STATE OF THE CLIMATE IN 2007

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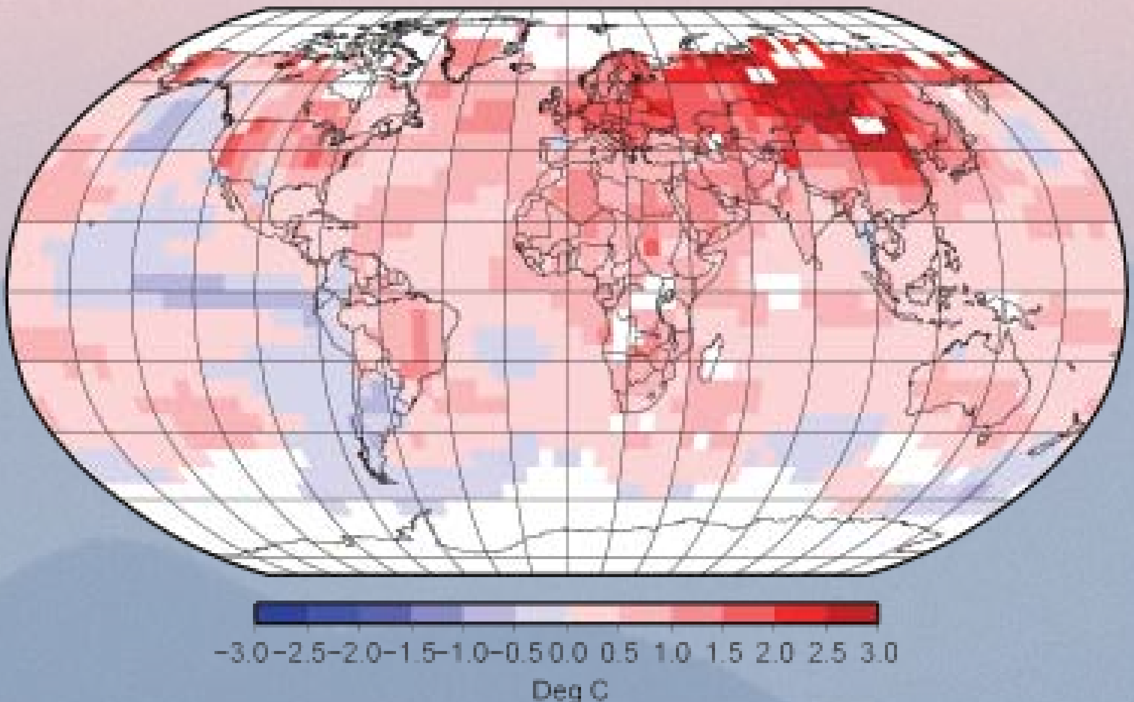

Geographic distribution of global surface temperature anomalies in 2007, relative to the 1961 to 1990 average.

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On the front cover: Geographic distribution of temperature anomalies in 2007. Departure from the 1961 to 1990 average. (Source: NOAA/NCDC.) More information on global surface temperatures can be found in section 2b of the report.

On the back cover: The annual mean latent plus sensible heat fluxes (in W m^{-2}) in 2007. (Source: Woods Hole Oceanographic Institution.) More information on global ocean heat fluxes can be found in section 3b of the report.

extent and melt intensity. Surface melt primarily took place in December, January, and February, and the extent peaked on 21 January 2007.

6) Sea ice extent and concentration—R. A. Massom, P. Reid, S. Barreira, and S. Stammerjohn

Antarctic sea ice in 2007 was characterized by considerable temporal and spatial variability, with ice extent anomalies ranging from a record low in May of –12% or -1.2×10^6 km^2 (equal to 1980) to a record high in December of +14% or $+1.7 \times 10^6$ km^2 for the satellite time series (1978–present; Fig. 5.26). The analysis is based on monthly mean SSM/I-derived sea ice concentration data produced by the NSIDC Sea Ice Index project (Fetterer et al. 2002, updated monthly).

With the exception of May, sea ice extent overall was generally close to or only slightly lower than the long-term mean for January through August. There was, however, considerable regional variability, largely in response to the strong circulation and temperature patterns described earlier. This resulted in sea ice extent and concentration anomalies that were both greater and zonally asymmetric (Fig. 5.26).

