# CLIMATE DIAGNOSTICS BULLETIN

CLIMATE PREDICTION CENTER

## FEBRUARY 2008

NEAR REAL-TIME OCEAN / ATMOSPHERE

Monitoring, Assessments, and Prediction

**U.S. DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
**National Weather Service**
**National Centers for Environmental Prediction**

# CLIMATE DIAGNOSTICS BULLETIN

**CLIMATE PREDICTION CENTER**
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# Tropical Highlights - February 2008

Atmospheric and oceanic indices during February 2008 indicated a further strengthening of La Niña. This strengthening is highlighted by a decrease in the Niño 4 sea surface temperature (SST) index to -1.6 and a drop in the Niño 3.4 index to -1.9, the lowest value since January 2000. Overall, equatorial sea surface temperatures (SST) were more than 2.0°C below average across parts of the central and east-central equatorial Pacific (**Fig. T18**). Meanwhile, the SST anomalies in the Niño 1+2 region became positive for the first time since February 2007 (**Table T2**, **Figs. T5, T18**).

Accompanying these surface conditions, the oceanic thermocline during February remained shallower than normal across the equatorial Pacific east of 150°W and continued to deepen in the region west of the Date Line (**Fig. T16**). Consistent with this structure, sub-surface temperature at thermocline depth remained below average (-2°C to -5°C) across the eastern equatorial Pacific, and above average west of 170°W (**Fig. T17**).

Strong low-level easterly anomalies persisted across the western and central equatorial Pacific during the month (**Fig. T20**, **Table T1**), which is consistent with the shallower-than-average thermocline in the central and eastern equatorial Pacific (**Figs. T15, T16**). These conditions were associated with enhanced convection (above-average rainfall amounts) across the Indian Ocean, Indonesia and the far western tropical Pacific, and a continuation of suppressed convection (below-average rainfall amounts) across the central equatorial Pacific (**Figs. T25, T26, E3**). Consistent with these anomalies, the Tahiti – Darwin SOI remained strongly positive for the third consecutive month (+2.7) (**Table T1, Fig. T1**), while the equatorial SOI remained above +3.0 (**Fig. T2**).

For the latest status of the ENSO cycle see the ENSO Diagnostic Discussion at:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.html

| MONTH | SLP ANOMALIES | | TAHITI minus DARWIN SOI | 850-hPa ZONAL WIND INDEX | | | 200-hPa WIND INDEX | OLR Index |
|---|---|---|---|---|---|---|---|---|
| | TAHITI | DARWIN | | 5N-5S 135E-180 | 5N-5S 175W-140W | 5N-5S 135W-120W | 5N-5S 165W-110W | 5N-5S 160E-160W |
| FEB 08 | 2.6 | -1.7 | 2.7 | 2.7 | 1.6 | -0.6 | 2.5 | 2.5 |
| JAN 08 | 1.7 | -1.3 | 1.9 | 1.1 | 1.6 | -0.1 | 1.8 | 1.0 |
| DEC 07 | 1.5 | -1.3 | 1.8 | 3.7 | 1.7 | -0.1 | 0.8 | 2.2 |
| NOV 07 | 0.3 | -1.1 | 0.9 | 1.3 | 1.8 | 1.0 | 1.7 | 0.8 |
| OCT 07 | 0.3 | -0.6 | 0.6 | 1.1 | 0.6 | -0.1 | 0.2 | 1.4 |
| SEP 07 | -0.1 | -0.4 | 0.2 | 1.0 | 1.3 | 1.2 | 1.5 | 0.8 |
| AUG 07 | 0.9 | 0.8 | 0.1 | 0.9 | 0.4 | 0.1 | 0.2 | 0.6 |
| JUL 07 | 0.5 | 1.4 | -0.5 | 1.1 | 0.1 | -1.0 | 0.2 | 1.1 |
| JUN 07 | -0.5 | -0.8 | 0.2 | 1.8 | 0.8 | -0.1 | 1.2 | 0.6 |
| MAY 07 | 0.3 | 0.9 | -0.4 | 0.5 | 0.6 | -0.5 | -0.1 | 0.2 |
| APR 07 | 0.5 | 1.2 | -0.4 | 1.5 | 1.1 | -0.6 | 0.4 | 0.1 |
| MAR 07 | -0.3 | 0.3 | -0.4 | 0.8 | 1.2 | 0.1 | 0.9 | 0.8 |
| FEB 07 | 0.0 | 0.7 | -0.5 | 0.9 | 1.1 | -0.5 | -0.4 | 0.1 |

* *Preliminary*

** *Revised*

TABLE T1 - Atmospheric index values for the most recent 12 months. Indices are standardized by the mean annual standard deviation, except for the Tahiti and Darwin SLP anomalies which are in units of hPa. Positive (negative) values of 200-hPa zonal wind index imply westerly (easterly) anomalies. Positive (negative) values of 850-hPa zonal wind indices imply easterly (westerly) anomalies.

| MONTH | PACIFIC SST | | | | | | | | ATLANTIC SST | | | | Global | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NIÑO 1+2 0-10°S 90°W-80°W | | NIÑO 3 5°N-5°S 150°W-90-°W | | NIÑO 3.4 5°N-5°S 170°W-12-0°W | | NIÑ0 4 5°N-5°S 160°E-150-°W | | N. ATL 5N-20N 60W-30W | | S. ATL 0-20S 30W-10E | | TROPICS 10N-10S 0W-360W | |
| FEB 08 | 0.2 | 26.3 | -1.4 | 25.0 | -1.9 | 24.8 | -1.6 | 26.4 | -0.1 | 25.4 | 0.4 | 26.8 | -0.3 | 27.4 |
| JAN 08 | -0.7 | 23.8 | -1.5 | 24.1 | -1.8 | 24.7 | -1.5 | 26.6 | 0.1 | 26.0 | 0.2 | 25.6 | -0.3 | 27.2 |
| DEC 07 | -2.0 | 20.8 | -1.5 | 23.6 | -1.5 | 25.0 | -0.9 | 27.4 | 0.2 | 26.9 | 0.1 | 24.6 | -0.2 | 27.2 |
| NOV 07 | -2.2 | 19.5 | -1.8 | 23.2 | -1.5 | 25.1 | -0.9 | 27.4 | 0.2 | 27.7 | 0.0 | 23.9 | -0.3 | 27.2 |
| OCT 07 | -2.1 | 18.8 | -1.5 | 23.4 | -1.4 | 25.2 | -0.6 | 27.9 | 0.2 | 28.1 | -0.1 | 23.3 | -0.2 | 27.2 |
| SEP 07 | -1.9 | 18.6 | -1.3 | 23.6 | -0.8 | 25.8 | -0.4 | 28.1 | 0.1 | 28.0 | 0.2 | 23.1 | -0.1 | 27.0 |
| AUG 07 | -1.6 | 19.2 | -1.1 | 23.9 | -0.5 | 26.2 | 0.1 | 28.6 | 0.1 | 27.7 | 0.1 | 23.1 | 0.0 | 27.1 |
| JUL 07 | -1.6 | 20.3 | -0.8 | 24.8 | -0.3 | 26.8 | 0.2 | 28.8 | 0.2 | 27.2 | 0.2 | 23.8 | 0.1 | 27.4 |
| JUN 07 | -1.4 | 21.7 | -0.5 | 25.9 | 0.1 | 27.6 | 0.4 | 29.0 | 0.2 | 26.8 | 0.4 | 25.2 | 0.2 | 28.1 |
| MAY 07 | -1.6 | 22.8 | -0.7 | 26.4 | -0.2 | 27.6 | 0.2 | 28.9 | 0.2 | 26.4 | 0.3 | 26.3 | 0.1 | 28.5 |
| APR 07 | -1.1 | 24.4 | -0.3 | 27.1 | 0.1 | 27.8 | 0.3 | 28.7 | 0.4 | 26.2 | 0.3 | 27.1 | 0.2 | 28.7 |
| MAR 07 | -0.7 | 25.8 | -0.3 | 26.8 | 0.0 | 27.1 | 0.5 | 28.6 | 0.4 | 25.8 | 0.1 | 27.0 | 0.2 | 28.3 |
| FEB 07 | 0.2 | 26.3 | 0.1 | 26.5 | 0.1 | 26.8 | 0.6 | 28.6 | 0.7 | 26.1 | 0.1 | 26.5 | 0.4 | 28.1 |

* *Preliminary*
** *Revised*

TABLE T2. Mean and anomalous sea surface temperature (°C) for the most recent 12 months. Anomalies are departures from the 1971–2000 adjusted OI climatology (Smith and Reynolds 1998, *J. Climate*, **11**, 3320-3323).

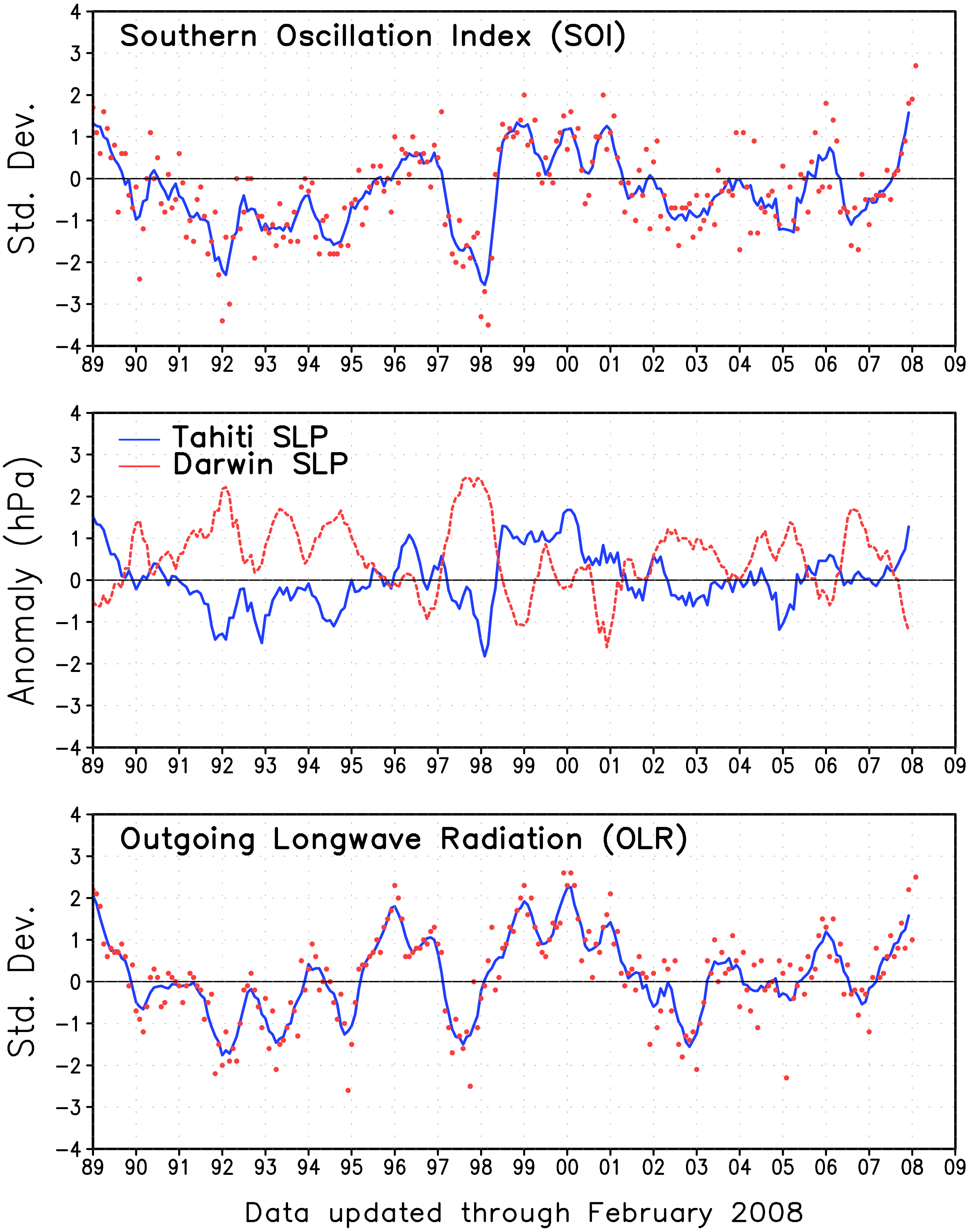



FIGURE T1. Five-month running mean of the Southern Oscillation Index (SOI) (top), sea-level pressure anomaly (hPa) at Darwin and Tahiti (middle), and outgoing longwave radiation anomaly (OLR) averaged over the area 5N-5S, 160E-160W (bottom). Anomalies in the top and middle panels are departures from the 1951-1980 base period means and are normalized by the mean annual standard deviation. Anomalies in the bottom panel are departures from the 1979-1995 base period means. Individual monthly values are indicated by “x”s in the top and bottom panels. The x-axis labels are centered on July.

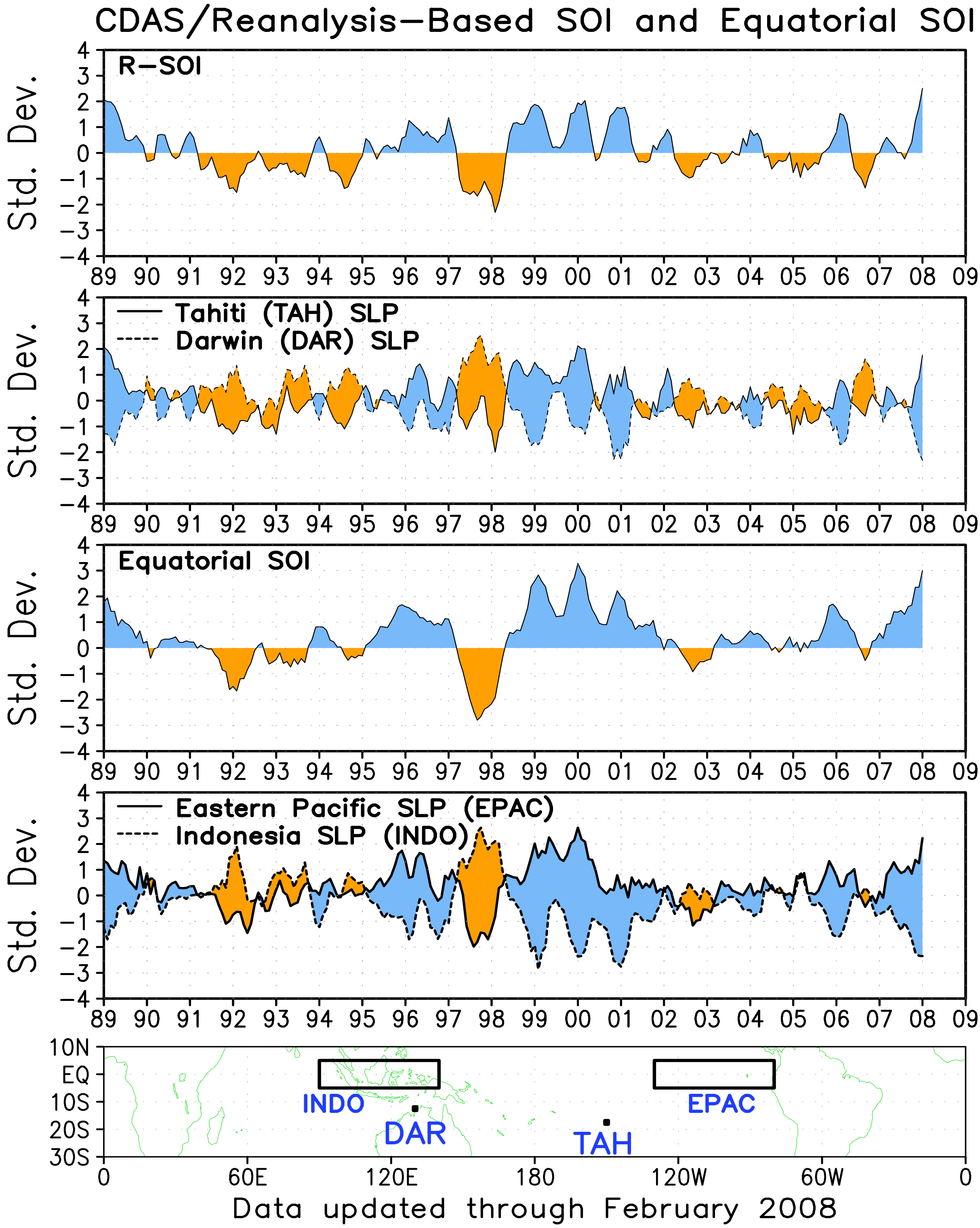



FIGURE T2. Three-month running mean of a CDAS/Reanalysis-derived (a) Southern Oscillation Index (RSOI), (b) standardized pressure anomalies near Tahiti (solid) and Darwin (dashed), (c) an equatorial SOI ([EPAC] - [INDO]), and (d) standardized equatorial pressure anomalies for (EPAC) (solid) and (INDO) (dashed). Anomalies are departures from the 1979–95 base period means and are normalized by the mean annual standard deviation. The equatorial SOI is calculated as the normalized difference between the standardized anomalies averaged between 5°N–5°S, 80°W–130°W (EPAC) and 5°N–5°S, 90°E–140°E (INDO).

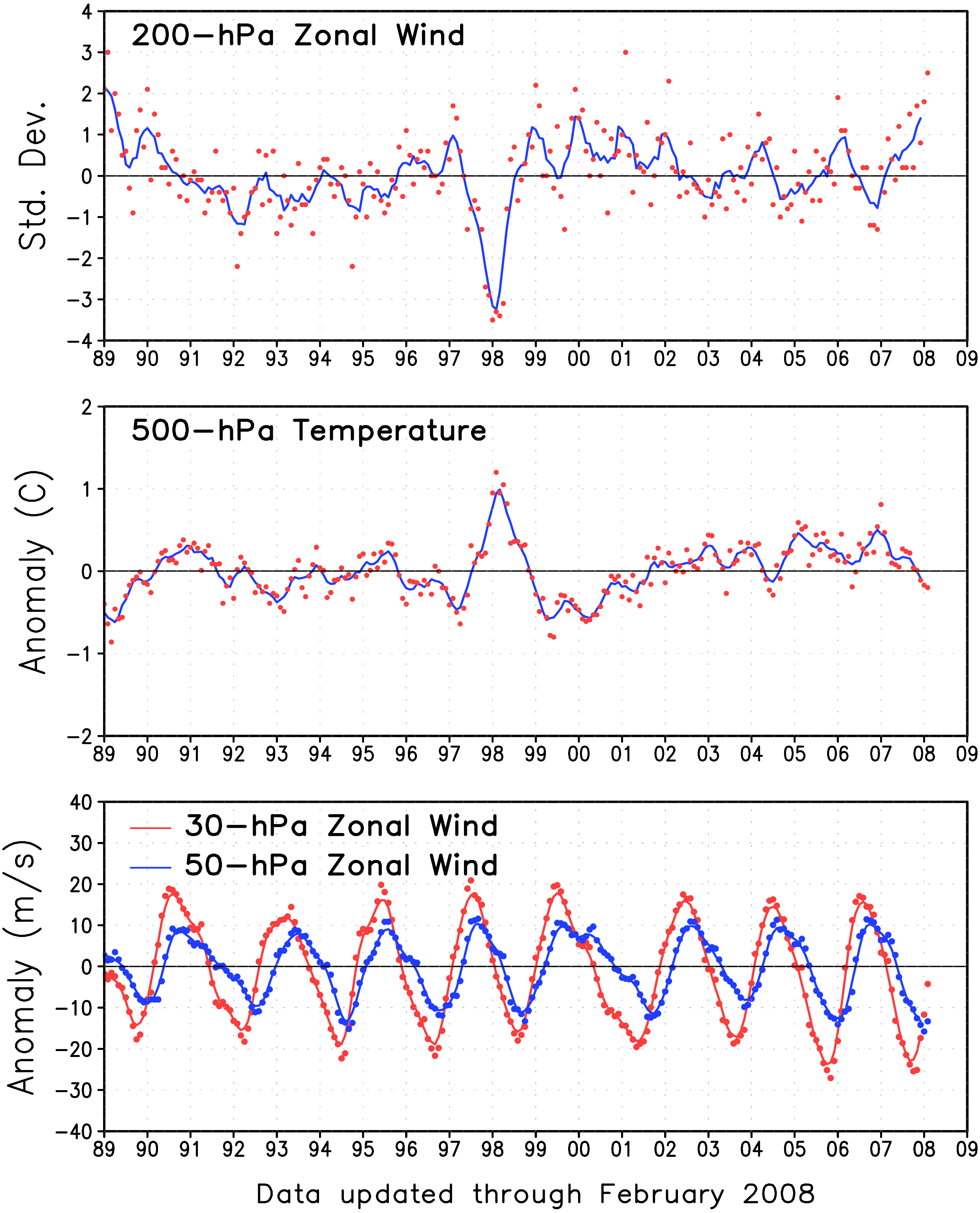



FIGURE T3. Five-month running mean (solid lines) and individual monthly mean (dots) of the 200-hPa zonal wind anomalies averaged over the area 5N-5S, 165W-110W (top), the 500-hPa virtual temperature anomalies averaged over the latitude band 20N-20S (middle), and the equatorial zonally-averaged zonal wind anomalies at 30-hPa (red) and 50-hPa (blue) (bottom). In the top panel, anomalies are normalized by the mean annual standard deviation. Anomalies are departures from the 1979-1995 base period means. The x-axis labels are centered on January.

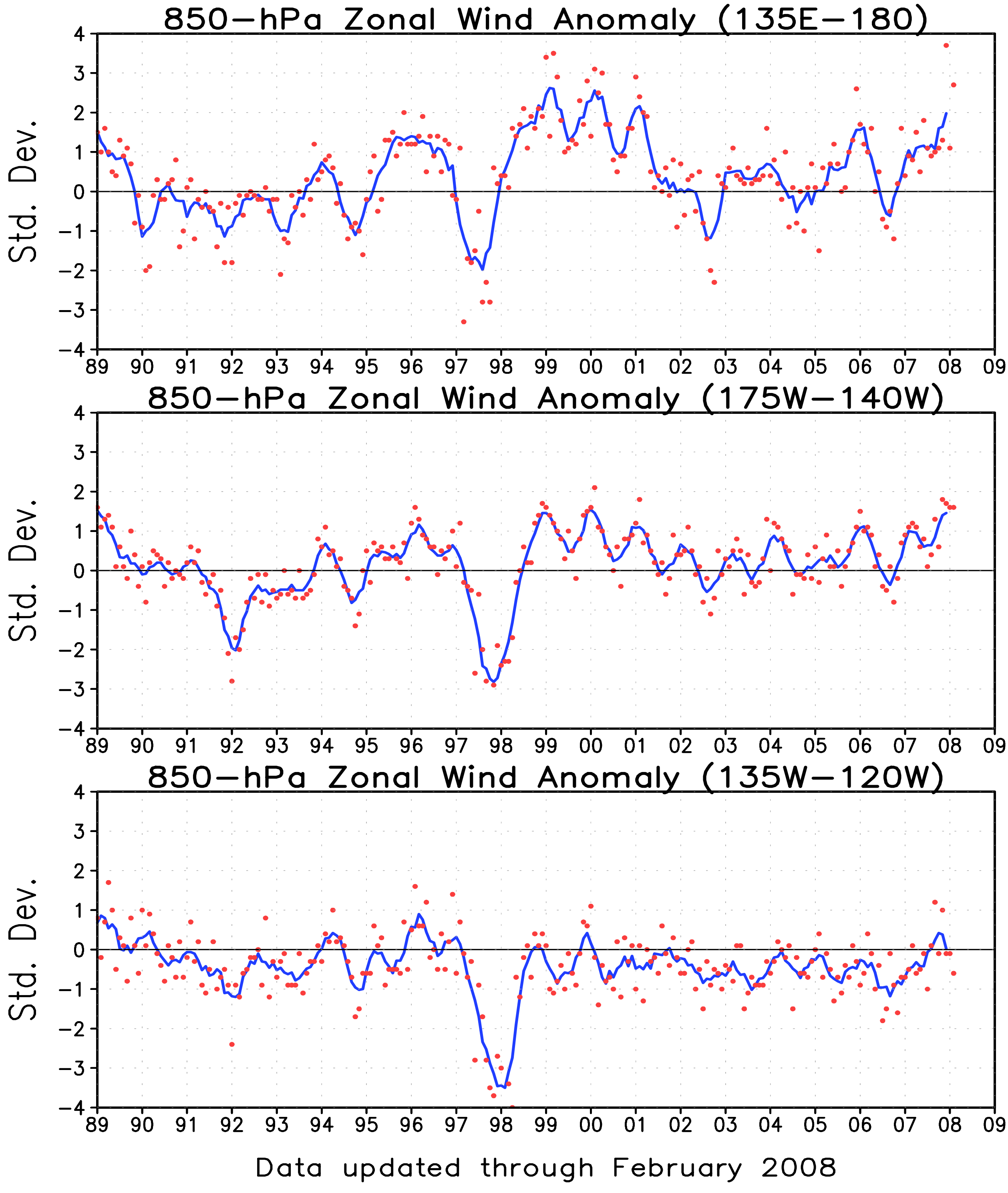



FIGURE T4. Five-month running mean (solid line) and individual monthly mean (dots) of the standardized 850-hPa zonal wind anomaly index in the latitude belt 5N-5S for 135E-180 (top), 175W-140W (middle) and 135W-120W (bottom). Anomalies are departures from the 1979-1995 base period means and are normalized by the mean annual standard deviation.The x-axis labels are centered on January. Positive (negative) values indicate easterly (westerly) anomalies.

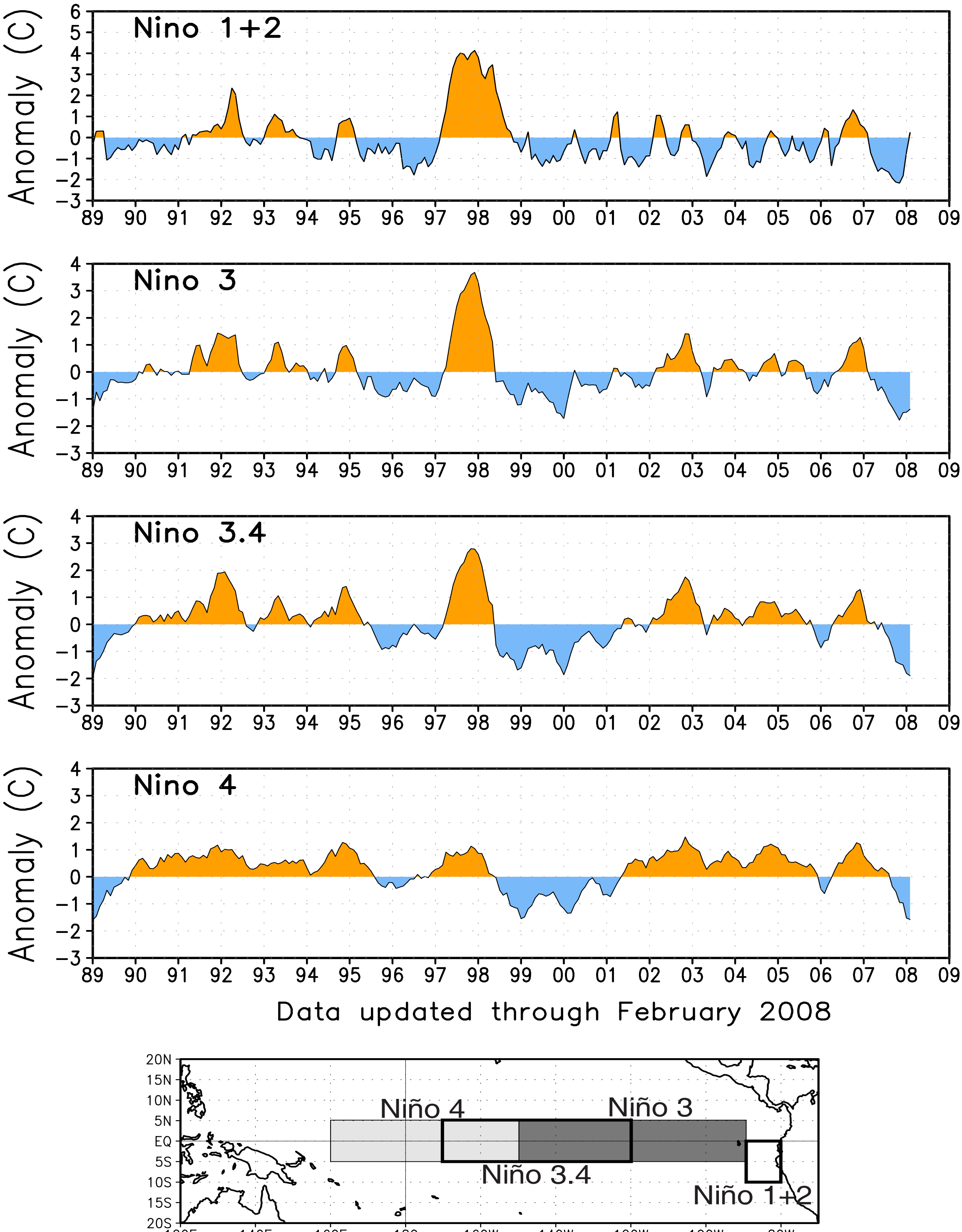



FIGURE T5. Nino region indices, calculated as the area-averaged sea surface temperature anomalies (C) for the specified region. The Nino 1+2 region (top) covers the extreme eastern equatorial Pacific between 0-10S, 90W-80W. The Nino-3 region (2nd from top) spans the eastern equatorial Pacific between 5N-5S, 150W-90W. The Nino 3.4 region 3rd from top) spans the east-central equatorial Pacific between 5N-5S, 170W-120W. The Nino 4 region (bottom) spans the date line and covers the area 5N-5S, 160E-150W. Anomalies are departures from the 1971-2000 base period monthly means *(Smith and Reynolds 1998, J. Climate, 11, 3320-3323)*. Monthly values of each index are also displayed in Table 2.

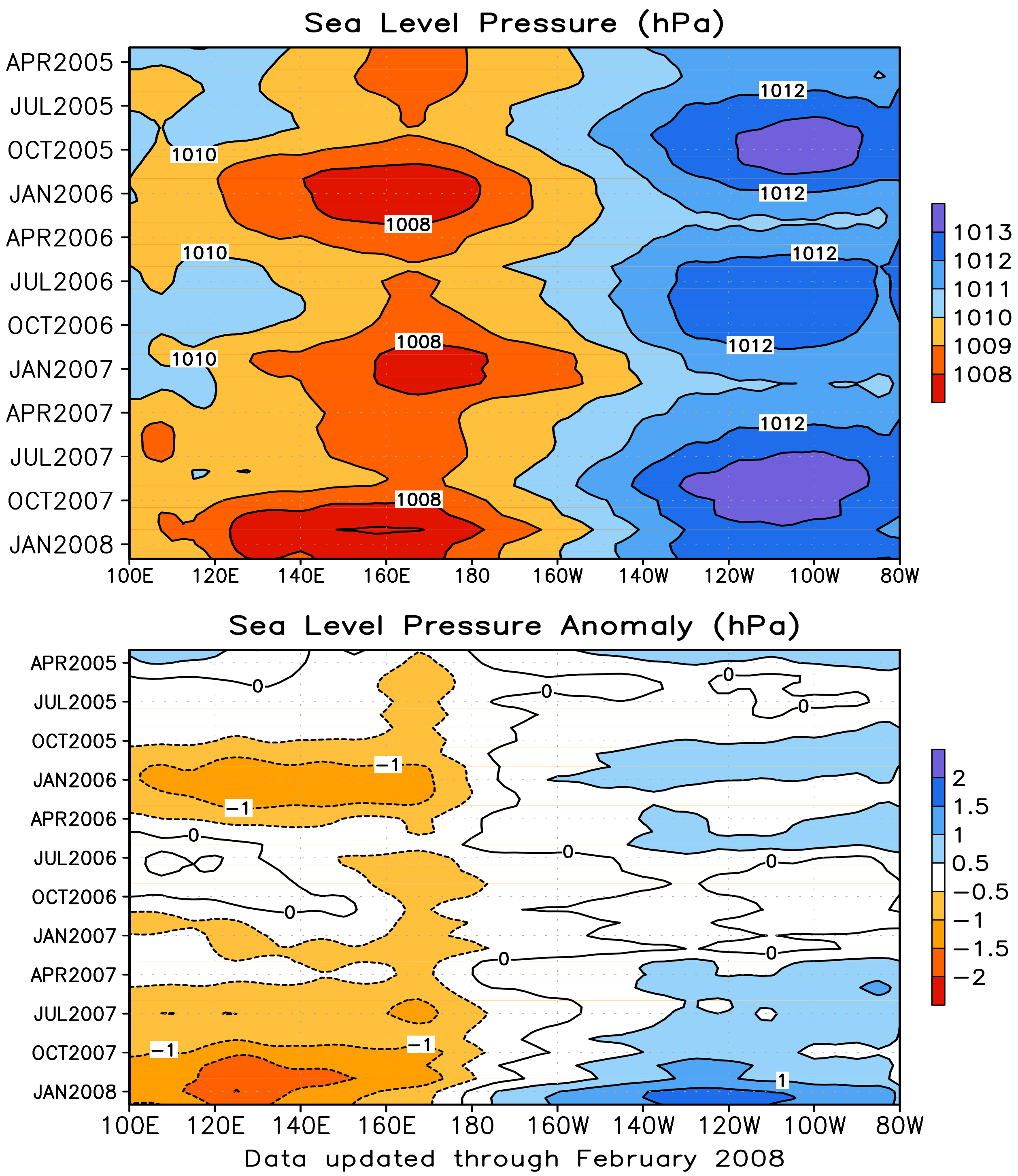



FIGURE T6. Time-longitude section of mean (top) and anomalous (bottom) sea level pressure (SLP) averaged between 5N-5S (CDAS/Reanalysis). Contour interval is 1.0 hPa (top) and 0.5 hPa (bottom). Dashed contours in bottom panel indicate negative anomalies. Anomalies are departures from the 1979-1995 base period monthly means. The data are smoothed temporally using a 3-month running average.

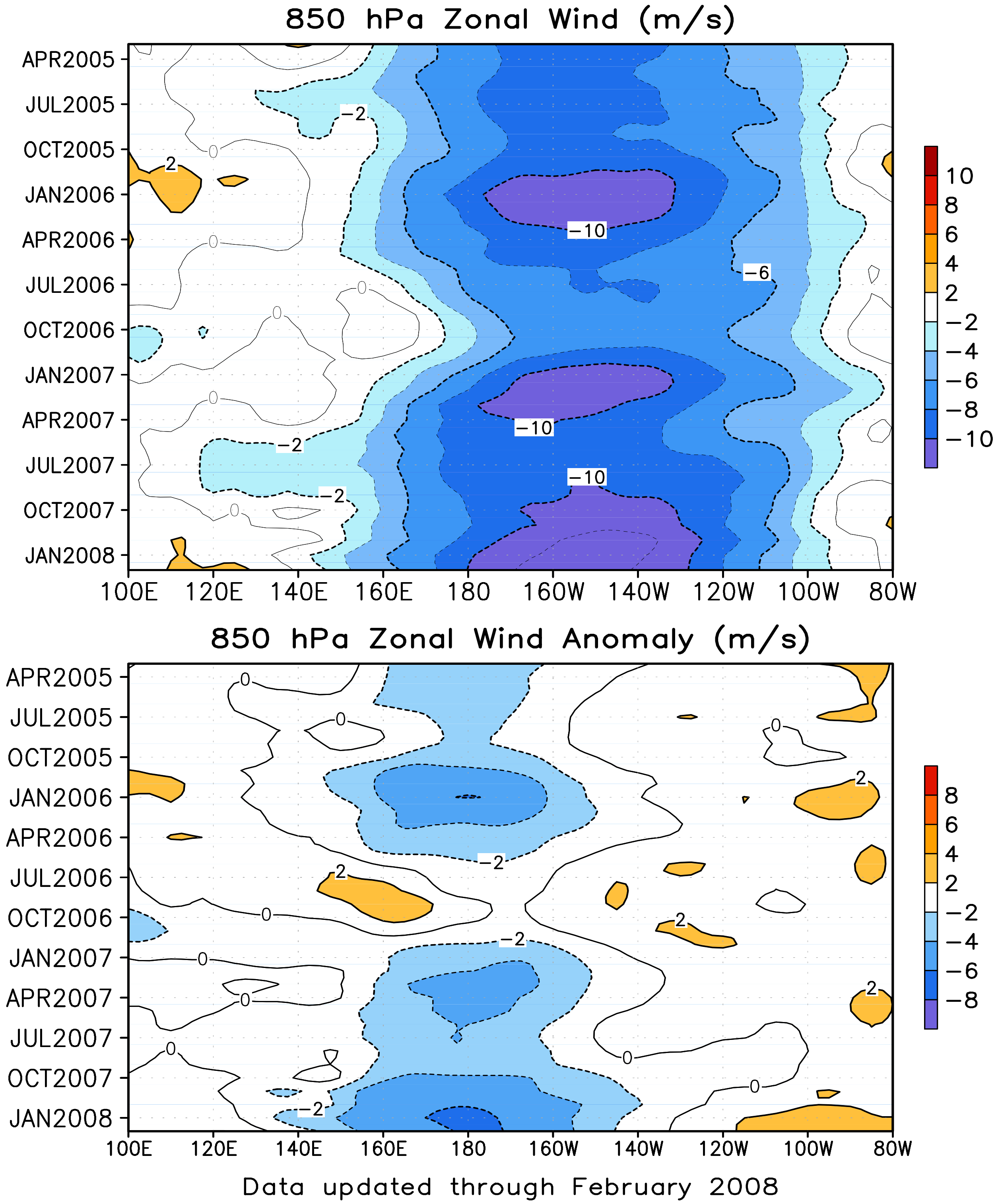



FIGURE T7. Time-longitude section of mean (top) and anomalous (bottom) 850-hPa zonal wind averaged between 5N-5S (CDAS/Reanalysis). Contour interval is 2 $ms^{-1}$. Blue shading and dashed contours indicate easterlies (top) and easterly anomalies (bottom). Anomalies are departures from the 1979-1995 base period monthly means. The data are smoothed temporally using a 3-month running average.

