d. Central America and the Caribbean—E. K. Grover-Kopec[31]

i) Temperature

Annual mean surface temperatures were slightly above average across Central America and the Caribbean during 2005 (Fig. 6.16). Temperatures were at least 0.5°C above normal for the year over the entire region except for western Cuba and the Pacific coastal regions of Costa Rica and Panama. The warmest conditions, relative to climatology, were observed in Guatemala and Belize, where annual departures from the 1971–2000 mean exceeded 1°C.

ii) Precipitation

Most of the Central American isthmus experienced drier-than-normal conditions in 2005, though precipitation deficits were not as severe and widespread as those seen in recent years. The most significant standardized 12-month precipitation anomalies occurred across Honduras, Nicaragua, central Costa Rica, and southern Panama (Fig. 6.16). The largest absolute annual precipitation deficits compared to the 1979–2000 base period were observed in this same region. Negative anomalies exceeding 1000 mm were observed in eastern Honduras and Nicaragua, accounting for approximately half of the climatological mean annual precipitation in these areas, typically among the wettest regions in Central America.

The largest contrast between the precipitation regime of 2005 and that of recent years was observed in the Caribbean, particularly in Jamaica, eastern Cuba, and western Haiti. Drought conditions, which have had a large impact on water resources and agriculture over the past few years in Cuba (Levinson 2005), eased a bit as the eastern portion of the island received 25% more precipitation than normal during the year. Much of this excess precipitation came during May, June, and October, which are among the wettest months of the year in that area. The climatological precipitation distribution across most of the Caribbean and Central American region is bimodal, with relative maxima occurring in May–June and September–October.

iii) Notable events

The record-breaking 2005 Atlantic hurricane season (see section 4 sidebar) caused devastating losses across the region from July to November. Most damage came from Hurricanes Dennis, Emily, Stan and Beta, and Tropical Storm Gamma, which primarily affected the countries of Cuba, Grenada, Guatemala, Nicaragua, and Honduras, respectively.

While all of these storms had tremendous localized impacts, Stan was arguably the most destructive and certainly the deadliest in the region, affecting eight countries in early October. The storm brought 150–400 mm of precipitation to western Guatemala. One-third of the population of Guatemala was affected by Stan and more than 1000 deaths were reported. Agence France-Presse and Reuters reported that most of these deaths occurred when mudslides buried the villages of Panabaj and Tzanchal in the southwestern department of San Marcos, where some of the largest precipitation accumulations were reported.

e. South America

i) Overview—M. Rusticucci[78] and J. L. Camacho[13]

South America experienced below-normal precipitation anomalies across a majority of the conti-

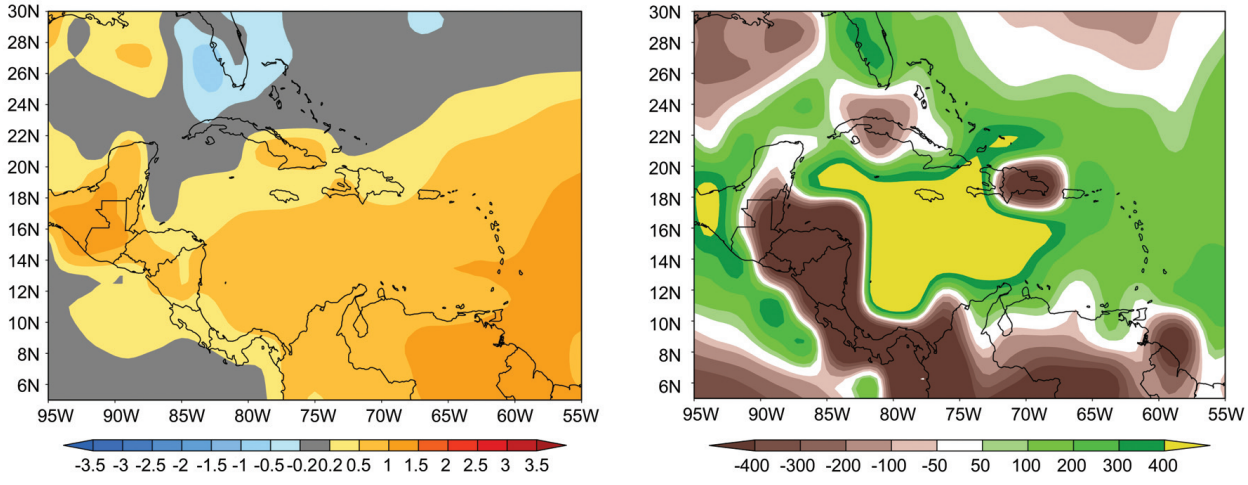

Fig. 6.16. Central American and Caribbean 2005 annual (left) temperature anomalies (°C; 1971–2000 base), and (right) precipitation anomalies (mm; 1979–2000 base) from CAMS–OPI.

nent in 2005, with some excesses in the northwest and southwest (Fig. 6.17). However, despite overall deficits, extreme but inconsistent and widely scattered precipitation events over most of the continent adversely impacted the population. Additionally, anomalously frequent cold air advection from higher latitudes was experienced by both the north and south sides of the continent.

