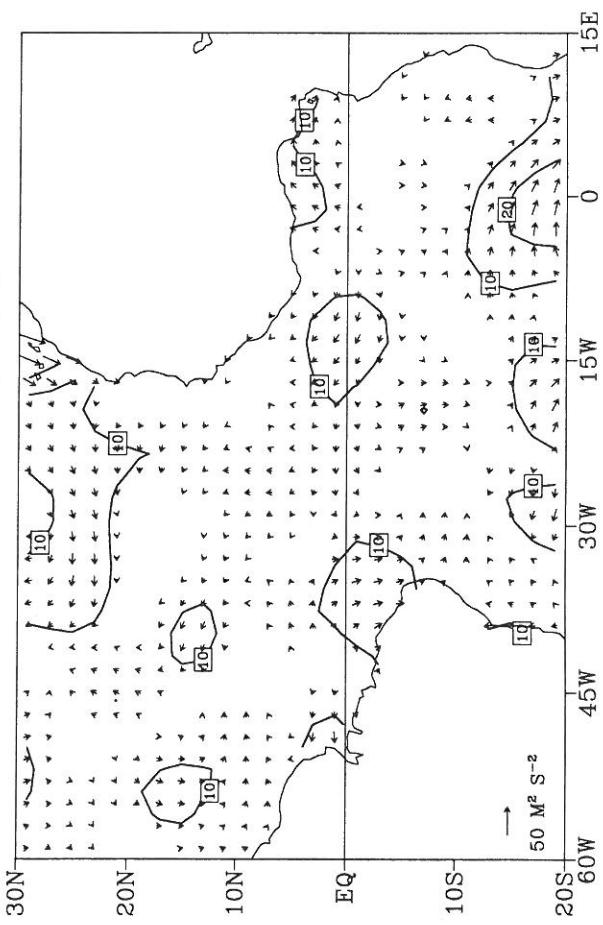


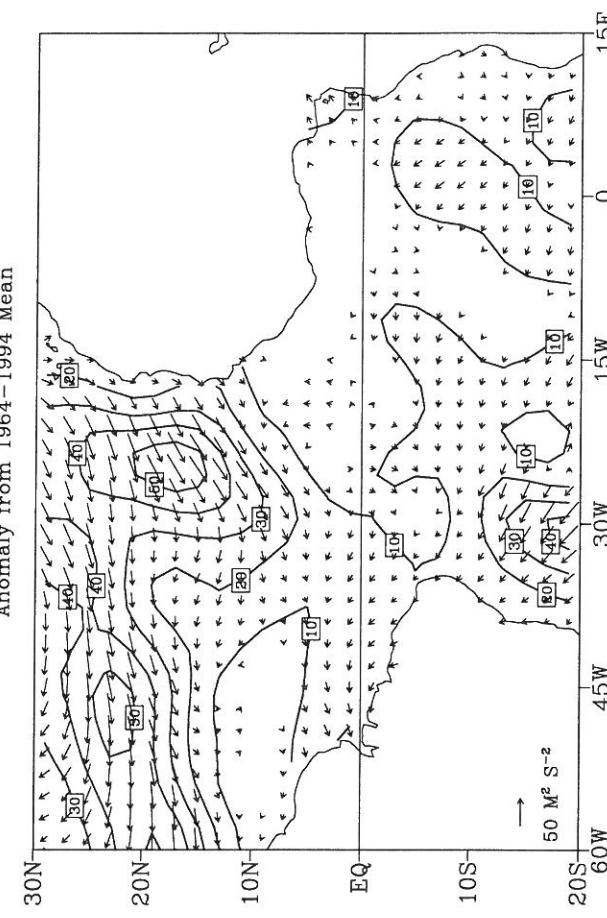
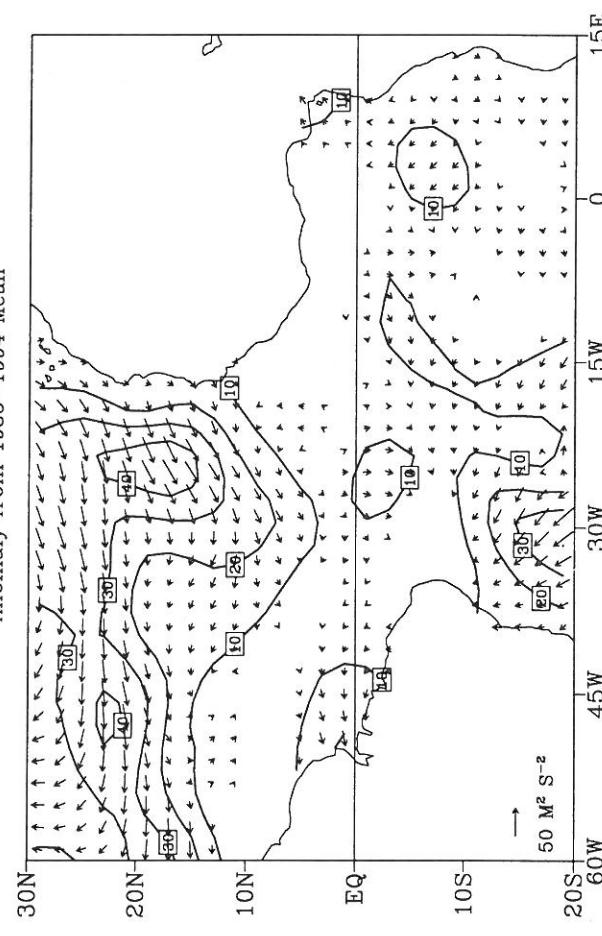
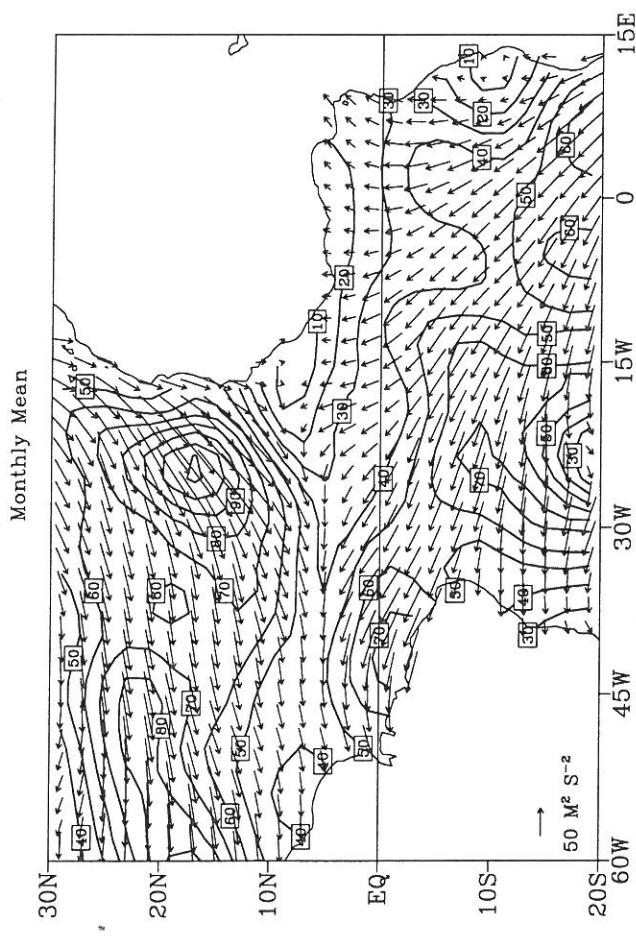


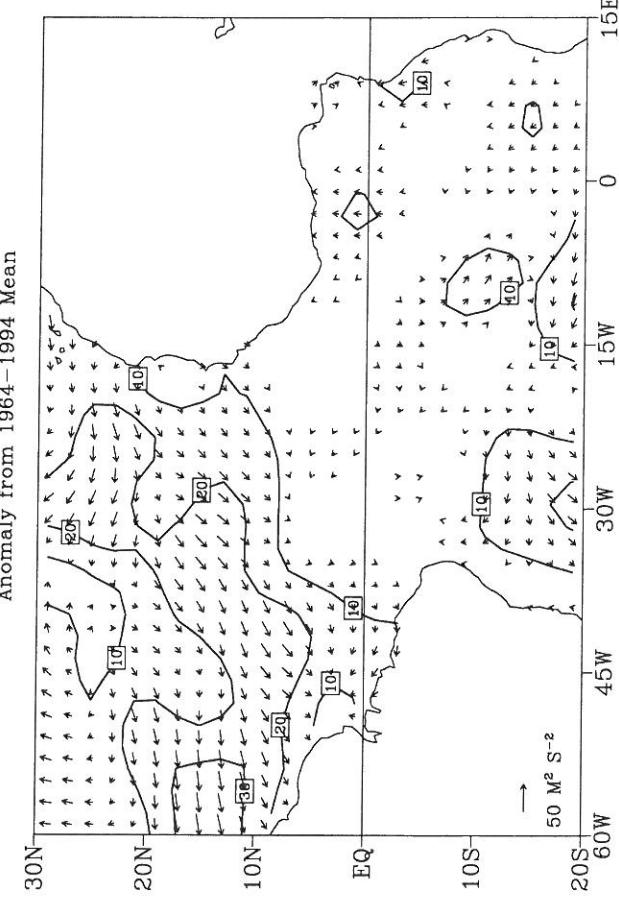
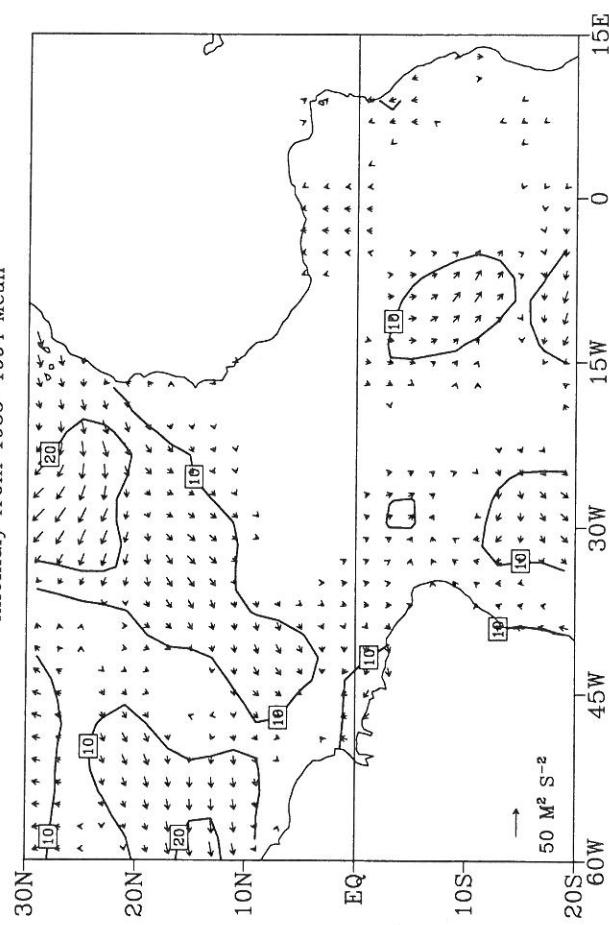
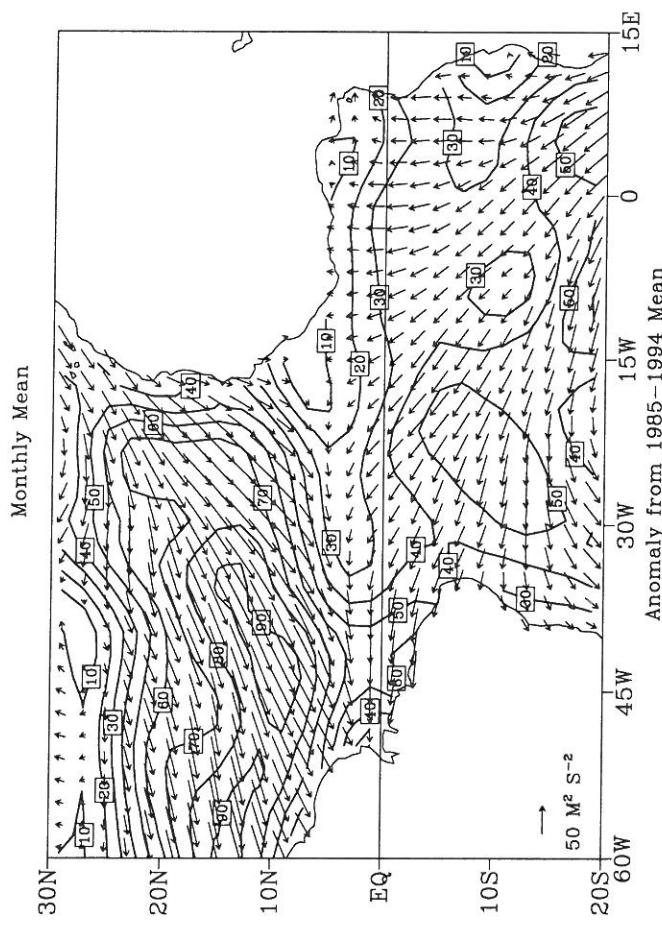




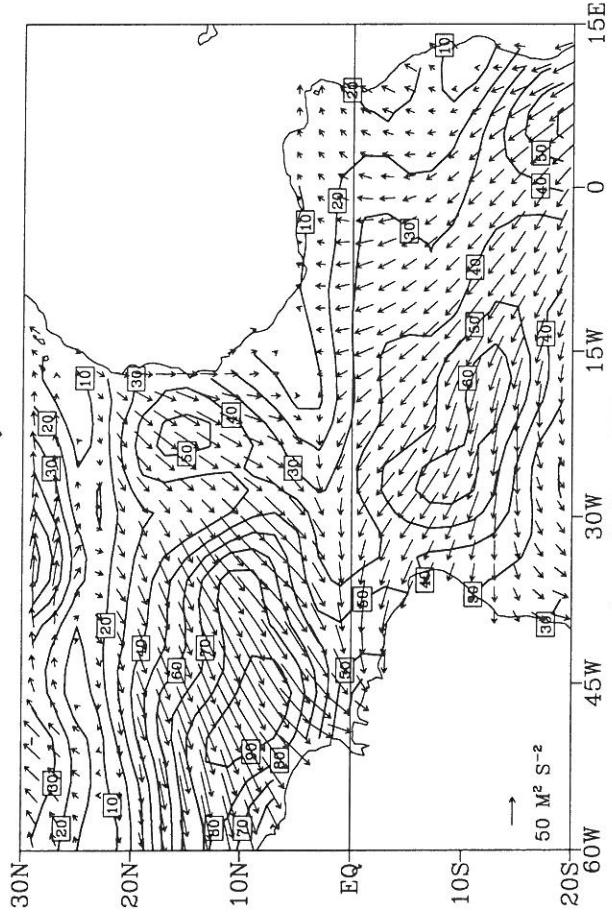
October 1986  
Pseudostress Vectors



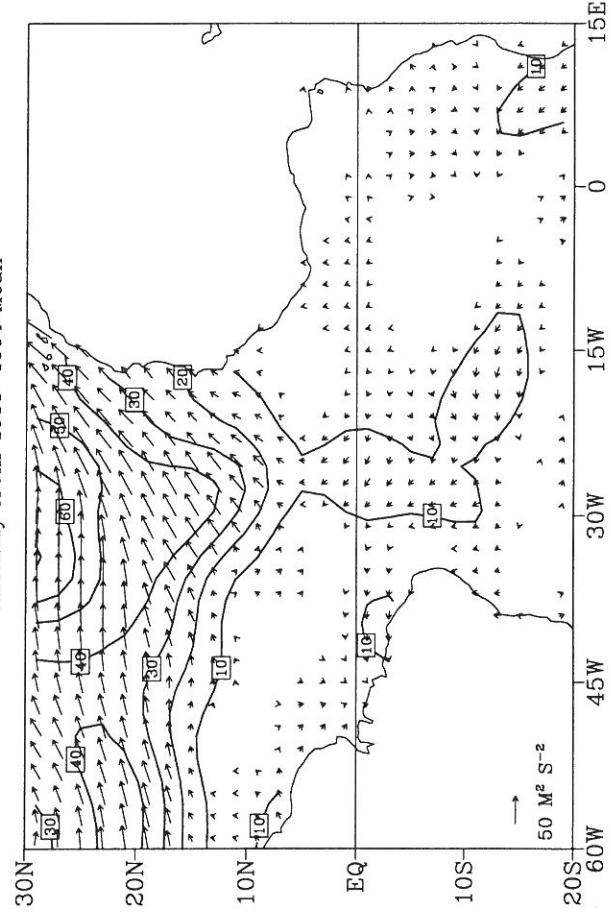




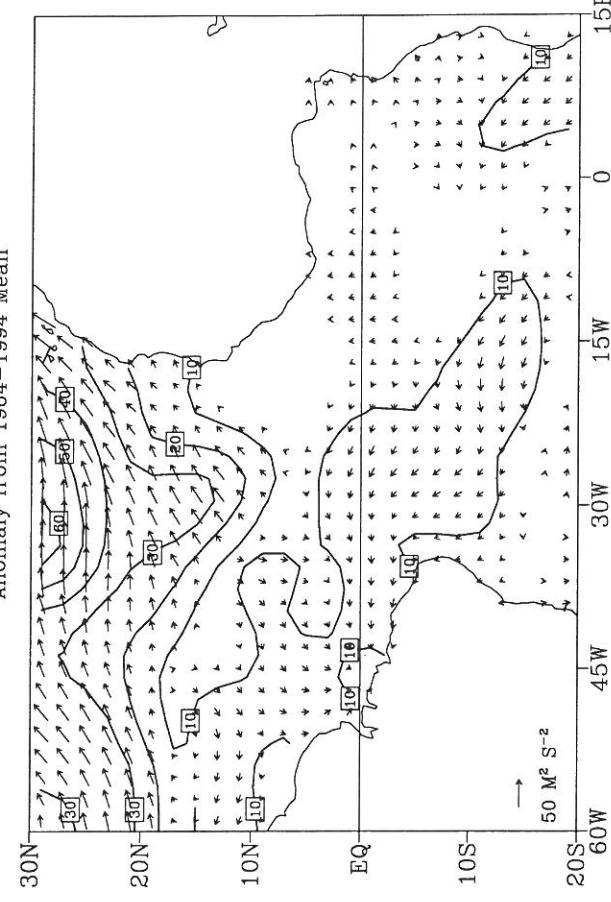
Monthly Mean

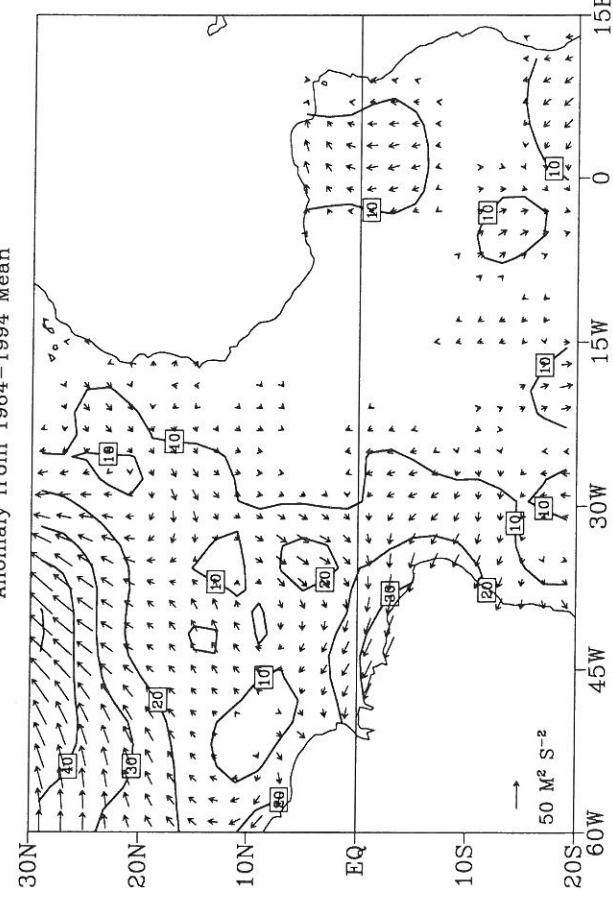
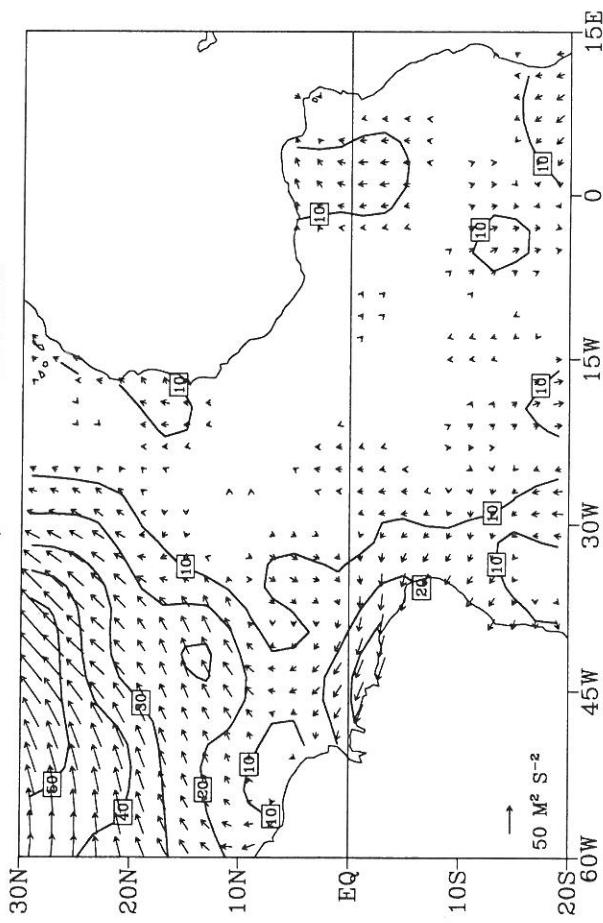
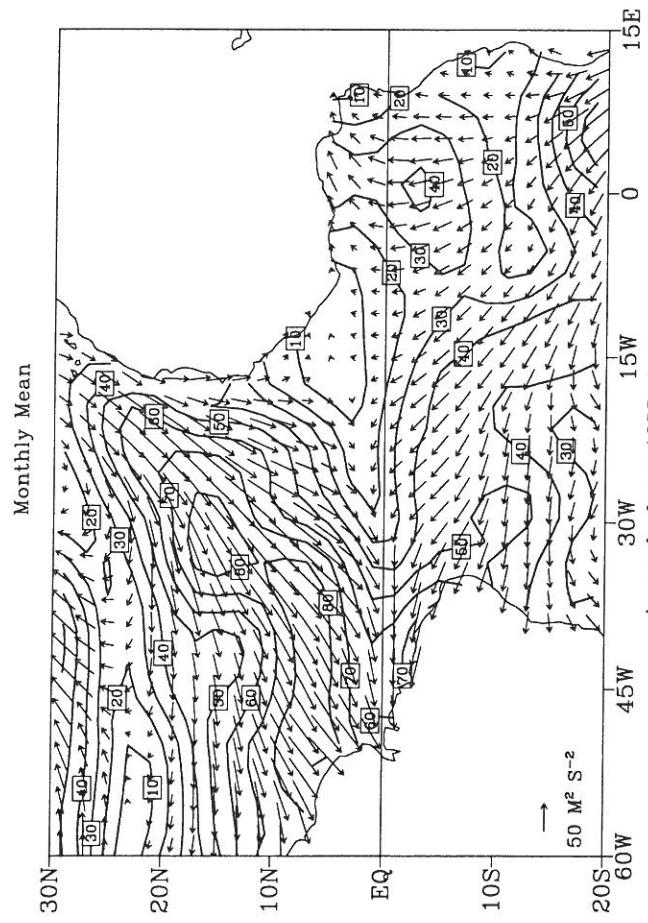


January 1987  
Pseudostress Vectors

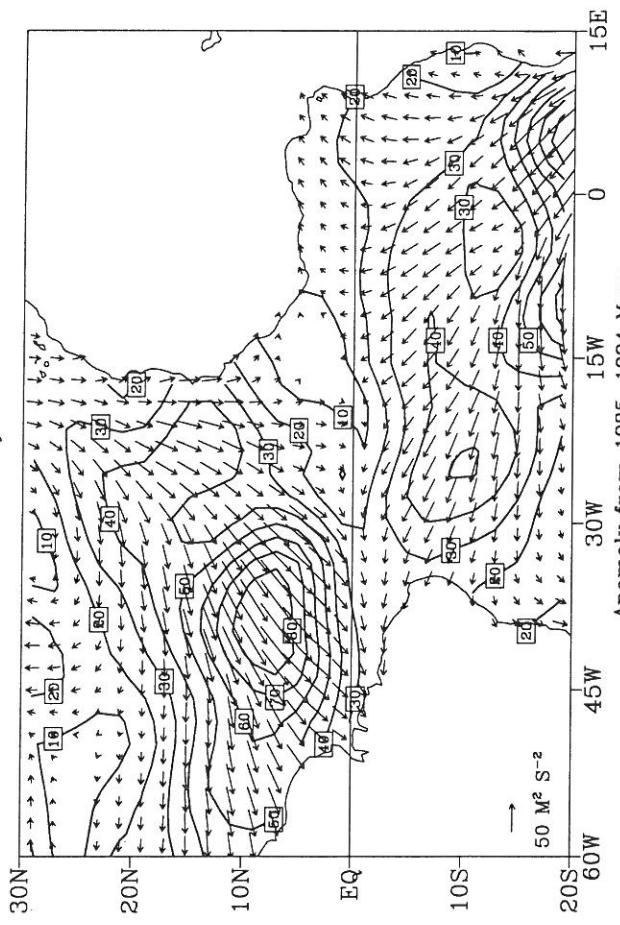


Anomaly from 1964–1994 Mean



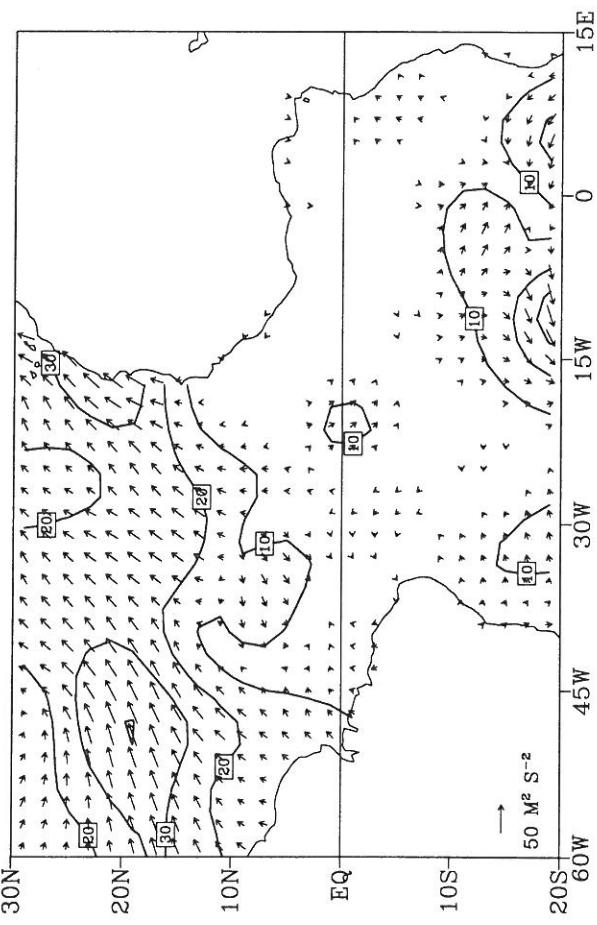


Monthly Mean

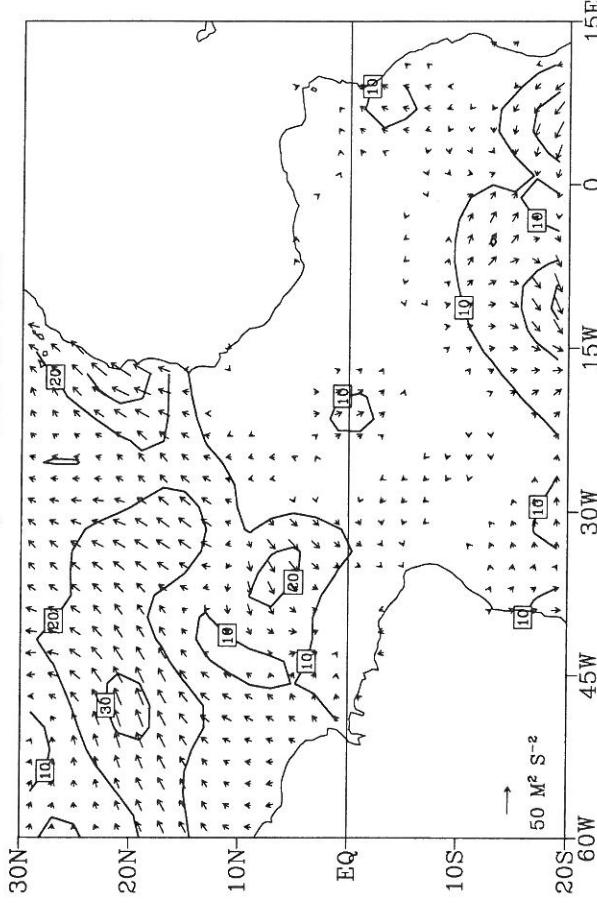


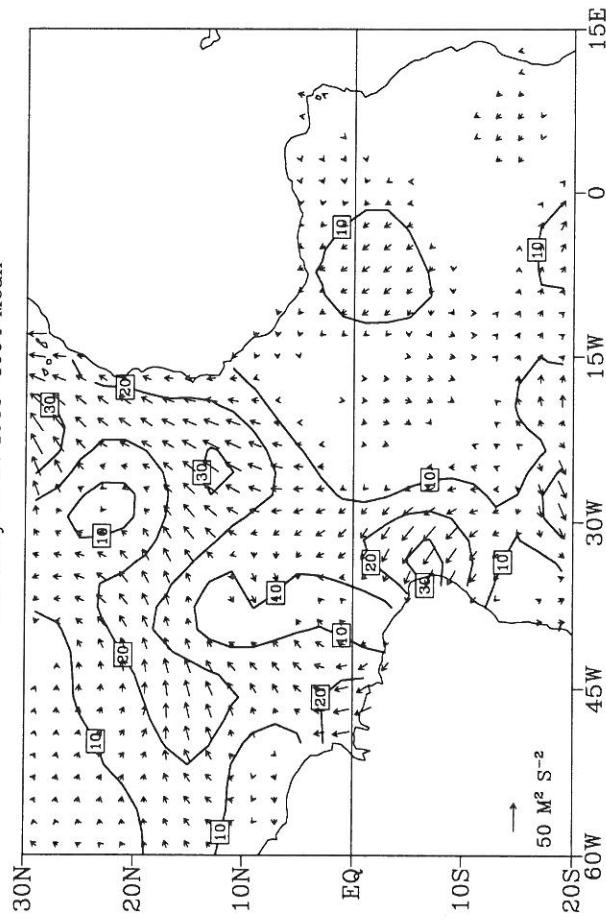
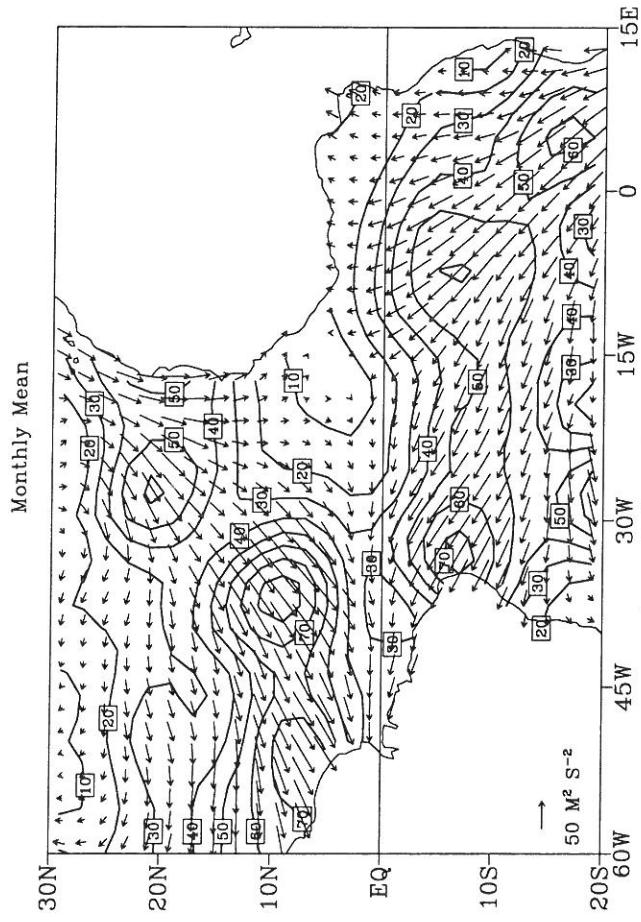
March 1987  
Pseudostress Vectors

Anomaly from 1985–1994 Mean

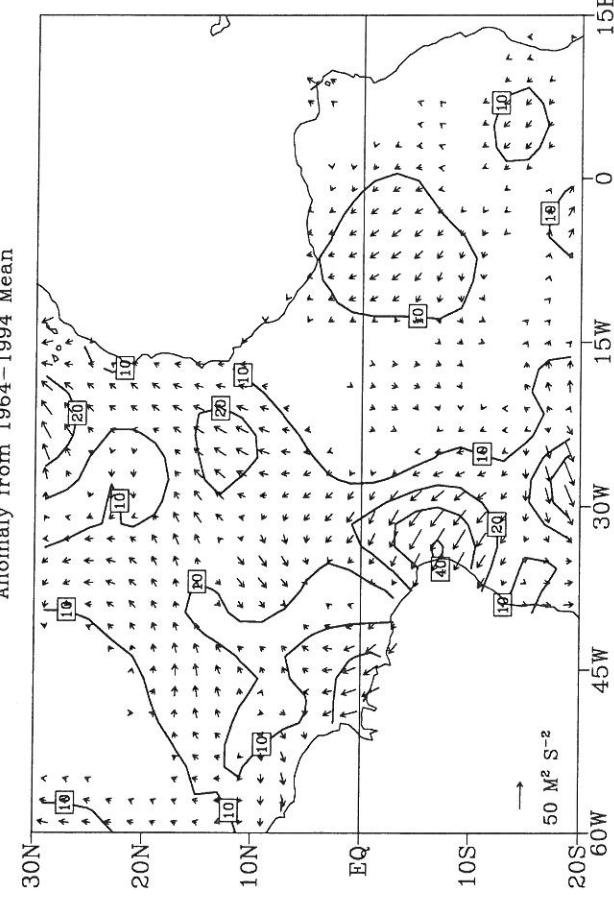


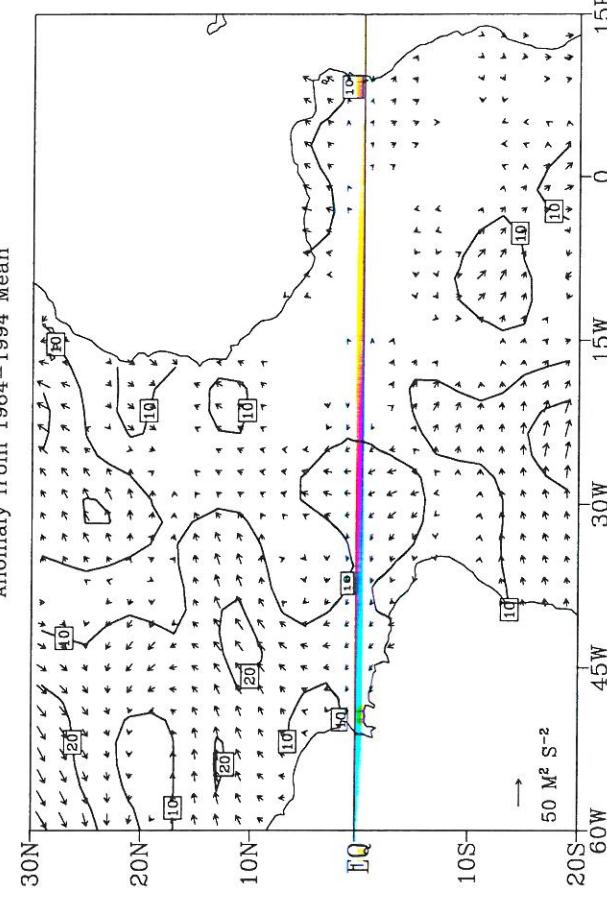
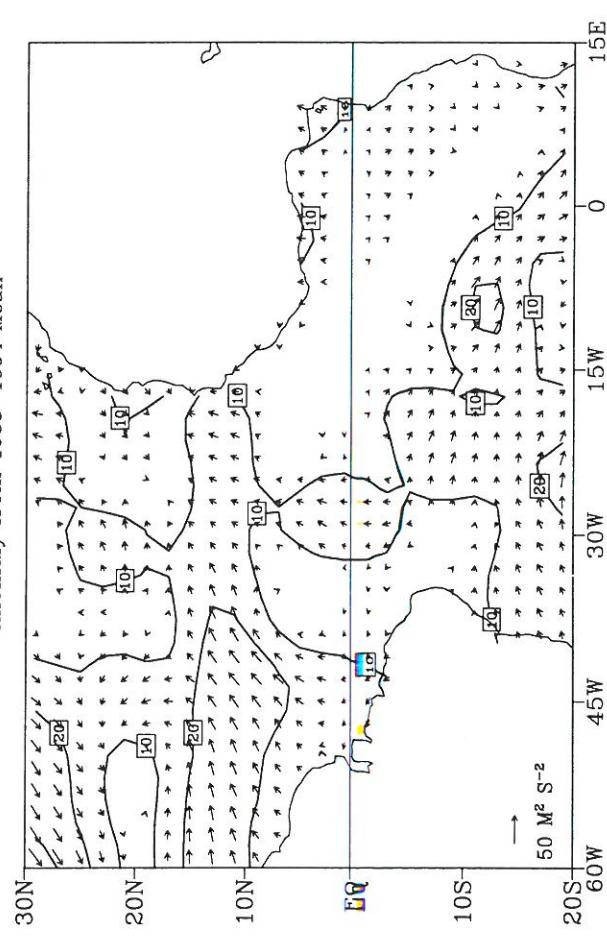
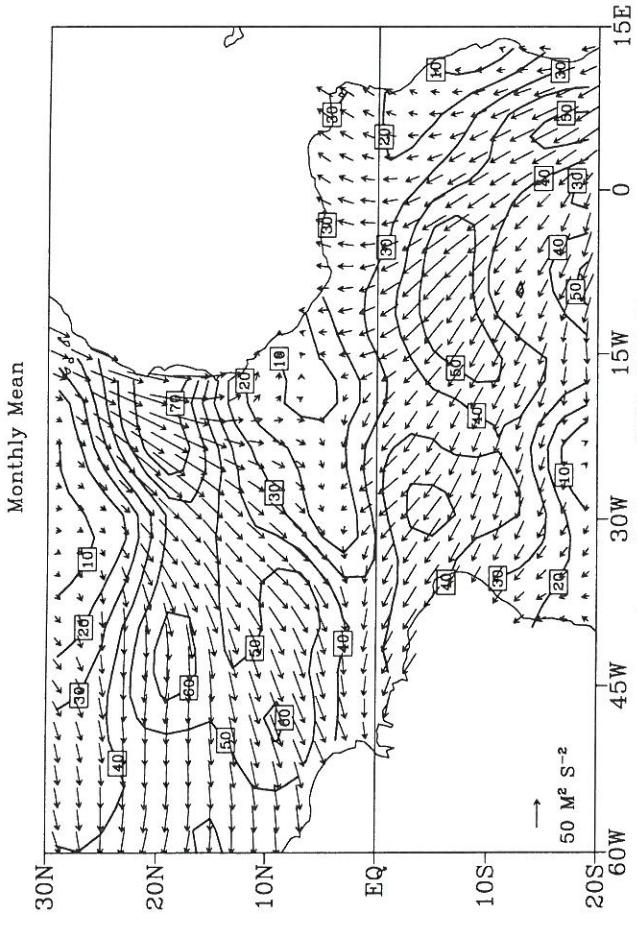
Anomaly from 1964–1994 Mean

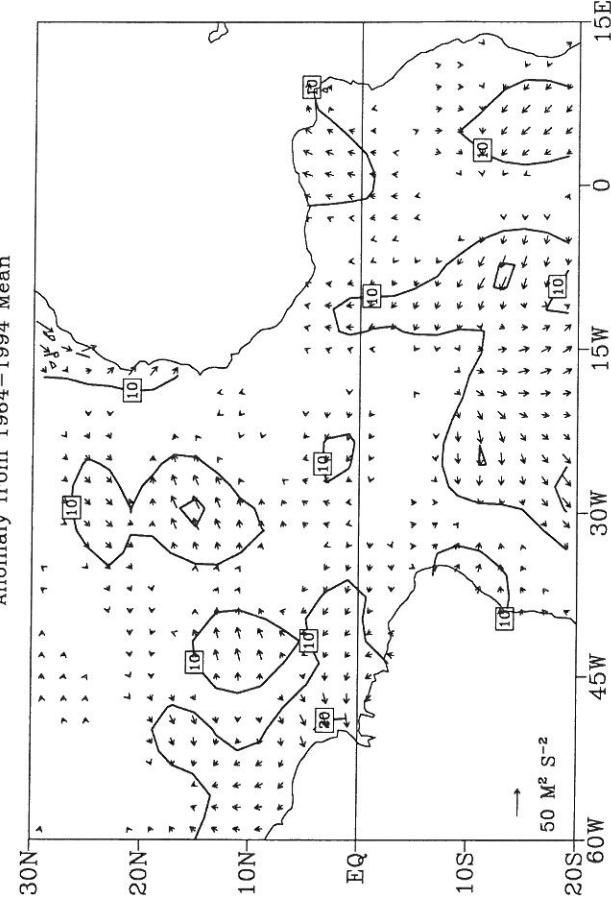
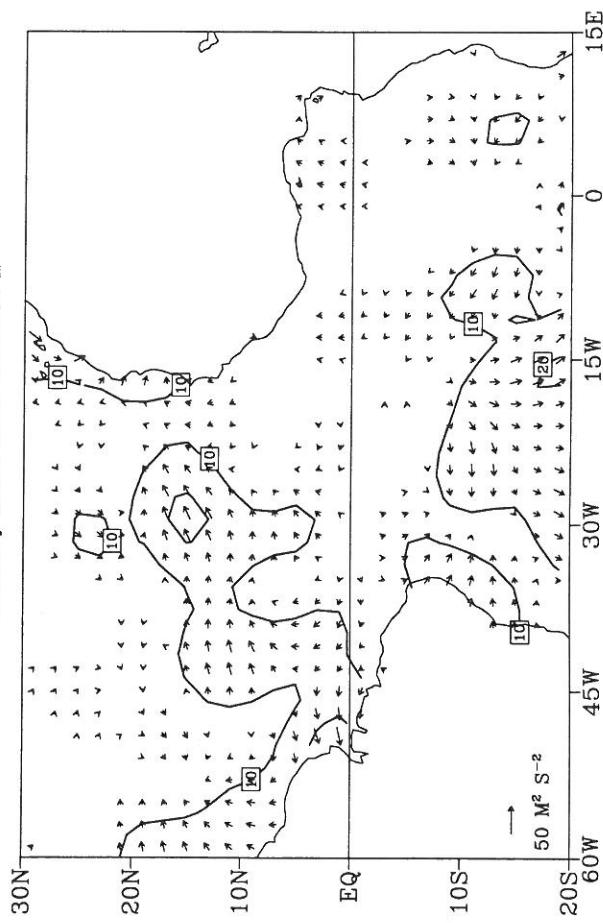
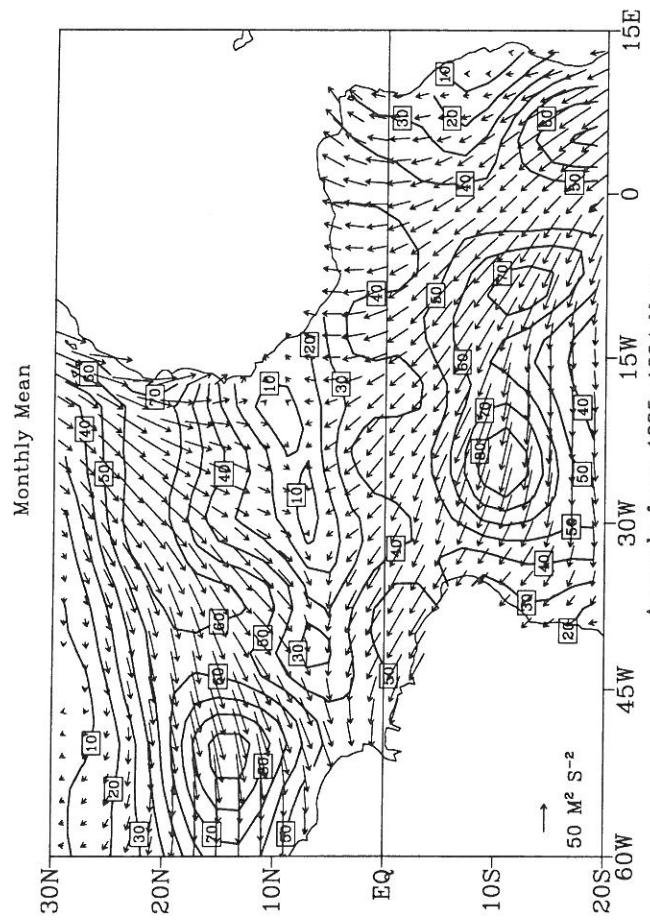


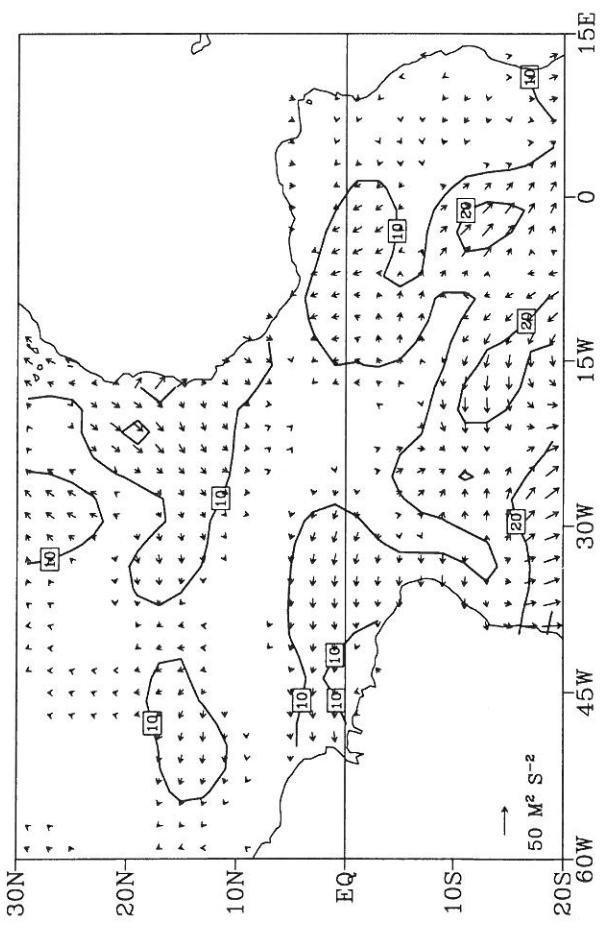
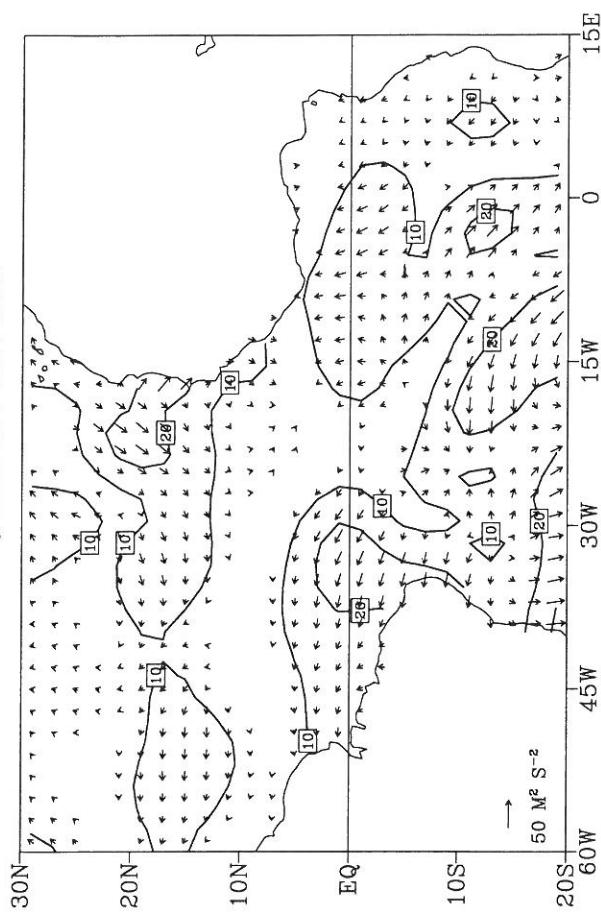
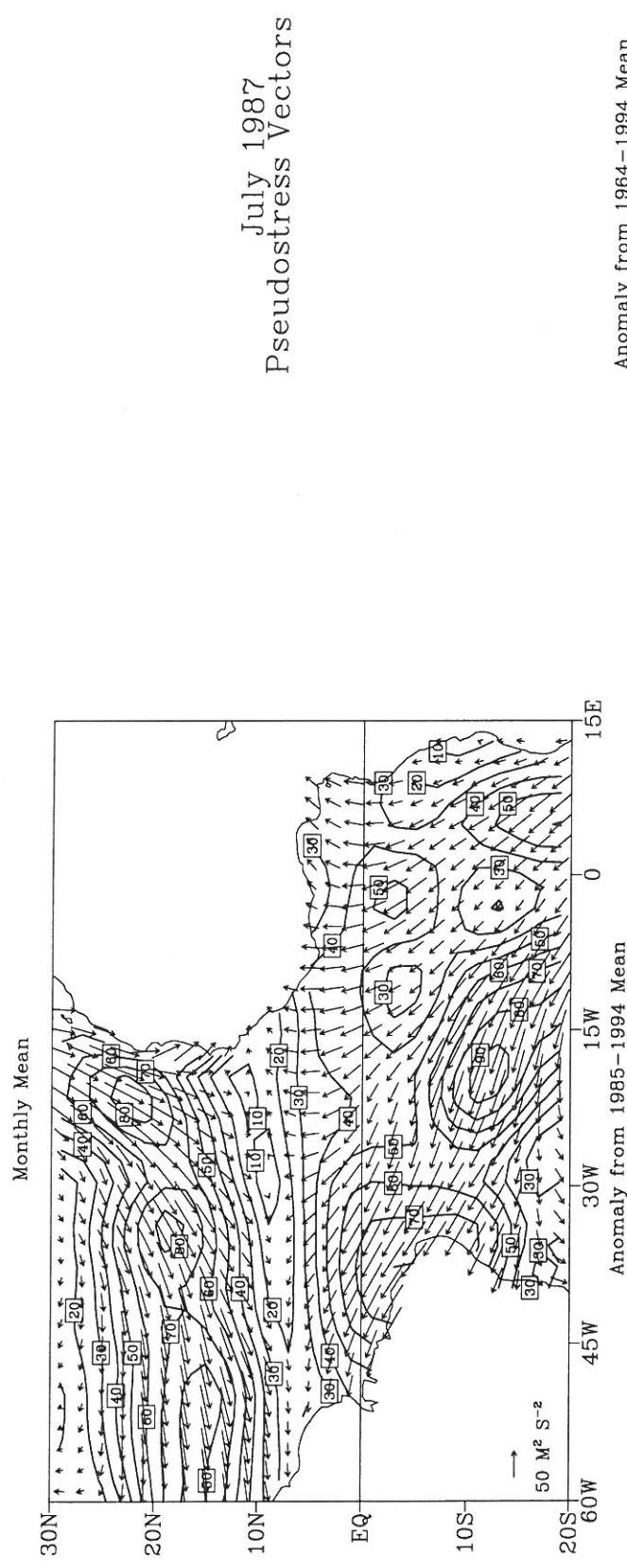
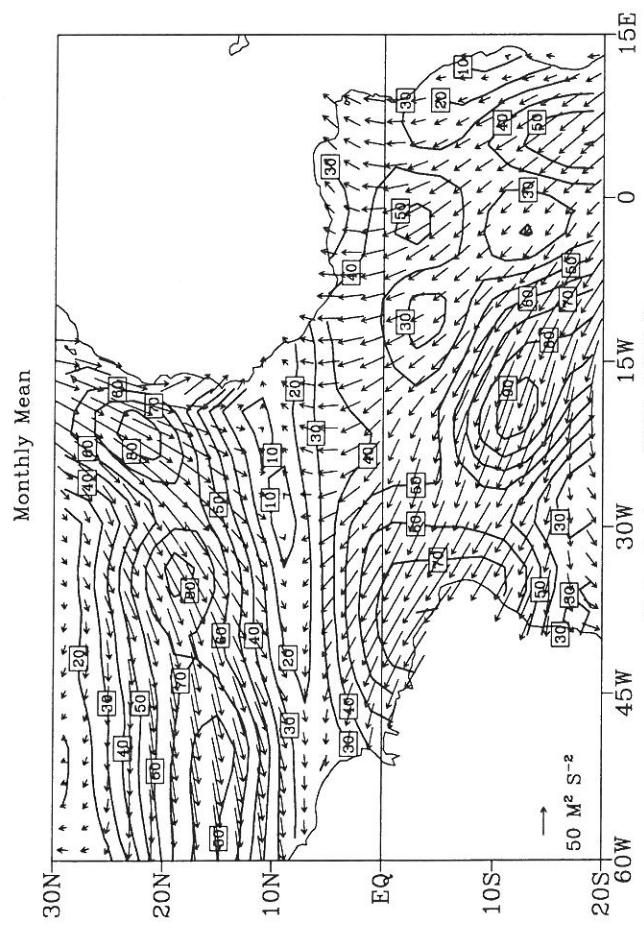


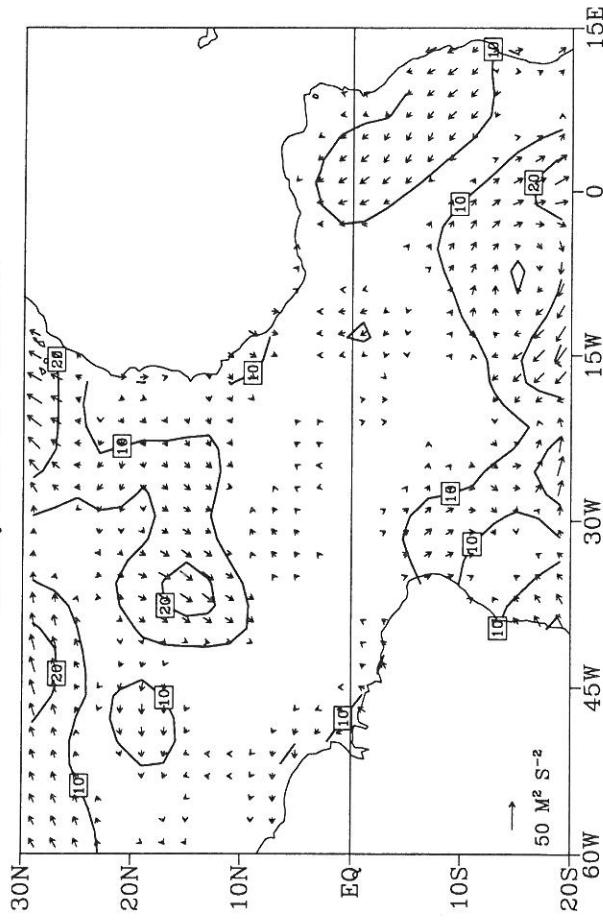
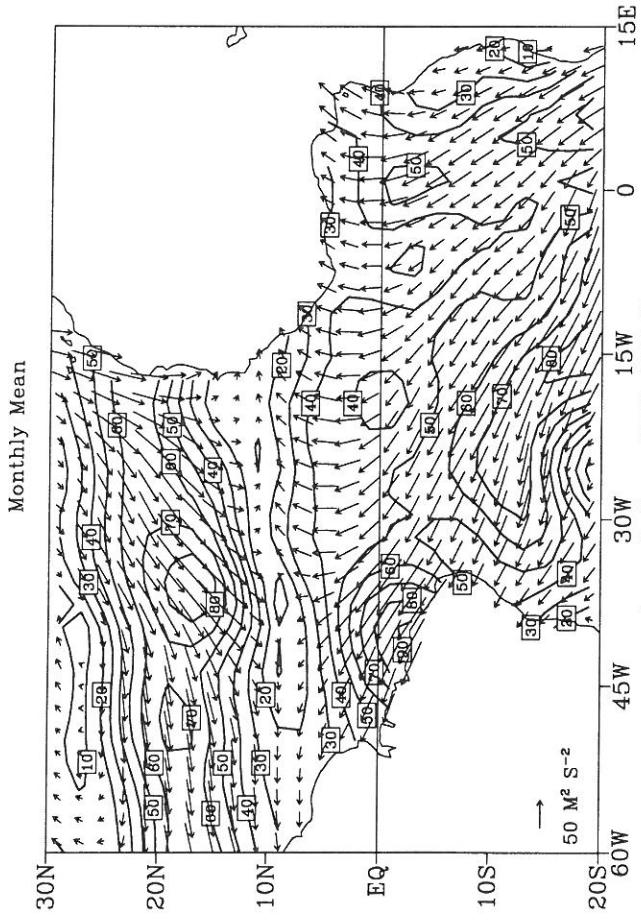
April 1987  
Pseudostress Vectors



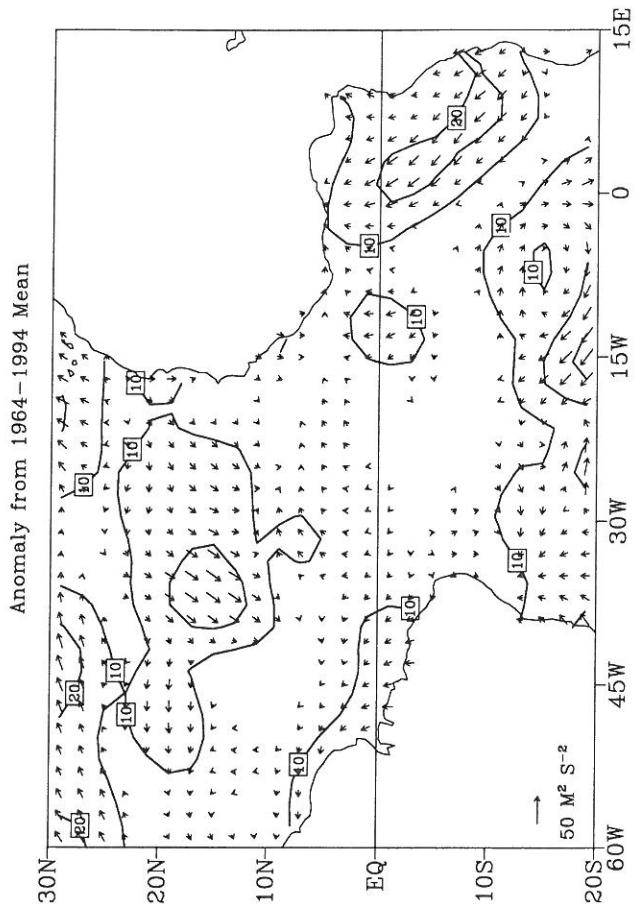




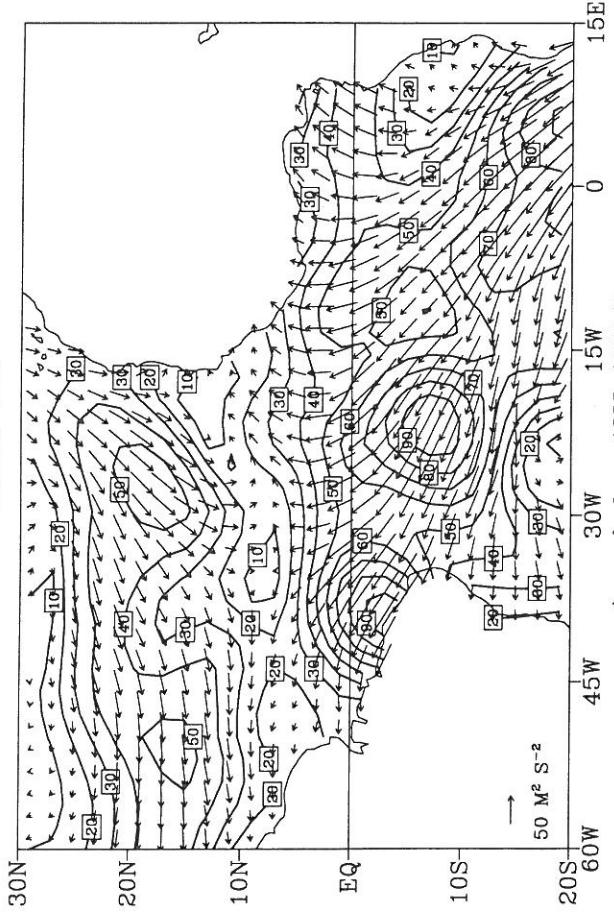




August 1987  
Pseudostress Vectors

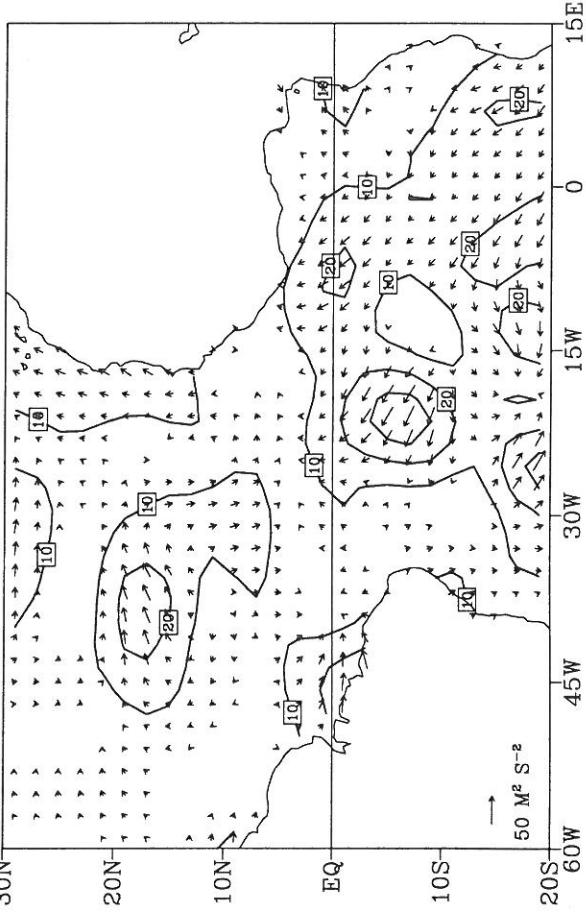


Monthly Mean

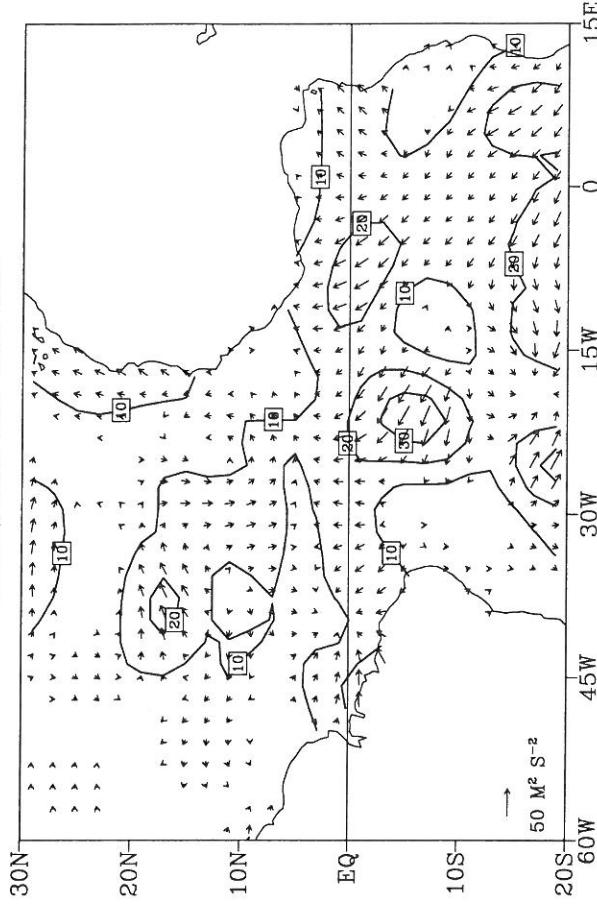


September 1987  
Pseudostress Vectors

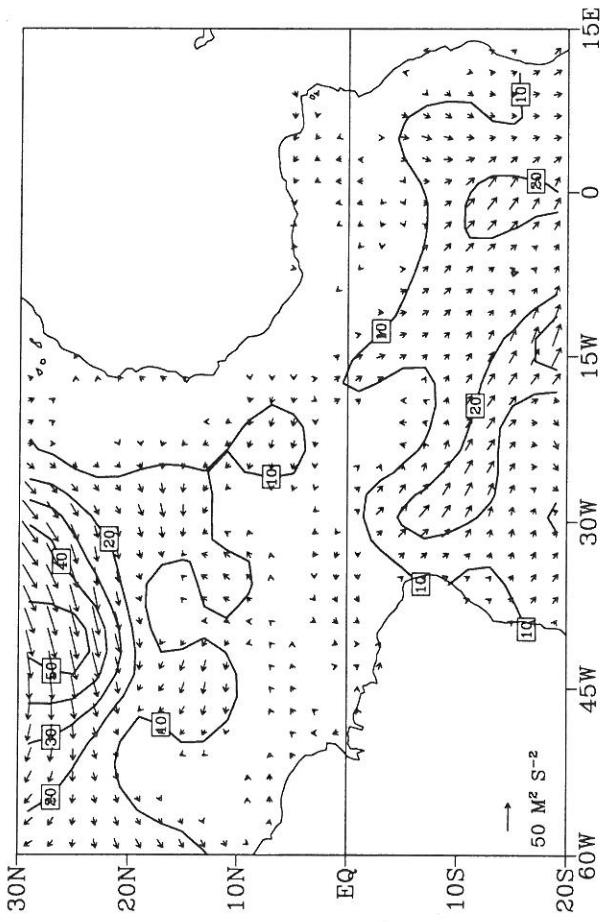
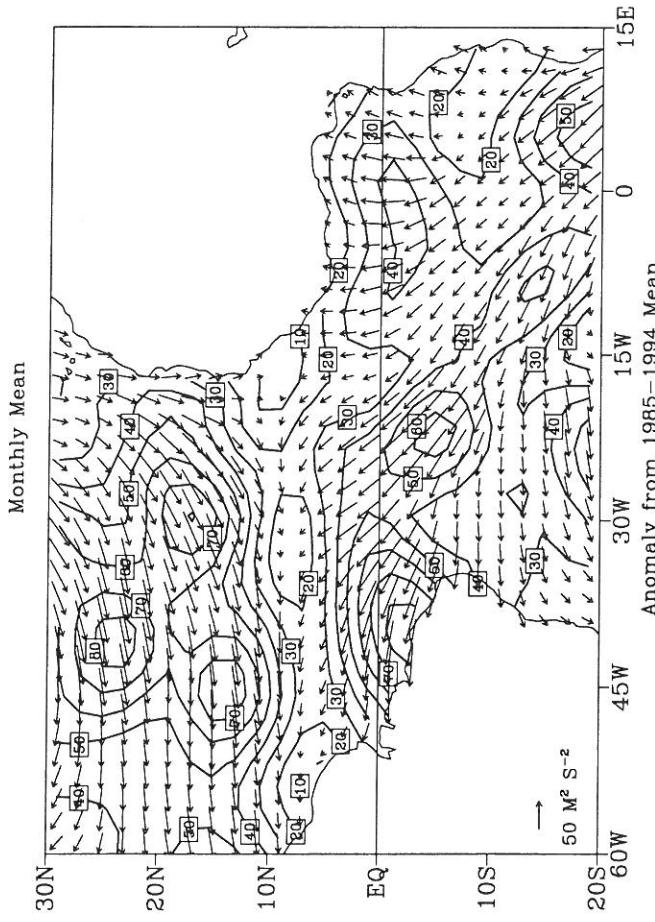
Anomaly from 1985–1994 Mean