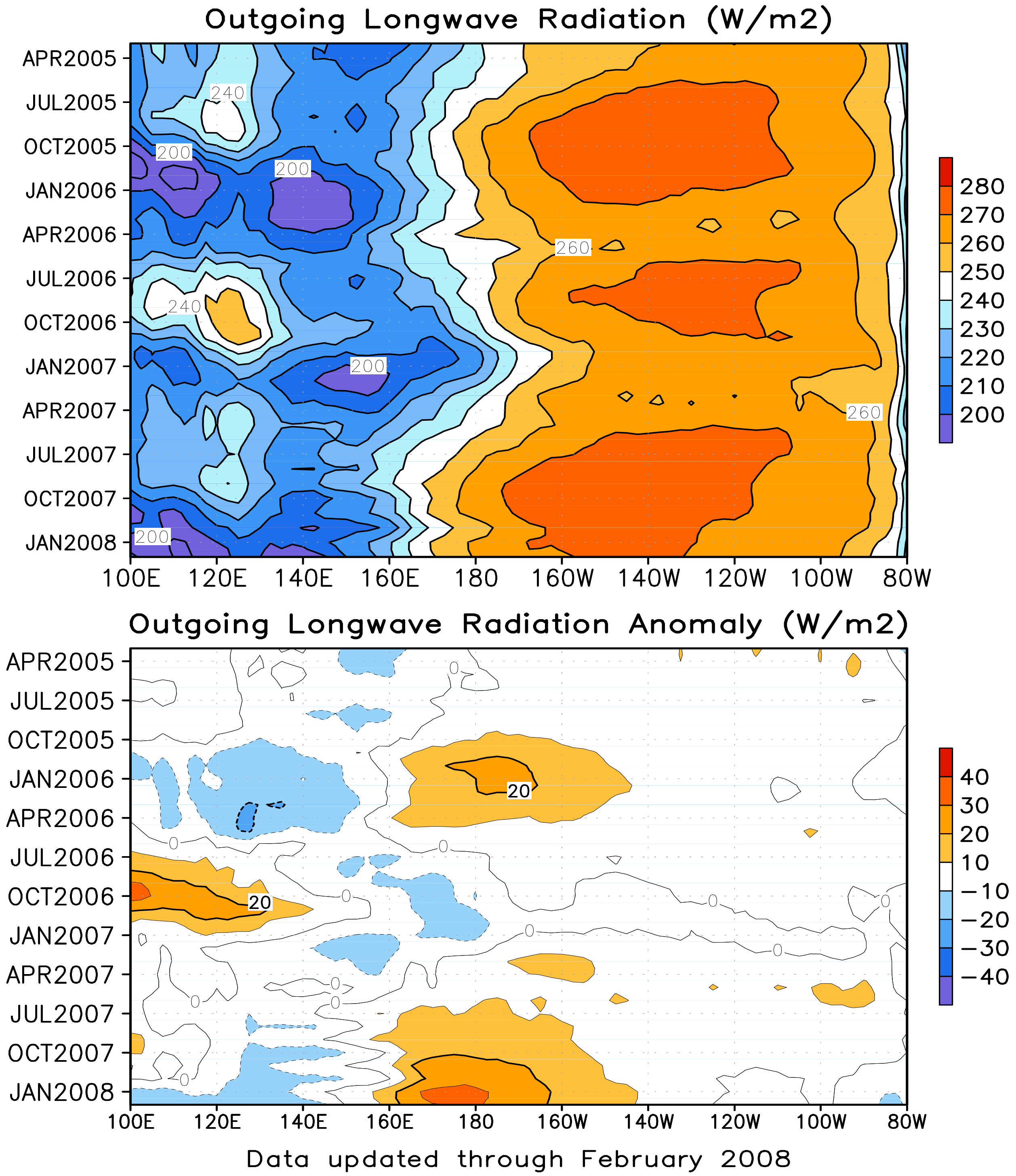



FIGURE T8. Time-longitude section of mean (top) and anomalous (bottom) outgoing longwave radiation (OLR) averaged between 5N-5S. Contour interval is 10 $Wm^{-2}$. Dashed contours in bottom panel indicate negative OLR anomalies. Anomalies are departures from the 1979-1995 base period monthly means. The data are smoothed temporally using a 3-month running average.

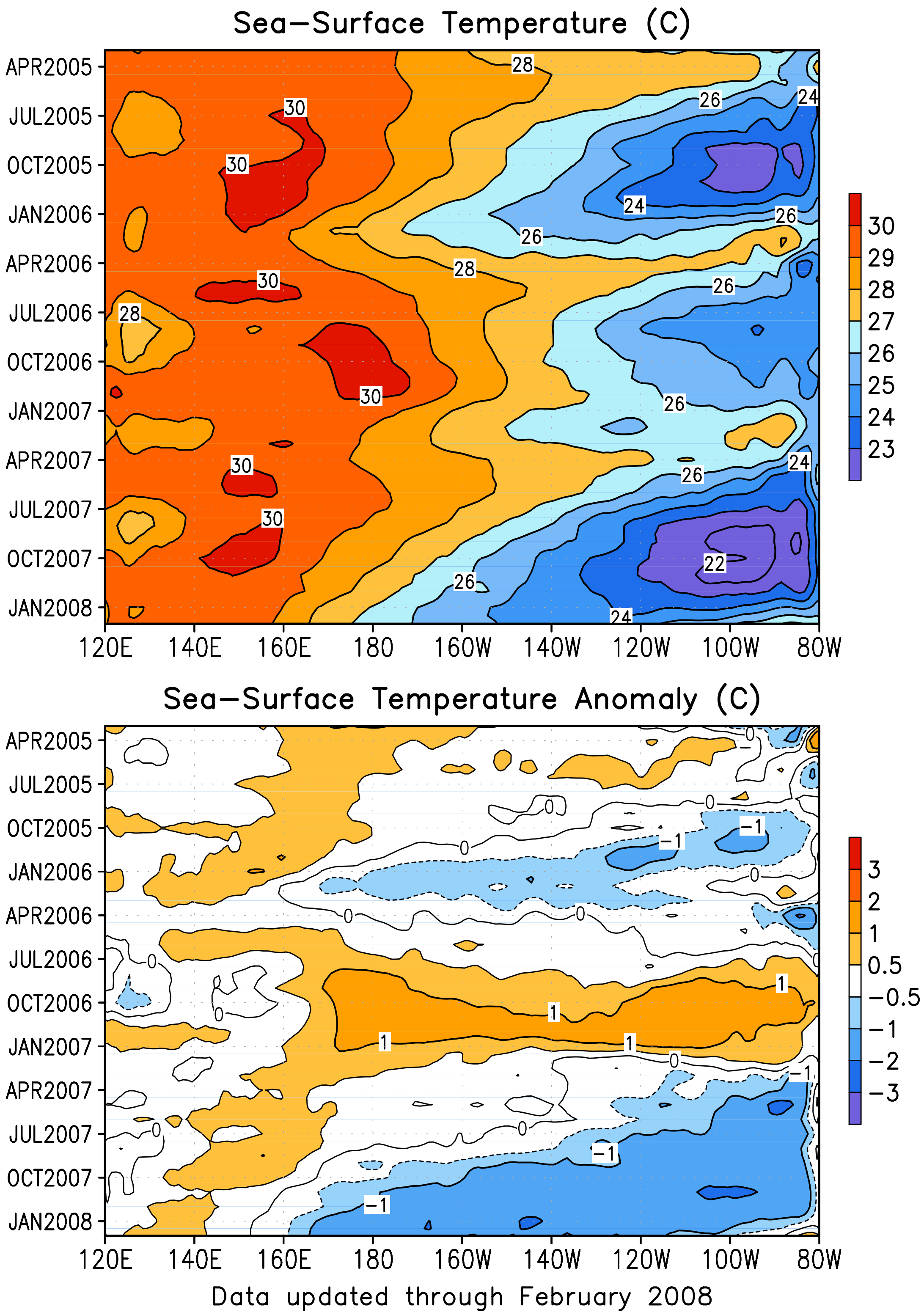



FIGURE T9. Time-longitude section of monthly mean (top) and anomalous (bottom) sea surface temperature (SST) averaged between 5N-5S. Contour interval is 1C (top) and 0.5C (bottom). Dashed contours in bottom panel indicate negative anomalies. Anomalies are departures from the 1971-2000 base period means (Smith and Reynolds 1998, *J. Climate*, **11**, 3320-3323).

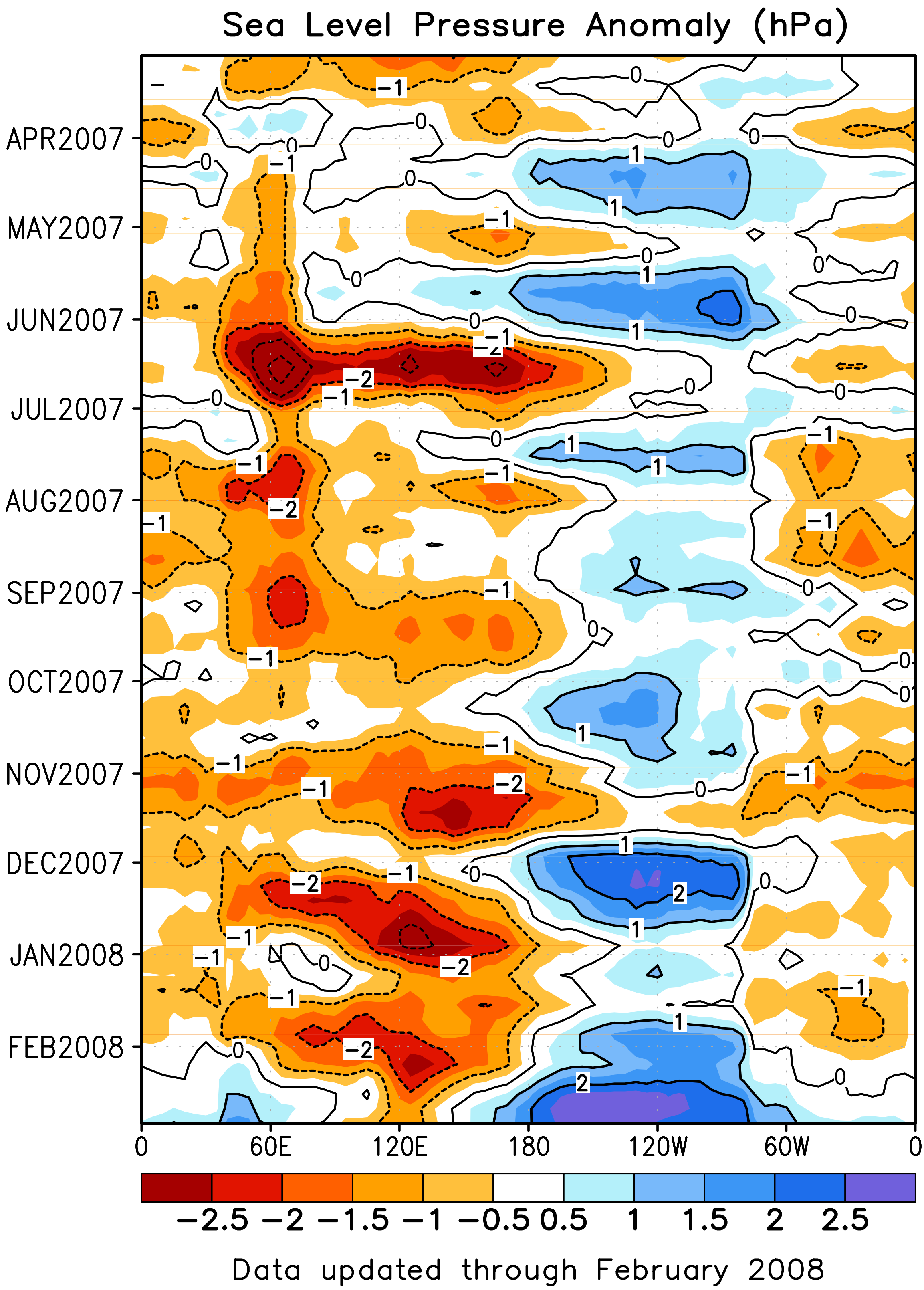



FIGURE T10. Time-longitude section of anomalous sea level pressure (hPa) averaged between 5N-5S (CDAS/Reanaysis). Contour interval is 1 hPa. Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally using a 3-point running average.

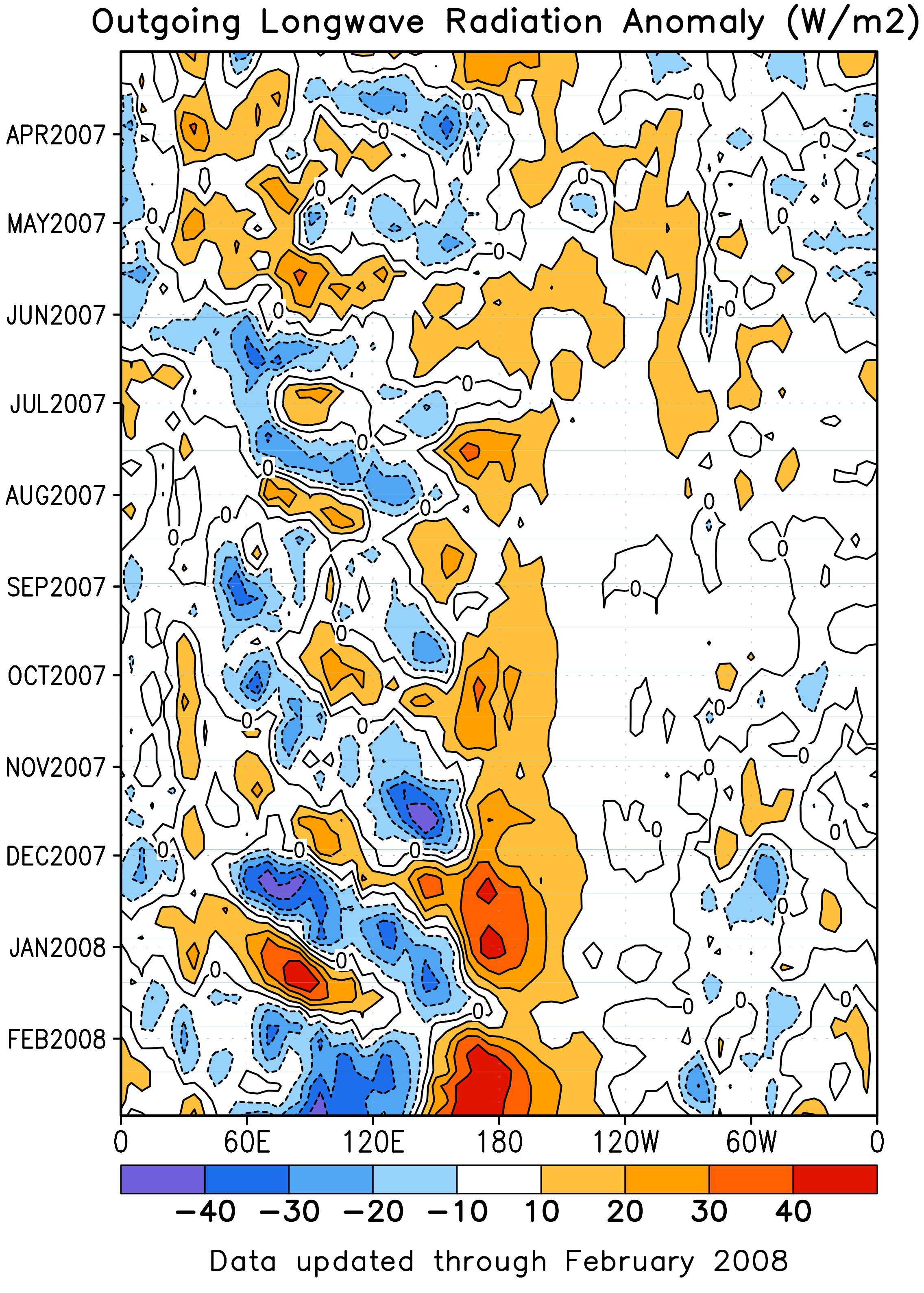



FIGURE T11. Time-longitude section of anomalous outgoing longwave radiation averaged between 5N-5S. Contour interval is 15 Wm$^{-2}$. Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally using a 3-point running average.

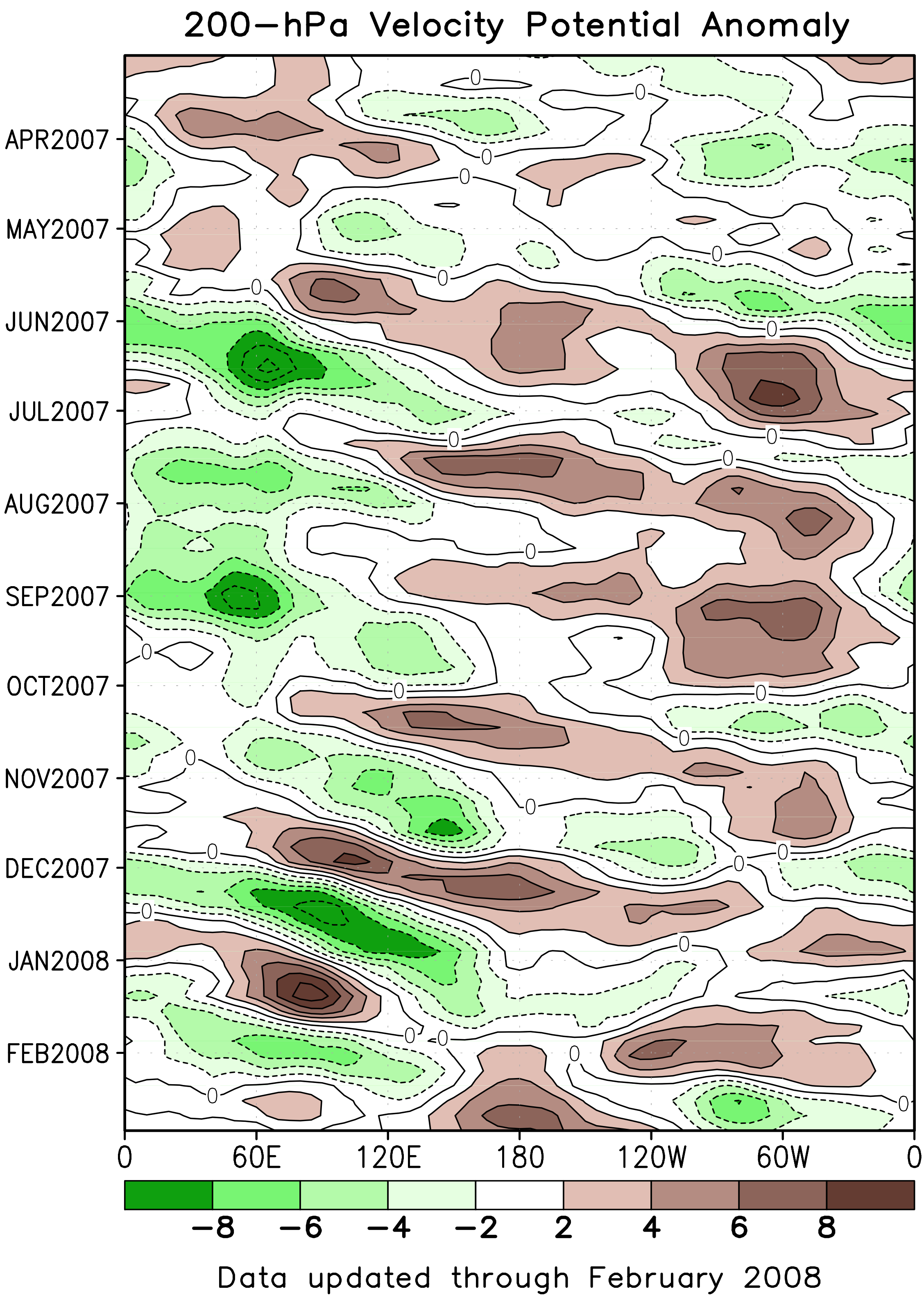



FIGURE T12. Time-longitude section of anomalous 200-hPa velocity potential averaged between 5N-5S (CDAS/Reanalysis). Contour interval is 3 x $10^6$ $m^2s^{-1}$. Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally using a 3-point running average.

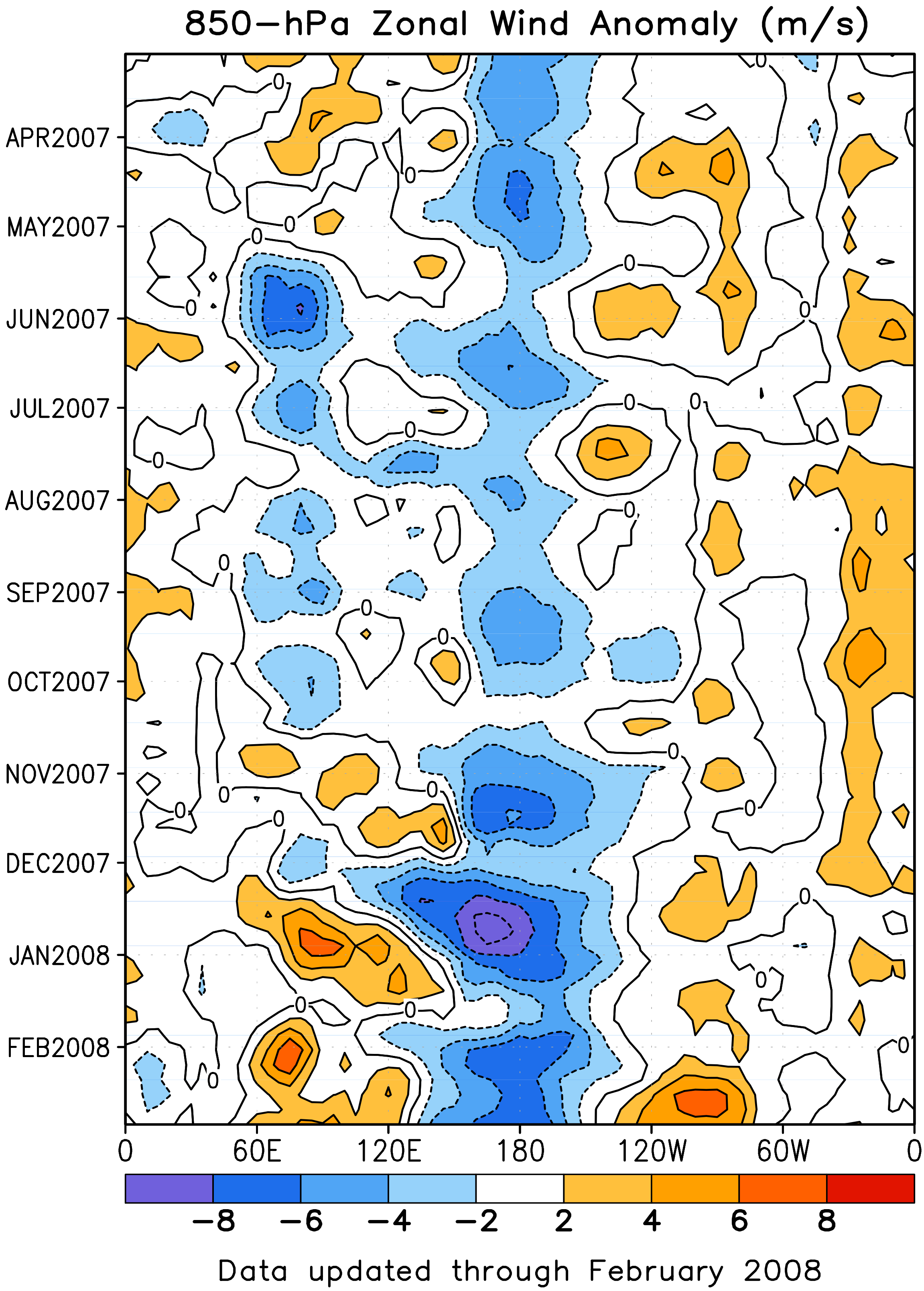



FIGURE T13. Time-longitude section of anomalous 850-hPa zonal wind averaged between 5N-5S (CDAS/Reanalysis). Contour interval is 2 $ms^{-1}$. Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally by using a 3-point running average.

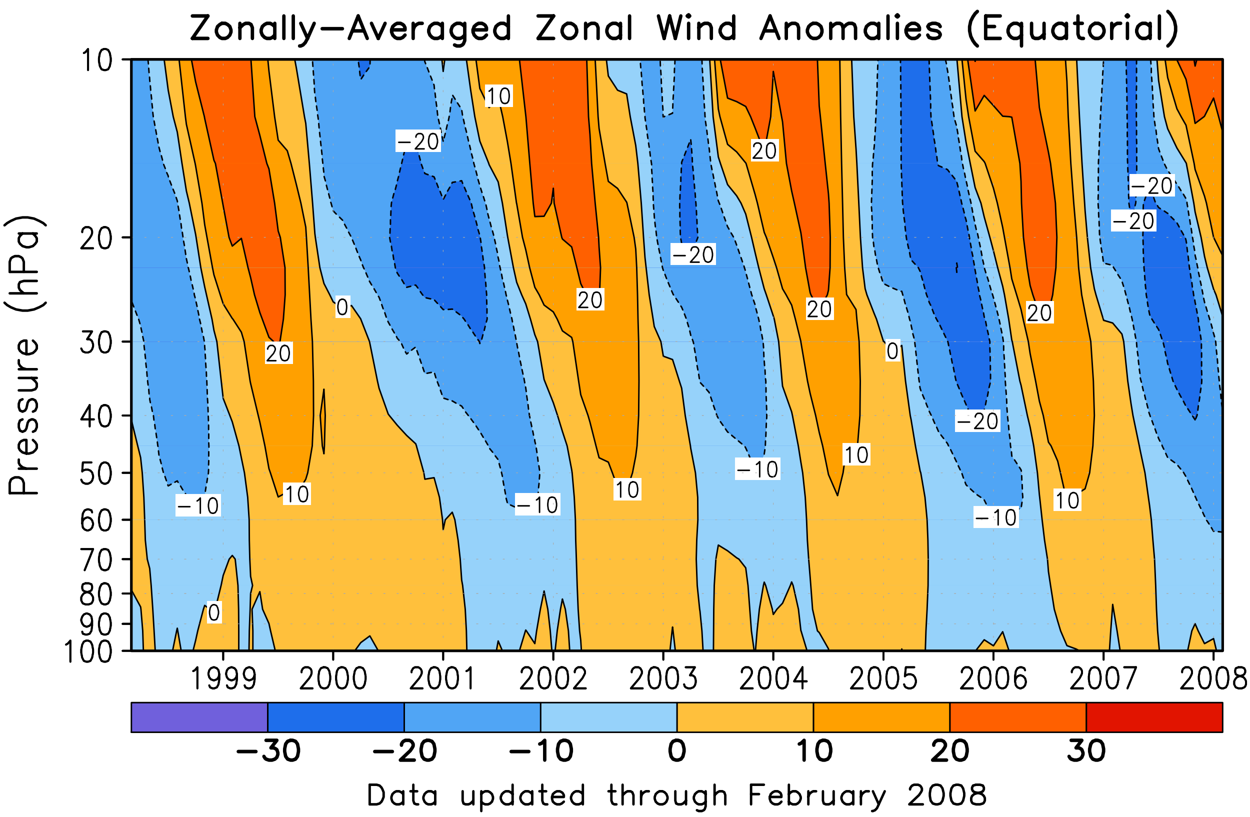



FIGURE T14. Equatorial time-height section of anomalous zonally-averaged zonal wind (m $s^{-1}$) (CDAS/Reanalysis). Contour interval is 10 $ms^{-1}$. Anomalies are departures from the 1979-1995 base period monthly means.

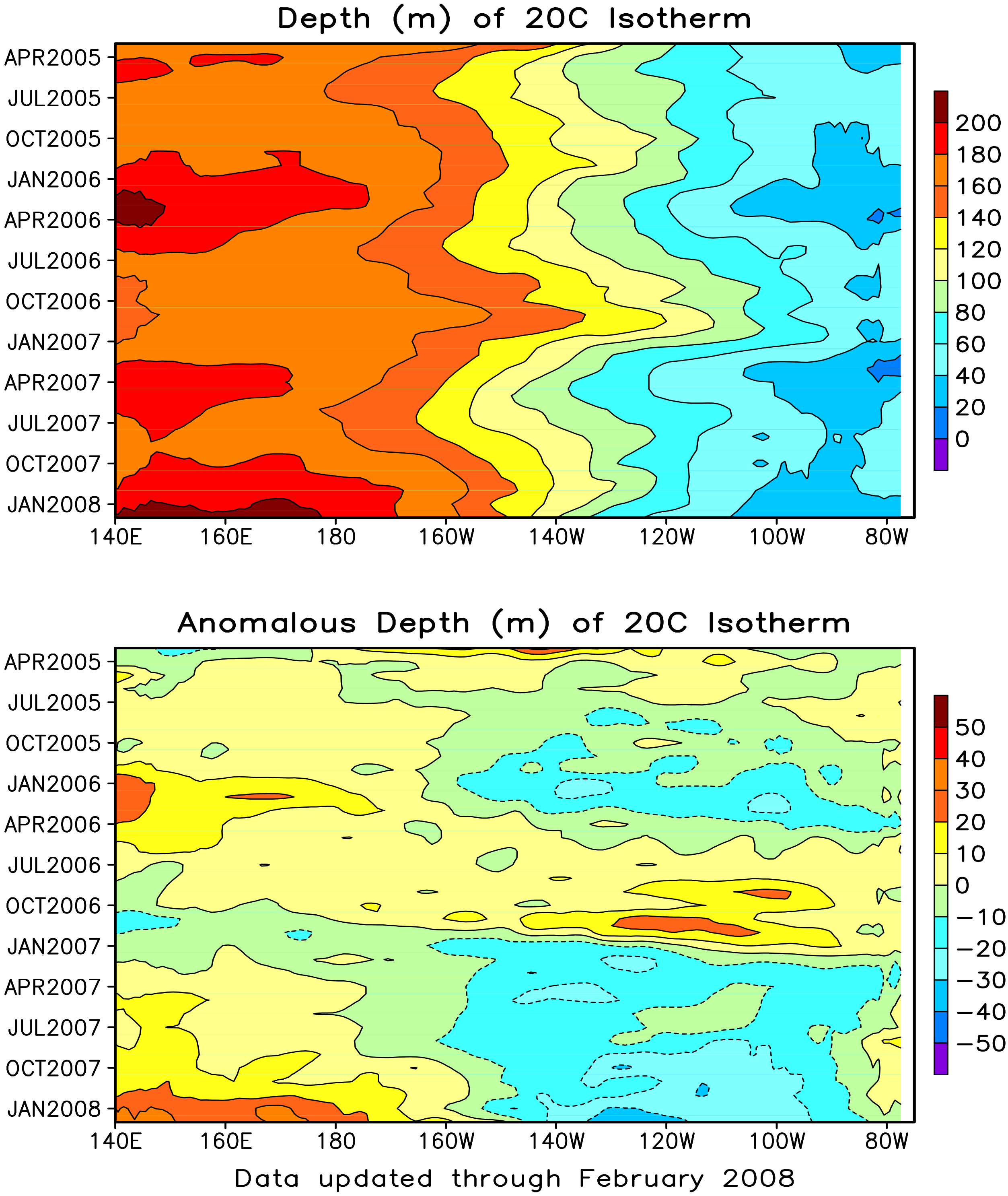



FIGURE T15. Mean (top) and anomalous (bottom) depth of the 20C isotherm averaged between 5N-5S in the Pacific Ocean. Data are derived from the NCEP's global ocean data assimilation system which assimilates oceanic observations into an oceanic GCM (Behringer, D. W., and Y. Xue, 2004: Evaluation of the global ocean data assimilation system at NCEP: The Pacific Ocean. AMS 84th Annual Meeting, Seattle, Washington, 11-15). The contour interval is 10 m. Dashed contours in bottom panel indicate negative anomalies. Anomalies are departures from the 1982-2004 base period means.

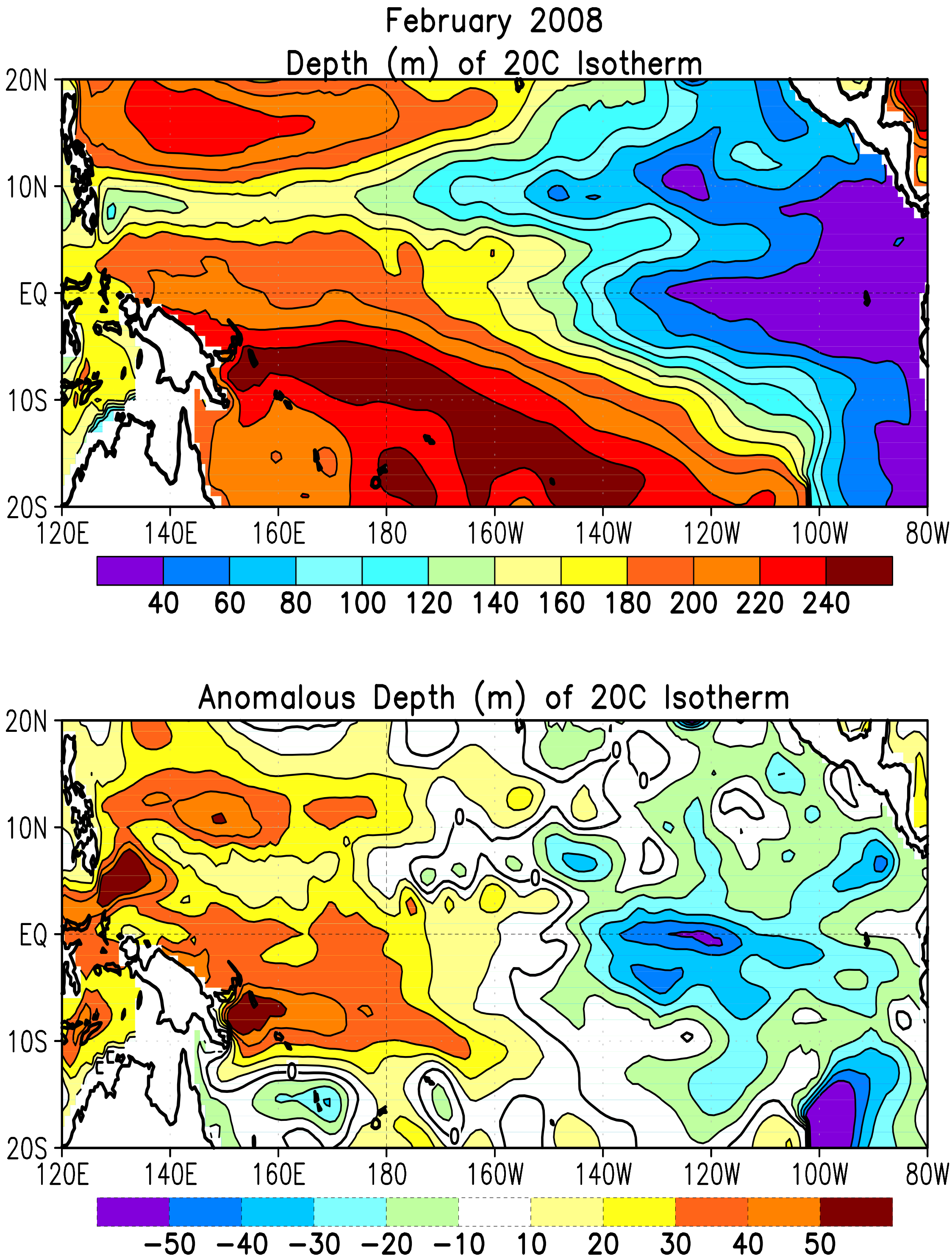



FIGURE T16. Mean (top) and anomalous (bottom) depth of the 20°C isotherm for FEB 2008. Contour interval is 40 m (top) and 10 m (bottom). Dashed contours in bottom panel indicate negative anomalies. Data are derived from the NCEP's global ocean data assimilation system version 2 which assimilates oceanic observations into an oceanic GCM (Xue, Y. and Behringer, D.W., 2006: Operational global ocean data assimilation system at NCEP, to be submitted to BAMS). Anomalies are departures from the 1982–2004 base period means.

