

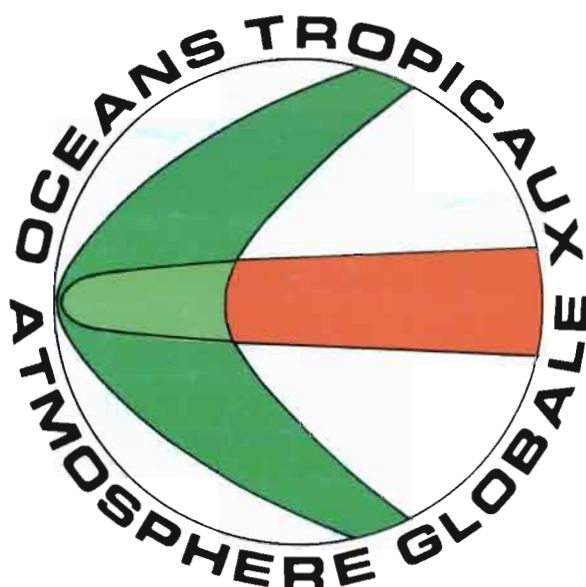
CLIMATIC ATLAS OF THE TROPICAL ATLANTIC WIND STRESS AND SEA SURFACE TEMPERATURE 1985-1989

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JUNE 1990



ORSTOM



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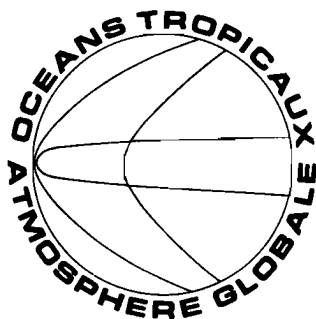
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INTRODUCTION

Cet atlas rassemble les cartes mensuelles décrivant les champs de moyennes et d'anomalies de la pseudo tension du vent (c'est-à-dire le produit des composantes du vent par un module) et de la température de la surface de la mer dans l'Atlantique tropical entre janvier 1985 et décembre 1989. Cette période couvre les cinq premières années du programme international Tropical Ocean Global Atmosphere (TOGA). Ce document fait suite à deux précédentes publications de même nature : la première concernait la période 1964-1979 (Picaut *et al.*, 1985), et la seconde décrivait la période 1980-1984 (Servain *et al.*, 1987).

Les données brutes sont issues pour une large part de mesures météorologiques de surface effectuées en routine à bord de navires marchands sélectionnés. Un nombre restreint d'observations en provenance de quelques bouées fixes ou en dérive complète l'information originale. L'ensemble de ces données transite généralement sous la forme de messages radio sur le Système Mondial de Transmission (SMT) et sont archivées en temps réel par le National Meteorological Center (NMC, Washington, DC) ou en temps différé par le National Climatic Data Center (NCDC, Asheville, NC). La sélection sur notre zone de travail, de 60°W à la cote africaine et de 30°N à 20°S, est assurée par le Mesoscale Air-Sea Interaction Group (MASIG) à Florida State University, Tallahassee, FL. Nous recevons entre 7000 et 9000 enregistrements chaque mois (Fig. 1).

Bien qu'en constante augmentation, le nombre d'enregistrements reçus en temps réel par le NMC est évidemment inférieur à celui disponible en temps différé (le délai est d'au minimum 6 mois) à partir du NCDC. En 1987 par exemple cette différence était de l'ordre de 20 %. Cependant, la perte d'information inhérente à un traitement en temps réel n'est pas dommageable dans la même proportion : certaines observations en provenance des fichiers NCDC sont redondantes (de l'ordre de 5 à 10 % des données), et l'on y observe généralement une surabondance d'information dans des régions déjà suffisamment échantillonnées. Notons finalement que la relative étroitesse du bassin tropical de l'Atlantique, en comparaison avec celui du Pacifique, explique que la densité spatio-temporelle des observations marines de surface y est deux fois plus importante.

Une description détaillée de notre système de traitement des données de vent et de température de surface de la mer peut être consultée dans Picaut *et al.*, 1985, Servain *et al.*, 1984, 1985 et 1987. Rappelons brièvement que notre méthode de traitement est basée sur une combinaison d'analyses objectives et subjectives. Les données sont d'abord moyennées et testées à l'intérieur de pavés rectangulaires de 5° de longitude par 2° de latitude. Pour chaque variable et chaque pavé, les observations individuelles considérées comme étant aberrantes – suivant les différents critères de nos tests statistiques – sont éliminées, corrigées ou conservées en les comparant, non seu-

lement à la climatologie du mois considéré, mais aussi aux valeurs du même type associées aux pavés environnants. Cette procédure permet une meilleure critique des données de base dans le cas d'événements particulièrement anormaux. Une analyse objective itérative faisant intervenir la répartition spatiale des données (Cressman, 1959) permet d'obtenir pour chaque variable des champs mensuels selon un maillage régulier et sans trous de 2° par 2°. Finalement, les champs d'anomalies sont calculés en se référant à une climatologie mensuelle. Dans le cas de cet atlas nous avons utilisé notre climatologie la plus récente, c'est-à-dire celle couvrant la période 1964-1989 (voir ici les pages 1 à 13). Cette climatologie est très peu différente de la précédente basée sur la période 1964-1984 (voir les figures 3 à 15 dans Servain *et al.*, 1987).

La méthode de traitement a été utilisée de façon identique pour la réalisation de l'ensemble des cartes présentées dans cet atlas. Cependant, si les données brutes en provenance du NCDC – reçues en différé par année entière – ont été exploitées pour le calcul des années 1985 et 1986, une adaptation de notre chaîne de traitement a permis d'utiliser depuis janvier 1987 les données brutes mensuelles sélectionnées par le MASIG-FSU à partir d'une acquisition effectuée en temps réel par le NMC.

Les données concernant les années 1985, 1987 et 1988 ont été traitées au Centre ORSTOM de Brest. Celles relatives aux années 1986 et 1987 ont été traitées à l'Instituto de Pesquisas Espaciais (INPE) de São José dos Campos, SP, Brésil. Les dessins originaux ont été réalisés au Joint Institut for Marine and Atmospheric Research (JIMAR) à l'Université d'Hawaï, Honolulu, HI.

INTRODUCTION

Monthly mean and anomaly fields of pseudo wind stress (the wind component x the magnitude) and sea surface temperature of the tropical Atlantic Ocean from January 1985 thru December 1989, are presented in this atlas. This period coincides with the first five years of the international Tropical Ocean Global Atmosphere (TOGA) program. This is an update of the two atlases covering the periods 1964-1979 (Picaut et al., 1985) and 1980-1984 (Servain et al., 1987).

Most of the raw data are measurements made on ship of opportunity. The rest is from fixed or drifting buoys. The data are transmitted over the Global Telecommunication System (GTS) and recorded in real time by the National Meteorological Center (NMC, Washington, DC), or in delayed time 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 Mesoscale Air-Sea Interaction Group (MASIG) at Florida State University, Tallahassee, FL. We receive between 7000 and 9000 records for each month (Fig. 1).

Though continuously increasing, the number of real time reports collected by NMC is of course less than that of the delayed mode data available (after at least 6 months) at NCDC. In 1987 for instance, the difference was about 20 %. However, this difference does not affect significantly the reliability of the real time analysis : in fact 5 to 10 % of the observations in the NCDC data set are redundant and most of the extra information is recovered 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.

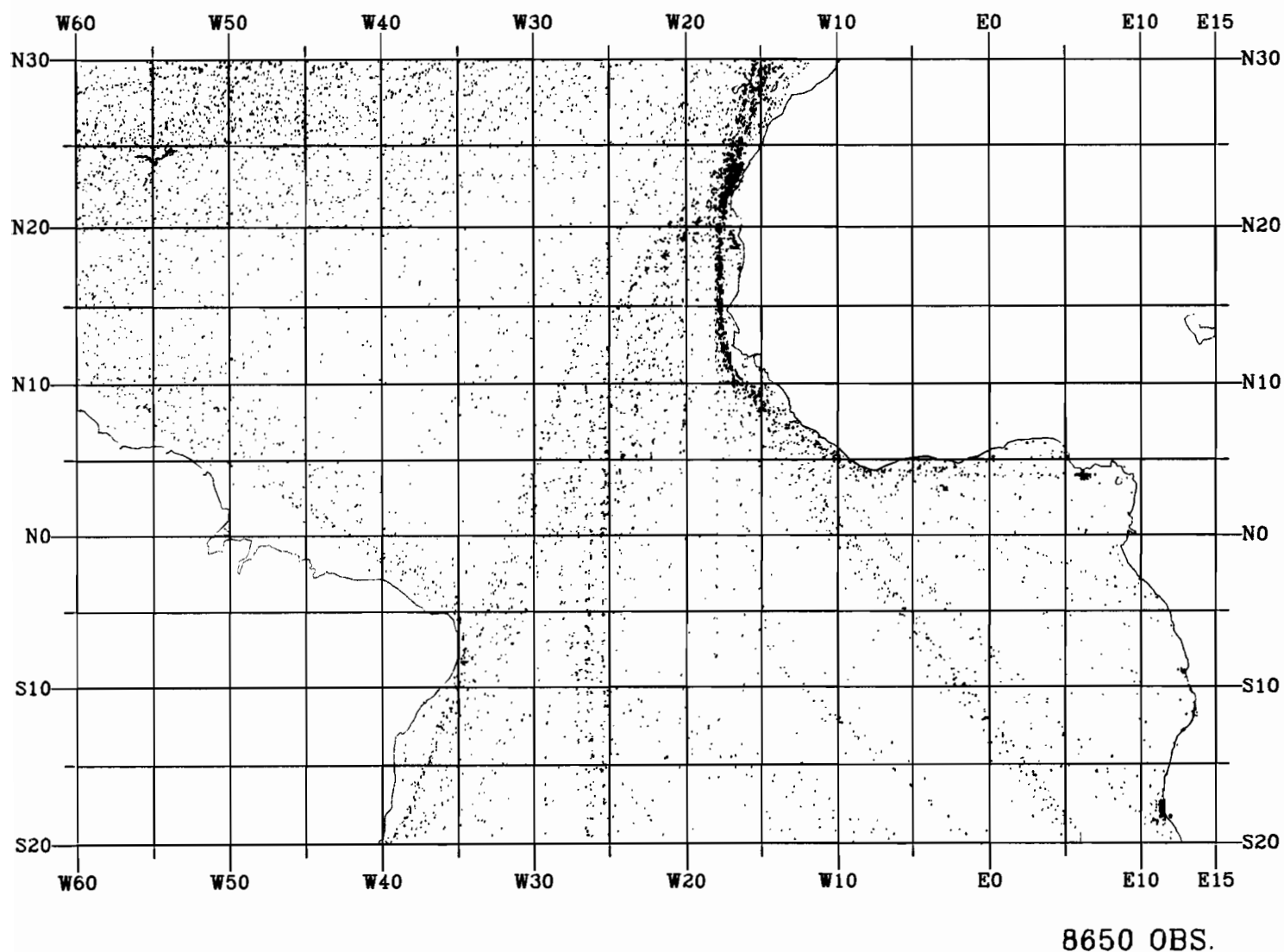
Details of the data processing method to calculate the monthly pseudo wind stress and sea surface temperature fields can be found in Picaut et al., 1985, Servain et al., 1984, 1985 and 1987. Briefly summarized, this method is based on a combination of objective and subjective analysis. The data are first 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 from rejecting the 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 base. Finally, the monthly anomaly fields are computed using our latest climatology, i.e. that covering the 1964-1989 period (see the pages 1 to 13). This climatology is very close to the previous one computed over the 1964-1984 period (see the figures 3 to 15 in Servain et al., 1987).

The same techniques have been used for all the charts presented in this atlas. The raw data from NCDC (delivered by yearly data set) were used to create the plots

for 1985 and 1986. Since January 1987, we have used the monthly real time data sets selected by MASIG-FSU.

The 1985, 1988 and 1989 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 Jose dos Campos, SP, Brazil. The original plots were generated at the Joint Institut of Marine and Atmospheric Research, University of Hawaii at Honolulu, HI.

Figure 1 – Répartition spatiale des données brutes utilisées dans l'Atlantique tropical. Exemple pour le mois de décembre 1989.
– *Distribution of tropical Atlantic Ocean raw data. Example for December 1989.*



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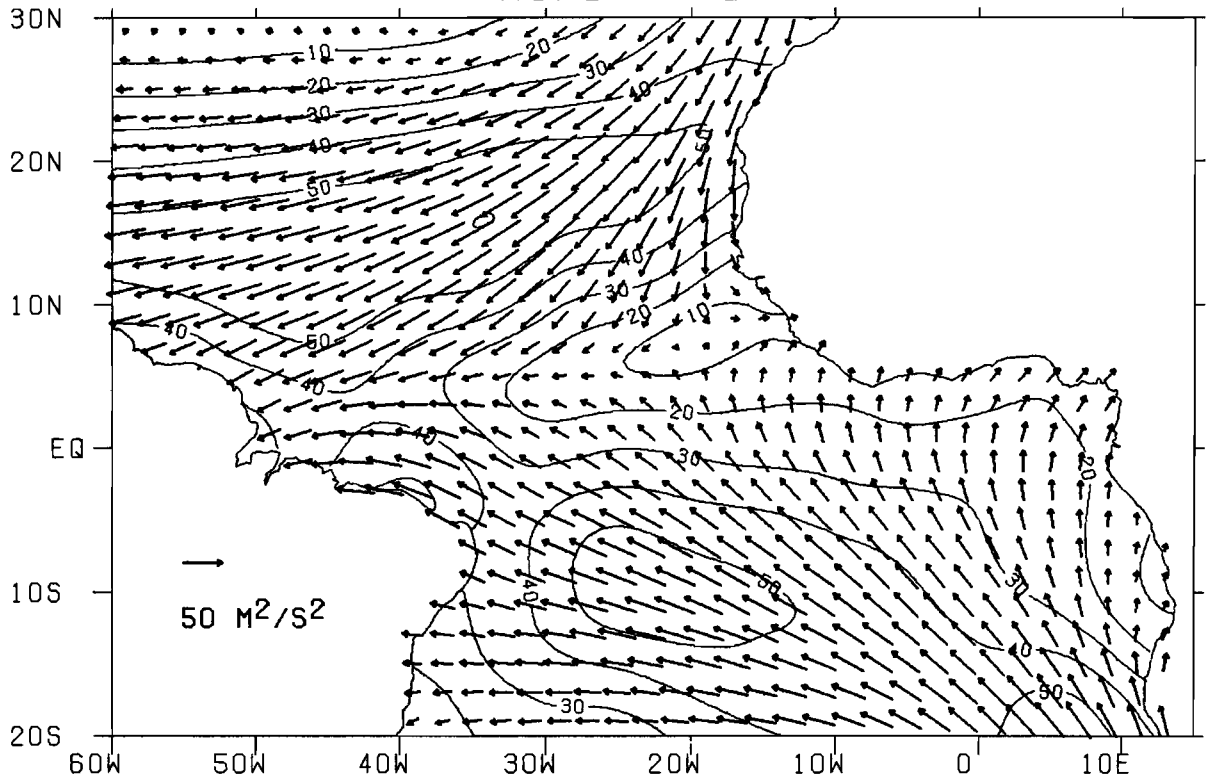
We thank Jim O'Brien, Jean-René Donguy, Jacques Merle, Dennis Moore and Bruno Voituriez for their support in this project. David Legler and James Stricherz from MASIG-FSU have always given proof of availability and swiftness for selecting and sending the raw data. Marc Séva, Guilherme Teixeira Mendes, Roseli Yoshioka and Daniel Corre have successively helped for adapting our data processing on various machines. J.S. thank the INPE (São José dos Campos, SP), and the FAPESP (São Paulo, SP) for their assistance during his 1986-1988 Brazil visit. This work is sponsored by ORSTOM, IFREMER and JIMAR (University of Hawaii, NOAA Cooperative Agreement #NA85ABH00032).

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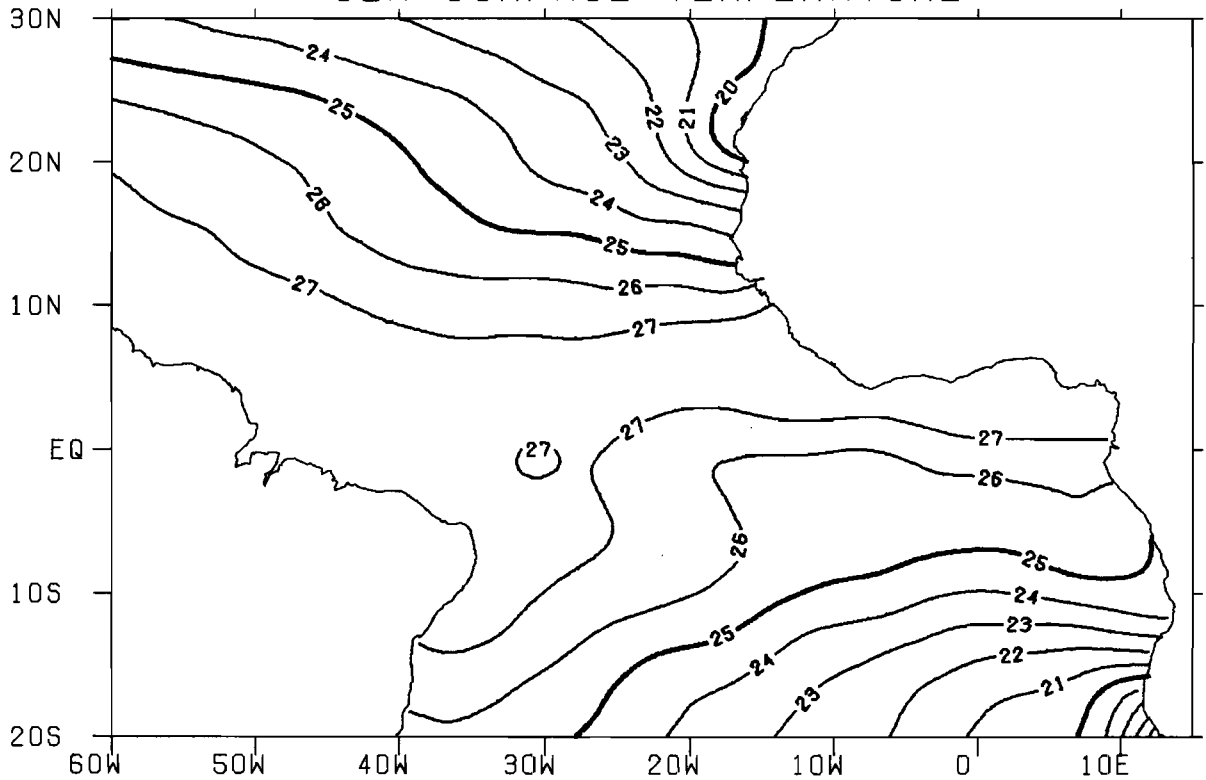
TOTAL MONTHLY MEAN

1964-1989

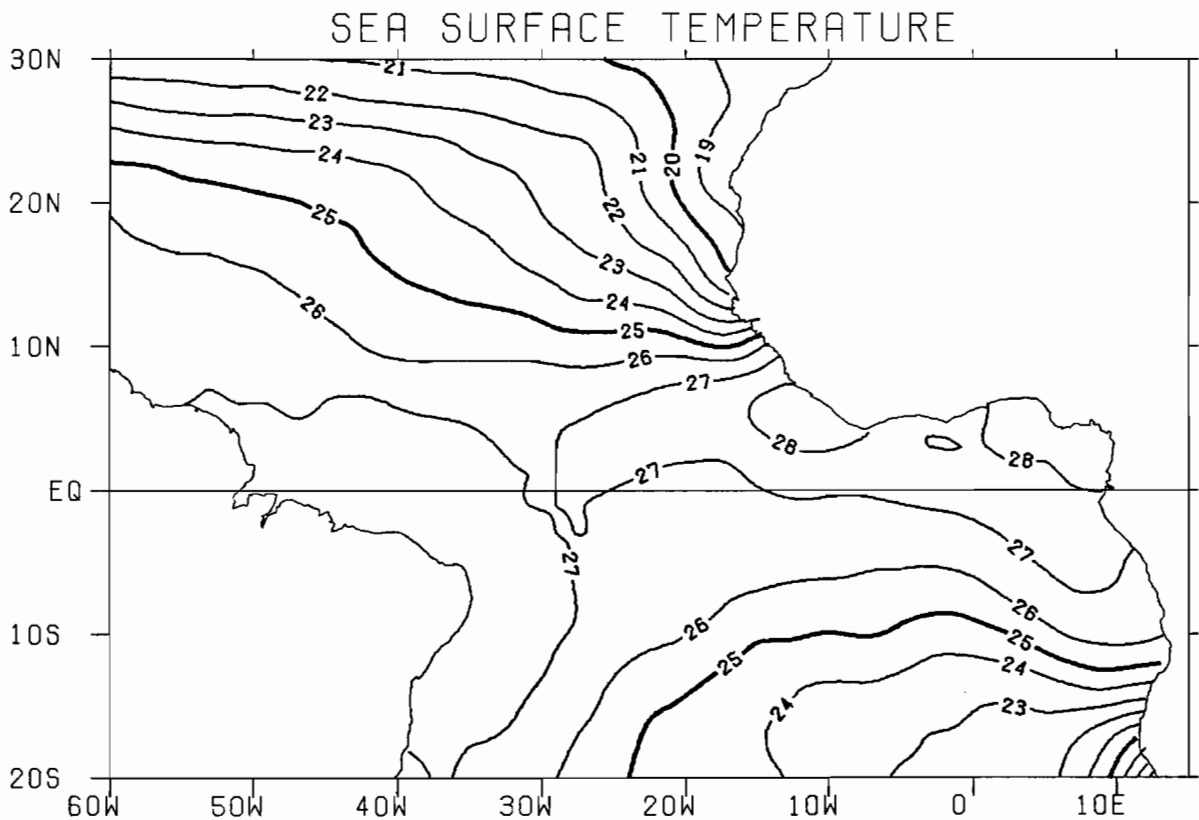
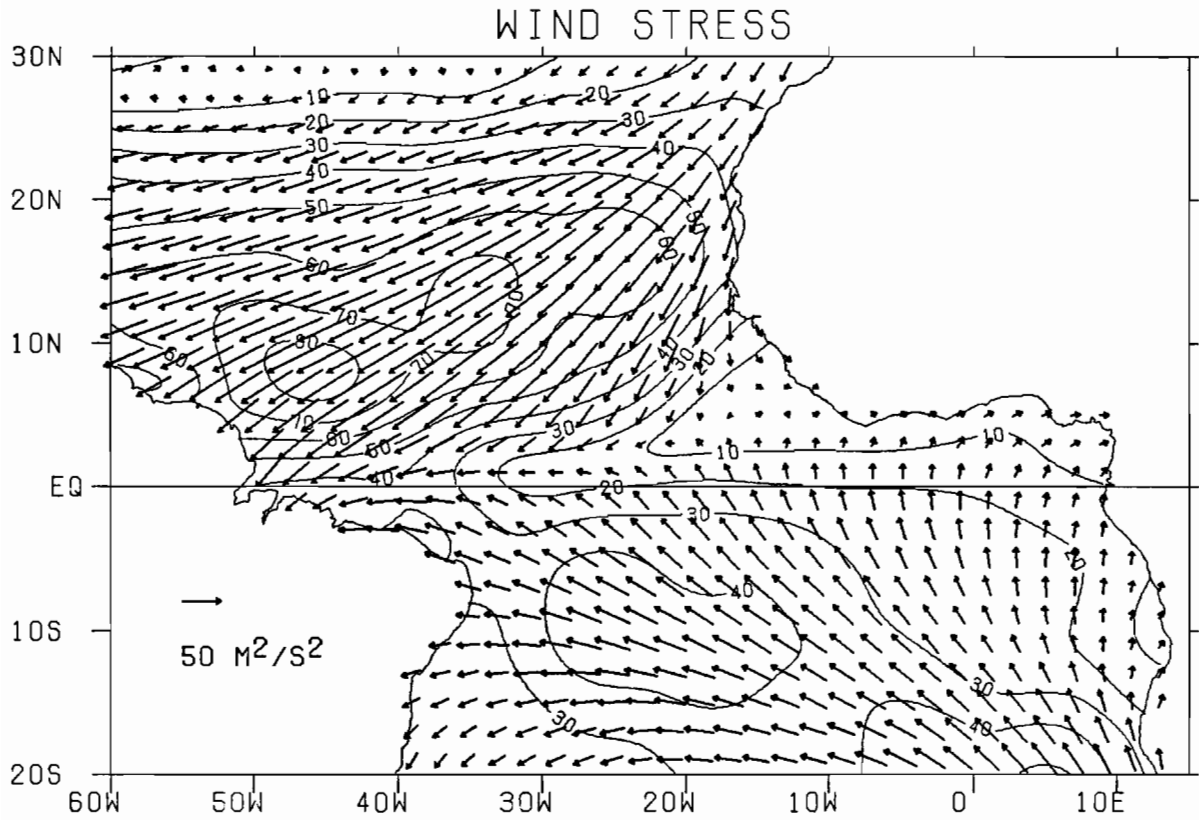
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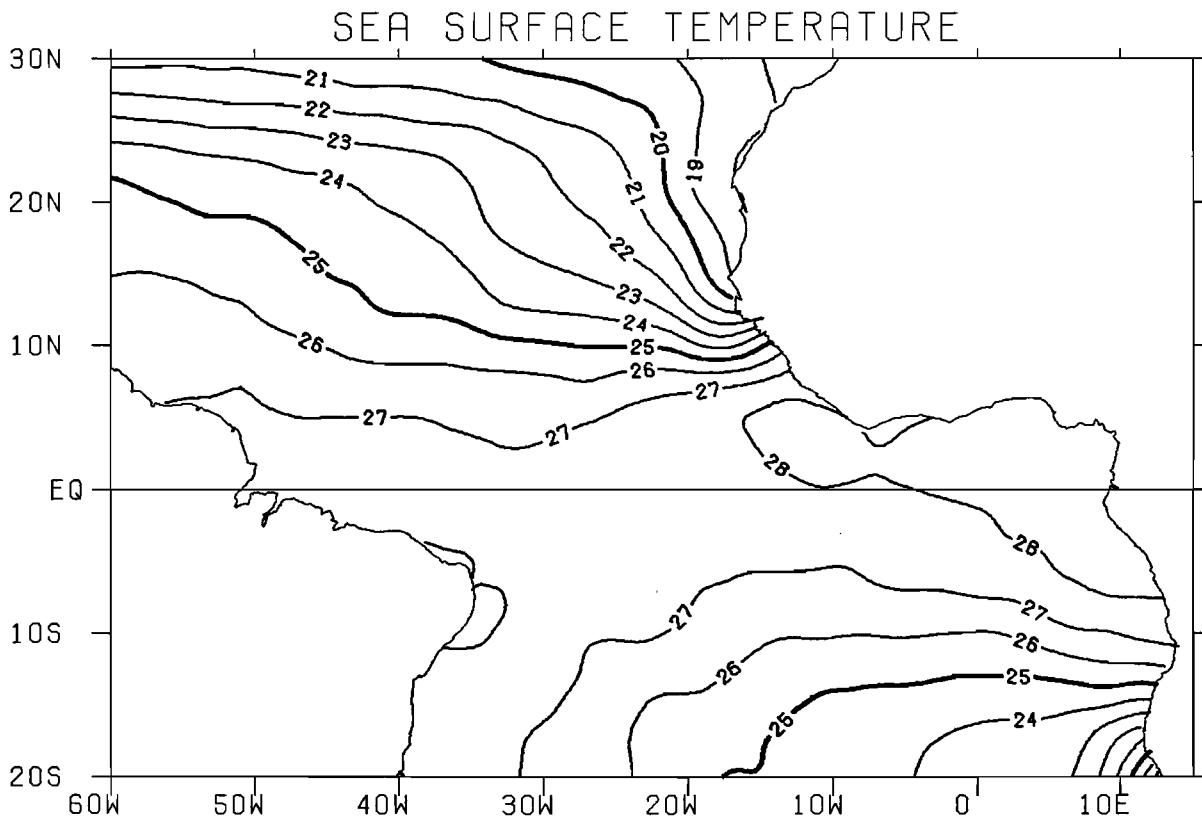
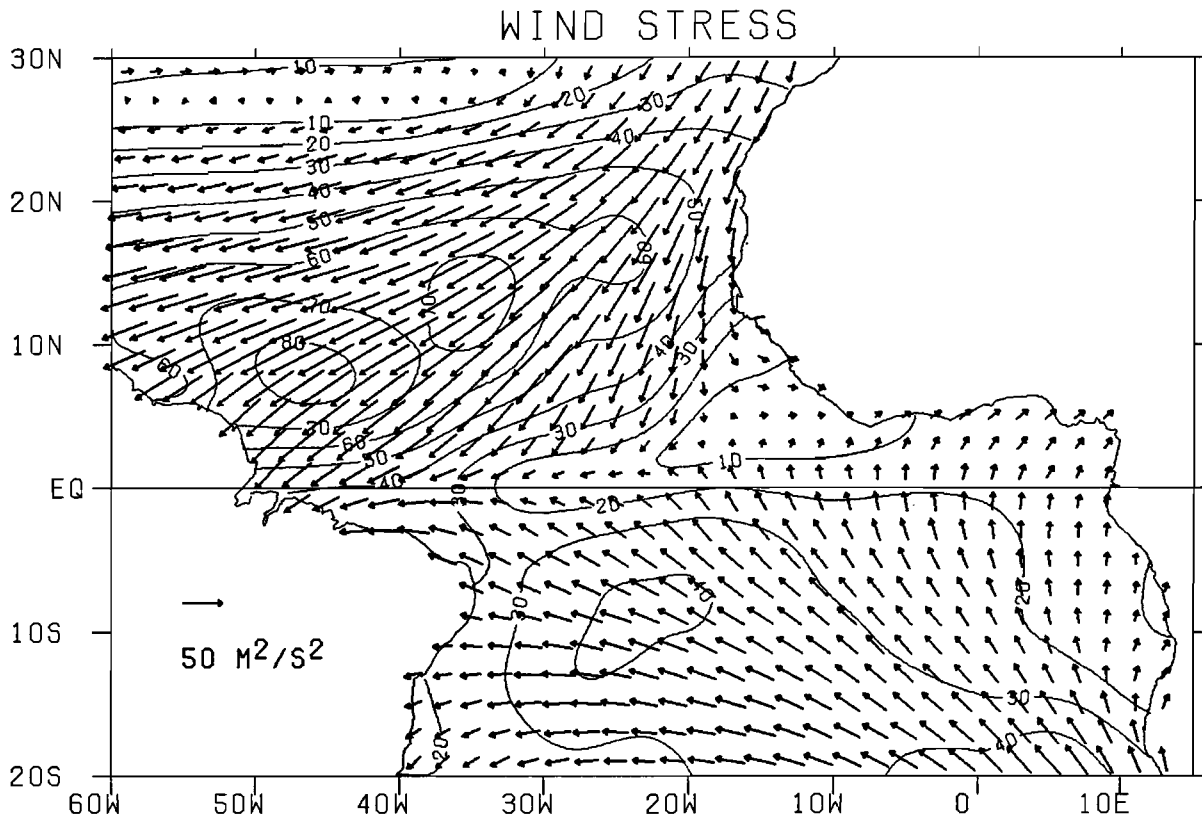
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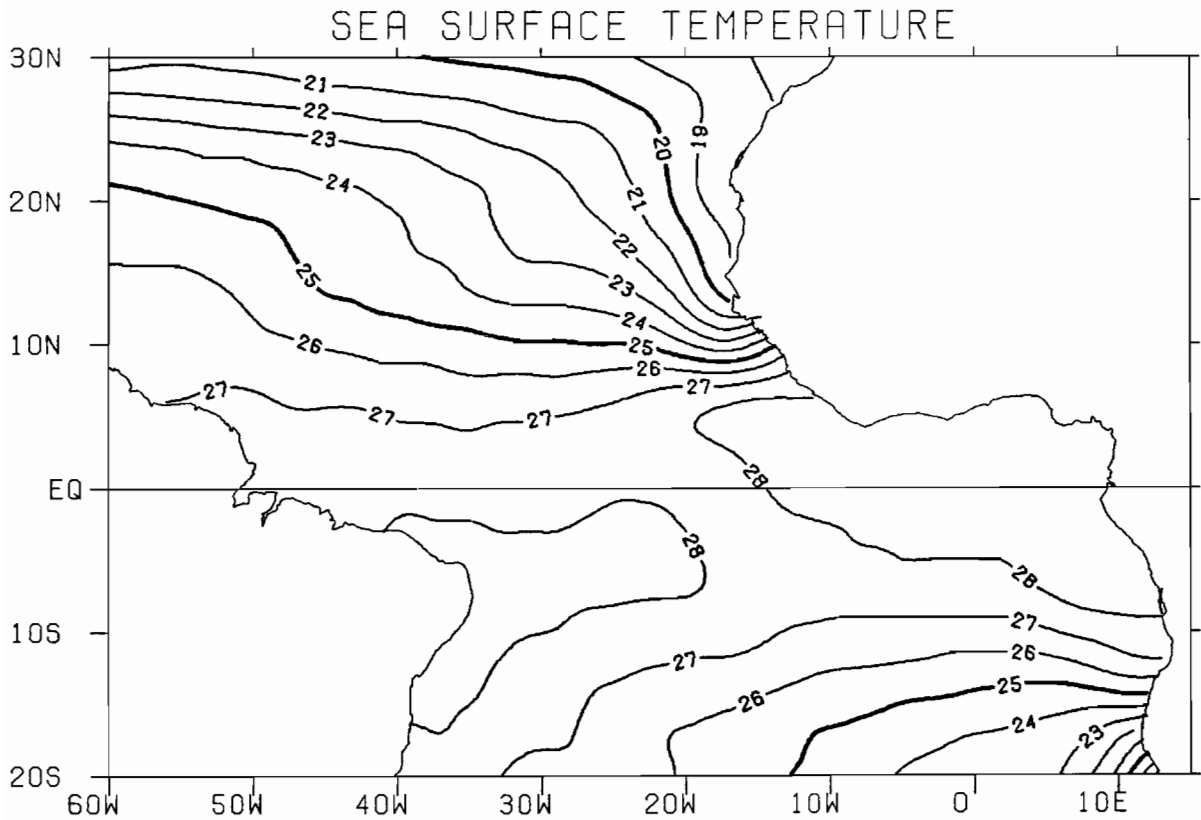
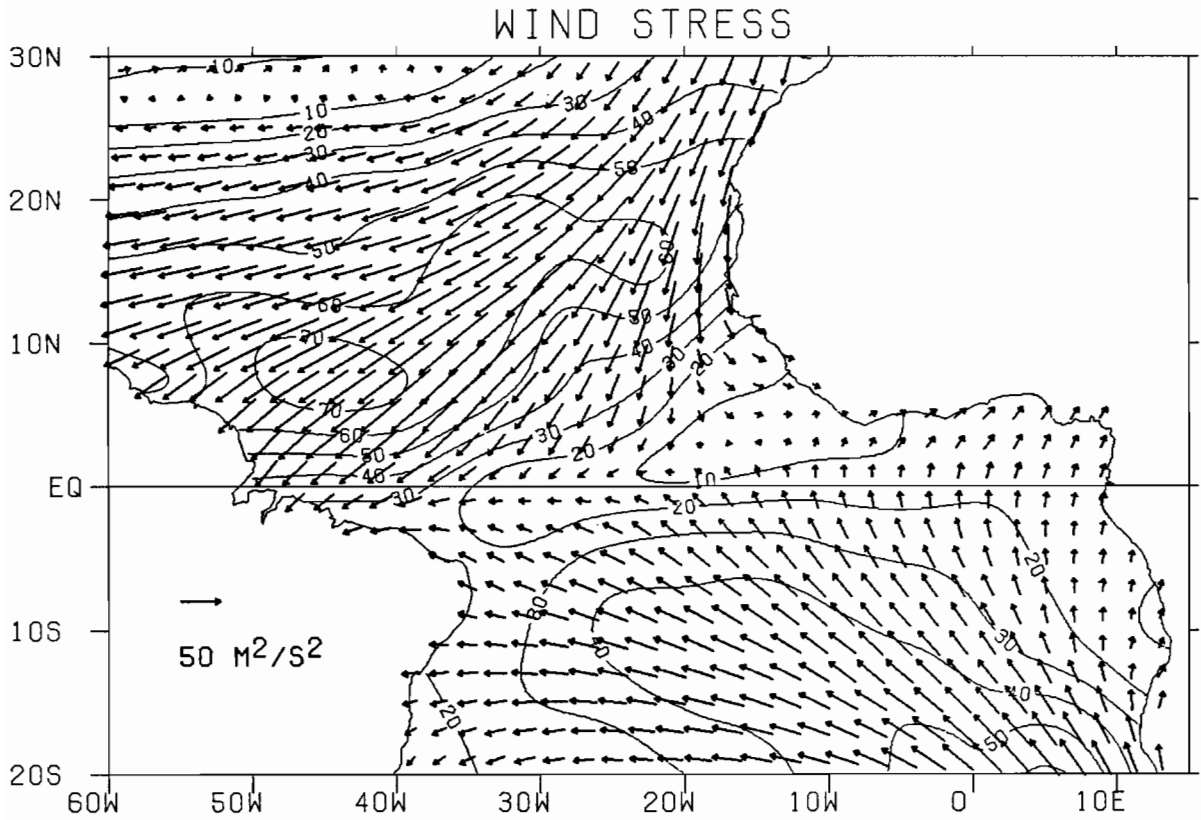
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JANUARY 1964-1989



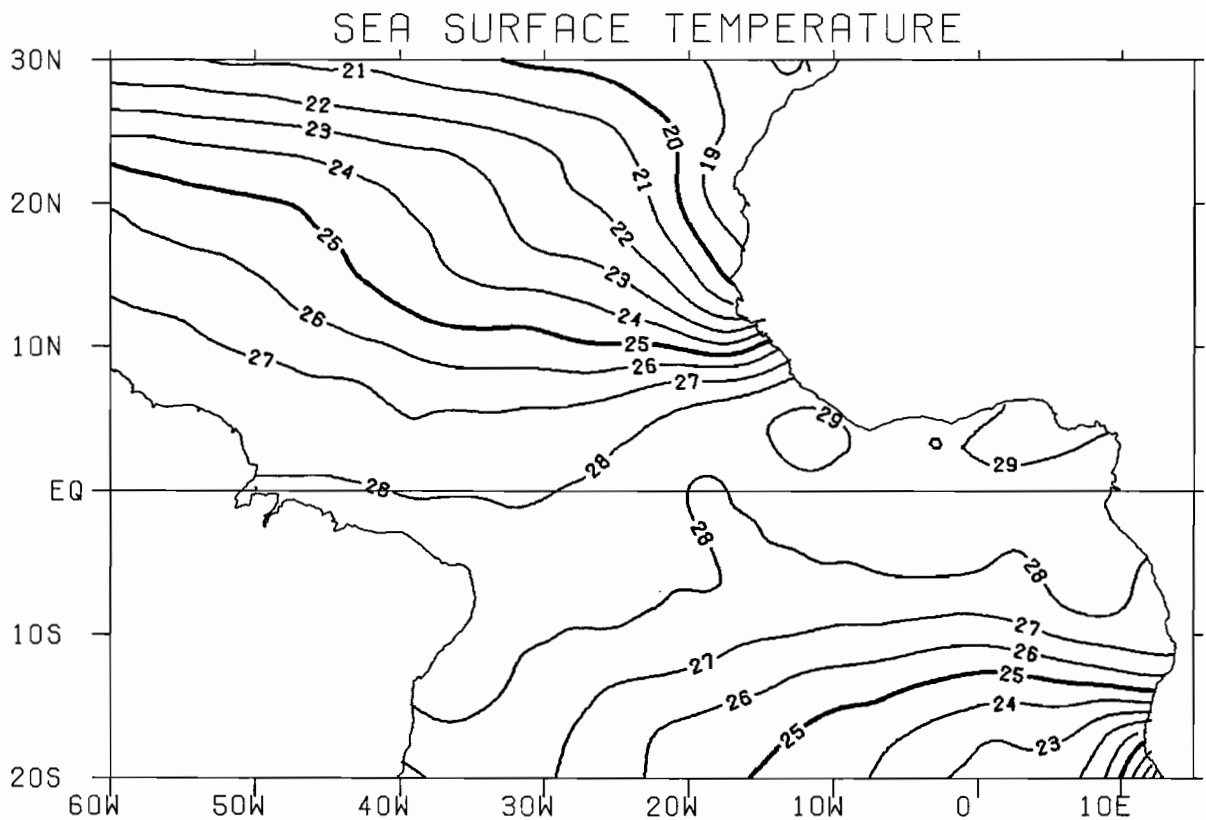
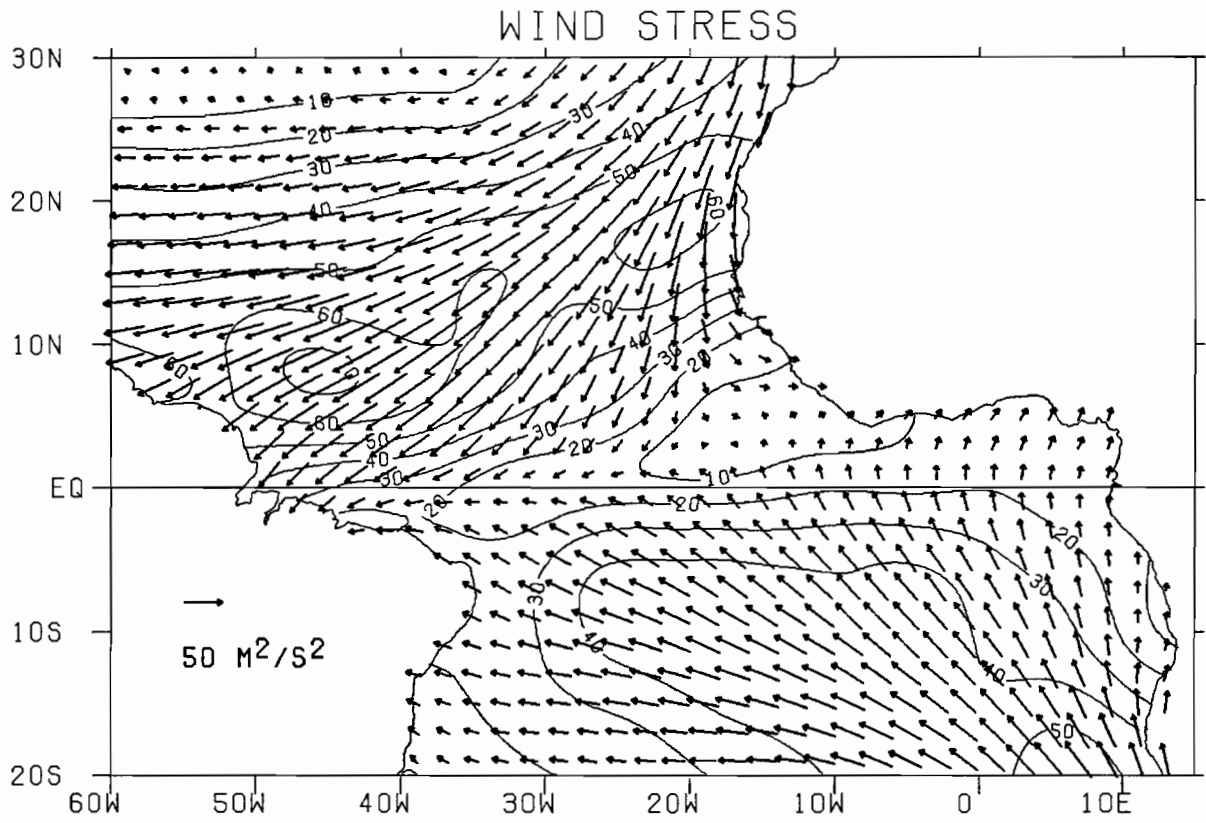
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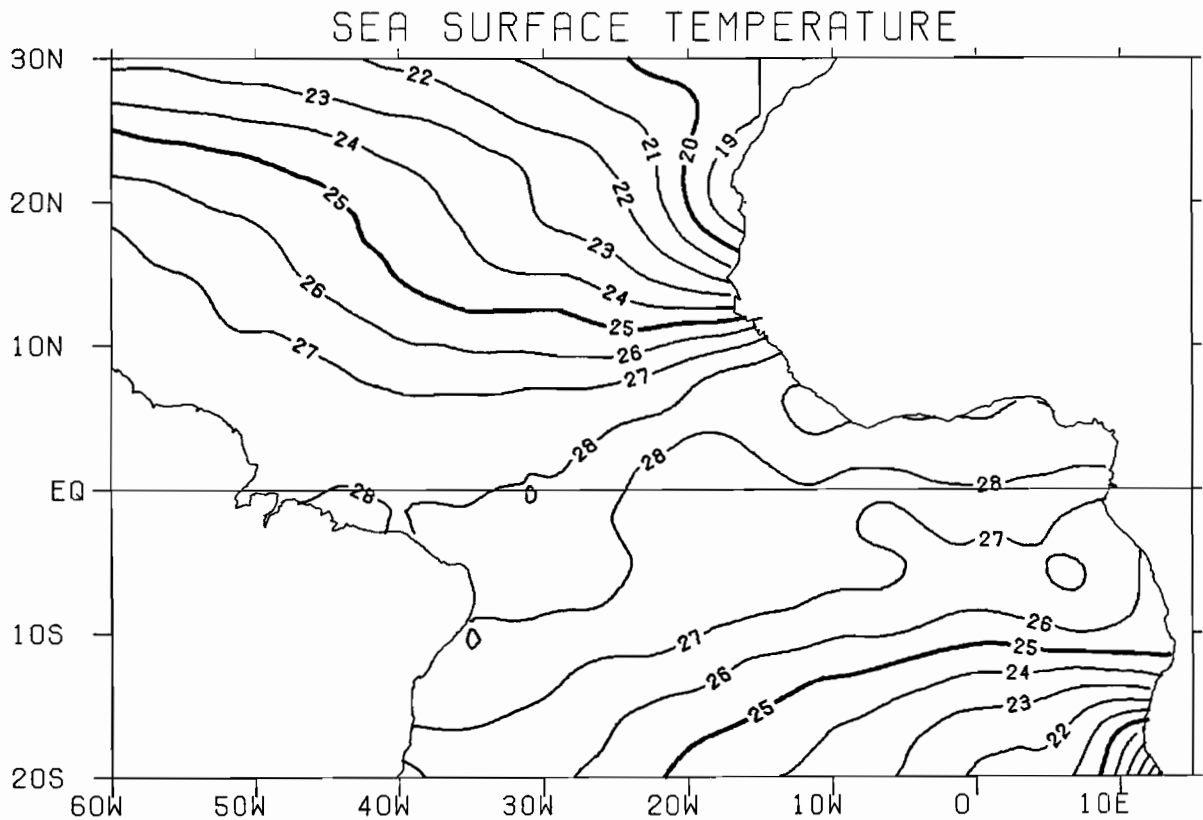
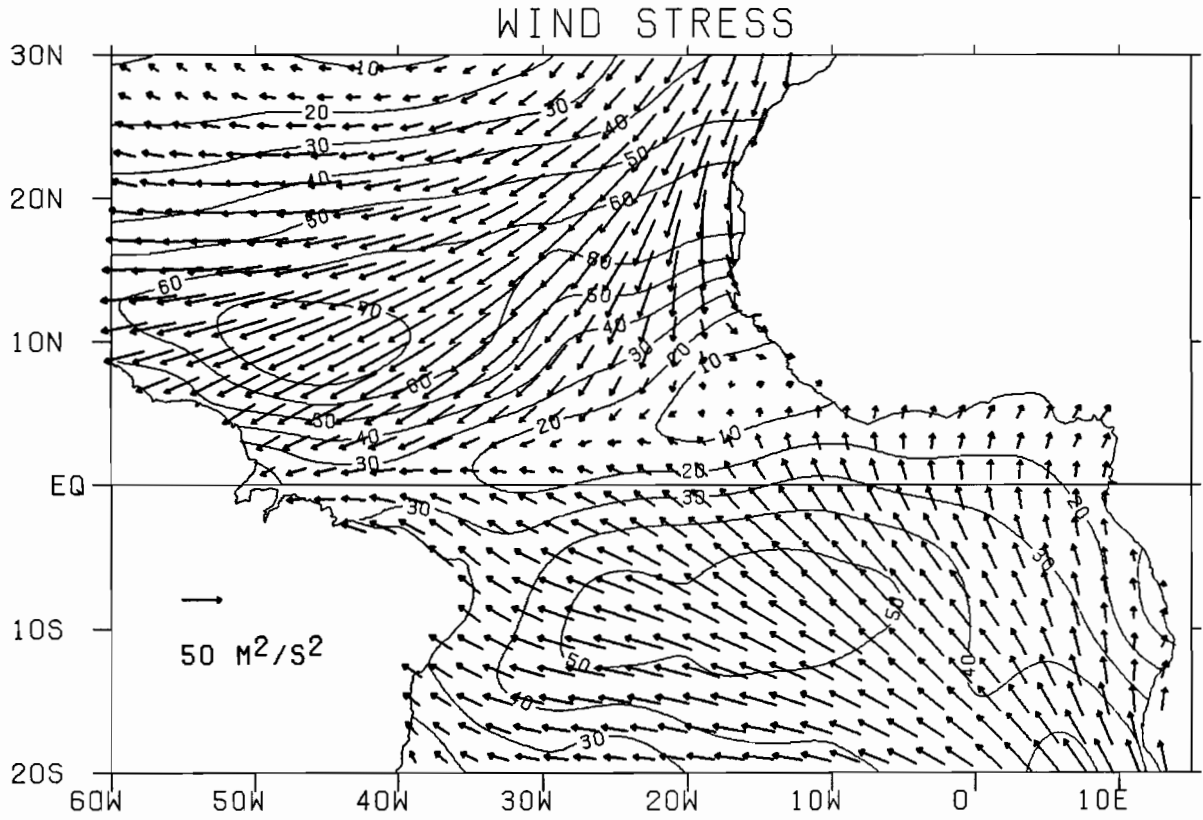
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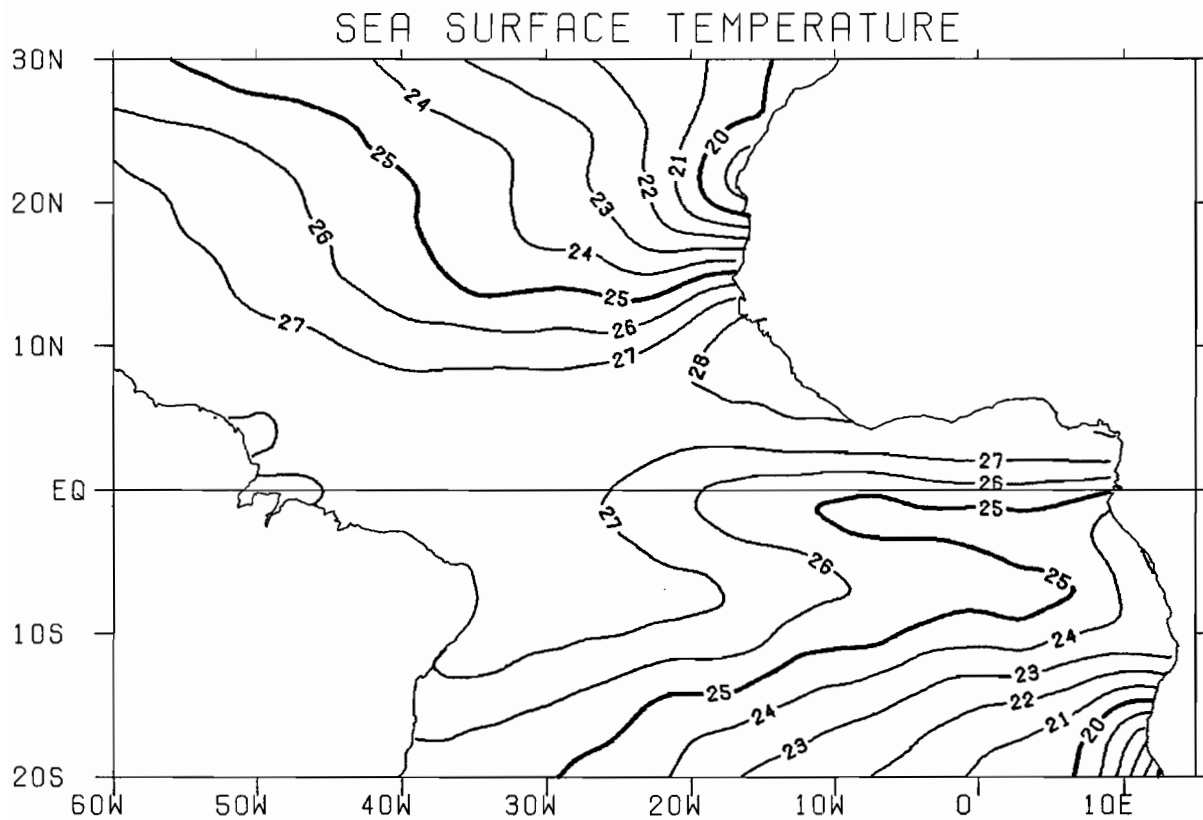
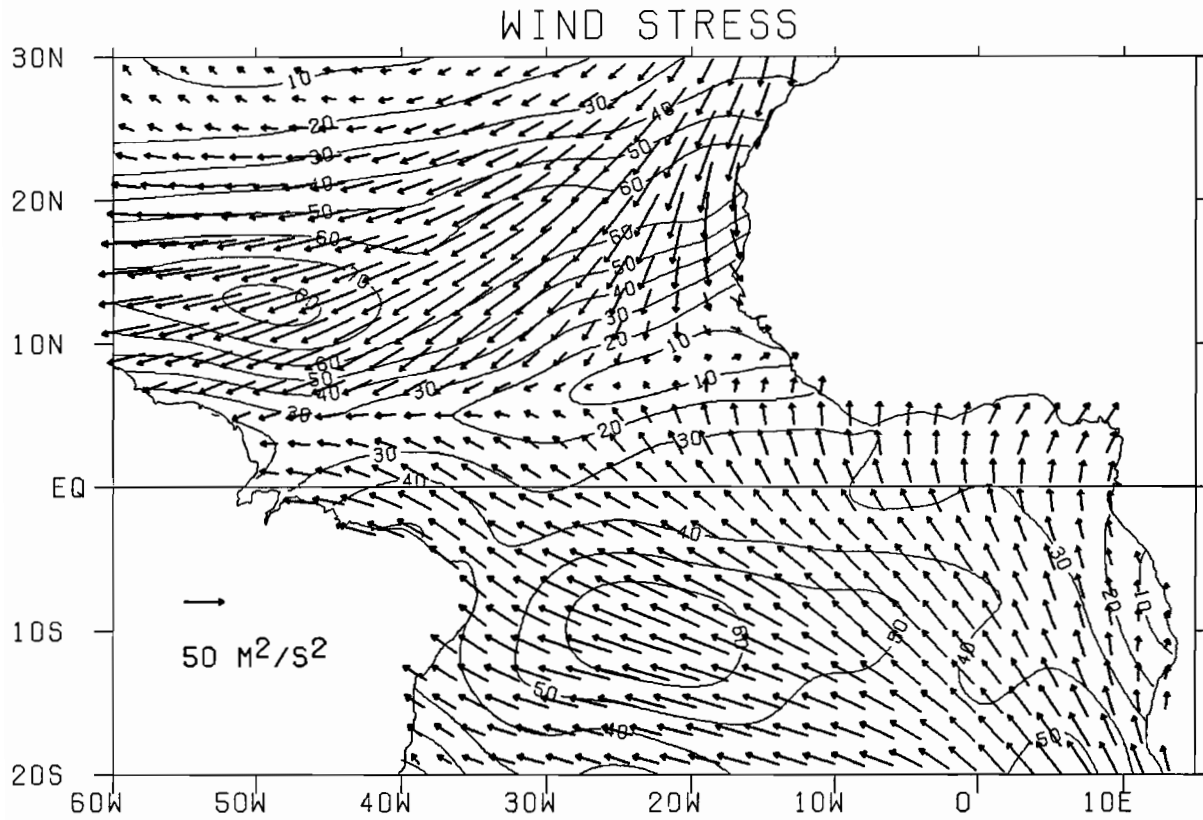
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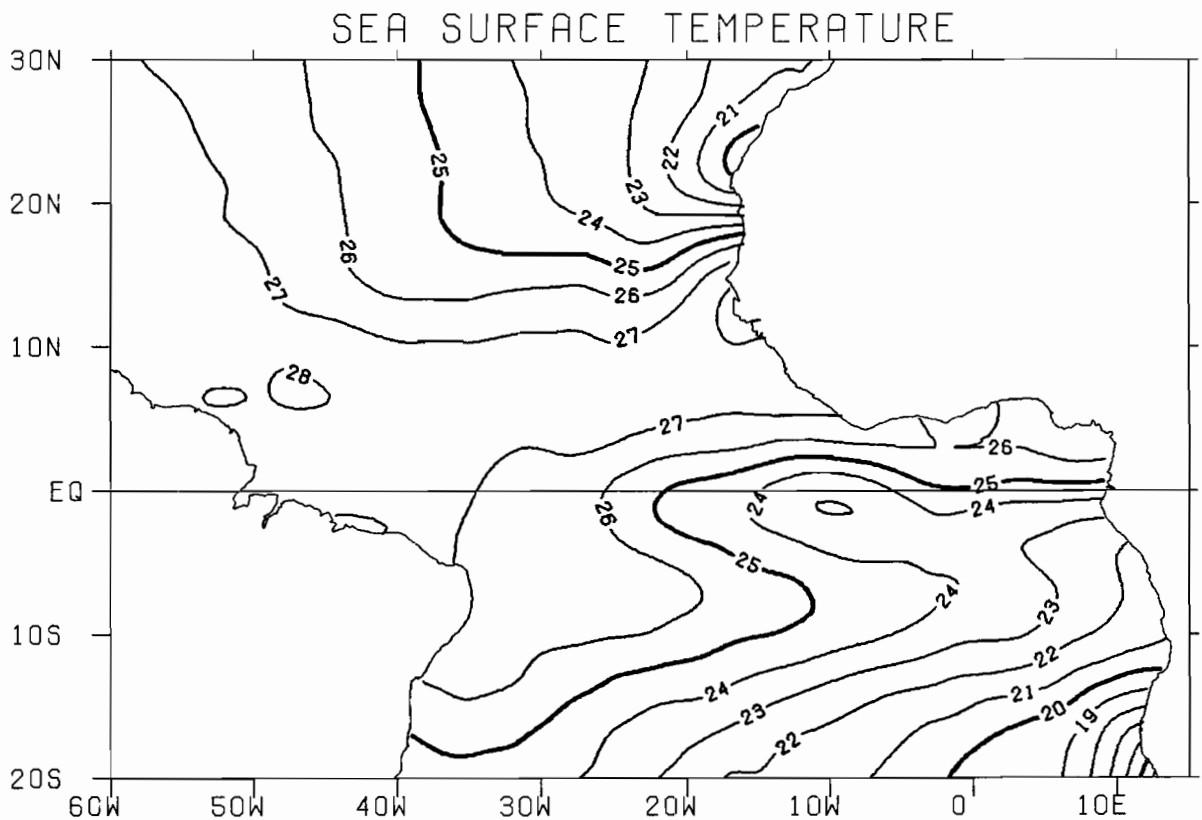
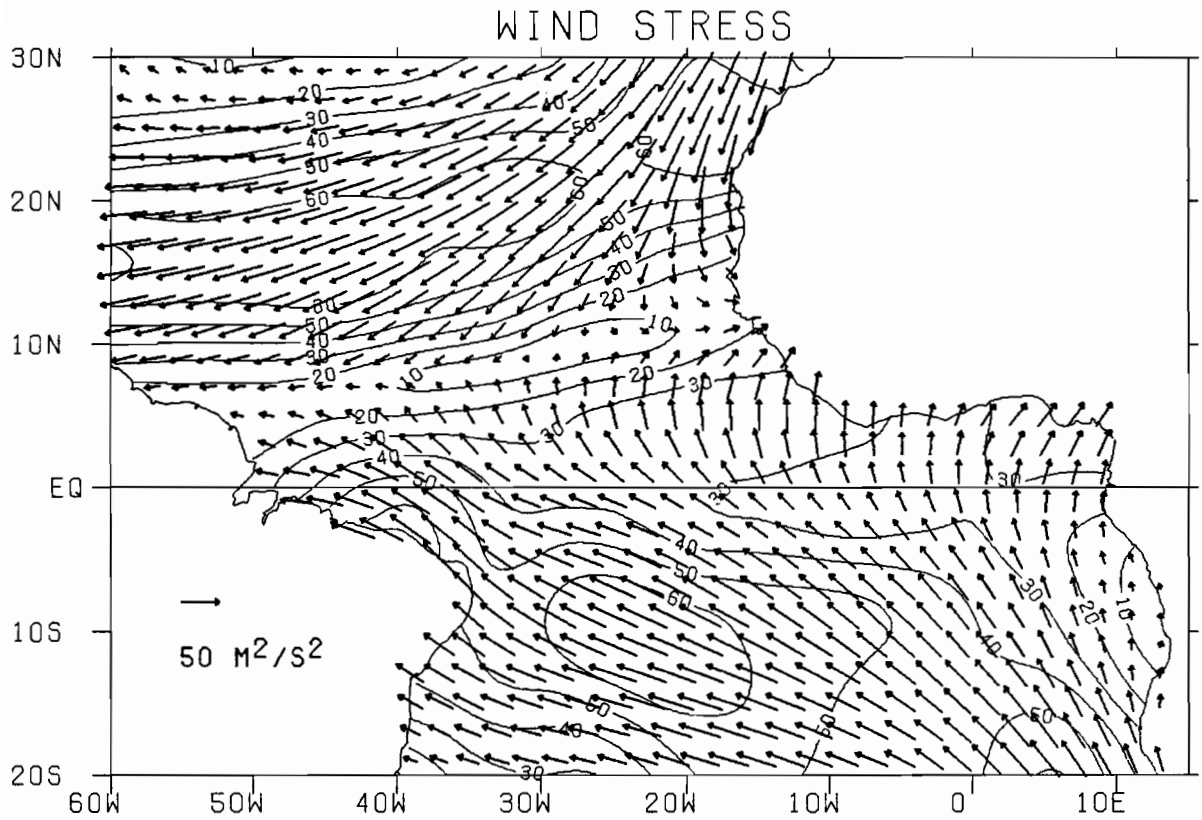
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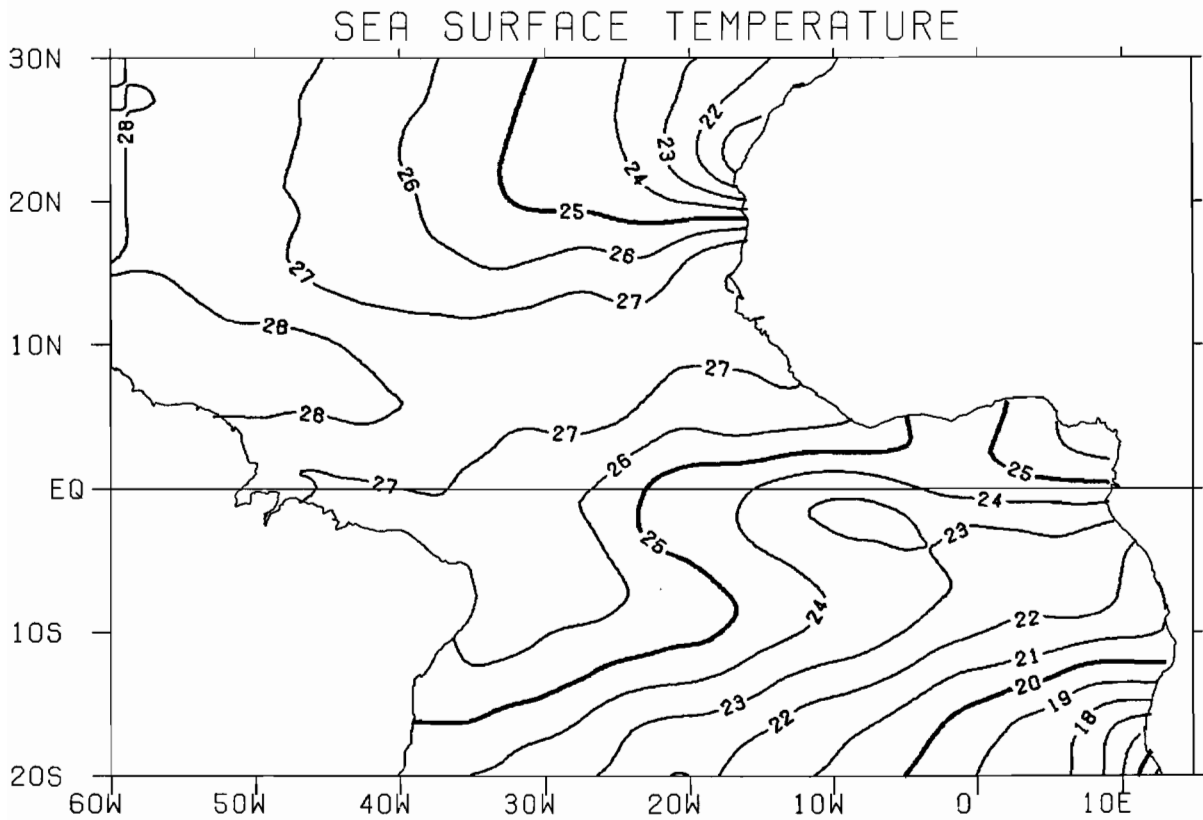
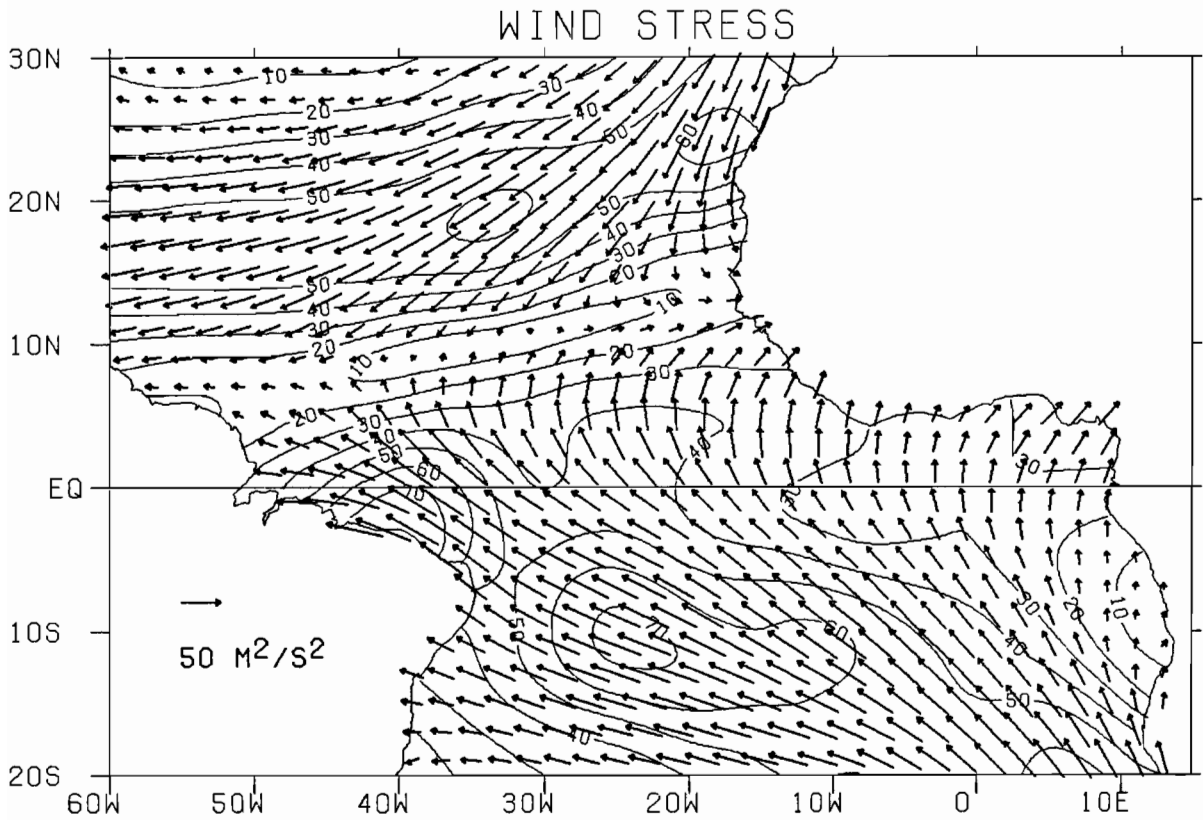
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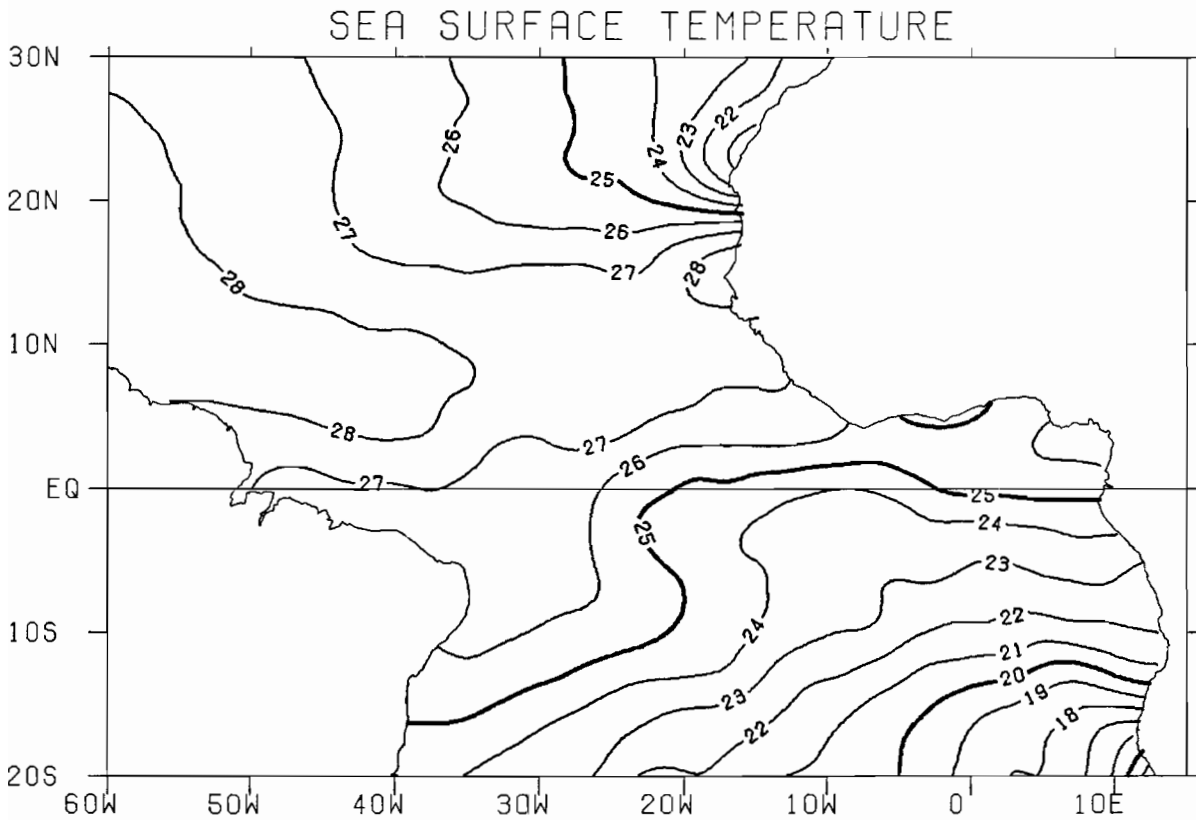
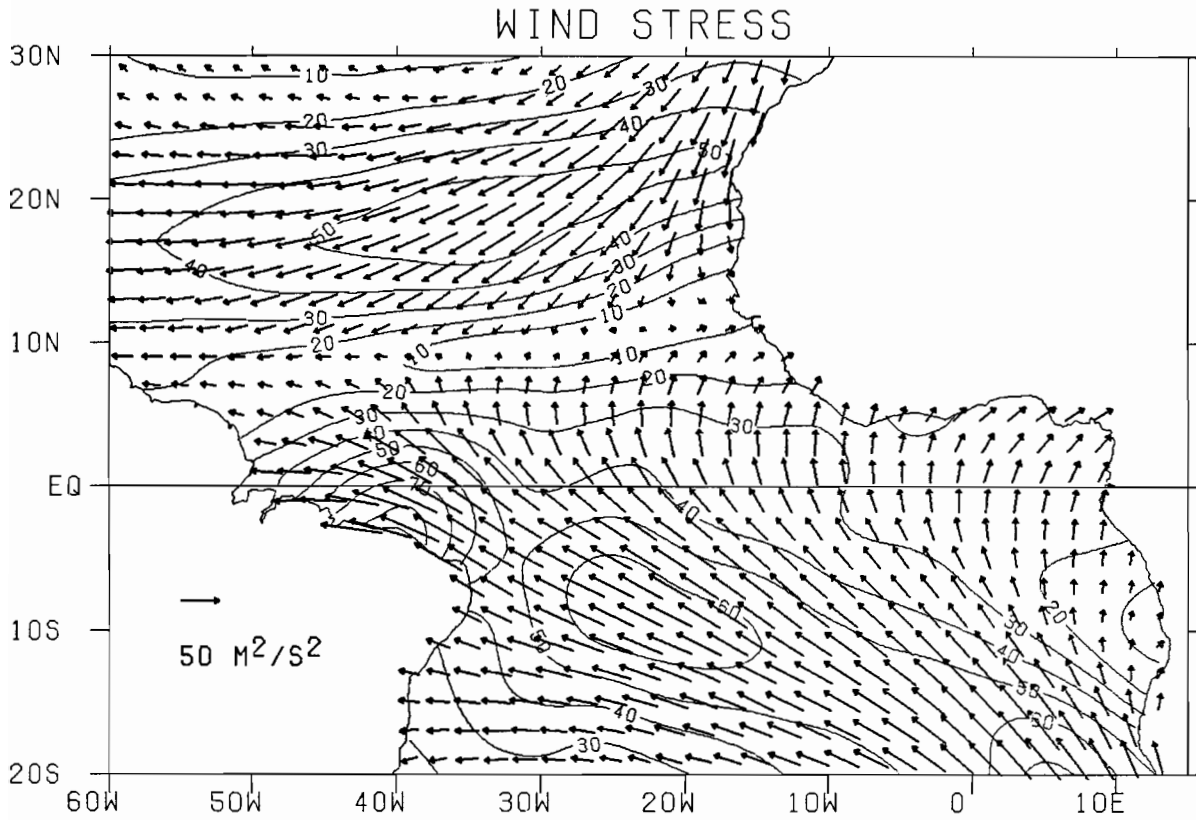
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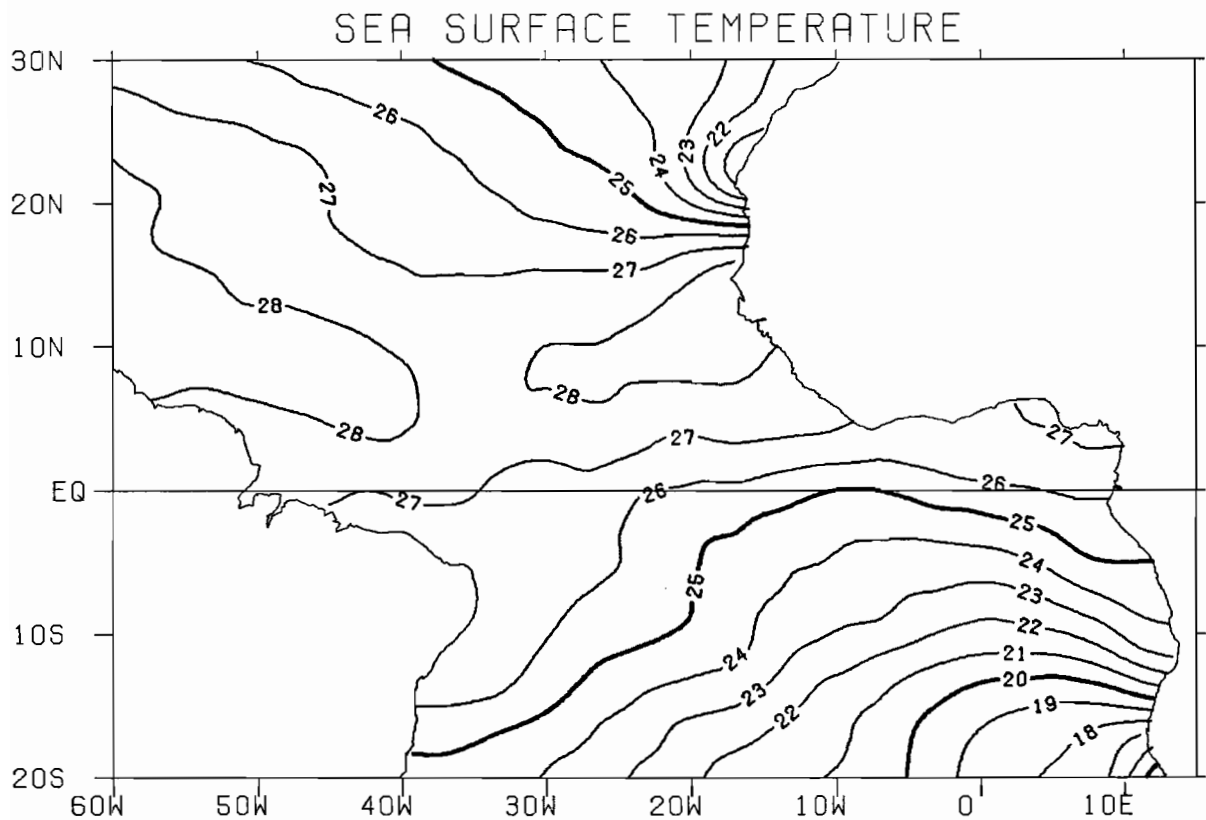
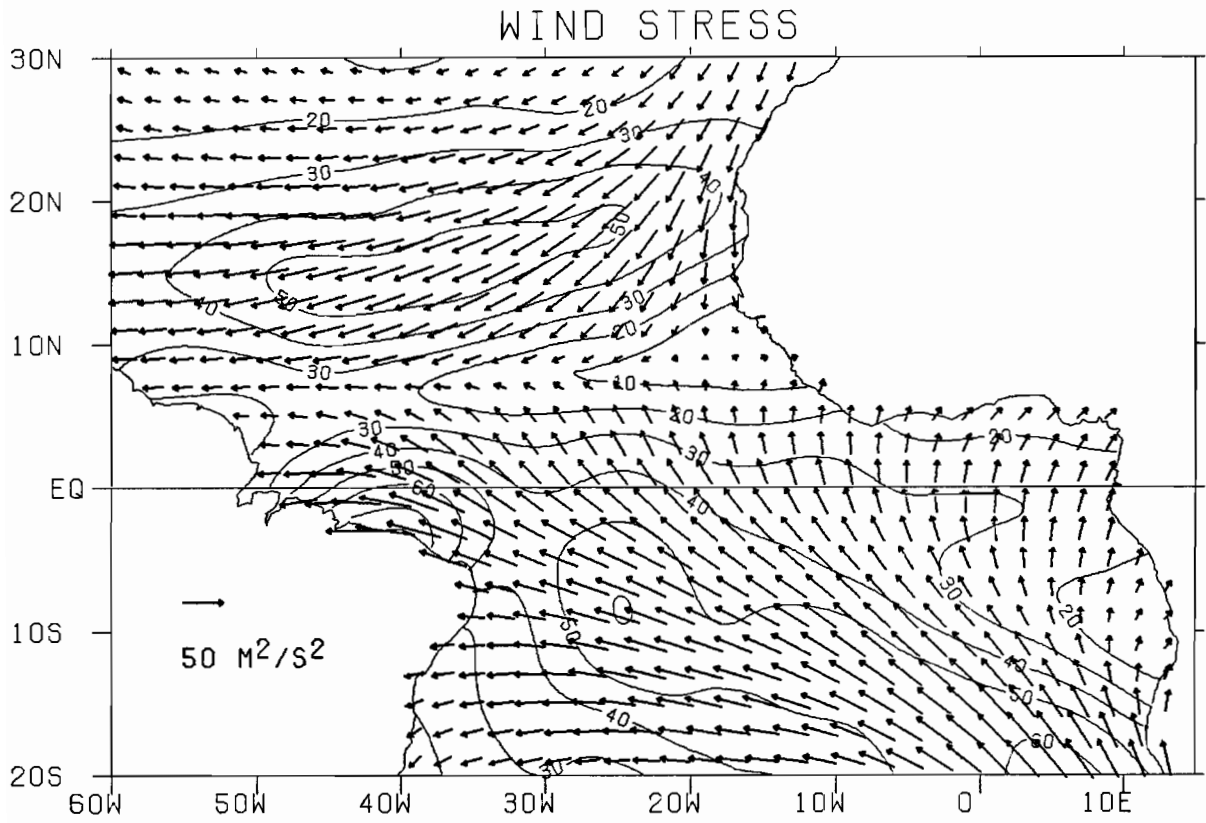
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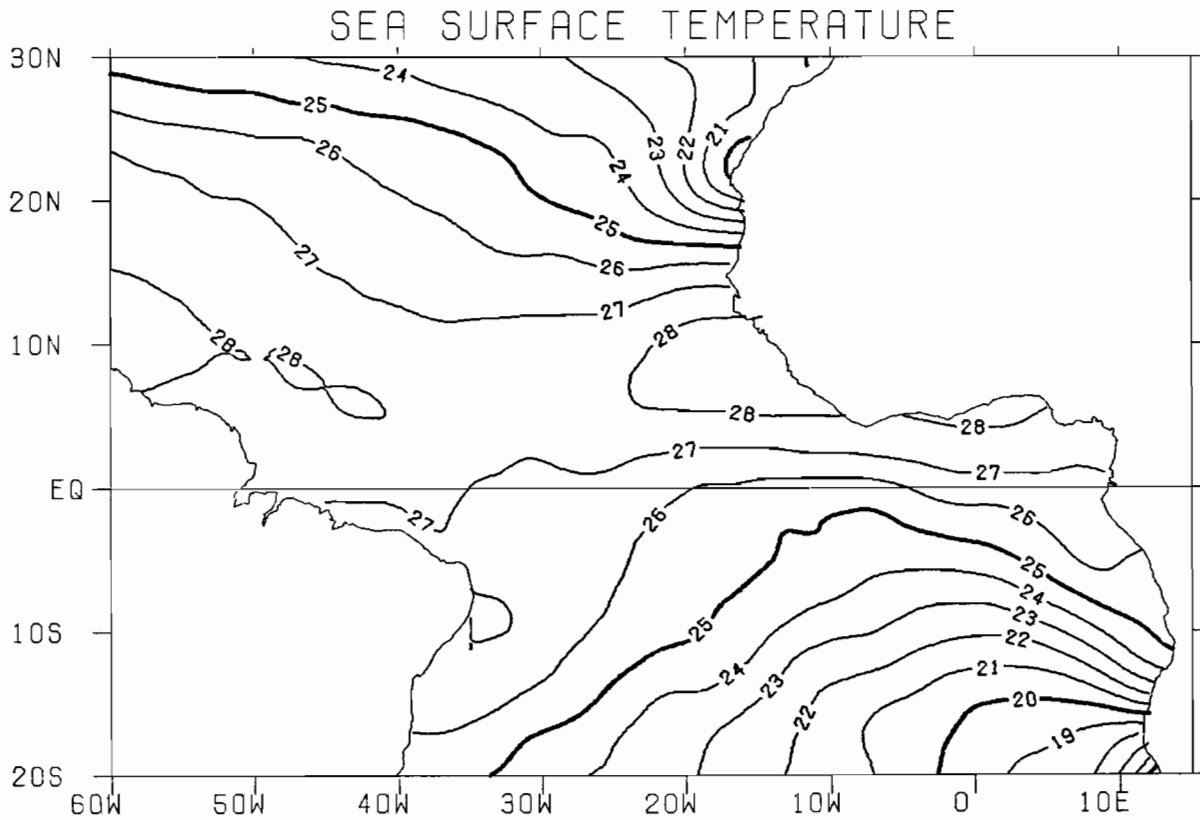
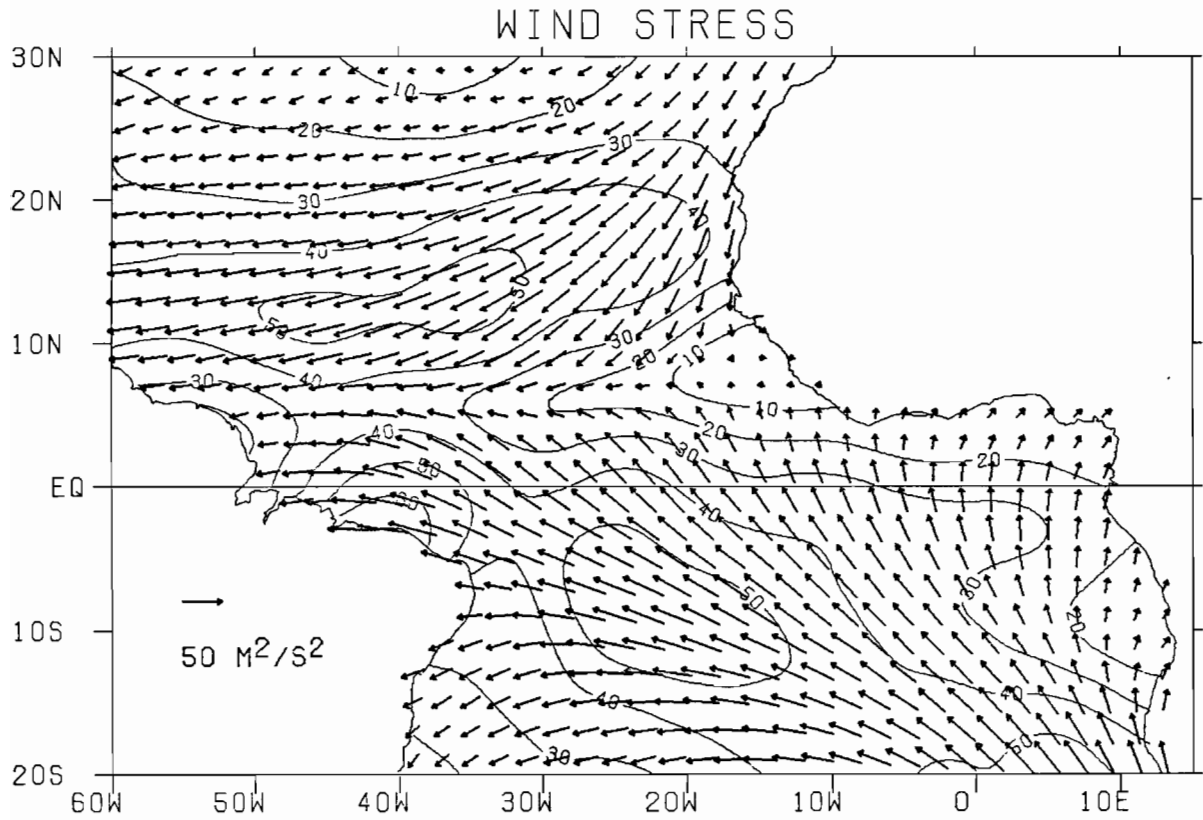
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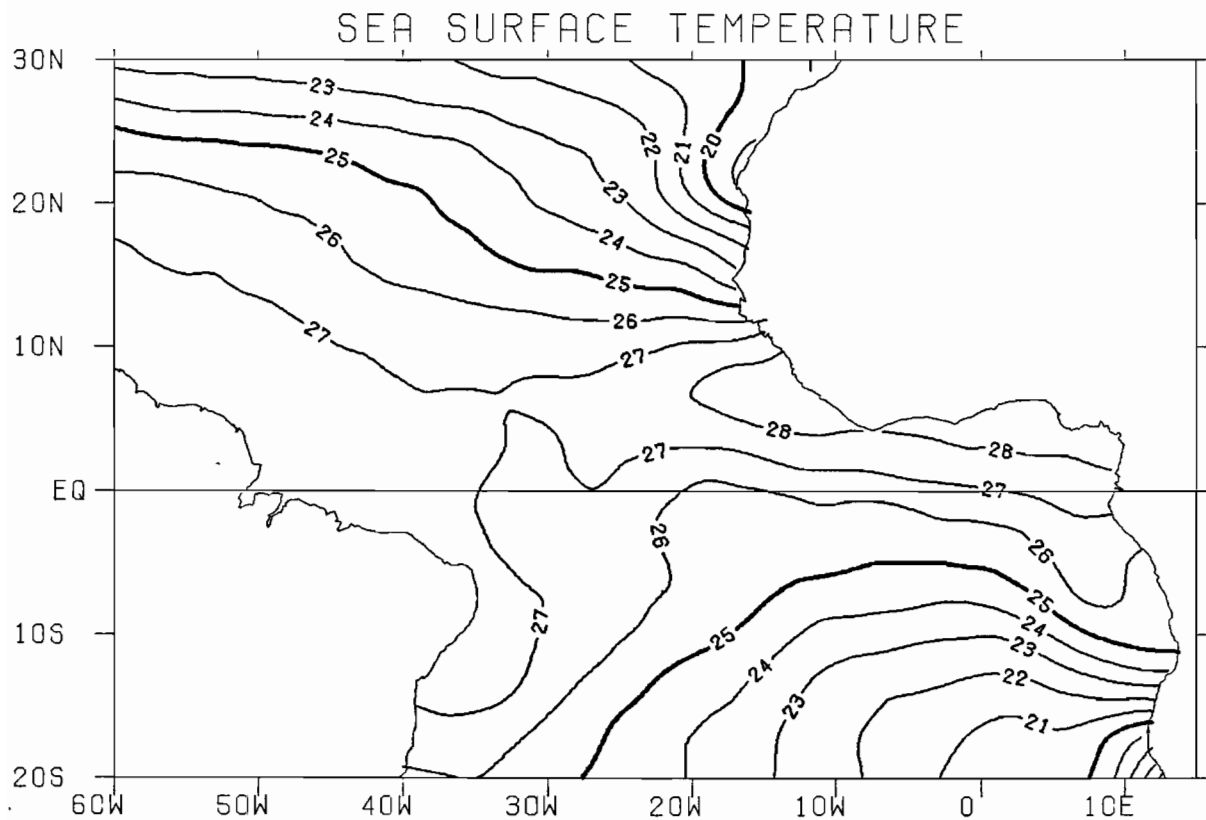
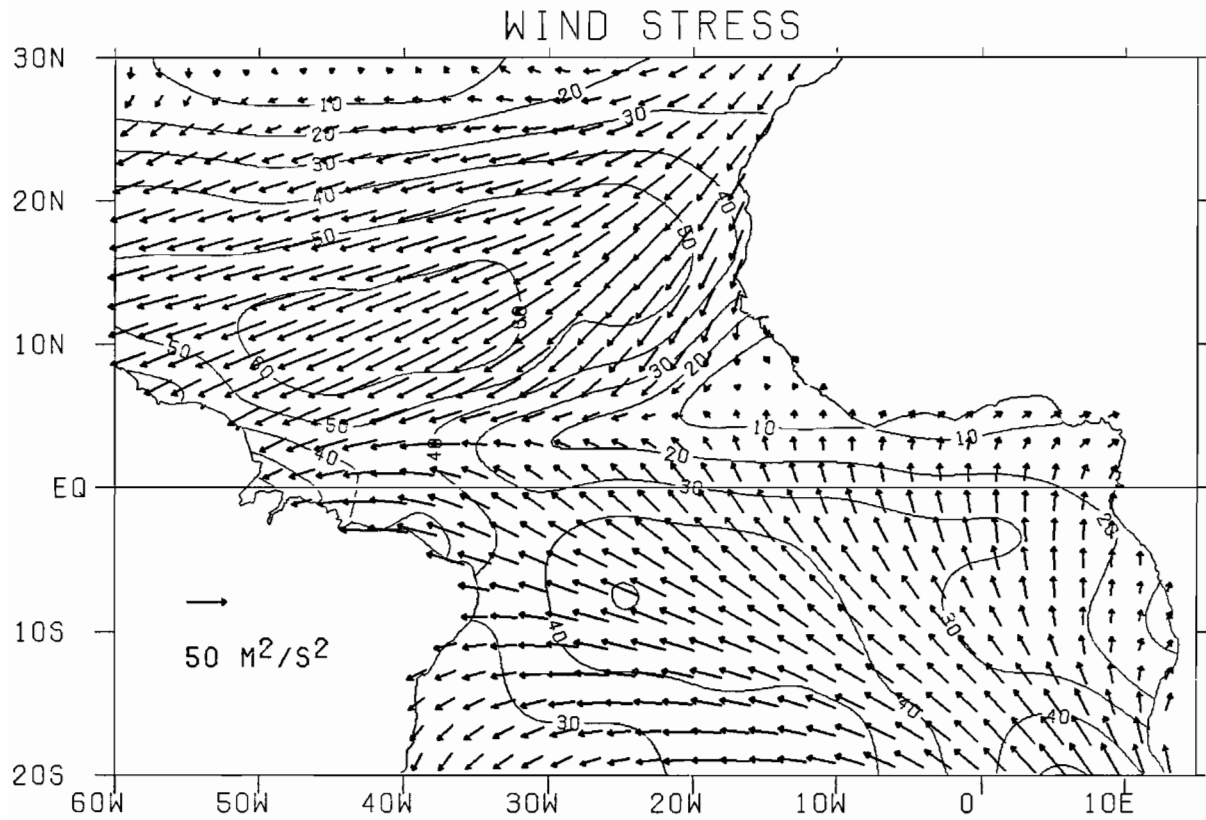
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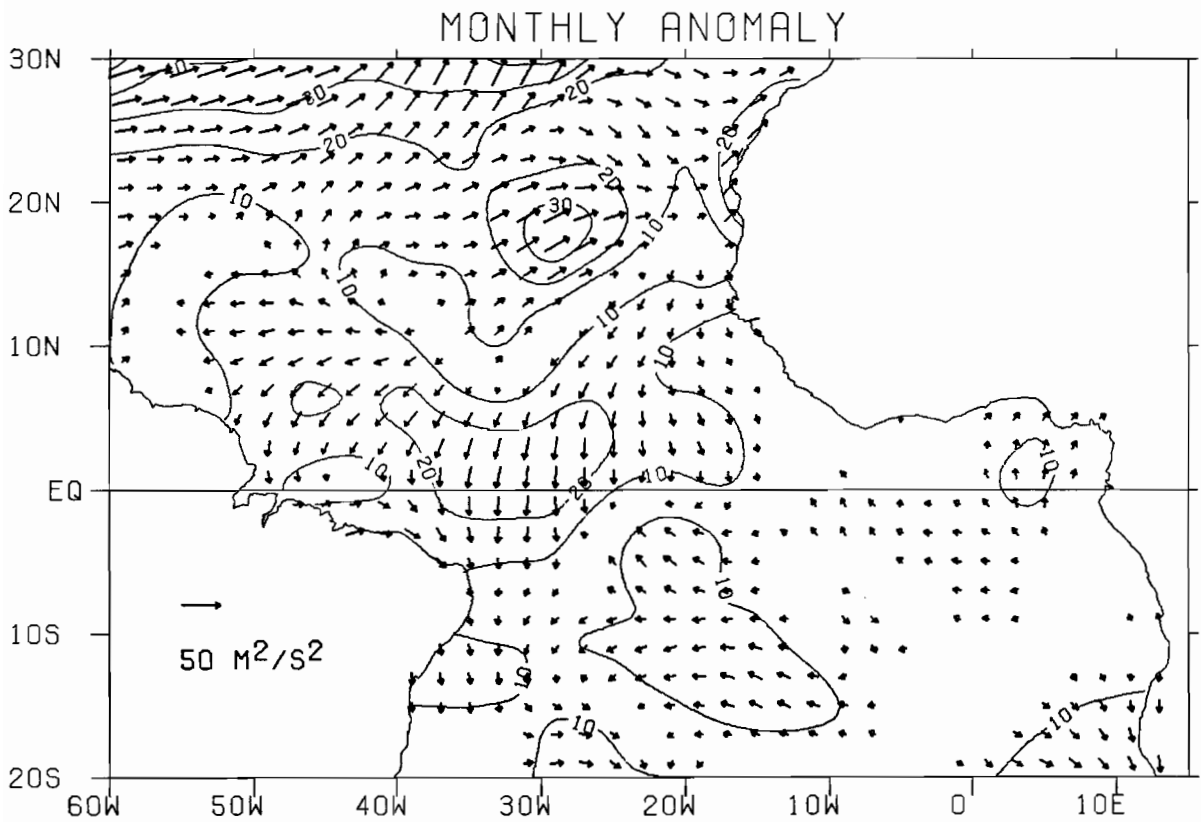
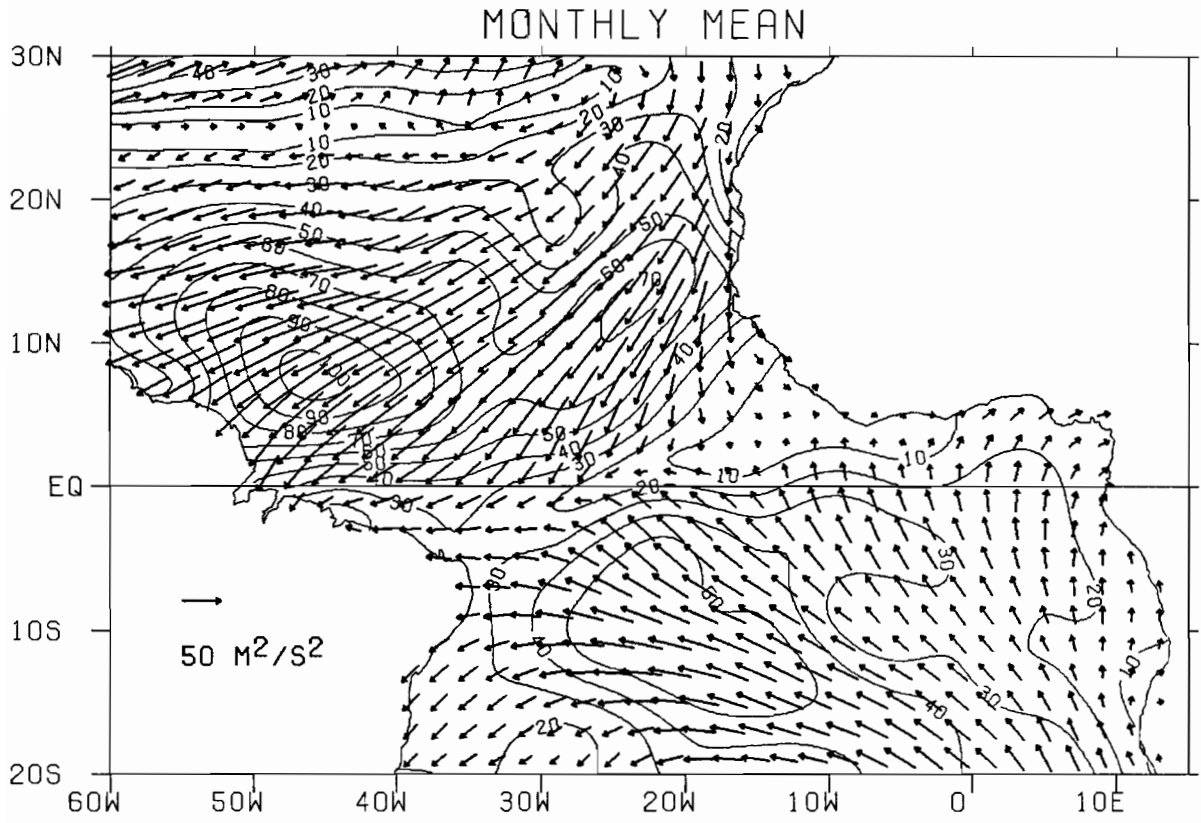