A strong feature of the 2007 austral minimum ice extent period (January–March) was the persistence of zones of high concentration ice in the east Weddell Sea, the Ross Sea, around the BI, and along the Indian Ocean coastal sector (Fig. 5.26a). Conversely, significantly less

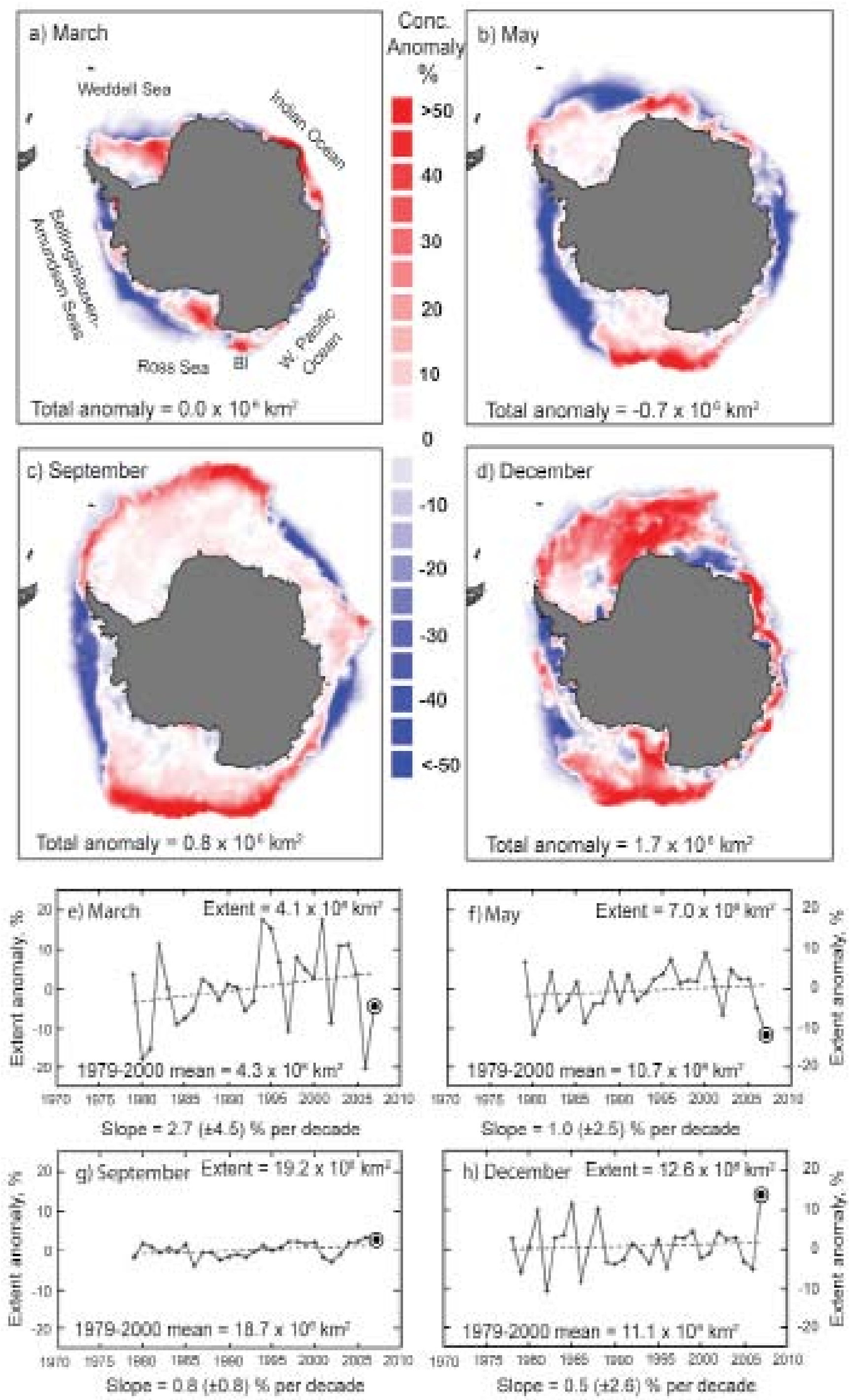

Fig. 5.26. Antarctic sea ice concentration anomalies in 2007 relative to the 1979–2000 mean for the month for (a) Mar, (b) May, (c) Sep, and (d) Dec, and (e)–(h) trends in sea ice extent for the same months. "BI" in (a) indicates the Balleny Islands area. Sea ice concentration is the area covered by ice per unit area. Concentration is derived for 25-km grid cells; the color mapped monthly concentration anomalies are the difference between the 2007 value and the 1979–2000 mean value for those grid cells. The total concentration anomaly is the sum of anomalies over all grid cells. Ice extent is the total area covered by ice at any concentration. From the Sea Ice Index (http://nsidc.org/data/seaice_index/).

ice occurred in the Amundsen Sea and west Pacific Ocean sectors at this time compared to the mean.