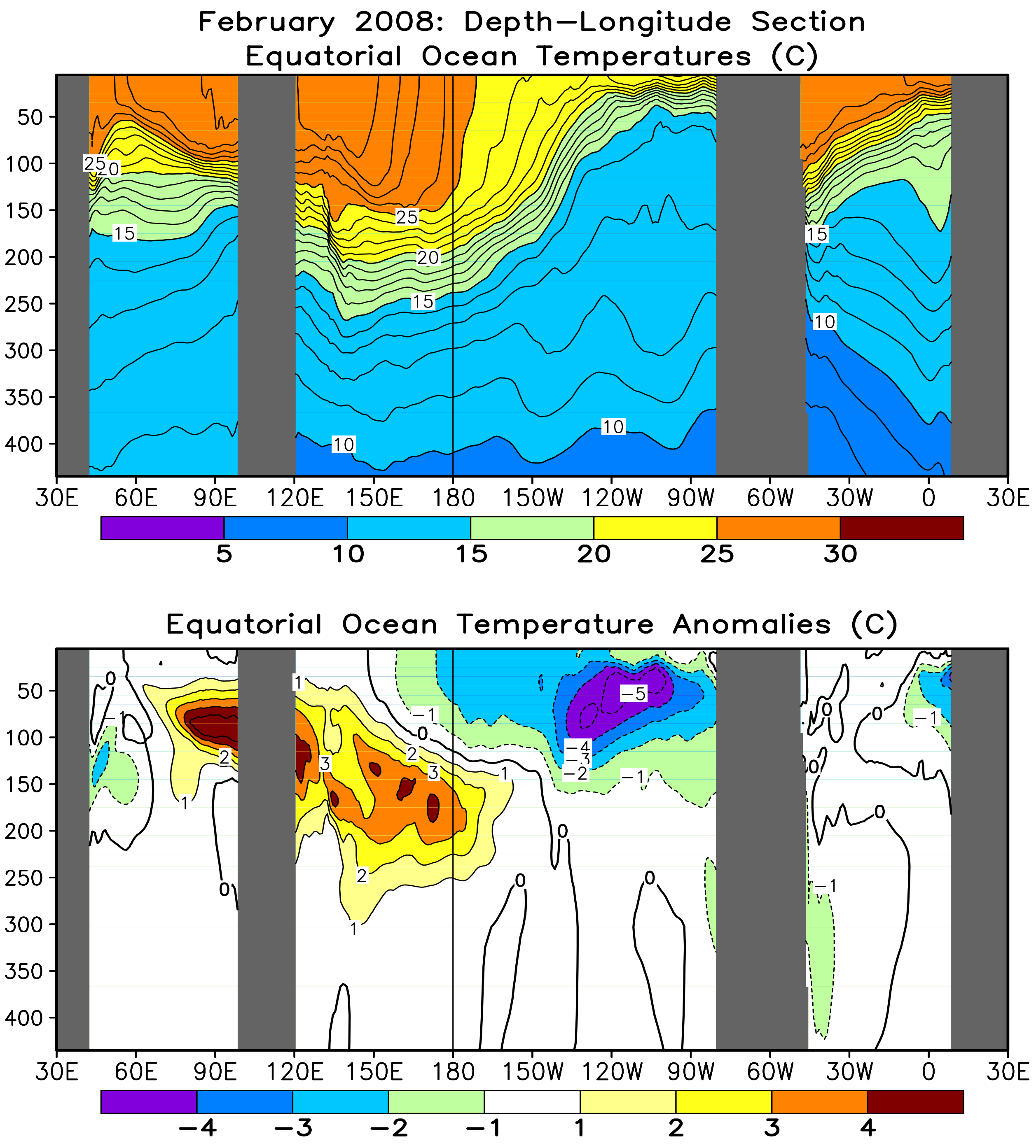



FIGURE T17. Equatorial depth-longitude section of ocean temperature (top) and ocean temperature anomalies (bottom) for FEB 2008. Contour interval is 1°C. Dashed contours in bottom panel indicate negative anomalies. Data are derived from the NCEP's global ocean data assimilation system version 2 which assimilates oceanic observations into an oceanic GCM (Xue, Y. and Behringer, D.W., 2006: Operational global ocean data assimilation system at NCEP, to be submitted to BAMS). Anomalies are departures from the 1982–2004 base period means.

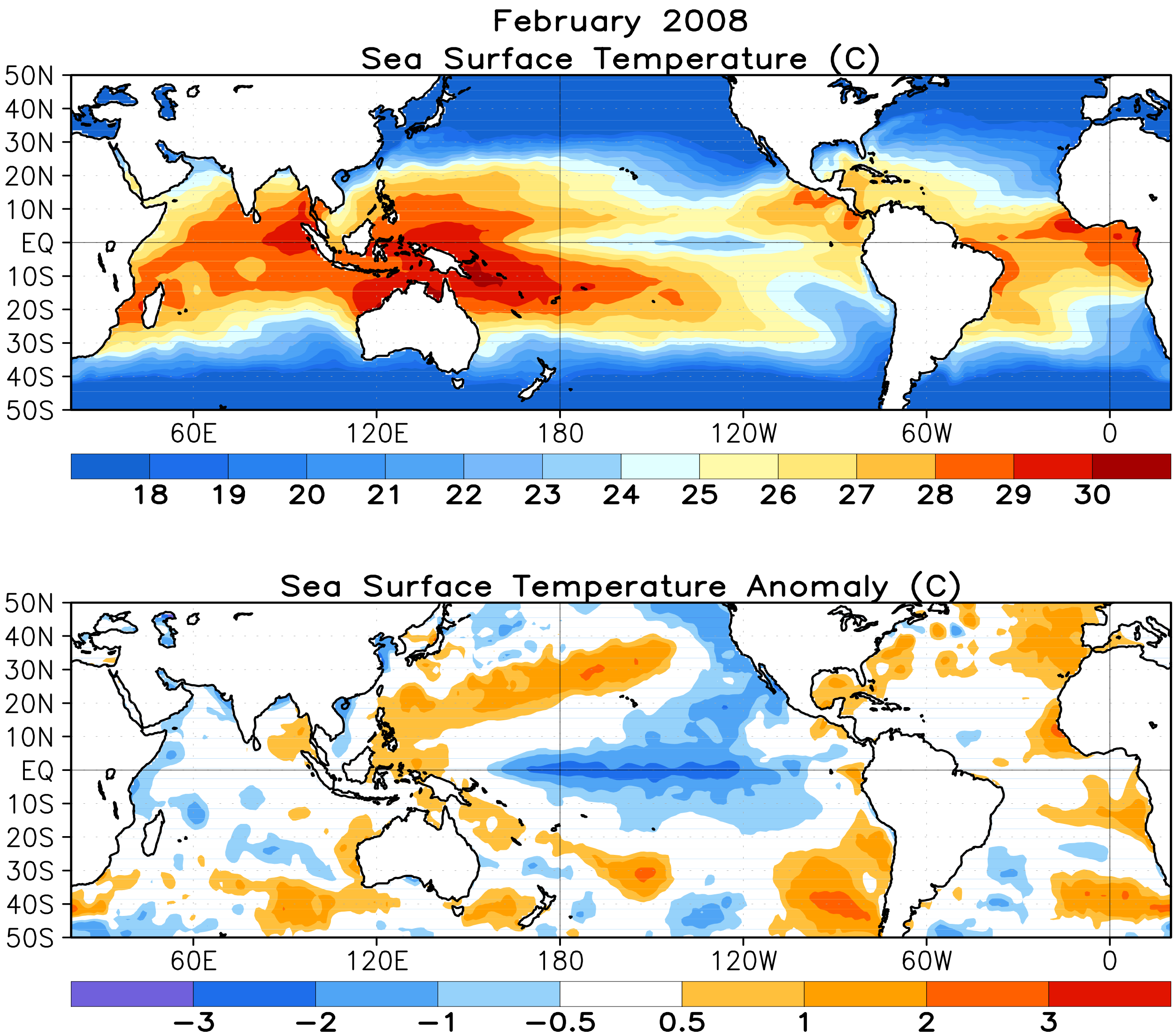



FIGURE T18. Mean (top) and anomalous (bottom) sea surface temperature (SST). Anomalies are departures from the 1971-2000 base period monthly means (Smith and Reynolds 1998, *J. Climate*, **11**, 3320-3323).

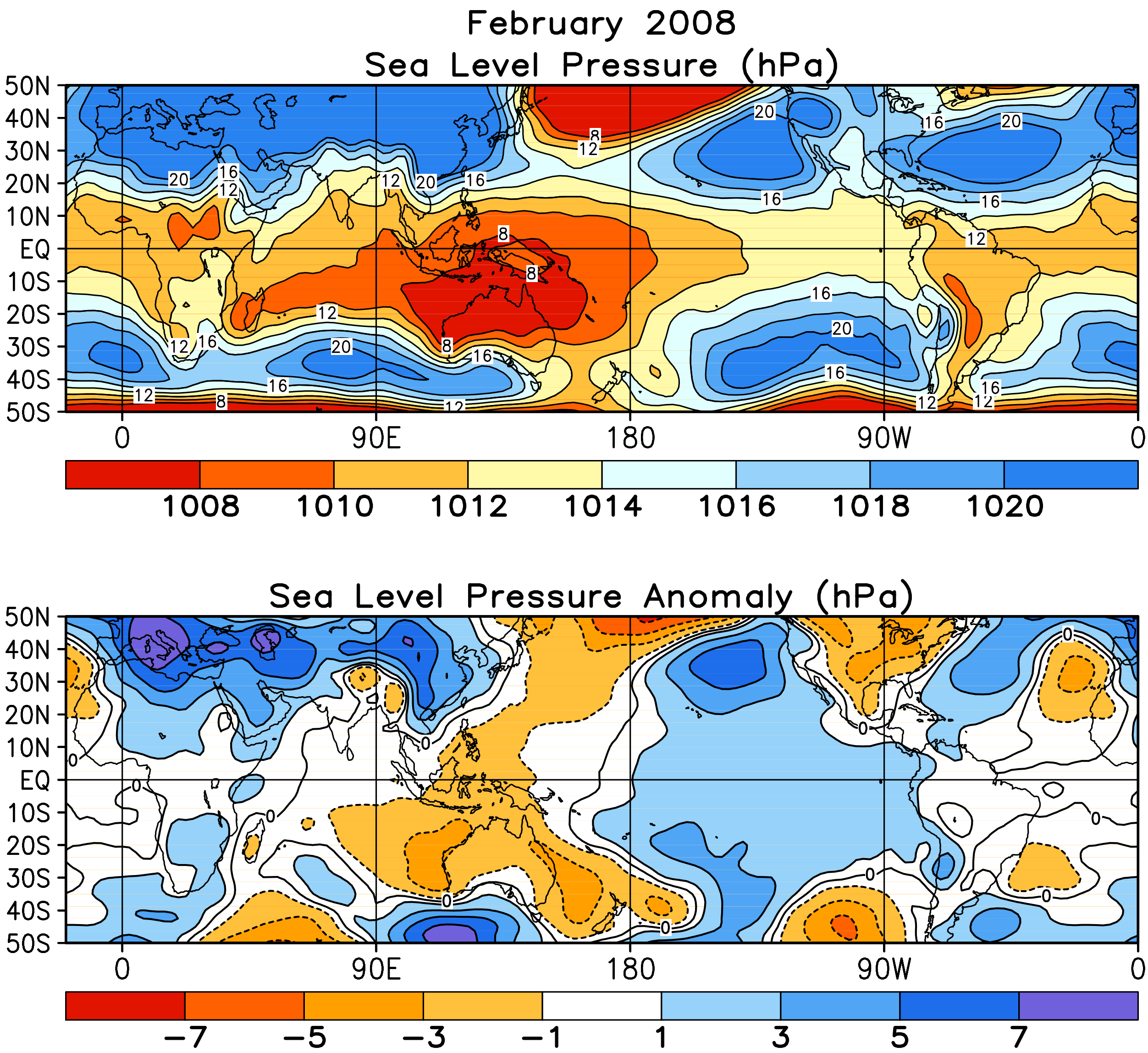



FIGURE T19. Mean (top) and anomalous (bottom) sea level pressure (SLP) (CDAS/Reanalysis). In top panel, 1000 hPa has been subtracted from contour labels, contour interval is 2 hPa, and values below 1000 hPa are indicated by dashed contours. In bottom panel, anomaly contour interval is 1 hPa and negative anomalies are indicated by dashed contours. Anomalies are departures from the 1979-1995 base period monthly means.

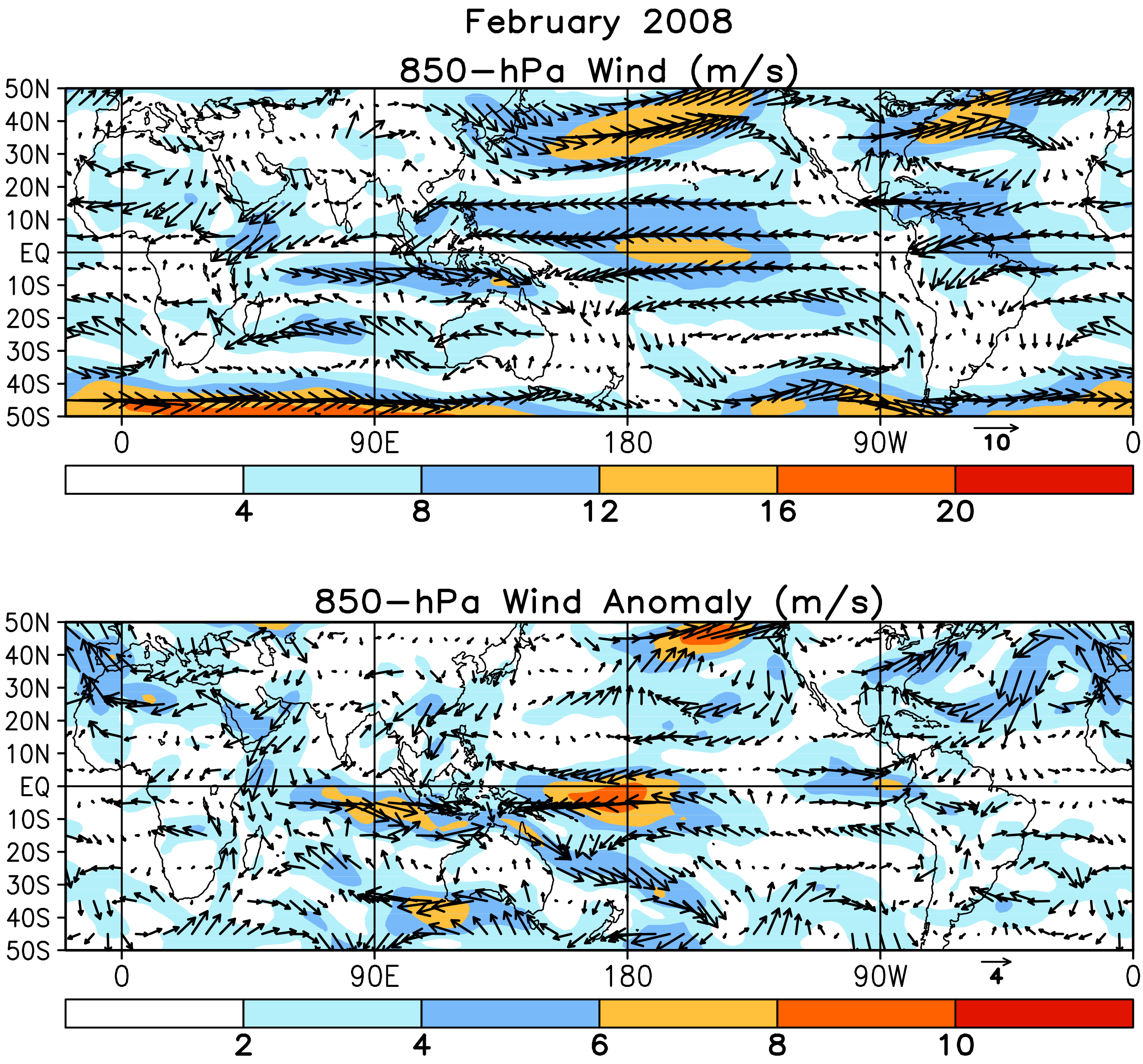



FIGURE T20. Mean (top) and anomalous (bottom) 850-hPa vector wind (CDAS/Reanaysis) for FEB 2008. Contour interval for isotachs is 5 $ms^{-1}$ (top) and 3 $ms^{-1}$ (bottom). Anomalies are departures from the 1979–95 base period monthly means.

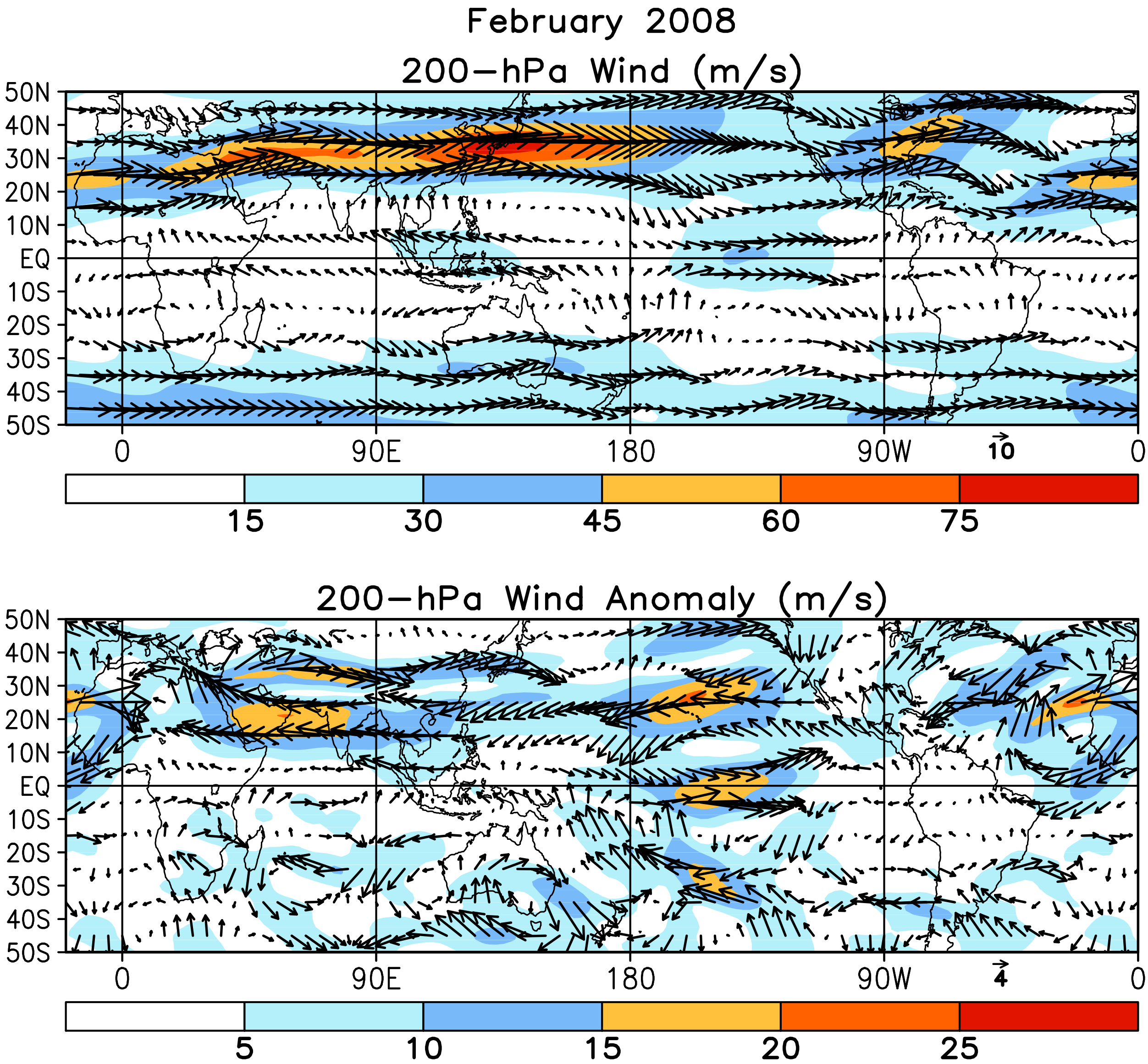



FIGURE T21. Mean (top) and anomalous (bottom) 200-hPa vector wind (CDAS/Reanalysis) for FEB 2008. Contour interval for isotachs is 10 $ms^{-1}$ (top) and 5 $ms^{-1}$ (bottom). Anomalies are departures from 1979–95 base period monthly means.

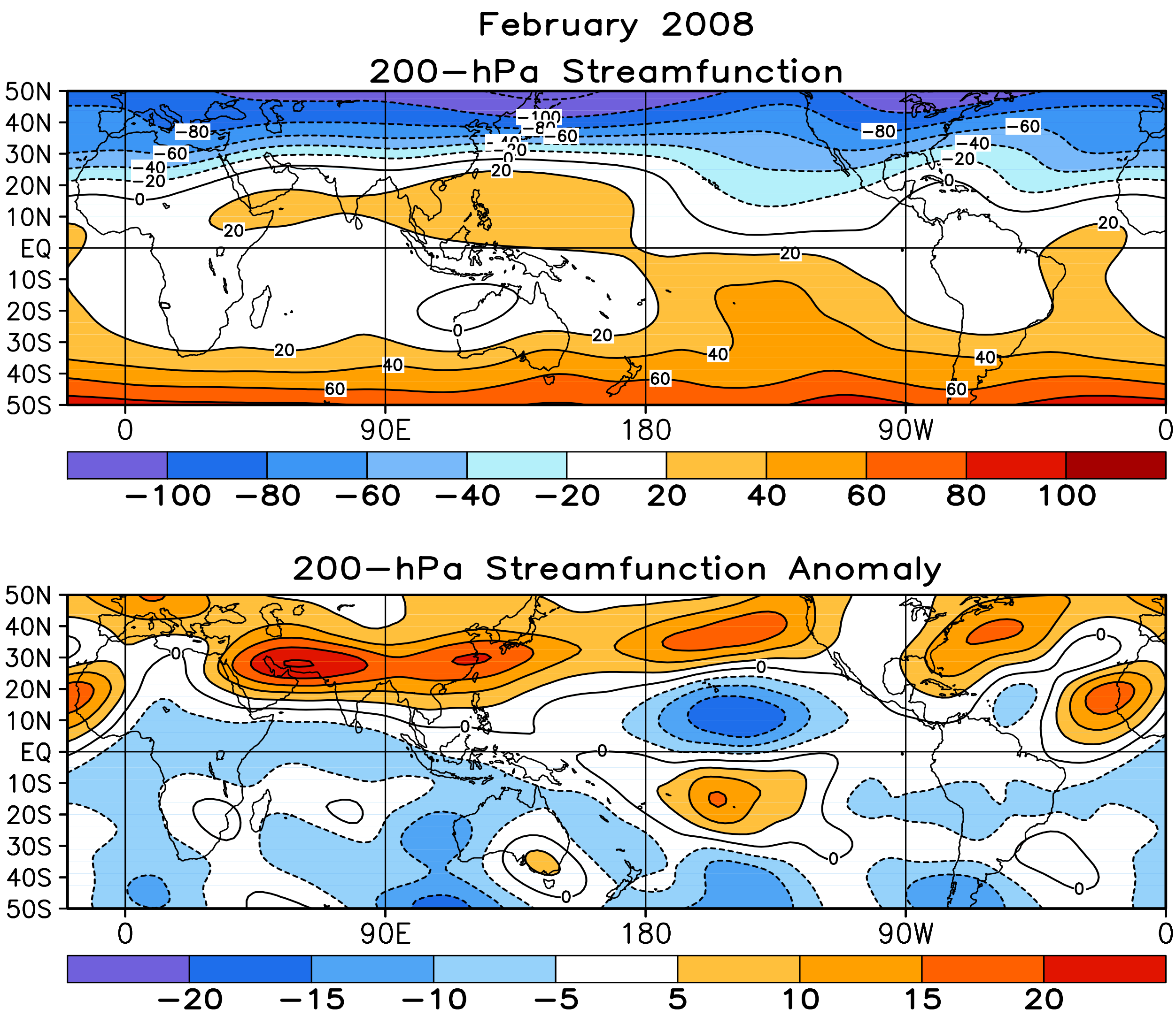
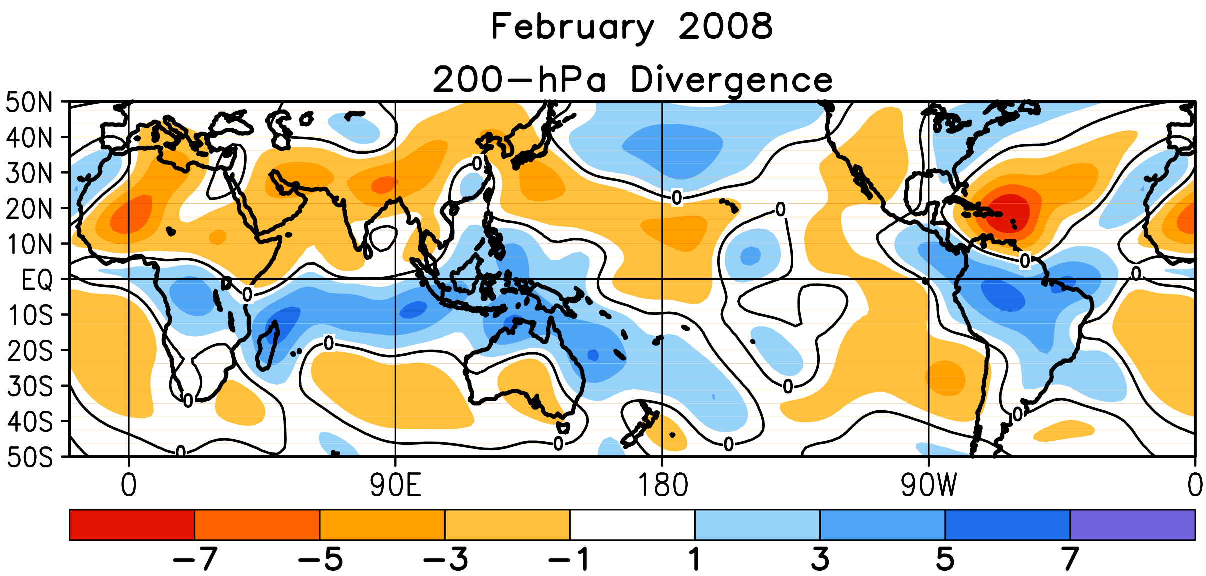



FIGURE T22. Mean (top) and anomalous (bottom) 200-hPa streamfunction (CDAS/Reanalysis). Contour interval is 20 x $10^6$ $m^2s^{-1}$ (top) and 5 x $10^6$ $m^2s^{-1}$ (bottom). Negative (positive) values are indicated by dashed (solid) lines. The non-divergent component of the flow is directed along the contours with speed proportional to the gradient. Thus, high (low) stream function corresponds to high (low) geopotential height in the Northern Hemisphere and to low (high) geopotential height in the Southern Hemisphere. Anomalies are departures from the 1979-1995 base period monthly means.



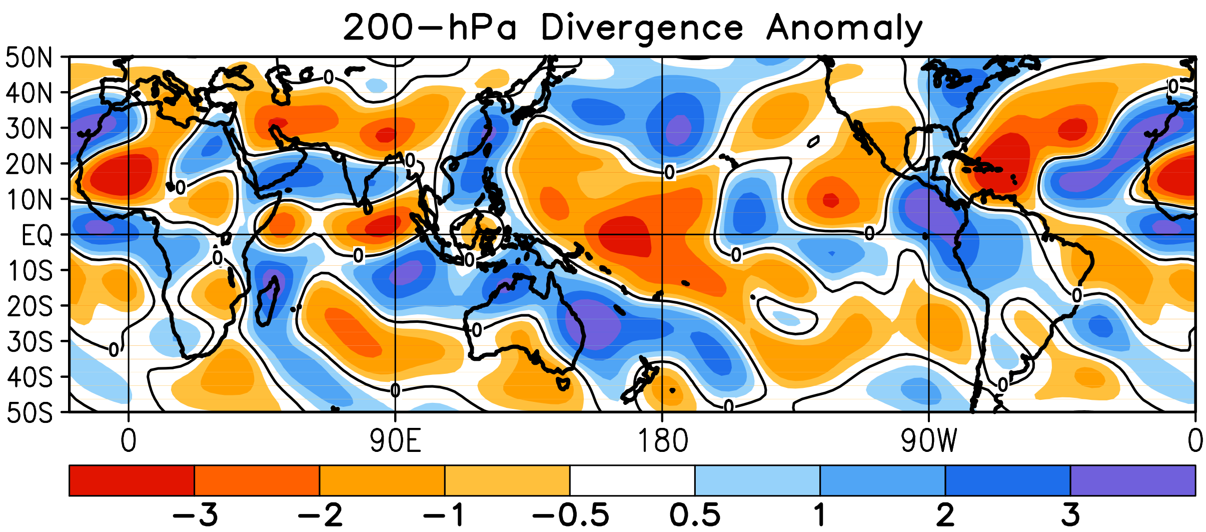




FIGURE T23. Mean (top) and anomalous (bottom) 200-hPa divergence (CDAS/Reanalysis). Divergence and anomalous divergence are shaded blue. Convergence and anomalous convergence are shaded orange. Anomalies are departures from the 1979-1995 base period monthly means.

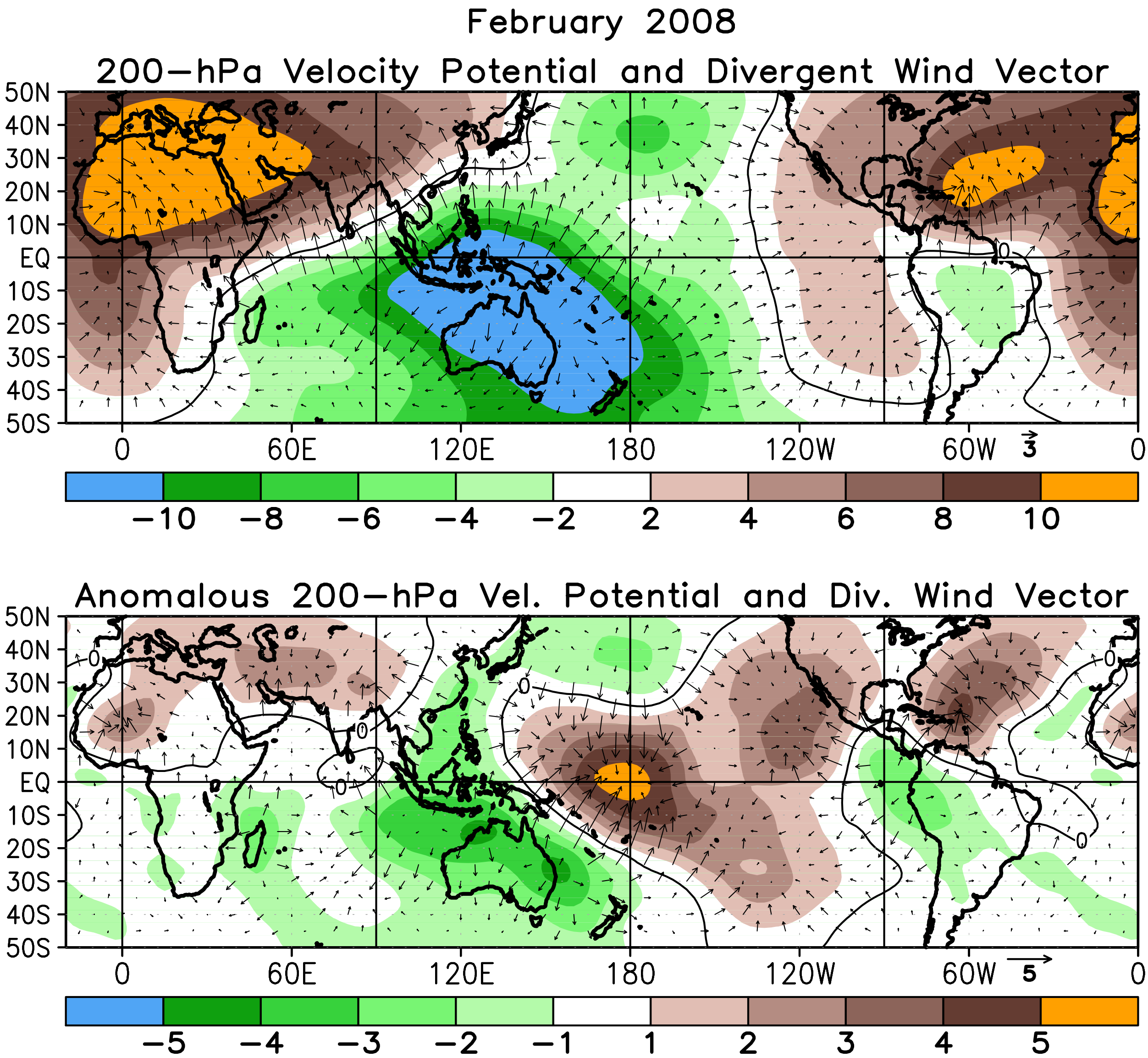



FIGURE T24. Mean (top) and anomalous (bottom) 200-hPa velocity potential ($10^6 m^2 s$) and divergent wind (CDAS/Reanalysis). Anomalies are departures from the 1979-1995 base period monthly means.

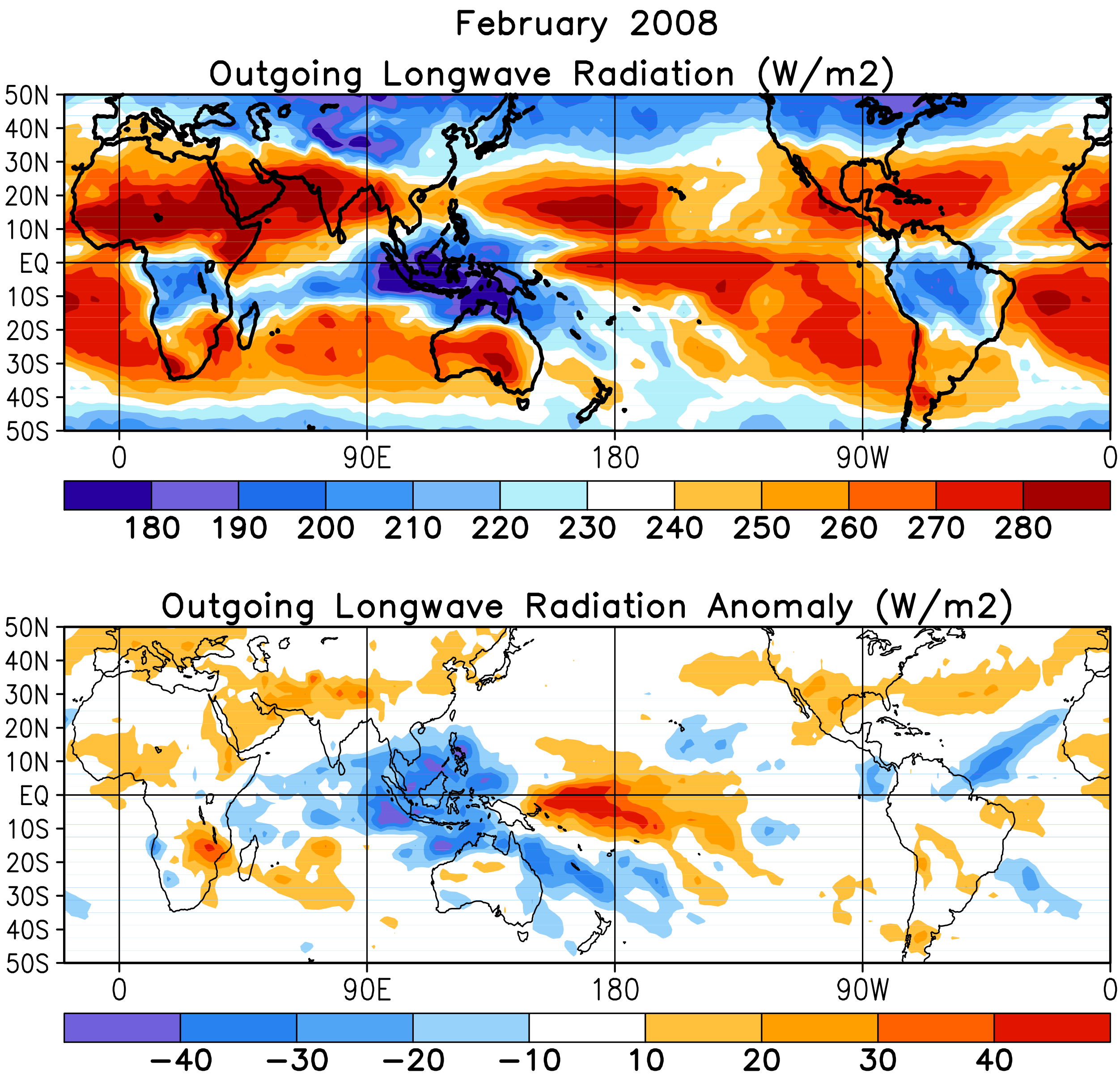



FIGURE T25. Mean (top) and anomalous (bottom) outgoing longwave radiation for FEB 2008 (NOAA 18 AVHRR IR window channel measurements by NESDIS/ORA). OLR contour interval is 20 $Wm^{-2}$ with values greater than 280 $Wm^{-2}$ indicated by dashed contours. Anomaly contour interval is 15 $Wm^{-2}$ with positive values indicated by dashed contours and light shading. Anomalies are departures from the 1979–95 base period monthly means.