Anomaly from 1964–1994 Mean

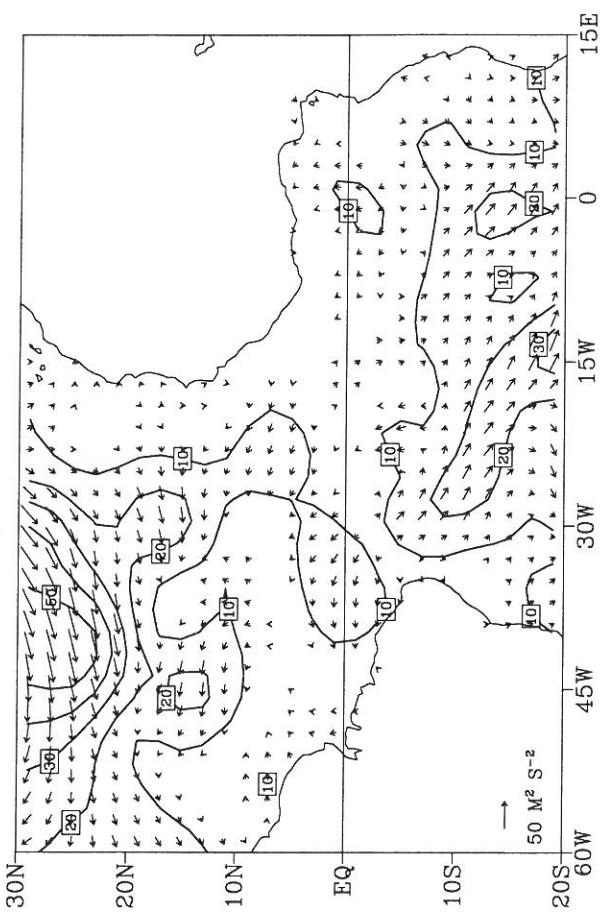


September 1987  
Pseudostress Vectors

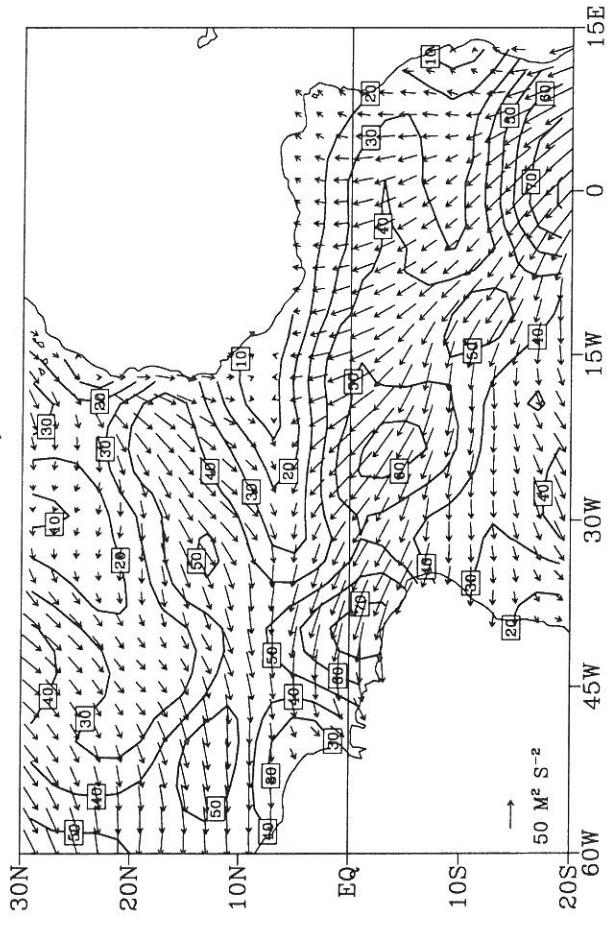


October 1987  
Pseudostress Vectors

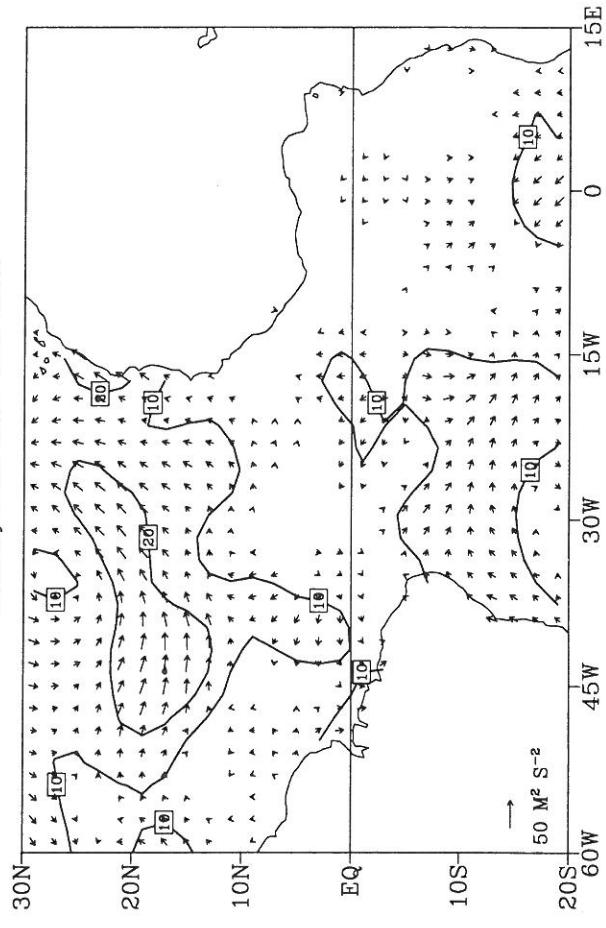
Anomaly from 1964–1994 Mean



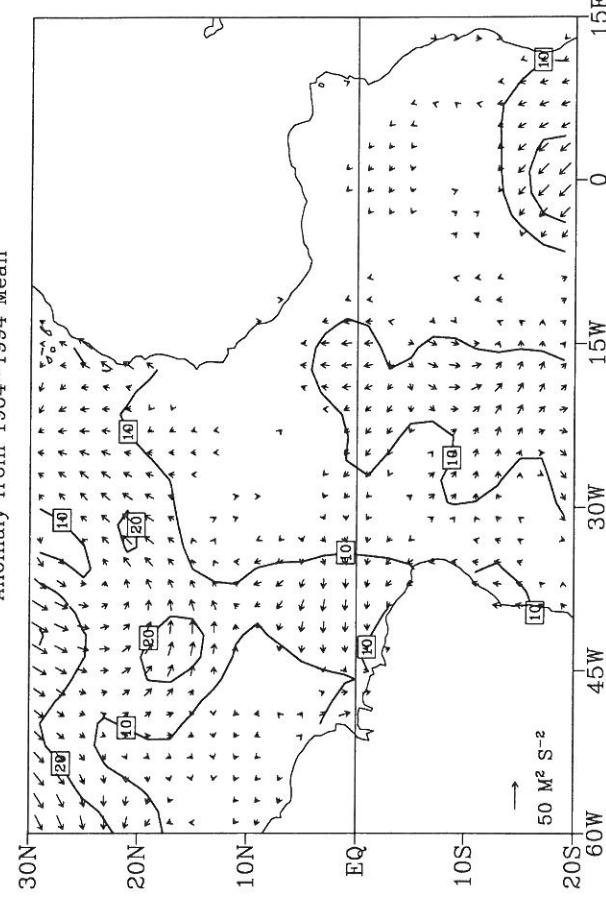
Monthly Mean



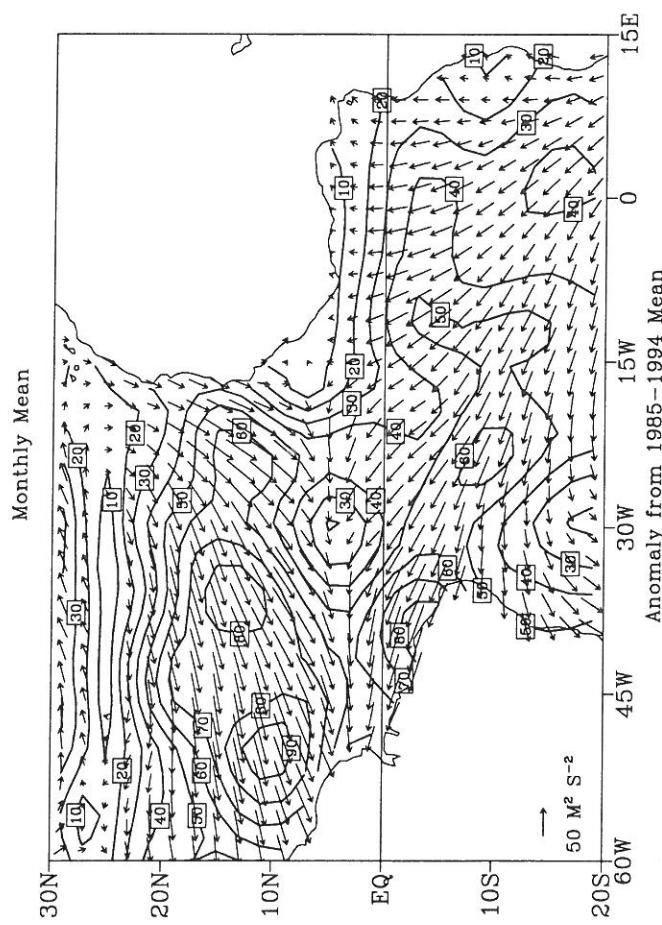
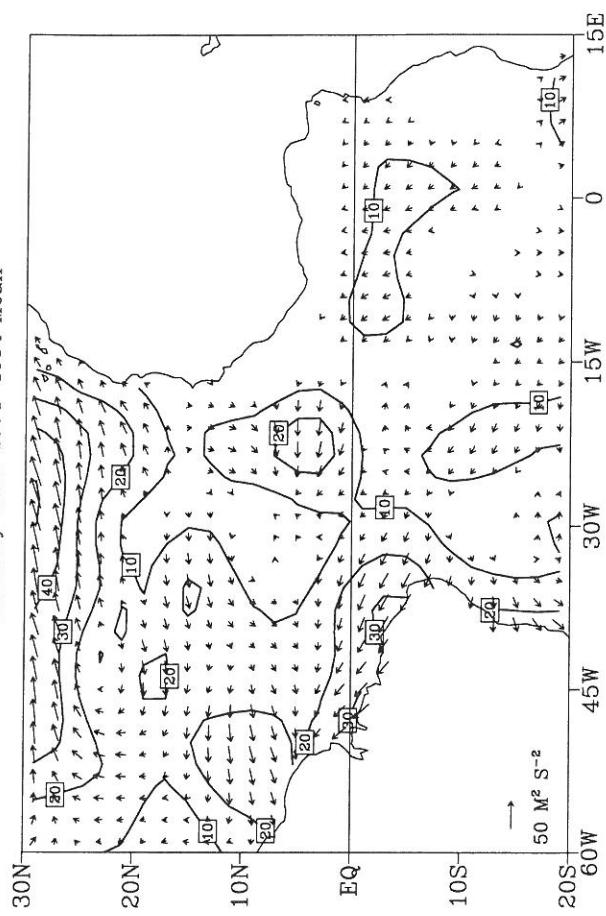
Anomaly from 1985–1994 Mean

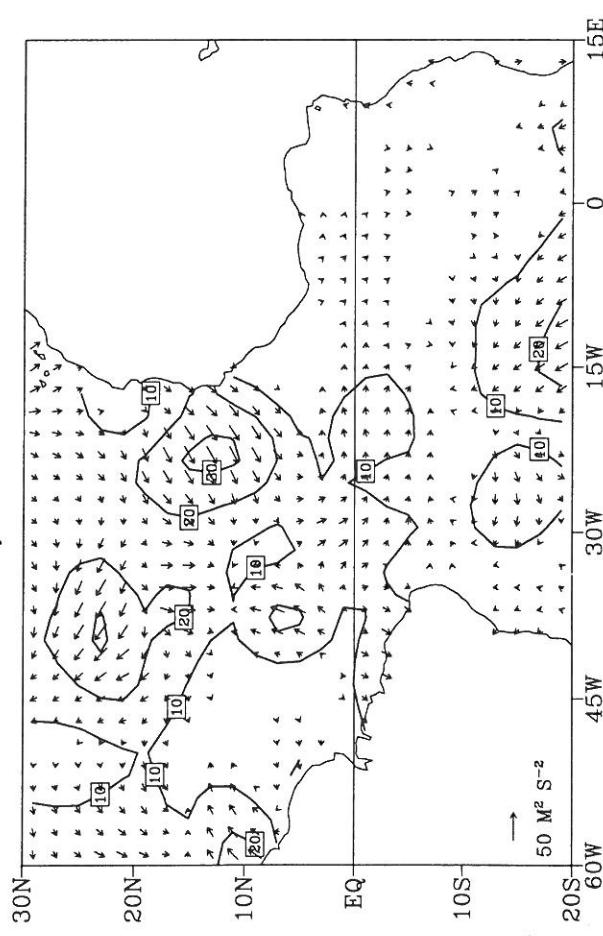
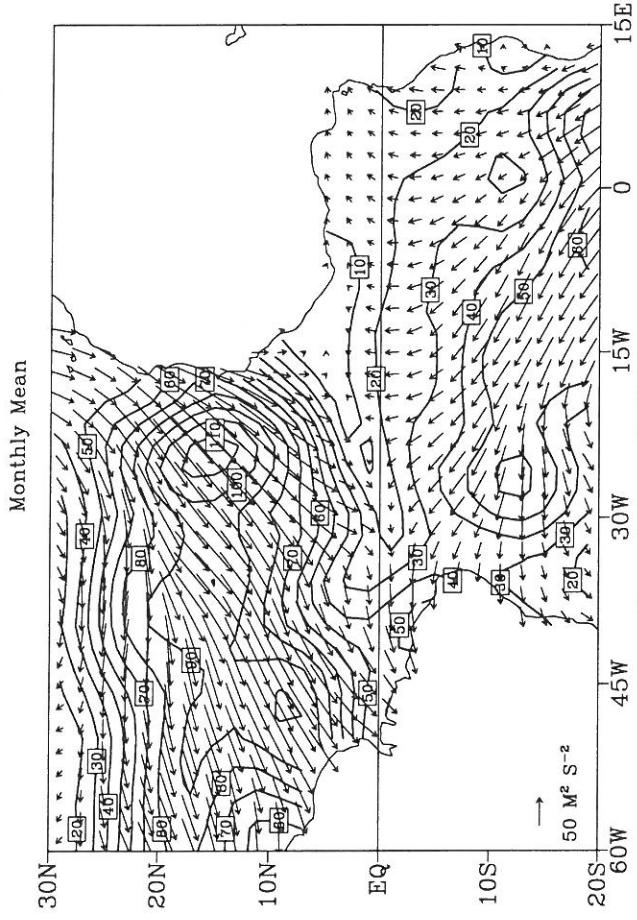


Anomaly from 1964–1994 Mean

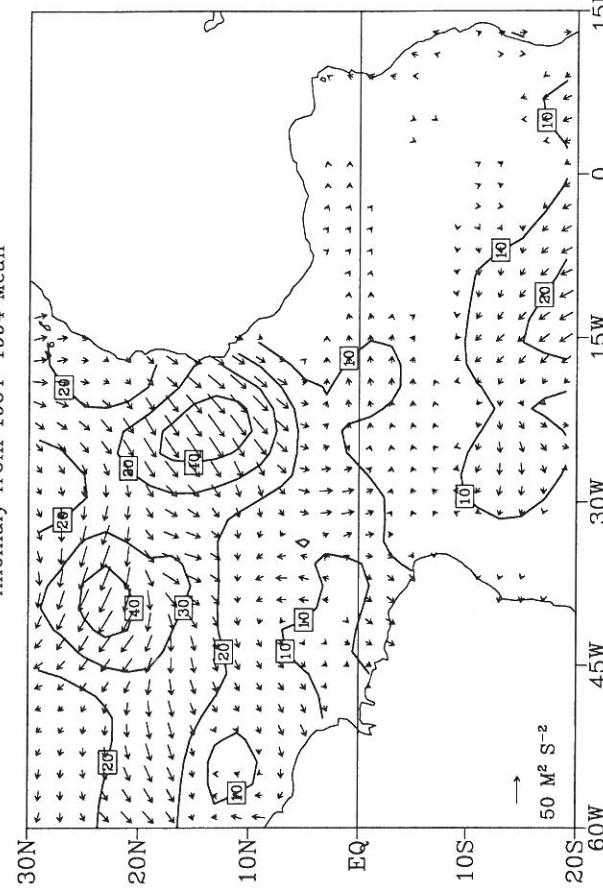


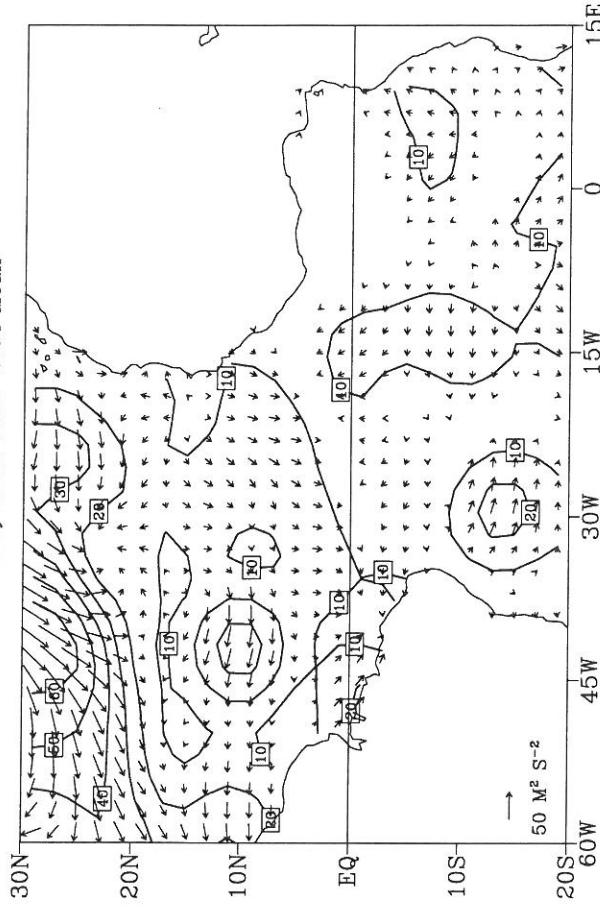
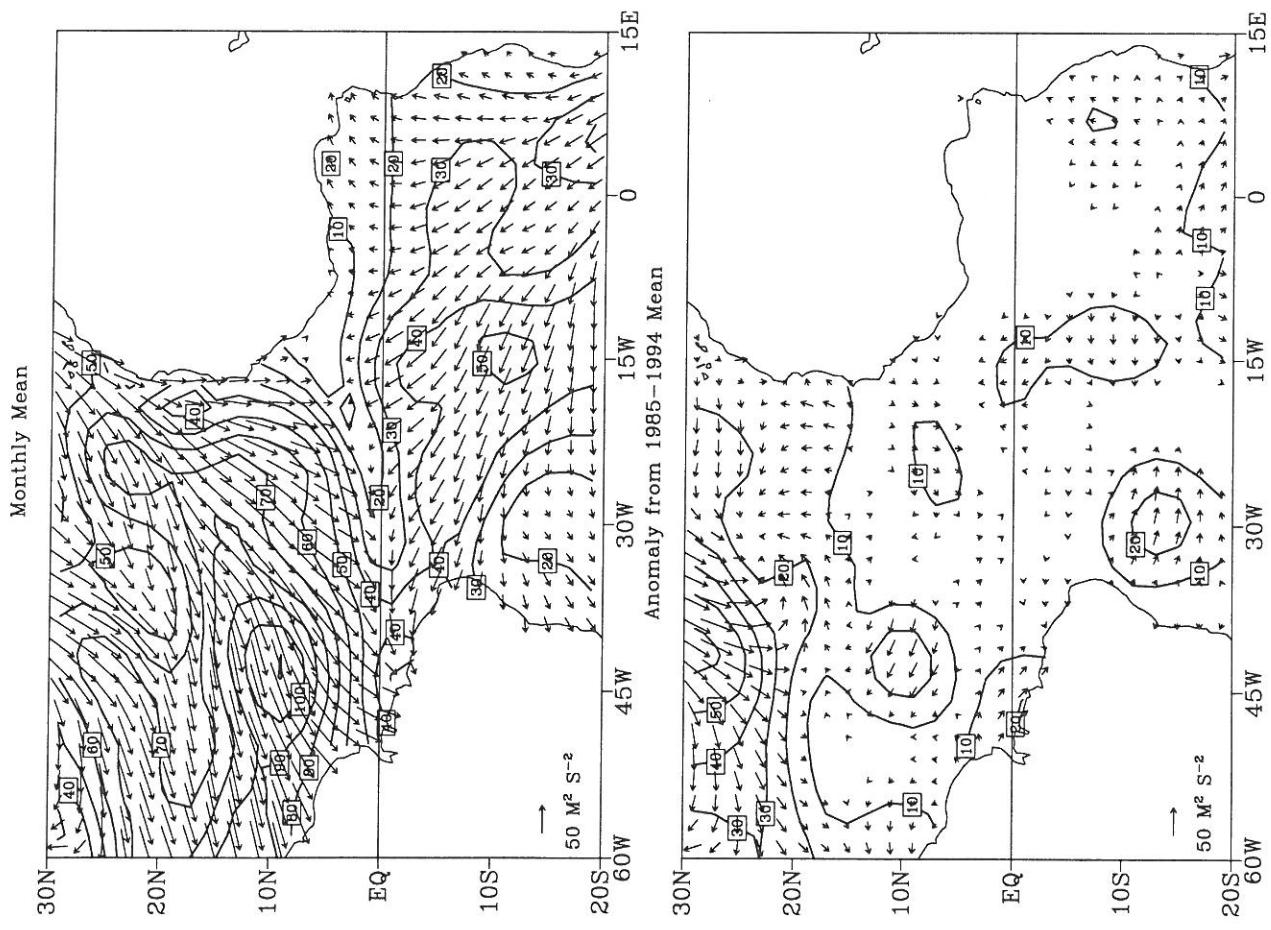
November 1987  
Pseudostress Vectors

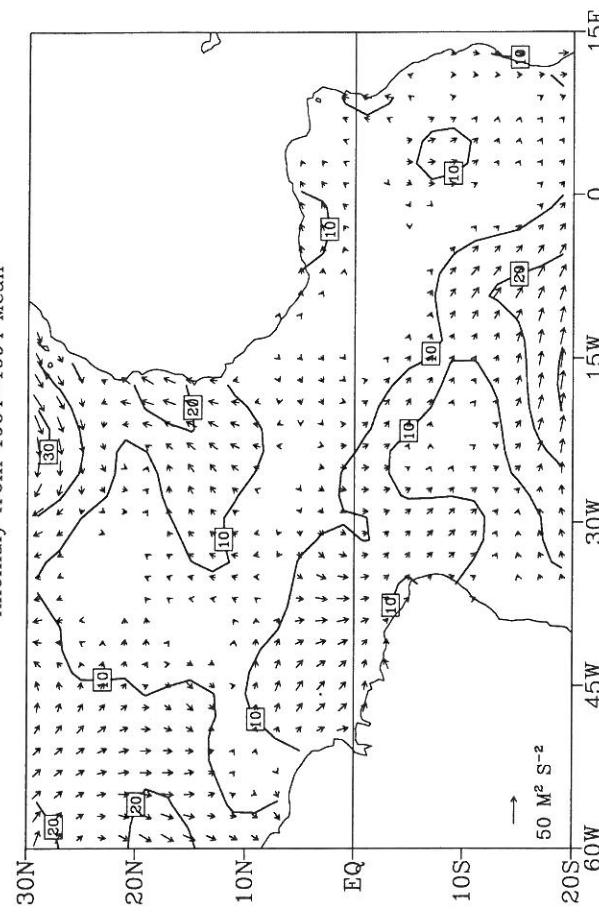
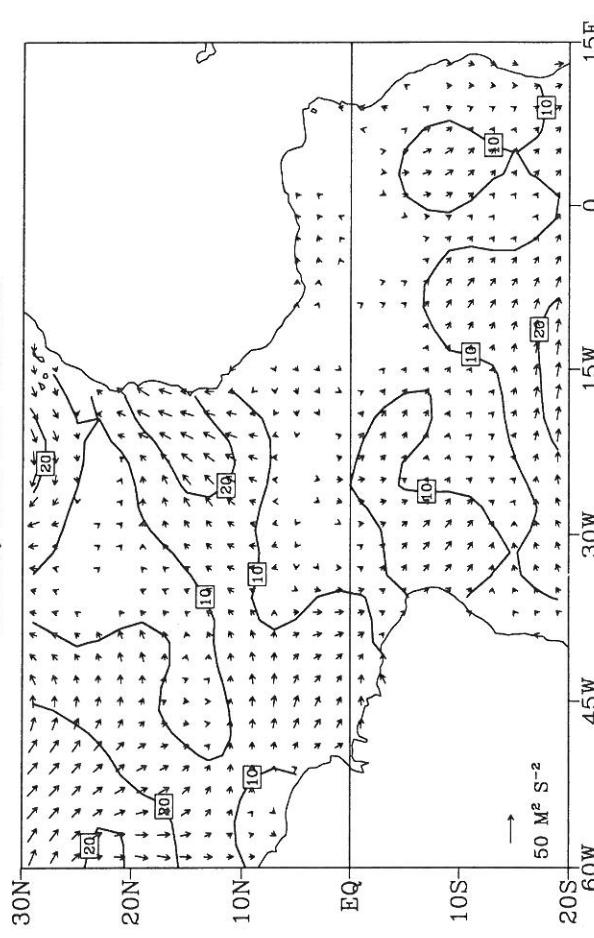
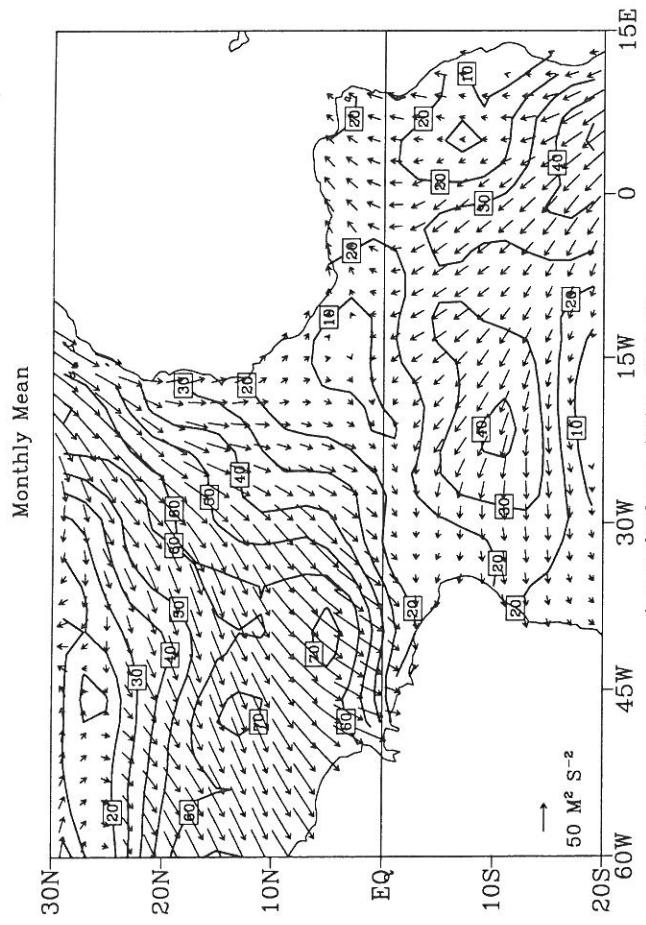


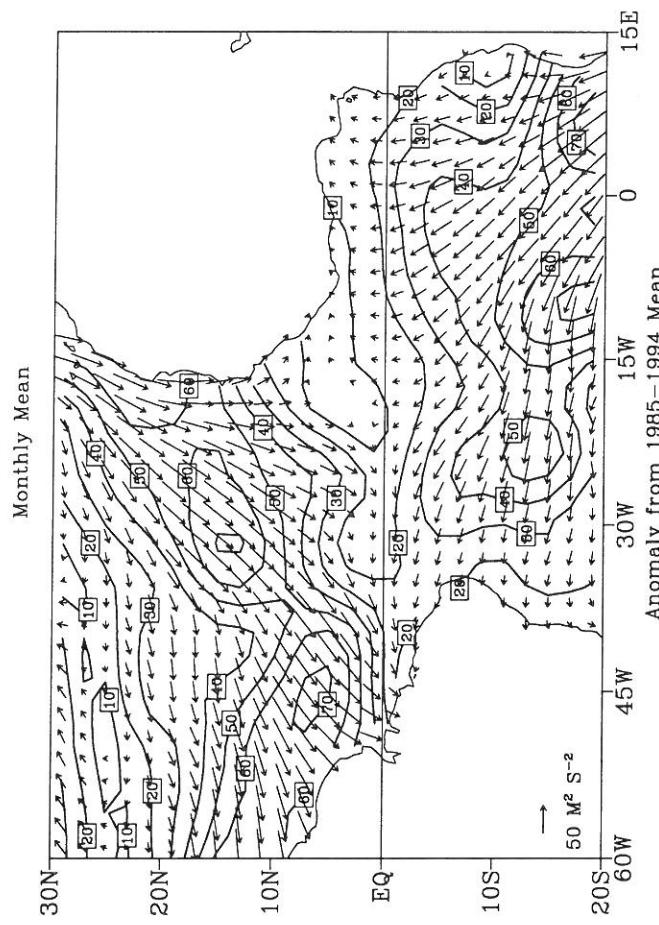


Anomaly from 1964–1994 Mean

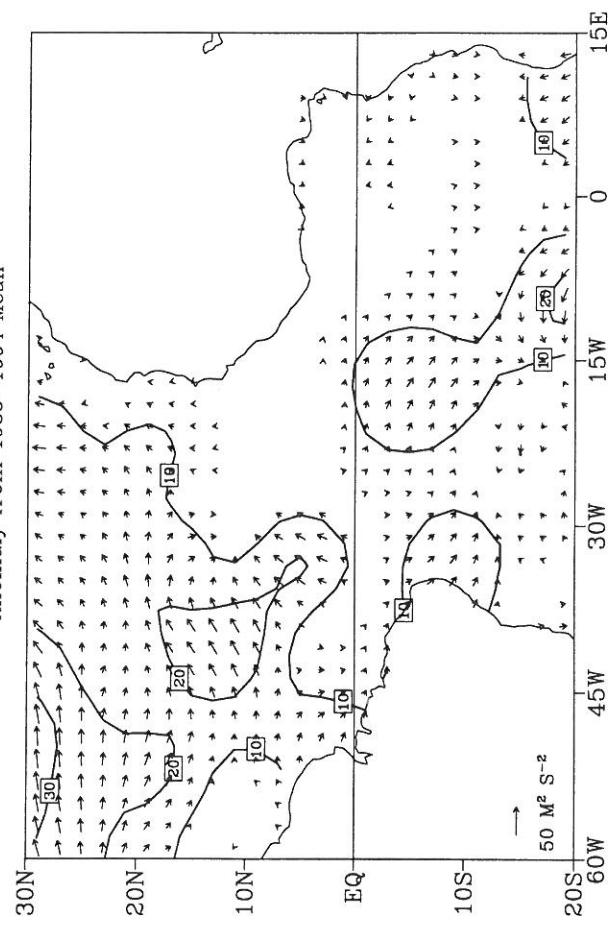




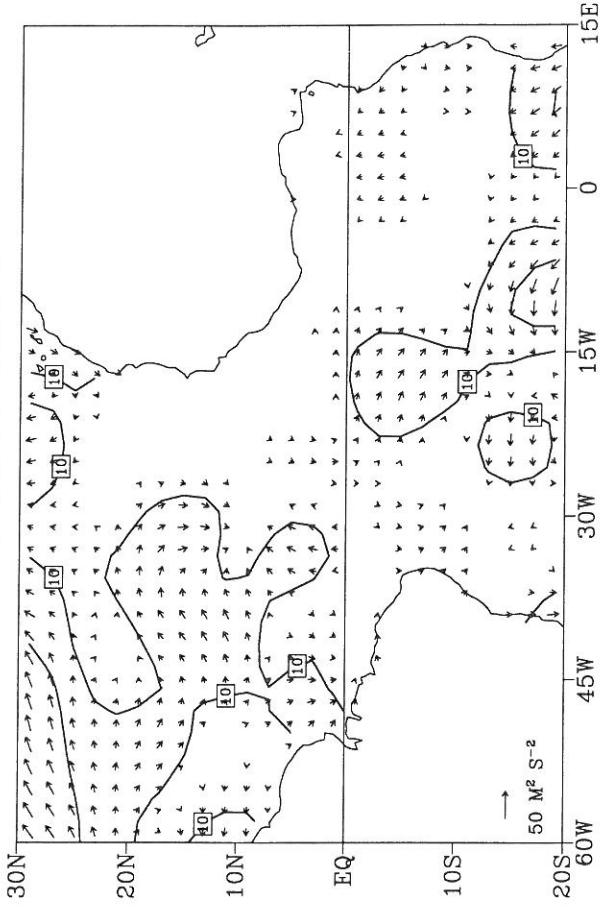


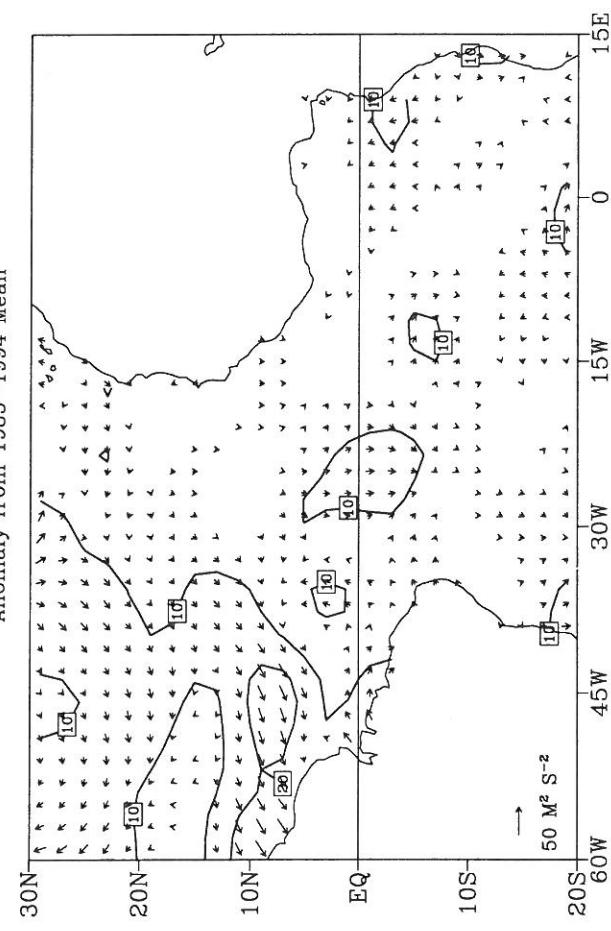
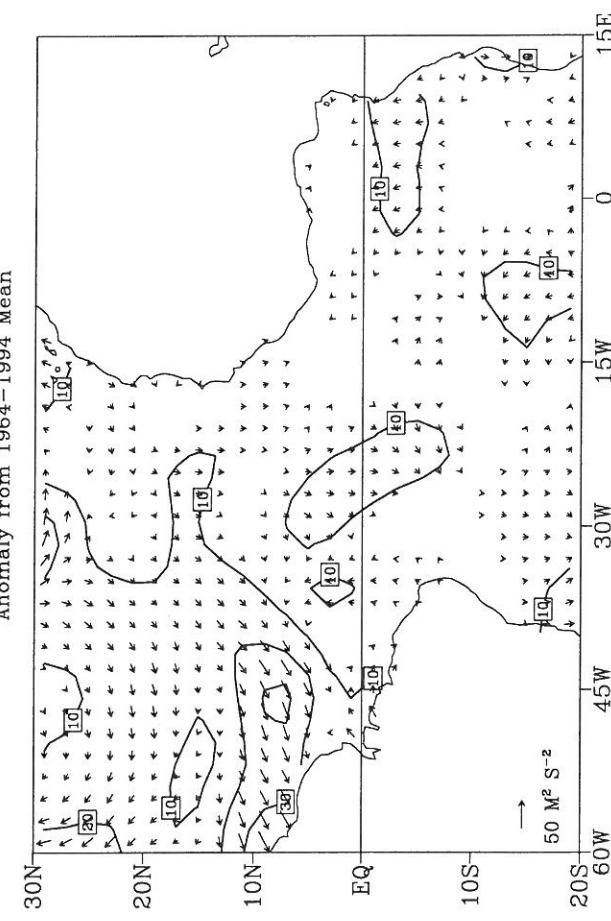
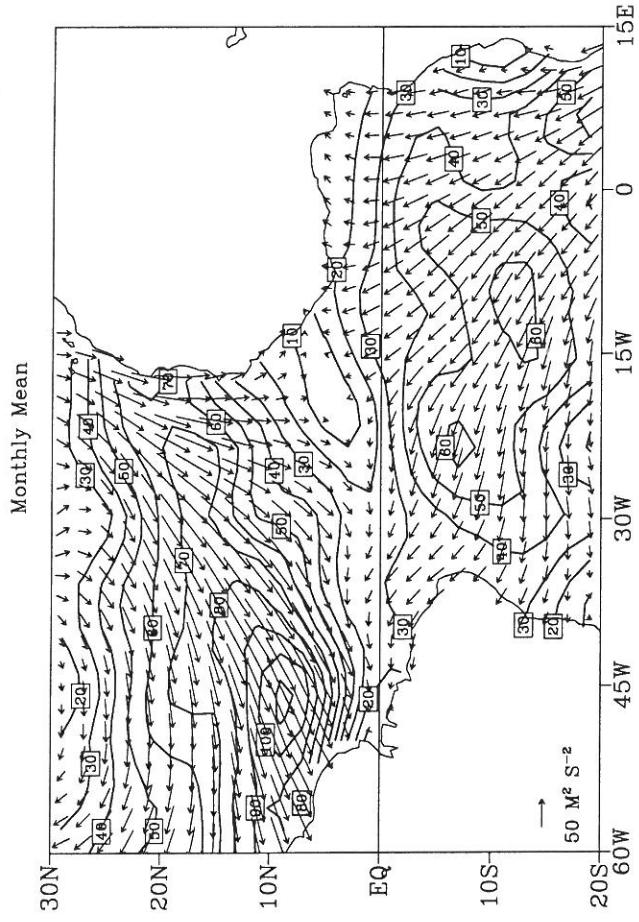


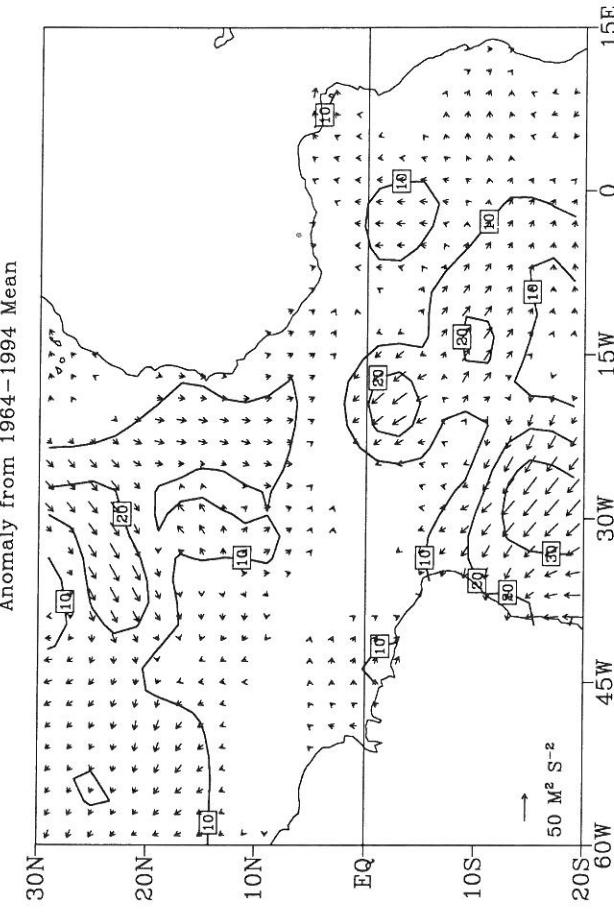
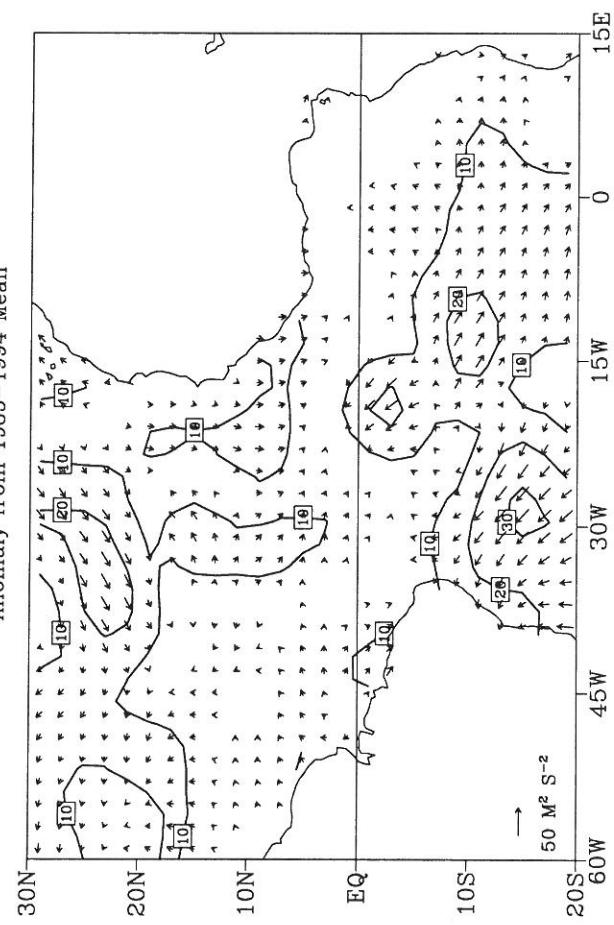
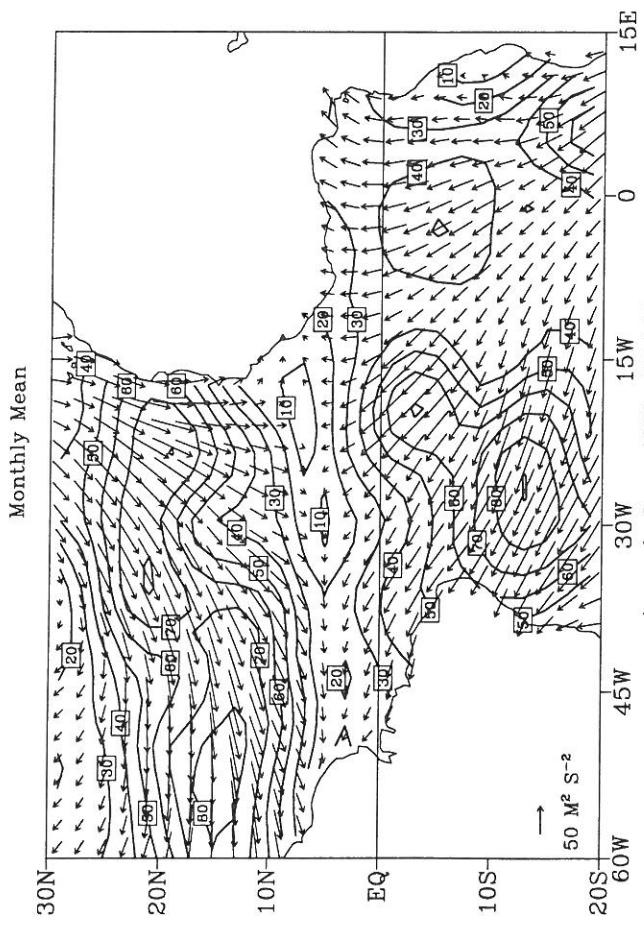
April 1988  
Pseudostress Vectors



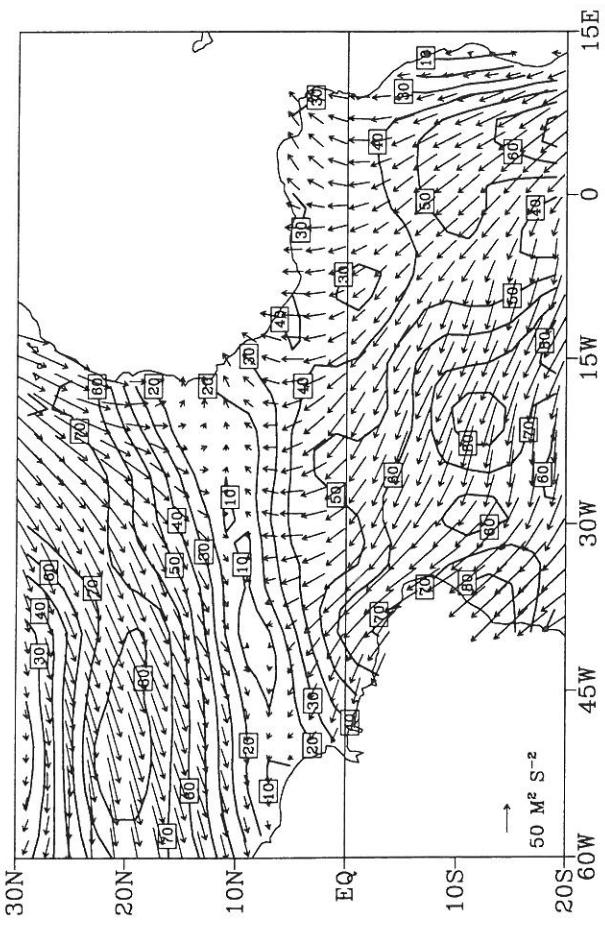
Anomaly from 1964–1994 Mean



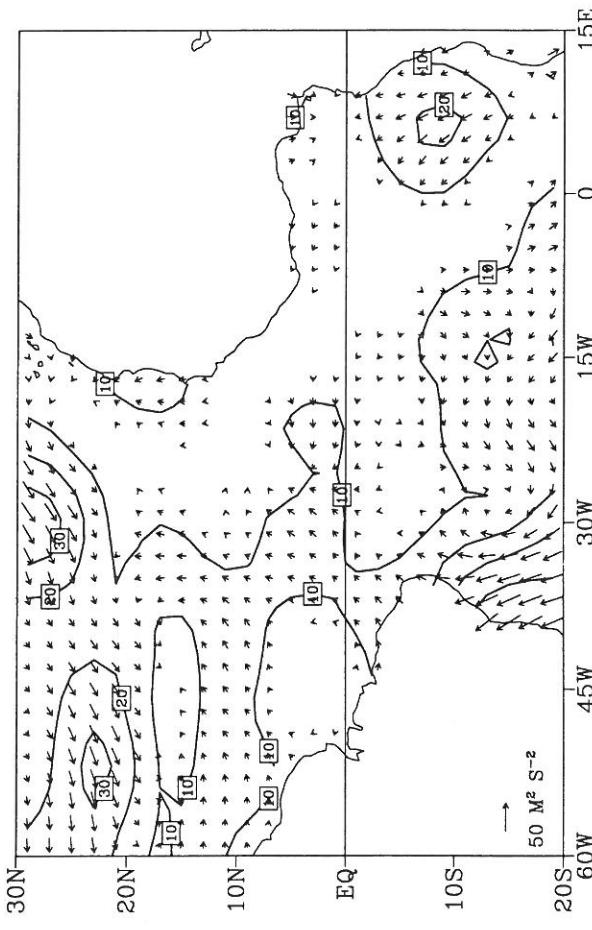




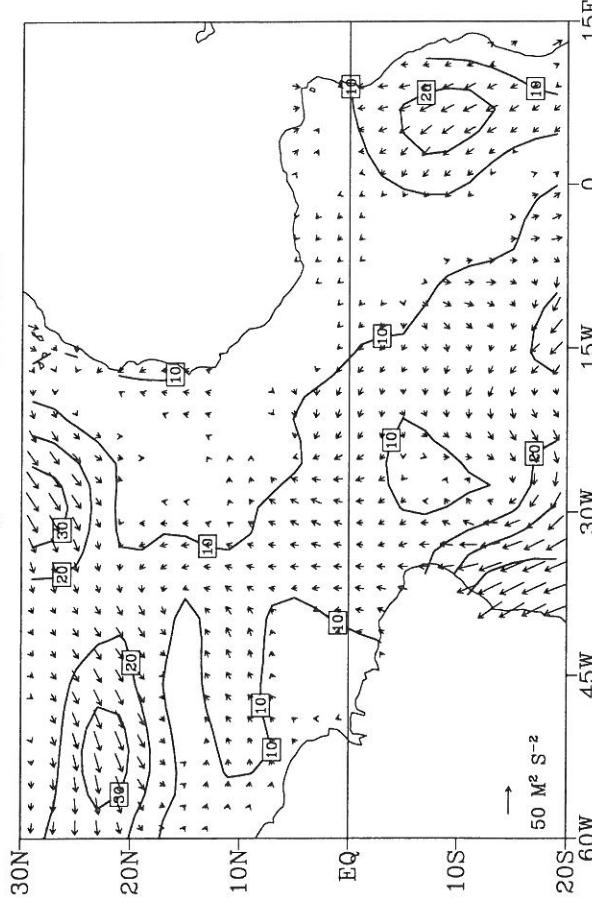
Monthly Mean



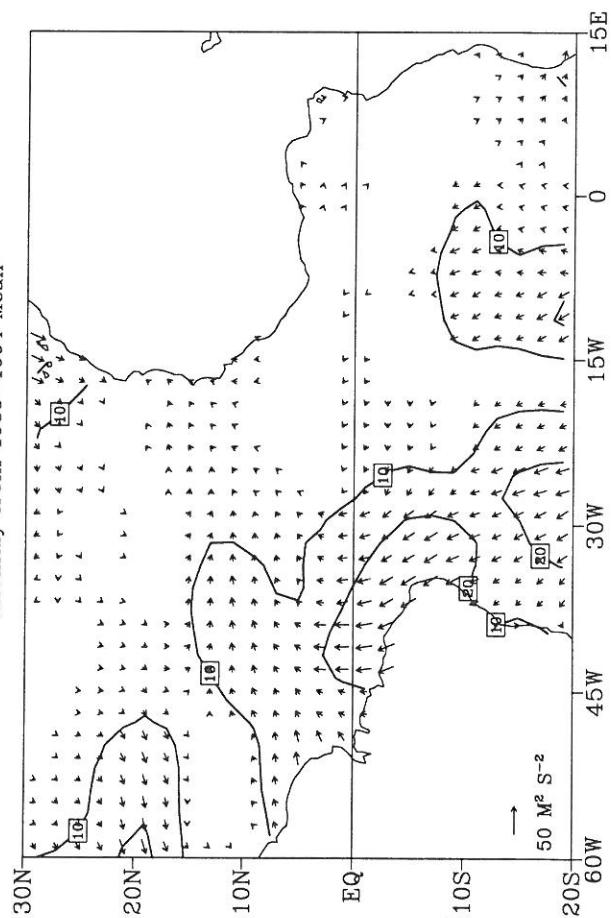
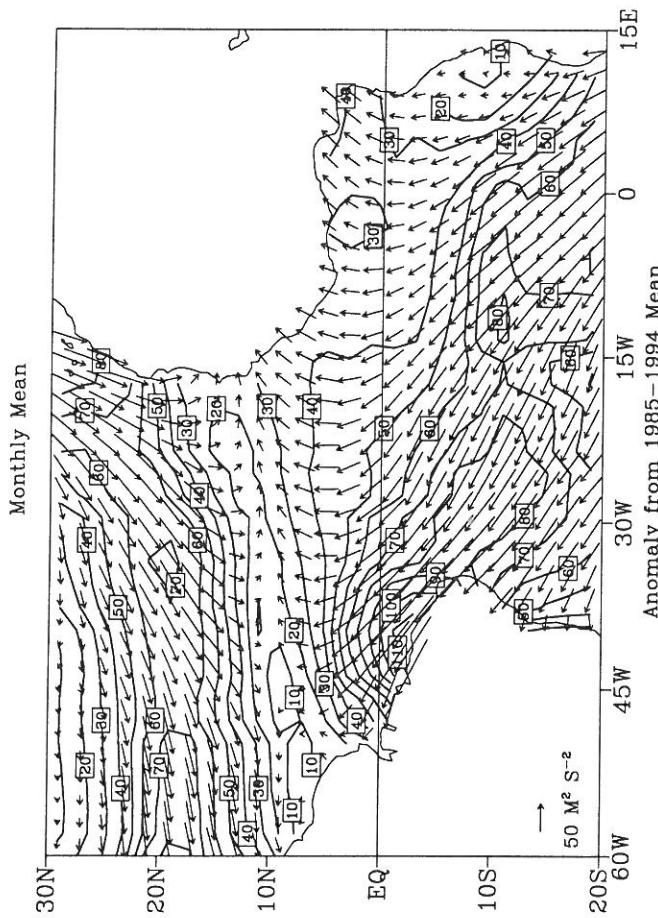
Anomaly from 1985–1994 Mean



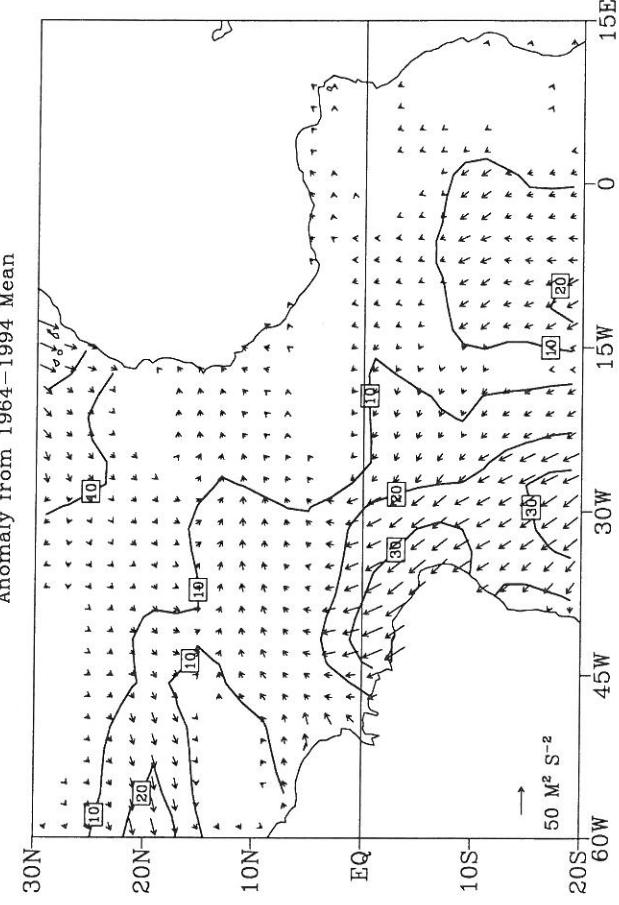
Anomaly from 1964–1994 Mean



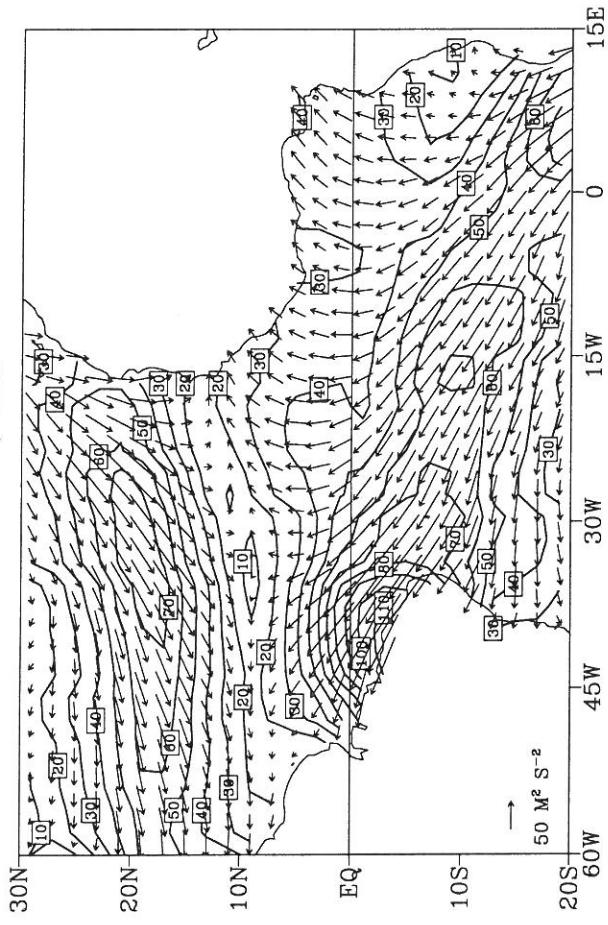
July 1988  
Pseudostress Vectors



August 1988  
Pseudostress Vectors

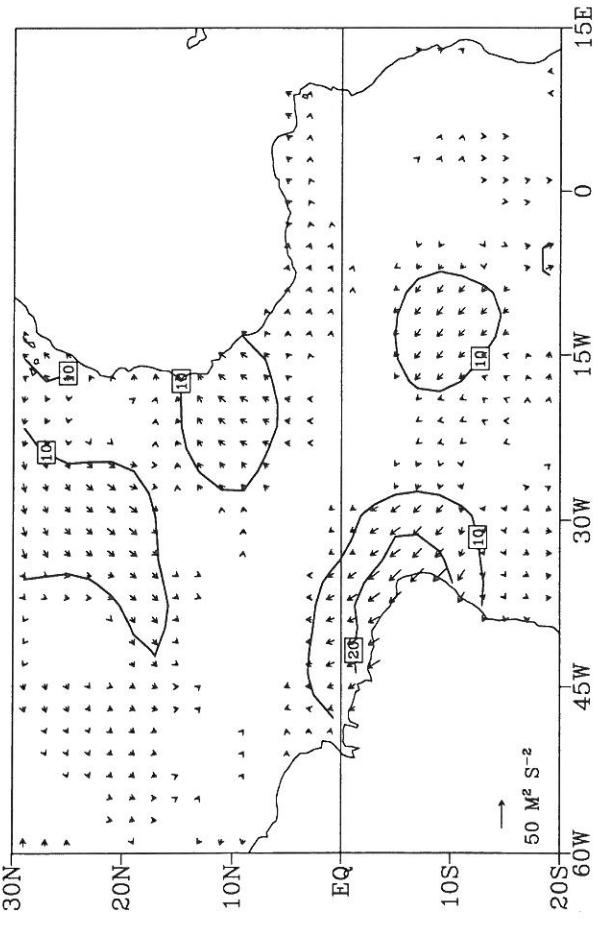


Monthly Mean

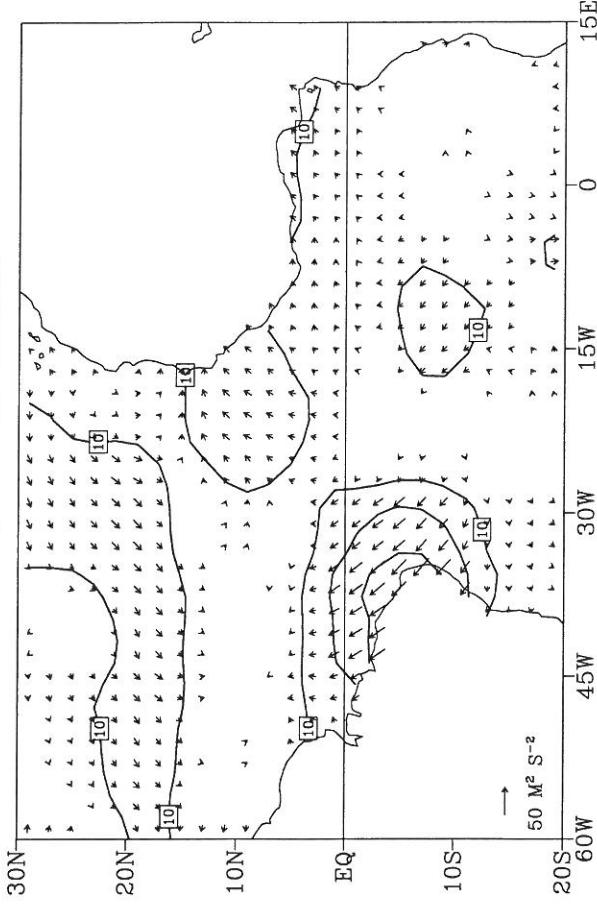


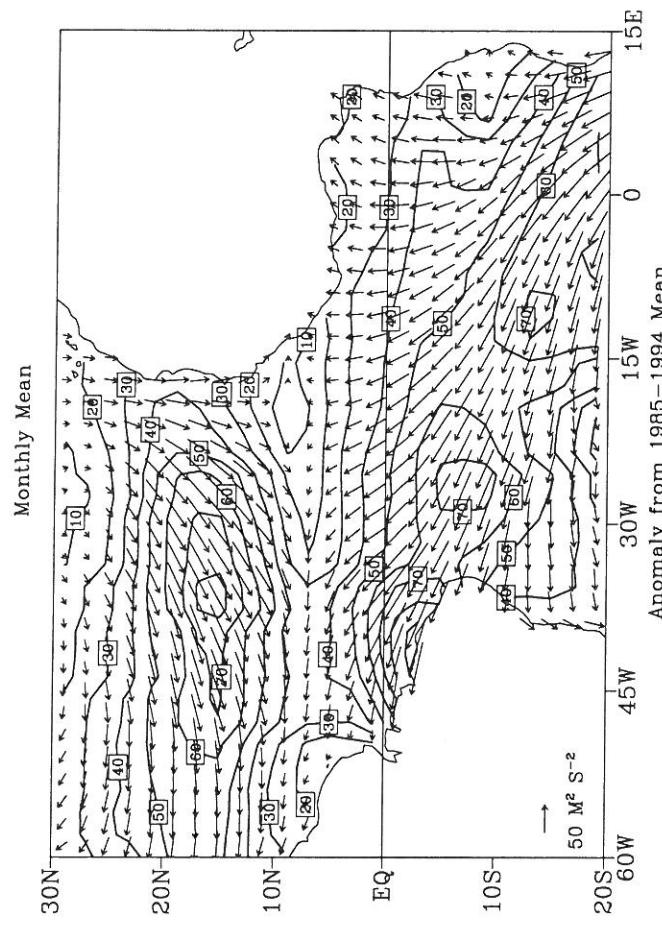
September 1988  
Pseudostress Vectors

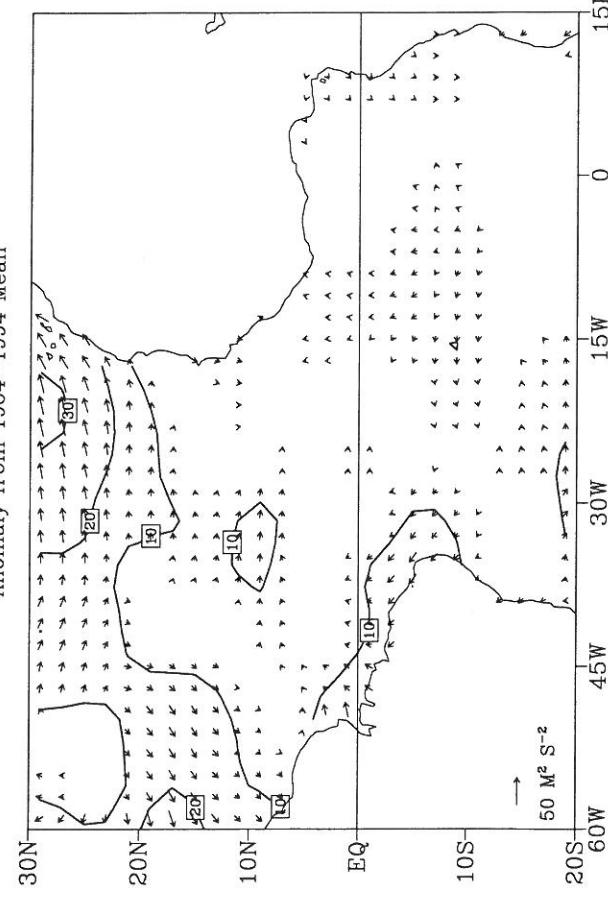
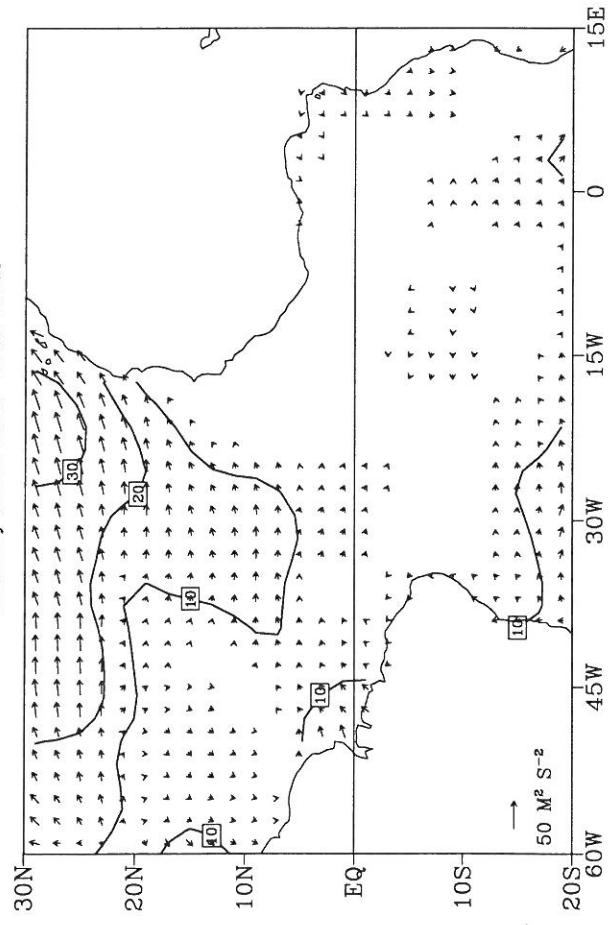
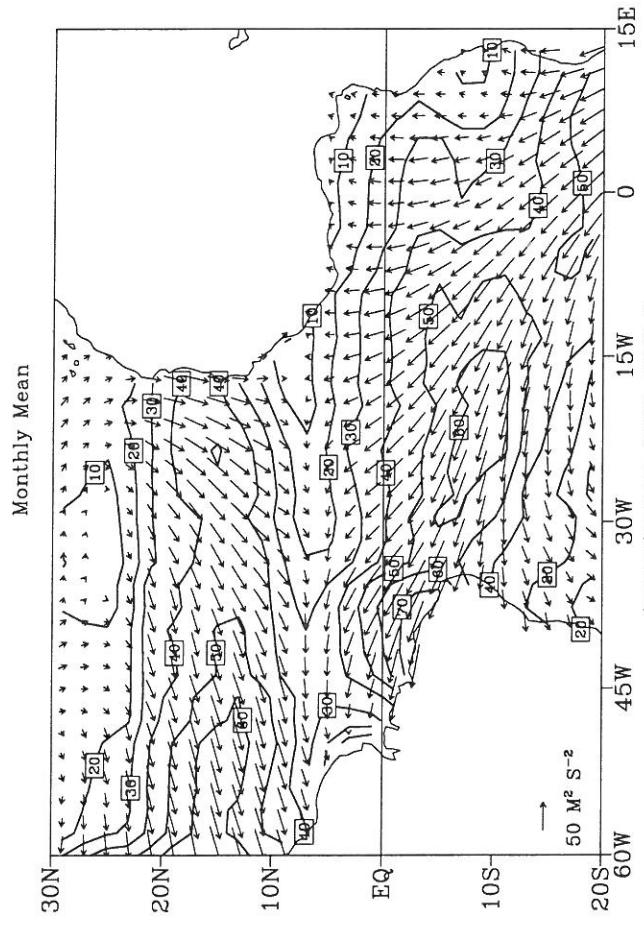
Anomaly from 1985–1994 Mean