Most of northern and eastern South America experienced temperatures above the 1961–90 normal, while western parts were below average. This is generally reflected in Fig. 6.17.

One important recent improvement in the climatic analysis of South America has been the addition of annual or monthly averages from up to 516 individual stations, as provided by the National Meteorological and Hydrometeorological Services of Argentina, Bolivia, Chile, Colombia, Ecuador, Uruguay, Paraguay, Peru, and Venezuela, and also from the Brazilian Centre de Provisão de Tempo Estudos Climáticos (CPTEC). Attention has been given to minimizing excessive local-scale influence to better establish the regional behavior of extreme climatic events. These data are the primary source for subsequent precipitation analyses, and they have been blended with the NCDC/GHCN database for temperatures; the reference period is 1961–90.

ii) Northern South America and the Southern Caribbean—J. D. Pabón[63]

Typical responses to equatorial Pacific cold conditions were observed in northern and northwestern South America in 2005, with precipitation generally above normal except in the Colombian–Venezuelan Amazonia region, where precipitation deficits occurred. Intense rainfall, particularly from March to May and during the second half of the year caused flash flooding and landslides that resulted in death and considerable damage. Around 1 million people were affected during intense October–December rainfall events in Colombia, which caused more than 500 deaths, destroyed over 1,000 houses, and heavily damaged infrastructure.

Although average temperatures for several months were below normal over several regions of Colombia, northeastern parts of Columbia and Venezuela experienced annual average air temperature up to 1.0°C above normal, while western regions were slightly below normal. Northern Hemisphere midlatitude synoptic activity penetrated further south than normal, generating perturbations in the ITCZ and producing considerable precipitation over the Caribbean and northern South America. The Caribbean also was affected by the increased tropical cyclone activity in the Atlantic basin in 2005 (see section 4c).

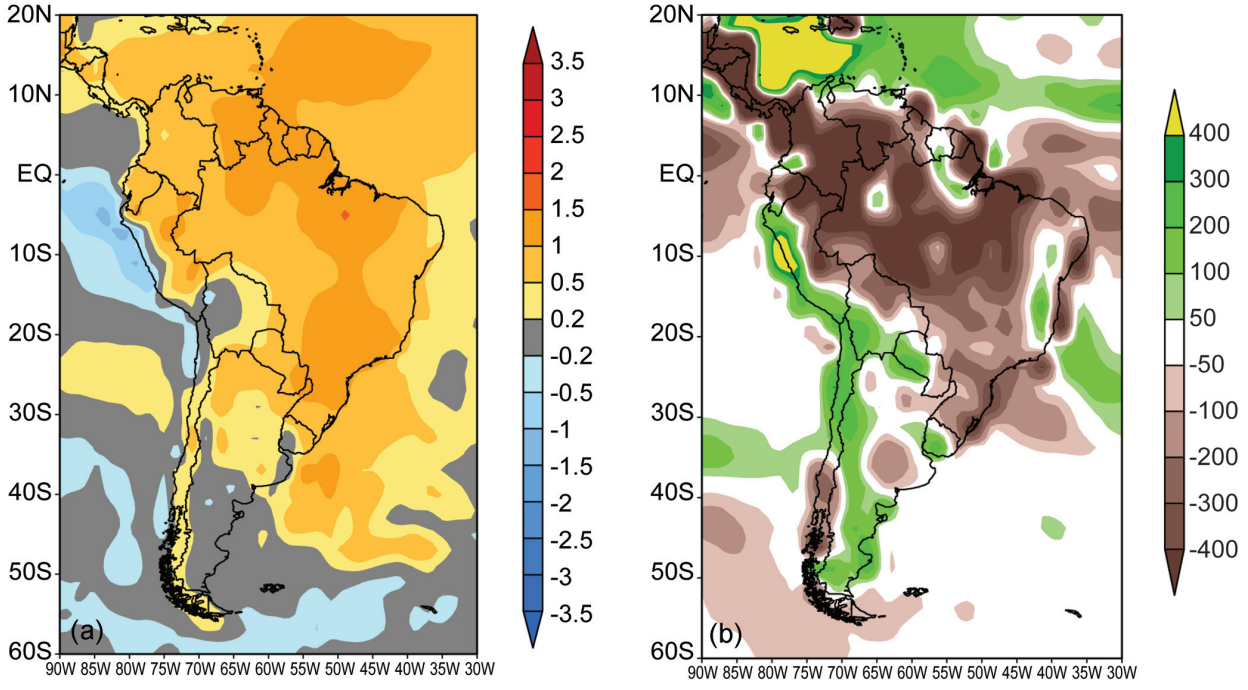

Fig. 6.17. South American 2005 annual (left) temperature anomalies (°C; 1971–2000 base), and (right) precipitation anomalies (mm; 1979–2000 base) from CAMS–OPI.

