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STATE OF THE CLIMATE IN 2011

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ABSTRACT—J. BLUNDEN AND D. S. ARNDT

Large-scale climate patterns influenced temperature and weather patterns around the globe in 2011. In particular, a moderate-to-strong La Niña at the beginning of the year dissipated during boreal spring but reemerged during fall. The phenomenon contributed to historical droughts in East Africa, the southern United States, and northern Mexico, as well the wettest two-year period (2010–11) on record for Australia, particularly remarkable as this follows a decade-long dry period. Precipitation patterns in South America were also influenced by La Niña. Heavy rain in Rio de Janeiro in January triggered the country's worst floods and landslides in Brazil's history.

The 2011 combined average temperature across global land and ocean surfaces was the coolest since 2008, but was also among the 15 warmest years on record and above the 1981–2010 average. The global sea surface temperature cooled by 0.1°C from 2010 to 2011, associated with cooling influences of La Niña. Global integrals of upper ocean heat content for 2011 were higher than for all prior years, demonstrating the Earth's dominant role of the oceans in the Earth's energy budget. In the upper atmosphere, tropical stratospheric temperatures were anomalously warm, while polar temperatures were anomalously cold. This led to large springtime stratospheric ozone reductions in polar latitudes in both hemispheres. Ozone concentrations in the Arctic stratosphere during March were the lowest for that period since satellite records began in 1979. An extensive, deep, and persistent ozone hole over the Antarctic in September indicates that the recovery to pre-1980 conditions is proceeding very slowly.

Atmospheric carbon dioxide concentrations increased by 2.10 ppm in 2011, and exceeded 390 ppm for the first time since instrumental records began. Other greenhouse gases also continued to rise in concentration and the combined effect now represents a 30% increase in radiative forcing over a 1990 baseline. Most ozone depleting substances continued to fall. The global net ocean carbon dioxide uptake for the 2010 transition period from El Niño to La Niña, the most recent period for which analyzed data are available, was estimated to be 1.30 Pg C yr^{-1}, almost 12% below the 29-year long-term average.

Relative to the long-term trend, global sea level dropped noticeably in mid-2010 and reached a local minimum in 2011. The drop has been linked to the La Nina conditions that prevailed throughout much of 2010–11. Global sea level increased sharply during the second half of 2011.

Global tropical cyclone activity during 2011 was well-below average, with a total of 74 storms compared with the 1981–2010 average of 89. Similar to 2010, the North Atlantic was the only basin that experienced above-normal activity. For the first year since the widespread introduction of the Dvorak intensity-estimation method in the 1980s, only three tropical cyclones reached Category 5 intensity level—all in the Northwest Pacific basin.

The Arctic continued to warm at about twice the rate compared with lower latitudes. Below-normal summer snowfall, a decreasing trend in surface albedo, and above-average surface and upper air temperatures resulted in a continued pattern of extreme surface melting, and net snow and ice loss on the Greenland ice sheet. Warmer-than-normal temperatures over the Eurasian Arctic in spring resulted in a new record-low June snow cover extent and spring snow cover duration in this region. In the Canadian Arctic, the mass loss from glaciers and ice caps was the greatest since GRACE measurements began in 2002, continuing a negative trend that began in 1987. New record high temperatures occurred at 20 m below the land surface at all permafrost observatories on the North Slope of Alaska, where measurements began in the late 1970s. Arctic sea ice extent in September 2011 was the second-lowest on record, while the extent of old ice (four and five years) reached a new record minimum that was just 19% of normal.

On the opposite pole, austral winter and spring temperatures were more than 3°C above normal over much of the Antarctic continent. However, winter temperatures were below normal in the northern Antarctic Peninsula, which continued the downward trend there during the last 15 years. In summer, an all-time record high temperature of -12.3°C was set at the South Pole station on 25 December, exceeding the previous record by more than a full degree. Antarctic sea ice extent anomalies increased steadily through much of the year, from briefly setting a record low in April, to well above average in December. The latter trend reflects the dispersive effects of low pressure on sea ice and the generally cool conditions around the Antarctic perimeter.

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