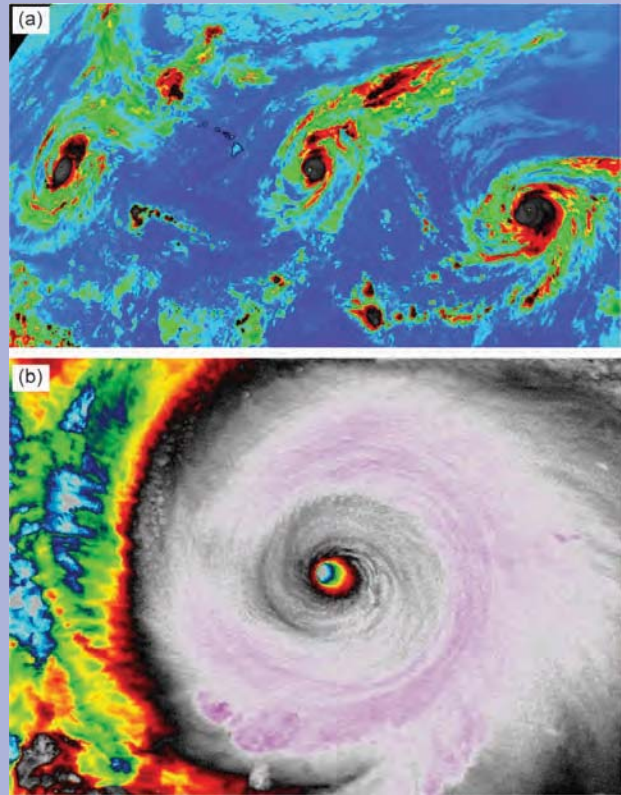


## SIDEBAR 4.1: THE RECORD-SHATTERING 2015 NORTHERN HEMISPHERE TROPICAL CYCLONE SEASON—P. J. KLOTZBACH AND C. T. FOGARTY

The 2015 Northern Hemisphere tropical cyclone (TC) season was one for the record books. The Atlantic basin hurricane season recorded below-average activity with an ACE of  $60 \times 10^4 \text{ kt}^2$ . The 1981–2010 median ACE for the Atlantic is 92, and NOAA defines any season with less than 66 ACE units as a below-average season. The remainder of the Northern Hemisphere basins (the eastern North Pacific, the western North Pacific, and the north Indian) were conversely quite active. Some of the most notable records set during this record-breaking year for these three basins individually, then collectively, for the Northern Hemisphere are documented. Table SB4.1 summarizes the statistics by basin and denotes records achieved in 2015. All statistics described are based on operational advisories from the National Hurricane Center, Central Pacific Hurricane Center, and Joint Typhoon Warning Center, and are then compared with archived best-track data compiled by those agencies. The data in these basins date back to 1851 in the North Atlantic, 1949 in the northeast Pacific, 1945 in the northwest Pacific, and 1972 in the north Indian; however, it should be noted that the data quality among these datasets is not uniform prior to about 1985 (Chu et al. 2002).

### *Eastern North Pacific*

The eastern North Pacific (to 180°) season in 2015 tied its record for number of hurricanes and set a record for major hurricanes. ACE for the eastern North Pacific in 2015 was also quite high, trailing only 1992. Two of the most notable storm events of 2015 occurred in this basin. In late August, Hurricanes Kilo, Ignacio, and Jimena



**FIG. SB4.1.** Satellite imagery showing (a) from left to right: Kilo, Ignacio, and Jimena at Category 4 intensity on 30 Aug 2015 and (b) Hurricane Patricia near time of peak intensity on 23 Oct 2015.

**TABLE SB4.1.** Northern Hemisphere TC summary statistics by basin.

| Basin                 | Named Storms | Hurricanes     | Major Hurricanes | Cat. 4–5 Hurricanes | ACE       |
|-----------------------|--------------|----------------|------------------|---------------------|-----------|
| North Atlantic        | 11 (12)      | 4 (6.5)        | 2 (2)            | 1 (1)               | 60 (92)   |
| Eastern North Pacific | 26 (17)      | <b>16*</b> (9) | <b>11</b> (4)    | <b>10</b> (2)       | 288 (119) |
| Western North Pacific | 26 (26.5)    | 20 (17)        | <b>16</b> (9)    | <b>14</b> (7)       | 479 (305) |
| North Indian          | 5 (5)        | 2 (1)          | <b>2*</b> (1)    | <b>1*</b> (0)       | 36 (16)   |
| Northern Hemisphere   | 68 (59)      | 42 (33.5)      | <b>31</b> (16.5) | <b>26</b> (11)      | 865 (545) |