MONTHLY MEAN
DECEMBER 1964-1989



WIND STRESS

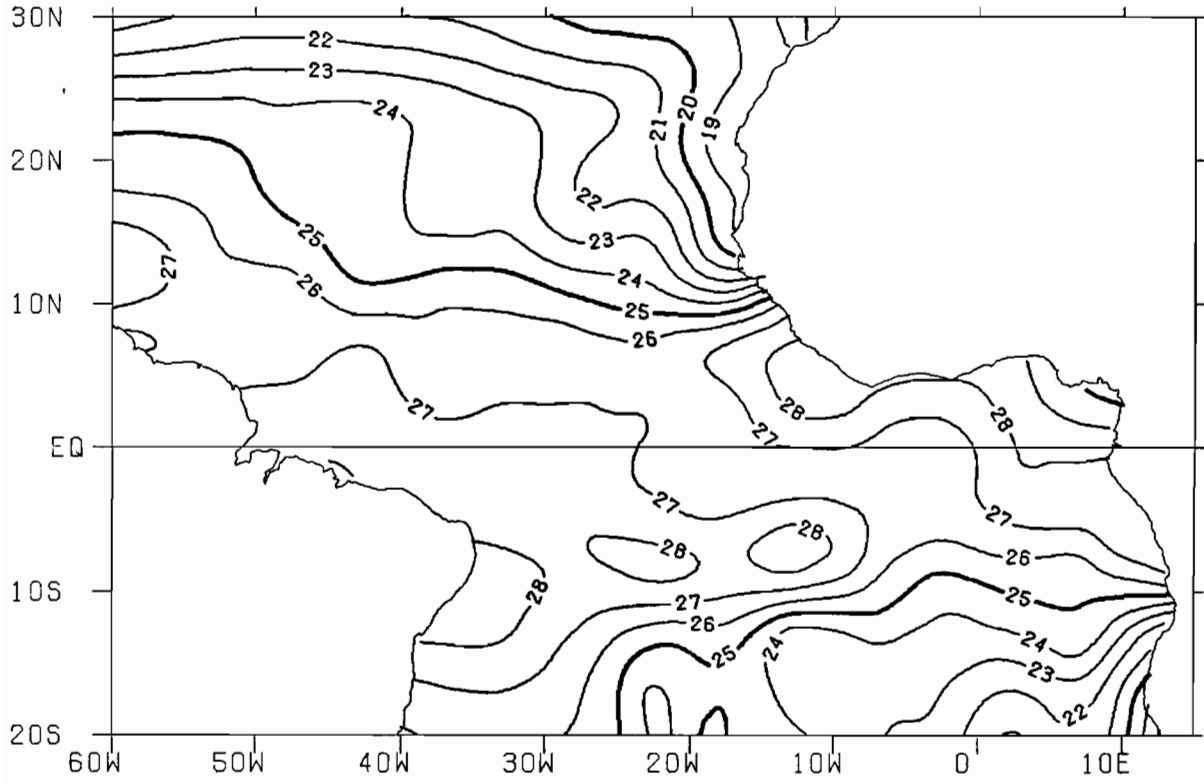
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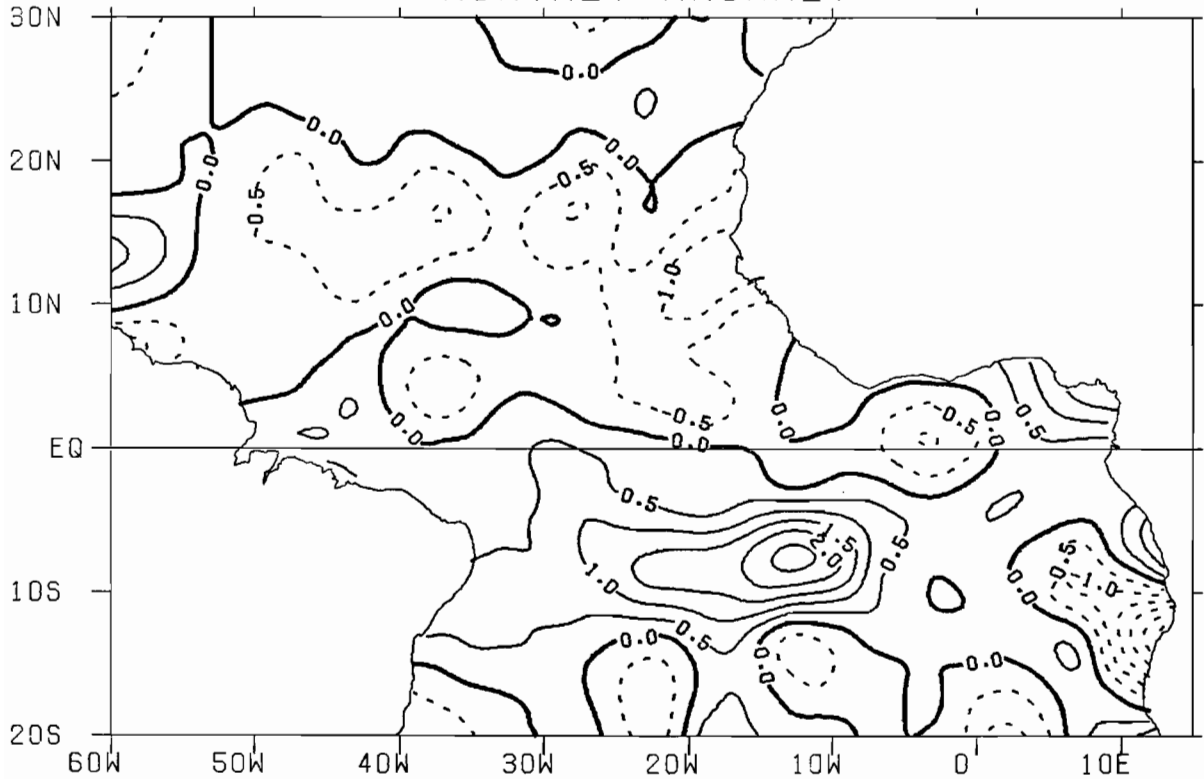
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MONTHLY MEAN

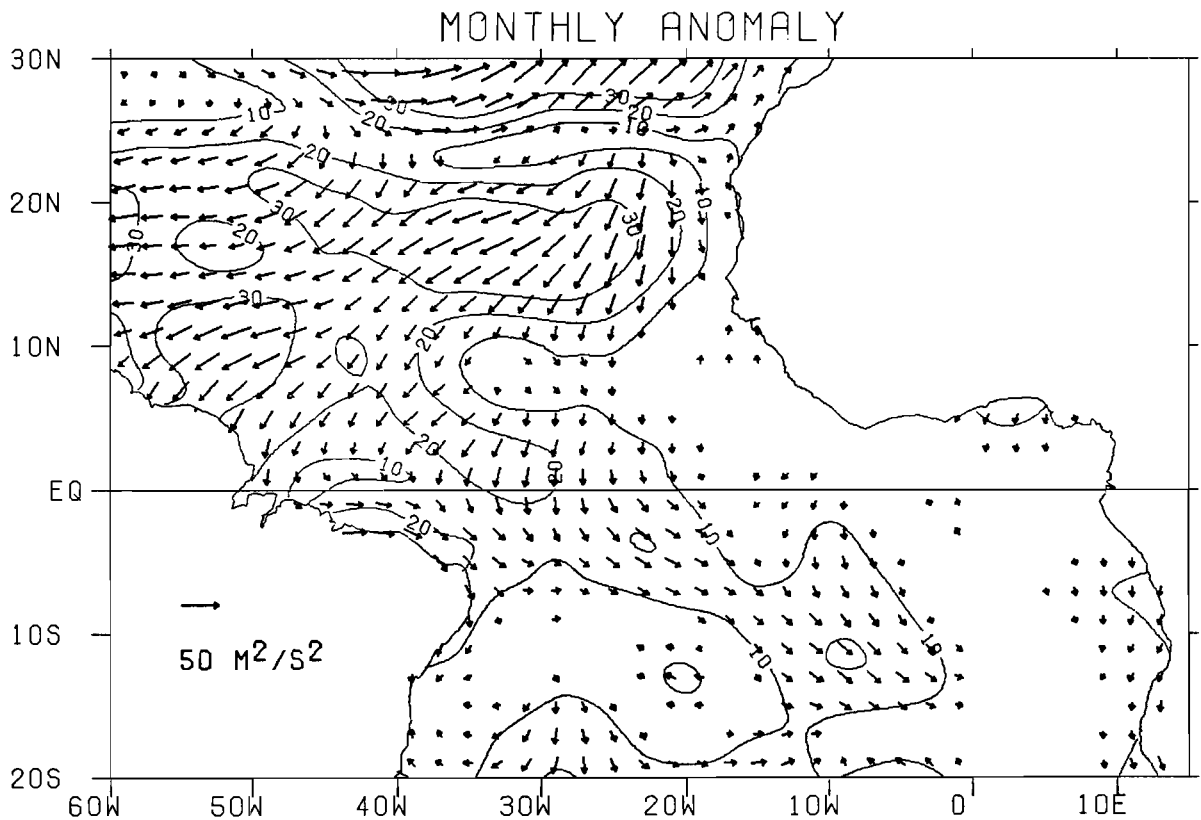
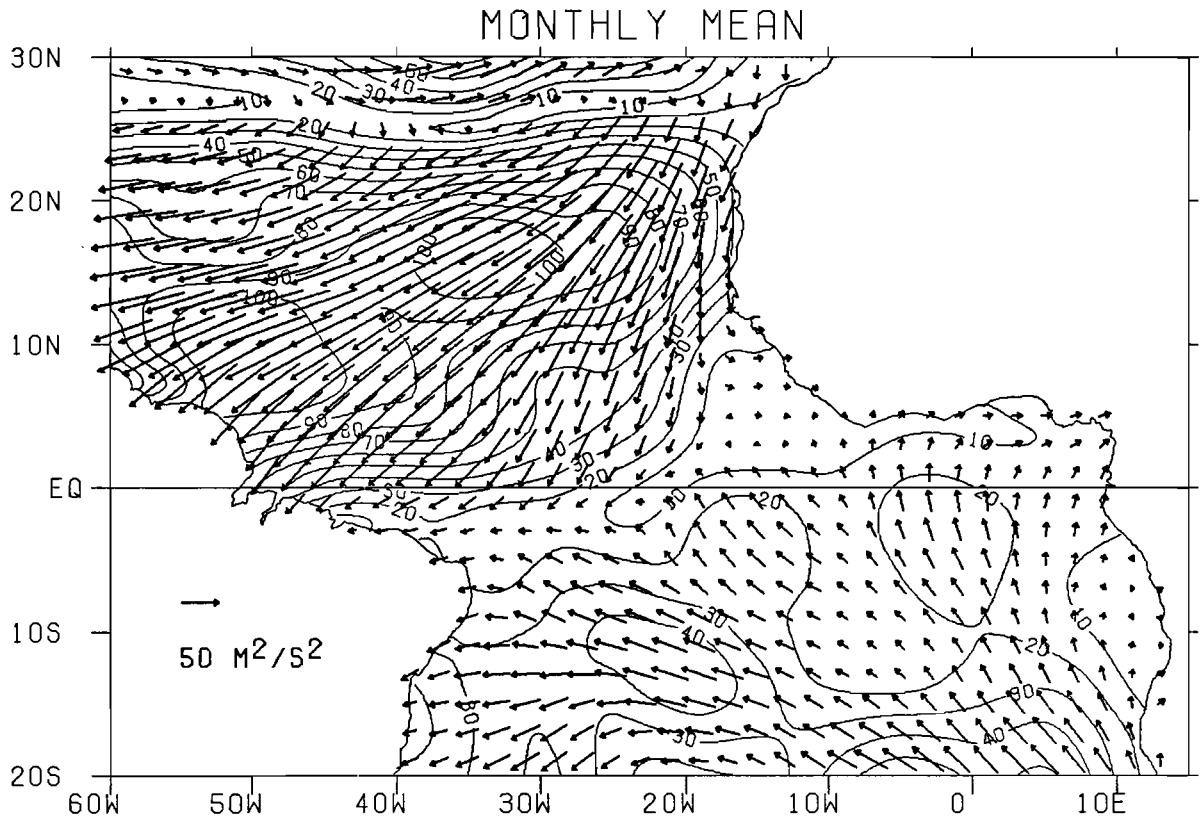


MONTHLY ANOMALY



WIND STRESS

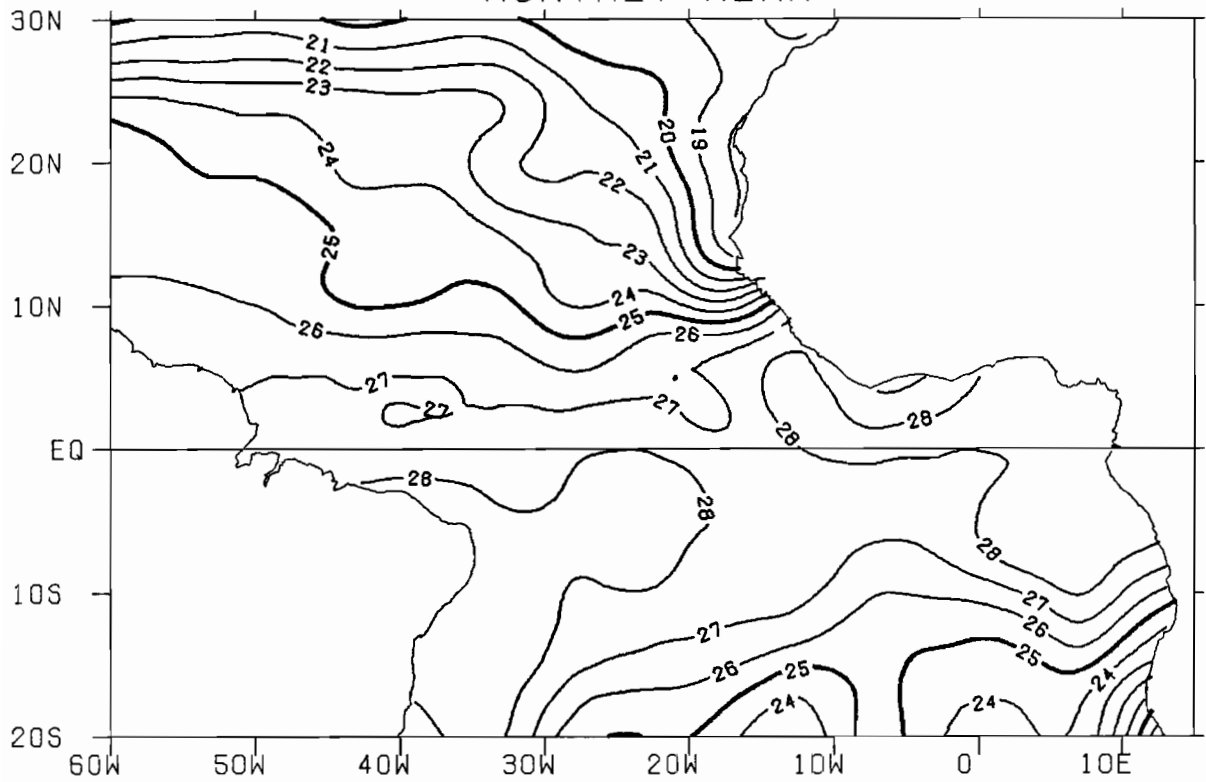
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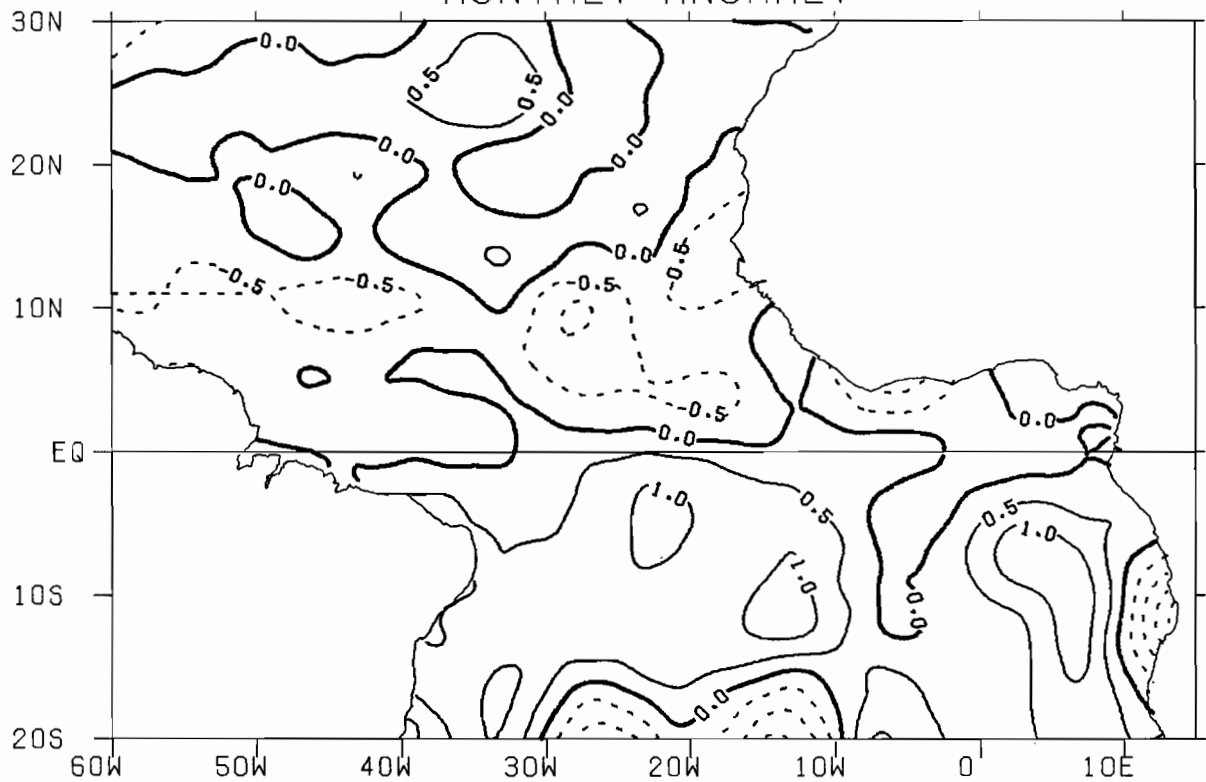
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MONTHLY MEAN



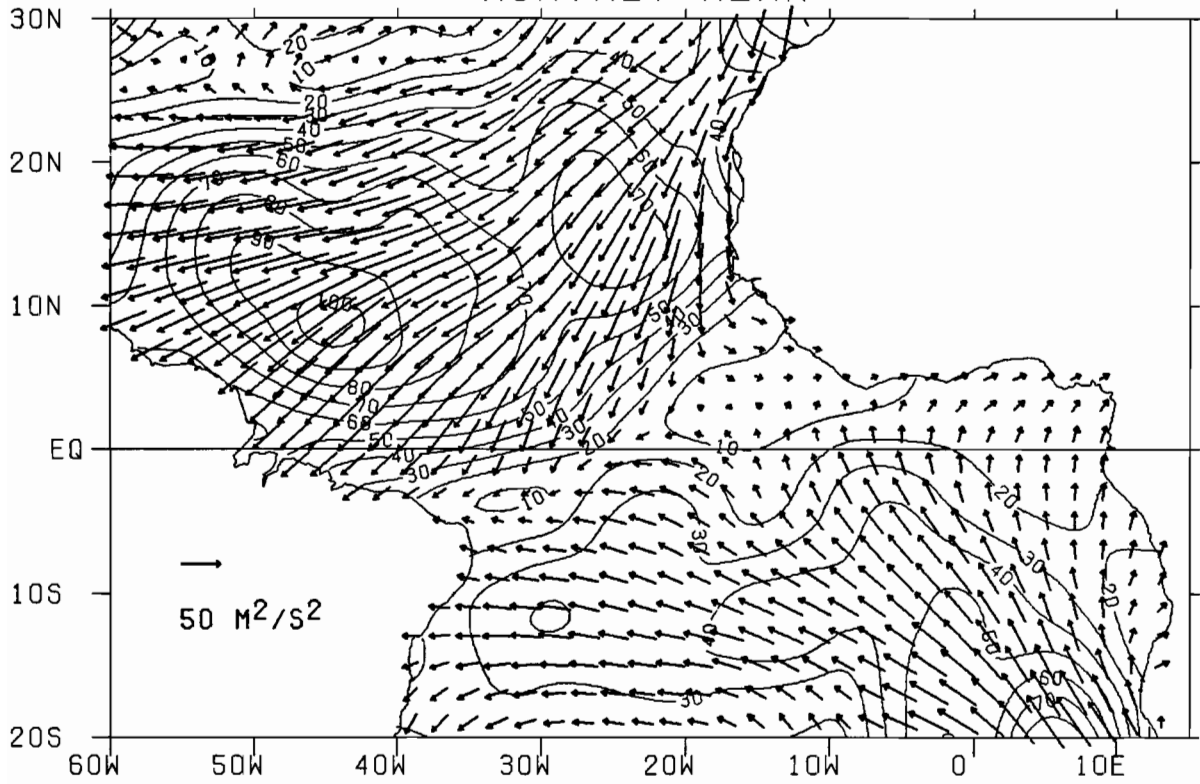
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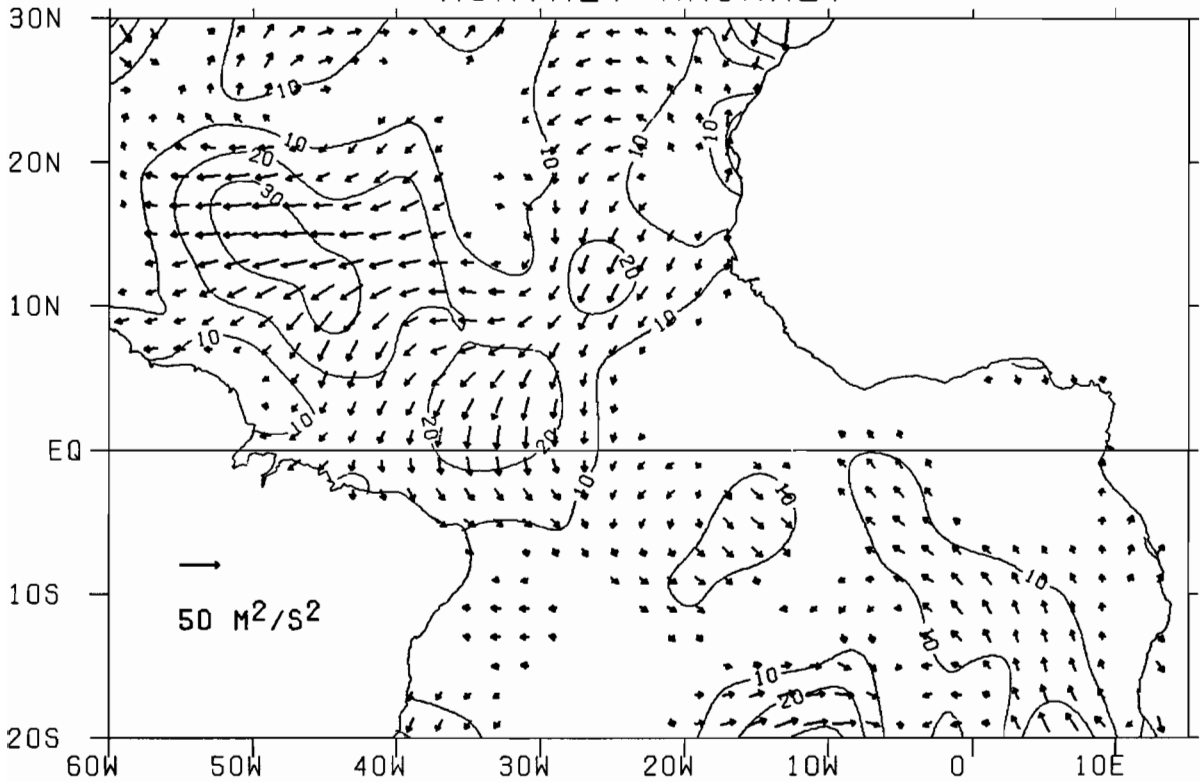
WIND STRESS

MARCH 1985

MONTHLY MEAN



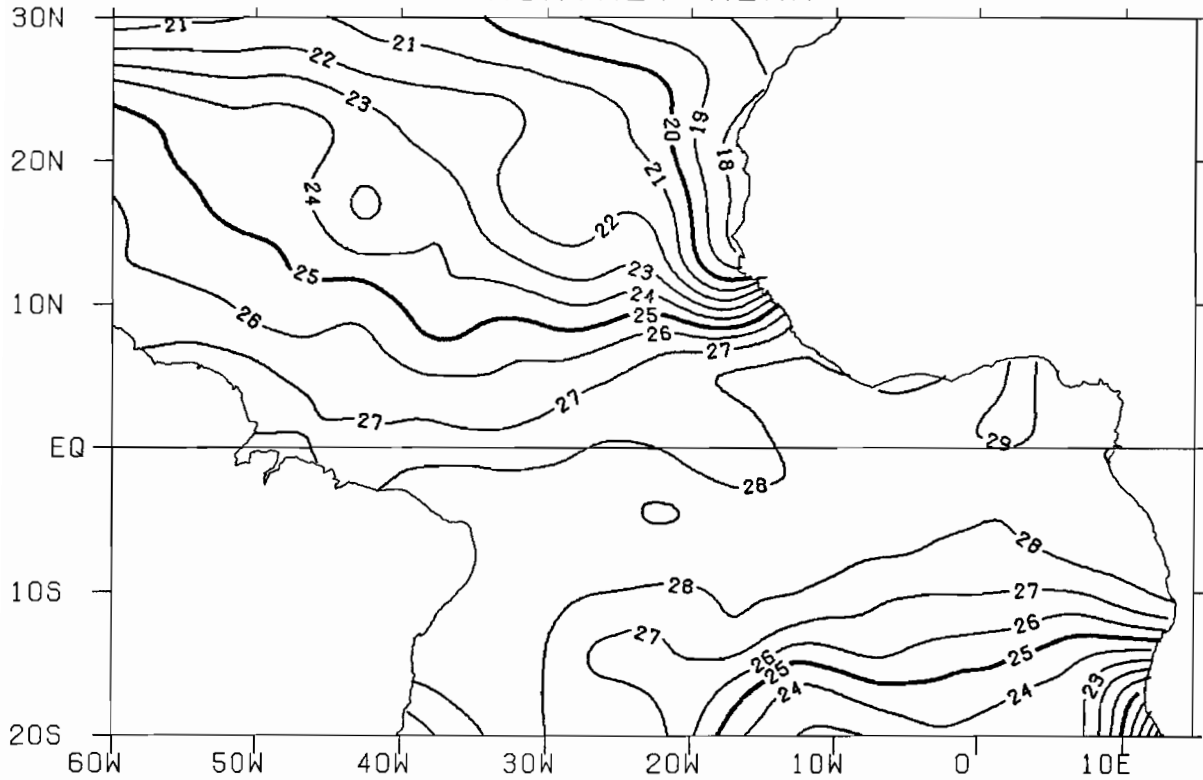
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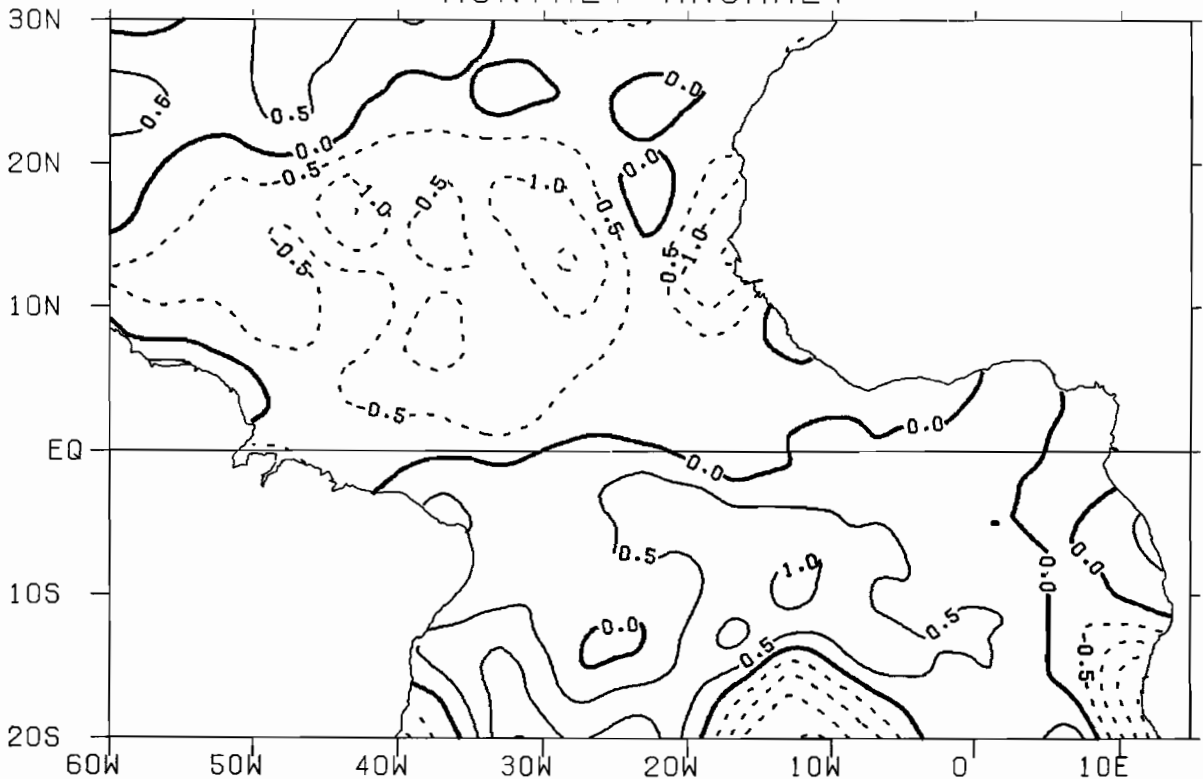
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MARCH 1985

MONTHLY MEAN



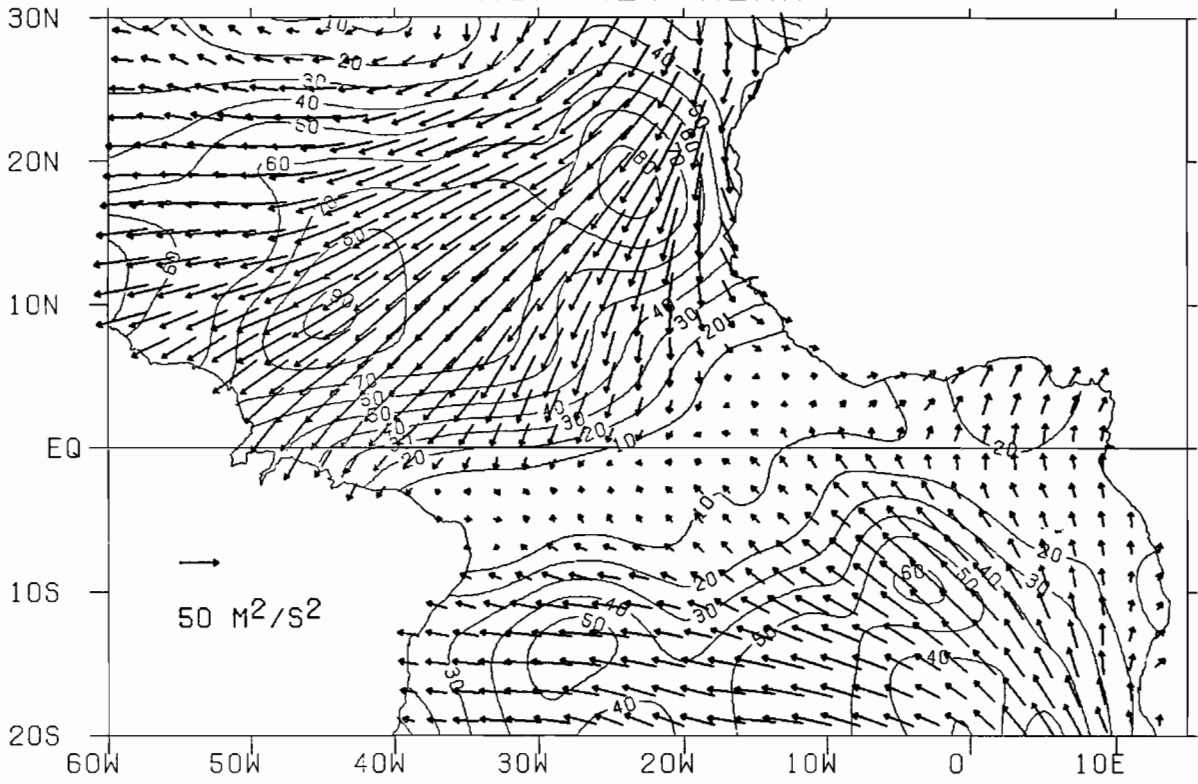
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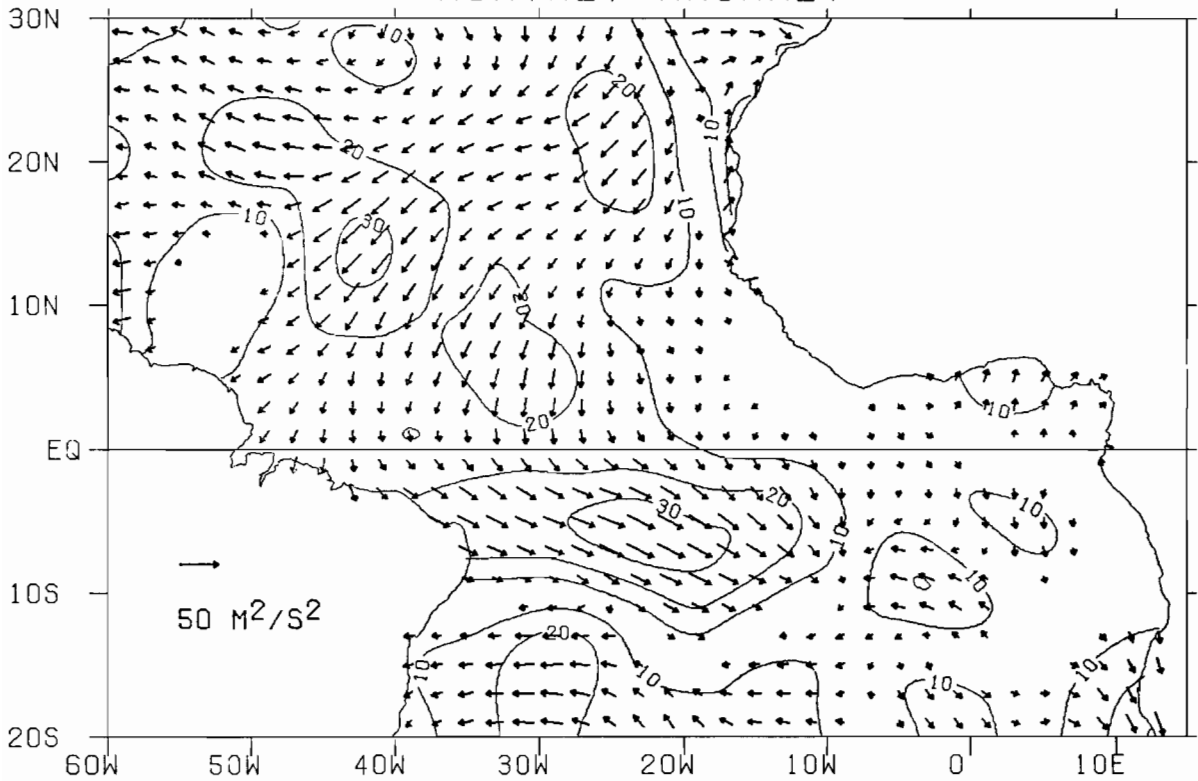
WIND STRESS

APRIL 1985

MONTHLY MEAN



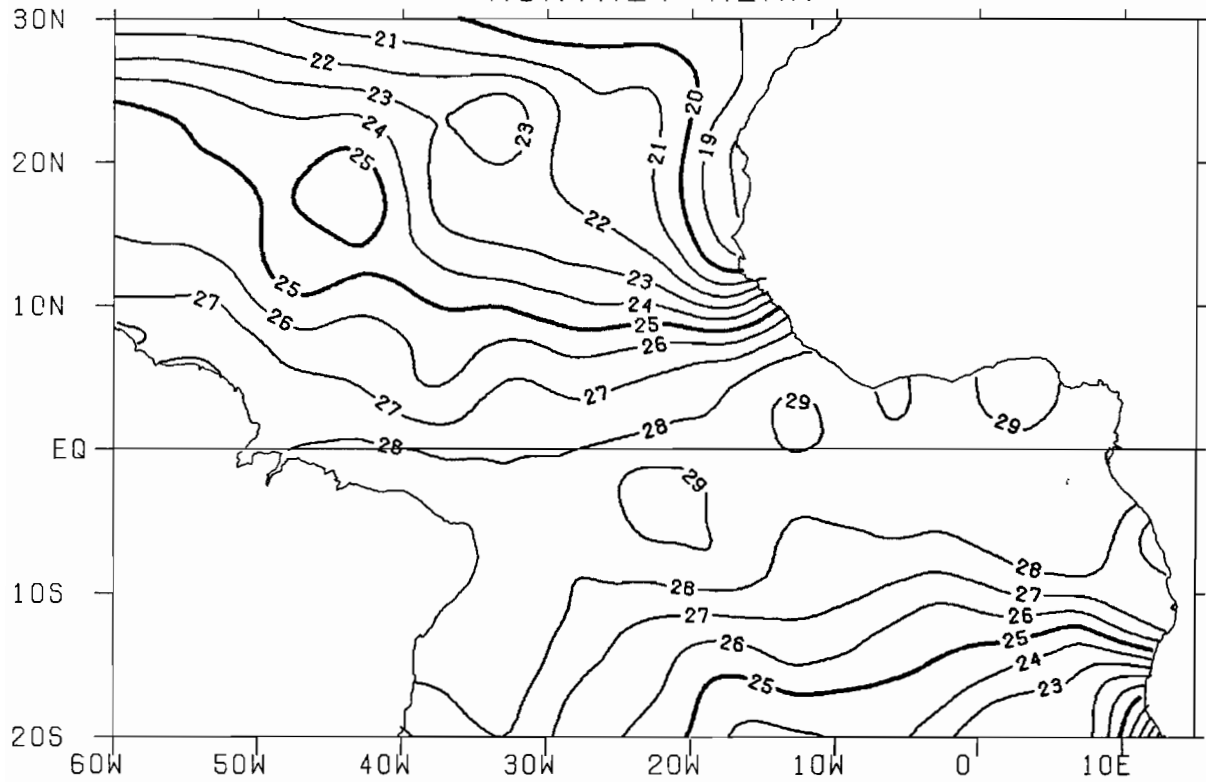
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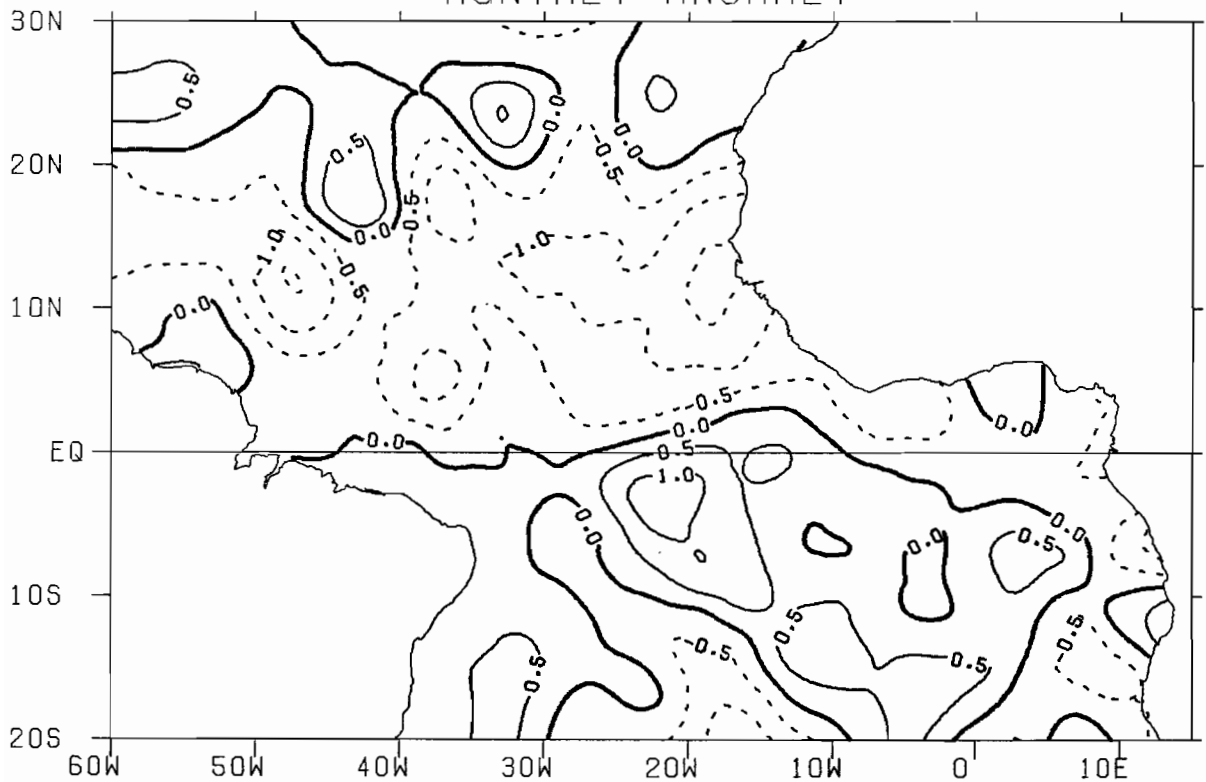
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MONTHLY MEAN



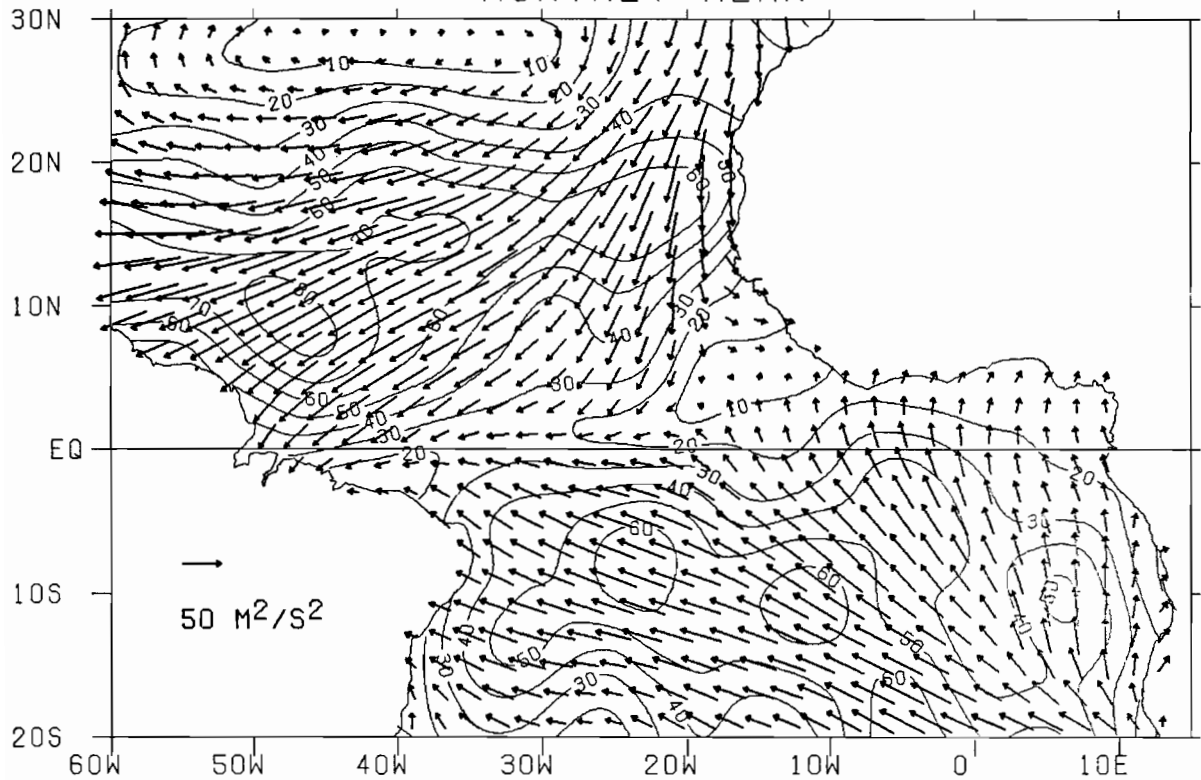
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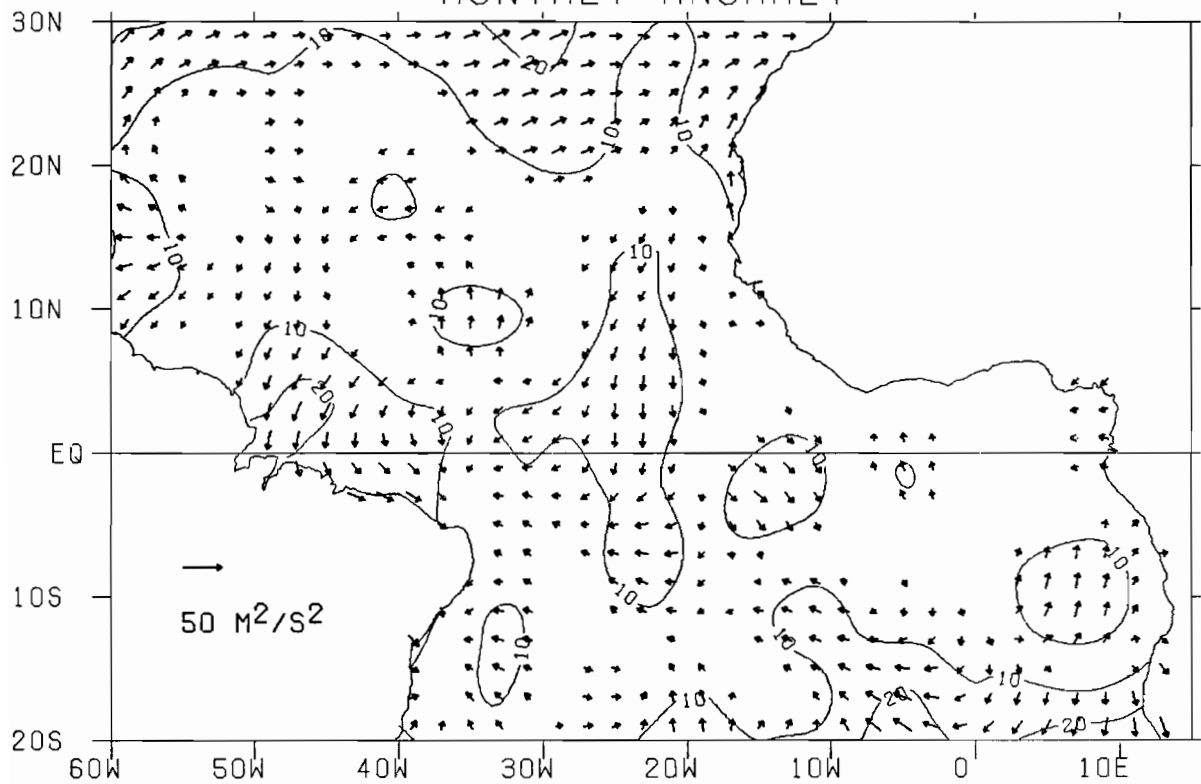
WIND STRESS

MAY 1985

MONTHLY MEAN



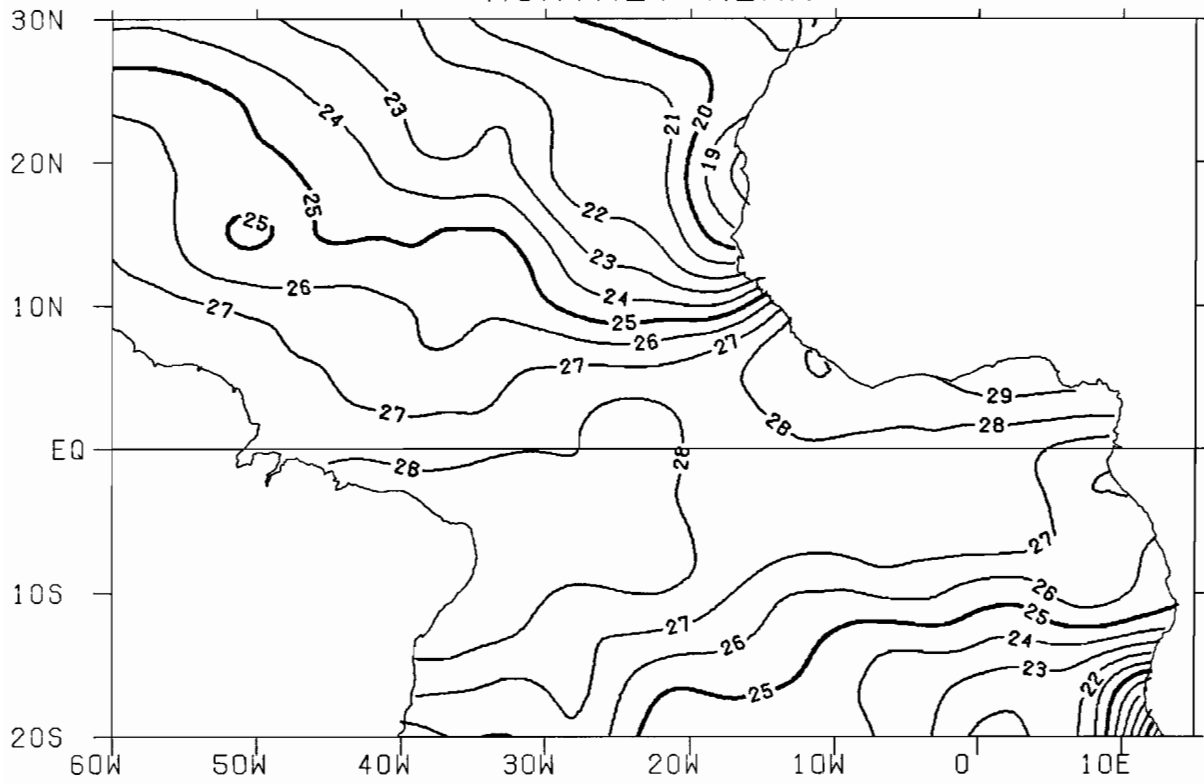
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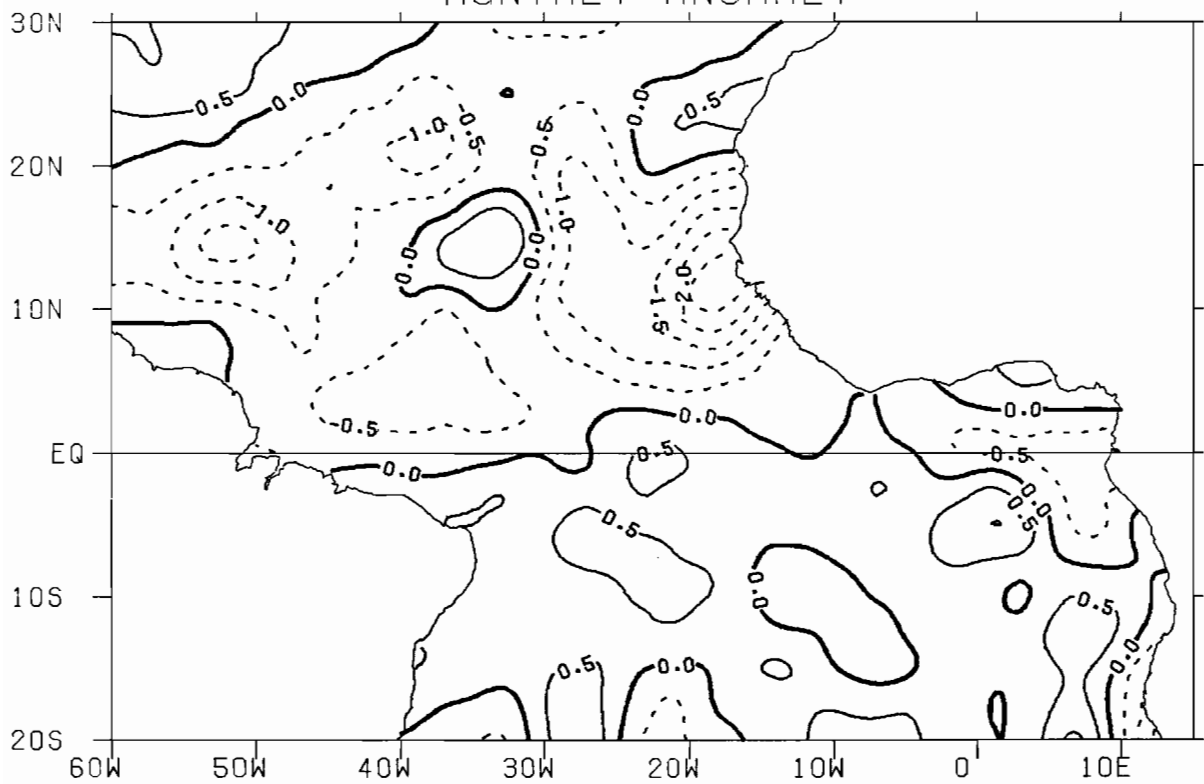
SEA SURFACE TEMPERATURE

MAY 1985

MONTHLY MEAN



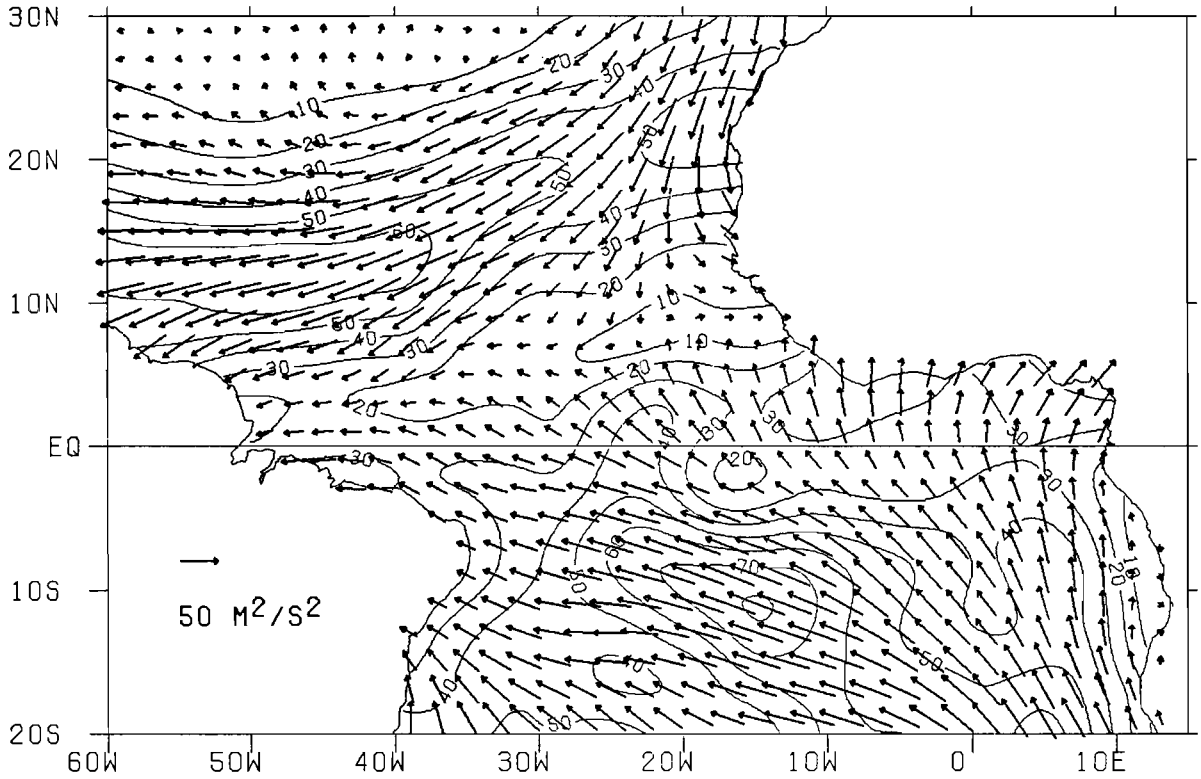
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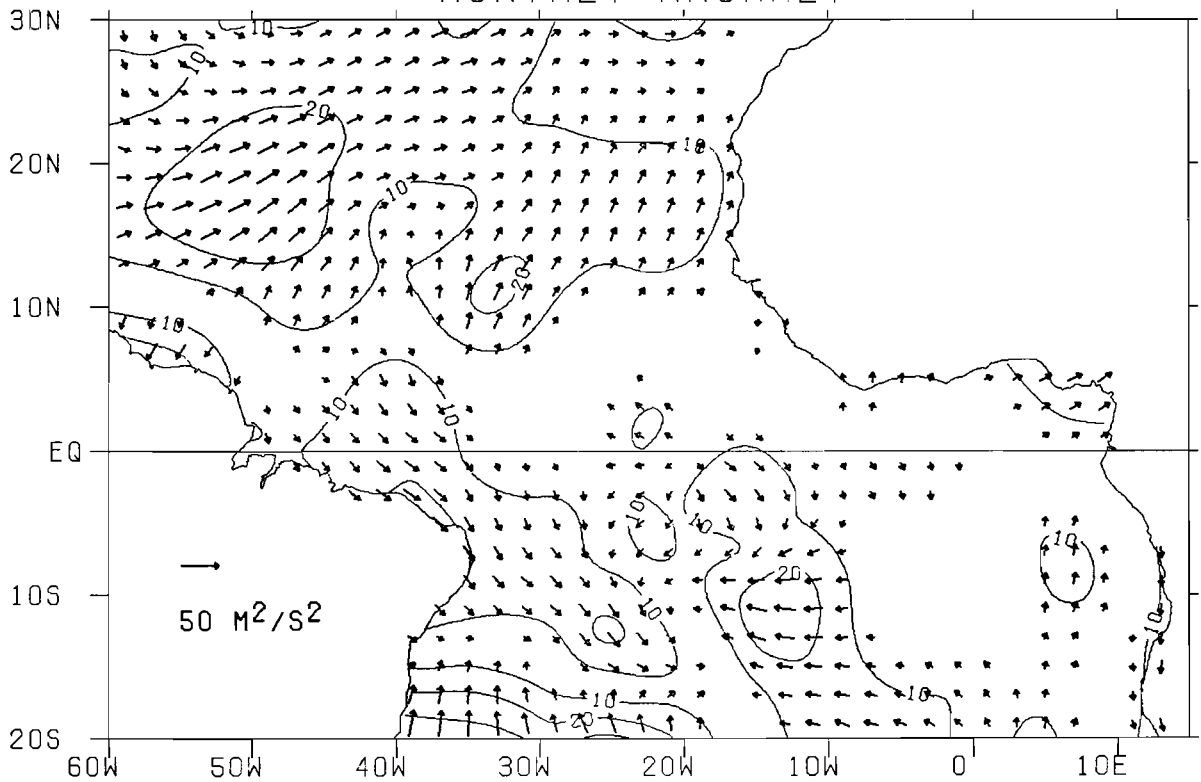
WIND STRESS

JUNE 1985

MONTHLY MEAN



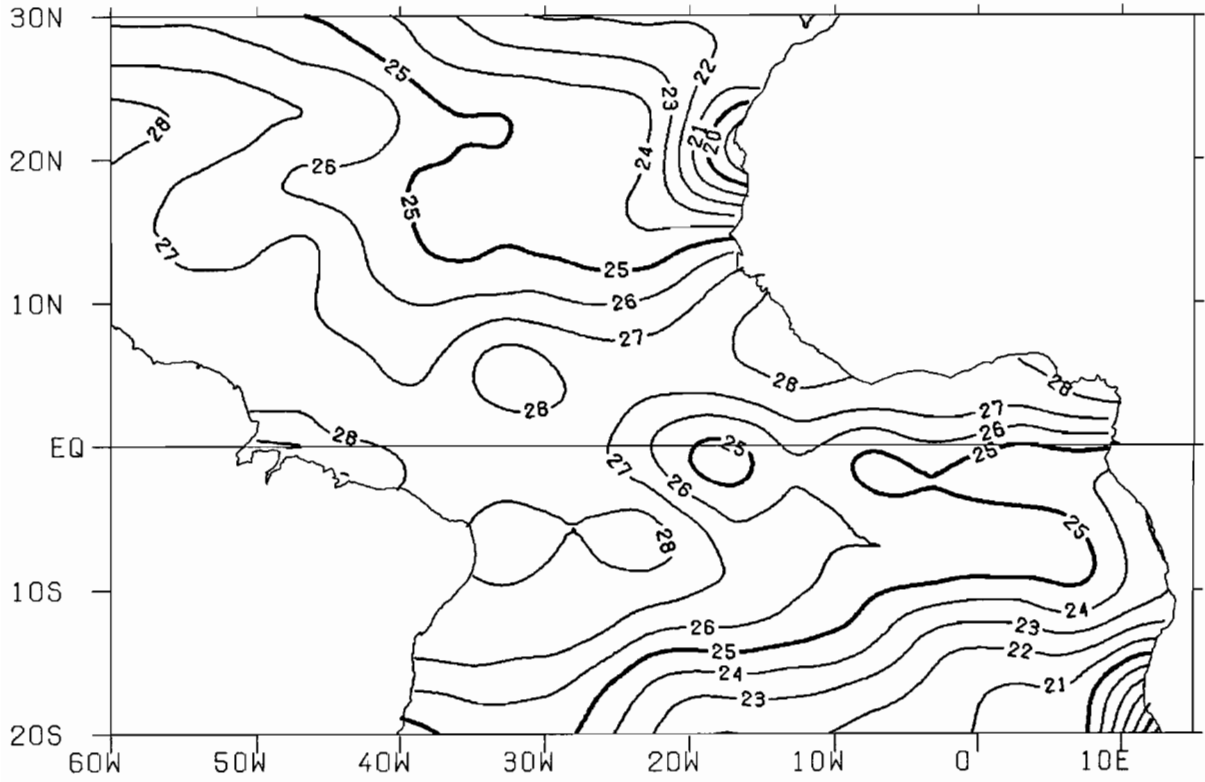
MONTHLY ANOMALY



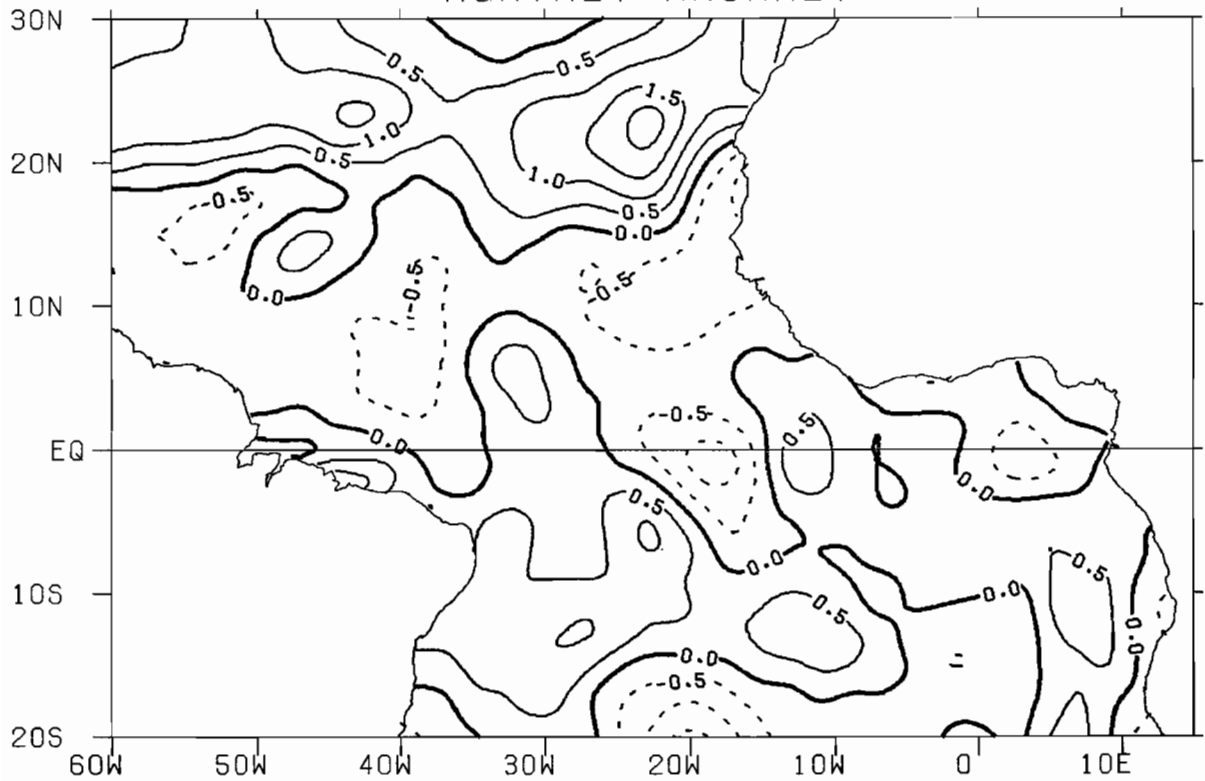
SEA SURFACE TEMPERATURE

JUNE 1985

MONTHLY MEAN



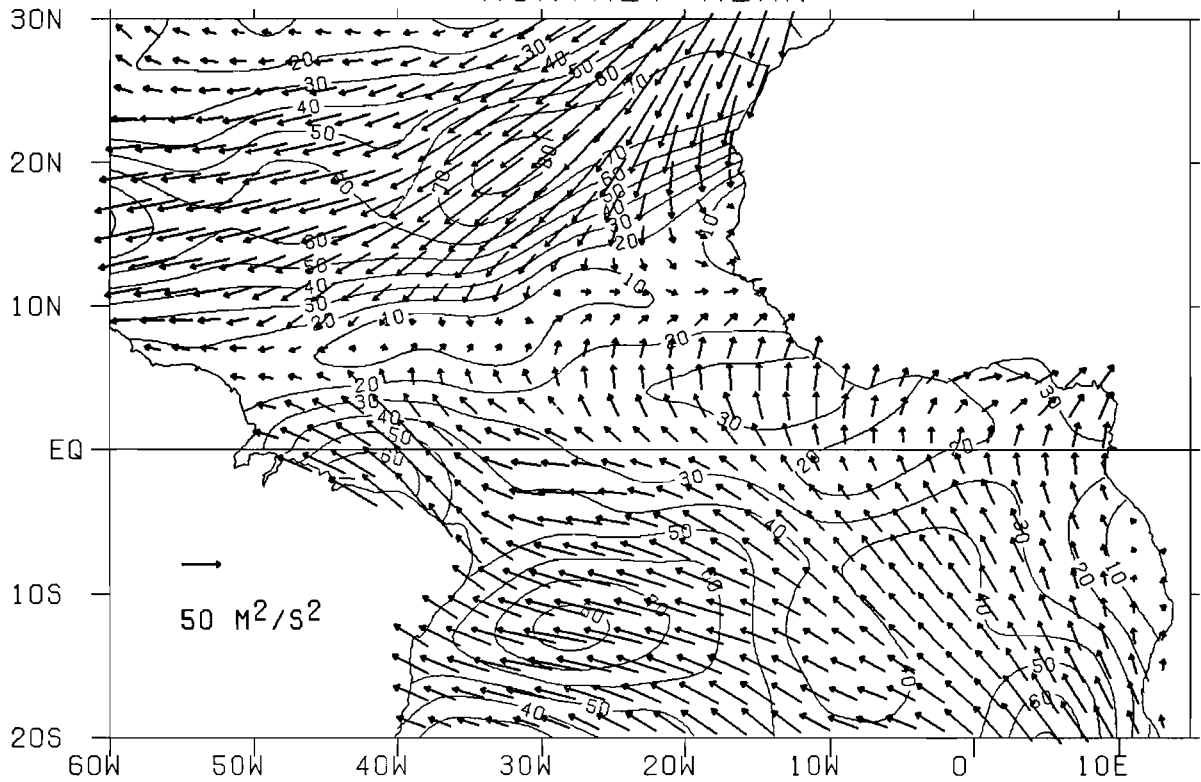
MONTHLY ANOMALY



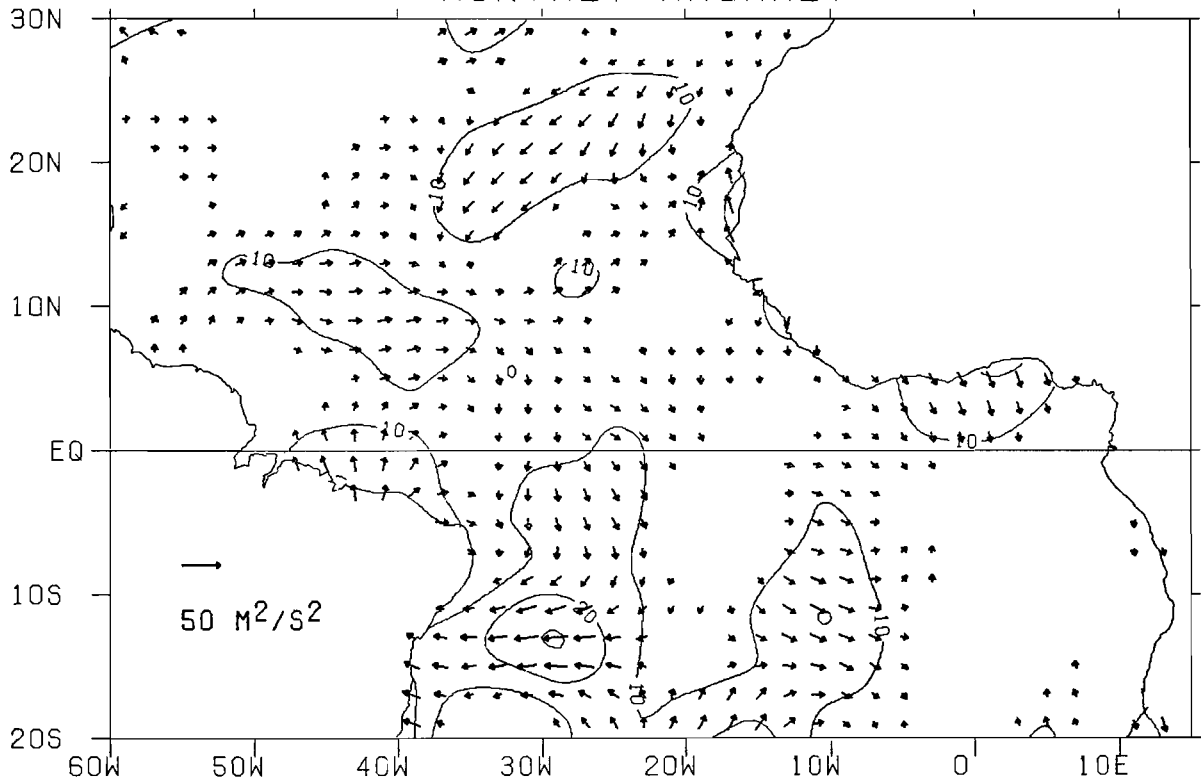
WIND STRESS

JULY 1985

MONTHLY MEAN



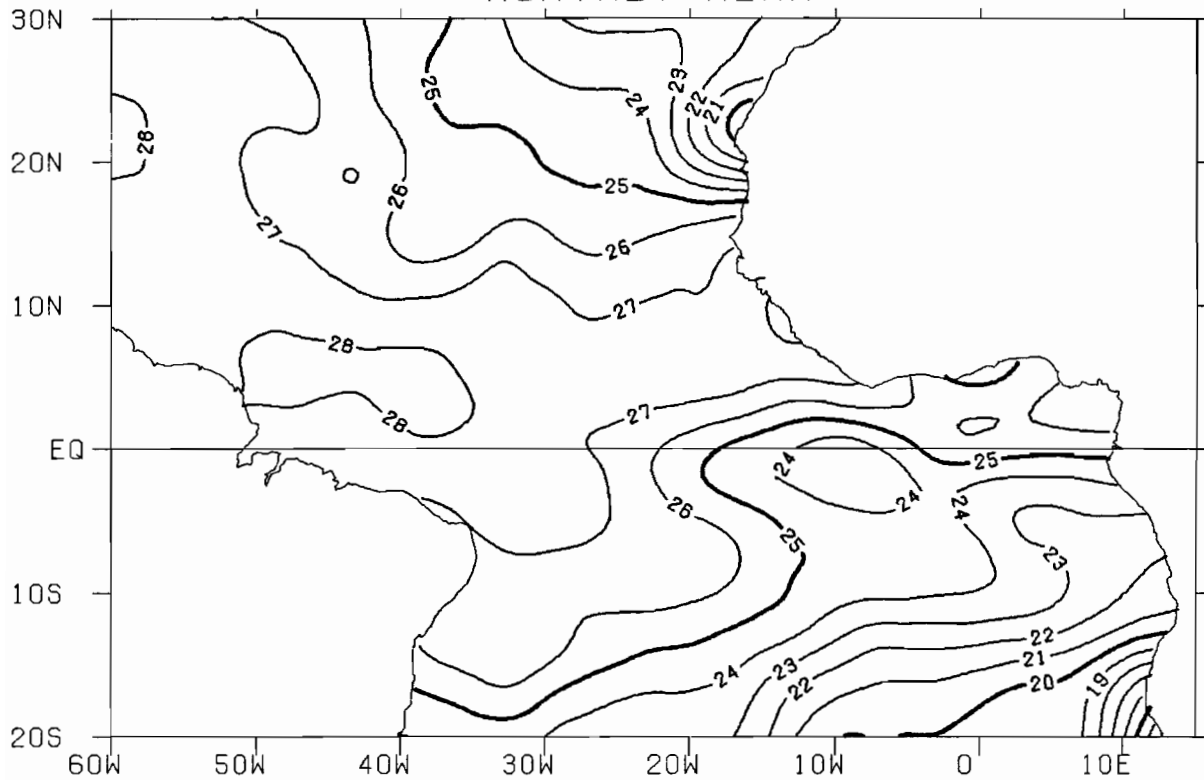
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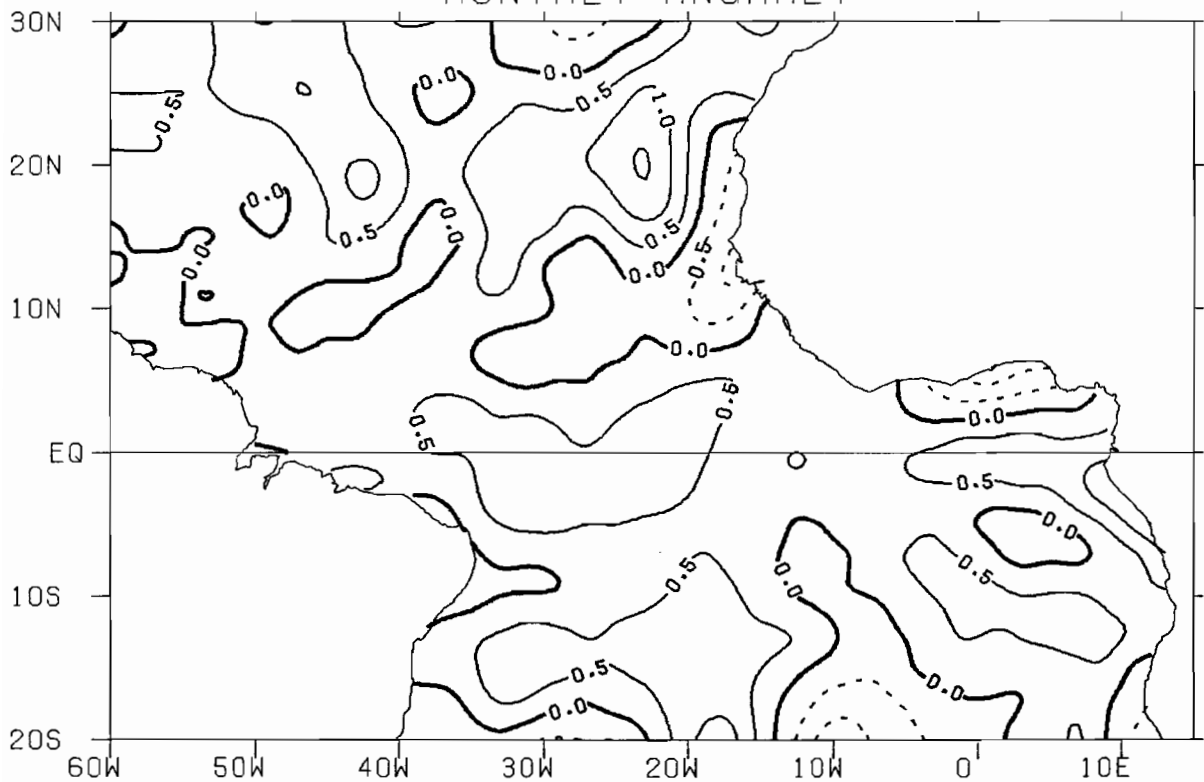
SEA SURFACE TEMPERATURE

JULY 1985

MONTHLY MEAN



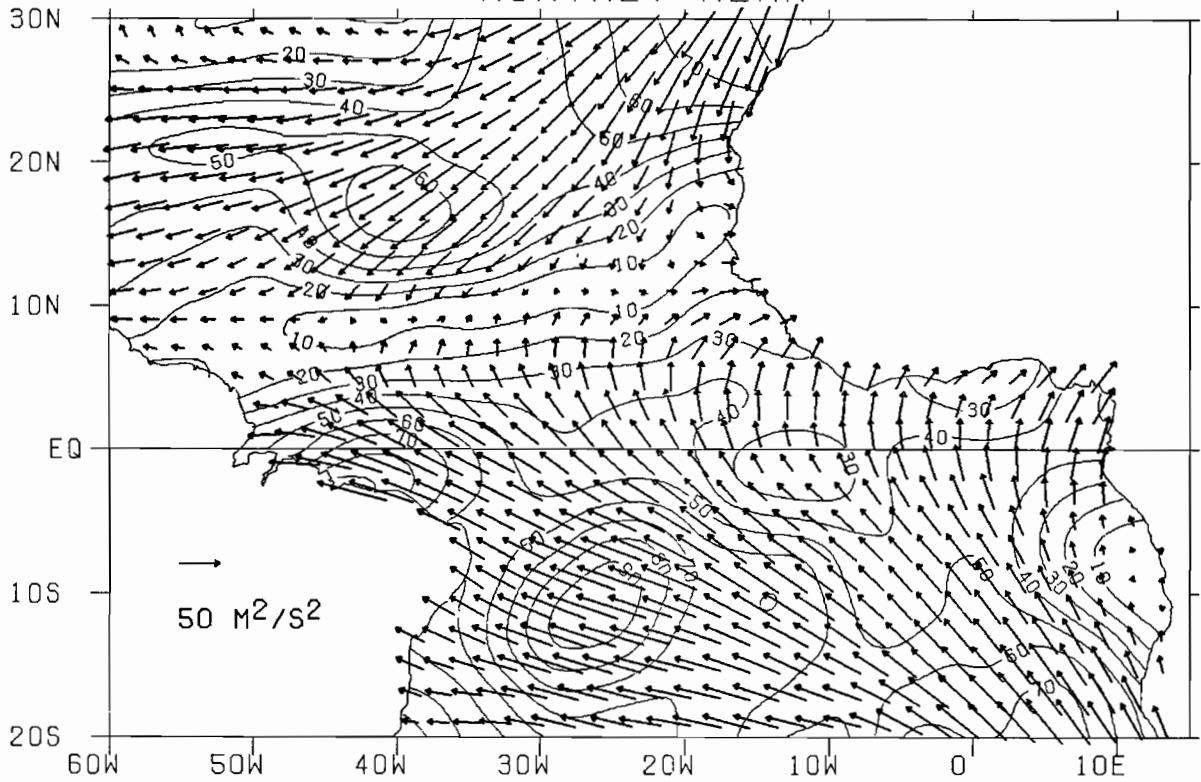
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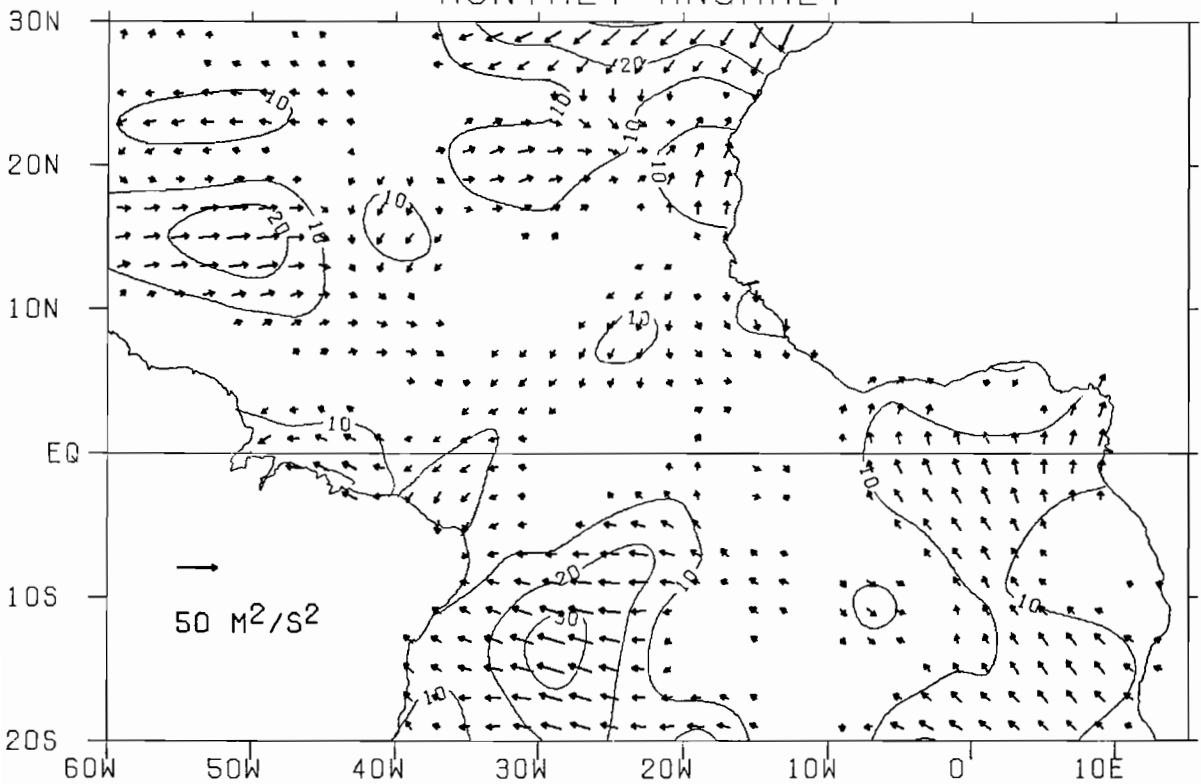
WIND STRESS

AUGUST 1985

MONTHLY MEAN



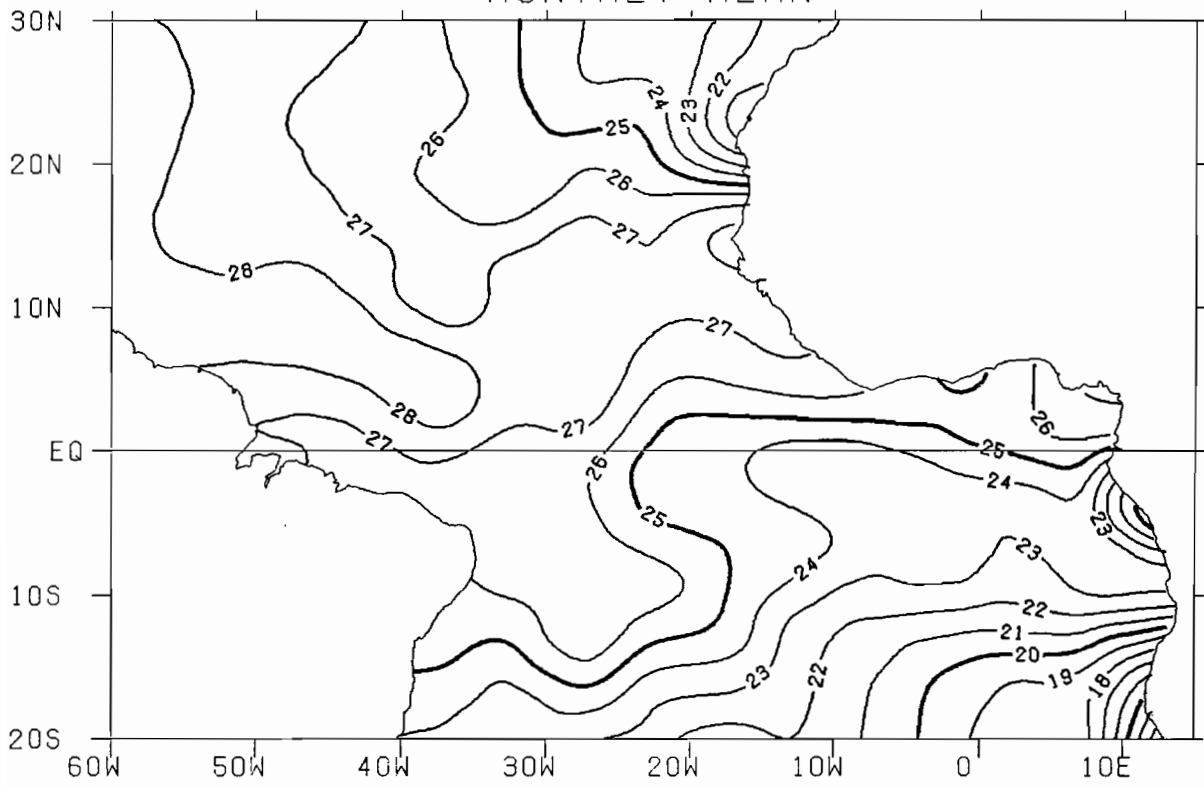
MONTHLY ANOMALY



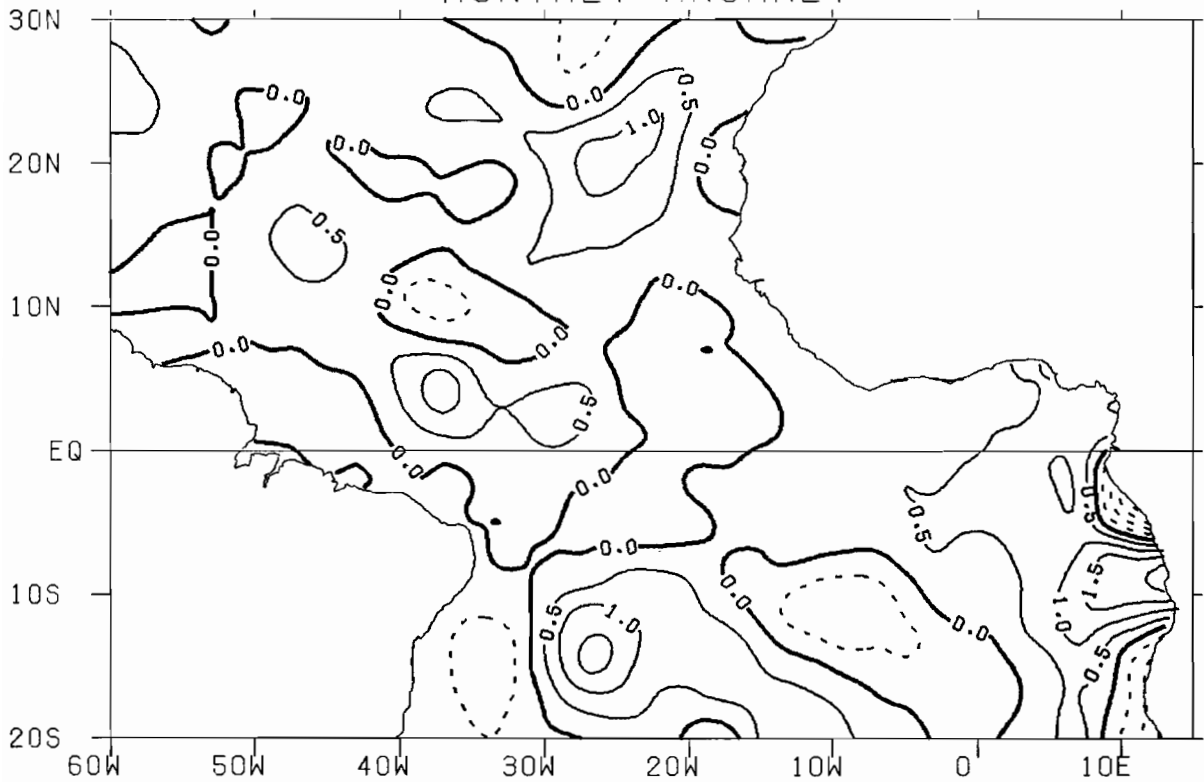
SEA SURFACE TEMPERATURE

AUGUST 1985

MONTHLY MEAN

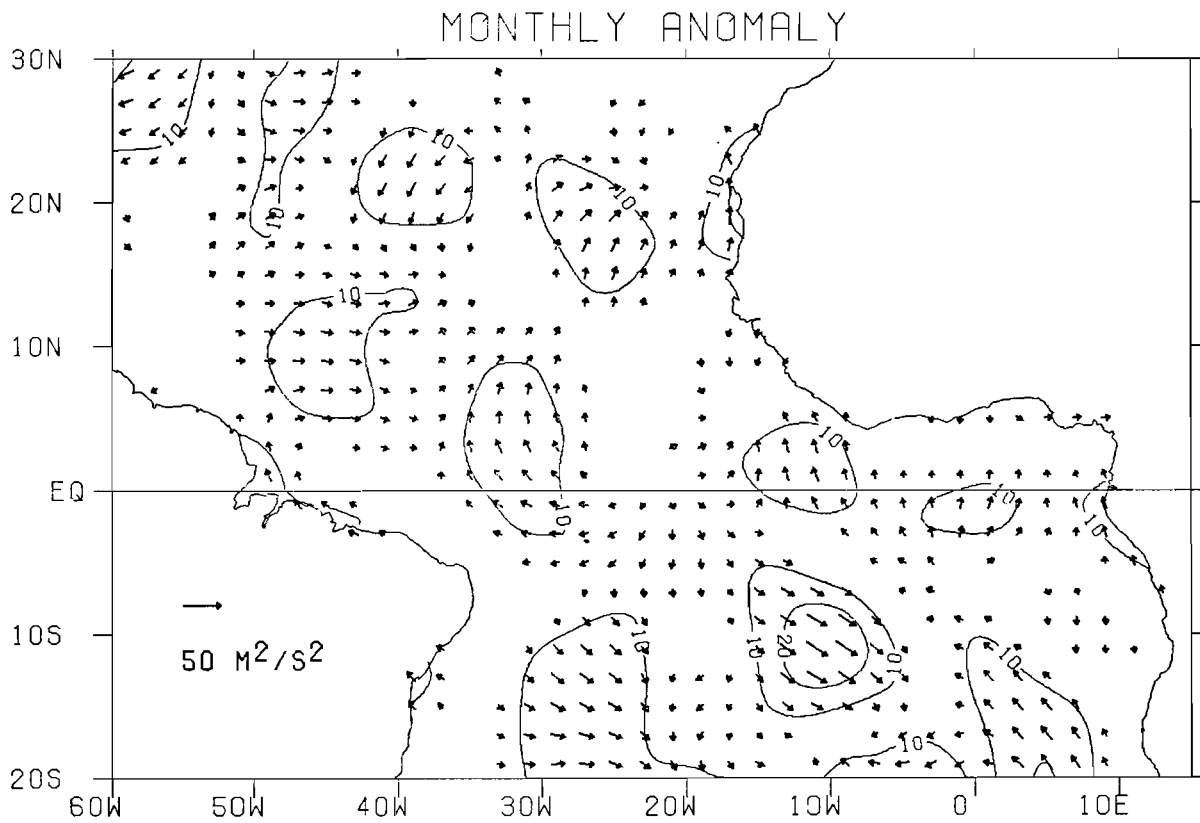
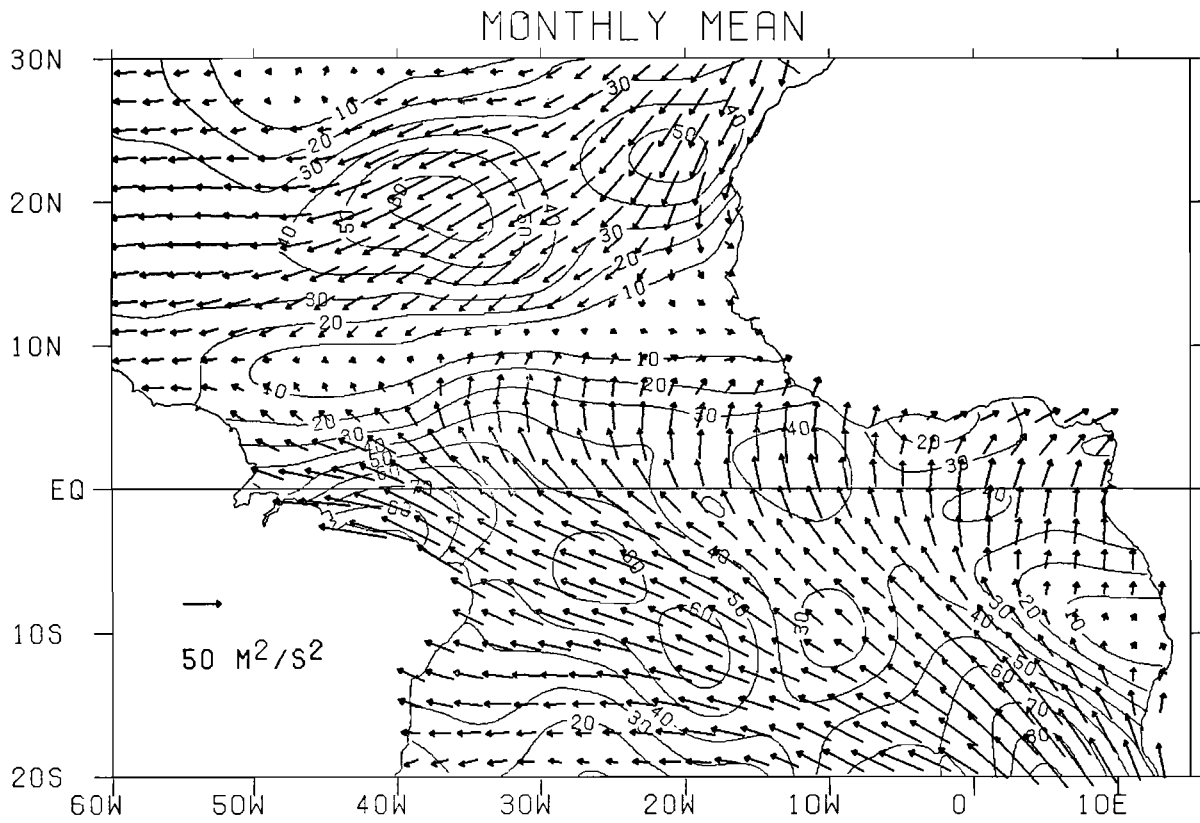


MONTHLY ANOMALY



WIND STRESS

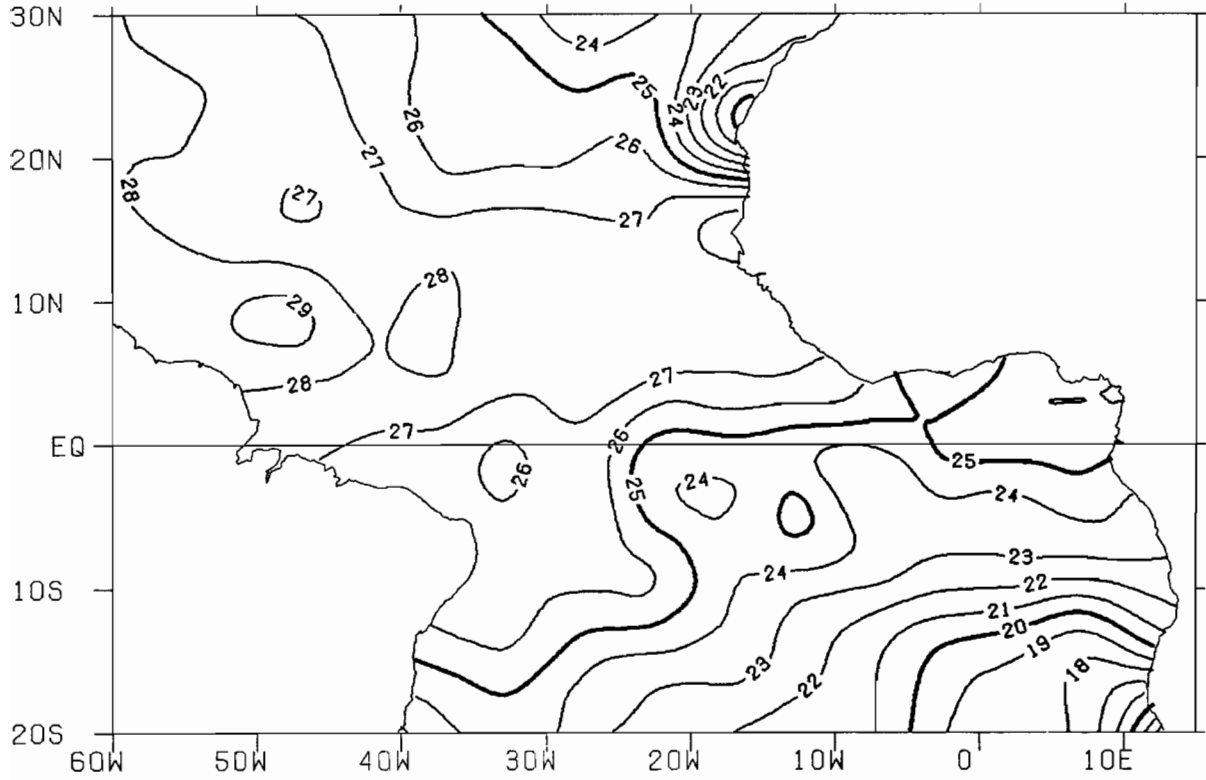
SEPTEMBER 1985



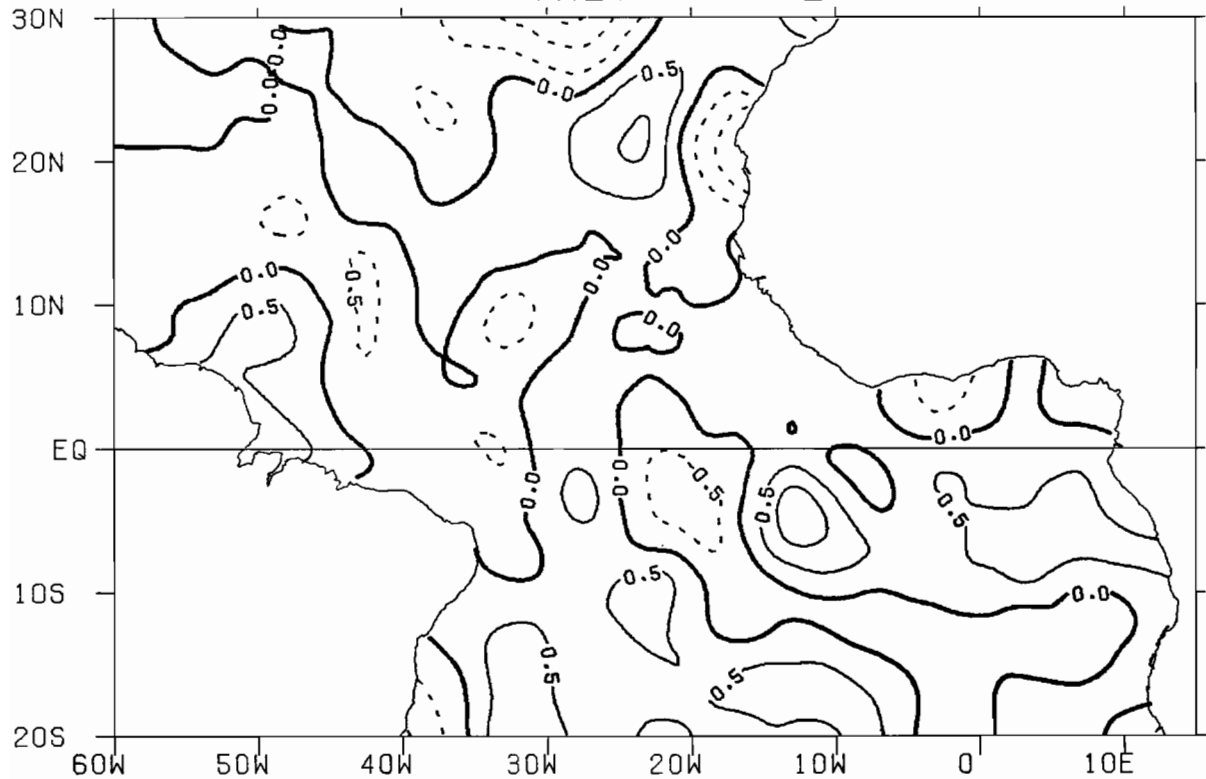
SEA SURFACE TEMPERATURE

SEPTEMBER 1985

MONTHLY MEAN

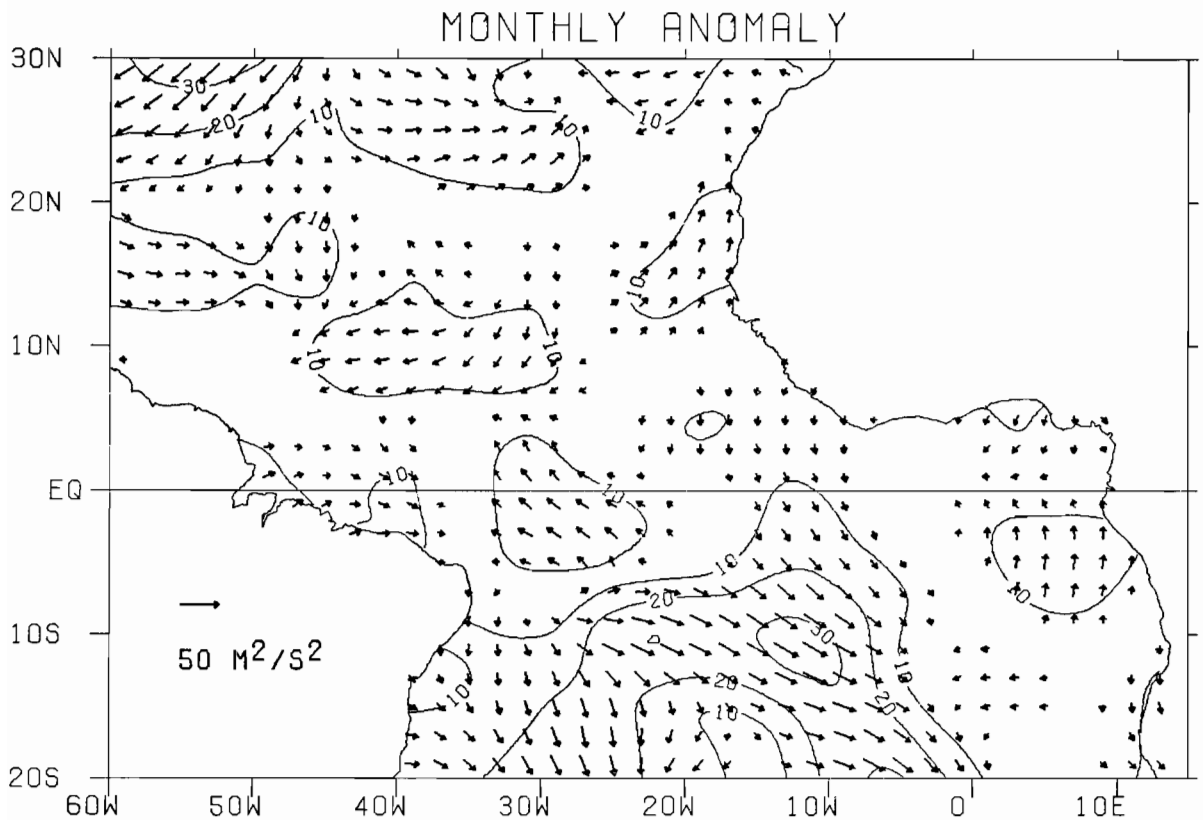
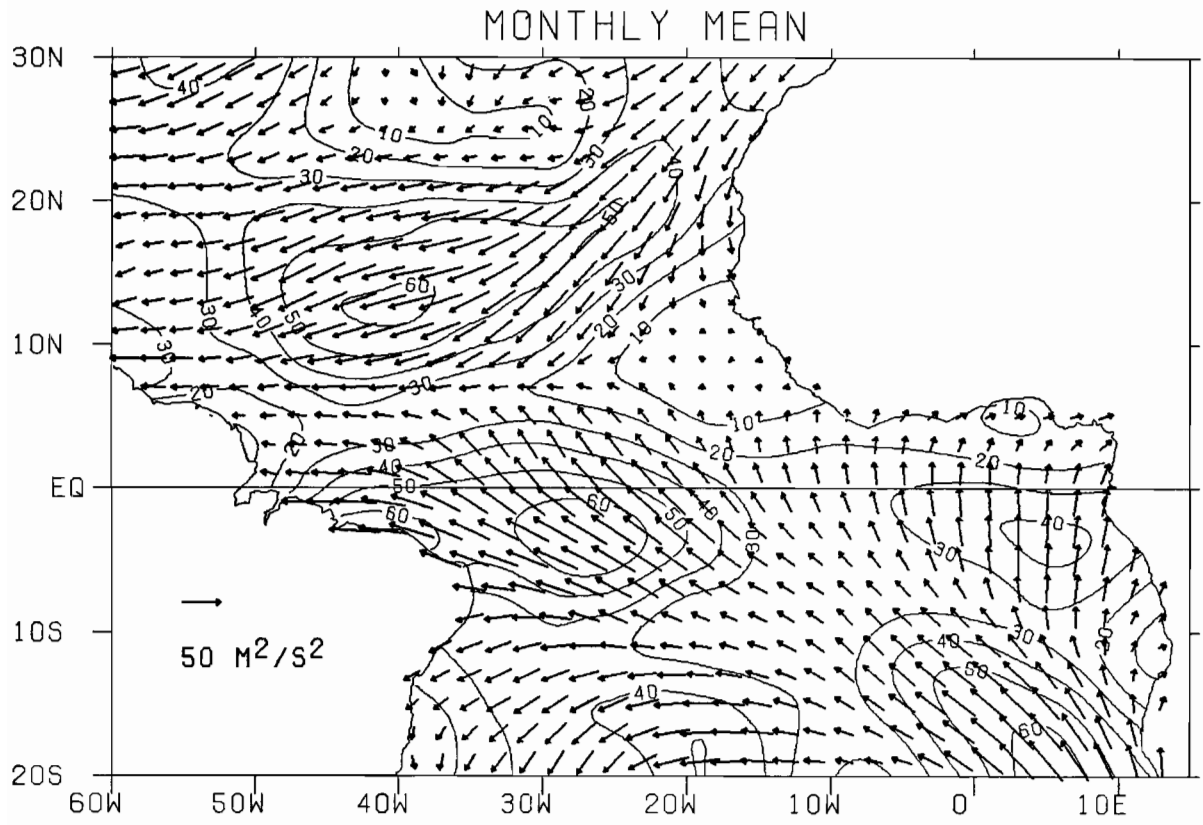