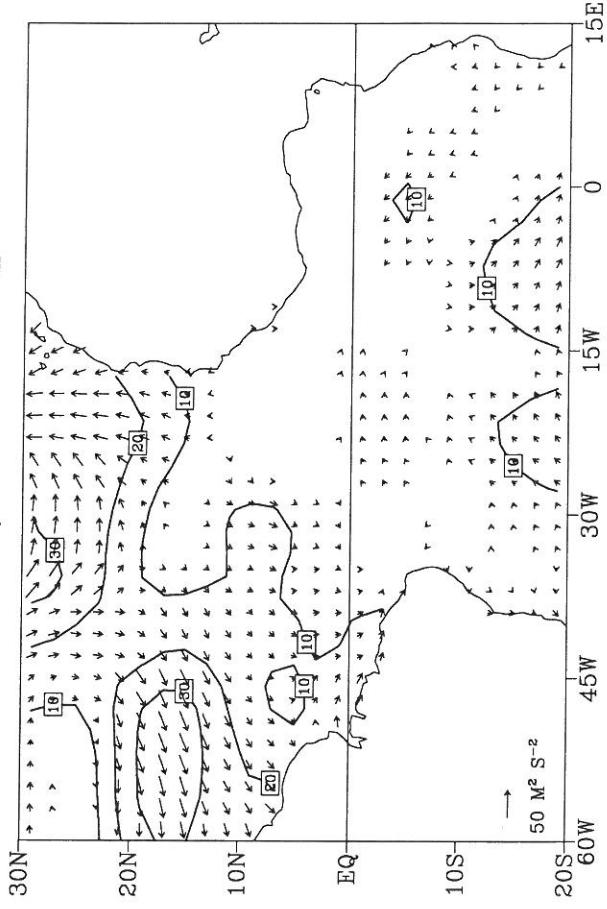
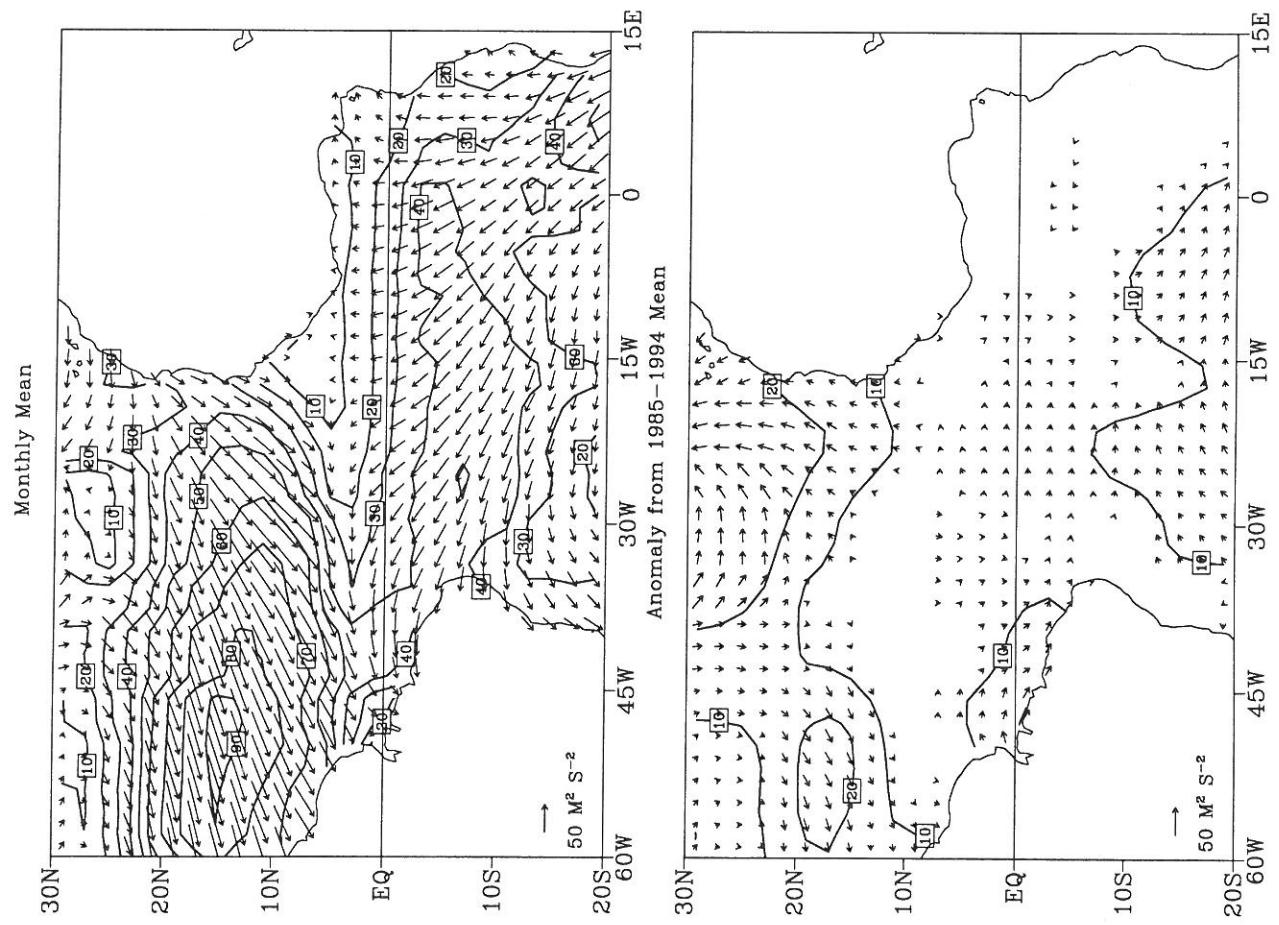


Anomaly from 1964–1994 Mean



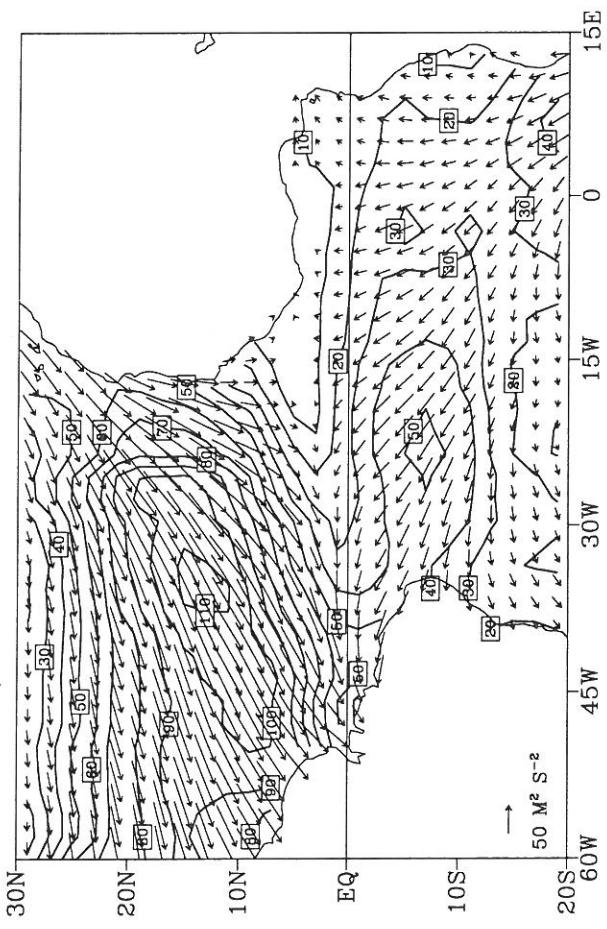






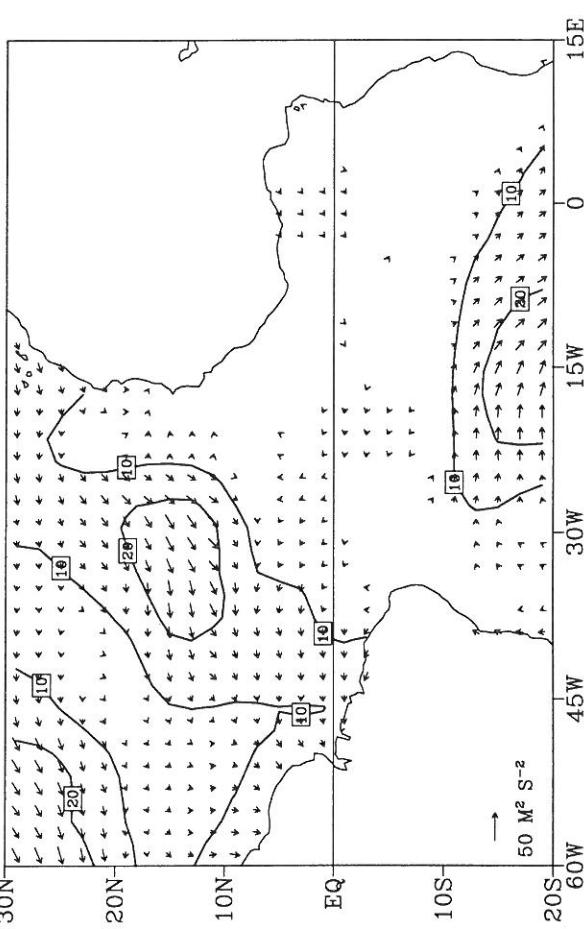
December 1988  
Pseudostress Vectors

Monthly Mean

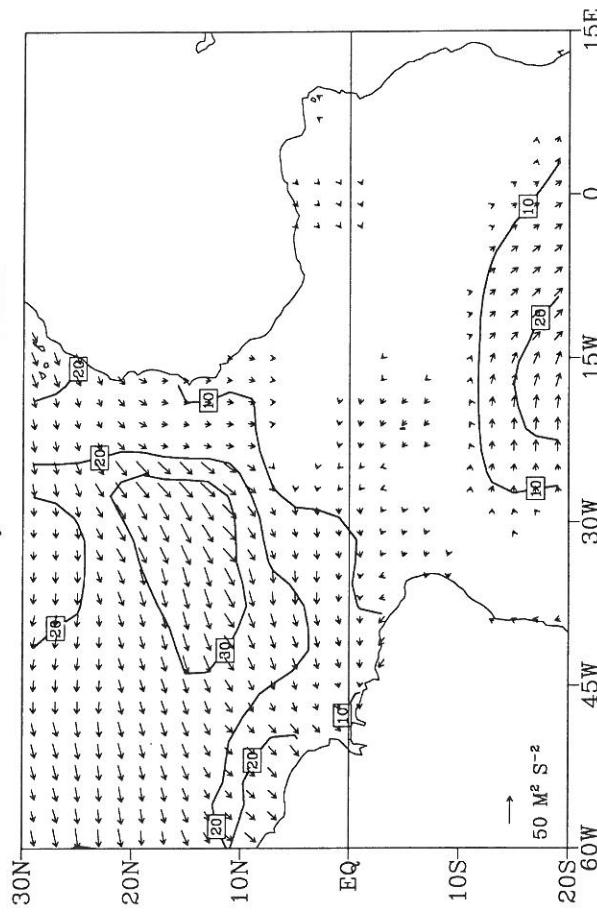


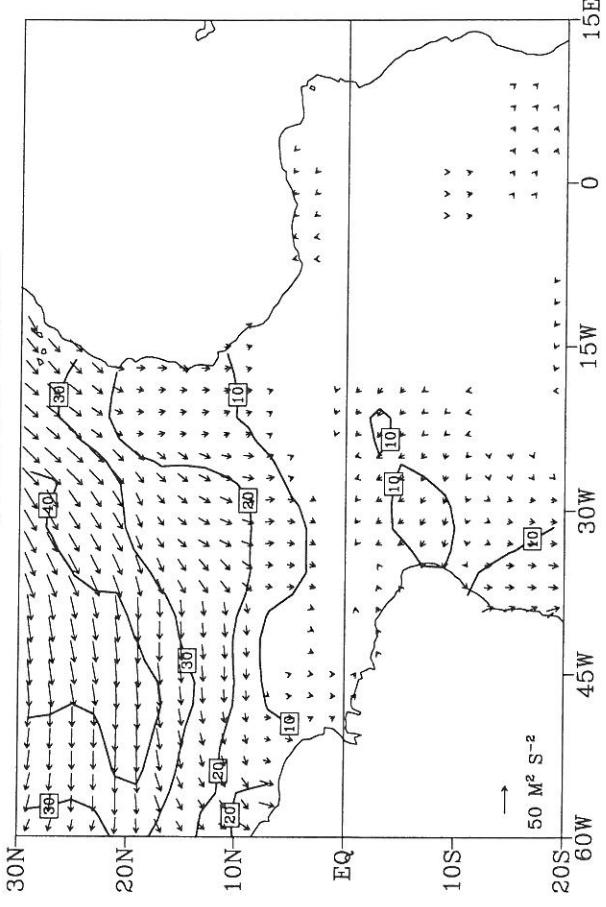
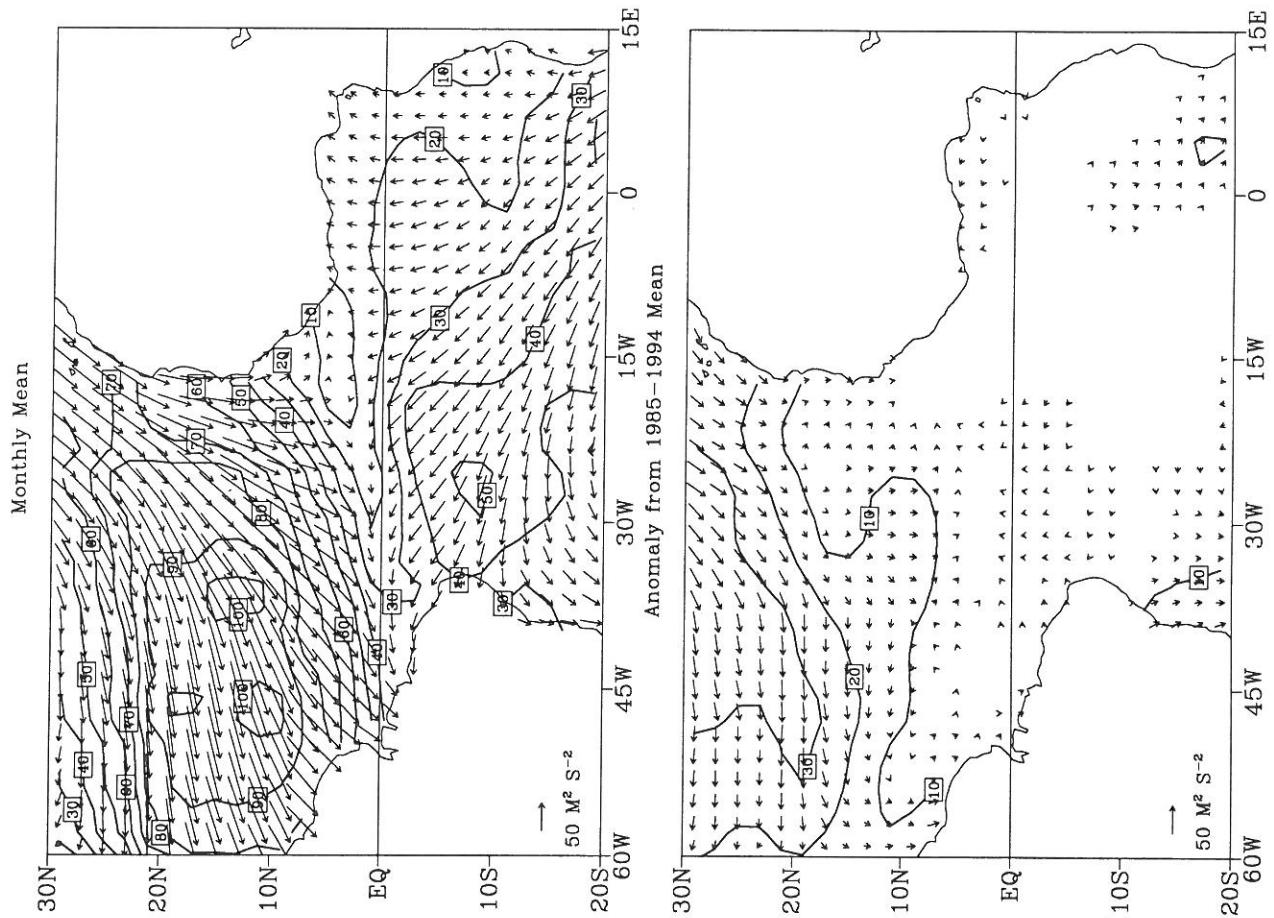
January 1989  
Pseudostress Vectors

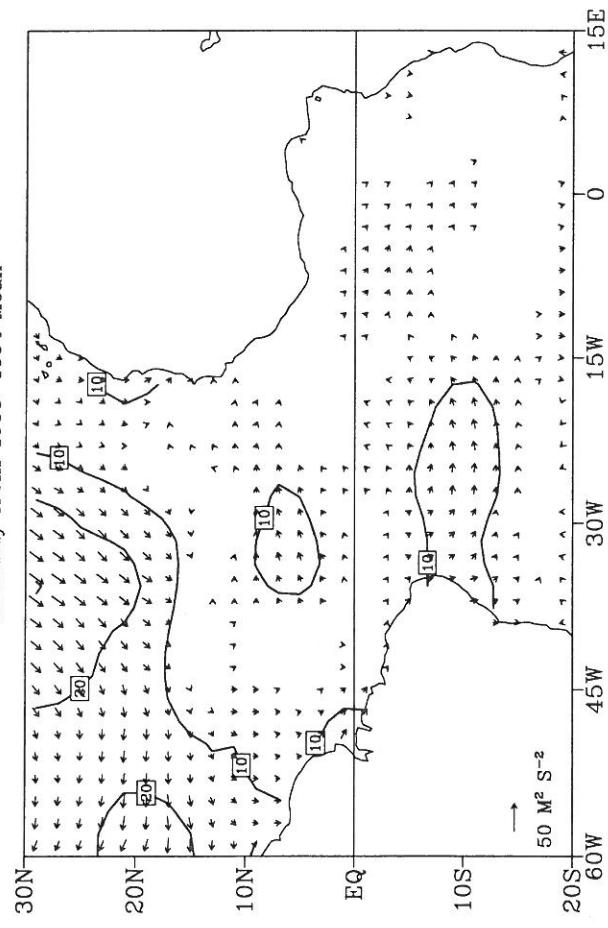
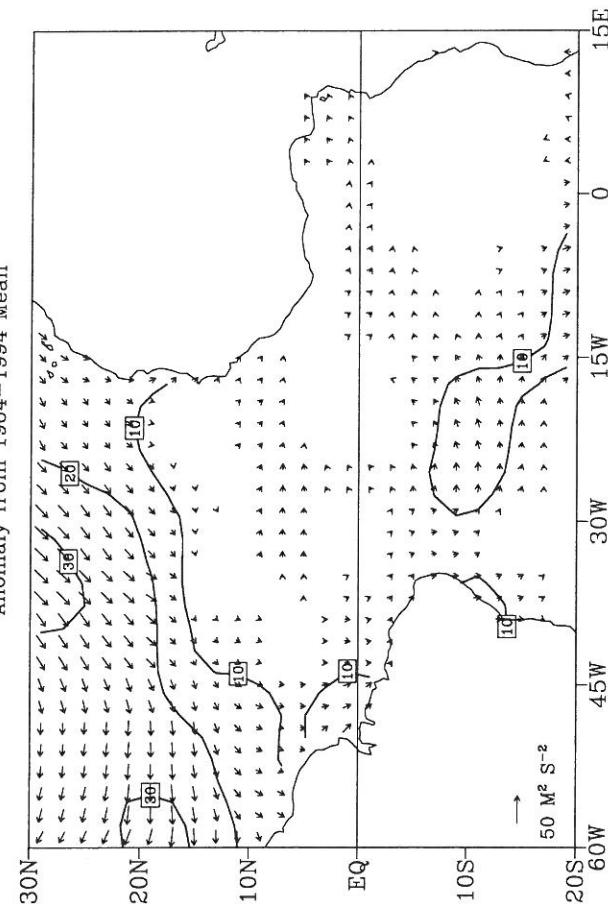
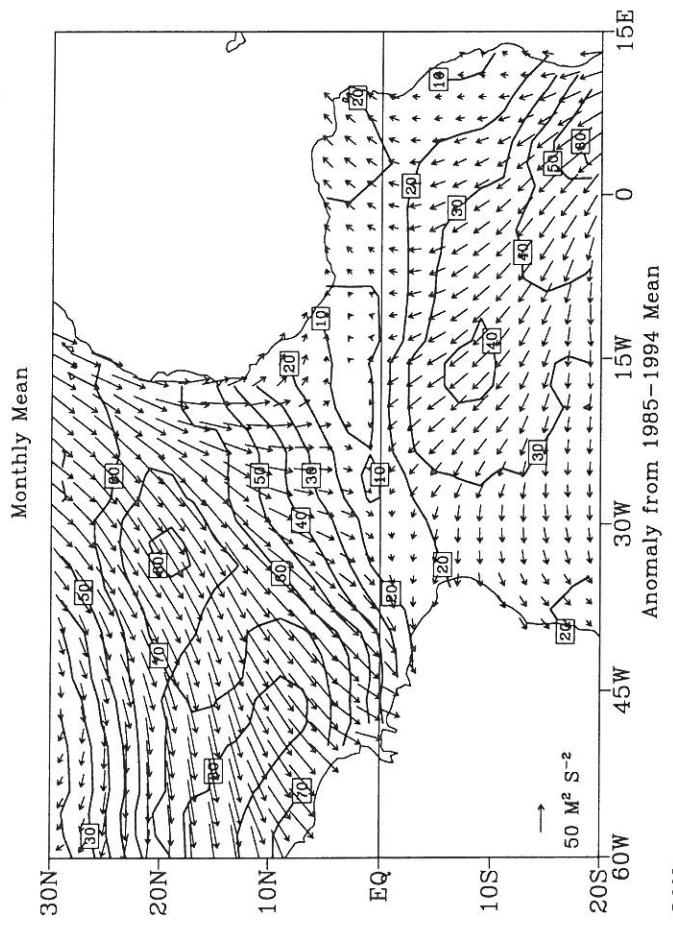
Anomaly from 1985–1994 Mean

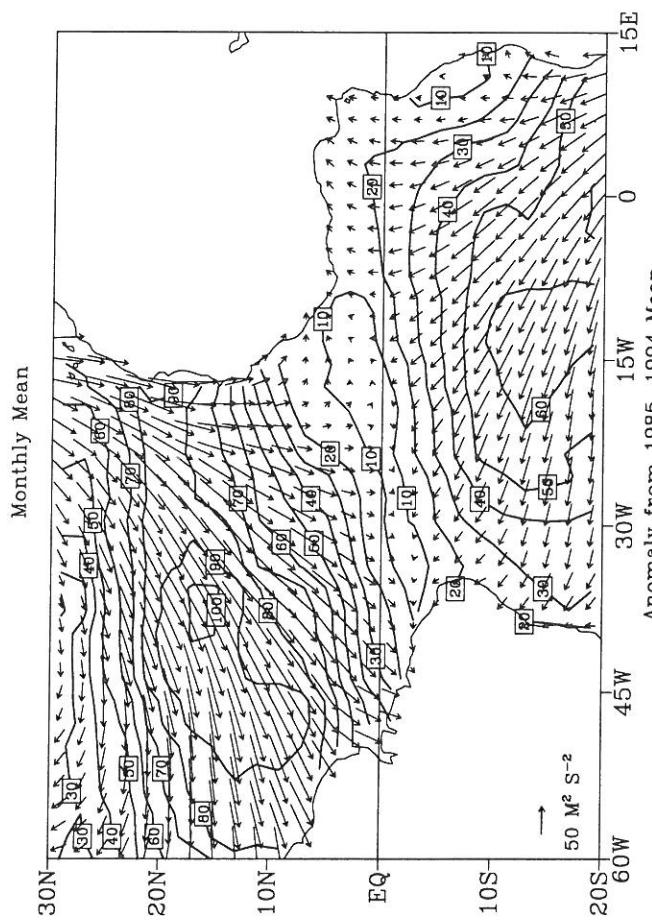


Anomaly from 1964–1994 Mean

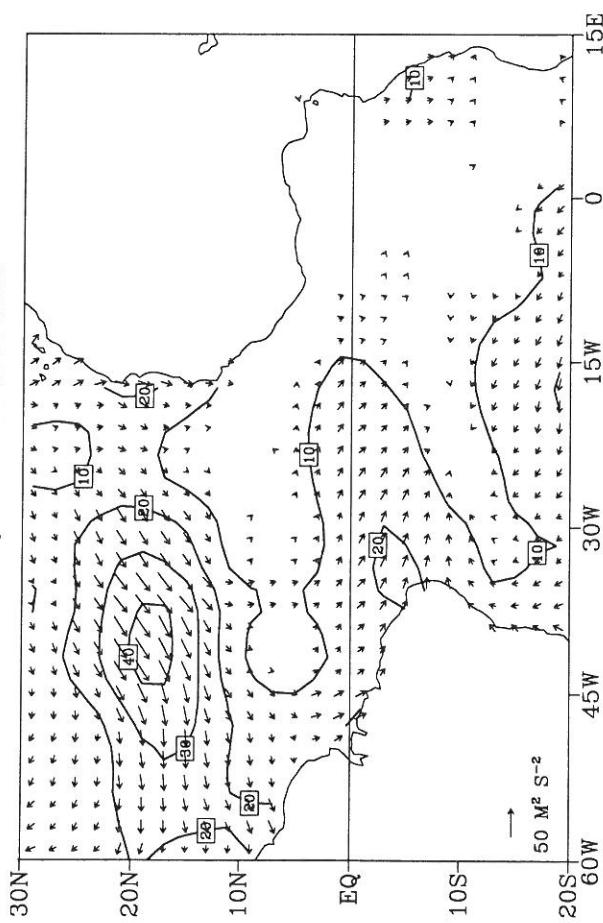




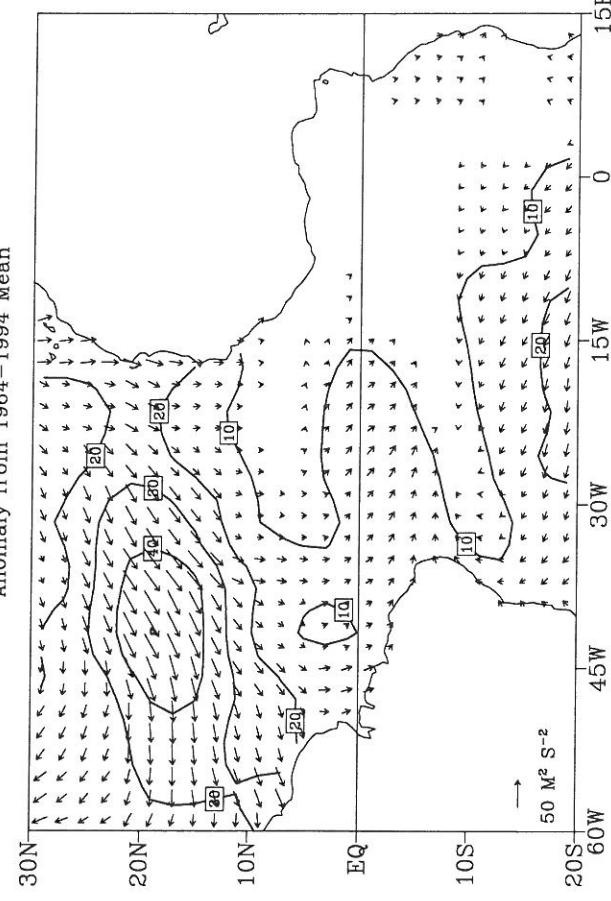




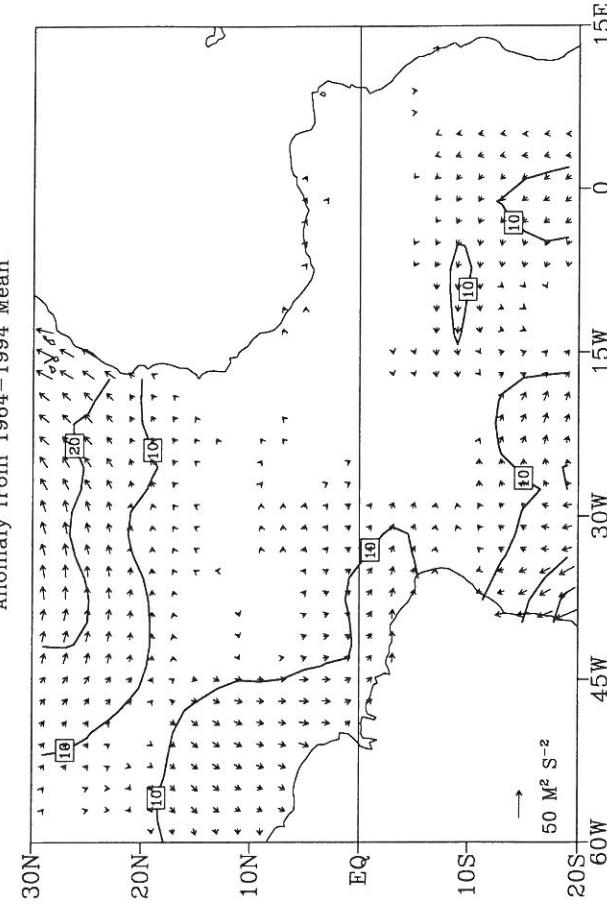
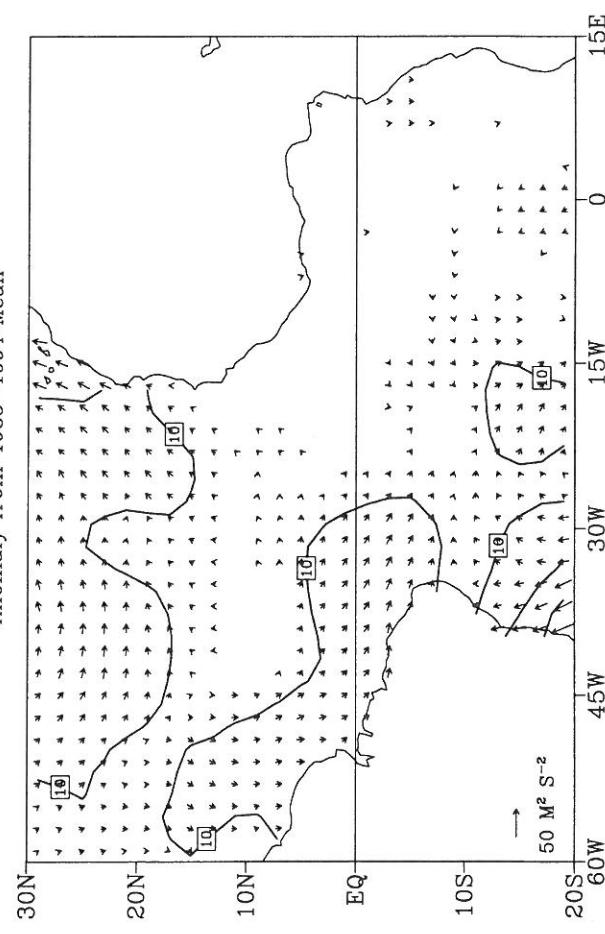
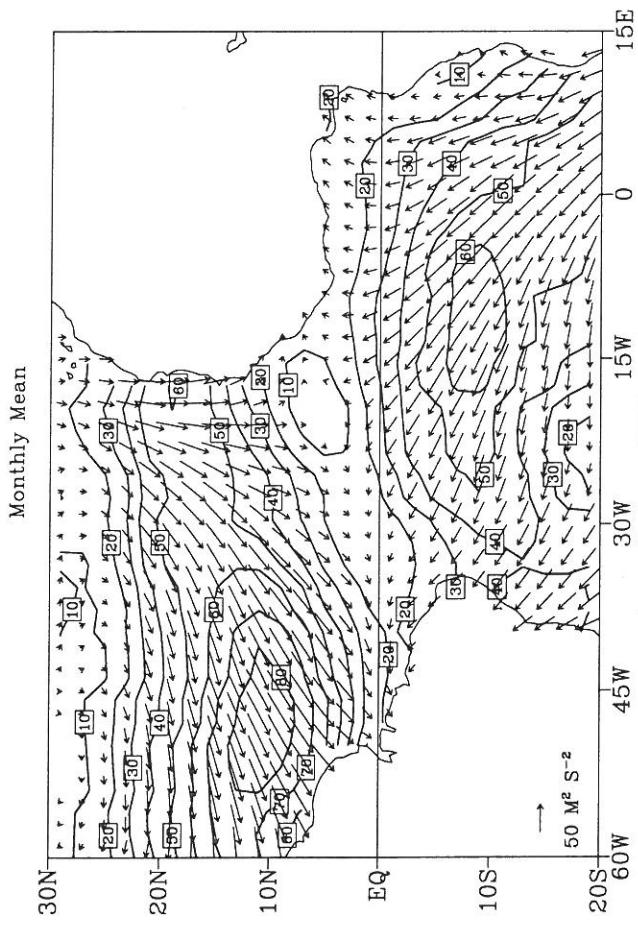
April 1989  
Pseudostress Vectors

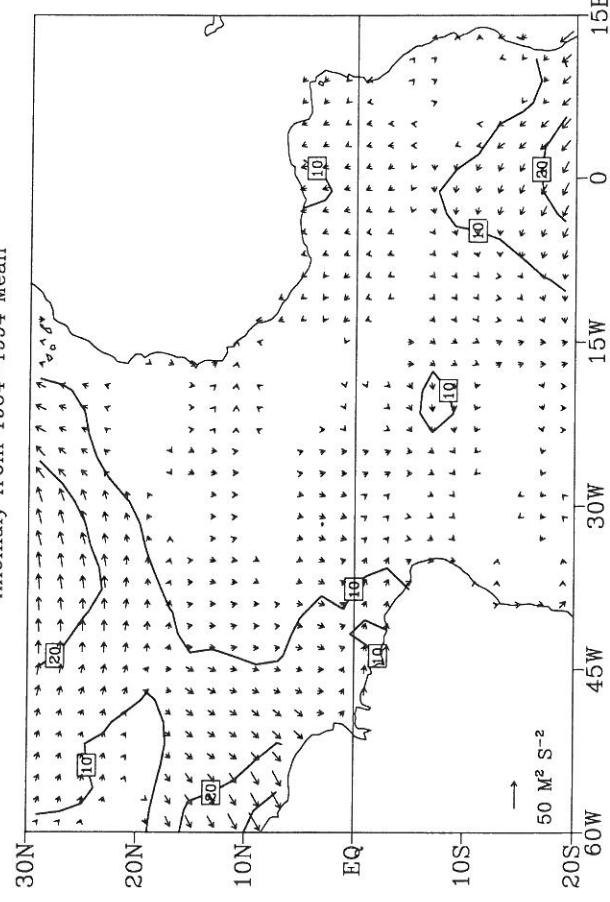
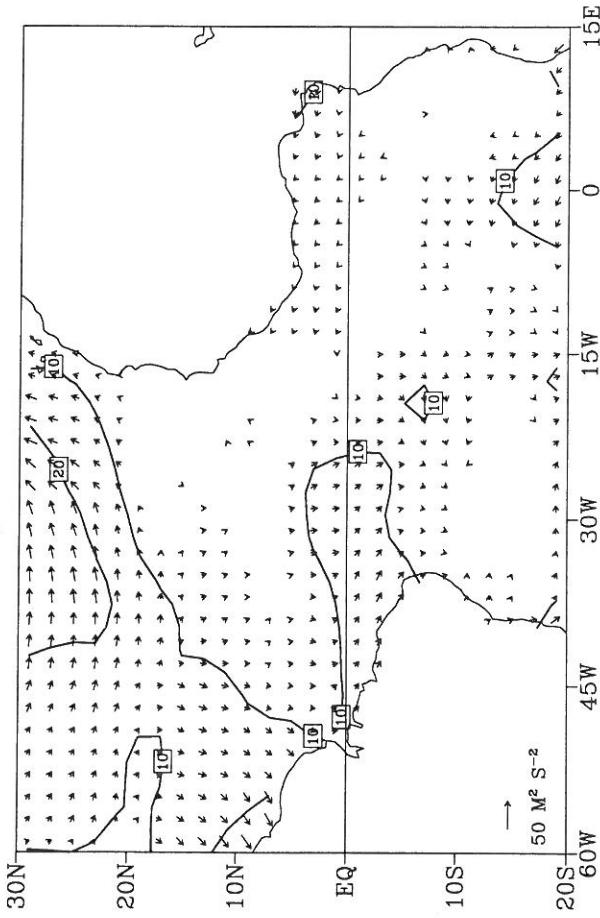
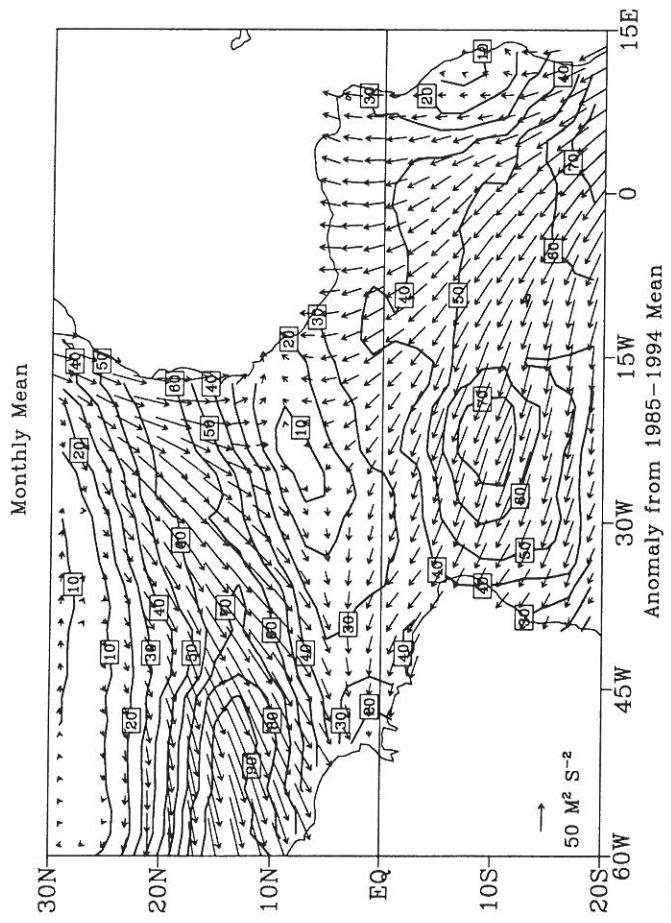


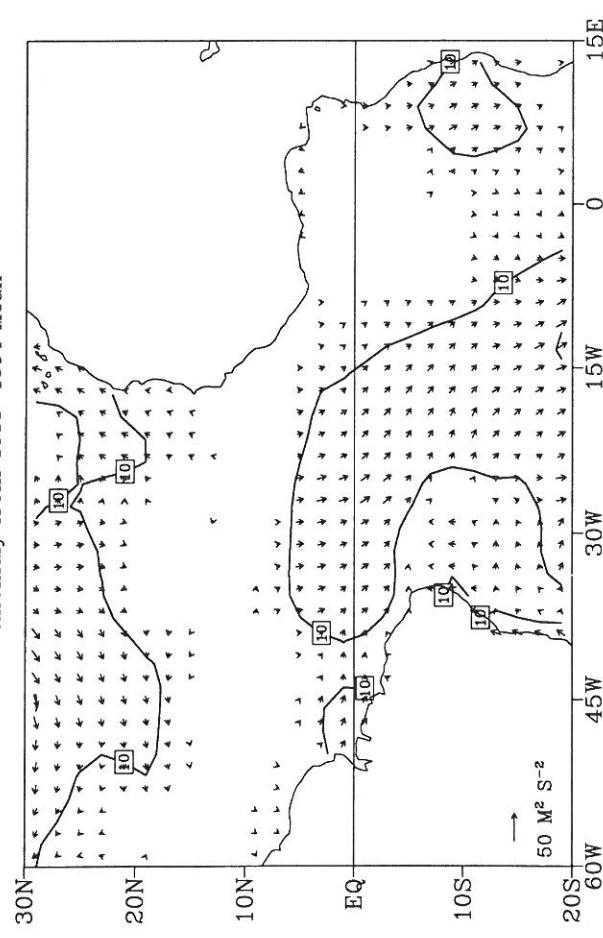
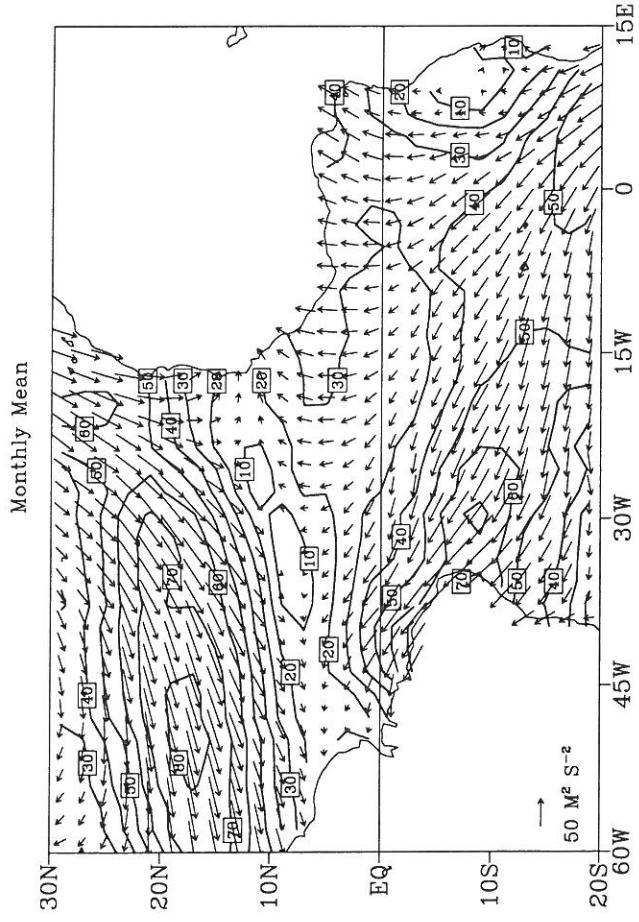
Anomaly from 1985–1994 Mean



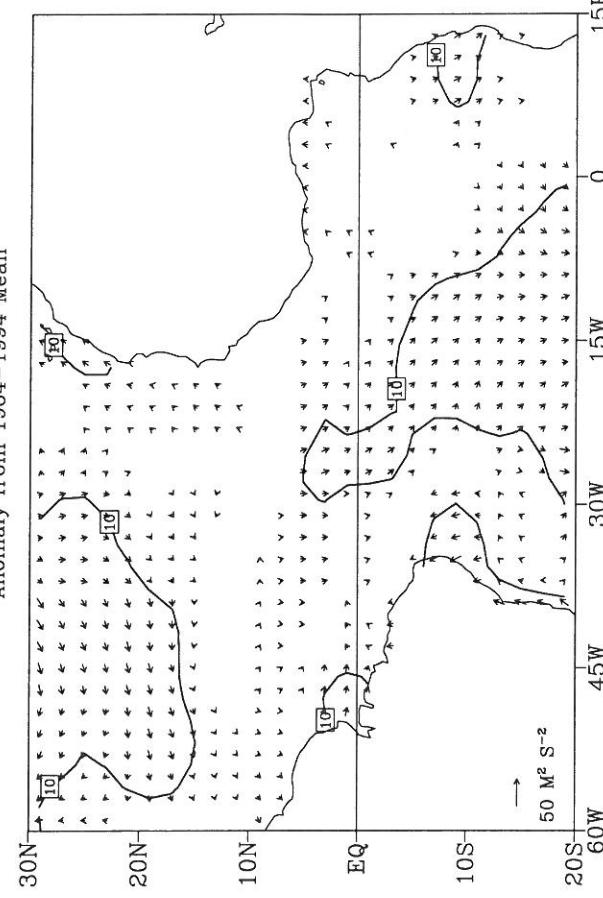
Anomaly from 1964–1994 Mean



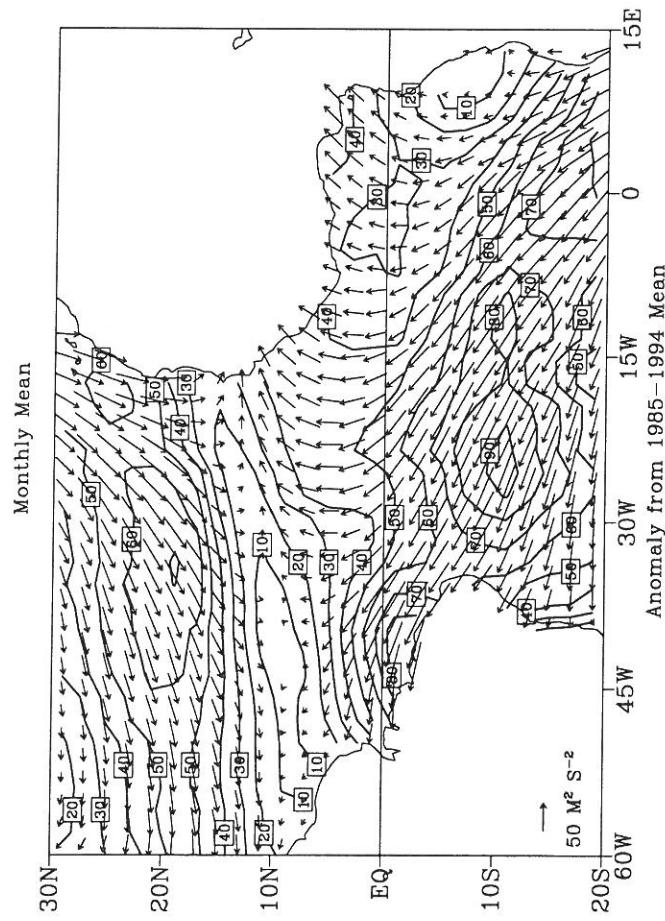




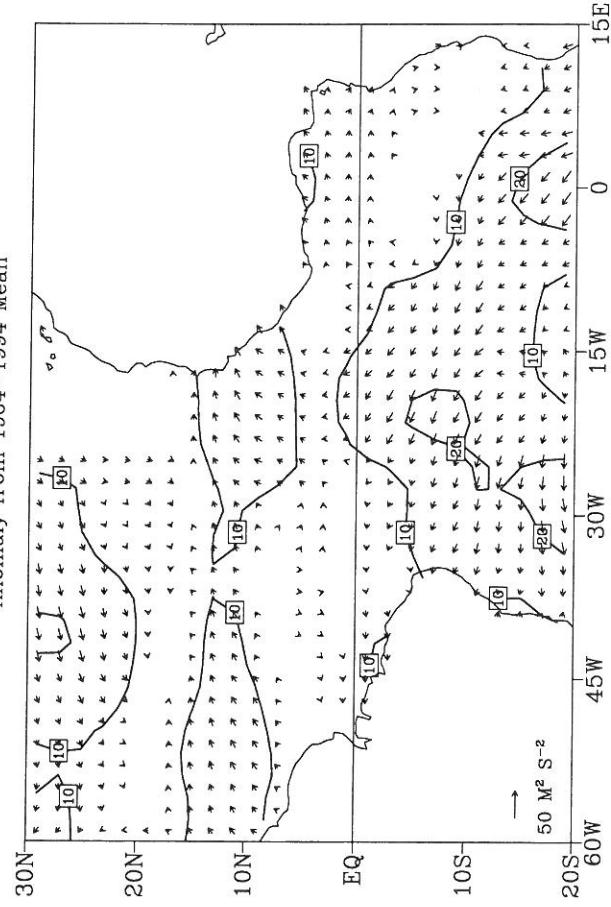
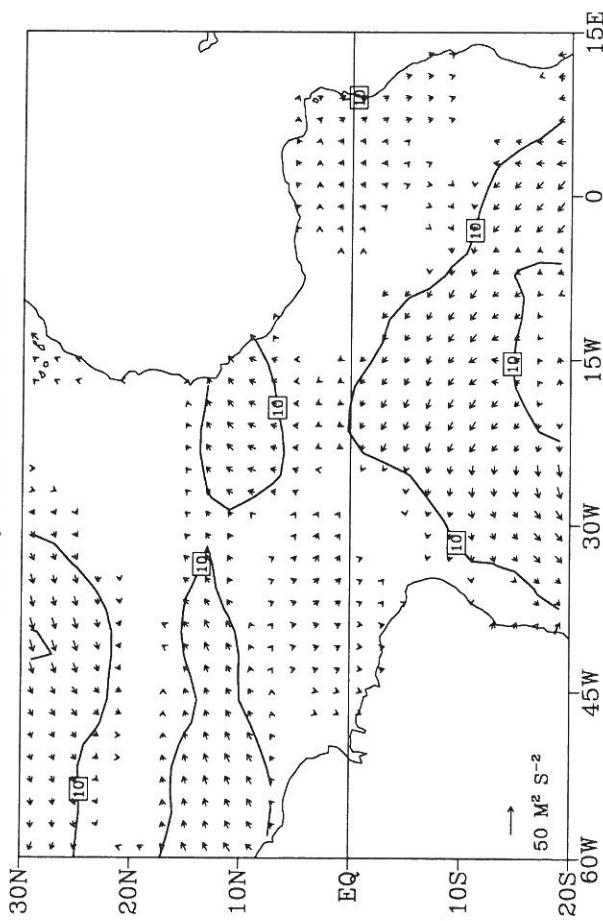
Anomaly from 1985–1994 Mean

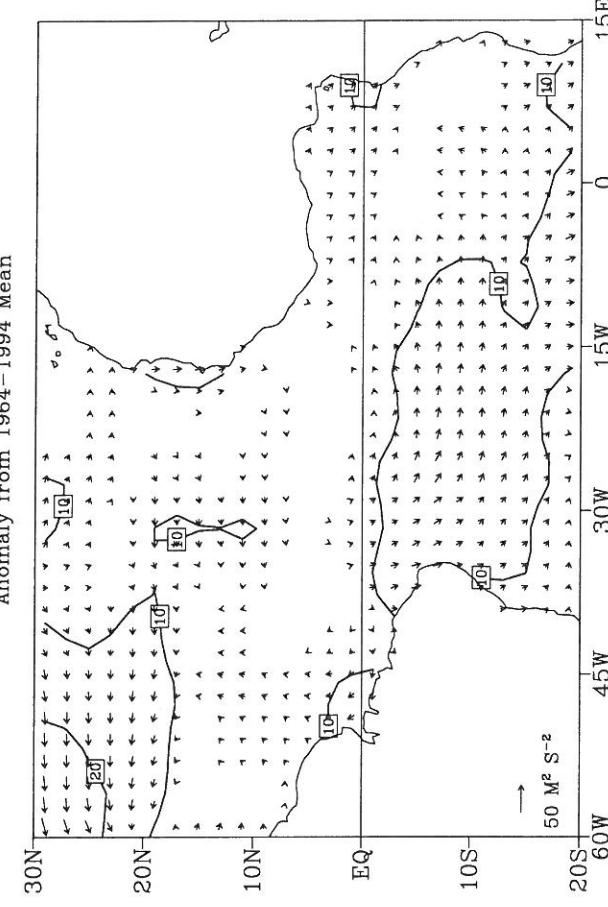
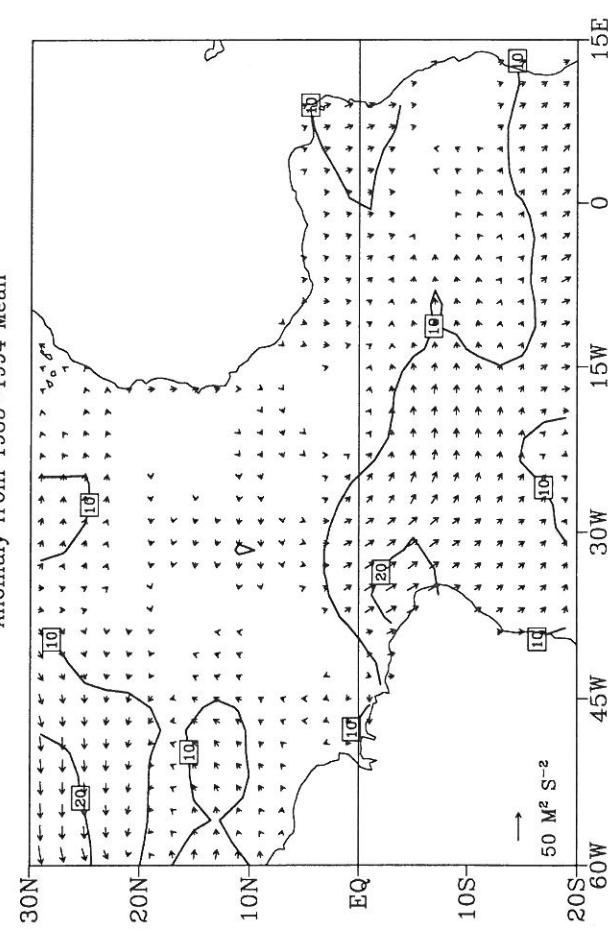
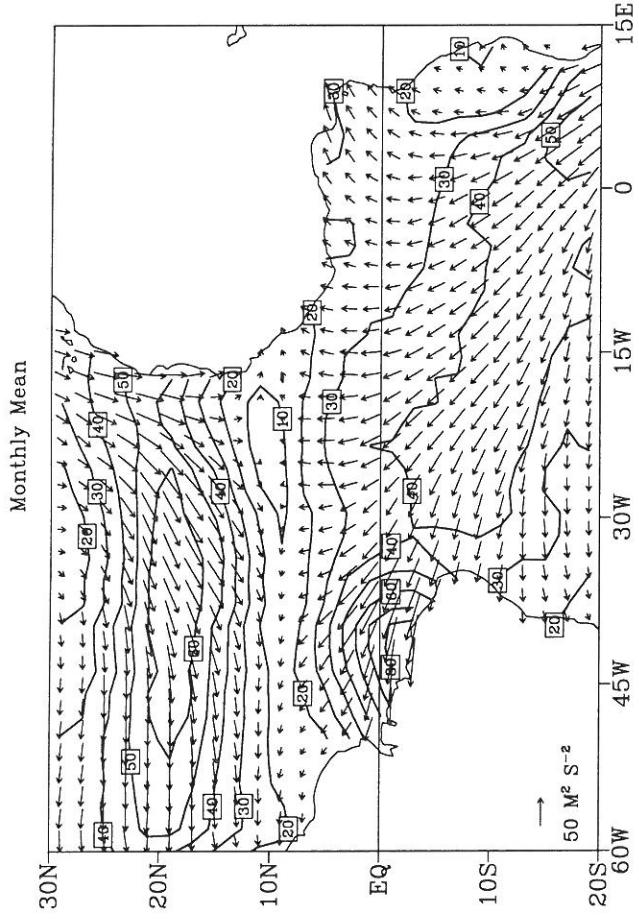


