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Temos o prazer de informar a V.Sa. que o artigo de sua autoria intitulado "THE REGIONAL PRECIPITATION OVER THE EASTERN AMAZON/NORTHEAST BRAZIL MODULATED BY TROPICAL PACIFIC AND ATLANTIC SST ANOMALIES ON WEEKLY TIMESCALE" de autoria de EVERALDO B. DE SOUZA, MARY T. KAYANO, TÉRCIO AMBRIZZI, foi aceito para publicação da Revista Brasileira de Meteorologia, no entanto para facilitar o processo de editoração, solicitamos que envie a versão final com abstract, palavras-chave e posição das figuras no texto bem como enviá-las, separadamente em formato tiff ou jpeg, com alta resolução.

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RBMet: Editor Responsável: Tércio Ambrizzi
E-MAIL: rbmet@model.iag.usp.br
Departamento de Ciências Atmosféricas – IAG/USP
Rua do Matão, 1224, São Paulo, SP, Brasil
Tel.: (11) 3091-4731 - FAX: (11) 3091-4714

THE EASTERN AMAZON/NORTHEAST BRAZIL REGIONAL PRECIPITATION IN A WEEKLY TIMESCALE MODULATED BY TROPICAL PACIFIC AND ATLANTIC SST ANOMALIES DURING AUSTRAL AUTUMN

EVERALDO B. DE SOUZA[1], MARY T. KAYANO[2] and TÉRCIO AMBRIZZI[1]

[1] Depto. de Ciências Atmosféricas, IAG-USP, 05508-900 São Paulo, SP, Brasil
[2] INPE/CPTEC, 12201-970 São José dos Campos, SP, Brasil
Email: ambrizzi@model.iag.usp.br, mary@cptec.inpe.br

ABSTRACT

This paper focuses the precipitation variability over the eastern Amazon (EAM) and Northeast Brazil (NEB) in a weekly timescale. Weekly climatologies and interannual features of the sea surface temperature (SST), outgoing longwave radiation (OLR), horizontal winds and vertical velocity at pressure-levels in the tropical South America and Atlantic and precipitation in the EAM/NEB are analyzed for the 1982-2001 austral autumns. Two prominent large-scale climatic scenarios which can have an impact in the Intertropical Convergence zone (ITCZ) the main modulator mechanism of the rainfall at EAM/NEB regions, are identified: El Niño and northward SST gradients in the Atlantic (1983, 1987, 1992 and 1998) and La Niña and southward SST gradients in the Atlantic (1984, 1985, 1989 and 1999). Composite analyses are used to investigate the weekly evolution and development of the statistically significant anomaly patterns dominant during these two aforementioned large-scale scenarios. Based on these composites, this paper provides detailed analyses of the anomalous autumn precipitation in the EAM/NEB, as well as the related dynamics reflected in the anomalous patterns for the SST, OLR and vertical structure of the atmospheric circulation over the South America and Atlantic.

Key words: Climatology, Eastern Amazon, Northeast Brazil, Precipitation anomalies, Weekly timescale

RESUMO: A PRECIPITAÇÃO REGIONAL NO LESTE DA AMAZÔNIA/NORDESTE BRASILEIRO EM ESCALA SEMANAL MODULADA PELAS ANOMALIAS DE TSM NO PACÍFICO E ATLÂNTICO TROPICAL DURANTE O OUTONO AUSTRAL

Este artigo focaliza a variabilidade de precipitação sobre o leste da Amazônia (EAM) e Nordeste do Brasil (NEB) numa escala de tempo semanal. Climatologias e características interanuais semanais de temperatura da superfície do mar (TSM), radiação de onda longa (ROL), ventos horizontais e velocidade vertical em vários níveis de pressão na América do Sul e Atlântico tropicais e precipitação no EAM/NEB são analizados para outonos austrais de 1982-2001. Dois cenários climáticos de grande escala que impactam a Zona de Convergência Intertropical (ZCIT), o principal mecanismo gerador das chuvas no EAM/NEB são identificados: El Niño e gradiente de TSM para norte no Atlântico (1983, 1987, 1992 e 1998) e La Niña e gradiente de TSM para sul no Atlântico (1984, 1985, 1989 e 1999). Análises por composições são usadas para investigar a evolução e desenvolvimento semanal dos padrões anômalos estatisticamente significantes durante os dois referidos cenários de grande escala. Com base em composições, este artigo fornece análises detalhadas das anomalias de precipitação de outono no EAM/NEB, bem com da dinâmica relacionada aos padrões de TSM, ROL e a estrutura vertical da circulação atmosférica sobre a América do Sul e Atlântico.

Palavras chaves: Climatologia, Leste da Amazônia, Nordeste do Brasil, Anomalias de precipitação, Escala semanal

1. INTRODUCTION

The regional precipitation in the eastern Amazon (EAM) and Northeast Brazil (NEB) show similar seasonal percentages of the annual totals for austral autumn (March-May). Values between 35% and 50% occur in the northern EAM (Amapá, mid-east of Pará and Marajó island) and in the NEB semiarid region (Piauí, Ceará, Rio Grande do Norte, west of Paraíba and Pernambuco and north of Bahia) (Rao et al., 1996; Souza et al., 2000). The autumn rainfall in these regions is strongly modulated by the Intertropical Convergence Zone - ITCZ (e.g., Uvo and Nobre, 1989), which reaches its southernmost position in the equatorial South Atlantic around March (Waliser and Gautier, 1993; Xavier et al., 2000).

The EAM/NEB rainfall exhibits also interannual (IA) variations, which are related to near-global atmospheric circulation anomalous patterns associated with the El Niño-Southern Oscillation (ENSO) (Ropelewski and Halpert, 1987; 1989; Kiladis and Diaz, 1989; Kousky and Ropelewski, 1989). The ENSO oceanic component features an anomalous warming (El Niño) or cooling (La Niña) of the surface waters in the central and eastern Pacific, that dynamically links to the Southern Oscillation, a global-scale predominantly standing wave with sea level pressure (SLP) action centers over Indonesia and southeastern Pacific (e.g., Trenberth and Shea, 1987). Several studies showed that most of the EAM/NEB tends to receive negative (positive) precipitation anomalies during El Niño (La Niña) episodes (Hastenrath, 1976; Kousky et al., 1984; Kayano et al., 1988; Rao and Hada, 1990; Uvo et al., 1998; Coelho et al., 2002).

Otherwise, the EAM/NEB rainfall IA variations might also be modulated by the sea surface temperature (SST) anomalies in the Tropical Atlantic. One of the dominant IA SST modes in this area features a interhemispheric SST gradient (meridional SST gradient mode) during austral autumn (Hastenrath and Heller, 1977; Nobre and Shukla, 1996). A northward (southward) SST gradient mode features simultaneous positive/negative (negative/ positive) SST anomalies in the northern/southern sectors of the Tropical Atlantic (Servain, 1991). The meridional SST gradient modes, hydrostatically, control the SLP and wind patterns over the equatorial Atlantic (Hastenrath and Greischar, 1993), and influence the ITCZ latitudinal positioning (Nobre and Shukla, 1996; Souza and Nobre, 1998). Through the ITCZ, the southward (northward) SST gradient mode relates to EAM/NEB wetter (drier) than normal conditions (Hastenrath and Heller, 1977; Moura and Shukla, 1981; Hastenrath and Greischar, 1993; Nobre and Shukla, 1996; Souza et al., 1998; 2000).

