SIDEBAR 7.2: THE 2012 SEVERE DROUGHT OVER NORTHEAST BRAZIL—

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Northeast Brazil experienced severe drought during the 2012 wet season, which followed several years of near- to above-normal rainfall. During the rainy season of 2012, many areas received less than 50% of the average rainfall for the season, leading many municipalities to declare states of emergency. Lack of rain dried up rivers and damaged crops, which boosted food prices.

The rainy season over Northeast Brazil varies from region to region: December–February (DJF) or November–January (NDJ) in southern sections, January–March (JFM) in central sections, February–April (FMA) in northern sections, and May–July (MJJ) along the eastern coast. The 2012 precipitation anomalies for NDJ and FMA (see Fig. 7.15) show below-average rainfall over Northeast Brazil during both periods, with the largest deficits occurring in FMA when rainfall is usually a maximum over northern Northeast Brazil. The rainfall deficits in FMA extended over most of Brazil, except for the western and northern portions of the Amazon Basin where above-average rainfall was observed.

The El Niño–Southern Oscillation (ENSO) phenomenon has a significant impact on rainfall over tropical Brazil. The impacts on Northeast Brazil partly depend on the intensity and distribution of the SST departures in the tropical Pacific Ocean. Often, below-average rainfall over the central/eastern Amazon and the Northeast is associated with warmer-than-average SSTs (El Niño) in the equatorial Pacific, while above-average rainfall in those regions is associated with colder-than-average SSTs (La Niña). Other factors, such as the distribution of SST anomalies in the tropical Atlantic and, consequently, the position and intensity of the ITCZ, and transient systems (e.g, cold fronts and upper-level subtropical cyclonic vortices) are also important, and affect rainfall variability in Northeast Brazil. The 2012 Northeast drought was unexpected, since below-average SSTs were present in the central equatorial Pacific (La Niña).

The observed data for some selected stations, from the Brazilian National Weather Service, INMET, indicate that several Northeast stations had FMA 2012 precipitation deficits greater than 400 mm, indicating strong drought conditions, especially during March and April. Figure SB7.2 top panels show monthly precipitation anomalies calculated for the period July 2011–June 2012 in two selected 5° by 5° boxes: 1) Northern Northeast Brazil (NNEBR, 2°S–10°S, 37°W–45°W) and 2) Southern Northeast Brazil (SNEBR, 10°S–18°S, 40°W–48°W). It is clear that precipitation was below normal between December 2011 and May 2012 in both regions, with maximum deficits occurring in March and April. The FMA average daily precipitation for each year during 1979–2012 in the two selected boxes (Fig. SB7.2, bottom panels) shows that 2012 was the driest FMA period in the entire 34-year record for both NNEBR and SNEBR. The preceding years (2006–11) were generally quite wet for both regions.

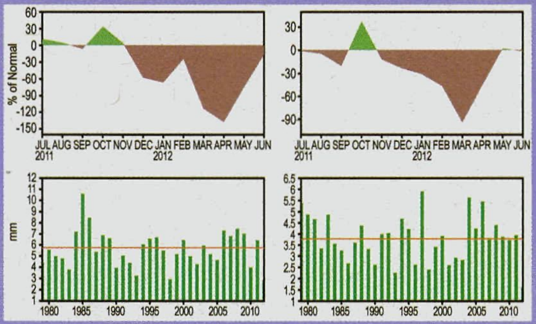

FIG. SB.7.2. (Top) Monthly precipitation anomalies (mm) for Jul 2011–Jun 2012, for NNEBR (left) and SNEBR (right). Anomalies are computed with respect to 1981–2010. (Bottom) Average daily precipitation (mm) for Feb–Mar in the two regions for 1979–2012. The orange lines indicate the 1981–2010 mean daily precipitation.

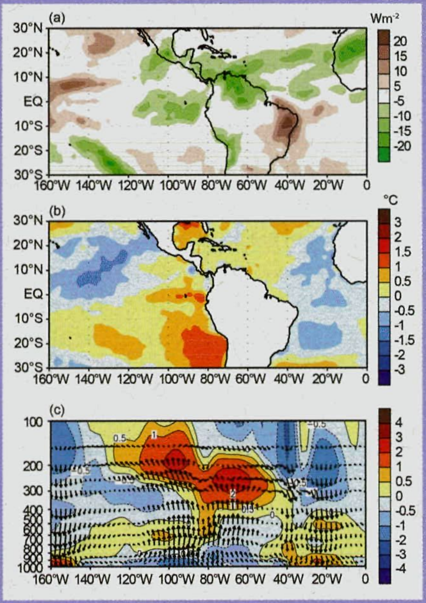

FIG. SB.7.3. (a) Anomalous outgoing longwave radiation (OLR, W m^{-2}), (b) sea surface temperatures (SSTs, °C), and (c) zonal divergent circulation, for Feb–Apr 2012. (Source: NCEP/NCAR.)

The pattern of outgoing-longwave radiation (OLR) for FMA 2012 (Fig. SB.7.3a) shows negative anomalies (enhanced convective activity) in the tropical Atlantic north of the equator, indicating that the ITCZ had shifted northward from its normal position. This is consistent with below-average SSTs in the tropical Atlantic Ocean (Fig. SB.7.3b). The OLR pattern also shows enhanced convective activity over the northern Amazon Basin and over the eastern tropical Pacific where SSTs were above average.

A longitude-height cross section of the anomalous divergent circulation for the latitude band from the equator to 10°S (Fig. SB.7.3c) shows anomalous sinking motion in the mid-troposphere (400 hPa to 700 hPa) over Northeast Brazil (30°W–40°W) and anomalous rising motion over the Amazon Basin and the extreme eastern Pacific, consistent with the patterns of OLR and SST anomalies. This suggests that the distribution of SST anomalies in the tropical Atlantic and Pacific may have caused a westward shift in the divergent circulation cell (regional Walker circulation cell) from its normal position, contributing to the Northeast Brazil drought and heavy rainfall in the western Amazon Basin.