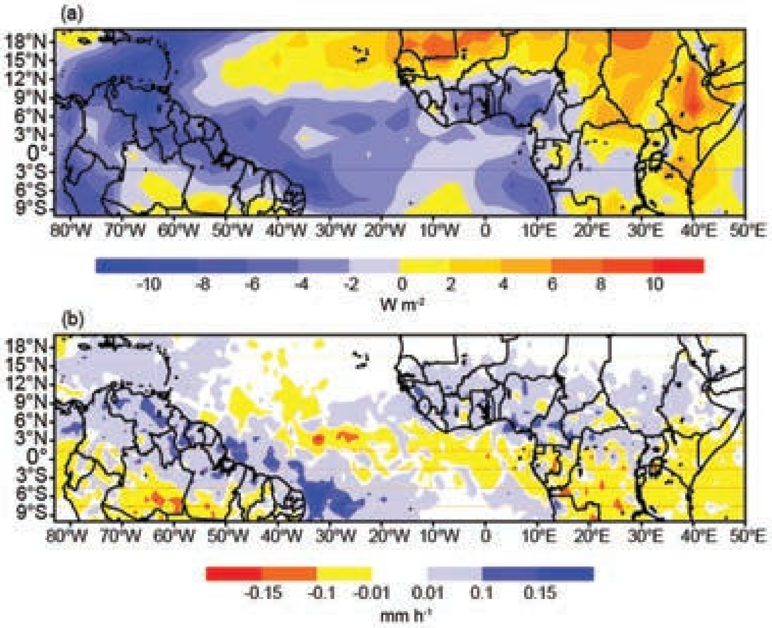

Fig. 4.32. (a) Atlantic NOAA-interpolated OLR (Liebmann and Smith 1996) anomalies (W m^{-2}) for 2011 and (b) TRMM anomalous precipitation rate (mm hr^{-1}) for Jan–Jun 2011. The anomalies were calculated based on the climatology for the period (a) 1975–2010 and (b) 1998–2010.

island groups south of the equator in particular tended to experience persistent rainfall anomalies for much of 2011, with an occasional respite during ENSO-neutral months. Tarawa (western Kiribati) and Penrhyn (Northern Cook Islands) had below-normal rainfall for 11 months of the year. Tahiti (French Polynesia), which lies farther to the east (150°W), received less than 50% of its normal rainfall for eight months of the year.

2) Atlantic—A. B. Pezza and C. A. S. Coelho

The Atlantic ITCZ is a well-organized convective band that oscillates approximately between 5°N–12°N during July–November and 5°N–5°S during January–May (Waliser and Gautier 1993; Nobre and Shukla 1996). Atmospheric equatorial Kelvin waves can modulate the ITCZ interannual variability (Mekonnen et al. 2008; Mounier et al. 2007) and ENSO is also known to influence the ITCZ on the seasonal time scale (Münnich and Neelin 2005). In 2011, the prevailing global scenario was that of a moderate-to-strong La Niña from January to April followed by yet another La Niña (weak to moderate) developing from September, with global climate anomalies typical of positive Southern Oscillation index (SOI) persisting in many areas of the globe. The ITCZ responded to this pattern and presented a noticeable enhancement, with negative average annual outgoing longwave radiation (OLR) anomalies in most of the equatorial Atlantic sector surrounding South America (Fig. 4.32a) driven primarily by the anomalous convection observed during the first half of the year (Fig. 4.32b). This pattern contributed to breaking the drought conditions