Previous studies using monthly/seasonal data have provided evidences that both El Niño (La Niña) and northward (southward) SST gradient mode favor EAM/NEB drier (wetter) than normal conditions. These studies do not provide shorter timescale information demanded from some sectors (agriculture and hydroelectric power). Thus, the present paper uses 1982-2001 weekly data and investigates the simultaneous influences of the ENSO and meridional SST gradient modes on the EAM/NEB autumn rainfall. The associated atmospheric circulation anomalies are analyzed and the climatological aspects of the rainfall in the EAM/NEB and the related atmospheric circulation will also be discussed.

2. DATA AND METHODOLOGY

The data used consist of 20 years (1982-2001) of reanalyzed daily-mean vertical velocity and horizontal wind fields, at 11 pressure-levels (1000, 925, 850, 700, 600, 500, 400, 300, 250, 200 and 150 hPa), produced by the Climate Data Assimilation System/Reanalysis Project (Kalnay et al., 1996). Daily OLR data for the same period are also used. The reanalyzed and OLR data are on a 2.5º by 2.5º latitude-longitude resolution grid and were obtained from the Climate Diagnostic Center of the National Centers for Environmental Predictions (NCEP). Weekly gridded SST data in a horizontal resolution of 1° obtained from the Climate Prediction Center/NCEP are also used (Reynolds et al., 2002). The OLR, SST and reanalyzed variables are selected in the 20°N-25°S band of the western hemisphere.

Daily precipitation records from raingauge stations in the EAM/NEB for 1982-2001 were obtained from the Instituto Nacional de Meteorologia and Agência Nacional de Energia Elétrica of Brazil and some State meteorological centers. A quality control procedure, to check for possible errors in this dataset, is based on daily standard deviations (σ) obtained for each month of the year. Daily precipitations of a given month of 20 years are used to compute the daily σ for that month. Daily values of a given month $> 3\sigma$ are replaced by a missing data code. Series with 3 or more subsequent days with missing data are not considered. This procedure yields 104 raingauge stations with uninterrupted daily observations for 1982-2001. The scattered station data (Fig. 1a) in the area limited at 3°N, 15°S, 65°W and 35°W are spatially interpolated into a regular grid (Fig. 1b) with horizontal resolution of 1°, using the method of the inverse of the quadratic distances.

The divergent wind components are obtained from the horizontal winds at each pressure-level. The divergent zonal (meridional) wind and the vertical velocity meridionally (zonally) averaged in the 5°N-10°S (57.5°W-35°W) band will be displayed as vectors in the pressure-longitude (latitude) cross-sections. They represent the divergent zonal (meridional) atmospheric circulations that describe the Walker (Hadley) cell.

Except for the SST, weekly average values are computed for each variable for the 1982-2001 periods and following the calendar dates[1] considered by Reynolds et al. (2002). The SST horizontal resolution has been changed from 1º by 1º to 2.5º by 2.5º. The horizontal resolution for precipitation has been maintained at 1º by 1º. For each variable and grid point, weekly climatologies and standard deviations are computed.

Standardized weekly SST anomalies are obtained for each grid point in the tropical Pacific and Atlantic. The SST indices are the spatially averaged standardized weekly SST anomalies for selected areas in the: equatorial Pacific for the Niño 1.2 (90°W-80°W/5°S-5°N), Niño 3 (150°W-90°W/5°S-5°N), Niño 3.4 (170°W-120°W/5°S-5°N) and Niño 4 (160°E- 150°W/5°S-5°N) regions, Tropical North Atlantic - TNA (50°W-20°W/2.5°N-17.5°N) and Tropical South Atlantic - TSA (30°W-0°E/17.5°S-2.5°S). The Niño SST indices represent the ENSO phases. The difference of the TNA SST index and TSA SST index (Atlantic difference index) describes the phases of the meridional SST gradient mode in the tropical Atlantic (Servain, 1991). Positive (negative) Atlantic difference index represents a northward (southward) SST gradient in the intertropical oceanic sector. The SST indices are used to select periods for composites. In addition, precipitation indices are obtained in areas where there is a good coverage such as the mid-east EAM and the northern NEB (Fig. 1).

3. WEEKLY CLIMATOLOGY

Precipitation exceeding 11 mm day^{-1} is found in the Marajó Island, central and coastal regions of Pará and northern Maranhão, and lower than 5 mm day^{-1} in the NEB semiarid region for weeks 10-11 (Fig. 2). This pattern expands southeastward and covers the entire NEB by week 13, the peaking of the NEB rainy season. Precipitation of 11-15 mm day^{-1} in the eastern Pará and northern Maranhão and Piauí and lower values in the remaining areas persist up to week 15. Gradually, the largest values move to the northwest of the domain and values lower than 3 mm day^{-1} remain in the NEB during the latest 5 autumn weeks indicating the end of the rainy season. The narrow strip along the eastern NEB coast with precipitation ranging from 3 to 5 mm day^{-1} during weeks 19-21 indicates the beginning of the rainy season for this area (Rao et al., 1993).

[1] Reynolds et al (2002) defined the center of the week as Sunday in the 1980s and Wednesday from January 1990 to the present.

Assuming that OLR ≤ 240 Wm^{-2} in the tropics represents deep convection, the OLR patterns (Fig. 3b) over the tropical South America are consistent with the precipitation fields. The OLR area over most of the continental region during the weeks 11-13, gradually reduces its size being confined in the northwestern South America by the end of the autumn. The area with OLR ≤ 200 Wm^{-2} in the central tropical South America is northwest/southeast oriented (typical of the summertime convection) during week 11 and more zonally oriented by week 13. Over the continent, the OLR and upper level circulation climatological patterns are consistent. As the deep convection moves northwestward (weeks 11-17), the Bolivian high and the associated trough move equatorward disappearing during the last 3 weeks (Fig. 3d). The OLR patterns in the oceanic areas are related to the positioning and intensity of the ITCZ. In fact, the OLR values ≤ 240 Wm^{-2} are found along the Atlantic ITCZ, as indicated by the SST ≥ 28°C (Fig. 3a) and near surface confluence of easterlies (Fig. 3c) in the equatorial Atlantic latitudes. The strong Atlantic convection along the NEB coast during weeks 13-17 (Fig. 3b) contributes to organize the rainfall in the EAM/NEB (Fig. 2). These conditions are accompanied by the wind confluence at 1000-hPa to the south of equator and SST ≥ 28°C over most of the equatorial Atlantic, including the northern NEB coast (Fig. 3a and 3c).

Strong ascending motion in the troposphere is observed over the Amazon and adjacent Atlantic longitudes and an outflow directed westward and eastward at 150-hPa (Fig. 4a). The upper-level westward flow converges downstream and contributes to enhance subsidence in the eastern Pacific (not shown). The upper-level eastward flow diverges aloft and sinks over the eastern Atlantic, between 5°W and 0° (Fig. 4a). Ascending motion over the equatorial Atlantic centered on 15°W from week 15 to 17 (Fig. 4a) is associated with warm waters (SST ≥ 28°C) in the eastern Atlantic (Fig. 3a). In the lower troposphere easterlies prevail over the equatorial Atlantic. Tropical air rises over most of the South American latitudes, diverges northward and southward at the 150-hPa and then descends around 15°N and 30°S during weeks 11-15 (Fig. 4b). Ascending motion over equatorial areas (10°S-5°N), diverging flow in the upper troposphere, sinking motions in the subtropical North Atlantic and Brazil and equatorward flow in the lower troposphere are observed from weeks 17 to 21. The latitudinal positions of the upward and downward motions, in particular in the Southern Hemisphere (SH), are consistent with the climatological shifts of the South American convection (Fig. 3b) and rainfall over the EAM/NEB (Fig. 2).