The 1981–2010 median values are in parentheses. Record high values are highlighted in bold-faced font, while second highest values are italicized. An asterisk by a record means that several years tied for that record. A TC is counted based in the basin where the storm first achieved a specific intensity. Northern Hemisphere ACE does not exactly add as sum of four individual basins due to rounding. In the case of Halola, it was counted as a named storm in the northeast Pacific and a hurricane in the northwest Pacific. Hurricanes are used colloquially to refer to all hurricane-strength TCs in the Northern Hemisphere.

## CONT. SIDEBAR 4.1: THE RECORD-SHATTERING 2015 NORTHERN HEMISPHERE TROPICAL CYCLONE SEASON—P. J. KLOTZBACH AND C. T. FOGARTY

reached Category 4 status at the same time (Fig. SB4.1a). This was the first time on record that three Category 4 or stronger TCs were present at the same time in any global TC basin. On October 23, Hurricane Patricia became the strongest hurricane on record in the Western Hemisphere when an aircraft reconnaissance plane estimated 1-minute maximum sustained winds of 175 knots (Fig. SB4.1b). The central North Pacific (180°–140°W) portion of the eastern North Pacific was extraordinarily active (Collins et al. 2016, manuscript submitted to *Geophys. Res. Lett.*). Eight named storms formed in this portion of the basin, shattering the old record of four named storms set in 1982, and an additional eight storms spent some portion of their life in the basin. The central Pacific alone also accounted for an ACE level of  $127 \times 10^4 \text{ kt}^2$ , breaking the record of  $107 \times 10^4 \text{ kt}^2$  set in 1994. The  $127 \times 10^4 \text{ kt}^2$  ACE level is especially impressive given that the 1981–2010 median for the full northeast Pacific basin was  $119 \times 10^4 \text{ kt}^2$ .

### *Western North Pacific*

The western North Pacific was quite active from an ACE perspective, generating the third highest ACE value of all time for the basin. In addition, 16 major (Category 3–5) typhoons occurred, breaking the record of  $15 \times 10^4 \text{ kt}^2$  set in 1958 and tied in 1965, both well before the era of reliable best track data (Chu 2002). As is typically the case in strong El Niño seasons, while ACE increases significantly, the number of storm formations changes little (Camargo and Sobel 2005). The western North Pacific was extraordinarily active during the month of May. Two typhoons, Noul and Dolphin, reached Category 5 status ( $> 137$  knots) in May. This was the first time on record that two typhoons reached Category 5 status in May.

### *North Indian*

The north Indian Ocean also experienced well above-average ACE in 2015, with  $30 \times 10^4 \text{ kt}^2$  generated, which is over twice the median value for the basin. Cyclones Chapala and Megh were significant storms that resulted in serious impacts on the island of Socotra. This was the first time in recorded history that two cyclone-strength TCs made landfall on Socotra in the same year (see section 4e5). Chapala also became the first cyclone-strength storm to make landfall in Yemen in recorded history, and just a week later Cyclone Megh also made landfall in Yemen.

### *Northern Hemisphere*

The Northern Hemisphere shattered several records for intense TCs. A total of 31 major (Category 3–5) TCs occurred in 2015, breaking the old record of 23 major hurricanes set in 2004. The previous record of 18 Category 4–5 TCs, set in 1997 and tied in 2004, was also eclipsed in 2015, with 26 Category 4–5 TCs occurring. In addition, 62% of all hurricane-strength TCs that formed in 2015 reached Category 4–5 intensity, breaking the old record of 50% that happened four different times (1994, 1997, 2002, and 2011). As noted in Klotzbach and Landsea (2015), significant underestimates in Category 4–5 TCs are likely prior to ~1990. In terms of integrated metrics, Northern Hemisphere ACE was at its second highest level on record. The 2015 season generated  $821 \times 10^4 \text{ kt}^2$ , trailing only the  $876 \times 10^4 \text{ kt}^2$  value generated in 1992. In summary, the Northern Hemisphere TC season was extraordinarily active, due in large part to the strong El Niño conditions that prevailed throughout the year.