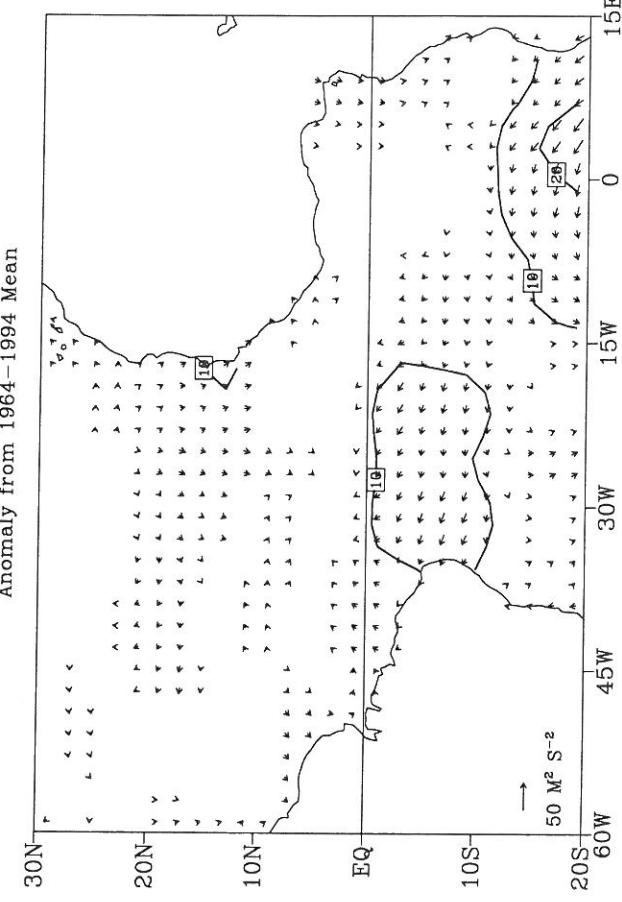
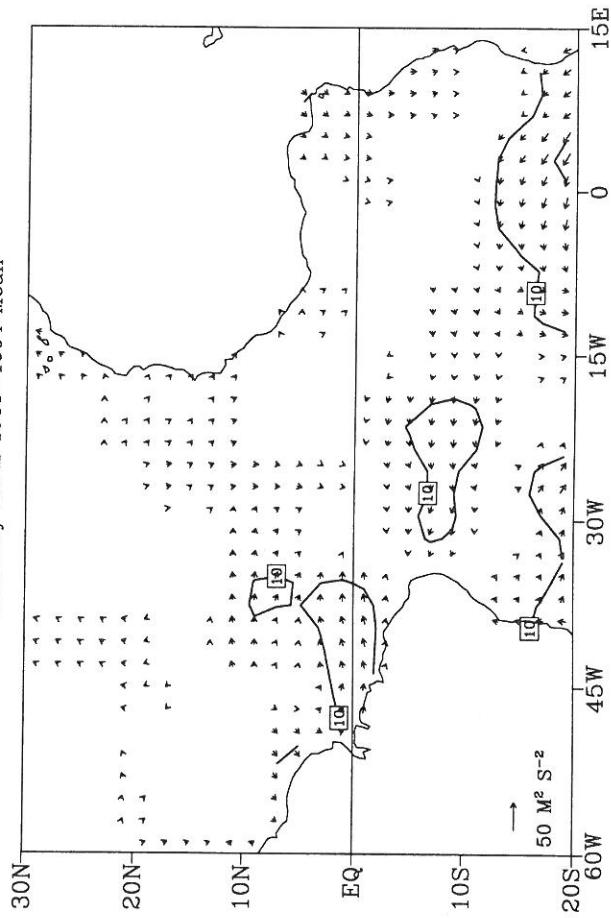
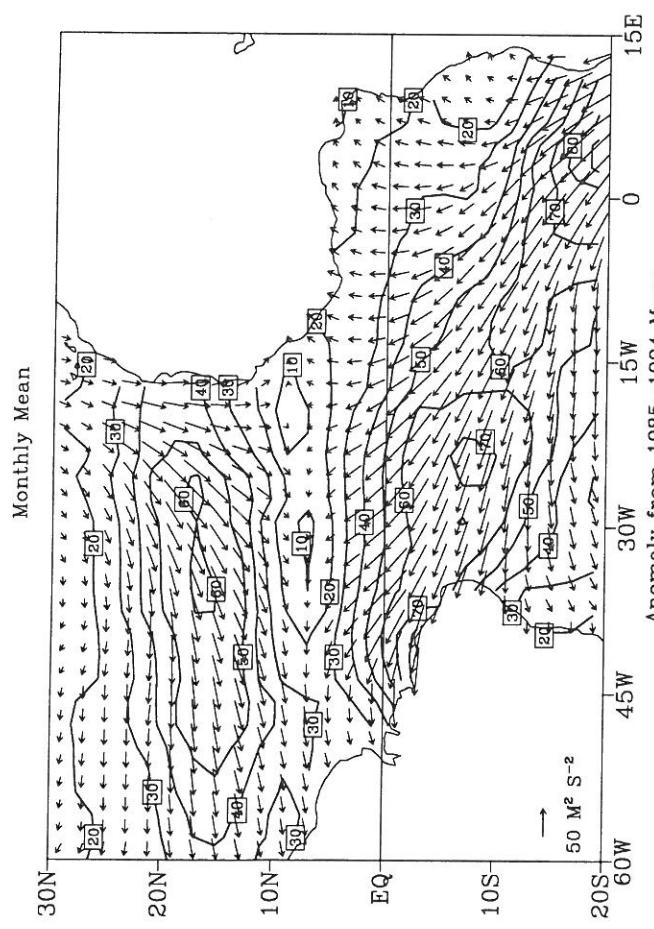
July 1989  
Pseudostress Vectors

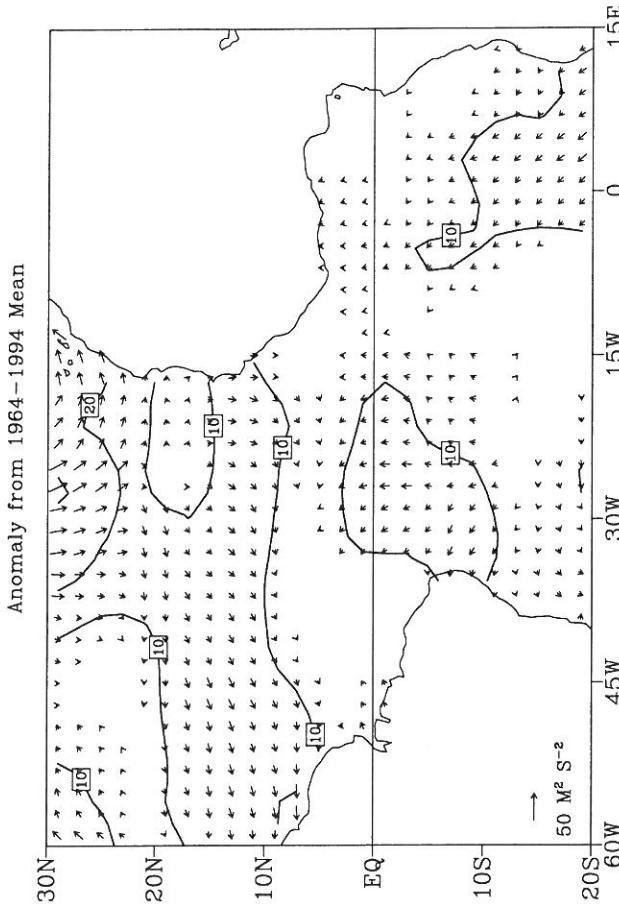
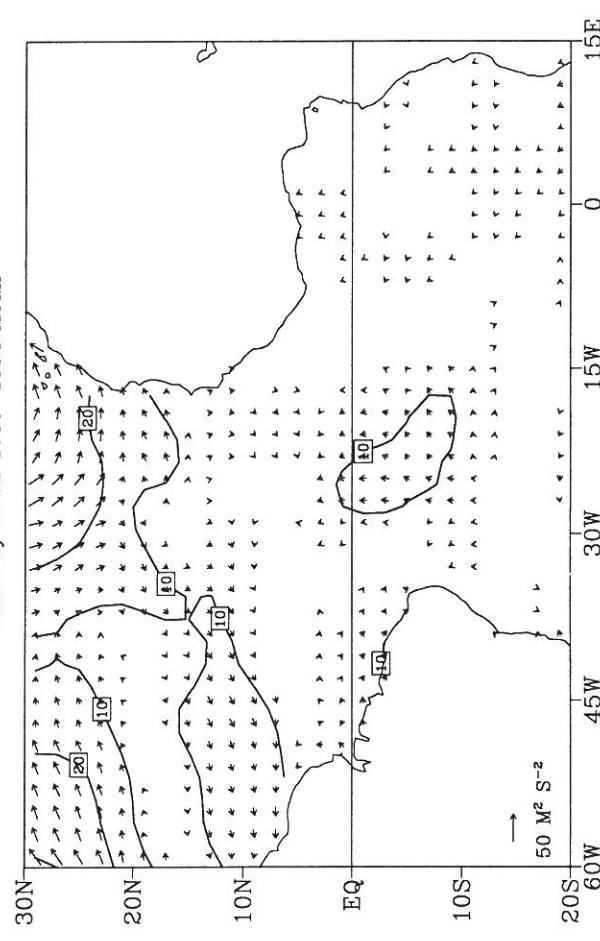
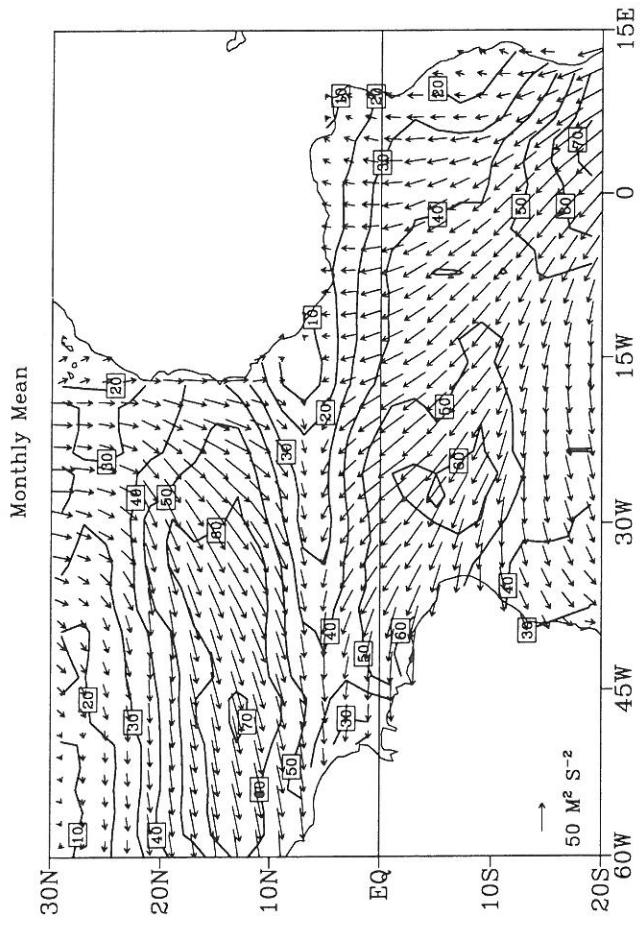


August 1989  
Pseudostress Vectors

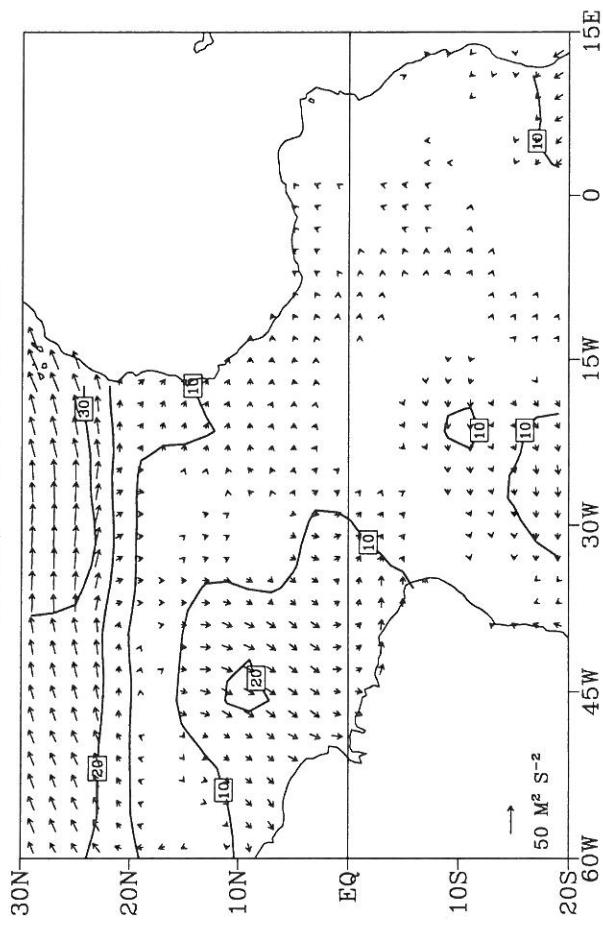
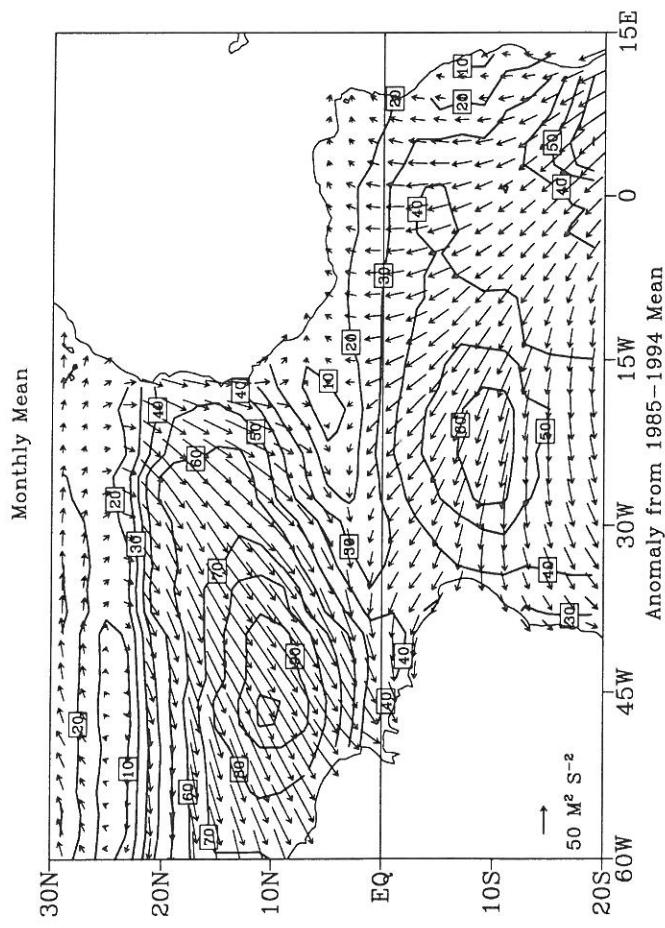




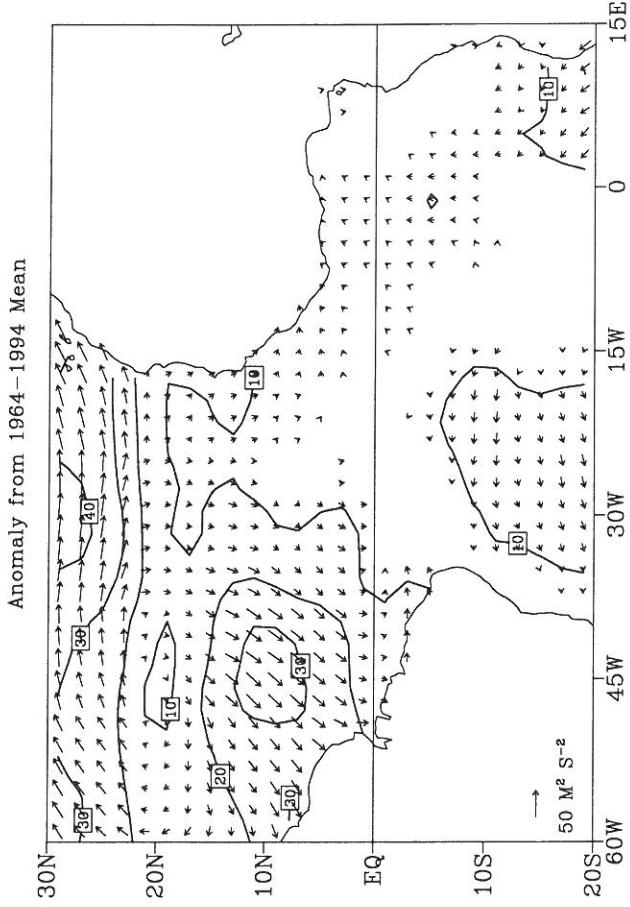


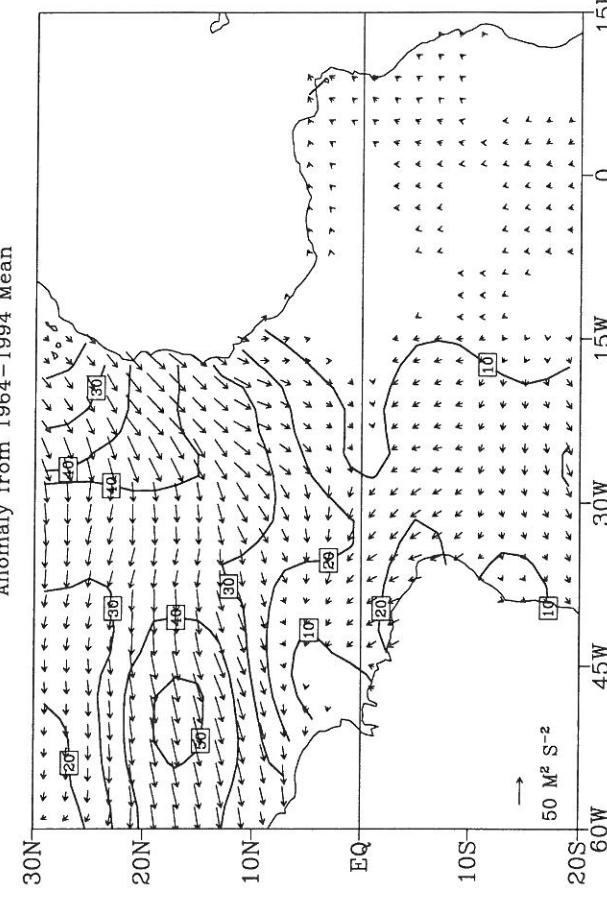
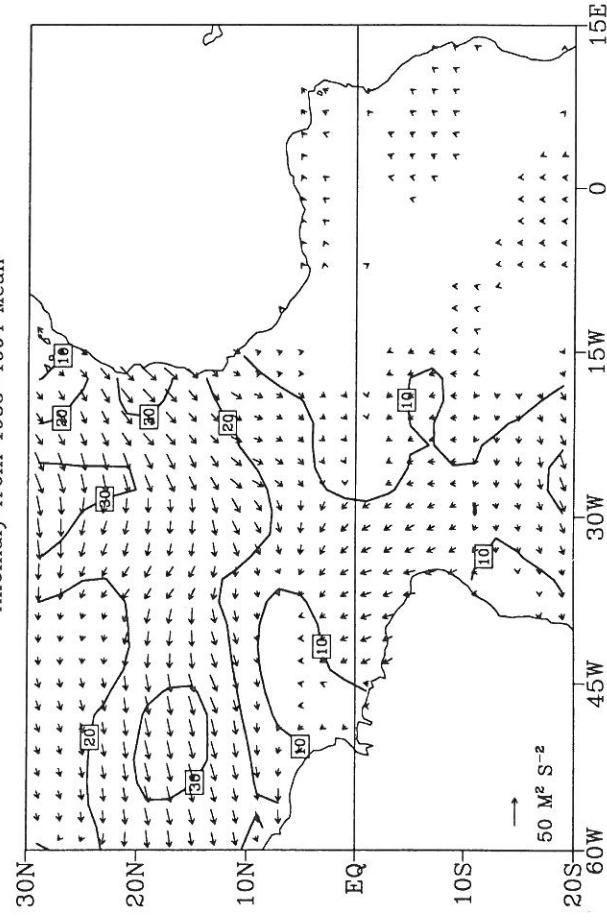
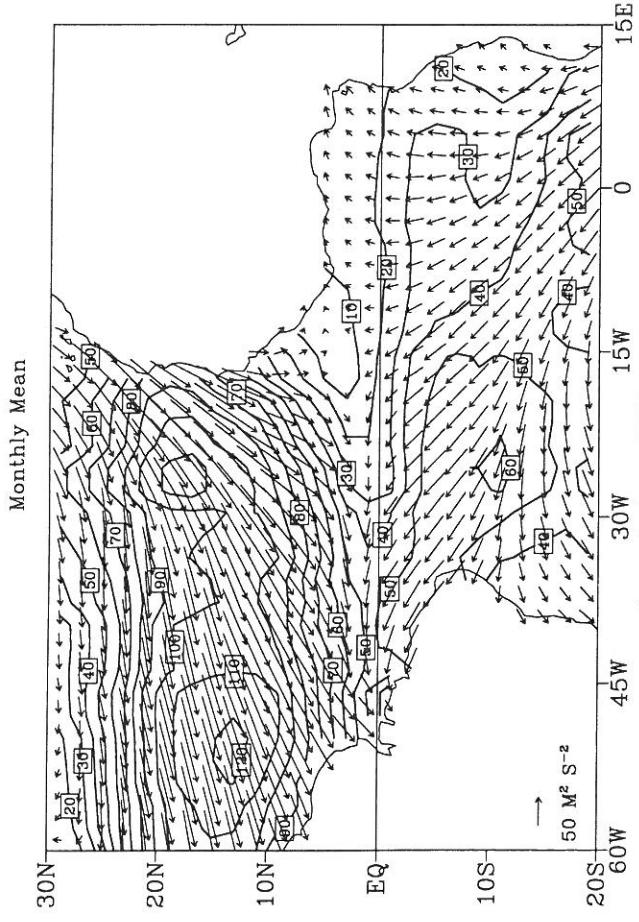


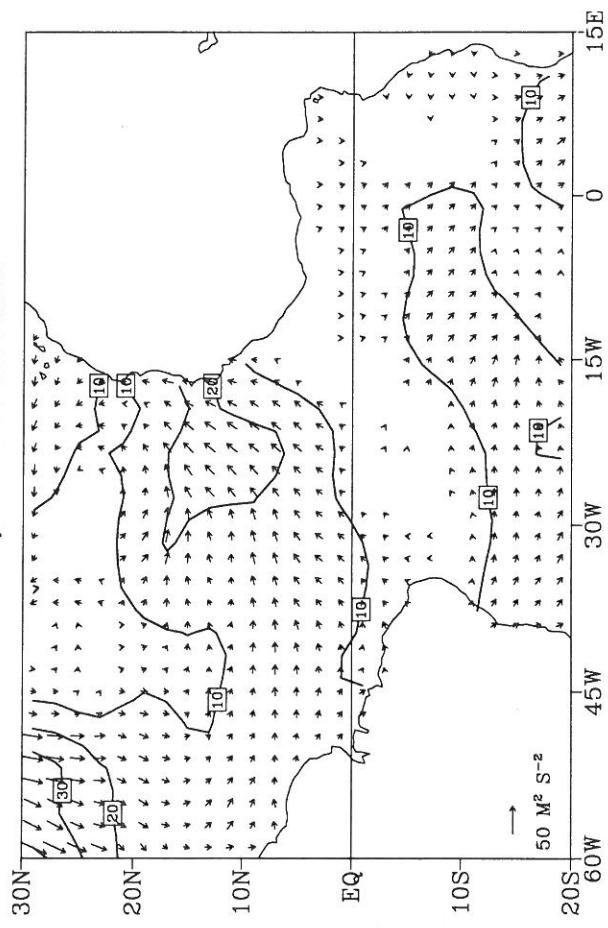
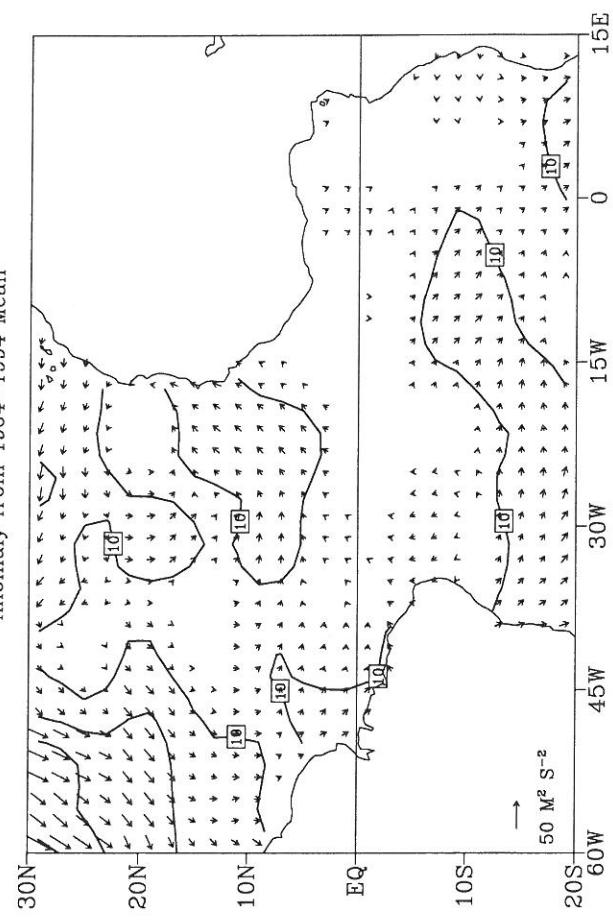
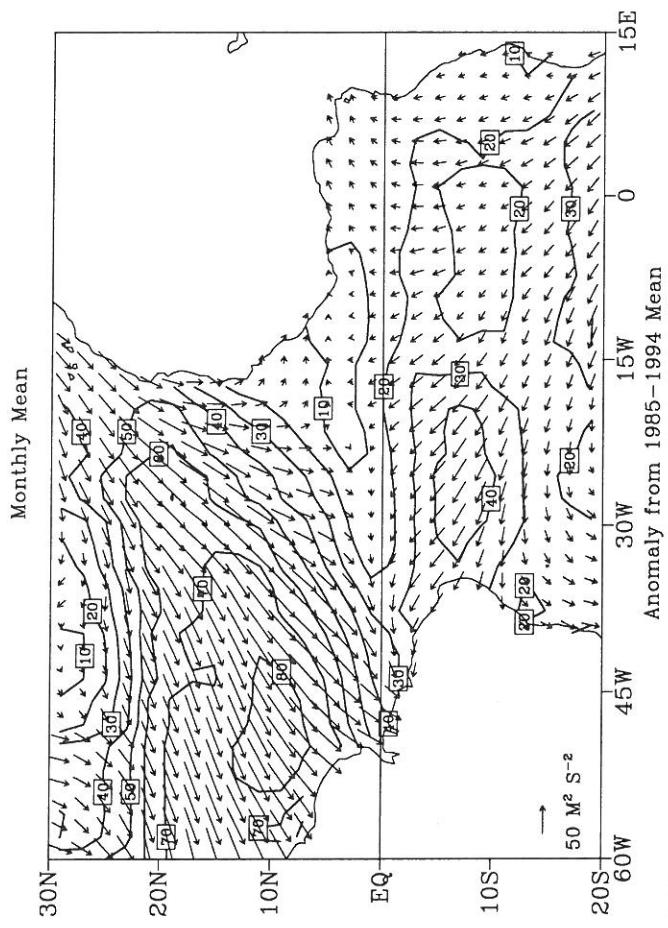
November 1989  
Pseudostress Vectors

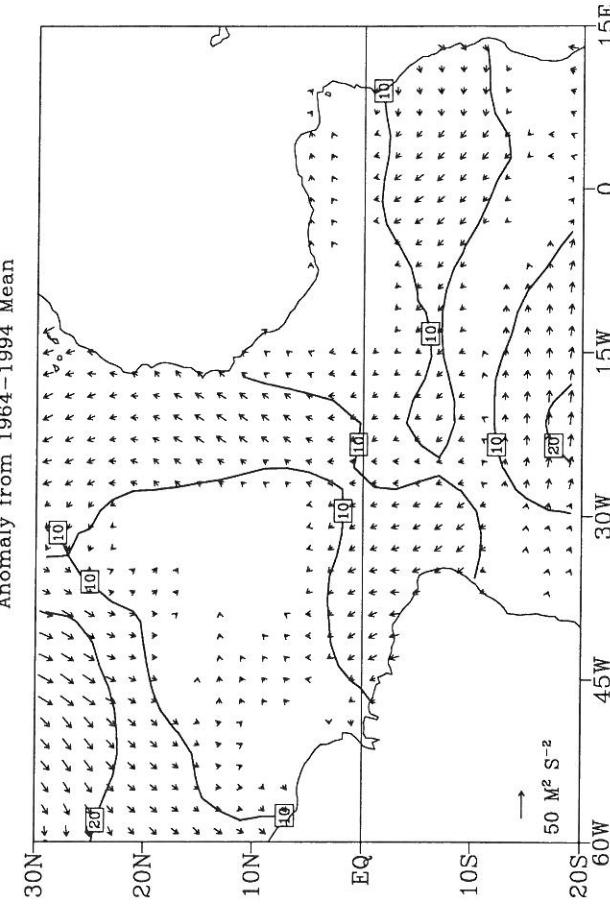
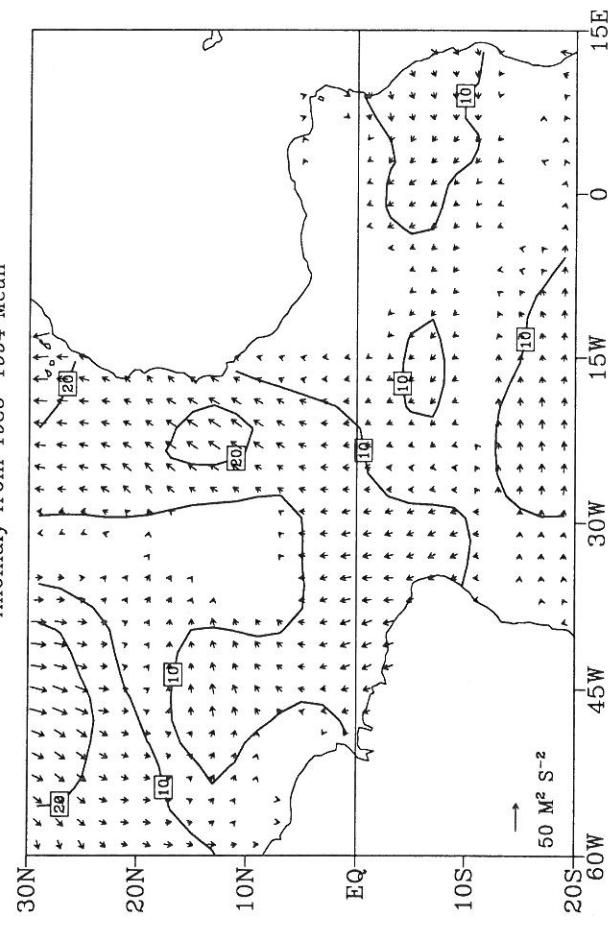
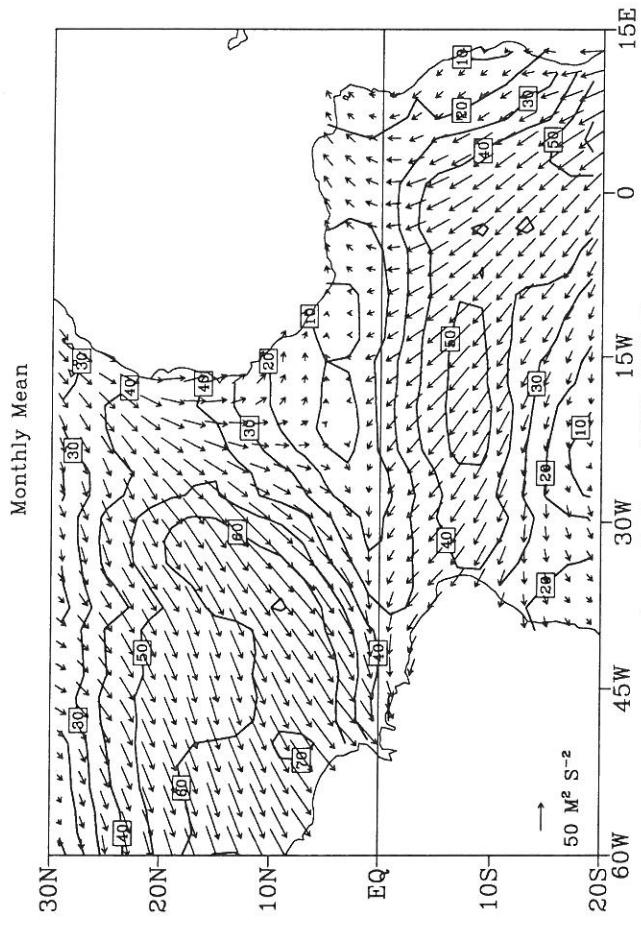


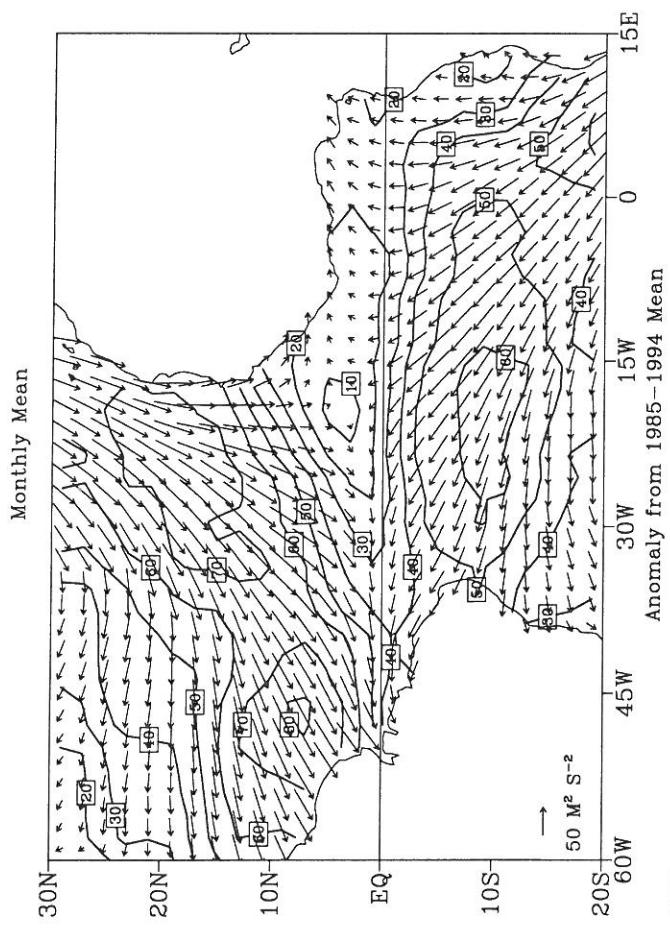
December 1989  
Pseudostress Vectors



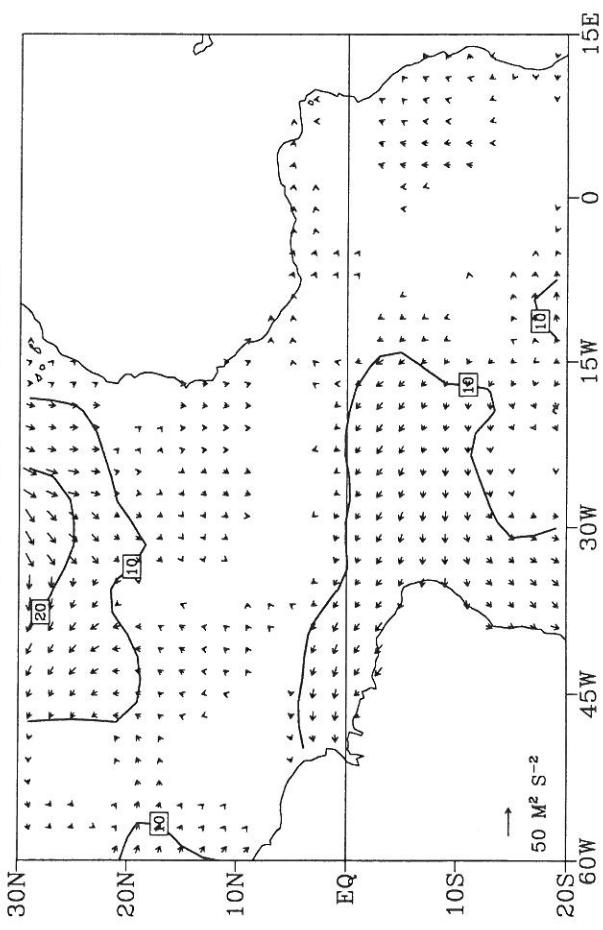
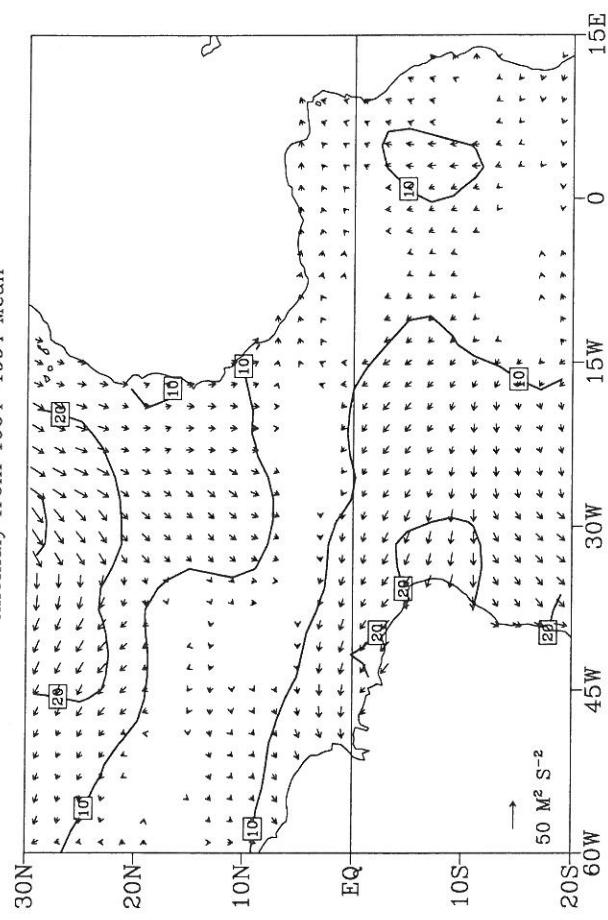




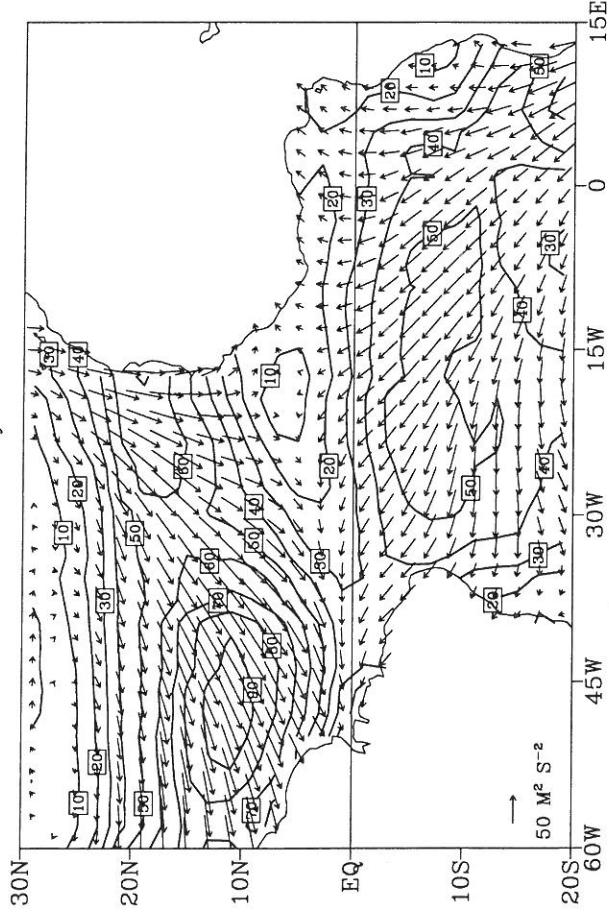




April 1990  
Pseudostress Vectors

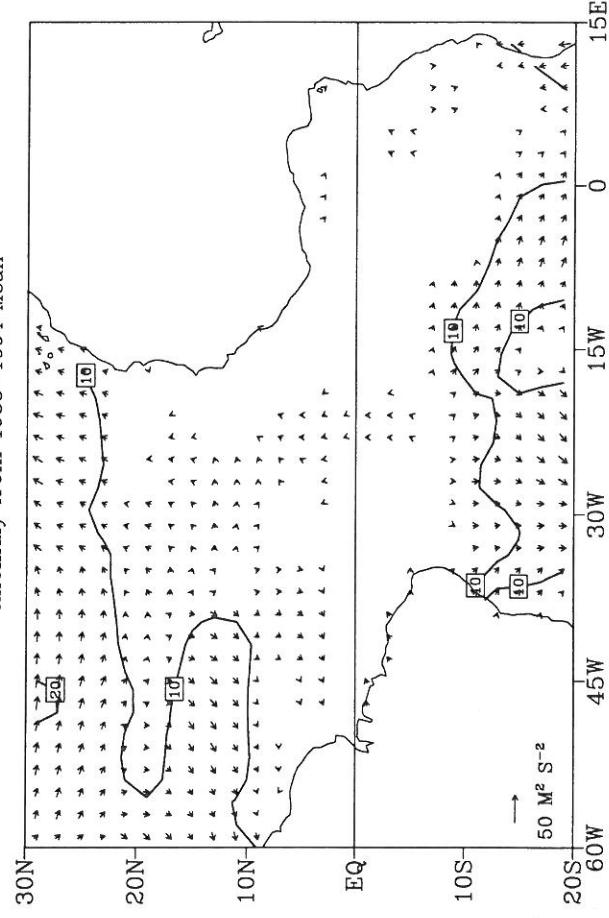


Monthly Mean

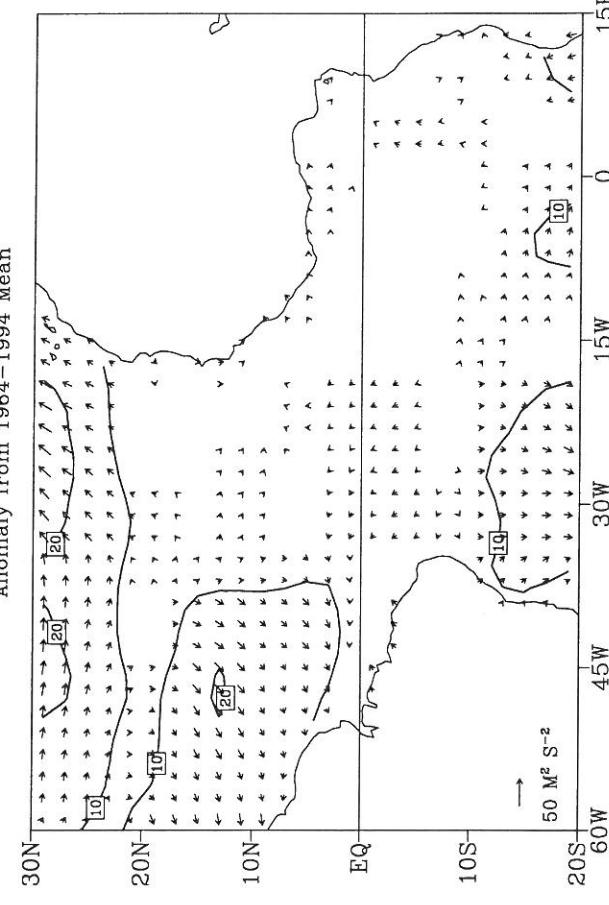


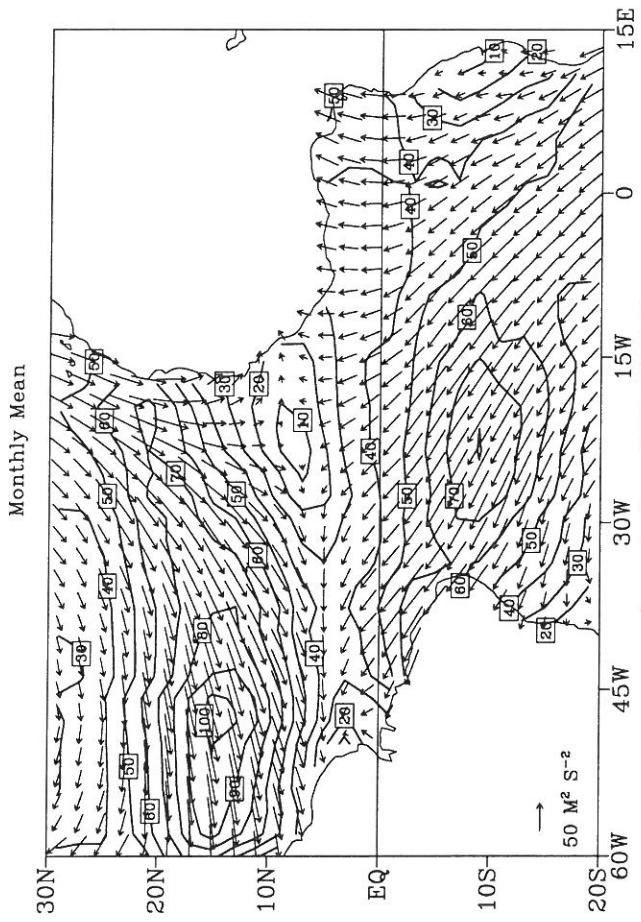
May 1990  
Pseudostress Vectors

Anomaly from 1985–1994 Mean

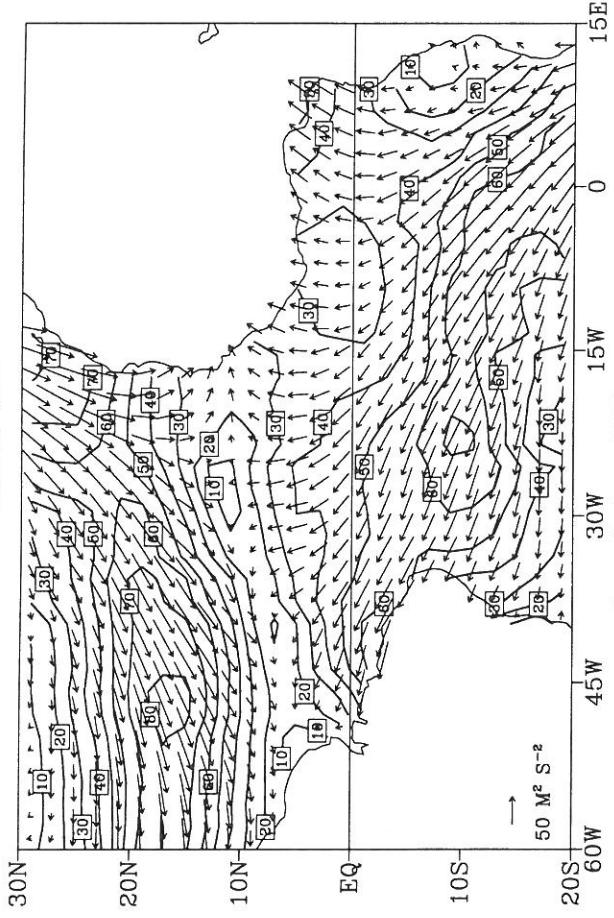


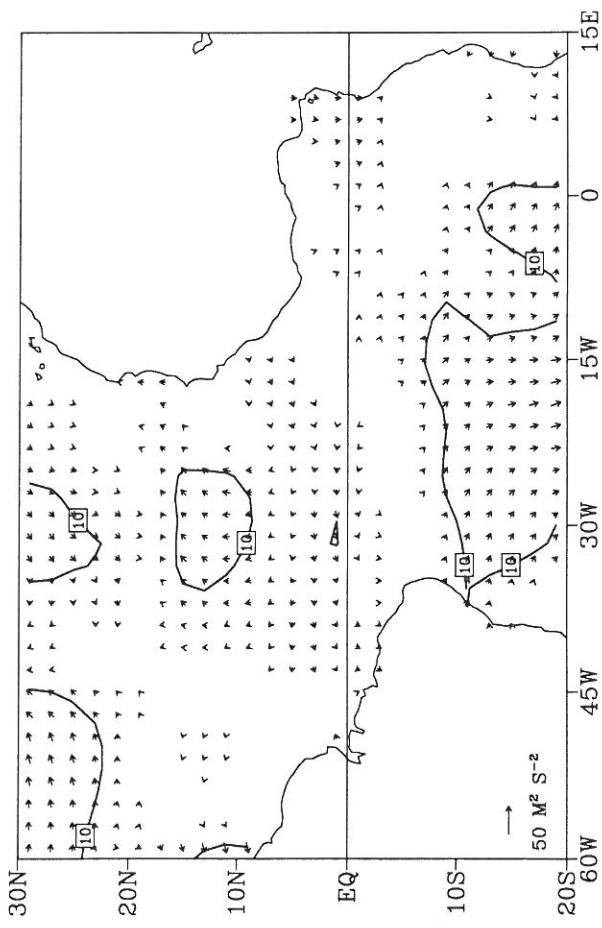
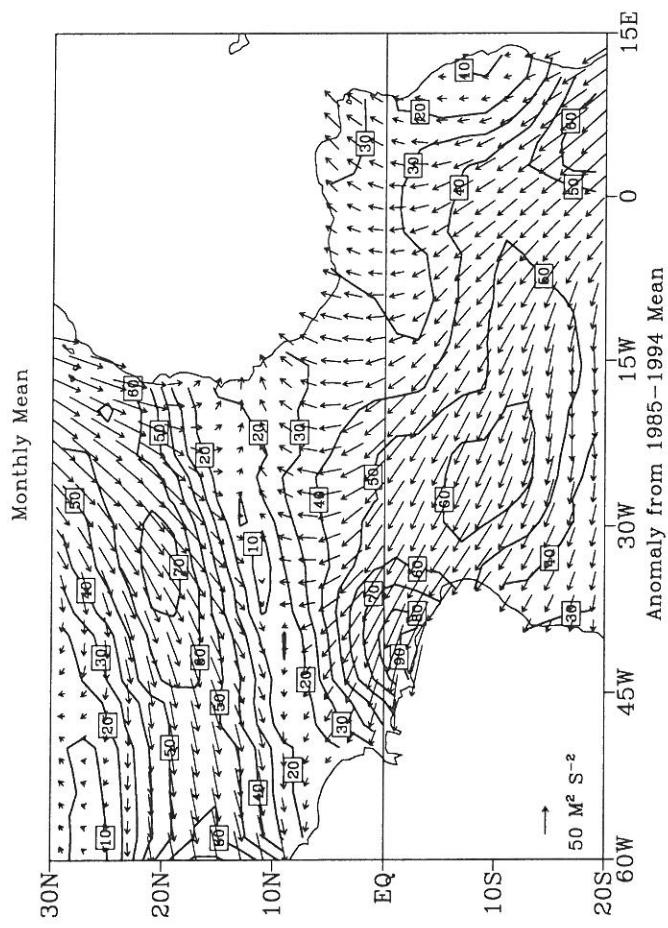
Anomaly from 1964–1994 Mean





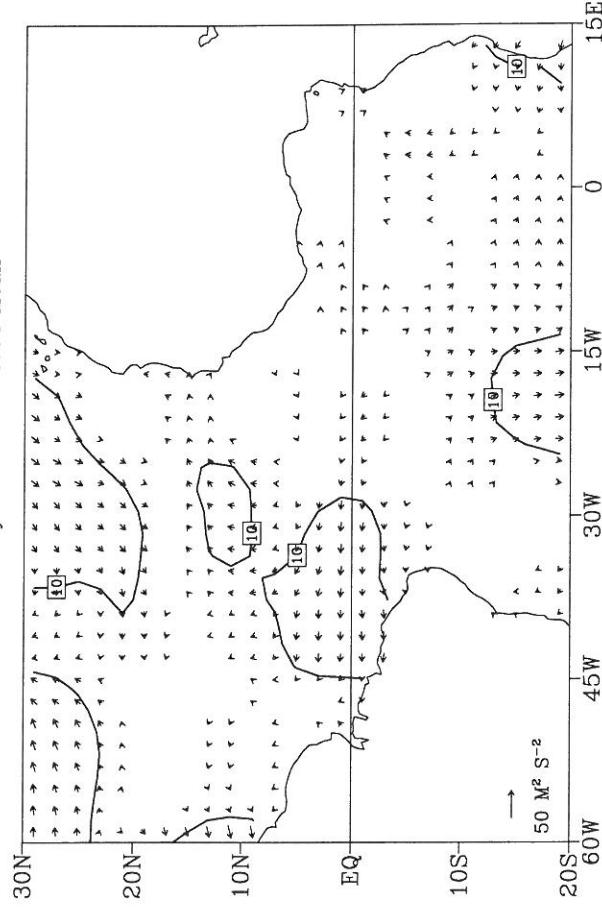
Monthly Mean

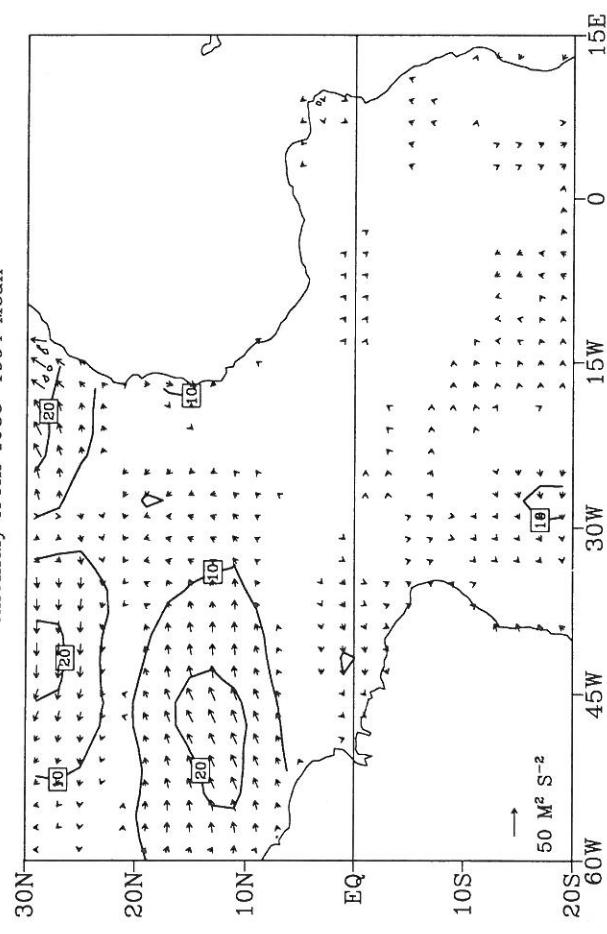
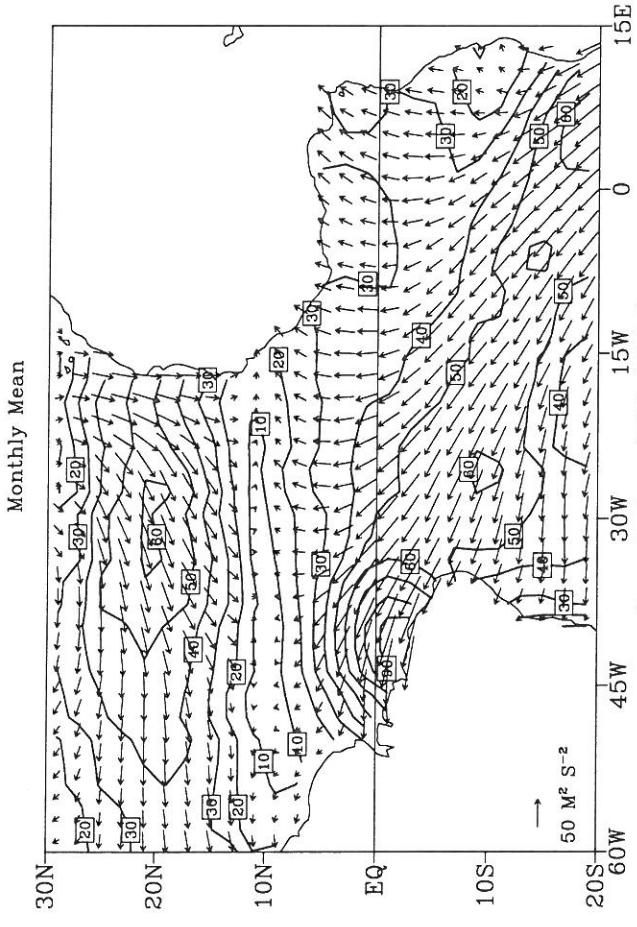




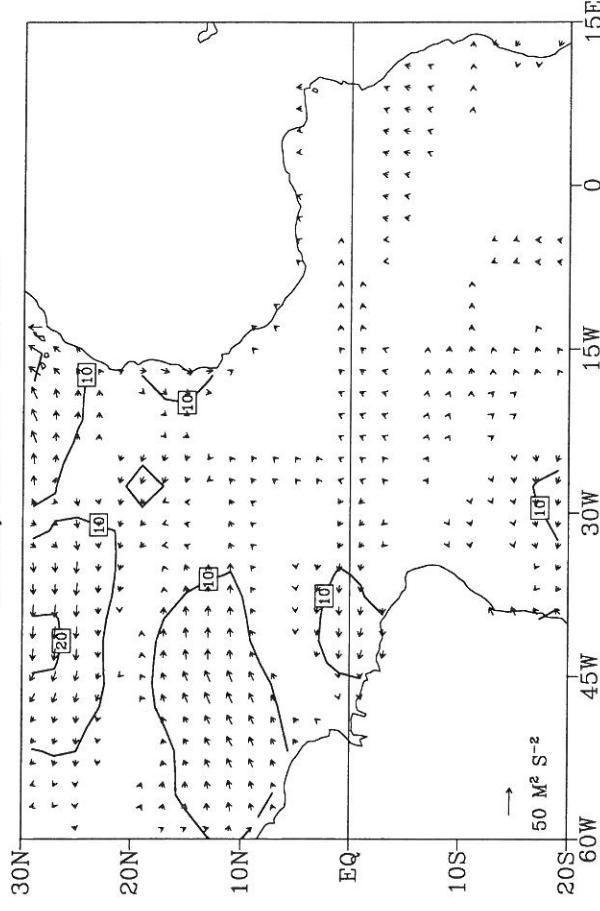
August 1990  
Pseudostress Vectors

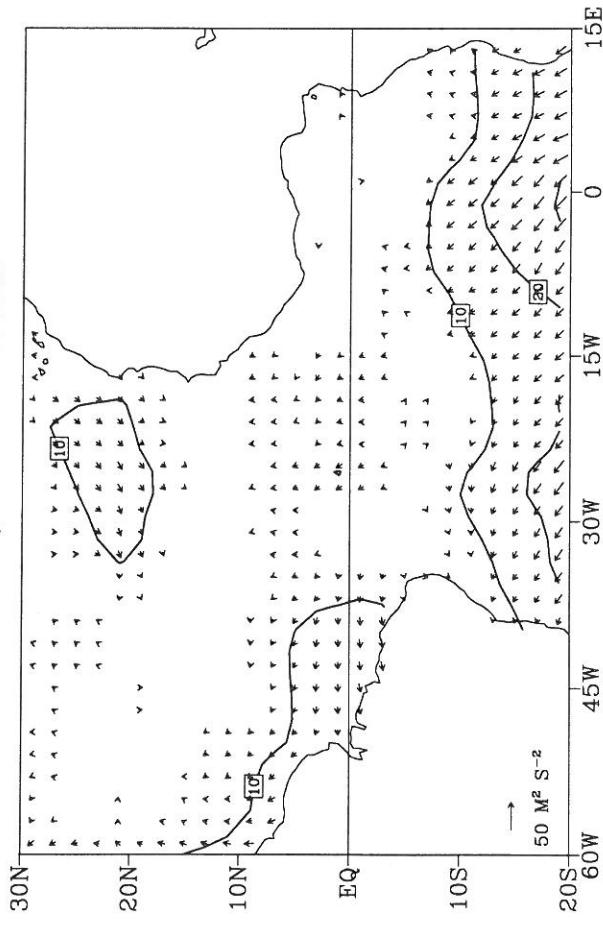
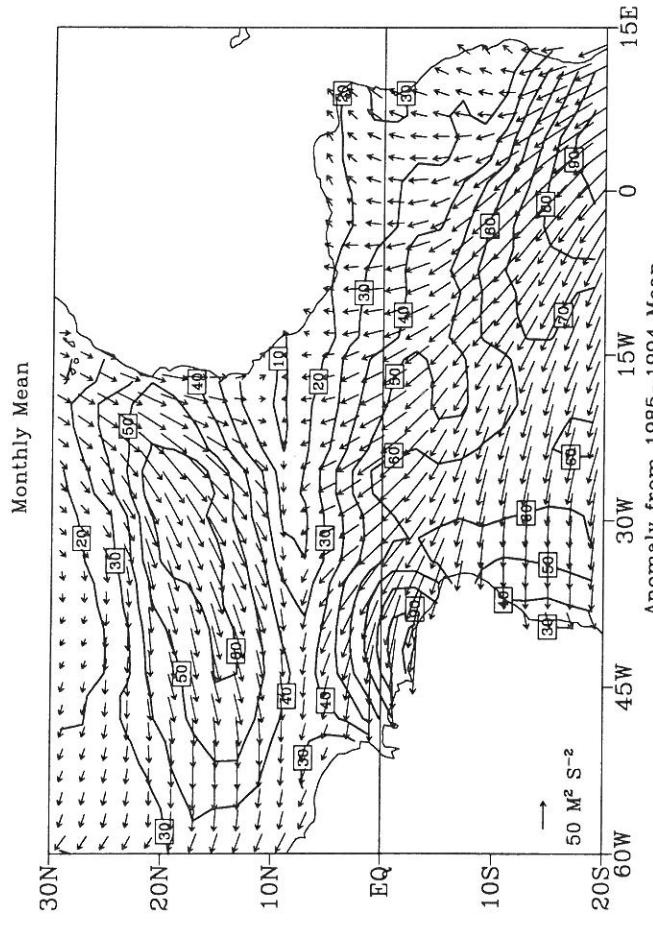
Anomaly from 1964–1994 Mean



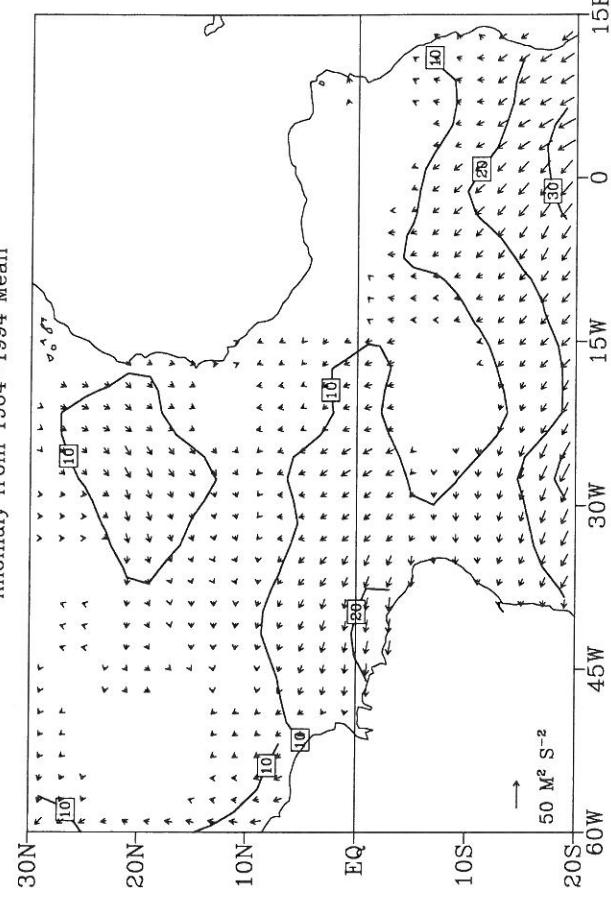


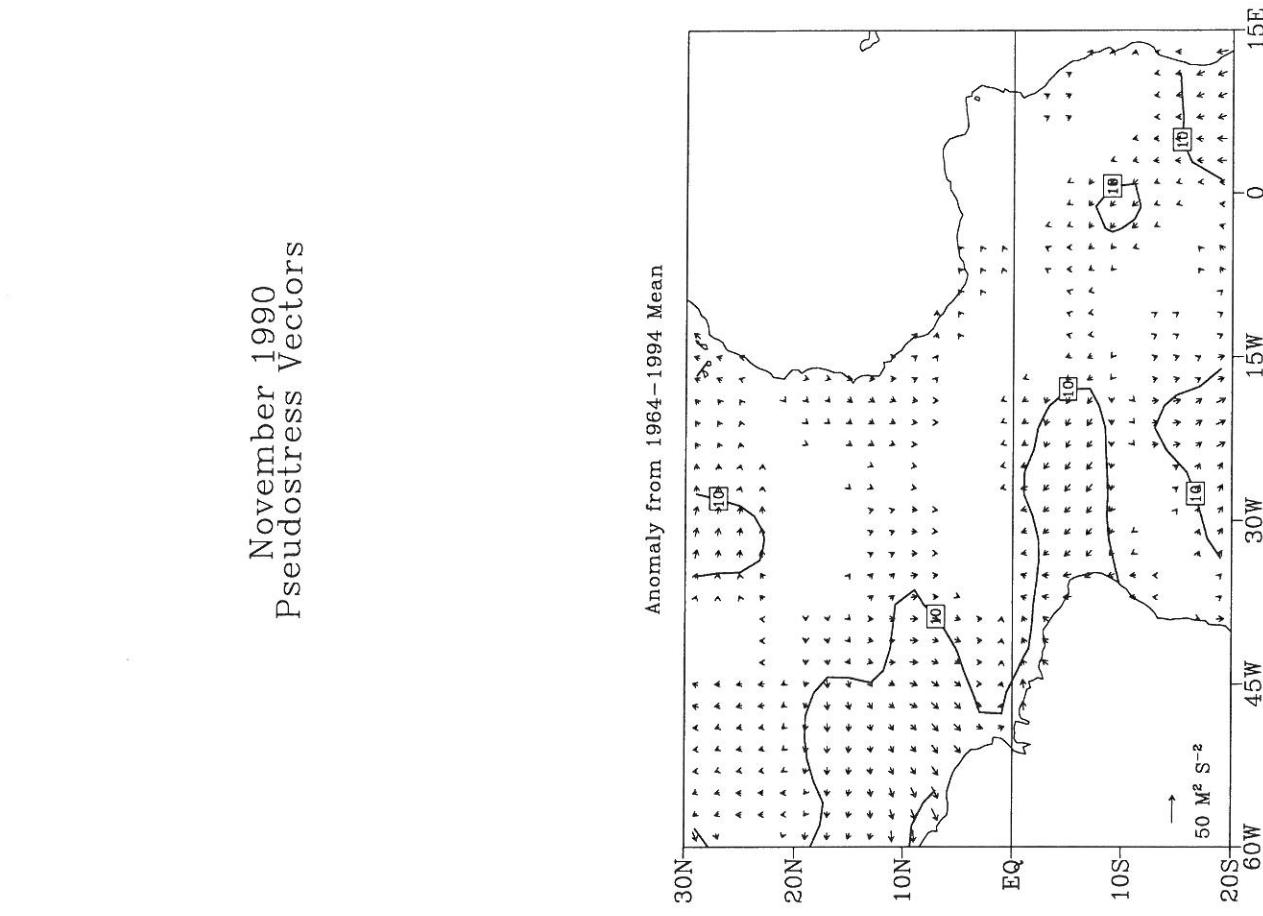
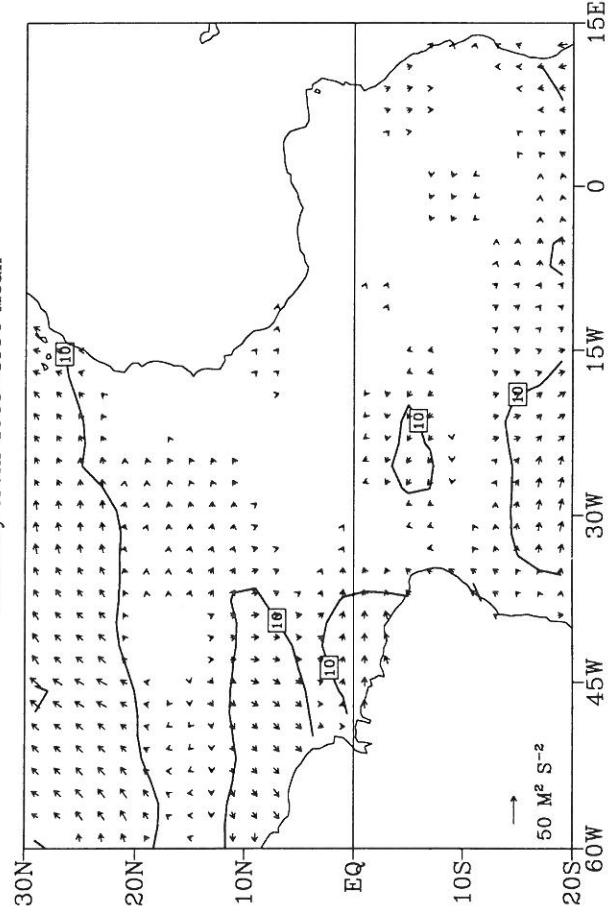
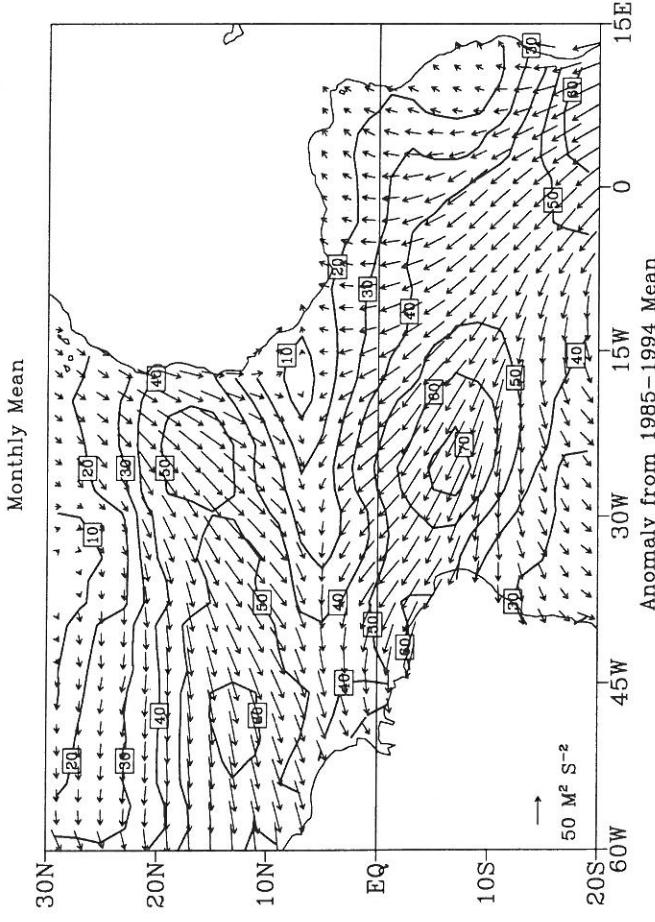
Anomaly from 1964–1994 Mean