4. COMPOSITES ON WEEKLY TIMESCALE

a. SST and Precipitation Indices

Fig. 5 shows weekly SST and precipitation indices for the austral autumn seasons of 1982-2001. The SST indices reveal two contrasting prominent large-scale climatic IA modes with simultaneous occurrences: *i)* El Niño (large positive Pacific indices) and northward SST gradient mode in the Atlantic (large positive Atlantic difference index) during the 1983, 1987, 1992 and 1998 years; *ii)* La Niña (large negative Pacific indices) and southward SST gradient mode in the Atlantic (large negative Atlantic difference index) during the 1984, 1985, 1989 and 1999 years. Neutral SST conditions in the equatorial Pacific simultaneously occurred with a southward SST gradient mode during the 1986, 1988, 1991, 1994 and 1995 years and a northward SST gradient mode during the 1982, 1990 and 2001 autumn seasons. The phases of Atlantic meridional SST gradient mode and the El Niño and La Niña episodes identified here are in agreement with previous works (e.g., Servain, 1991; Nobre and Shukla, 1996; Souza et al., 2000; Trenberth, 1997).

Precipitation indices show weekly timescale variations superimposed to IA variations, which are related to the tropical Pacific and Atlantic large-scale climate IA modes. This issue is further explored by calculating the autumn weekly anomaly composites of the variables for the years of the aforementioned two climatic situations. A composite value is significant at the 95% confidence level if its absolute value is greater than $(z_{95}(n) \times \sigma_c)/(n)^{1/2}$, where n is the number of values used in the composite, σ_c is the standard deviation of these values and z_{95} is the value of t-distribution for n degrees of freedom and 95% confidence level (Harrison and Larkin, 1998). Composites for the years of mode *i)* are referred to as unfavorable composites and for the mode *ii)* as favorable composites.

b. Unfavorable composite (El Niño and Atlantic northward SST gradient)

Negative precipitation anomalies over eastern Pará, Marajó Island and NEB semiarid region are accompanied by positive SST anomalies in most of the TNA. Negative SST anomalies are seen in a narrow area in the equatorial and eastern South Atlantic (weak northward SST gradient) and by cross-equatorial anomalous southeasterly trade winds in the 7.5°N-7.5°S band during the first 5 weeks (Figs. 6, 7a and 7c). As the negative SST anomalies intensify and expand westward along the equatorial latitudes, the northward SST gradient mode and the cross-equatorial southeasterly trades are strengthened and the negative precipitation anomalies magnitudes increase (-2 to -6 mm day^{-1}) during weeks 15-21 (Fig. 6, 7a and 7c). The OLR anomalous patterns show consistent evolving features. A well-defined band with positive OLR anomalies stretching from the EAM/NEB regions towards the entire equatorial South Atlantic indicates a suppression of the convective activity in this region due to an early northward displacement of Atlantic ITCZ between weeks 13-15 (Fig. 7b). Positive OLR anomalies in the tropical Brazil and equatorial Atlantic and negative OLR anomalies to the north of this area clearly indicate the anomalously northern positioning of the Atlantic ITCZ compared to its climatological position during subsequent weeks.

The anomalous sinking motions in the EAM/NEB regions and Atlantic longitudes and between equator and 10°S during most of autumn weeks reflect the weakening of the climatological upward branch of the Hadley cell in the equatorial latitudes and the Walker cell in the tropical longitudes of the South America/Atlantic region (Figs. 8a and 8b). These anomalous sinking motions agree with precipitation deficit in the EAM/NEB regions (Fig. 6) and positive OLR anomalies in the equatorial Atlantic (Fig. 7b).

Despite of the dominance of negative precipitation anomalies for the unfavorable composites, positive precipitation anomalies are noted for some small areas and weeks: in the mid-southern EAM during week 10, in the NEB eastern coast and central/northwestern EAM during week 11, and in the northwestern EAM during weeks 15, 17 and 18 (Fig. 6). These patterns are related to anomalous rising motions noted from 1000-hPa to 400-hPa at 60°W and 50°W and in the troposphere in the 35°W-15°W band during week 12; in the troposphere in the 60°W-50°W band during week 15; and from 700-hPa to 200-hPa in the 60°W-50°W band during week 17 (Fig. 8a).

c. Favorable composite (La Niña and Atlantic southward SST gradient)

Unfavorable and favorable composites show approximately reversed sign patterns for the corresponding variables (Figs. 6, 7, 8, 9, 10 and 11). Indeed, positive precipitation anomalies in a large area of the EAM/NEB regions during most autumn weeks are consistent with relatively weak cross-equatorial southward SST gradient during March and stronger during April and May weeks. It is also observed an anomalously reduced/accelerated southeasterly/northeasterly trade winds characterizing intense cross-equatorial flow coming from the Northern Hemisphere (NH) in the tropical Atlantic during most autumn weeks (Figs. 9, 10a and 10c). In agreement with this pattern, negative OLR anomalies in a zonally elongated band from central Amazon to eastern equatorial Atlantic and positive OLR anomalies to the north/northeast of this band during the last 5 weeks indicate enhanced and anomalous southward displacement of the Atlantic ITCZ (Fig. 10b). This anomalous system contributes to the rainfall excess in large portions of the EAM/NEB regions during most of autumn weeks. Consistently, anomalous ascending motions in the 60°W-35°W band are particularly conspicuous during the last 3 weeks (Fig. 11a). Anomalous upward motions in the equatorial and southern latitudes and anomalous downward motions in latitudes north of the equator are consistent to positive SST anomalies in the TNA and negative SST anomalies along the equatorial Atlantic and in the TSA (Figs. 10a and 11b). These upward anomalous motions favor a southward displaced and intensified ITCZ.

5. DISCUSSIONS AND CONCLUDING REMARKS

Weekly SST, OLR, horizontal winds and vertical velocity at pressure-levels in the tropical South America/Atlantic and precipitation in the eastern Amazon/Northeastern Brazil (EAM/NEB) for 1982-2001 are used to study their climatological and interannual (IA) features during the austral autumn.

Weekly climatological patterns of the precipitation and atmospheric circulation in the EAM/NEB regions as well as over the oceanic neighboring areas show consistent features. The largest precipitation values (deep convection) in the central and eastern South America during the first weeks of autumn are gradually confined to the northwestern South America as the upper level systems (Bolivian high and associated downstream trough) move equatorward weakening and disappearing by the end of the season. The OLR values $\leq$ 240 Wm^{-2} in the oceanic areas are accompanied by surface waters with SST $\geq$ 28°C and near surface confluence of easterlies in the equatorial latitudes (Atlantic ITCZ). The location of the Atlantic ITCZ to south of equator during most autumn weeks contributes to organize the convection and therefore the rainfall in the EAM/NEB regions. The divergent zonal and meridional circulation climatological patterns are part of the Walker and Hadley cells and are consistent with the climatological tropospheric circulation patterns previously documented (Oort and Yienger, 1996; Hastenrath, 2001; Wang, 2002a; 2002b; Souza and Ambrizzi, 2002).