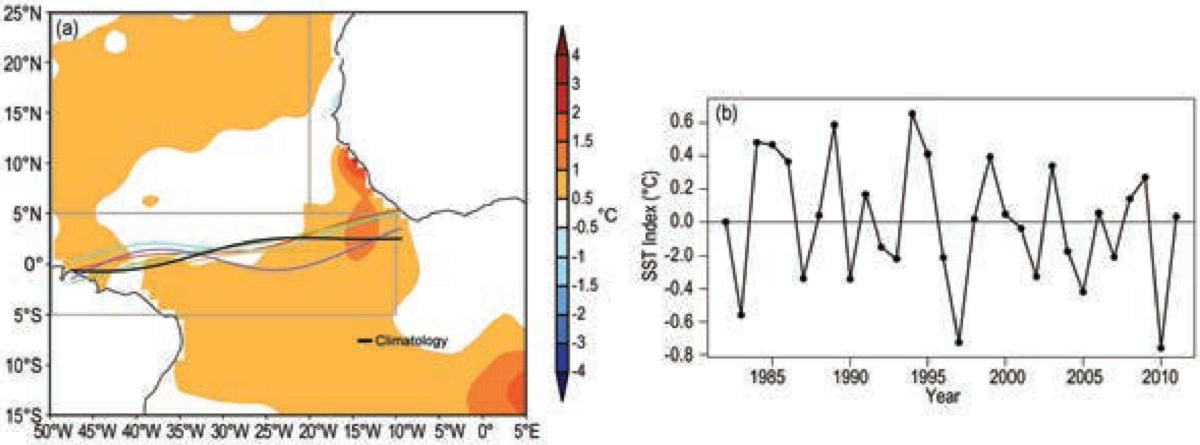

Fig. 4.33. (a) Atlantic ITCZ position inferred from OLR during March 2011. The colored thin lines indicate the approximate position for the six pentads of March 2011. The black thick line indicates the Atlantic ITCZ climatological position. The SST anomalies (°C, Reynolds et al. 2002) for March 2011 based on the 1982–2010 climatology are shaded. The two boxes indicate the areas used for the calculation of the new Atlantic Index in (b); (b) March SST anomaly time series (°C) averaged over the South American sector (5°S–5°N, 10°W–50°W) minus the SST anomaly time series averaged over the tropical coast of northern Africa (5°N–25°N, 20°W–50°W) for the period 1982–2011 forming the Atlantic Index. The positive phase of the index indicates favorable conditions for enhanced Atlantic ITCZ activity.

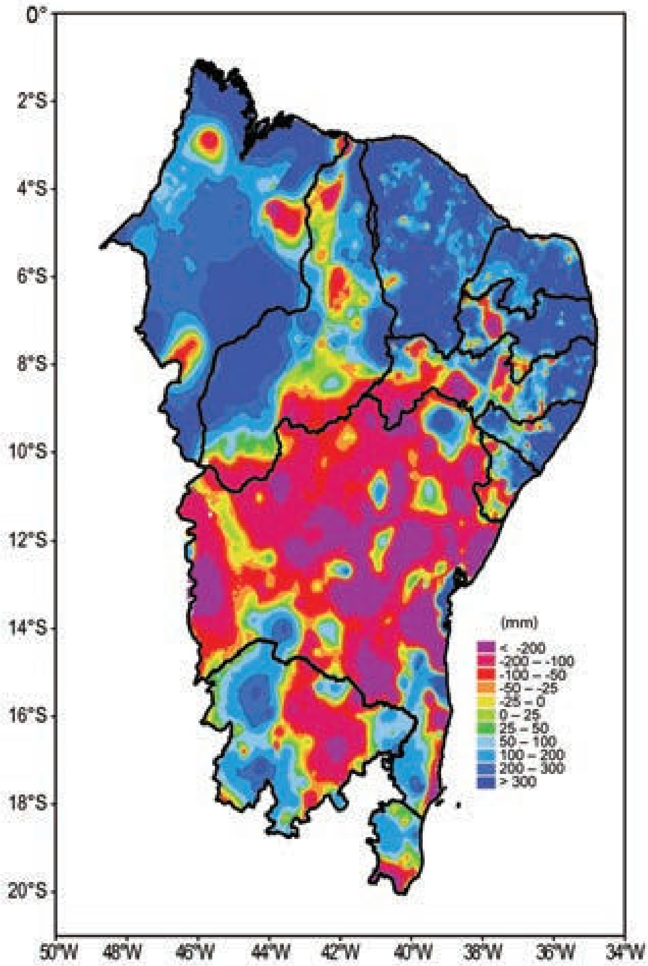

Fig. 4.34. Northeastern Brazil average 2011 precipitation anomaly (mm) with respect to 1961–90 climatology based on high-resolution station data. (Source: federal and regional networks CMCD/INPE, INMET, SUDENE, ANEEL, FUNCEME/CE, LMRS/PB, EMPARN/RN, LAMEPE/ITEP/PE, CMRH/SE, SEAAB/PI, SRH/BA, CEMIG/SIMGE/MG, and SEAG/ES)

that had previously been established in northeastern Brazil and parts of the Amazon in the previous year.

