Central America [in "State of the Climate in 2017"]

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STATE OF THE CLIMATE IN 2017

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STATE OF THE CLIMATE IN 2017

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Front: ©Ron_ Thomas/Spring desert wildflowers in Anza Borrego Desert State Park, CA/Getty Images.

Back: Smoke and Fire in Southern California: Thick smoke was streaming from several fires in Southern California when the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Terra* satellite acquired a natural-color image in the afternoon on December 5, 2017. On the same day, the Multi Spectral Imager (MSI) on the European Space Agency's Sentinel-2 satellite captured the data for a false-color image of the burn scar. Active fires appear orange; the burn scar is brown. Unburned vegetation is green; developed areas are gray. The Sentinel-2 image is based on observations of visible, shortwave infrared, and near infrared light.

NASA Earth Observatory images by Joshua Stevens, using MODIS data from LANCE/EOSDIS Rapid Response and modified Copernicus Sentinel data (2017) processed by the European Space Agency. Story by Adam Voiland.
Instrument(s):
Terra - MODIS
Sentinel-2

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fected southern Sinaloa, in northwest Mexico, causing agricultural and livestock losses, and a shortage of drinking water in more than 400 rural communities.

Several heat waves affected eastern Mexico, notably the Huastecas (an area that encompasses the states of San Luis Potosi, Hidalgo, and Veracruz) from 26–30 April and again from 5–8 June. During both heat waves, the maximum temperature reached 50°C, breaking the previous record of 49°C in Huejutla, Hidalgo, set in April 2013. These heat waves were produced by a broad high pressure system located over northeastern Mexico, inhibiting cloudiness and thus increasing temperature. Another major heat wave affected the municipality of Aldama, Chihuahua, during 11–20 June.

c. Central America and the Caribbean

1) Central America—J. A. Amador, H. G. Hidalgo, E. J. Alfaro, B. Calderón, and N. Mora

For this region, nine stations from five countries were analyzed (Fig. 7.9). Stations on the Caribbean slope are: Philip Goldson International Airport, Belize; Puerto Barrios, Guatemala; Puerto Lempira, Honduras; and Puerto Limón, Costa Rica. Stations located on the Pacific slope are: Tocumen International Airport and David, Panamá; Liberia, Costa Rica; Choluteca, Honduras; and Puerto San José, Guatemala. The station distribution covers the relevant precipitation regimes located on the Caribbean and Pacific slopes of Central America (Magaña et al. 1999). Precipitation and temperature records for the stations analyzed were provided by Central American