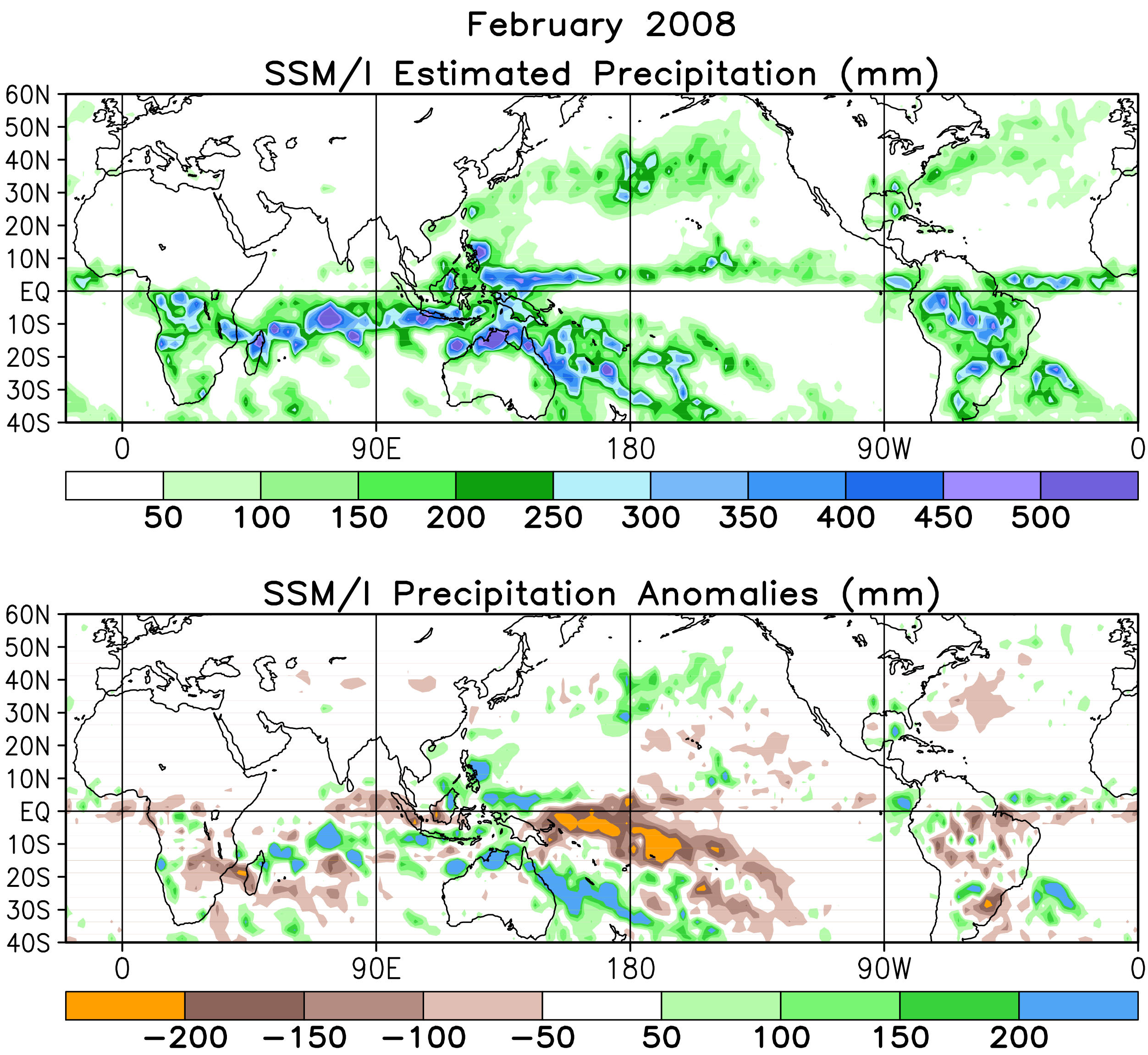



FIGURE T26. Estimated total (top) and anomalous (bottom) rainfall (mm) based on the Special Sensor Microwave/ Imager (SSM/I) precipitation index (Ferraro 1997, *J. Geophys. Res.*, **102**, 16715-16735). Anomalies are computed from the 1987-2006 base period monthly means. Anomalies have been smoothed for display purposes.

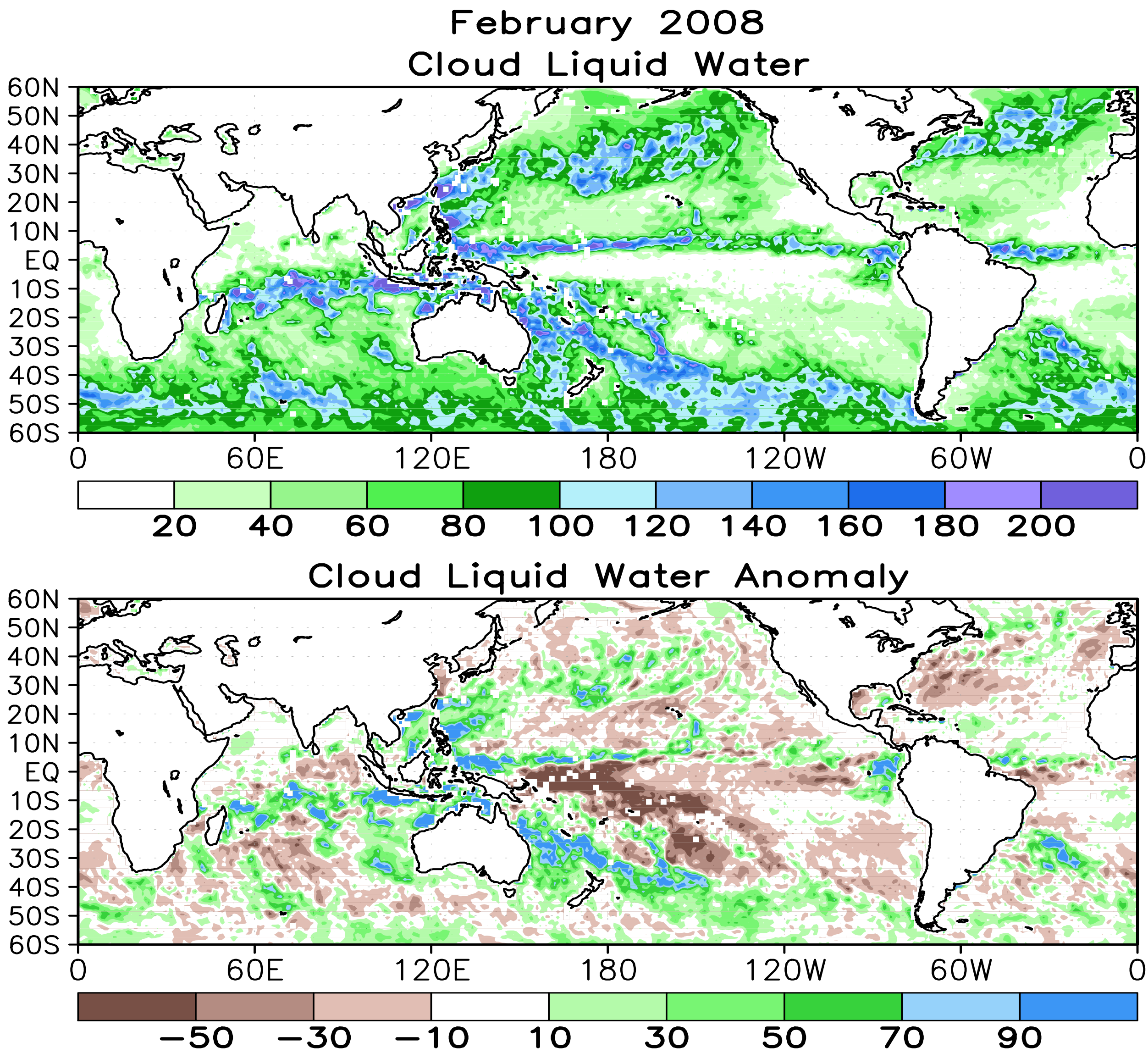



FIGURE T27. Mean (top) and anomalous (bottom) cloud liquid water (g m$^{-2}$) based on the Special Sensor Microwave/ Imager (SSM/I) (Weng et al 1997: *J. Climate*, **10**, 1086-1098). Anomalies are calculated from the 1987-2006 base period means.

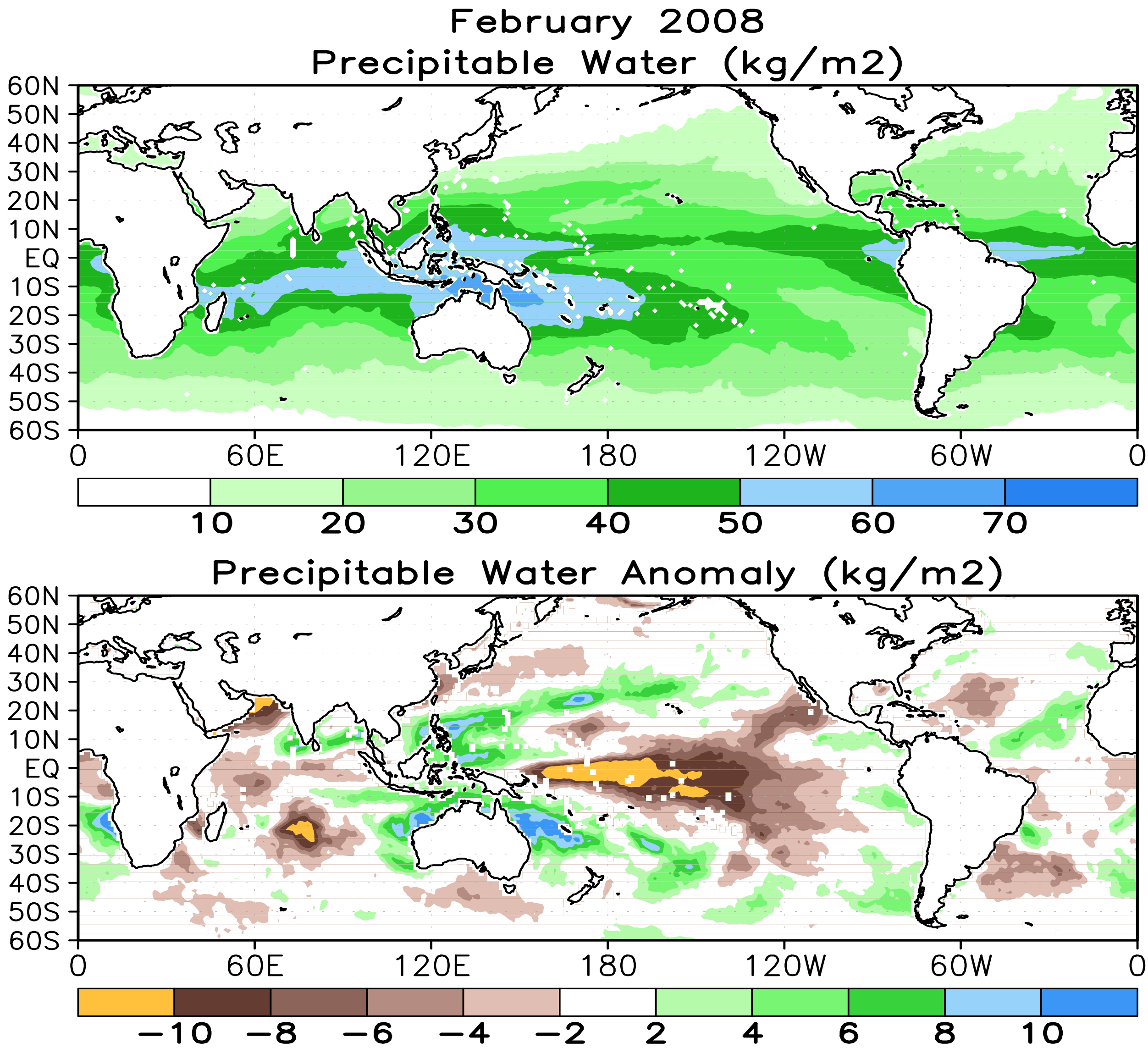



FIGURE T28. Mean (top) and anomalous (bottom) vertically integrated water vapor or precipitable water (kg m$^{-2}$) based on the Special Sensor Microwave/Imager (SSM/I) (Ferraro et. al, 1996: *Bull. Amer. Meteor. Soc.*, 77, 891-905). Anomalies are calculated from the 1987-2006 base period means.

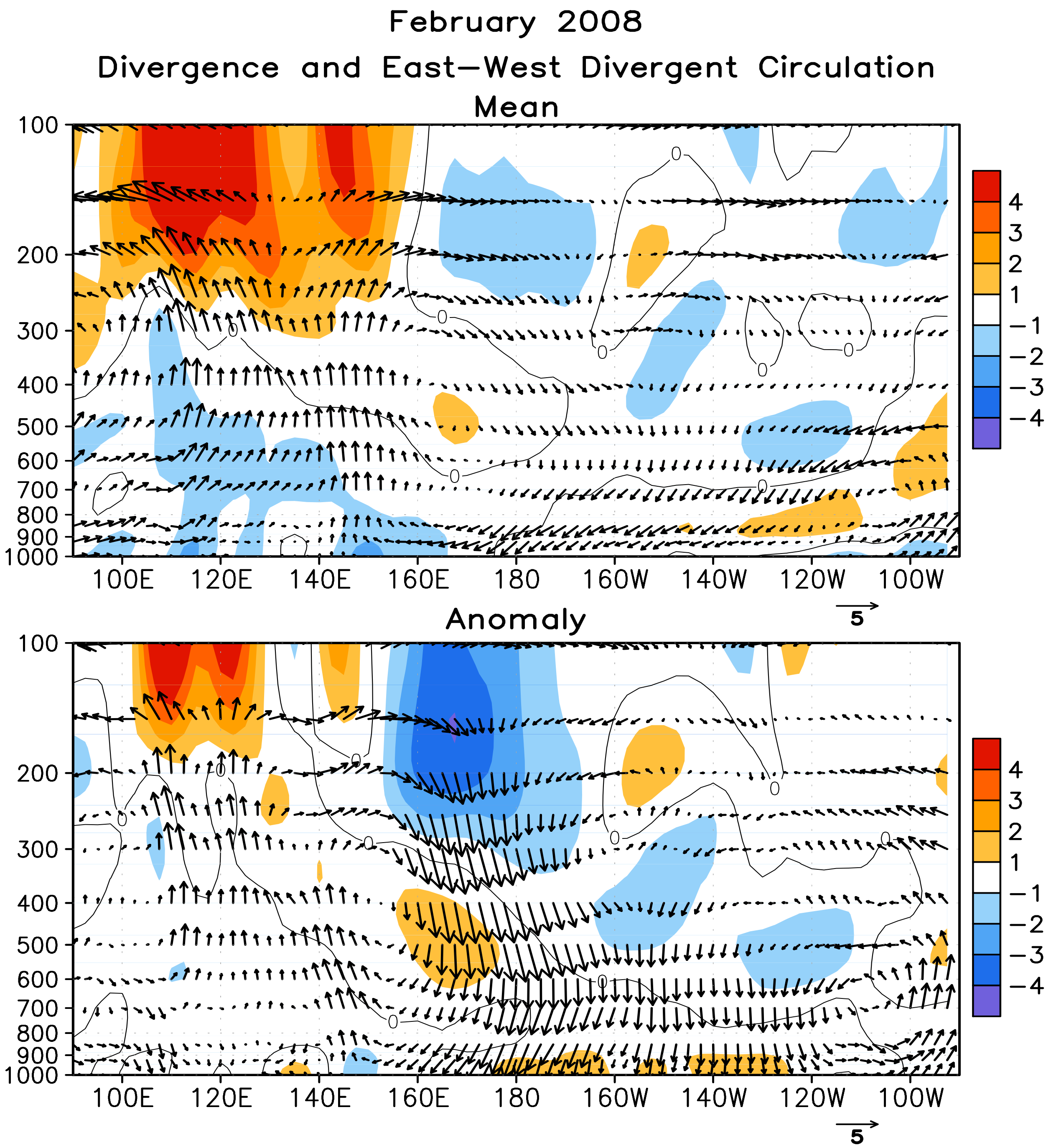



FIGURE T29. Pressure-longitude section (100E-80W) of the mean (top) and anomalous (bottom) divergence (contour interval is 1 x $10^{-6}$ $s^{-1}$) and divergent circulation averaged between 5N-5S. The divergent circulation is represented by vectors of combined pressure vertical velocity and the divergent component of the zonal wind. Red shading and solid contours denote divergence (top) and anomalous divergence (bottom). Blue shading and dashed contours denote convergence (top) and anomalous convergence (bottom). Anomalies are departures from the 1979-1995 base period monthly means.

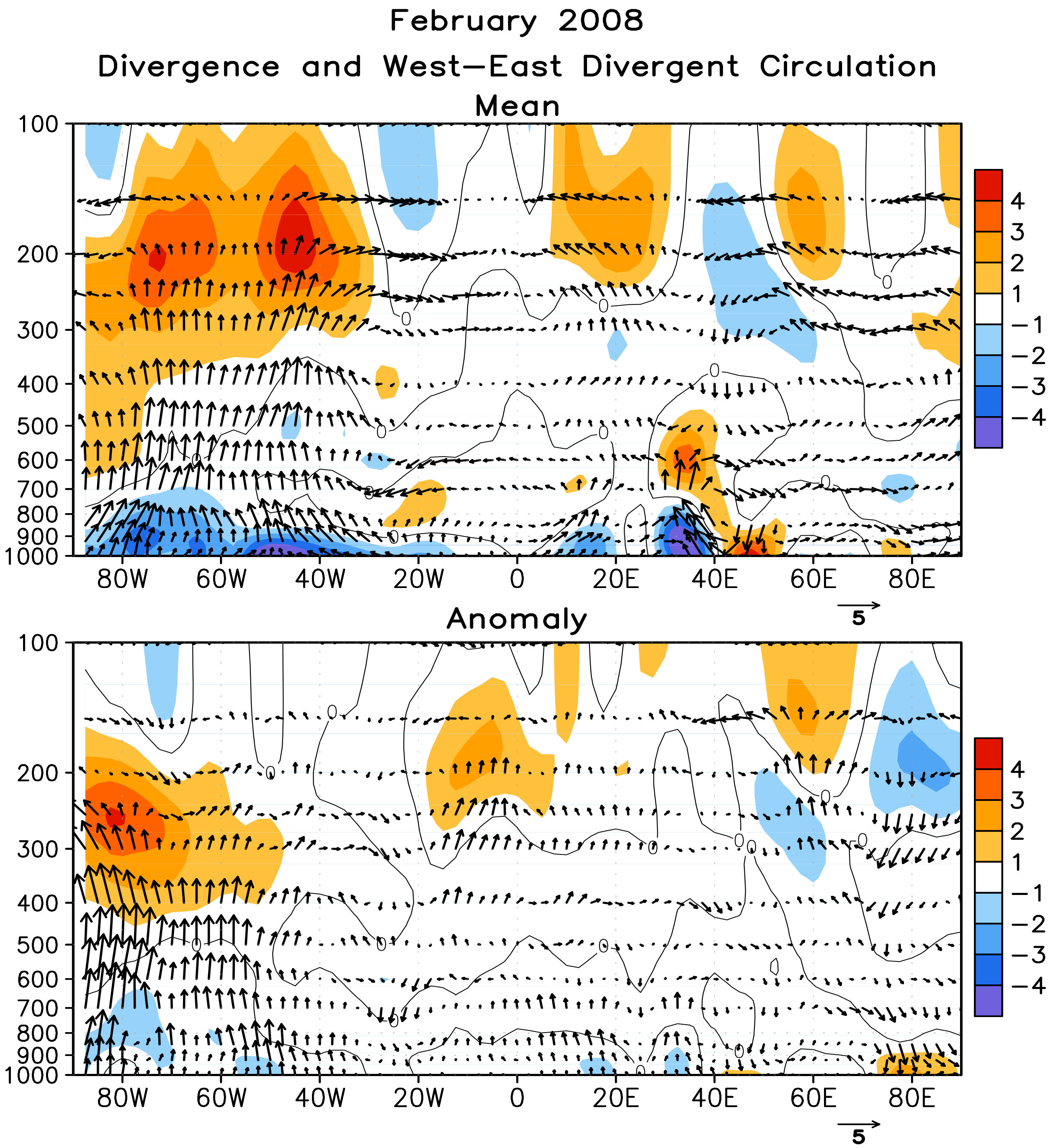



FIGURE T30. Pressure-longitude section (80W-100E) of the mean (top) and anomalous (bottom) divergence (contour interval is 1 x $10^{-6}$ $s^{-1}$) and divergent circulation averaged between 5N-5S. The divergent circulation is represented by vectors of combined pressure vertical velocity and the divergent component of the zonal wind. Red shading and solid contours denote divergence (top) and anomalous divergence (bottom). Blue shading and dashed contours denote convergence (top) and anomalous convergence (bottom). Anomalies are departures from the 1979-1995 base period monthly means.

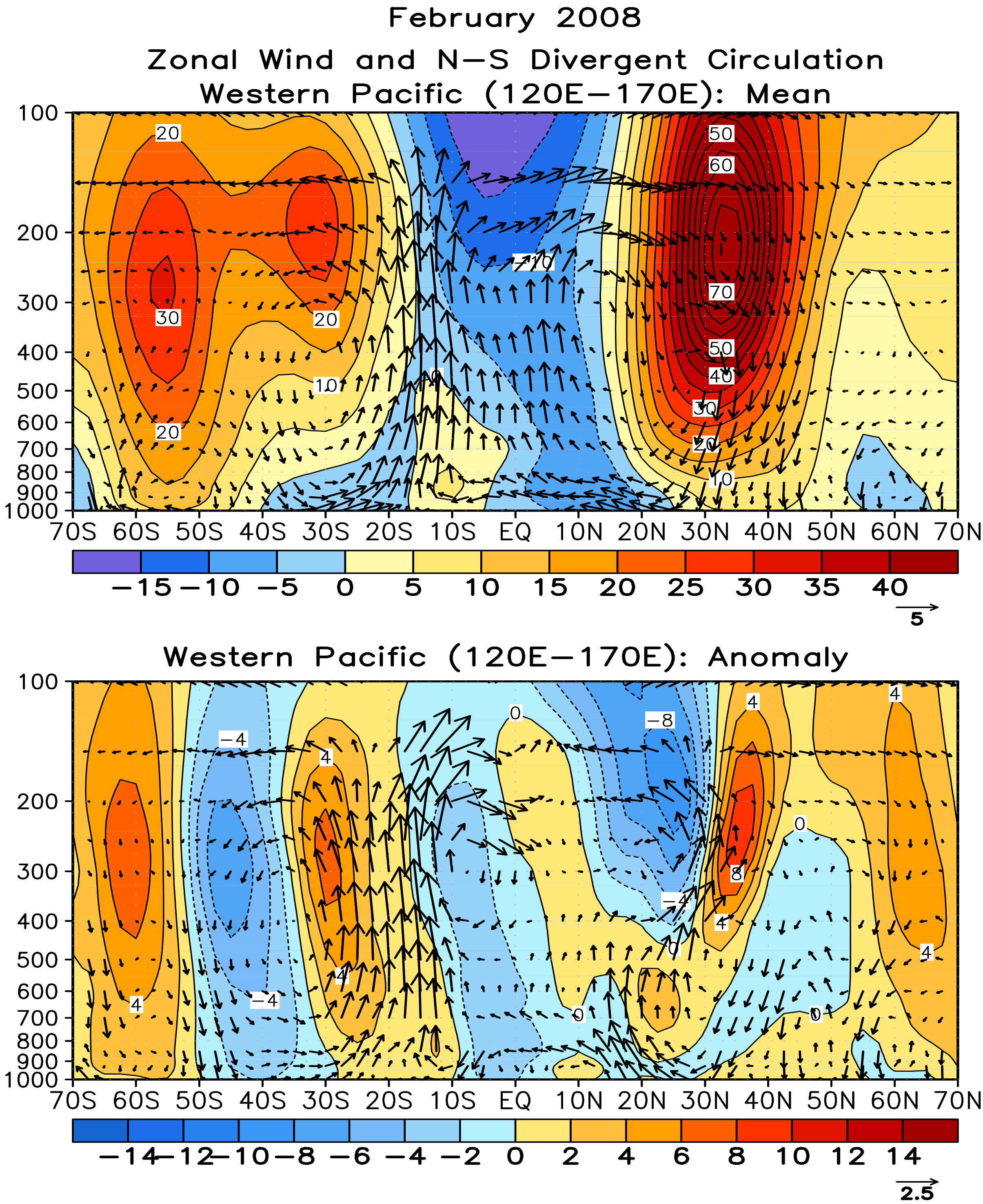



FIGURE T31. Pressure-latitude section of the mean (top) and anomalous (bottom) zonal wind (m $s^{-1}$) and divergent circulation averaged over the west Pacific sector (120E-170E). The divergent circulation is represented by vectors of combined pressure vertical velocity and the divergent component of the meridional wind. Red shading and solid contours denote a westerly (top) or anomalous westerly (bottom) zonal wind. Blue shading and dashed contours denote an easterly (top) or anomalous easterly (bottom) zonal wind. Anomalies are departures from the 1979-1995 base period monthly means.

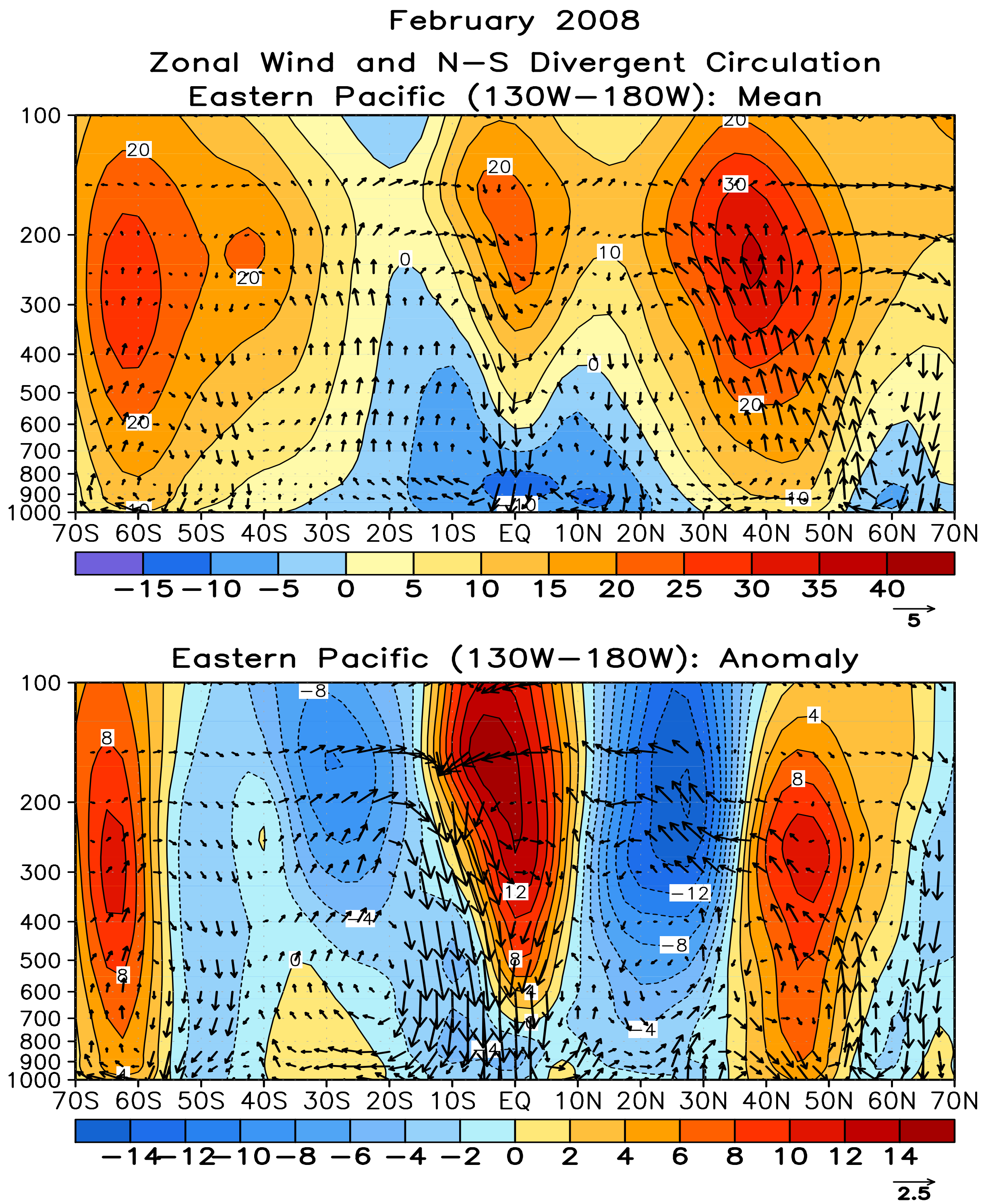



FIGURE T32. Pressure-latitude section of the mean (top) and anomalous (bottom) zonal wind ($m\ s^{-1}$) and divergent circulation averaged over the central Pacific sector (130W-180W). The divergent circulation is represented by vectors of combined pressure vertical velocity and the divergent component of the meridional wind. Red shading and solid contours denote a westerly (top) or anomalous westerly (bottom) zonal wind. Blue shading and dashed contours denote an easterly (top) or anomalous easterly (bottom) zonal wind. Anomalies are departures from the 1979-1995 base period monthly means.

During February 2008, 288 satellite-tracked surface drifting buoys, 77% with subsurface drogues attached for measuring mixed layer currents, were reporting from the tropical Pacific. Westward anomalies were observed throughout most of the tropical Pacific basin, except in the latitude band 0-5N. Anomalies were 20-30 cm/s westward between 9 and 10N, a persistent feature in the last several months; they averaged 5-10 cm/s westward south of the equator. Eastward anomalies of 20 cm/s were measured by several drifters between 0-5N, 140-160W. Cold SST anomalies (-0.5 to -3.0C) persisted across the basin between 10S and 15N, while most drifters south of 10S and west of 140E measured SST near normal February values. Warm anomalies of +0.5 to +3.0C were common in the region 120E-160W, 20-30N, and spanned the Pacific basin south of 20S.

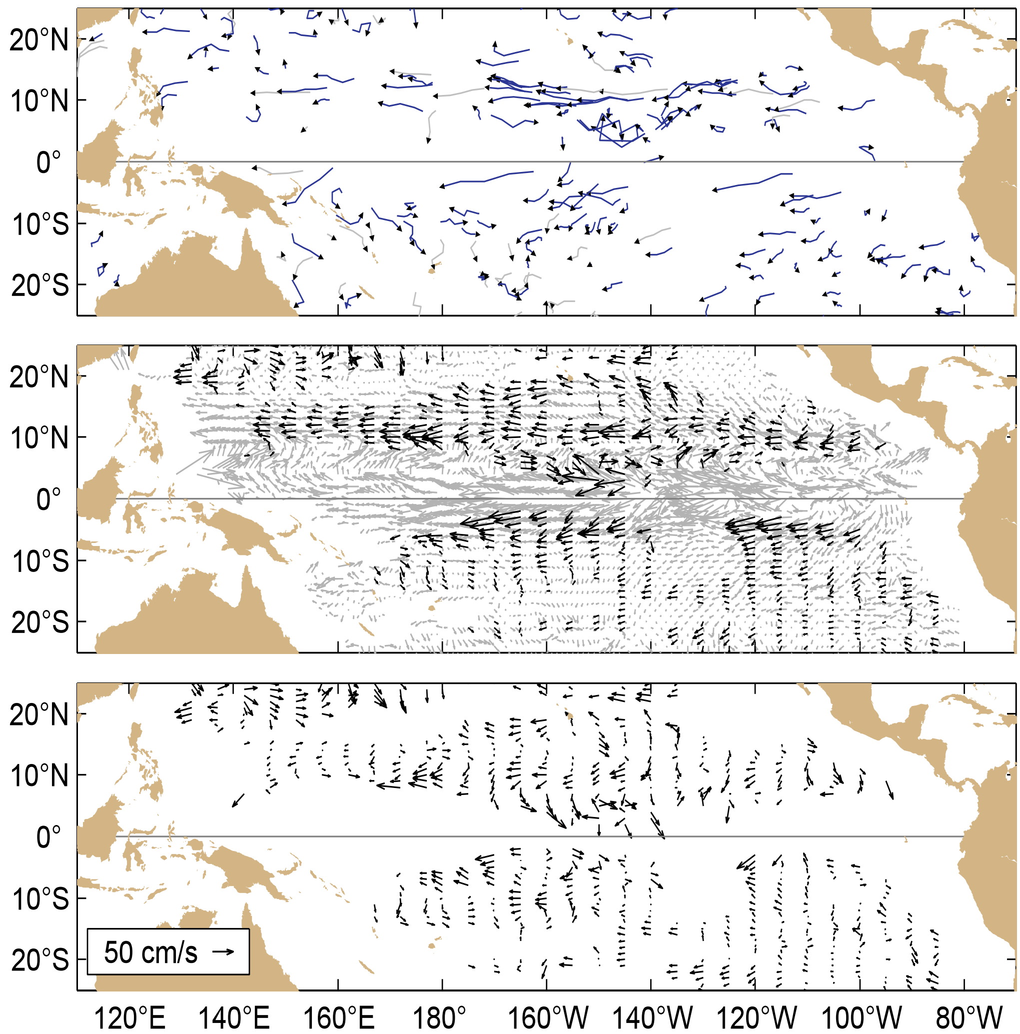



**Figure A1.1 Top:** Movements of drifting buoys in the tropical Pacific Ocean during February 2008. The linear segments of each trajectory represent a one week displacement. Trajectories of buoys which have lost their subsurface drogues are gray; those with drogues are black.
**Middle:** Monthly mean currents calculated from all buoys 1993-2002 (gray), and currents measured by the drogued buoys this month (black) smoothed by an optimal filter.
**Bottom:** Anomalies from the climatological monthly mean currents for this month.

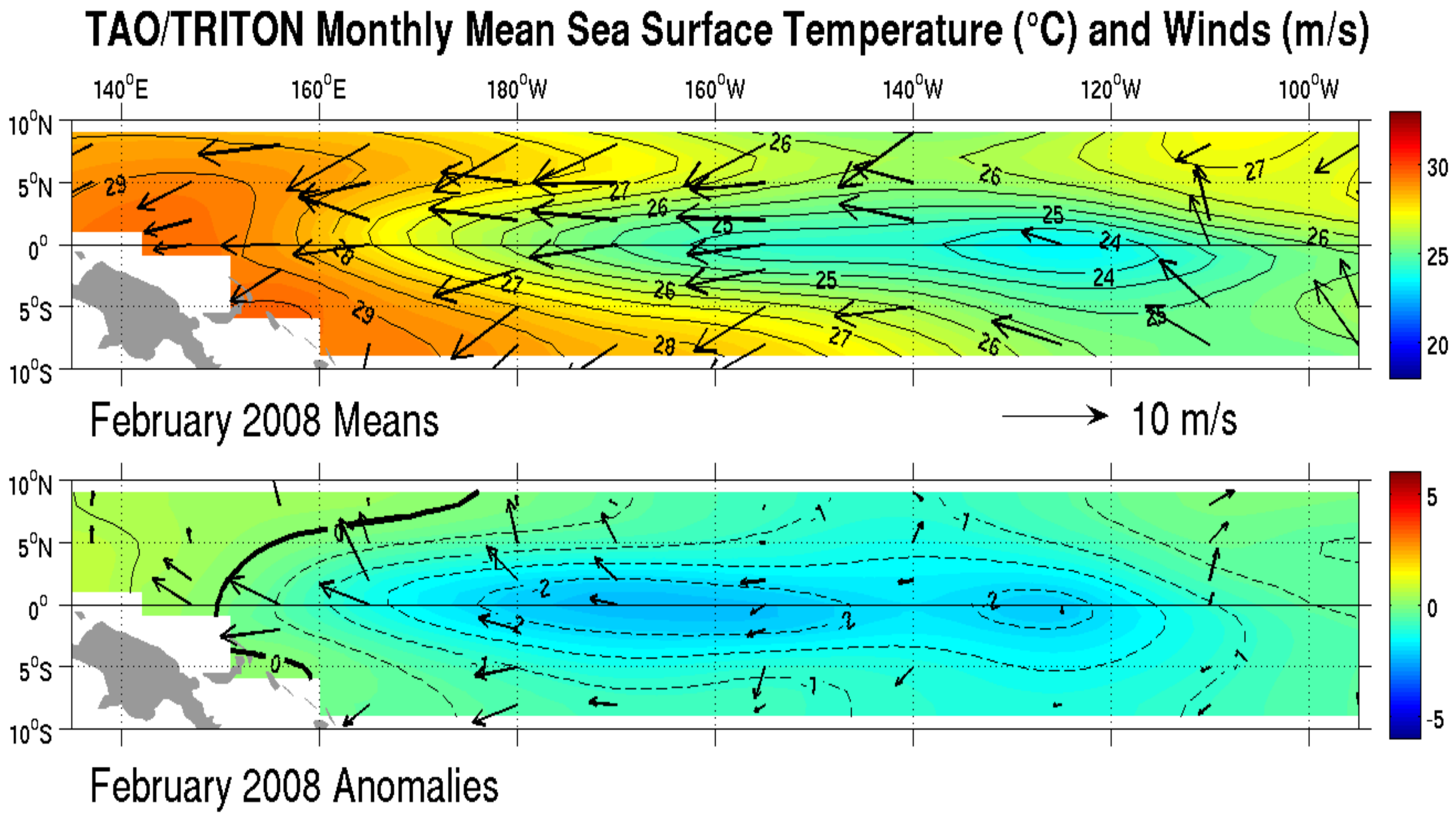



FIGURE A1.2. Wind Vectors and sea surface temperature (SSTs) from the TAO/TRITON mooring array. Top panel shows monthly means; bottom panel shows monthly anomalies from the COADS wind climatology and Reynolds SST climatology (1971-2000). The TAO/TRITON array is presently supported by the United States (NOAA), Japan (STA), and France (IRD). Further information is available from Richard L. Crout (NOAA/NDBC).

