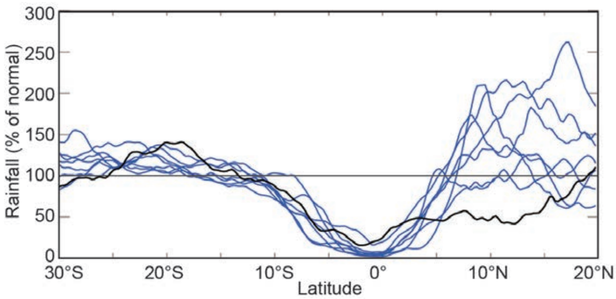

Fig. 4.30. South-north cross-sections of Jan–Mar rainfall anomalies (% of 1998–2011) for all La Niña seasons since 1998, averaged over the sector 180° to 150°W. The black line represents 2012, and the blue lines the years 1999, 2000, 2001, 2006, 2008, 2009, and 2011.

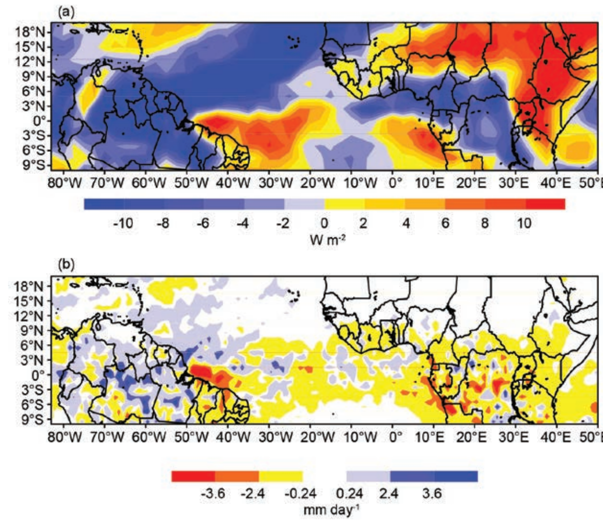

Fig. 4.31. (a) Atlantic NOAA interpolated OLR (Liebmann and Smith 1996) anomalies (W m^{-2}) for Jan–Feb 2012 and (b) TRMM anomalous precipitation rate (mm day^{-1}) for Jan–Mar 2012. Anomalies are based on the climatology for (a) 1975–2011 and (b) 1998–2011.

at Rarotonga (21°S, 160°W) in the southern Cook Islands it was 53% of normal (http://www.niwa.co.nz/climate/icu). These islands typically experience dry conditions during El Niño periods.

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 and 12°N during July–November and 5°N and 5°S during January–May (Waliser and Gautier 1993; Nobre and Shukla 1996). Equatorial Kelvin waves can modulate the ITCZ intraseasonal variability (Wang and Fu 2007; Mounier et al. 2007; and Mekonnen et al. 2008); and ENSO is also known to influence it on the seasonal time scale (Münnich and Neelin 2005). In 2012 the prevailing equatorial Pacific scenario was a moderate La Niña that began retreating in March, leading to slightly warm to neutral conditions for the remaining of the year. The ITCZ responded to this pattern and presented a noticeable enhancement in January and February, with negative outgoing longwave radiation (OLR) anomalies in most of the western sector of the equatorial Atlantic surrounding South America (Fig. 4.31a). This pattern contributed to above-average rainfall in the Amazon sector of Brazil, Peru, Colombia, and Venezuela, but it was not sufficiently strong to produce significant rainfall in the drought-prone area of northeastern Brazil during the first three months of 2012 (Fig. 4.31b).

The ending of La Niña conditions in March helped enhance the ITCZ via Kelvin wave-induced upper level divergence in the western Atlantic sector during January and February. For the remainder of the year the ITCZ presented a near-normal convective intensity, with occasional bursts of severe convection towards the Caribbean Sea. This anomalous activity to the west responded to a cooler-than-average SST pattern in both the North and South Atlantic (Fig. 4.32a) prevailing until austral winter. Such an SST pattern favored the ITCZ predominant location to the north of its climatological position particularly during the first four months of the year. During boreal summer, the North Atlantic warmed up considerably and remained warm until the end of the year. The interplay of the SST gradient between the South and North Atlantic is seen by the Atlantic Index (see Fig. 4.32b caption for definition), which shows a return to negative conditions (unfavorable for convection within the ITCZ) contrasting with parts of 2010 and 2011, yet not as severe as in early 2010. Within this scenario, the ITCZ oscillated north of its average climatological position for most of the year, with precipitation well below average over most of northeastern Brazil (Fig. 4.33; see Sidebar 7.2 for more details on the drought in this region).

g. *Atlantic warm pool*—C. Wang

The Atlantic warm pool (AWP) is a large body of warm water in the lower latitudes of the North Atlantic, comprising the Gulf of Mexico, the Caribbean Sea, and the western tropical North Atlantic (Wang and Enfield 2001, 2003). Previous studies have shown that the AWP plays an important role in Atlantic tropical cyclone activity, and in rainfall in the central United States (Wang et al. 2006, 2008a, 2011). Unlike the Indo-Pacific warm pool, which straddles the equator, the AWP is entirely north of the equator. In addition to the large seasonal cycle, AWP variability occurs on both interannual and multidecadal timescales, and