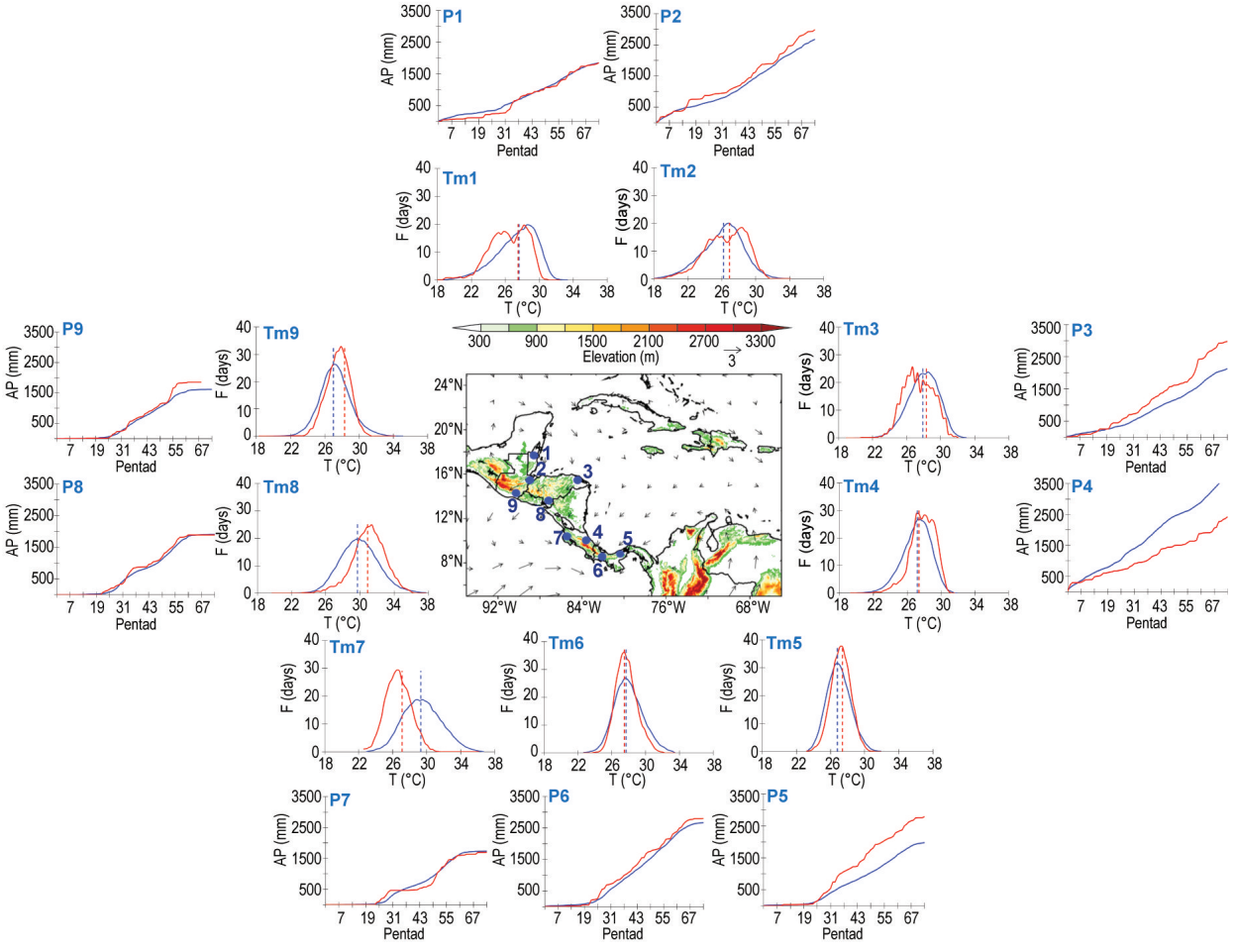

Fig. 7.9. Mean surface temperature (Tm; °C) frequency (F; days) and accumulated pentad precipitation (AP; mm) time series are shown for nine stations (blue dots) in Central America: (1) Philip Goldson International Airport, Belize; (2) Puerto Barrios, Guatemala; (3) Puerto Lempira, Honduras; (4) Puerto Limón, Costa Rica; (5) Tocumen International Airport, Panamá; (6) David, Panamá; (7) Liberia, Costa Rica; (8) Choluteca, Honduras; and (9) Puerto San José, Guatemala. The blue solid line represents the 1981–2010 average values and the red solid line shows 2017 values. Vertical dashed lines show the mean temperature for 2017 (red) and the 1981–2010 period (blue). Vectors indicate July wind anomalies at 925 hPa (1981–2010 base period). Shading depicts regional elevation (m). (Sources: NOAA/NCEI and CA-NWS.)

National Weather Services (CA-NWS) or by NOAA. Anomalies are reported using a 1981–2010 base period and were calculated using CA-NWS data. The methodologies used for all variables can be found in Amador et al. (2011).

(i) Temperature

The mean temperature (Tm) frequency distribution for the climatology and for 2017 for all stations is shown in Fig. 7.9. Five stations on the Caribbean slope and northern Central America (Tm2, Tm3, Tm5, Tm8, and Tm9) had a higher annual mean temperatures than the base period. The largest annual mean temperature occurred at Puerto San José and Choluteca (Tm8 and Tm9, respectively), which were about 1.0°C above normal. Three stations (Tm1, Tm4, and Tm6) had a mean annual temperature similar to the reference period, and the Liberia Station (Tm7) mean annual temperature was colder by 2.0°C. On the Caribbean side, three stations (Tm1, Tm2, and Tm3) depicted a bi-modal temperature distribution during 2017.