While the La Niña conditions indirectly helped enhance the ITCZ via Kelvin wave-induced upper-level divergence in the Atlantic sector, the demise of record-breaking warm SST anomalies observed over the subtropical North Atlantic (Fig. 4.33a) played a fundamental role via a favorable (enhanced) meridional SST gradient, expressed here by the Atlantic Index (see Fig. 4.33b caption for definition). A positive index in 2011, contrasting with the record-breaking negative index of 2010, implies a return to a more favorable pattern for frequent bursts of organized convection in the southern part of the basin and ultimately an overall enhancement of the ITCZ. Within this scenario, the ITCZ oscillated around its average climatological position for most of the year, with precipitation above average in parts of the eastern Amazon and northeastern Brazil (Fig. 4.34). This effect was due to the explicit dynamical response to upper-level divergence as well as the direct evaporative effect of the onshore trade winds responding to the north-south water temperature gradient, giving a typical La Niña response both in terms of positioning and strength of the ITCZ in 2011.

g. Atlantic multidecadal oscillation—C. Wang

The Atlantic Multidecadal Oscillation (AMO) is an oscillatory mode defined by the detrended North Atlantic SST anomalies over the region of 0°–60°N and from the east coast of the Americas to 0° longitude (Figs. 4.35a,b; Delworth and Mann 2000; Enfield et al. 2001; Wang et al. 2008a). A driving mechanism for the AMO may be the Atlantic meridional overturning circulation (Delworth and Mann 2000; Knight et al. 2005; Dijkstra et al. 2006; R. Zhang et al. 2007; see also section 3h of this report for detailed information on the meridional overturning circulation). A new study shows that the AMO varies with dust aerosol in the tropical North Atlantic and rain-

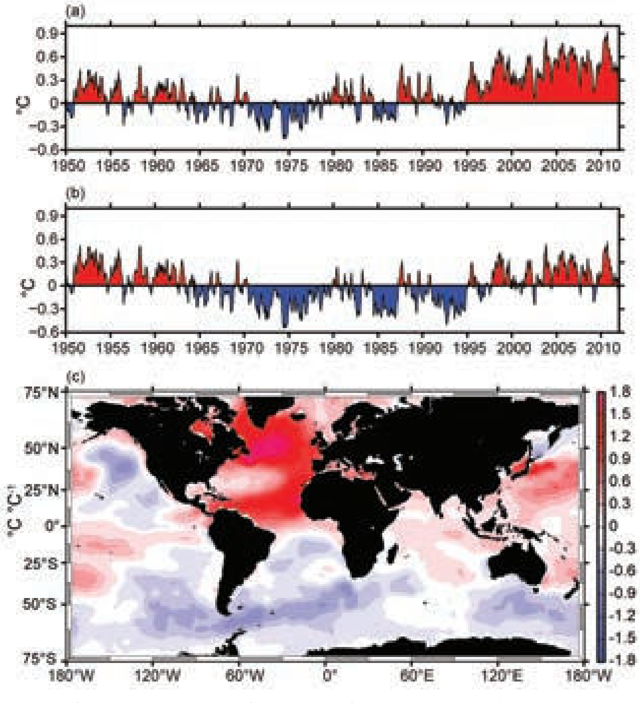

Fig. 4.35. The index of the AMO and its spatial pattern. Shown are (a) SST anomalies (°C) in the North Atlantic of 0°–60°N and from the east coast of the Americas to 0° longitude, (b) the AMO index (°C) defined by the detrended (removing the linear trend) North Atlantic SST anomalies, and (c) regression (°C per °C) of global SST anomalies onto the AMO index of (b). The monthly SST anomalies are calculated as departures from the 1971–2000 base period.