MONTHLY ANOMALY



WIND STRESS

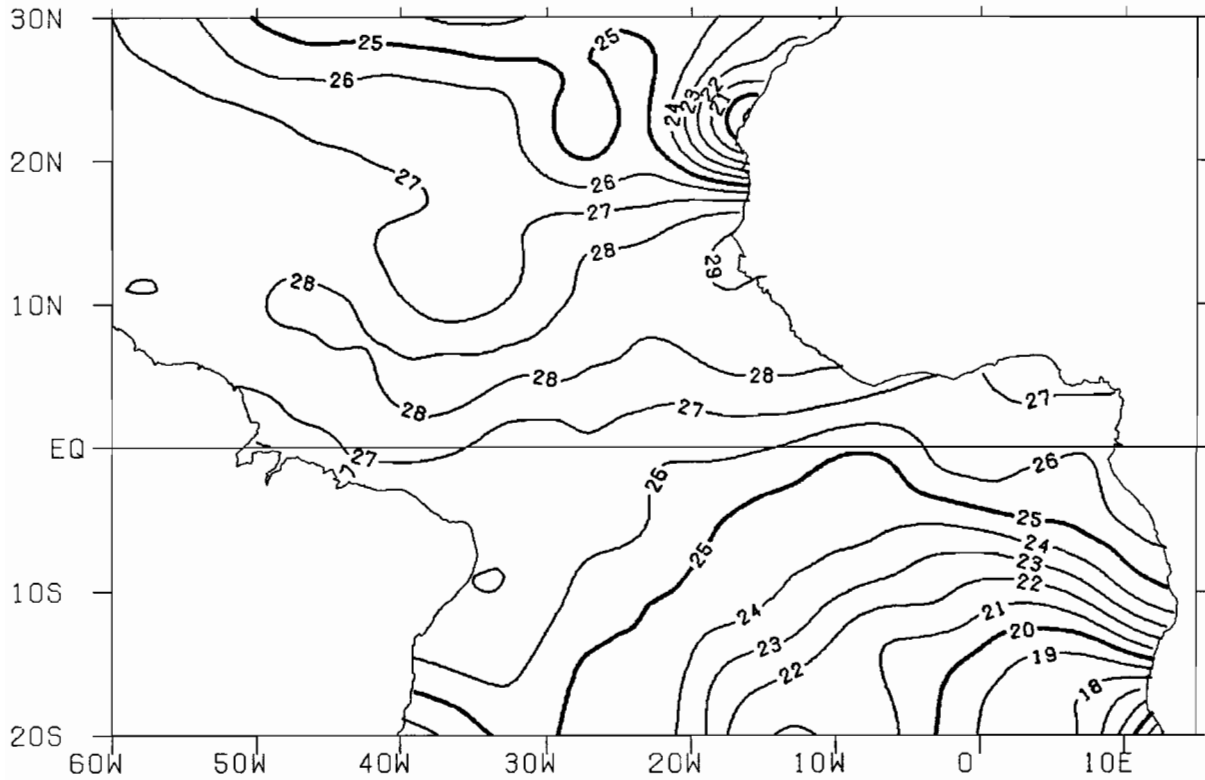
OCTOBER 1985



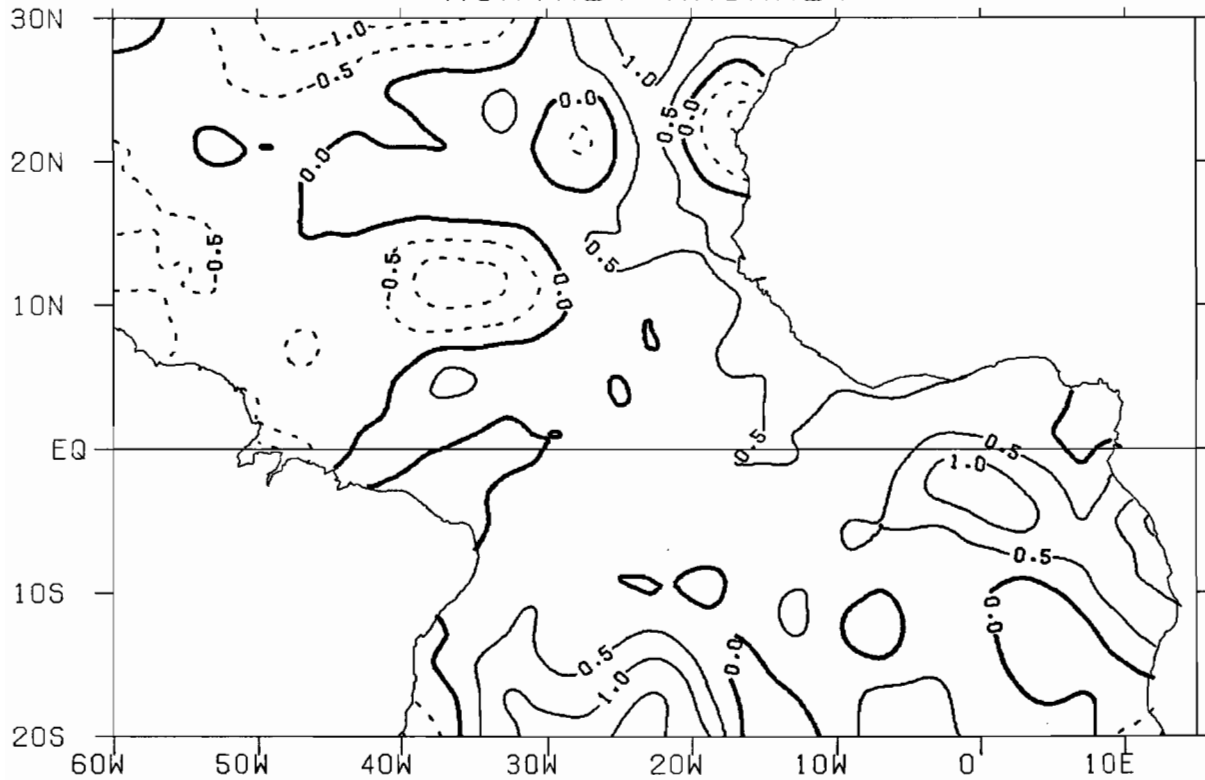
SEA SURFACE TEMPERATURE

OCTOBER 1985

MONTHLY MEAN



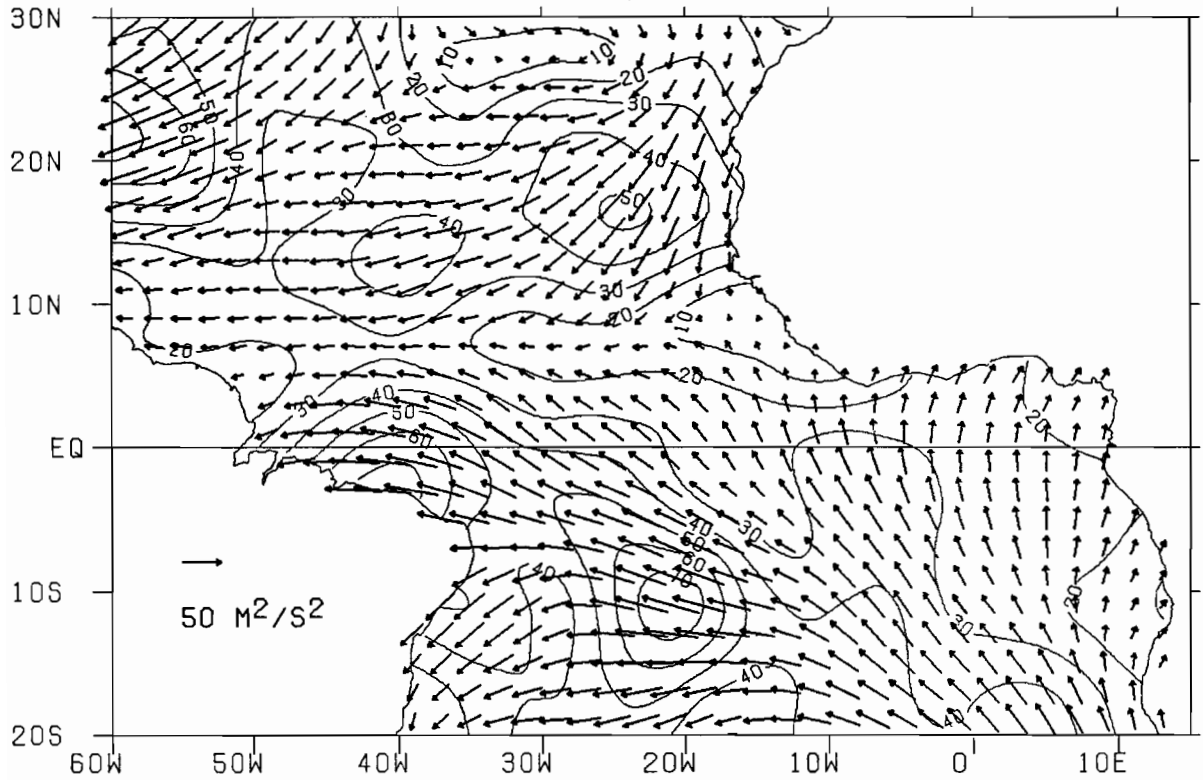
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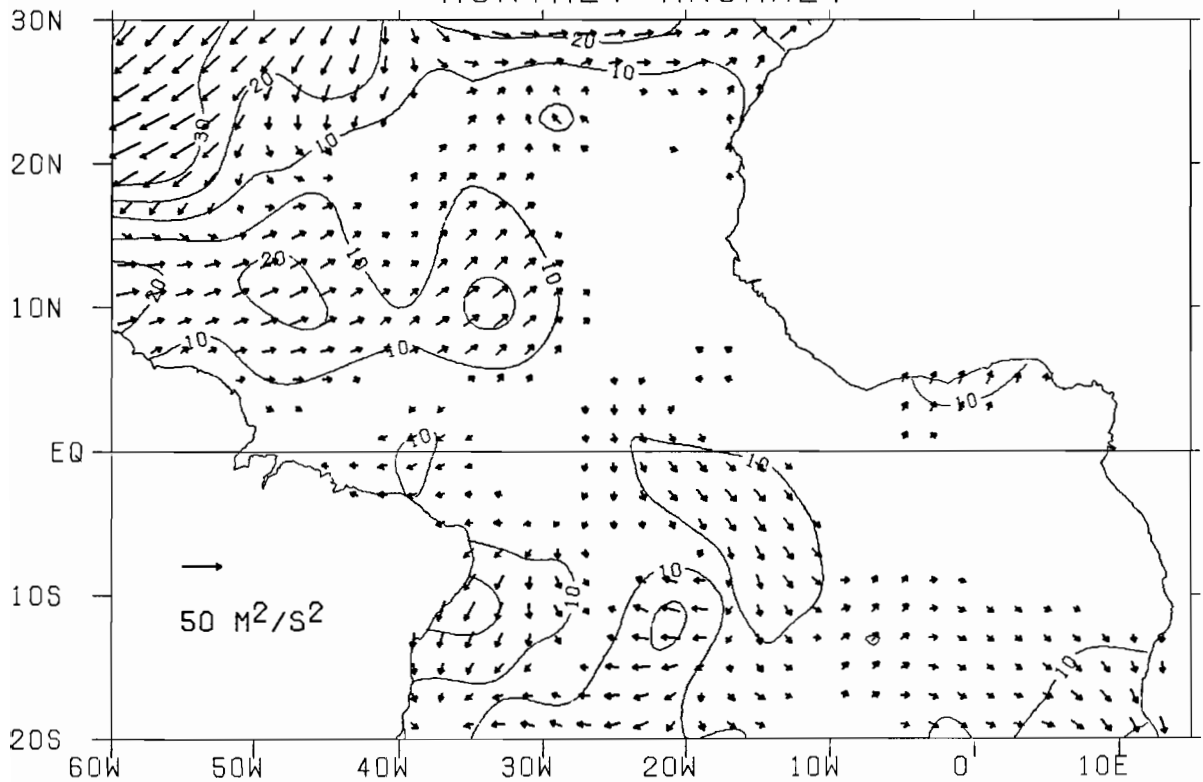
WIND STRESS

NOVEMBER 1985

MONTHLY MEAN



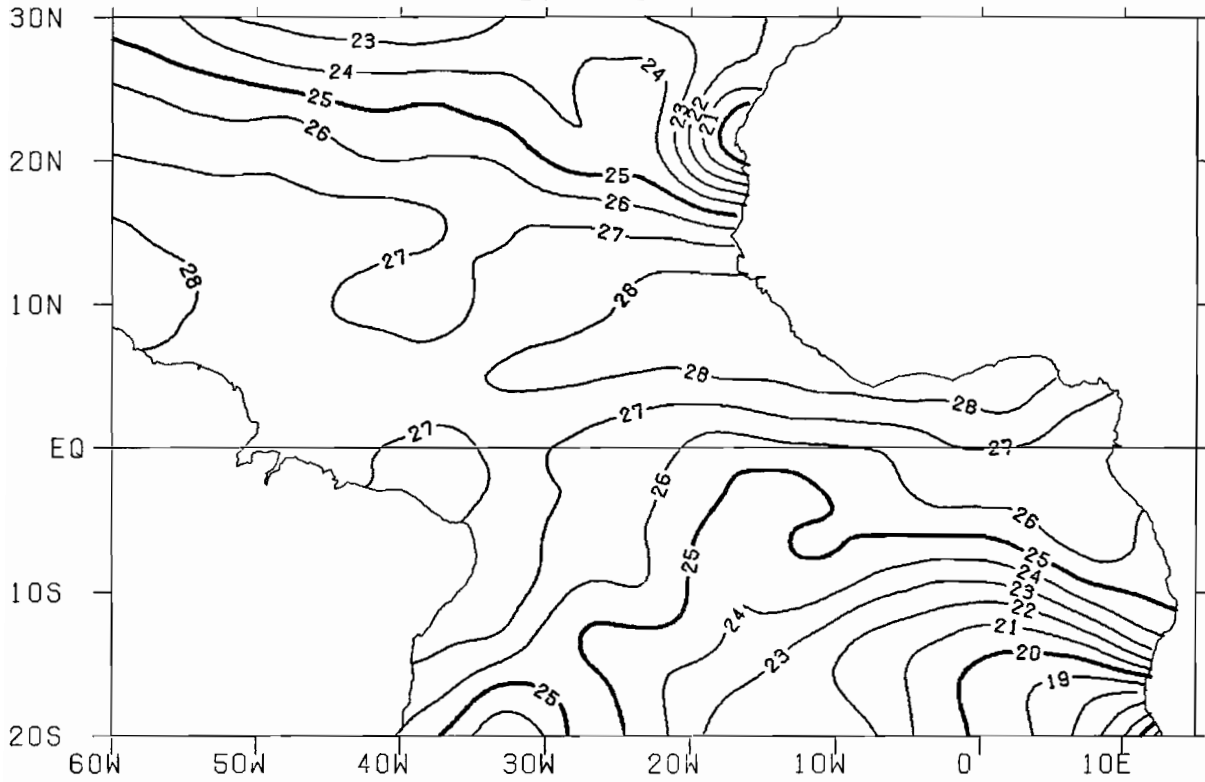
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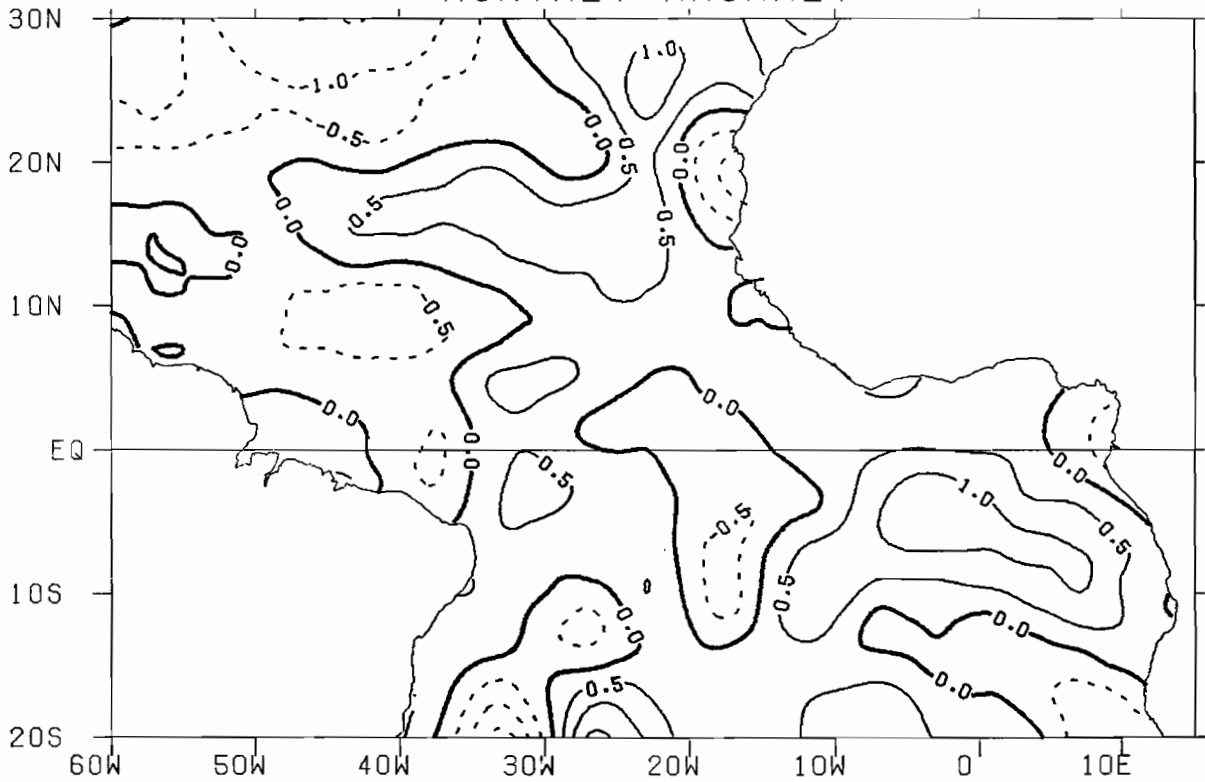
SEA SURFACE TEMPERATURE

NOVEMBER 1985

MONTHLY MEAN



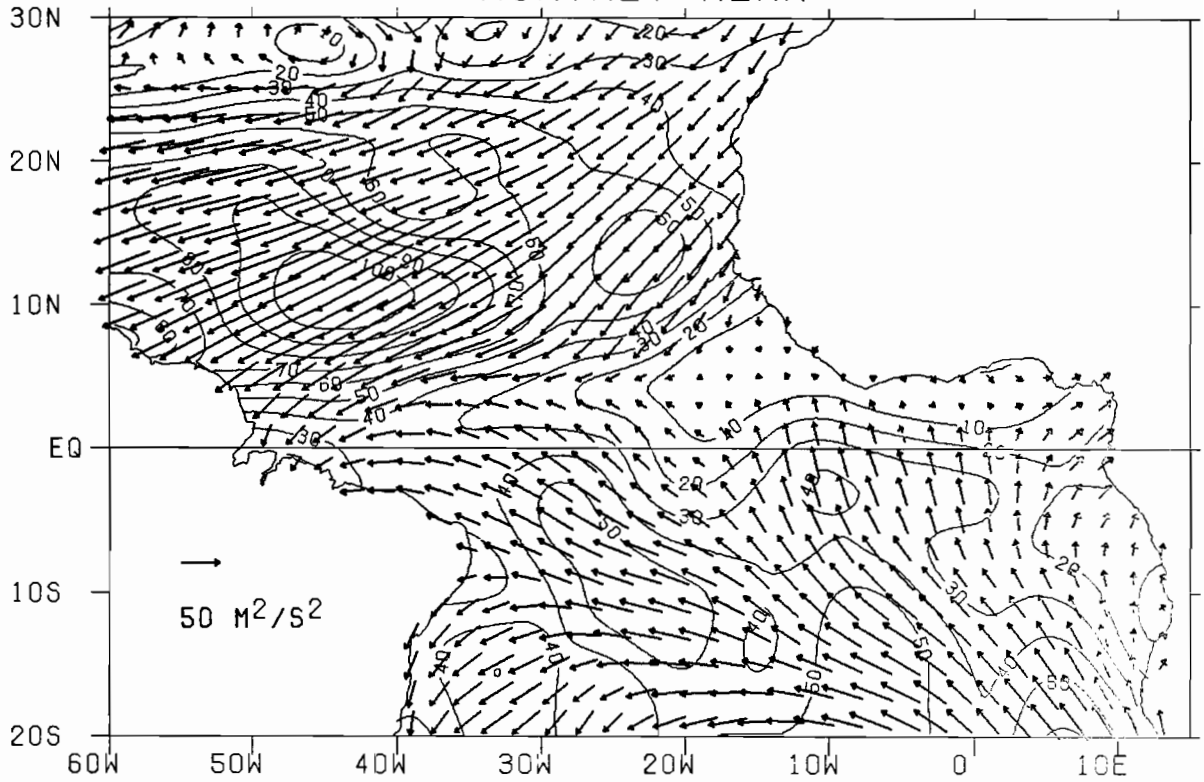
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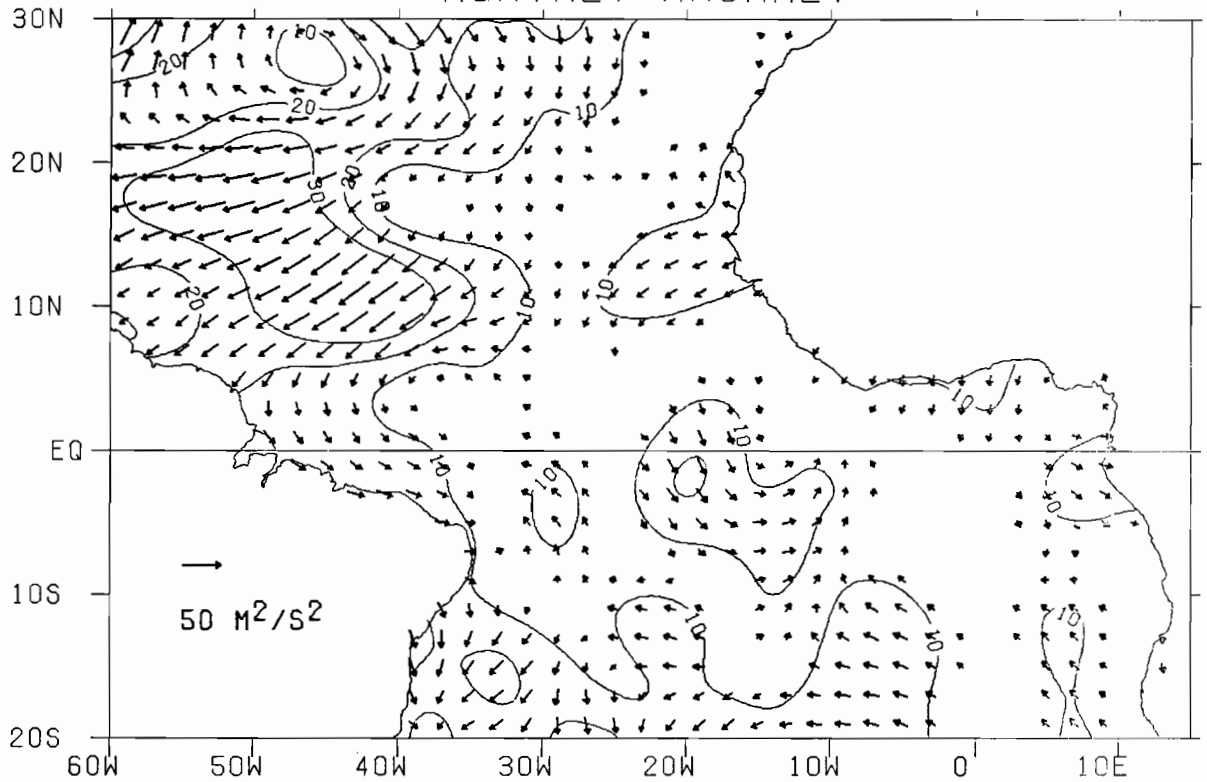
WIND STRESS

DECEMBER 1985

MONTHLY MEAN



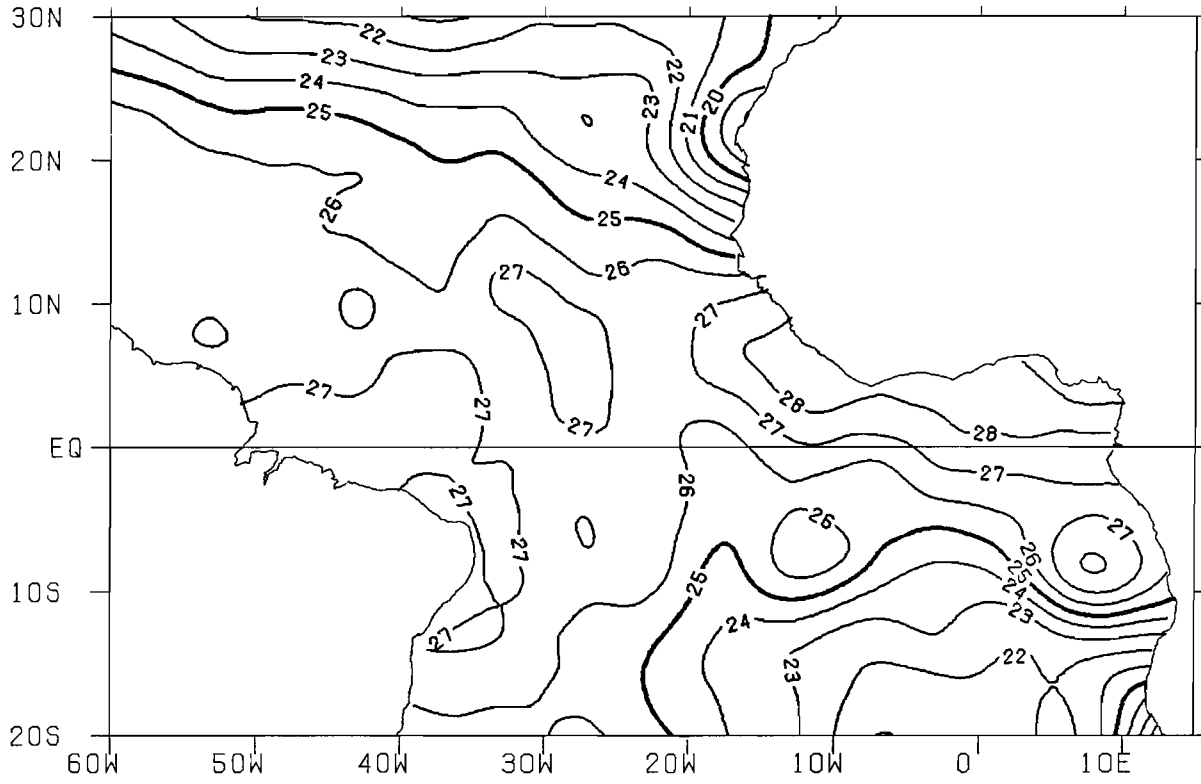
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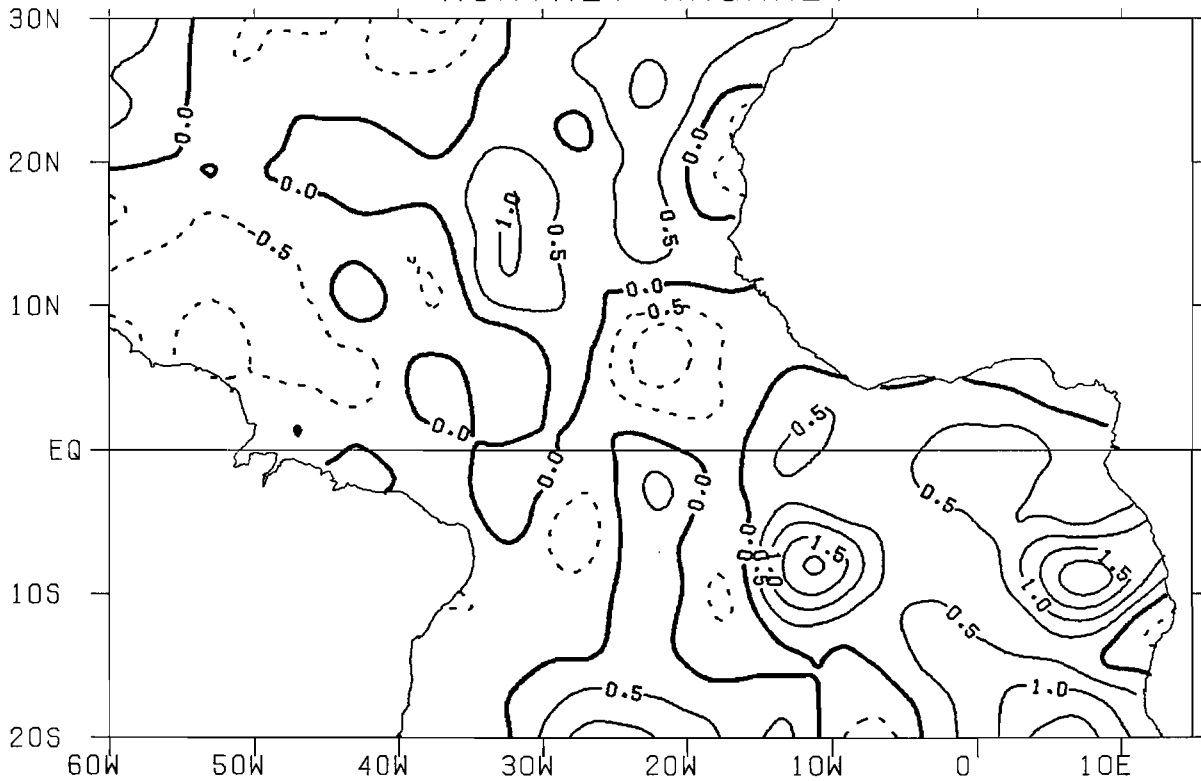
SEA SURFACE TEMPERATURE

DECEMBER 1985

MONTHLY MEAN



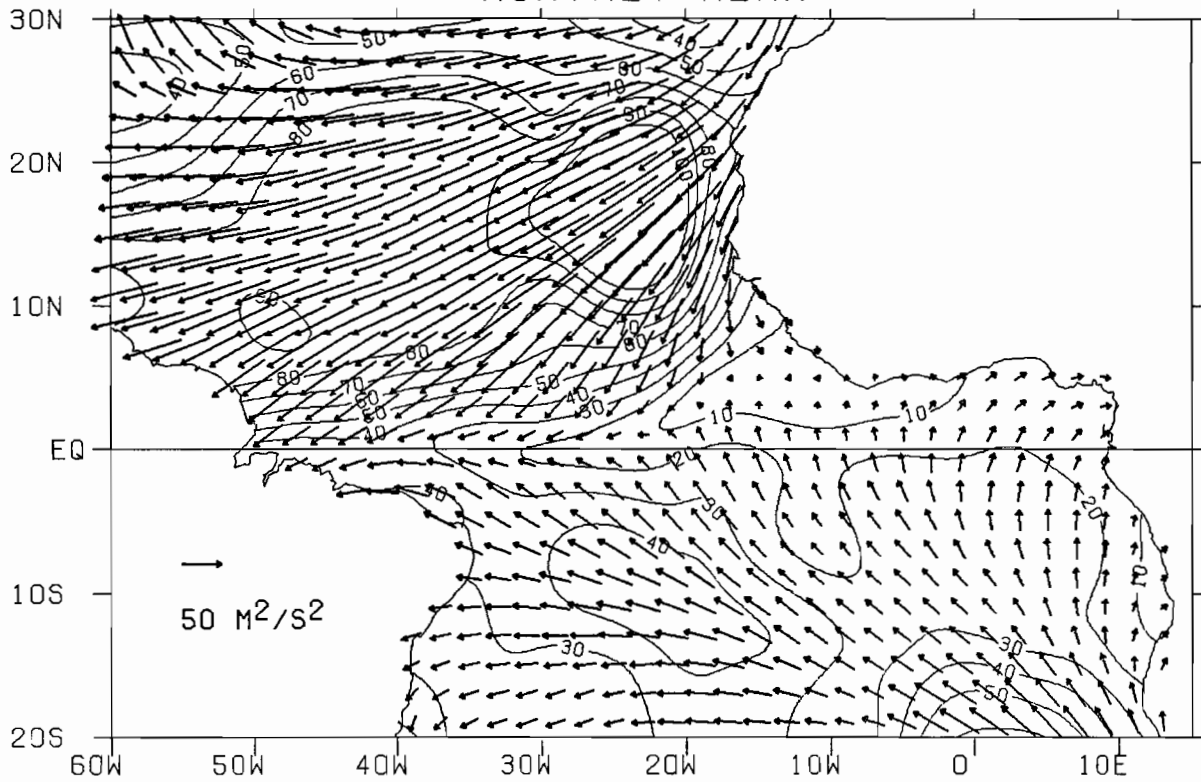
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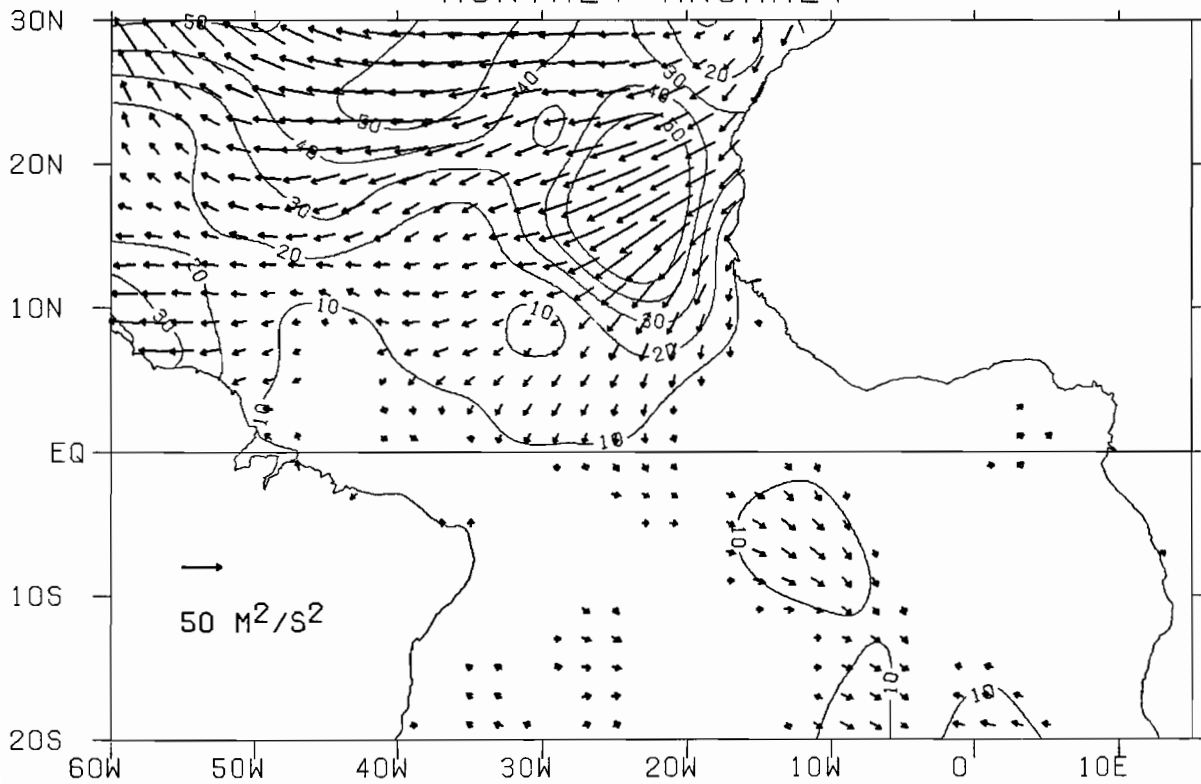
WIND STRESS

JANUARY 1986

MONTHLY MEAN



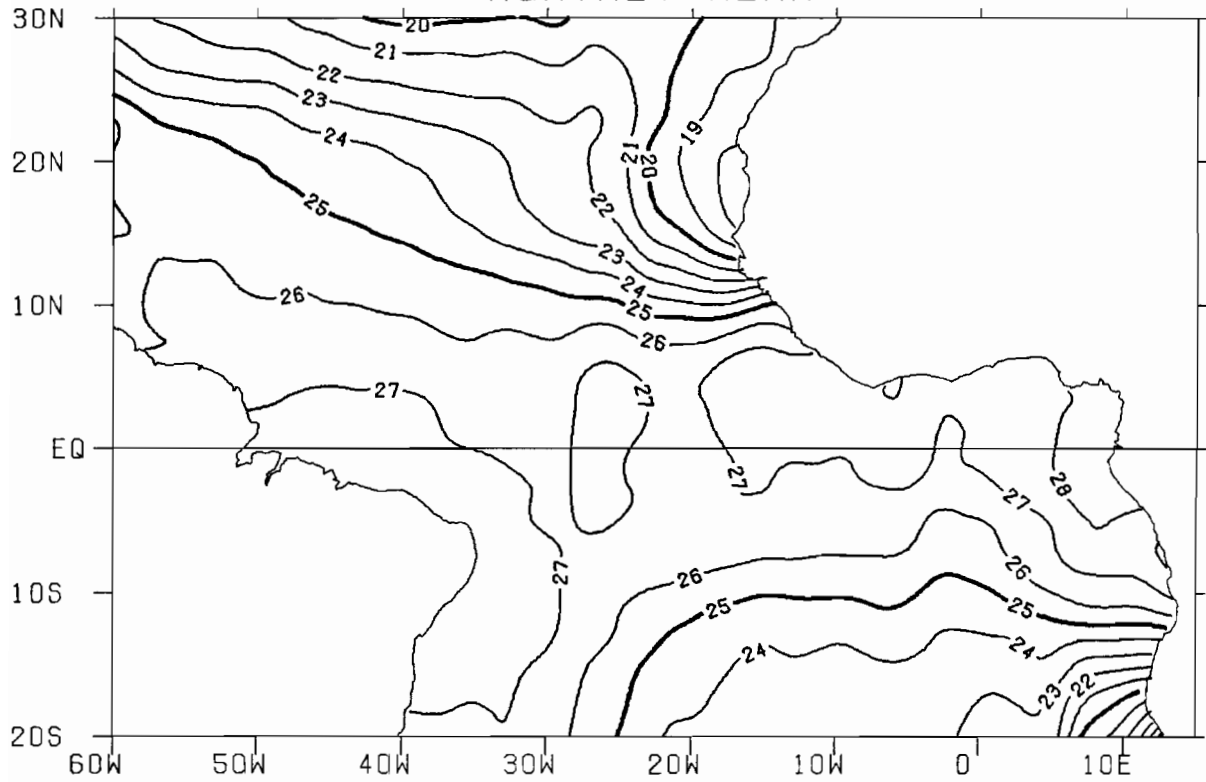
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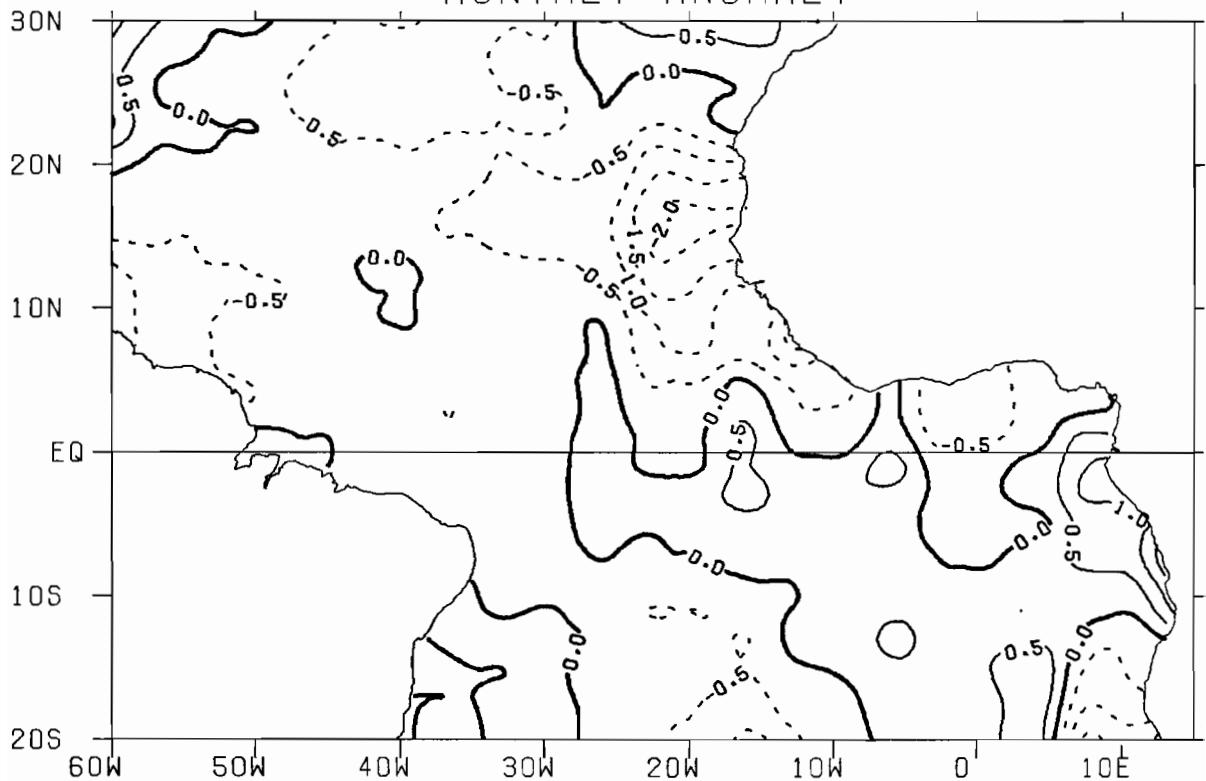
SEA SURFACE TEMPERATURE

JANUARY 1986

MONTHLY MEAN



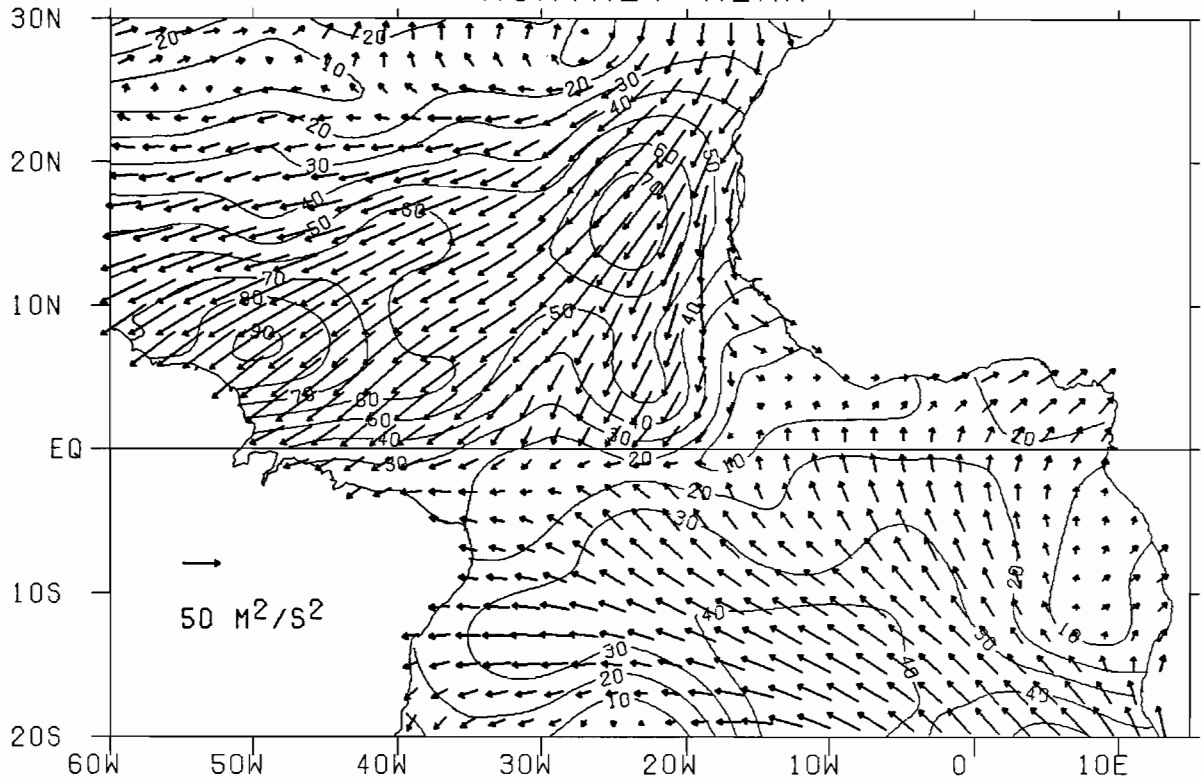
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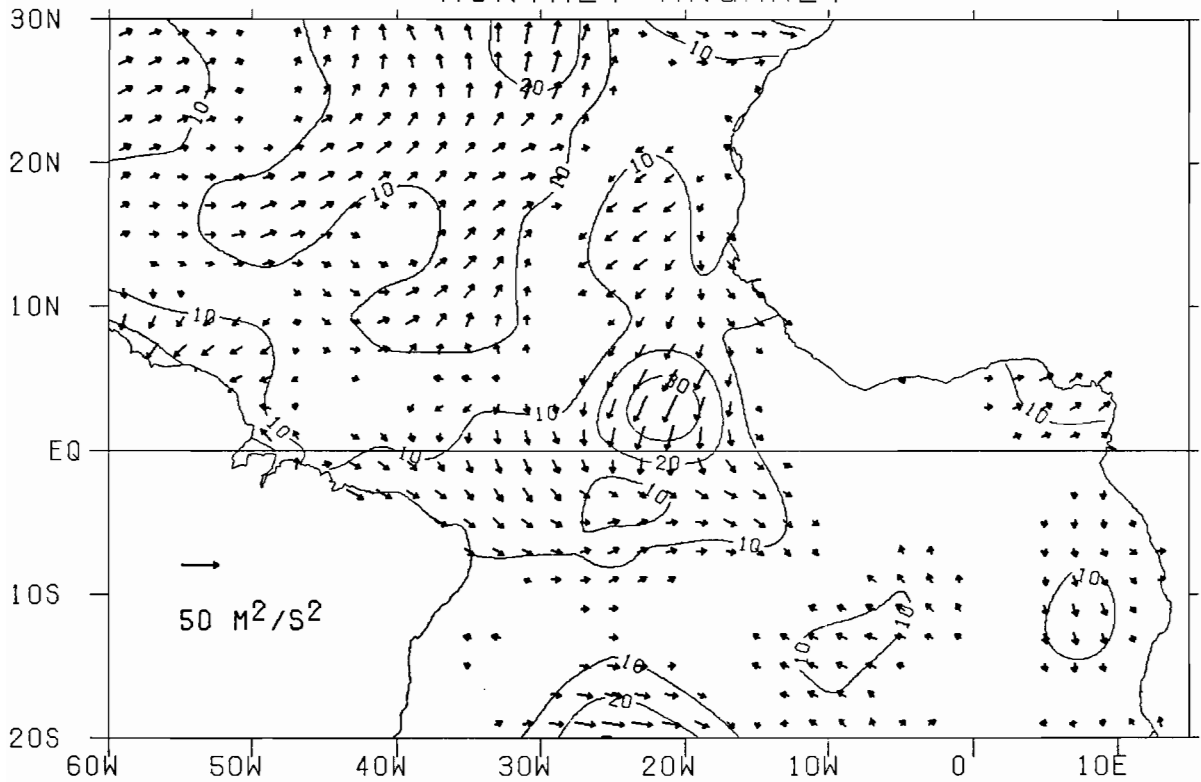
WIND STRESS

FEBRUARY 1986

MONTHLY MEAN



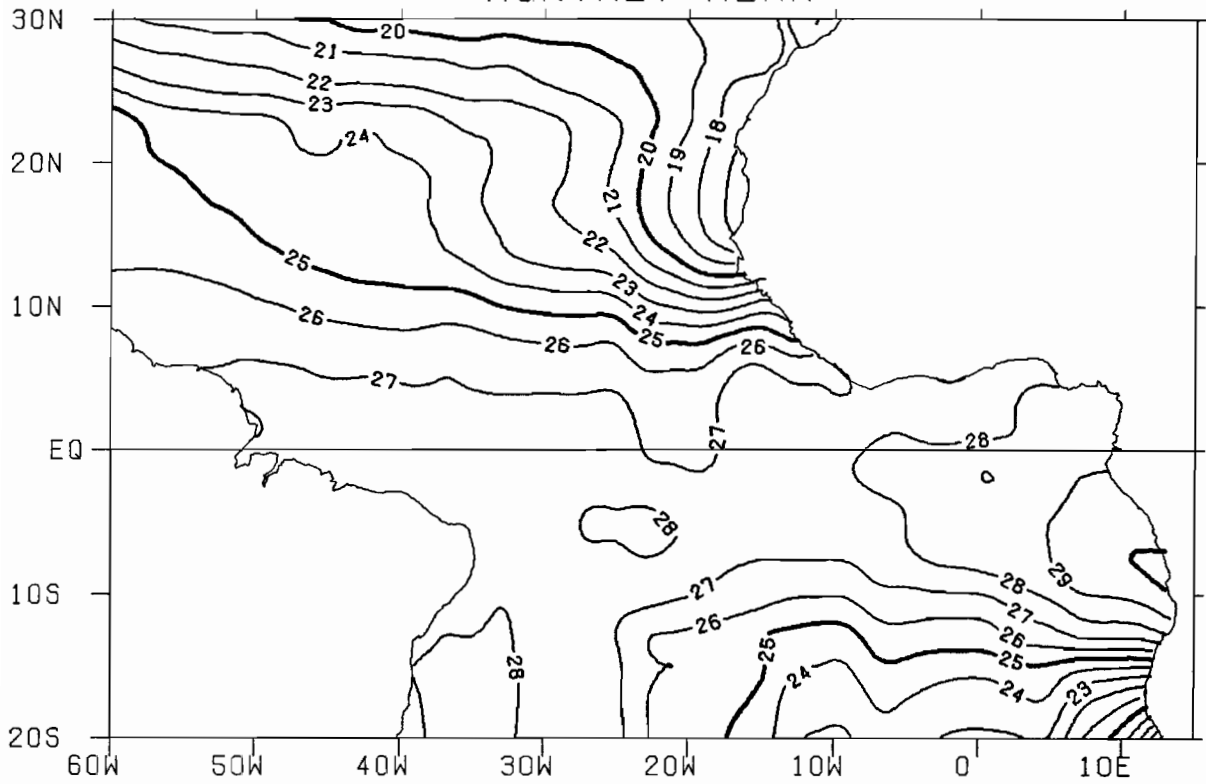
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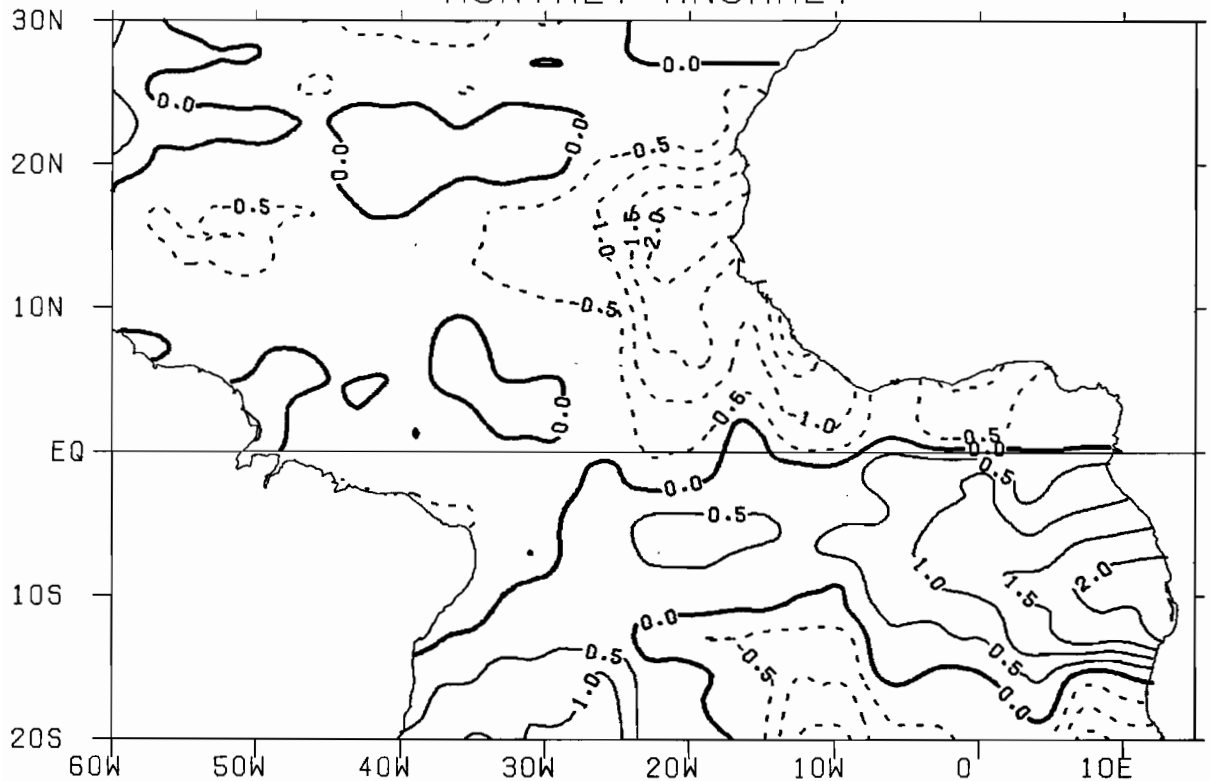
SEA SURFACE TEMPERATURE

FEBRUARY 1986

MONTHLY MEAN



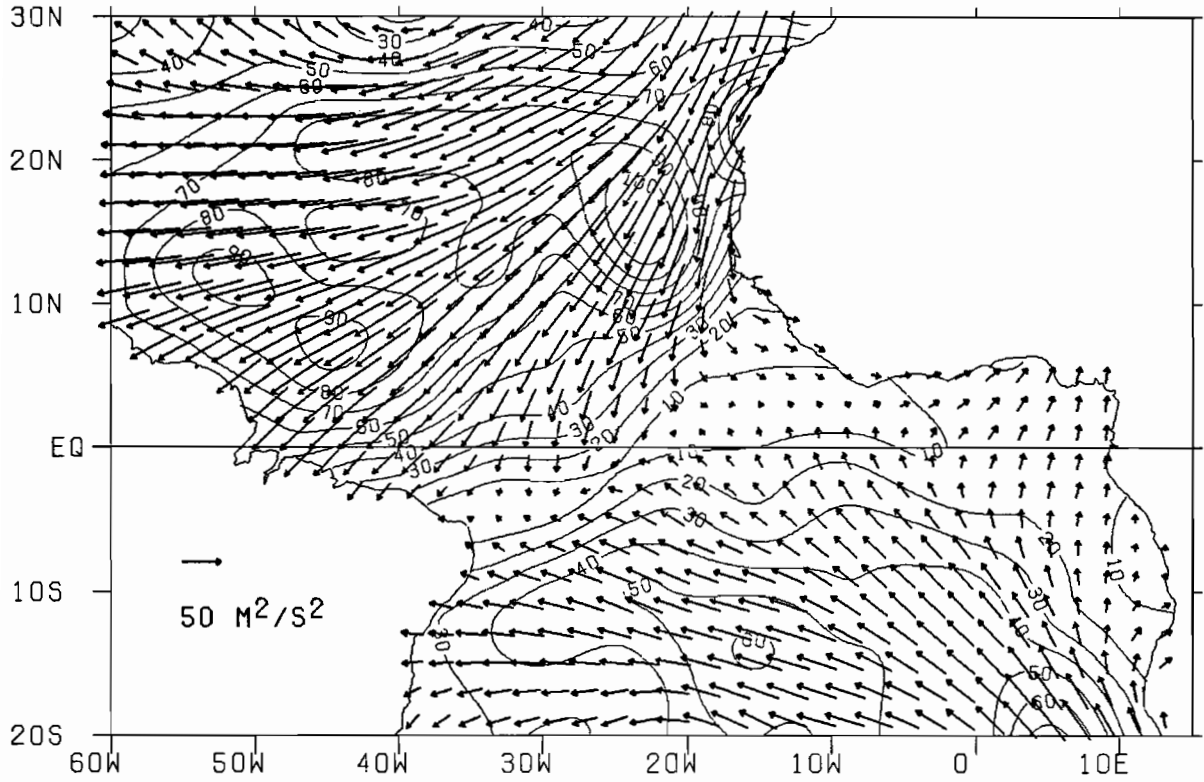
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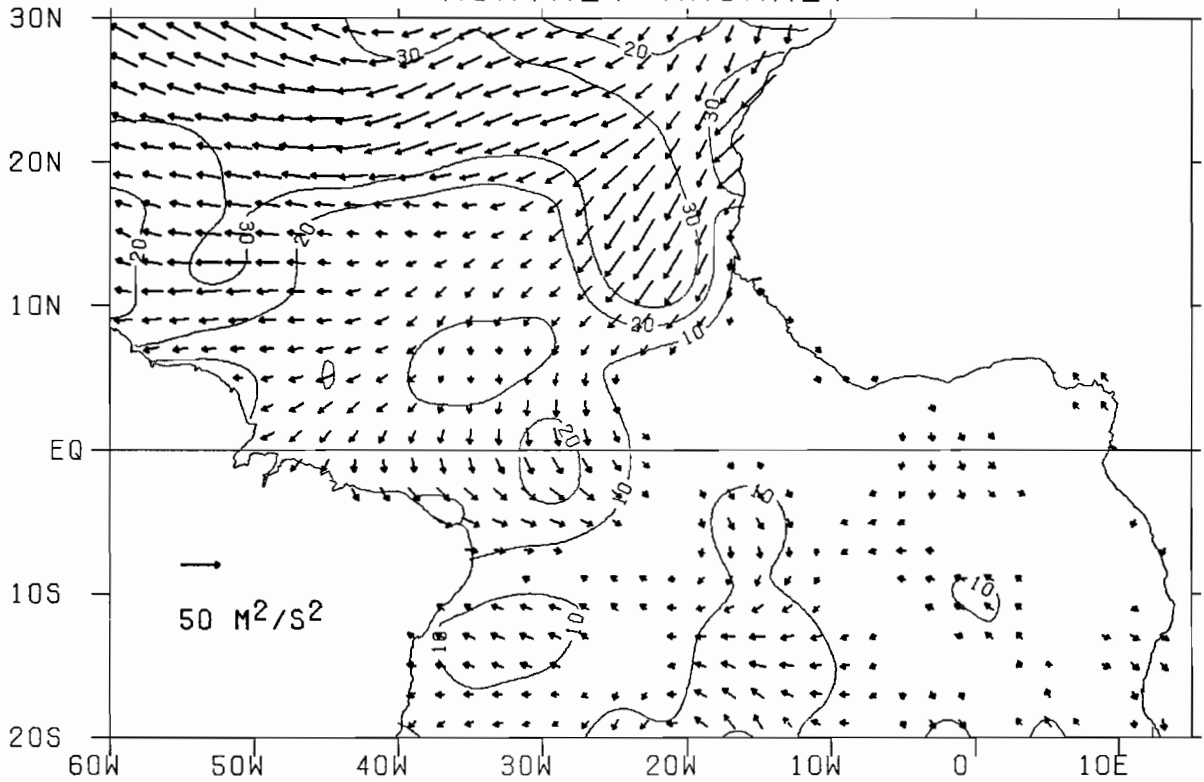
WIND STRESS

MARCH 1986

MONTHLY MEAN



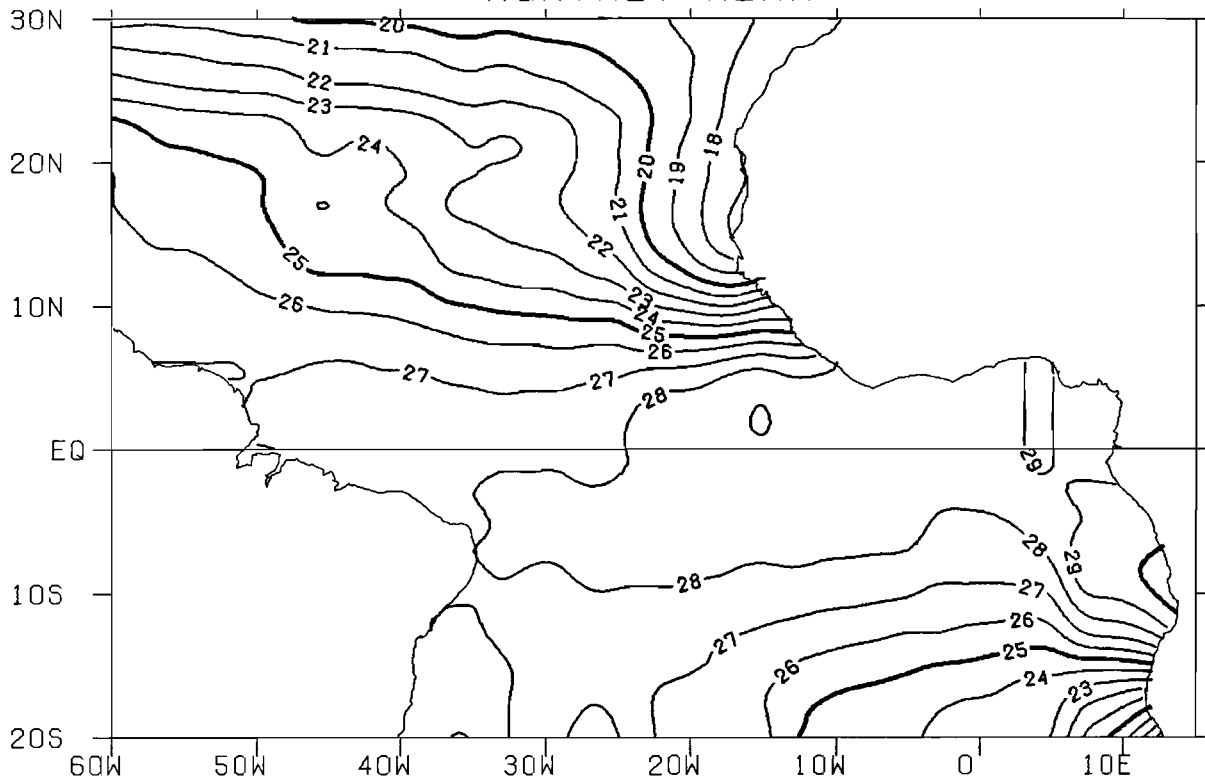
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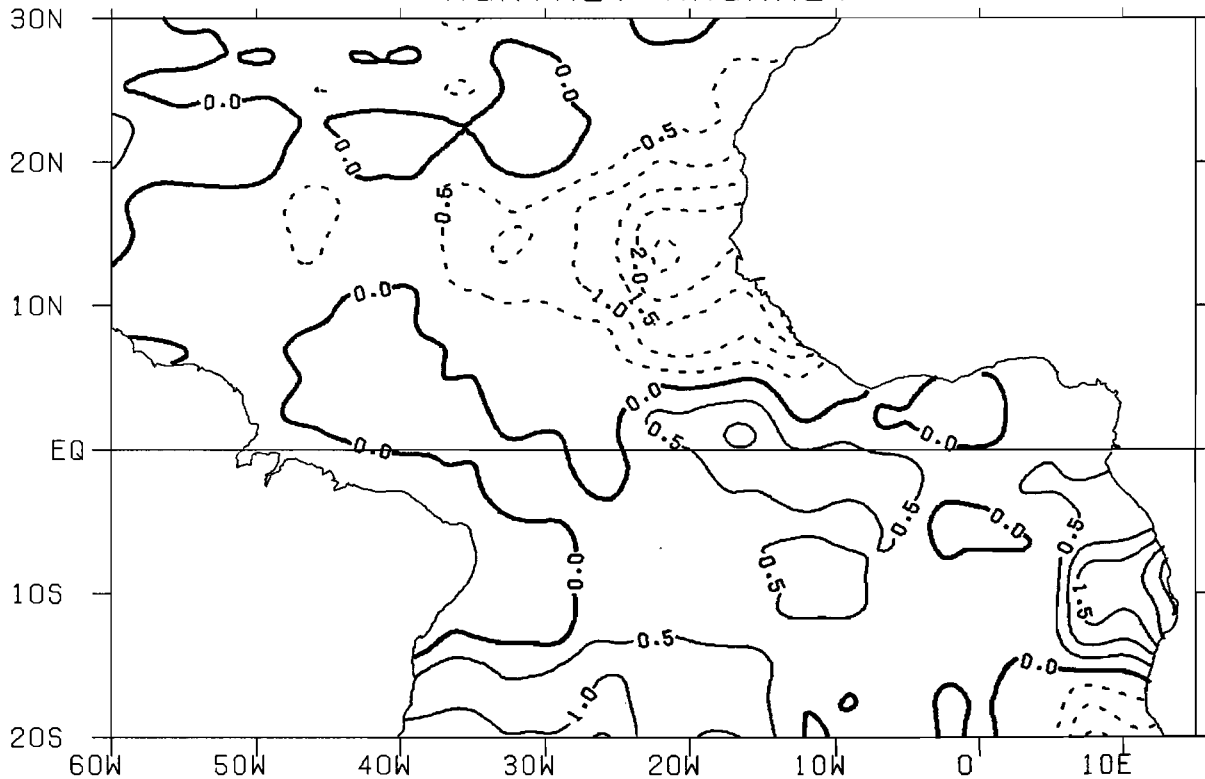
SEA SURFACE TEMPERATURE

MARCH 1986

MONTHLY MEAN



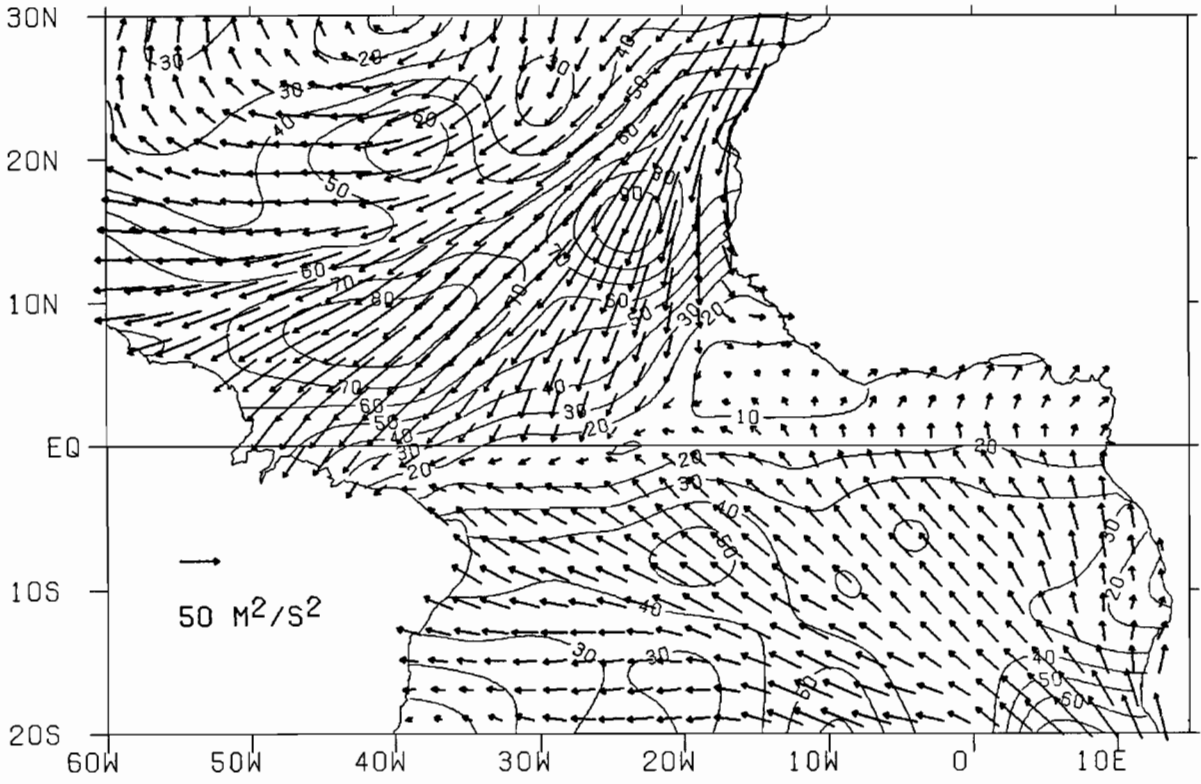
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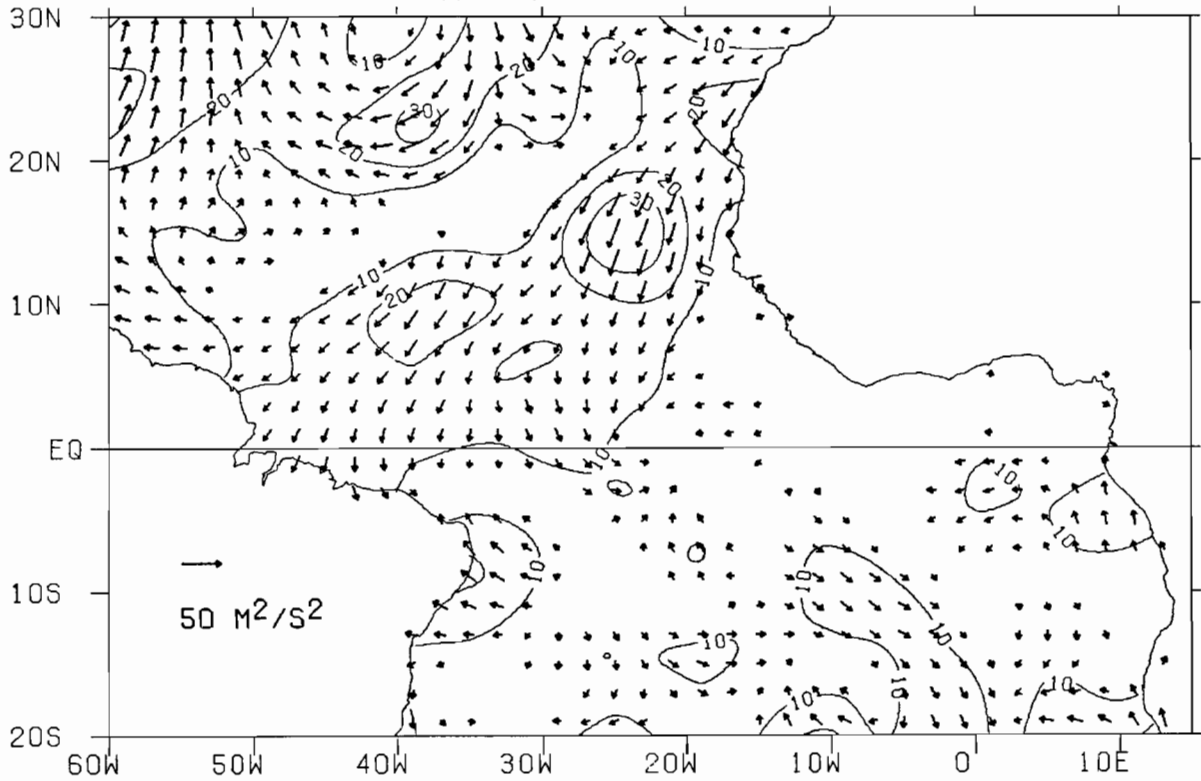
WIND STRESS

APRIL 1986

MONTHLY MEAN



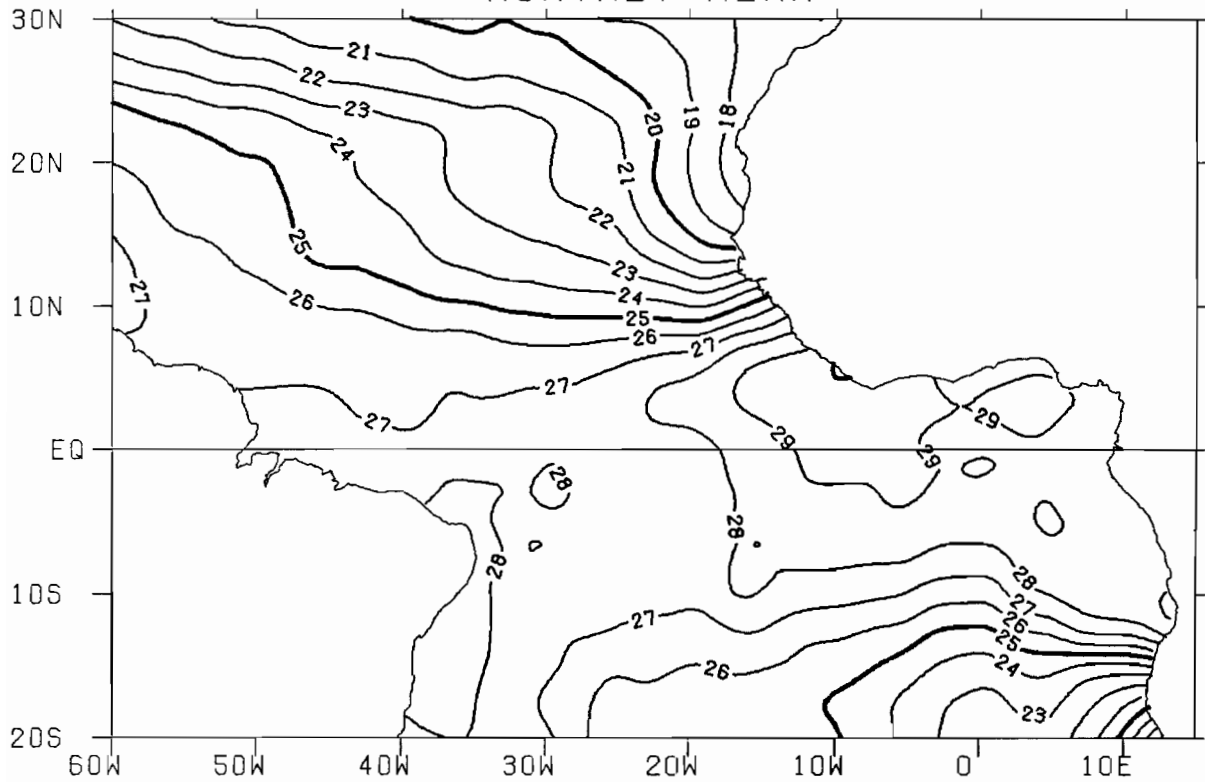
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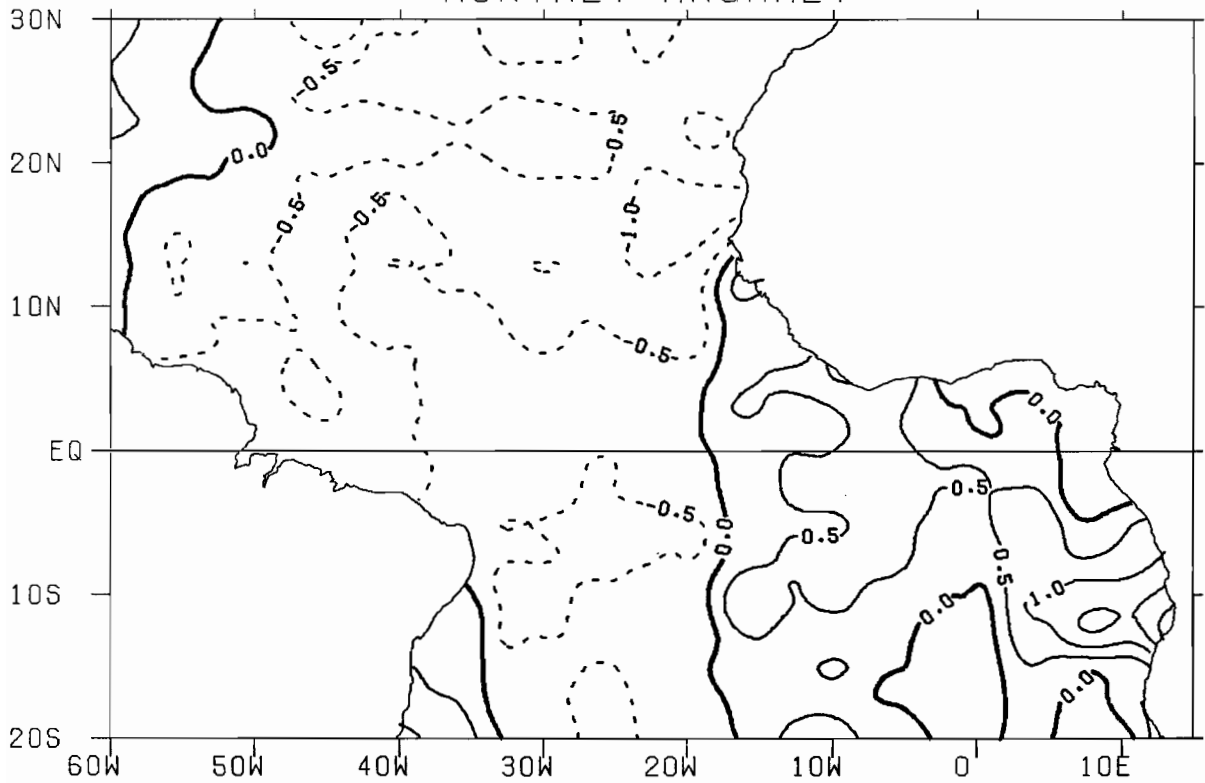
SEA SURFACE TEMPERATURE

APRIL 1986

MONTHLY MEAN



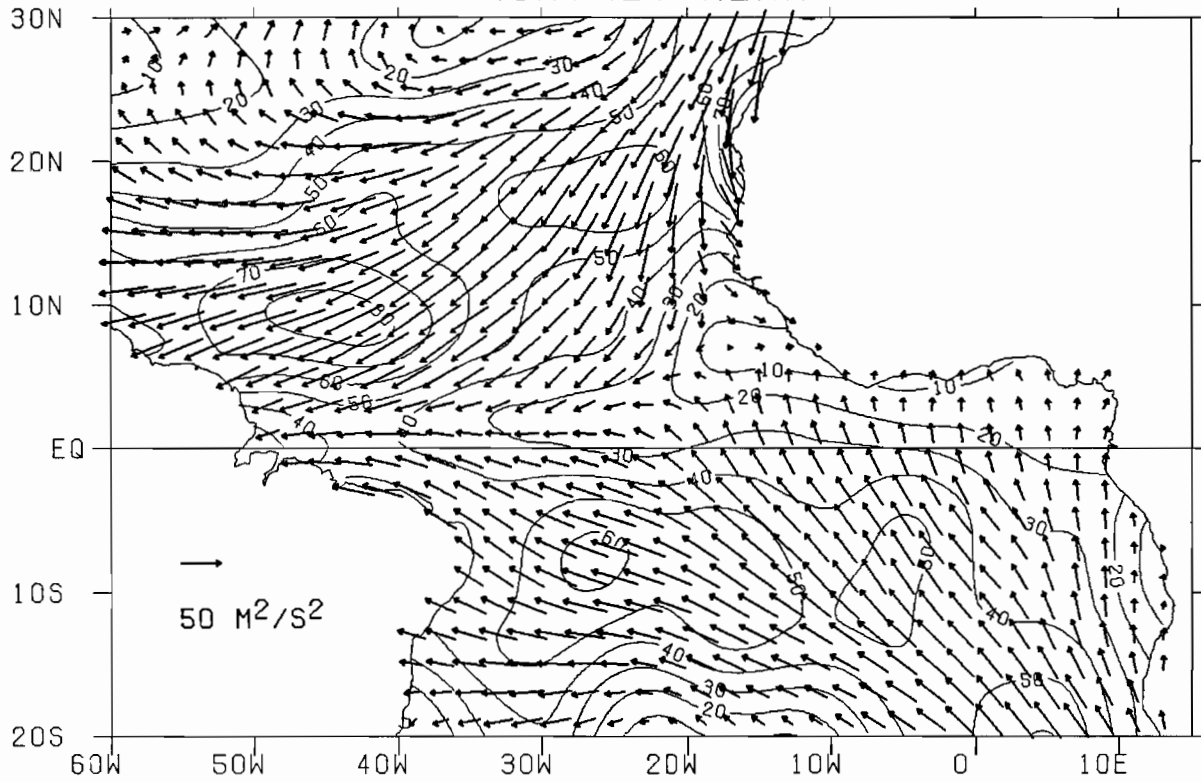
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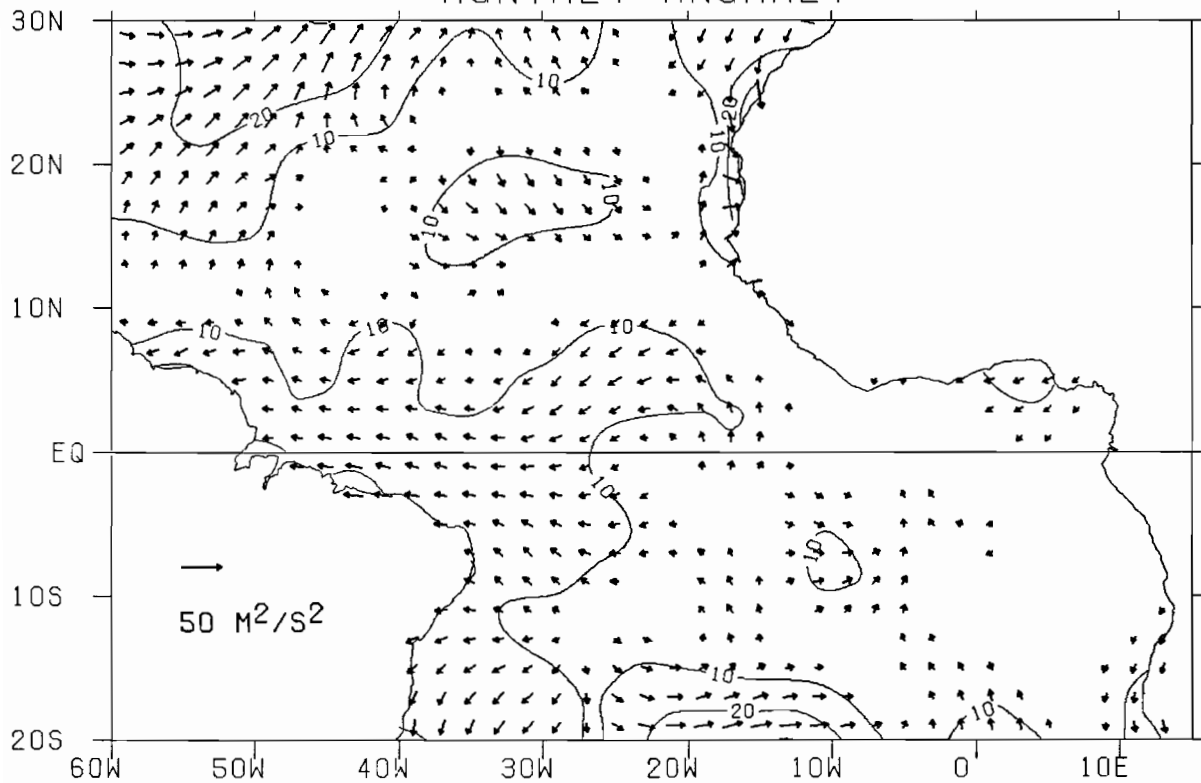
WIND STRESS

MAY 1986

MONTHLY MEAN



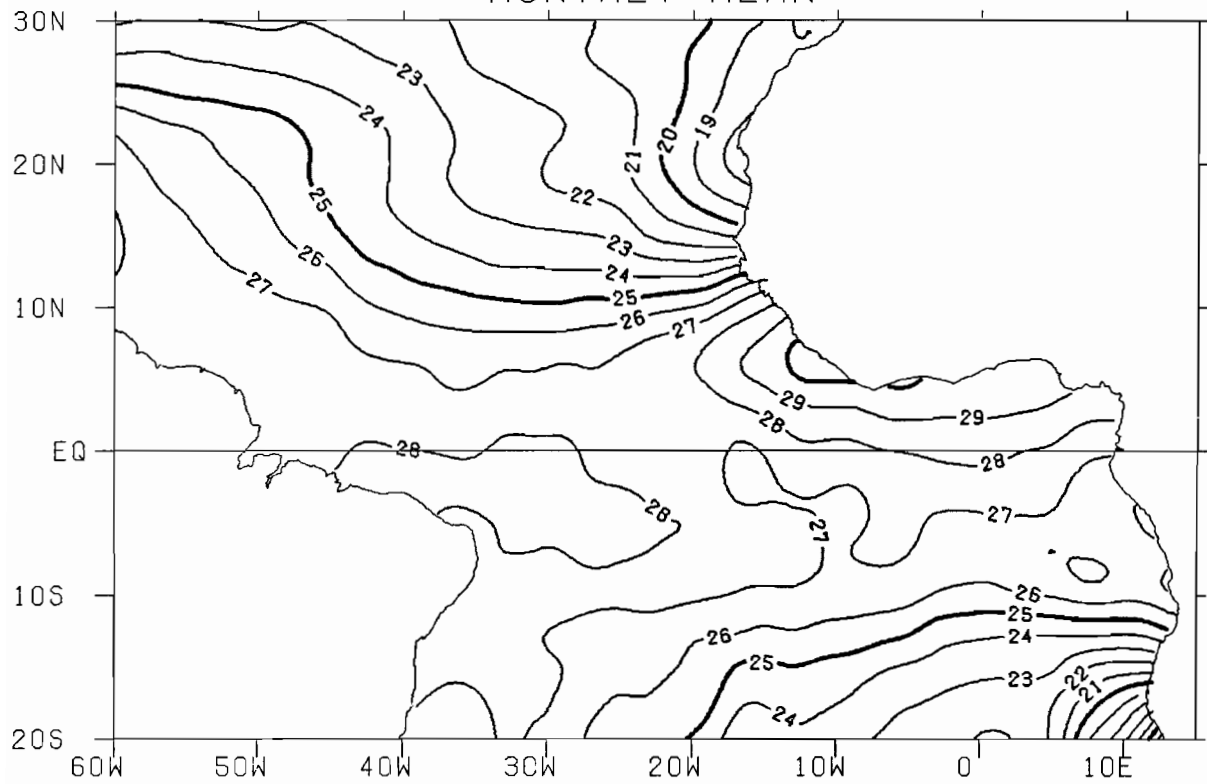
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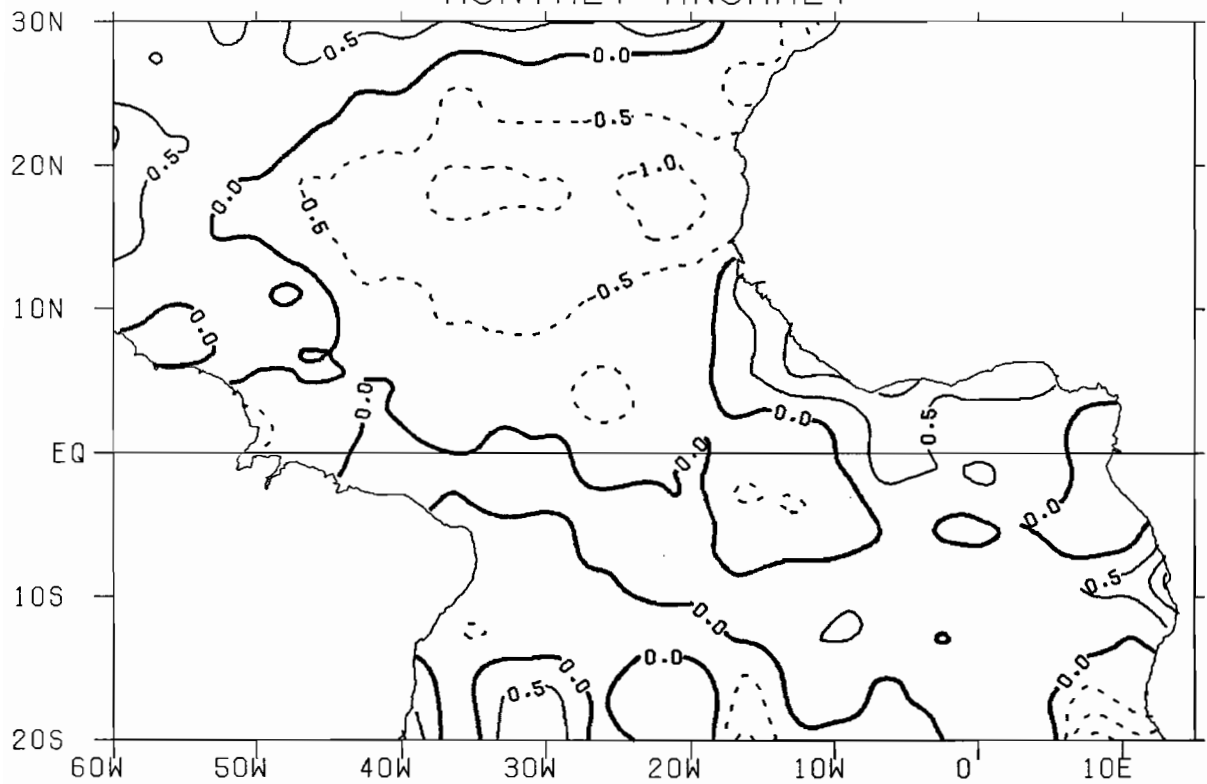
SEA SURFACE TEMPERATURE

MAY 1986

MONTHLY MEAN



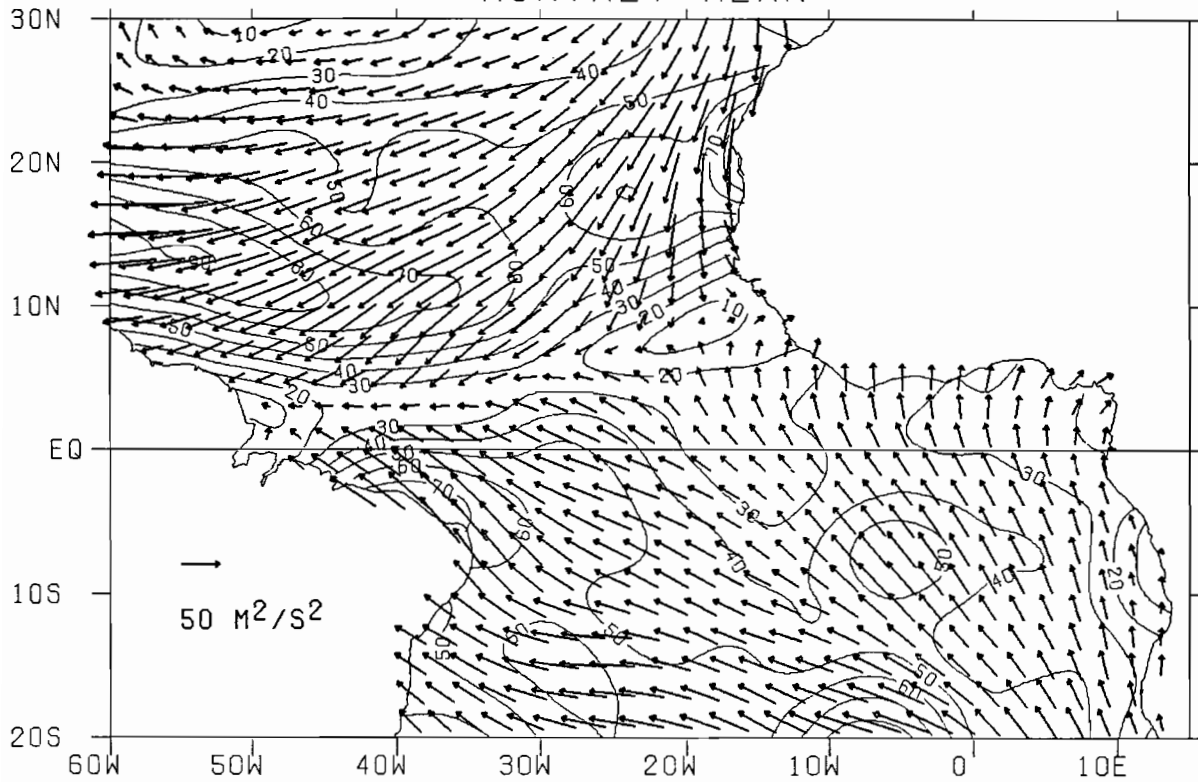
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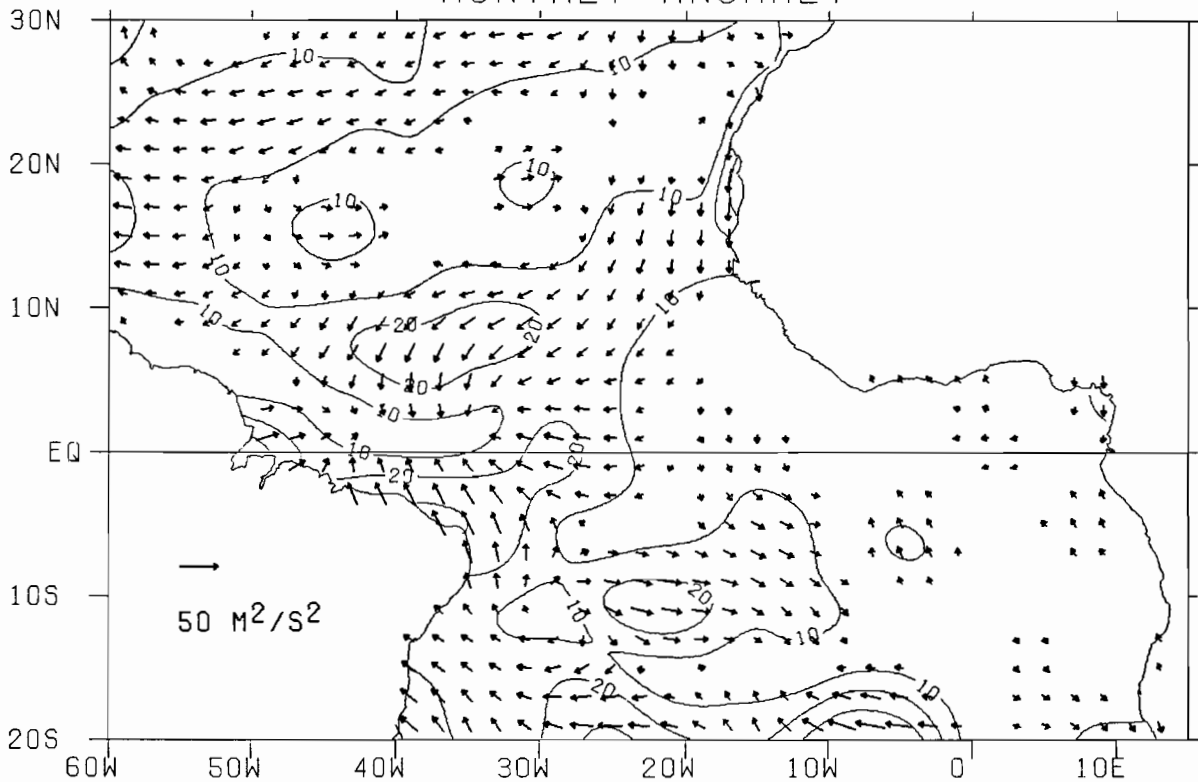
WIND STRESS

JUNE 1986

MONTHLY MEAN



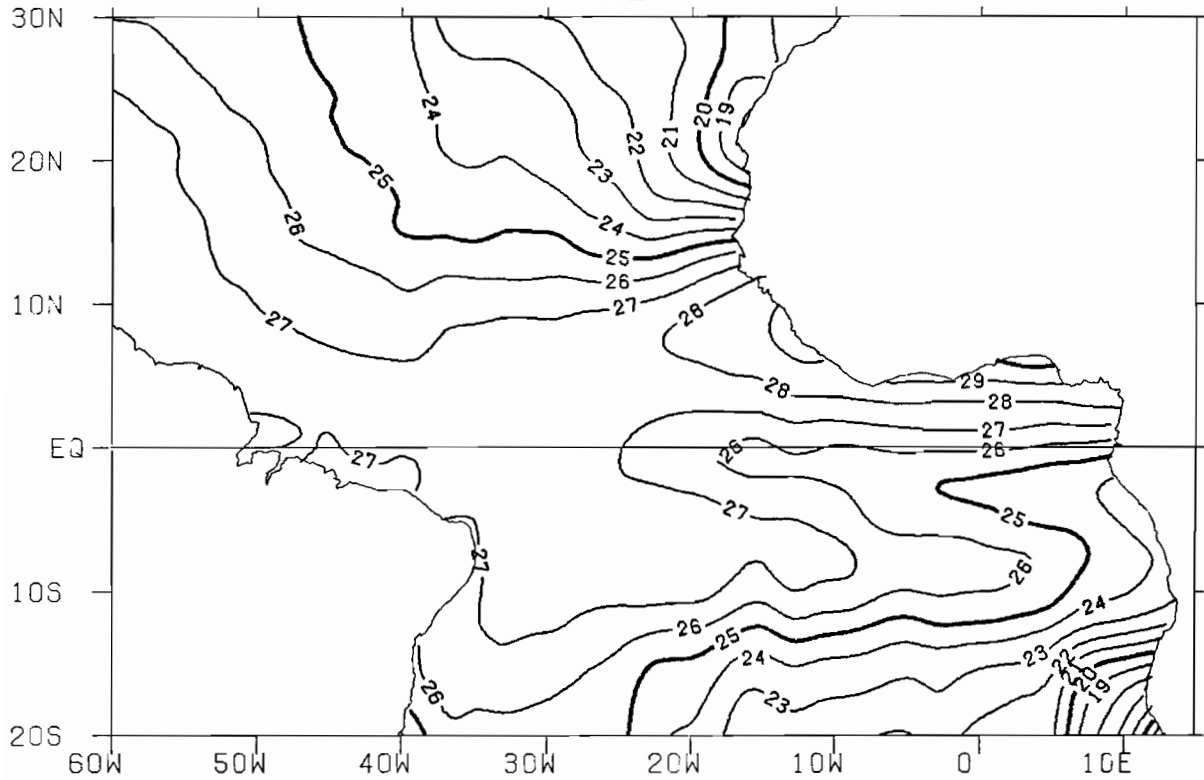
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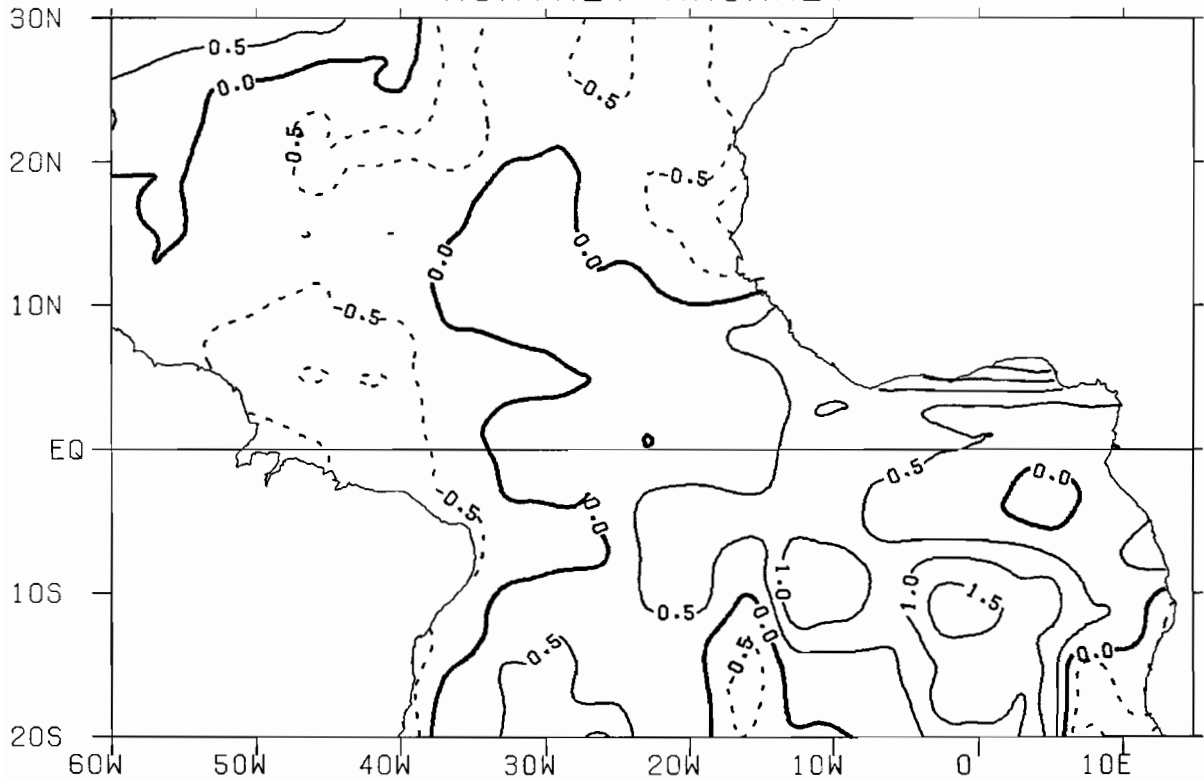
SEA SURFACE TEMPERATURE