(ii) Precipitation

The accumulated pentad precipitation (P; mm) time series for the nine stations in Central America are presented in Fig. 7.9. Puerto San José (P9) was close to normal until pentad 55, when storms produced above-average conditions that continued through pentad 59, followed by a sparse rain period that lasted for over 2 months. This was sufficient to yield above-normal precipitation accumulations at the end of the year. Choluteca (P8) was generally near-normal all year but had a light mid-summer drought from pentad 35 to 41. Liberia (P7) started with significantly above-average conditions during the first part of its rainy season, then experienced a deep midsummer drought (Magaña et al. 1999) and a near-normal second part of the rainy season that resulted in near-normal annual accumulations. During most of the year, David (P6) recorded slightly-above-average conditions, while Puerto Barrios (P2) and Tocumen (P5) were wetter than normal during most of the year, and extremely wet from pentad 32, with values that surpassed the normal average at the 95% confidence level. Belize (P1) had considerable rainfall deficit until pentad 35, after which it recuperated due to wetter-than-average conditions and remained normal until the end of the year. Lempira (P3) recorded conditions during most of the year that were significantly higher than normal at the 95% confidence level, while Puerto Limón (P4) was the only station that had below-average conditions during 2017. Low-level circulations in the region showed a slightly stronger-than-average Caribbean low-level jet (Amador 1998) during summer (July vectors in Fig. 7.9), a condition usually associated with wetter (drier and more intense mid-summer drought) conditions in the Caribbean (Pacific) slope of Central America.

(iii) Notable events and impacts

Tropical storms were very active in the Caribbean basin (6°–24°N, 92°–60°W) during 2017. There were eight named storms: five tropical storms (Bret, Franklin, Harvey, Nate, and Phillipe) and three major hurricanes (Irma, José, and María). Tropical Storm Nate made landfall in Nicaragua and crossed Honduras on 5–6 October. Nate induced indirect cyclonic circulations (Peña and Douglas 2002) over the isthmus, impacting the Pacific slope of Costa Rica. According to the Costa Rica National Emergency Commission (CNE, its Spanish acronym), Nate caused more than $540 million U.S. dollars in damages, the highest amount in the country's documented history of natural disasters since 1996. This information is based on a CNE study (Hidalgo 2017) of economic loses including Tropical Storms Alma (2008) and Nate (2017) and Hurricanes Cesar (1996), Mitch (1998), Tomas (2010), and Otto (2016). As with Tropical Depression 12-E in 2011 (Amador et al. 2012), the relative position of Nate with respect to highly vulnerable areas in Central America is as important as tropical storm intensity. Tropical Storm Selma developed in the eastern tropical Pacific and affected Central America during 27–28 October. Selma made landfall in El Salvador on 28 October, marking the first time on record a tropical storm made landfall in El Salvador. For additional information on regional impacts from hydrometeorological events during the year, please refer to Online Table 7.1.

2) Caribbean—T. S. Stephenson, M. A. Taylor, A. R. Trotman, C. J. Van Meerbeeck, V. Marcellin, K. Kerr, J. D. Campbell, J. M. Spence, G. Tamar, M. Hernández Sosa, and K. Stephenson

(i) Temperature

Normal to above-normal annual mean temperatures were recorded across the Caribbean in 2017 (Fig. 7.10a). Some locations in the northern Caribbean (including southern Cuba and Bahamas) experienced below-normal surface temperatures during January–June. In the latter half of the year, above-normal surface temperatures (+0.2° to +1.0°C) were spread across the entire region.