Two contrasting anomalous climatic scenarios identified with simultaneous occurrences of: *(i)* El Niño and northward SST gradients in the Atlantic and *(ii)* La Niña and southward SST gradients in the Atlantic are unfavorable and favorable to modulate rainfall over the EAM/NEB regions, respectively. The dominant features of weekly precipitation composites for situation *(i)* and the nearly reversed patterns, for situation *(ii)* are consistent with previous findings that were based on seasonal or monthly data.

For brevity only the composites for situation *i)* are discussed. Negative precipitation anomalies in the eastern Pará, Marajó Island and NEB semiarid region are observed during the first 5 weeks and their magnitudes increase during the last weeks of the autumn season. Also, the relatively weak anomalous northward SST gradient and cross-equatorial anomalous southeasterly winds during weeks 11-13 are intensified by the last autumn weeks. In addition, suppression of convection over EAM/NEB regions and equatorial South Atlantic as well as the northward displacement of Atlantic ITCZ are evident during week 13 and continuing during the subsequent weeks as Atlantic ITCZ anomalously locates to the north of its climatological position. The anomalous sinking motions over EAM/NEB regions and Atlantic longitudes (from the equator to 10°S) during autumn reflect the weakening of the ascending motions associated with the Walker and Hadley cells, respectively.

This study has shown that a deficient rainfall is unevenly distributed during the autumn season and it is concentrated from the middle to the end of the season. It also illustrates that under unfavorable rainfall scenarios, some small areas in the EAM/NEB regions receive excessive rainfall during first weeks of the autumn season. The rainfall excess is associated to local features of the zonal and meridional divergent circulations. The analyses of IA variations on weekly basis suggest that, weekly timescale monitoring is important for many different users.

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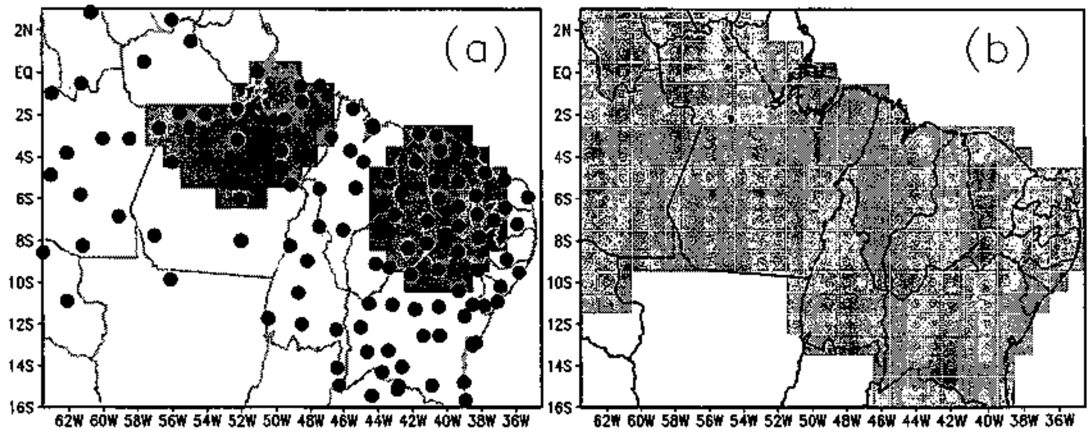

Figure 1. (a) Locations of the raingauge stations; and (b) the station data interpolated in a grid resolution of 1º by 1º. Regional precipitation indices are calculated for shaded regions in (a).

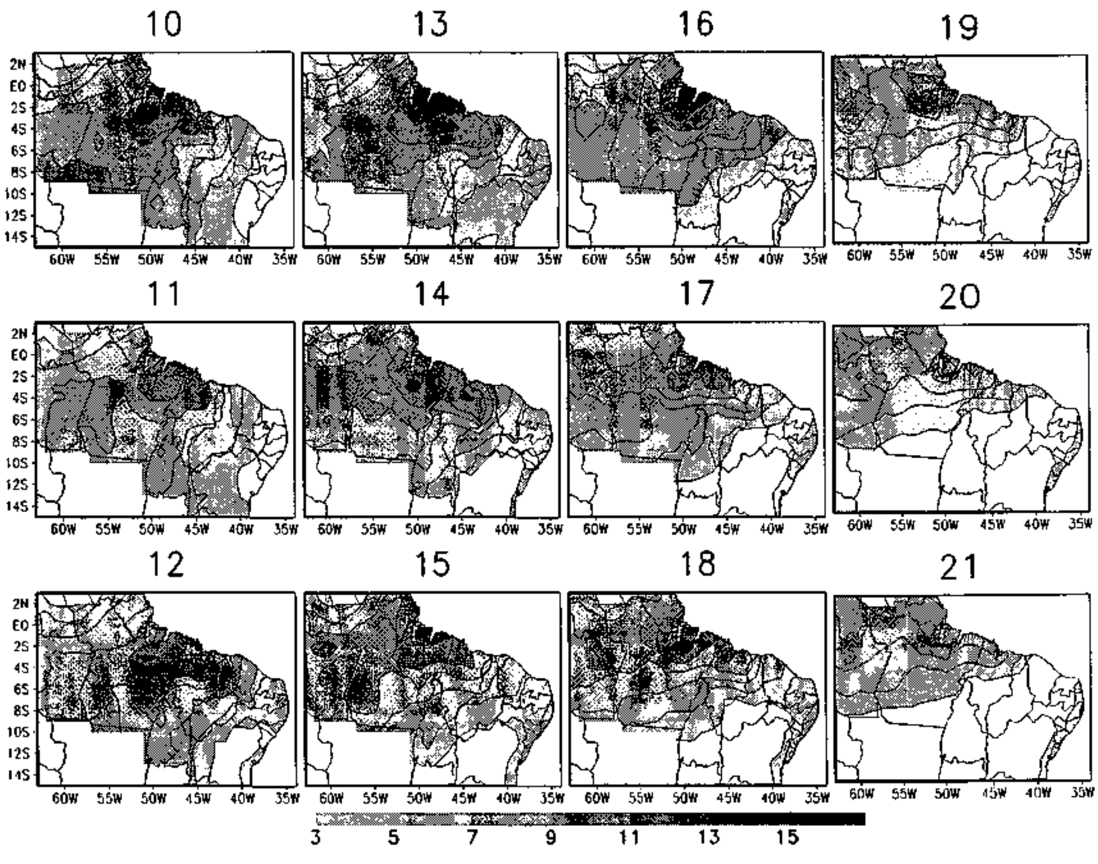

Figure 2. Weekly precipitation climatologies. Contour interval is 2 mm day^{-1} (only values ≥ 3 mm day^{-1} are plotted and shaded). The numbers at the top of each panel refer to weeks.