iii) Tropical South America East of the Andes—J. A. Marengo[50]

Heavy rain in January caused flooding in Georgetown, Guyana, and surrounding areas, affecting an estimated 290,000 people. Conversely, large negative rainfall anomalies were measured east of the Andes in the Amazon, northeast and southern Brazil, and in the South American monsoon–Pantanal regions. The rainy season in northeast Brazil during February–May was below normal, reaching drought levels in some semiarid interior regions, and severely impacting over two million inhabitants. Amazonia also experienced intense drought during most of 2005, especially in southern and western sections of the basin (see sidebar). More than 167,000 people have been affected by the drought, both directly and indirectly. Low river levels impacted the region's main source of transport and contributed to the deaths of large numbers of already endangered manatees and river dolphins.

In west-central and southeastern Brazil, the rainy season was from below to slightly below the normal. Drought conditions were present in the Chaco region of Bolivia and Paraguay during January and February 2005. Low water levels on the Paraguay River significantly reduced barge traffic in 2005.

Rainfall in southeastern Brazil was primarily in the form of intense events that lasted several days. Several of Brazil's large cities were flooded by these events, leaving much of the population without power or shelter. In and around São Paulo and Rio de Janeiro, dozens of people died due to landslides and flooding.

Annual air temperature anomalies reached almost 3°C above normal in eastern Brazil, with every month above normal and the warmest months being April, August and October. In October, typically the onset of the rainy season in the southern areas, temperature anomalies were up to 5°C above normal. From Octo-

DROUGHT IN AMAZONIA—J. Marengo[50]

In 2005, large sections of the western part of the Amazon Basin endured the worst drought in 40 years and also one of the most intense since the beginning of the twentieth century. While the Amazon normally rises and falls in conjunction with seasonal precipitation, 2005 rainfall was well below normal (Fig. 6.18), which allowed rivers to drop to record low levels. Levels of the Madeira and Solimões Rivers, two of the Amazon's major tributaries, dropped to record and 38-yr lows, respectively. In the Brazilian states of Rio Branco, Rondonia, southern Para, and southern Amazonas, rainfall was 30%–50% below normal in January–April 2005, 33% below normal in June and August, and 65% below normal in July. According to the meteorological service of Peru, the hydrological year of 2004/05 exhibited rainfall well below normal in Peruvian Amazonia, with mean rainfall for the hydrological year September 2004–August 2005 up to 39% below normal. Rainfall on the basins of the Bolivian Beni and Mamoré Rivers was about 20%–30% below normal for January–April. Drought conditions favored the occurrence of forest fires, and in September the number of fires was about 300% more than those detected in September 2004.

Levels of the Amazonas River at Iquitos, Peru, and Leticia, Colombia; the Solimões River at Tabatinga and Fonte Boa, Brazil; the Acre River at Rio Branco, Brazil; the Mamoré at Puerto Varador, Bolivia; and the Ibaré River at Puerto Almacén, Bolivia all were well below the normal during most of 2005 until September, in some cases as much as 2 m below normal monthly means. At daily time scales, the situation was even more dramatic. The level of the Solimões River at Tabatinga and Fonte Boa decreased from 11.5 and 21 m (respectively) in May to near 1 and 11 m (respectively) in September. Rainfall started by the end of October 2005, reached a November mean of almost 107% above normal, and recharged the Rio Amazonas in Iquitos to a normal level by November. By January 2006 the Acre and Madeiras Rivers achieved anomalously high levels (11.08 and 12.34 m, respectively) due to the intense rains. In contrast to the intense drought of the 1982/83 and 1997/98 El Niño years, the 2005 drought was concentrated in western and southern Amazonia and was not related to El Niño, which brings drought to central and eastern Amazonia, but rather to a warming of the tropical North Atlantic during most of 2004 and 2005.