Trinidad reported its tenth warmest annual mean temperature (28.0°C) since records began in 1946;

SUPPLEMENT

STATE OF THE CLIMATE IN 2017

Gail Hartfield, Jessica Blunden, and Derek S. Arndt, Eds.

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Online table 7.1 supplements main report section 7c: Central America and the Caribbean

Table S7.1. Summary of events and impacts, including number of fatalities (f), missing people (m), injured people (i), affected people (a), number of affected families (n), and damaged houses (d), by country and specific region. (Data sources: Guatemala: www.redhum.org; Central America: National Weather Services, National Emergency Committees communications, and regional newspapers).

Country	Specific Region	Date (2017)	Hydrometeorological Conditions	Fatalities (f); Missing people (m); Injured people (i); Affected people (a); Number of affected familes (n); Damaged houses (d);
Panamá	Panamá Oeste province	23 Jul	Heavy rainfall and floods	1f, 1i
	Los Santos province	08–12 Aug	Heavy rainfall, thunderstorms, and floods	2f, 1i, 450d
	Comarca Ngäbe-Buglé	01 Oct	Rainfall and landslides	6f
	Veraguas, Panamá Oeste, Comarca Ngäbe-Buglé, Cerro Hacha, and Chiriquí province	06 Oct	Rainfall and floods associated with Tropical Storm Nate	4974a
	Panamá, and San Miguelito districts, Chiriquí provinces	26 Nov	Heavy rainfall and floods	1f, 7d
	Changuinoa and Comarca Ngäbe-Buglé	10 Dec	Rainfall, floods, and strong winds associated with a cold front	1f, 200d
Costa Rica	Caribe region, Cartago, and Alajuela provinces	07 Jan	Rainfall, floods, and strong winds associated with a cold front	48d
	Acosta, Aserrí, Buenos Aires, Coto Brus, Pérez Zeledón, Quepos, Parrita, Puntarenas, Cañas, Bagaces, Carrilo, La Cruz, and Santa Cruz	06 Oct	Rainfall and floods associated with Tropical Storm Nate	14f, 14733a
	The entire country	10 Dec	Rainfall, floods, and strong winds associated with a cold front	4f, 8a, 68d

Table S7.1. (Cont).				
Country	**Specific Region**	**Date (2017)**	**Hydrometeorological Conditions**	**Fatalities (f); Missing people (m); Injured people (i); Affected people (a); Number of affected familes (n); Damaged houses (d);**
Nicaragua	Chinandega, Villanueva, and Somotillo municipalitles	25 May	Rainfall, thunderstorms, and strong winds associated with a tropical wave	1f, 10d
	Casa Roja, Casas Viejas, La Estancia, Jalapa, and Nueva Segovia	07 Jun	Rainfall, thunderstorm, and strong winds	18n, 42d
	Corinto, Nandaime, Tola, Juigalpa, Acoyapa (Pacific), and Rosita (Caribbean)	17 Jun	Rainfall and floods associated with a tropical wave	52d
	Boaco, Jinotega, and Rivas departments	25 Aug	Rainfall and floods	464a, 124n, 124d
	William Fonseca, León department	18 Oct	Rainfall and floods associated with a tropical wave	7i, 1d
	The entire country	06 Oct	Rainfall and floods associated with Tropical Storm Nate	15f, 29100a, 6842n, 5953d
	North and south Caribbean coasts	24–30 Oct	Rainfall associated with a cold front	11f, 1m, 2000a, 3064d
El Salvador	Cuscatlán, Chalatenango, San Salvador, Sonsonate, Santa Ana, La Libertad, Ahuachapán, and La Paz departments	13–20 Jun	Rainfall, floods, and landslides	4f, 5i, 389a, 7d
	La Libertad, Cuscatlán, and San Salvador departments	20–21 Jul	Rainfall and floods associated with a tropical wave	1f, 2i, 15a
	Cuscatlán department	13–15 Aug	Rainfall, thunderstorm	1f
	San Salvador, Usulután, and Sonsonate departments	22–30 Sep	Rainfall and floods associated with Hurricane Maria and the ITCZ	5f, 57a, 40d
	San Miguel, La Libertad, Sonsonate, Morazán, and Usulután departments	06 Oct	Rainfall and floods associated with Tropical Storm Nate	5f, 1m, 268a, 115d
	La Libertad, San Salvador and Sonsonate departments	09–12 Dec	Strong winds and low temperatures associated with a cold front	1f, 3m, 3i, 7a

Table S7.1. (Cont).