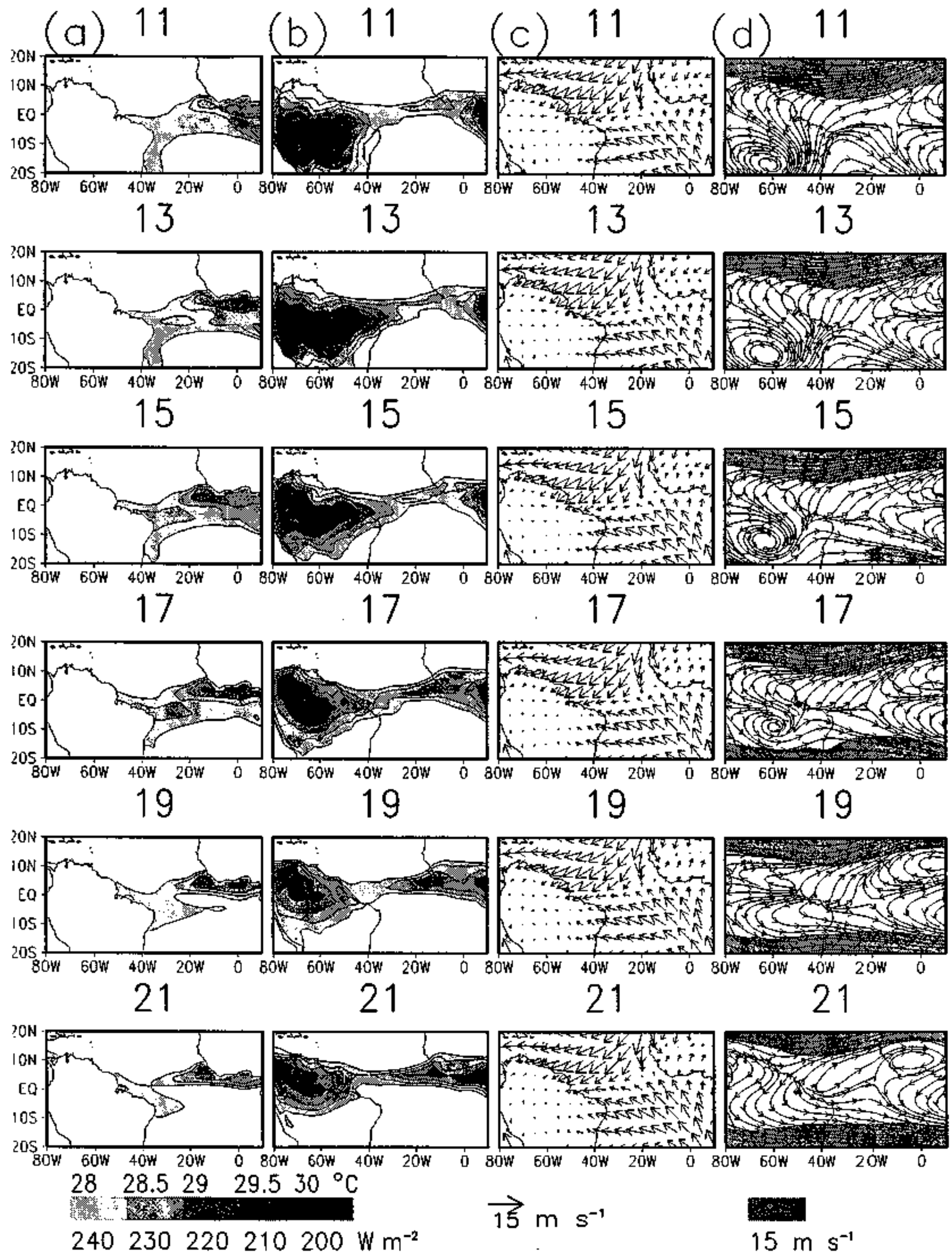

Figure 3. Weekly climatologies for: (a) SST; (b) OLR; (c) 1000-hPa winds and (d) 200-hPa divergent flow. The OLR contour interval is 10 Wm^{-2} and only values ≤ 240 Wm^{-2} are plotted and shaded. The SST shaded contour interval is 0.5 °C and only values ≥ 28°C are plotted. The 1000-hPa wind vectors magnitude is at the bottom of the figure. The 200-hPa divergent shaded contour interval is 5 ms^{-1} and only values ≥ 15 ms^{-1} are plotted. Weeks are indicated as in Fig 2 and only odd weeks are displayed.

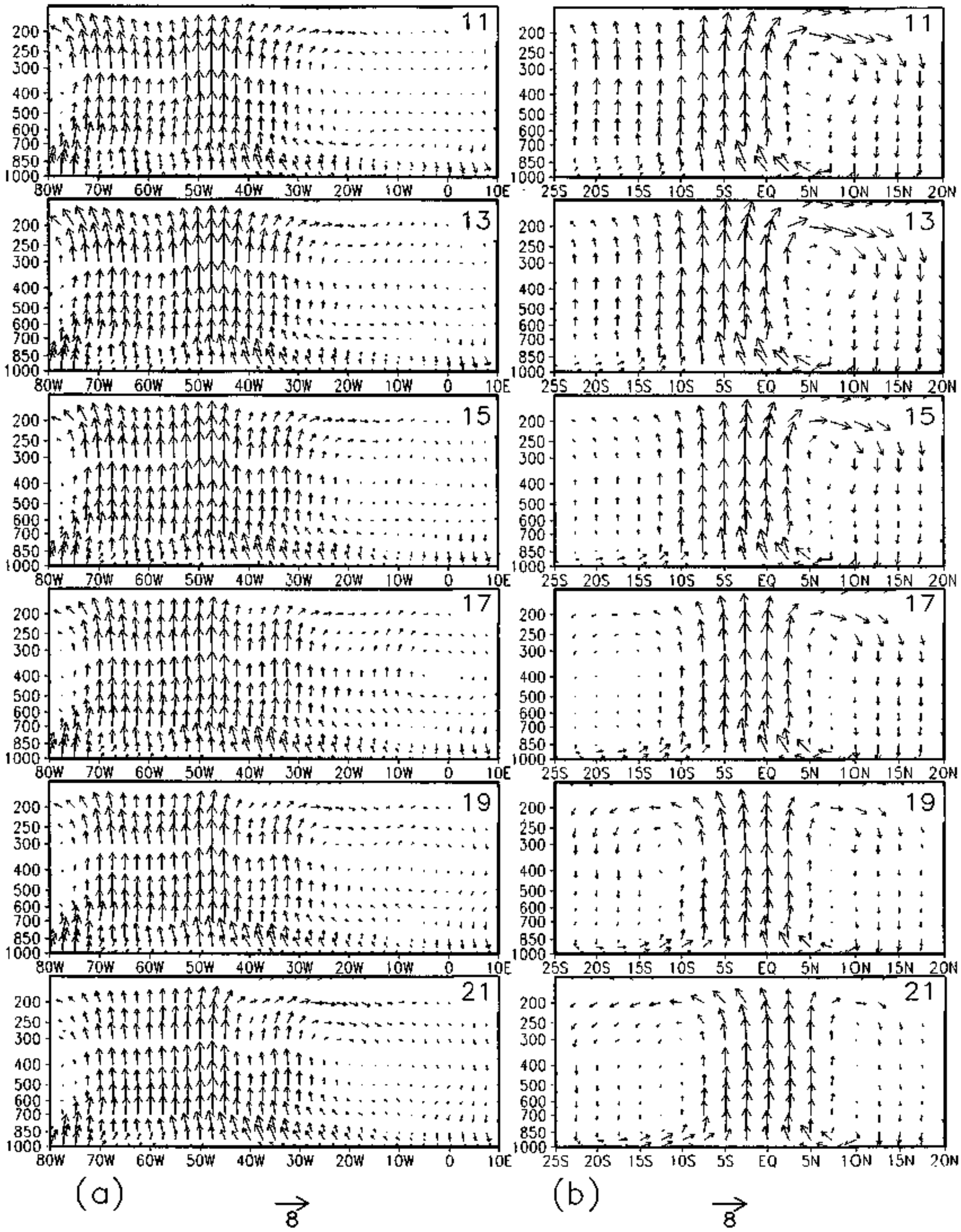

Figure 4. (a) Divergent zonal circulation averaged in the 10°S-5°N band; (b) Divergent meridional circulation averaged in the 57.5°W-35°W band. Vectors magnitudes in ms^{-1} are at the bottom of the figure. Numbers in the upper left corner in each panel refer to weeks and only odd weeks are displayed.