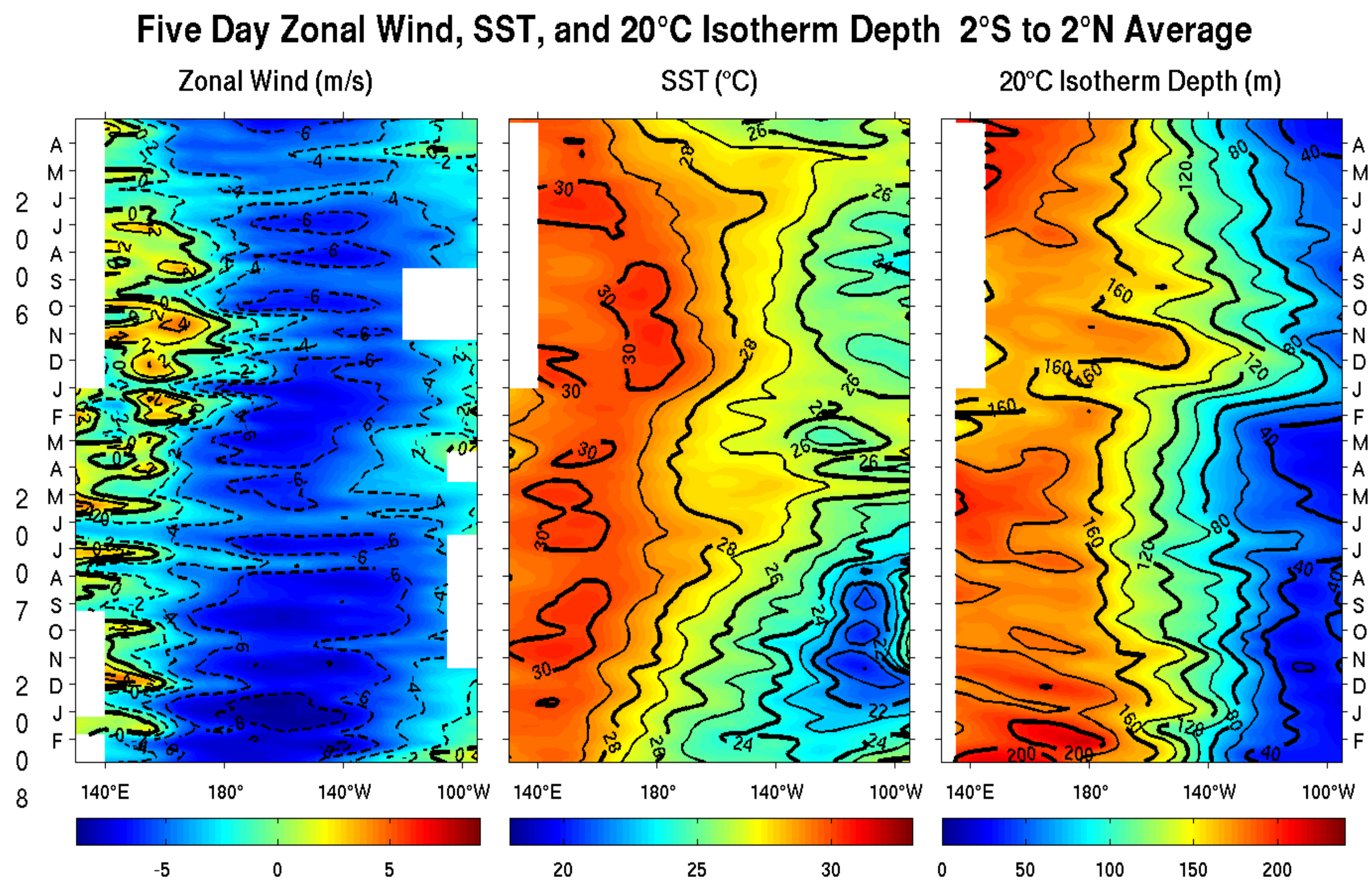



FIGURE A1.3. Time-longitude sections of surface zonal winds (m s$^{-1}$), sea surface temperature (C) and 20C isotherm depth (m) for the past 24 months. Analysis is based on 5-day averages of moored time series data from the TAO/TRITON array. Positive winds are westerly. Squares on the abscissas indicate longitude where data were available at the start of the time series (top) and end of the time series (bottom). The TAO/TRITON array is presently supported by the United States (NOAA), Japan (STA), and France (IRD). Further information is available from Richard L. Crout (NOAA/NDBC)

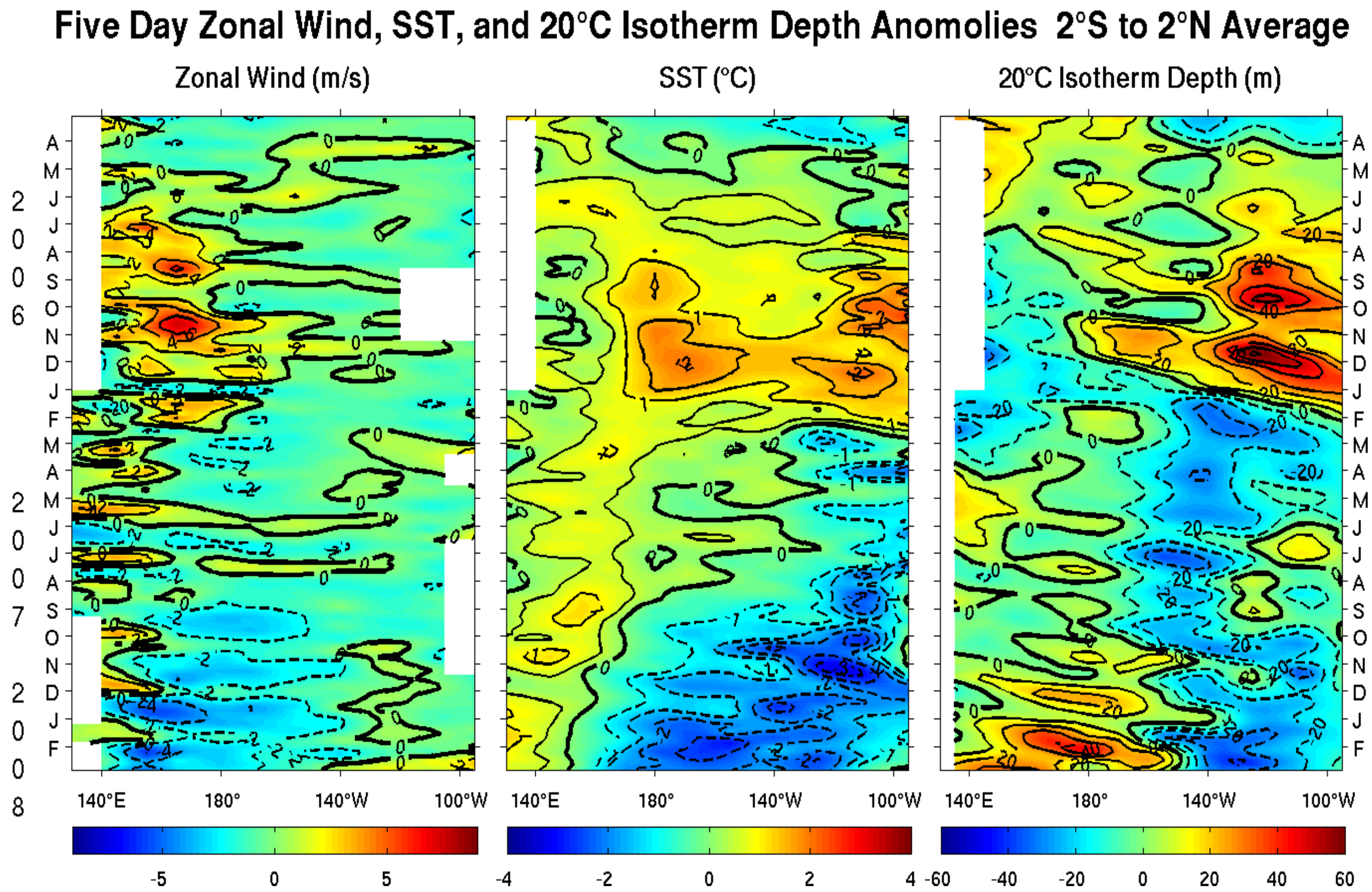



FIGURE A1.4. Time-longitude sections of surface zonal winds (m $s^{-1}$), sea surface temperature (C) and 20C isotherm depth (m) for the past 24 months. Analysis is based on 5-day averages of moored time series data from the TAO/TRITON array. Anomalies are relative to monthly climatologis cubic spline fitted to 5-day intervals (COADS winds, Reynolds SST, CTD/XBT 20C depth). Positive winds are westerly. Squares on the abscissas indicate longitude where data were available at the start of the time series (top) and end of the time series (bottom). The TAO/TRITON array is presently supported by the United States (NOAA), Japan (STA), and France (IRD). Further information is available from Richard L. Crout (NOAA/

# Sea Surface Temperature and Sea Level From Eastern Pacific GOES Stations

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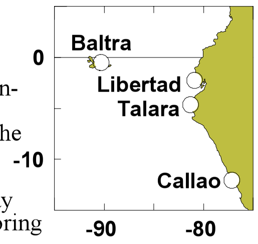


In cooperation with institutions in Peru and Ecuador, NOAA-AOML maintained a network coastal stations reporting SST and sea level in real time (via satellite downlink) during the TOGA program, from 1985 to 1995. The South American partners took over full operational responsibility thereafter while NOAA-AOML assumed a data management role, continuing publication of these monthly reports along with their partners. The five-day averages (pentads)at critical stations give us an effective means of monitoring coastal conditions with good time resolution and compact data volume.

Thanks to another intraseasonal Kelvin wave pulse arriving at the end of February, coastal SSTs and sea levels are once again rising from negative anomalies toward normal along the Peru coast. With warmer water upwelling near the coast, cooler water still offshore, and the onshore winds typical of the rainy season, Ecuador can probably expect continued unstable atmospheric conditions through March.

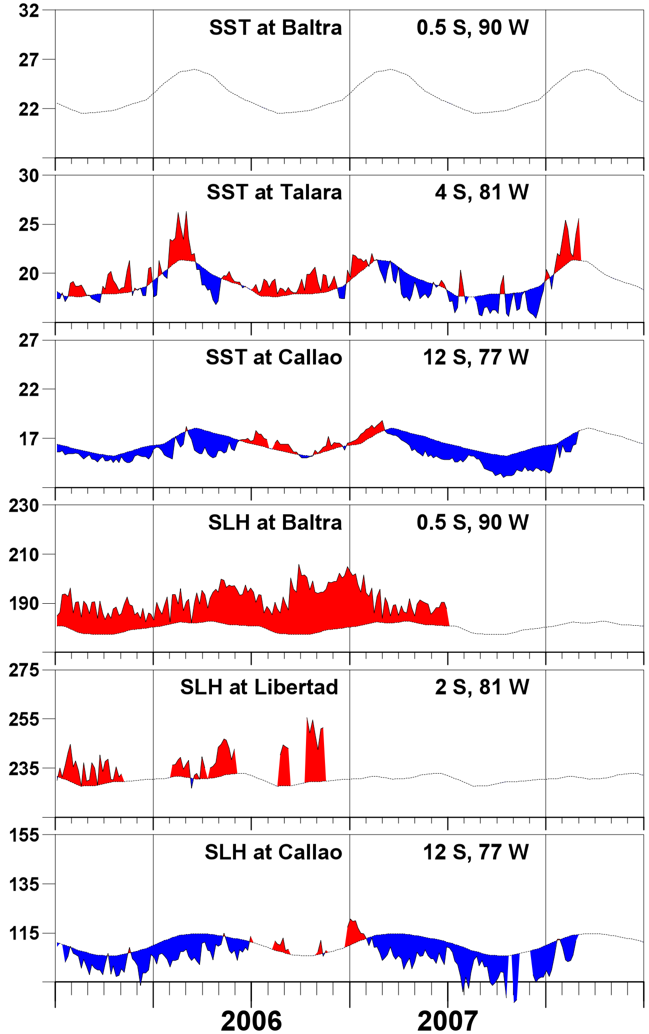


FIGURE A1.5. Five-day averages of sea surface temperature (SST,°C) and sea level height (SLH,cm) from GOES receiving stations in Ecuador & Peru. Dashed line and shading show climatology, departures.

| | Sea Sfc Temperature | | | Sea Level Height | | |
|---|---|---|---|---|---|---|
| FEB | Baltra | Talara | Callao | Baltra | Libertad | Callao |
| 2 | ** | 25.4 | 15.6 | ** | ** | 104.1 |
| 7 | ** | 24.5 | 15.6 | ** | ** | 103.2 |
| 12 | ** | 22.1 | 15.6 | ** | ** | 103.7 |
| 17 | ** | 21.7 | 16.3 | ** | ** | 106.0 |
| 22 | ** | 24.0 | 16.4 | ** | ** | 111.8 |
| 27 | ** | 25.6 | 17.8 | ** | ** | ** |

Anomalies

| FEB | Baltra | Talara | Callao | Baltra | Libertad | Callao |
|---|---|---|---|---|---|---|
| 2 | ** | 4.6 | -1.4 | ** | ** | -9.0 |
| 7 | ** | 3.4 | -1.5 | ** | ** | -10.3 |
| 12 | ** | 0.8 | -1.7 | ** | ** | -10.2 |
| 17 | ** | 0.3 | -1.2 | ** | ** | -8.1 |
| 22 | ** | 2.7 | -1.2 | ** | ** | -2.4 |
| 27 | ** | 4.3 | 0.1 | ** | ** | ** |

Email: David.Enfield@noaa.gov; Phone: (305) 361-4351; Fax: (305) 361-4392
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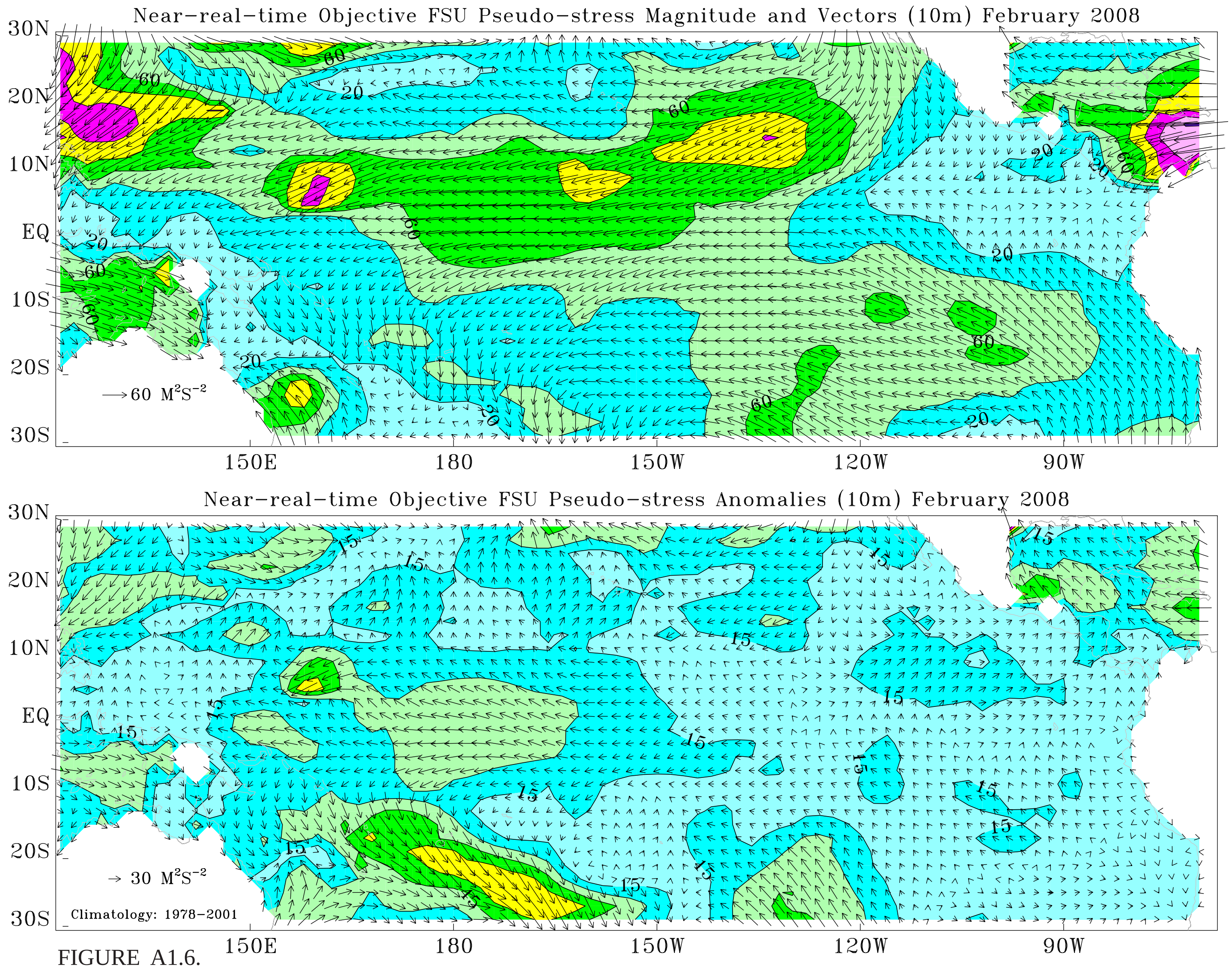
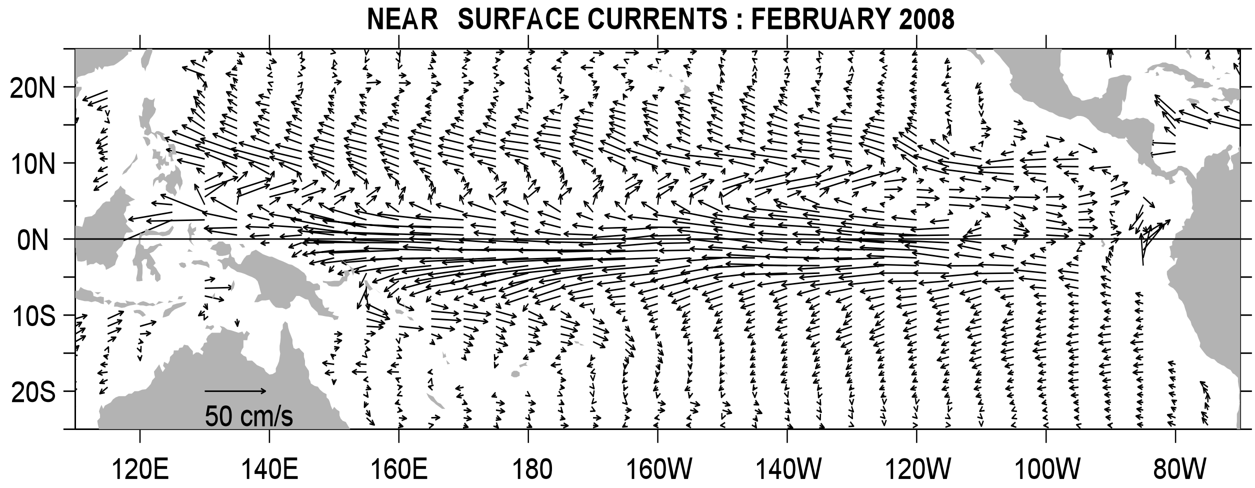



FIGURE A1.6.

FSU SURFACE PSEUDO-STRESS VECTORS AND ANOMALIES: February 2008. Pseudo-stress vectors (top) are objectively analyzed from ship and buoy winds on a 2° grid. Ship and buoy data are independently weighted and the background field is created from the data. Contour interval of the vector magnitudes is 20 $M^2S^{-2}$. Anomalies (bottom) are departures from 1978–2001 mean. The contour interval is 15 $M^2S^{-2}$. For more information, please visit our web site at http://www.coaps.fsu.edu/RVSMDC/html/winds.shtml. Produced by Jeremy Rolph, Mark A. Bourassa, and Shawn R. Smith, Center for Ocean-Atmospheric Prediction Studies, Florida State University, Tallahassee, FL 32306-2840, USA.



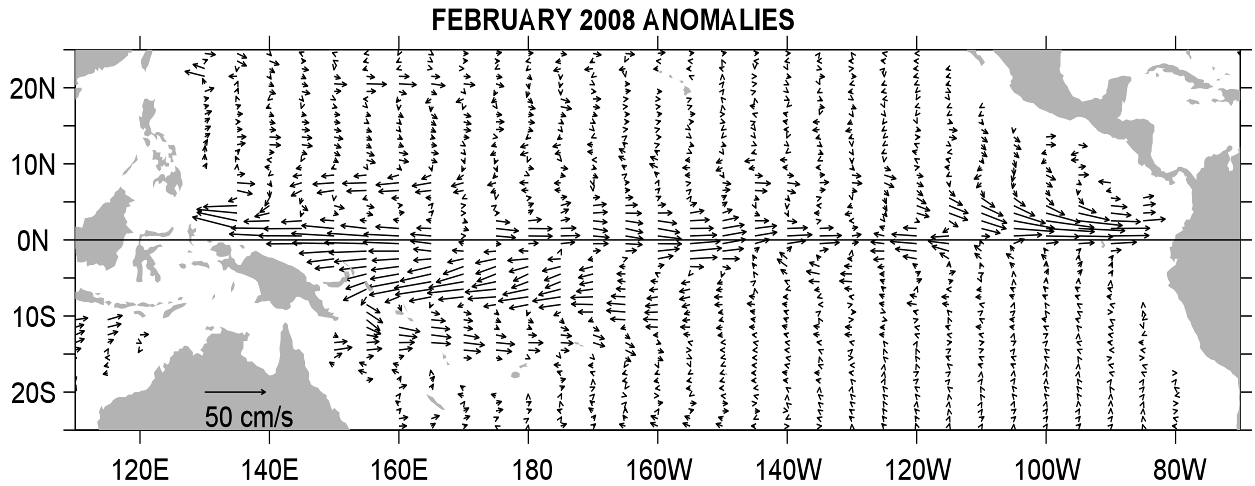




FIGURE A1.7. Ocean Surface Current Analysis-Real-time (OSCAR) for FEB 2008 (Bonjean and Lagerloef 2002, J. Phys. Oceanogr., Vol. 32, No. 10, 2938-2954; Lagerloef et al. 1999, JGR-Oceans, 104, 23313-23326). (top) Total velocity. Satellite data included FEB 2008 Jason sea level anomalies and QuickScat winds. Data were smoothed with optimal filter (Lx~10°, Ly~2°). (bottom) Velocity anomalies. The subtracted climatology was based on SSM/I and QuickScat winds and Topex/Poseidon and Jason from 1993-2003. See also http://www.oscar.noaa.gov.

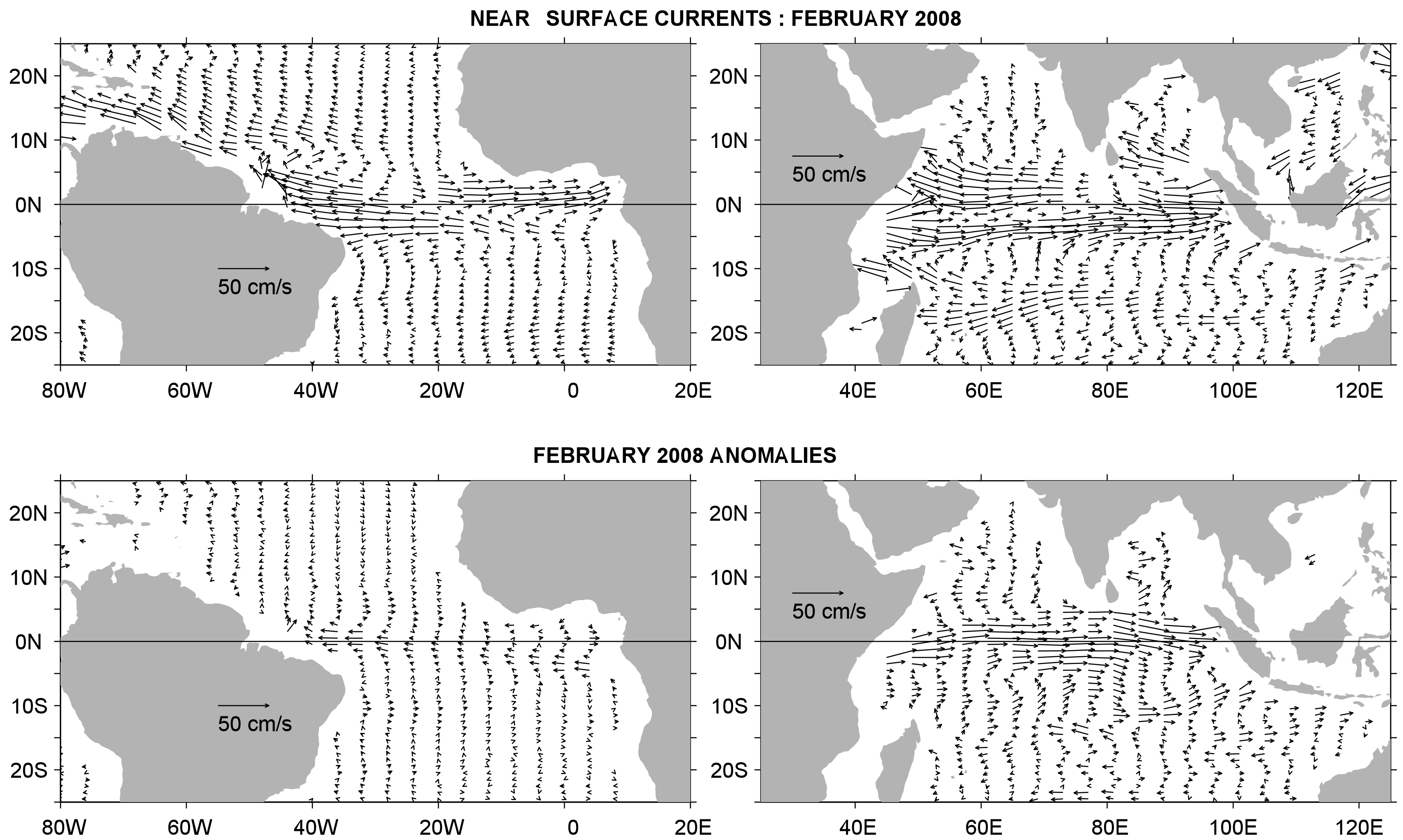



FIGURE A1.8. Ocean Surface Current Analysis-Real-time (OSCAR) for FEB 2008 (Bonjean and Lagerloef 2002, J. Phys. Oceanogr., Vol. 32, No. 10, 2938-2954; Lagerloef et al. 1999, JGR-Oceans, 104, 23313-23326). (top) Total velocity. Satellite data included FEB 2008 Jason sea level anomalies and QuickScat winds. Data were smoothed with optimal filter (Lx~10°, Ly~2°). (bottom) Velocity anomalies. The subtracted climatology was based on SSM/I and QuickScat winds and Topex/Poseidon and Jason from 1993-2003. See also http://www.oscar.noaa.gov.

## Forecast Forum

The canonical correlation analysis (CCA) forecast of SST in the central Pacific (Barnett et al. 1988, *Science*, **241**, 192196; Barnston and Ropelewski 1992, *J. Climate*, **5**, 13161345), is shown in **Figs. F1 and F2.** This forecast is produced routinely by the Prediction Branch of the Climate Prediction Center. The predictions from the National Centers for Environmental Prediction (NCEP) Coupled Forecast System Model (CFS03) are presented in **Figs. F3 and F4a, F4b**. Predictions from the Markov model (Xue, et al. 2000: *J. Climate*, **13**, 849871) are shown in **Figs. F5 and F6.** Predictions from the latest version of the LDEO model (Chen et al. 2000: *Geophys. Res. Let*., **27**, 25852587) are shown in **Figs. F7 and F8**. Predictions using linear inverse modeling (Penland and Magorian 1993: *J. Climate,* **6**, 10671076) are shown in **Figs. F9 and F10.** Predictions from the Scripps / Max Planck Institute (MPI) hybrid coupled model (Barnett et al. 1993: *J. Climate*, **6**, 15451566) are shown in **Fig. F11.** Predictions from the ENSOCLIPER statistical model (Knaff and Landsea 1997, *Wea. Forecasting*, **12**, 633652) are shown in **Fig. F12.** Niño 3.4 predictions are summarized in **Fig. F13**, provided by the Forecasting and Prediction Research Group of the IRI.

The CPC and the contributors to the **Forecast Forum** caution potential users of this predictive information that they can expect only modest skill.

## Outlook

La Niña is expected to continue through the Northern Hemisphere spring 2008.

## Discussion

Atmospheric and oceanic conditions during February 2008 continued to reflect a strong La Niña. Equatorial SSTs were more than 2.0°C below average across large portions of the central and east-central equatorial Pacific (**Fig. T18**), and the corresponding monthly values of the Niño-4 and Niño-3.4 indices were -1.6°C and -1.9°C, respectively (**Table T2**). In contrast, SSTs in the far eastern equatorial Pacific were above average in association with a warming trend that began in mid-December. The upper-ocean heat content (average temperatures in the upper 300m of the oceans between 180° - 100°W) remained below average across the equatorial Pacific during February, with the largest temperature anomalies averaging -2°C to -5°C at thermocline depth (**Fig. T17**). Consistent with these oceanic conditions, stronger-than-average low-level easterly winds and upper-level westerly winds persisted across the central equatorial Pacific (**Figs. T20 and T21)**, convection remained suppressed throughout the central equatorial Pacific, and enhanced convection covered the far western Pacific (**Fig. T25**). Collectively, these oceanic and atmospheric conditions are similar to those accompanying the last strong La Niña episode during 1998-2000.

The most recent dynamical and statistical SST forecasts for the Niño 3.4 region continue to indicate a moderate-to-strong La Niña through March 2008, and a weaker La Niña through April-May-June 2008 (**Figs. F1-F13**). Thereafter, there is considerable spread in the forecasts, with approximately one-half indicating that La Niña could continue into the Northern Hemisphere fall. Current atmospheric and oceanic conditions and recent observed trends support the likely continuation of La Niña through the Northern Hemisphere spring 2008.

Weekly updates of oceanic and atmospheric conditions are available on the Climate Prediction Center homepage (El Niño/La Niña Current Conditions and Expert Discussions).

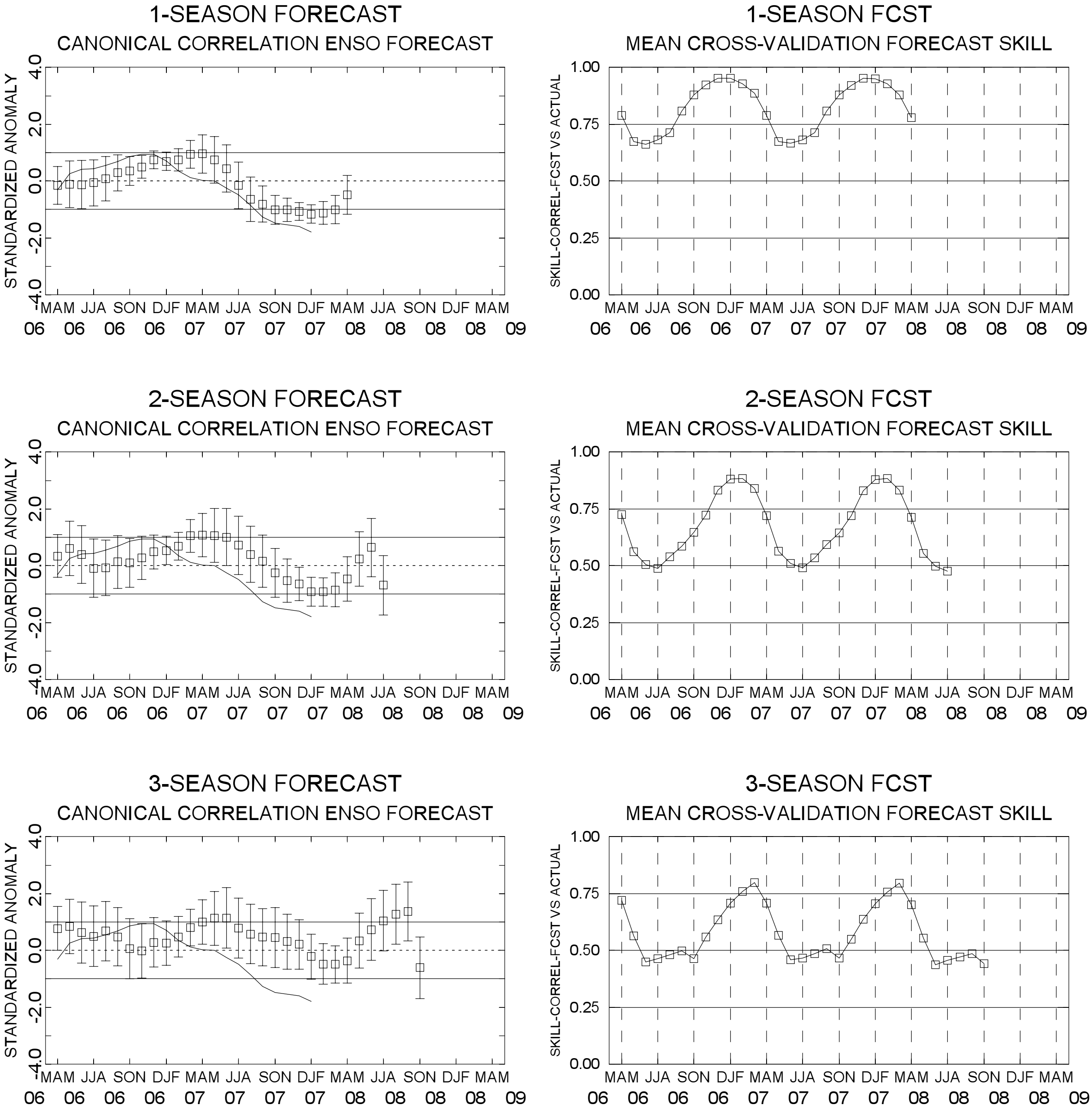



FIGURE F1. Canonical correlation analysis (CCA) sea surface temperature (SST) anomaly prediction for the central Pacific (5˚N to 5˚S, 120˚W to 170˚W (Barnston and Ropelewski, 1992, *J. Climate*, **5**, 1316-1345). The three plots on the left hand side are, from top to bottom, the 1-season, 2-season, and 3-season lead forecasts. The solid line in each forecast represents the observed SST standardized anomaly through the latest month. The small squares at the mid-points of the forecast bars represent the real-time CCA predictions based on the anomalies of quasi-global sea level pressure and on the anomalies of tropical Pacific SST, depth of the 20˚C isotherm and sea level height over the prior four seasons. The vertical lines represent the one standard deviation error bars for the predictions based on past performance. The three plots on the right side are skills, corresponding to the predicted and observed SST. The skills are derived from cross-correlation tests from 1956 to present. These skills show a clear annual cycle and are inversely proportional to the length of the error bars depicted in the forecast time series.

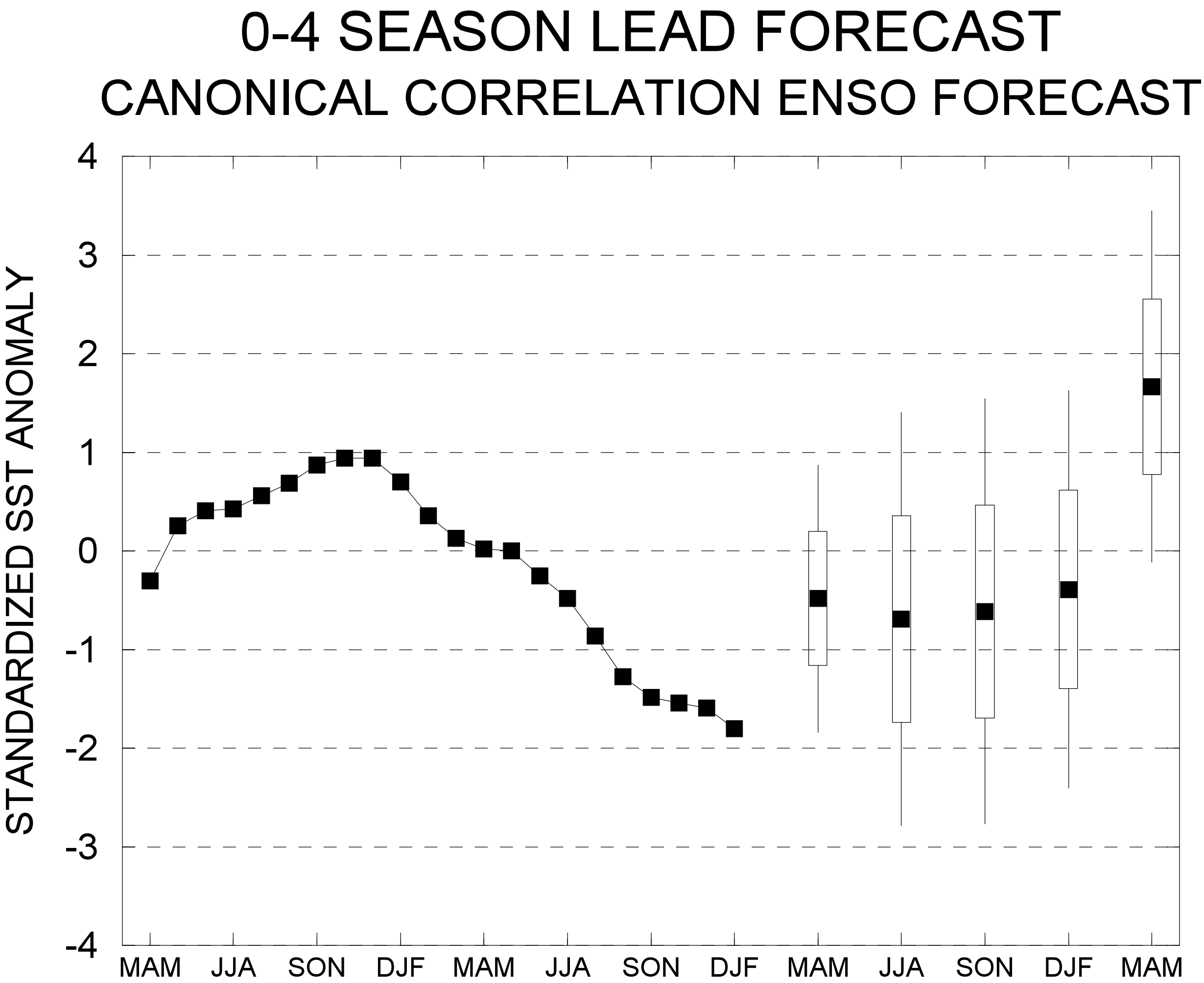



FIGURE F2. Canonical Correlation Analysis (CCA) forecasts of sea-surface temperature anomalies for the Nino 3.4 region (5N-5S, 120W-170W) for the upcoming five consecutive 3-month periods. Forecasts are expressed as standardized SST anomalies. The CCA predictions are based on anomaly patterns of SST, depth of the 20C isotherm, sea level height, and sea level pressure. Small squares at the midpoints of the vertical forecast bars represent the CCA predictions, and the bars show the one (thick) and two (thin) standard deviation errors. The solid continuous line represents the observed standardized three-month mean SST anomaly in the Nino 3.4 region up to the most recently available data.