Country	Specific Region	Date (2017)	Hydrometeorological Conditions	Fatalities (f); Missing people (m); Injured people (i); Affected people (a); Number of affected familes (n); Damaged houses (d);
Honduras	Omoa, Cortés, El Progreso and Yoro	07 Jan	Rainfall, floods, and strong winds associated with a cold front	4f, 6m, 693a, 7d
	Chinandega, Villanueva, and Somotillo	02–05 May	Rainfall, floods and, landslides	1f, 10d
	Southern Honduras	11 Jun	Rainfall, floods, and landslides	2f, 500a, 141n, 129d
	Lempira, Copán, Olancho, Ocotepeque, Francisco Morazán, Comayagua, La Paz, and Valle departments	17 Jun	Rainfall, thunderstorms, and floods associated with a tropical wave	1f, 230a, 55n
	Northern and central regions	08 Aug	Heavy rainfall and floods associated with Tropical Storm Franklin	3f, 25a, 7d
	Santa Bárbara department	21 Aug	Heavy rainfall, floods, and landslides	1f, 4i
	Lempira, Francisco Morazán, and La Paz departments	10–18 Sep	Heavy rainfall, floods, and landslides	5f
	Valle, Choluteca, Santa Barbara, and Francisco Morazán departments	06 Oct	Rainfall and floods associated with Tropical Storm Nate	2f, 143a, 27n, 41d
	The entire country	24 Oct–01 Nov	Rainfall, thunderstorm, and floods associated with a cold front	9f, 52794a, 10695n, 5629d
	Roatán	30 Nov	Heavy rainfall and landslides	1f, 2i
	Intibucá and Copán departments	12–13 Dec	Low temperatures associated with a cold front	3f
Guatemala	The entire country	07 Jan	Rainfall, low temperatures, and strong winds associated with a cold front	478a
	Villa Nueva, Guatemala department	26 May	Heavy rainfall and floods	1f
	Western, eastern, and southern coasts	17 Jun	Rainfall, thunderstorms, and floods associated with a tropical wave	2f, 1m, 509a
	San Pedro Soloma, Huehuetanango department	21 Jun	Heavy rainfall and landsides	12f, 9i
	Zunil, Quetzaltenango department	02 Jul	Heavy rainfall and landslides	1f

Table S7.1. (Cont).				
Country	**Specific Region**	**Date (2017)**	**Hydrometeorological Conditions**	**Fatalities (f); Missing people (m); Injured people (i); Affected people (a); Number of affected familes (n); Damaged houses (d);**
Guatemala	Colonia Guajitos (zona 21)	10 Aug	Rainfall and floods associated with a tropical wave	1f, 62a, 8d
	San Marcos, Guatemala, El Progreso, Zacapa, and Alta Verapaz departments	10 Sep	Rainfall and floods associated with the rainy season	1f, 135a, 27d
	Palencia, Escuintla, and Chimaltenango depart-ment	12–13 Sep	Rainfall and floods associated with the rainy season	2f, 4i, 1020a, 170d
	Alta Verapaz department	27 Sep	Rainfall and floods associated with the rainy season	2f, 8m, 200a, 25d
	Petén, Chiqimula, Huehuetenango, Zacapa, El Progresco, Quiché, Guatemala, and Alta Verapaz departments	06 Oct	Rainfall and floods associated with Tropical Storm Nate	5f, 6i, 2742a, 372d