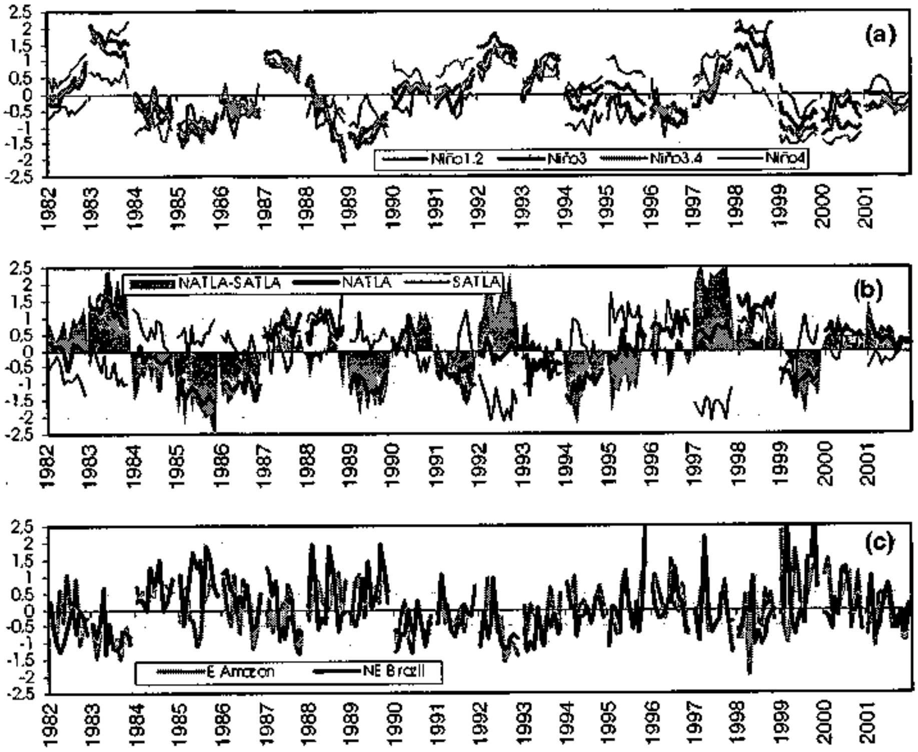

Figure 5. (a) SST Pacific indices; (b) SST Atlantic indices; (c) Precipitation indices. See text for details.

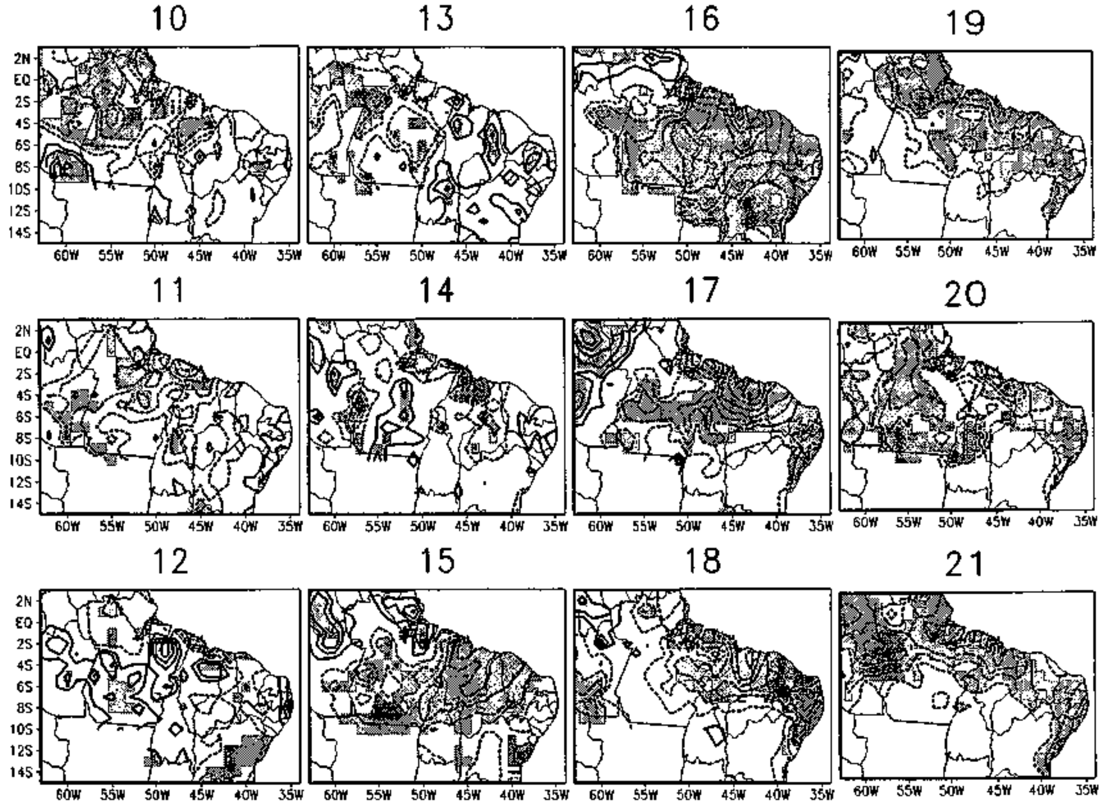

Figure 6. Precipitation anomaly composites for unfavorable climate scenario. Contour interval is 1 mm day^{-1}, with solid (dashed) contours for positive (negative) anomalies. The zero line has been omitted. Shading indicates areas with statistically significant anomalies at the confidence level of 95%. Week numbers are displayed as in Fig. 2.