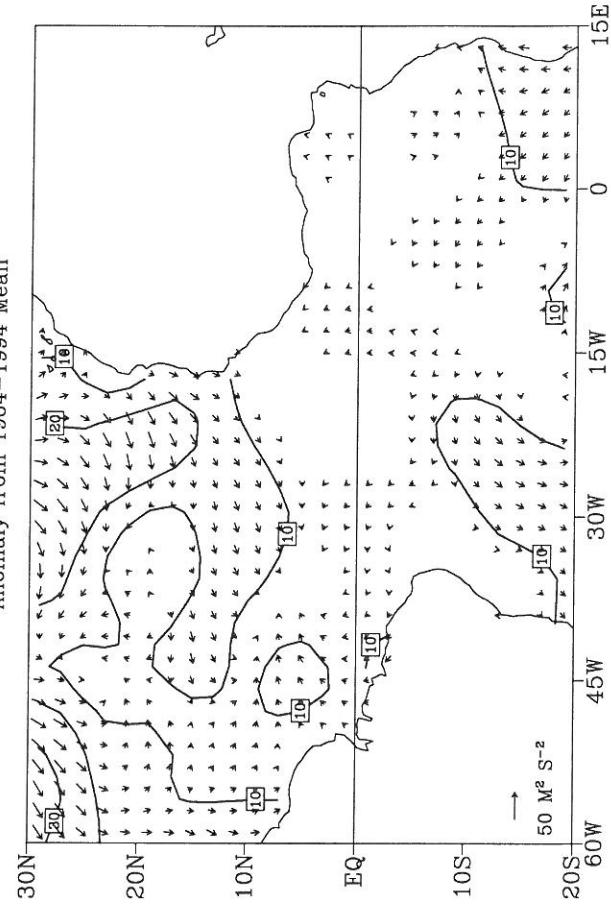
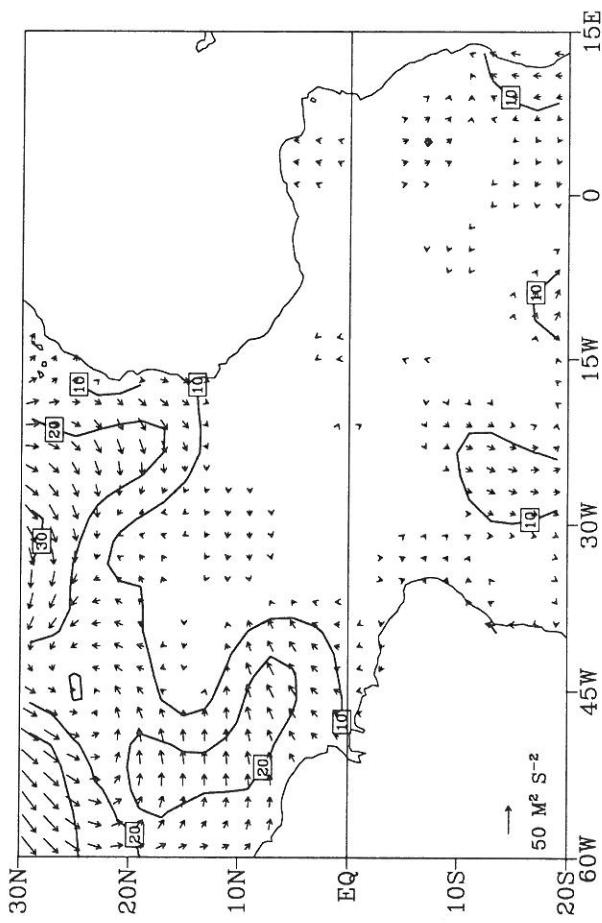
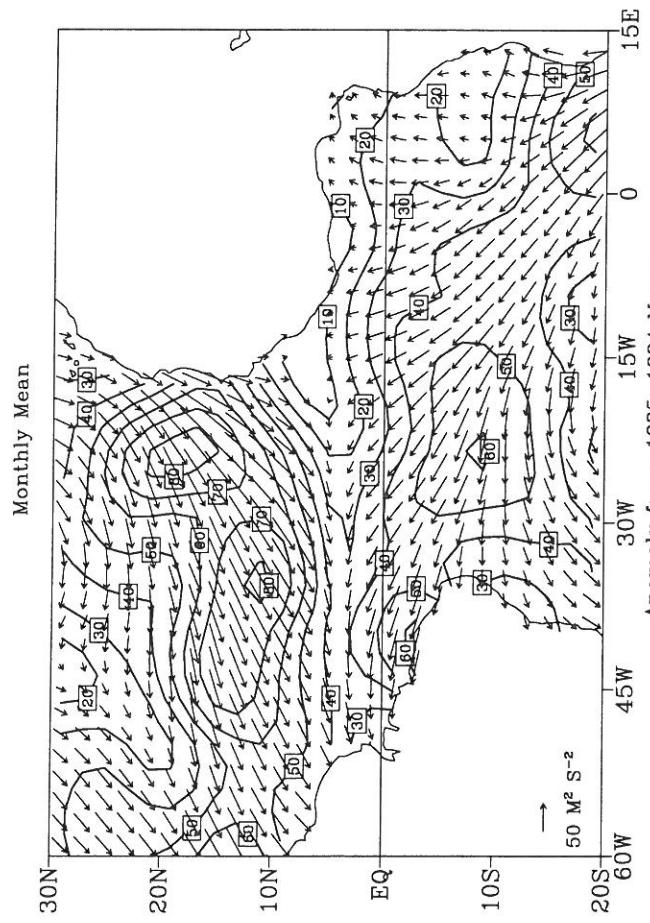


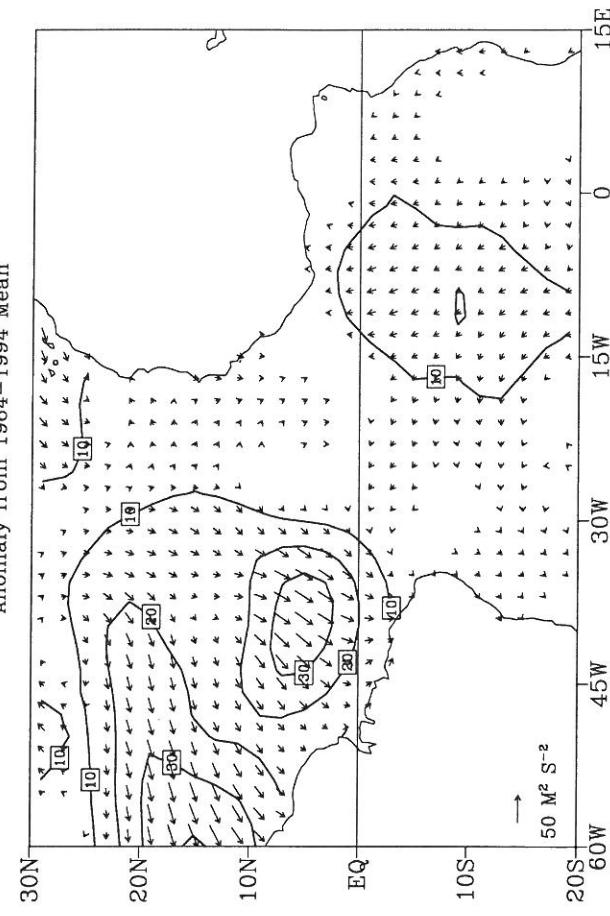
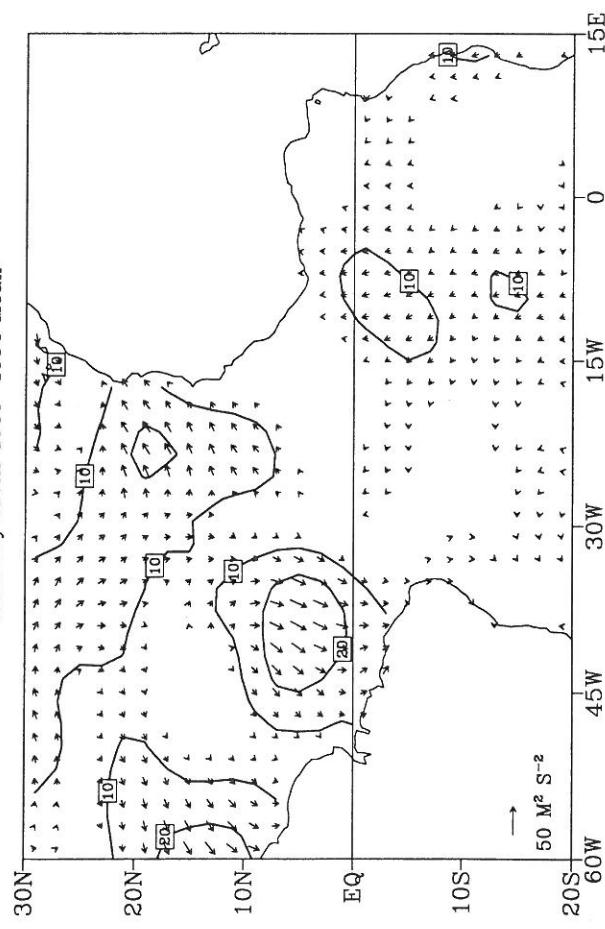
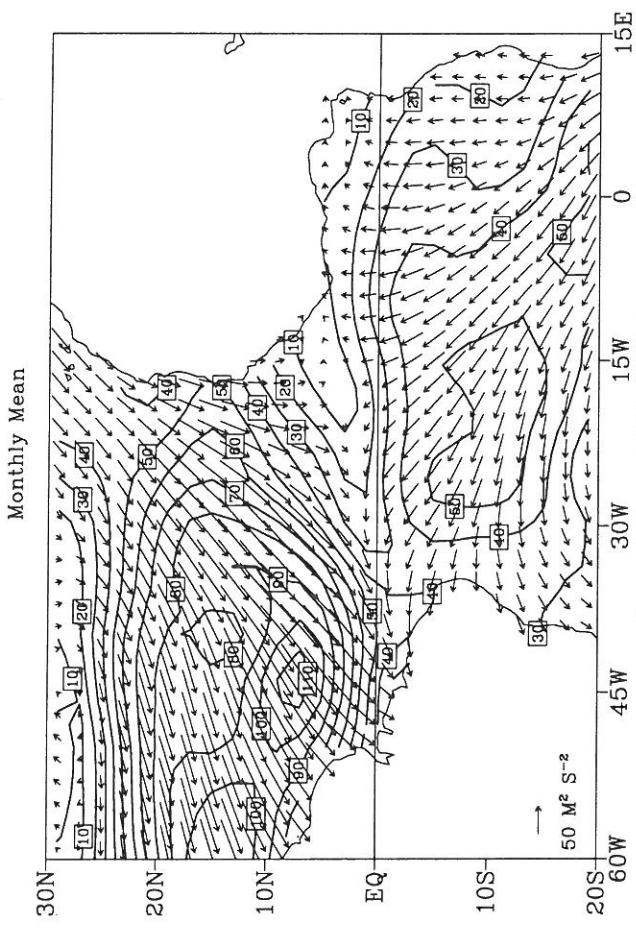


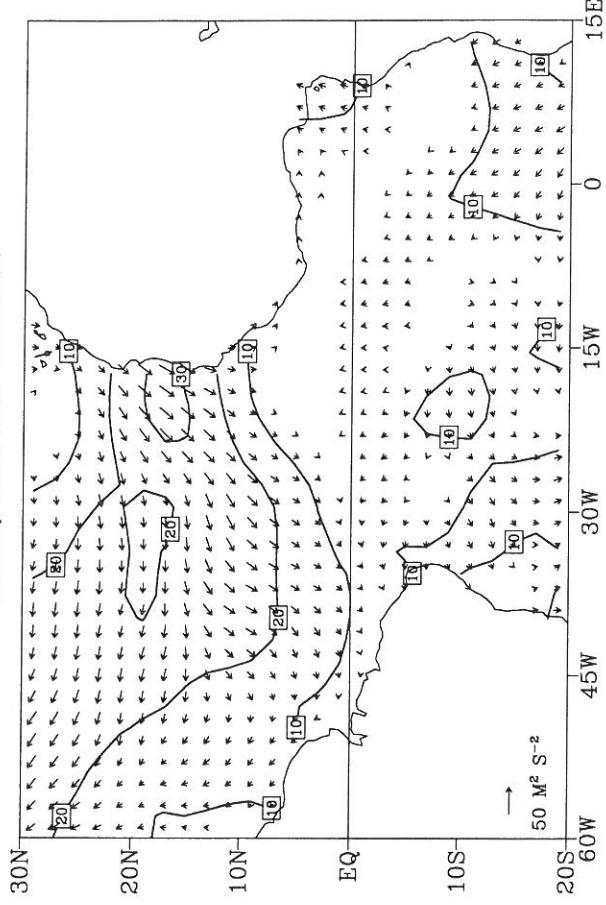
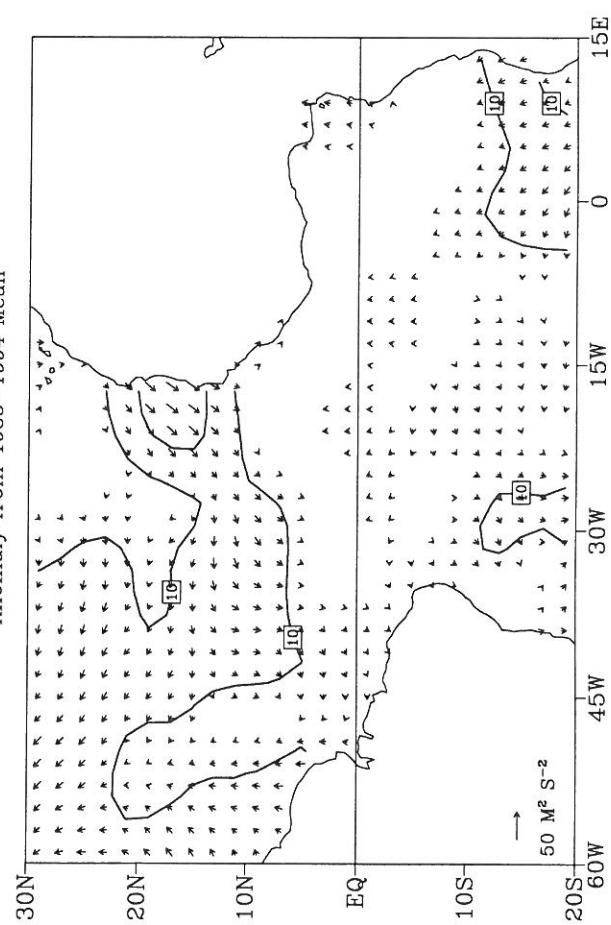
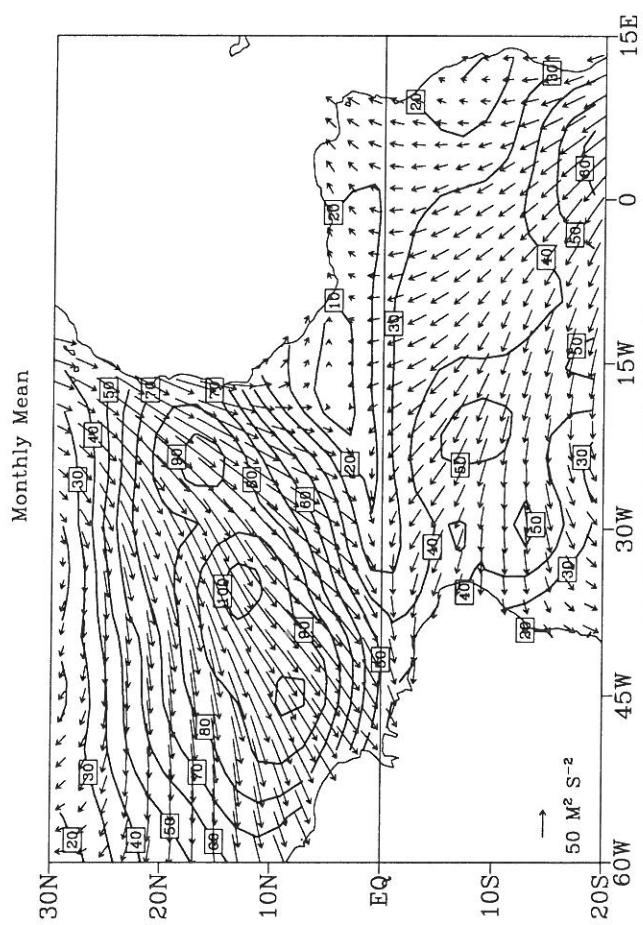
Anomaly from 1964–1994 Mean



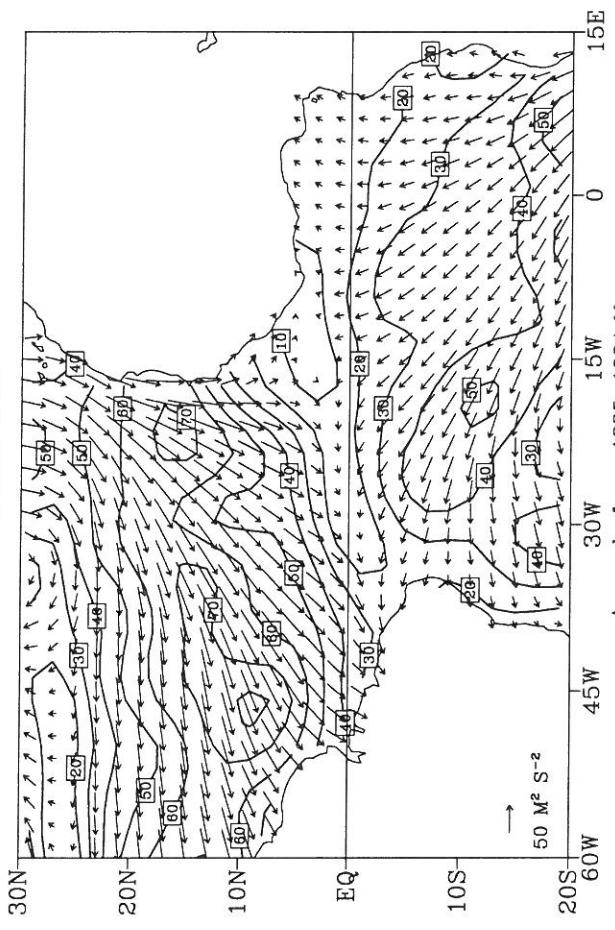






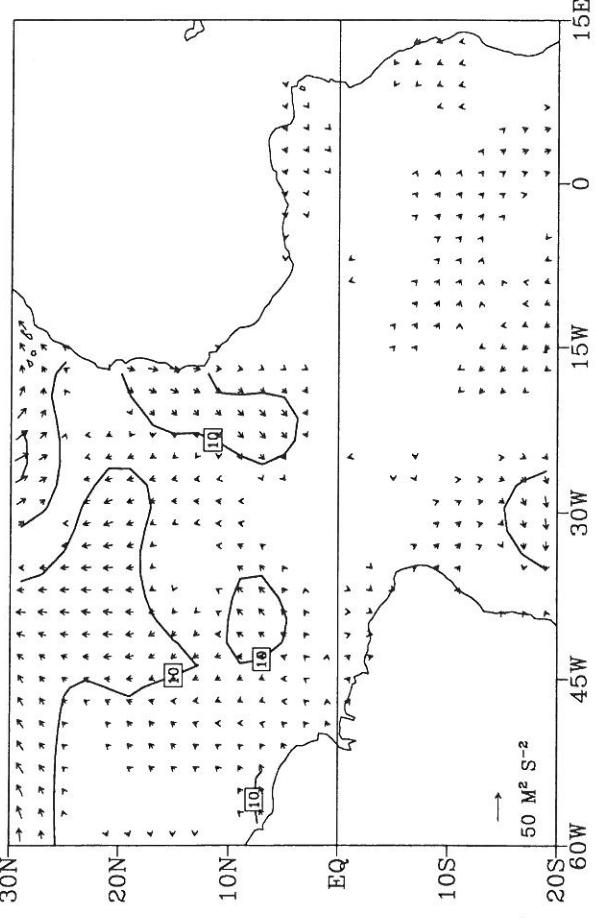


Monthly Mean

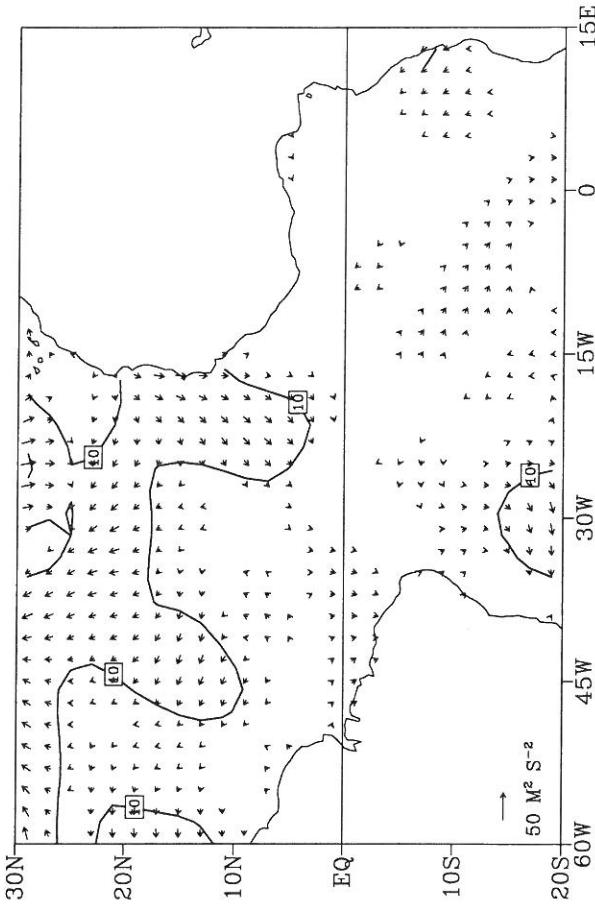


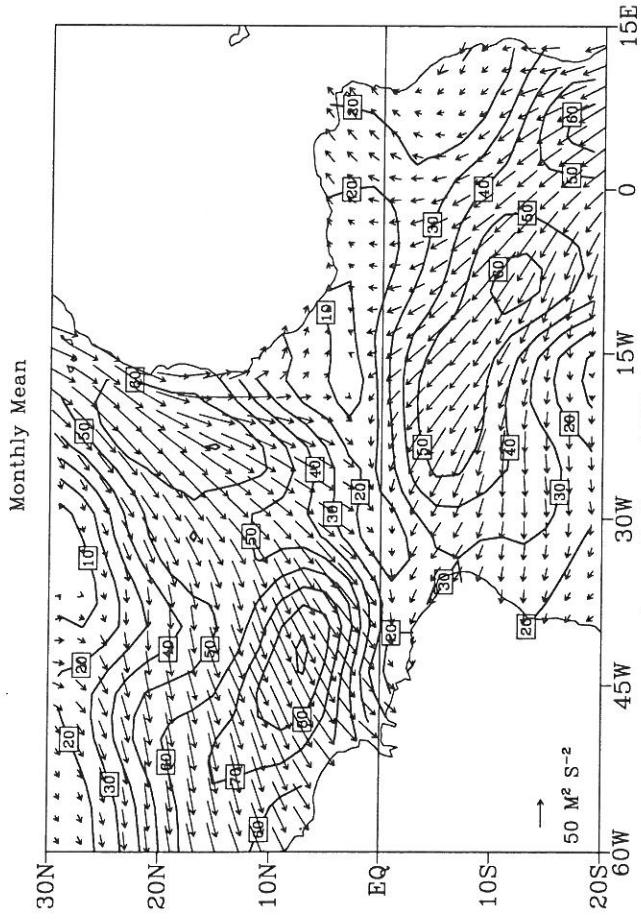
March 1991  
Pseudostress Vectors

Anomaly from 1985–1994 Mean

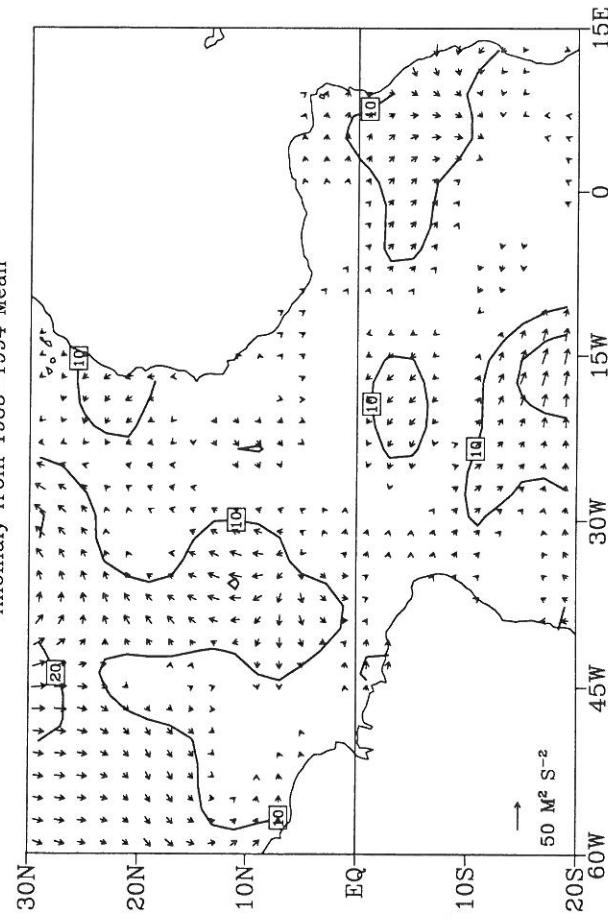


Anomaly from 1964–1994 Mean

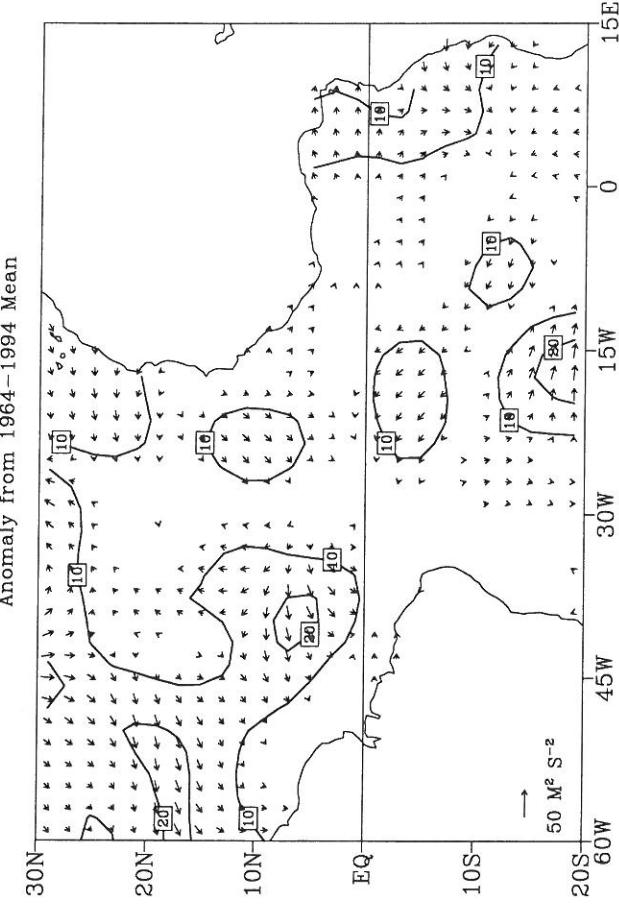
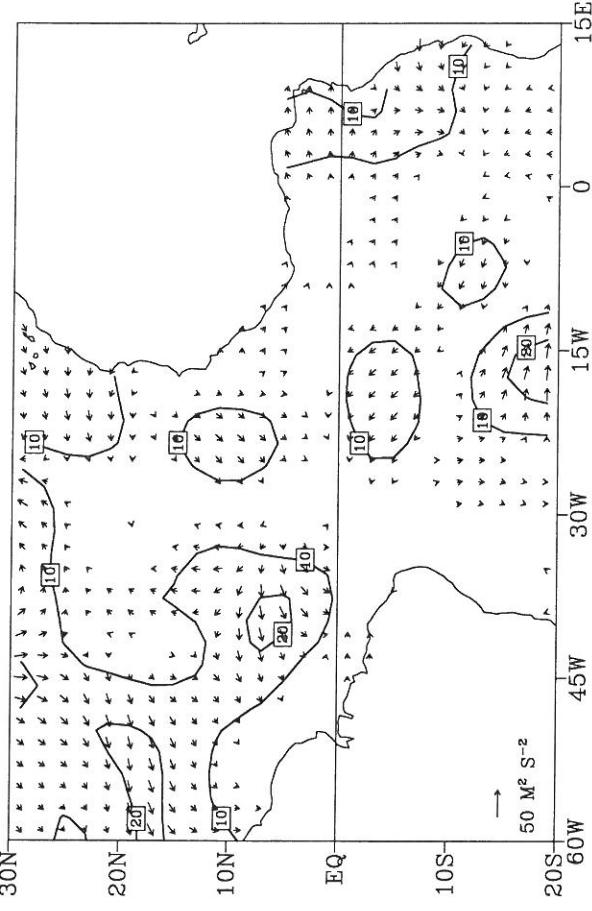


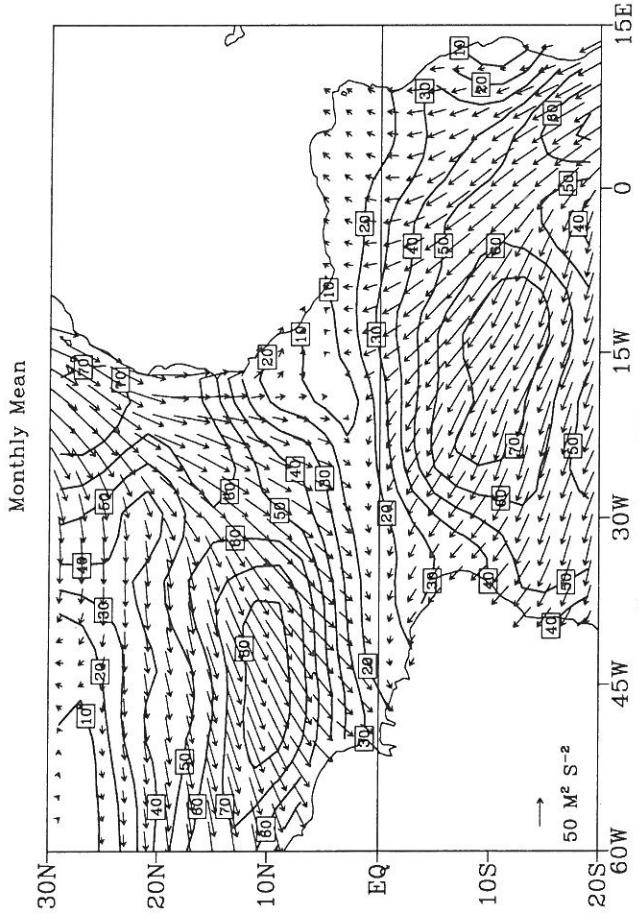


April 1991  
Pseudostress Vectors

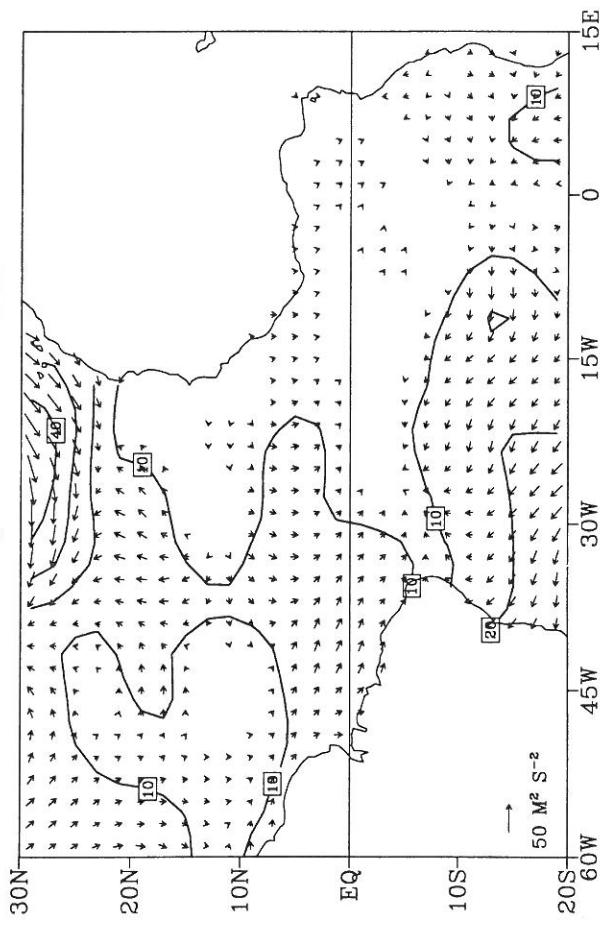


Anomaly from 1964–1994 Mean

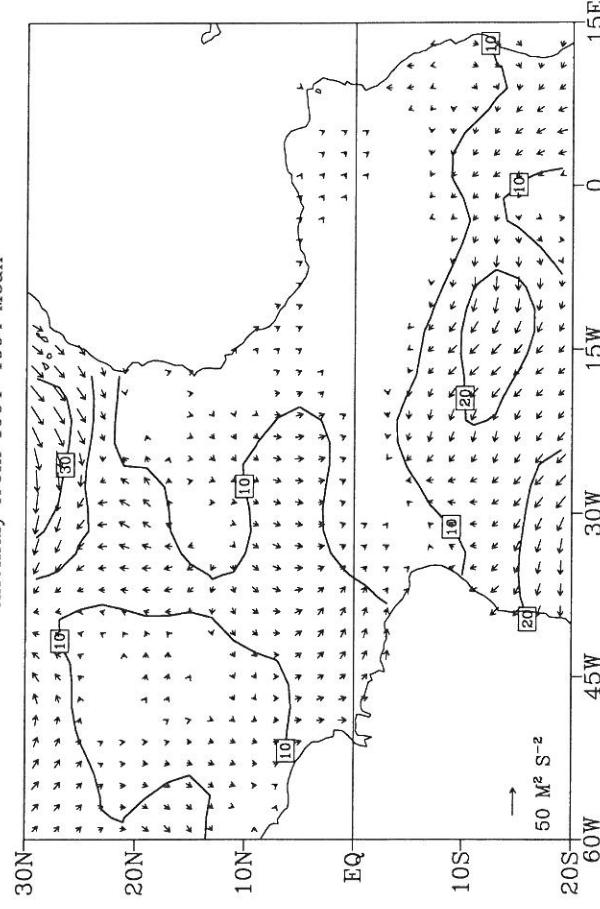




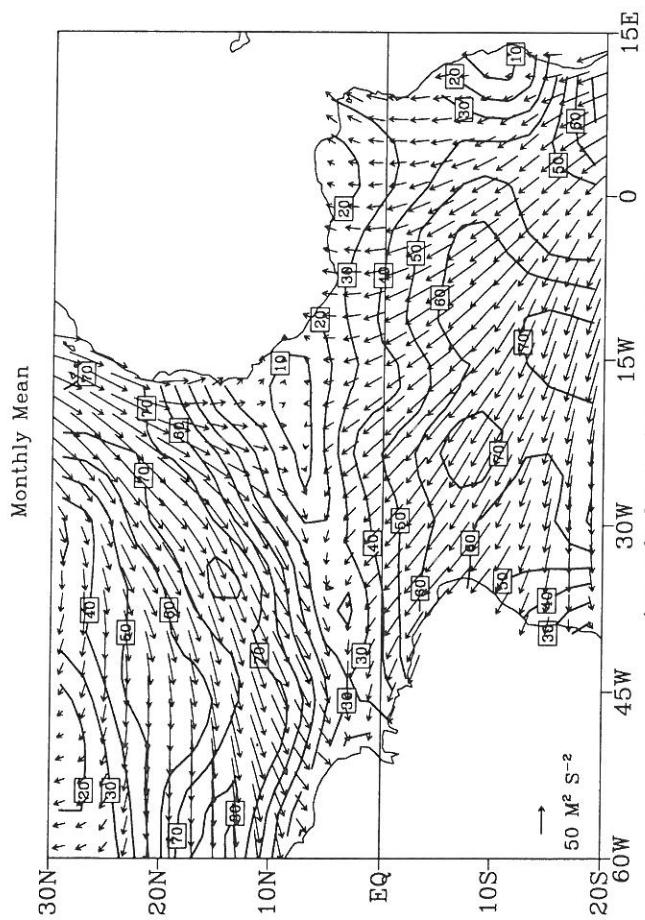
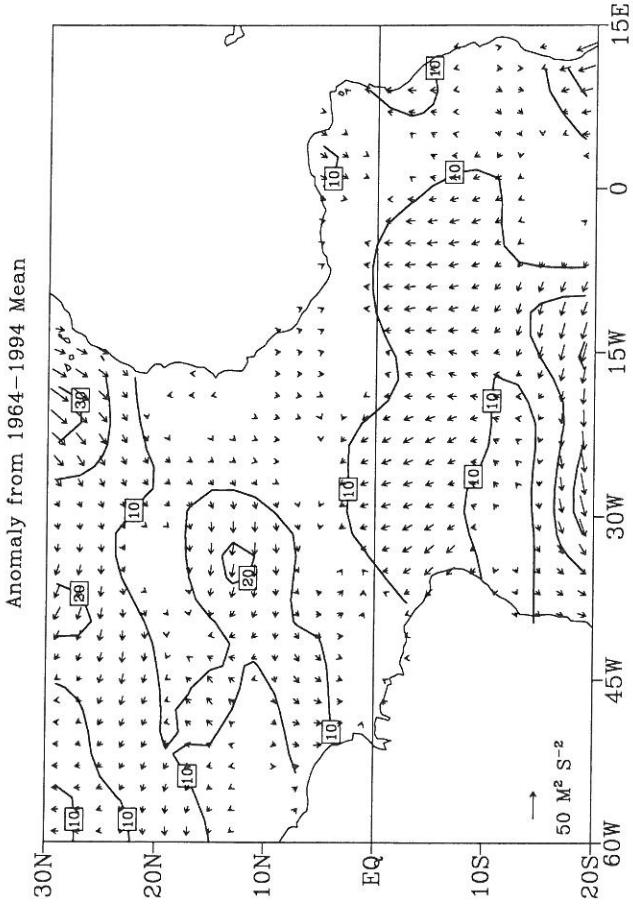
Anomaly from 1985–1994 Mean



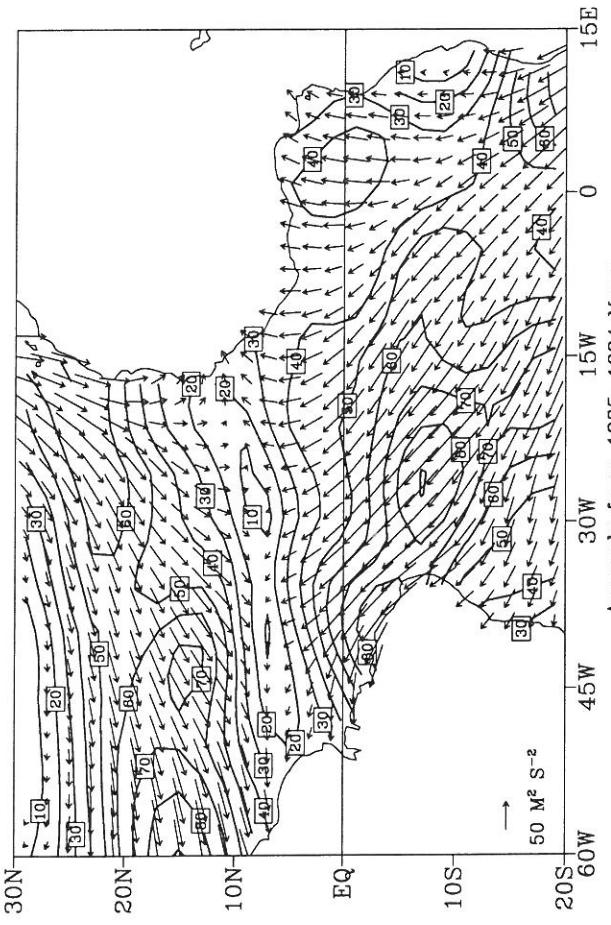
Anomaly from 1964–1994 Mean



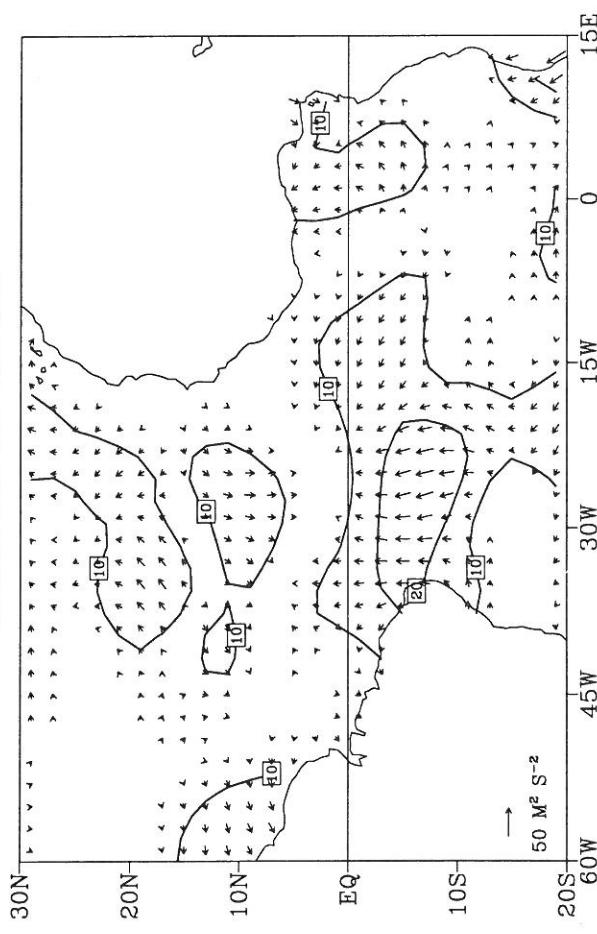
May 1991  
Pseudostress Vectors



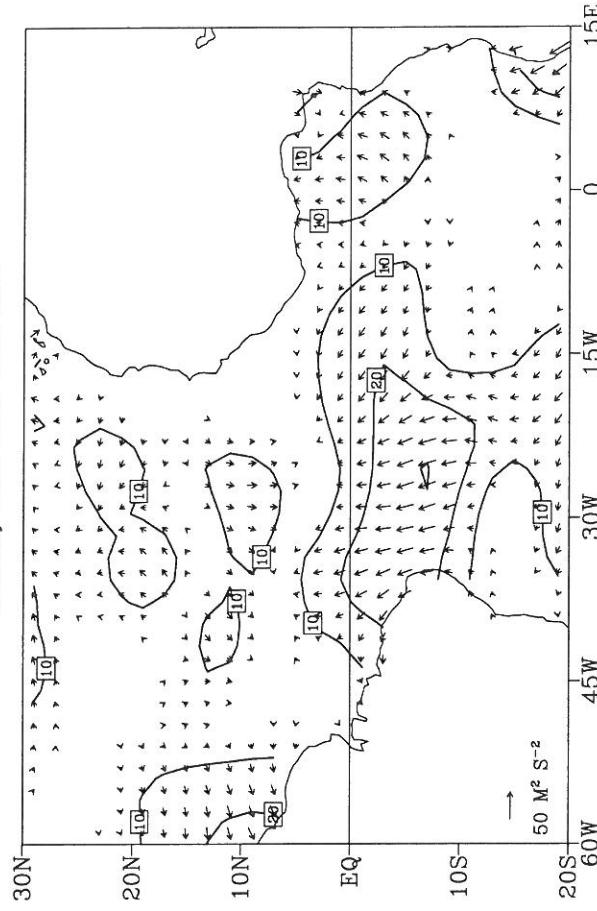
Monthly Mean



Anomaly from 1985–1994 Mean

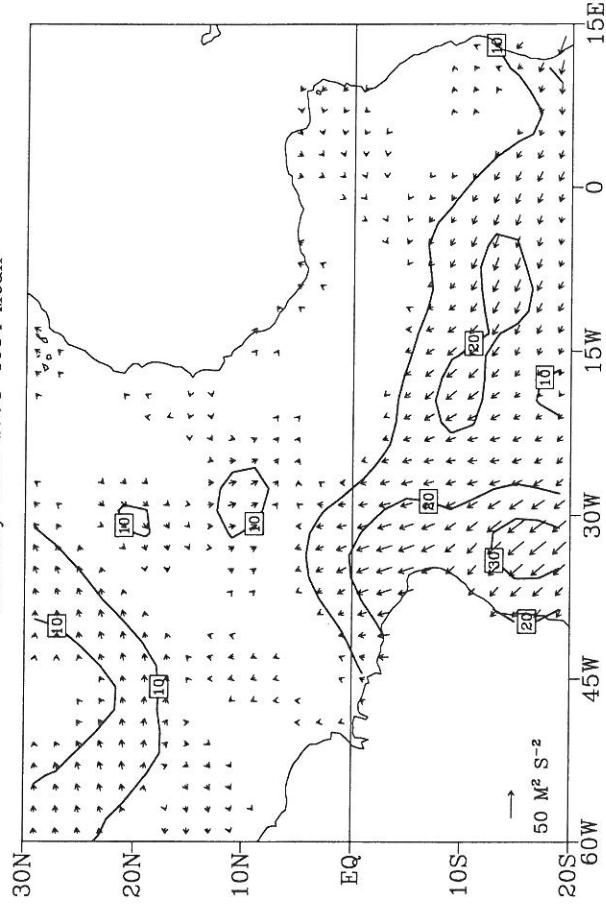
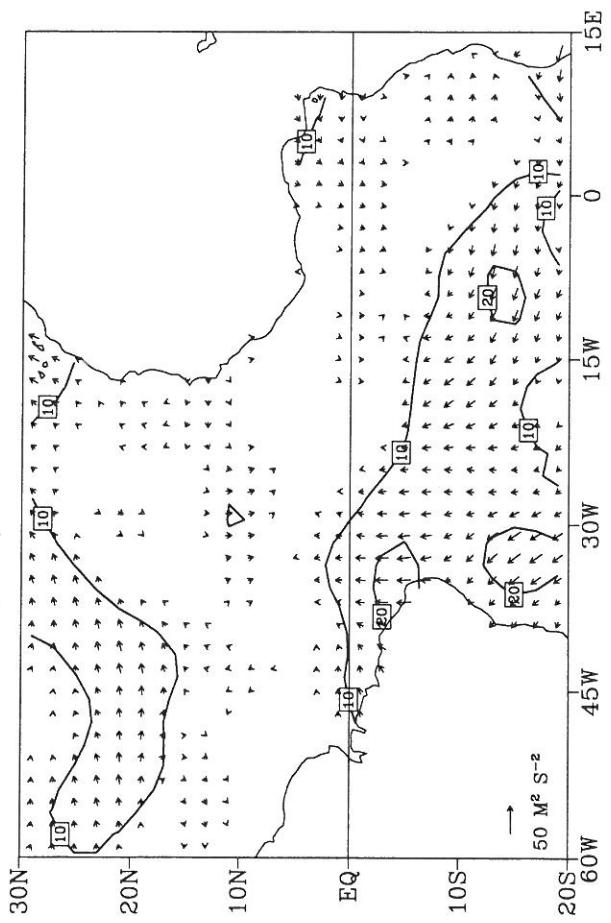
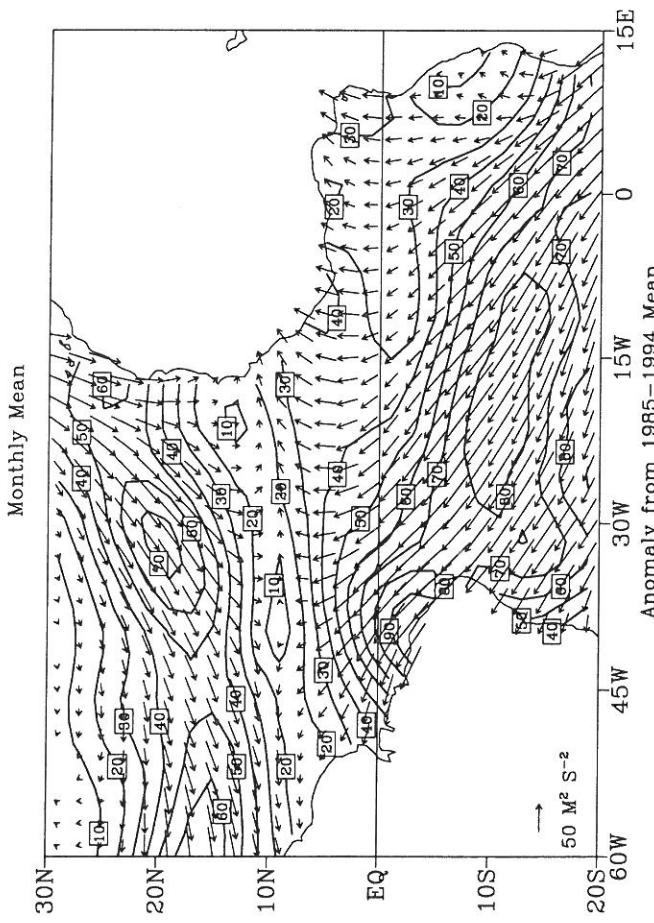


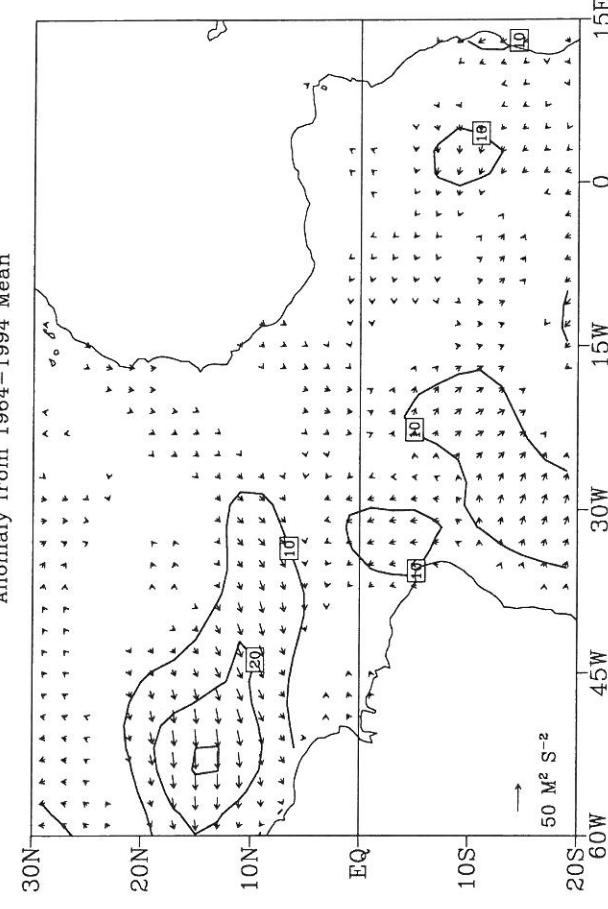
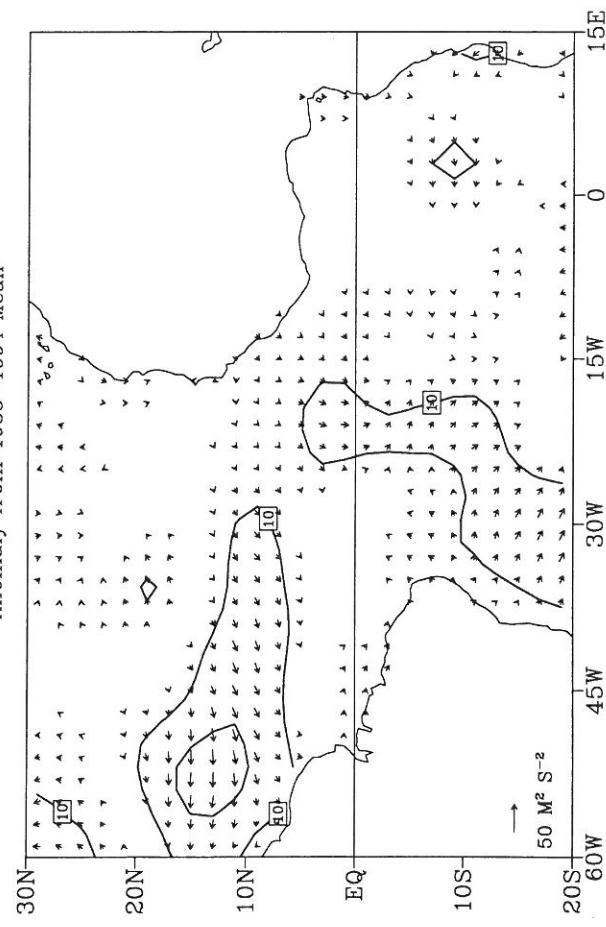
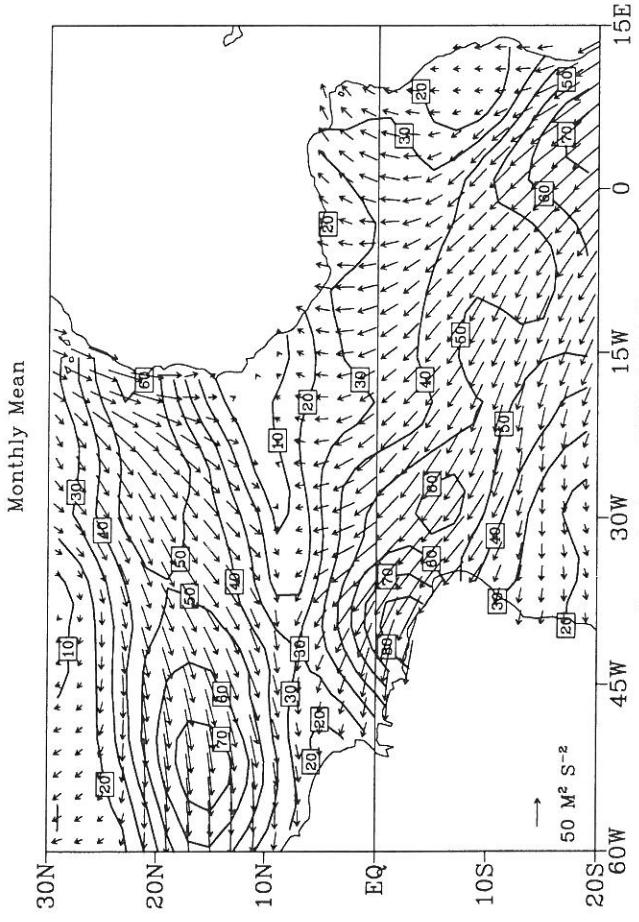
Anomaly from 1964–1994 Mean

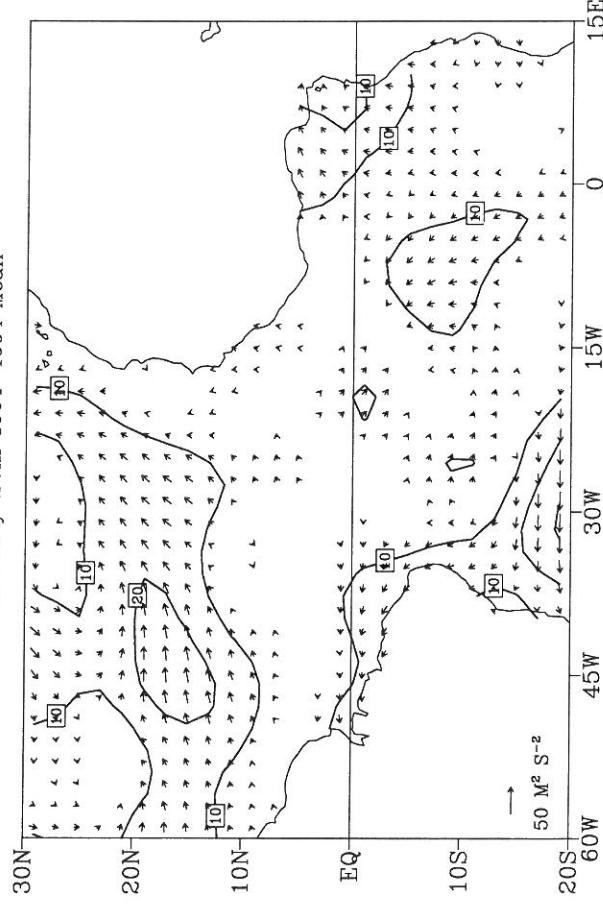
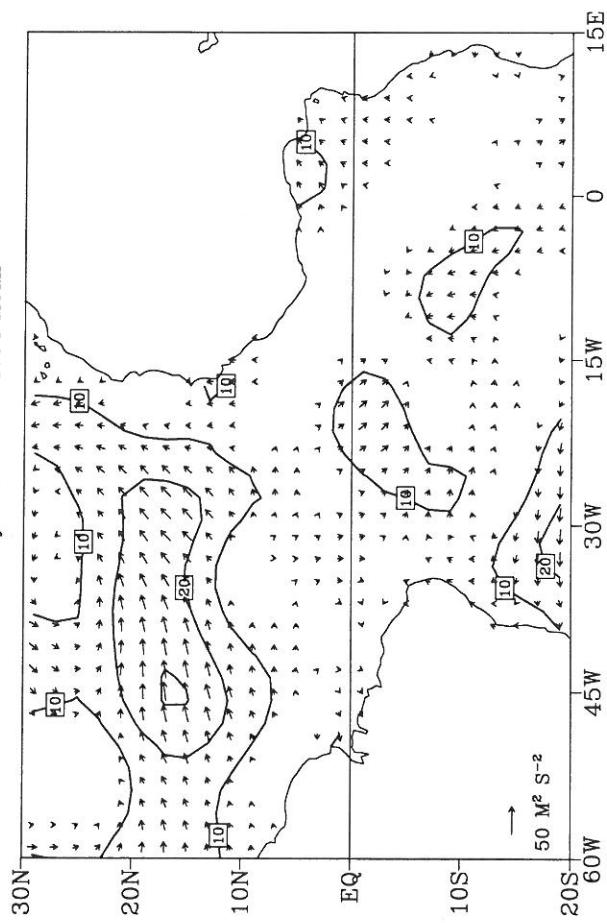
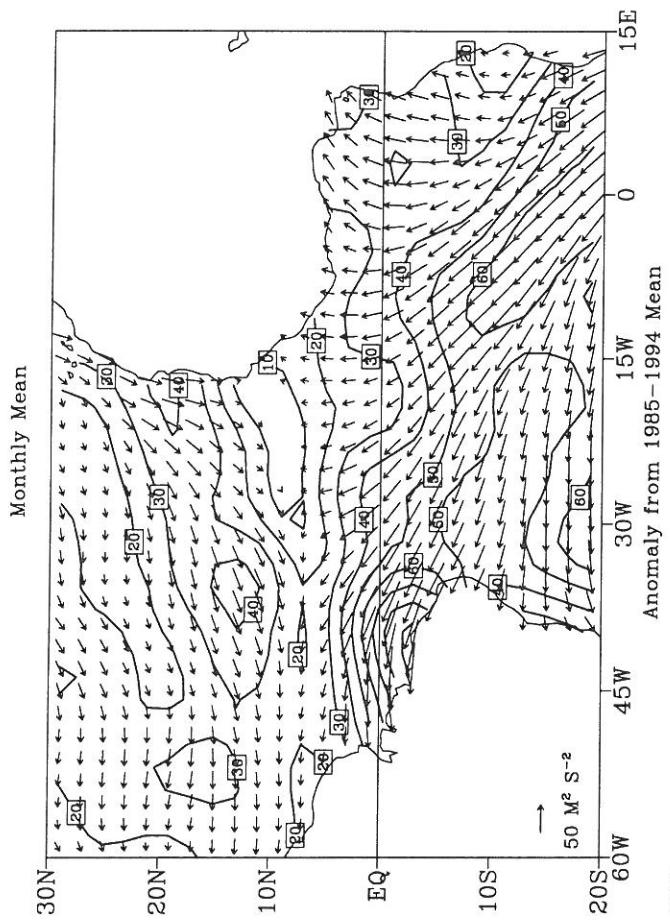