JUNE 1986

MONTHLY MEAN



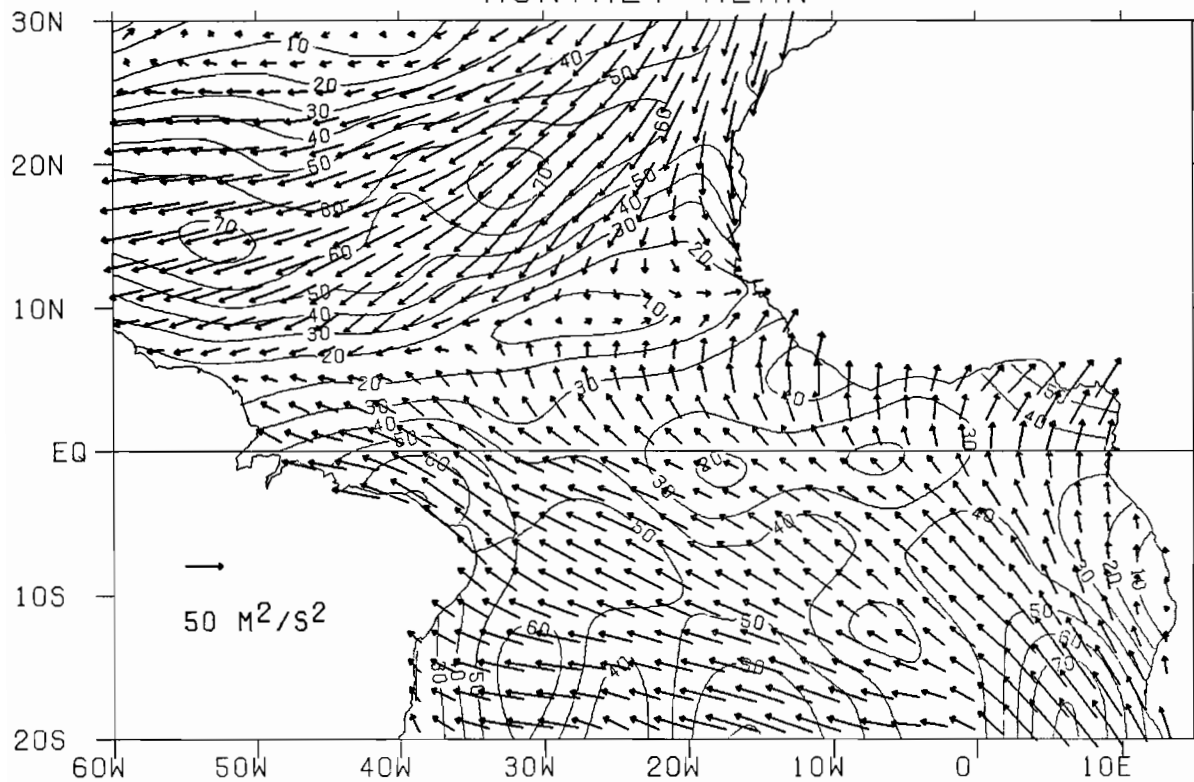
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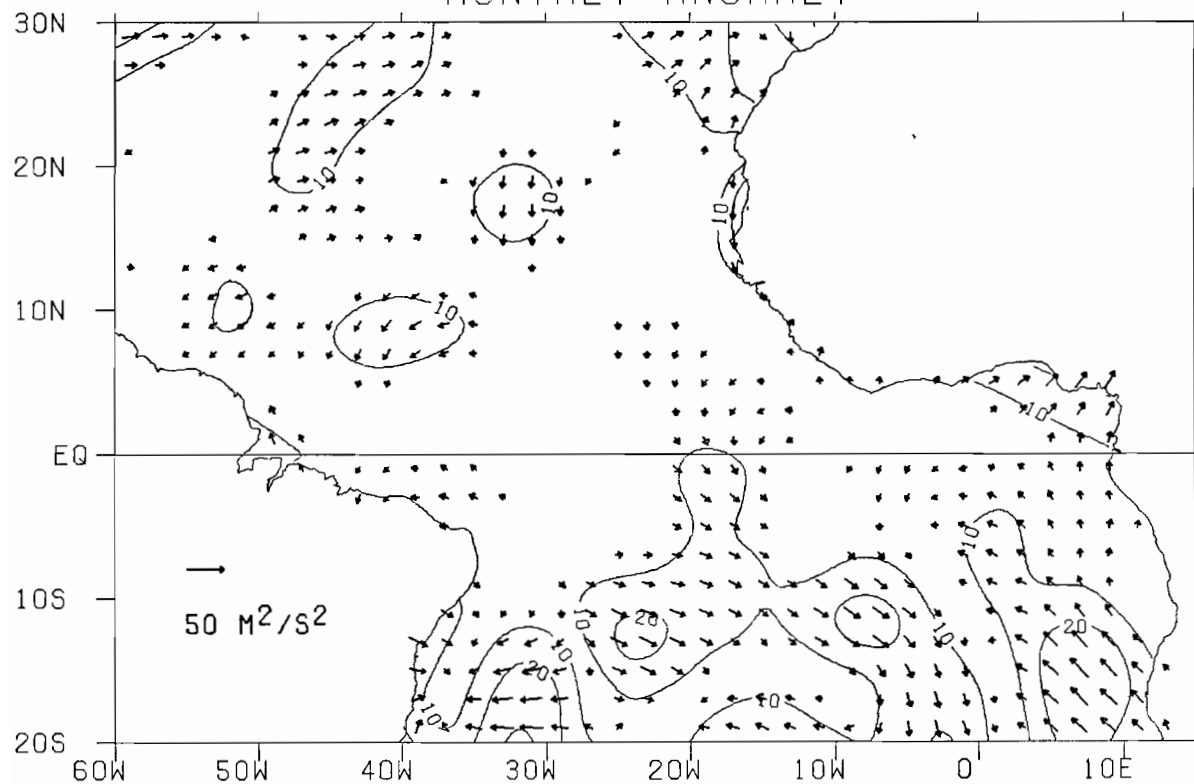
WIND STRESS

JULY 1986

MONTHLY MEAN



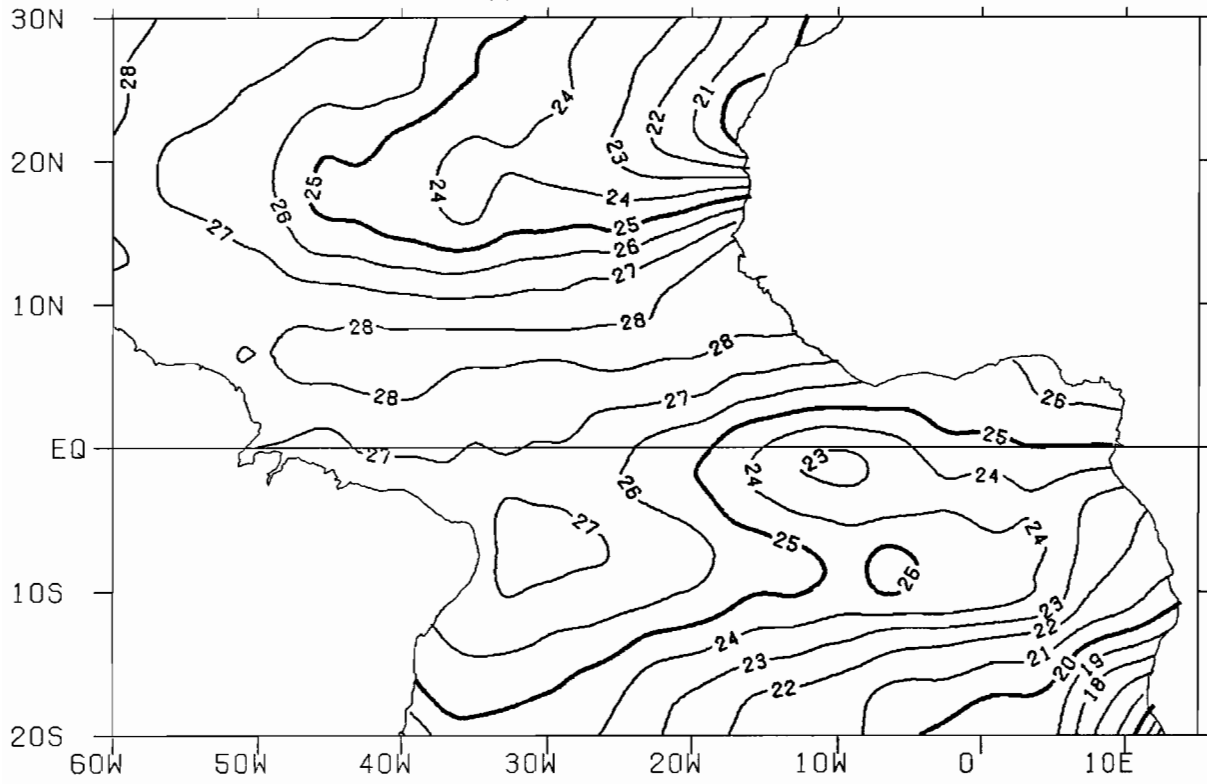
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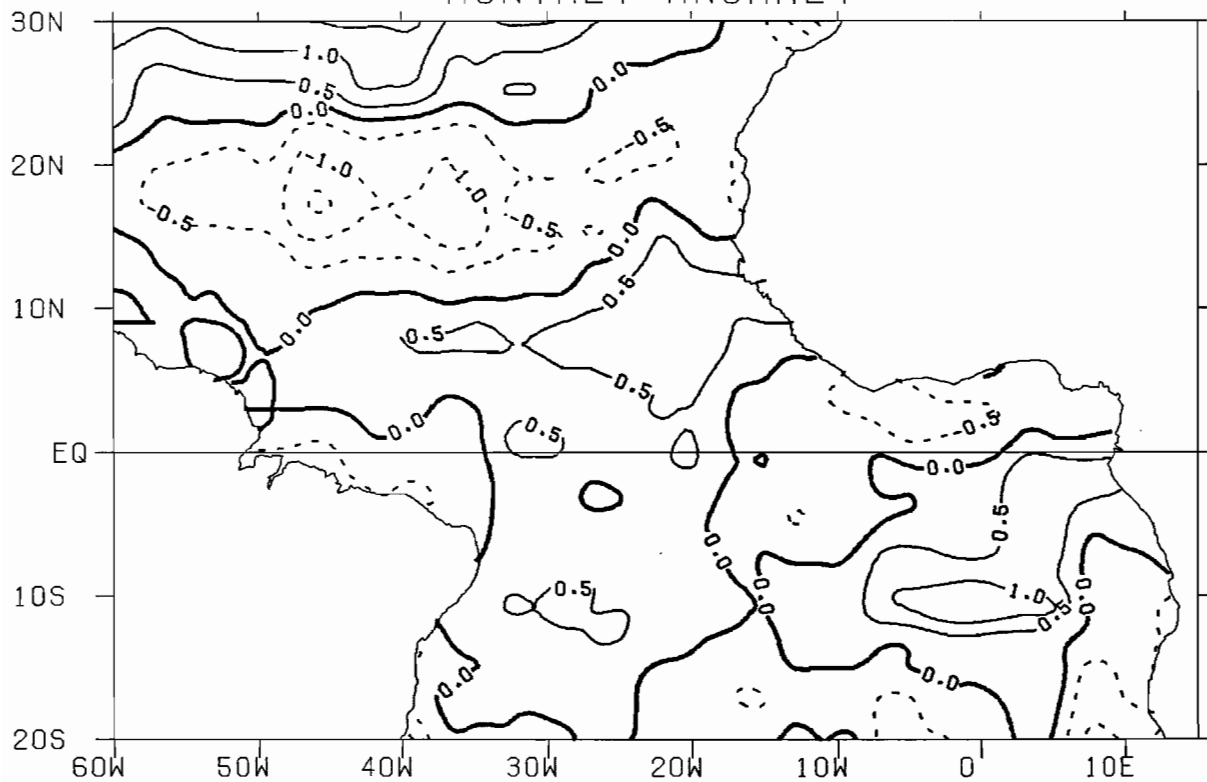
SEA SURFACE TEMPERATURE

JULY 1986

MONTHLY MEAN



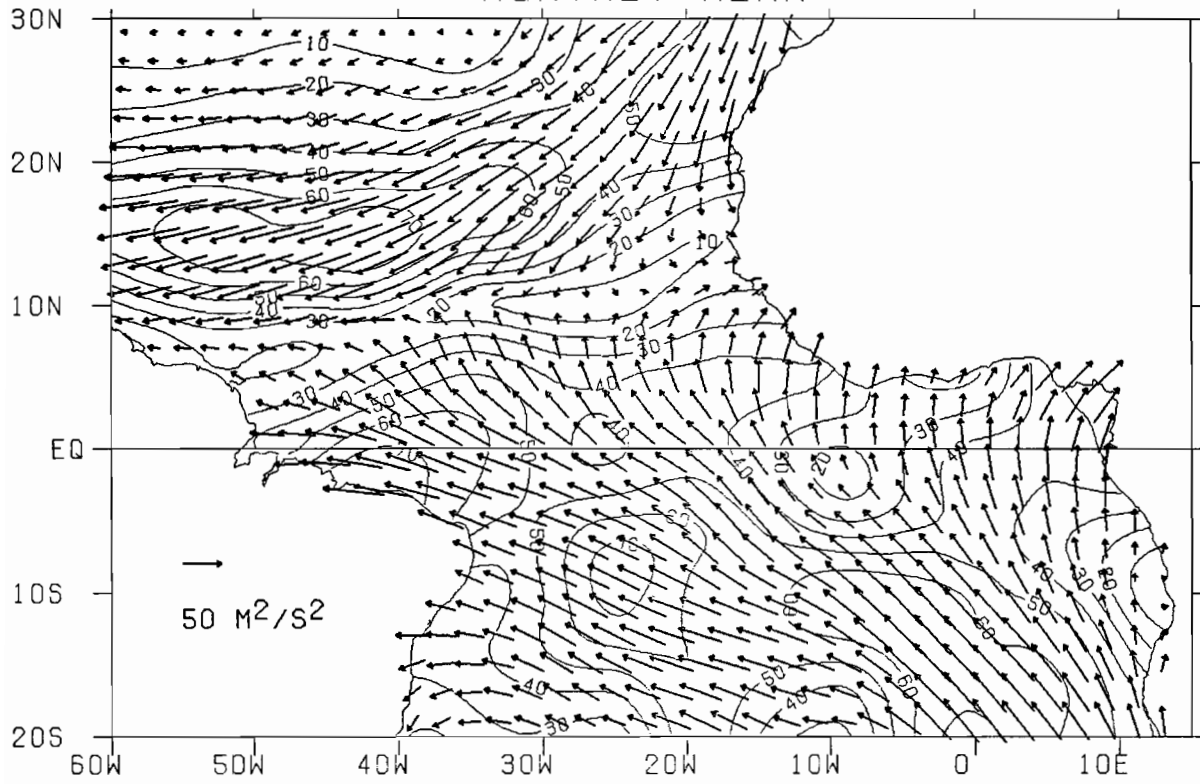
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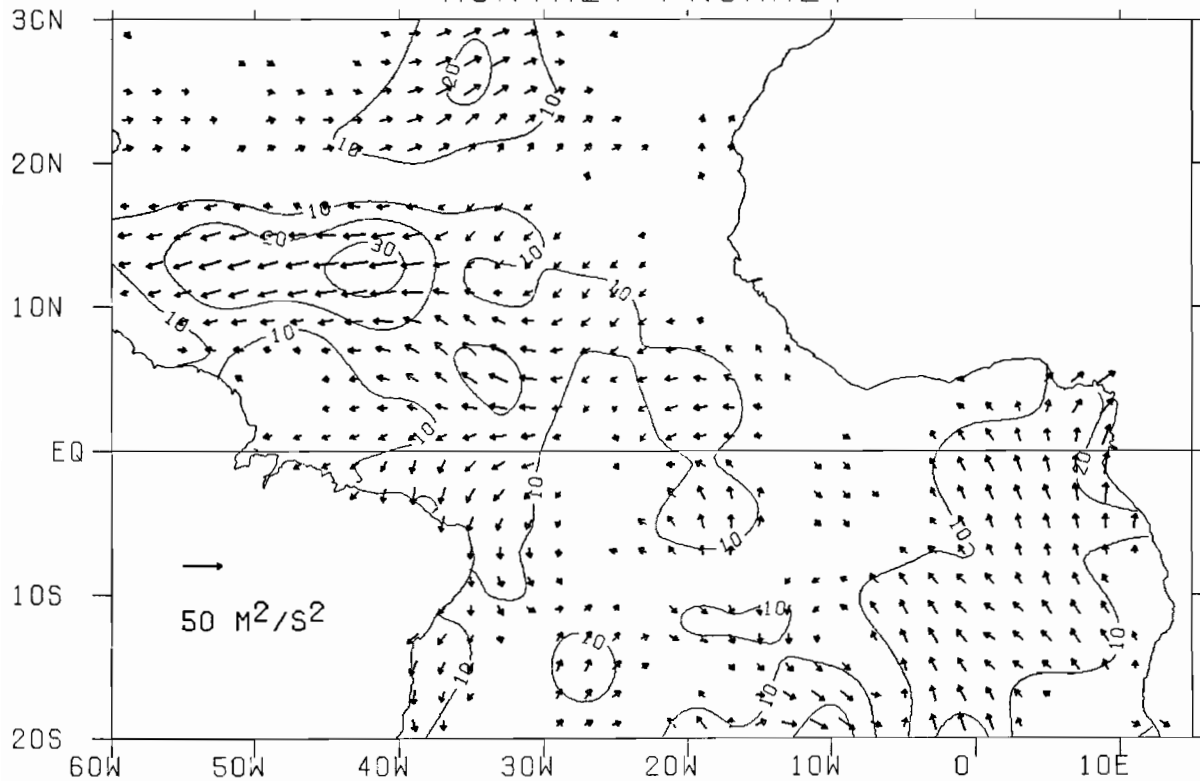
WIND STRESS

AUGUST 1986

MONTHLY MEAN



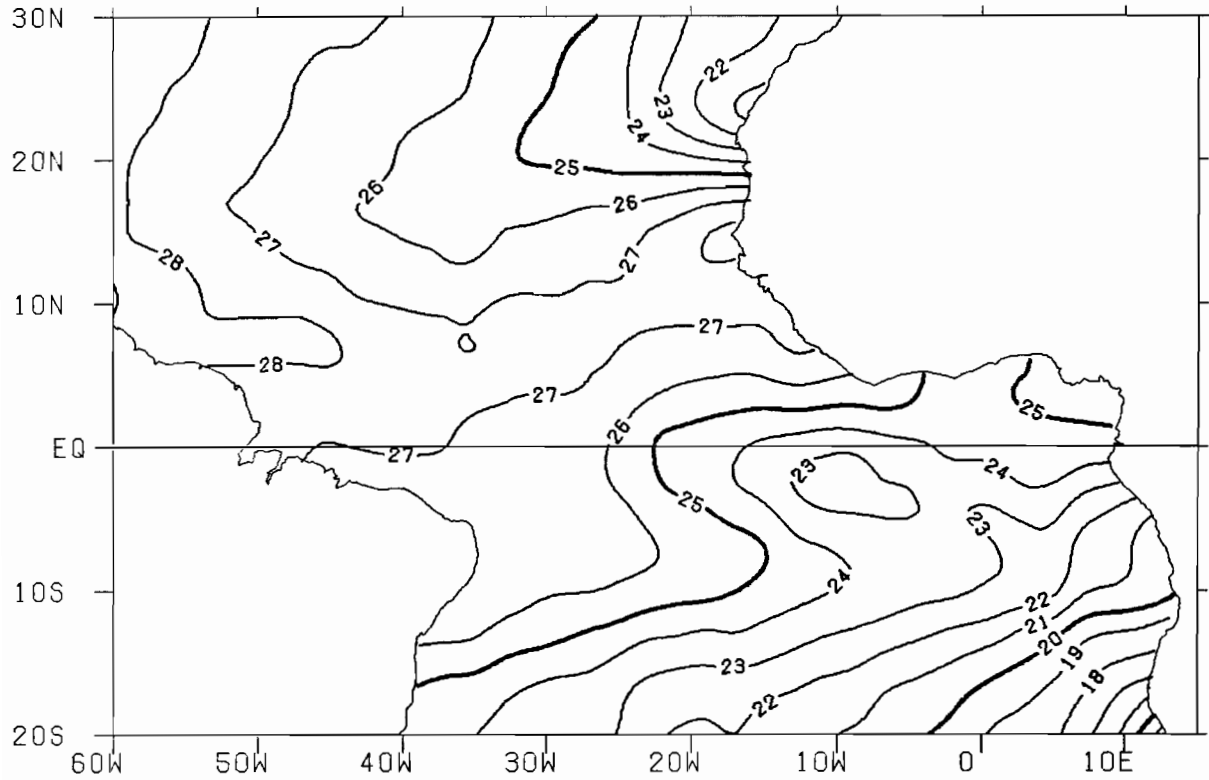
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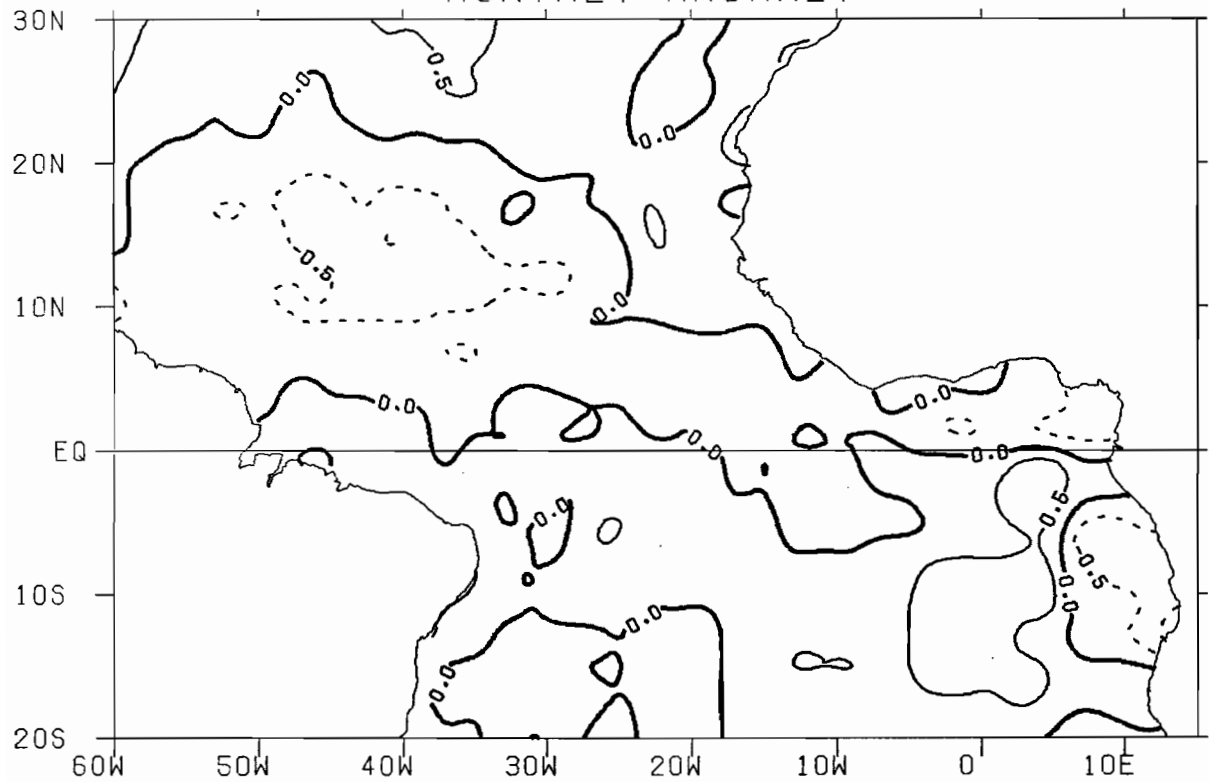
SEA SURFACE TEMPERATURE

AUGUST 1986

MONTHLY MEAN



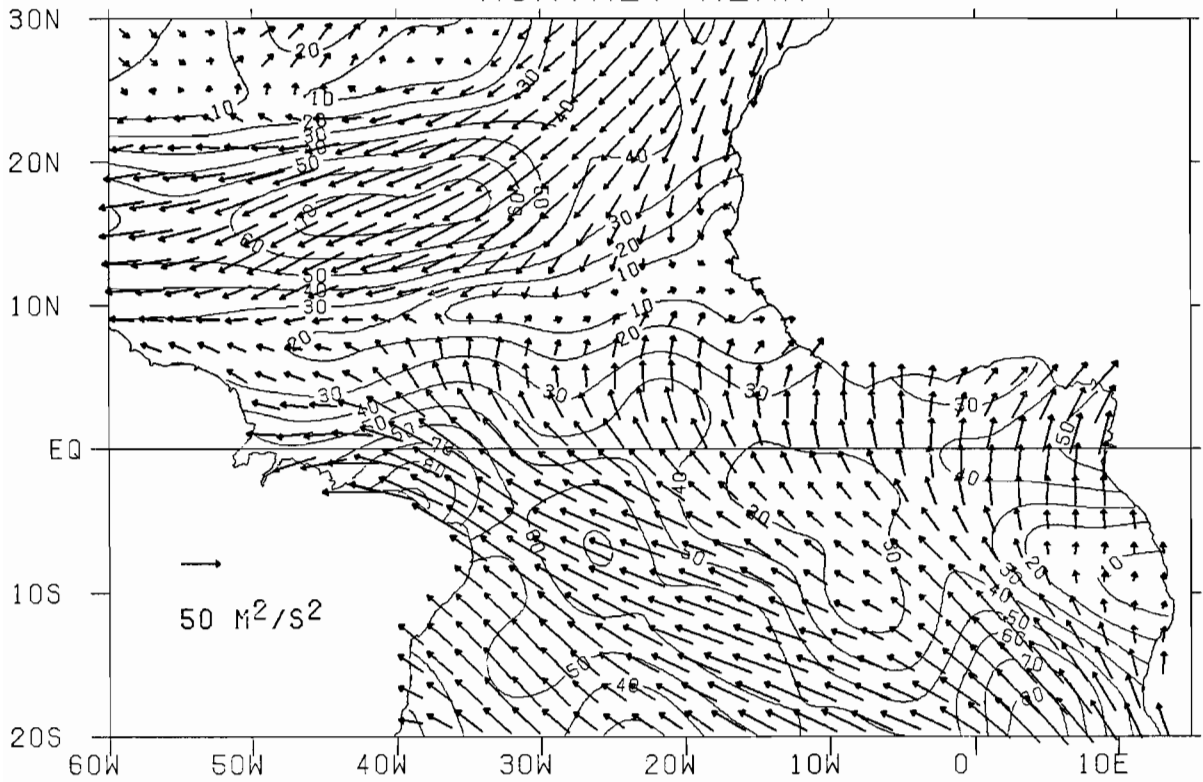
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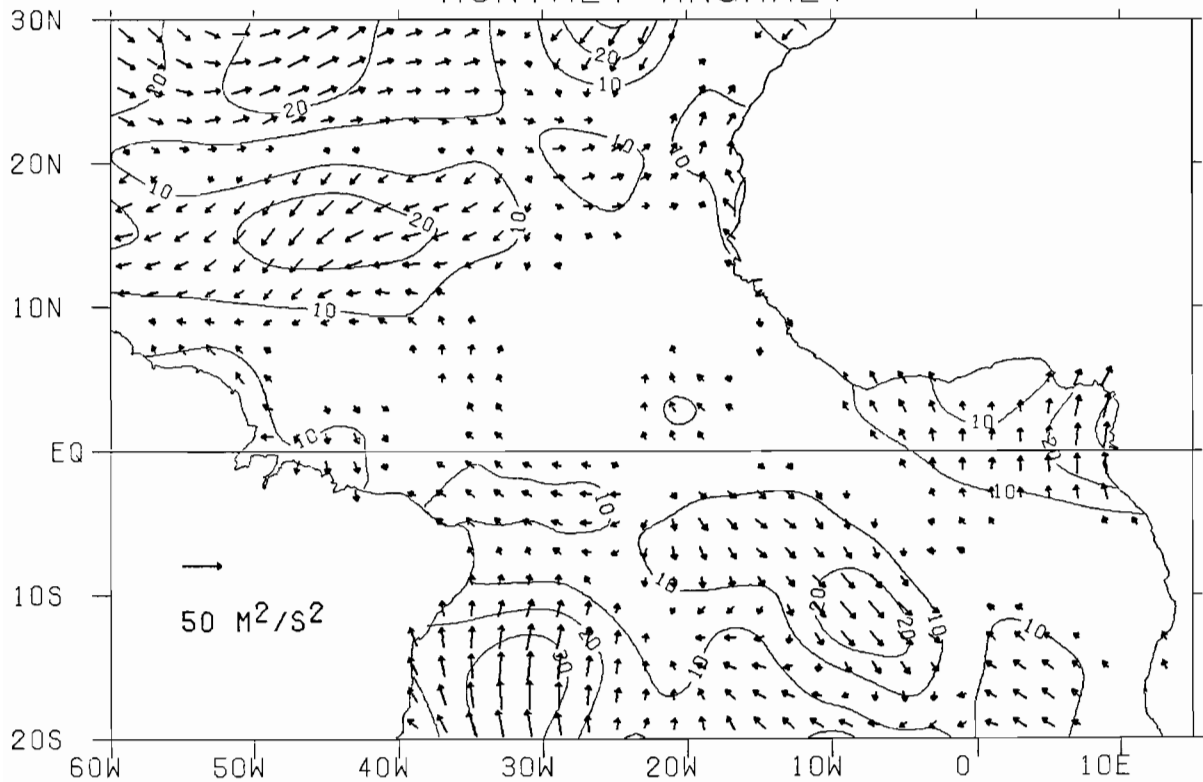
WIND STRESS

SEPTEMBER 1986

MONTHLY MEAN



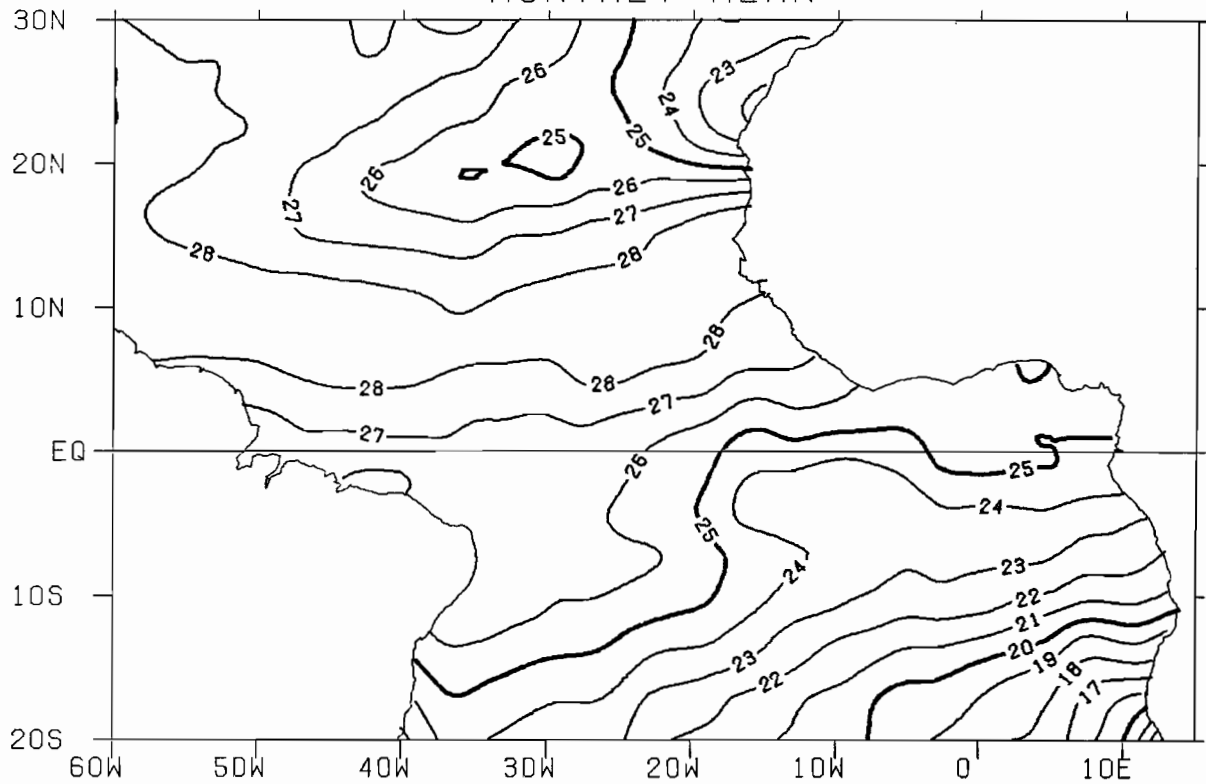
MONTHLY ANOMALY



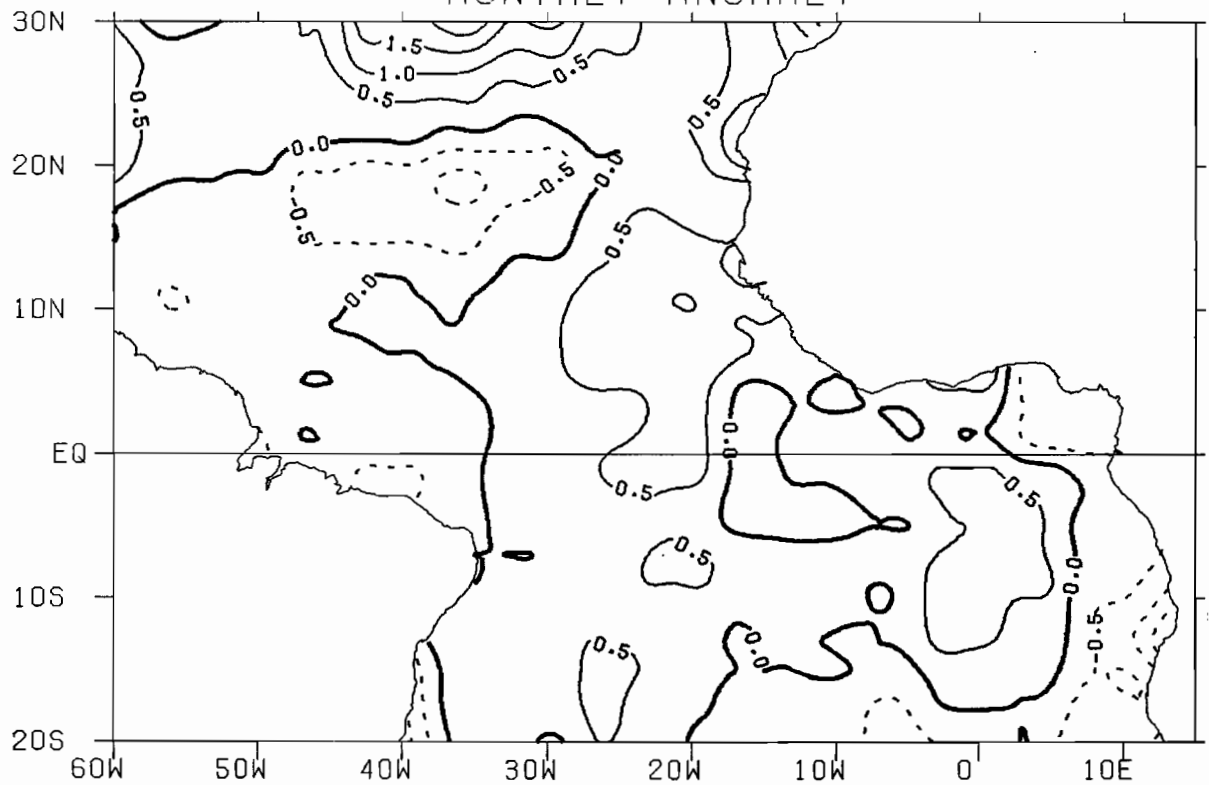
SEA SURFACE TEMPERATURE

SEPTEMBER 1986

MONTHLY MEAN

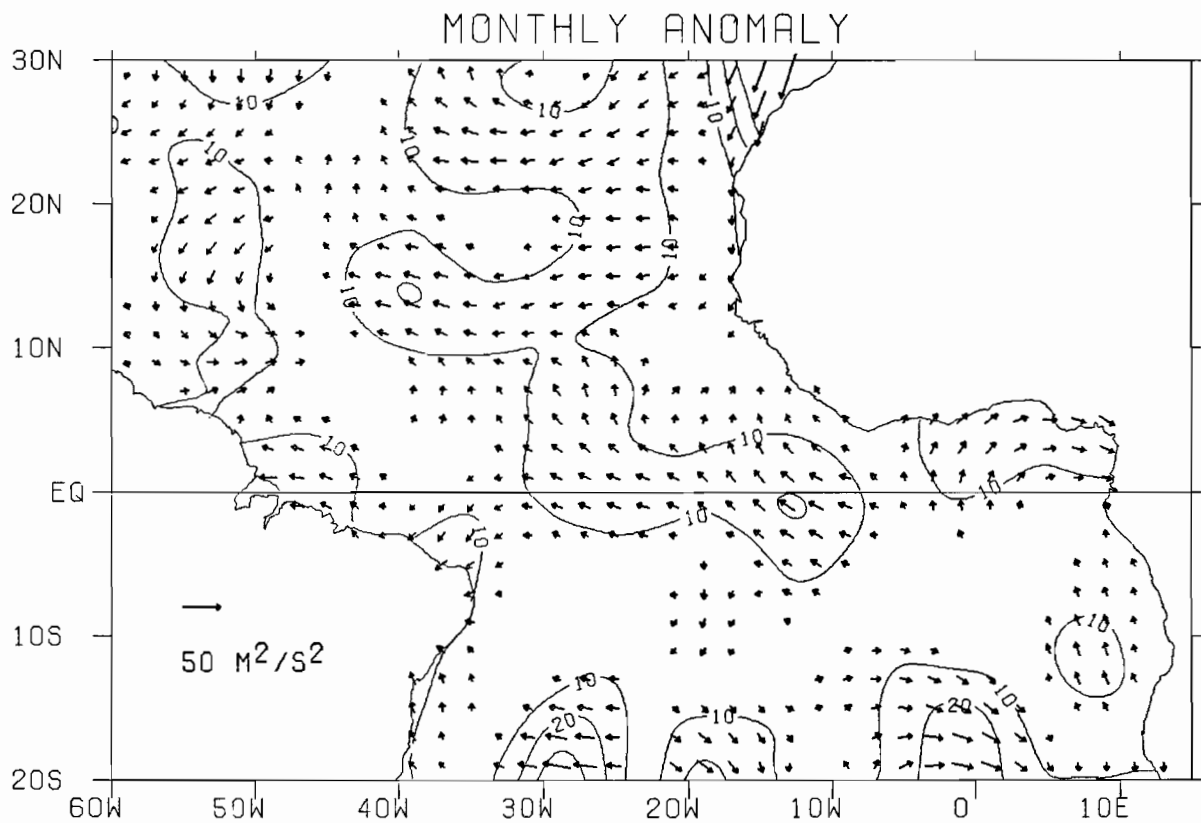
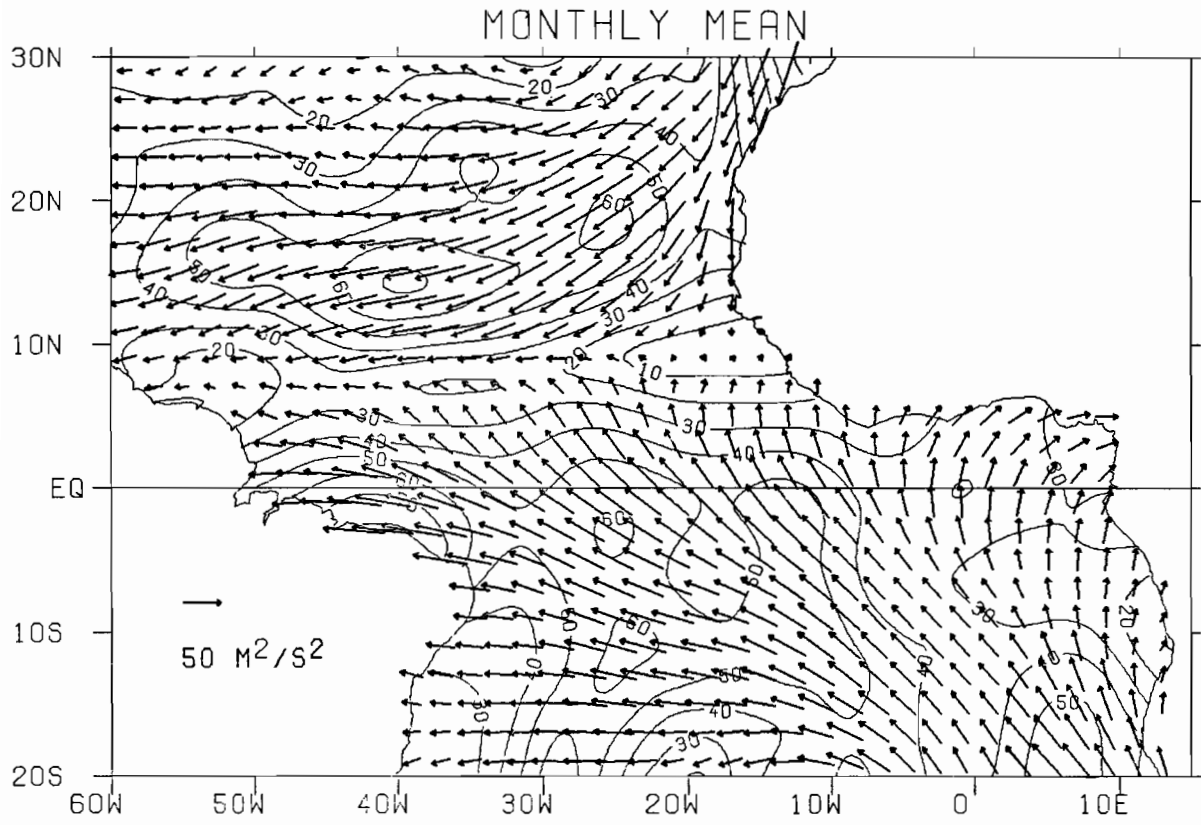


MONTHLY ANOMALY



WIND STRESS

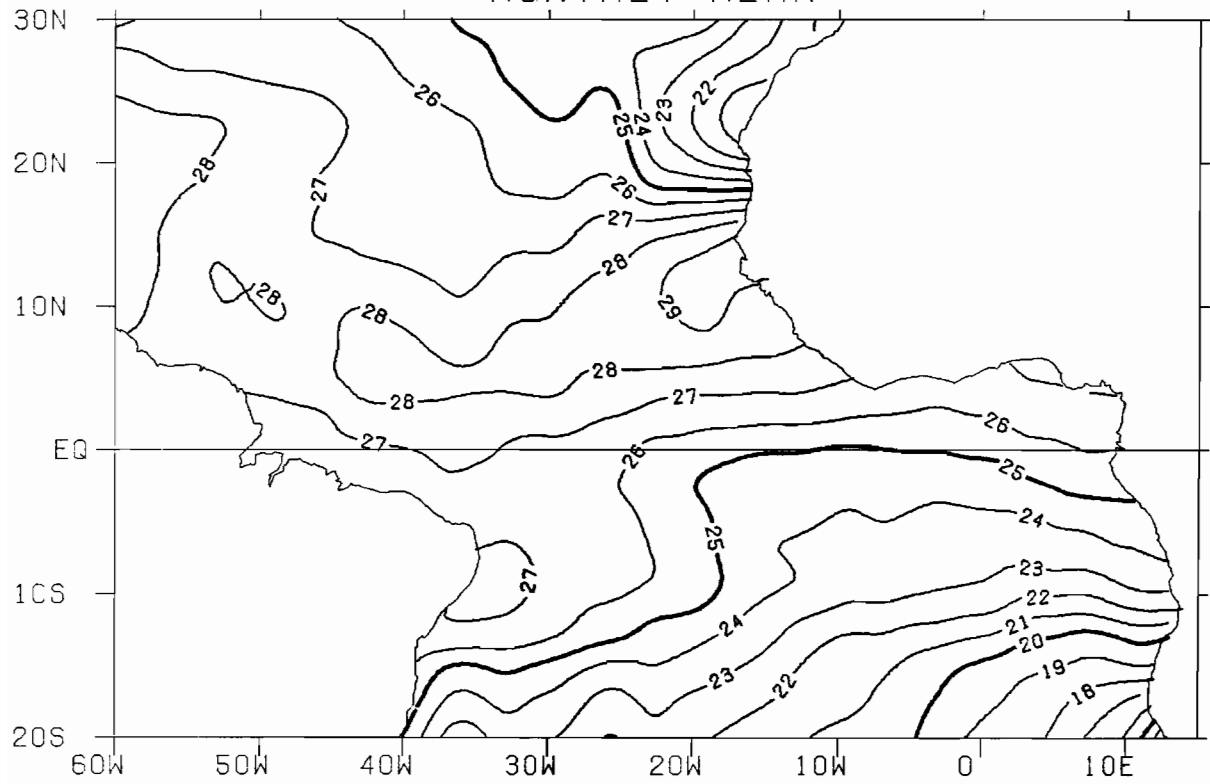
OCTOBER 1986



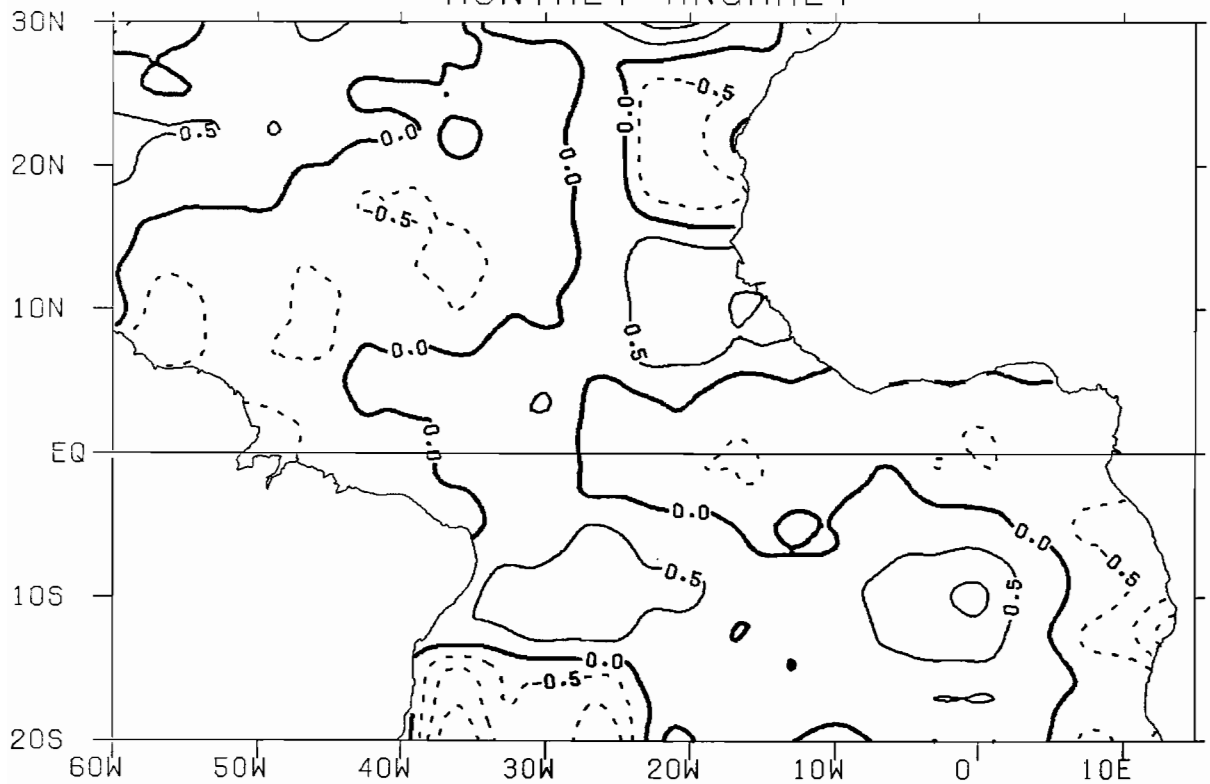
SEA SURFACE TEMPERATURE

OCTOBER 1986

MONTHLY MEAN

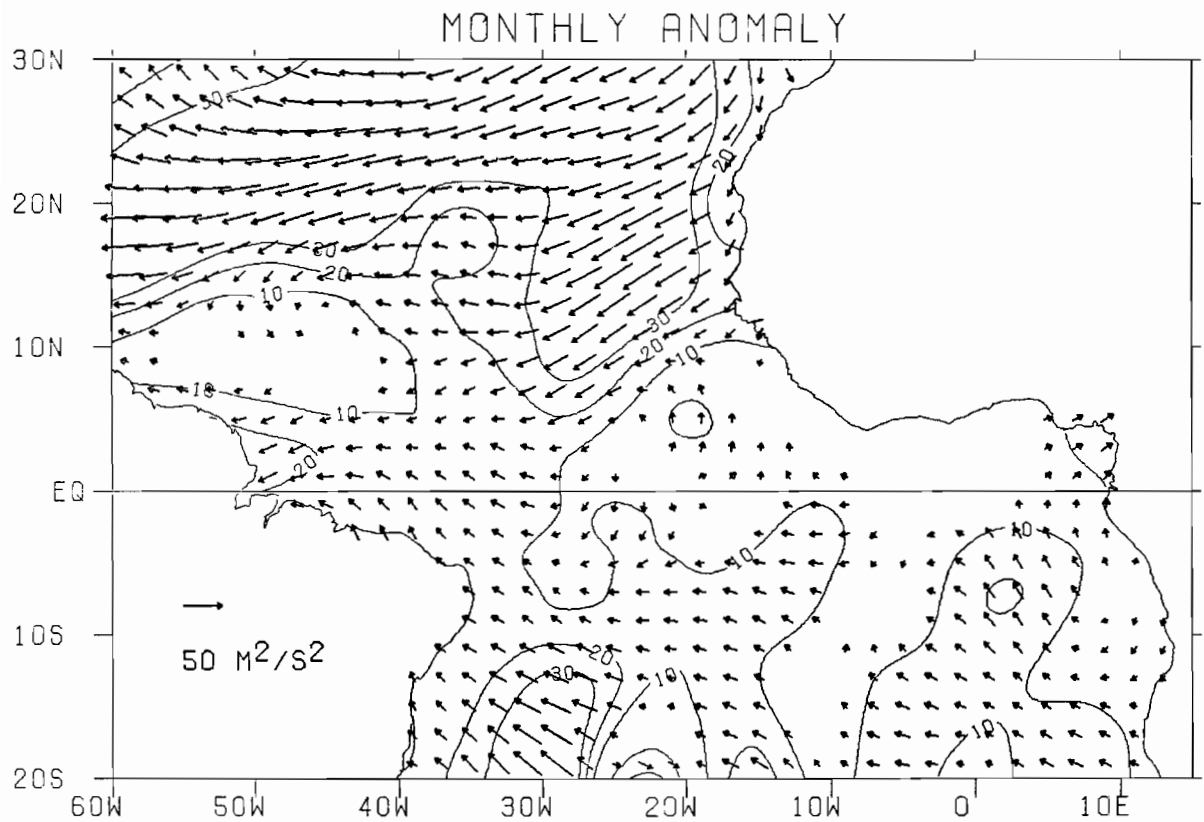
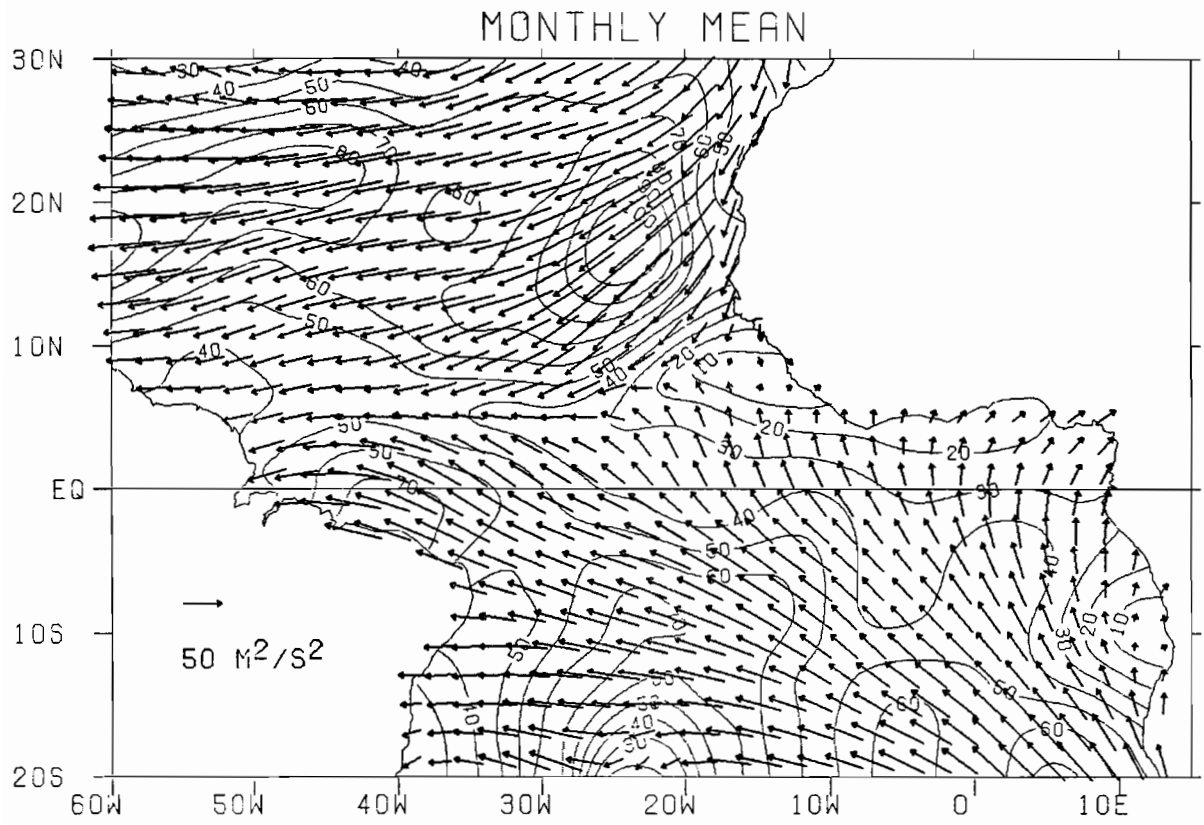


MONTHLY ANOMALY



WIND STRESS

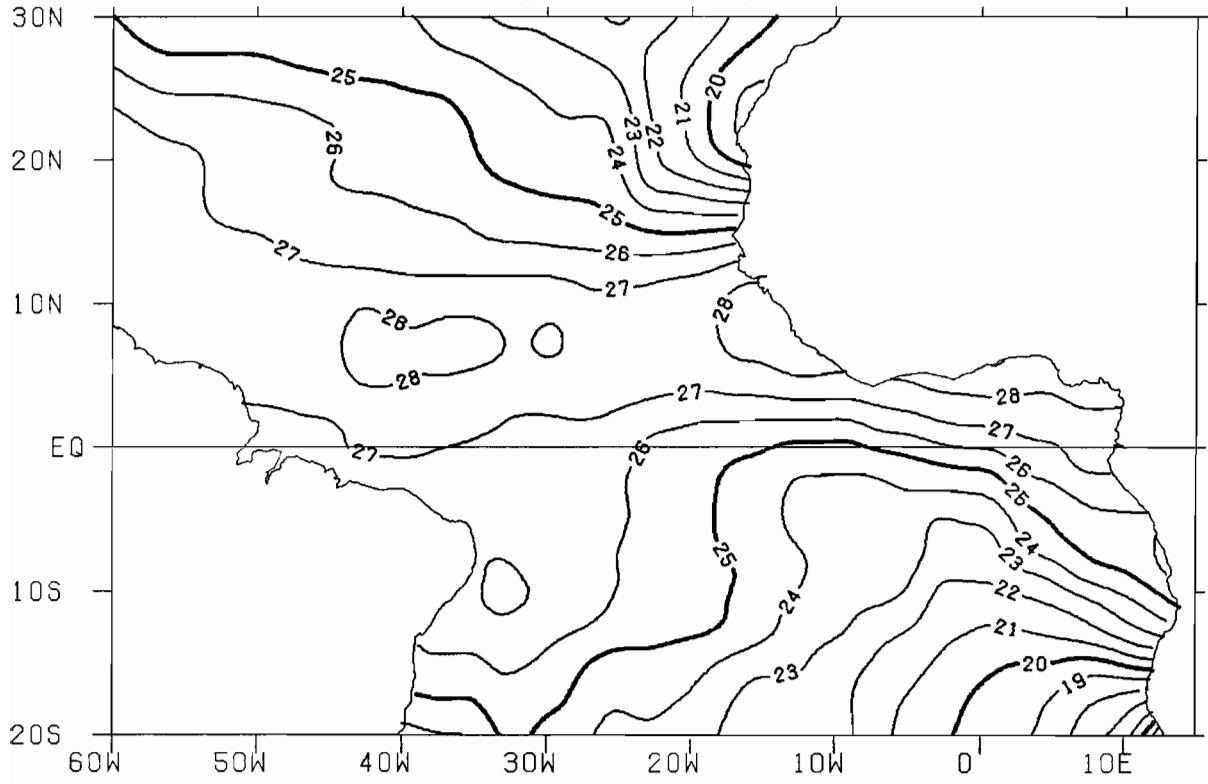
NOVEMBER 1986



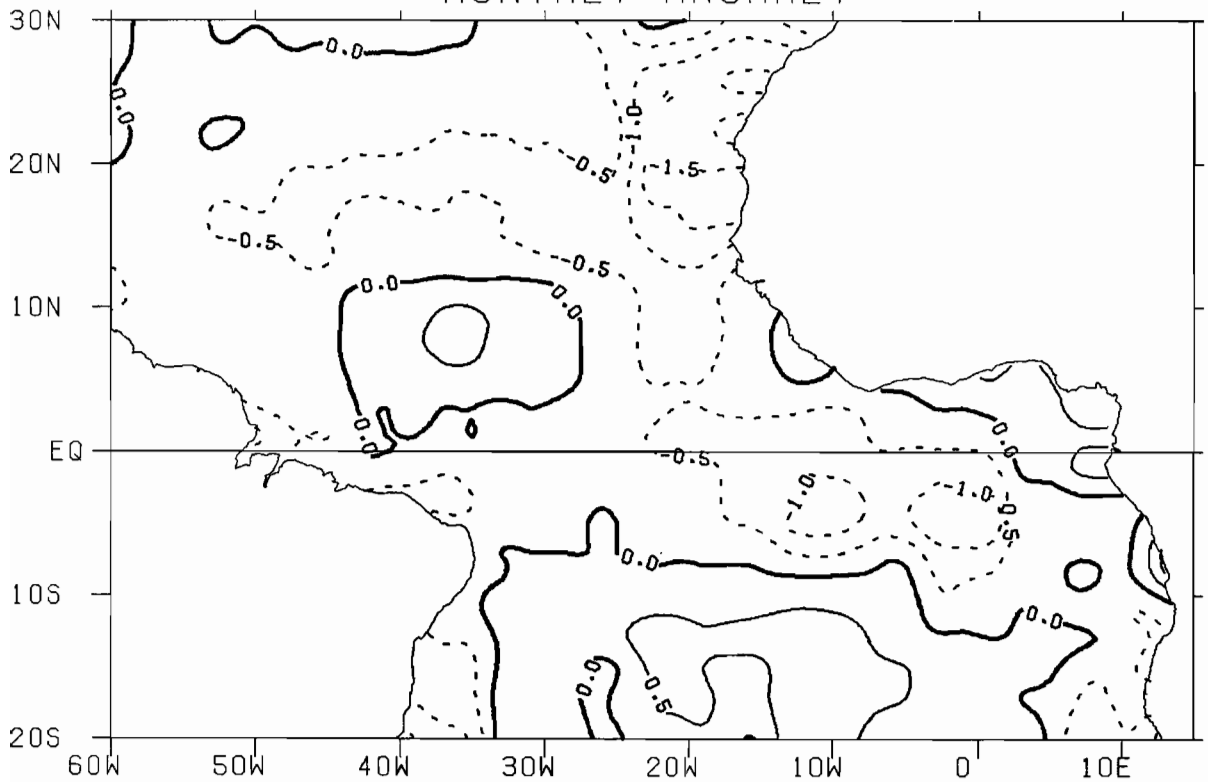
SEA SURFACE TEMPERATURE

NOVEMBER 1986

MONTHLY MEAN

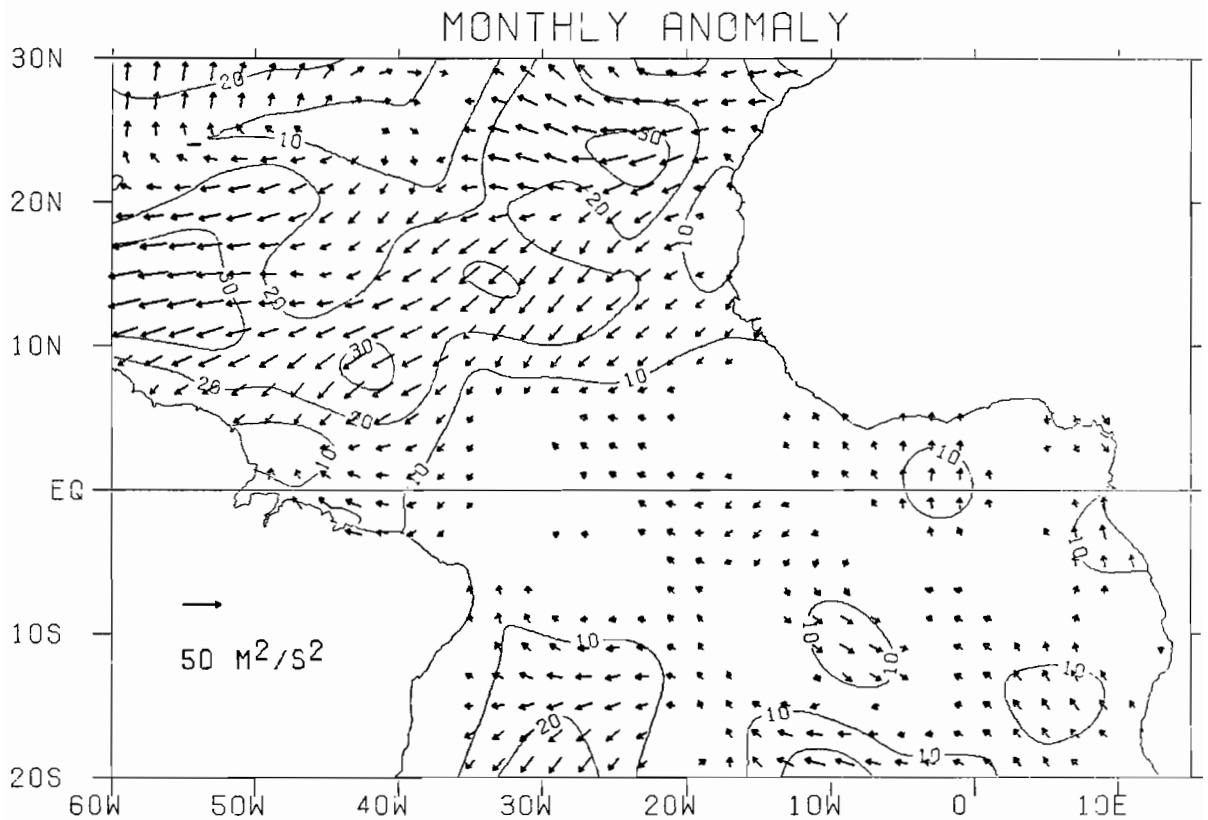
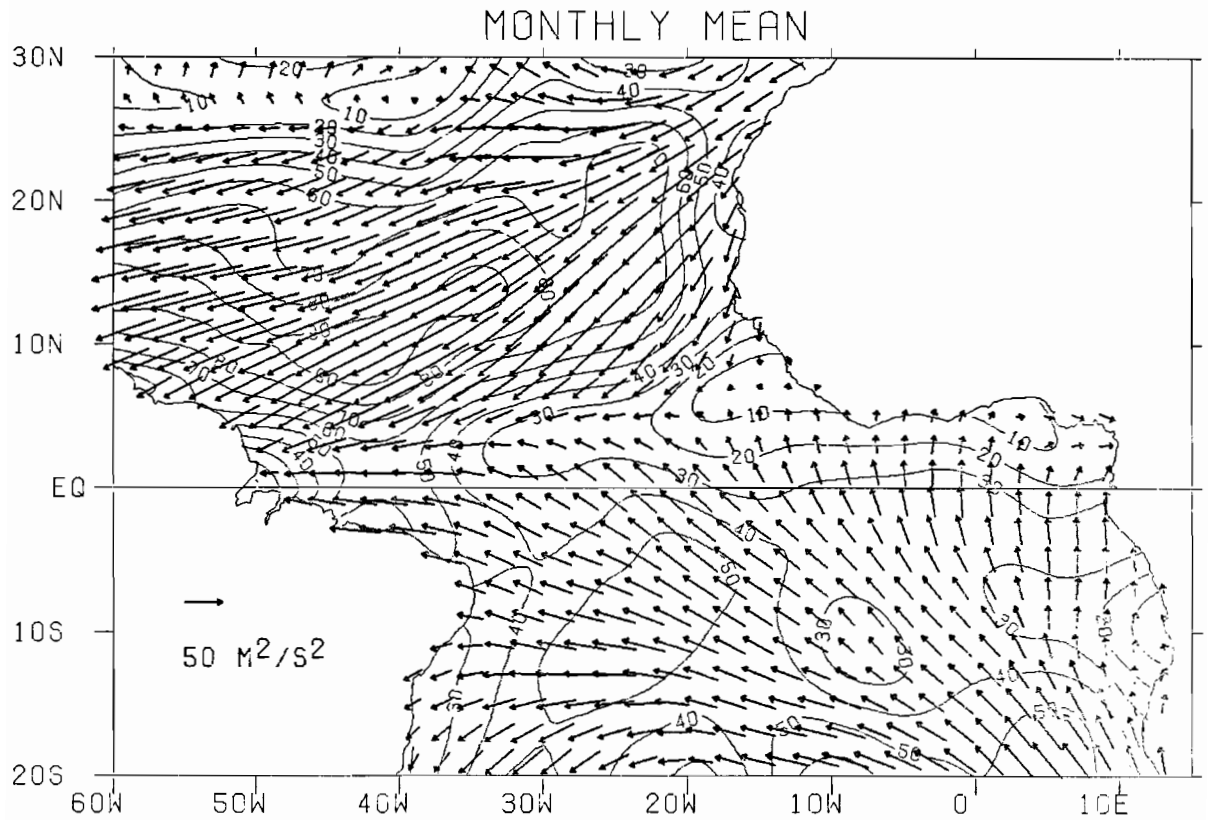


MONTHLY ANOMALY



WIND STRESS

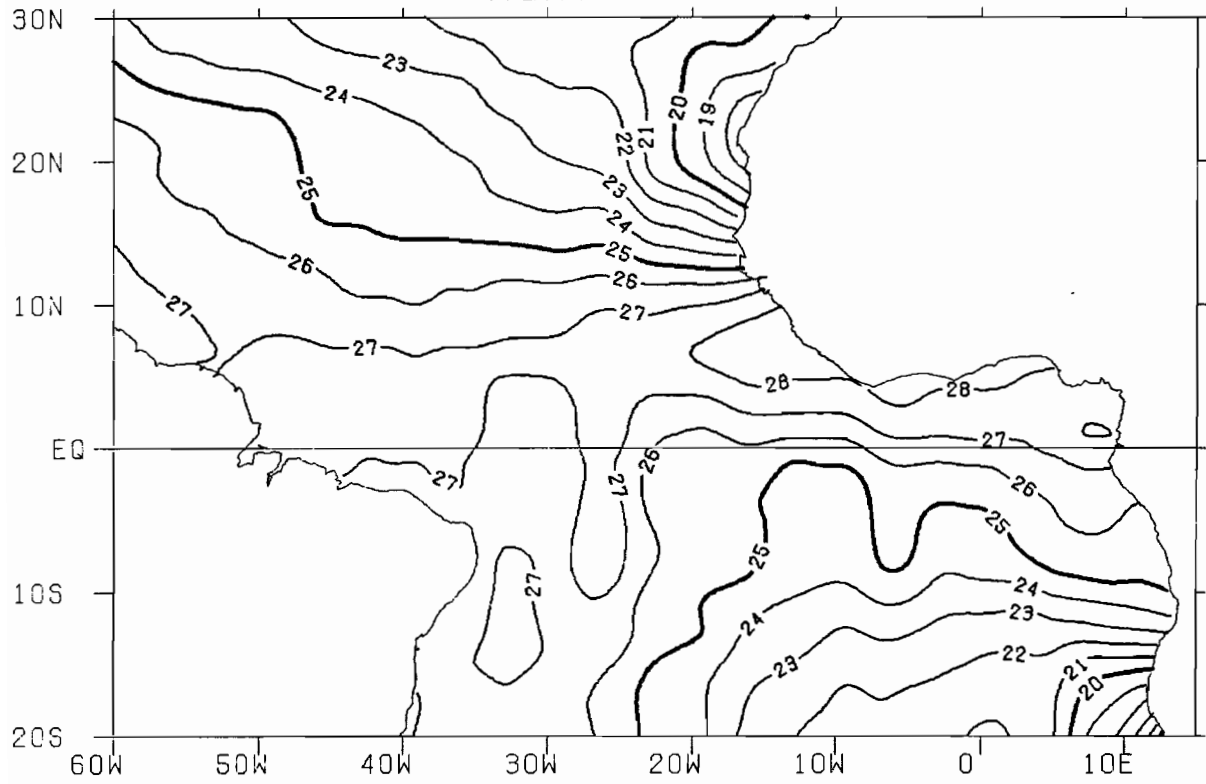
DECEMBER 1986



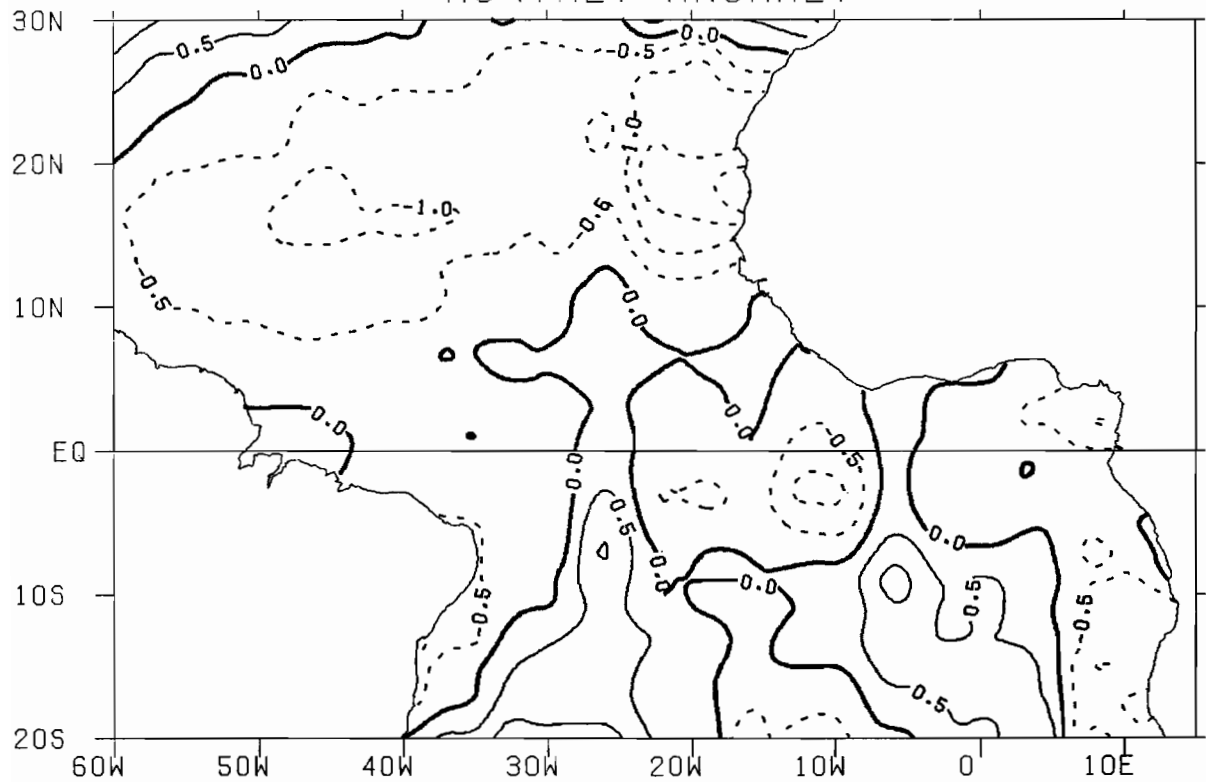
SEA SURFACE TEMPERATURE

DECEMBER 1986

MONTHLY MEAN

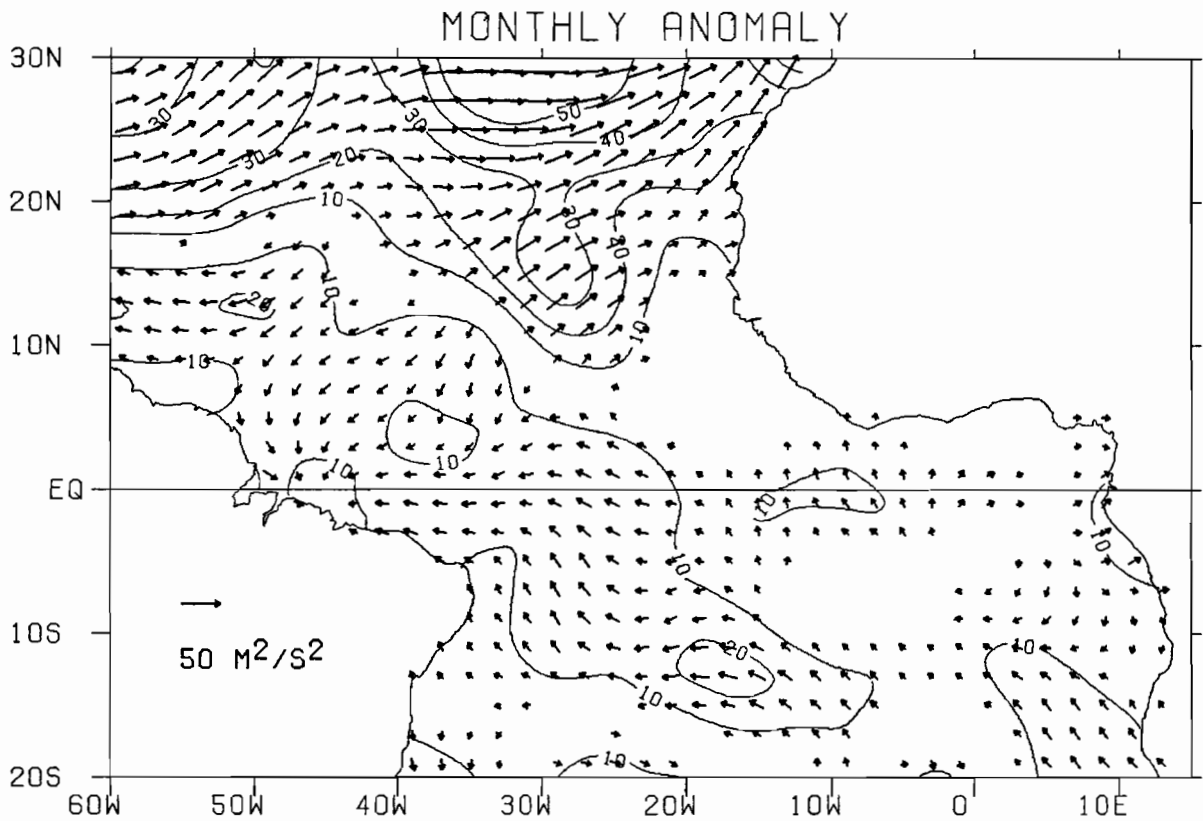
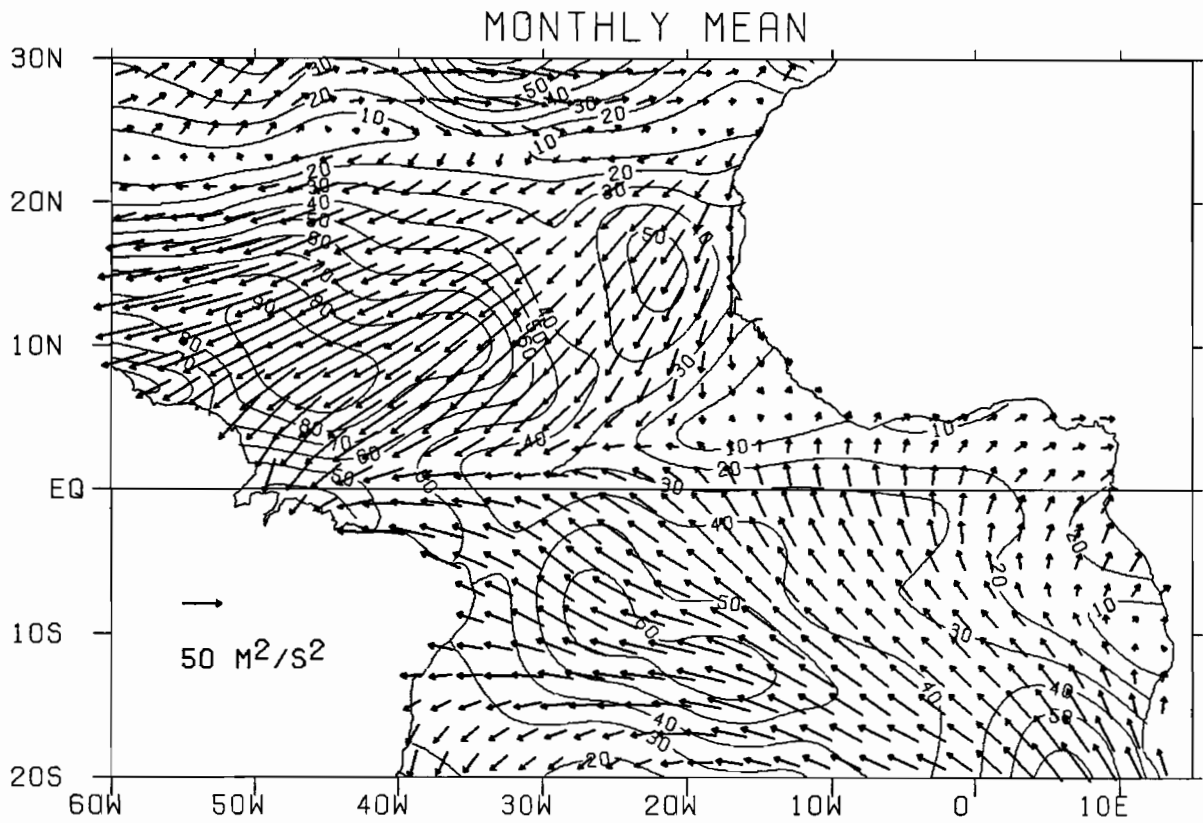


MONTHLY ANOMALY



WIND STRESS

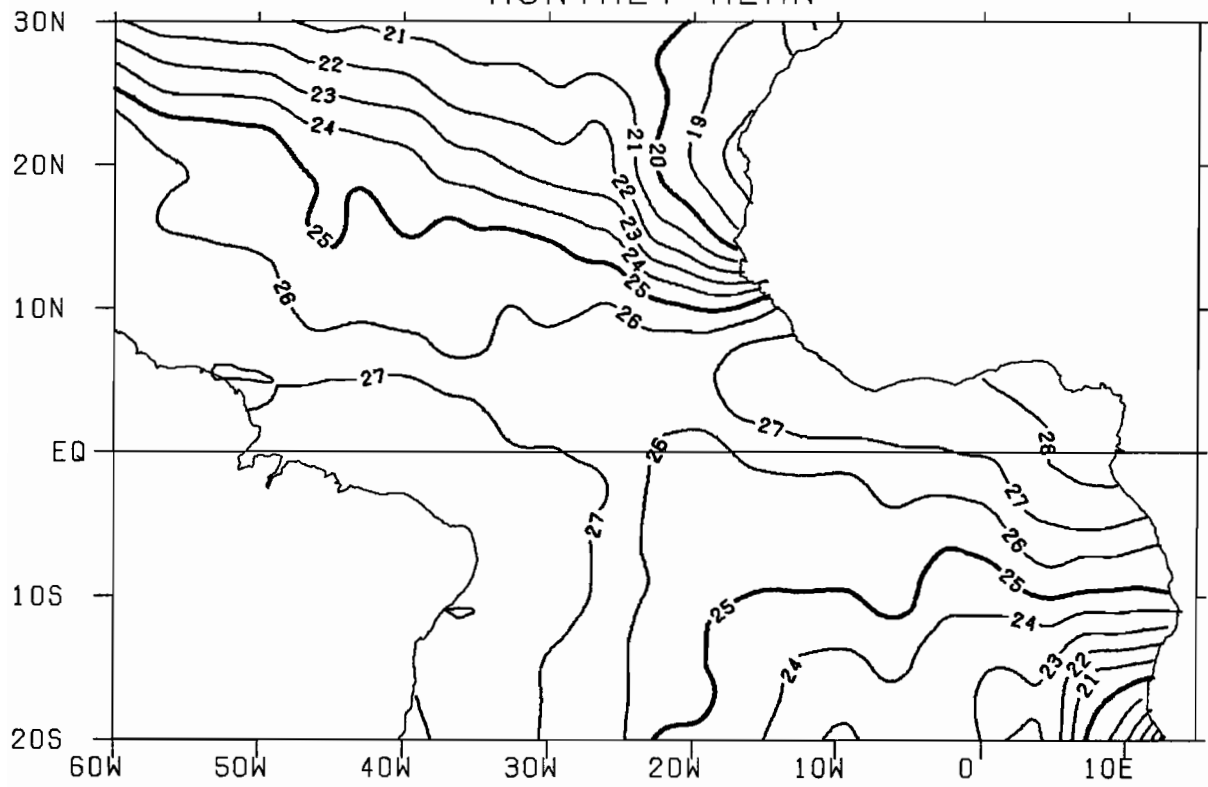
JANUARY 1987



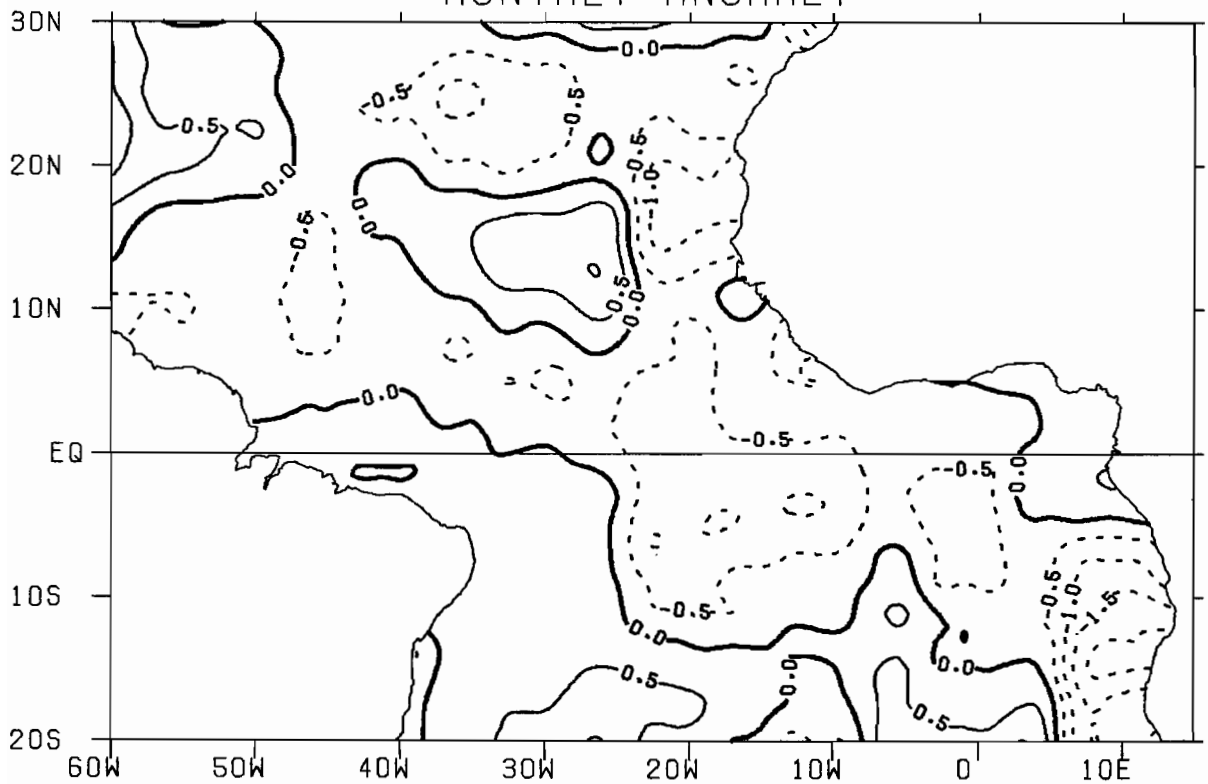
SEA SURFACE TEMPERATURE

JANUARY 1987

MONTHLY MEAN

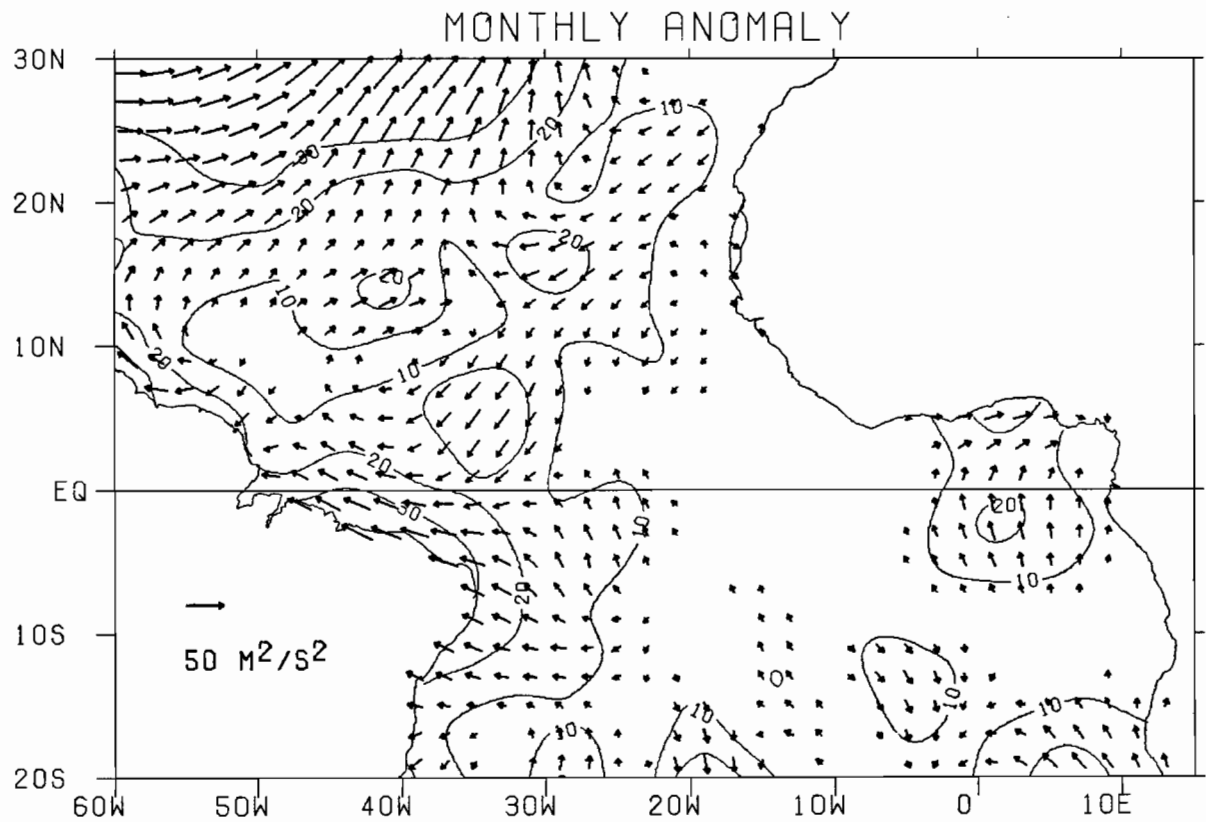
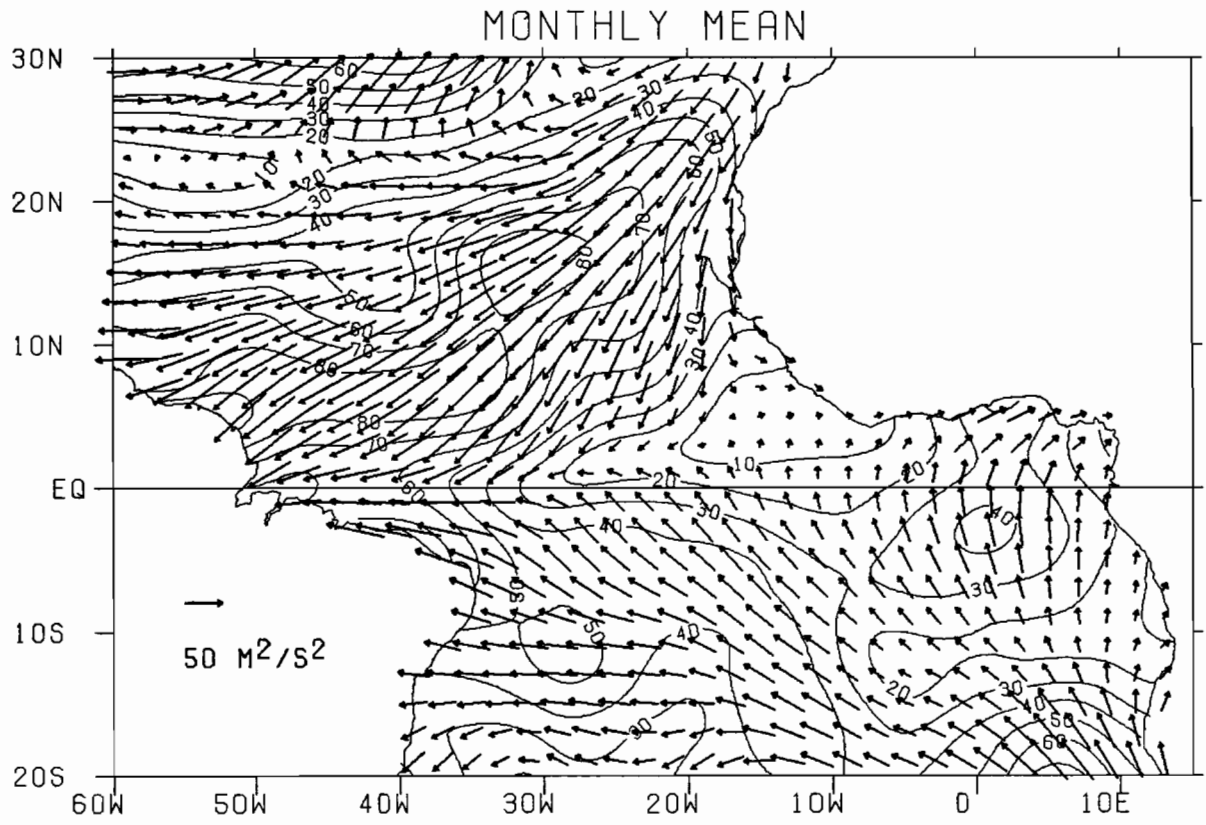


MONTHLY ANOMALY



WIND STRESS

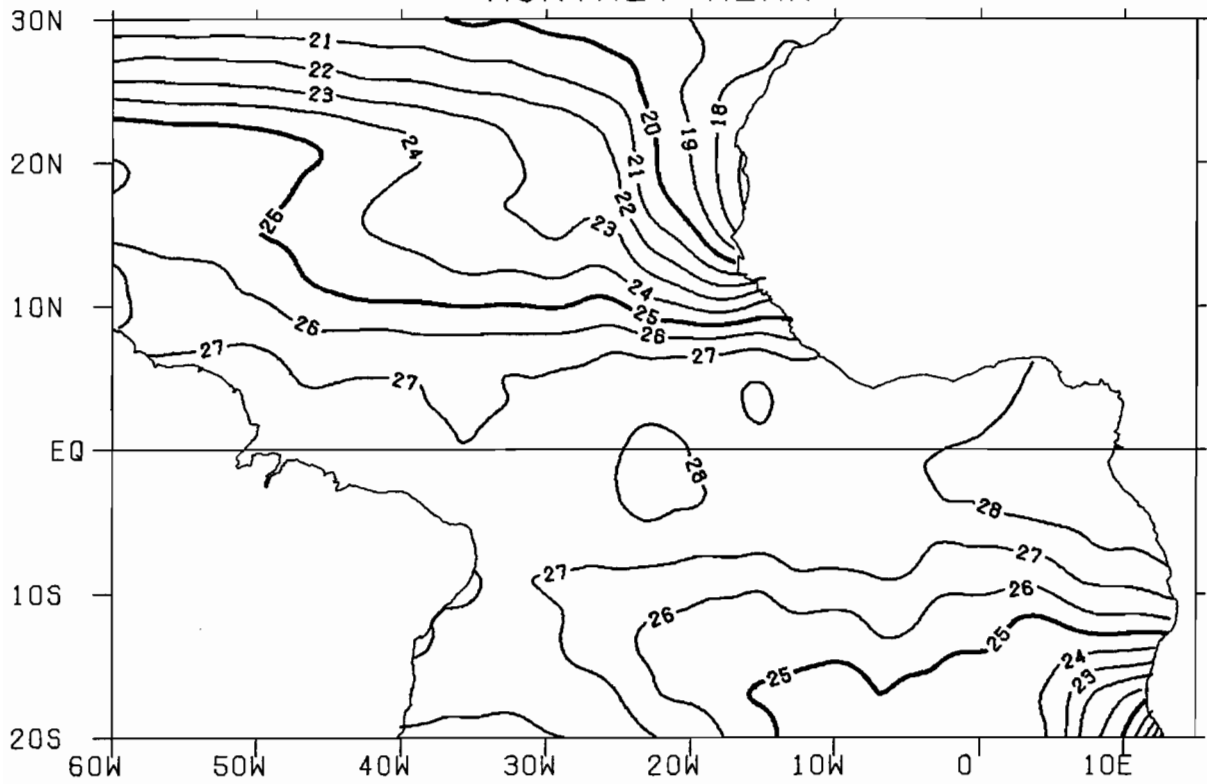
FEBRUARY 1987



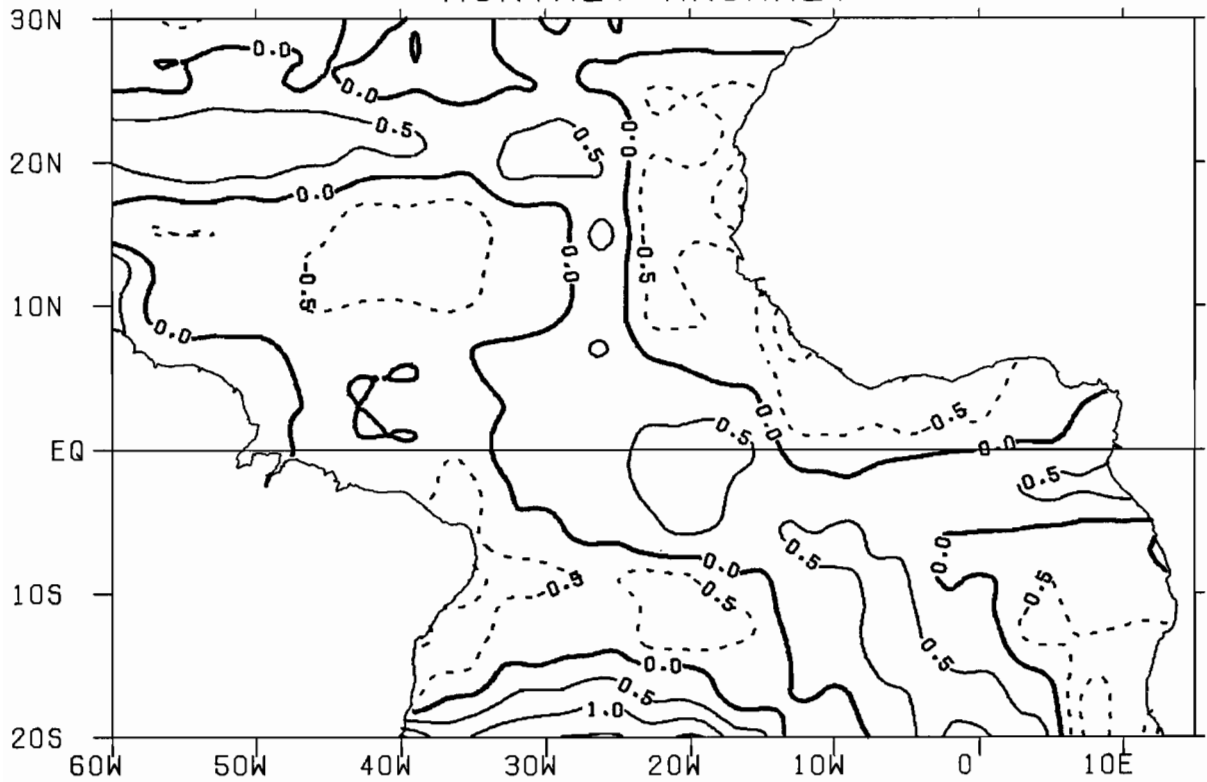
SEA SURFACE TEMPERATURE

FEBRUARY 1987

MONTHLY MEAN



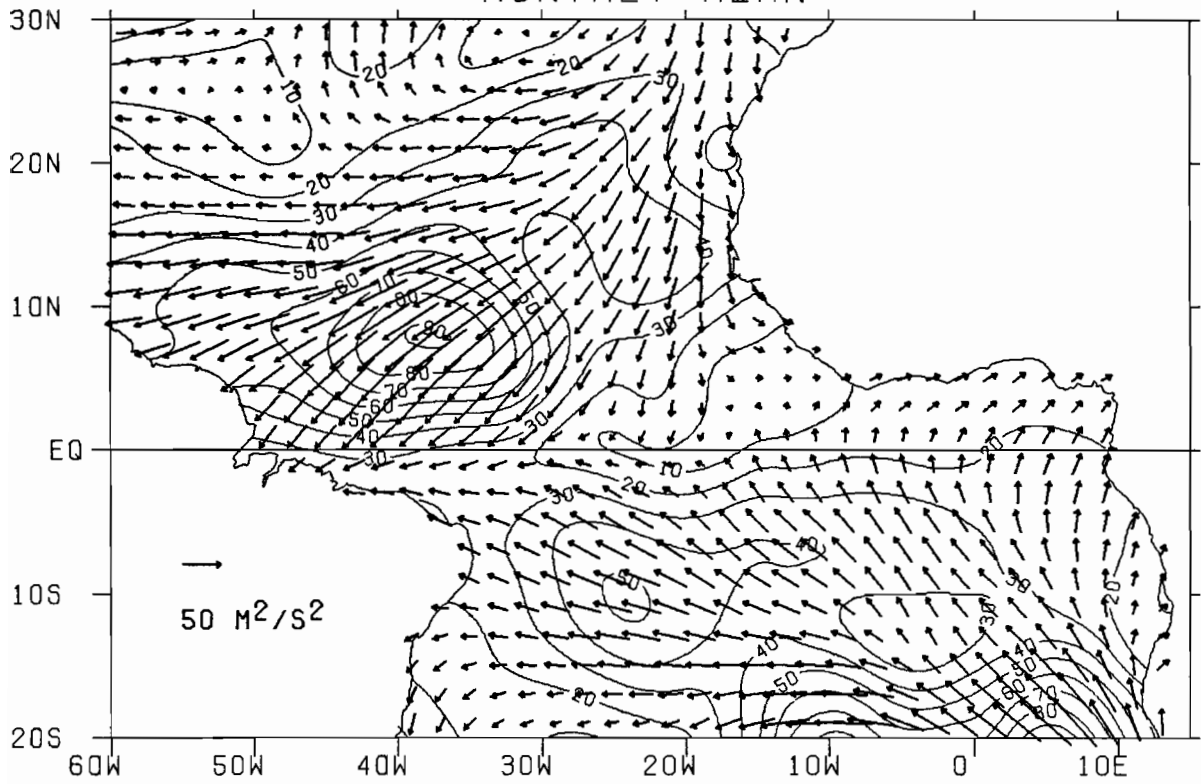
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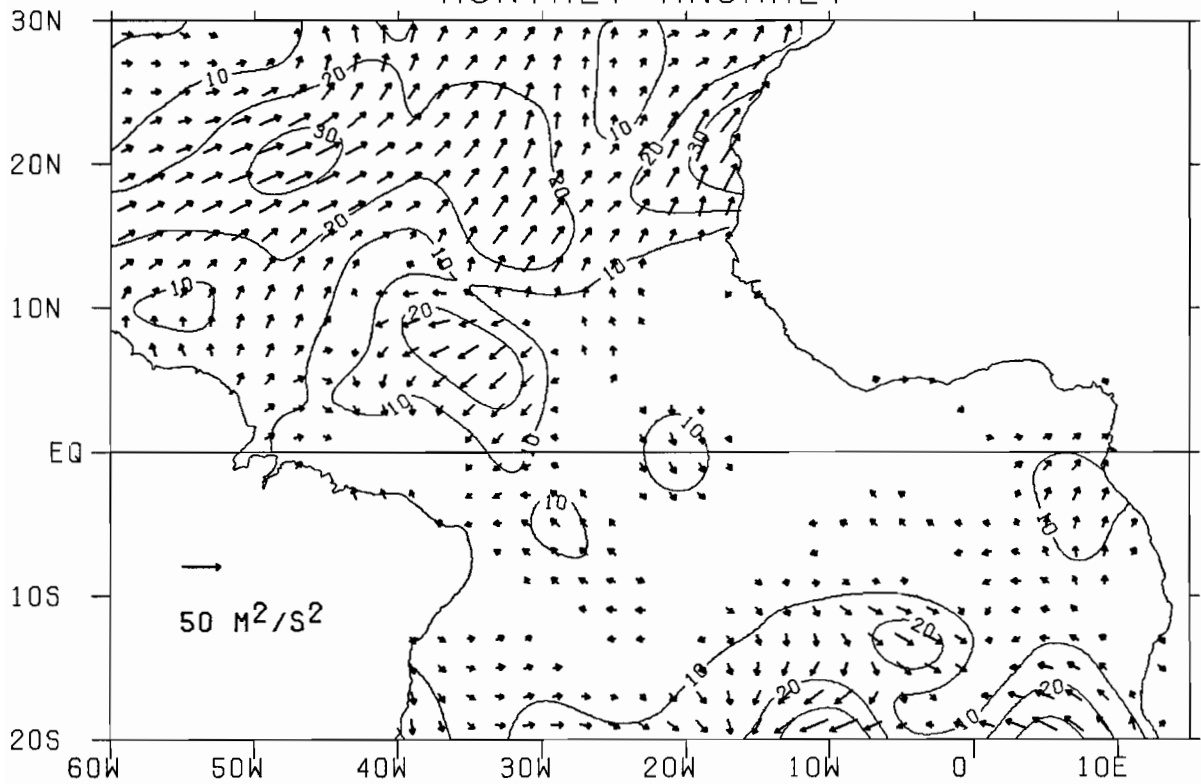
WIND STRESS