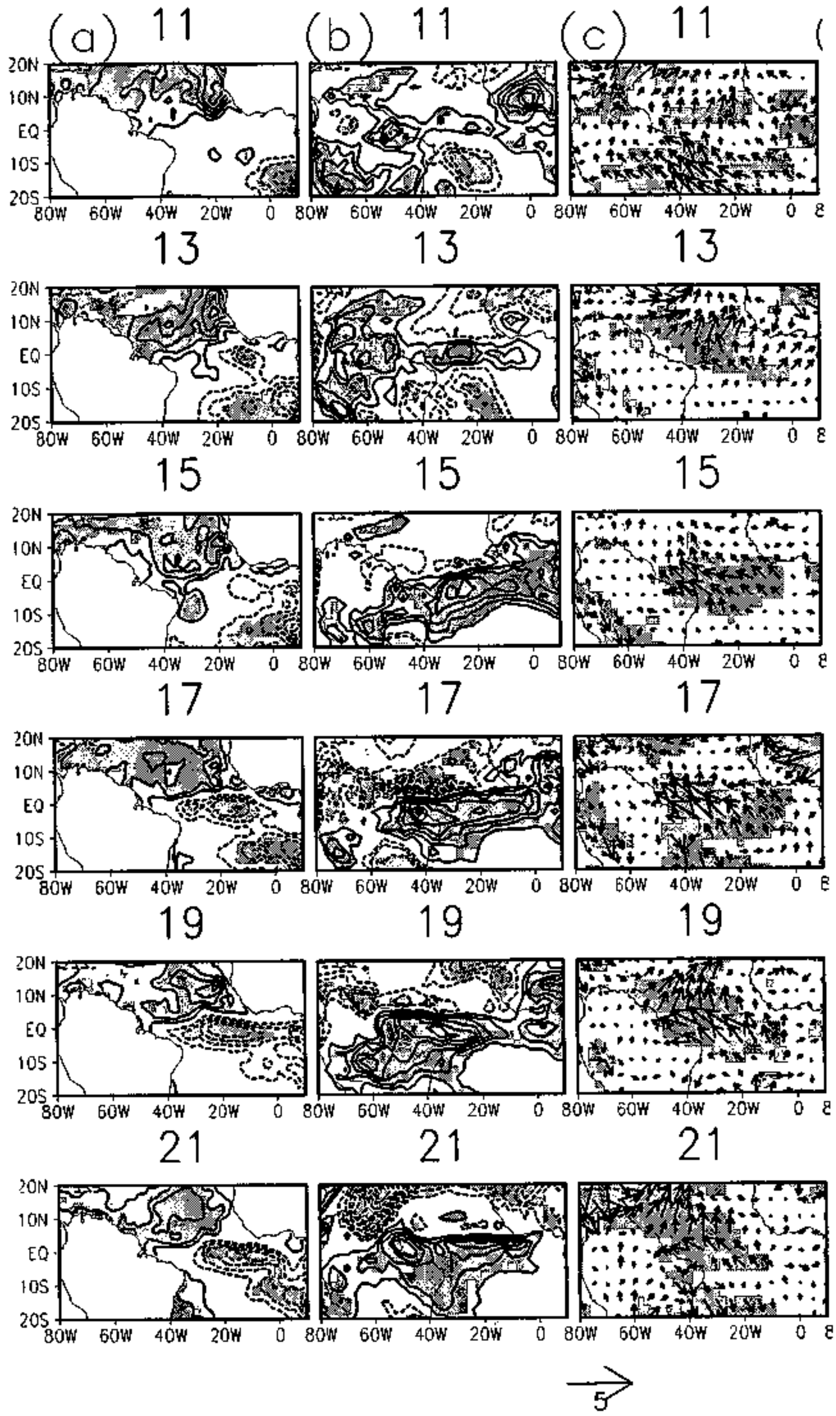

Figure 7. Anomalous composites for unfavorable scenario of the: (a) SST; (b) OLR and (c) 1000-hPa winds. The contour intervals are 5 Wm^{-2} for OLR and 0.2°C for SST. The 1000-hPa wind vectors magnitude is at the bottom of the figure. The zero line has been omitted in (a) and (b). Shading indicates areas with statistically significant anomalies at the confidence level of 95%. The week numbers are displayed as in Fig 2 and only odd weeks are displayed.

Figure 8. Anomalous composites for unfavorable scenario of the: (a) divergent zonal circulation averaged in the 10°S-5°N band; (b) Divergent meridional circulation averaged in the 57.5°W-35°W band. Vectors (m s^{-1}) magnitude is at the botton of the figure. Shading indicates areas with statistically significant anomalies at the confidence level of 95%. The week numbers are displayed as in Fig. 2 and only odd weeks are displayed.

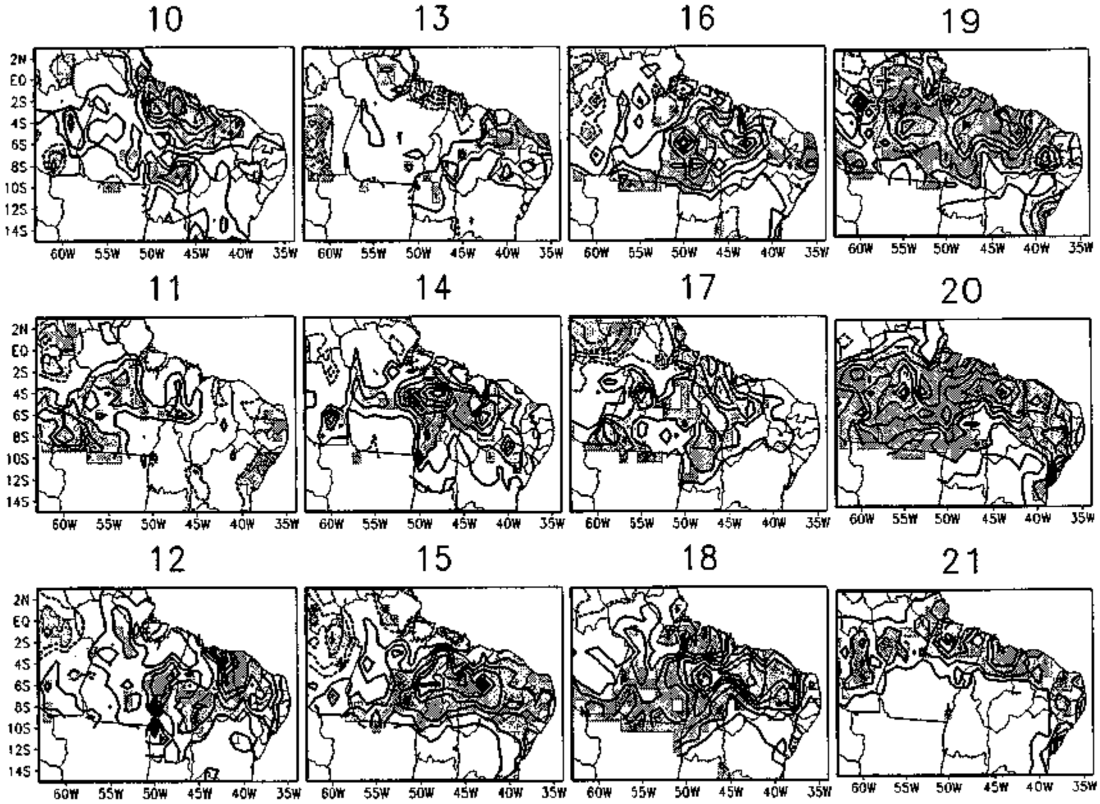

Figure 9. Precipitation anomaly composites for favorable climate scenario. Figure general features as in Fig. 6.