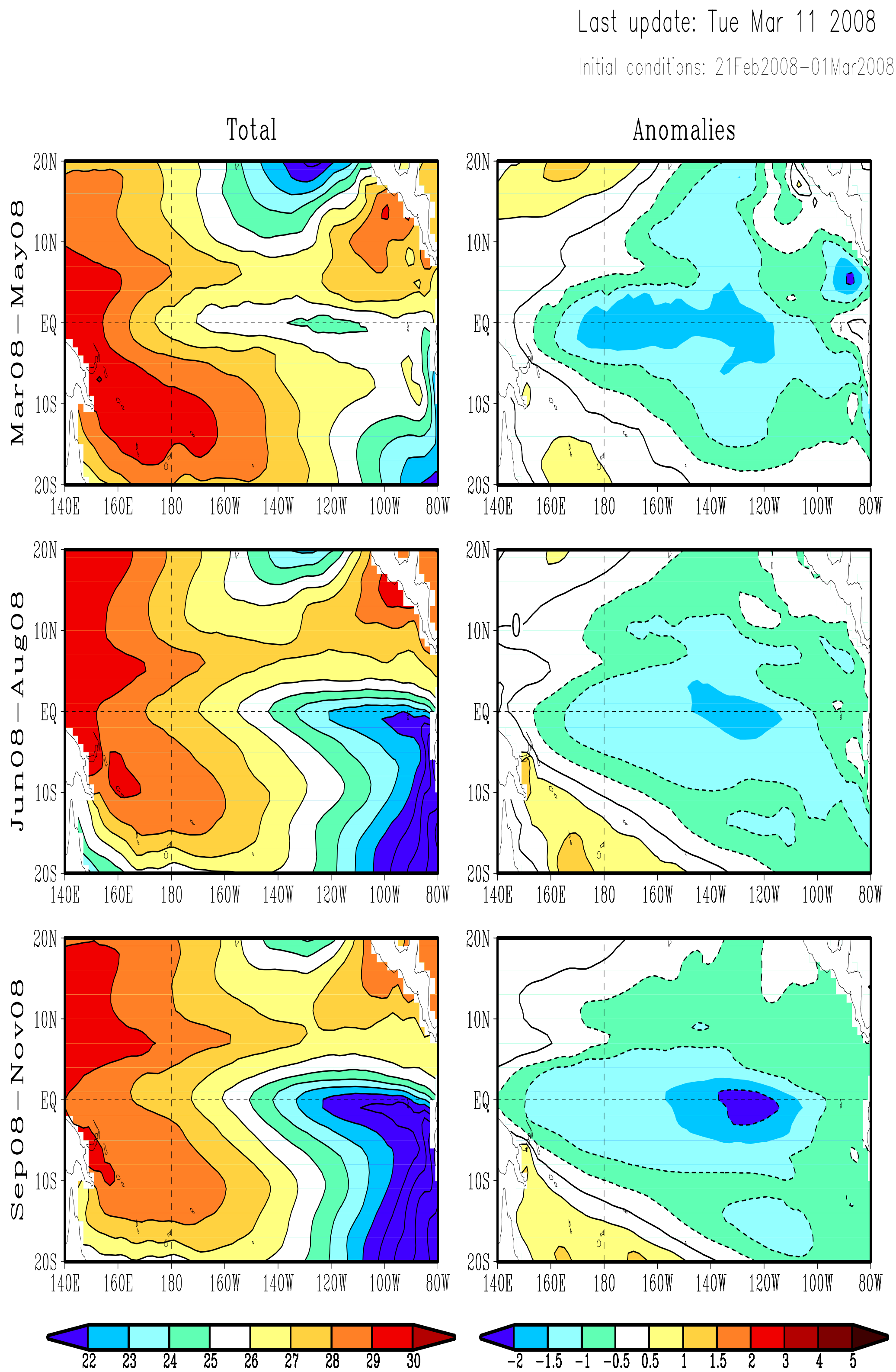



FIGURE F3. Predicted 3-month average sea surface temperature (left) and anomalies (right) from the NCEP Coupled Forecast System Model (CFS03). The forecasts consist of 40 forecast members. Contour interval is 1°C, with additional contours for 0.5°C and -0.5°C. Negative anomalies are indicated by dashed contours.

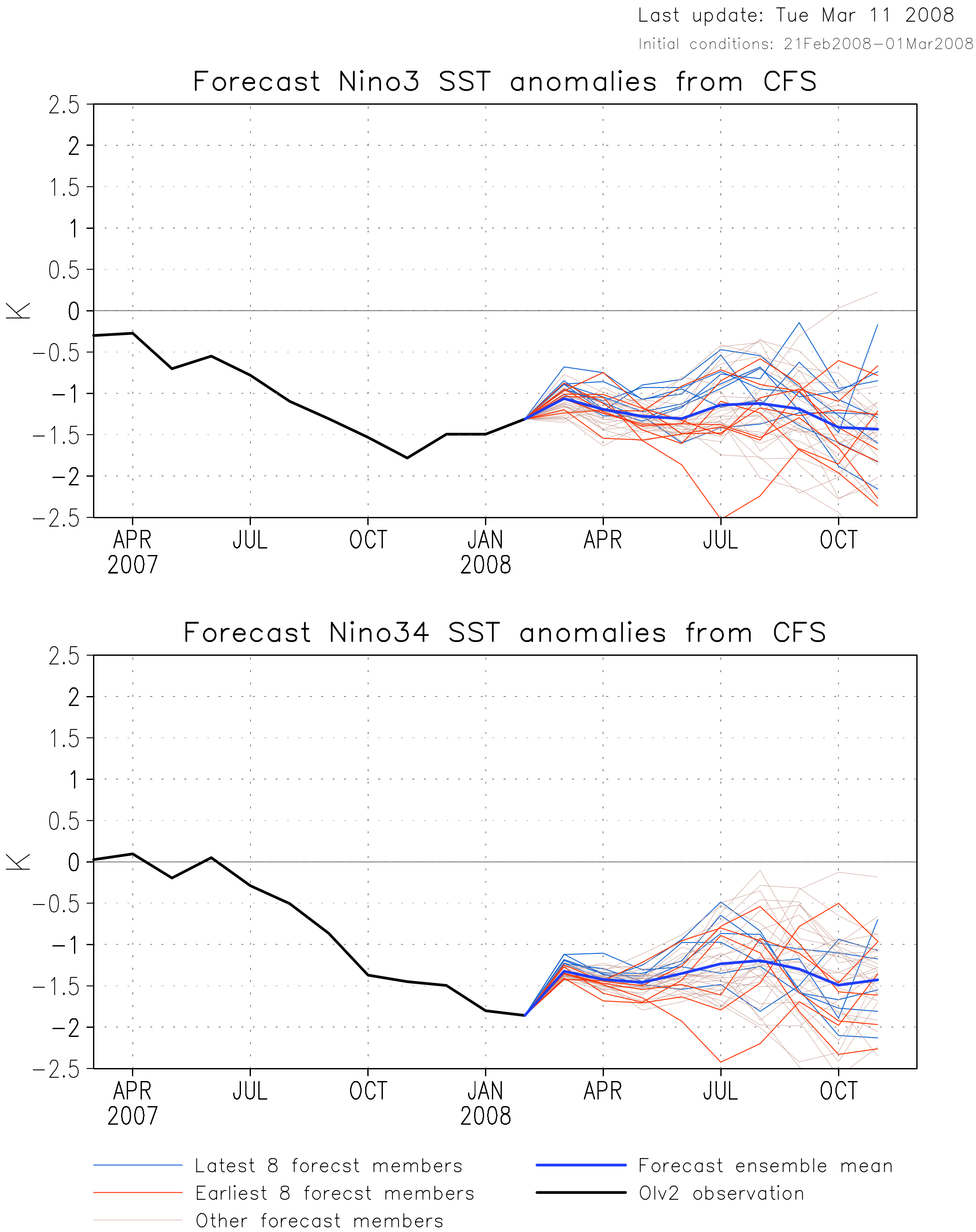



FIGURE F4. Predicted and observed sea surface temperature (SST) anomalies for the Nino 3 (top) and Nino 3.4 (bottom) regions from the NCEP Coupled Forecast System Model (CFS03). The forecasts consist of 40 forecast members. The ensemble mean of all 40 forecast members is shown by the blue line, individual members are shown by thin lines, and the observation is indicated by the black line. The Nino-3 region spans the eastern equatorial Pacific between 5N-5S, 150W-90W. The Nno 3.4 region spans the east-central equatorial Pacific between 5N-5S, 170W-120W.

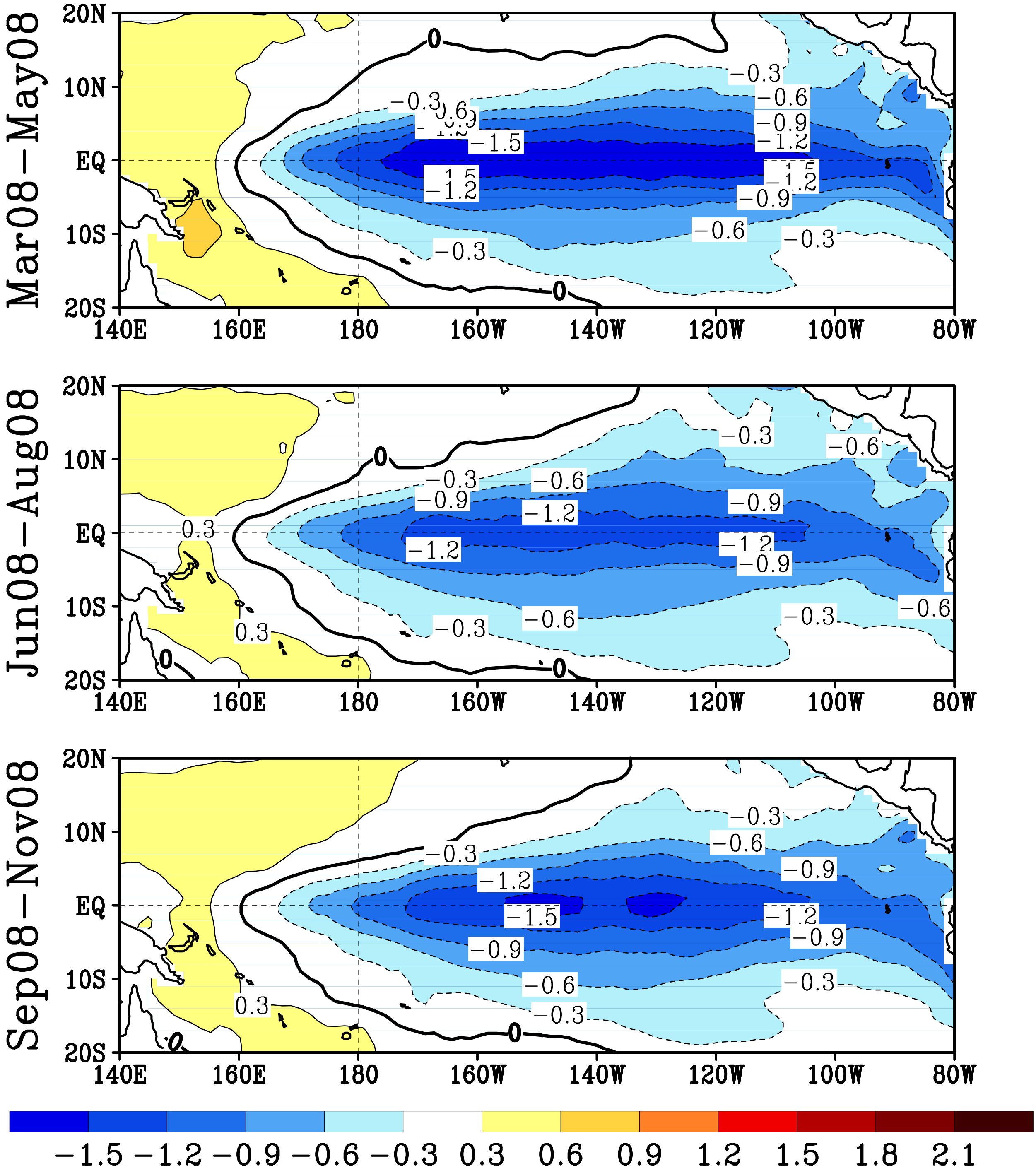



FIGURE F5. Predicted 3-month average sea surface temperature anomalies from the NCEP/CPC Markov model (Xue et al. 2000, *J. Climate*, **13**, 849-871). The forecast is initiated in FEB 2008 . Contour interval is 0.3C and negative anomalies are indicated by dashed contours. Anomalies are calculated relative to the 1971-2000 climatology.

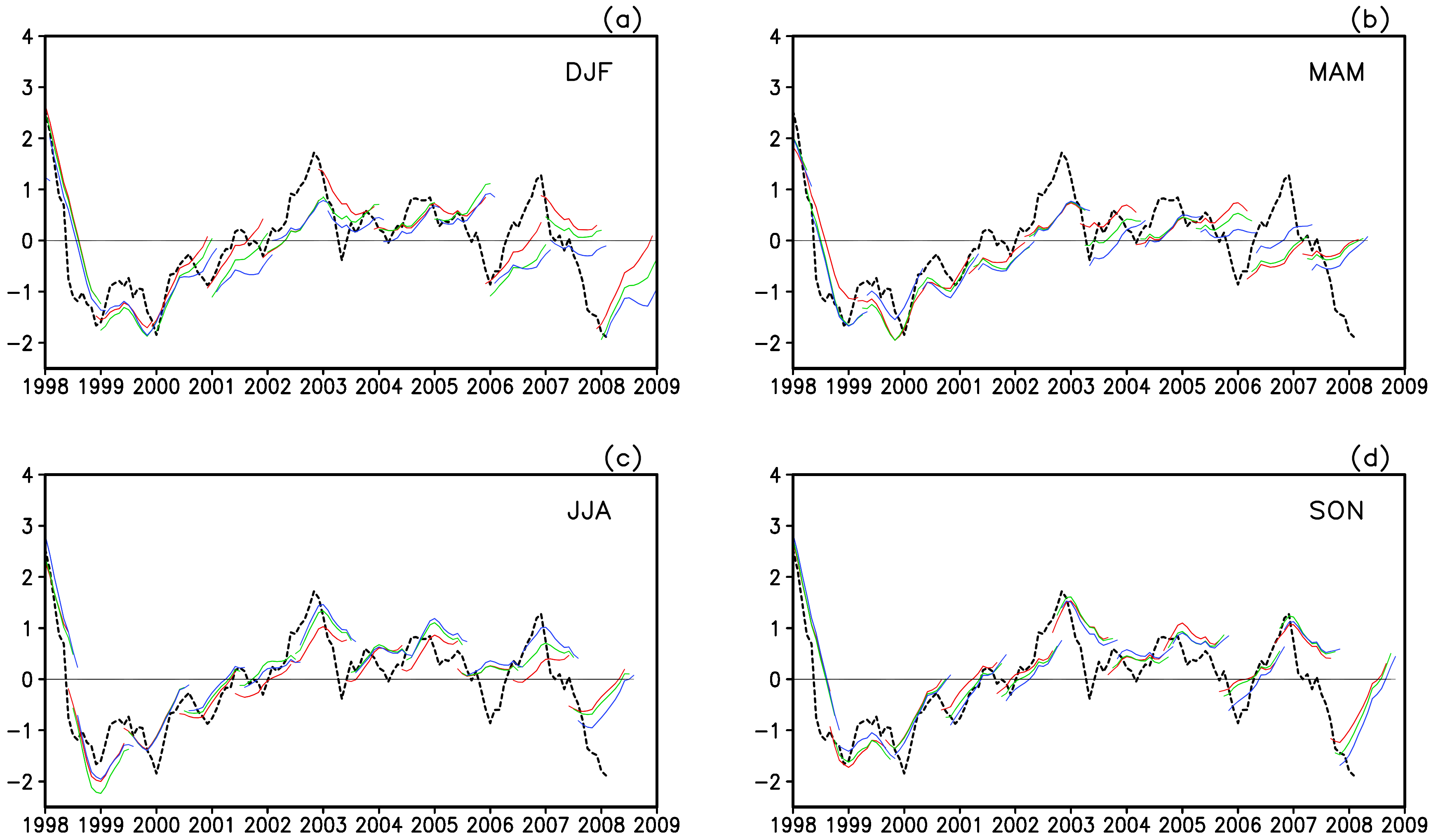



FIGURE F6. Time evolution of observed and predicted SST anomalies in the Nino 3.4 region (up to 12 lead months) by the NCEP/CPC Markov model (Xue et al. 2000, *J. Climate*, **13**, 849-871). Anomalies are calculated relative to the 1971-2000 climatology. Shown in each panel are the forecasts grouped by three consecutive starting months: (a) is for December, January, and February, (b) is for March, April, and May, (c) is for June, July, and August, and (d) is for September, October, and November. The observed Nino 3.4 SST anomalies are indicated by the black dashed lines. The Nino 3.4 region spans the east-central equatorial Pacific between 5N-5S, 170W-120W.

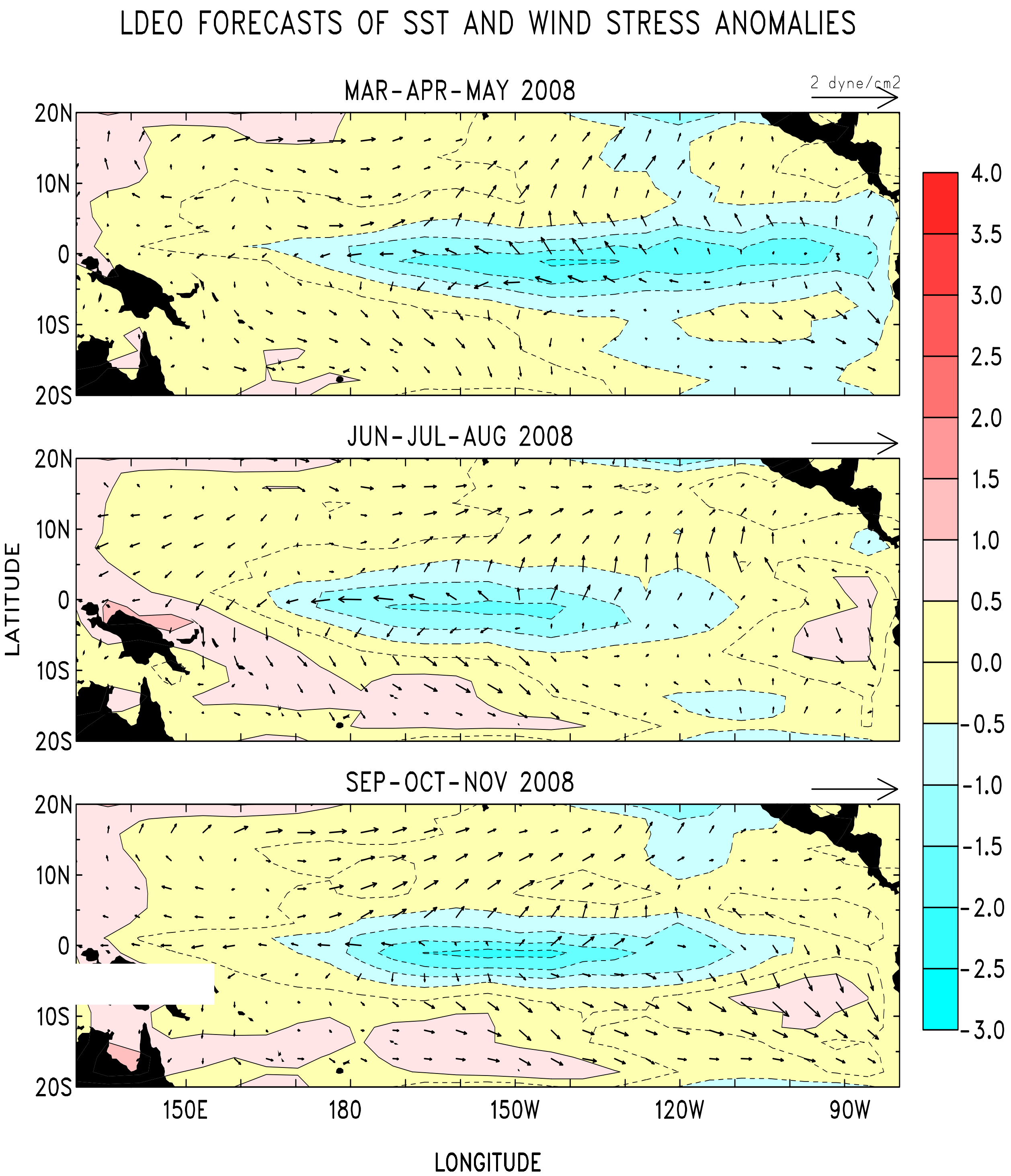



**FIGURE F7.** Forecasts of the tropical Pacific Predicted SST (shading) and vector wind anomalies for the next 3 seasons based on the LDEO model. Each forecast represents an ensemble average of 3 sets of predictions initialized during the last three consecutive months (see Figure F8).

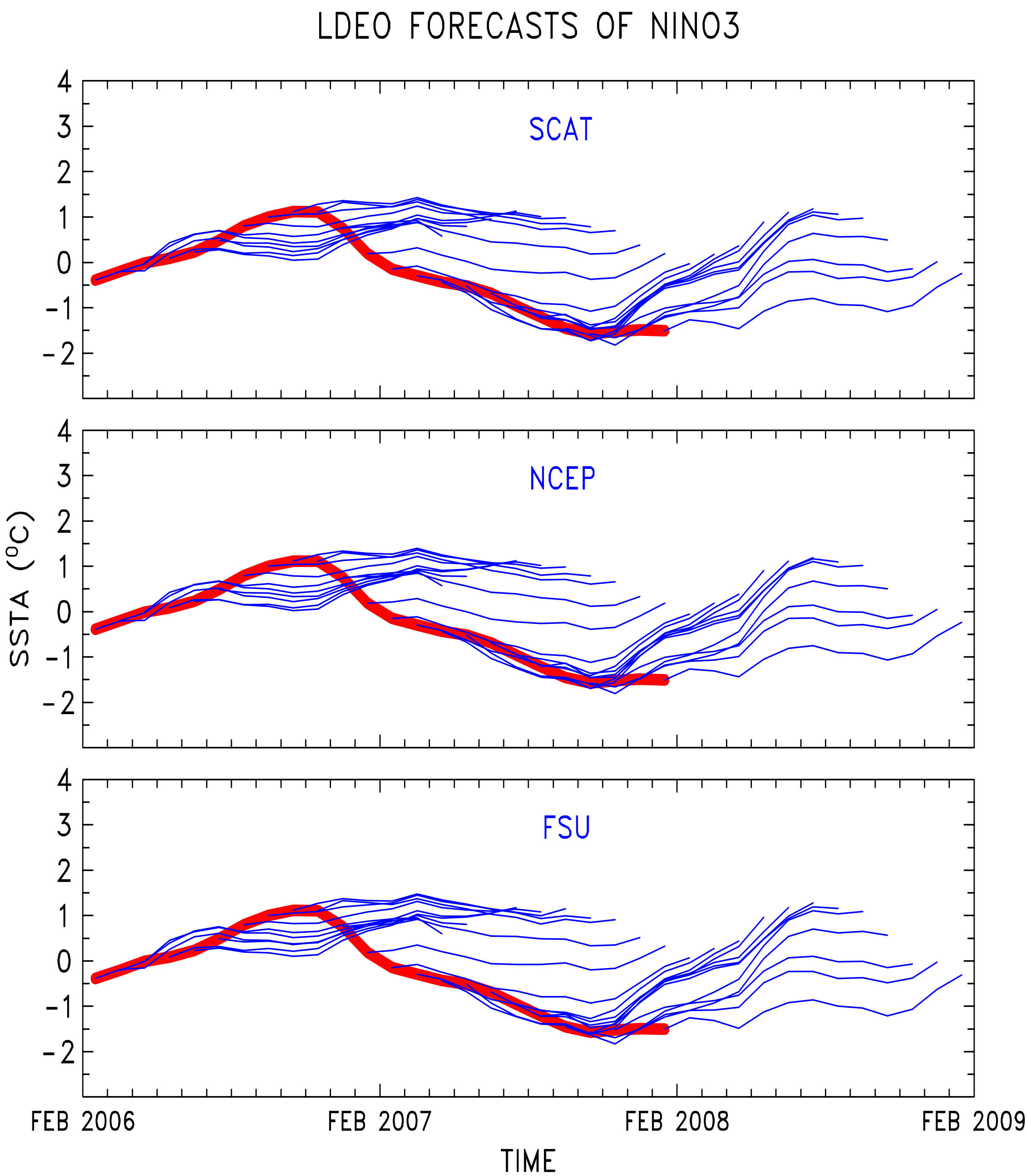



**FIGURE F8.** LDEO forecasts of SST anomalies for the Nino 3 region using wind stresses obtained from (top) QuikSCAT, (middle) NCEP, and (bottom) Florida State Univ. (FSU), along with SSTs (obtained from NCEP), and sea surface height data (obtained from TOPEX/POSEIDON) data. Each thin blue line represents a 12-month forecast, initialized one month apart for the past 24 months. Observed SST anomalies are indicated by the thick red line. The Nino-3 region spans the eastern equatorial Pacific between 5N-5S, 150W-90W.

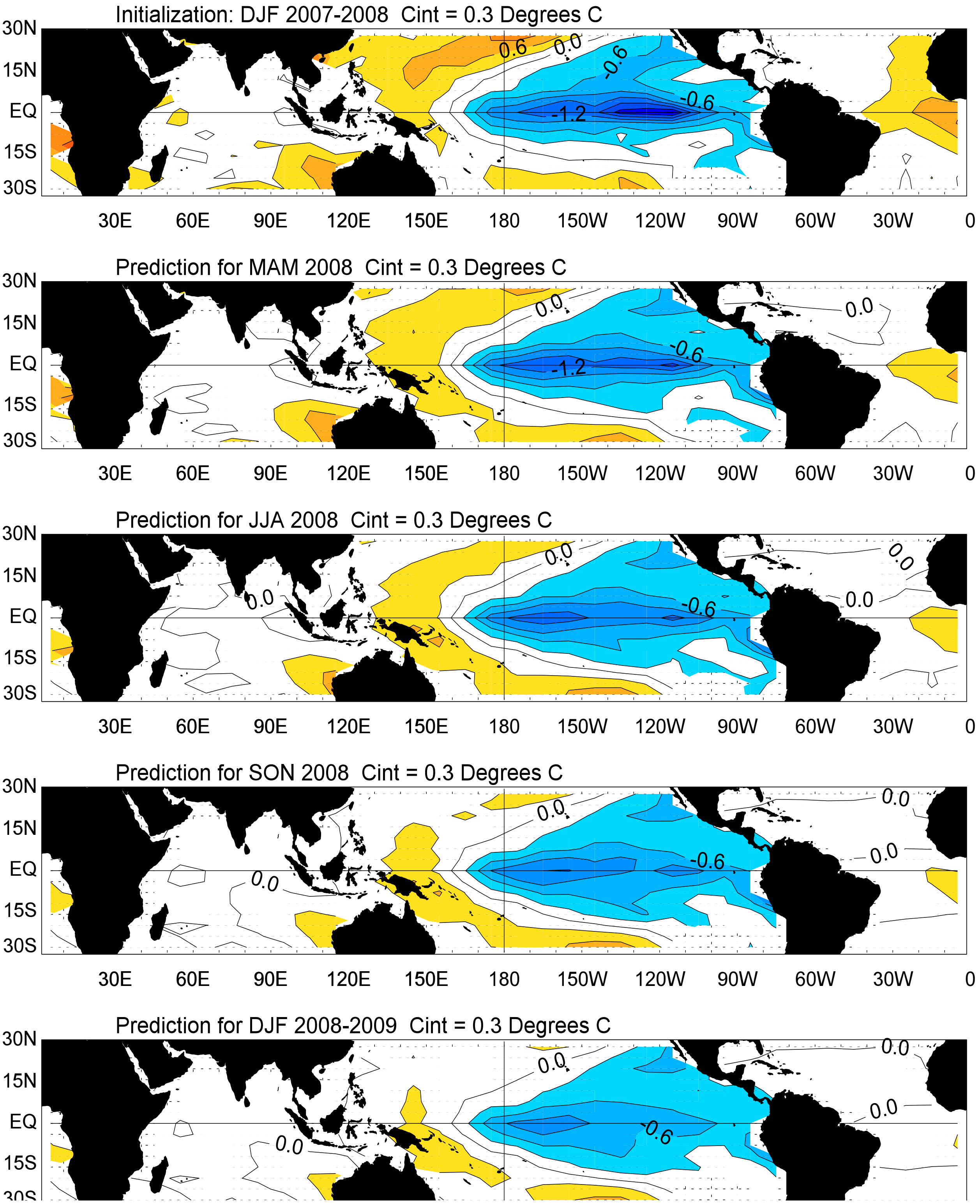



FIGURE F9. Forecast of tropical SST anomalies from the Linear Inverse Modeling technique of Penland and Magorian (1993: *J. Climate*, **6**, 1067-1076). The contour interval is 0.3C. Anomalies are calculated relative to the 1951-2000 climatology and are projected onto 20 leading EOFs.

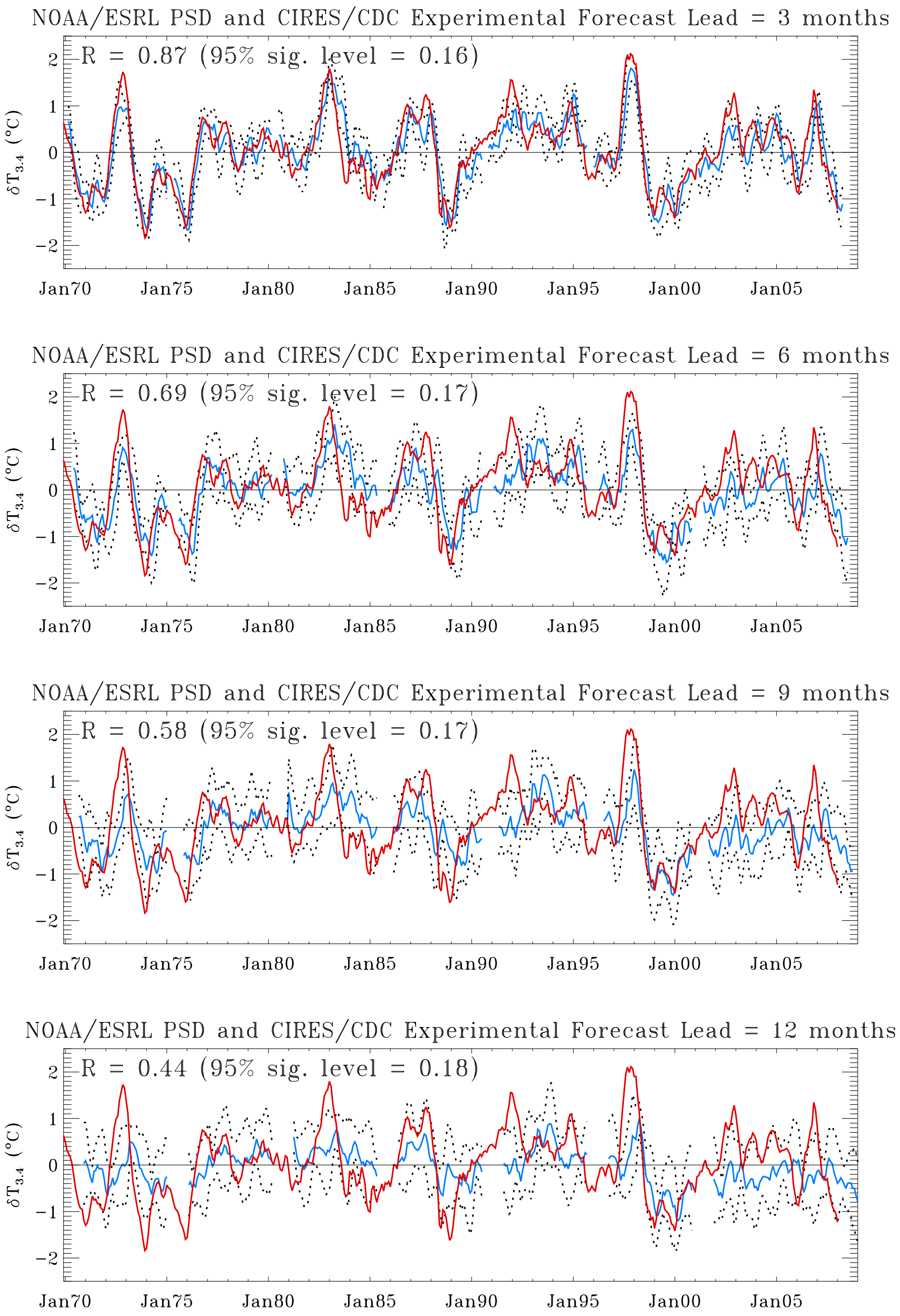



FIGURE F10. Predictions of SST anomalies in the Nino3.4 region (blue line) for leads of three months (top) to 12 months (bottom), from the Linear Inverse Modeling technique of Penland and Magorian (1993: *J. Climate*, **6**, 1067-1076). Observed SST anomalies are indicated by the red line. Anomalies are calculated relative to the 1951-2000 climatology and are projected onto 20 leading EOFs. The Nino 3.4 region spans the east-central equatorial Pacific between 5N-5S, 170W-120W.

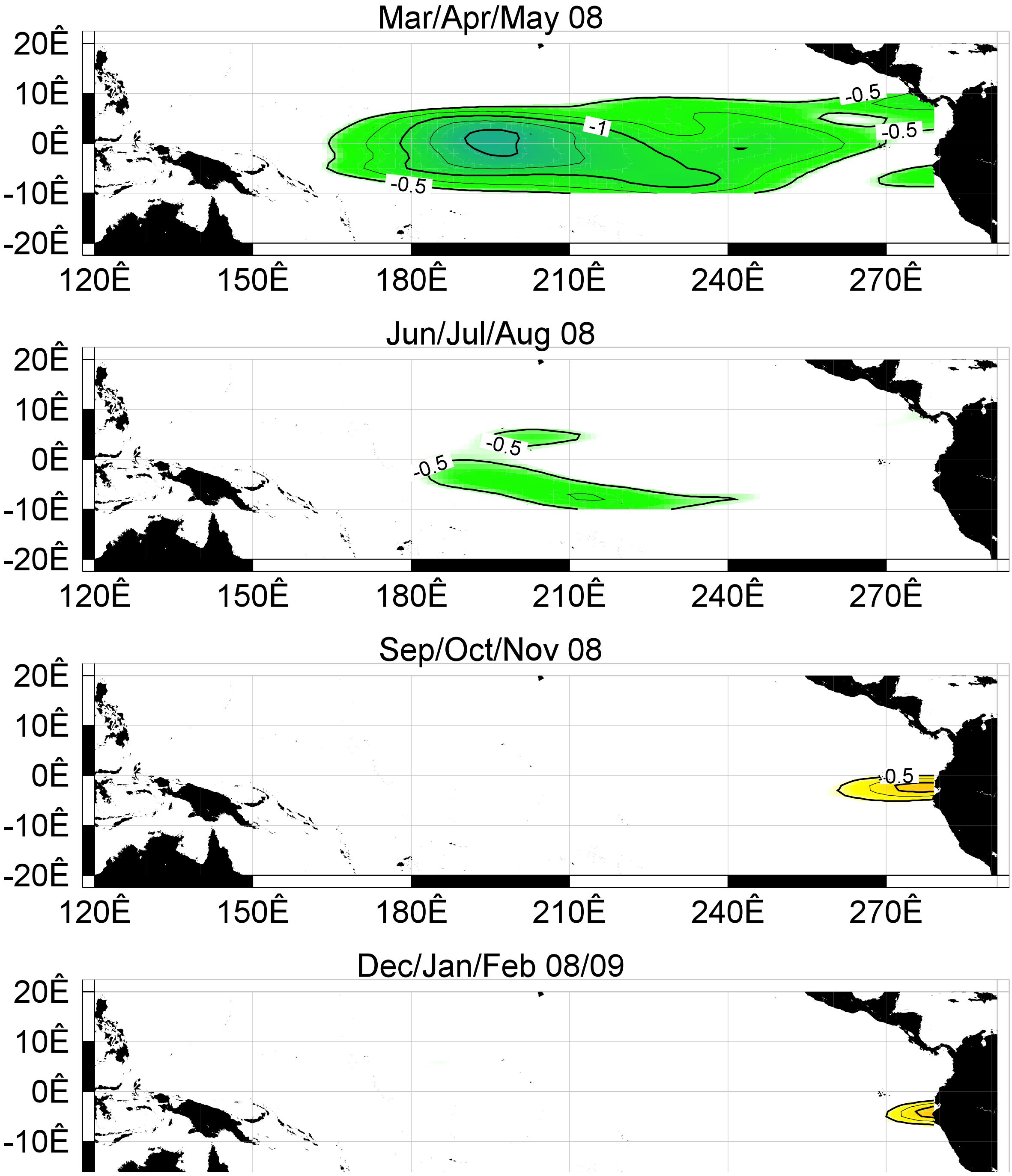



FIGURE F11. SST anomaly forecast for the equatorial Pacific from the Hybrid Coupled Model (HCM) developed by the Scripps Institution of Oceanography and the Max-Plank Institut fuer Meteorlogie.