MARCH 1987

MONTHLY MEAN



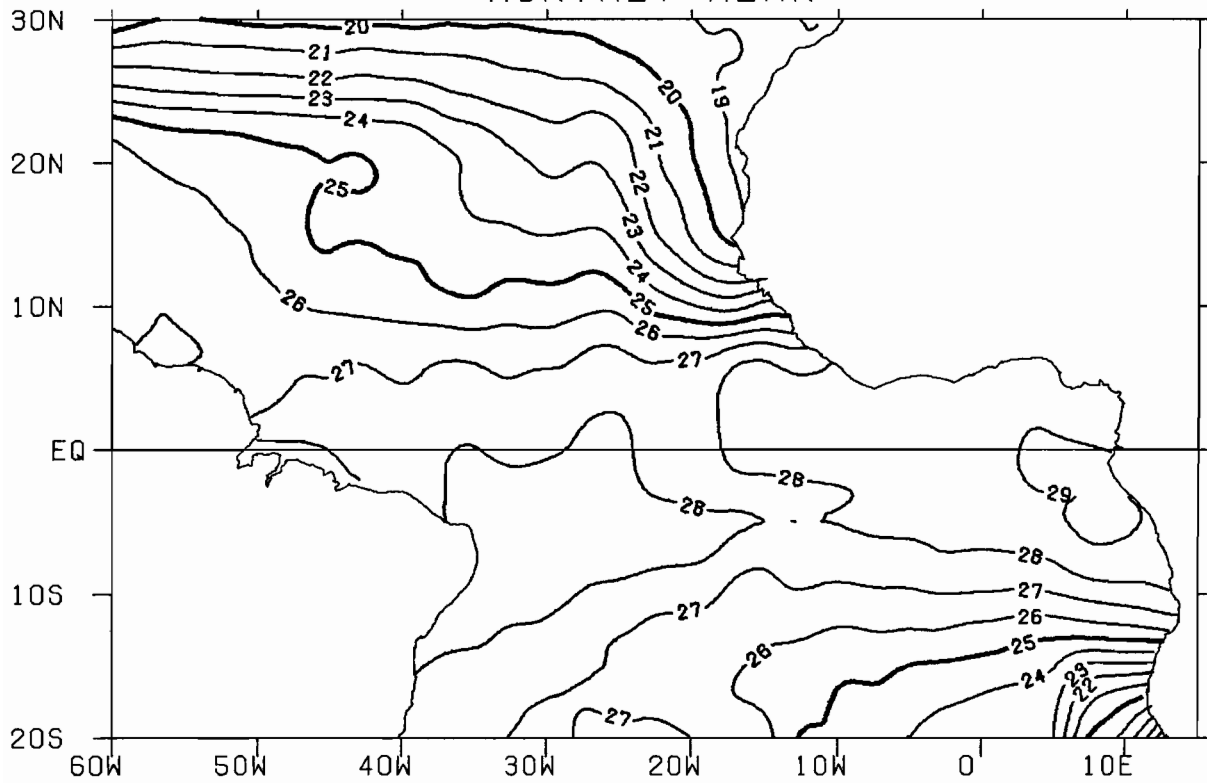
MONTHLY ANOMALY



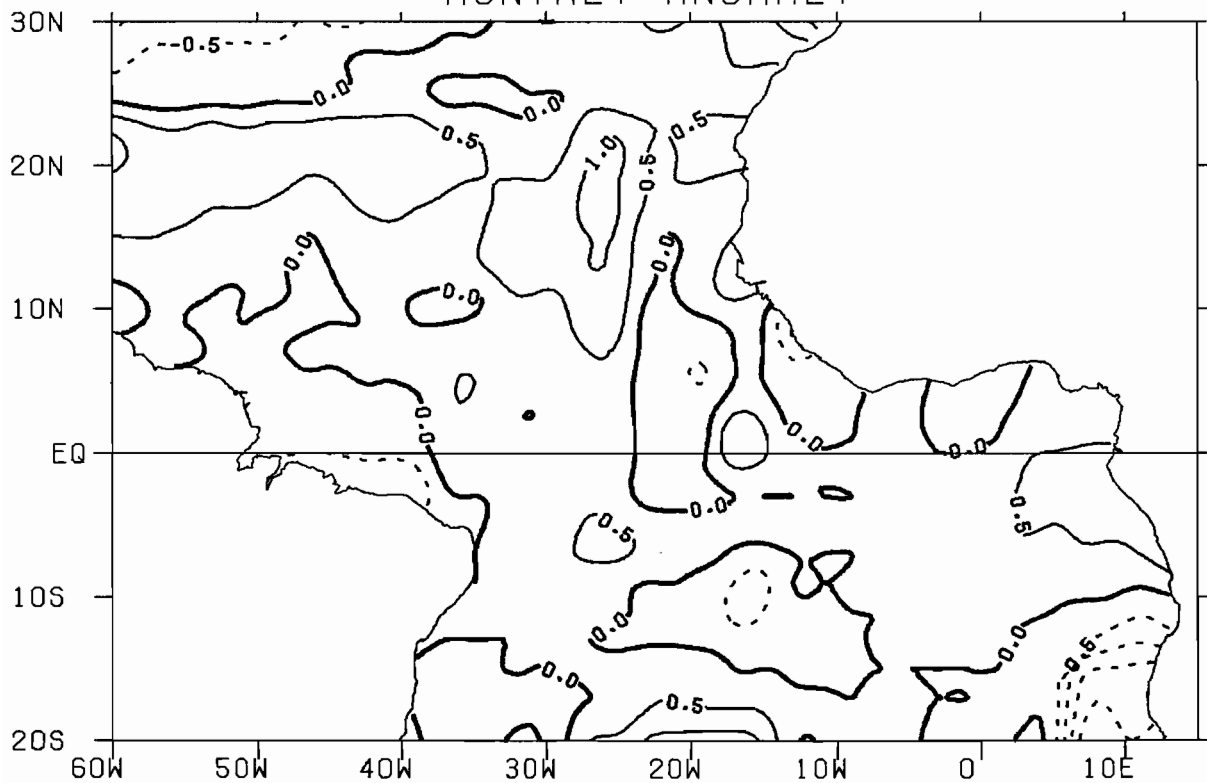
SEA SURFACE TEMPERATURE

MARCH 1987

MONTHLY MEAN



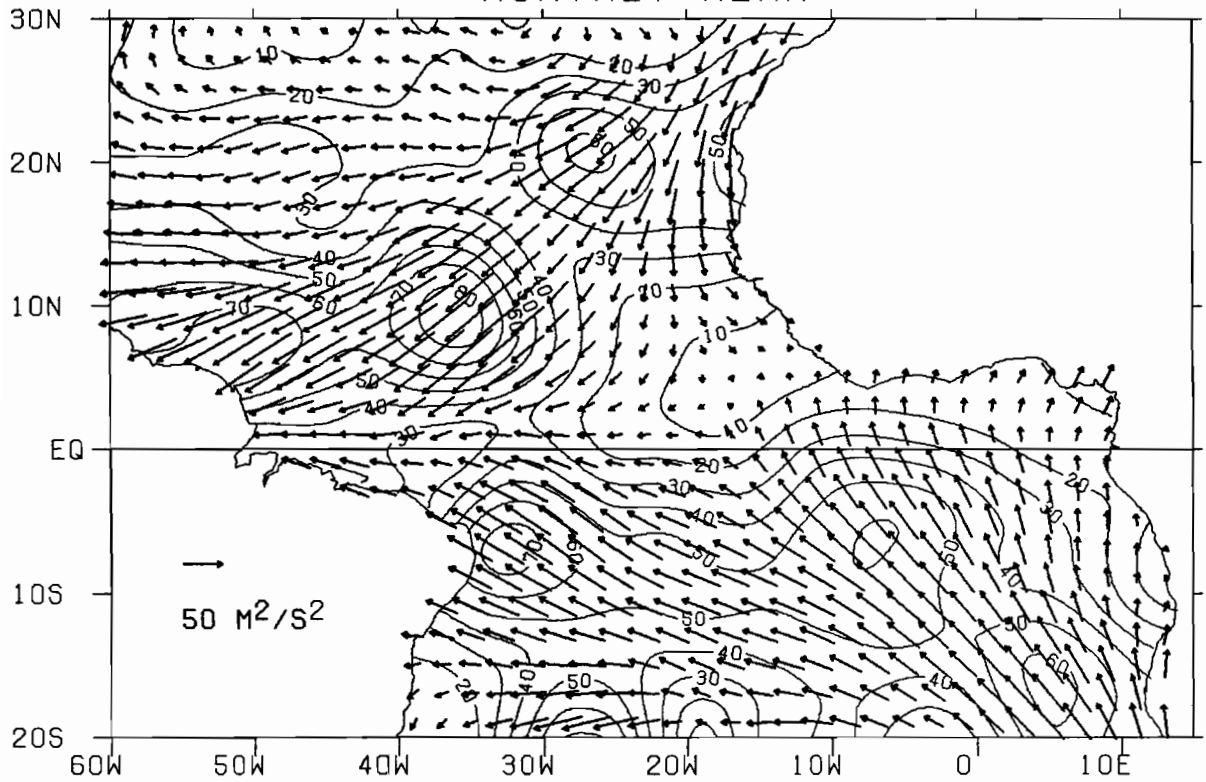
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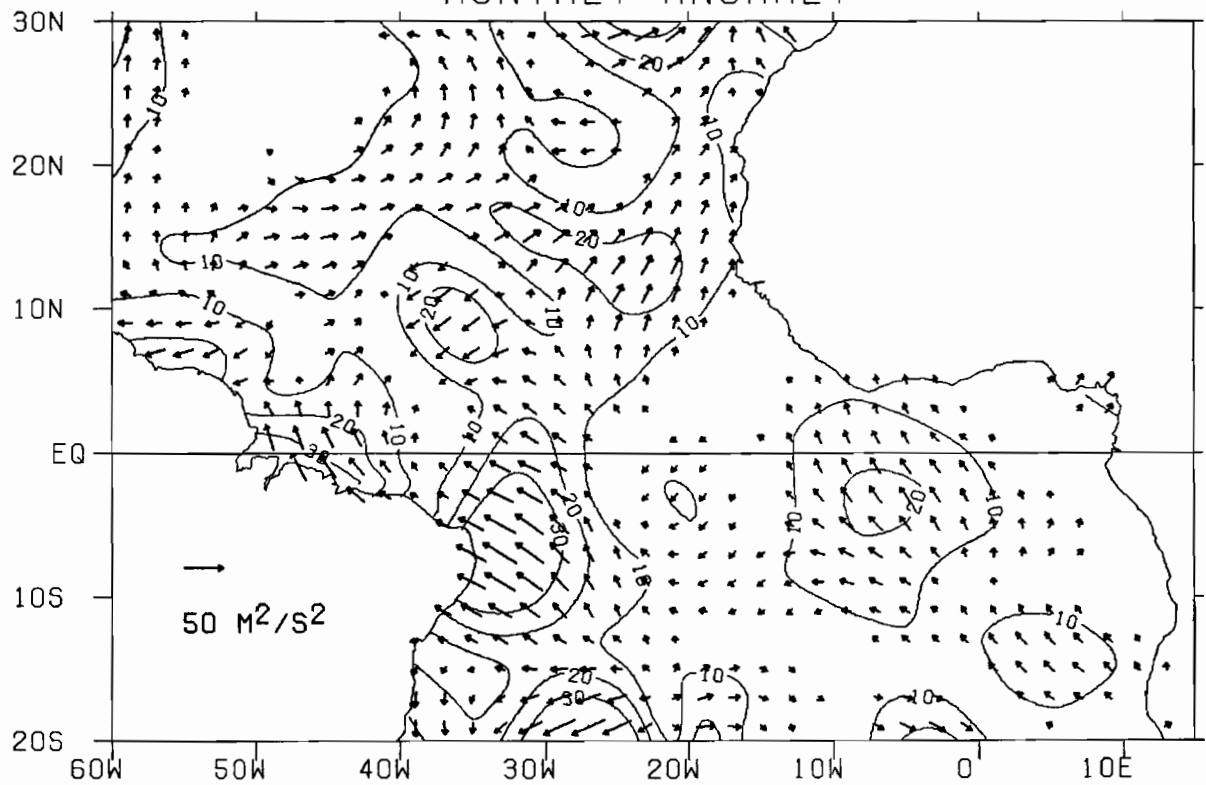
WIND STRESS

APRIL 1987

MONTHLY MEAN



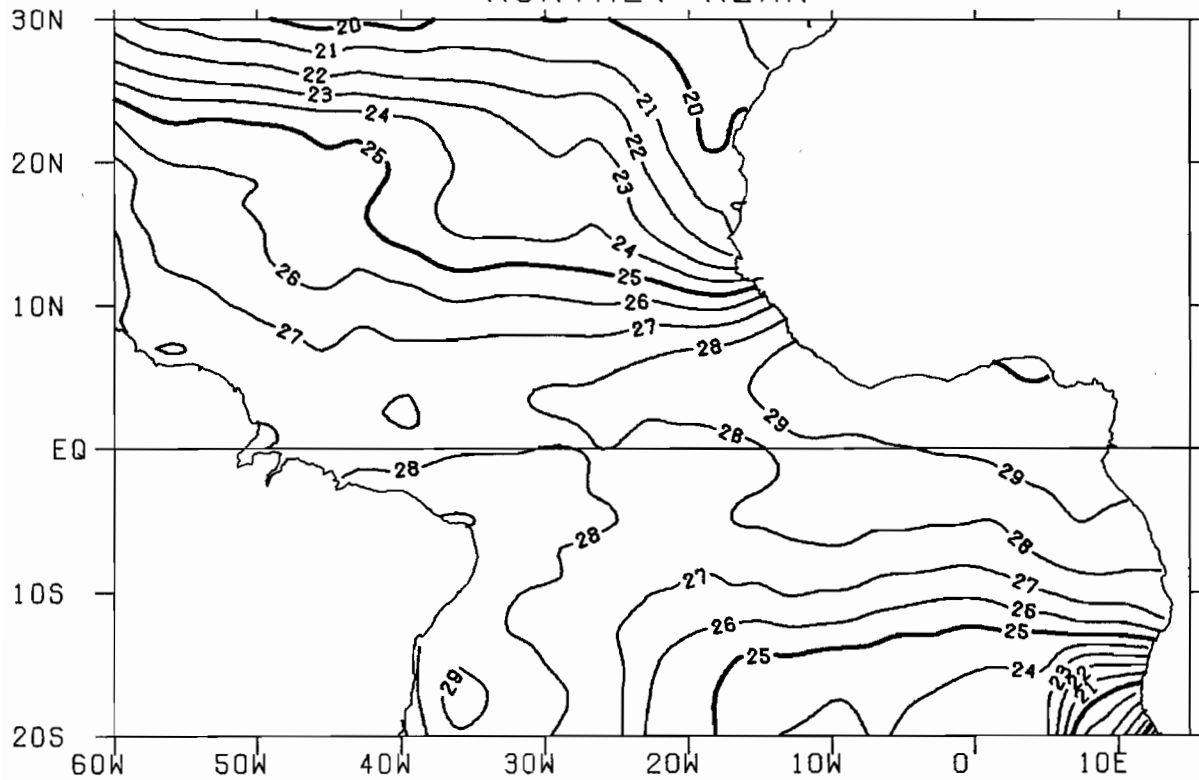
MONTHLY ANOMALY



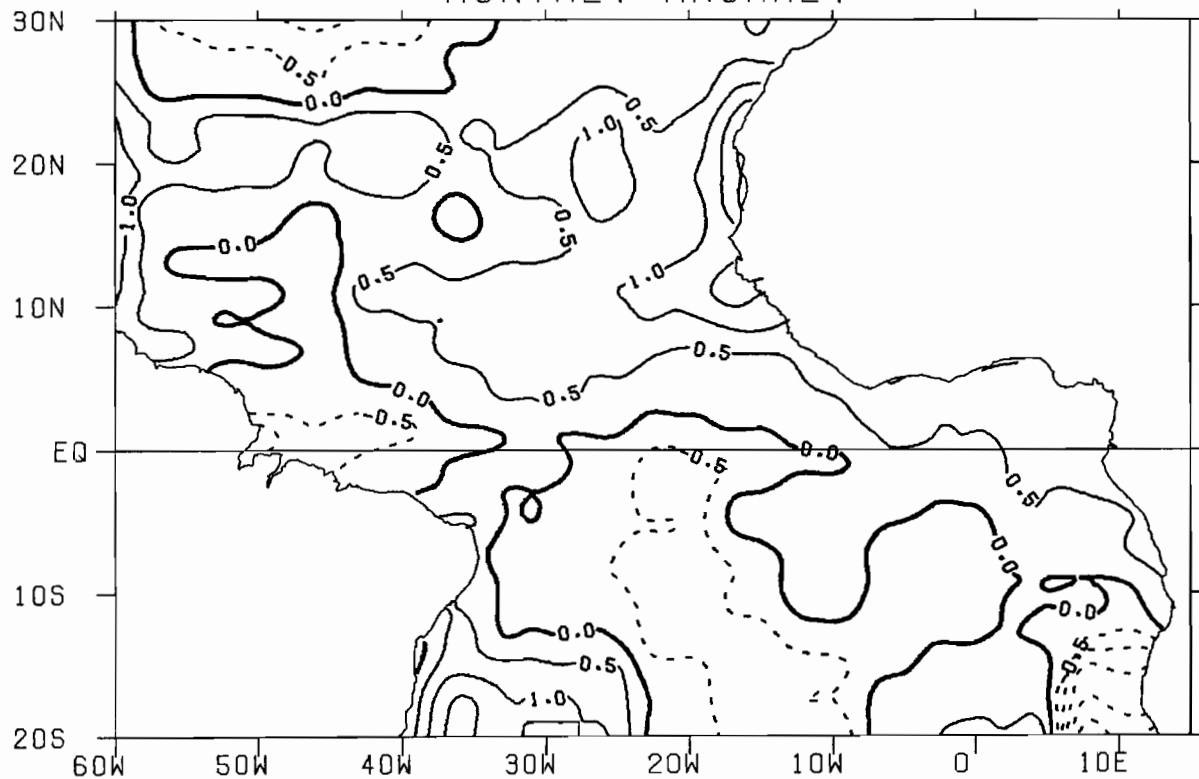
SEA SURFACE TEMPERATURE

APRIL 1987

MONTHLY MEAN



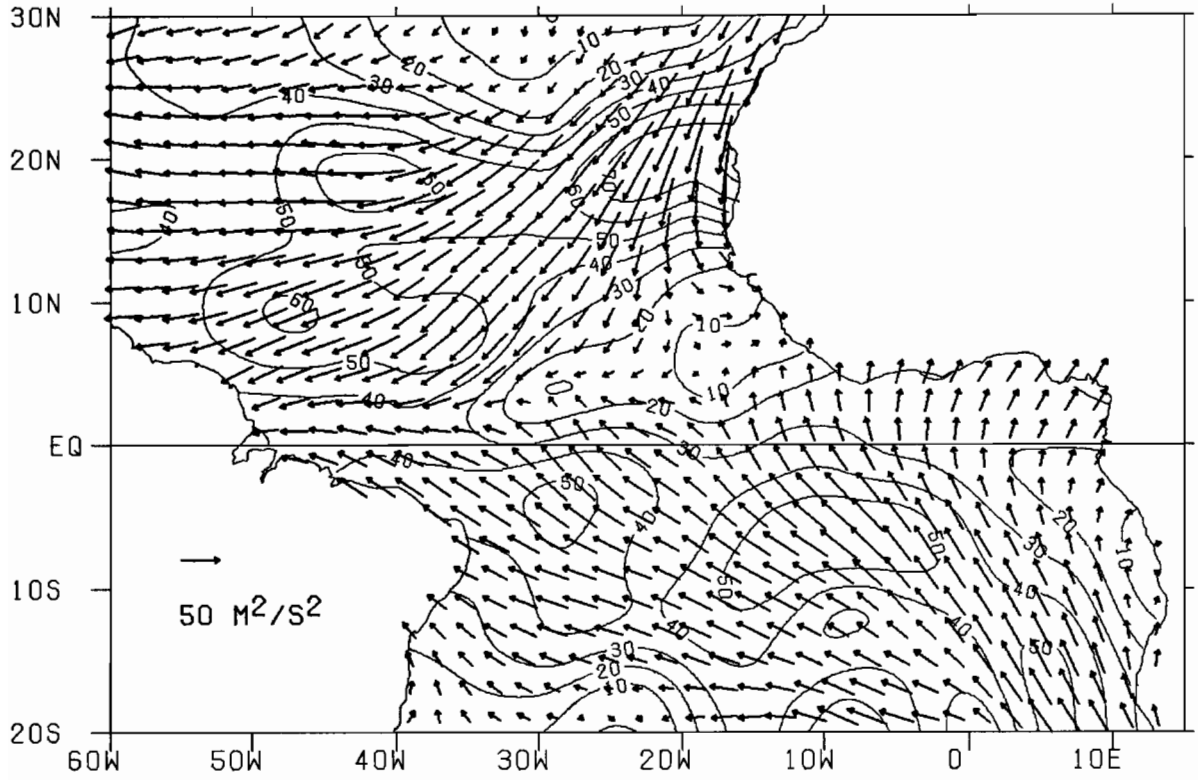
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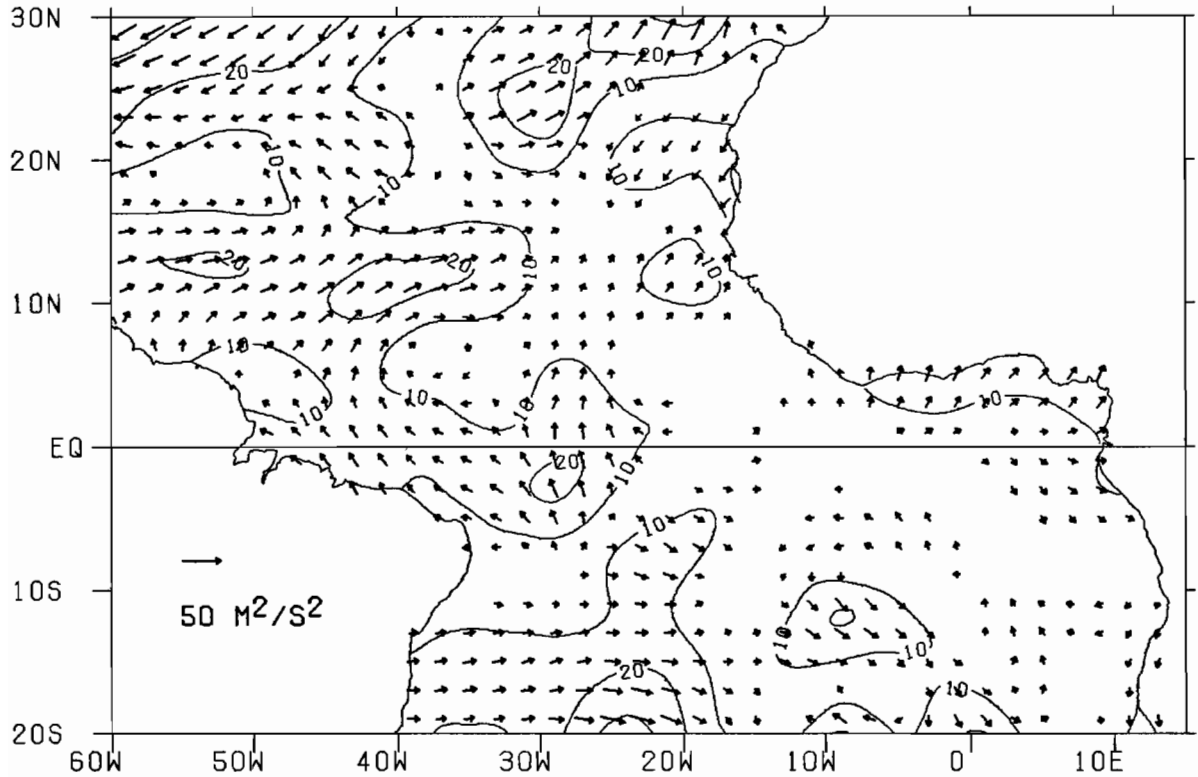
WIND STRESS

MAY 1987

MONTHLY MEAN



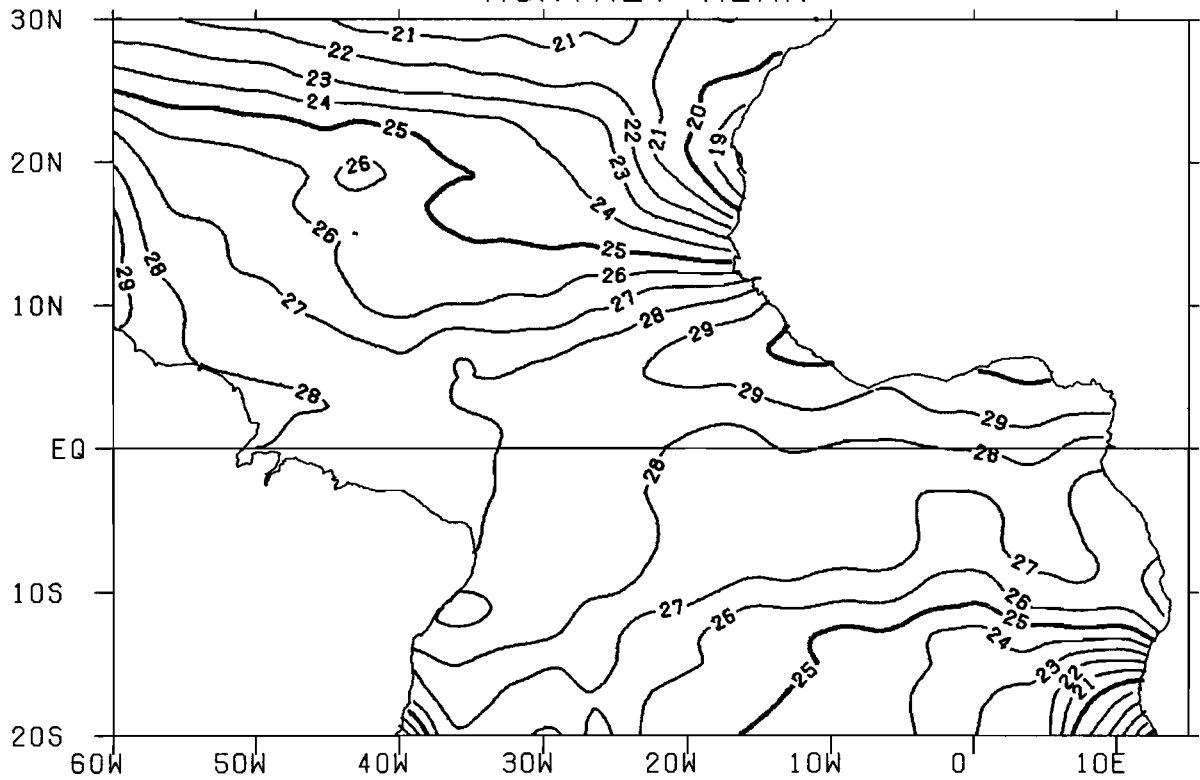
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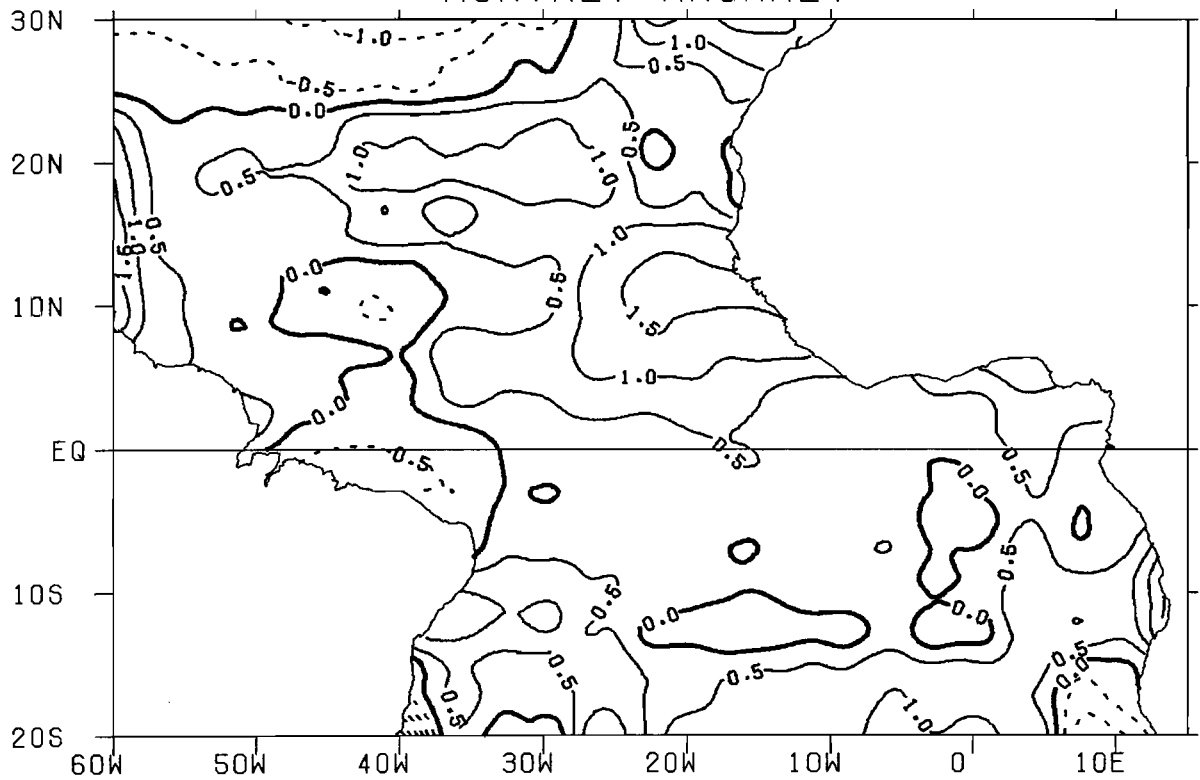
SEA SURFACE TEMPERATURE

MAY 1987

MONTHLY MEAN



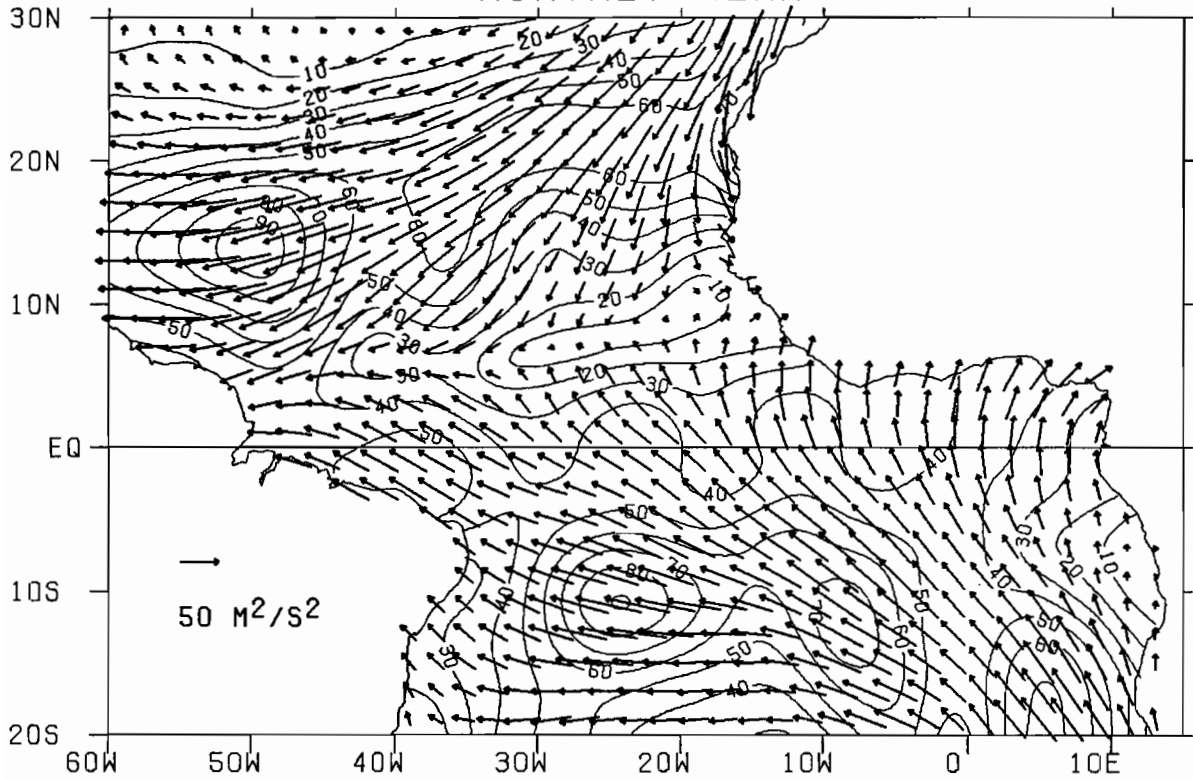
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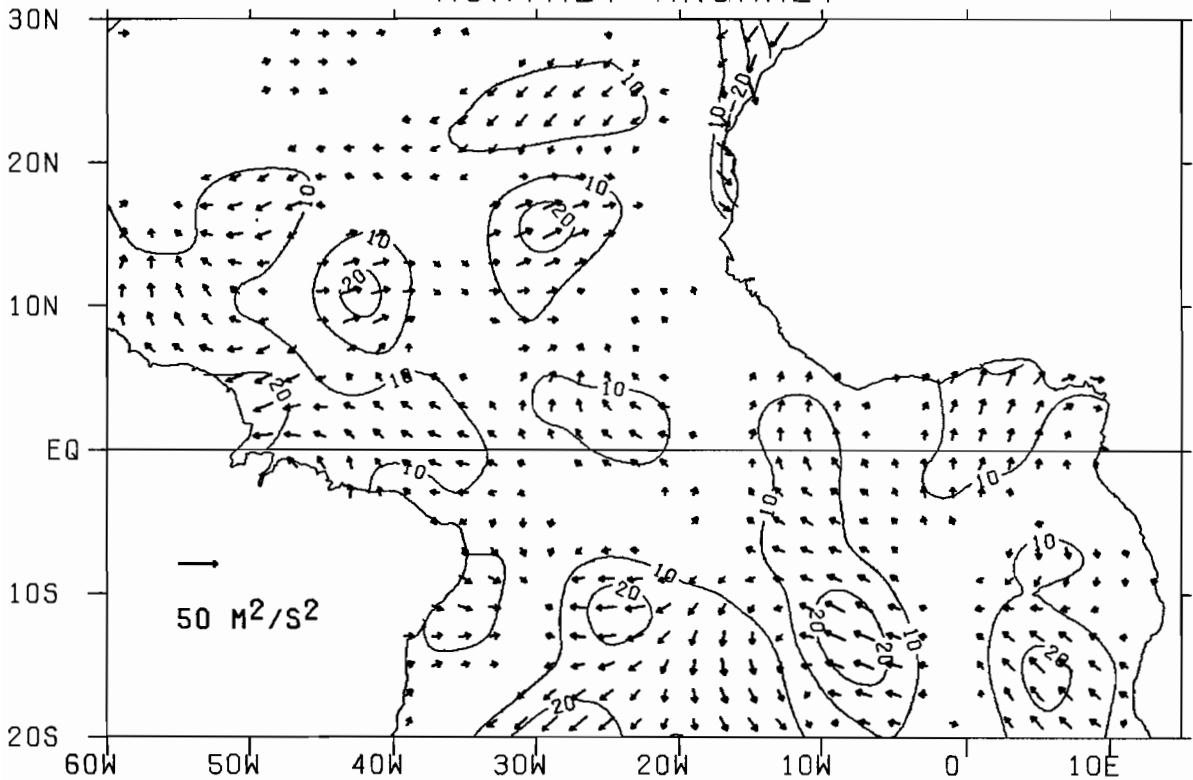
WIND STRESS

JUNE 1987

MONTHLY MEAN



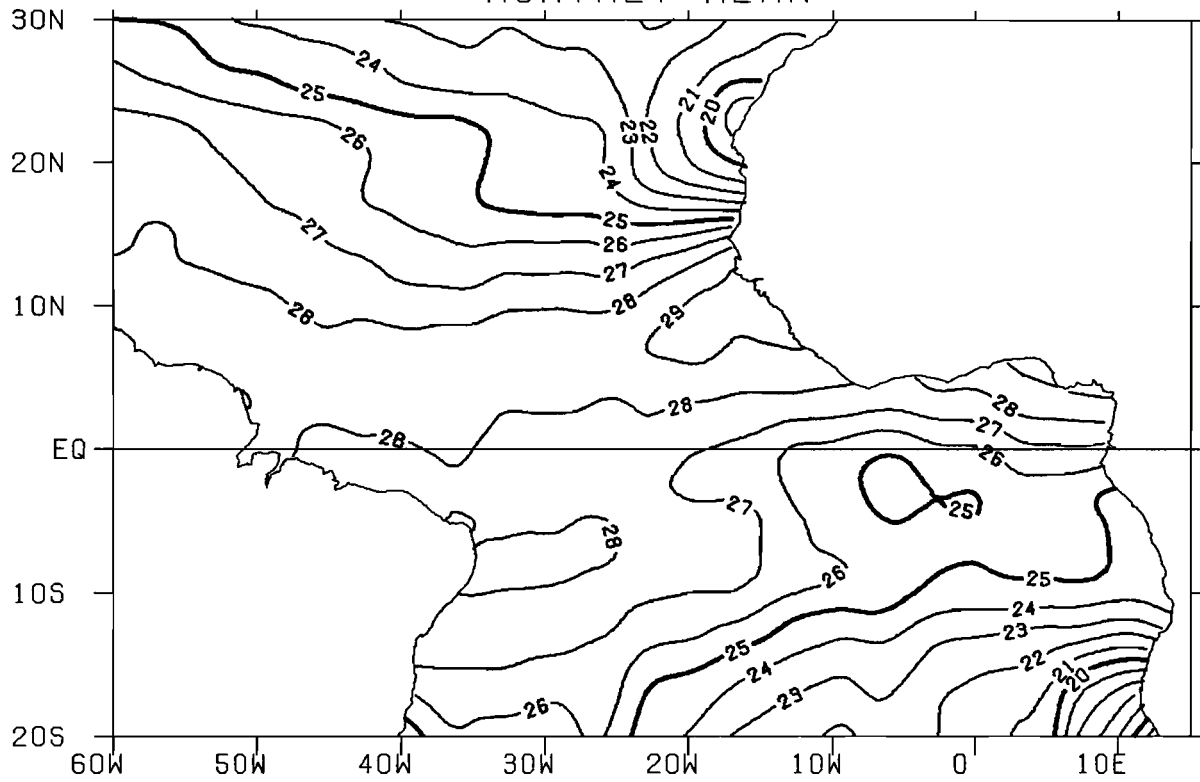
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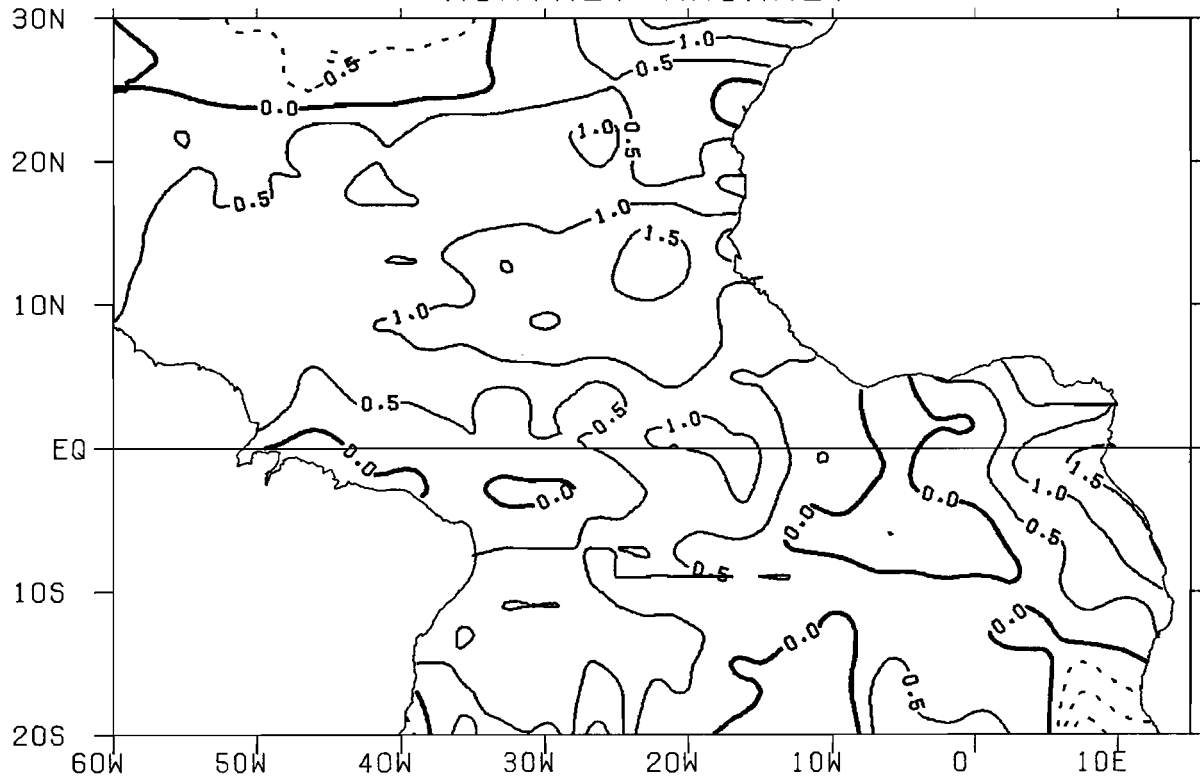
SEA SURFACE TEMPERATURE

JUNE 1987

MONTHLY MEAN



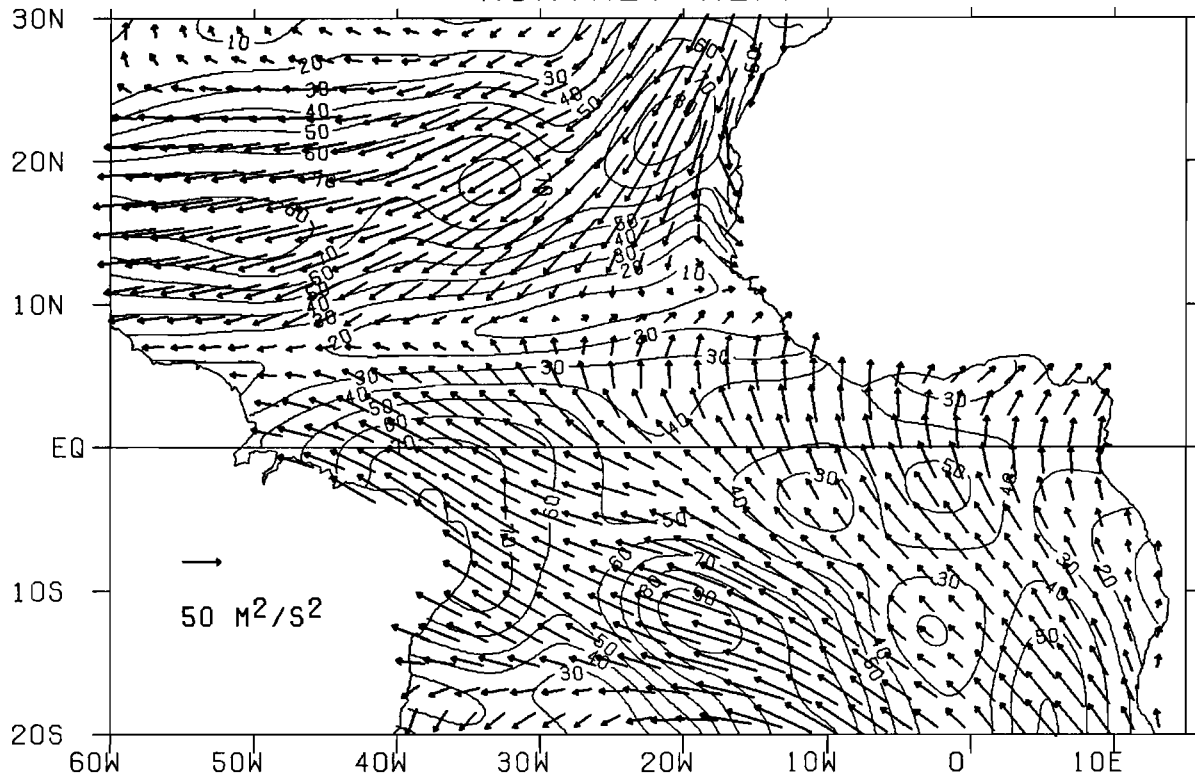
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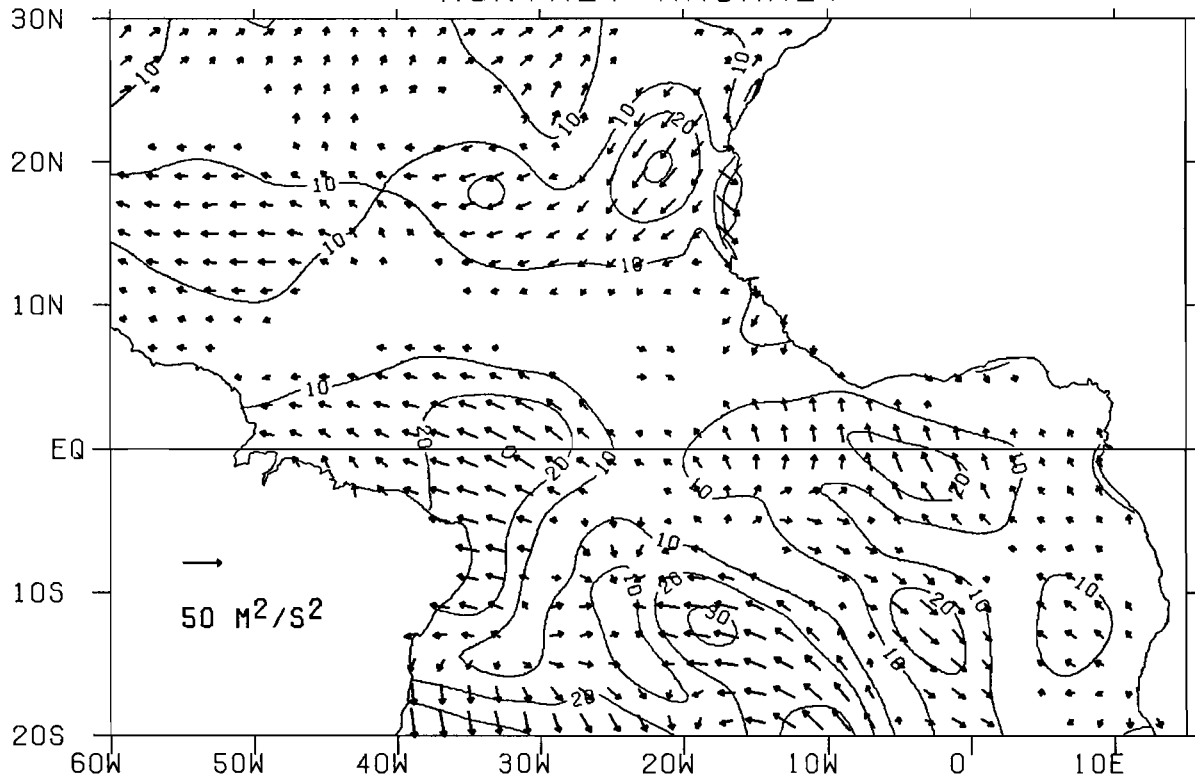
WIND STRESS

JULY 1987

MONTHLY MEAN



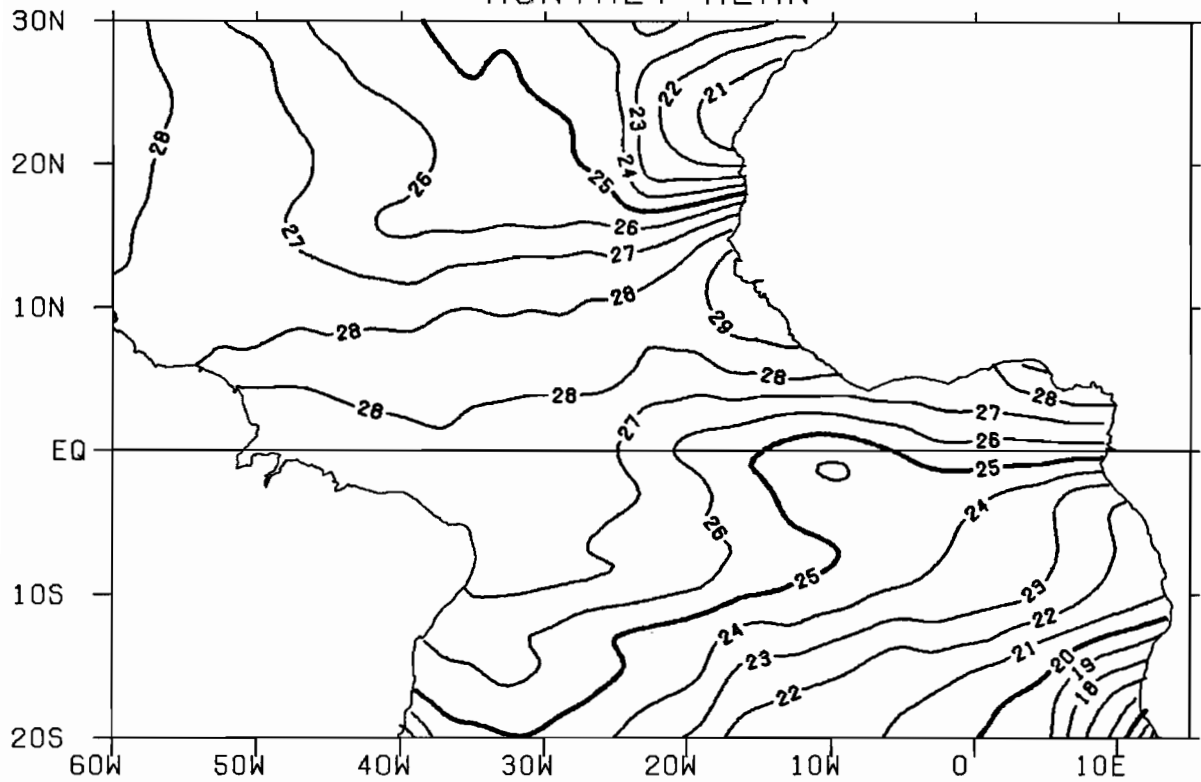
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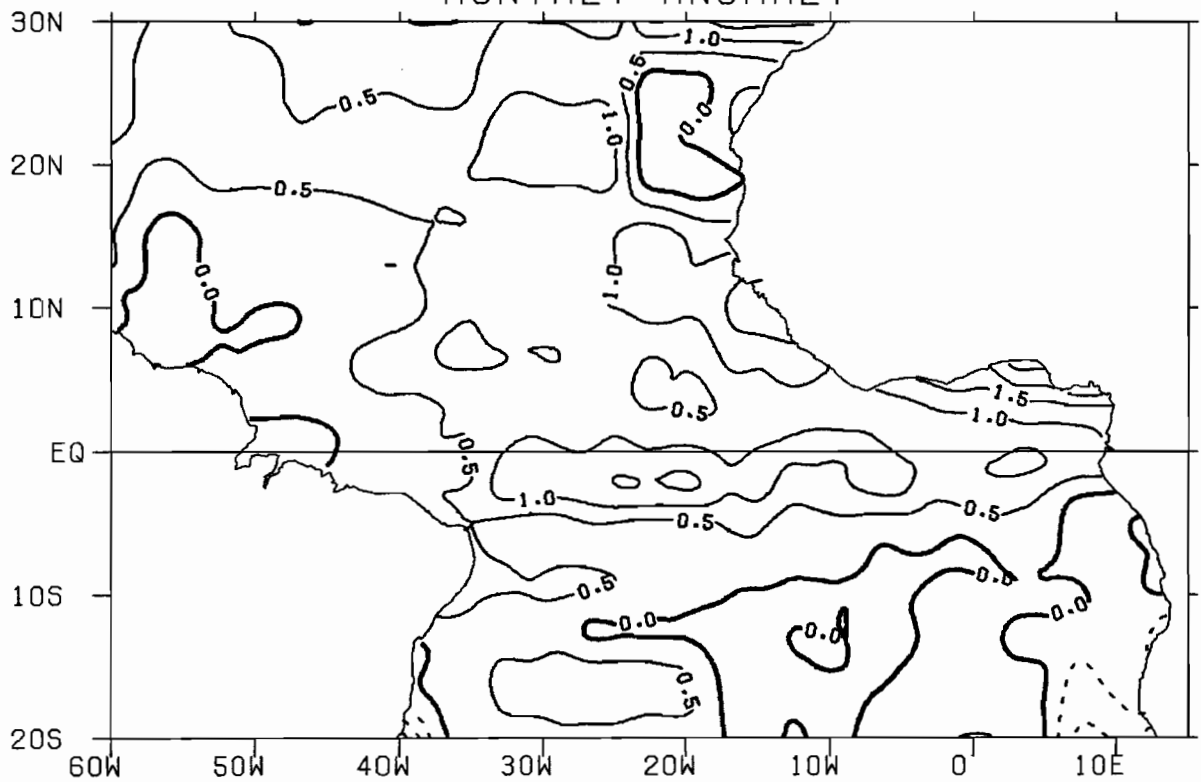
SEA SURFACE TEMPERATURE

JULY 1987

MONTHLY MEAN



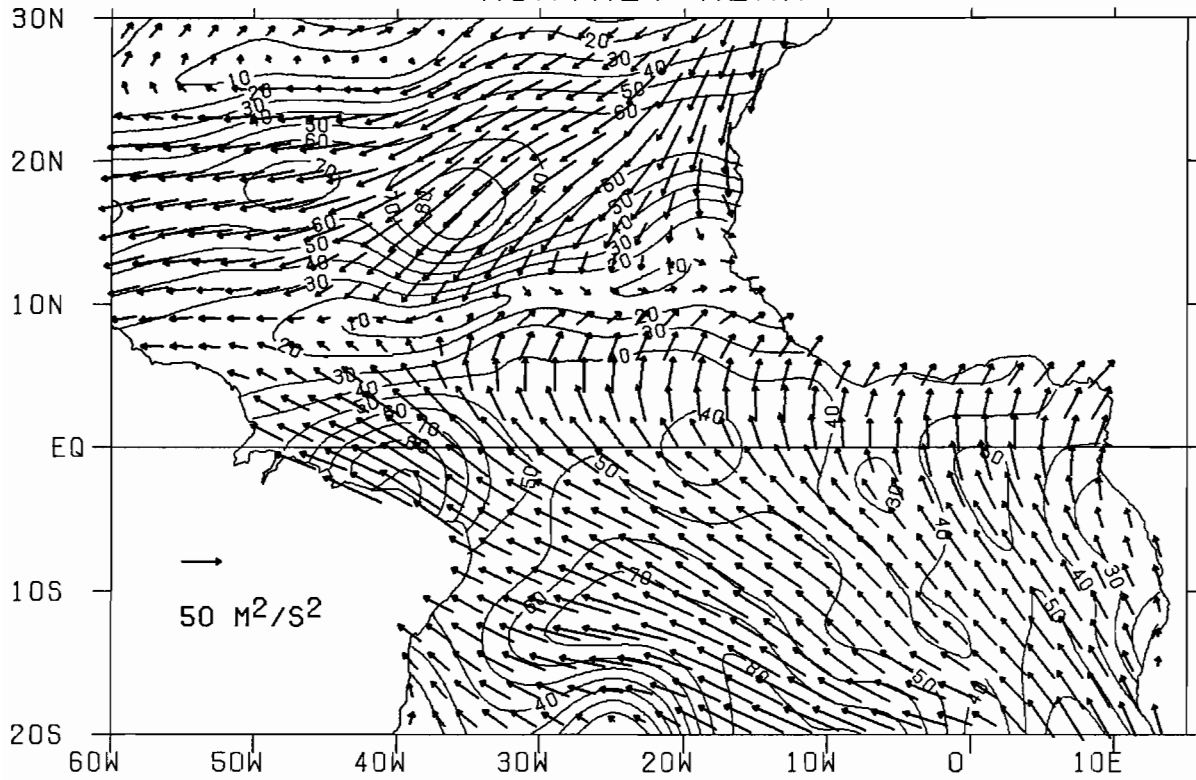
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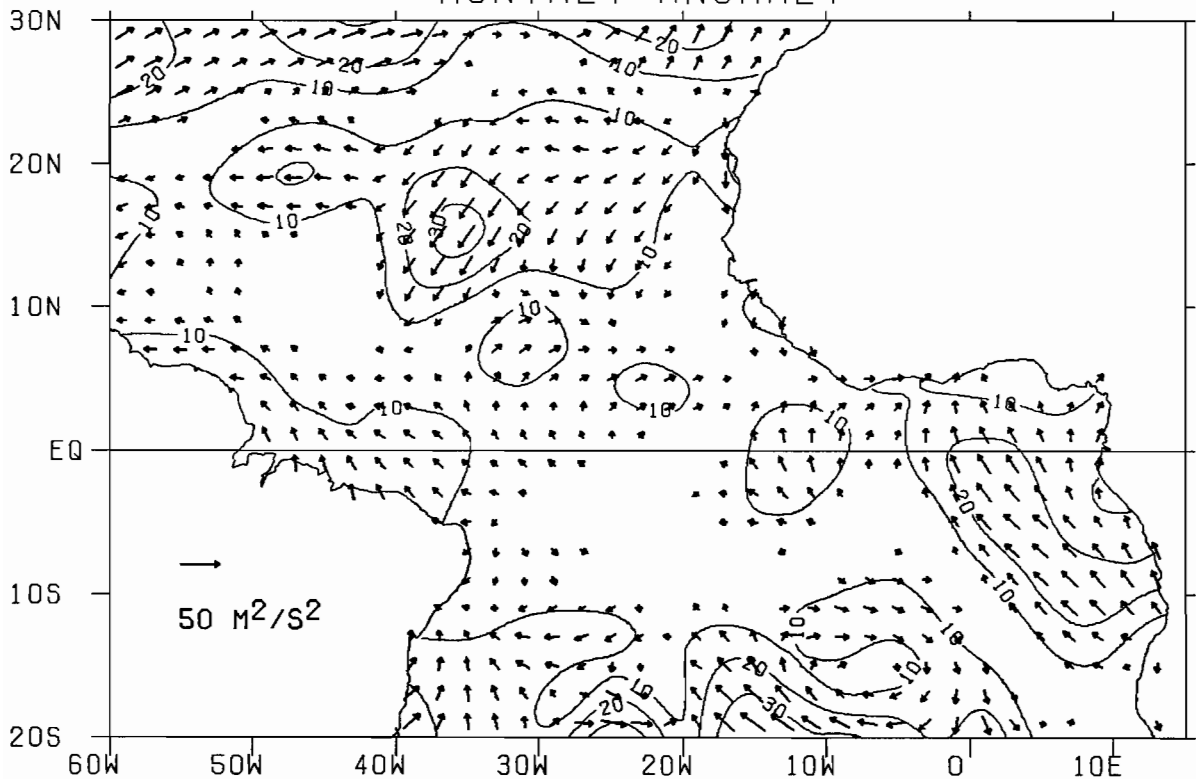
WIND STRESS

AUGUST 1987

MONTHLY MEAN



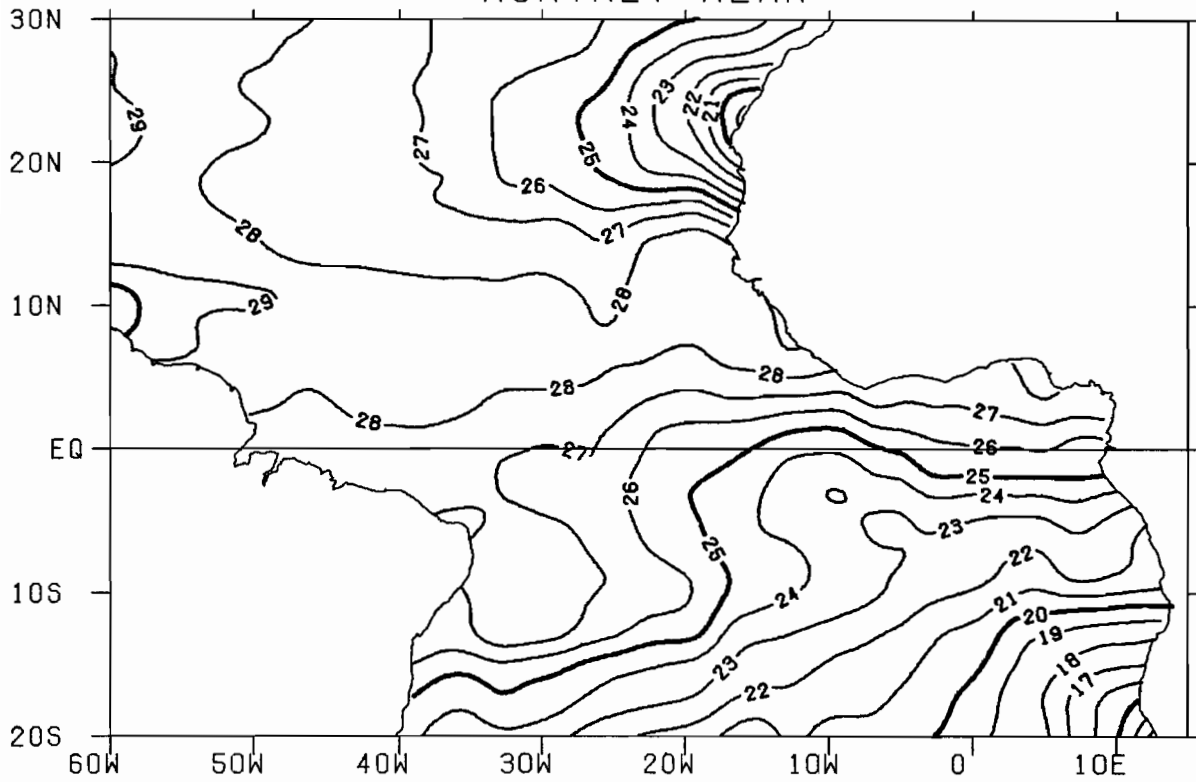
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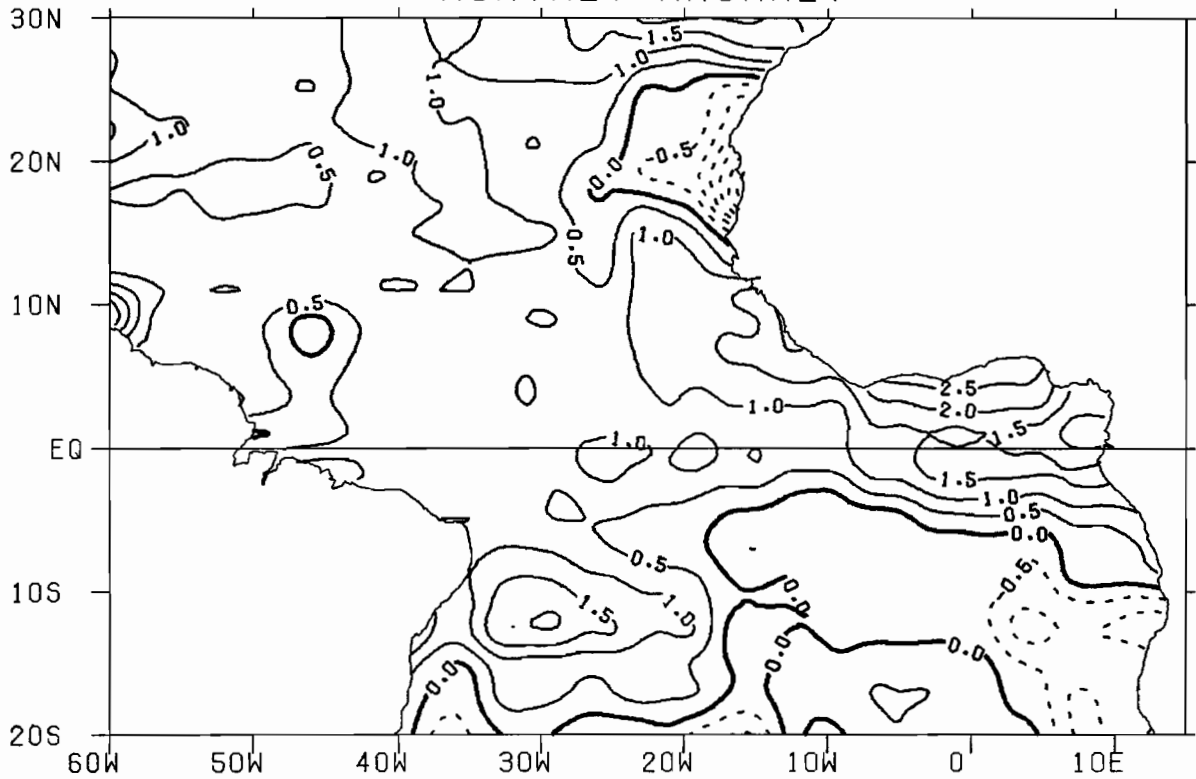
SEA SURFACE TEMPERATURE

AUGUST 1987

MONTHLY MEAN

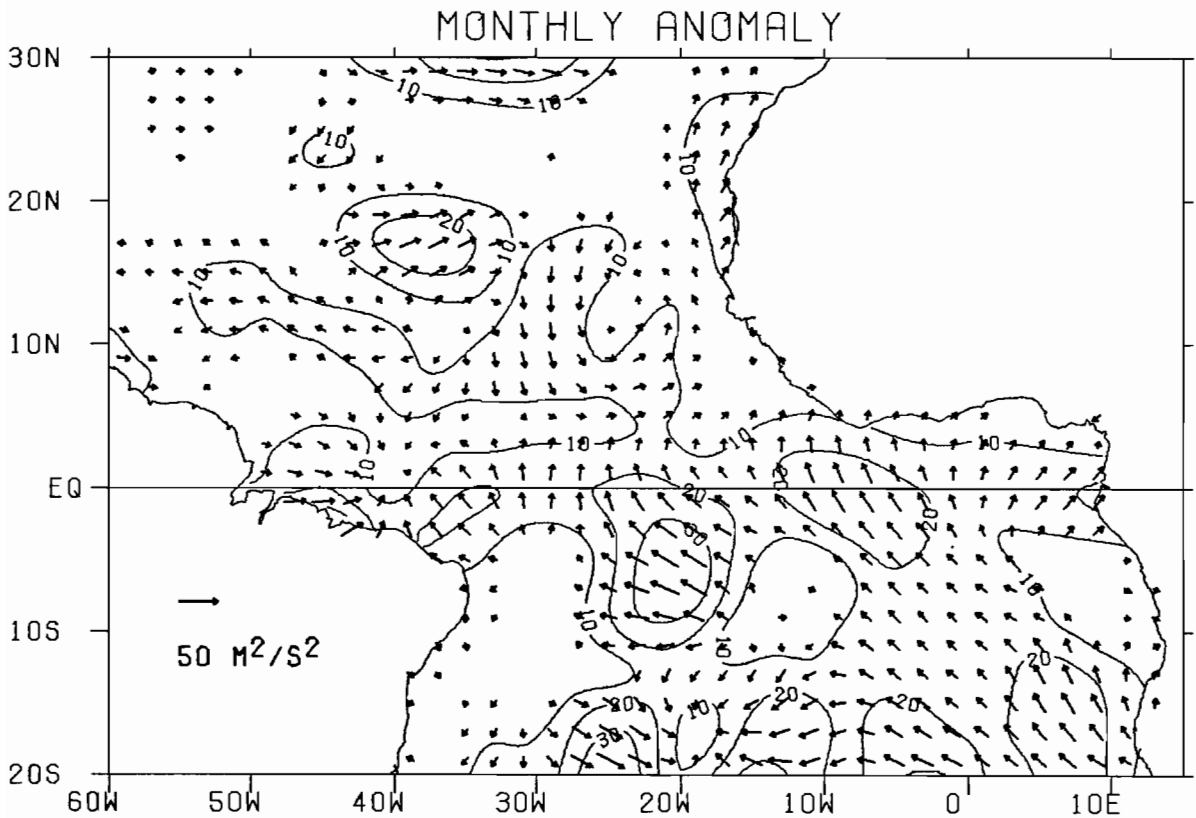
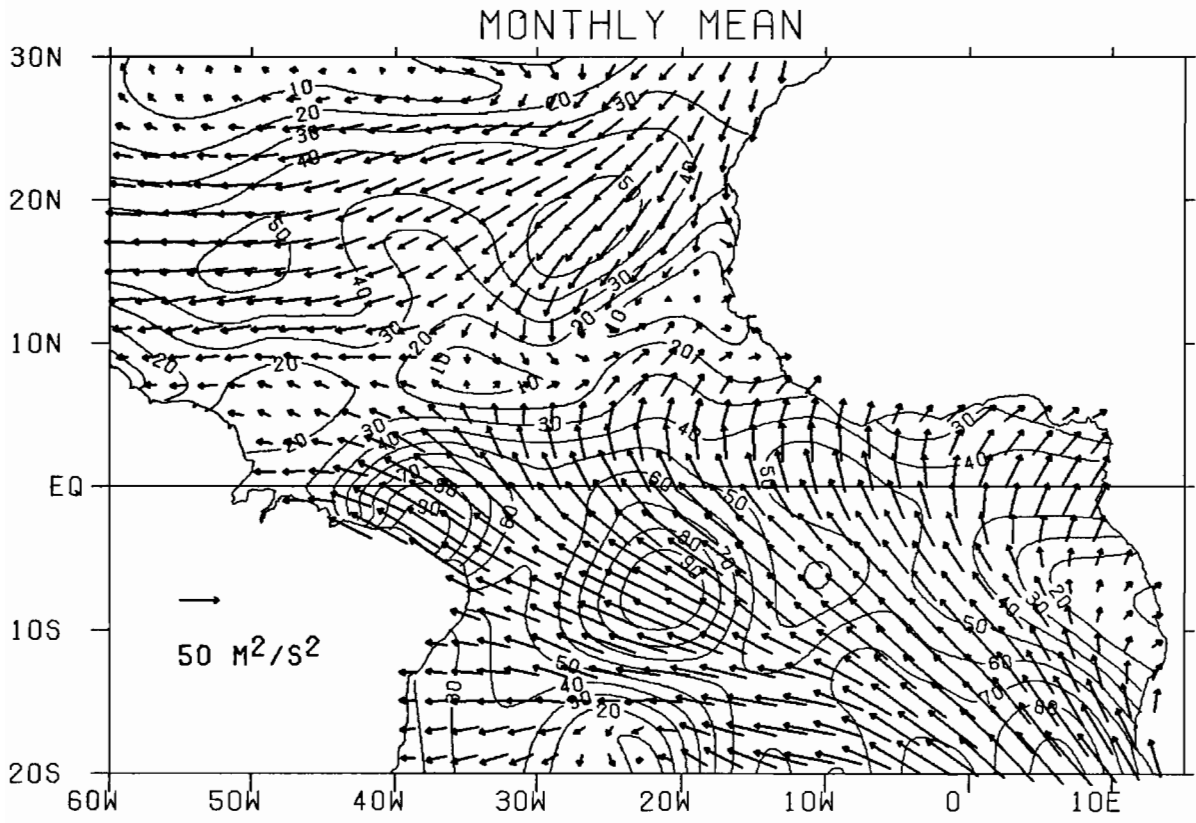


MONTHLY ANOMALY



WIND STRESS

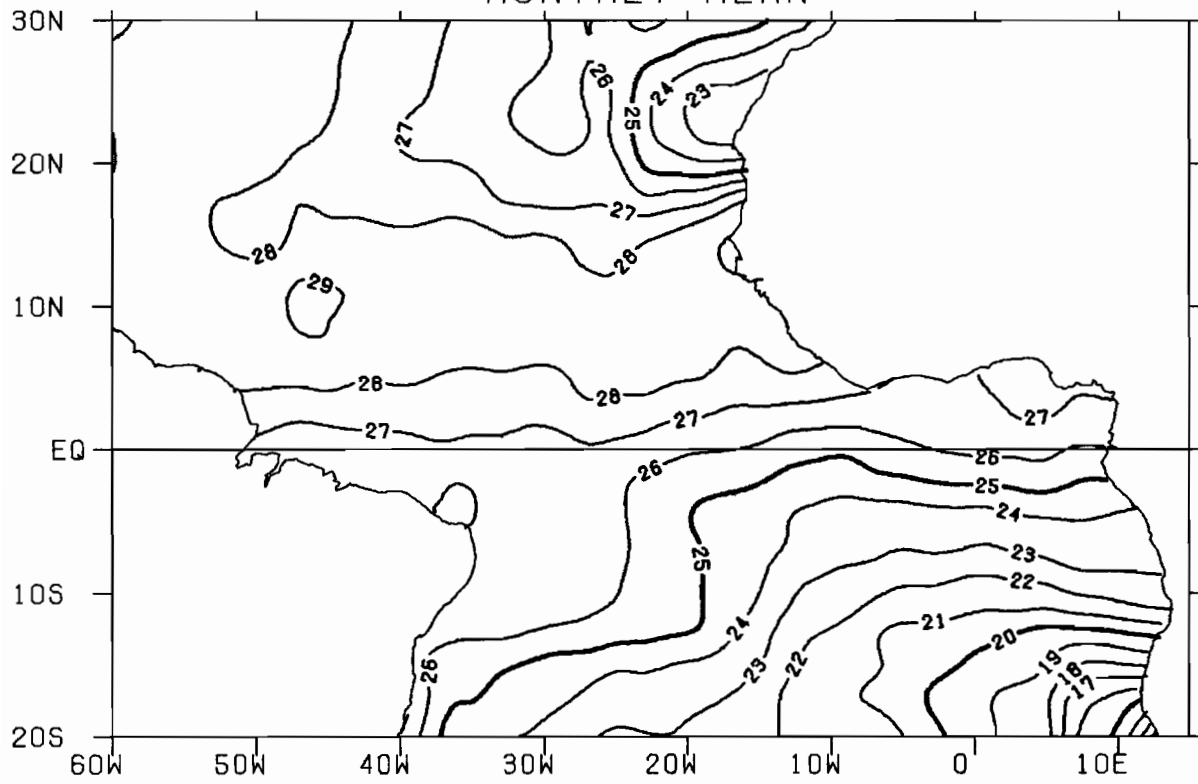
SEPTEMBER 1987



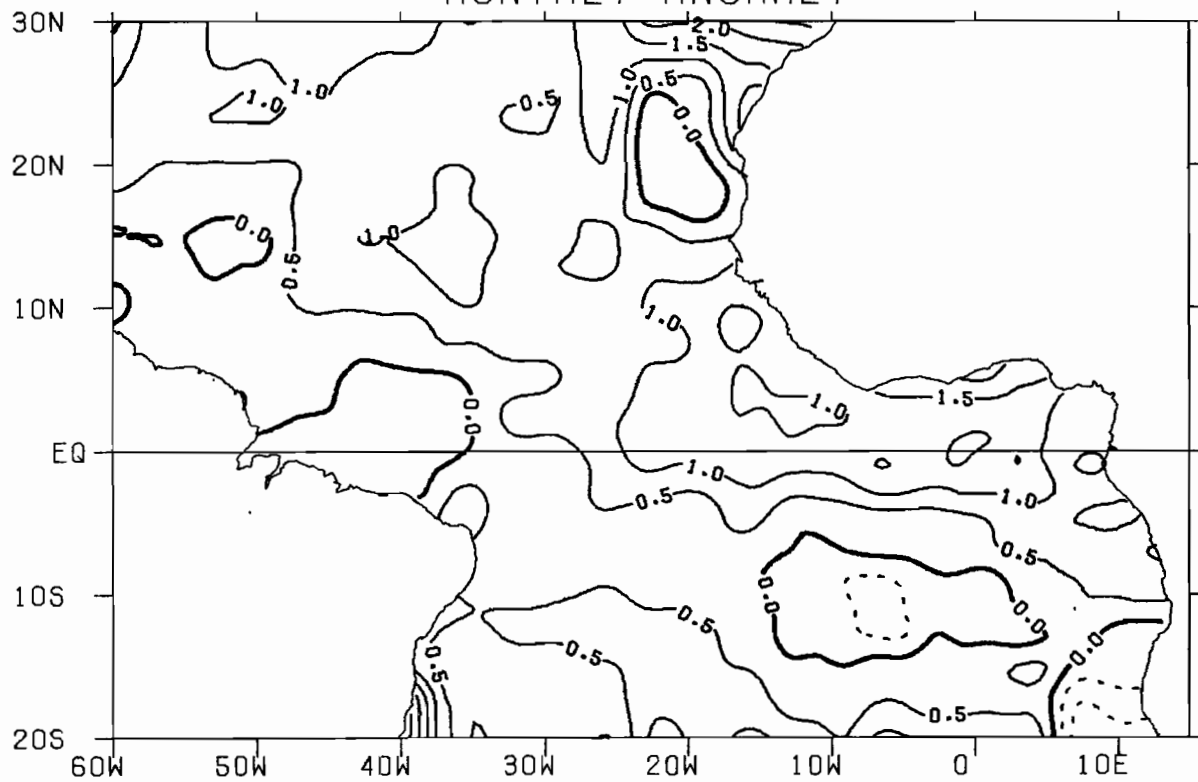
SEA SURFACE TEMPERATURE

SEPTEMBER 1987

MONTHLY MEAN



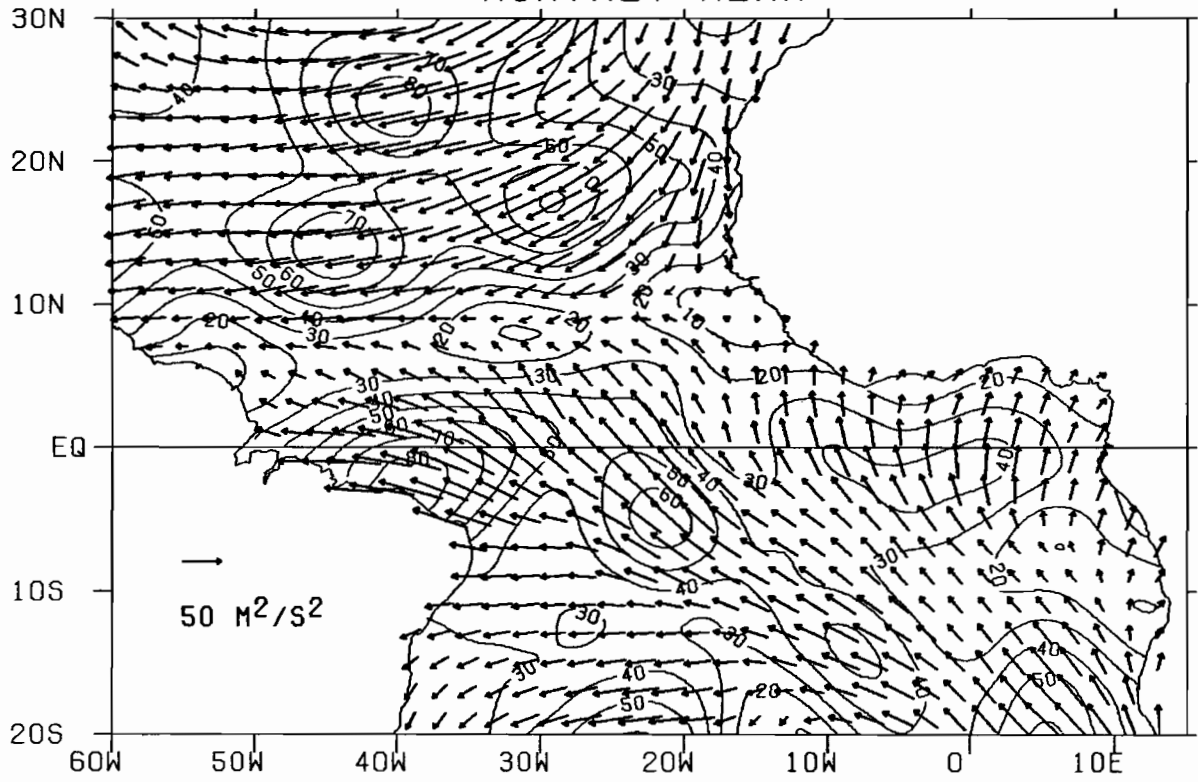
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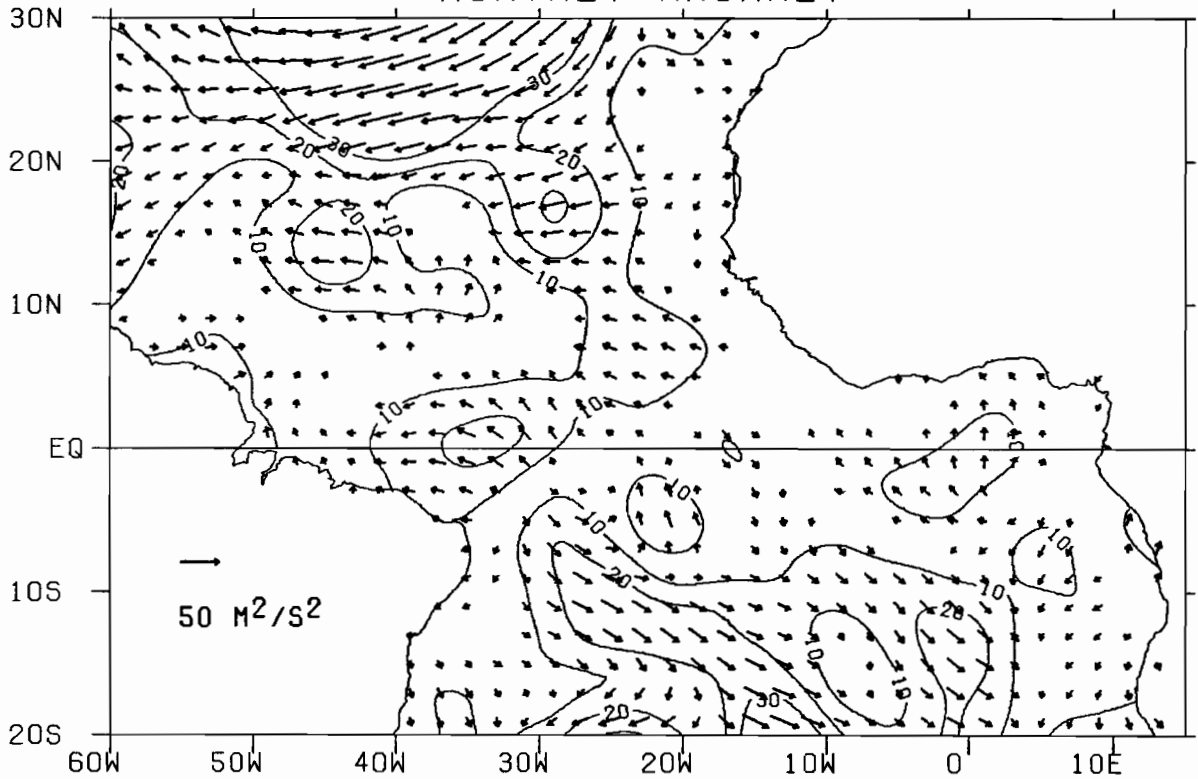
WIND STRESS

OCTOBER 1987

MONTHLY MEAN



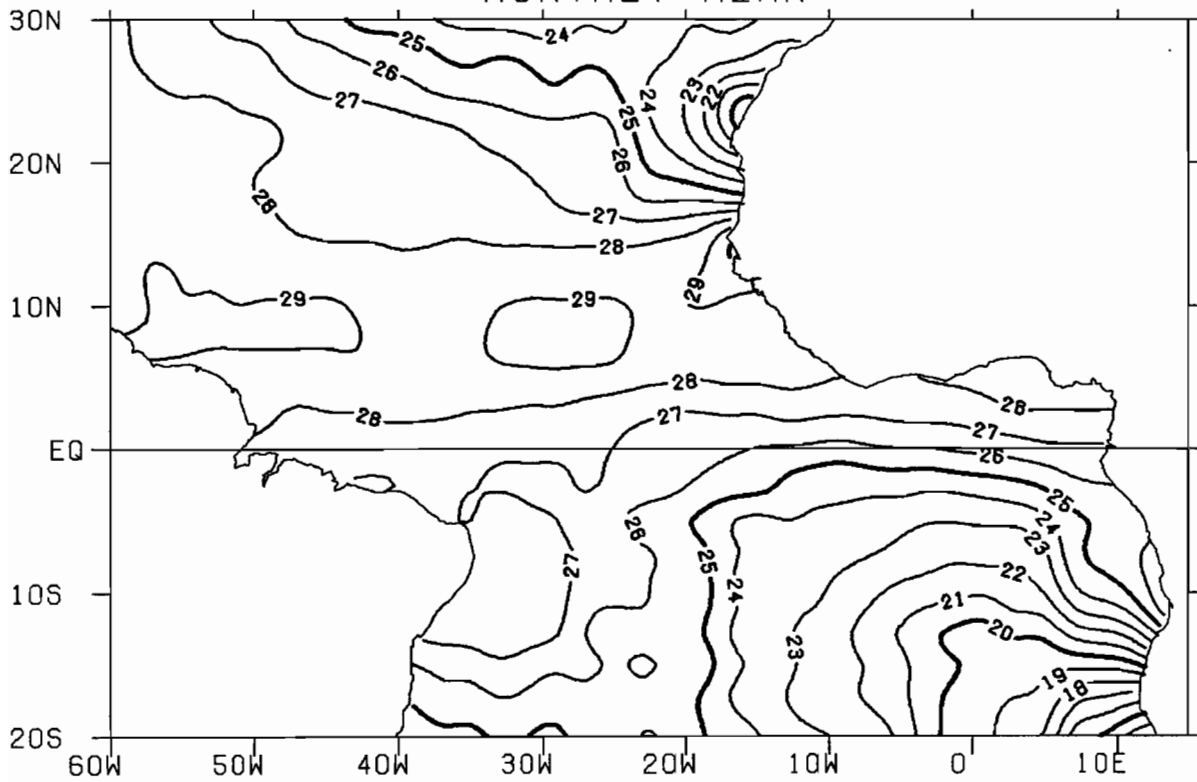
MONTHLY ANOMALY



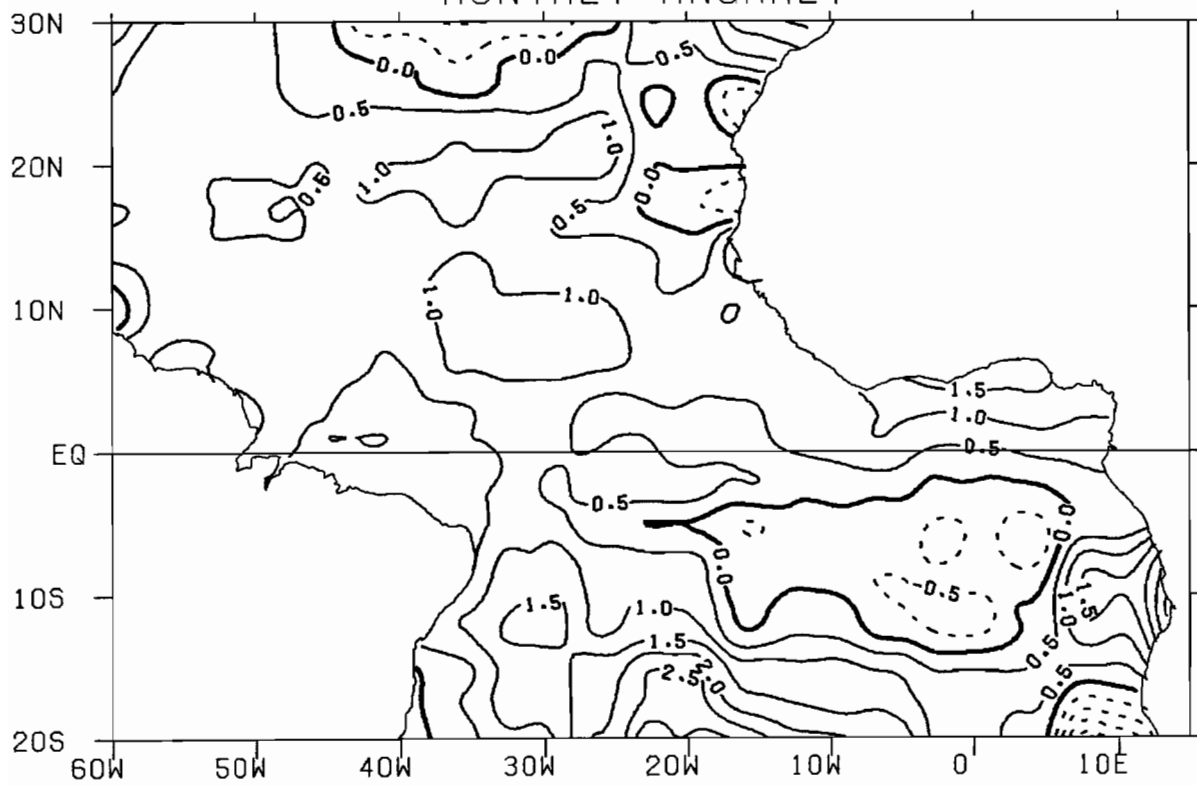
SEA SURFACE TEMPERATURE

OCTOBER 1987

MONTHLY MEAN

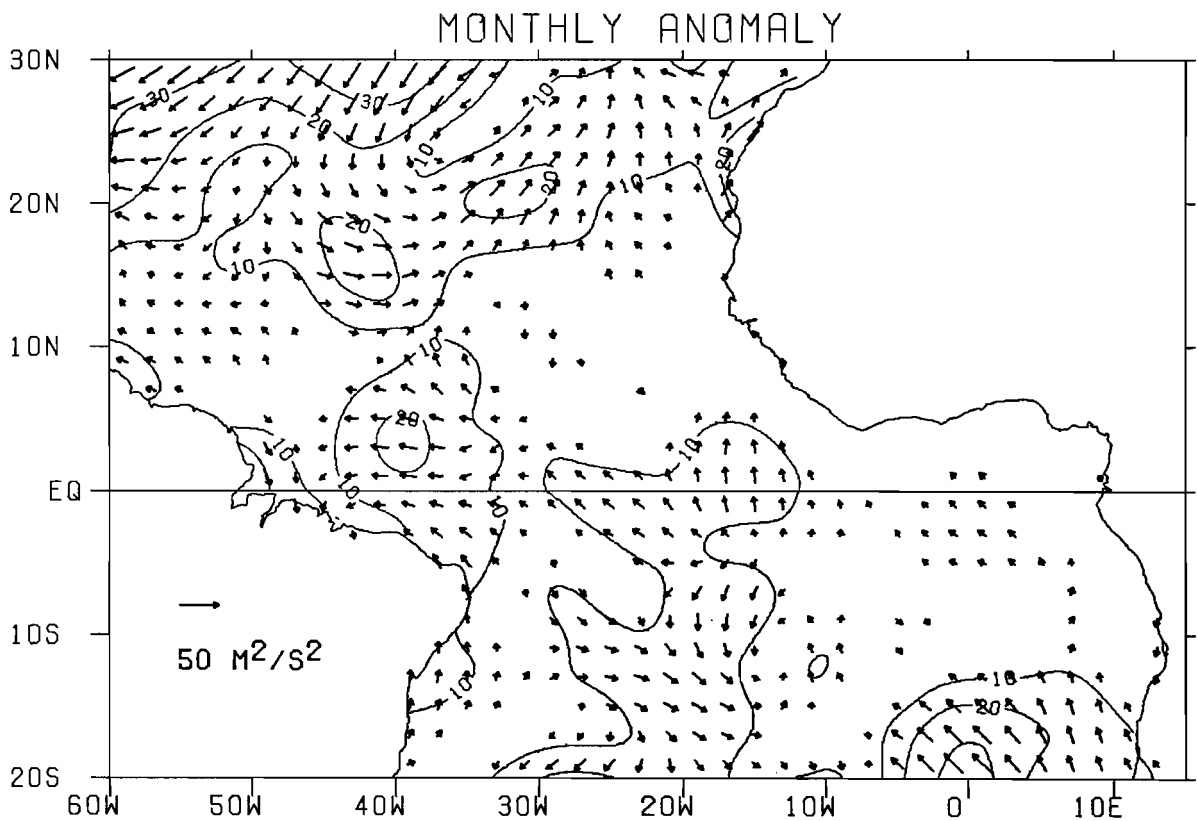
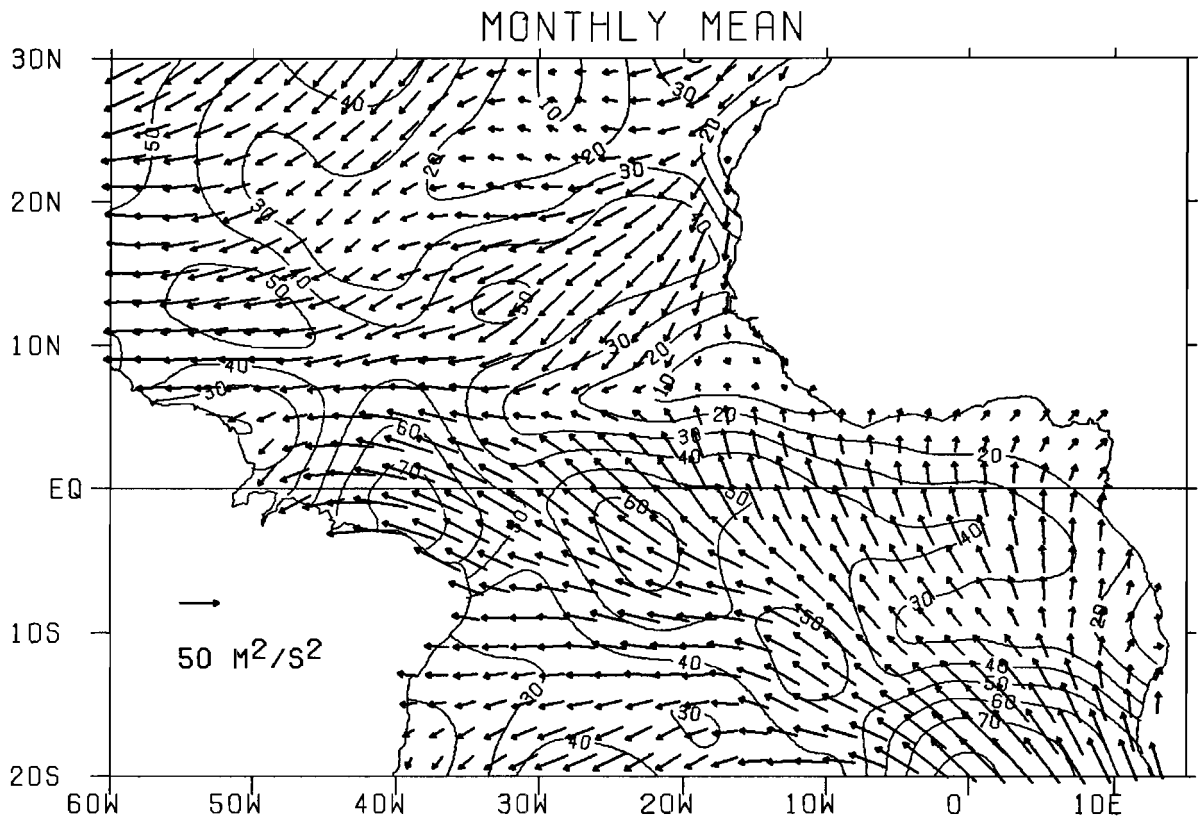