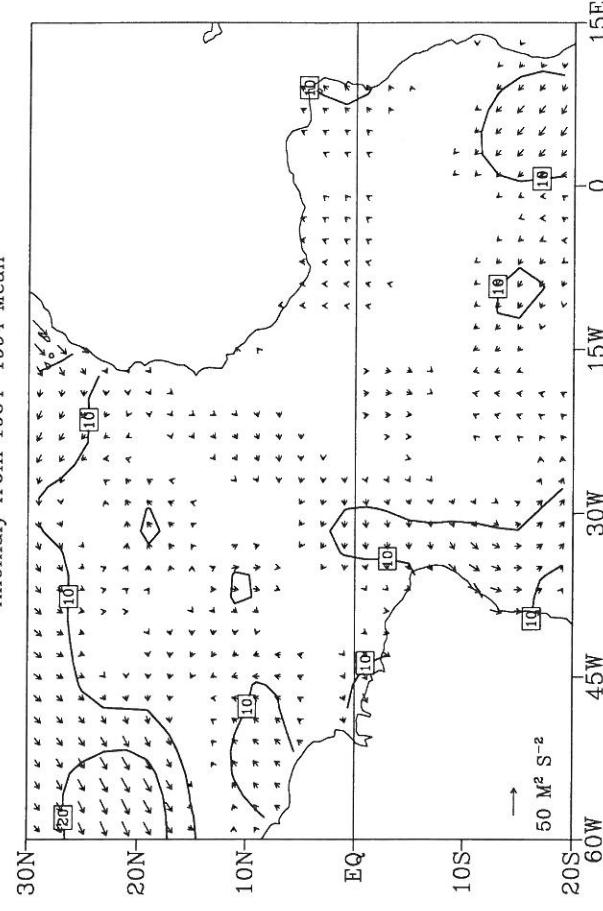
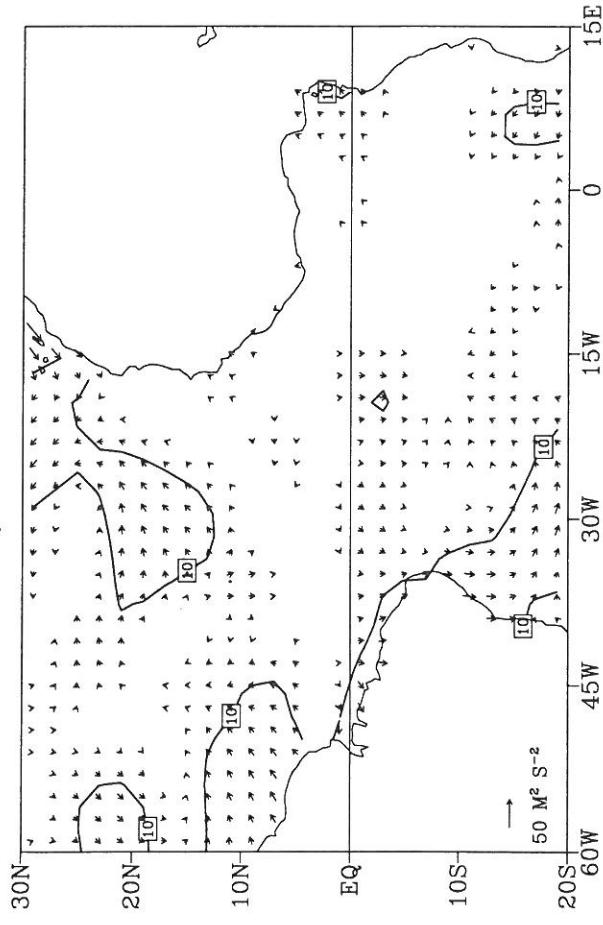
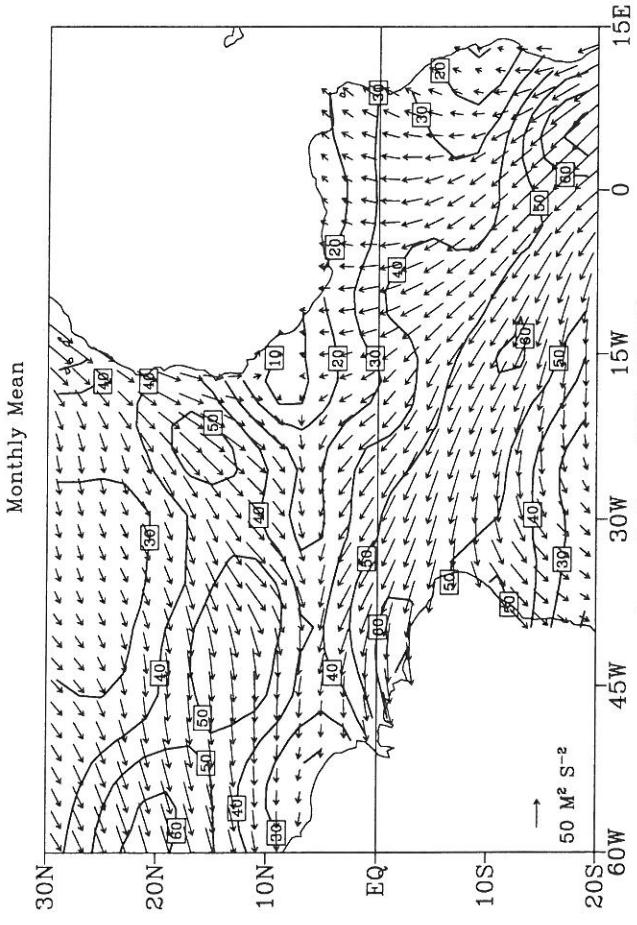
Anomaly from 1991

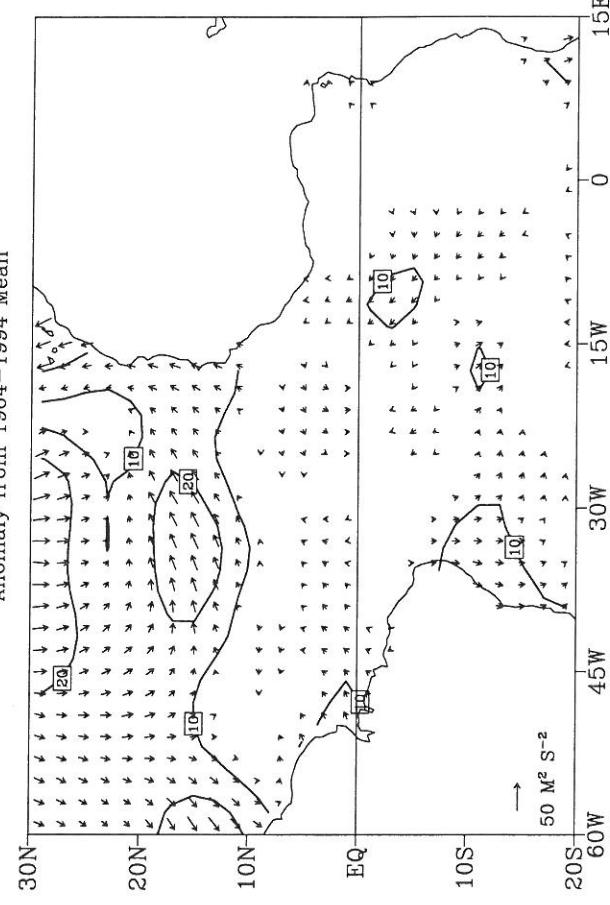
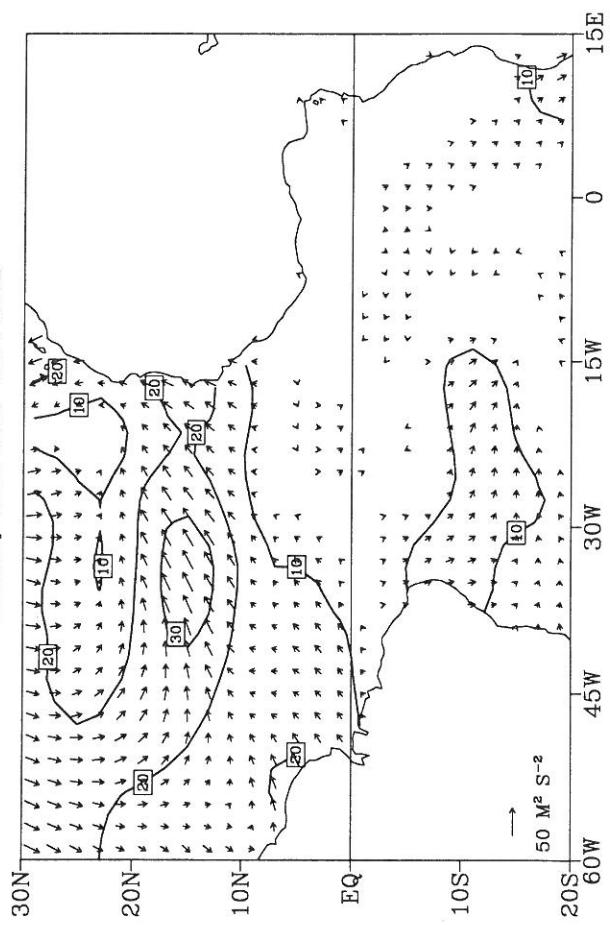
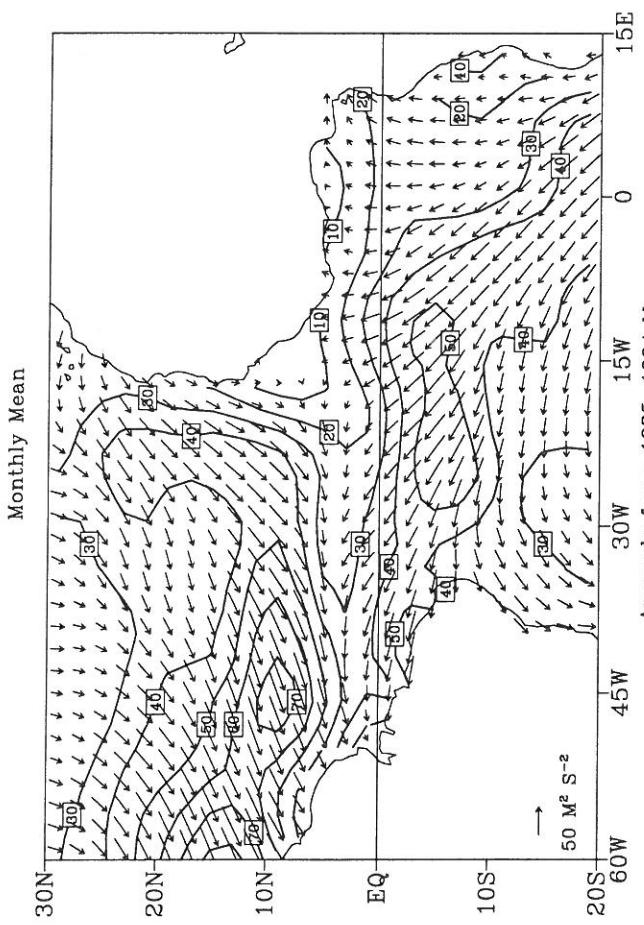
Pseudostress Vectors

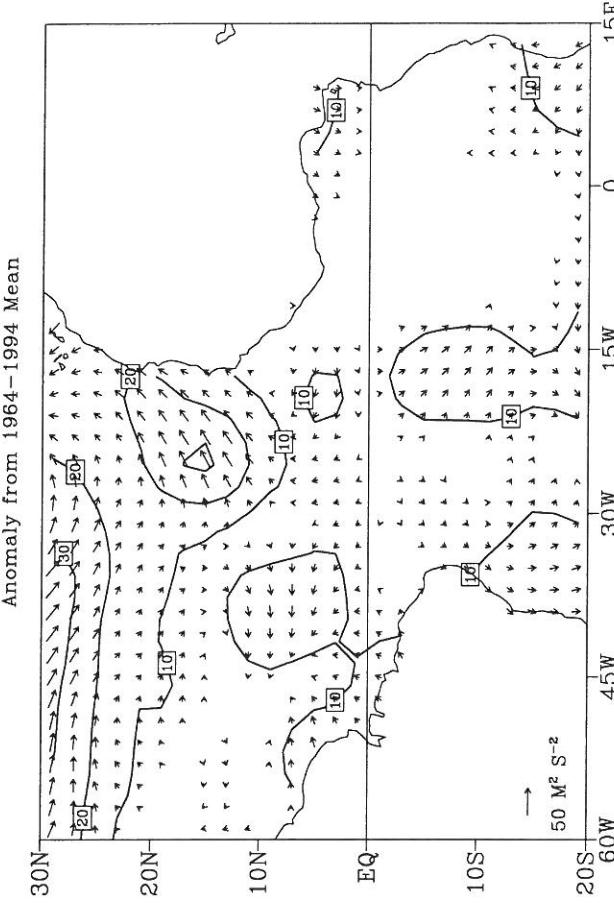
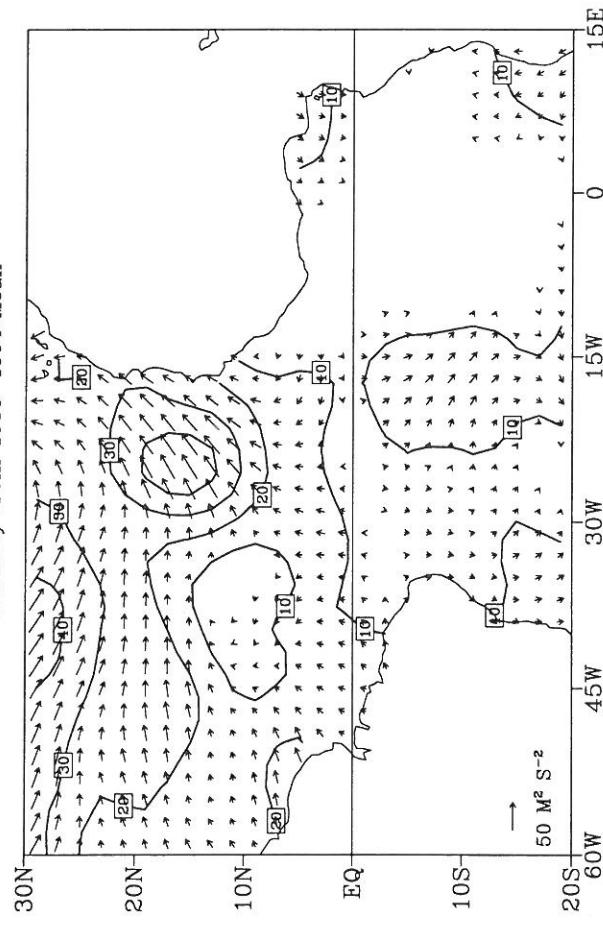
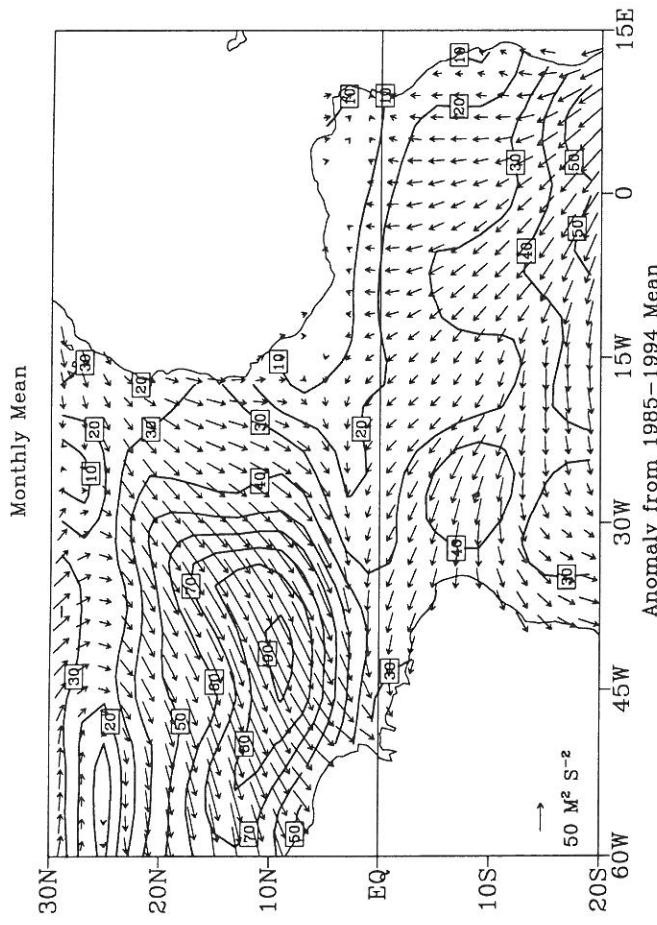




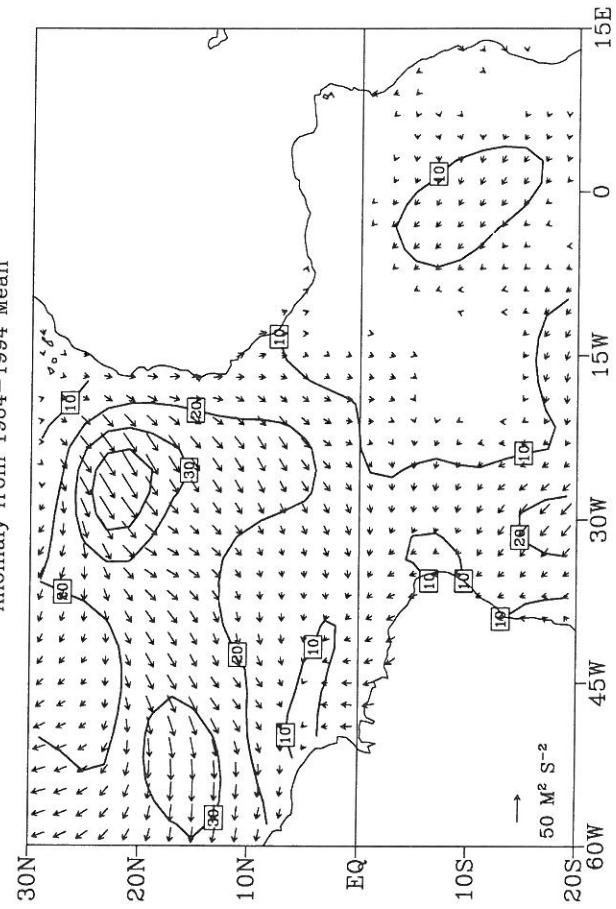
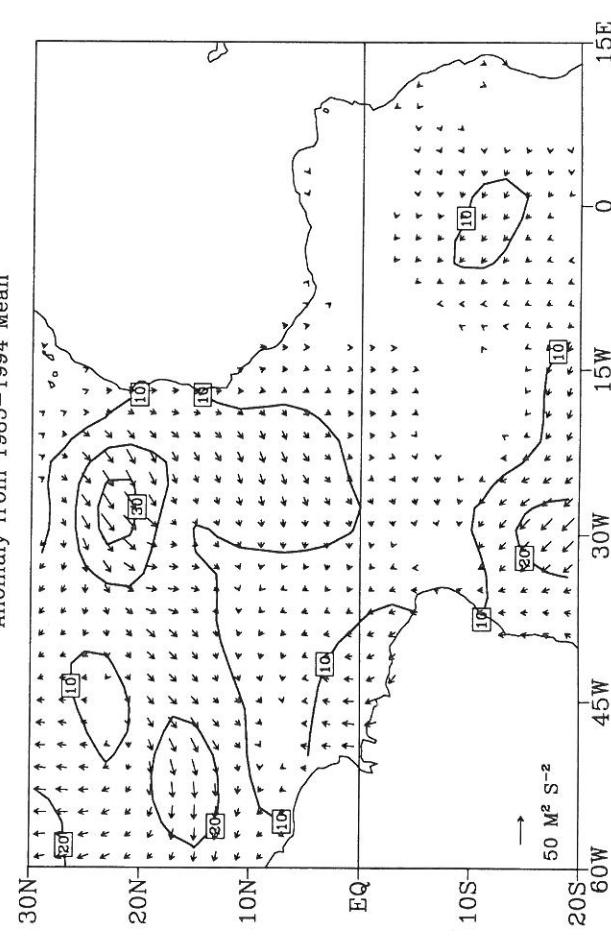
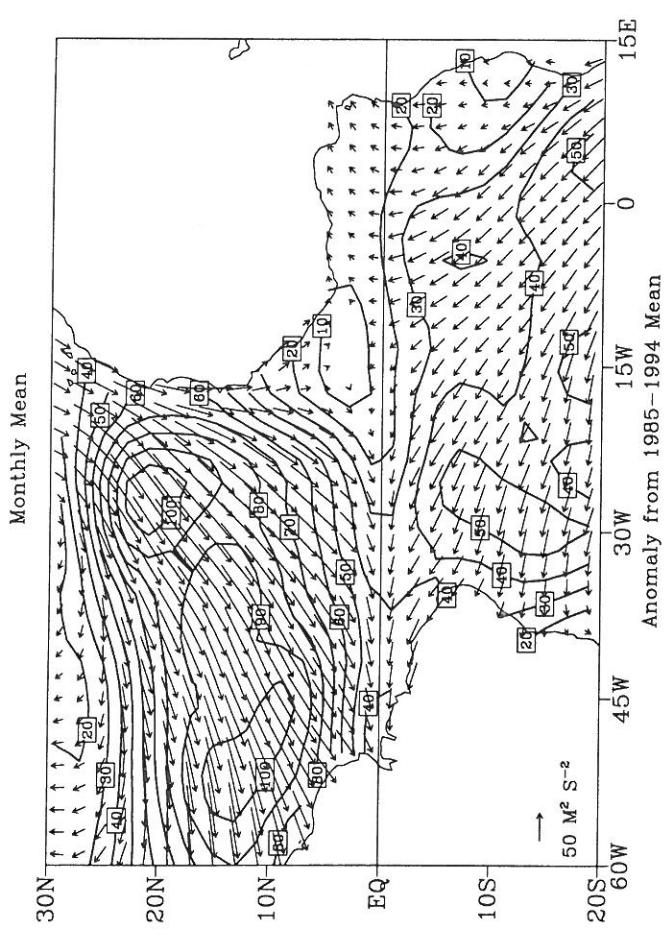






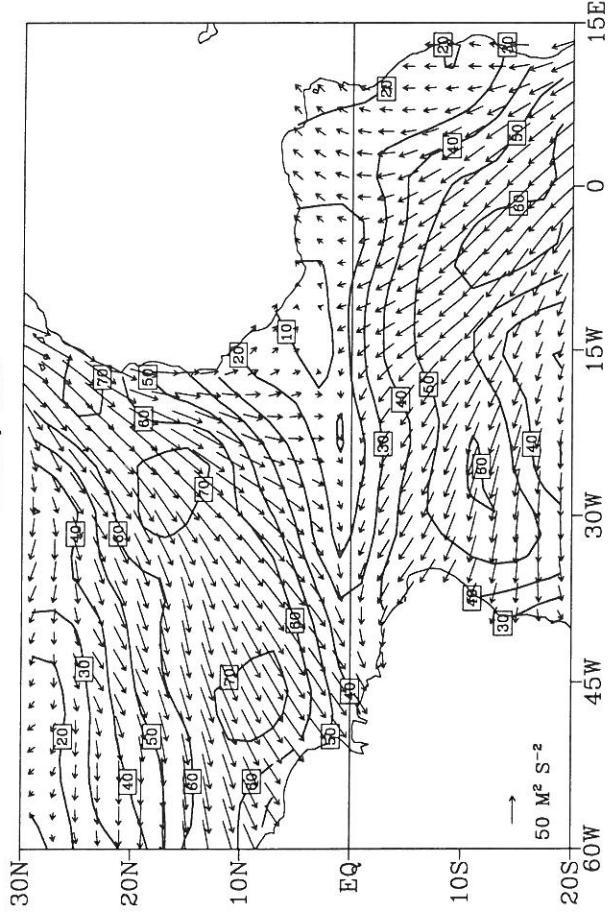


January 1992  
Pseudostress Vectors



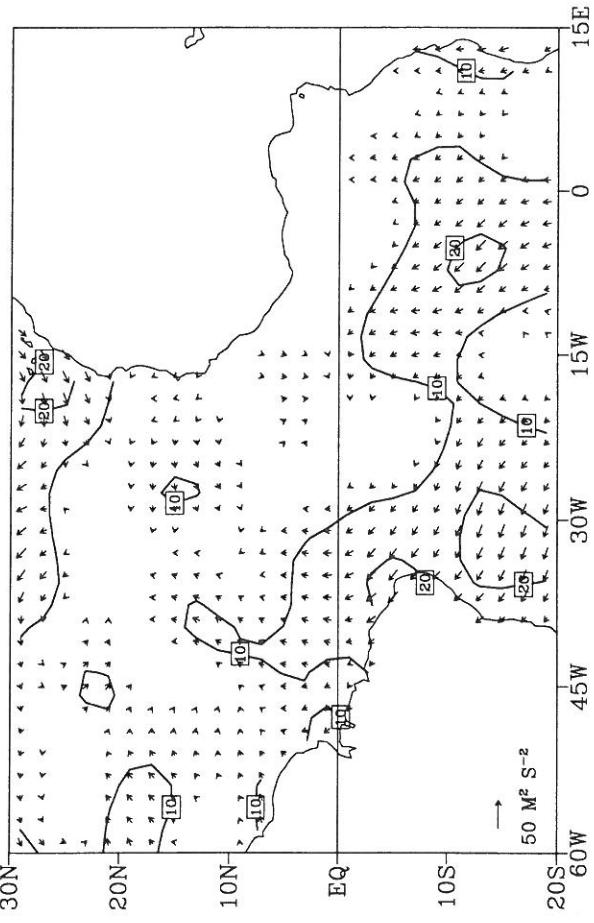
February 1992  
Pseudostress Vectors

Monthly Mean

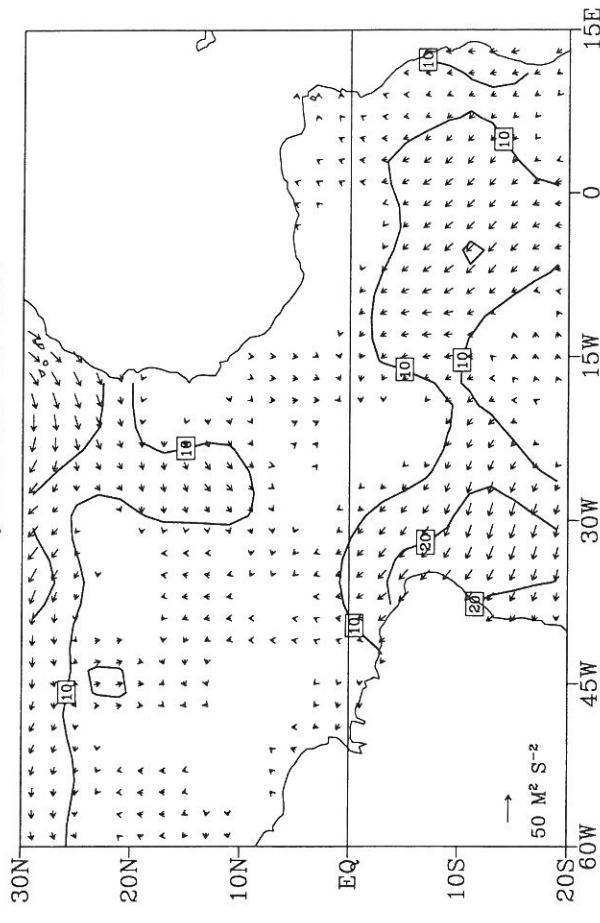


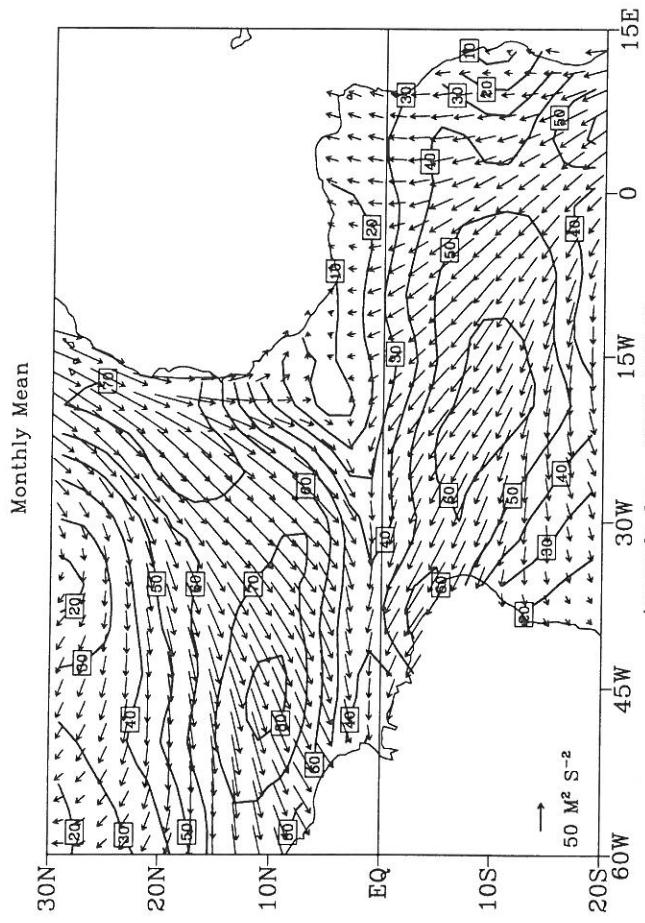
March 1992  
Pseudostress Vectors

Anomaly from 1985–1994 Mean

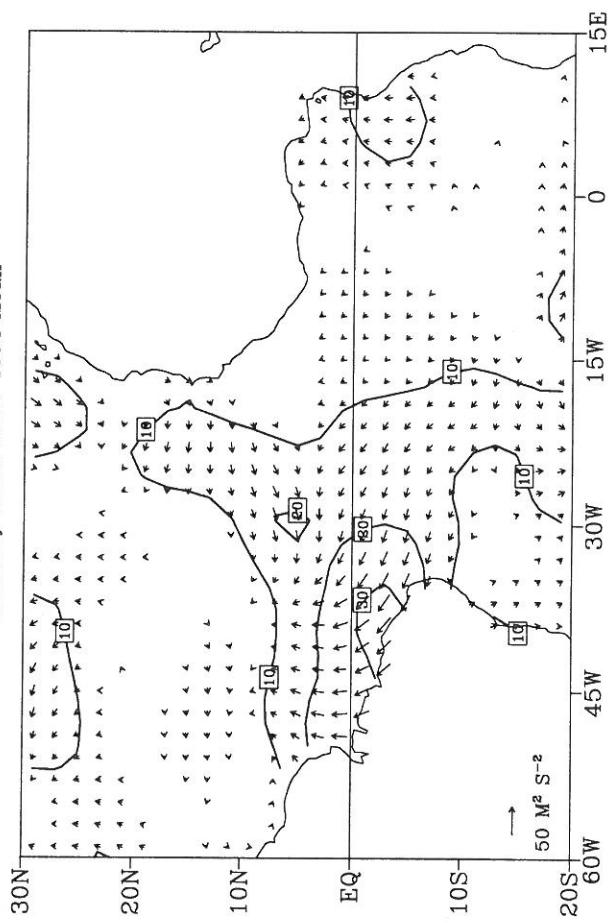


Anomaly from 1964–1994 Mean

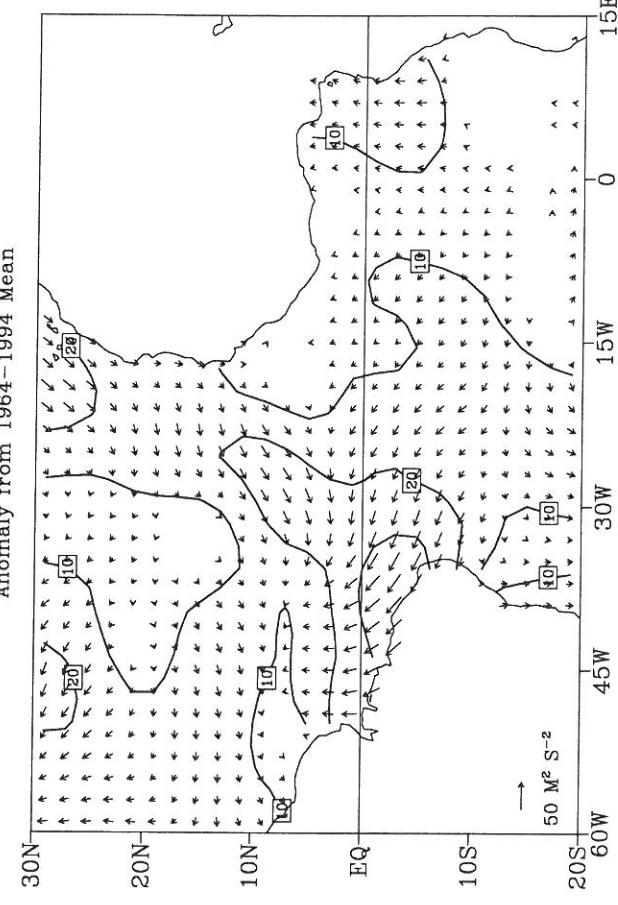




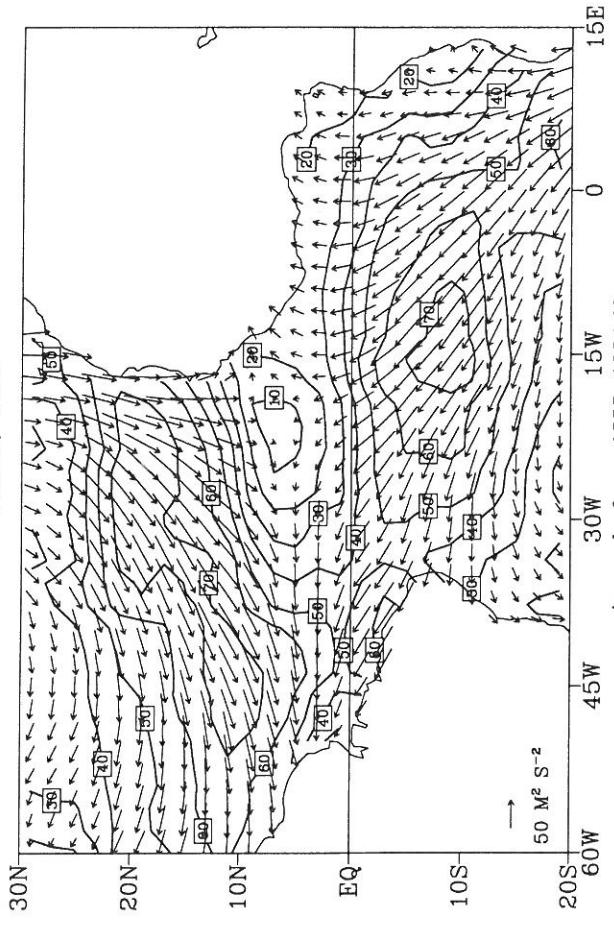
April 1992  
Pseudostress Vectors



Anomaly from 1964–1994 Mean

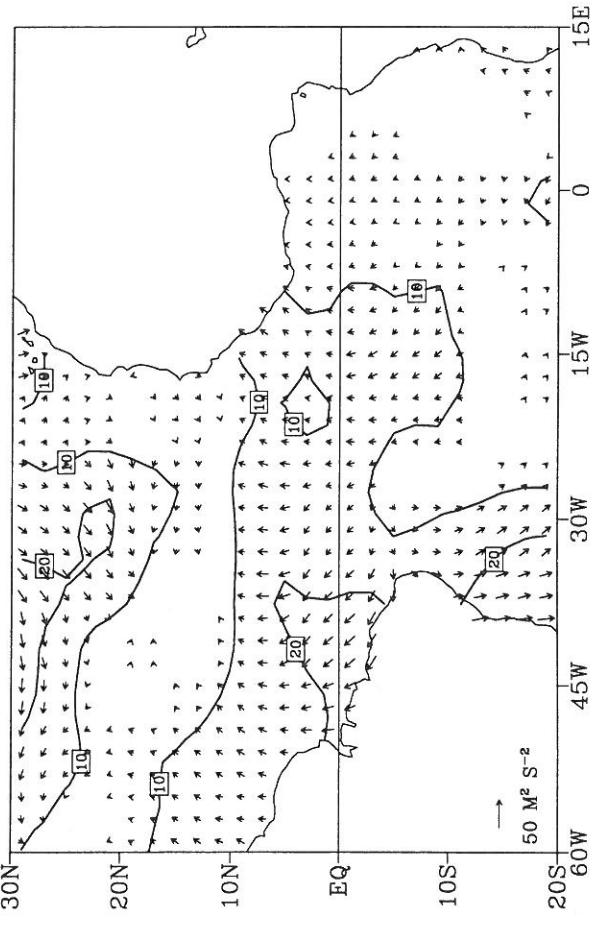


Monthly Mean

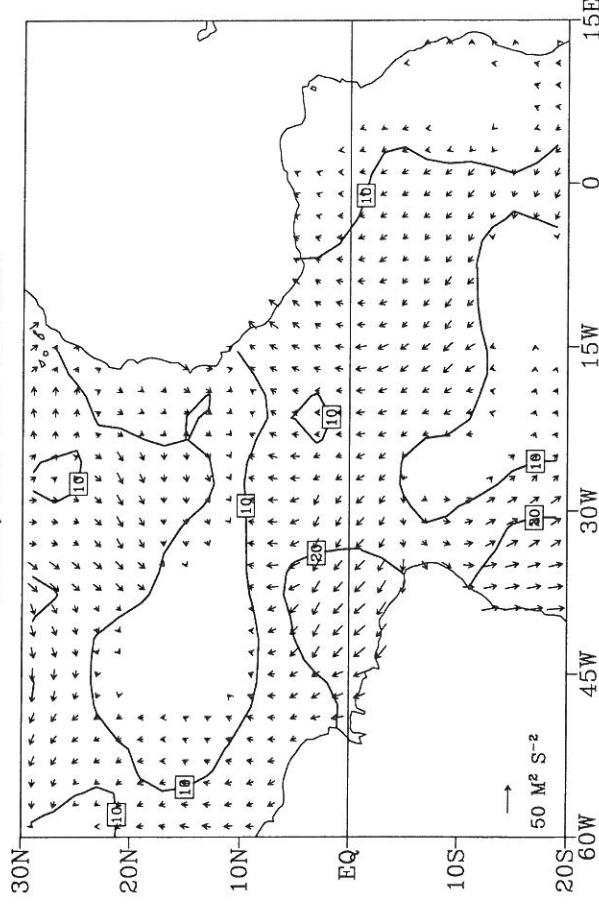


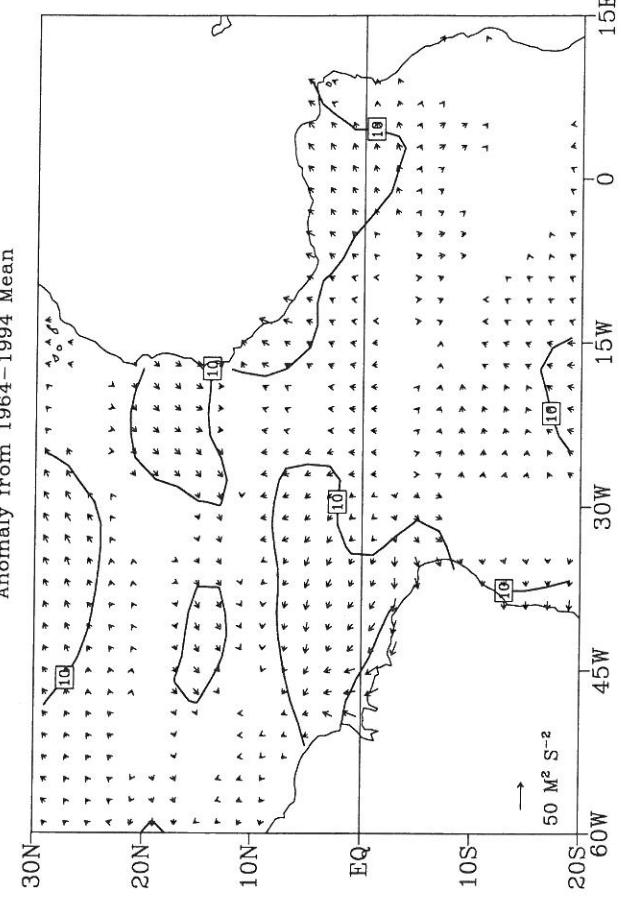
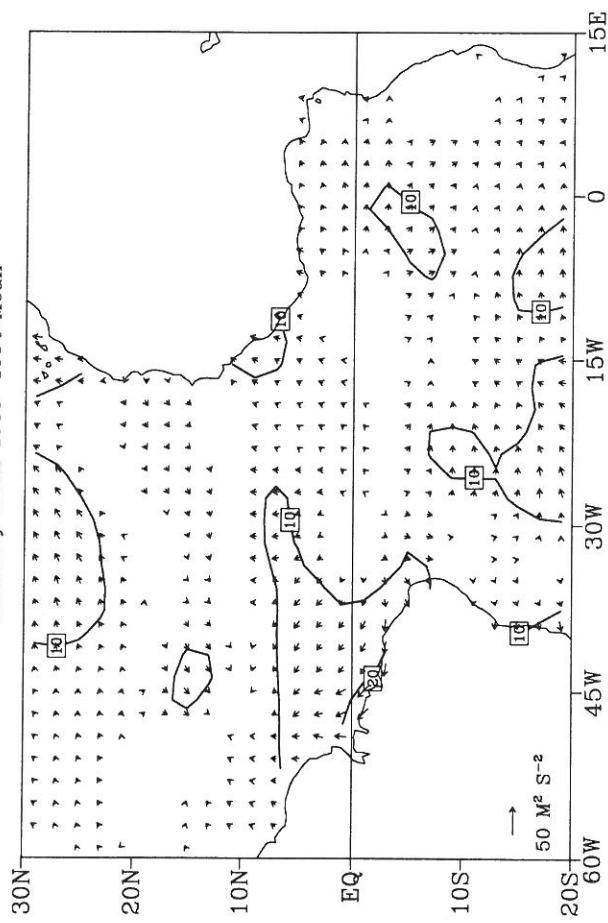
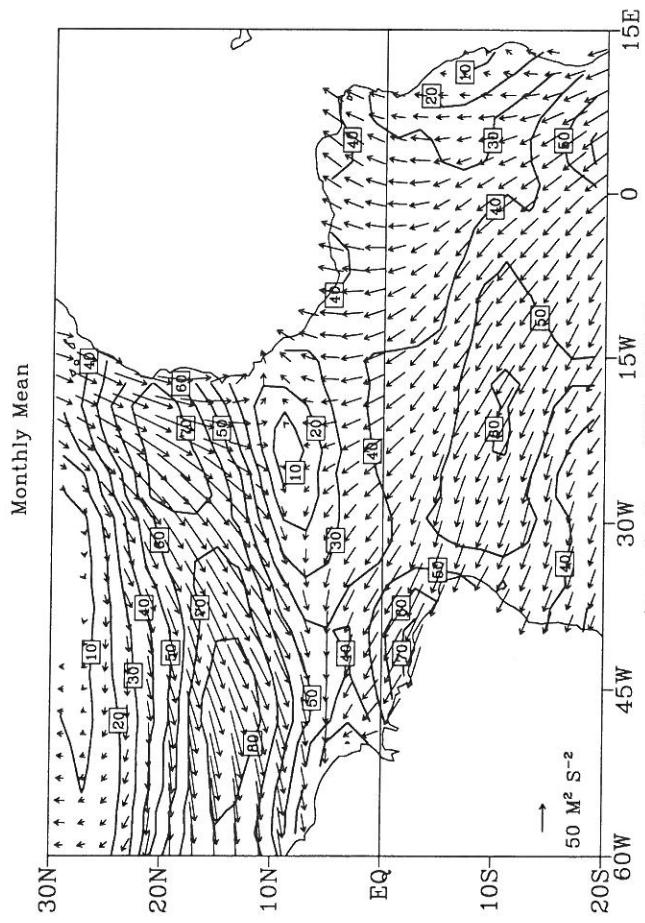
May 1992  
Pseudostress Vectors

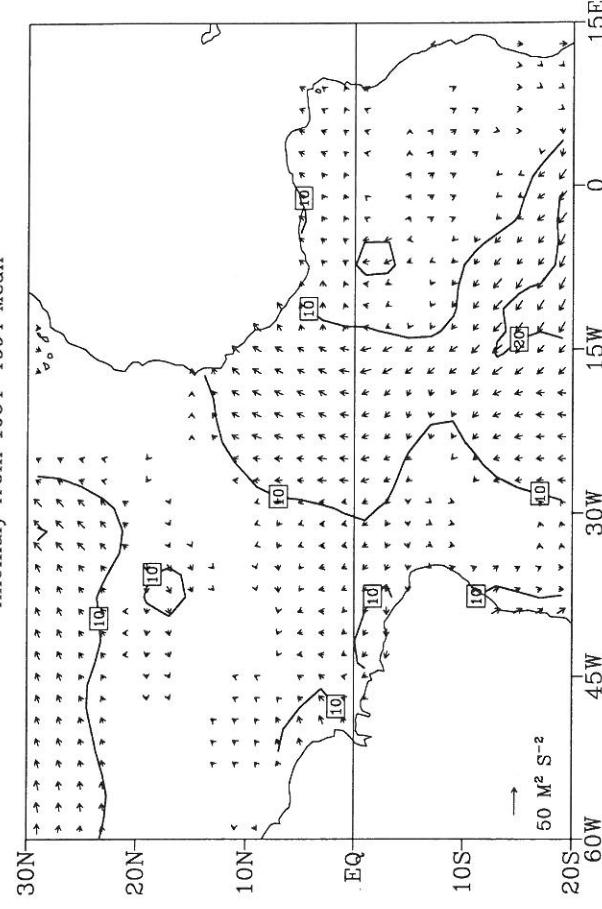
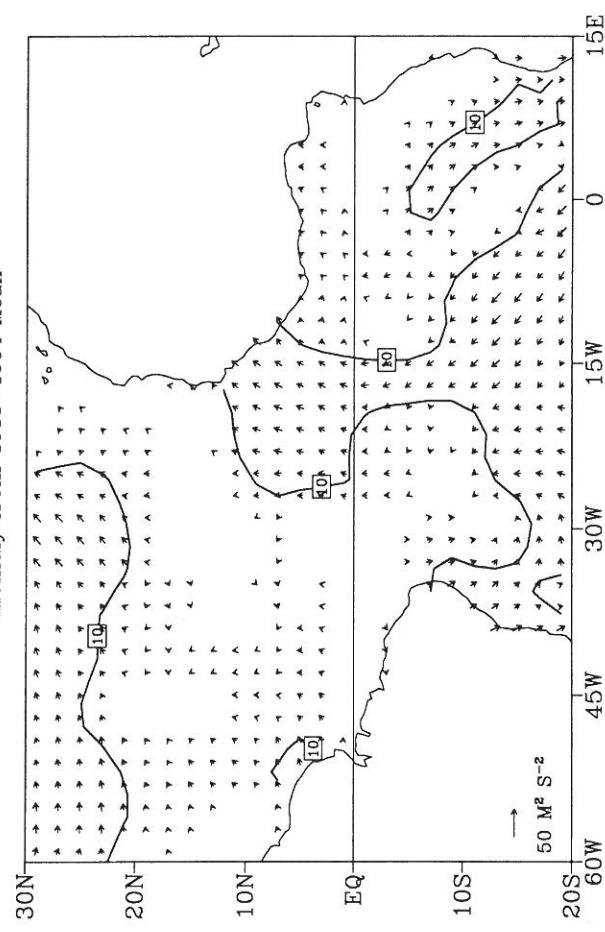
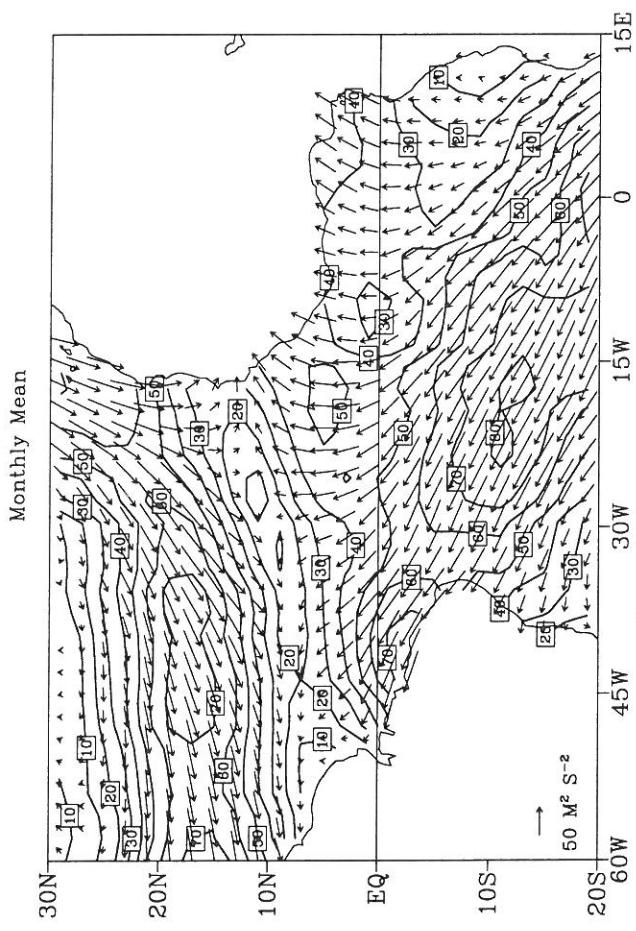
Anomaly from 1985–1994 Mean

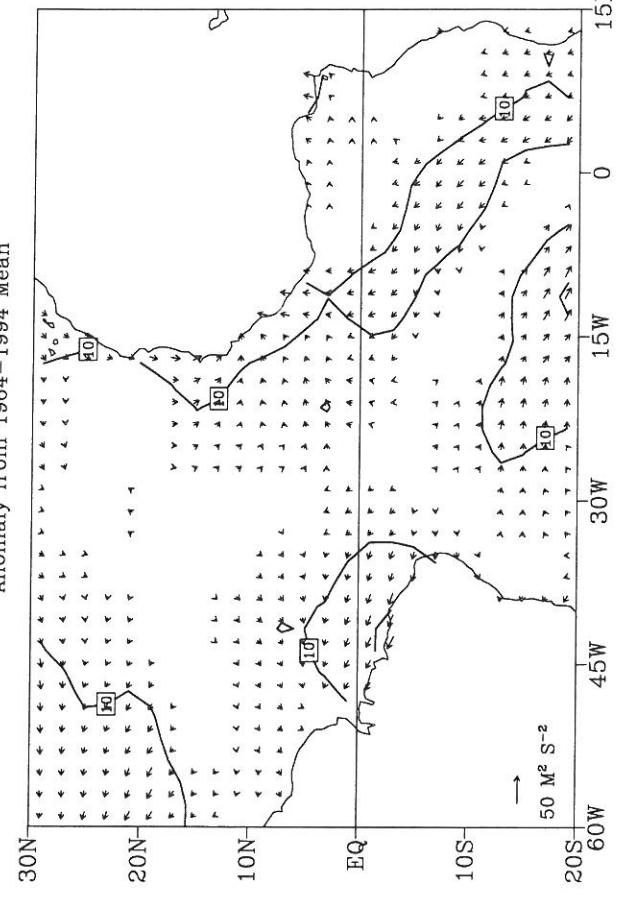
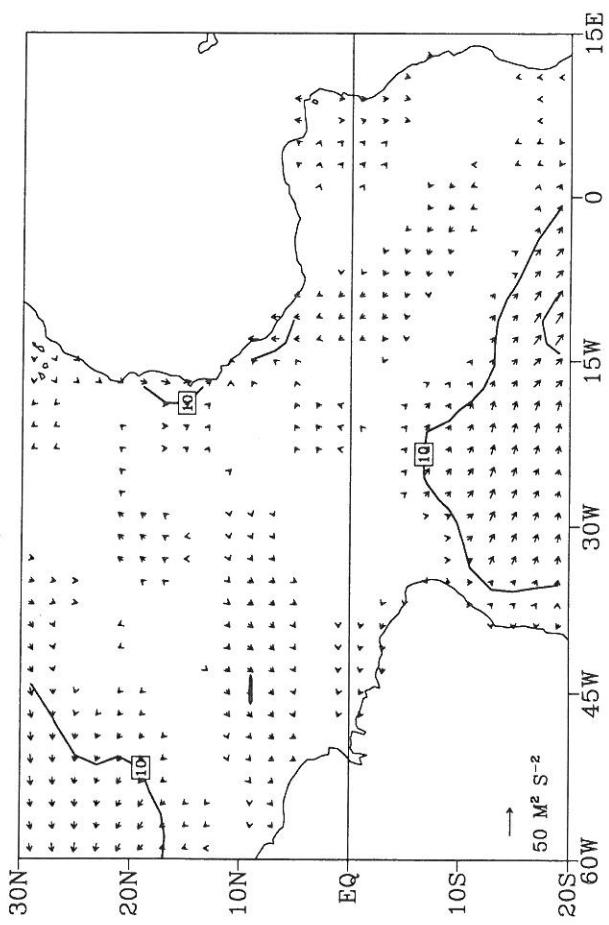
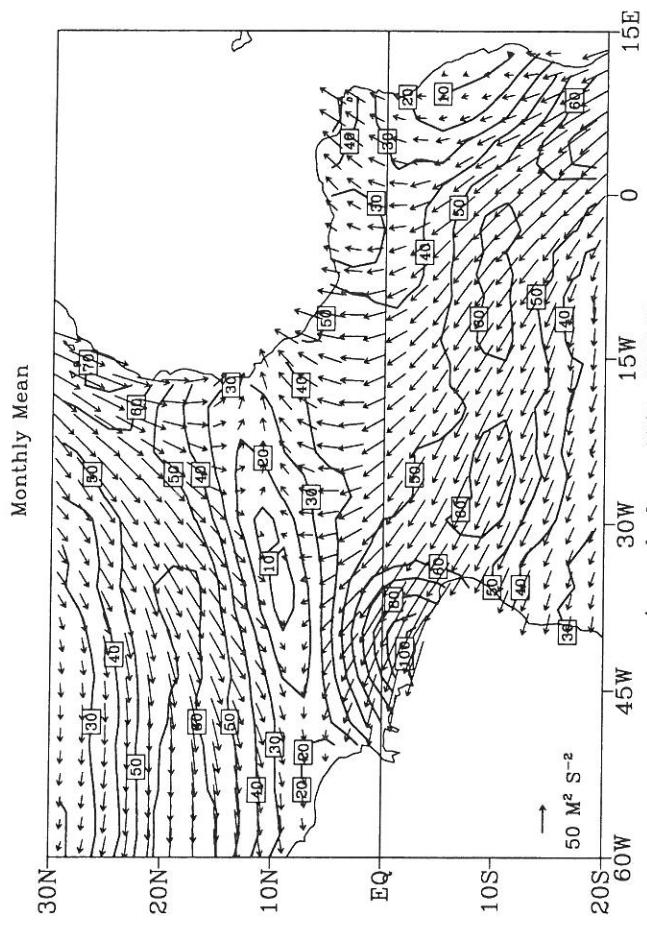


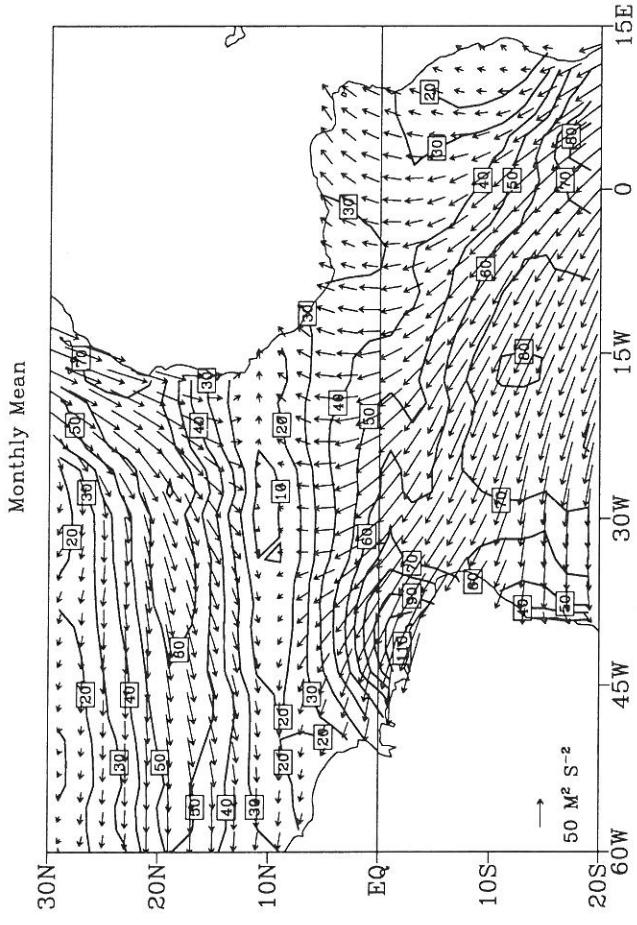
Anomaly from 1964–1994 Mean

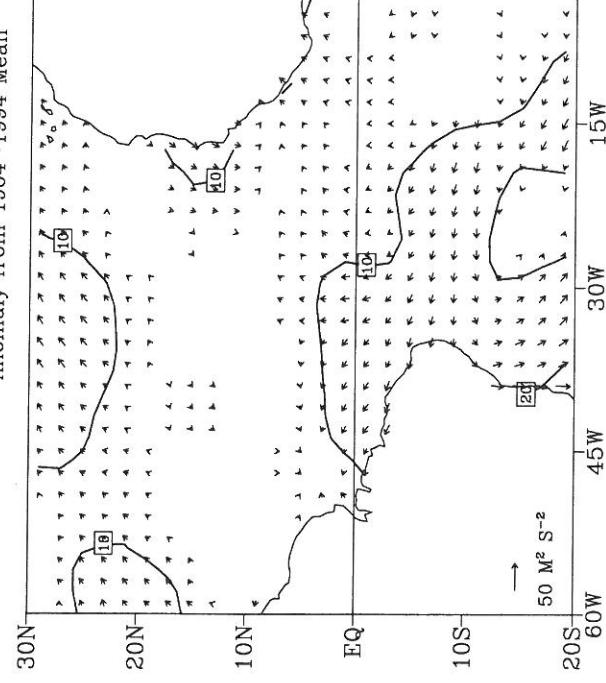
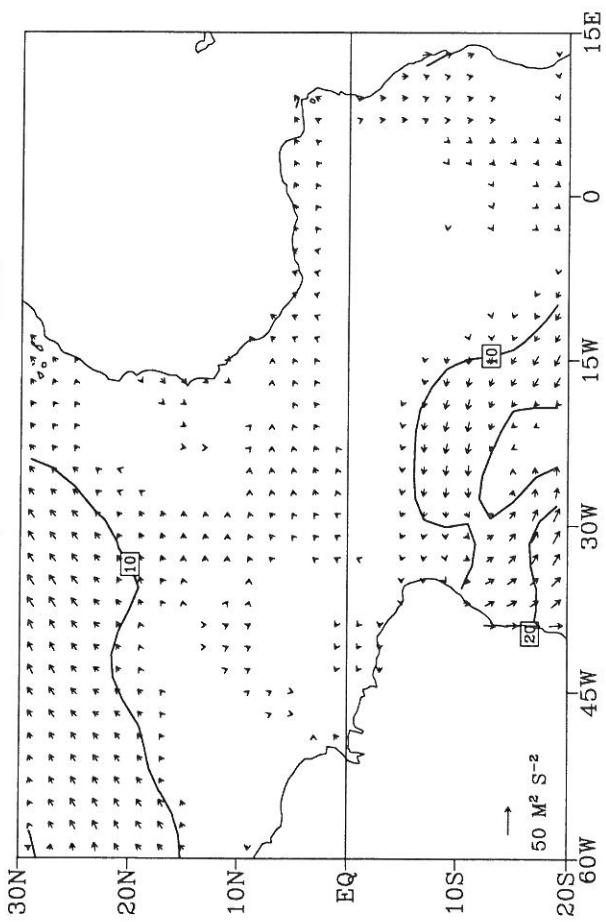
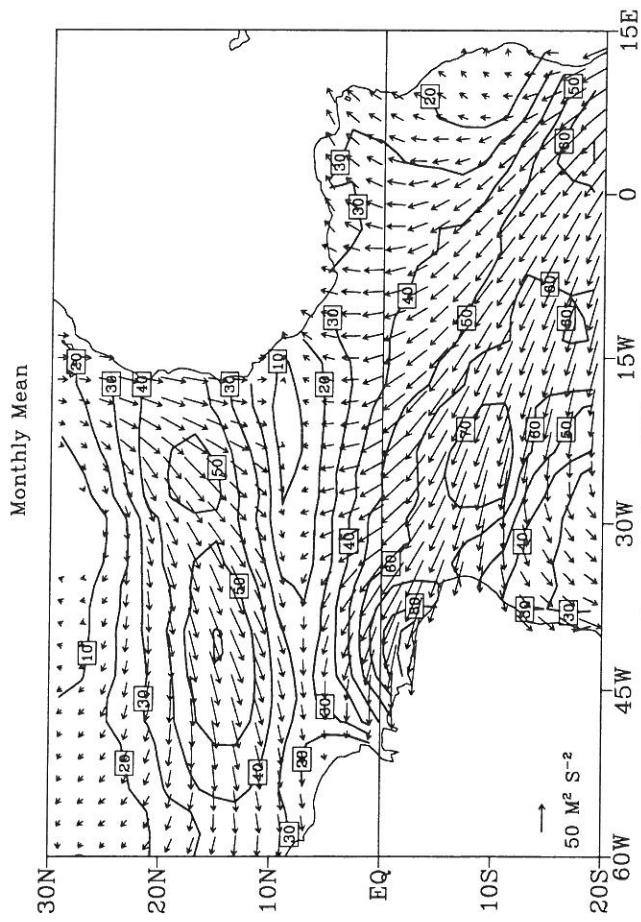