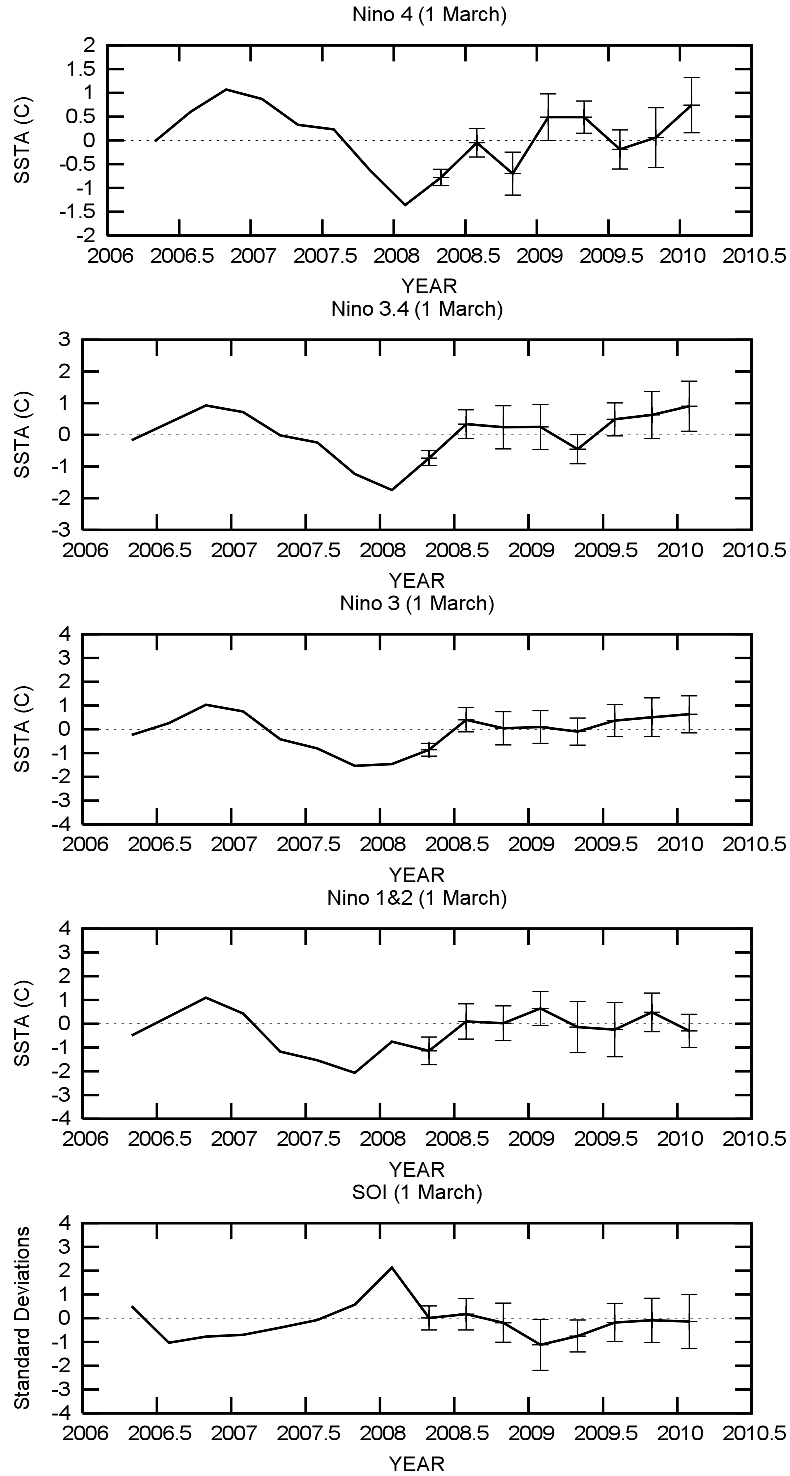



FIGURE F12. ENSO-CLIPER statistical model forecasts of three-month average sea surface temperature anomalies (green lines, deg. C) in (top panel) the Nino 4 region (5N-5S, 160E-150W), (second panel) the Nino 3.4 region (5N-5S, 170W-120W), (third panel) the Nino 3 region (5N-5S, 150W-90W), and (fourth panel) the Nino 1+2 region (0-10S, 90W-80W) (Knaff and Landsea 1997, *Wea. Forecasting*, **12**, 633-652). Bottom panel shows predictions of the three-month standardized Southern Oscillation Index (SOI, green line). Horizontal bars on green line indicate the adjusted root mean square error (RMSE). The Observed three-month average values are indicated by the thick blue line. SST anomalies are departures from the 1971-2000 base period means, and the SOI is calculated from the 1951-1980 base period means.

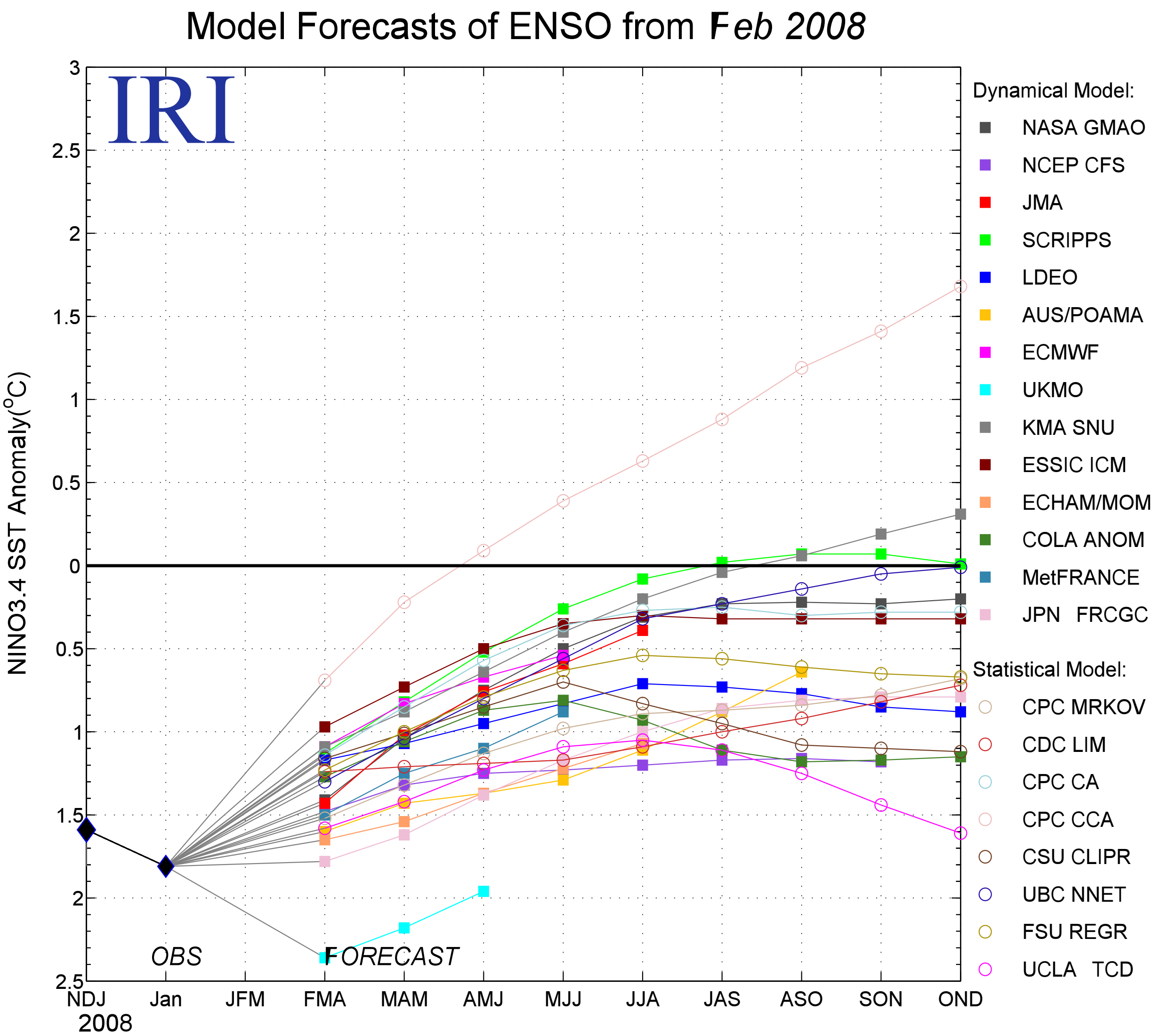



FIGURE F13. Time series of predicted sea surface temperature anomalies for the Nino 3.4 region (deg. C) from various dynamical and statistical models for nine overlapping 3-month periods. The Nino 3.4 region spans the east-central equatorial Pacific between 5N-5S, 170W-120W. Figure provided by the International Research Institute (IRI).

# Extratropical Highlights – February 2008

## 1. Northern Hemisphere

The 500-hPa height pattern during February 2008 featured positive anomalies across the eastern North Pacific, the central North Atlantic, and Europe, and negative anomalies over the high latitudes of the North Pacific and Alaska, central Canada, and Greenland (**Fig. E9**). The circulation across the North Pacific Ocean is consistent with La Niña. The subtropical circulation at 200-hPa was also consistent with La Niña, with enhanced mid-Pacific troughs in both hemispheres flanking the suppressed convection over the central equatorial Pacific, and enhanced ridges over the western Pacific and Australasia flanking the region of enhanced equatorial convection (**Fig. T22**).

The main surface temperature departures during February reflected warmer than average conditions in Europe and northern Russia, and below-average temperatures over central Canada and south-central Asia (**Fig. E1**). The main precipitation anomalies included above average totals over portions of the northwestern US, and from the upper Midwest to New England, and below-average totals across southern Europe (**Fig. E3**).

a. North Pacific/ North America

The La Niña signal was again prominent across the Pacific Ocean during February. La Niña is associated with a westward retraction of deep tropical convection toward Indonesia, and a complete disappearance of tropical convection from the central equatorial Pacific (**Fig. T25**). These conditions result in a westward retraction of deep tropospheric heating, and hence a westward retraction of the 200-hPasubtropical ridge toward Indonesia (**Fig. T22**). Over the central equatorial Pacific, the reduction in convective heating contributes to an increased strength of the mid-Pacific trough.

The strength, structure, and position of the wintertime East Asian jet stream are strongly linked to conditions in the tropics and subtropics. For example, the jet core coincides with the strongest north-south height gradient at 200-hPa, which is heavily influenced by the height anomalies in the subtropics. The jet exit region coincides with the area of strong diffluence between the subtropical ridge and trough axes. During La Niña, the core of the East Asian jet stream is often retracted westward toward Asia and the heart of the jet exit region is shifted westward to west of the date line (**Fig. T21**). The downstream circulation features such as the mean ridge over western North America and the Hudson Bay trough are retracted westward as well (**Fig. E9**).

During February, these conditions were associated with a continuation of above-average precipitation over the Inter-mountain region of the western US, and with well above-average precipitation from the Great Lakes to New England (**Figs. E3, E5**). They were also associated with below-average temperatures over central Canada (**Fig. E1**).

b. North Atlantic and Europe

The 500-hPa circulation during February featured a north-south dipole pattern height anomalies over the North Atlantic Ocean, with below-average heights centered over Greenland and above-average heights extending across the middle latitudes (**Fig. E9**). This overall pattern reflects the ongoing positive phase of the North Atlantic Oscillation (NAO), which has been prevailed for the past six months (**Fig. E7, Table E1**). Also during February large positive height anomalies were also evident across Europe.

These conditions were associated with an anomalously strong northeasterly transport of mild marine air into northern Europe and Scandinavia which, when combined with the strong ridge over Europe, resulted in a continuation of well above-average temperatures across Europe and northern Russia (**Fig. E1**). Also, anomalous sinking motion downstream of the European ridge resulted in significant precipitation deficits ($10^{th}$ percentile of occurrences) across southeastern Europe.

## 2. Southern Hemisphere

The 500-hPa height field during February featured a continuation of negative anomalies over Antarctica, and an anomalous zonal wave-4 pattern in the middle latitudes (**Fig. E15**). In the subtropics, negative 200-hPa streamfunction anomalies over the central Indian Ocean and positive streamfunction anomalies over the central Pacific was consistent with La Niña (**Fig. T22**).

In Australia, a persistent upper-level trough and anomalous low-level southerly flow from the Great Australian Bight led to a continuation of cooler than average conditions in the east. The mean trough axis also demarked the areas of above- and (below-) average precipitation (**Fig. E3**).

The South African rainy season extends from October to April, and is often stronger than average during La Niña. The region received well above average rains during October 2007-January 2008, but recorded a deficit during February with totals in the lowest $20^{th}$ percentile of occurrences (**Fig. E4**).

# TELECONNECTION INDICES

## NORTH ATLANTIC NORTH PACIFIC EURASIA

| MONTH | NAO | EA | WP | EP-NP | PNA | TNH | EATL/ WRUS | SCAND | POLEUR |
|---|---|---|---|---|---|---|---|---|---|
| FEB 08 | 0.7 | 0.6 | 0.5 | -0.1 | 0.5 | 1.0 | 0.4 | -0.3 | -0.2 |
| JAN 08 | 0.9 | 0.3 | 1.2 | -1.4 | -0.3 | 0.2 | -0.7 | 0.4 | -0.5 |
| DEC 07 | 0.3 | 0.3 | 0.5 | --- | 0.1 | 1.3 | 0.4 | 0.2 | -0.5 |
| NOV 07 | 0.6 | -1.7 | -0.1 | 0.8 | 0.7 | --- | -0.3 | -1.1 | -0.7 |
| OCT 07 | 0.4 | 0.1 | 0.1 | -2.3 | 0.6 | --- | -1.4 | -0.4 | -1.2 |
| SEP 07 | 0.7 | -0.3 | 1.3 | -2.0 | 1.9 | --- | -0.9 | -0.5 | 1.4 |
| AUG 07 | -0.1 | 0.7 | -0.3 | -1.5 | 2.0 | --- | -1.6 | -0.4 | 2.0 |
| JUL 07 | -0.6 | 0.6 | -0.7 | 0.4 | 2.2 | --- | -0.5 | -0.2 | -0.3 |
| JUN 07 | -1.3 | 0.7 | -0.4 | 0.2 | -0.4 | --- | -0.3 | 0.8 | -0.4 |
| MAY 07 | 0.7 | 1.3 | -1.2 | -0.6 | -0.1 | --- | 0.0 | 0.3 | -0.2 |
| APR 07 | 0.2 | -0.6 | -1.9 | 0.0 | 1.2 | --- | 1.7 | -1.5 | -0.3 |
| MAR 07 | 1.4 | 0.5 | -1.1 | -1.1 | 0.2 | --- | -0.1 | 0.4 | -0.4 |
| FEB 07 | -0.5 | 1.7 | 0.6 | 1.2 | -0.1 | 0.9 | 0.9 | 0.6 | -1.3 |

TABLE E1-Standardized amplitudes of selected Northern Hemisphere teleconnection patterns for the most recent thirteen months (computational procedures are described in Fig. E7). Pattern names and abbreviations are North Atlantic Oscillation (NAO); East Atlantic pattern (EA);West Pacific pattern (WP); East Pacific - North Pacific pattern (EP-NP); Pacific/North American pattern (PNA); Tropical/Northern Hemisphere pattern (TNH);East Atlantic/Western Russia pattern (EATL/WRUS-called Eurasia-2 pattern by Barnston and Livezey, 1987, *Mon. Wea. Rev*., **115**, 1083-1126); Scandanavia pattern (SCAND-called Eurasia-1 pattern by Barnston and Livezey 1987); and Polar Eurasia pattern (POLEUR). No value is plotted for calendar months in which the pattern does not appear as a leading mode.

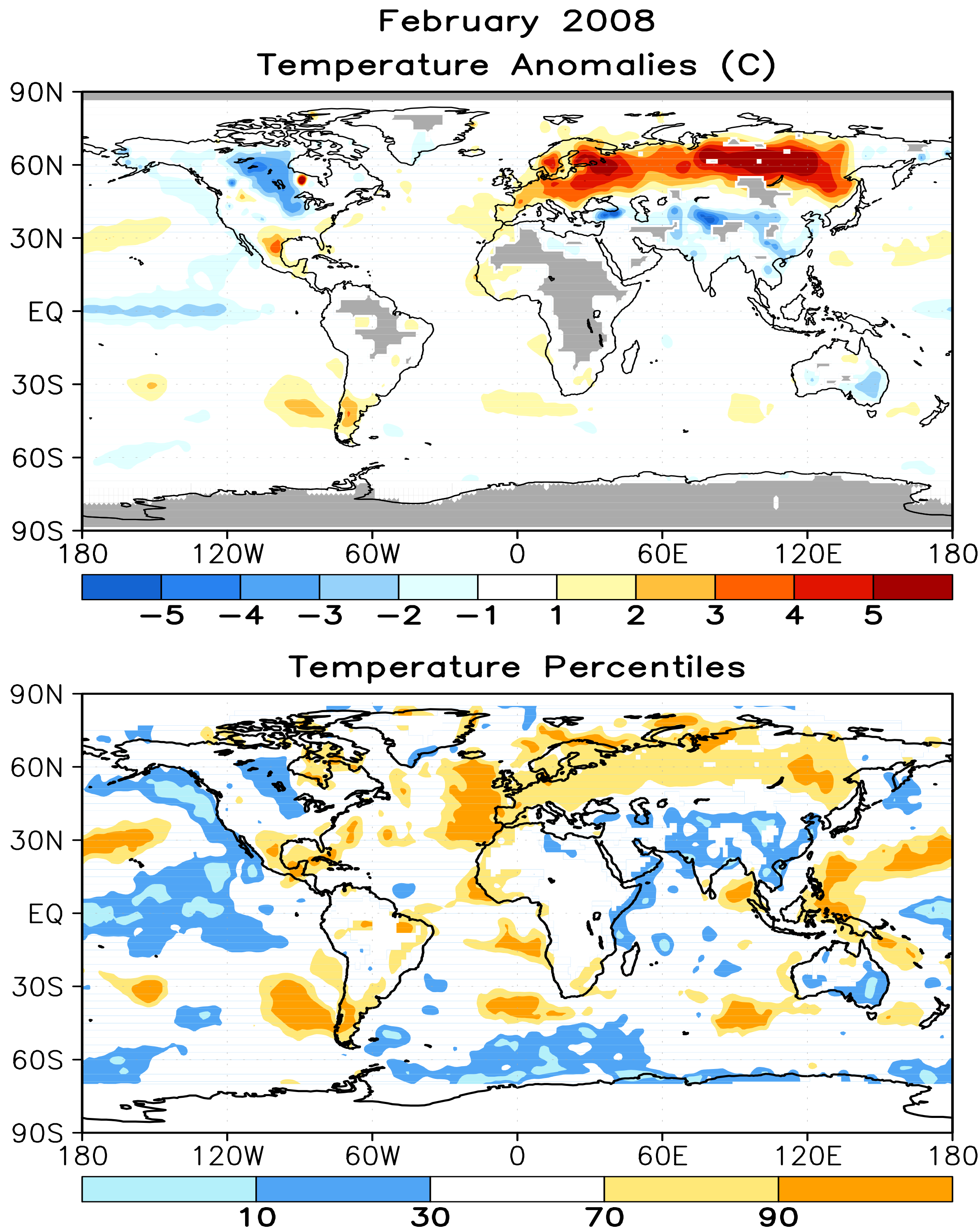



FIGURE E1. Surface temperature anomalies (°C, top) and surface temperature expressed as percentiles of the normal (Gaussian) distribution fit to the 1971–2000 base period data (bottom) for FEB 2008. Analysis is based on station data over land and on SST data over the oceans (top). Anomalies for station data are departures from the 1971–2000 base period means, while SST anomalies are departures from the 1971–2000 adjusted OI climatology. (Smith and Reynolds 1998, *J. Climate*, **11**, 3320-3323). Regions with insufficient data for analysis in both figures are indicated by shading in the top figure only.

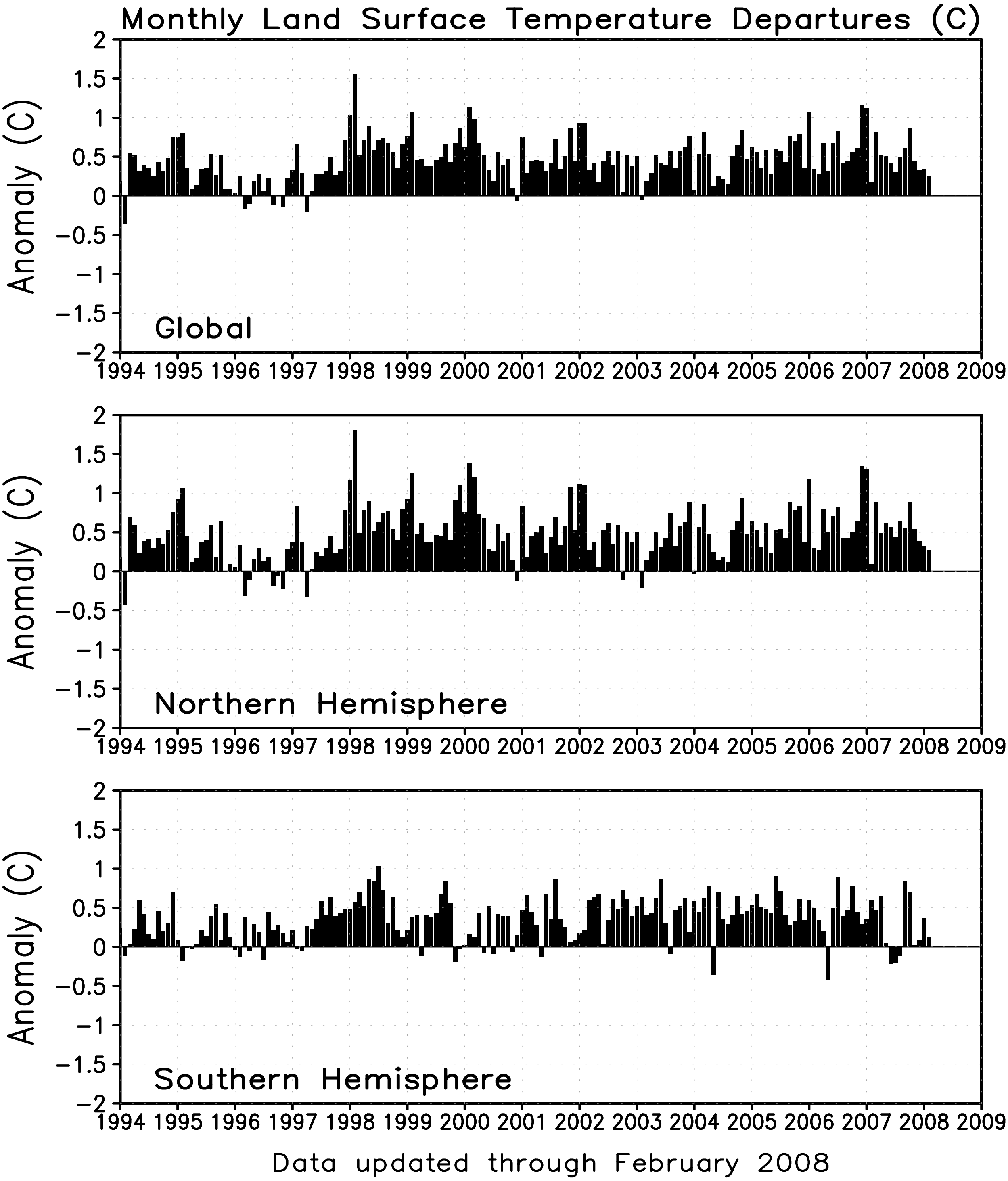



FIGURE E2. Monthly global (top), Northern Hemisphere (middle), and Southern Hemisphere (bottom) surface temperature anomalies (land only,˚C) from January 1990 - present, computed as departures from the 1971–2000 base period means.

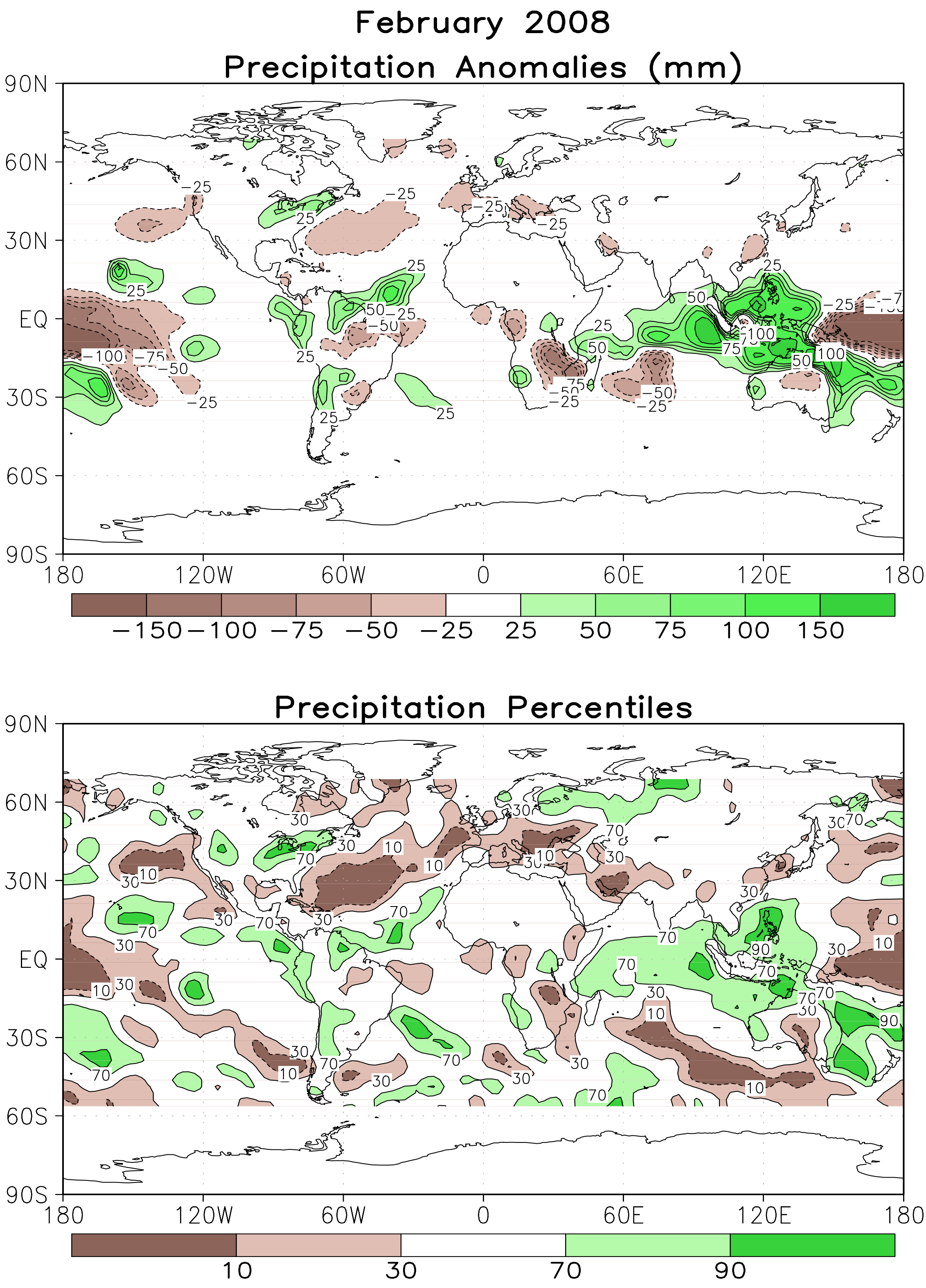



FIGURE E3. Anomalous precipitation (mm, top) and precipitation percentiles based on a Gamma distribution fit to the 1979–2000 base period data (bottom) for FEB 2008. Data are obtained from a merge of raingauge observations and satellite-derived precipitation estimates (Janowiak and Xie 1999, *J. Climate*, **12**, 3335–3342). Contours are drawn at 200, 100, 50, 25, -25, -50, -100, and -200 mm in top panel. Percentiles are not plotted in regions where mean monthly precipitation is <5mm/month.

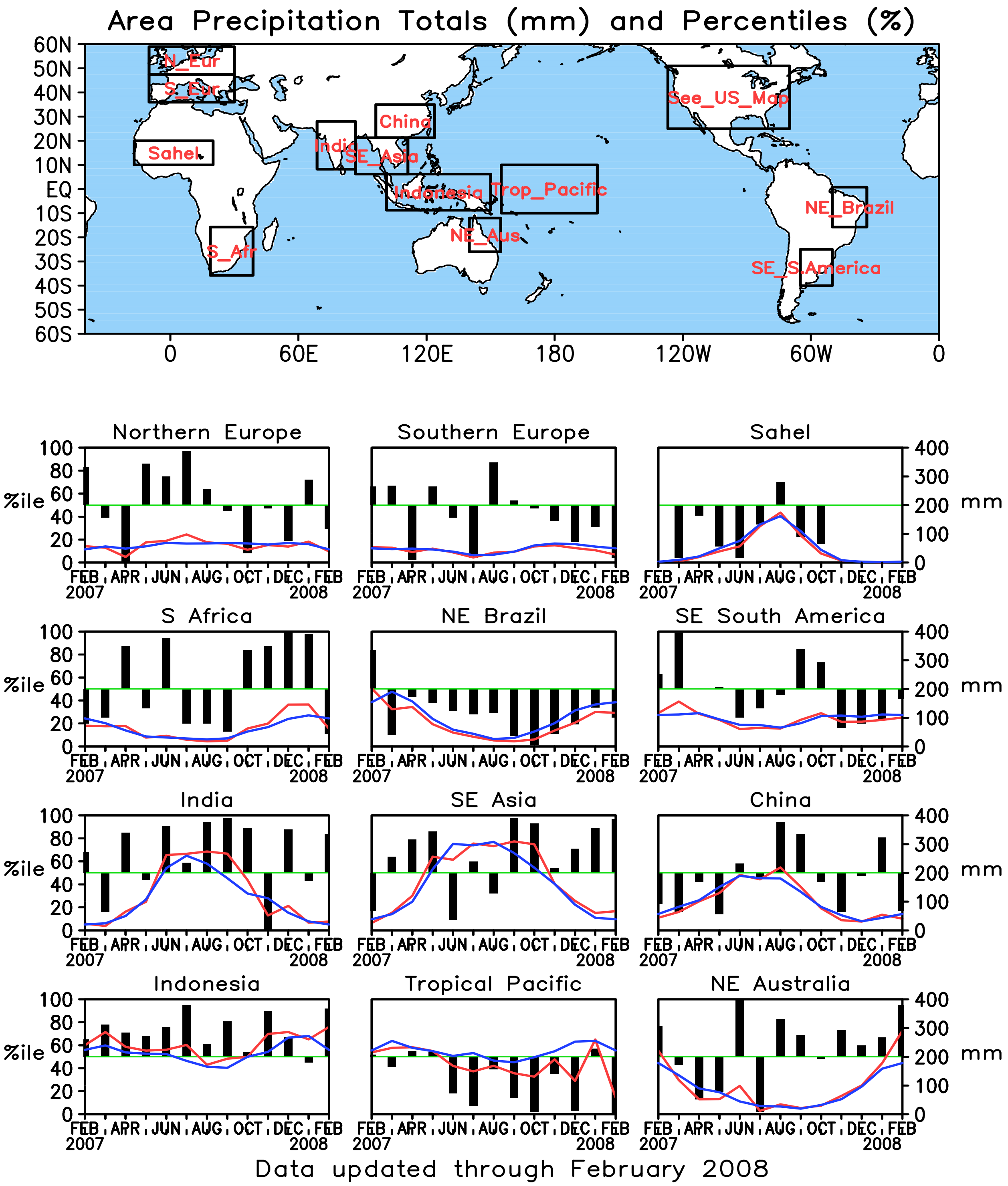



FIGURE E4. Areal estimates of monthly mean precipitation amounts (mm, solid lines) and precipitation percentiles (%, bars) for the most recent 13 months obtained from a merge of raingauge observations and satellite-derived precipitation estimates (Janowiak and Xie 1999, *J. Climate*, **12**, 3335–3342). The monthly precipitation climatology (mm, dashed lines) is from the 1979–2000 base period monthly means. Monthly percentiles are not shown if the monthly mean is less than 5 mm.

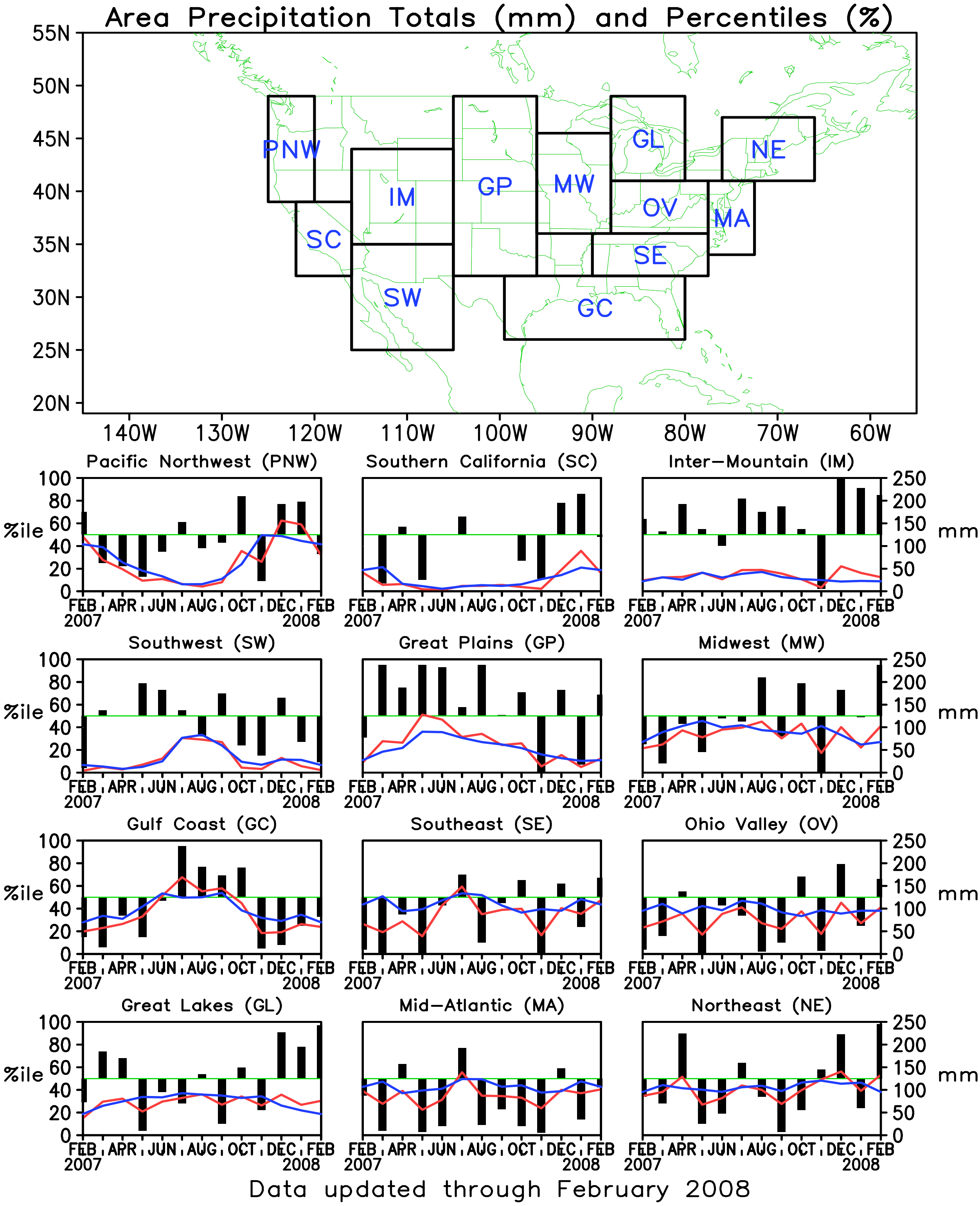



FIGURE E5. Areal estimates of monthly mean precipitation amounts (mm, solid lines) and precipitation percentiles (%, bars) for the most recent 13 months obtained from a merge of raingauge observations and satellite-derived precipitation estimates (Janowiak and Xie 1999, *J. Climate*, **12**, 3335–3342). The monthly precipitation climatology (mm, dashed lines) is from the 1979–2000 base period monthly means. Monthly percentiles are not shown if the monthly mean is less than 5 mm.