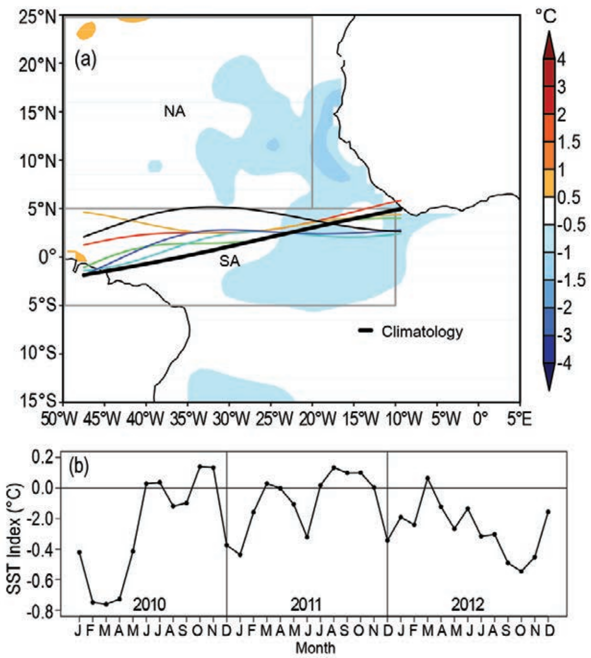

Fig. 4.32. (a) Atlantic ITCZ position inferred from OLR during Apr 2012. The colored thin lines indicate the approximate position for the six pentads of Apr 2012. The black thick line indicates the Atlantic ITCZ climatological position. The SST anomalies (°C; Reynolds et al. 2002) for Apr 2012 based on the 1982–2011 climatology are shaded. The two boxes indicate the areas used for the calculation of the Atlantic Index in (b). (b) Monthly SST anomaly time series averaged over the South American sector (SA region, 5°S–5°N, 10°W–50°W) minus the SST anomaly time series averaged over the tropical coast of northern Africa (NA region, 5°N–25°N, 20°W–50°W) for 2010–12 forming the Atlantic Index. The positive phase of the index indicates favorable conditions for enhanced Atlantic ITCZ activity.

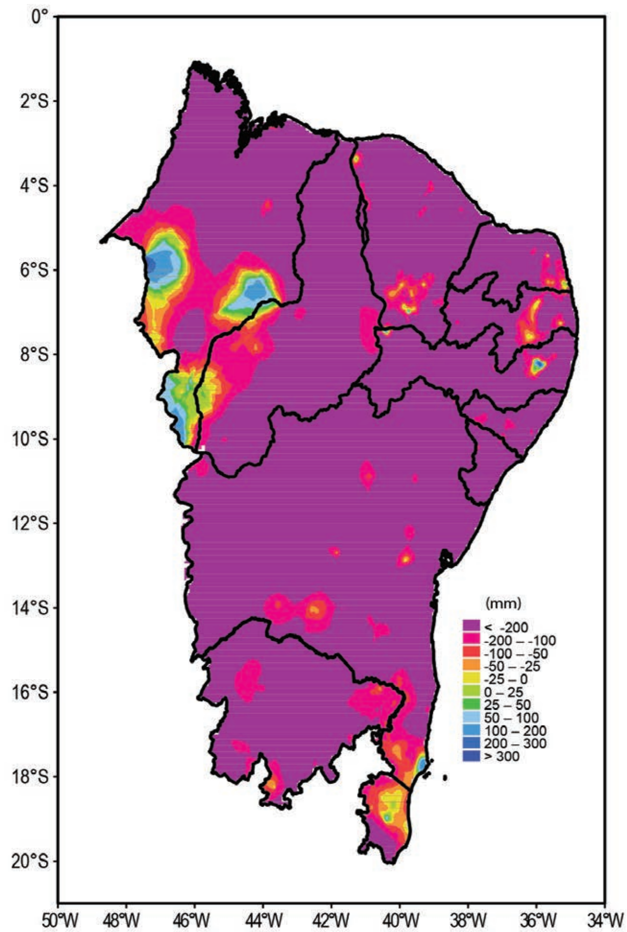

Fig. 4.33. Northeastern Brazil average 2012 precipitation anomaly (mm) with respect to 1961–90 climatology based on high resolution station data. [Data sources: federal and regional networks (CMCD/INPE, INMET, SUDENE, ANEEL, FUNCEME/CE, LMRS/PB, EMPARN/RN, LAMEPE/ITEP/PE, CMRH/SE, SEAAB/PI, SRH/BA, CEMIG/SIMGE/MG, SEAG/ES)].

has exhibited a long-term warming trend (Wang et al. 2006, 2008b). Figures 4.34a and b depict the long-term total and detrended June–November AWP area anomalies. The multidecadal variability (Fig. 4.34c) shows that the AWP was larger during the period 1930–60, as well as after the late 1990s; and smaller during the periods of 1905–25 and 1965–95. The periods for large and small AWPs coincide with the warm and cool phases of the AMO (Delworth and Mann 2000; Enfield et al. 2001). Wang et al. (2008b) showed that the influences of the AMO on tropical cyclone activity and climate might operate through the atmospheric changes induced by the AWP. The spatial distribution of AWP-related global SST anomalies is shown in Fig. 4.35, which depicts the AWP varied with the global SST on both interannual and multidecadal time scales.

In 2012, the AWP during the Atlantic hurricane season was larger than its climatological mean, with the largest AWP occurring in September (Fig. 4.36a). The large AWP in 2012 was associated with an active 2012 hurricane season in the North Atlantic, and consistent with that, a large AWP is generally associated with a reduction in vertical wind shear and an increase in atmospheric instability in the MDR—two factors favoring tropical cyclone development (Wang et al. 2008a). Spatially, the AWP started to develop in June in the Gulf of Mexico (Fig. 4.36b). By July and August, the AWP was well developed in the Gulf of Mexico and Caribbean Sea and reached eastward to the western tropical North Atlantic (Figs. 4.36c,d). By September, the AWP had further expanded southeastward and the isotherm of 28.5°C covered the entire tropical North Atlantic by crossing to the coast of