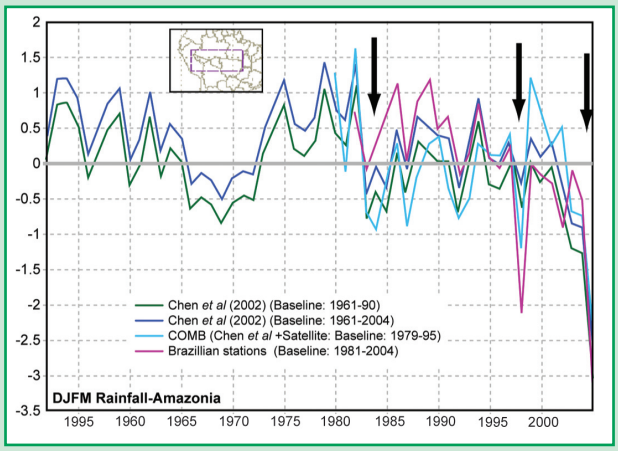

Fig. 6.18. Rainfall anomalies (mm day^{-1}) in central Amazonia during the peak season (December–May) 1951–2005. Black arrows represent drought years 1983, 1998, and 2005.

ber to December, temperatures were over 3°C above normal in far western Amazonia. Air temperatures in Bolivia and northern Paraguay were 1°–4°C below normal from September to November.

iv) Tropical South America West of the Andes—R. Martínez[51]

As in northern South America, rainfall in Ecuador and Peru was strongly influenced by SST over the Niño-1+2 region during 2005. Despite weak warming in the tropical Pacific, cold coastal SST anomalies led to negative rainfall anomalies along the Ecuadorian coast. Mean temperature also was below normal during 2005. In November 2005, a strong frost caused significant damage in the central and southern highland of Ecuador. In Peru, rainfall was below normal along the central and southern highlands, continuing several years of drought in this region. Bolivia also experienced drier-than-normal conditions in 2005, except for October and November when intense rains generated flooding and damage. The mean temperature in Bolivia was above normal across most of the country.

v) Southern South America—M. Bidegain[7] and M. Rusticucci[78]

Annual precipitation anomalies over southern South America show light deficits over the east and surplus over central Chile and western and southern Argentina. Above-normal precipitation for several months contributed to the positive anomalies in these regions. A series of intense summer (June–August) precipitation events also contributed, with some local anomalies exceeding 700% of the normal. On 26 June, 162.4 mm of rain fell over Concepción, Chile, generating landslides that killed 5 and injured 4,800. Between 26 and 28 August, 120 mm of rain fell in 48 h in Santiago, Chile, resulting in 1,153 injured, 755 houses damaged, and an estimated economic cost of $10 million USD.

The regional core of negative precipitation anomalies was in the Chaco region and southern Paraguay, where intense drought prevailed to spring 2005. Precipitation deficits produced livestock losses and reduced water levels on the Uruguay River, impacting hydroelectric generation. Strong negative October–December rainfall anomalies dominated the southern part of the region, affecting agriculture in this productive region. In southern Brazil, seasonal (December 2004–March 2005) rainfall 100–500 mm below normal produced intense drought and heavy agricultural losses. The southern state of Rio Grande do Sul was the most affected, and while May rainfall alleviated the drought, it produced flooding in some cities. Damage attributed to the drought of 2005 in southern Brazil was considerable: 2 million people were affected by water shortages, 13 million tons of agricultural products were lost, and economic losses were on the order of $3 billion USD.

Annual air temperature anomalies were generally near normal, with eastern regions above normal and central and western region slightly below normal. Uruguay experienced temperatures above the normal (up to +1.2°C), especially near the Brazilian border. From January to August most monthly temperatures were above normal, with May–August having the largest anomalies. June temperature broke records (for the 1961–2004 period) over northeastern Argentina, and winter was 2°C warmer than normal in Uruguay. In contrast, cold air advection in September affected the eastern part of the region. October–December temperature anomalies were up to 3°C below normal, with early December frosts, including a few intense frosts in the Andes that killed thousands of sheep. Annual air temperatures in Chile were slightly above normal in the central region, and slightly below normal in the south. April, May, and June temperatures were below normal, especially in southern Chile. The week of 26 June, a severe cold air outbreak between 34° and 36°S left 30,000 injured and affected 12,000 homes.

On 23–24 August 2005, an exceptionally strong midlatitude cyclone occurred over Rio de la Plata and southern Uruguay. The gale was characterized by unforced rapid deepening to a near–record (locally) low mean sea level pressure, very high winds, and anomalous cold surface temperatures. High winds contributed to extensive damage and 10 deaths along the Uruguayan riverside.

f. Asia

i) Russia—O. N. Bulygina,[11] N. N. Korshunova,[40] and V. N. Razuvaev[72]

(i) Temperature

Russia experienced very warm conditions in 2005. The mean annual air temperature anomaly relative to the period of record (1936–2005) was +1.6°C, which is the second highest value since 1936 (Fig. 6.19).

The year began with January temperatures above normal across all of Russia, although very cold weather was observed in places. Northeast European Russia experienced particularly warm conditions, with mean monthly temperature anomalies exceeding +8°C. Anomalies reached +7°C over central regions. Moscow's January 2005 temperature ranked third highest on record, with record maximum daily