MONTHLY ANOMALY



WIND STRESS

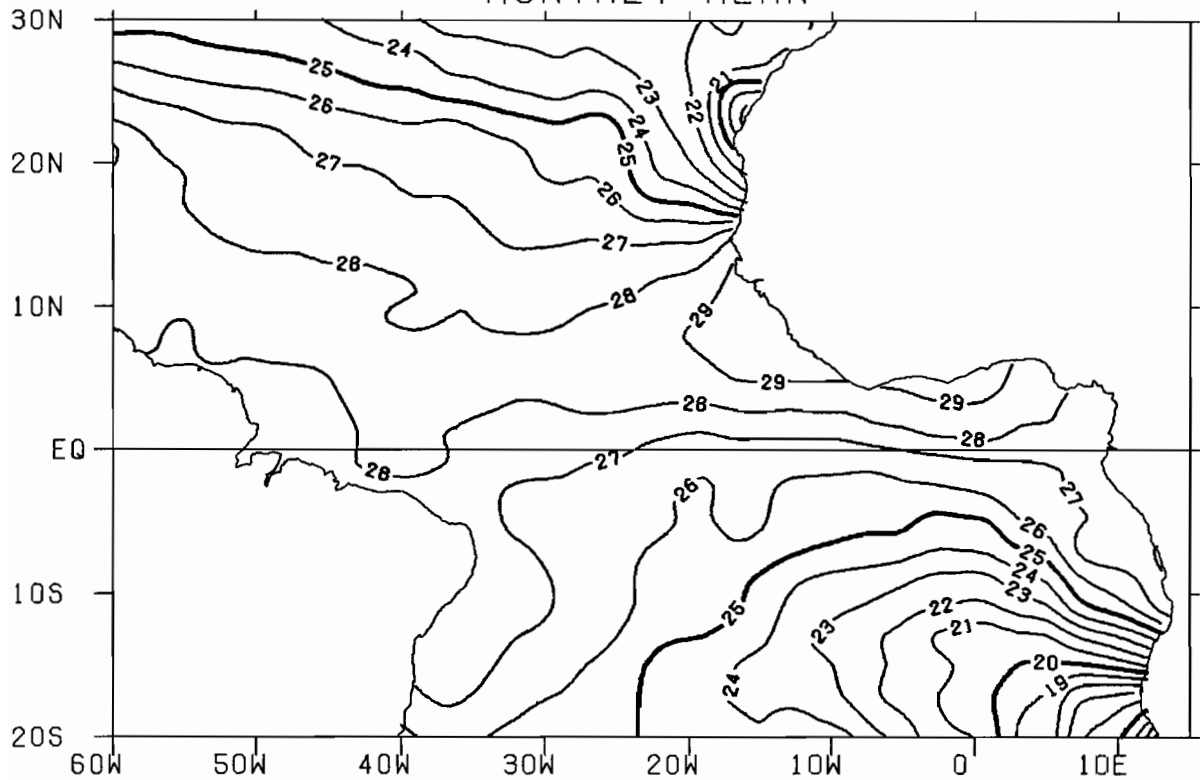
NOVEMBER 1987



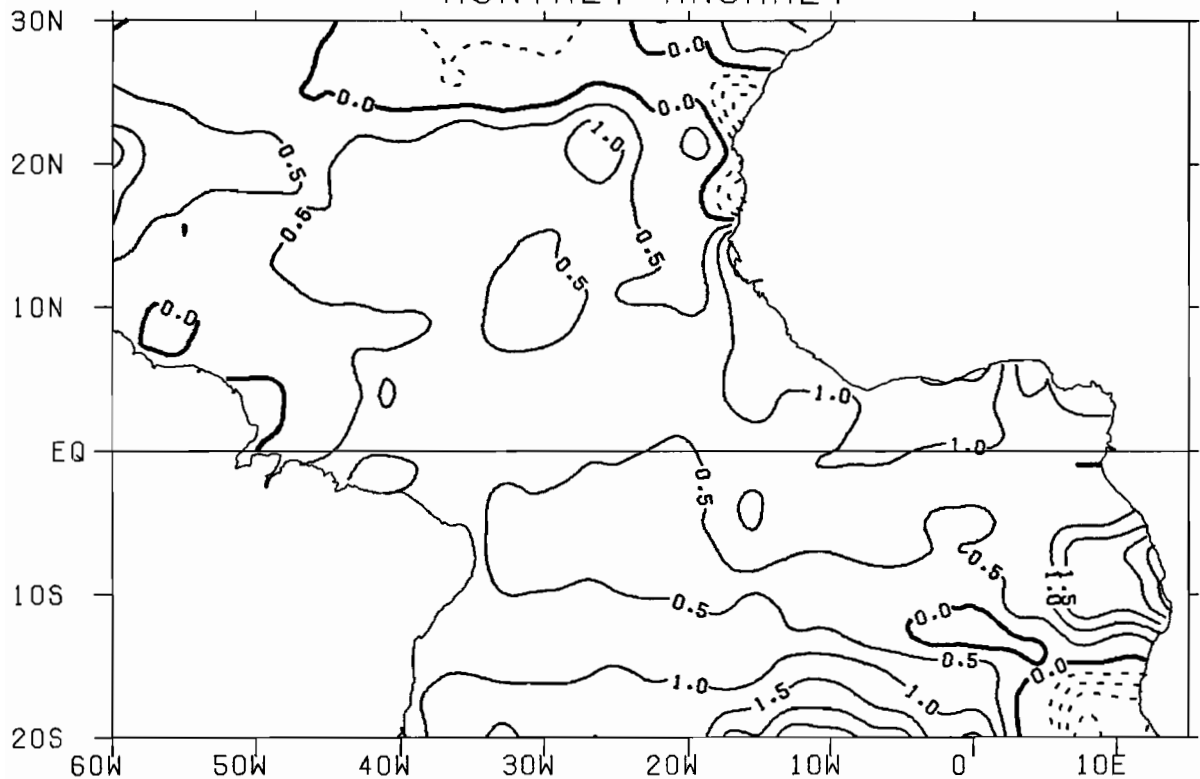
SEA SURFACE TEMPERATURE

NOVEMBER 1987

MONTHLY MEAN

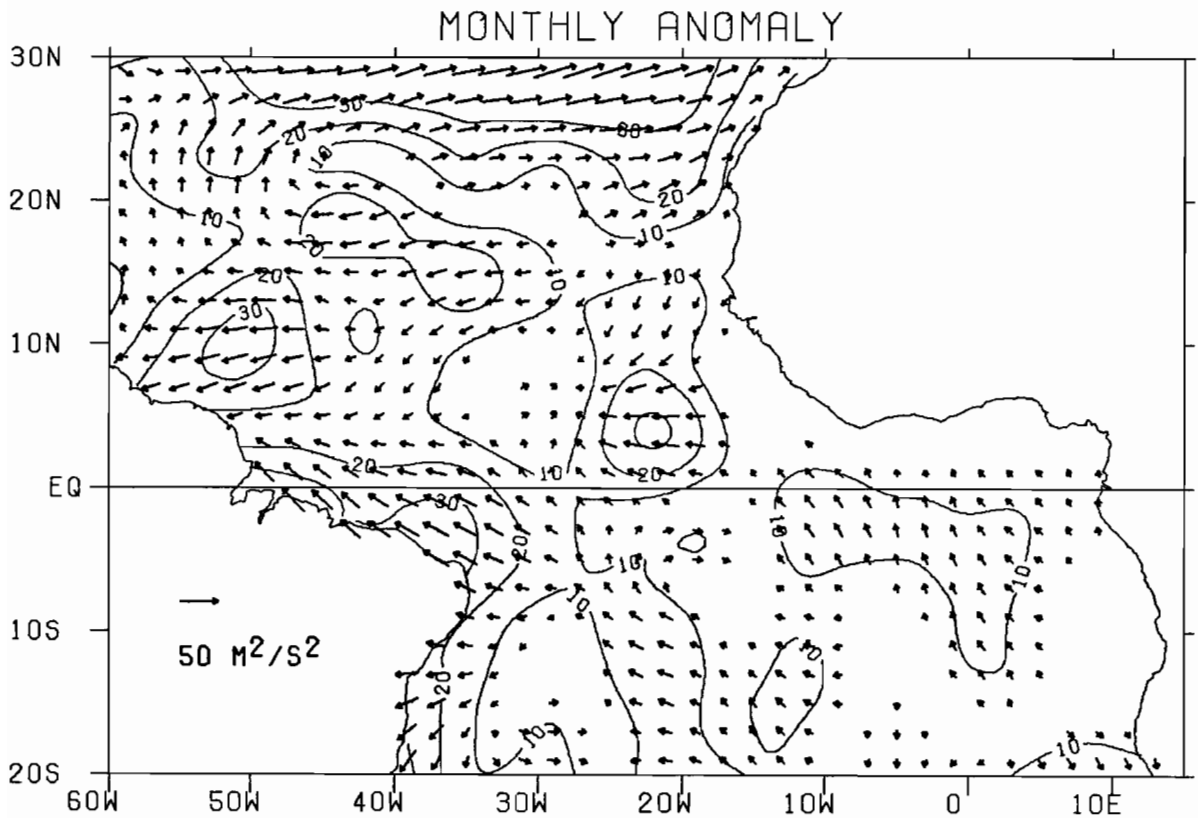
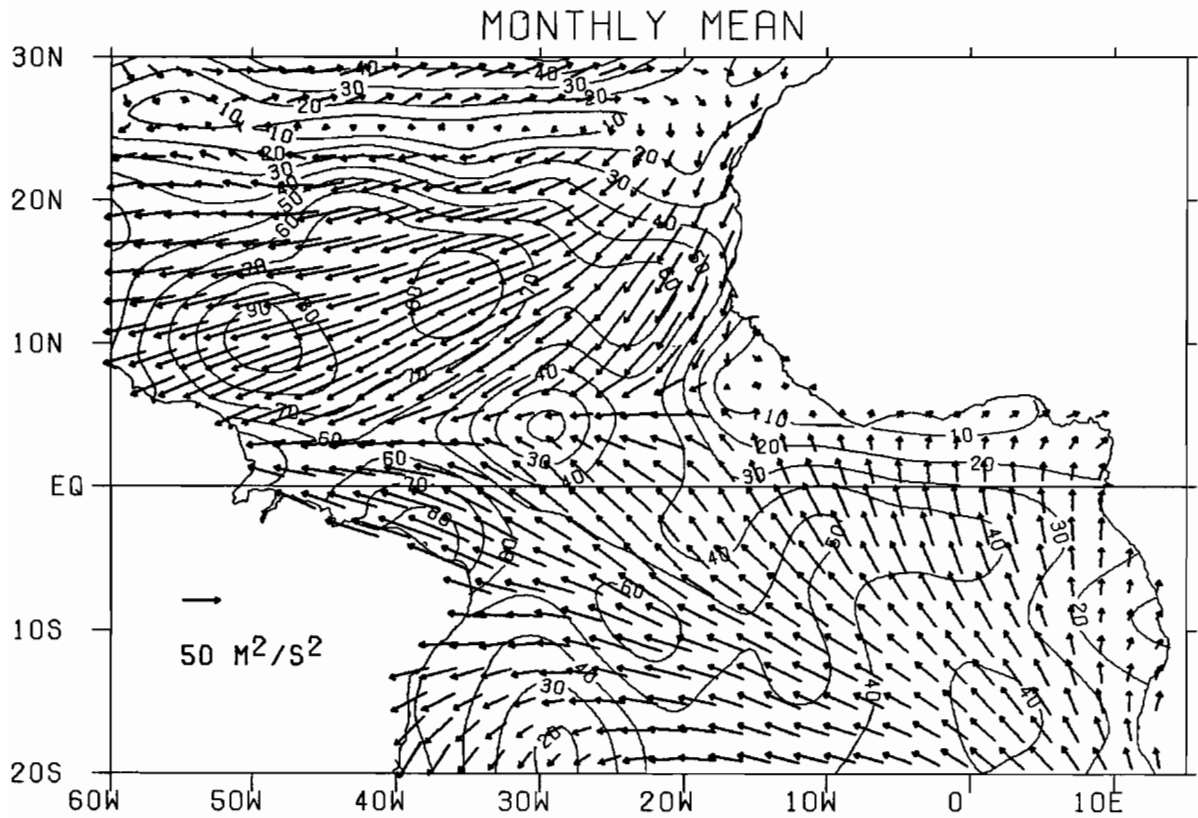


MONTHLY ANOMALY



WIND STRESS

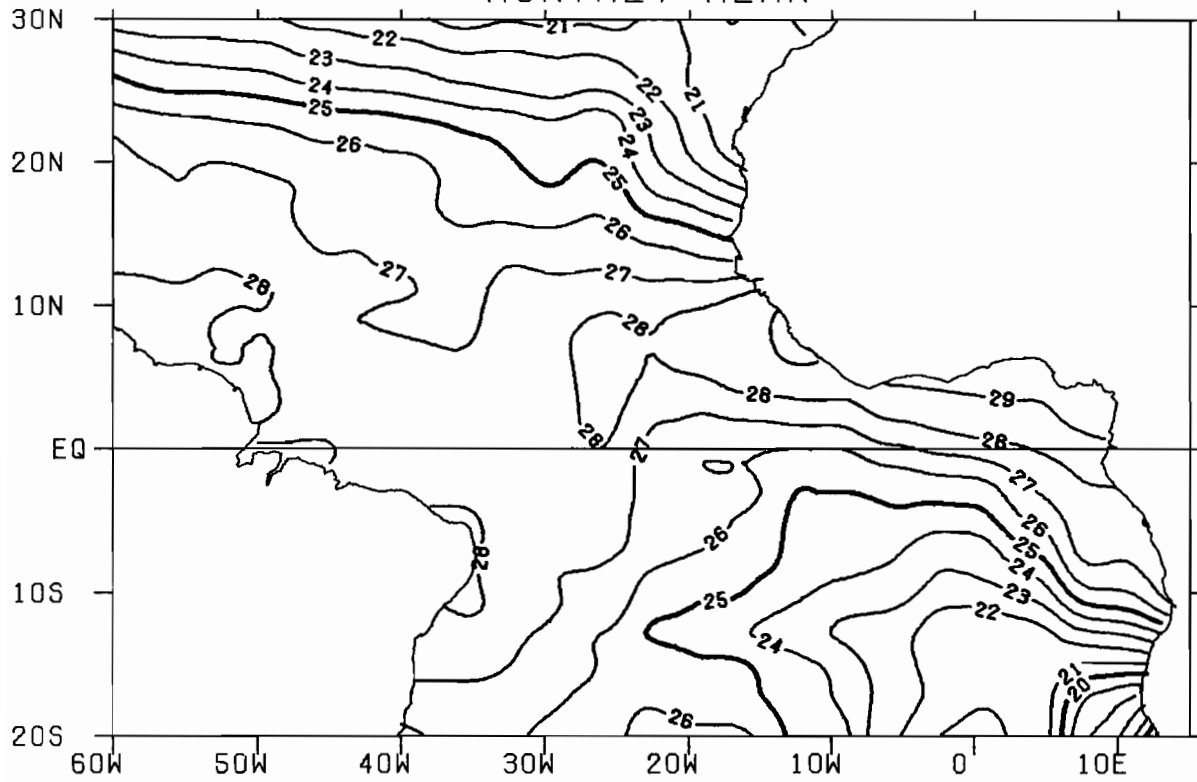
DECEMBER 1987



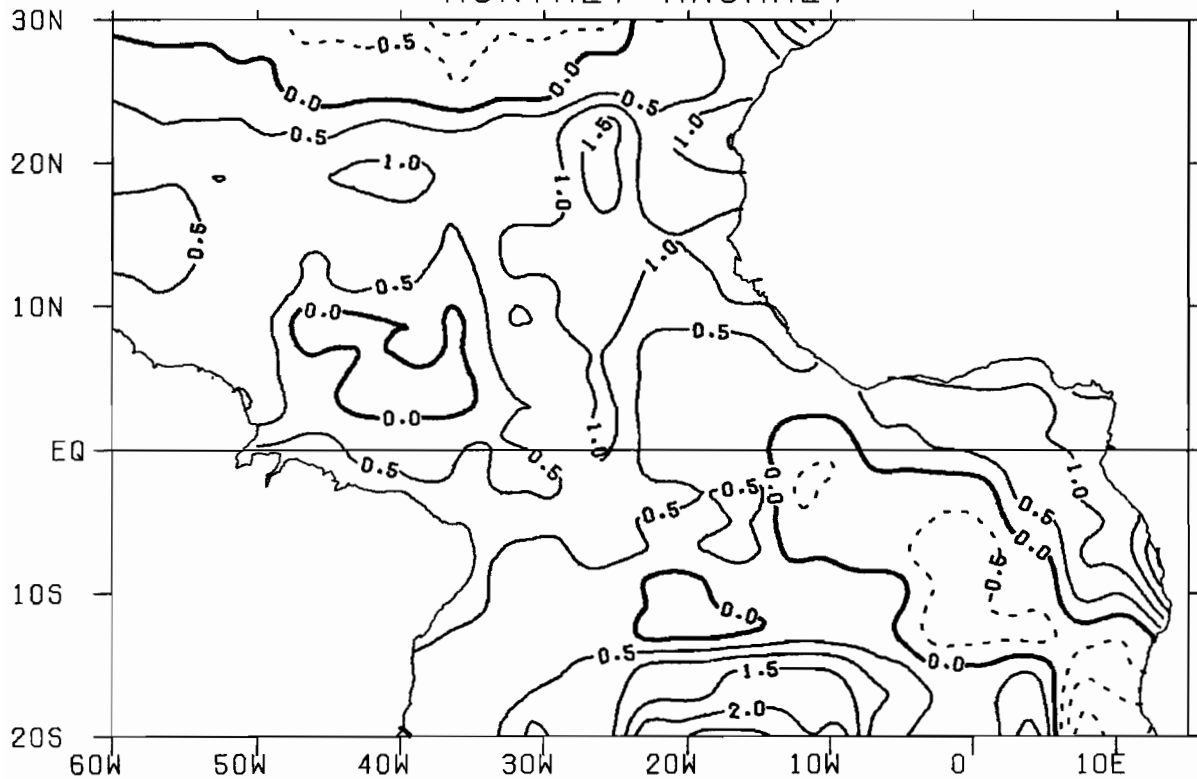
SEA SURFACE TEMPERATURE

DECEMBER 1987

MONTHLY MEAN

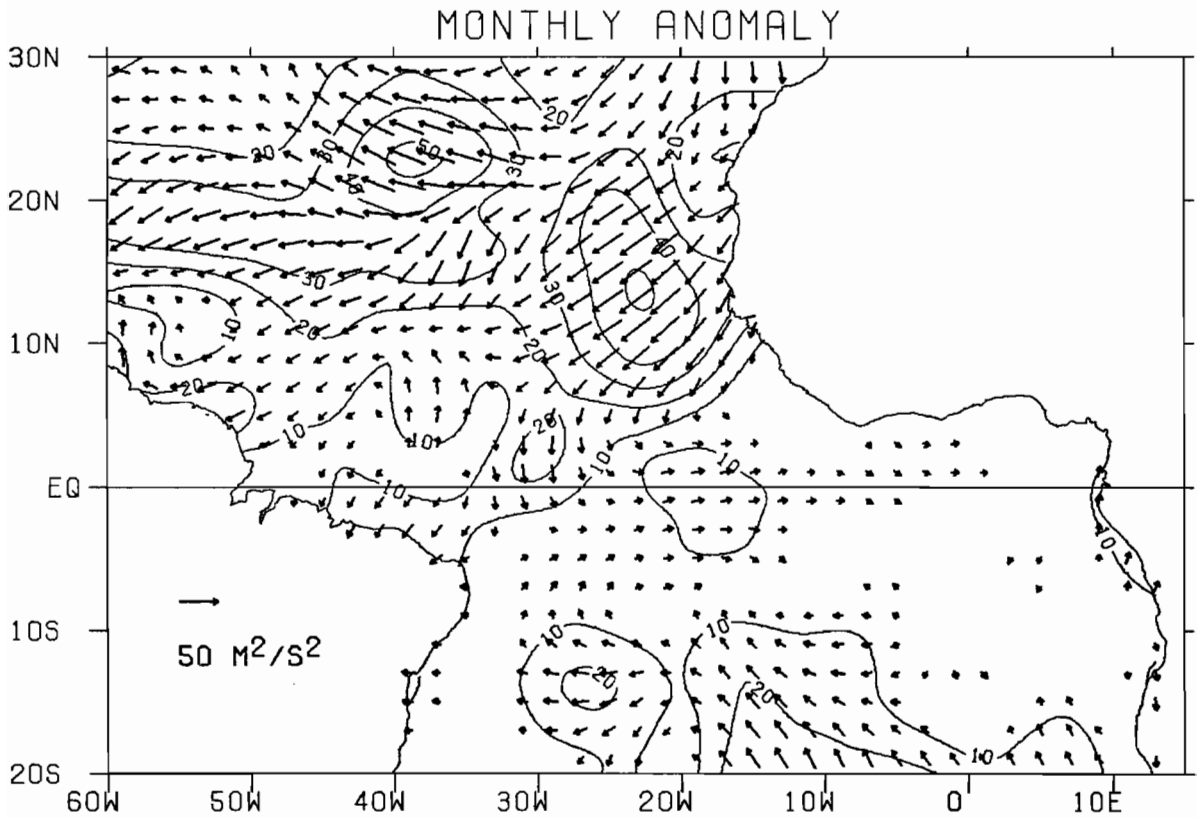
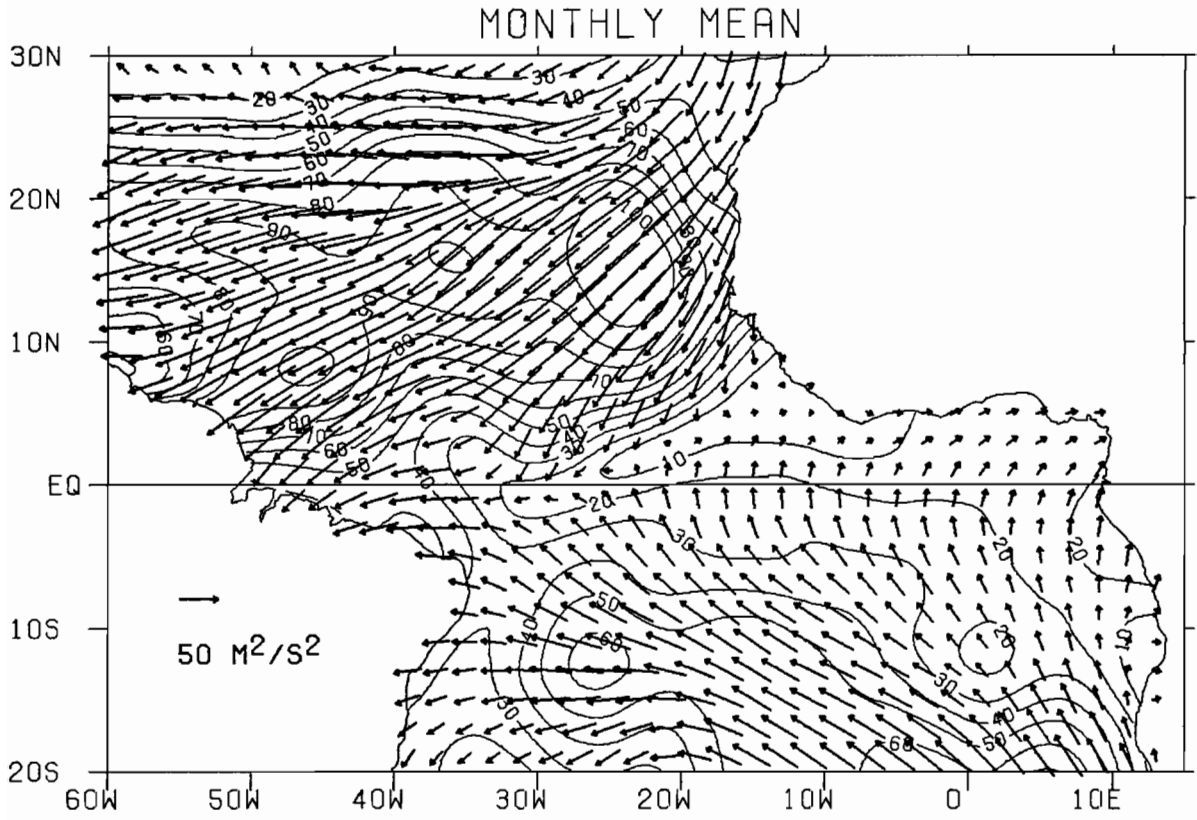


MONTHLY ANOMALY



WIND STRESS

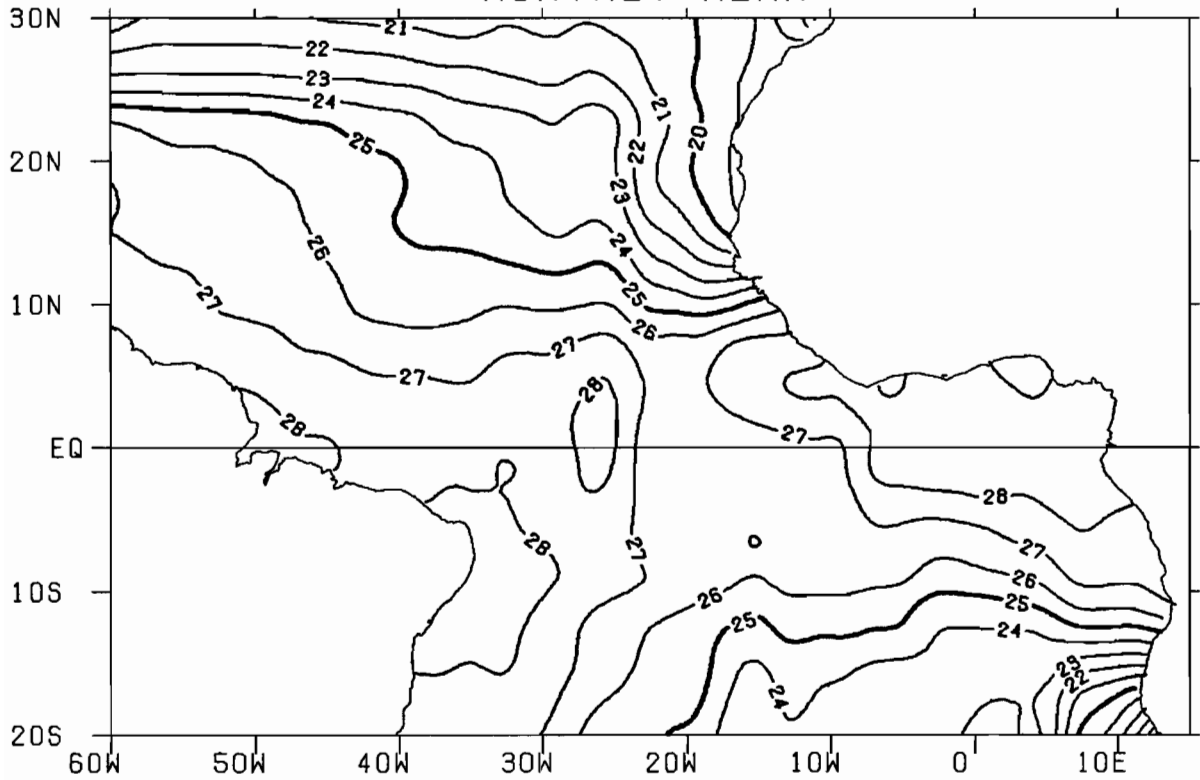
JANUARY 1988



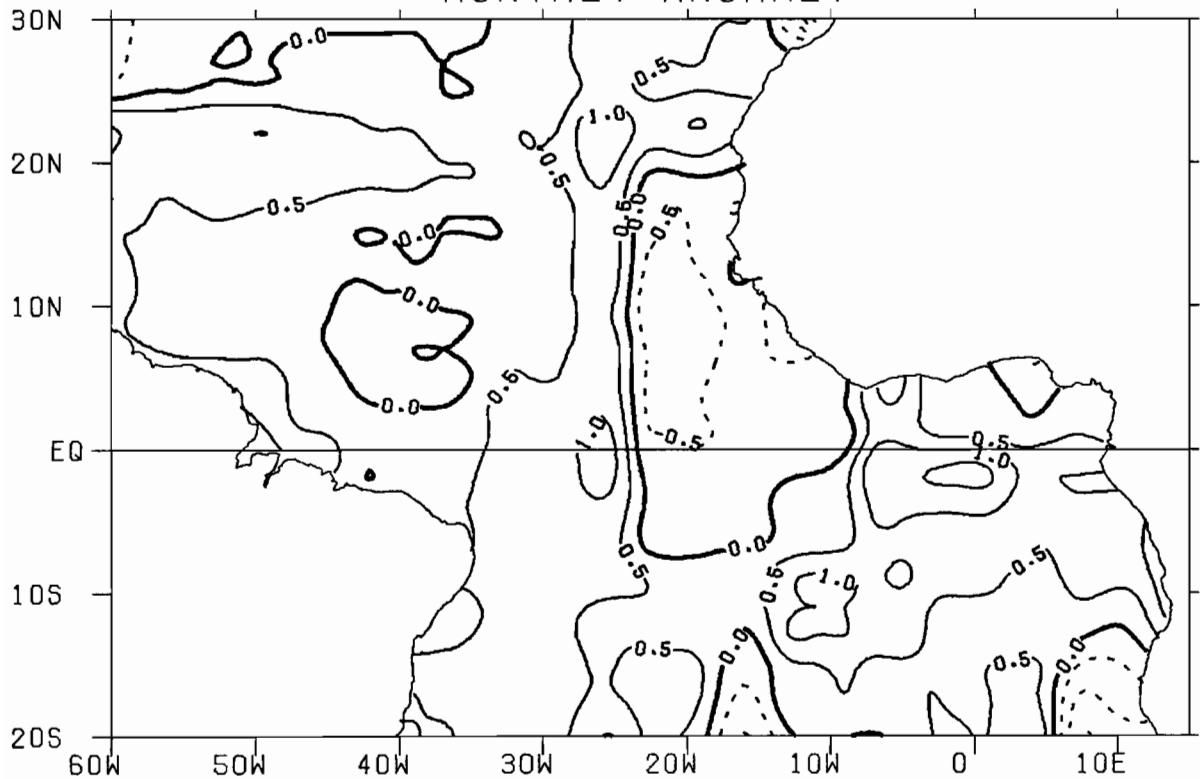
SEA SURFACE TEMPERATURE

JANUARY 1988

MONTHLY MEAN

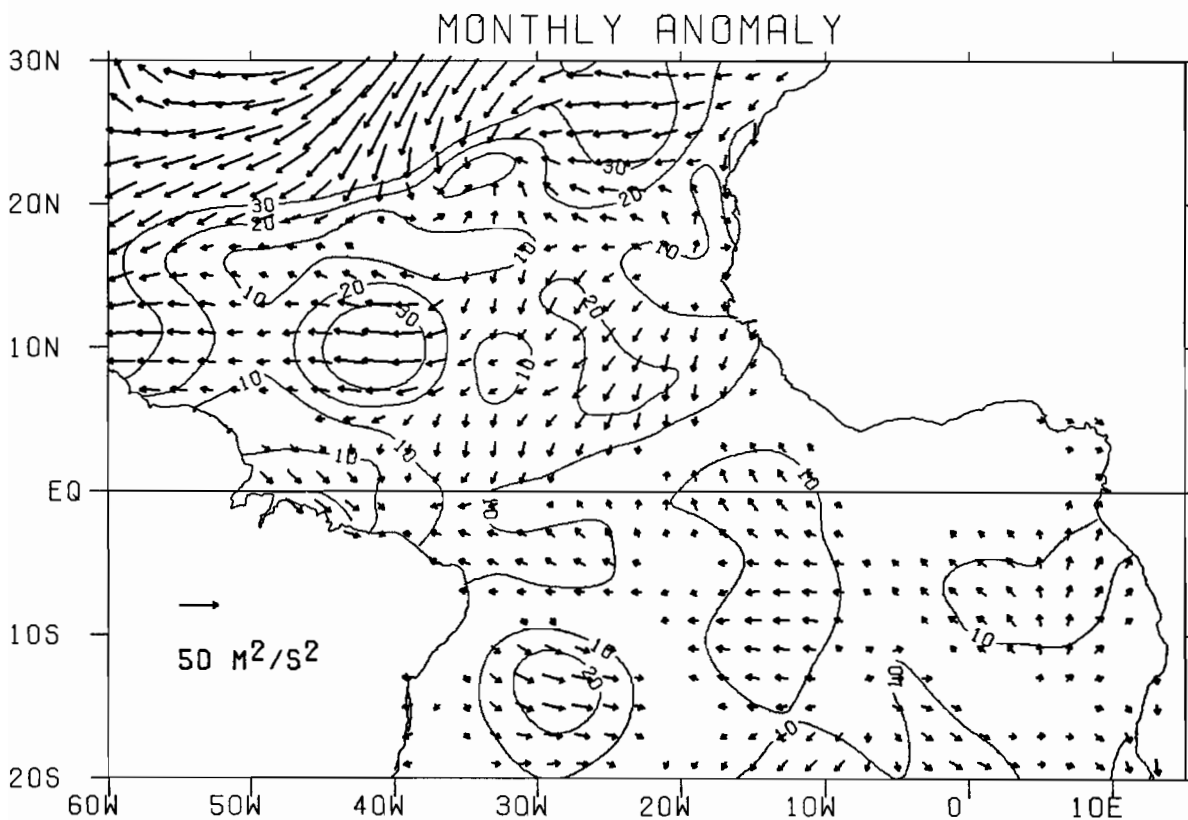
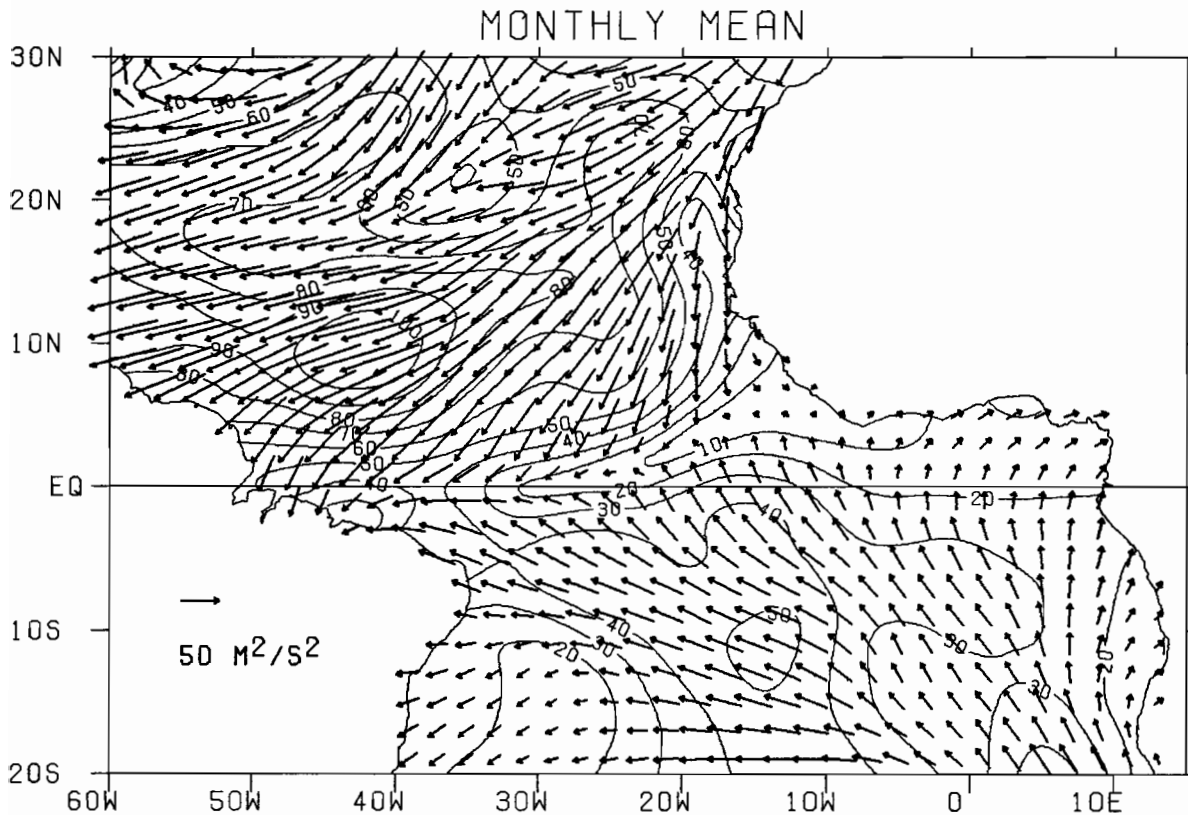


MONTHLY ANOMALY



WIND STRESS

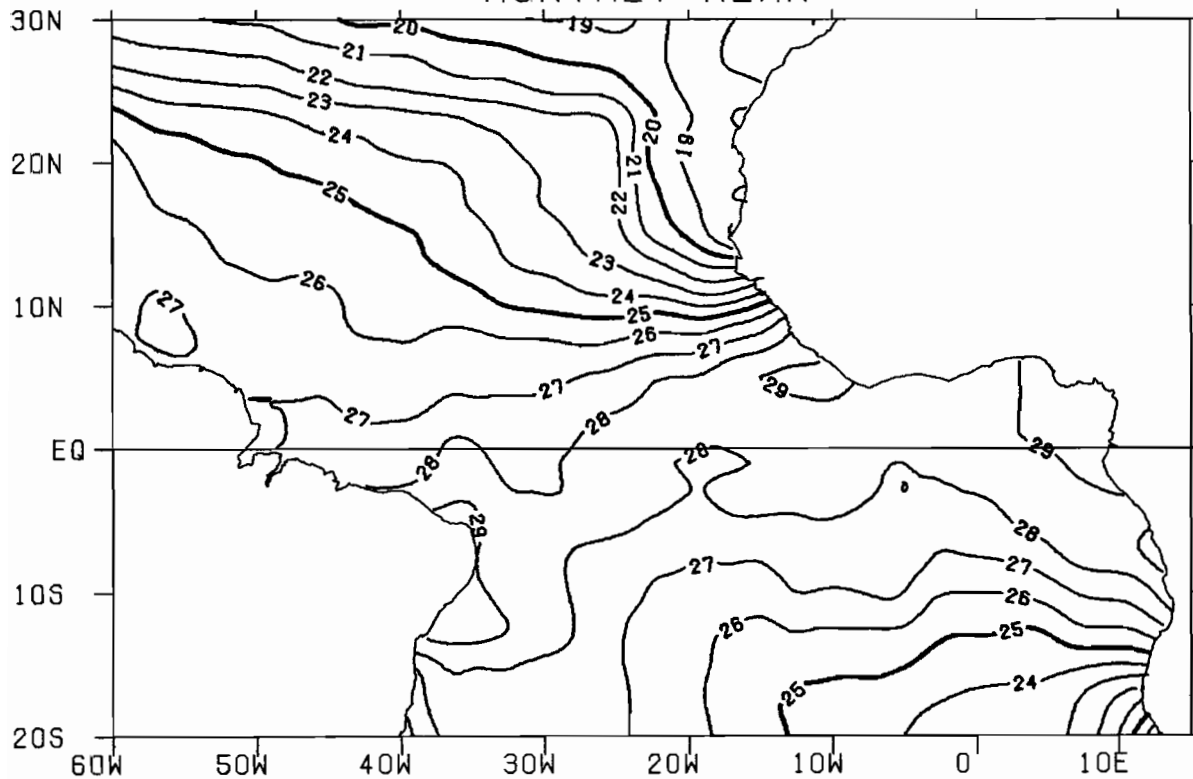
FEBRUARY 1988



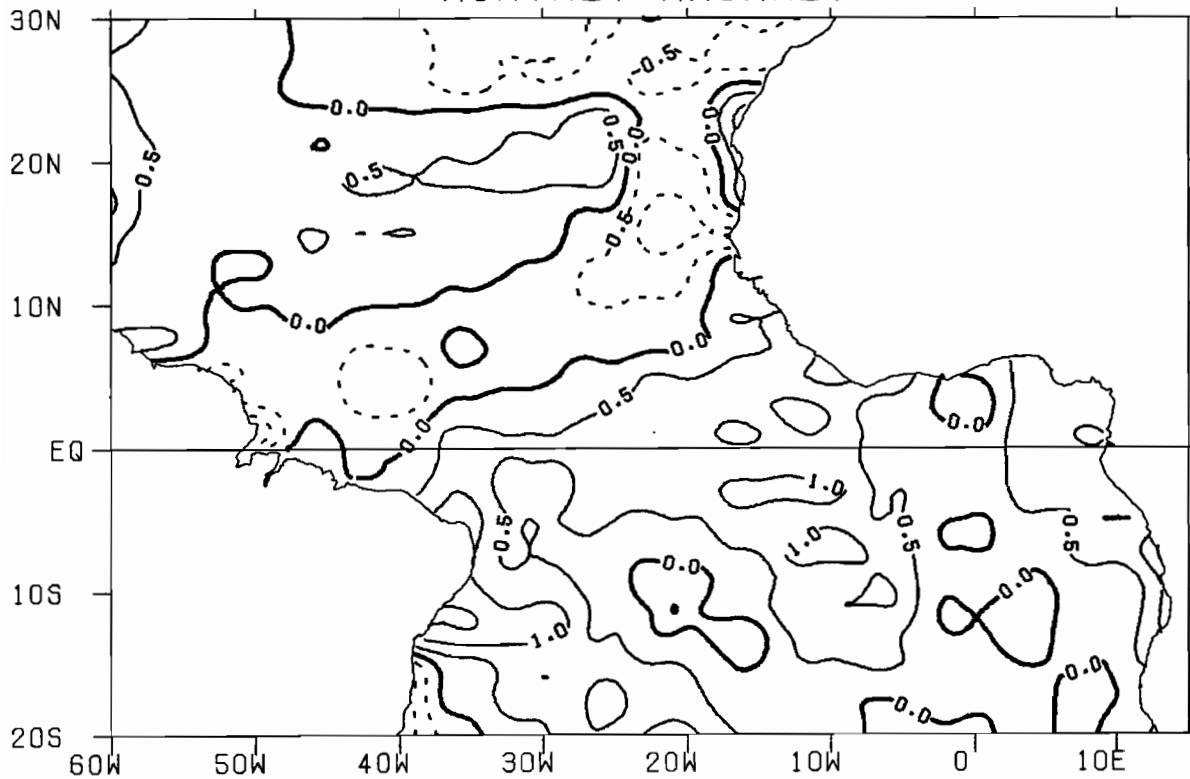
SEA SURFACE TEMPERATURE

FEBRUARY 1988

MONTHLY MEAN



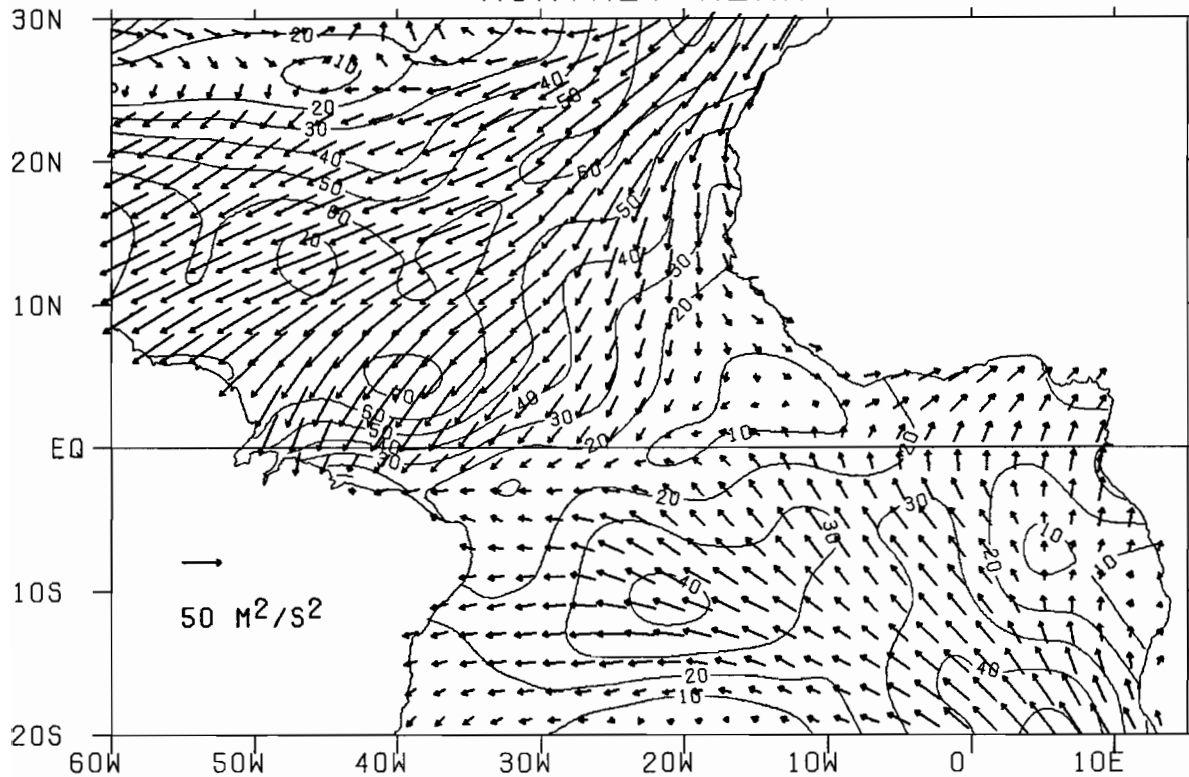
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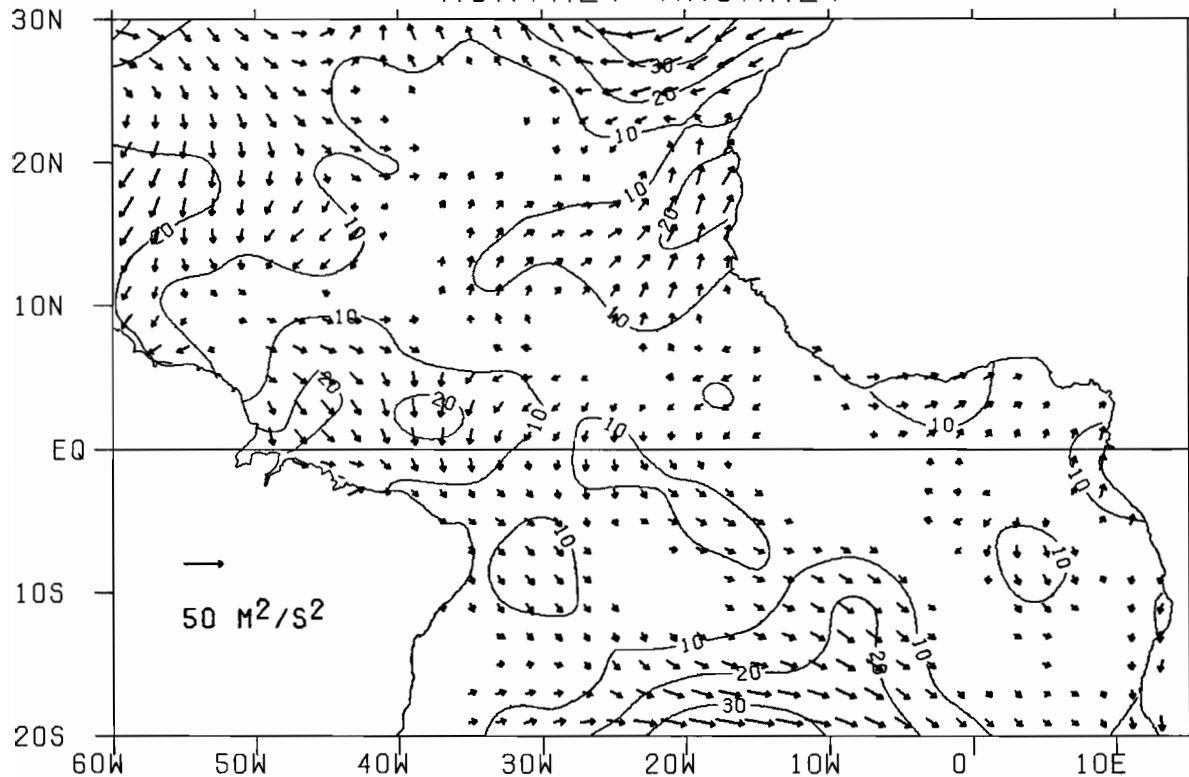
WIND STRESS

MARCH 1988

MONTHLY MEAN



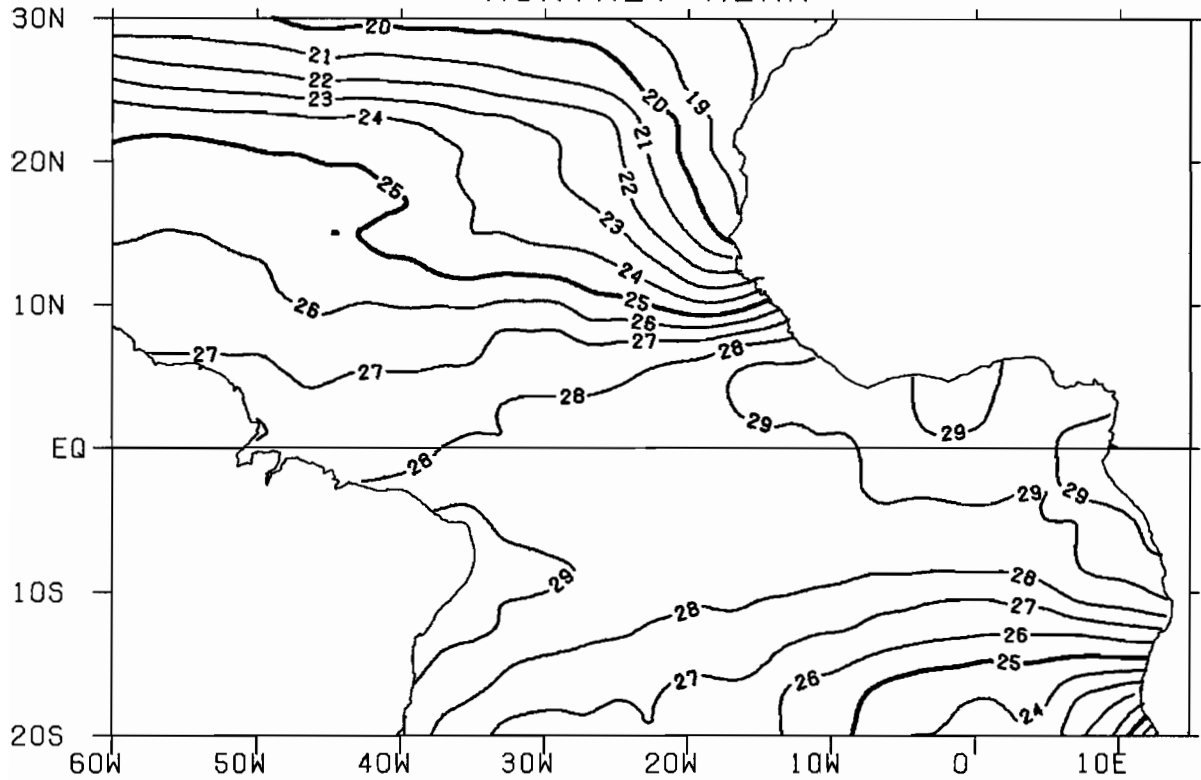
MONTHLY ANOMALY



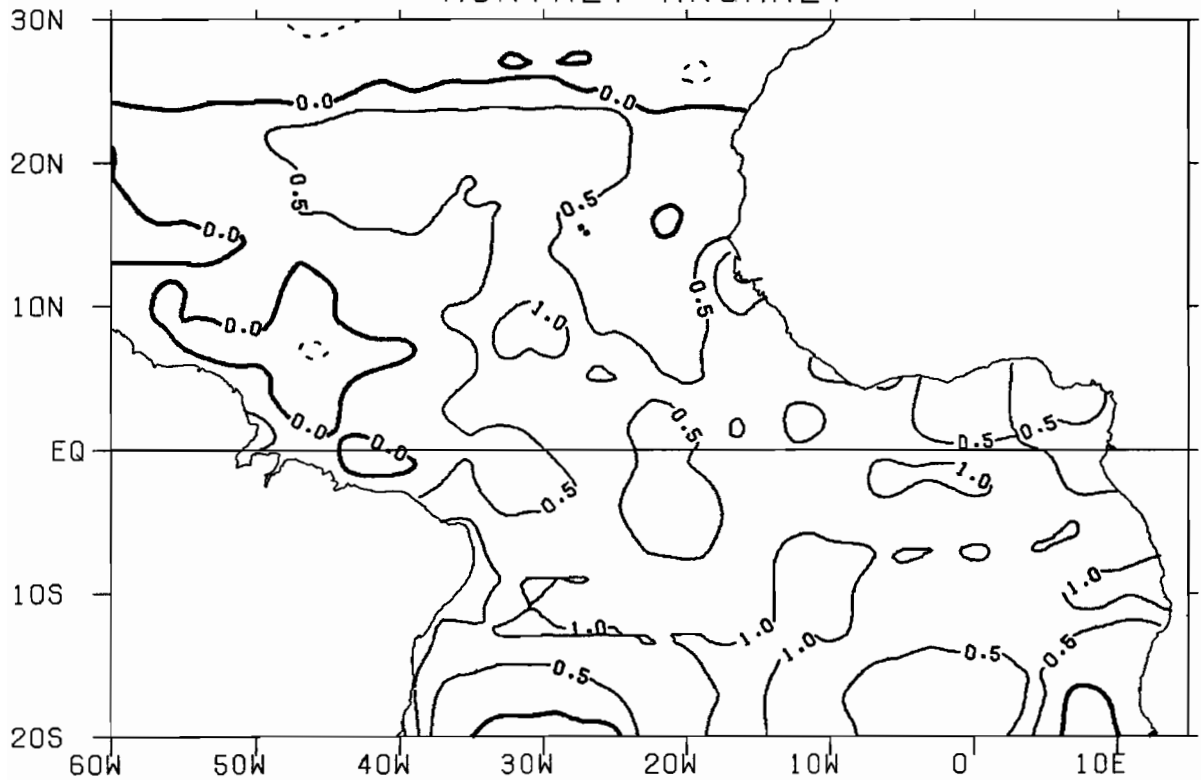
SEA SURFACE TEMPERATURE

MARCH 1988

MONTHLY MEAN



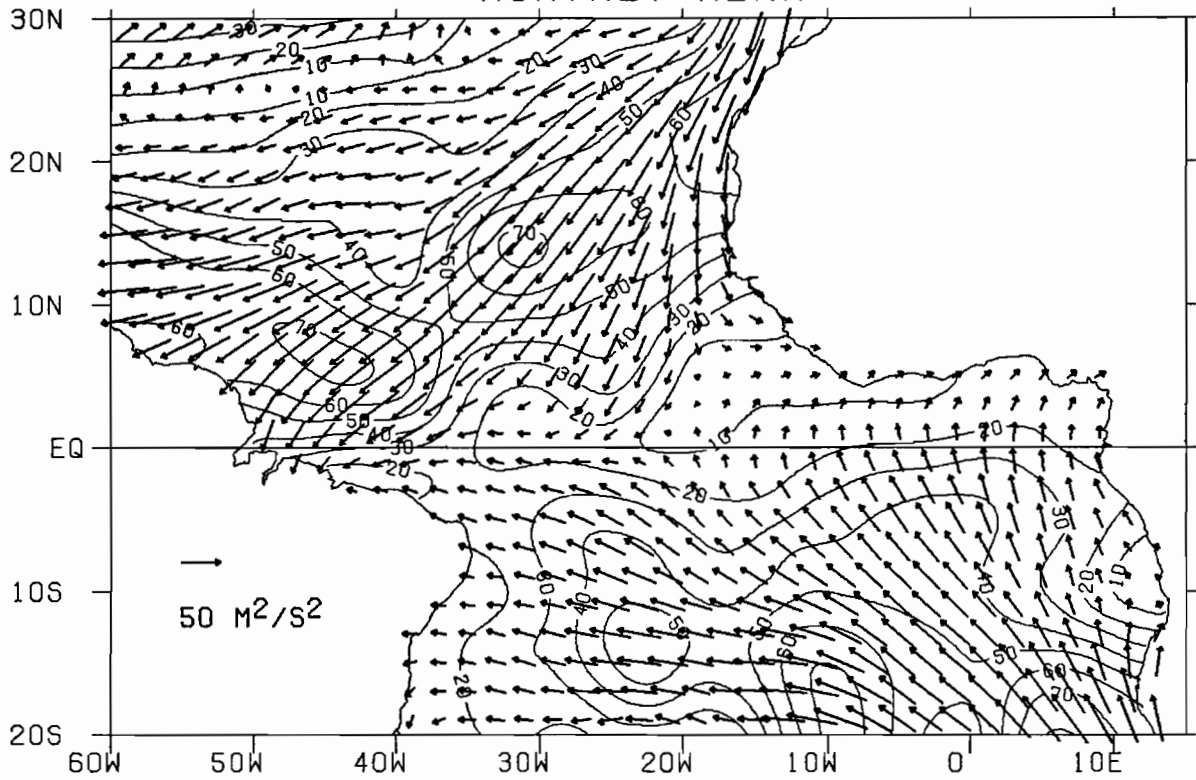
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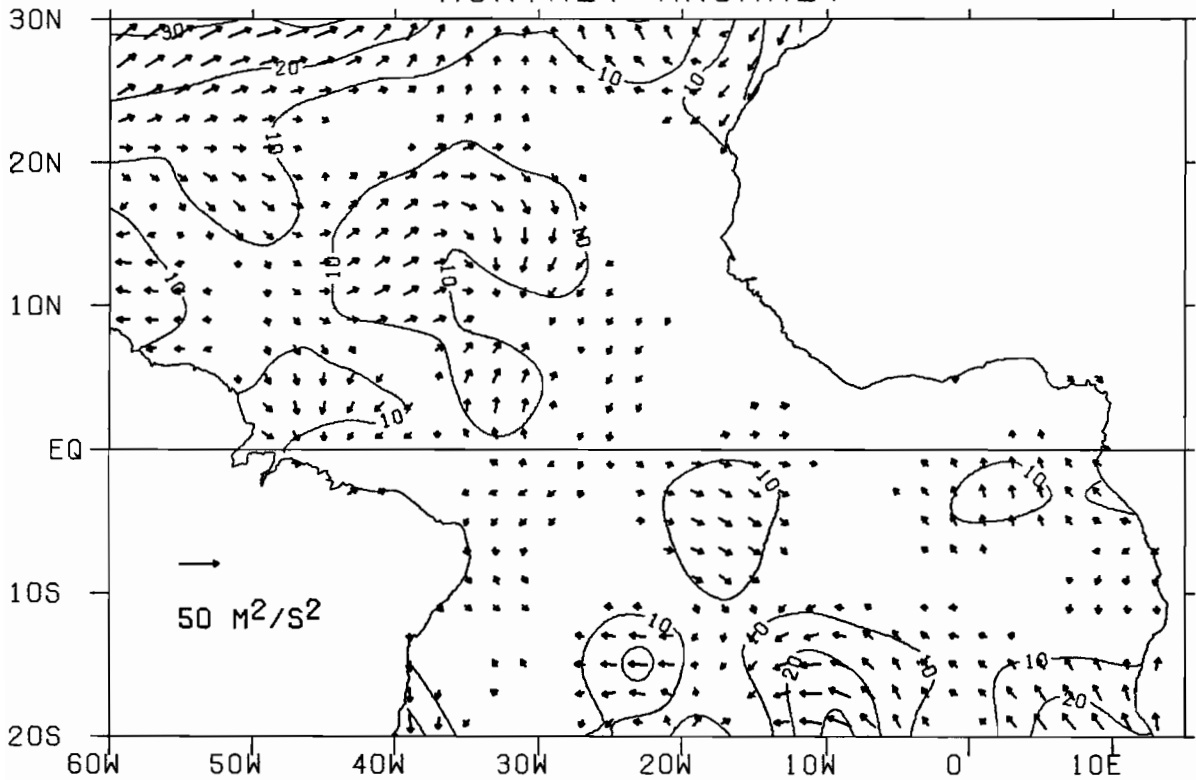
WIND STRESS

APRIL 1988

MONTHLY MEAN



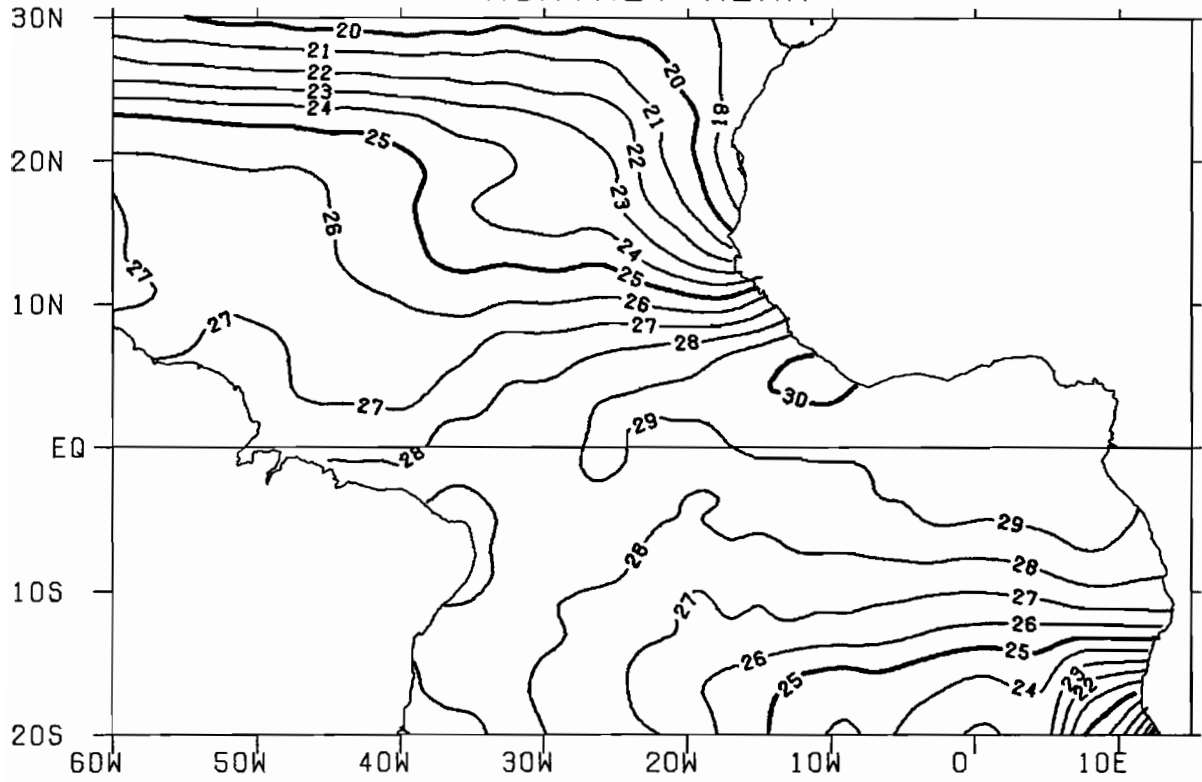
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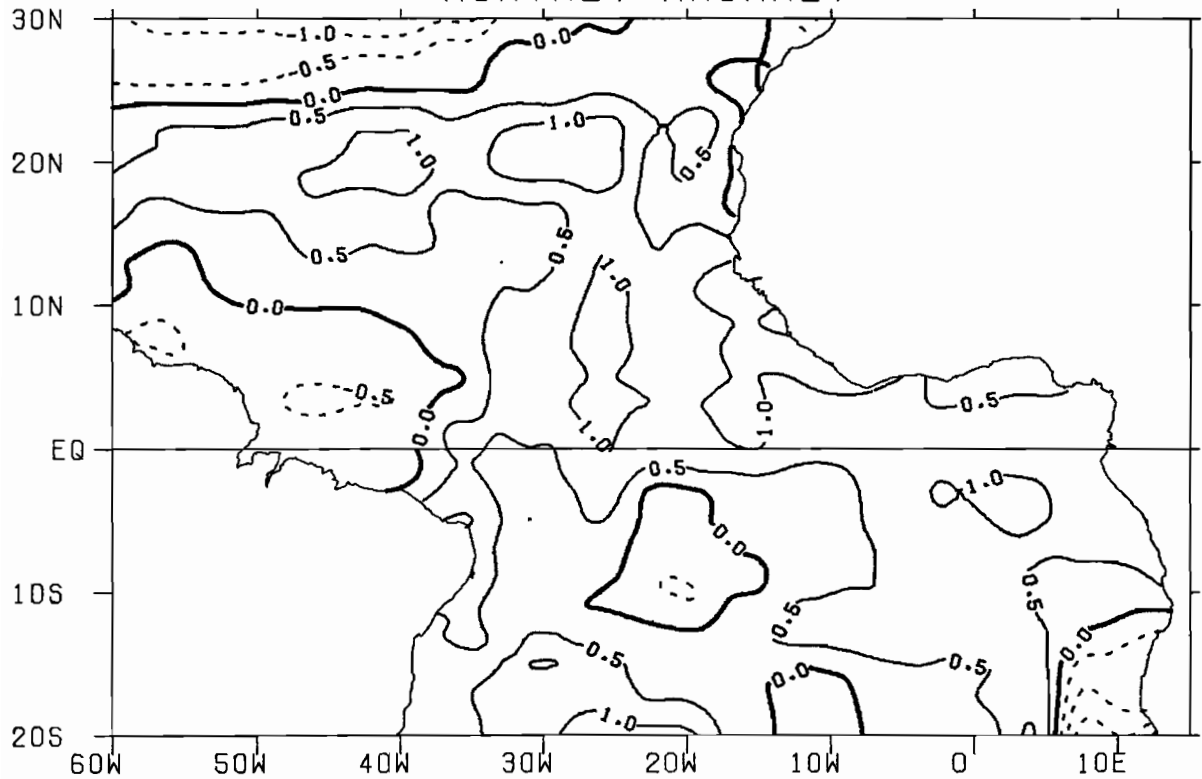
SEA SURFACE TEMPERATURE

APRIL 1988

MONTHLY MEAN



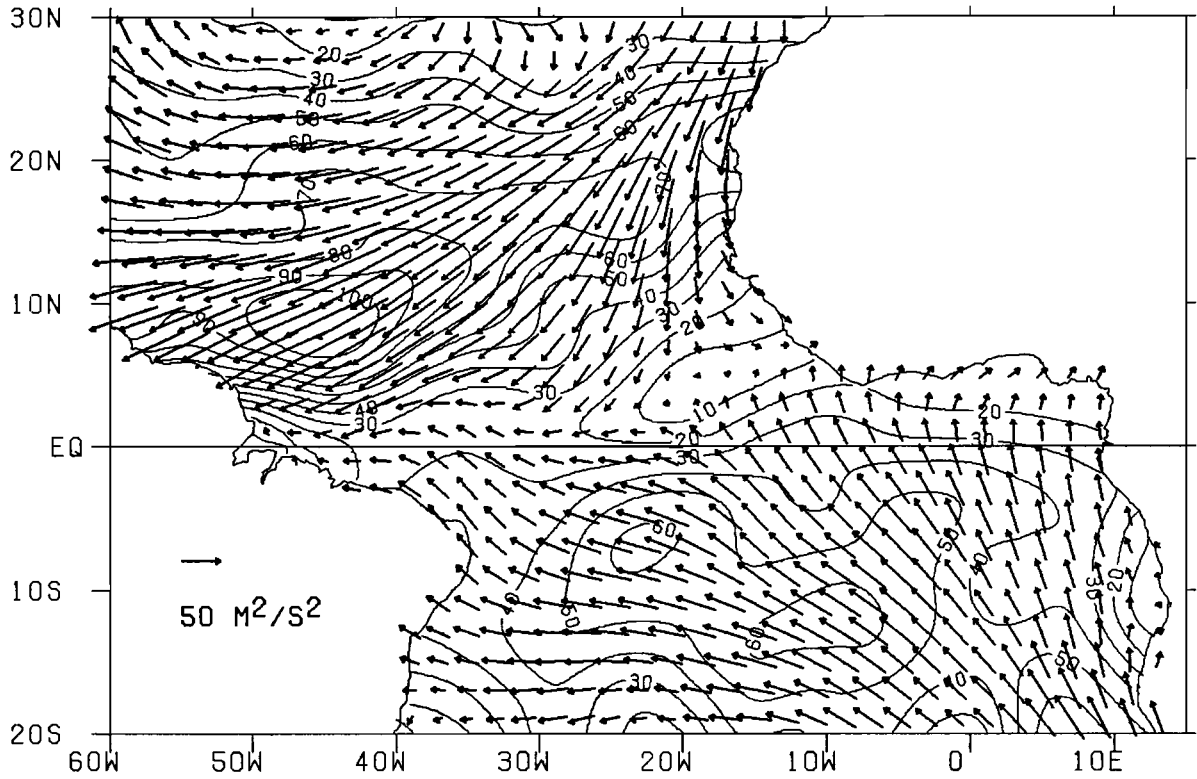
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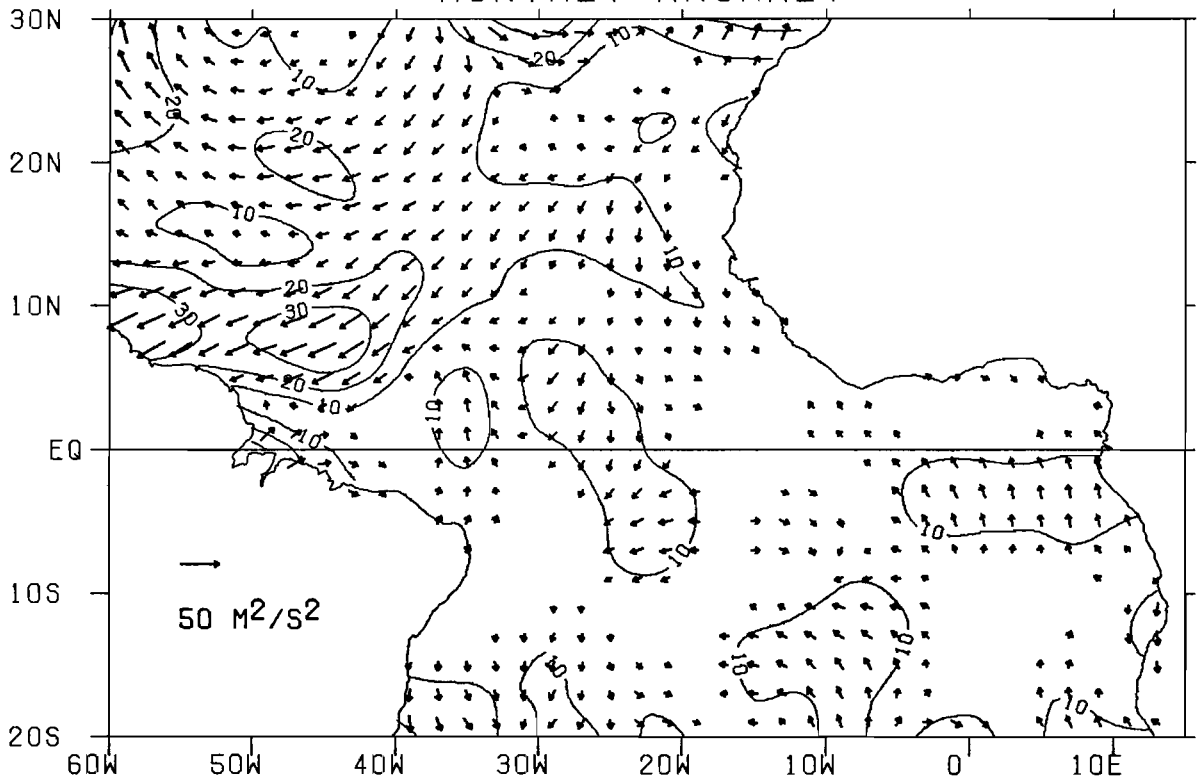
WIND STRESS

MAY 1988

MONTHLY MEAN



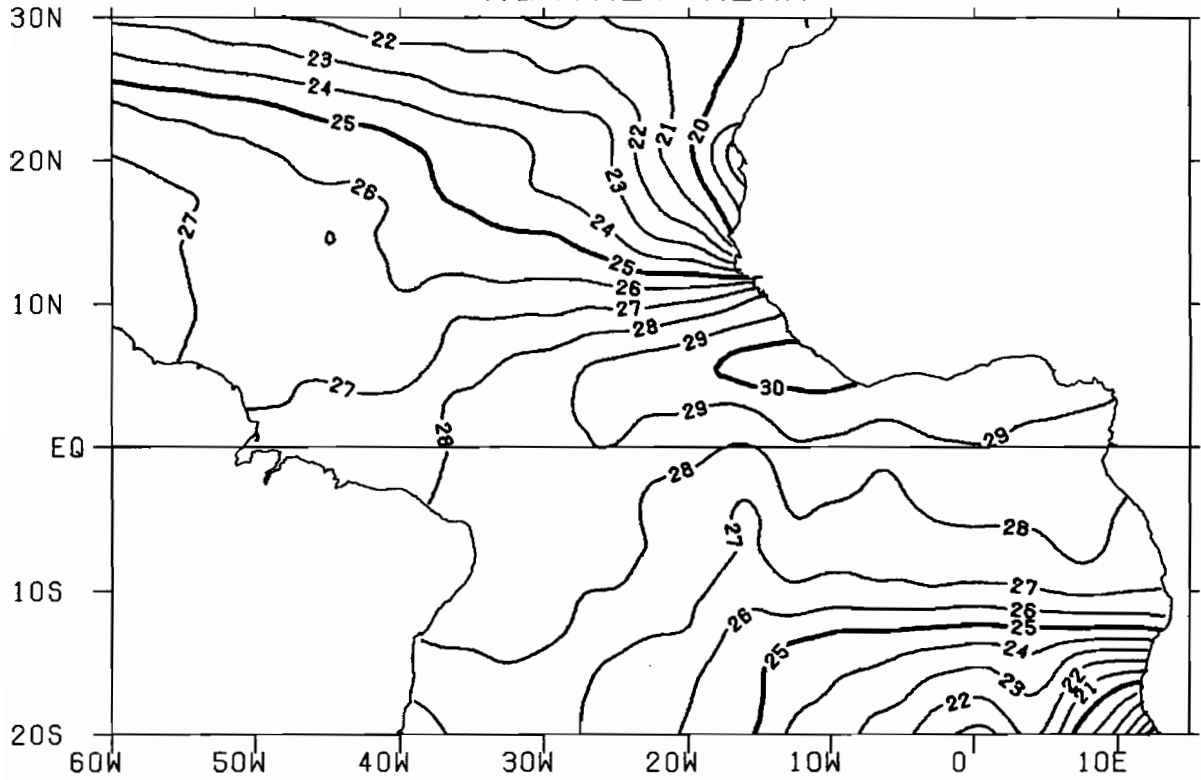
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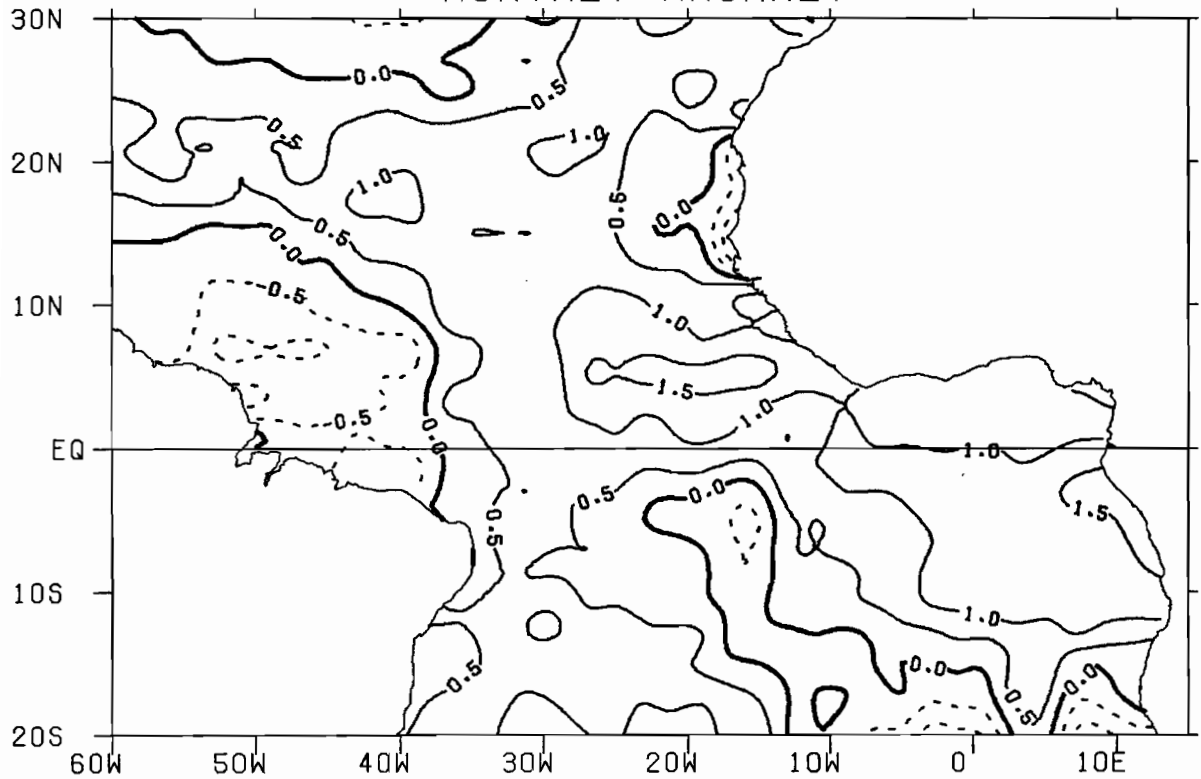
SEA SURFACE TEMPERATURE

MAY 1988

MONTHLY MEAN



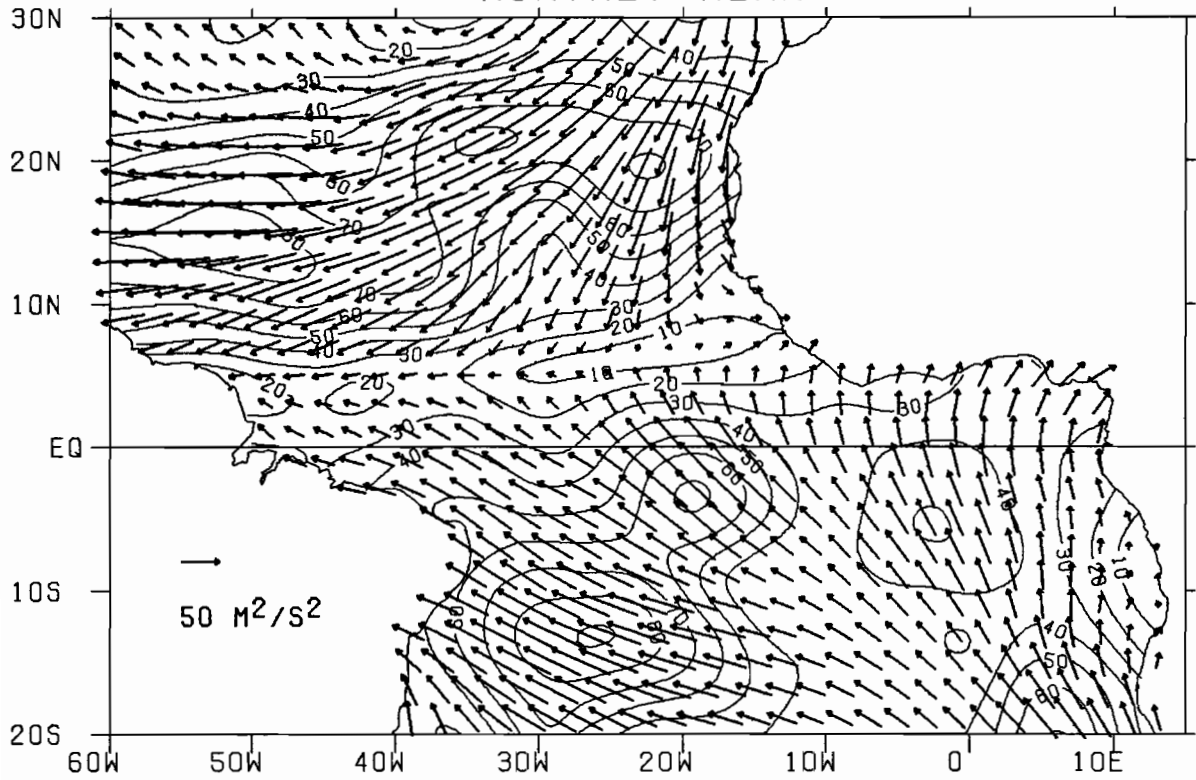
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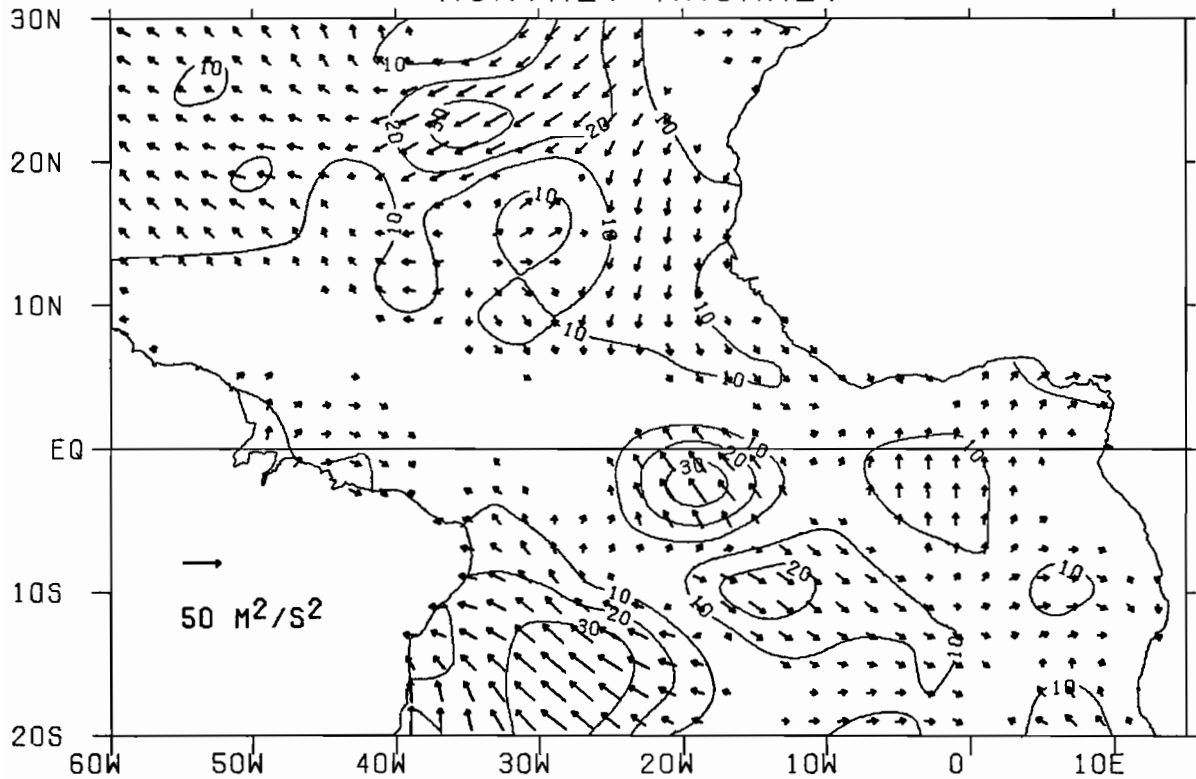
WIND STRESS

JUNE 1988

MONTHLY MEAN



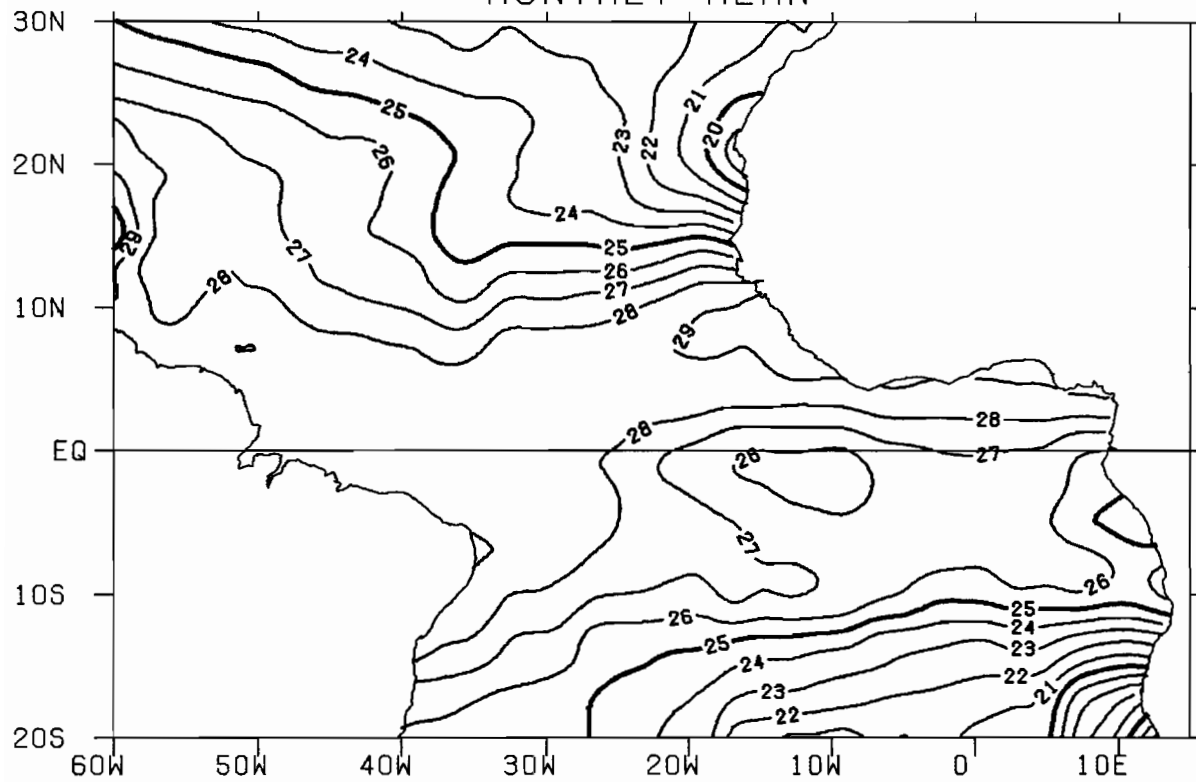
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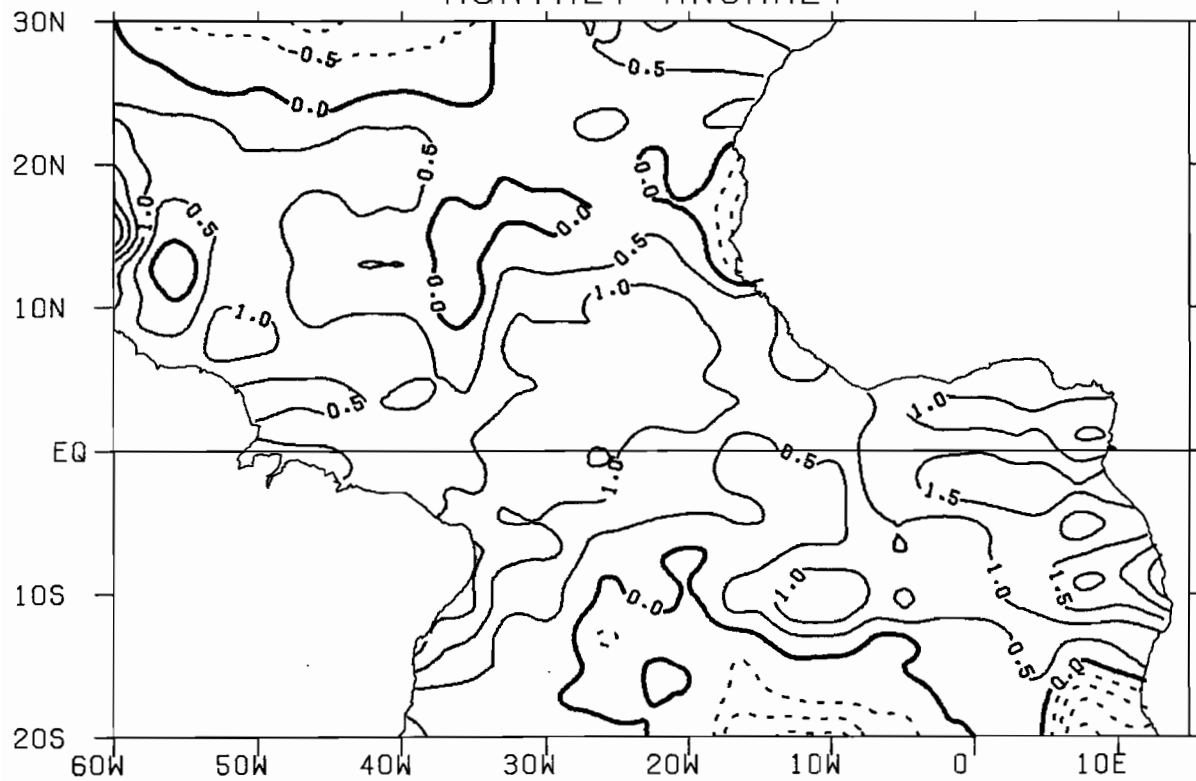
SEA SURFACE TEMPERATURE

JUNE 1988

MONTHLY MEAN



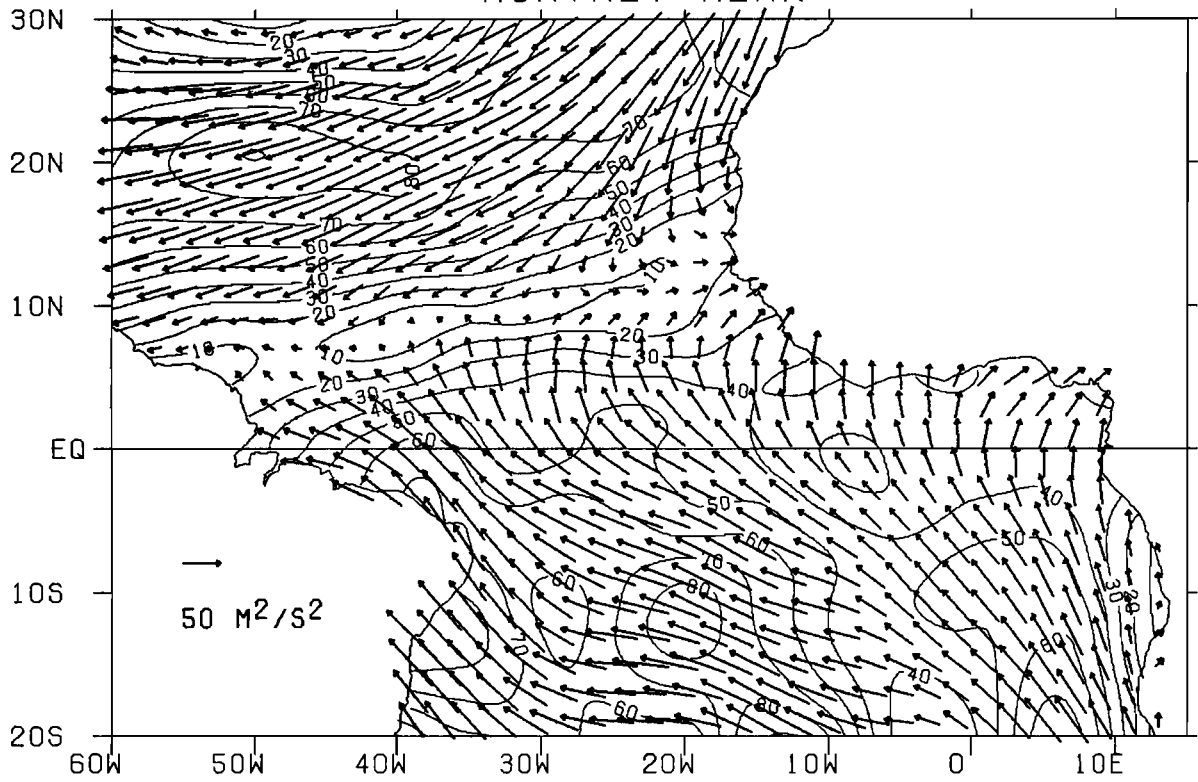
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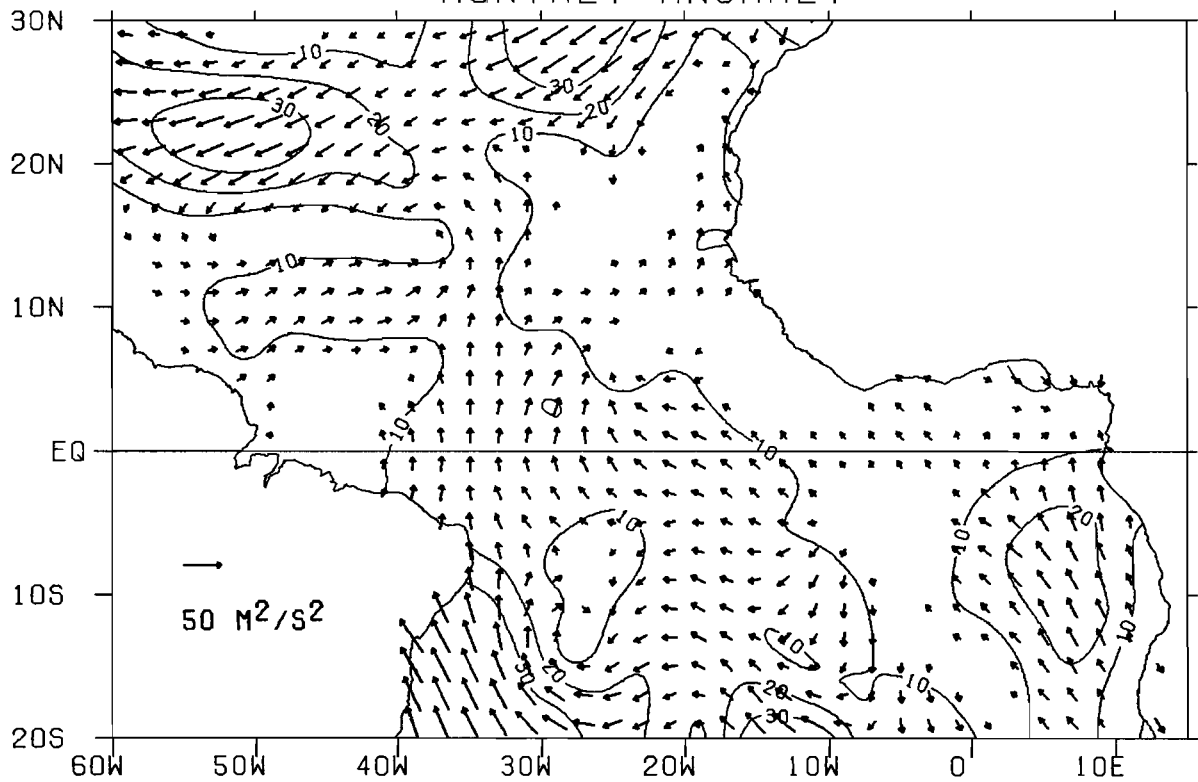
WIND STRESS

JULY 1988

MONTHLY MEAN



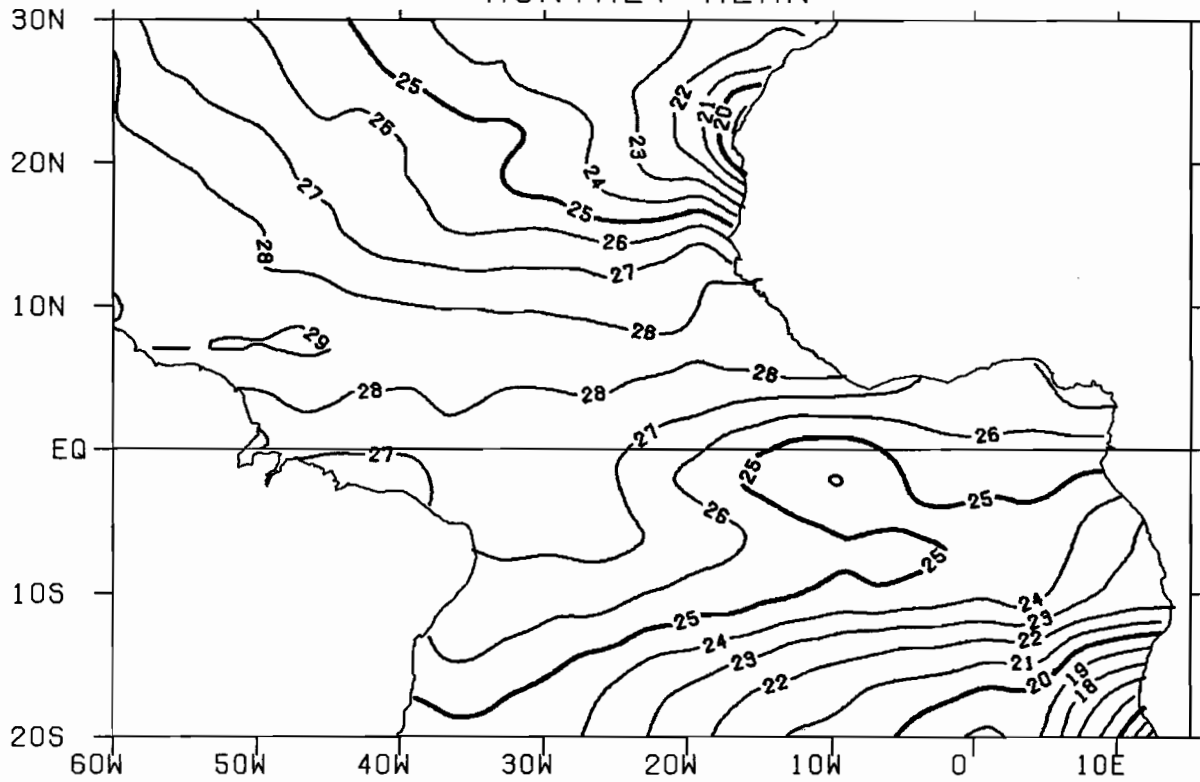
MONTHLY ANOMALY



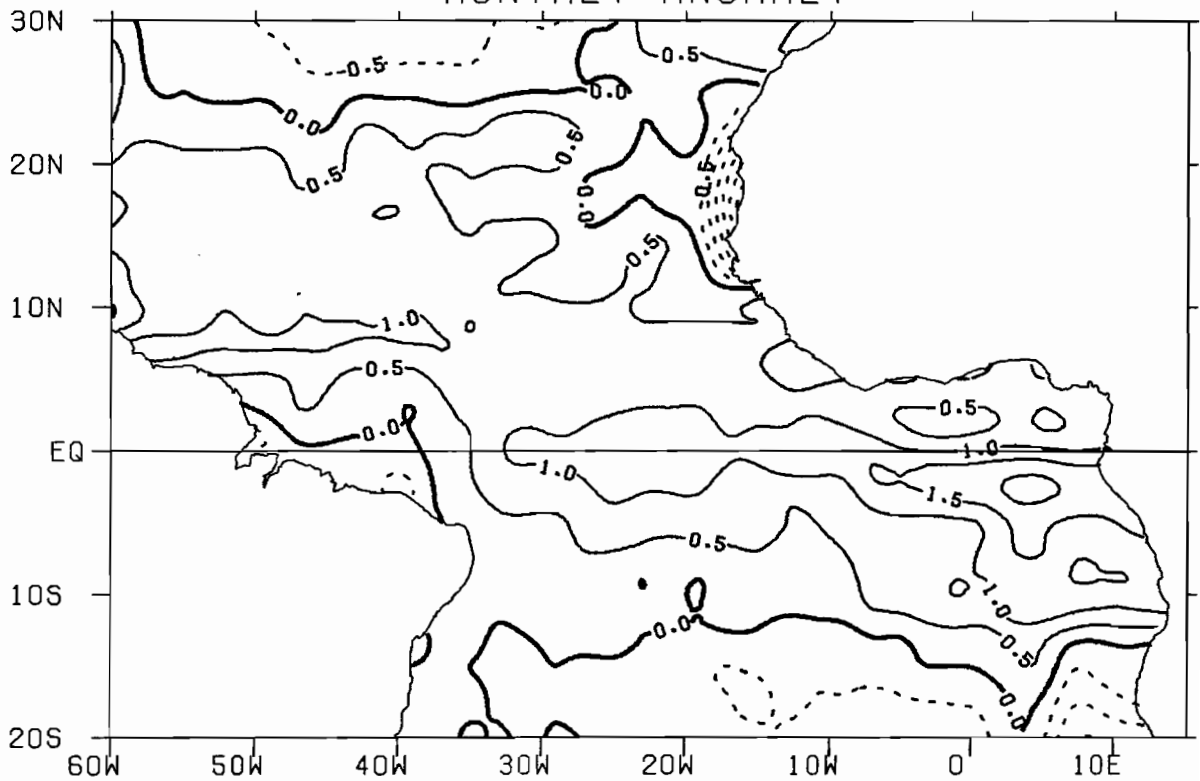
SEA SURFACE TEMPERATURE

JULY 1988

MONTHLY MEAN

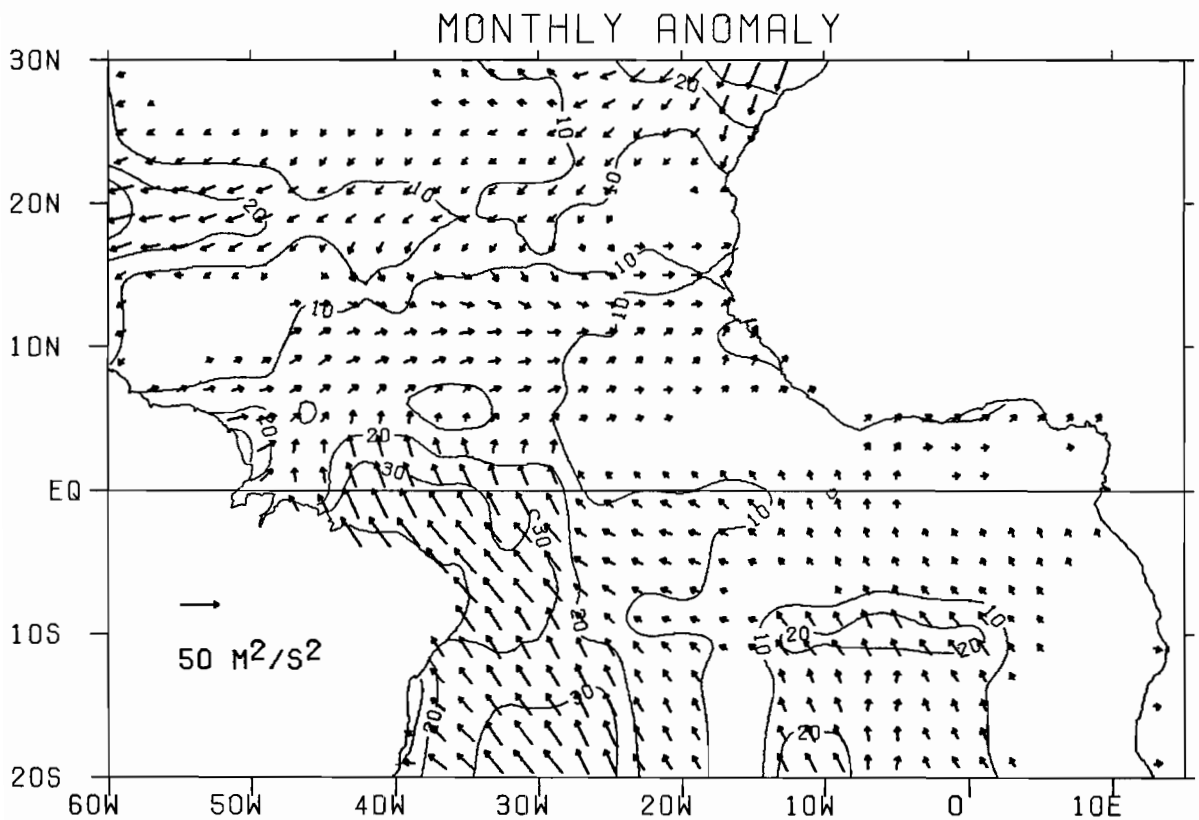
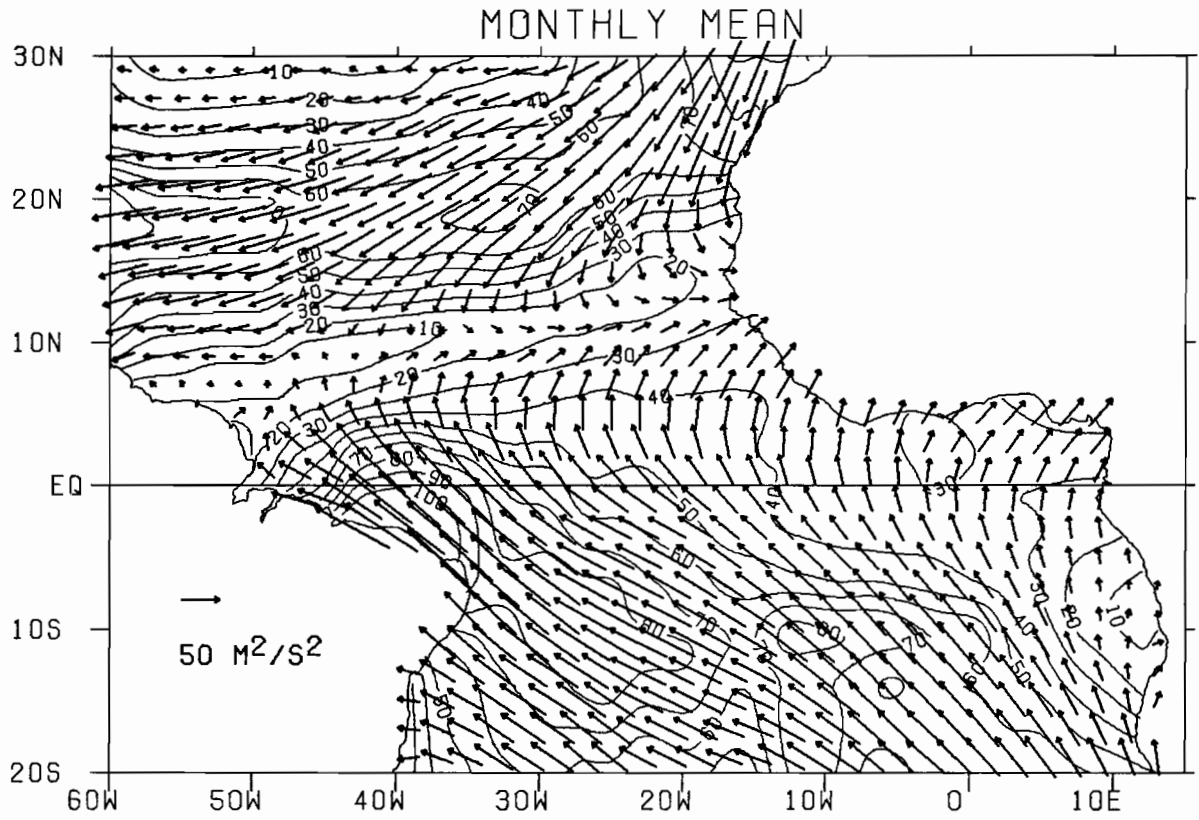