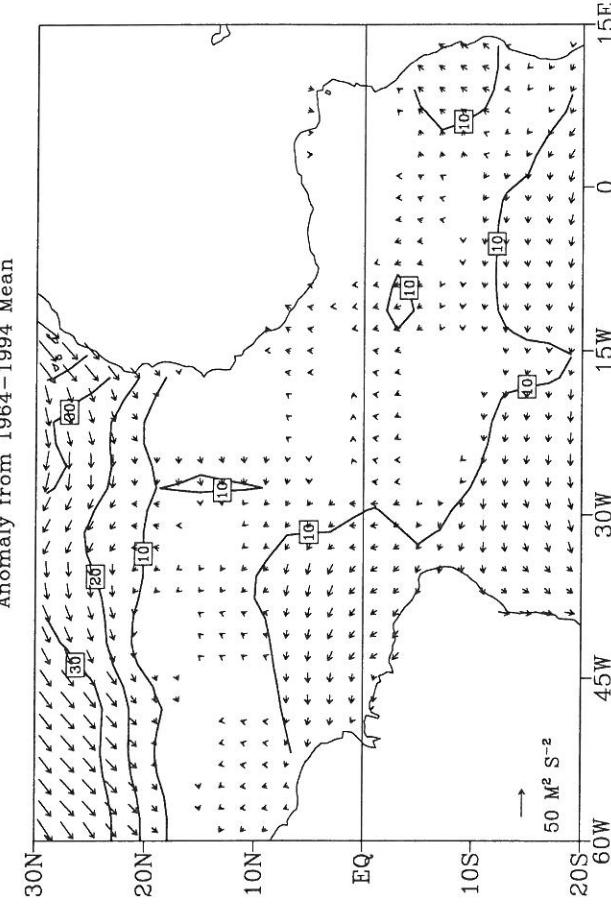
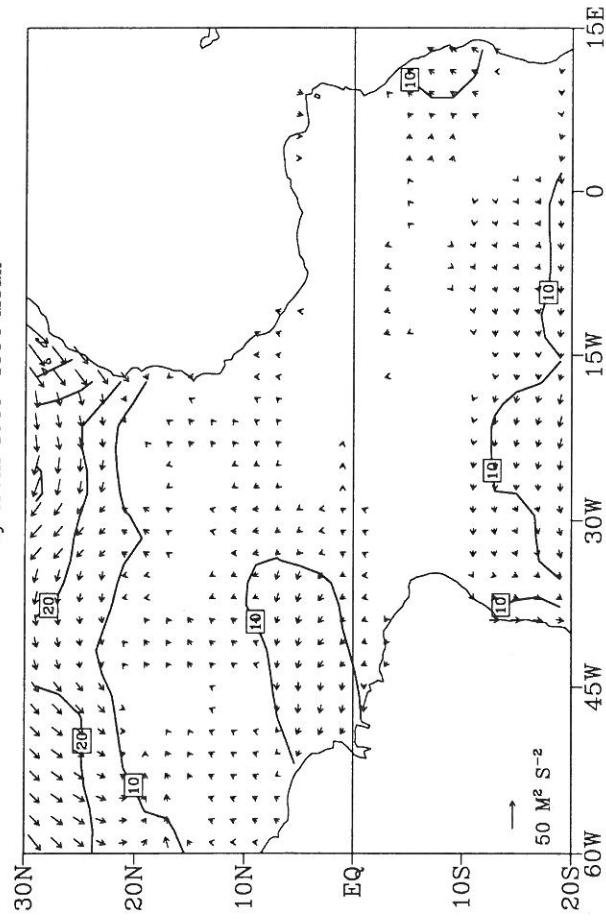
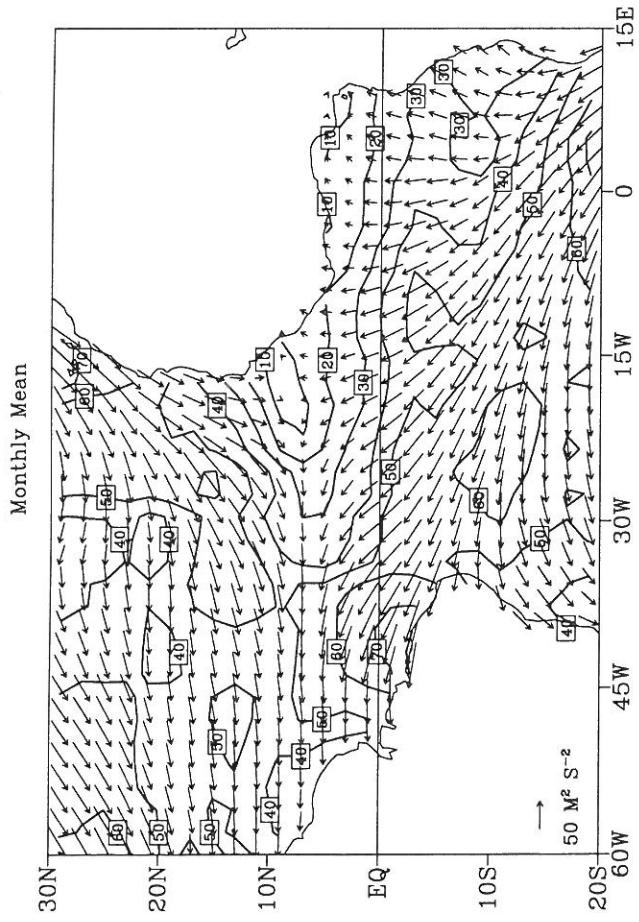


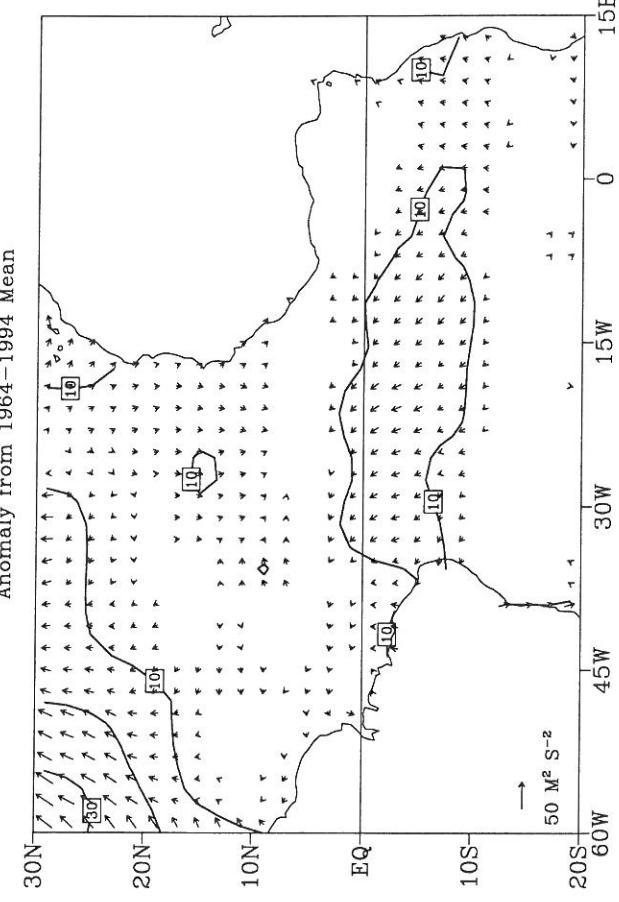
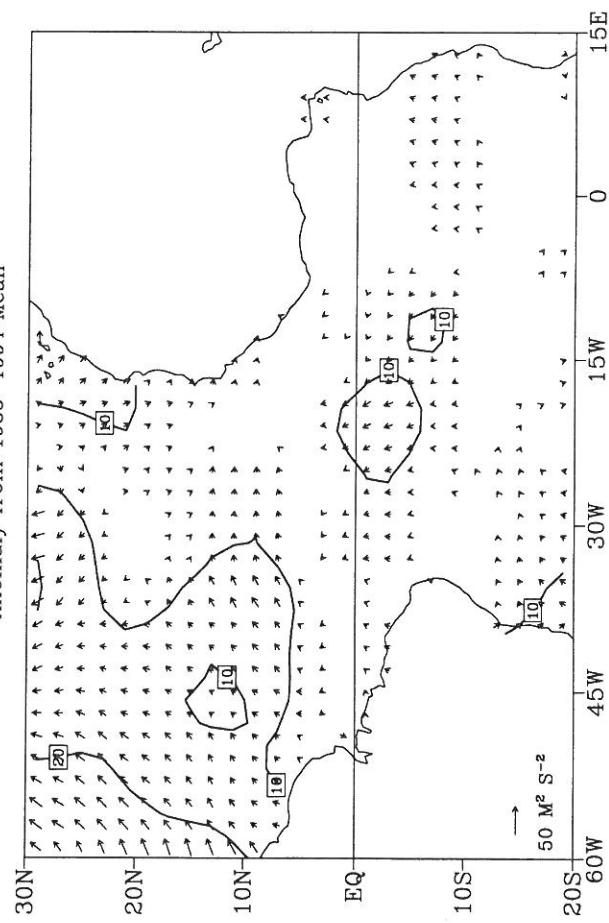
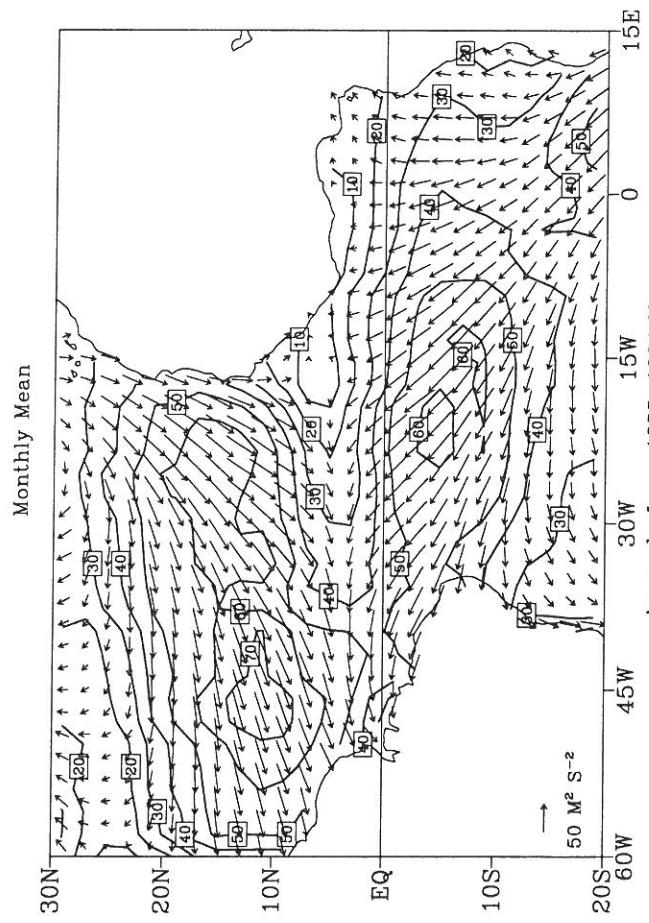




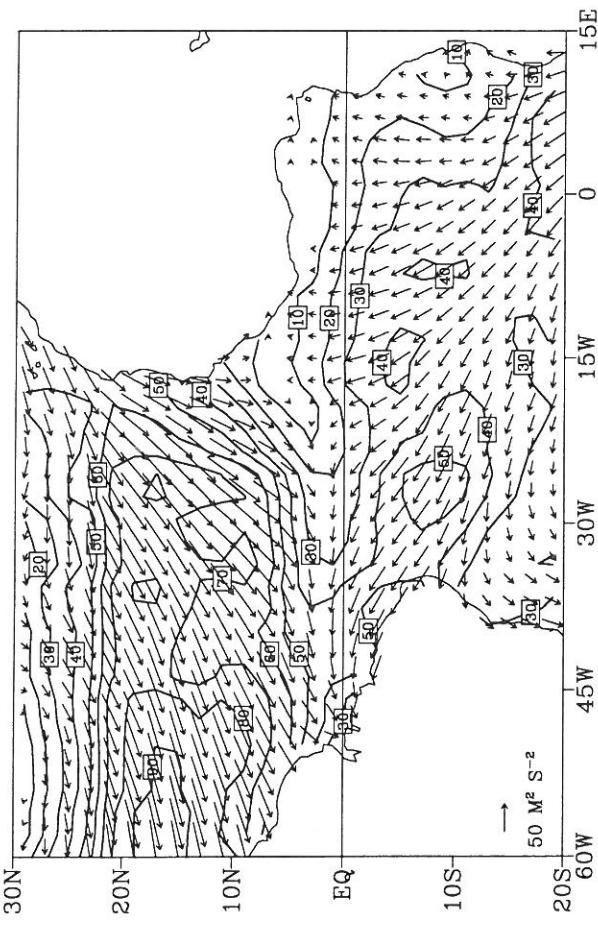




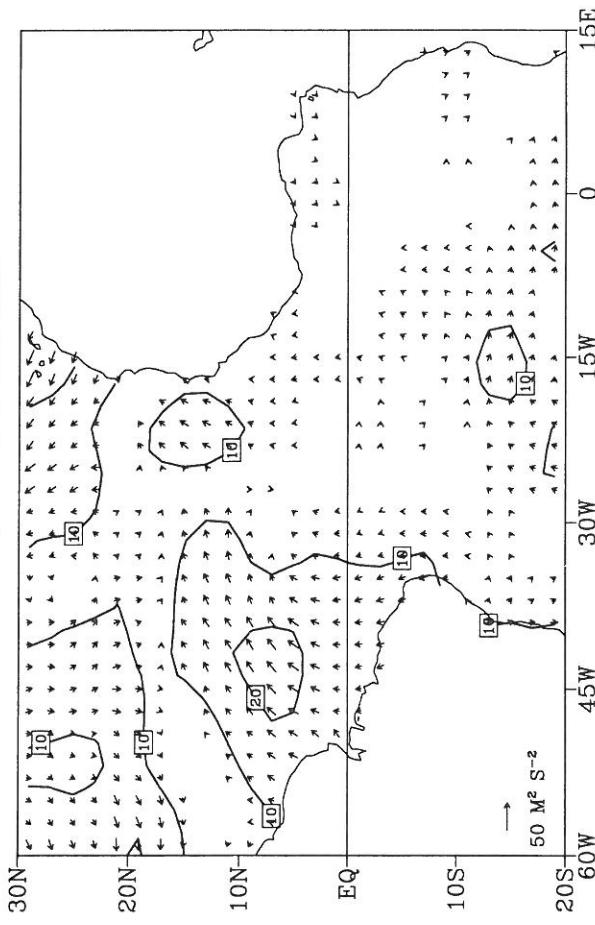




Monthly Mean

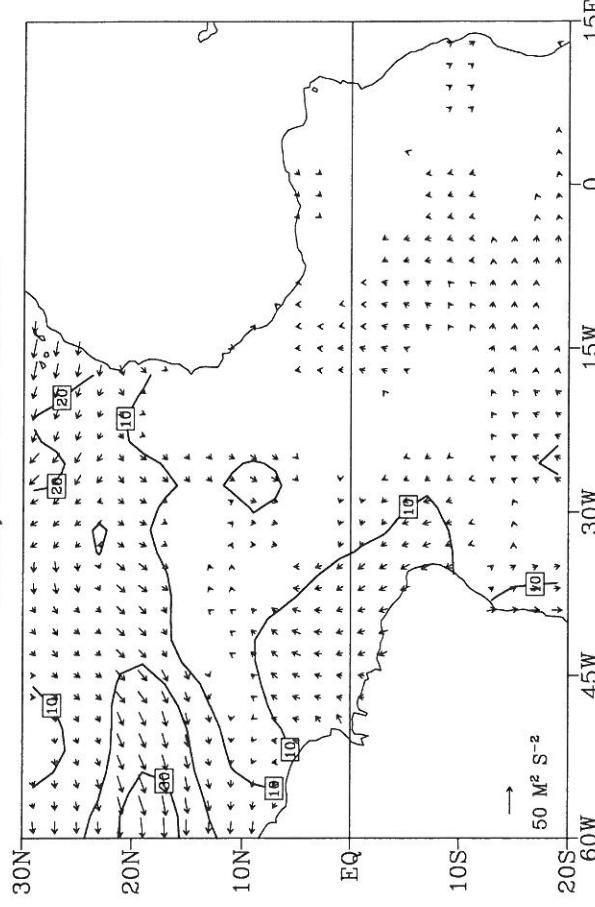


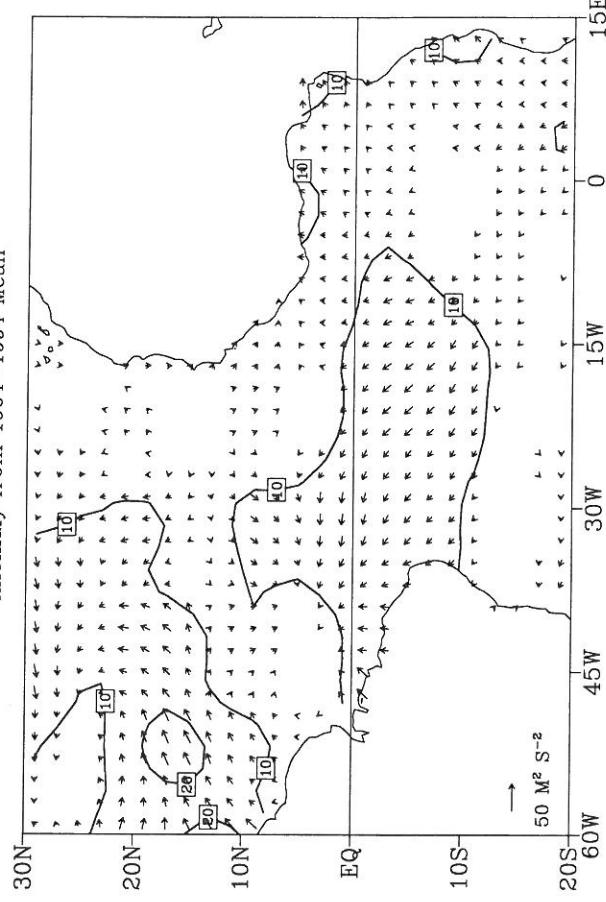
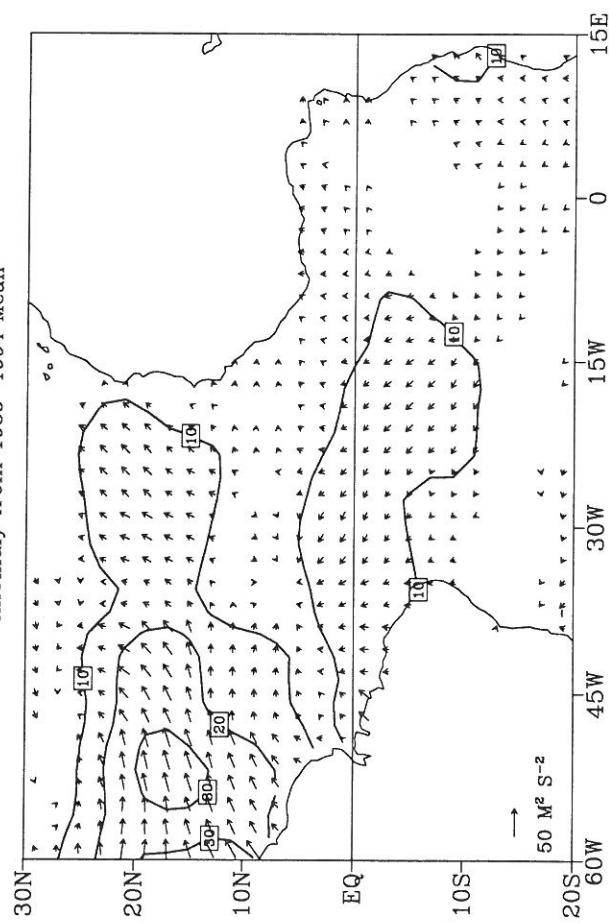
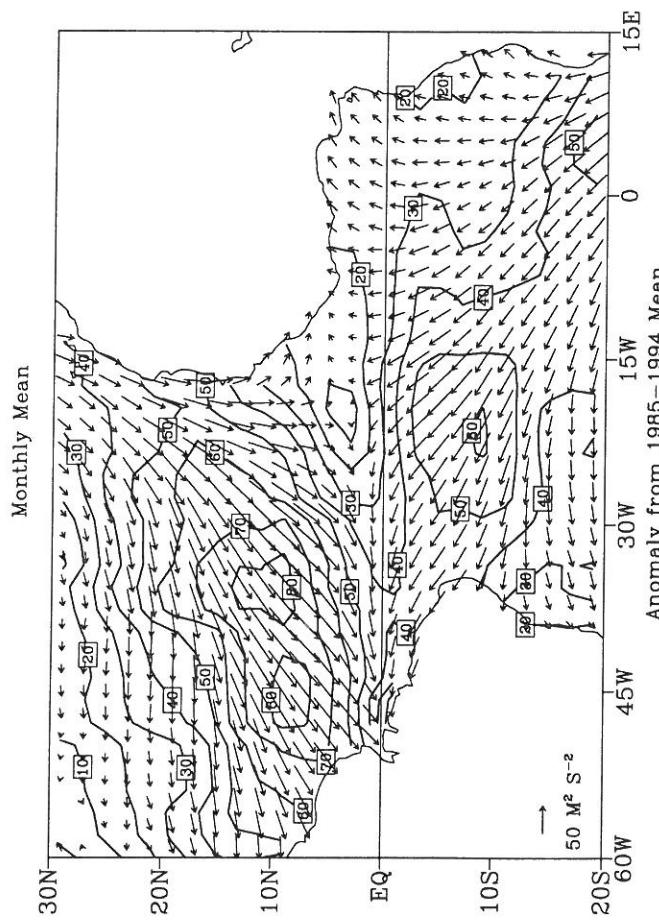
Anomaly from 1985–1994 Mean

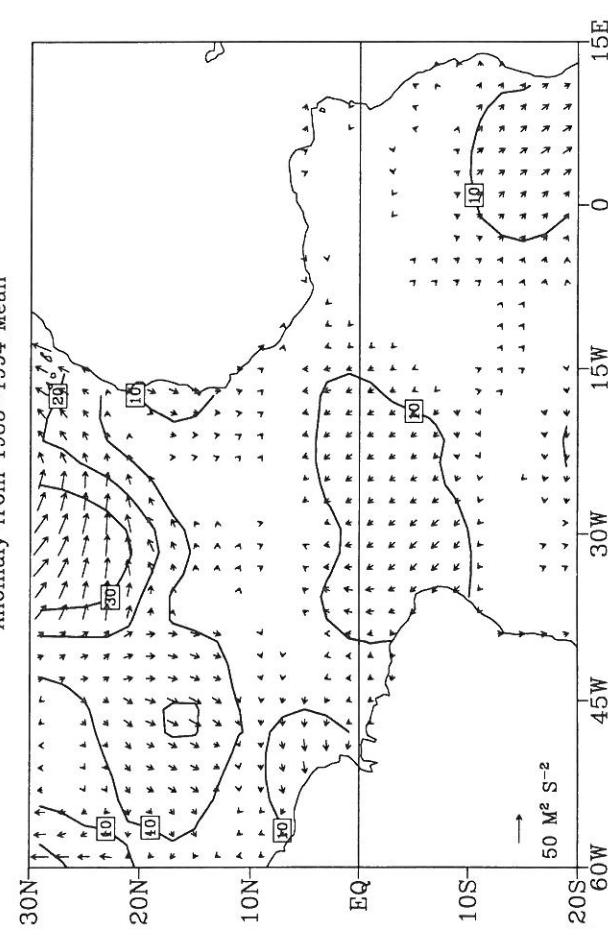
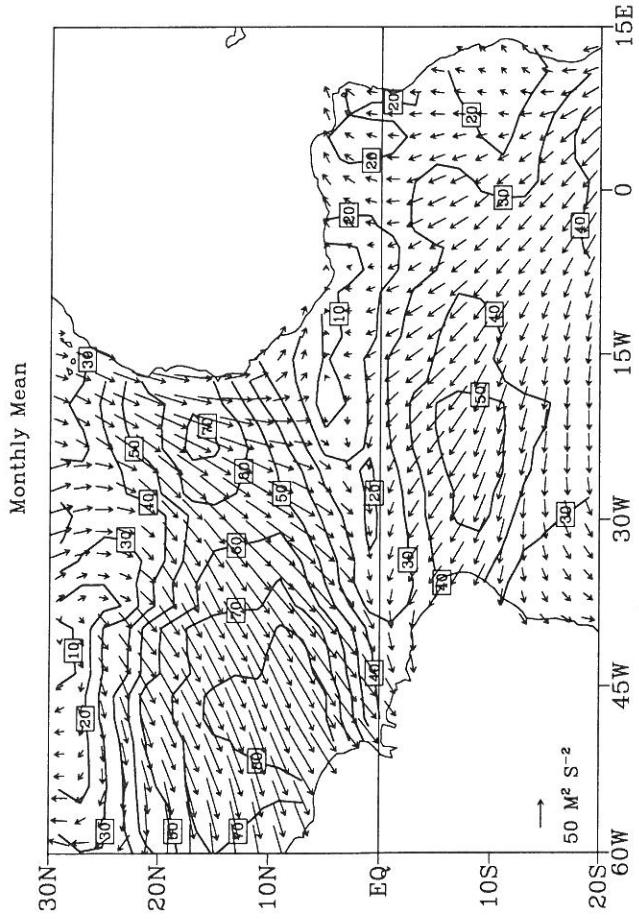


January 1993  
Pseudostress Vectors

Anomaly from 1964–1994 Mean

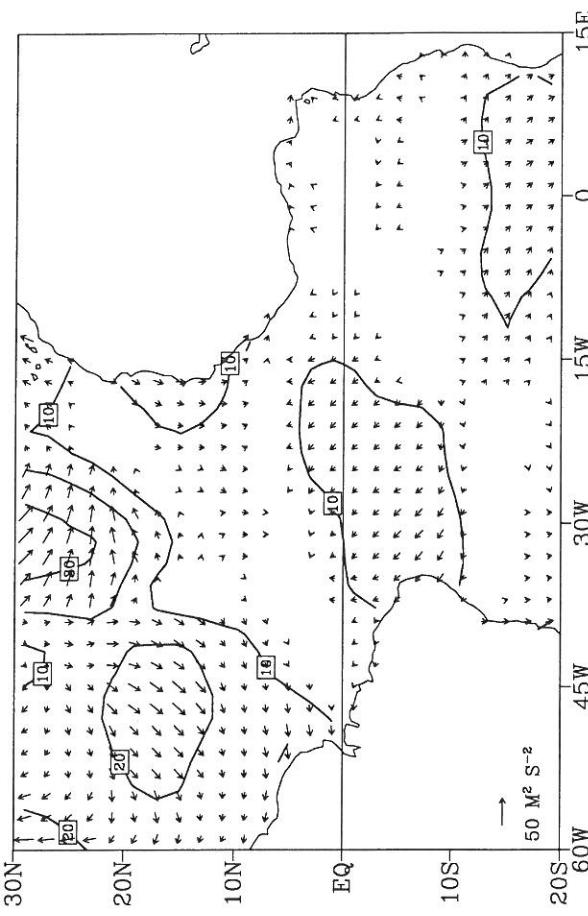


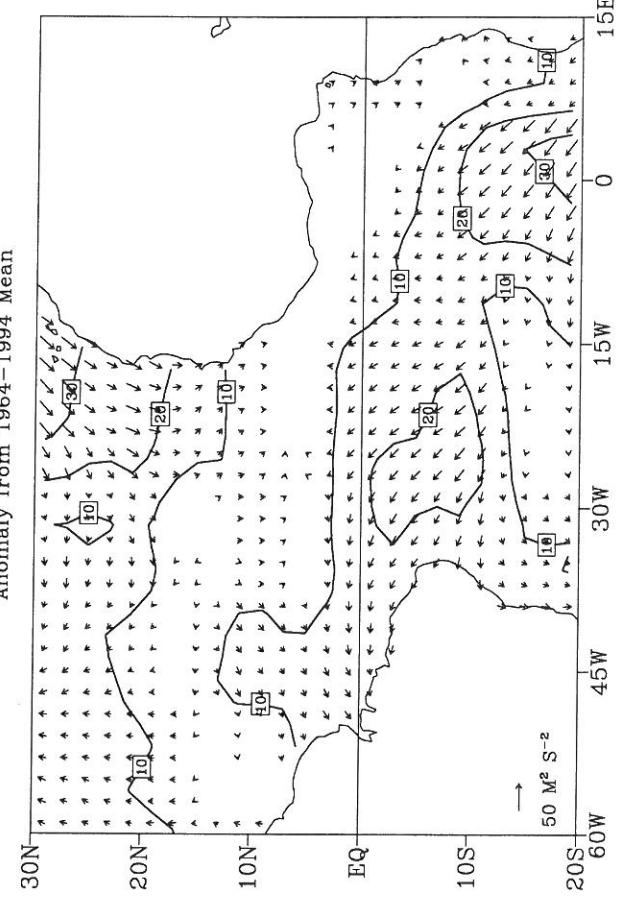
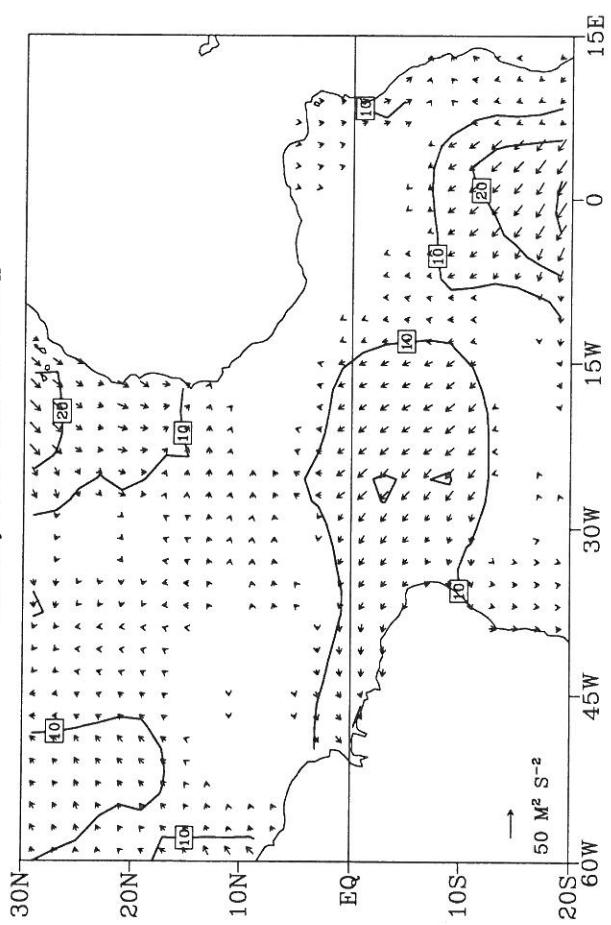
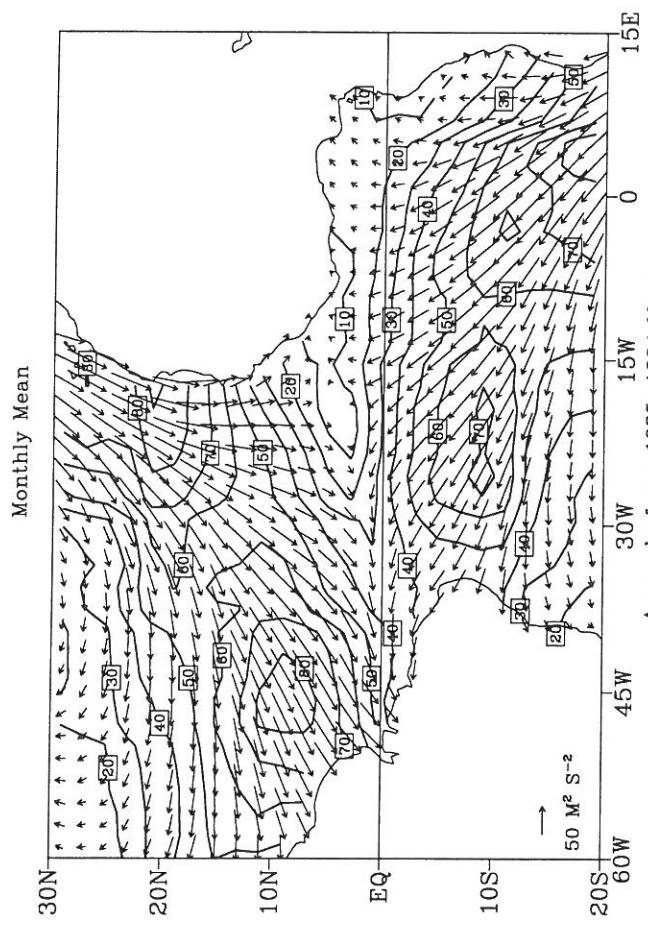


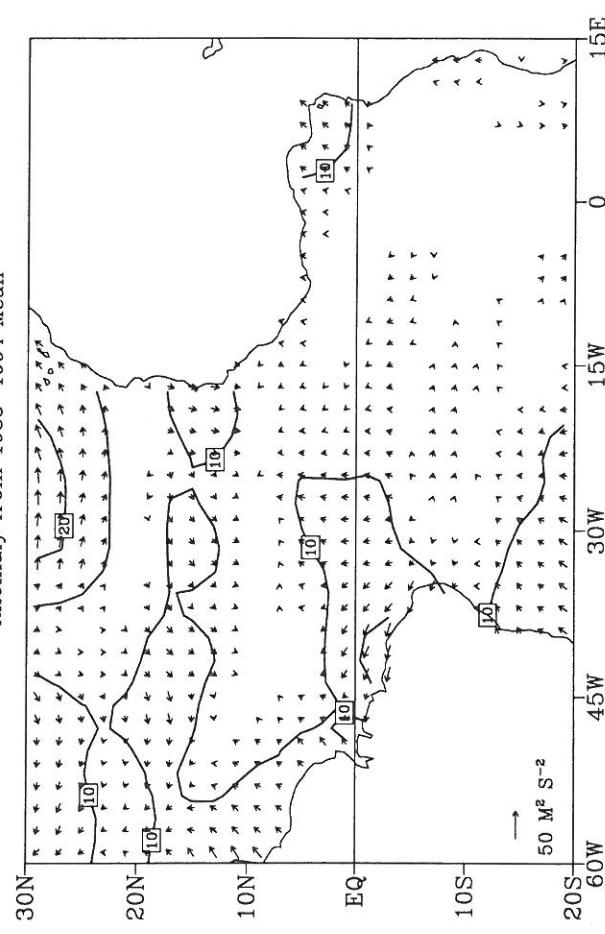
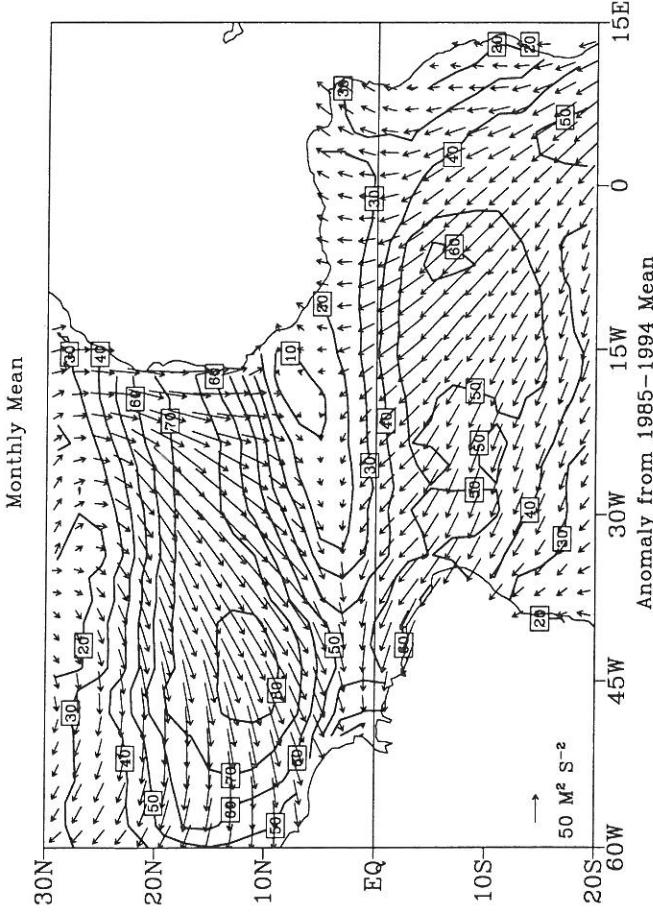


Anomaly from 1964-1994 Mean

March 1993  
Pseudostress Vectors

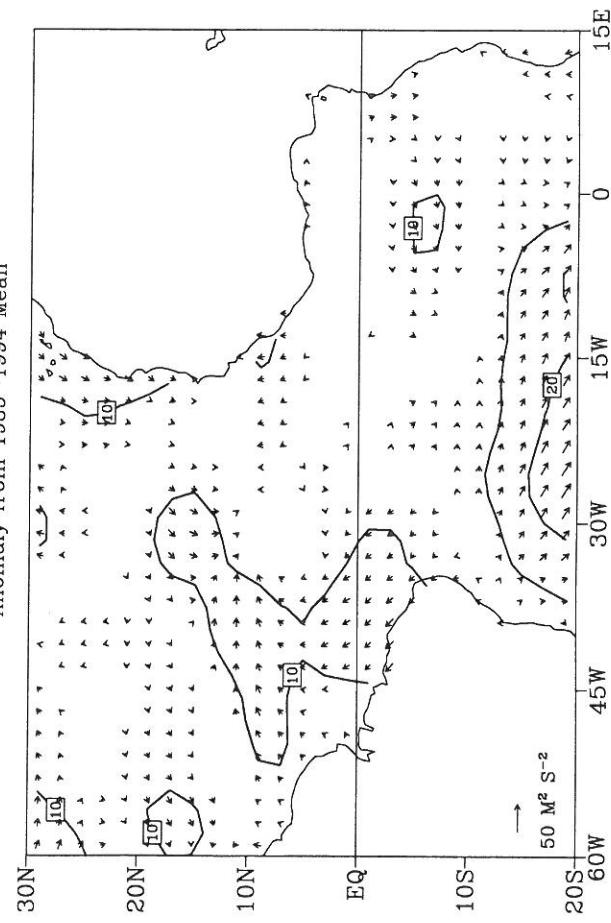
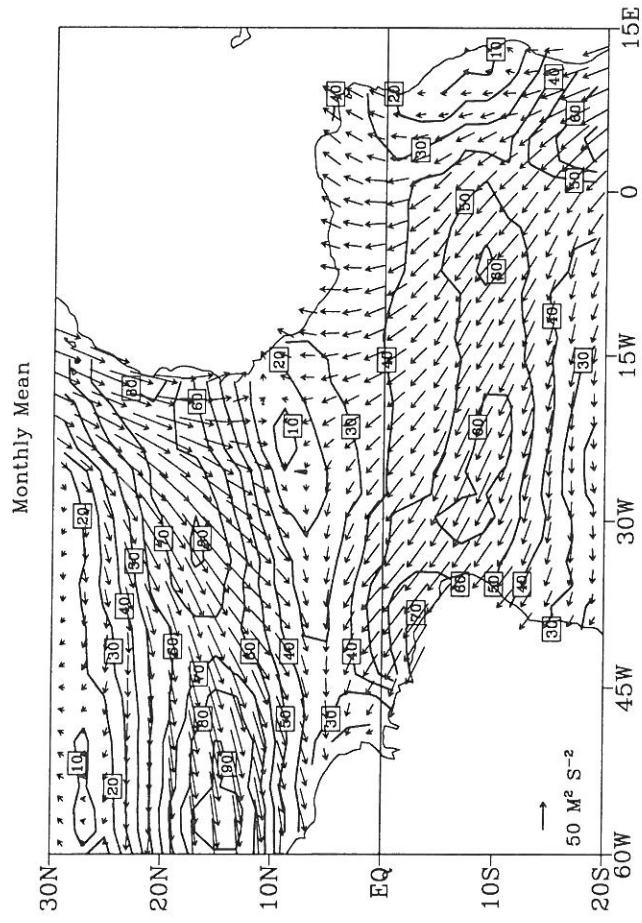






Anomaly from 1964-1994 Mean

May 1993  
Pseudostress Vectors



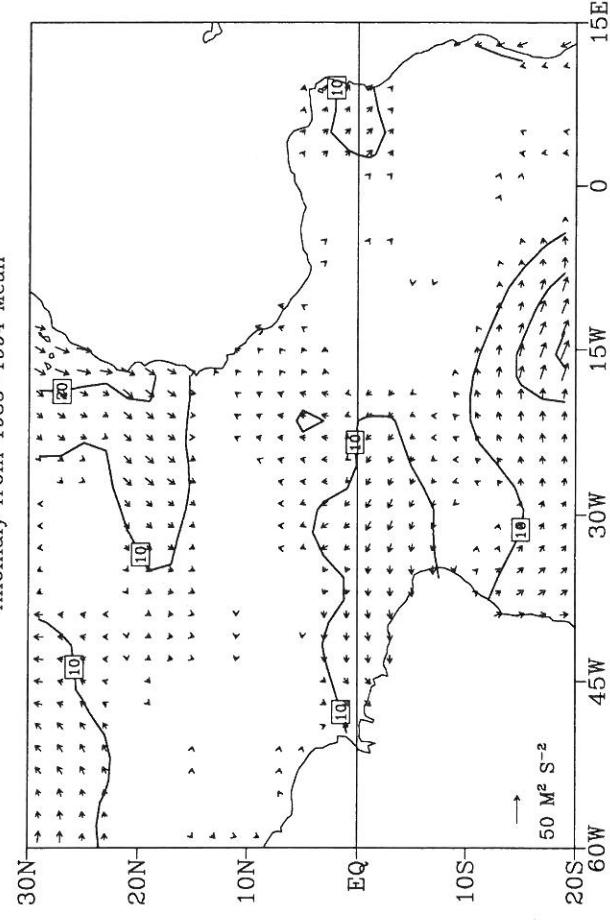
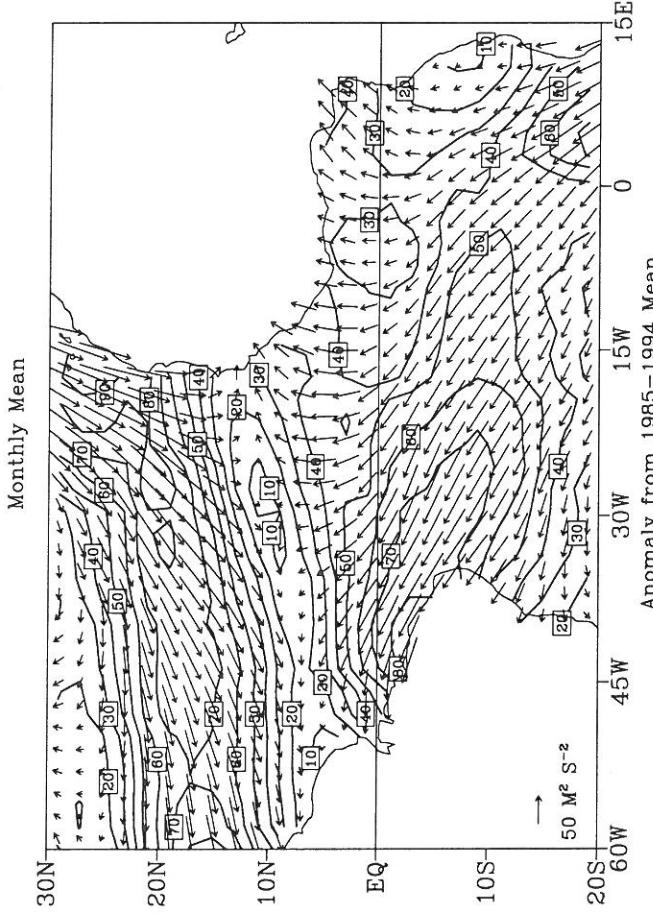
June 1993  
Pseudostress Vectors

Anomaly from 1964–1994 Mean

15E  
0  
30W 45W 60W  
30S 20S 10S EQ 10N 20N 30N

15E

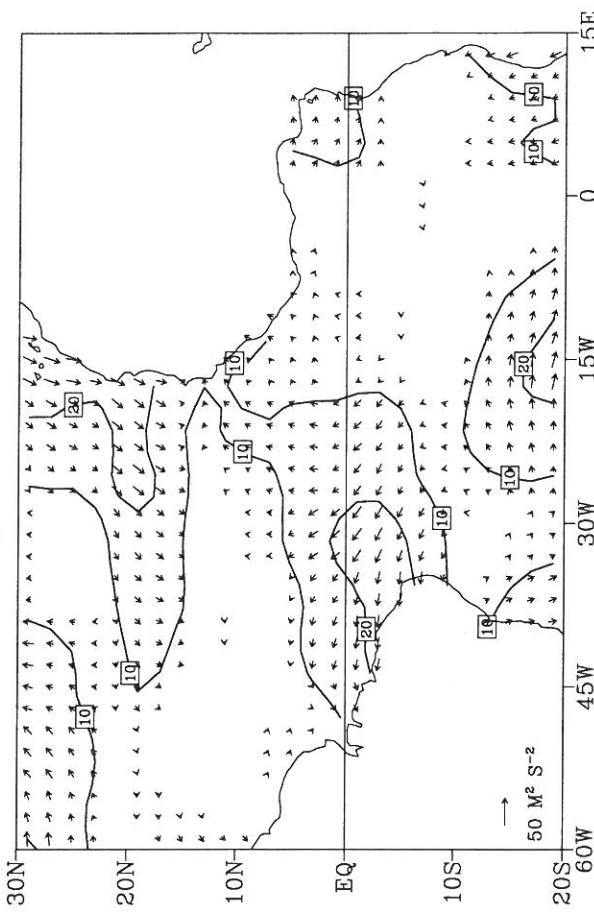
50  $\text{M}^2 \text{ s}^{-2}$



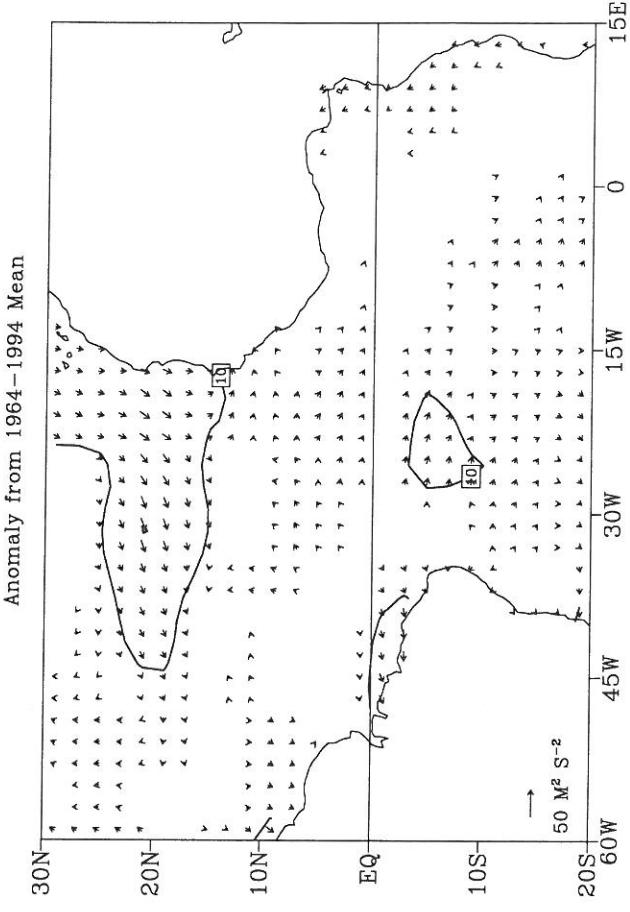
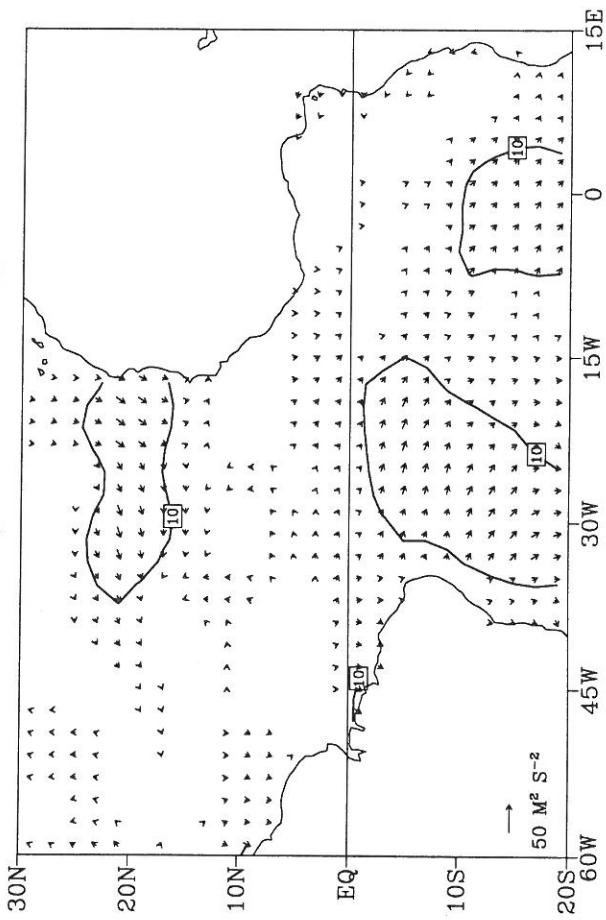
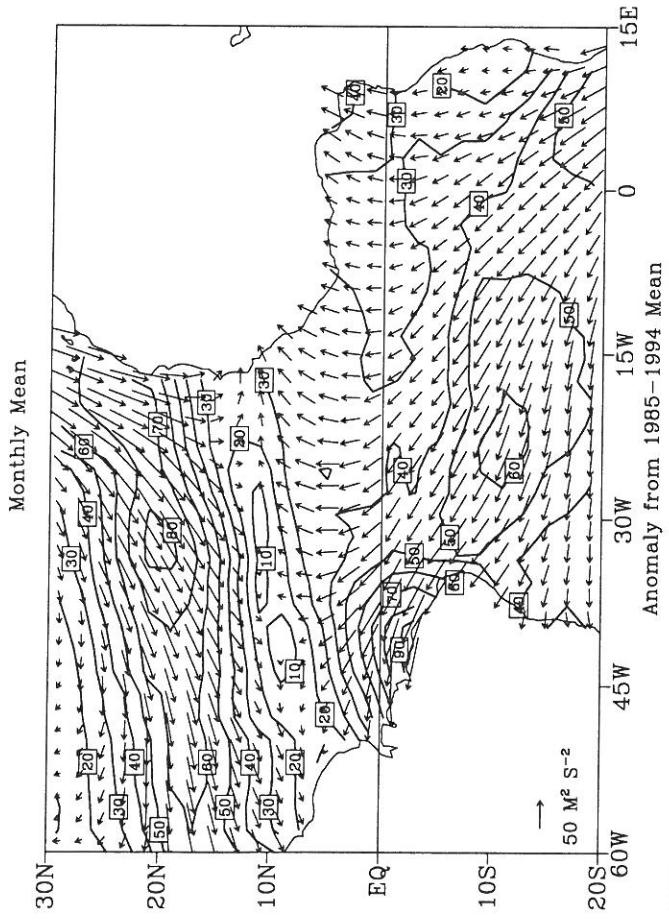
Anomaly from 1985–1994 Mean

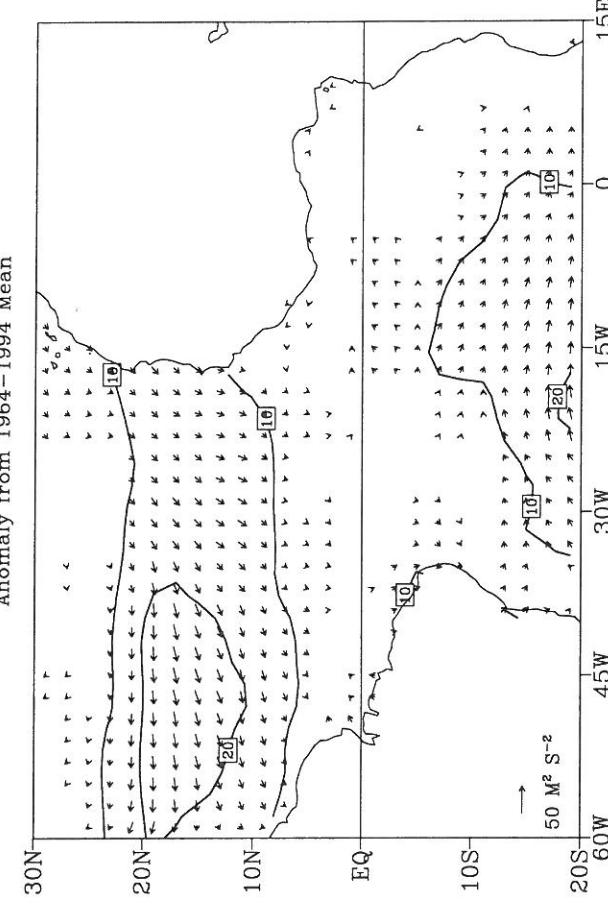
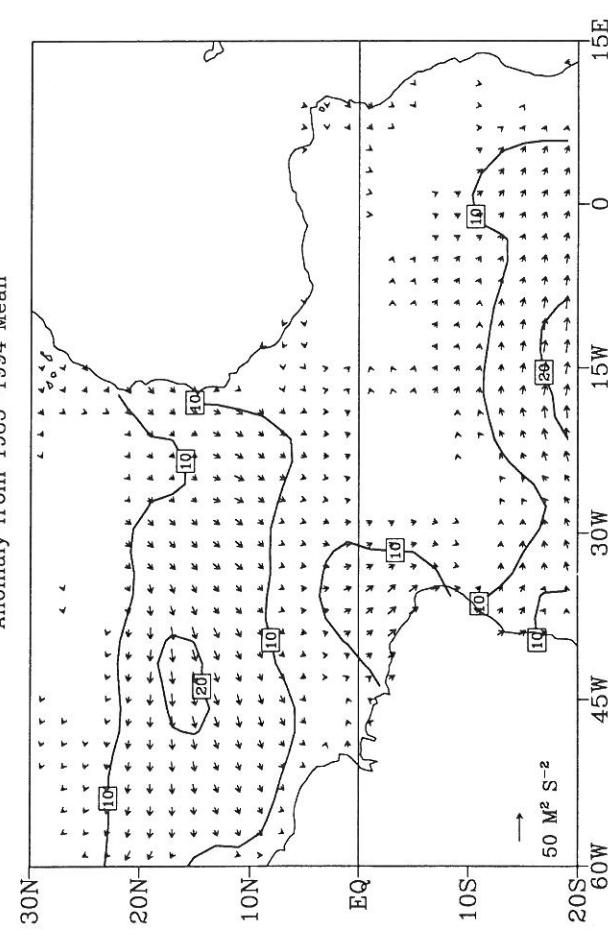
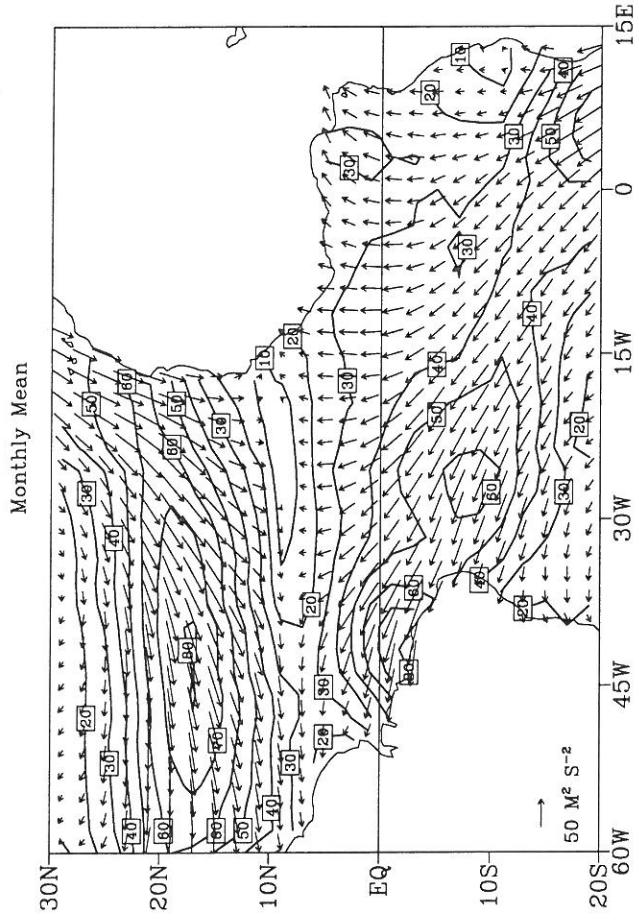


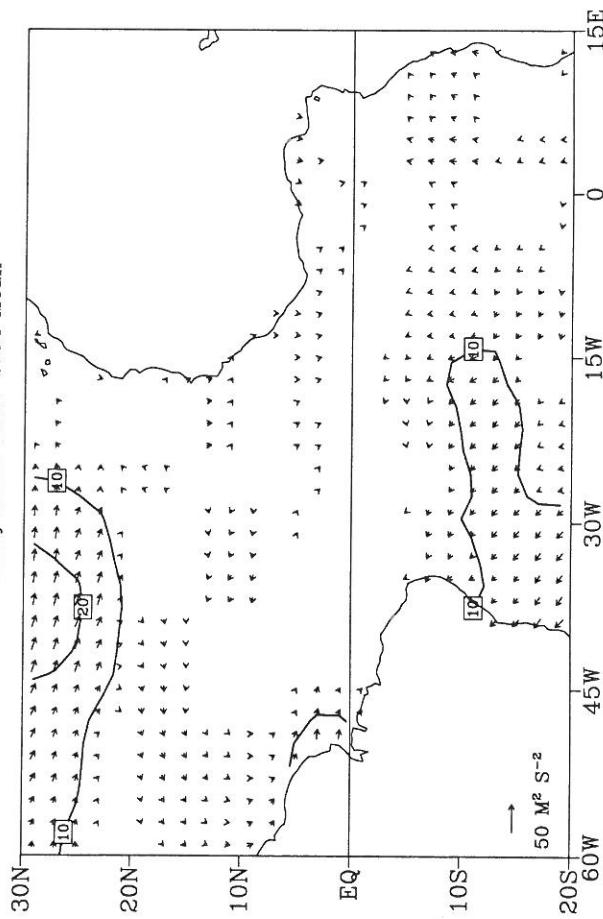
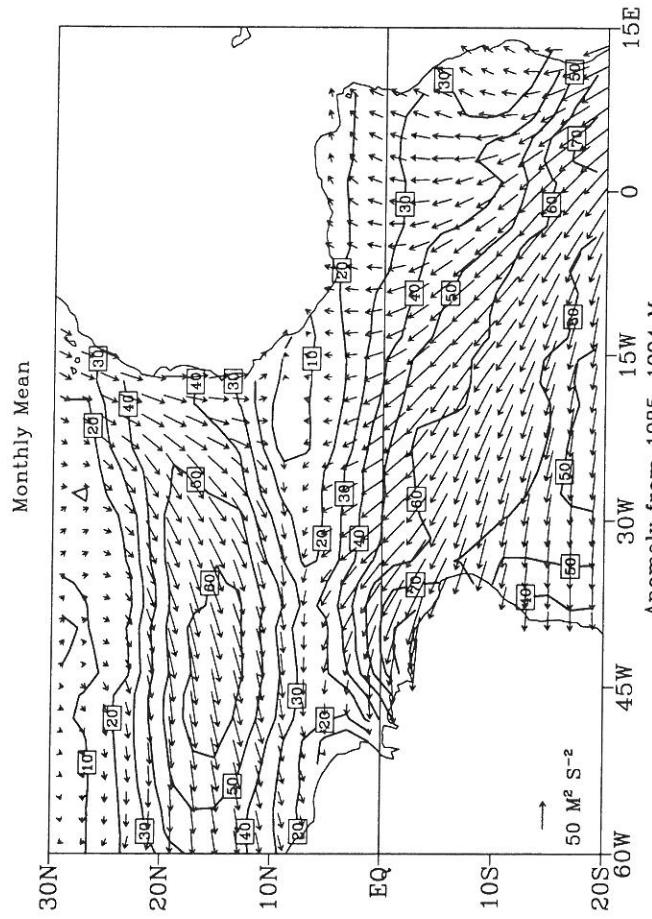
Anomaly from 1985–1994 Mean



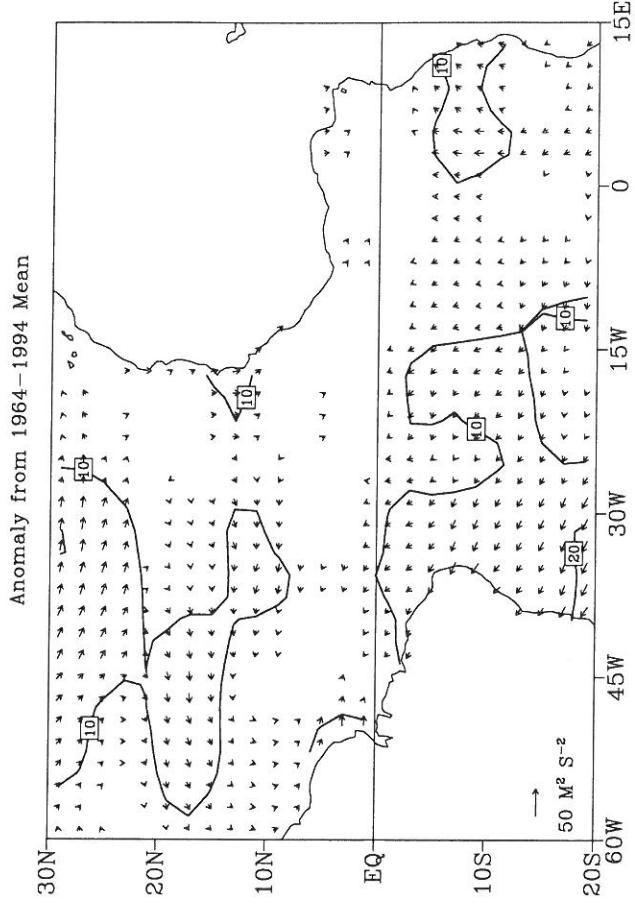
Anomaly from 1964–1994 Mean



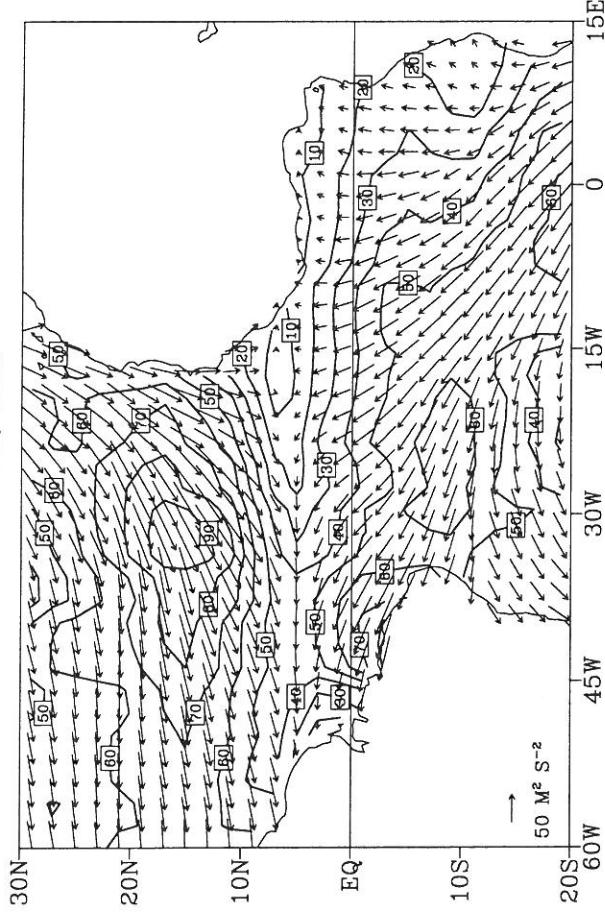




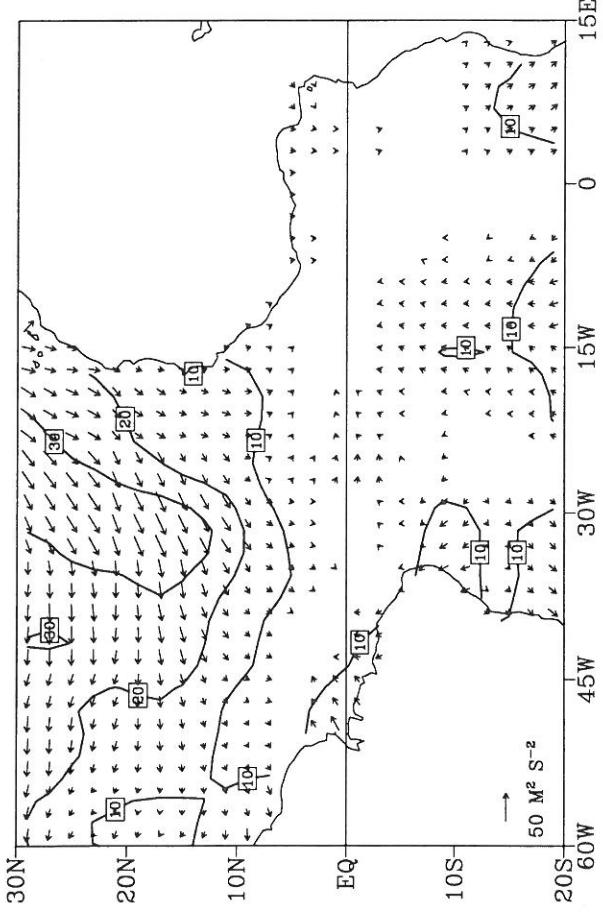
October 1993  
Pseudostress Vectors



Monthly Mean

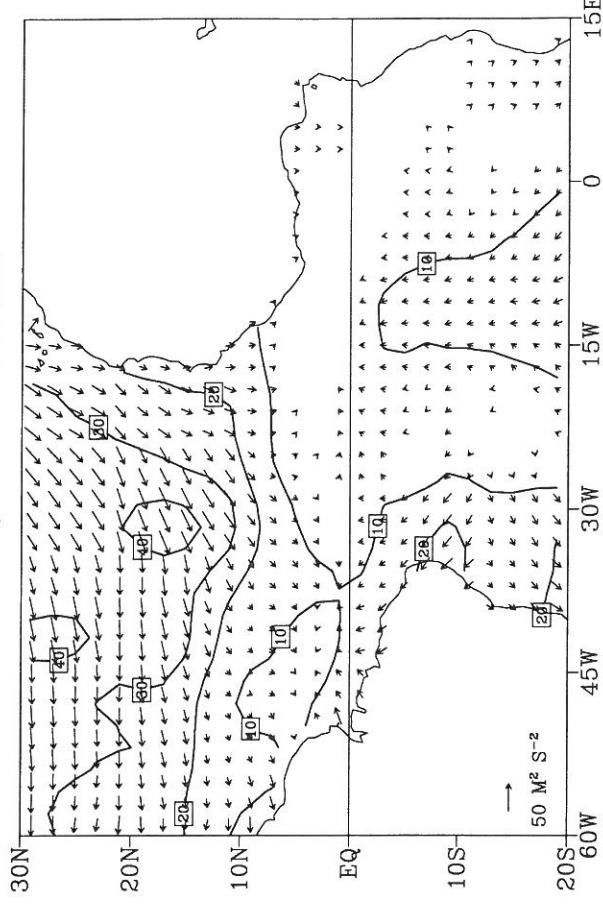


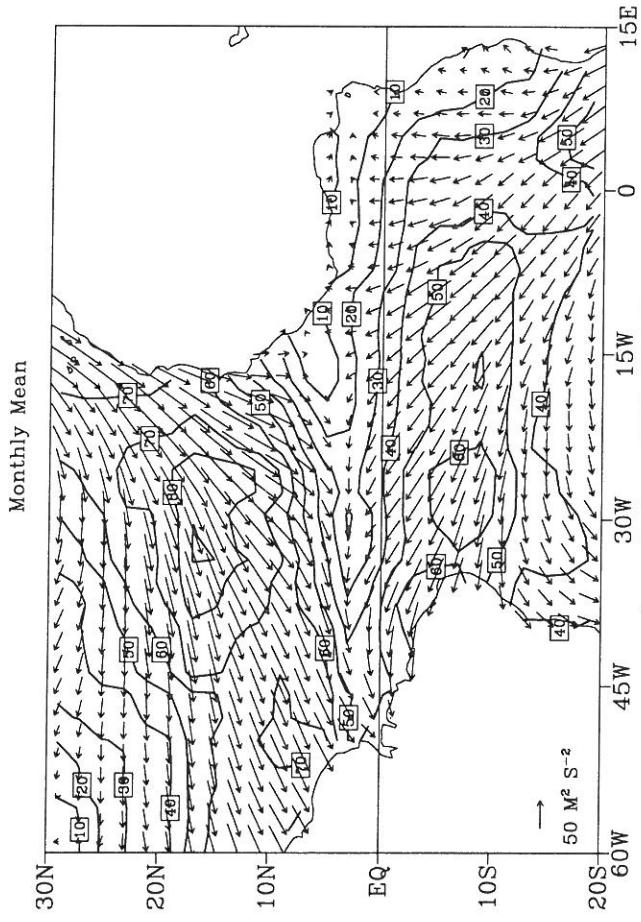
Anomaly from 1985–1994 Mean

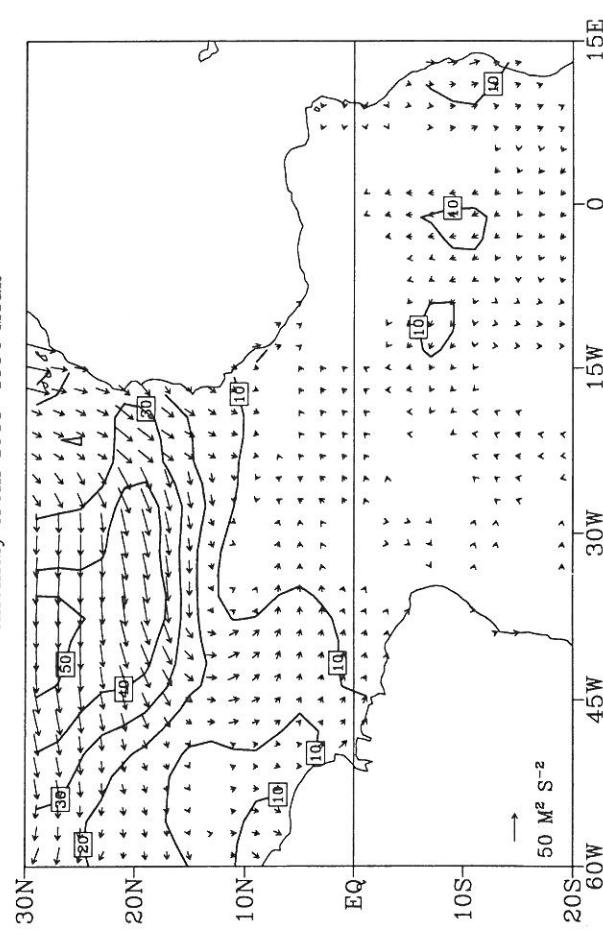
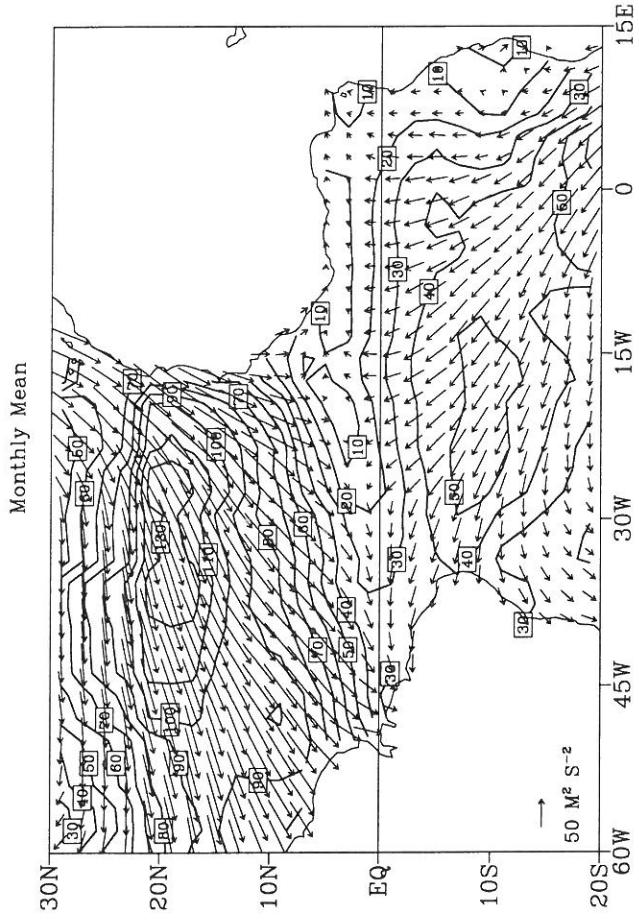