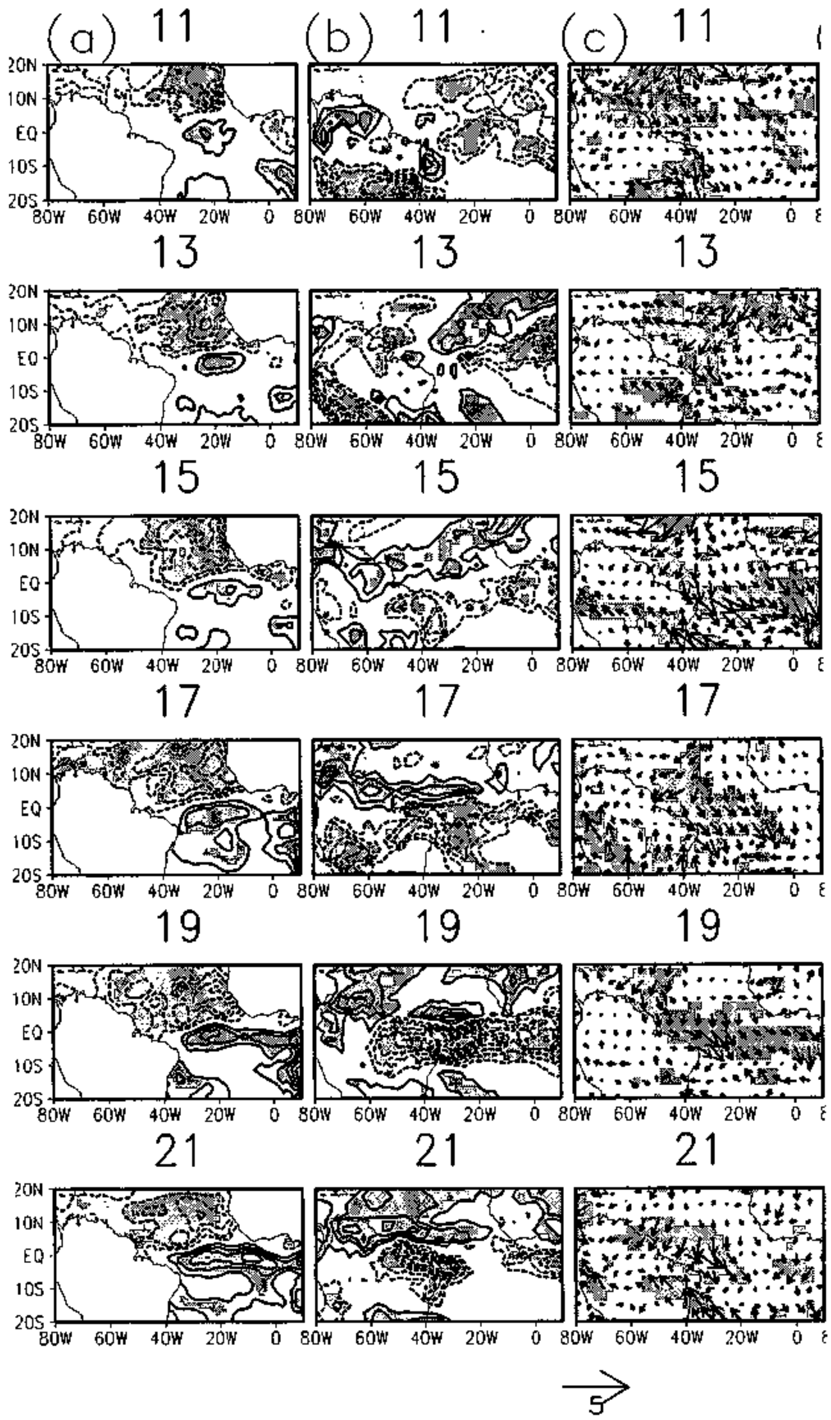

Figure 10. Anomalous composites for favorable climate scenario of the: (a) SST; (b) OLR and (c) 1000-hPa winds. Figure general features as in Fig. 7.

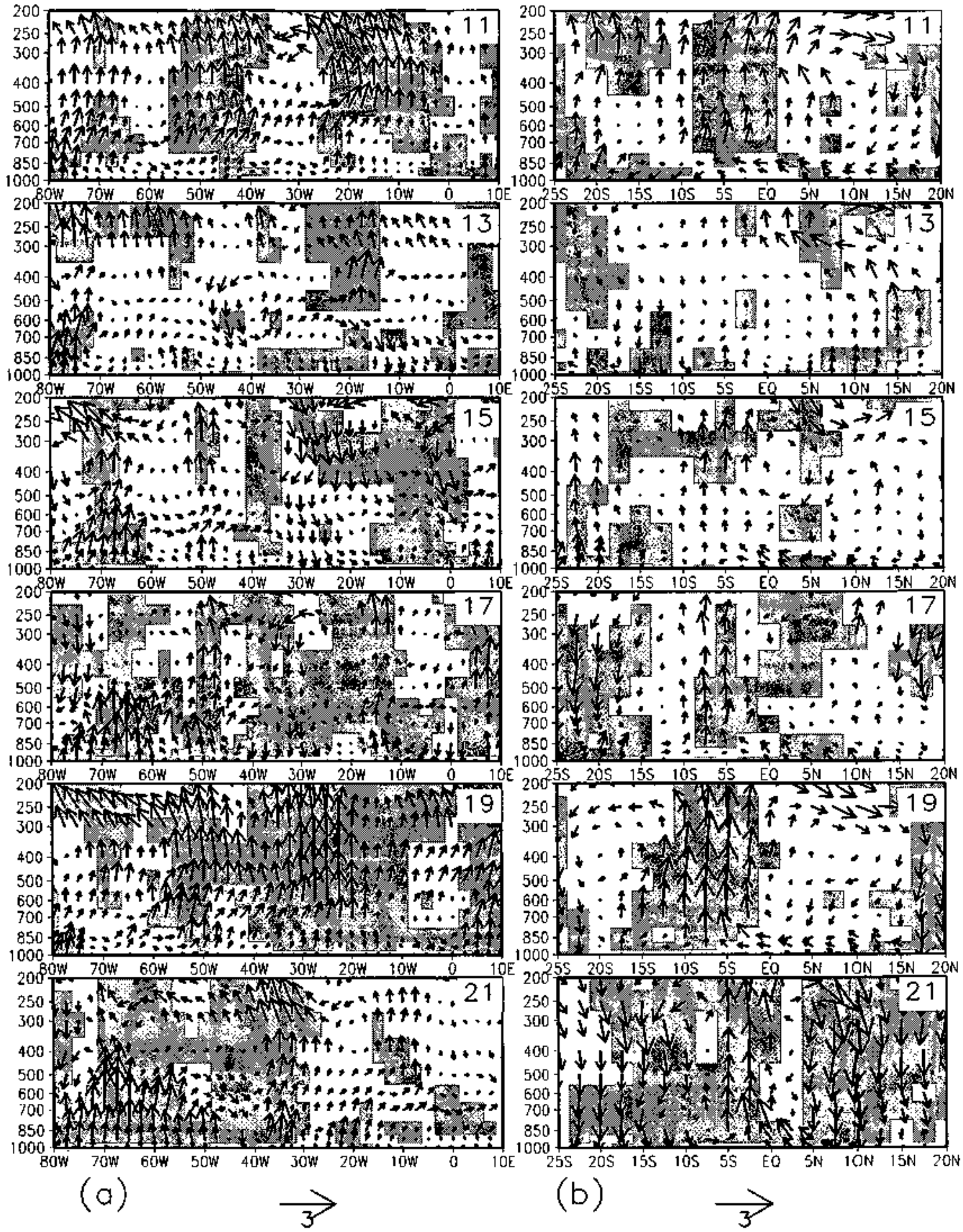

Figure 11. Anomalous composites for favorable scenario of the: (a) zonal circulation divergent averaged in the 10°S-5°N band; (b) meridional circulation divergent averaged in the 57.5°W-35°W band. Figure general features as in Fig. 8.