MONTHLY ANOMALY



WIND STRESS

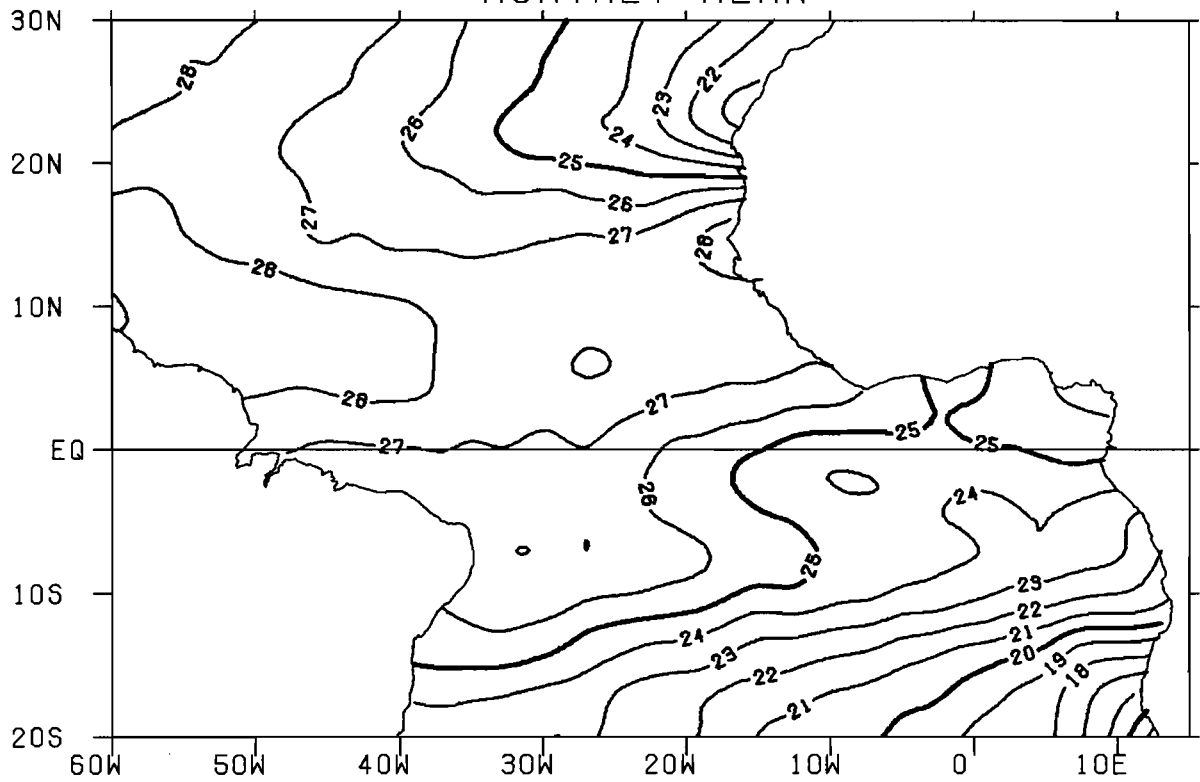
AUGUST 1988



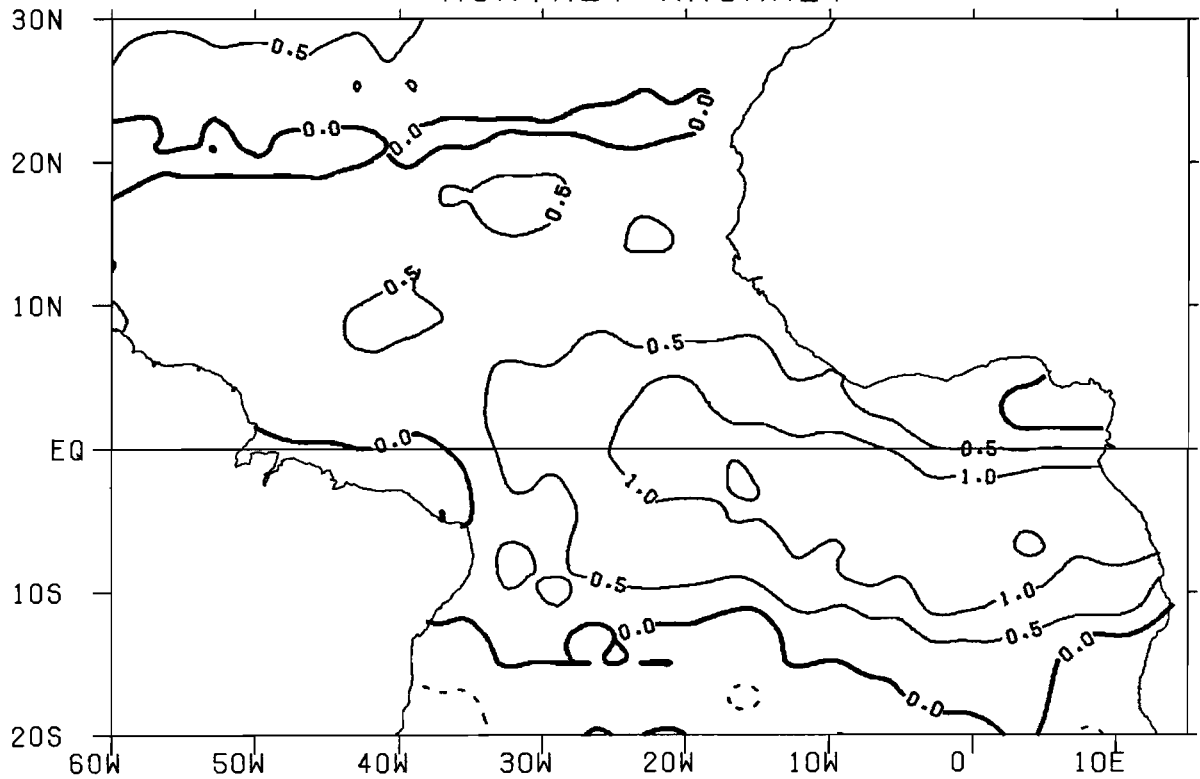
SEA SURFACE TEMPERATURE

AUGUST 1988

MONTHLY MEAN

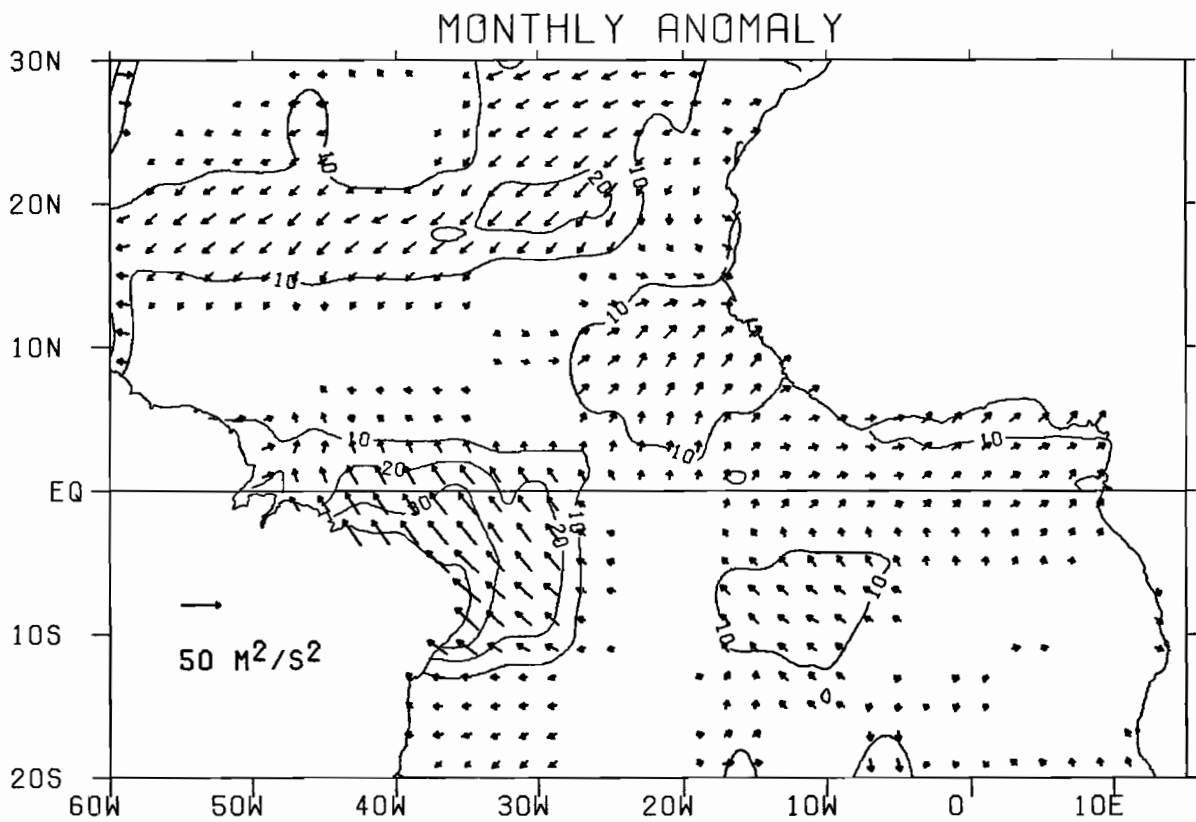
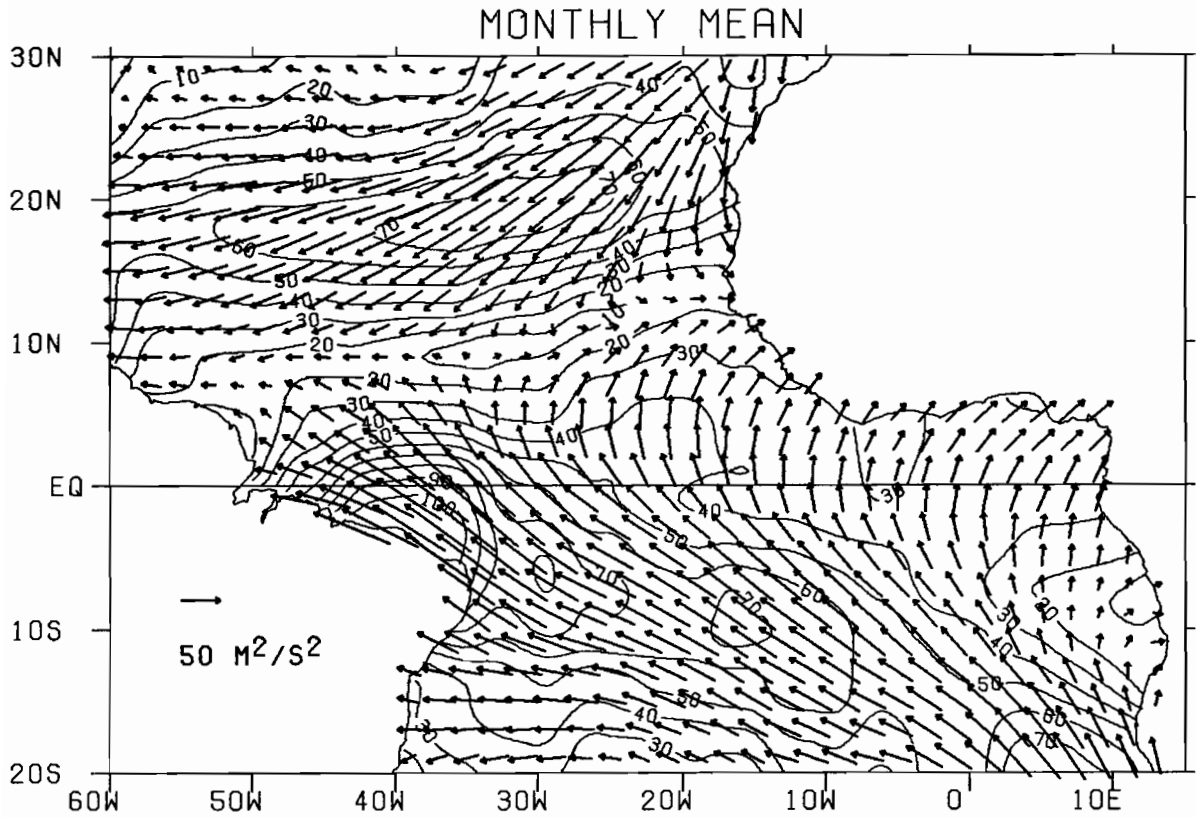


MONTHLY ANOMALY



WIND STRESS

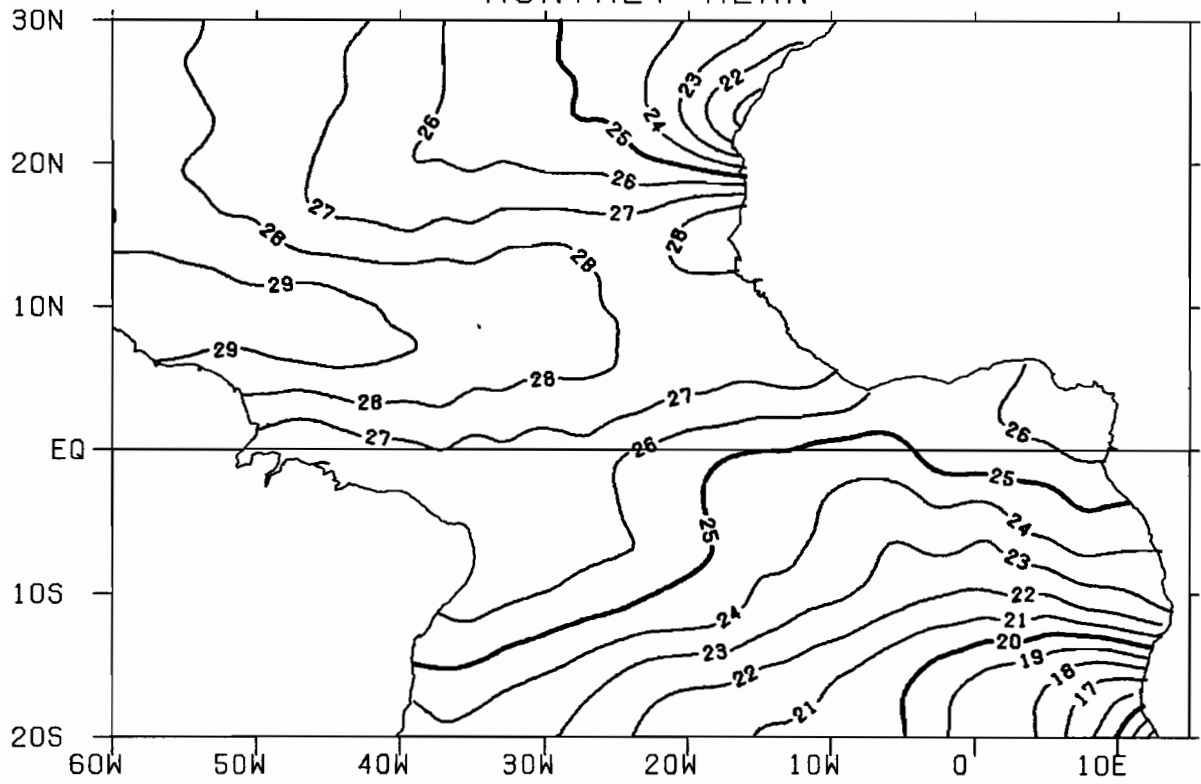
SEPTEMBER 1988



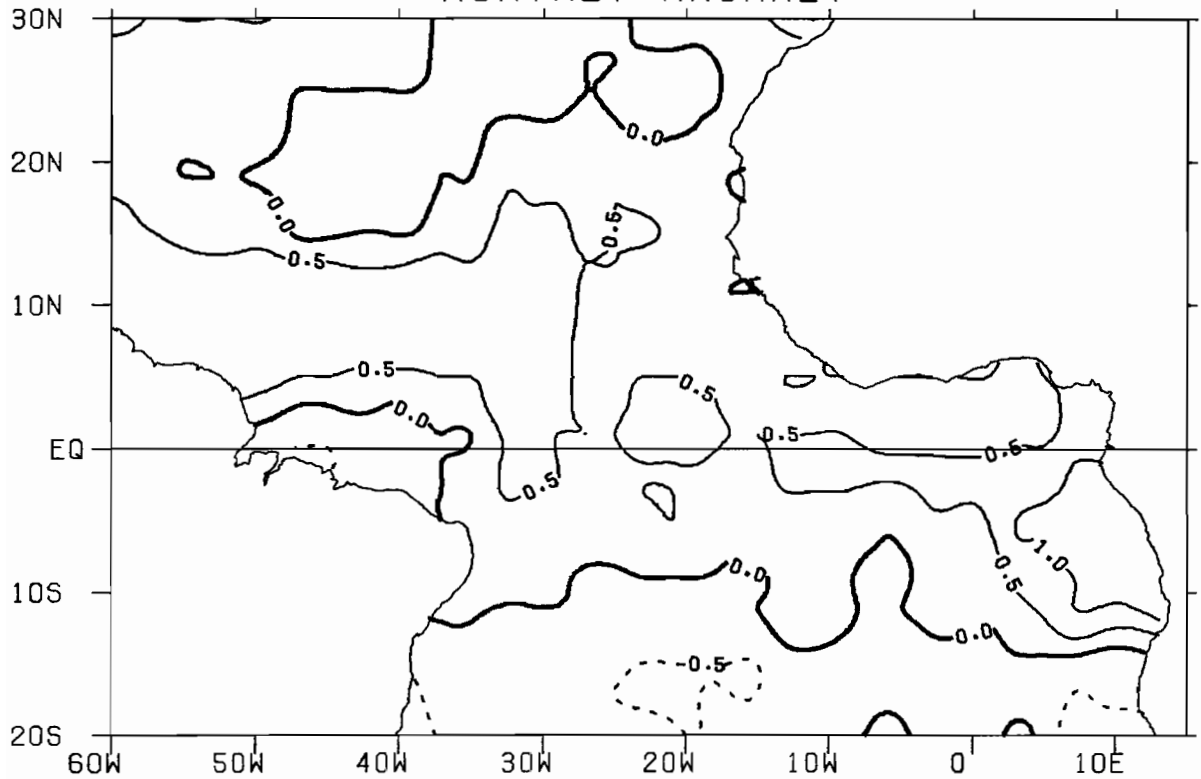
SEA SURFACE TEMPERATURE

SEPTEMBER 1988

MONTHLY MEAN

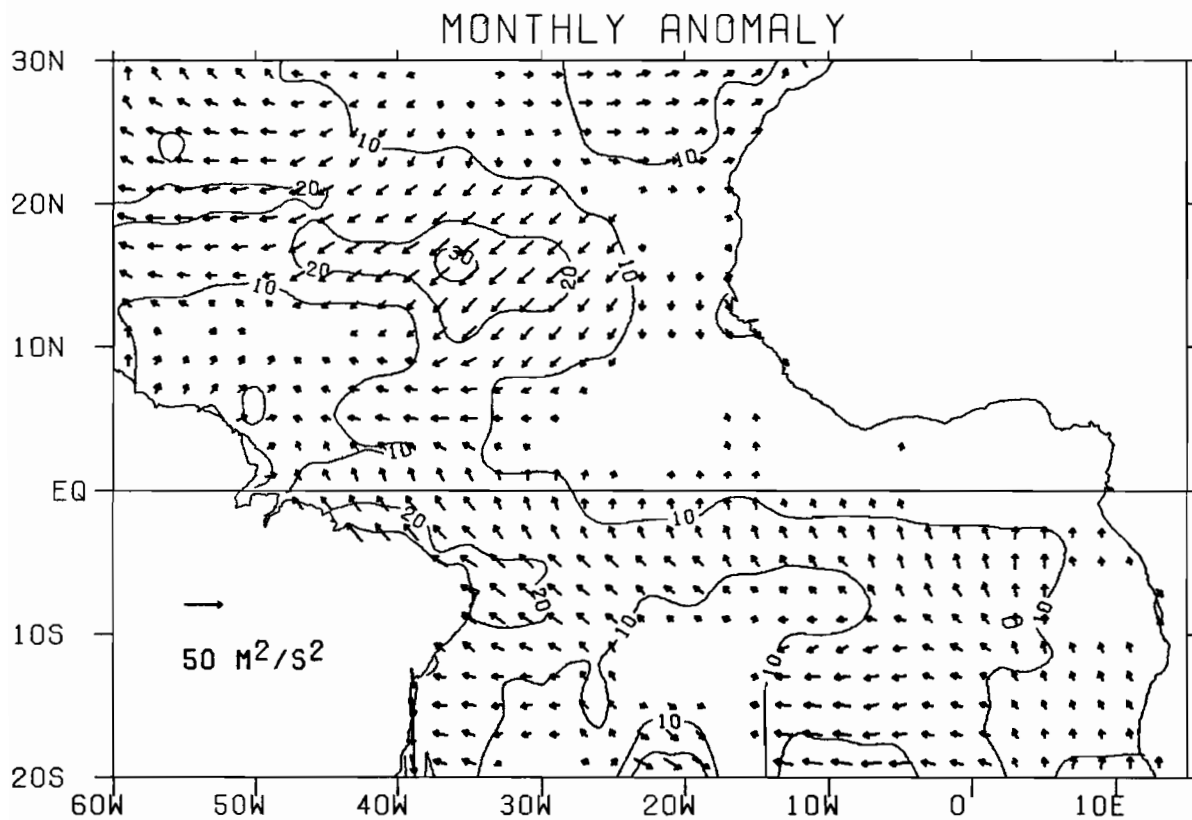
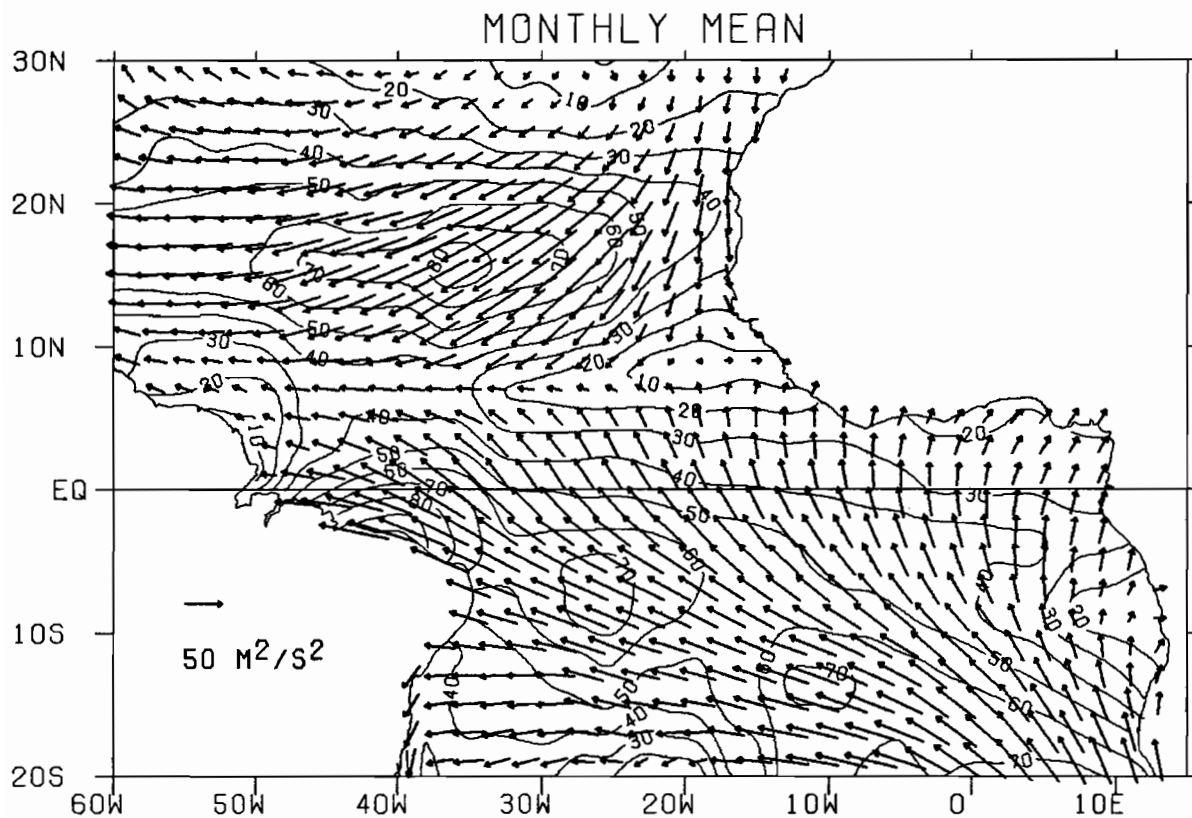


MONTHLY ANOMALY



WIND STRESS

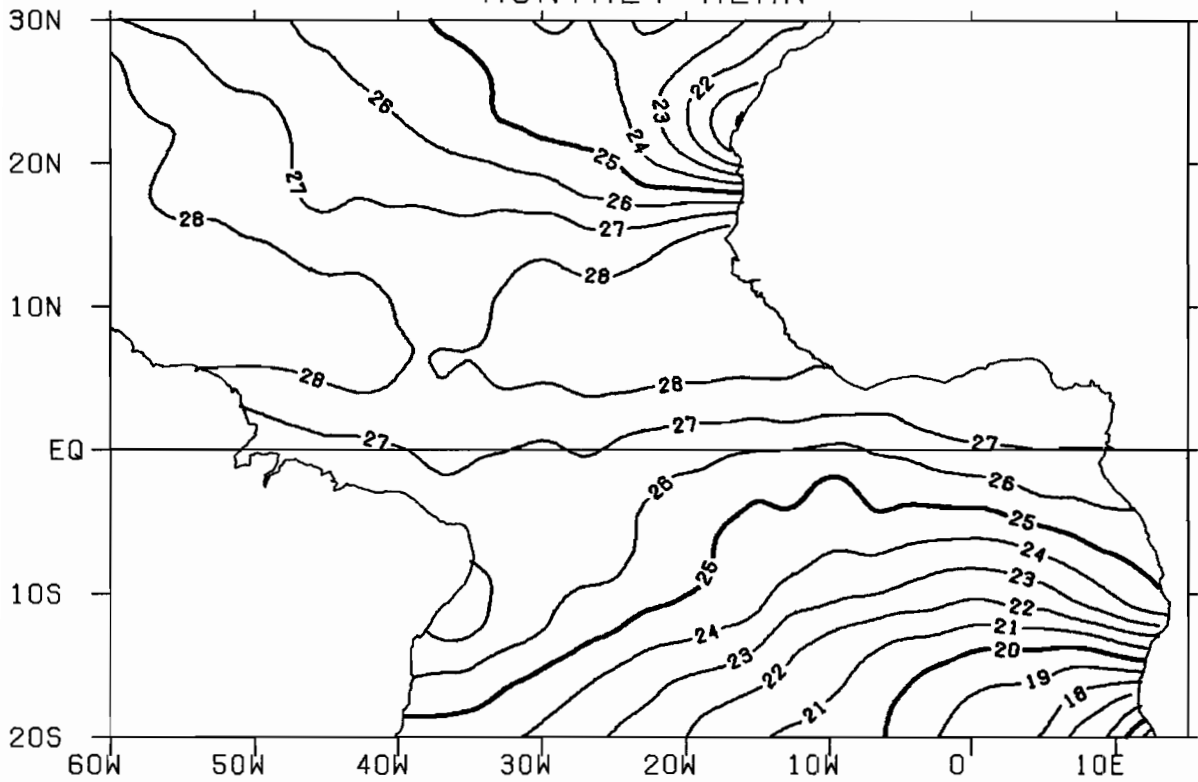
OCTOBER 1988



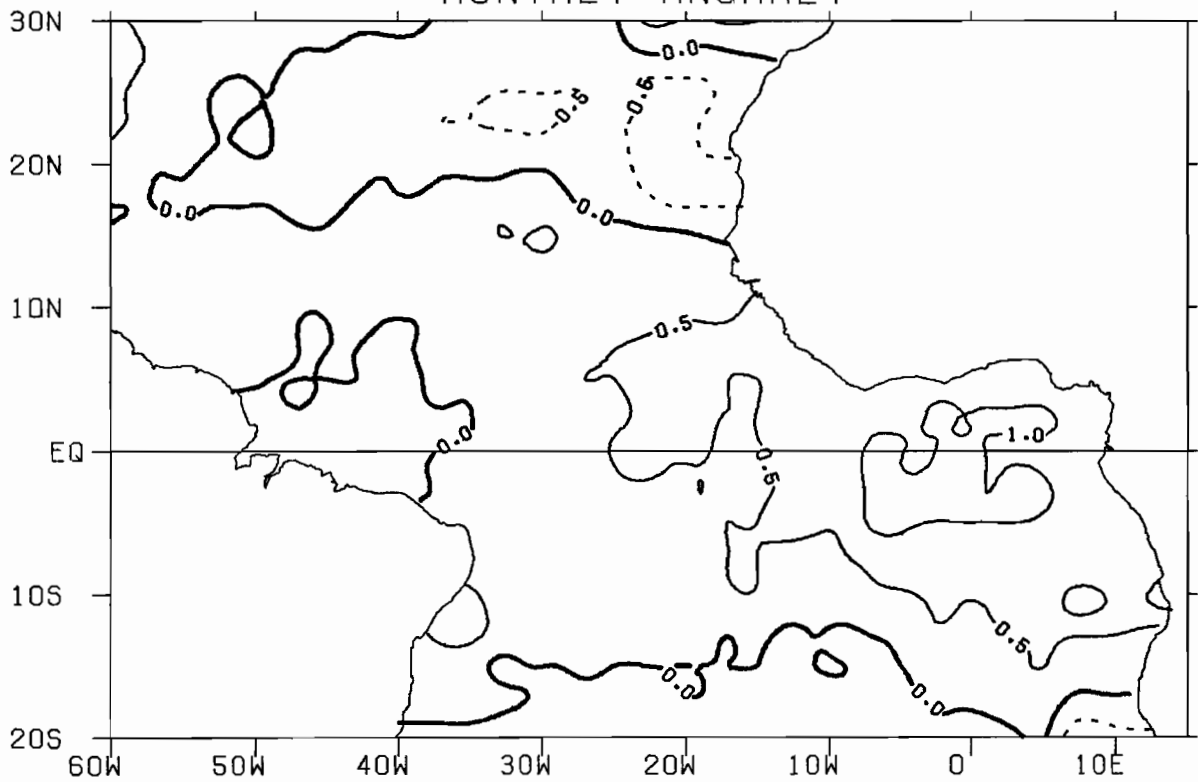
SEA SURFACE TEMPERATURE

OCTOBER 1988

MONTHLY MEAN

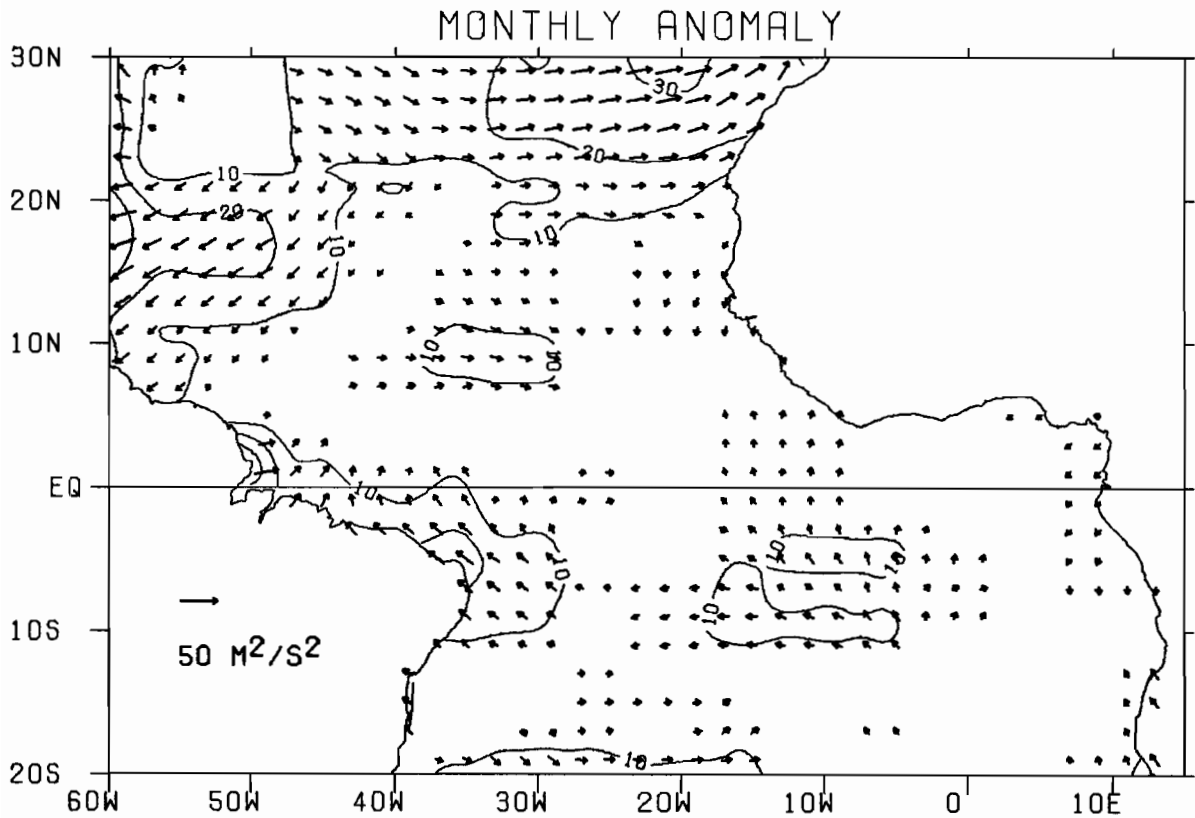
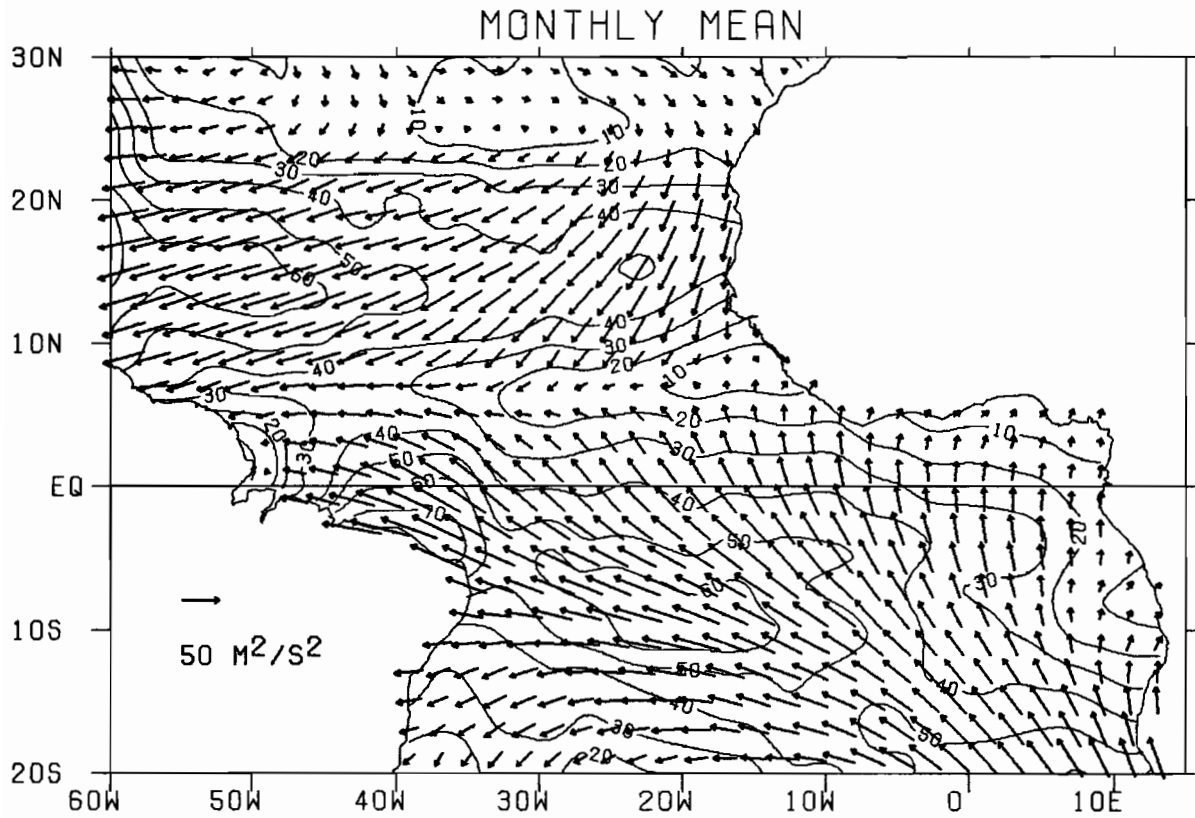


MONTHLY ANOMALY



WIND STRESS

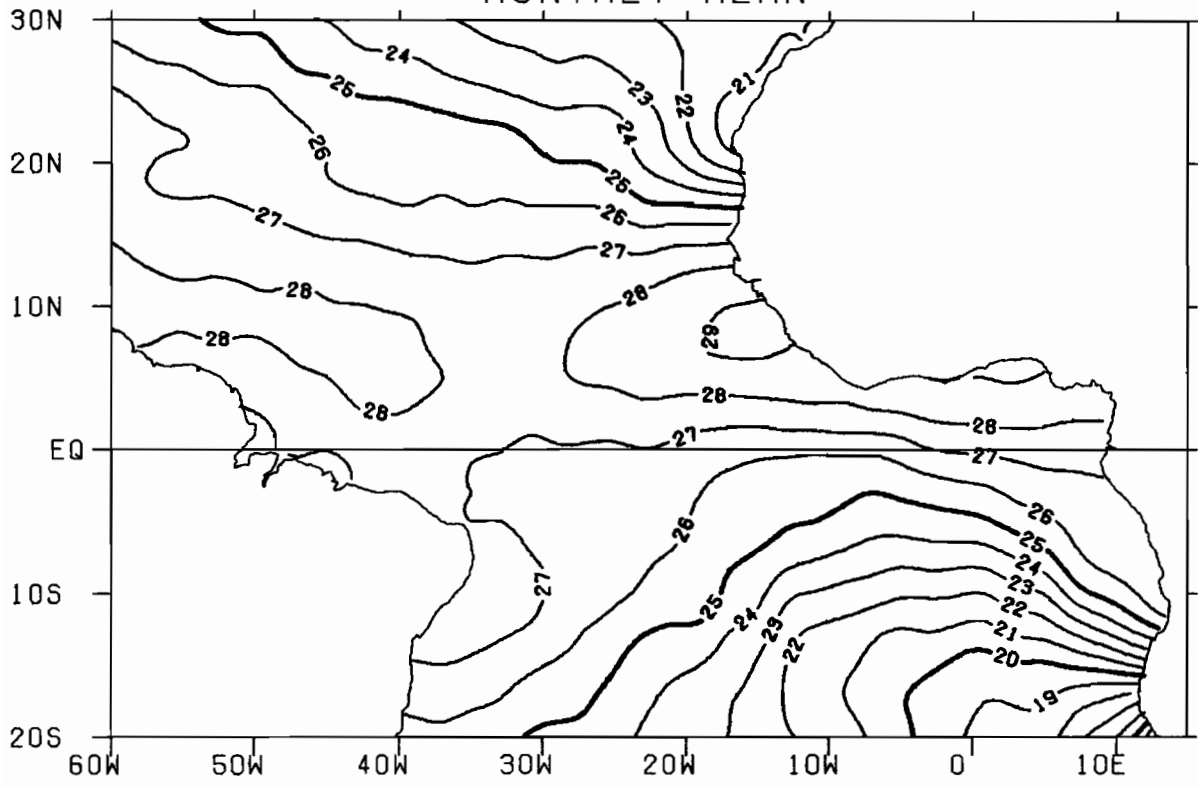
NOVEMBER 1988



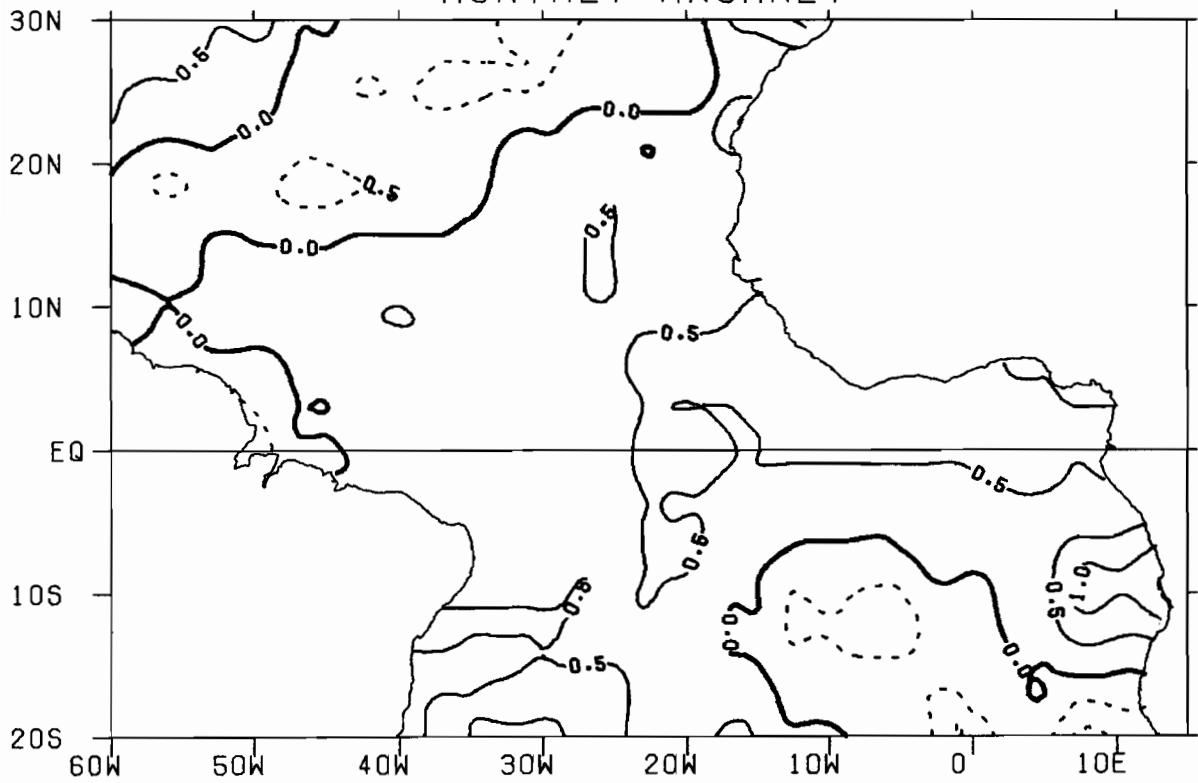
SEA SURFACE TEMPERATURE

NOVEMBER 1988

MONTHLY MEAN

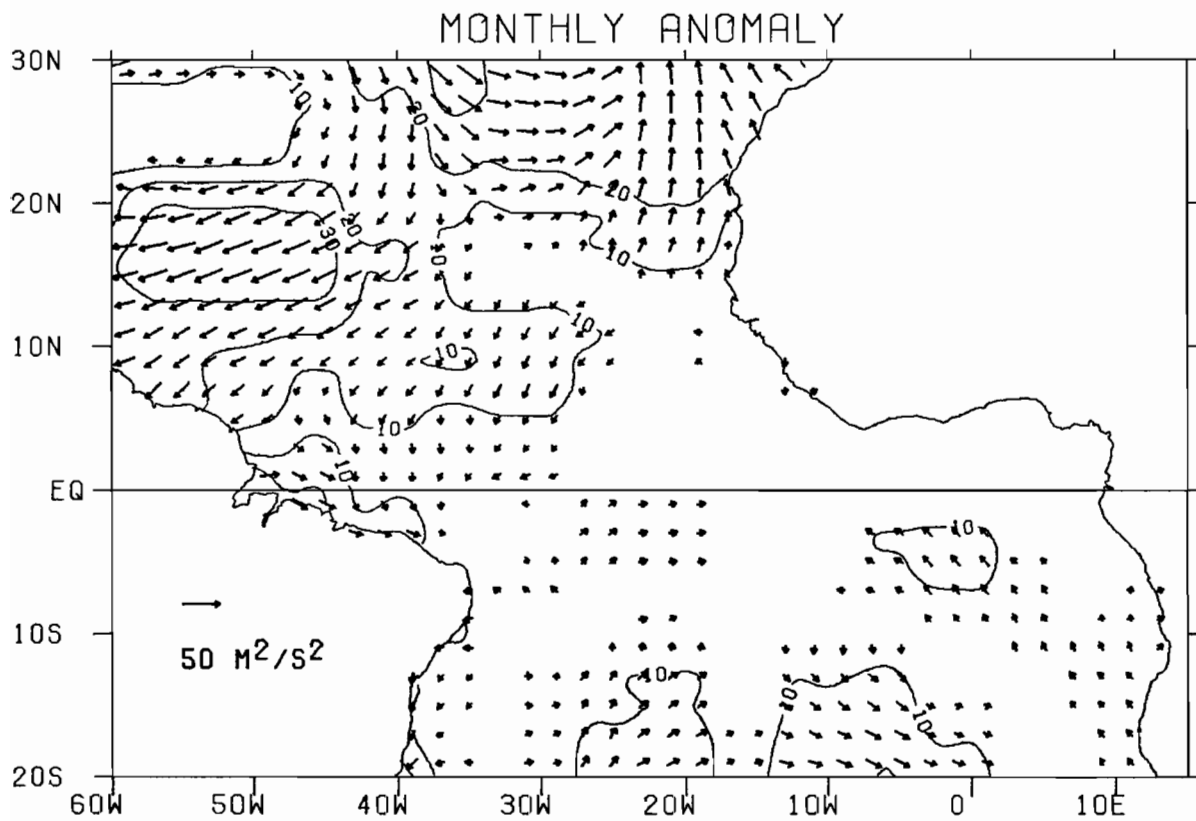
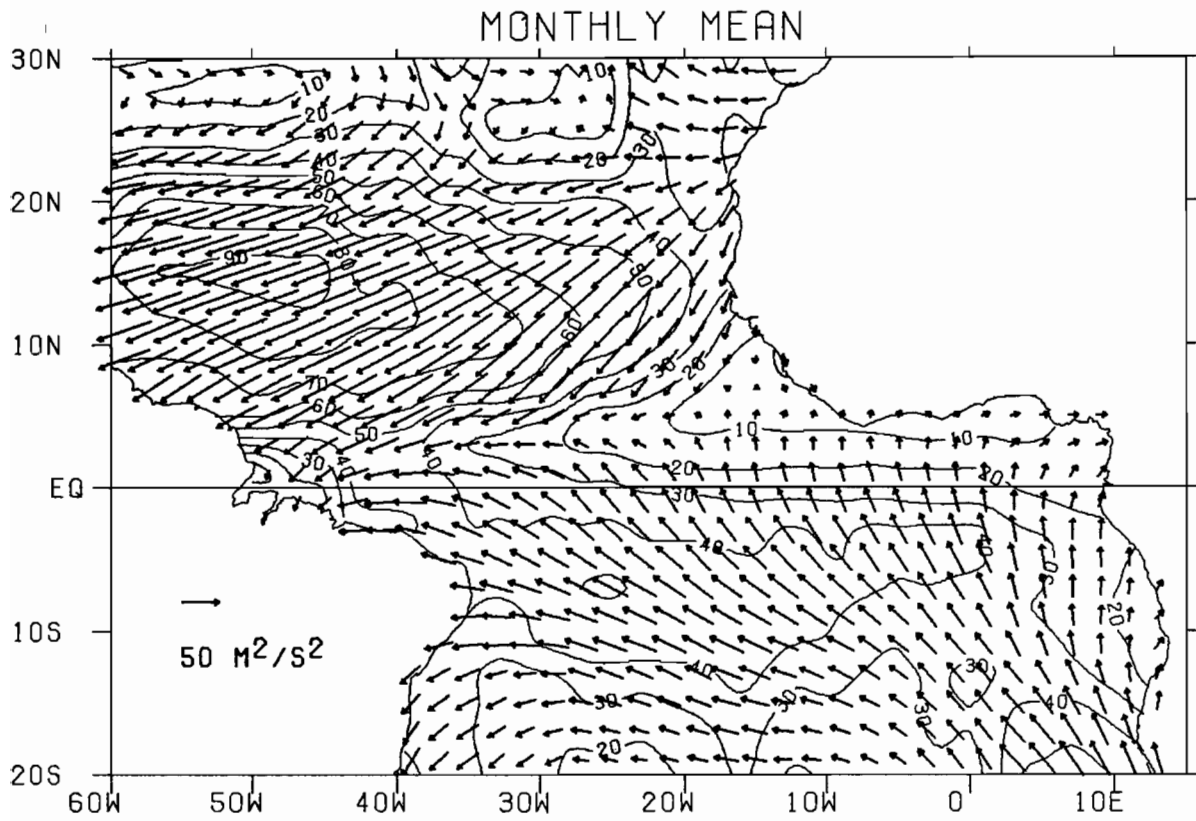


MONTHLY ANOMALY



WIND STRESS

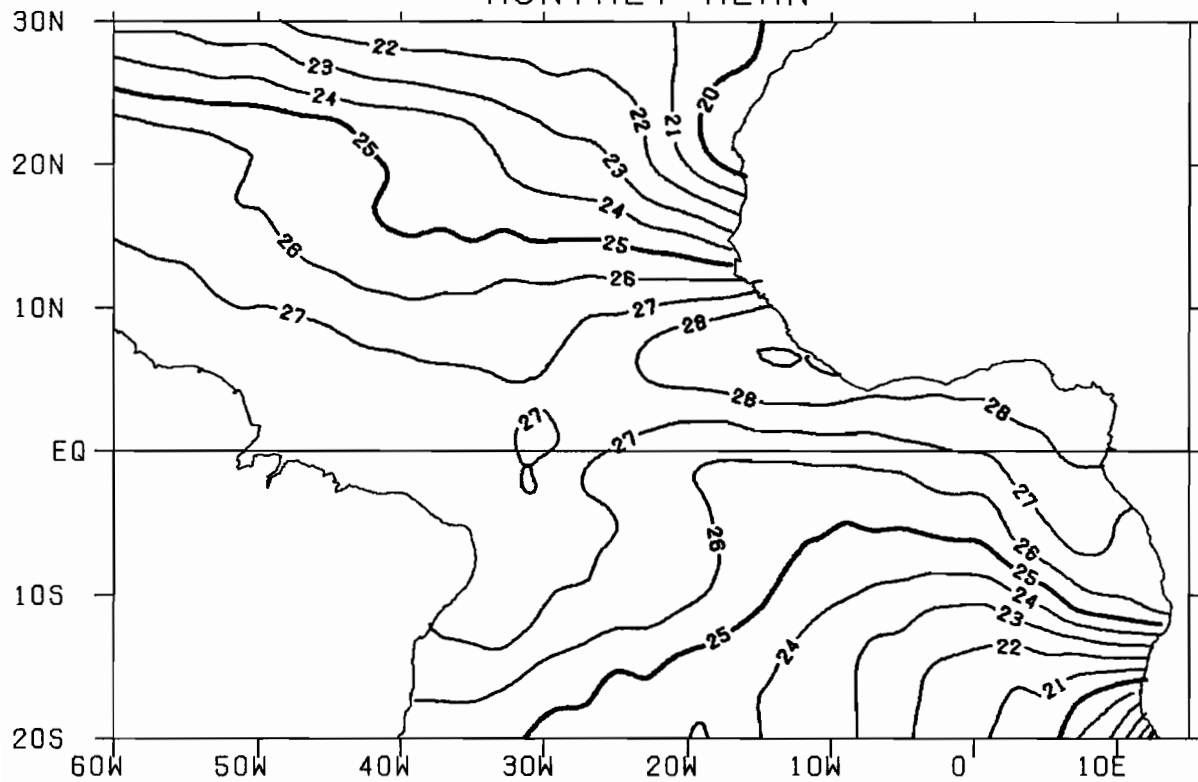
DECEMBER 1988



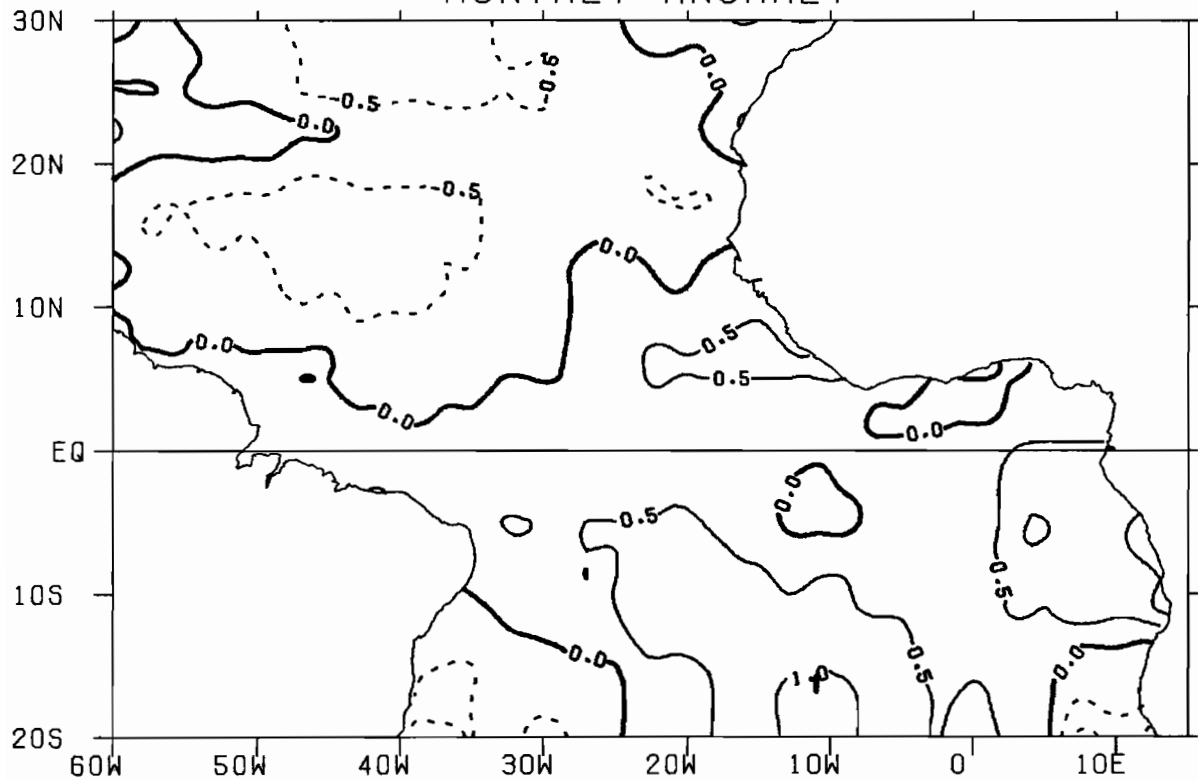
SEA SURFACE TEMPERATURE

DECEMBER 1988

MONTHLY MEAN



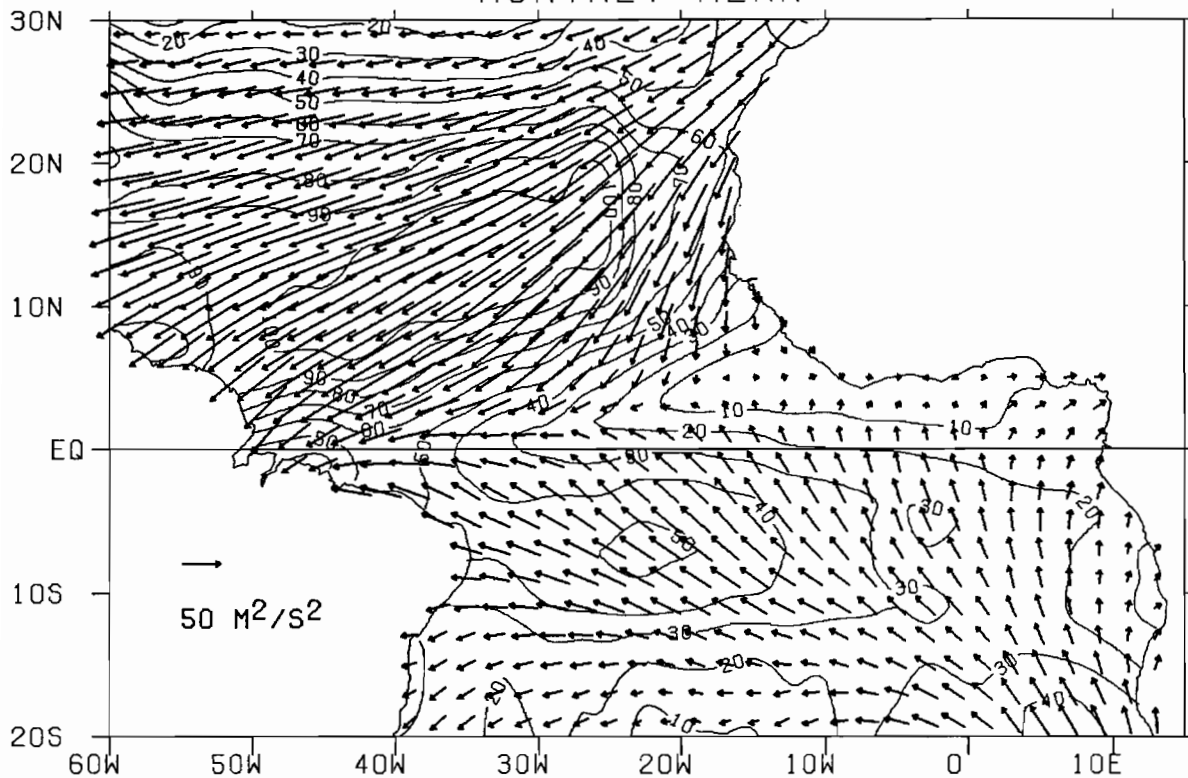
MONTHLY ANOMALY



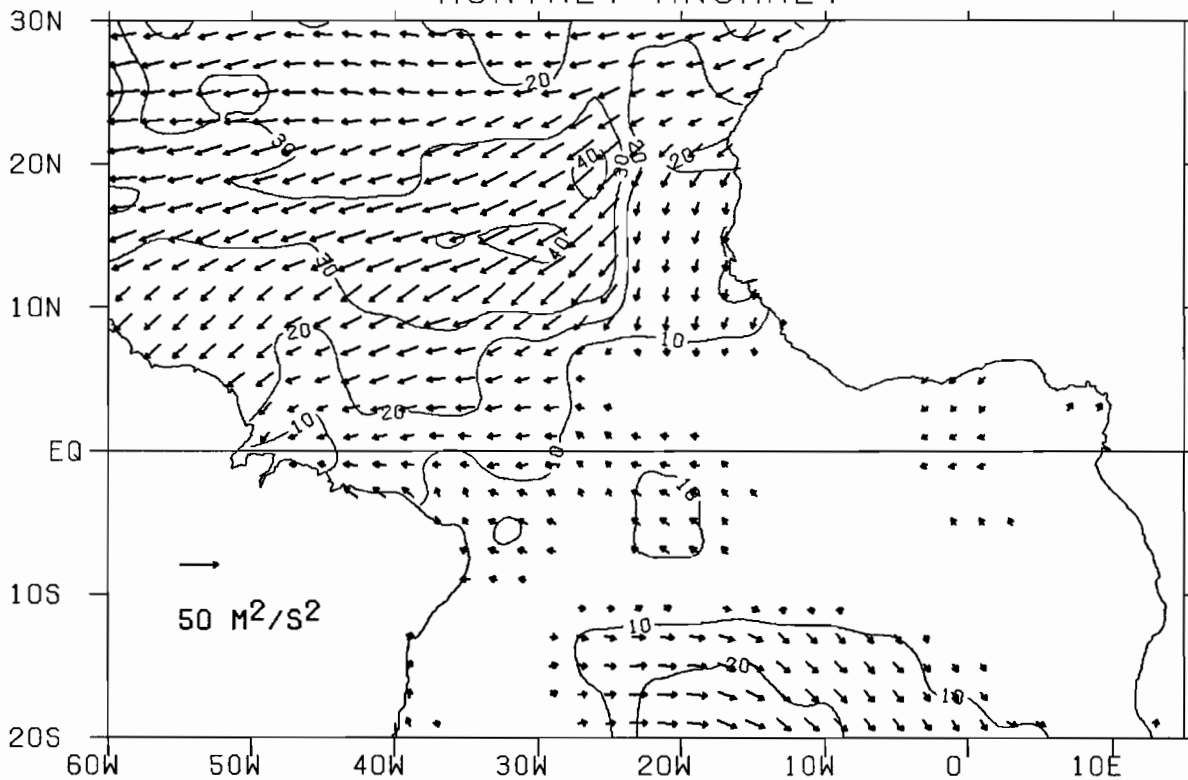
WIND STRESS

JANUARY 1989

MONTHLY MEAN



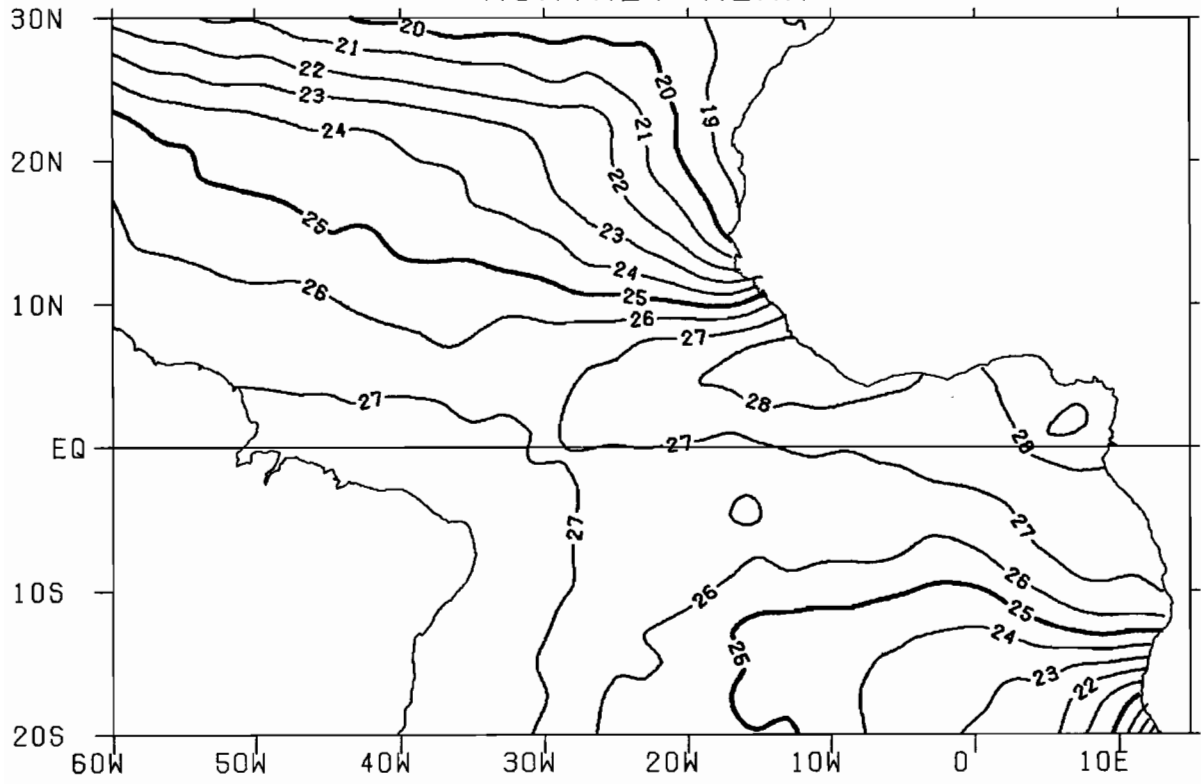
MONTHLY ANOMALY



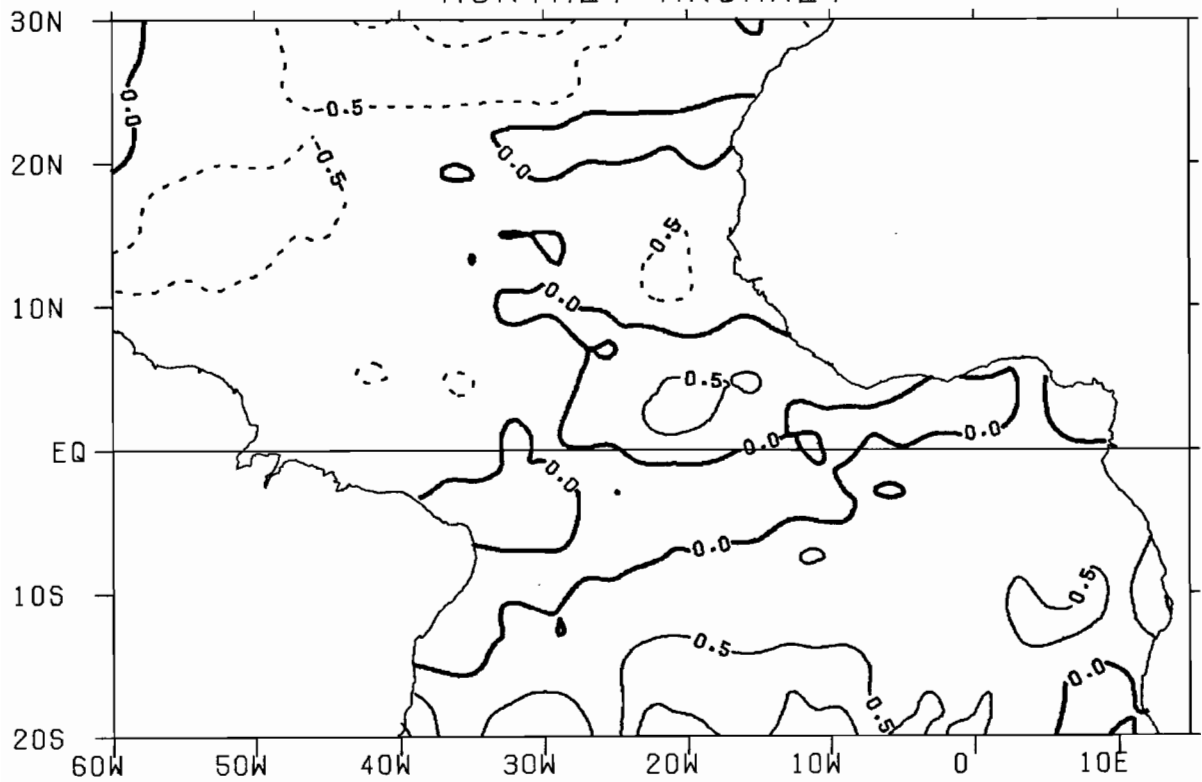
SEA SURFACE TEMPERATURE

JANUARY 1989

MONTHLY MEAN

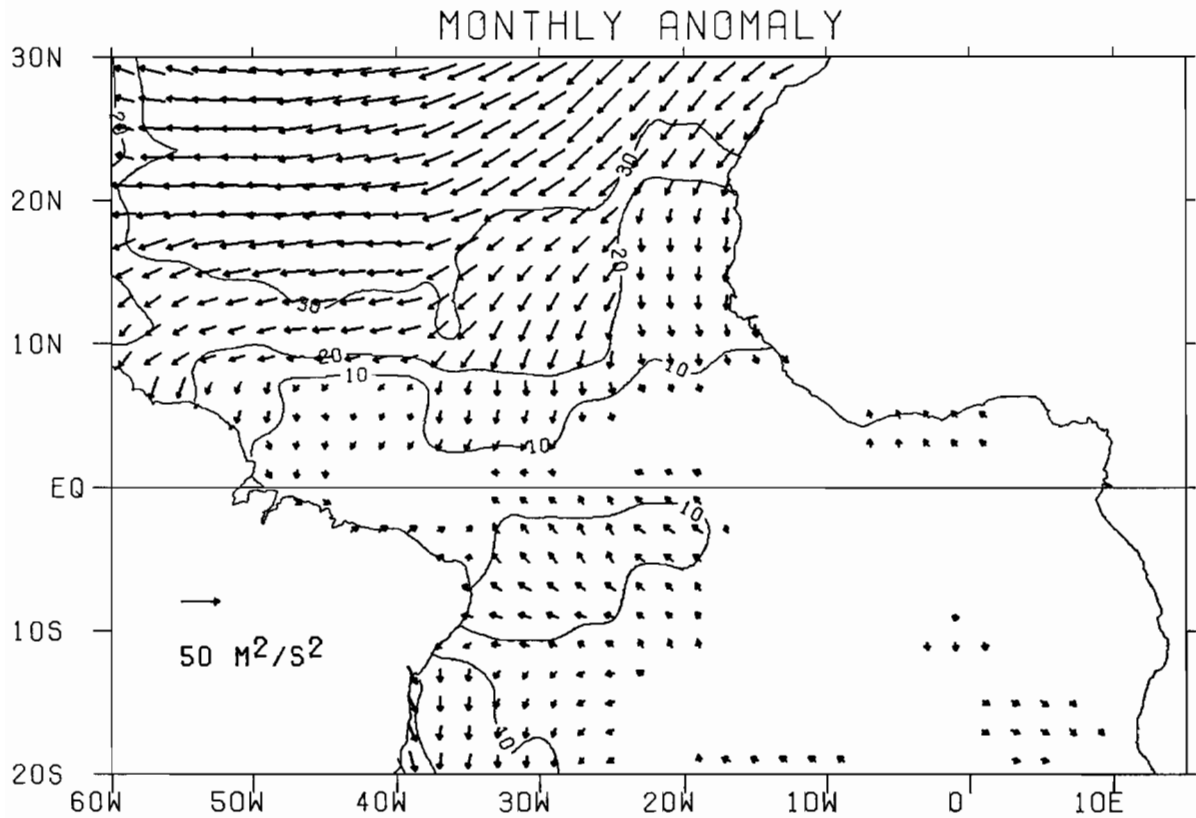
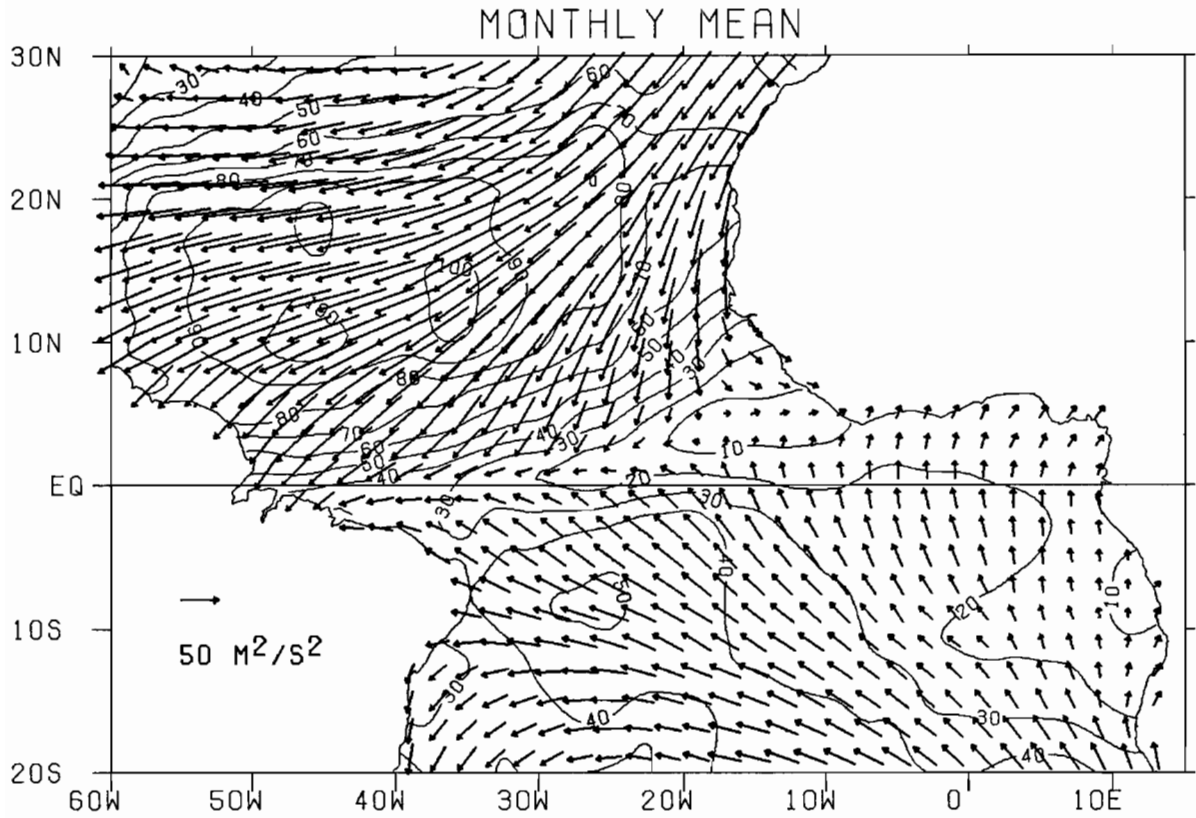


MONTHLY ANOMALY



WIND STRESS

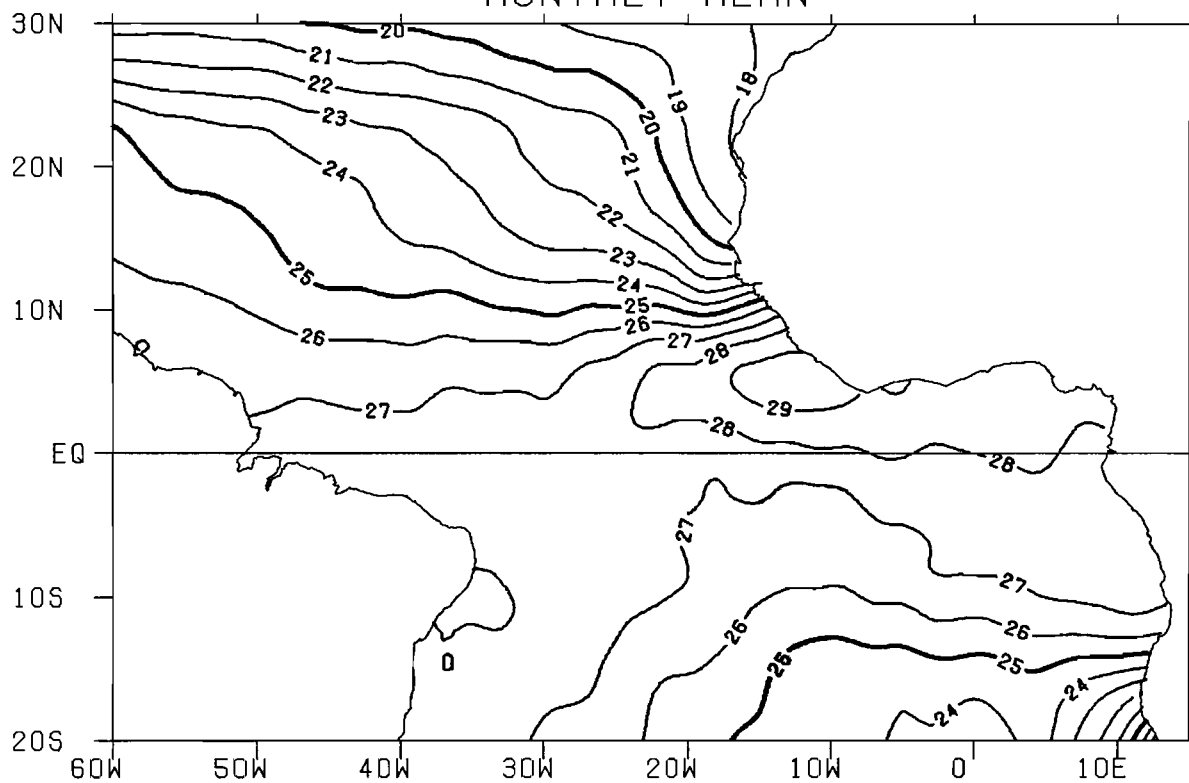
FEBRUARY 1989



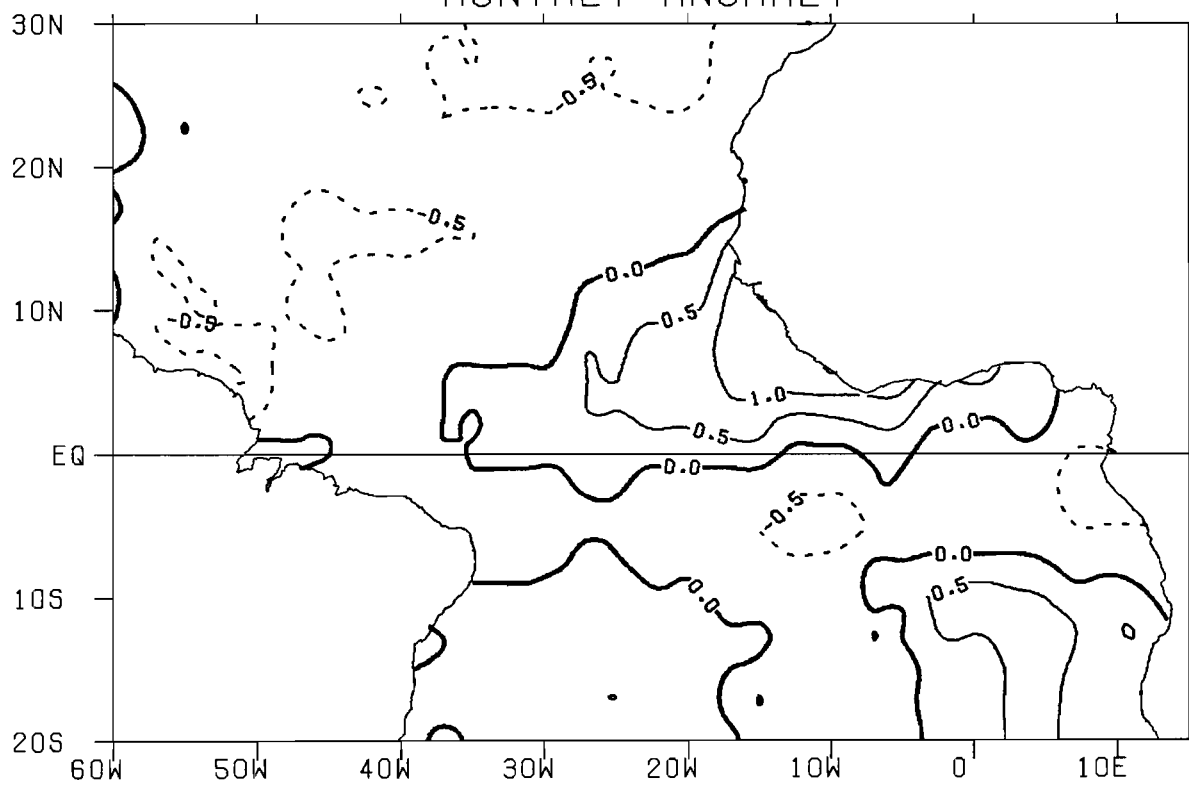
SEA SURFACE TEMPERATURE

FEBRUARY 1989

MONTHLY MEAN



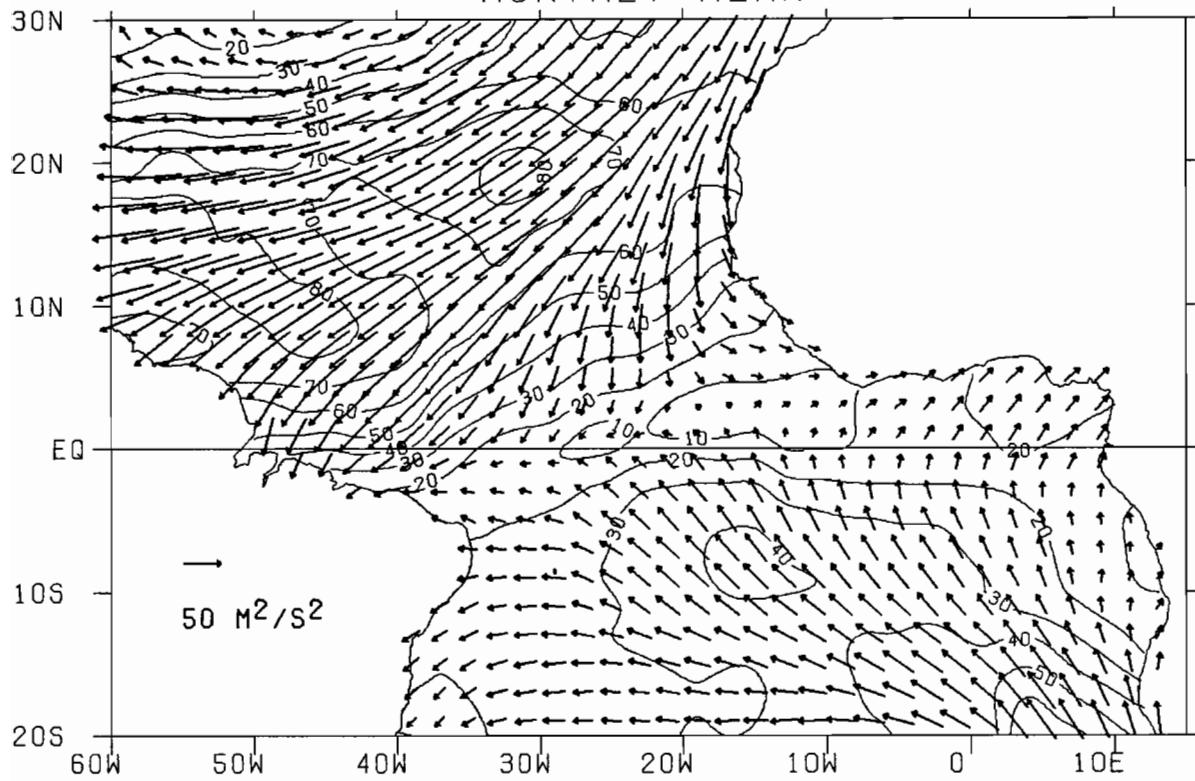
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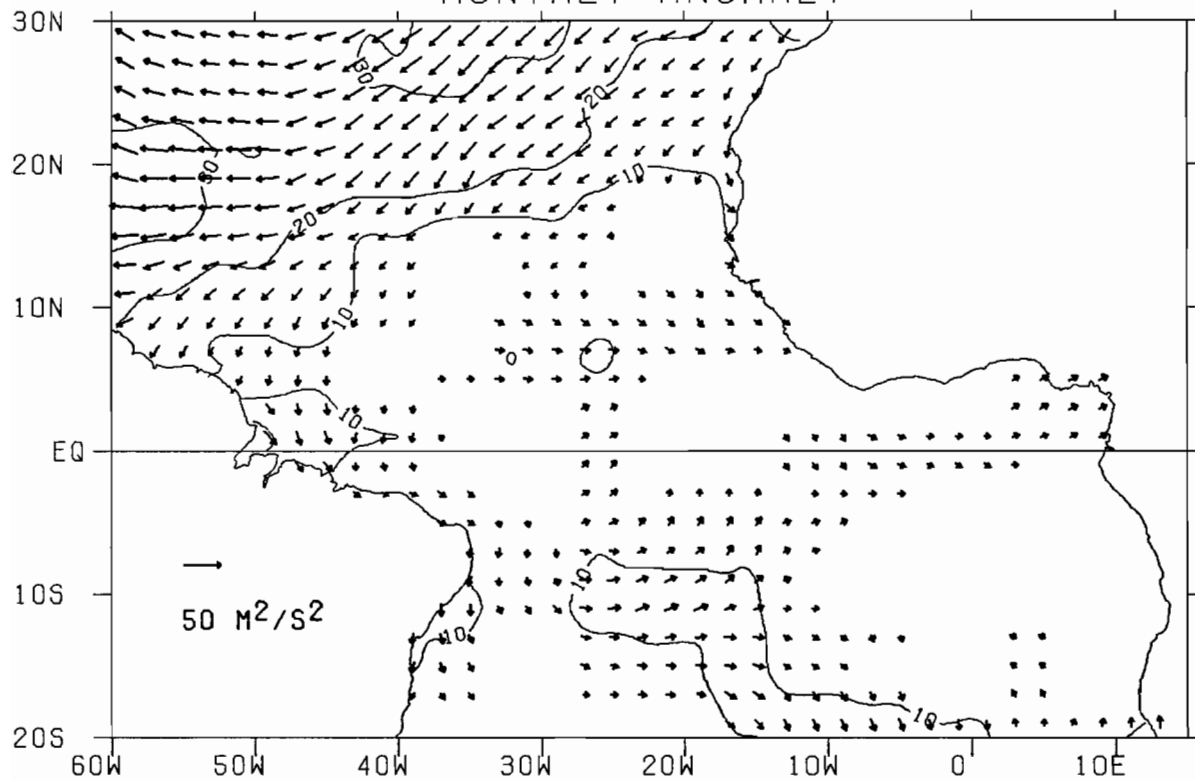
WIND STRESS

MARCH 1989

MONTHLY MEAN



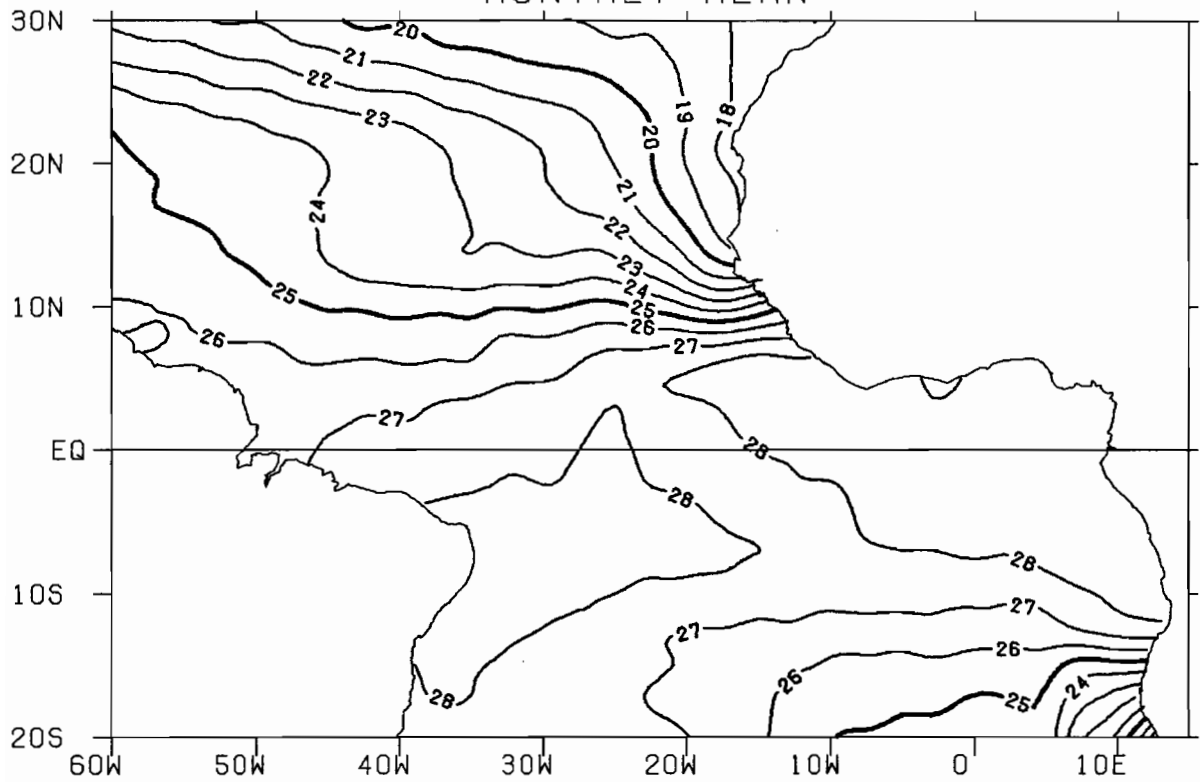
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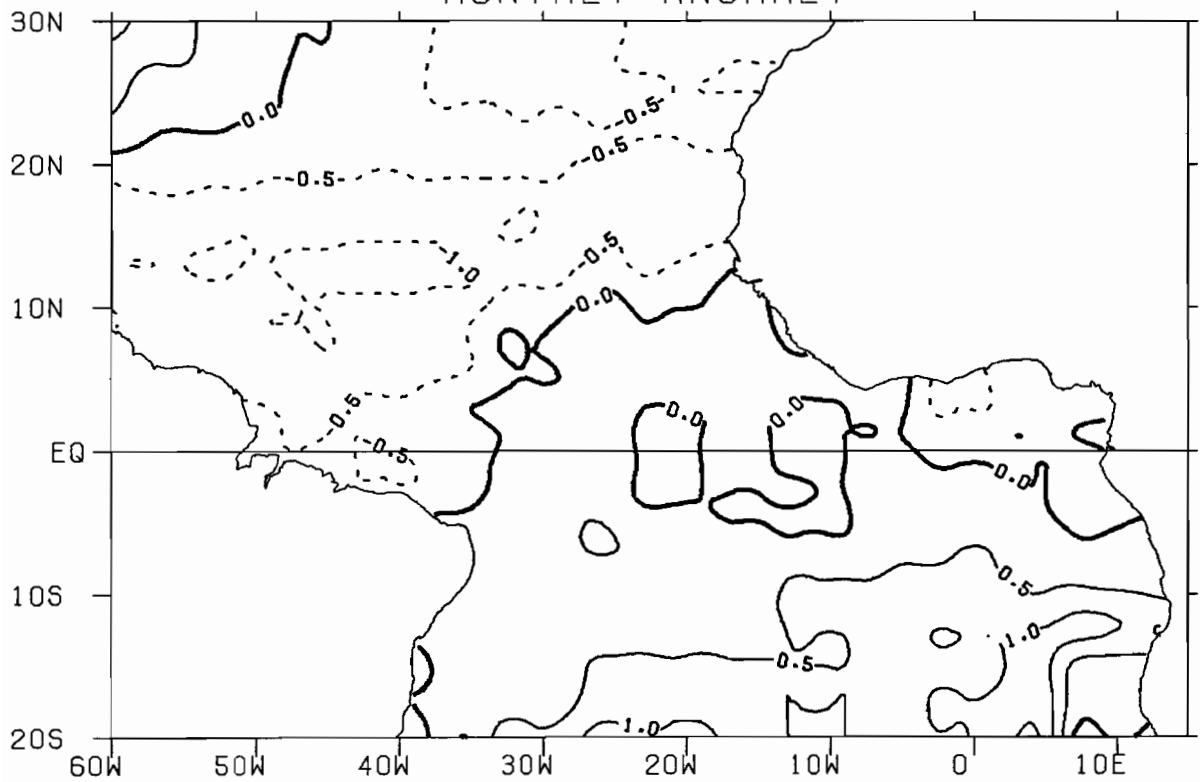
SEA SURFACE TEMPERATURE

MARCH 1989

MONTHLY MEAN

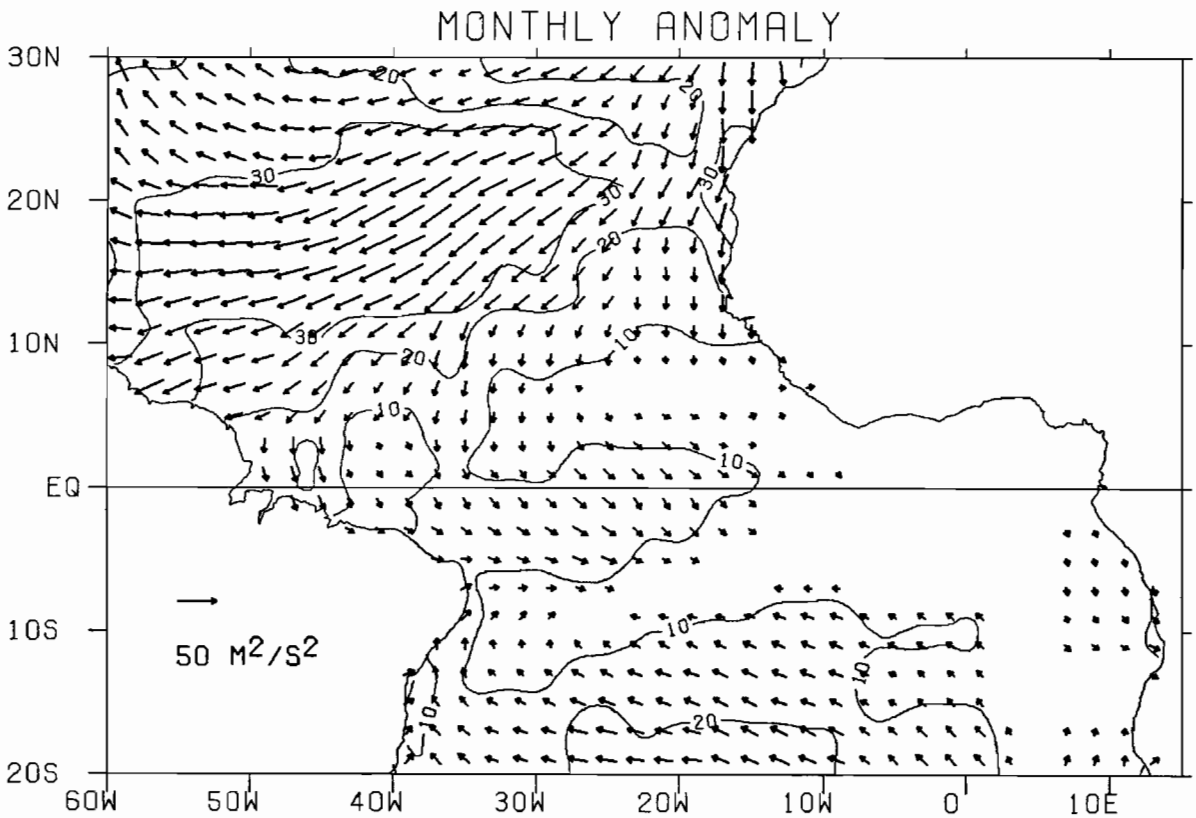
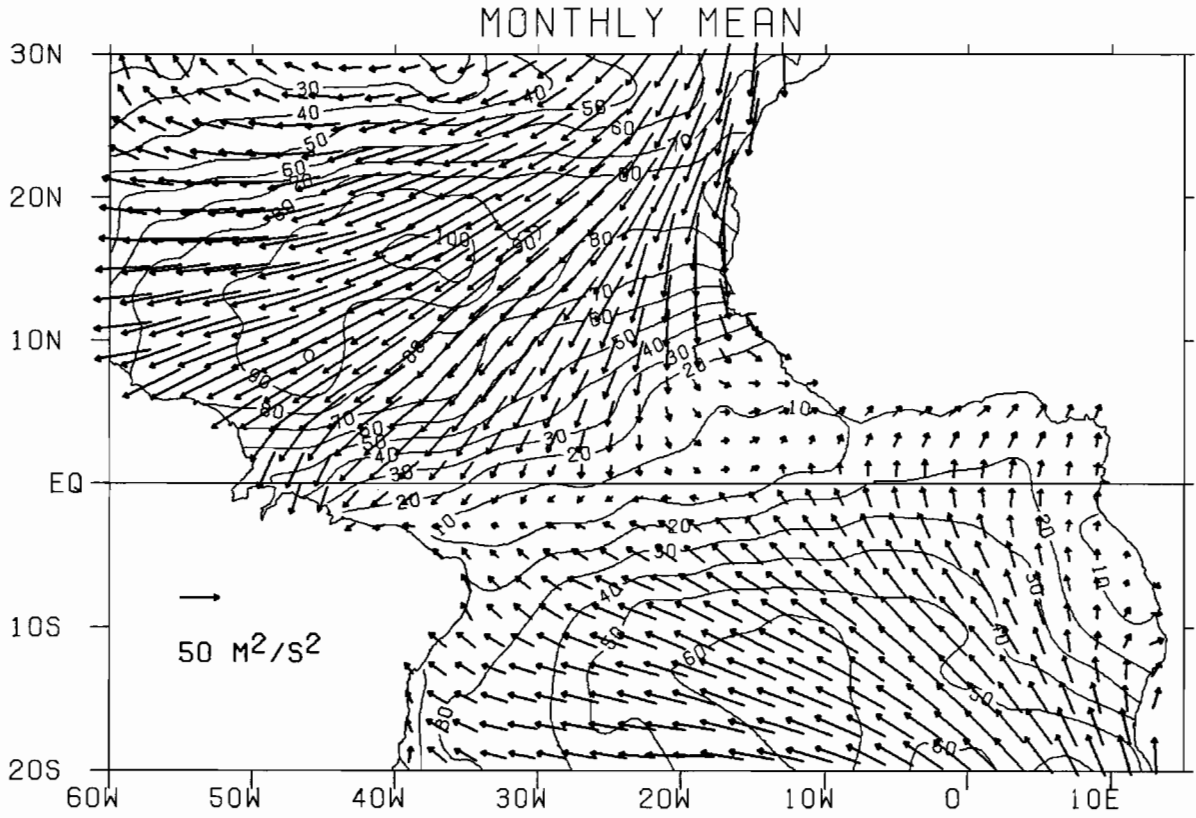