The distinctive zonal asymmetry in ice extent and concentration anomalies was particularly well developed in May (Fig. 5.26b). The record negative extent anomaly at this time, which represents a strong departure from the upward trend for ice extent in this month (Fig. 5.26f), resulted from lower-than-average autumnal advance over broad zones across the Weddell Sea, the sector 70°–110°E, and the Bellingshausen–Amundsen Seas. The latter was associated with a persistent, deep low pressure circulation centered on approximately 70°S, 135°W—the "Amundsen Sea Low." This created a persistent and dominant west-northwesterly airflow that led to compaction of the sea ice against the West Antarctic Peninsula and Amundsen Sea coasts, preventing normal autumnal ice edge advance (see Massom et al. 2008). Conversely, cold air outflow to the west from continental Antarctica resulted in an ice edge advance and a positive ice concentration anomaly across the Ross Sea sector.

The remainder of the year (September–December) was characterized by similar regional patterns in negative and positive ice extent, area, and concentration anomalies (Figs. 5.26c,d), but with overall extent anomalies becoming positive (Figs. 5.26g,h). At 19.2 $\times 10^6$ km^2, ice extent in September was 3% above the 1979–2000 September mean; this was the second highest extent on record (just behind 2006 at 19.35 $\times 10^6$ km^2), but the highest in terms of areal coverage, that is, the product of ice extent and concentration (at 15.2 $\times 10^6$ km^2 versus 15.1 $\times 10^6$ km^2 for September 2006). As was the case in May, a major determinant of the wide zone of negative extent and concentration anomalies across the Bellingshausen–Amundsen Seas sector was wind-driven compaction associated with a deep Amundsen Sea low air pressure anomaly, this time coupled with a blocking high-pressure anomaly in the South Atlantic.

Spatially, the August through October sea ice extent showed, in most areas, a continuation of the long-term trend in Southern Hemisphere sea ice extent for those months. For example, sea ice extent to the north of the Ross Sea continued to expand during these months, while farther to the east there was a contraction of ice extent. Both anomalies were primarily a result of deepening low pressure in the Amundsen Sea. Interestingly, in the far southwest of the Indian Ocean, sea ice extent was anomalously low, in contrast to the long-term trend in that area. This was primarily due to the central low pressure system being farther to the west than normal in that region. Both January and December 2007 had a continuation of the trend in lowering sea ice concentration around Davis Station (68° 35′S, 77° 58′E) and an increase in sea ice concentration around Mawson (67° 36′S, 62° 52′E).

As noted above, the December 2007 value of +14% (+1.7 $\times 10^6$ km^2) is the highest on record. Notable also is the SAM index value for December, which was +2.80, among the highest ever, based on observational records dating back to 1957 (www.nerc-bas.ac.uk/icd/gjma/sam.html; see also Marshall 2003). The 2007 La Niña also reached its maximum late in the year, with an SOI value[1] of 14.4 in December and the Niño-3 region reaching a minimum sea surface temperature in November. The persistence of unusually compact sea ice into the summer melt period of 2007–08 in the Weddell Sea, East Antarctic coastal, and Ross Sea sectors led to reported difficulties in ship navigation during the critical shipping (base resupply) season.

7) Ozone depletion—P. A. Newman

The Antarctic ozone hole was less deep in 2007 than the severely depleted 2006 ozone hole, and was near average in comparison to the last 15 yr. The areal extent of the hole was slightly smaller than average. South Pole ozonesondes showed higher than average ozone in comparison to the last 20 yr, and the OMI measurement of the Antarctic minimum ozone value was also slightly higher than average. This slightly improved Antarctic ozone situation resulted from warmer-than-average stratospheric temperatures during the ozone loss period in September–October (Fig. 5.21b).

The ozone hole is primarily caused by human-produced compounds that release chlorine and bromine gases in the stratosphere. Observations by the *Aura* satellite's MLS showed extremely high levels of ClO chemicals in the lower stratosphere (465 K, ~20 km) during August and September. These high levels of ClO covered almost the entire Antarctic region but had been largely converted to other nonozone destroying forms by early October. Coincident with the high ClO were extremely low values of ozone.

A fundamental process behind the formation of the ozone hole is the conversion of chlorine molecules from the nonreactive forms (HCl and ClONO2) into reactive forms on the surfaces of PSCs. This reactive chlorine leads to rapid ozone destruction. The CALIPSO satellite provides an extremely high-resolution estimate of PSC structure over Antarctica

[1] The December SOI value of 14.4 is based on nonstandardized data.