November 1993  
Pseudostress Vectors

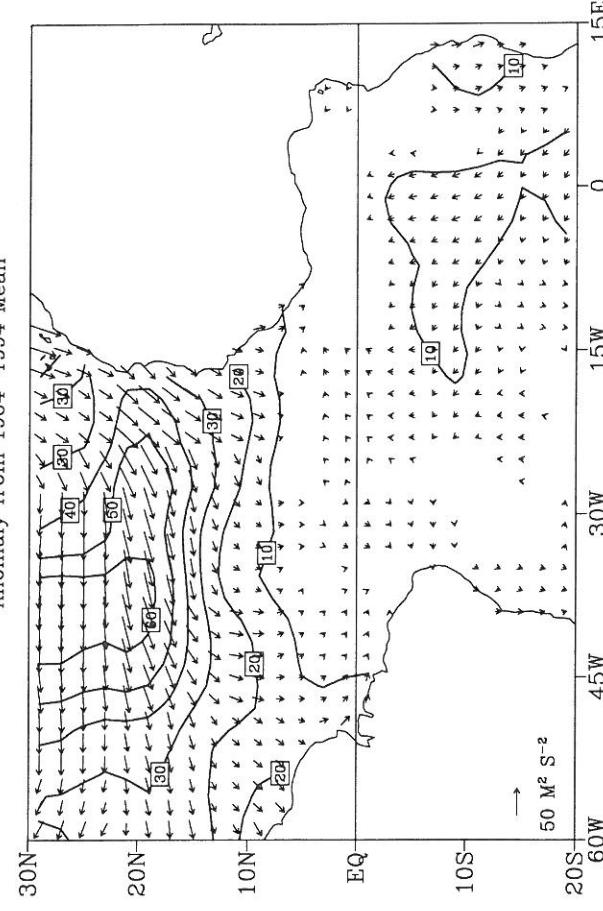
Anomaly from 1964–1994 Mean



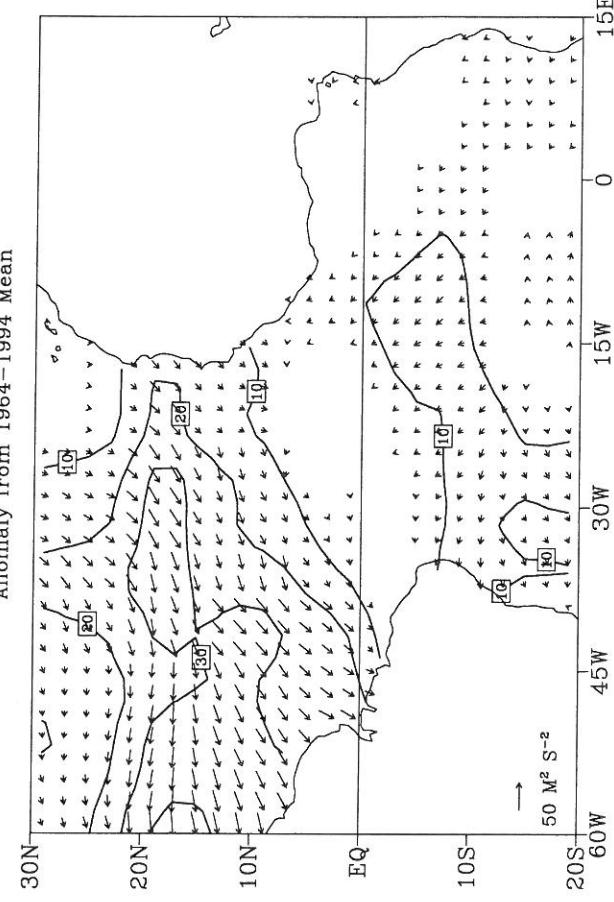
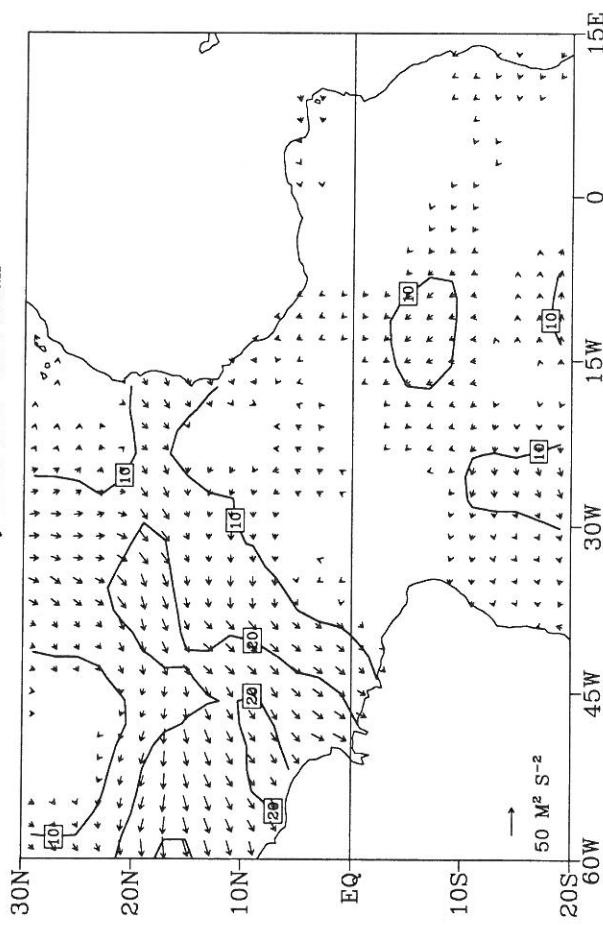
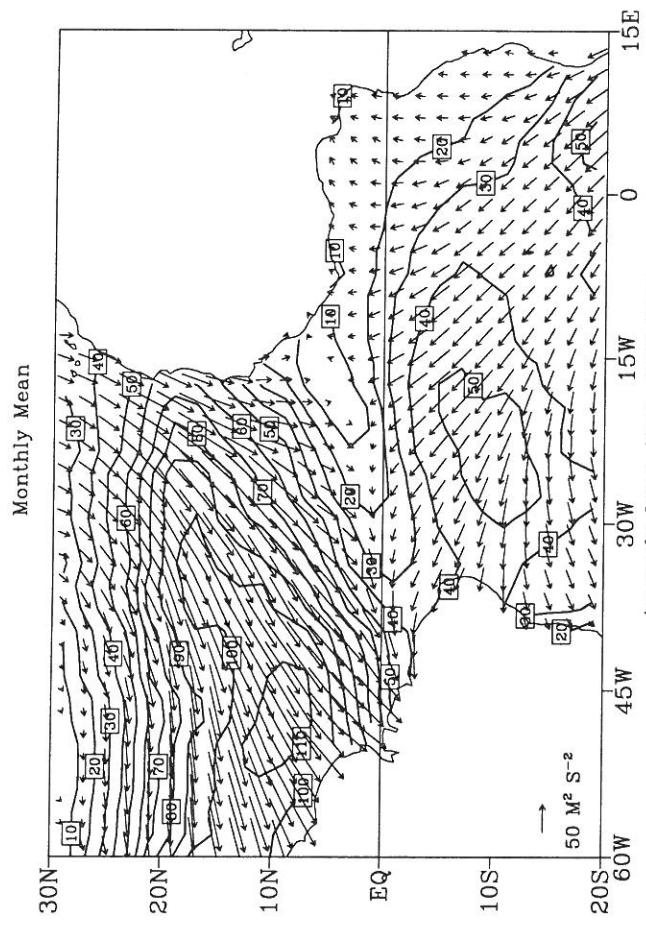


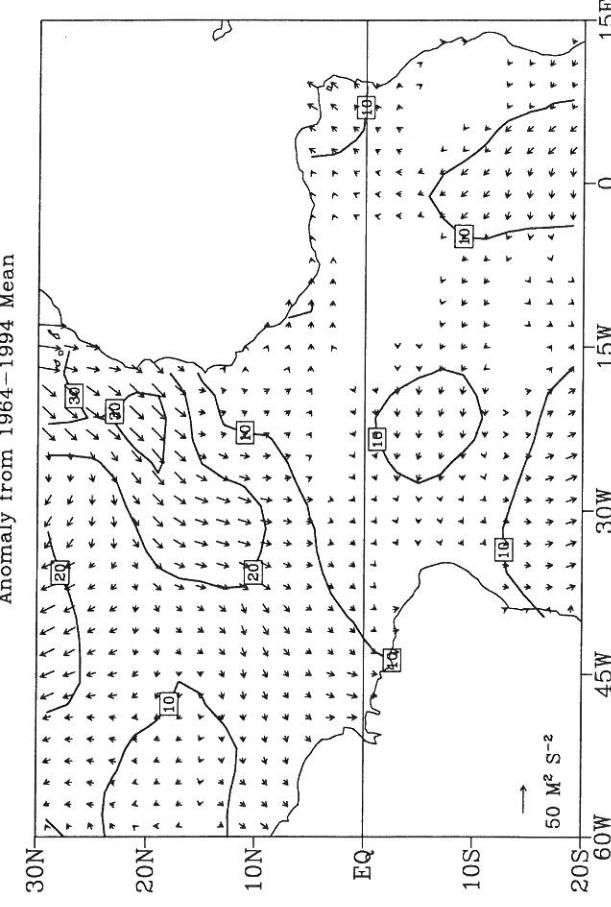
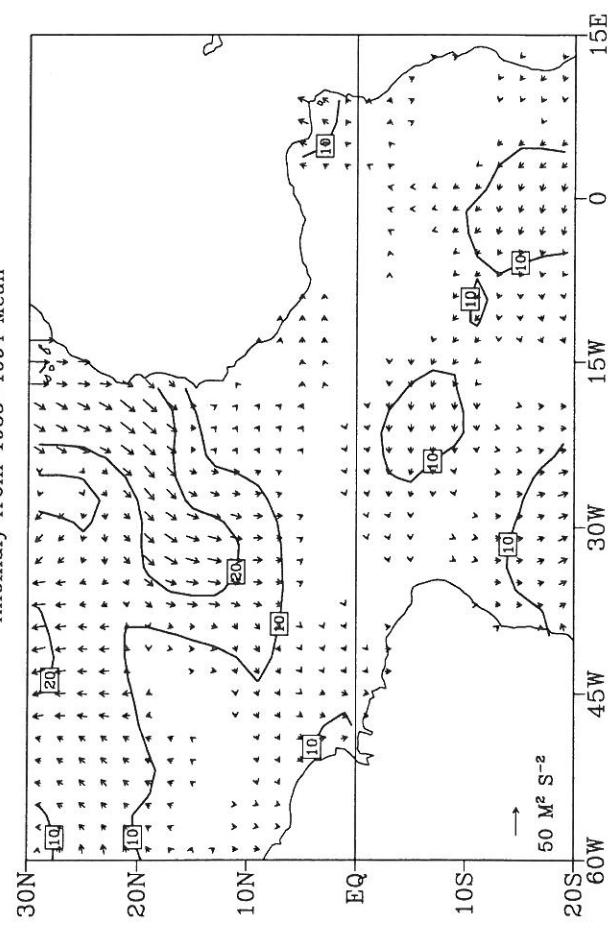
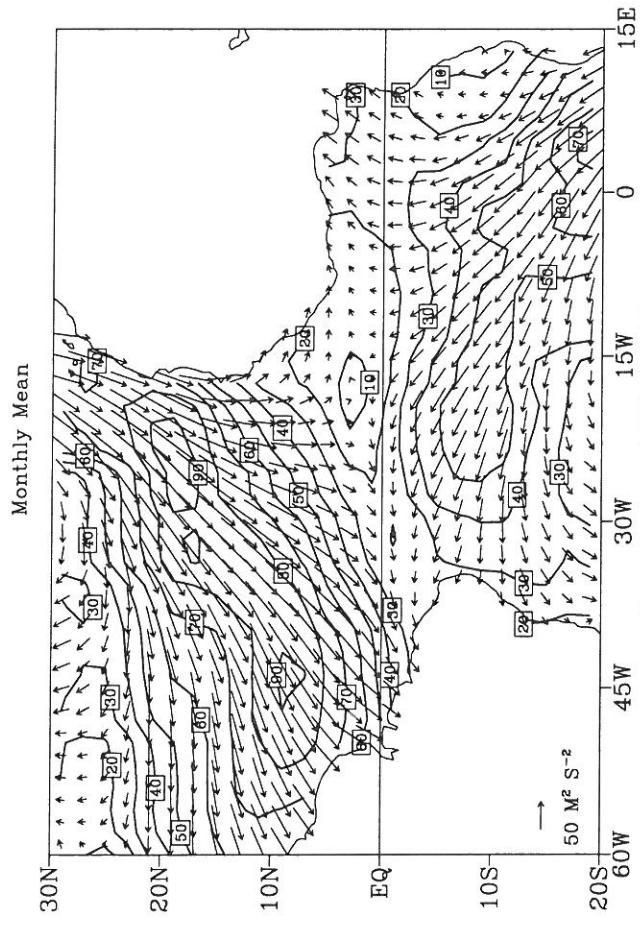


Anomaly from 1964–1994 Mean

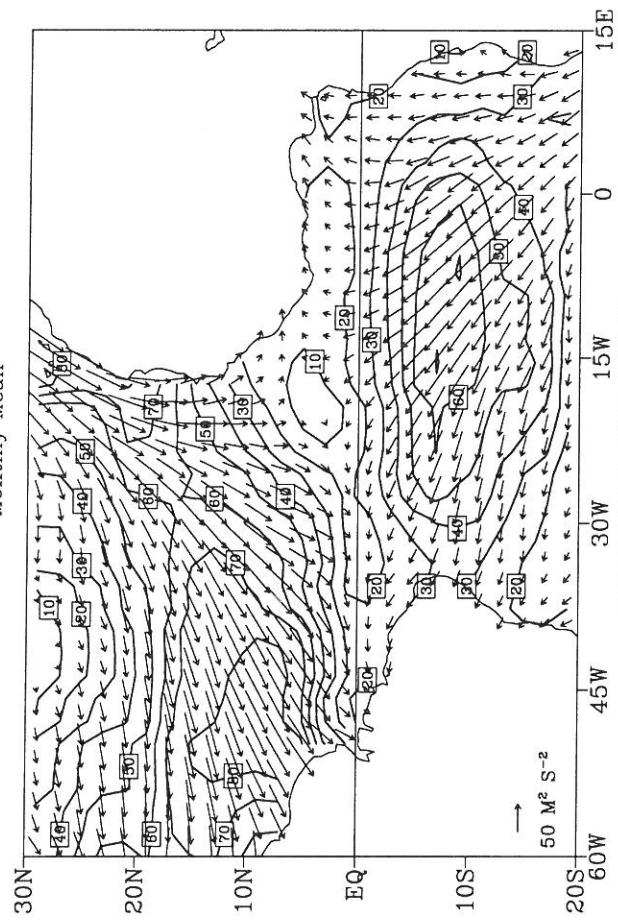


January 1994  
Pseudostress Vectors

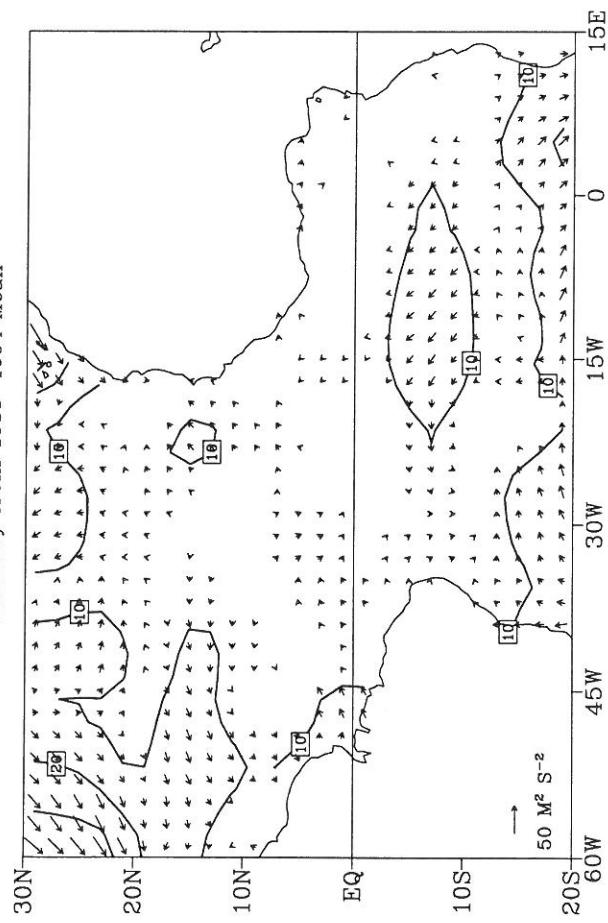




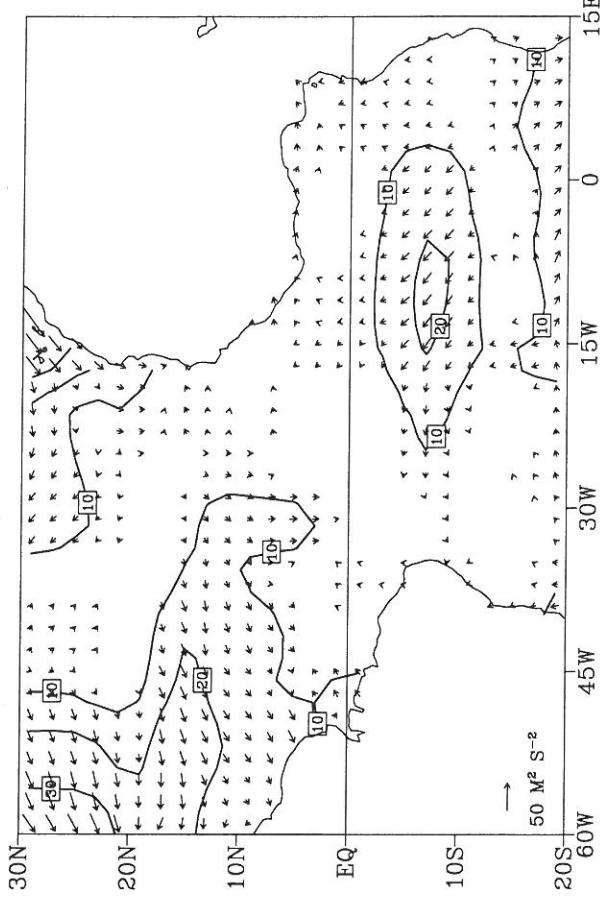
Monthly Mean

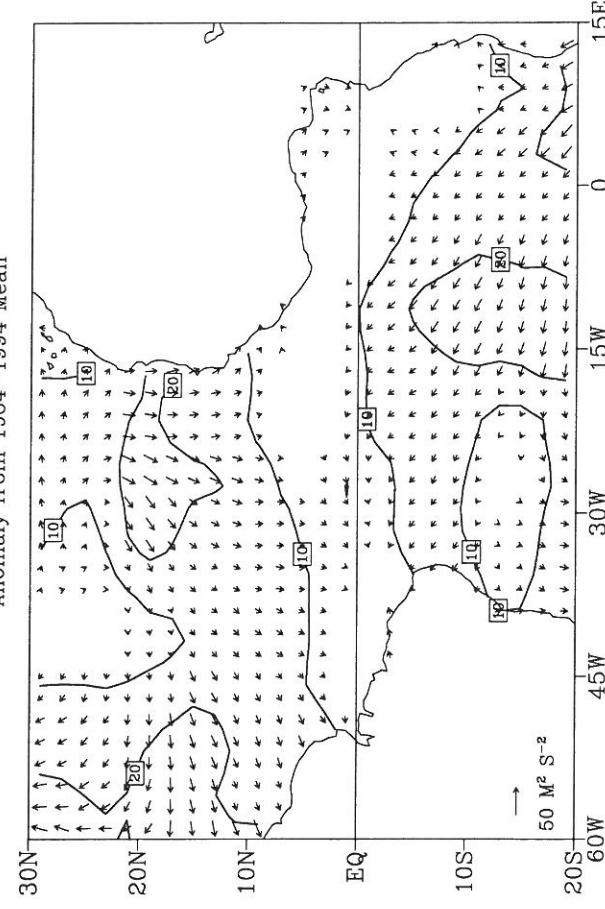
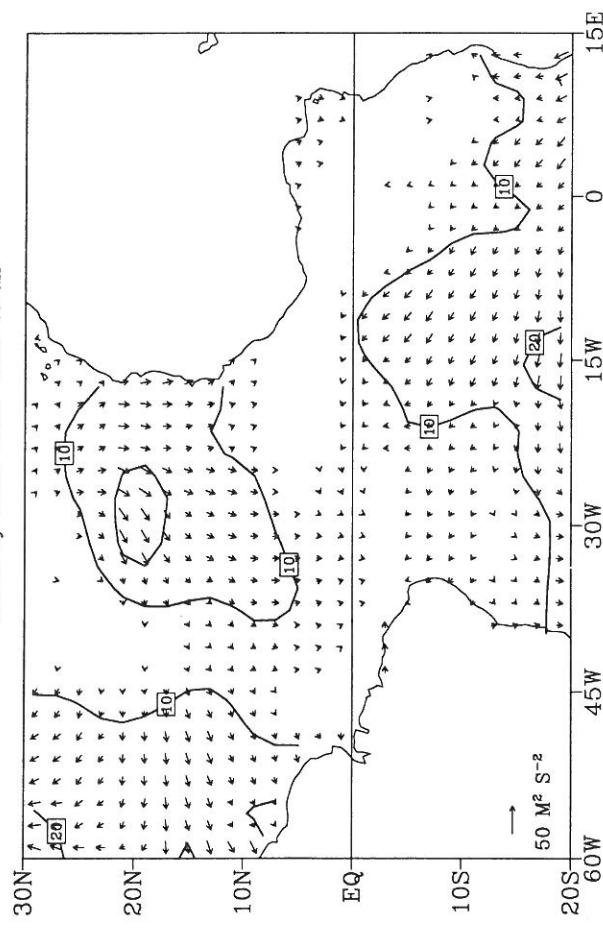
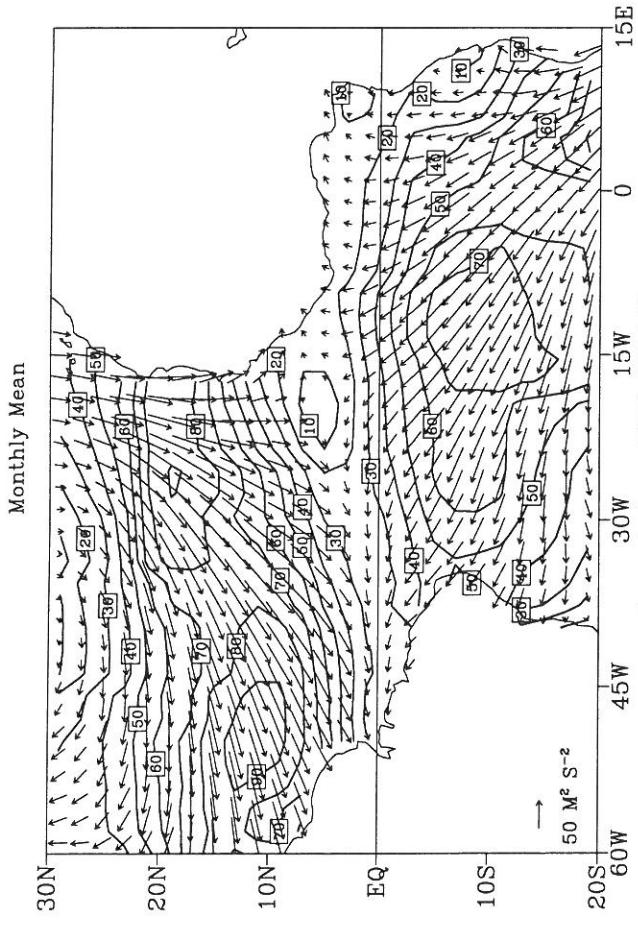


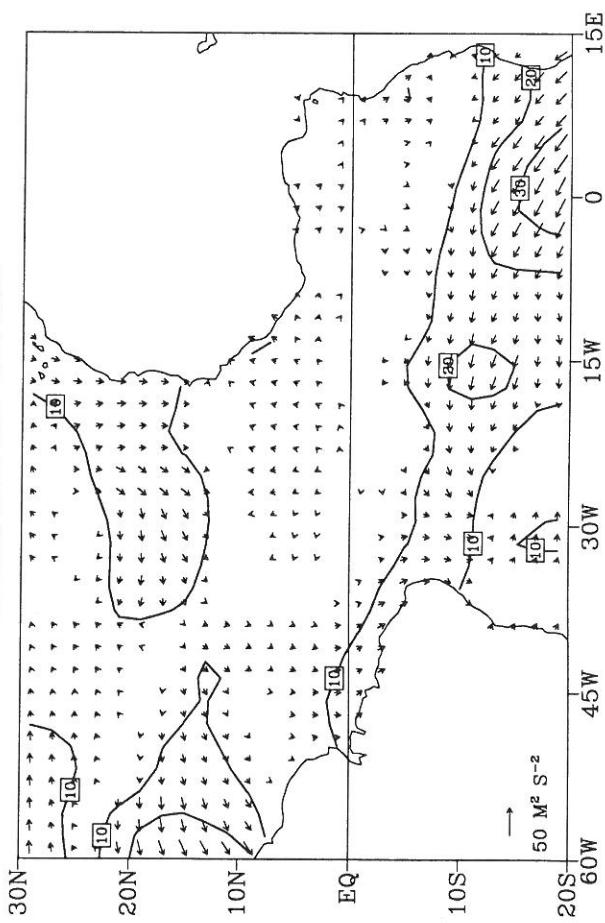
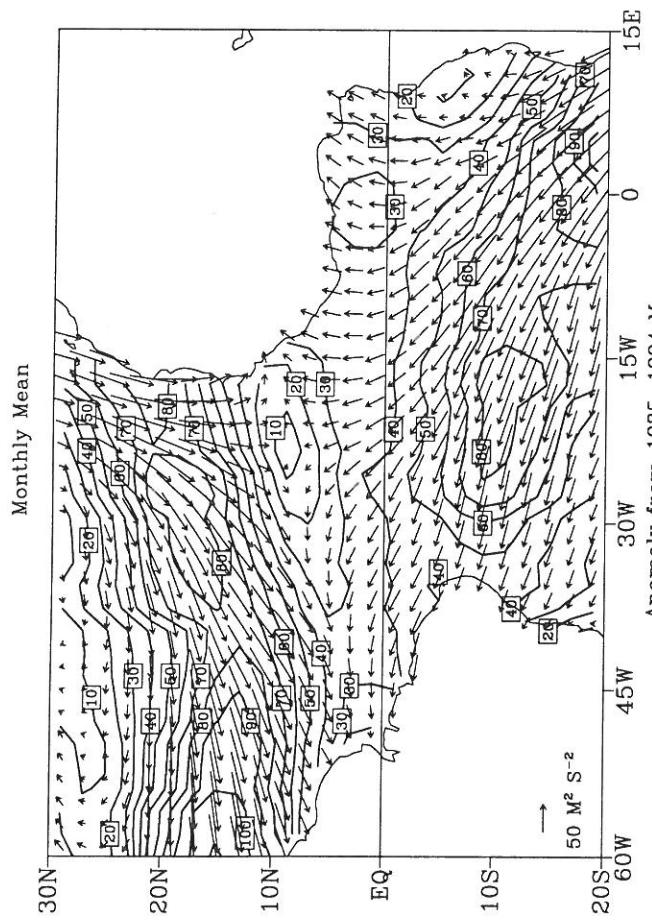
April 1994  
Pseudostress Vectors



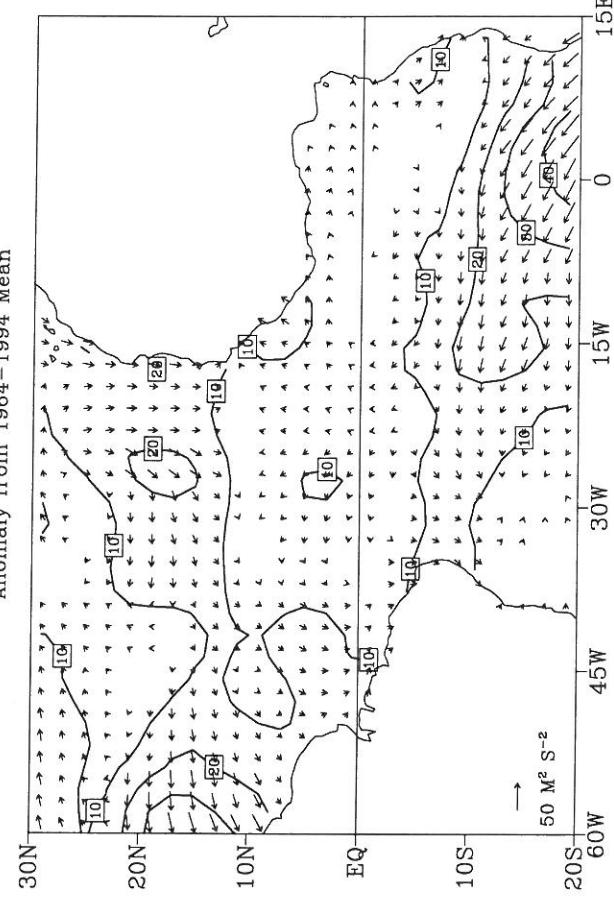
Anomaly from 1964–1994 Mean

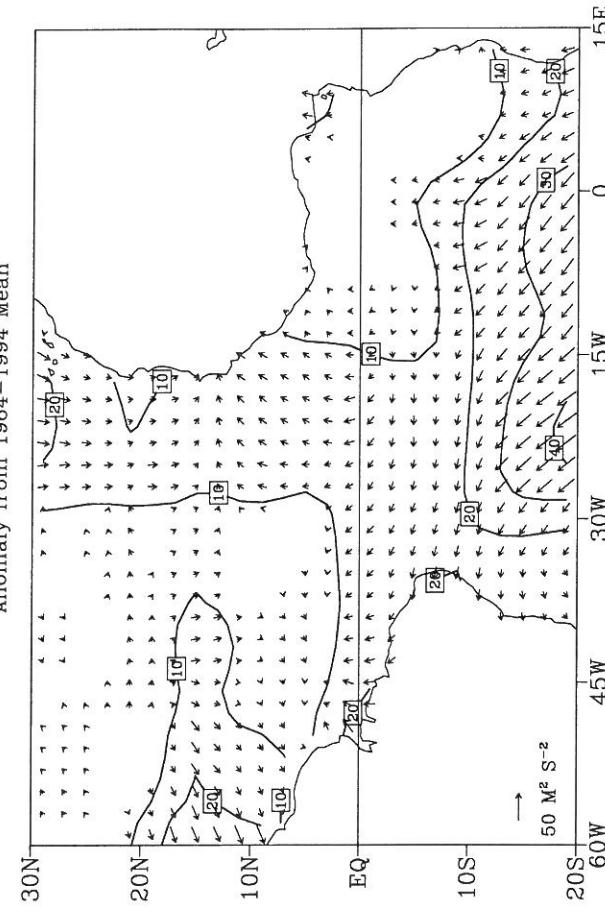
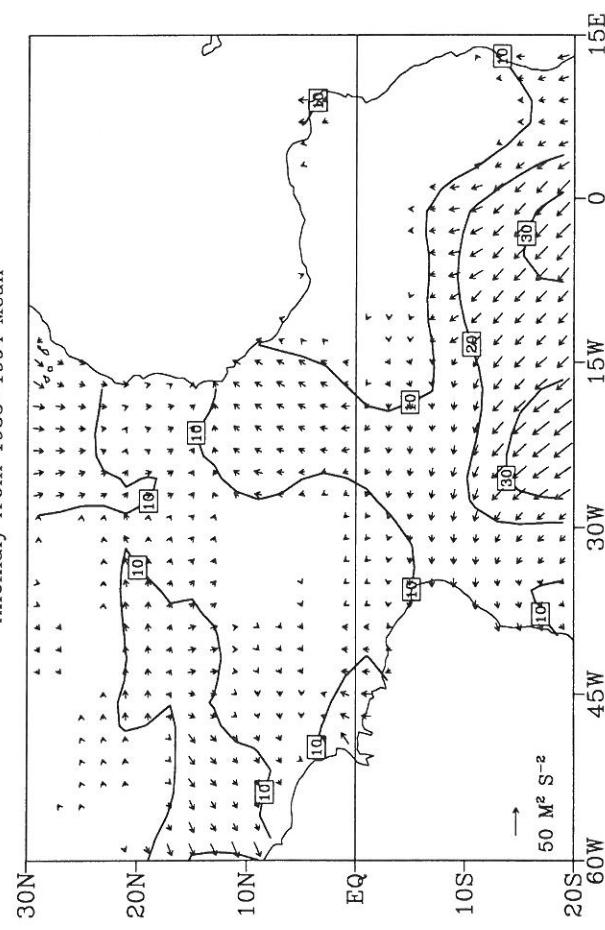
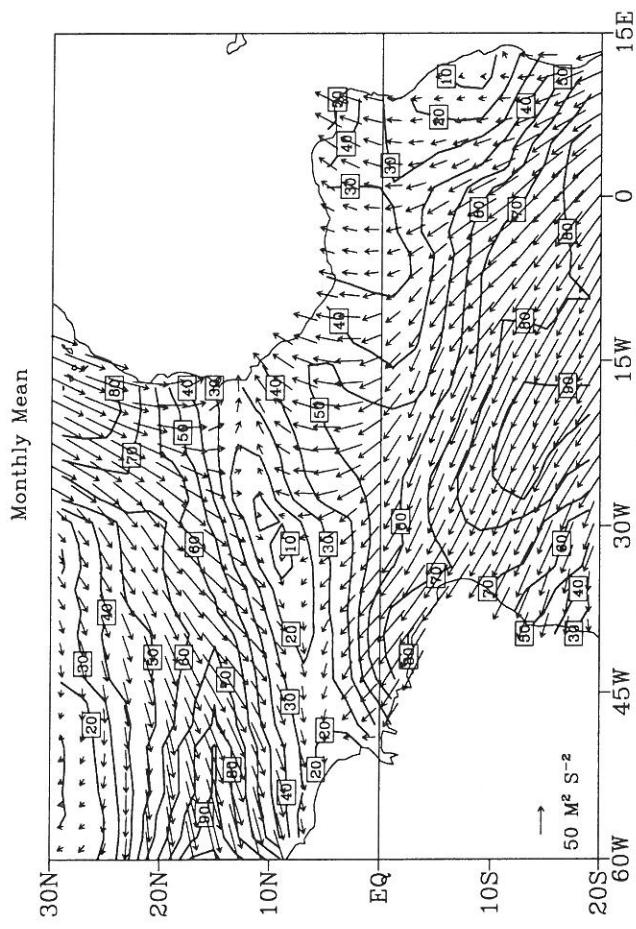


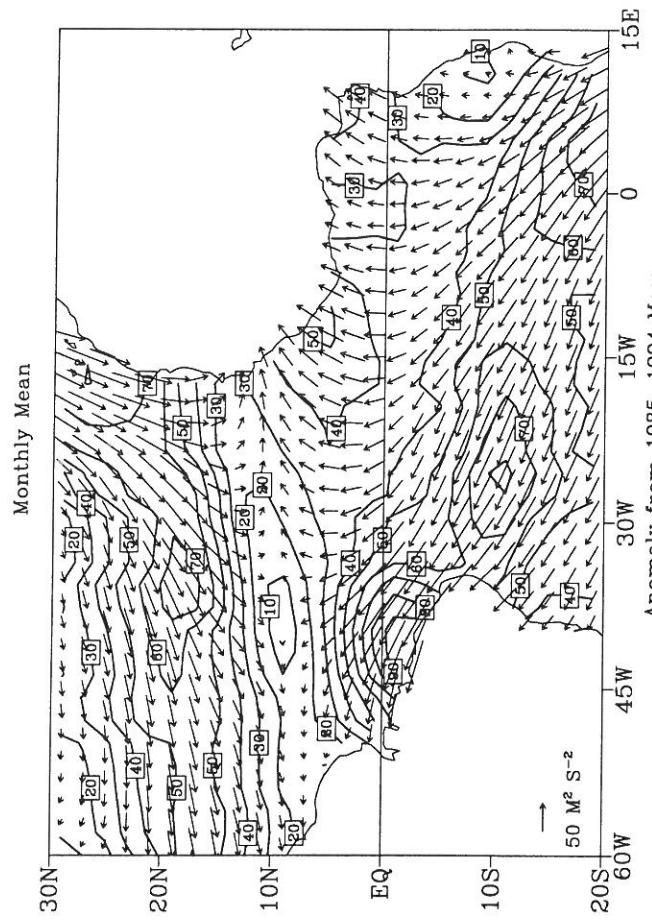




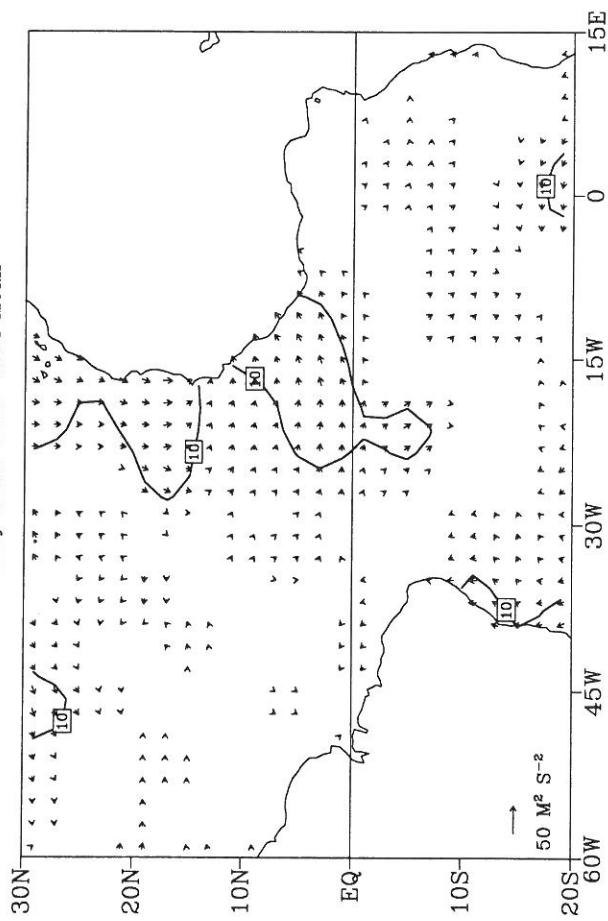
June 1994  
Pseudostress Vectors



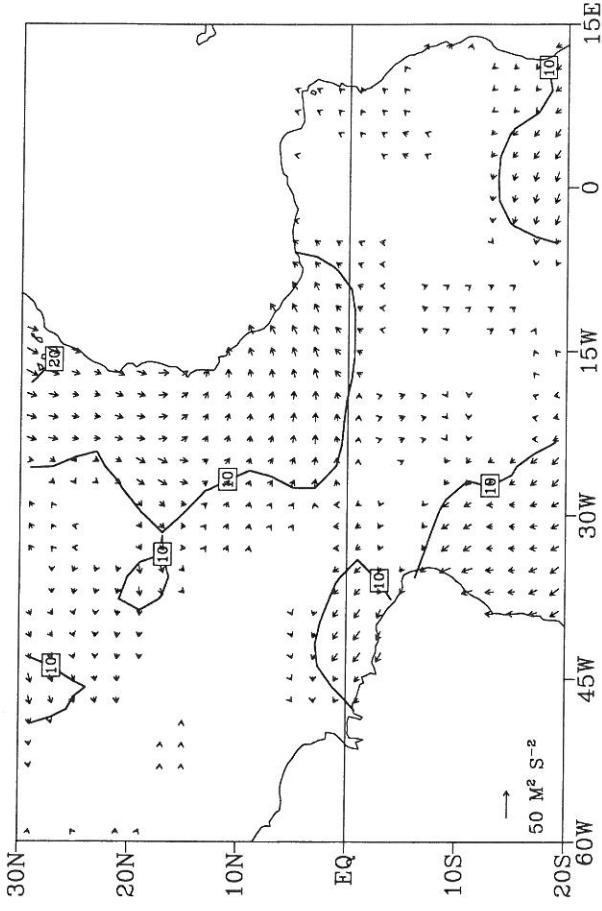




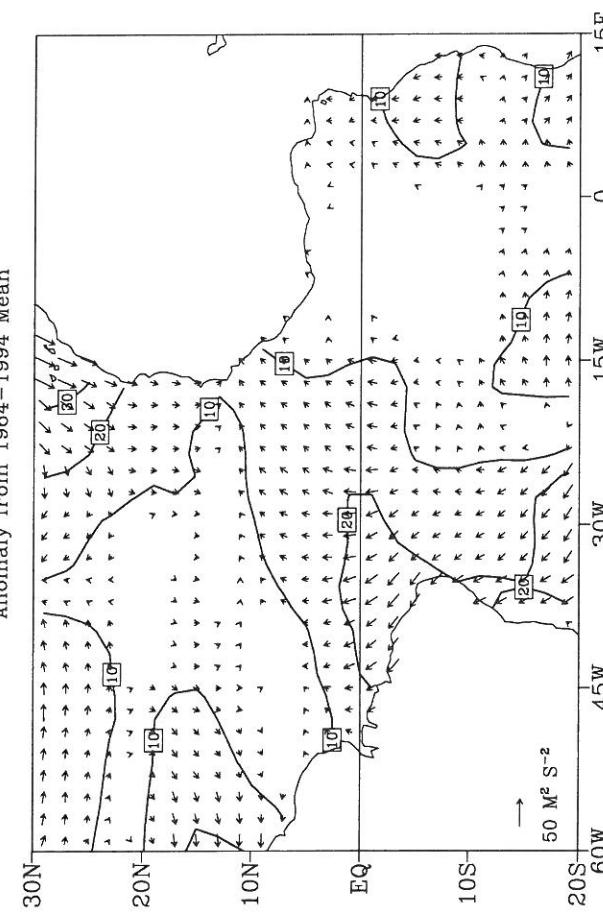
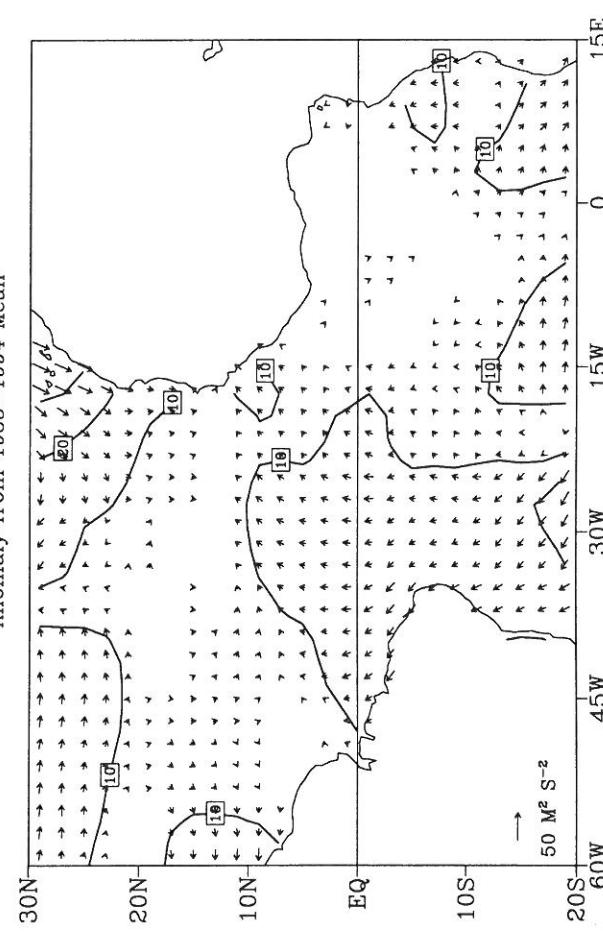
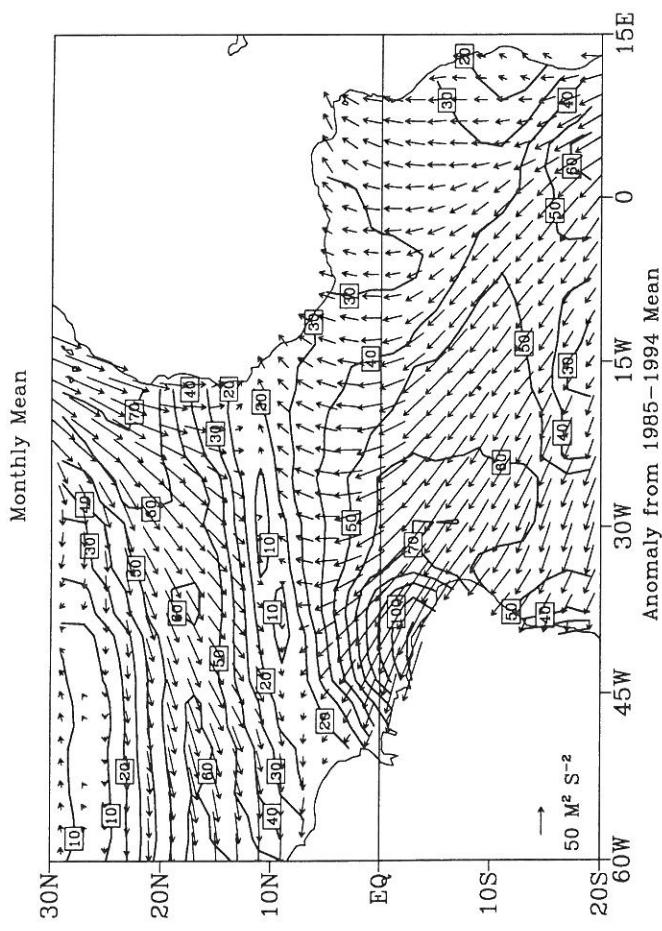
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Pseudostress Vectors

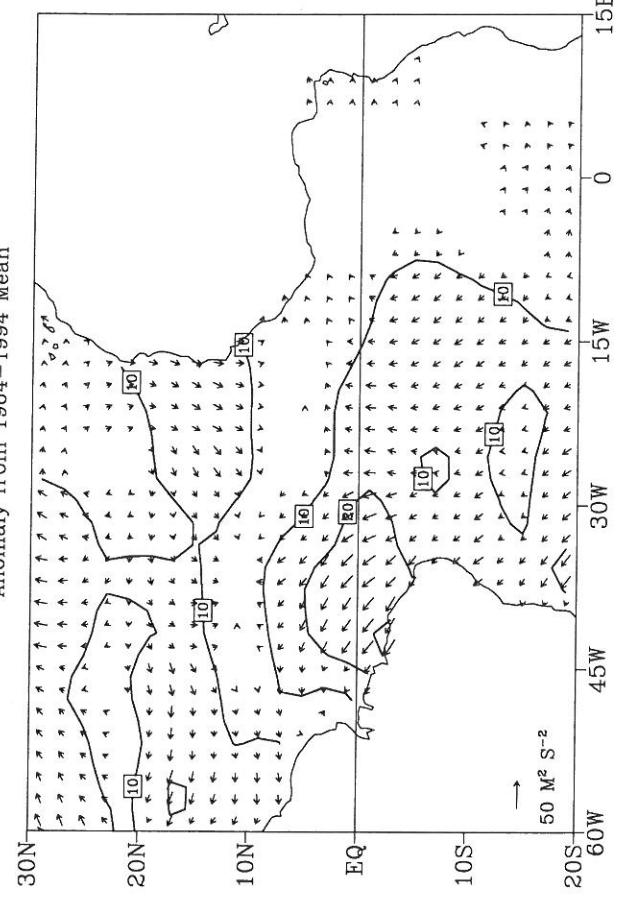
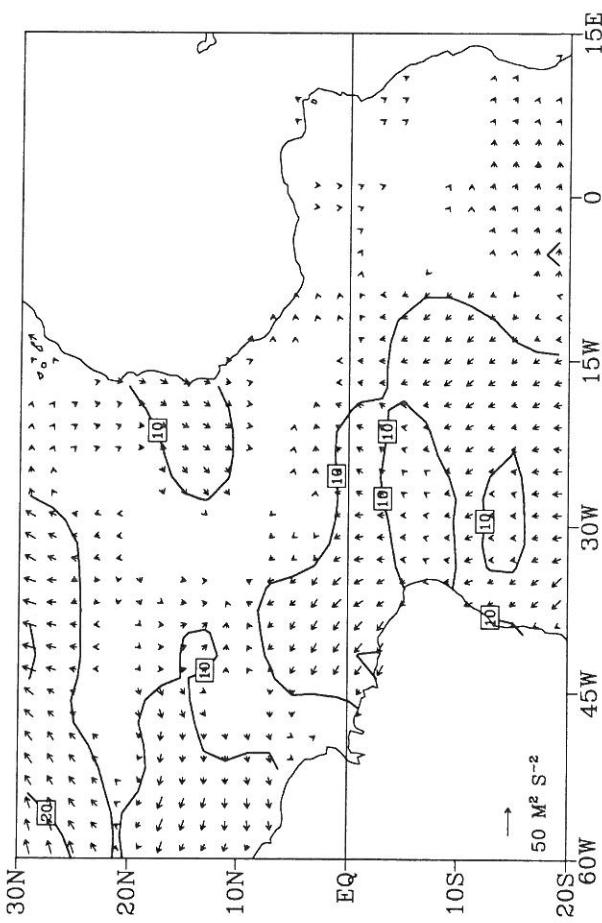
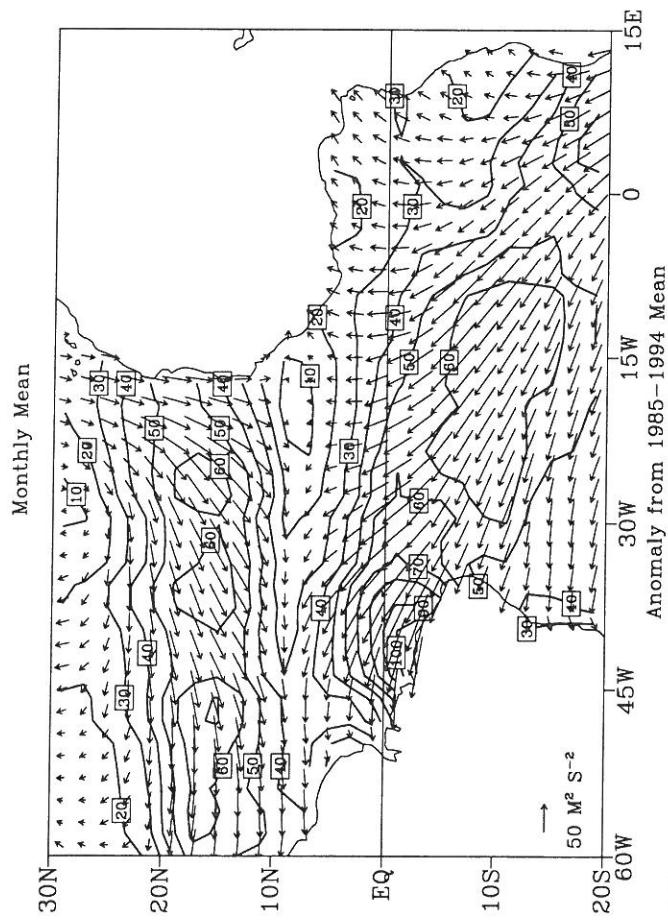


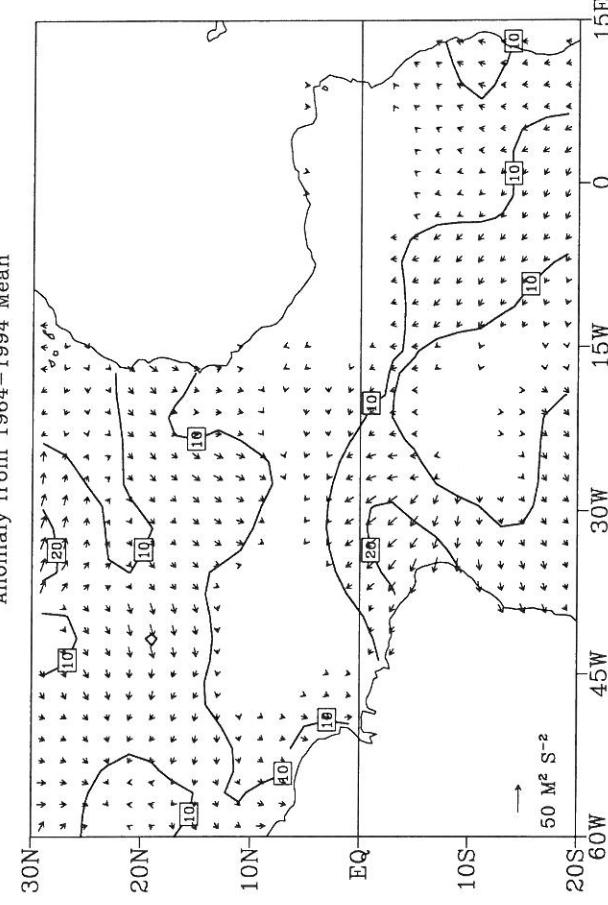
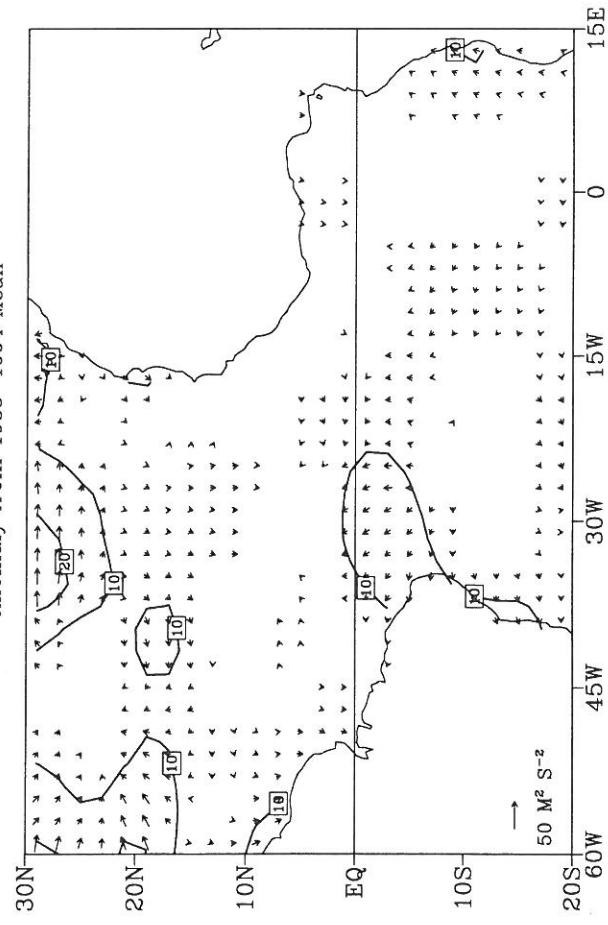
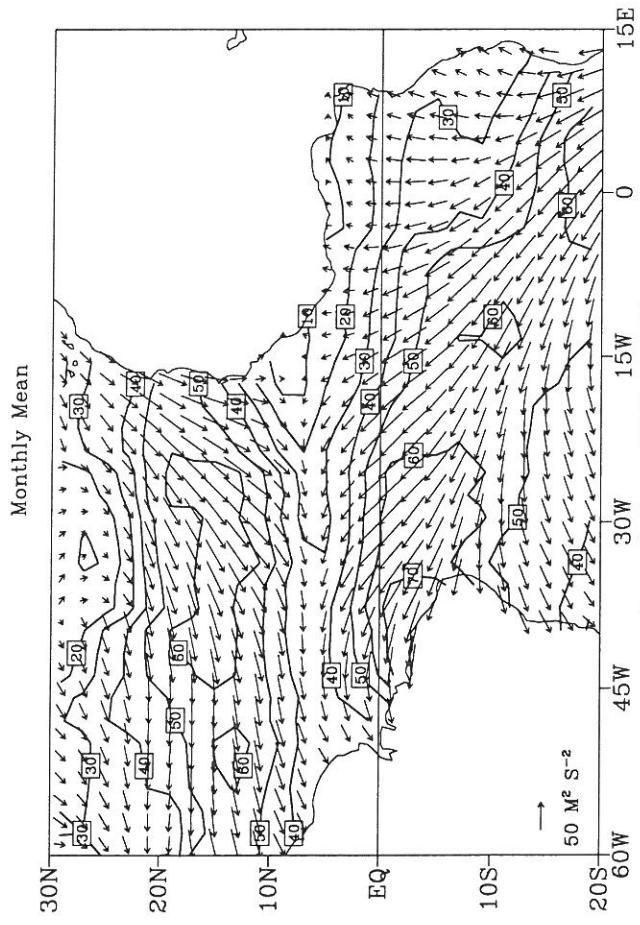
Anomaly from 1964–1994 Mean

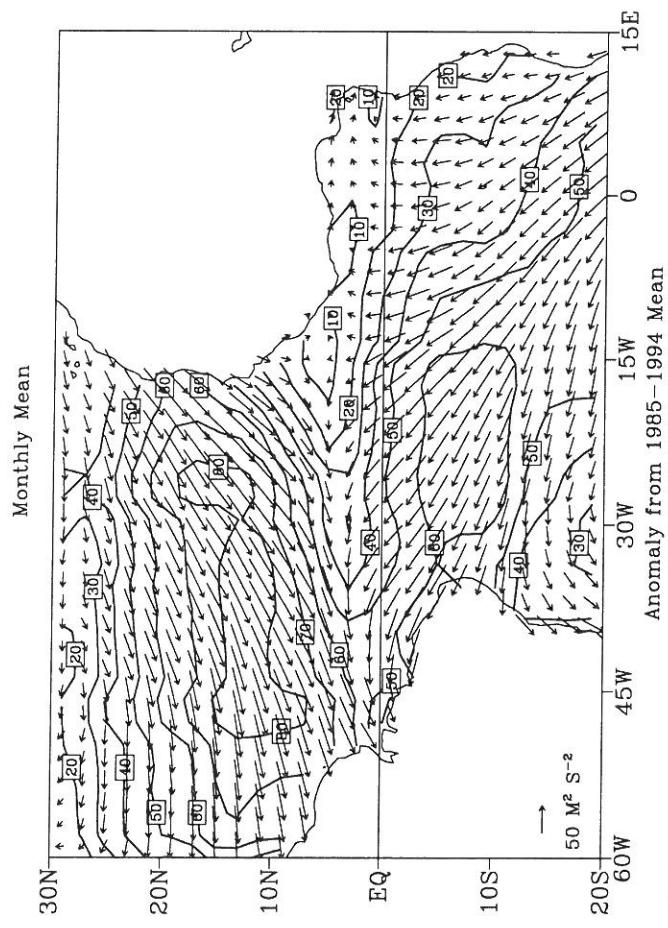


Anomaly from 1964–1994 Mean









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