MONTHLY ANOMALY



WIND STRESS

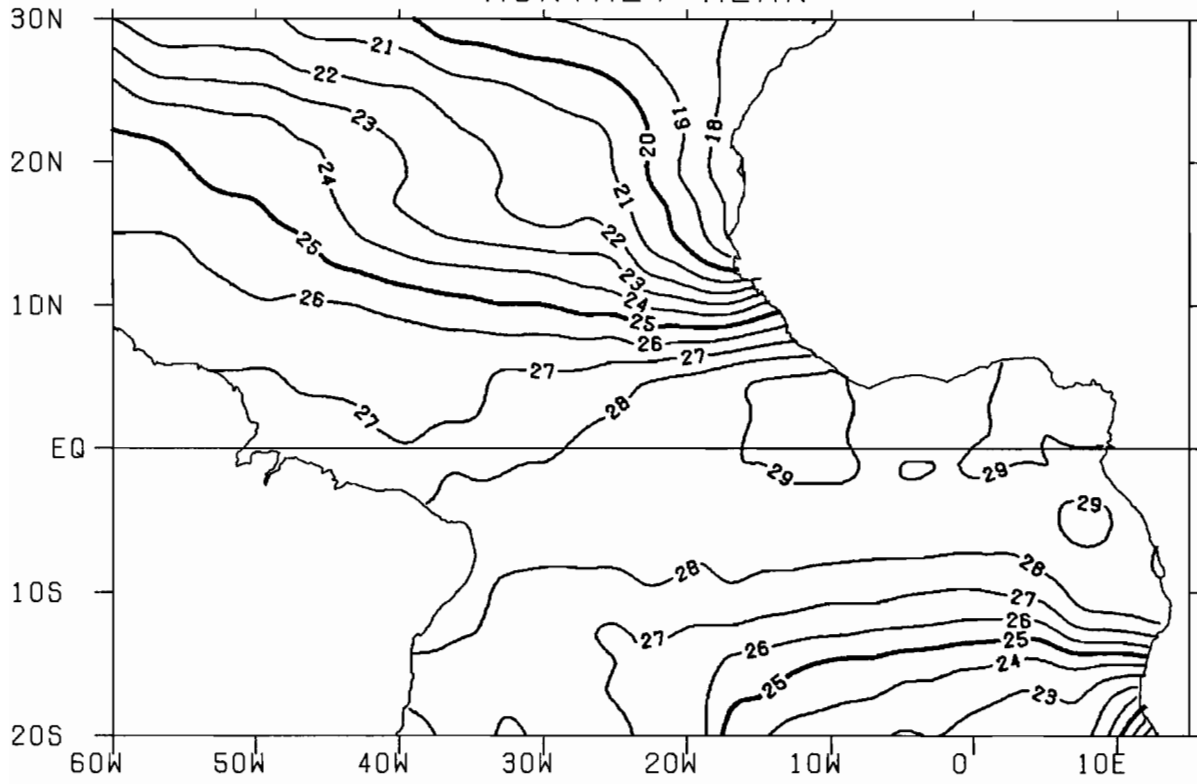
APRIL 1989



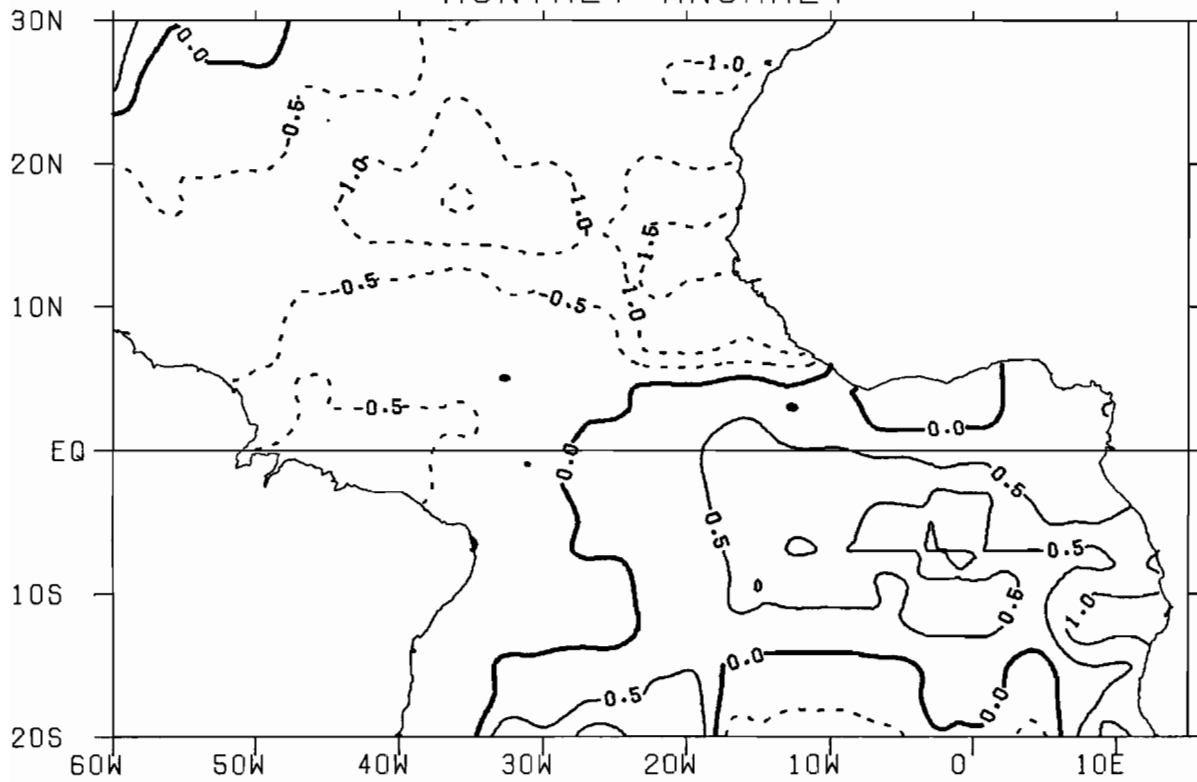
SEA SURFACE TEMPERATURE

APRIL 1989

MONTHLY MEAN

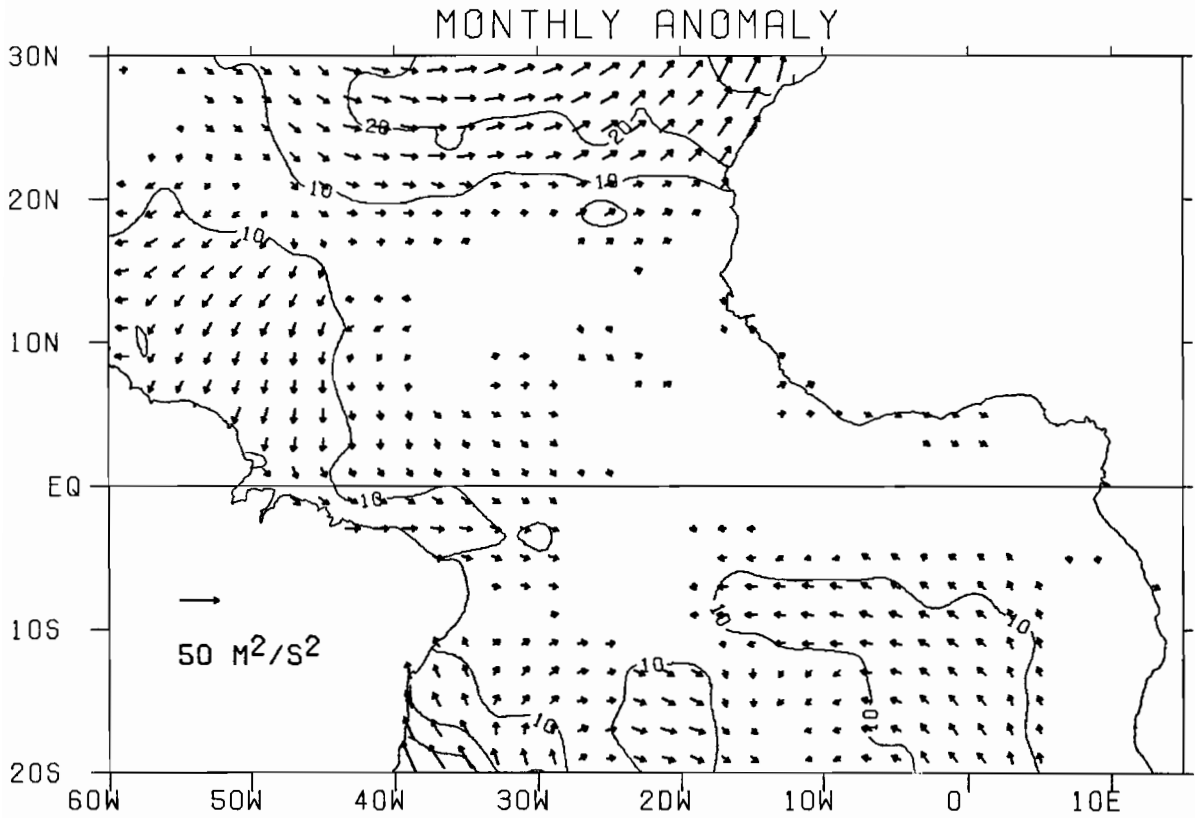
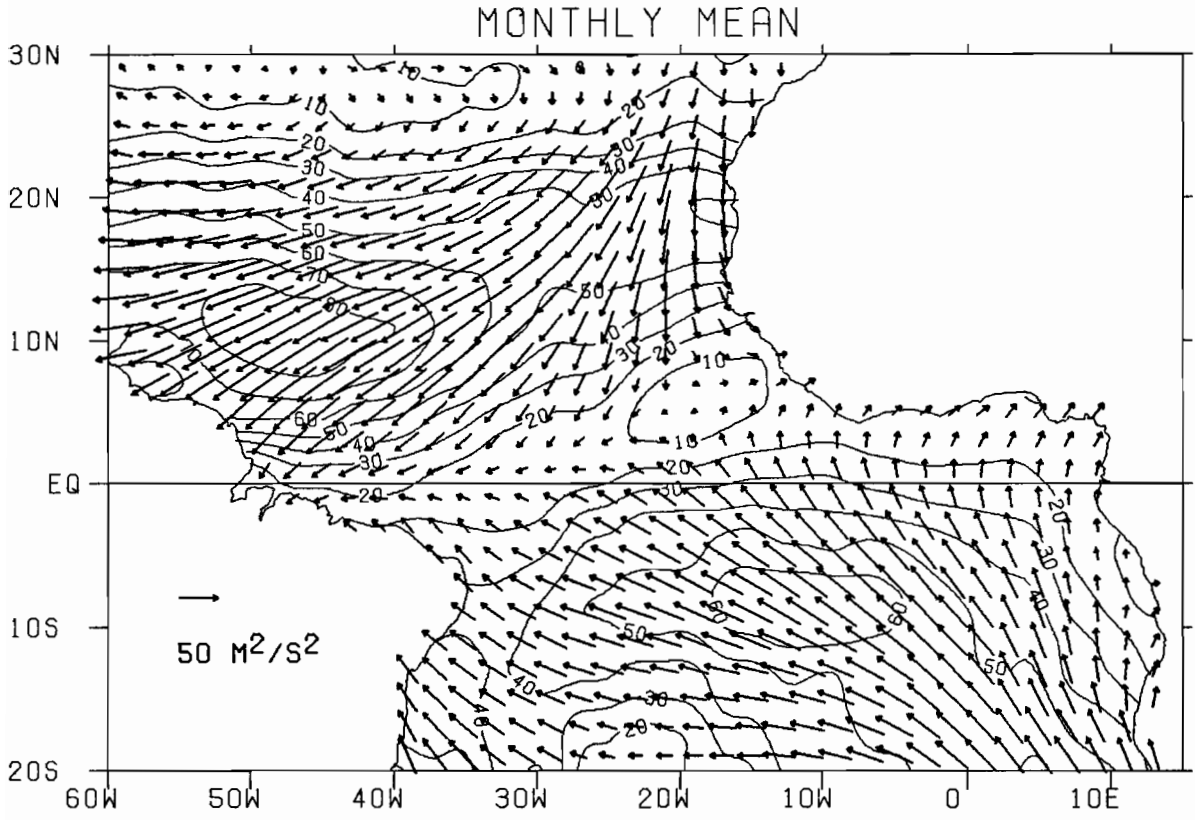


MONTHLY ANOMALY



WIND STRESS

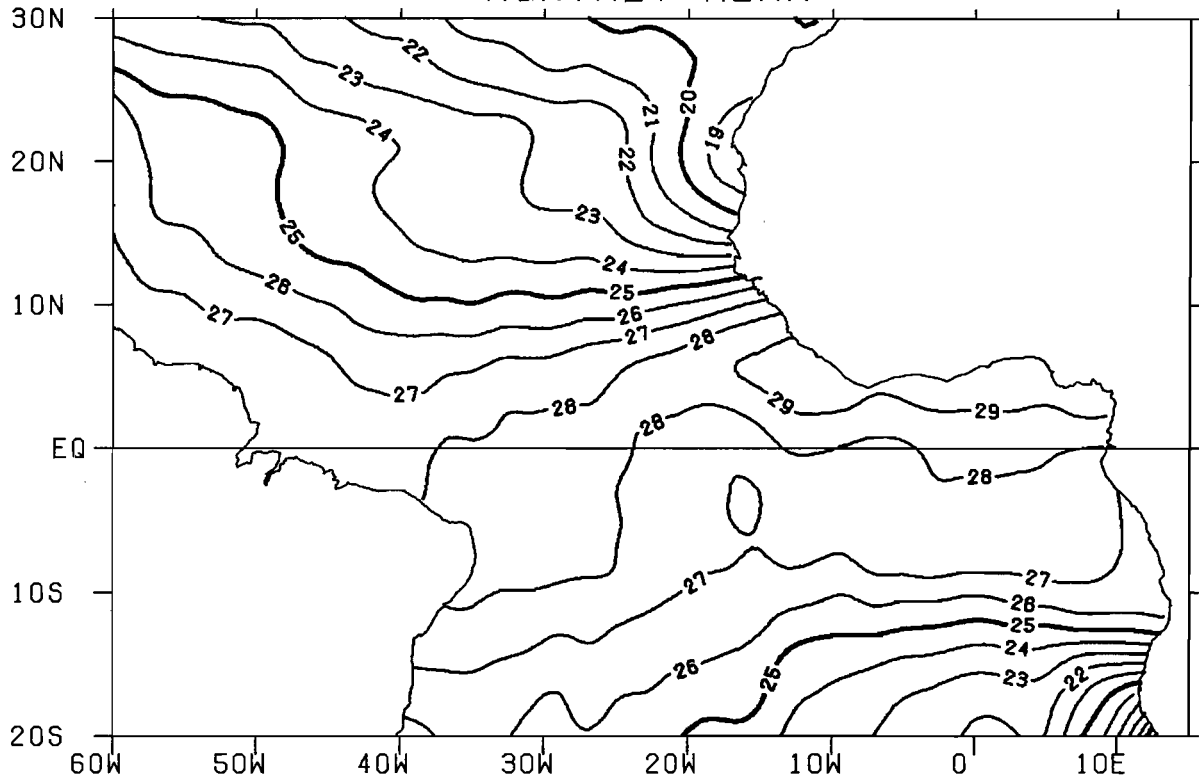
MAY 1989



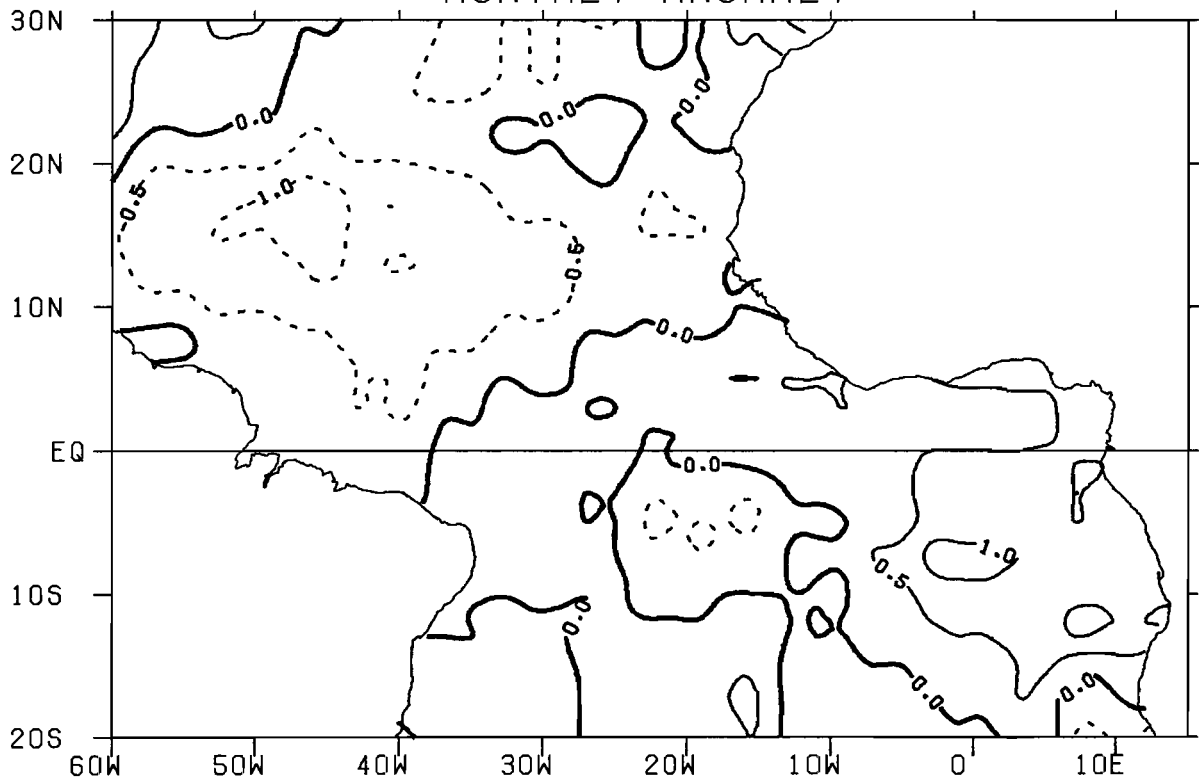
SEA SURFACE TEMPERATURE

MAY 1989

MONTHLY MEAN

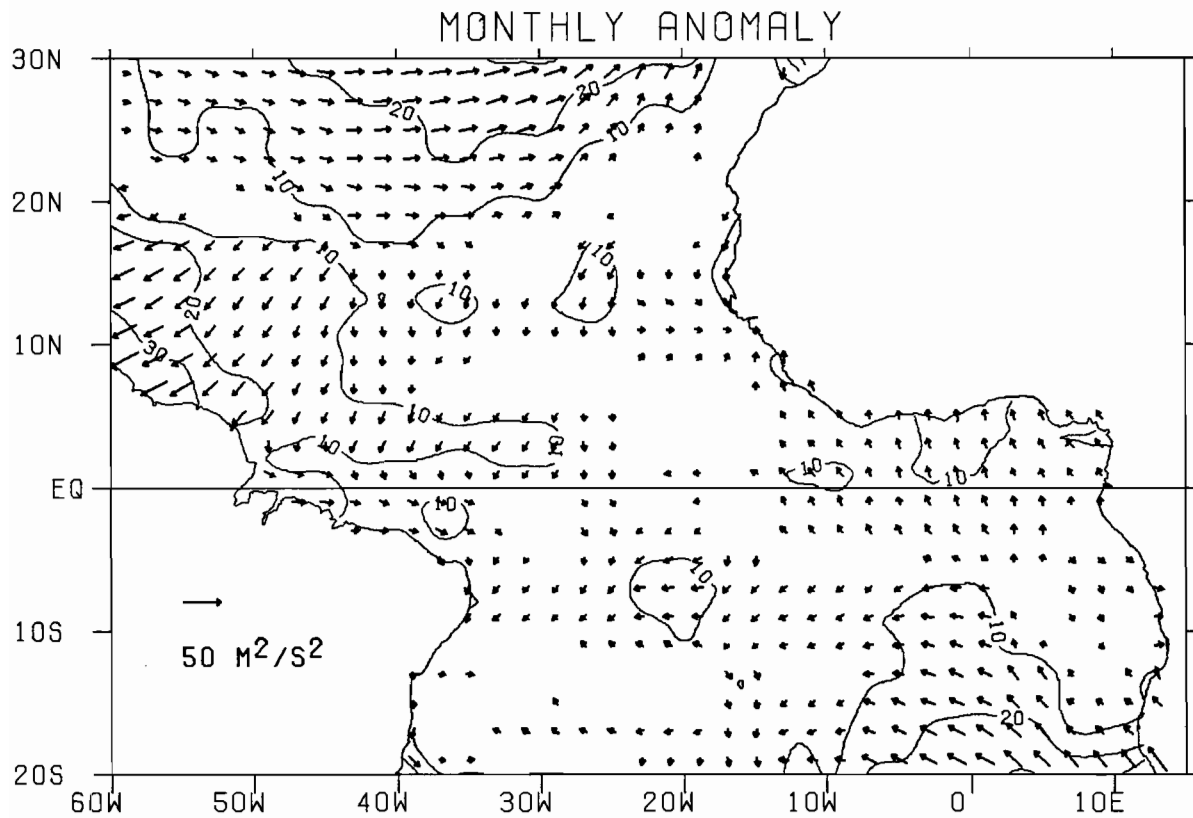
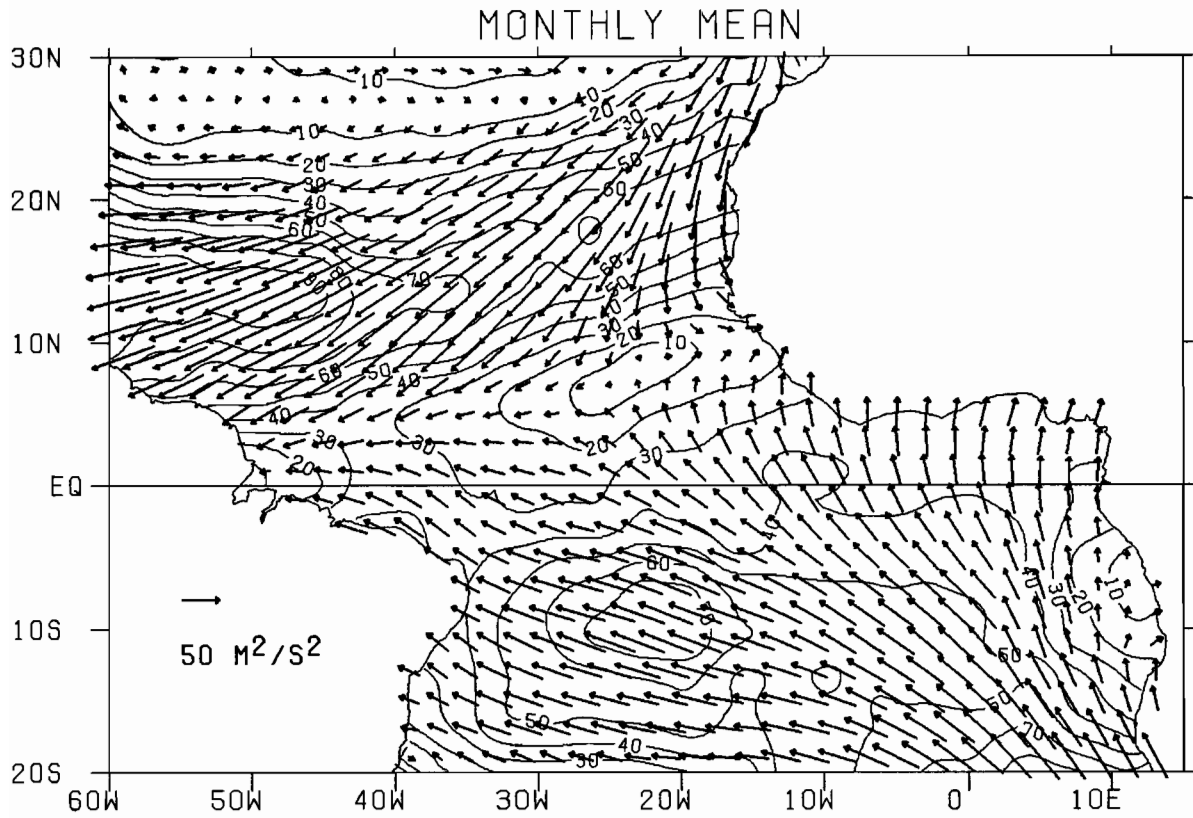


MONTHLY ANOMALY



WIND STRESS

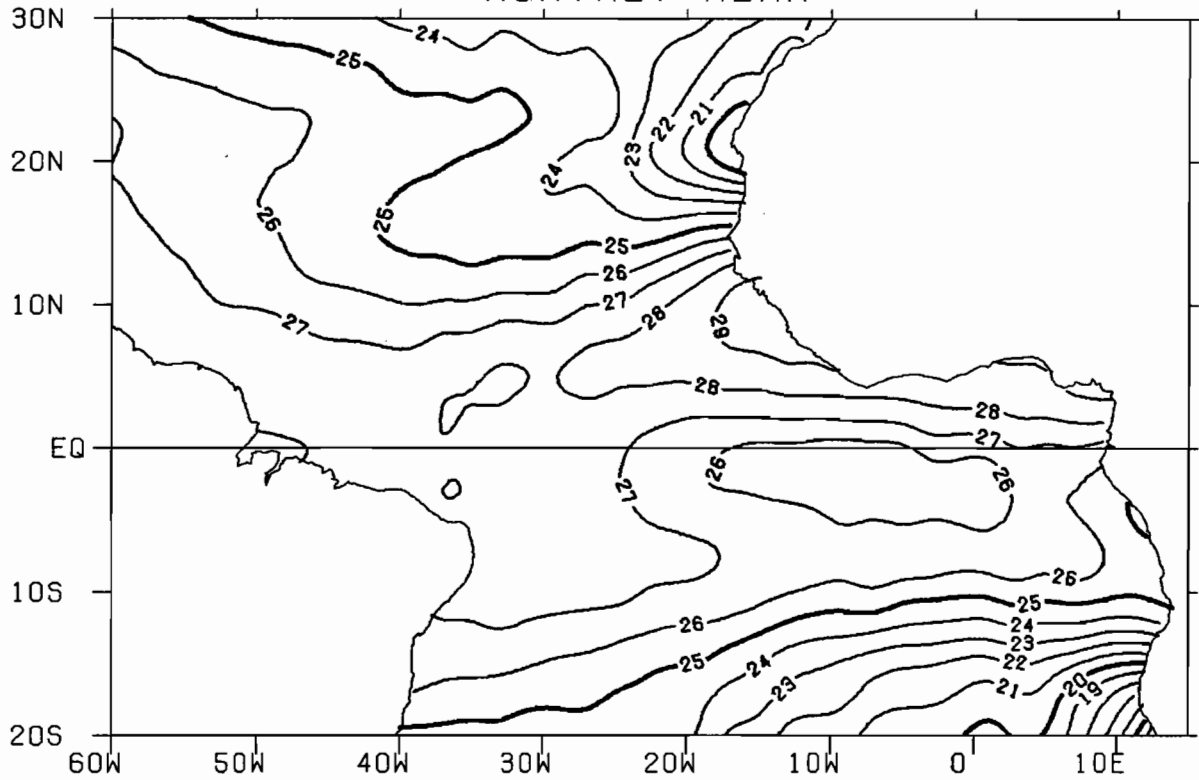
JUNE 1989



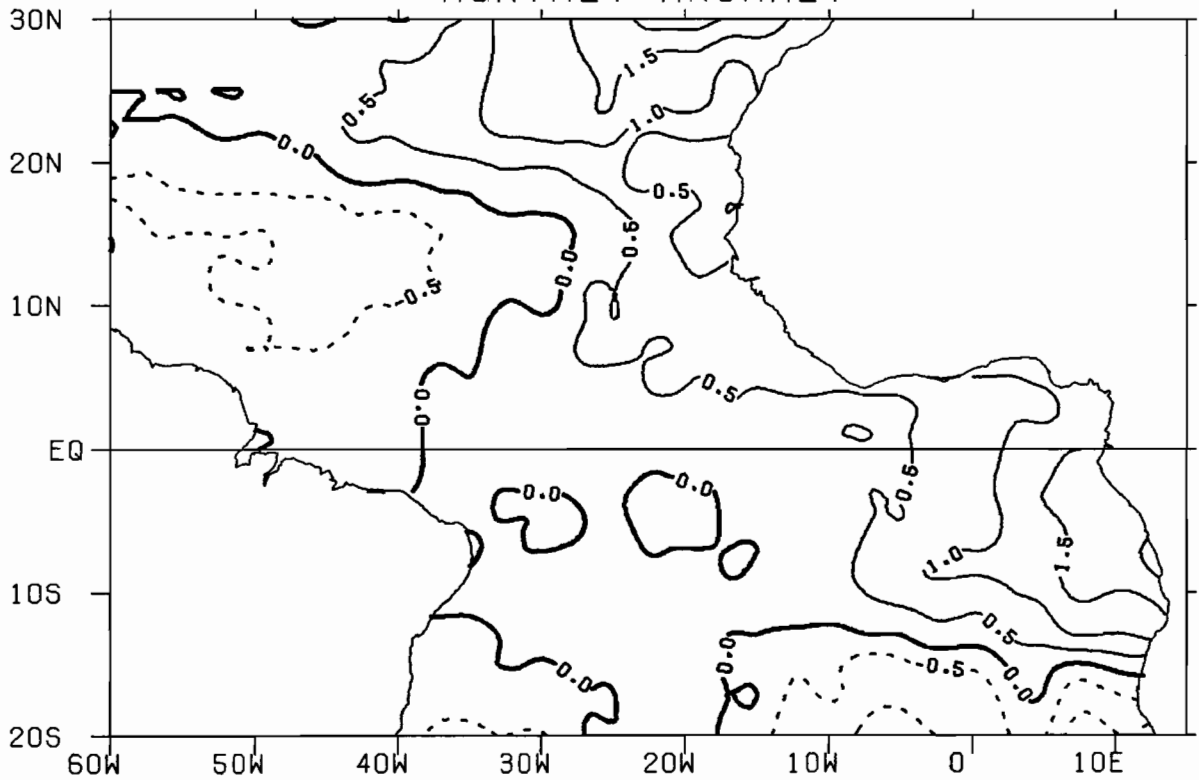
SEA SURFACE TEMPERATURE

JUNE 1989

MONTHLY MEAN



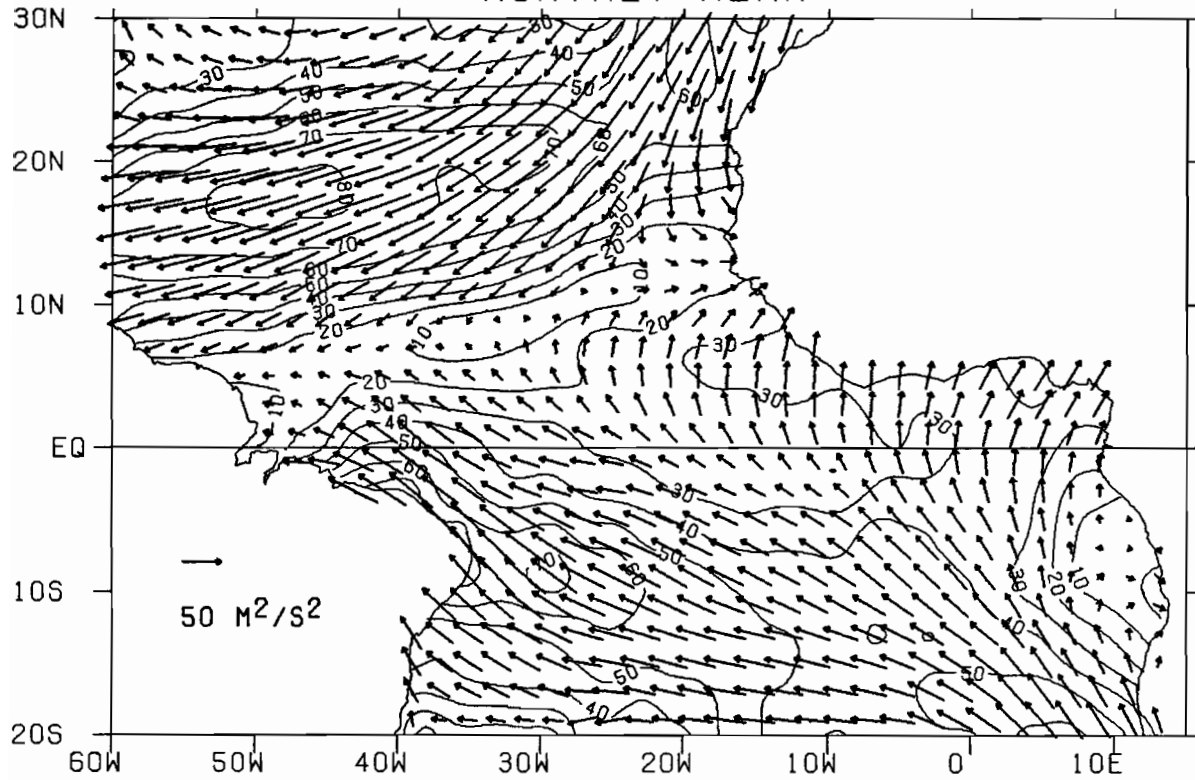
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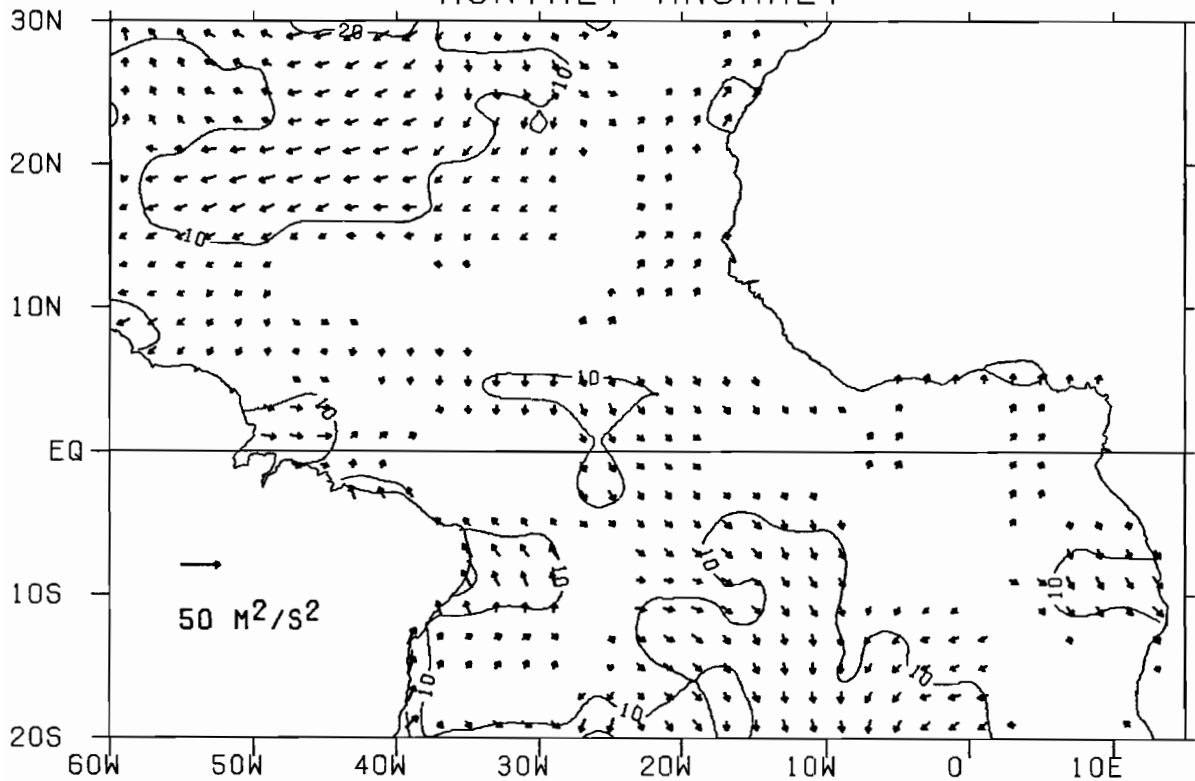
WIND STRESS

JULY 1989

MONTHLY MEAN



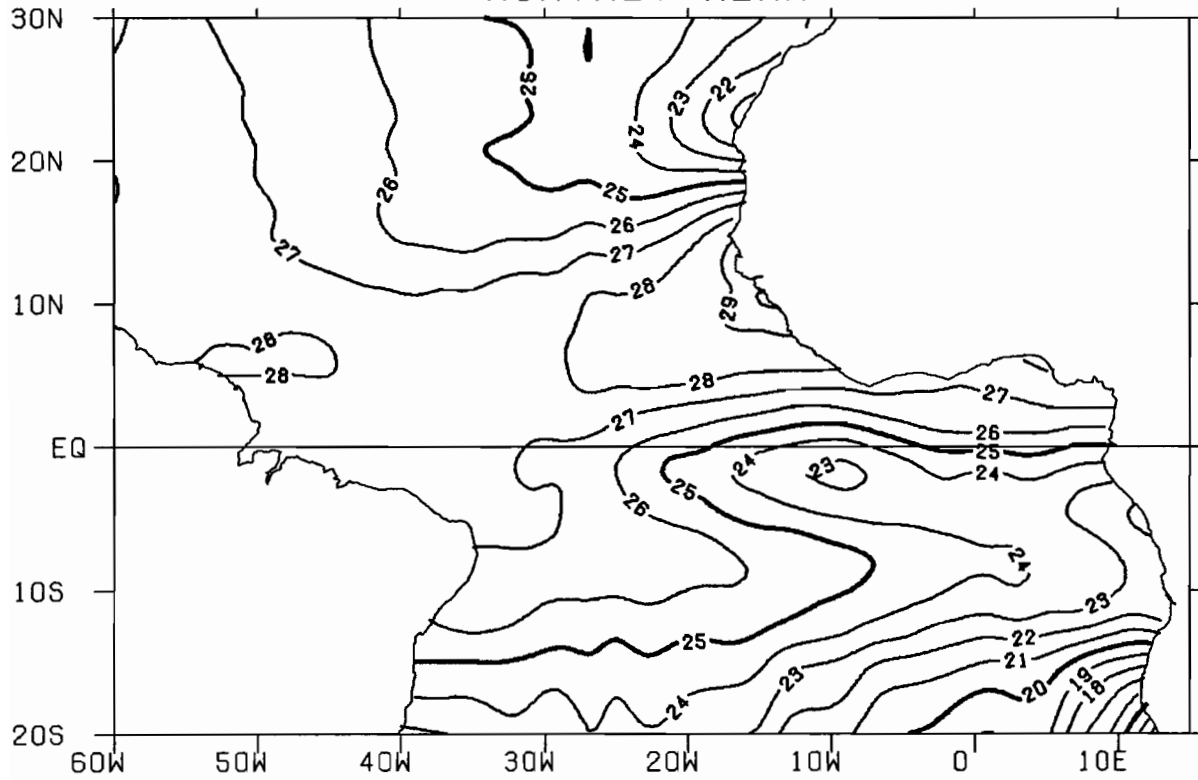
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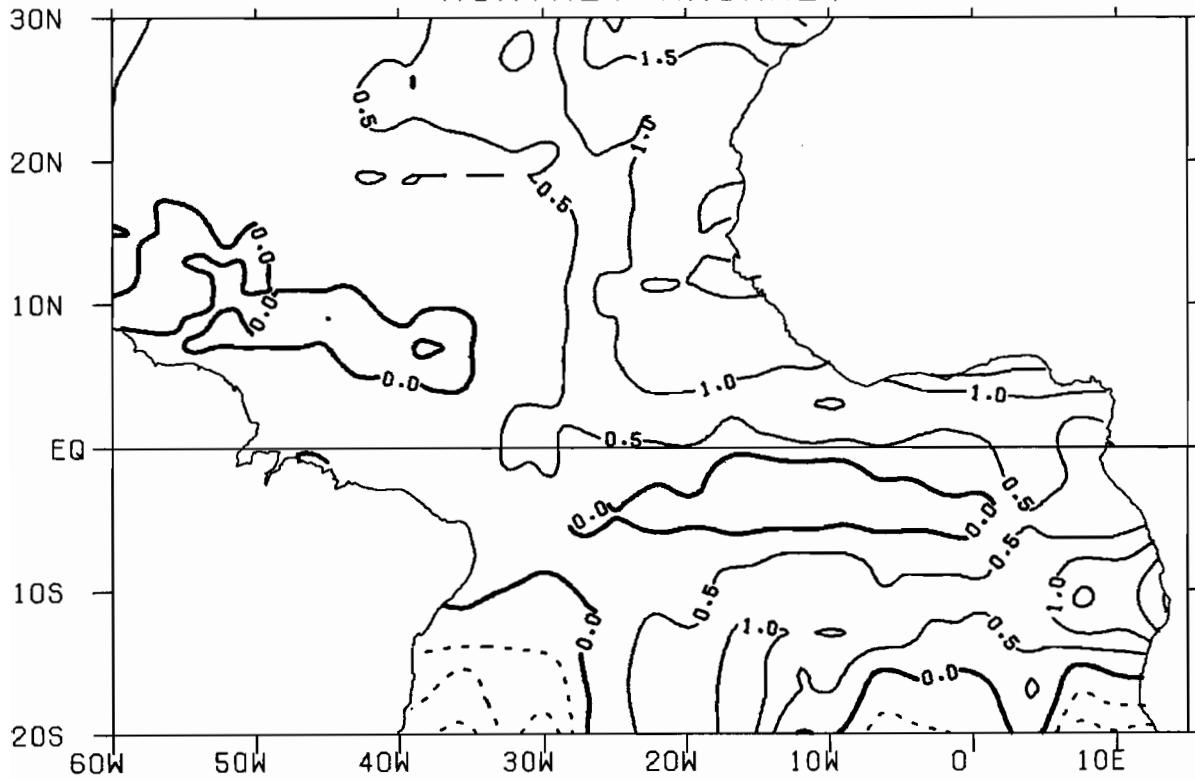
SEA SURFACE TEMPERATURE

JULY 1989

MONTHLY MEAN

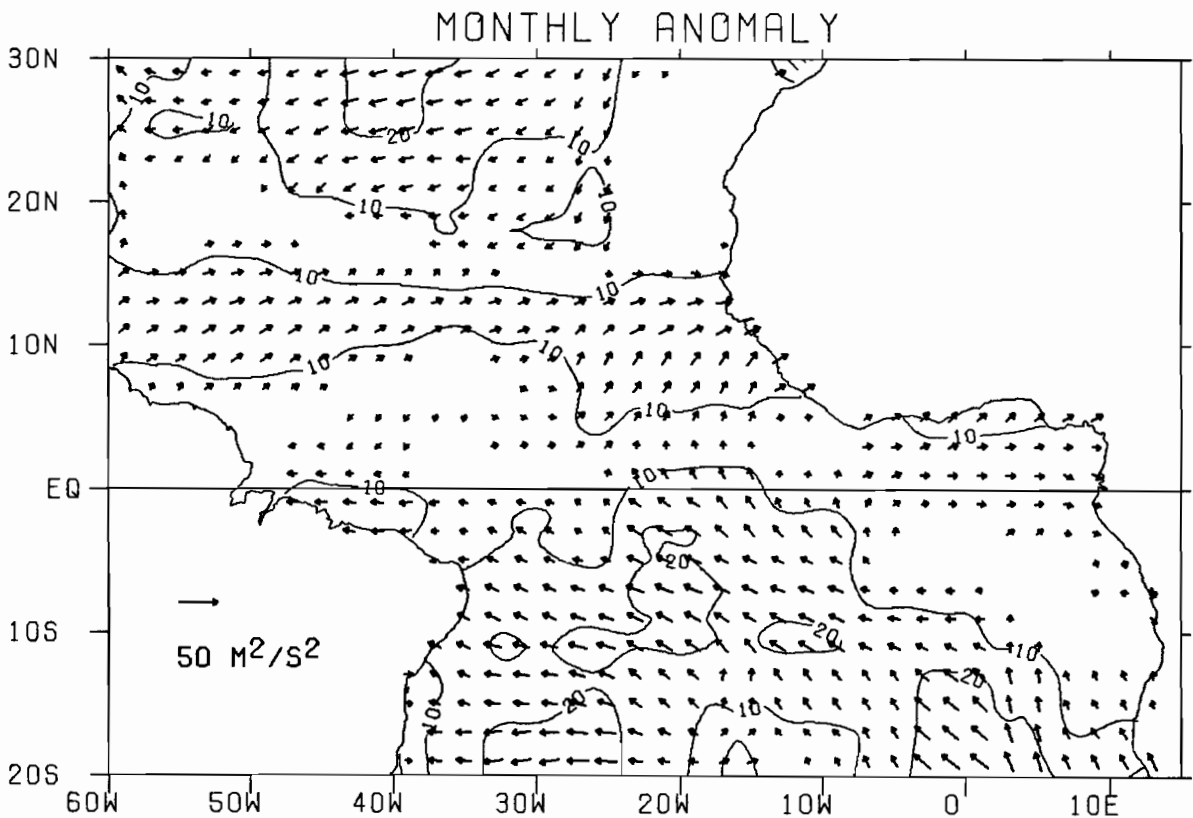
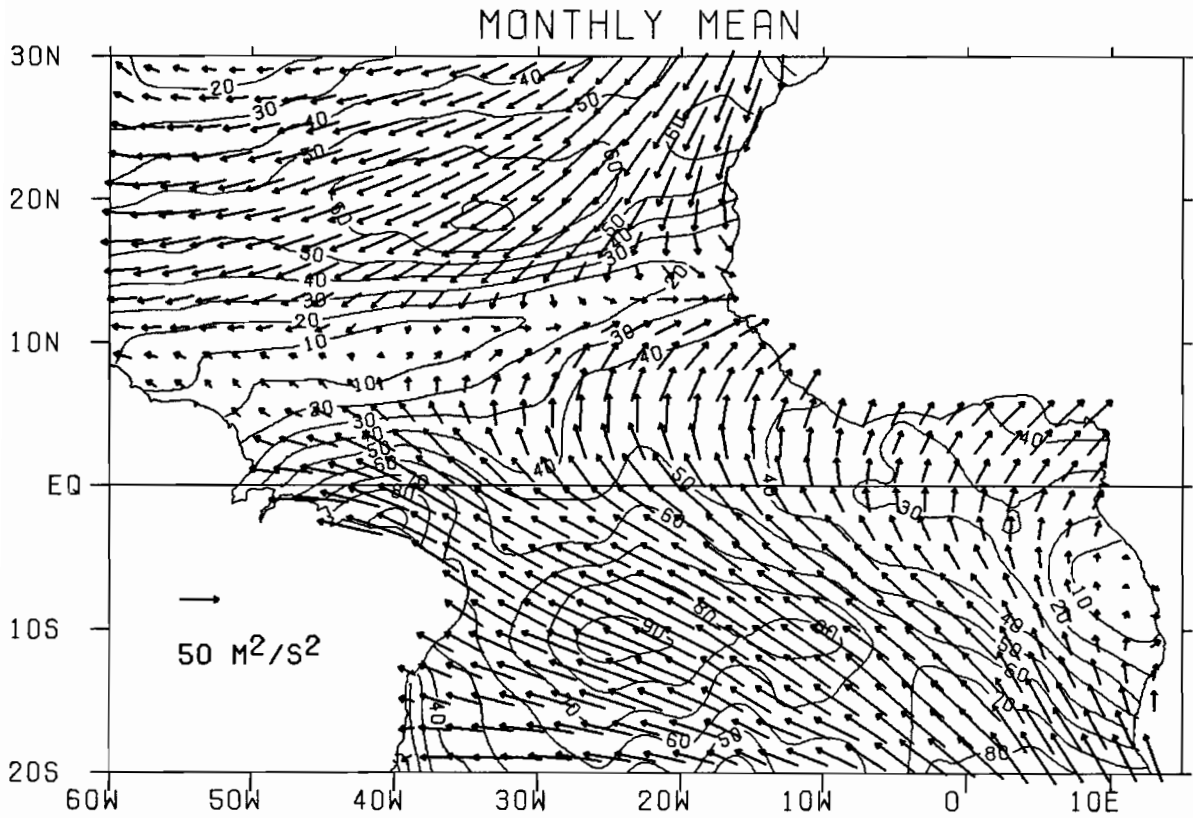


MONTHLY ANOMALY



WIND STRESS

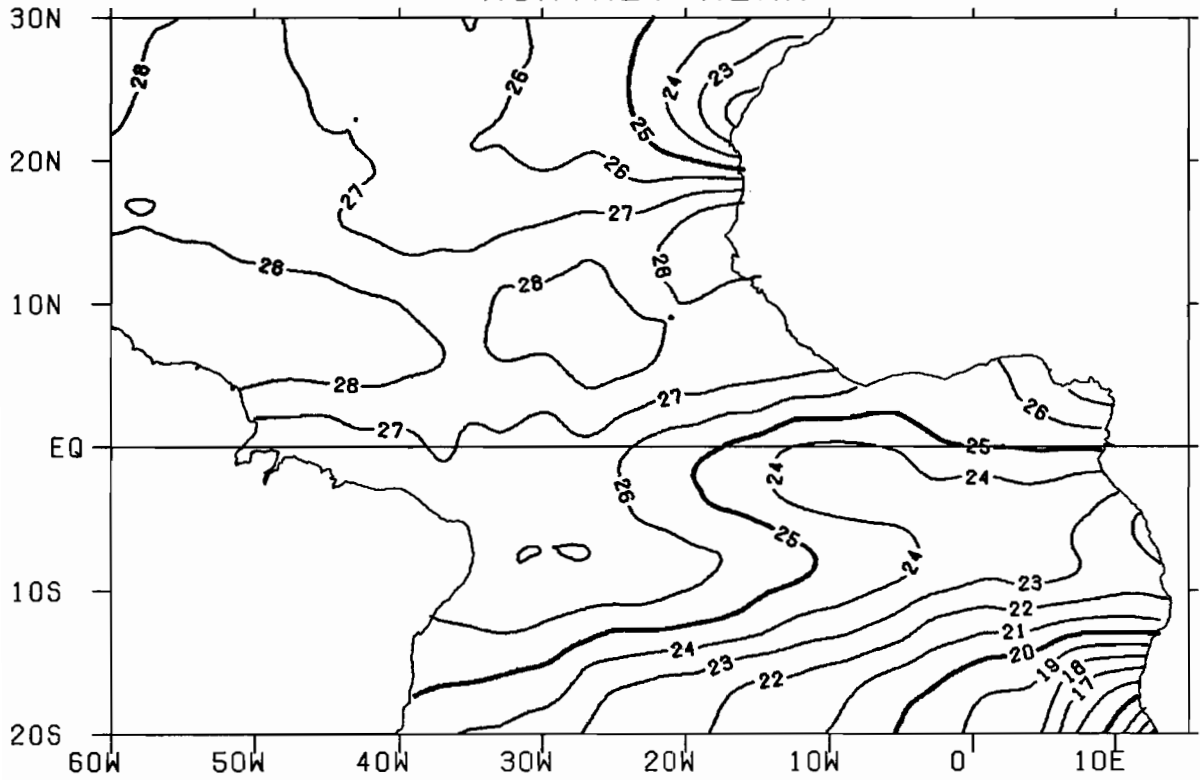
AUGUST 1989



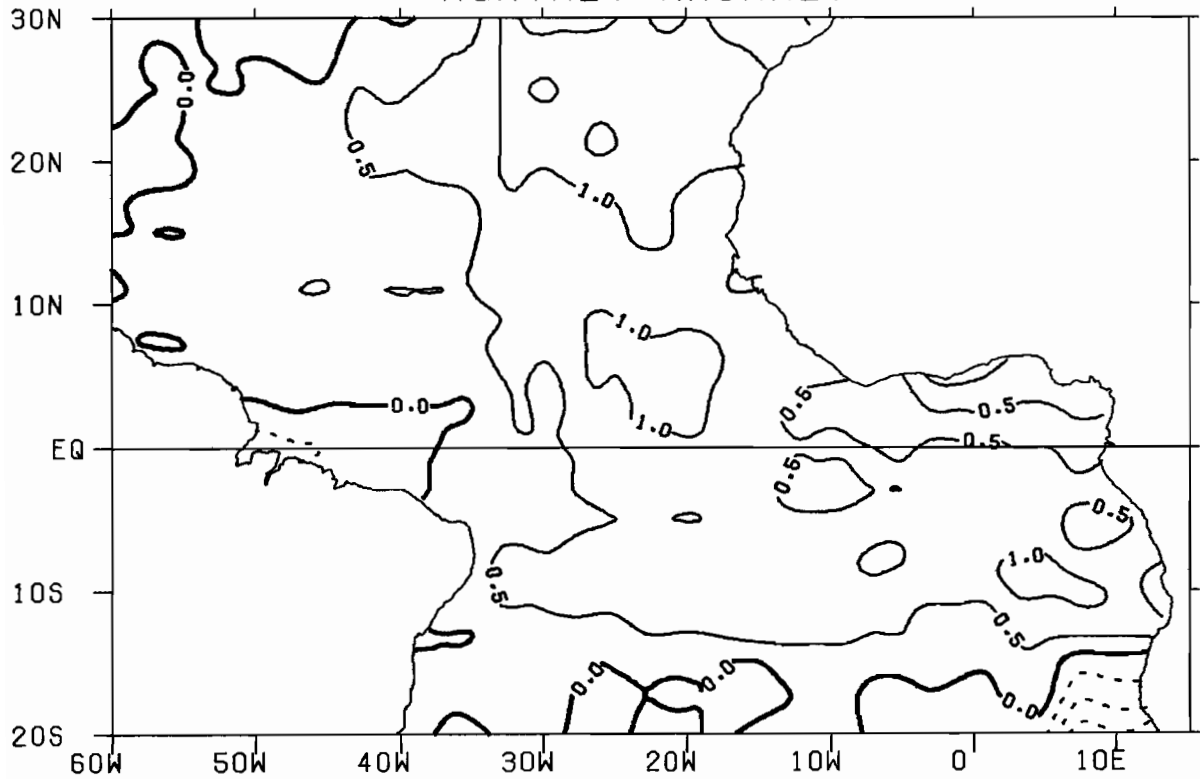
SEA SURFACE TEMPERATURE

AUGUST 1989

MONTHLY MEAN

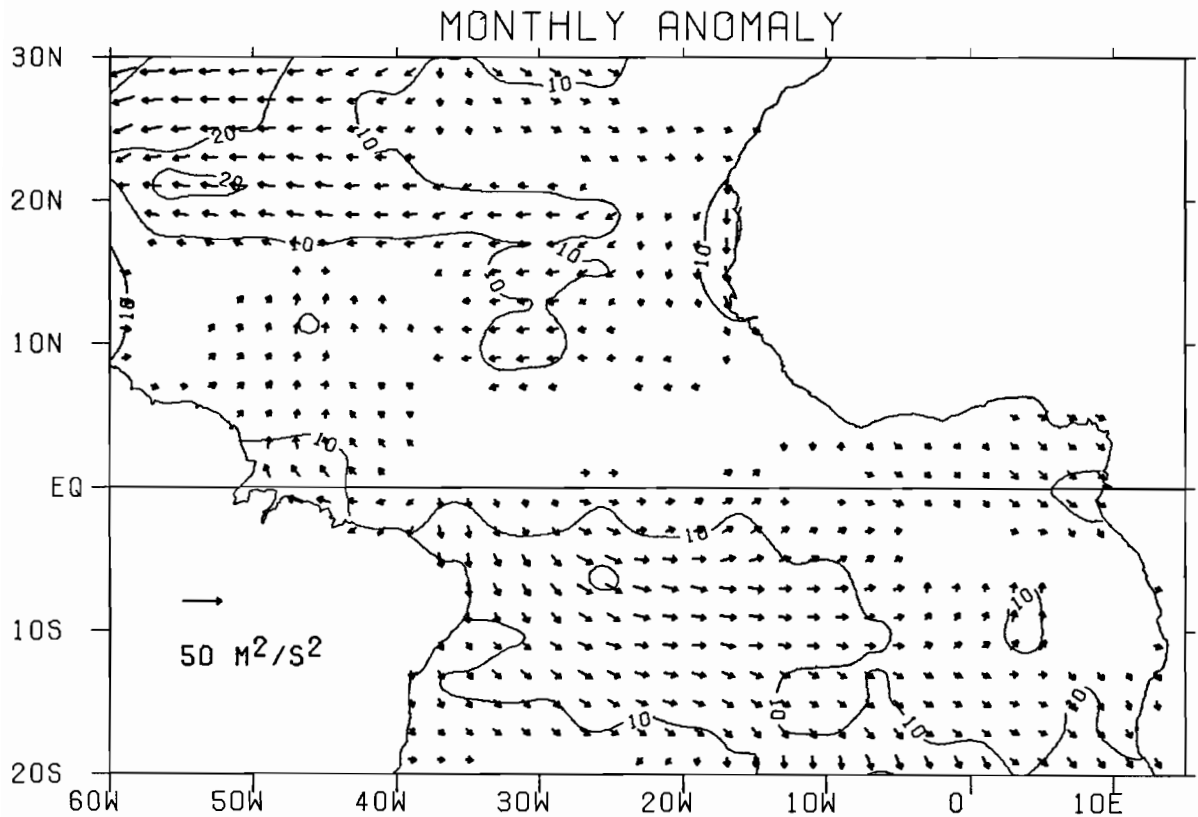
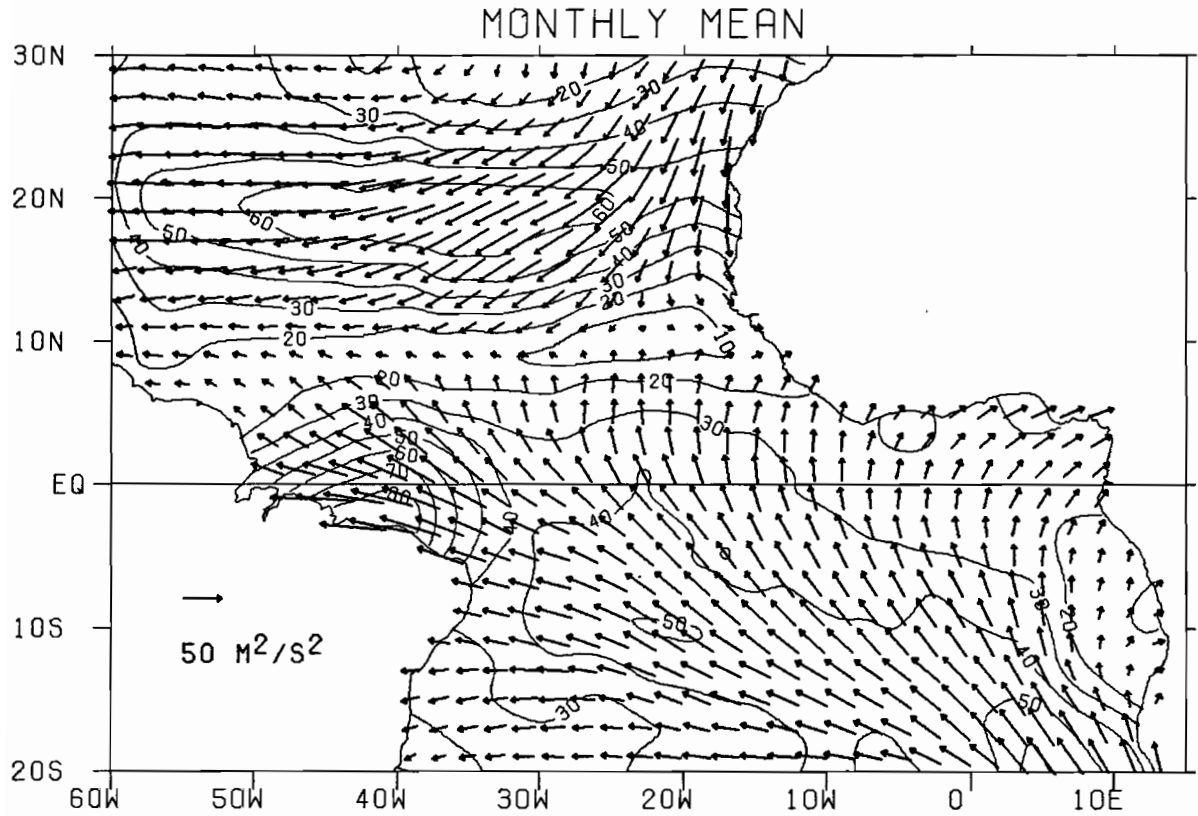


MONTHLY ANOMALY



WIND STRESS

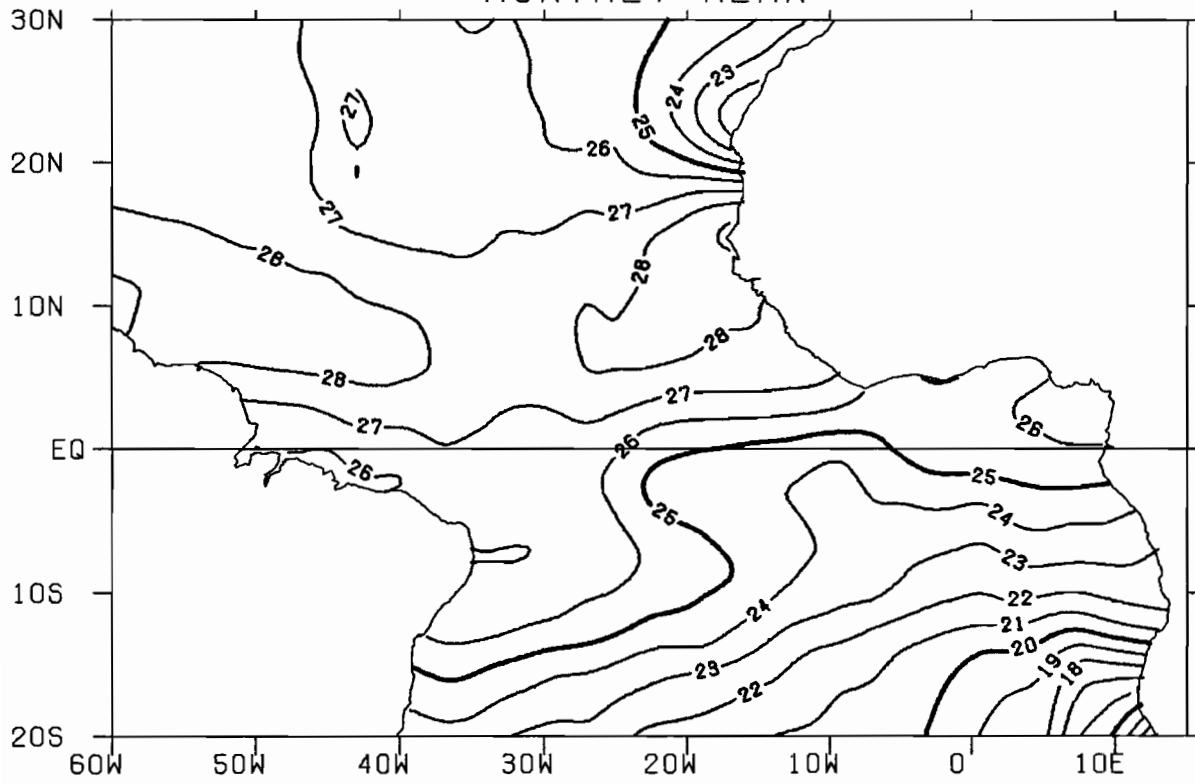
SEPTEMBER 1989



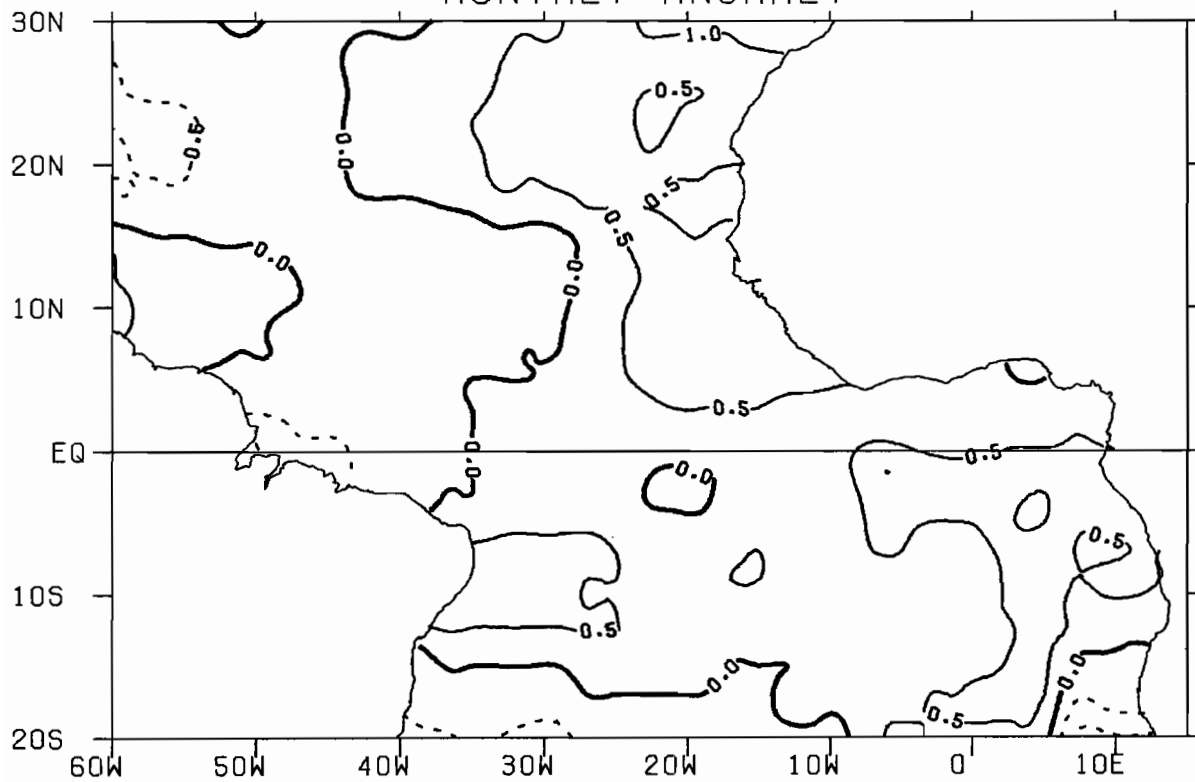
SEA SURFACE TEMPERATURE

SEPTEMBER 1989

MONTHLY MEAN



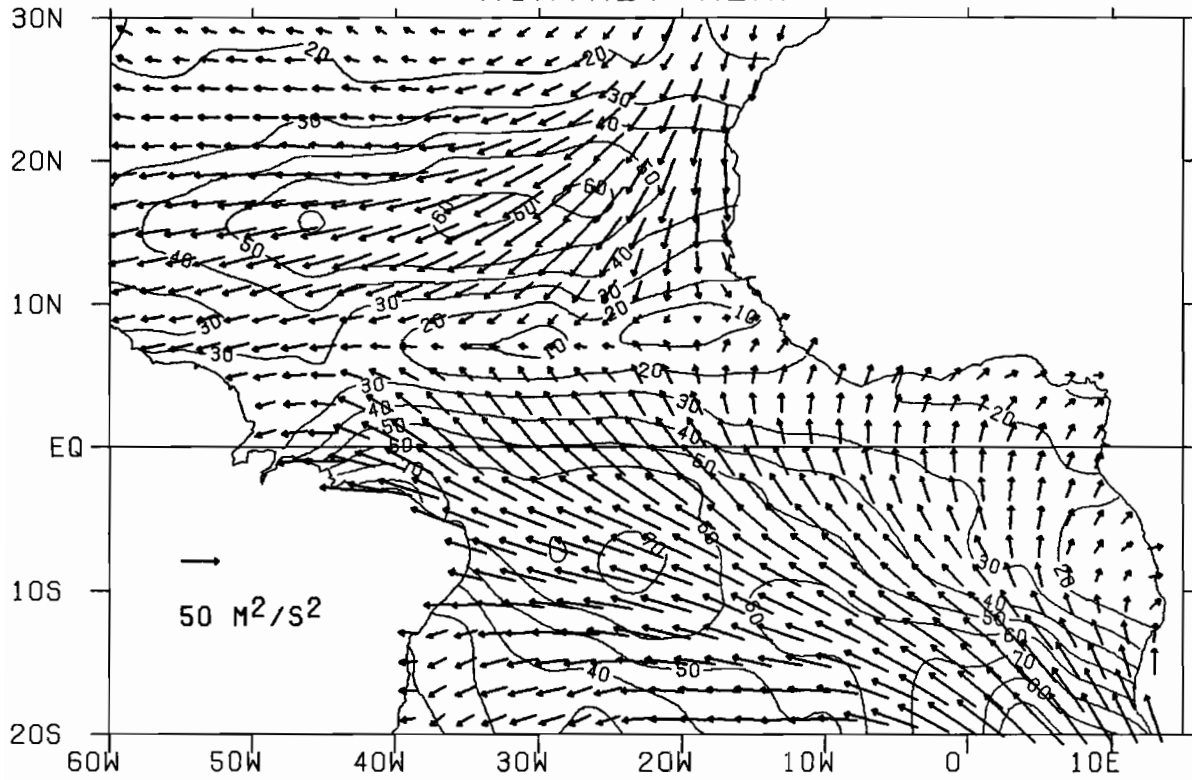
MONTHLY ANOMALY



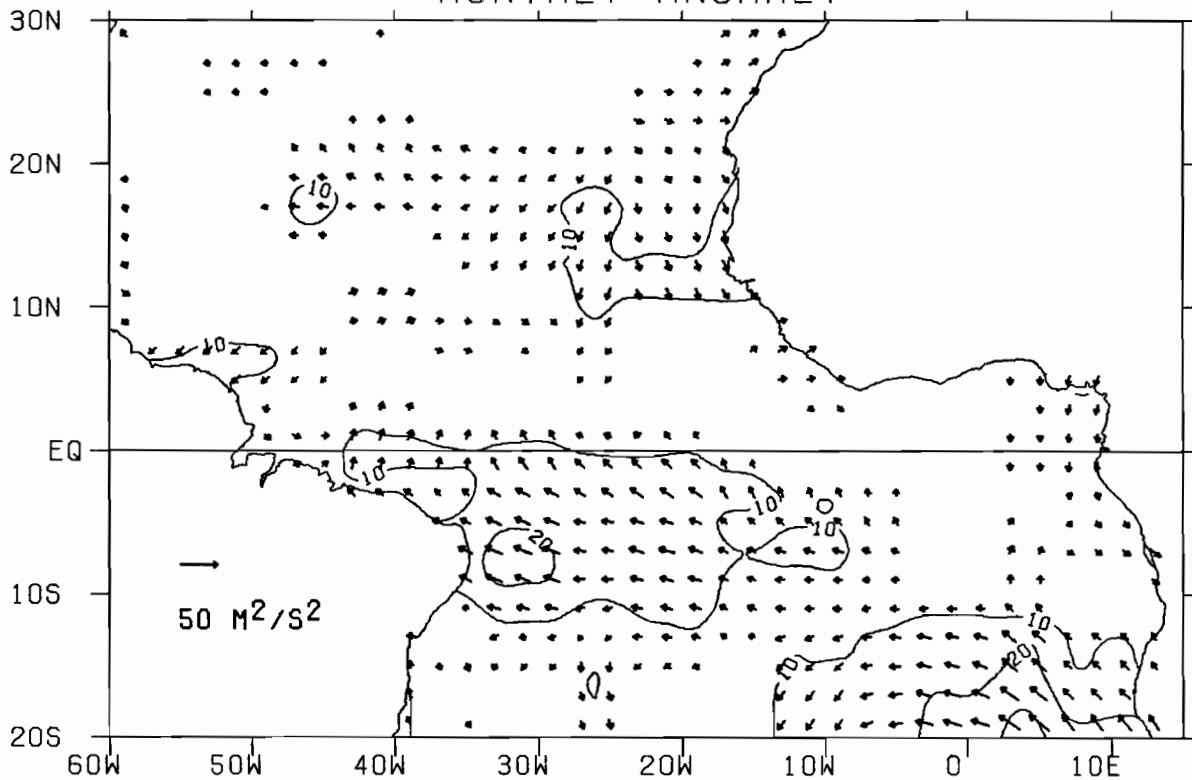
WIND STRESS

OCTOBER 1989

MONTHLY MEAN



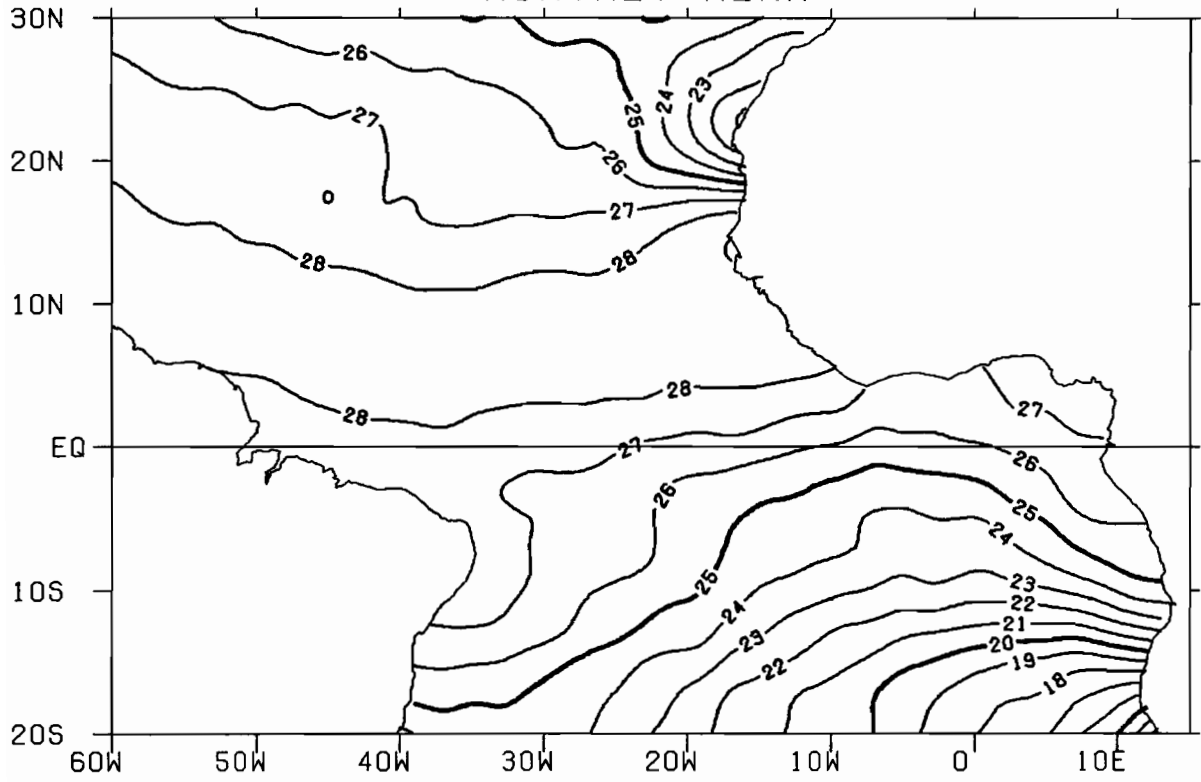
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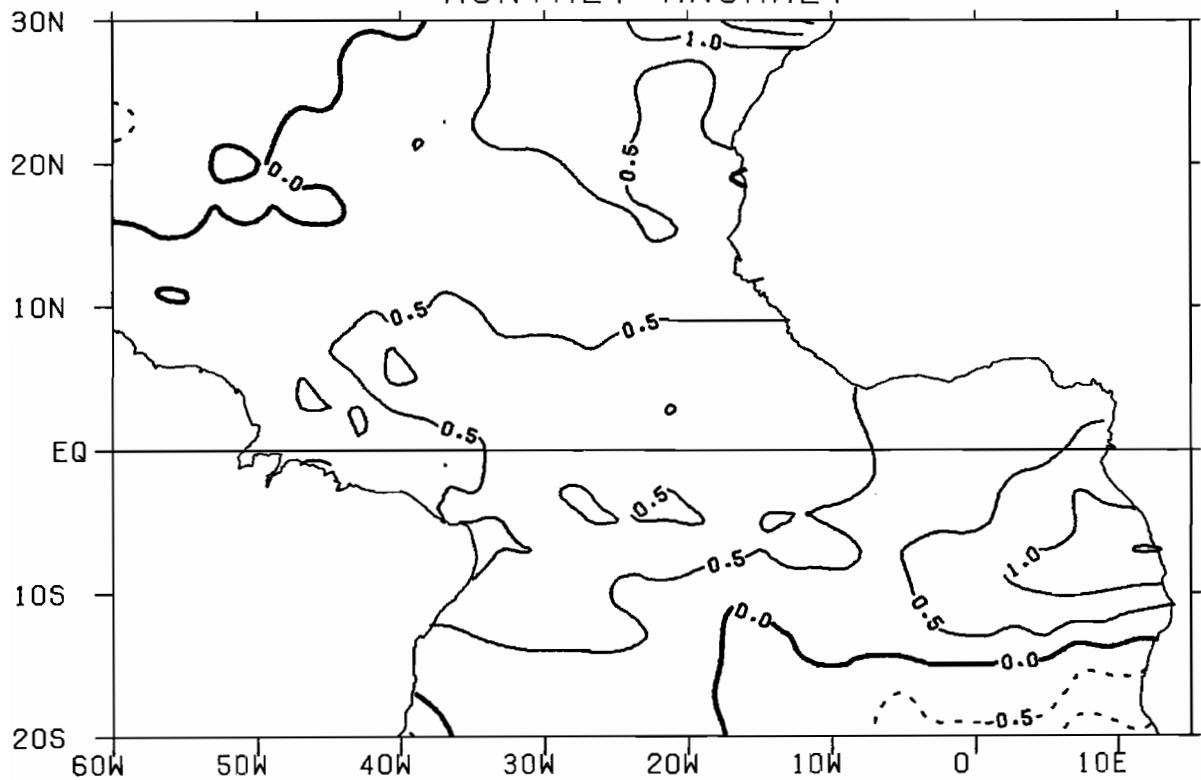
SEA SURFACE TEMPERATURE

OCTOBER 1989

MONTHLY MEAN

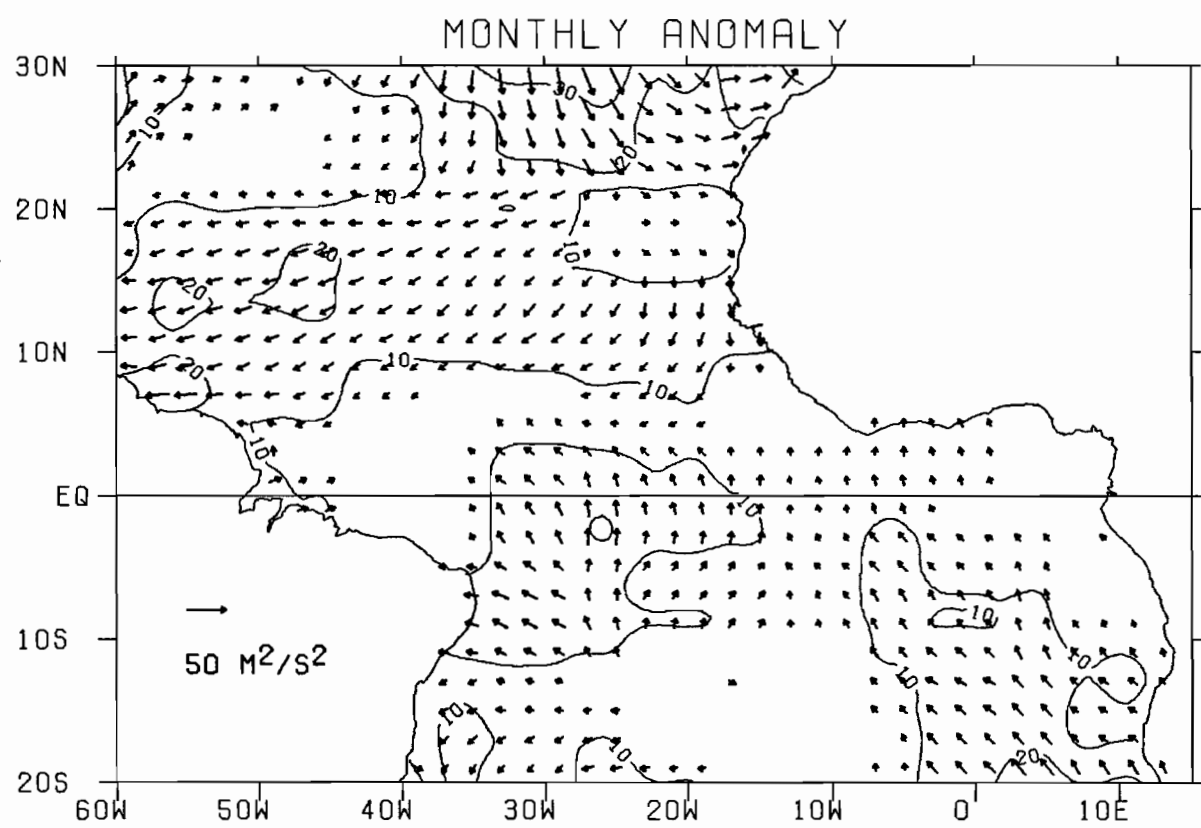
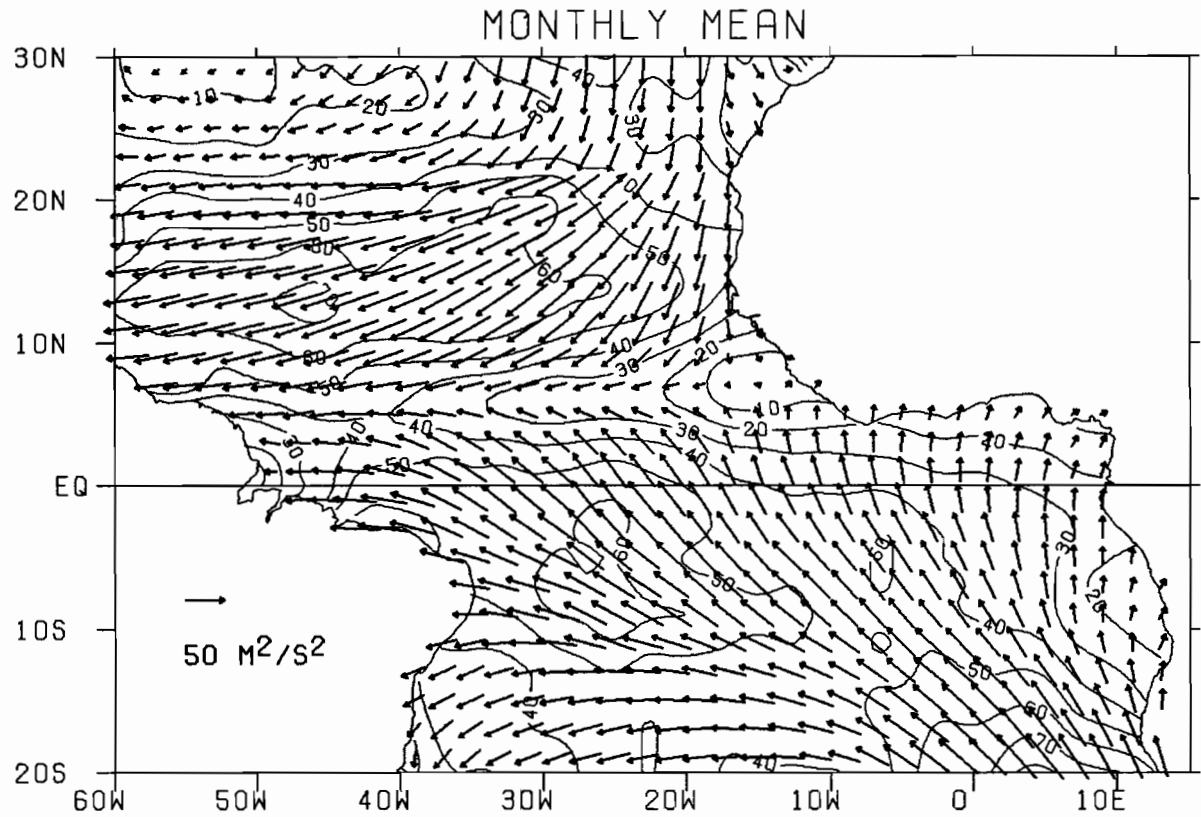


MONTHLY ANOMALY



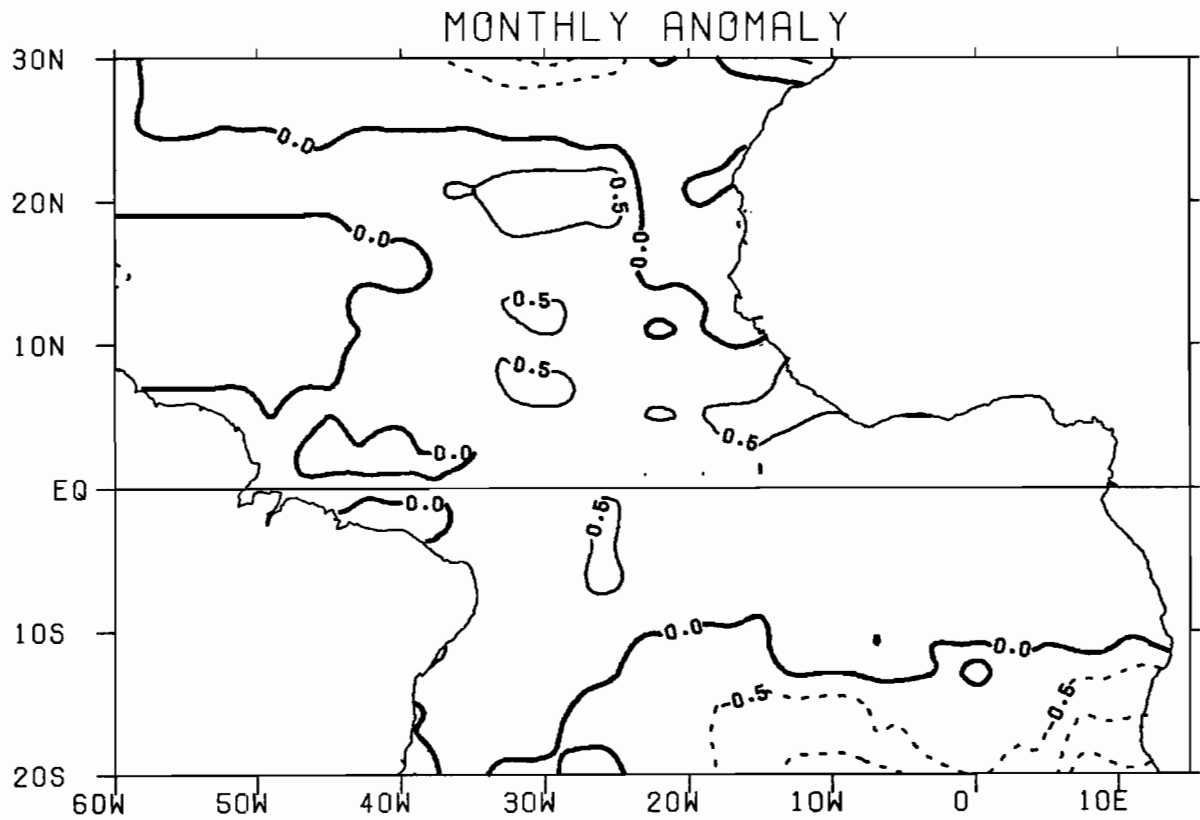
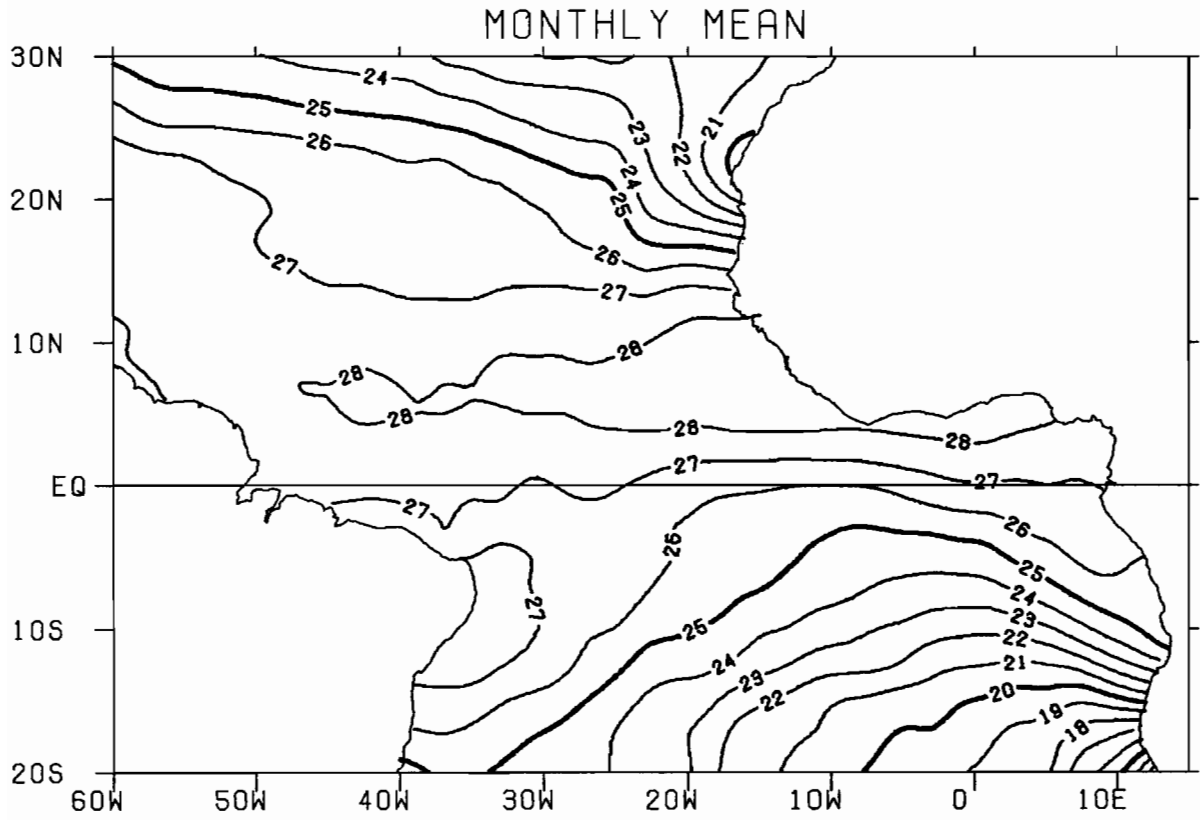
WIND STRESS

NOVEMBER 1989



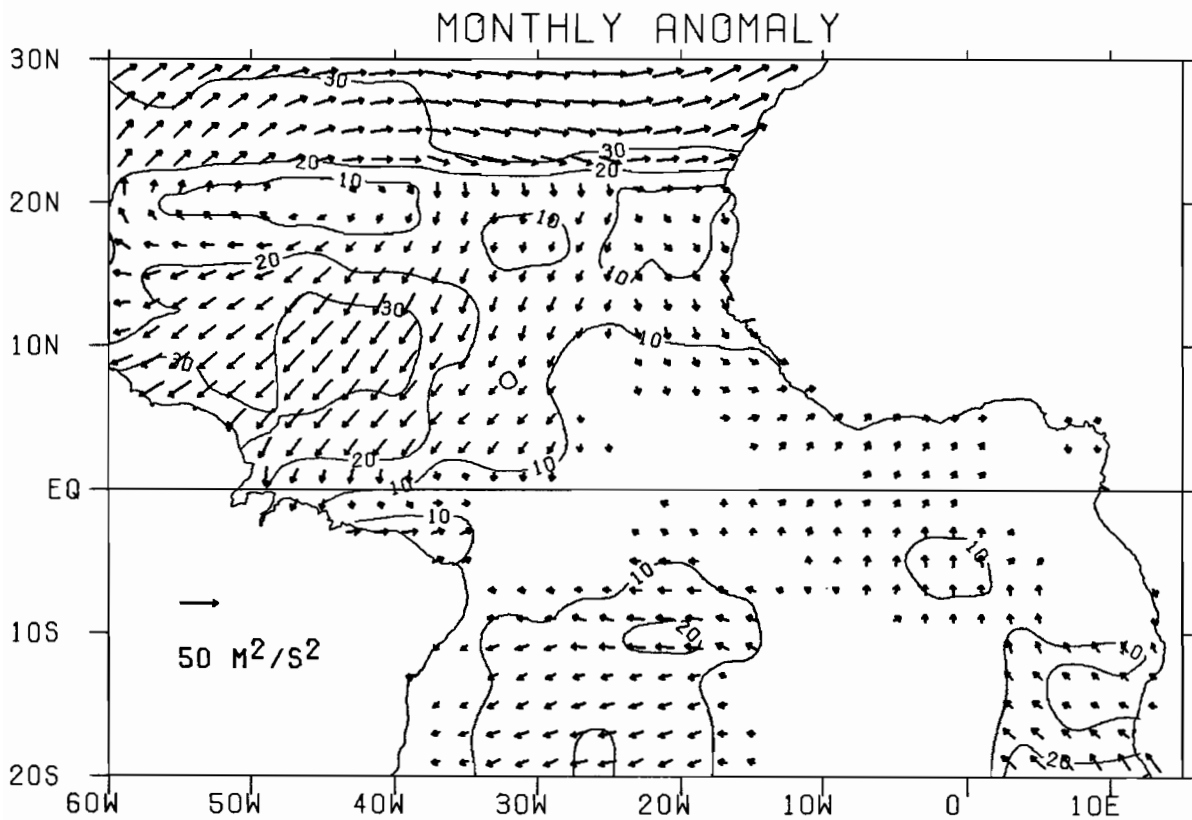
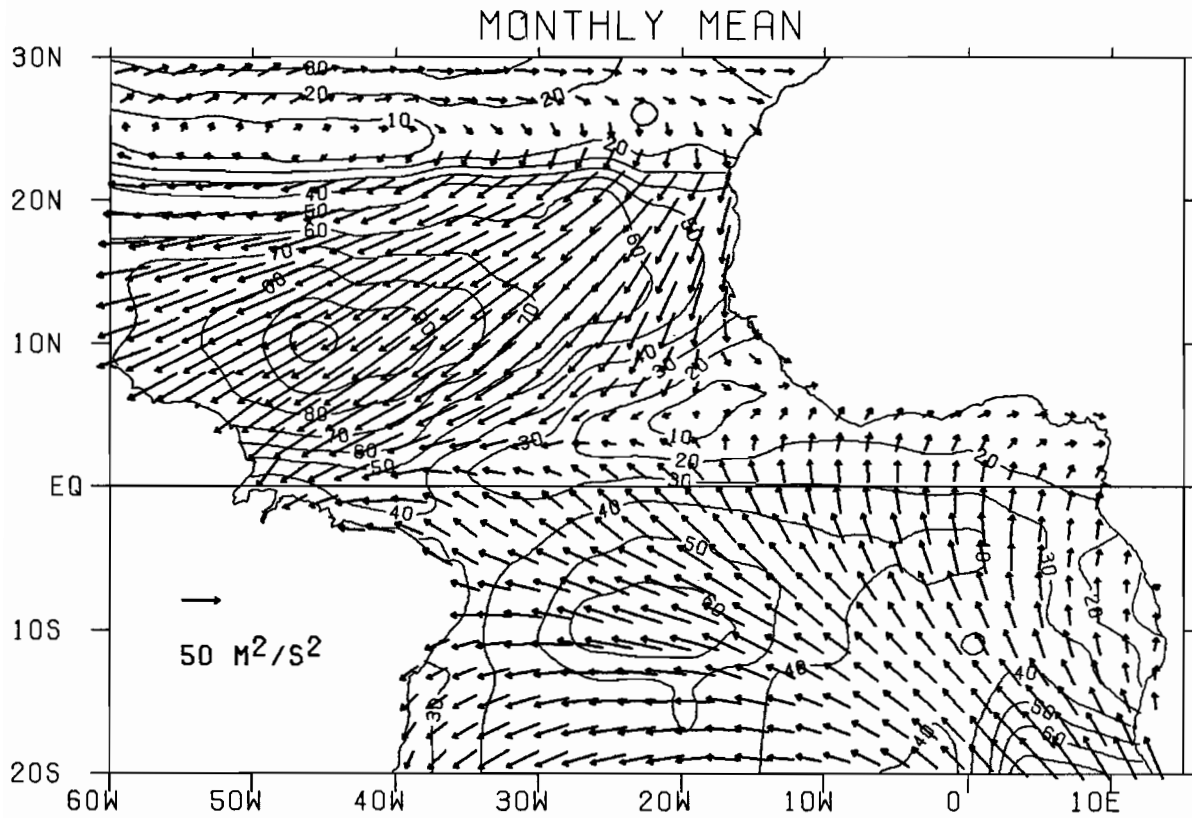
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NOVEMBER 1989



WIND STRESS

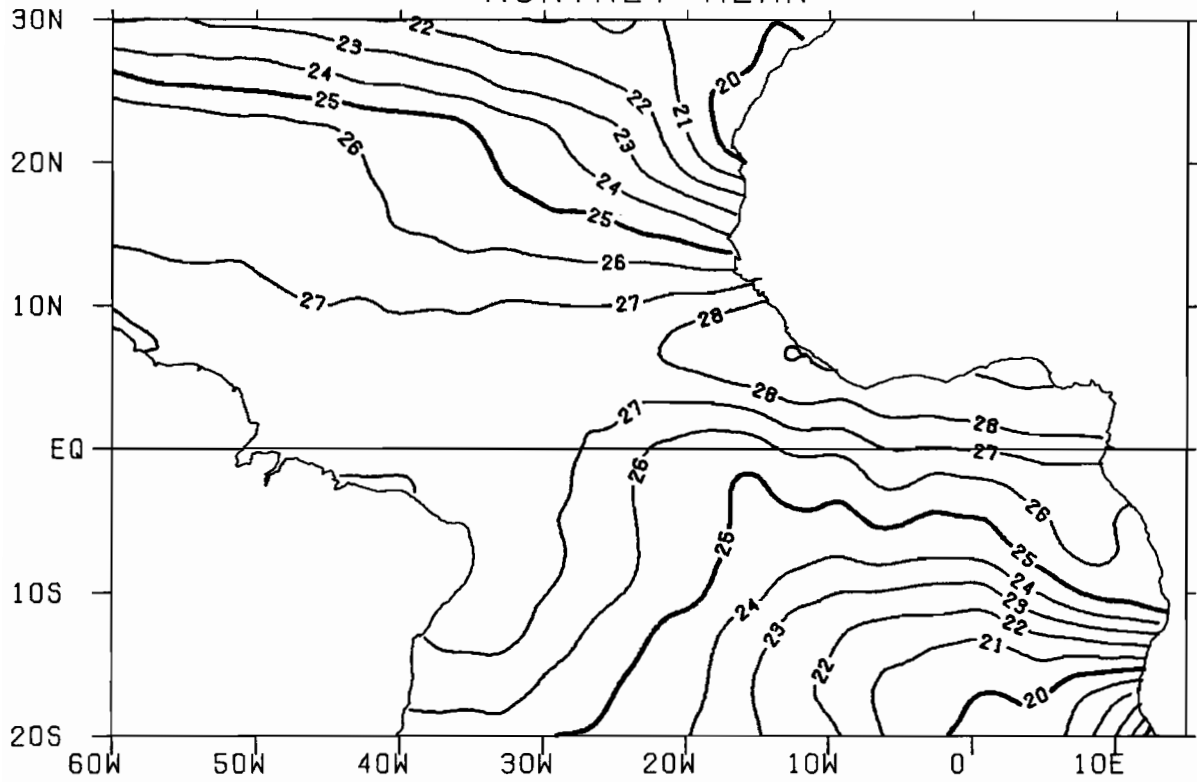
DECEMBER 1989



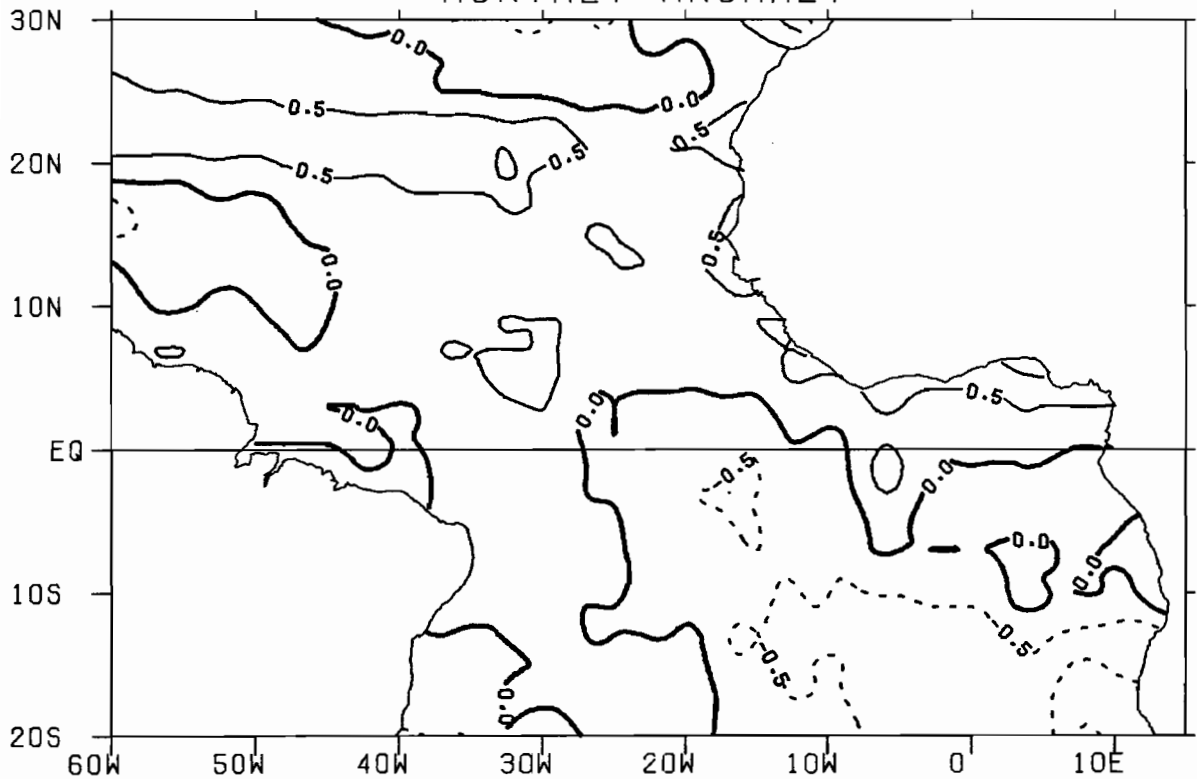
SEA SURFACE TEMPERATURE

DECEMBER 1989

MONTHLY MEAN



MONTHLY ANOMALY



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