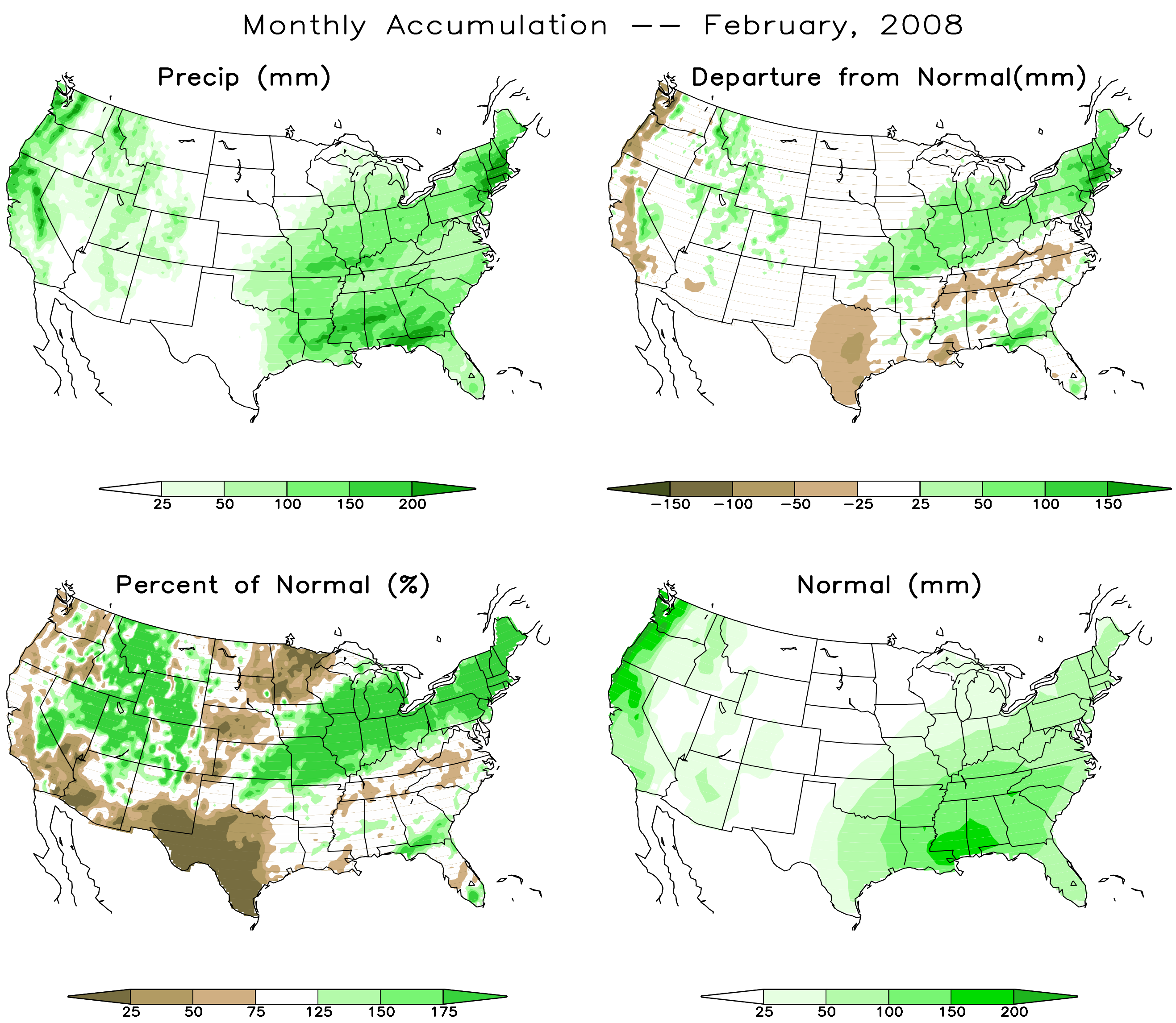



FIGURE E6. Observed precipitation (upper left), departure from average (upper right), percent of average (lower left), and average precipitation (lower right) for FEB 2008. The units are given on each panel. Base period for averages is 1971–2000. Results are based on CPC's U. S. daily precipitation analysis, which is available at http://www.cpc.ncep.noaa.gov/prodcuts/precip/realtime.

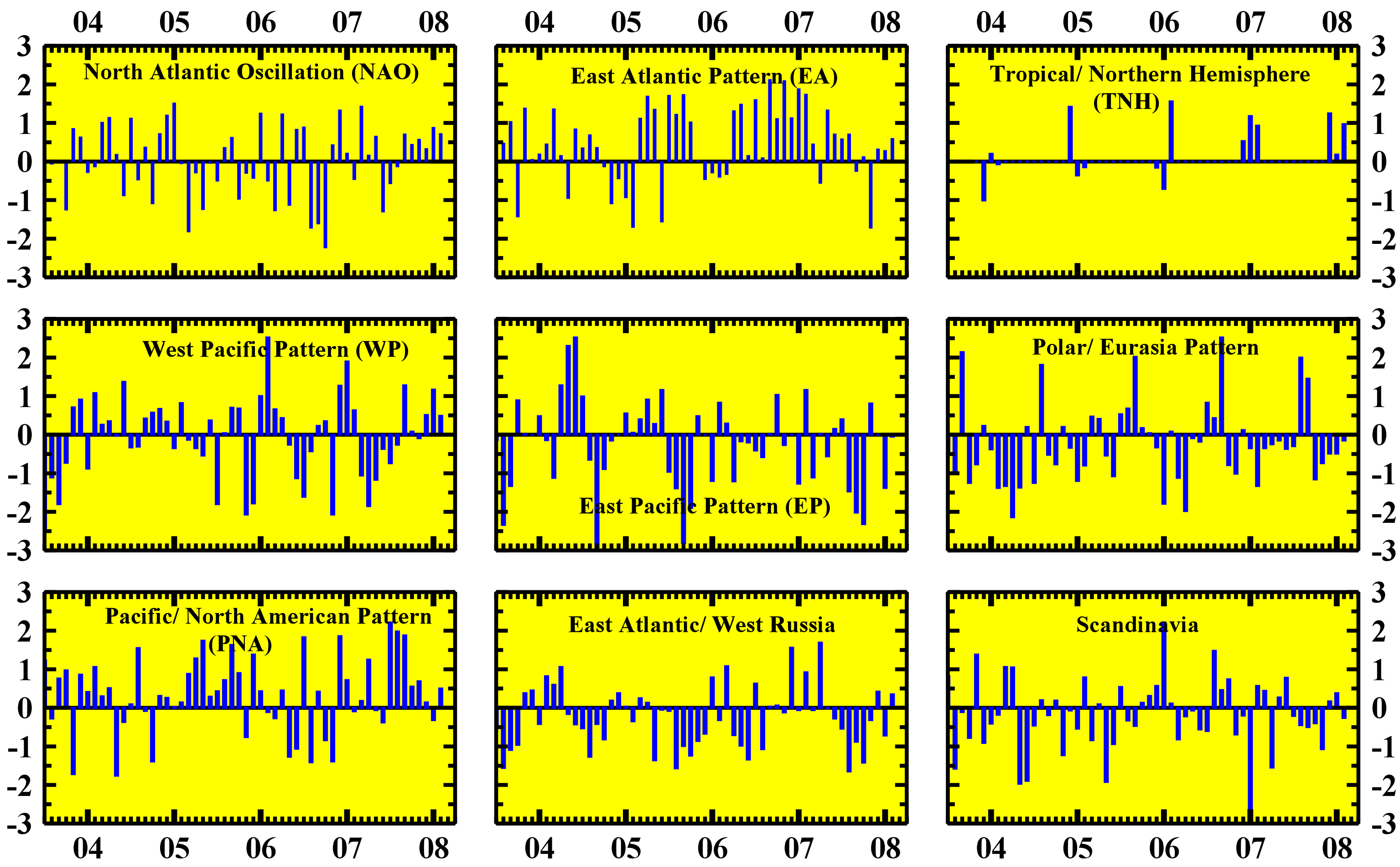



FIGURE E7. Standardized monthly Northern Hemisphere teleconnection indices. The teleconnection patterns are calculated from a Rotated Principal Component Analysis (RPCA) applied to monthly standardized 500-hPa height anomalies during January 1950 – December 2000. To obtain these patterns, ten leading un-rotated modes are first calculated for each calendar month by using the monthly height anomaly fields for the three-month period centered on that month: [i.e., The July modes are calculated from the June, July, and August standardized monthly anomalies]. A Varimax spatial rotation of the ten leading un-rotated modes for each calendar month results in 120 rotated modes (12 months x 10 modes per month) that yield ten primary teleconnection patterns.The teleconnection indices are calculated by first projecting the standardized monthly anomalies onto the teleconnection patterns corresponding to that month (eight or nine teleconnection patterns are seen in each calendar month). The indices are then solved for simultaneously using a Least-Squares approach. In this approach, the indices are the solution to the Least-Squares system of equations which explains the maximum spatial structure of the observed height anomaly field during the month. The indices are then standardized for each pattern and calendar month independently. No index value exists when the teleconnection pattern does not appear as one of the ten leading rotated EOF's valid for that month.

February 2008

Sea-Level Pressure and Anomaly

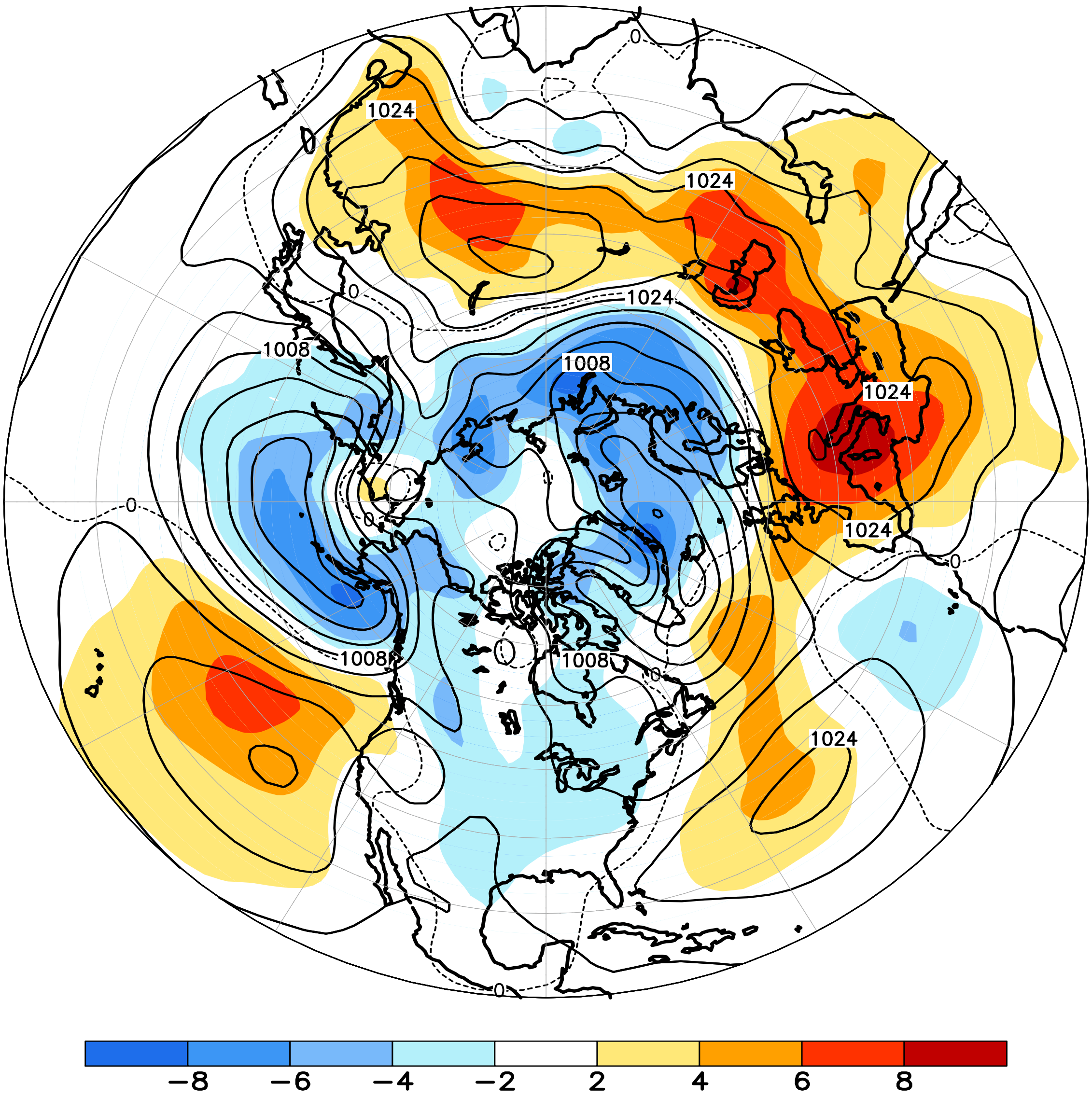



FIGURE E8. Northern Hemisphere mean and anomalous sea level pressure (CDAS/Reanalysis) for FEB 2008. Mean values are denoted by solid contours drawn at an interval of 4 hPa. Anomaly contour interval is 2 hPa with values less (greater) than -2 hPa (2 hPa) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.

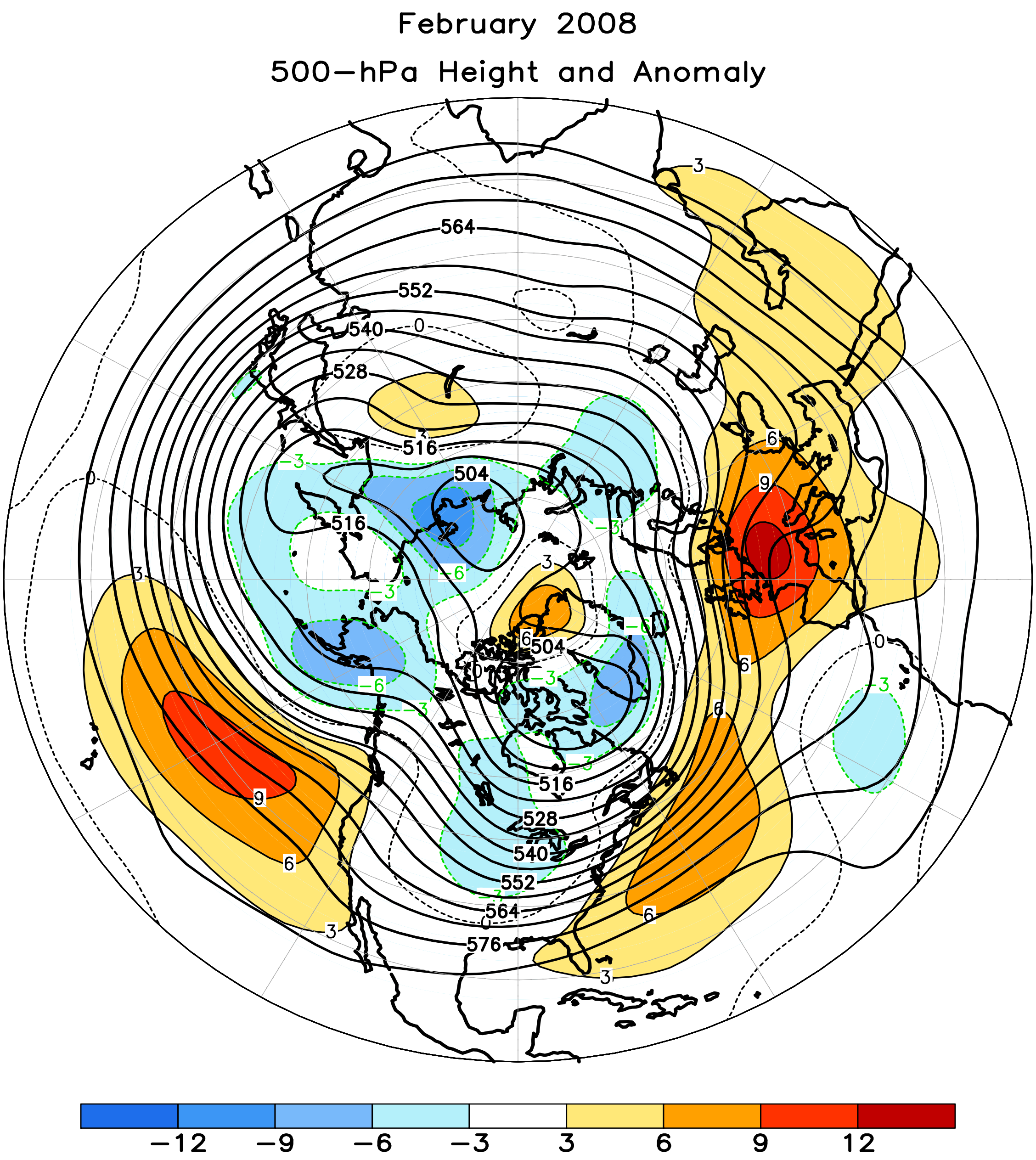
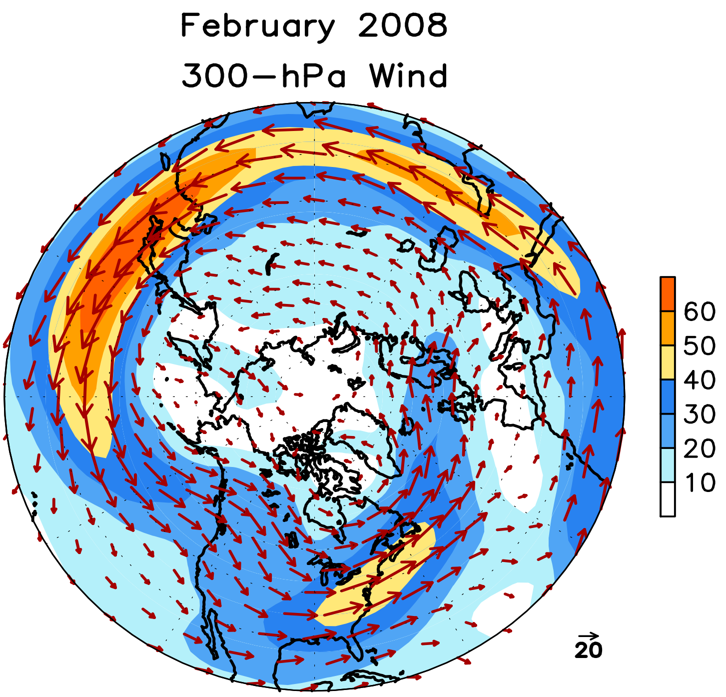



FIGURE E9. Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis) for FEB 2008. Mean heights are denoted by solid contours drawn at an interval of 8 dam. Anomaly contour interval is 3 dam with values less (greater) than -3 dam (3 dam) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.



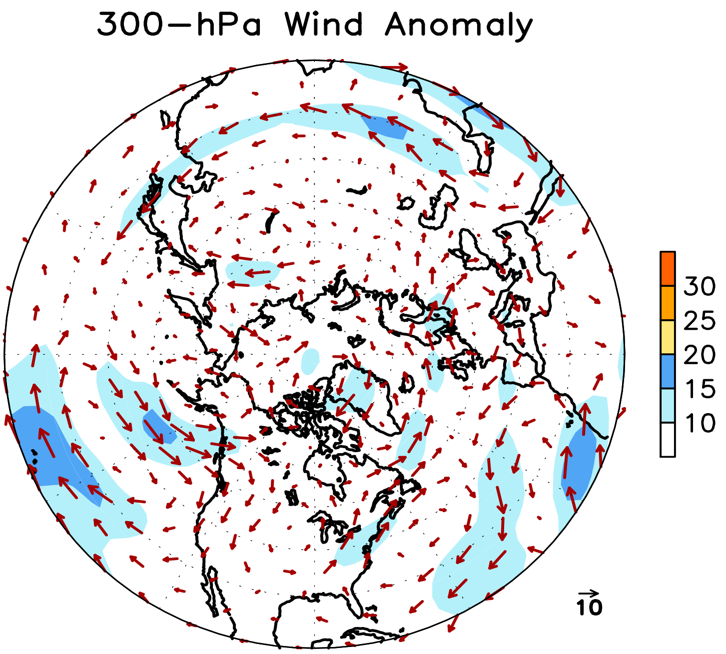




FIGURE E10. Northern Hemisphere mean (left) and anomalous (right) 300-hPa vector wind (CDAS/Reanalysis) for FEB 2008. Mean (anomaly) isotach contour interval is 10 (5) $ms^{-1}$. Values greater than 30 $ms^{-1}$ (left) and 10 $ms^{-1}$ (rights) are shaded. Anomalies are departures from the 1979-95 base period monthly means.

February 2008
500–hPa: Percentage of Anomaly Days

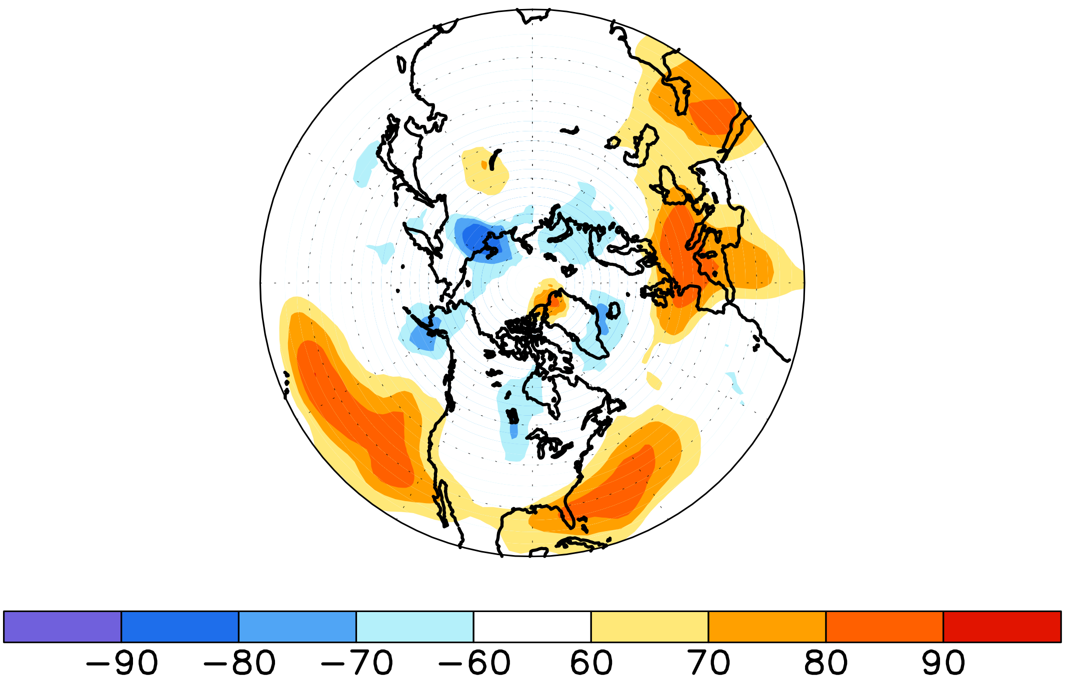



FIGURE E11. Northern Hemisphere percentage of days during FEB 2008 in which 500-hPa height anomalies greater than 15 m (red) and less than -15 m (blue) were observed. Values greater than 70% are shaded and contour interval is 20%.

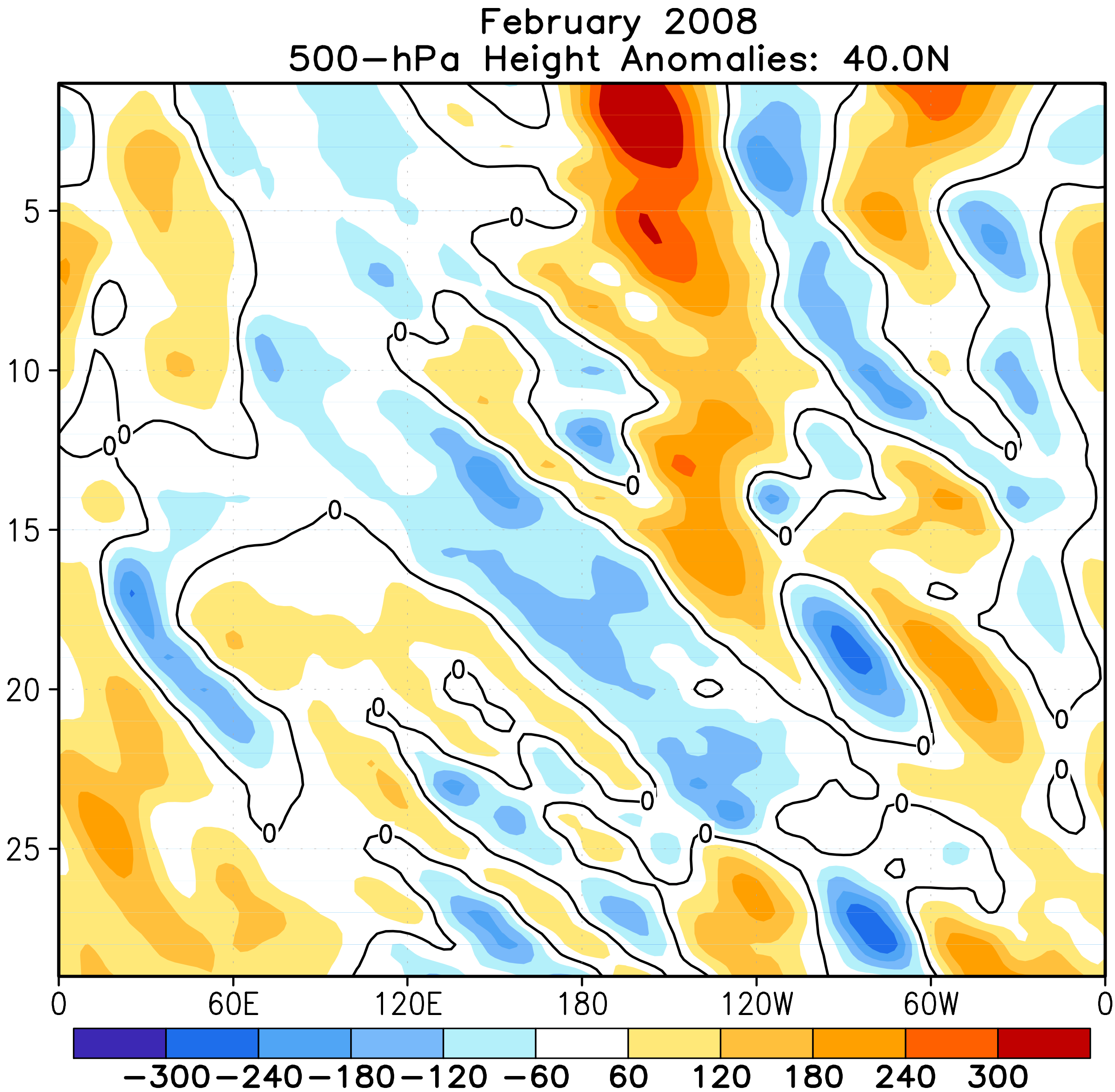



FIGURE E12. Northern Hemisphere: Daily 500-hPa height anomalies for FEB 2008 averaged over the 5° latitude band centered on 40°N. Positive values are indicated by solid contours and dark shading. Negative values are indicated by dashed coutours and light shading. Contour interval is 60 m. Anomalies are departures from the 1979-95 base period daily means.

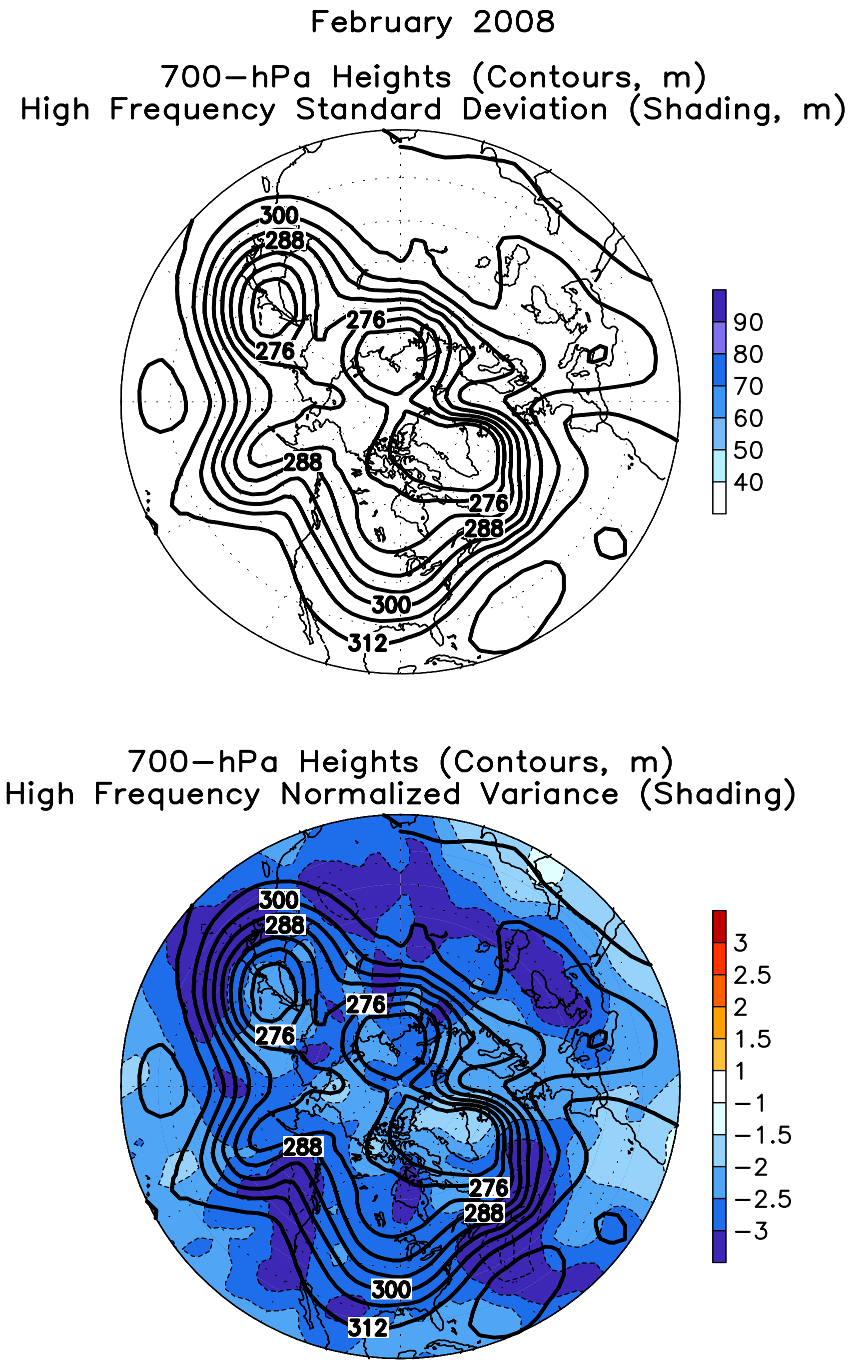



FIGURE E13. Northern Hemisphere: 700-hPa heights for FEB 2008 overlaid with standard deviation of high-pass filtered height (left) and normalized anomalous variance of high-pass filtered height (right). Heights are indicated by thick solid contours in both panels (interval is 60 m). High-pass filtered fields reflect fluctuations having periods less than 10 days, and are indicated by thin contours and shading. Contour interval for standard deviation is 15 m with values > 45 m shaded. Contour interval for normalized variance is 1 standard deviation, with positive values shown by solid contours and dark shading and negative values shown by dashed contours and light shading. Anomalies are departures from the 1964-93 base period monthly means.

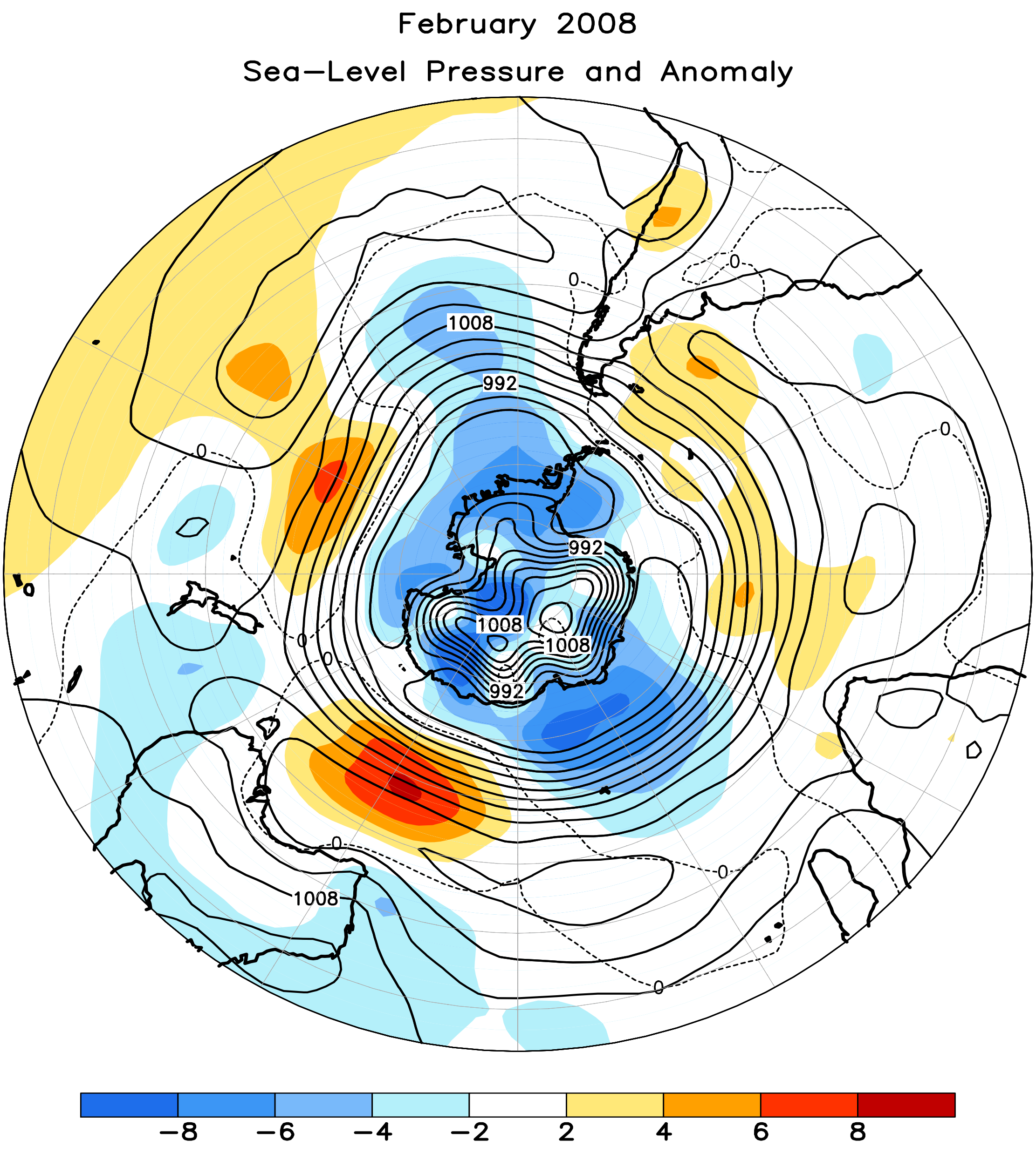



FIGURE E14. Southern Hemisphere mean and anomalous sea level pressure(CDAS/Reanalysis) for FEB 2008. Mean values are denoted by solid contours drawn at an interval of 4 hPa. Anomaly contour interval is 2 hPa with values less (greater) than -2 hPa (2 hPa) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.

February 2008

500−hPa Height and Anomaly

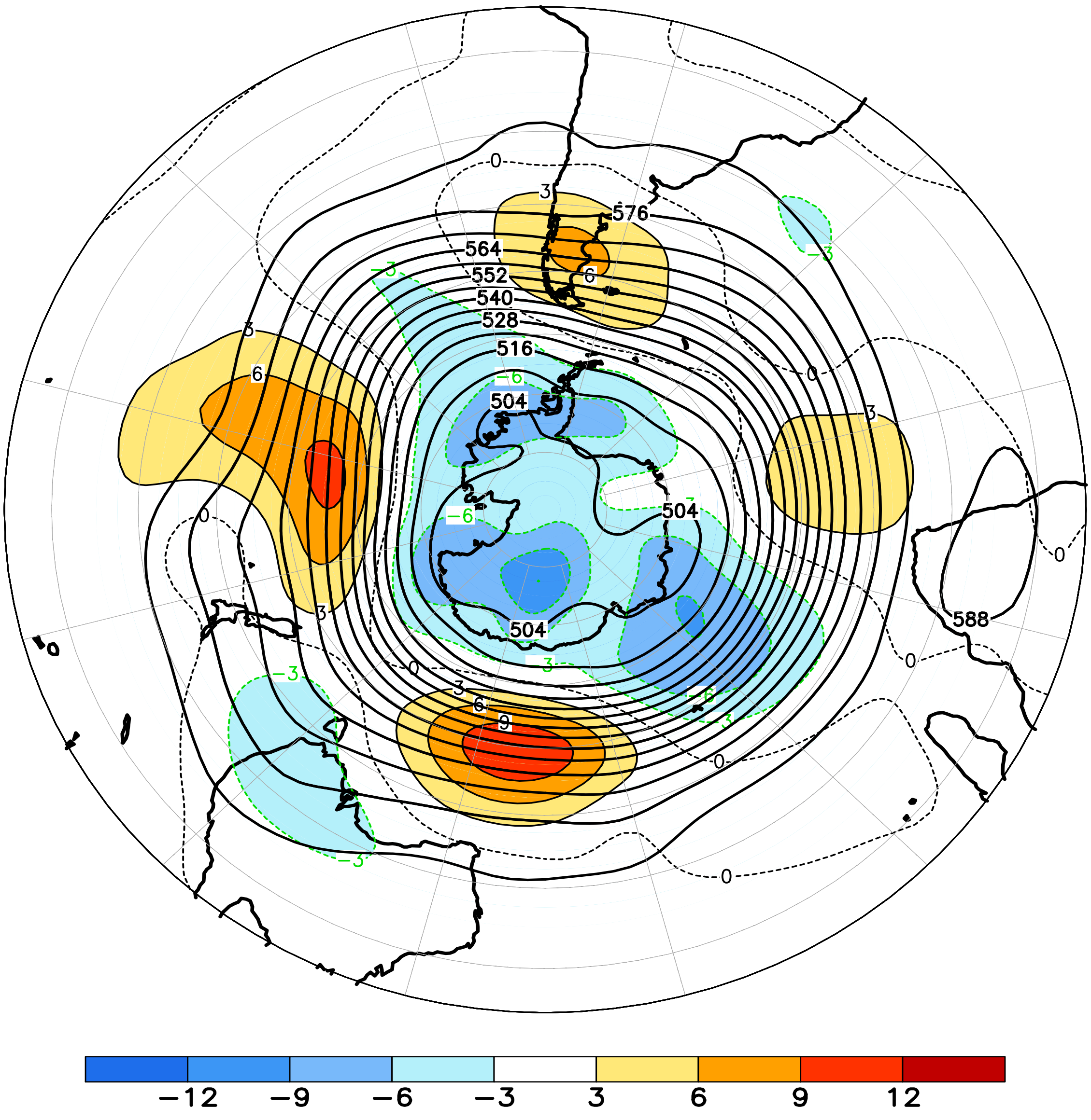



FIGURE E15. Southern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis) for FEB 2008. Mean heights are denoted by solid contours drawn at an interval of 8 dam. Anomaly contour interval is 3 dam with values less (greater) than -3 dam (3 dam) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.

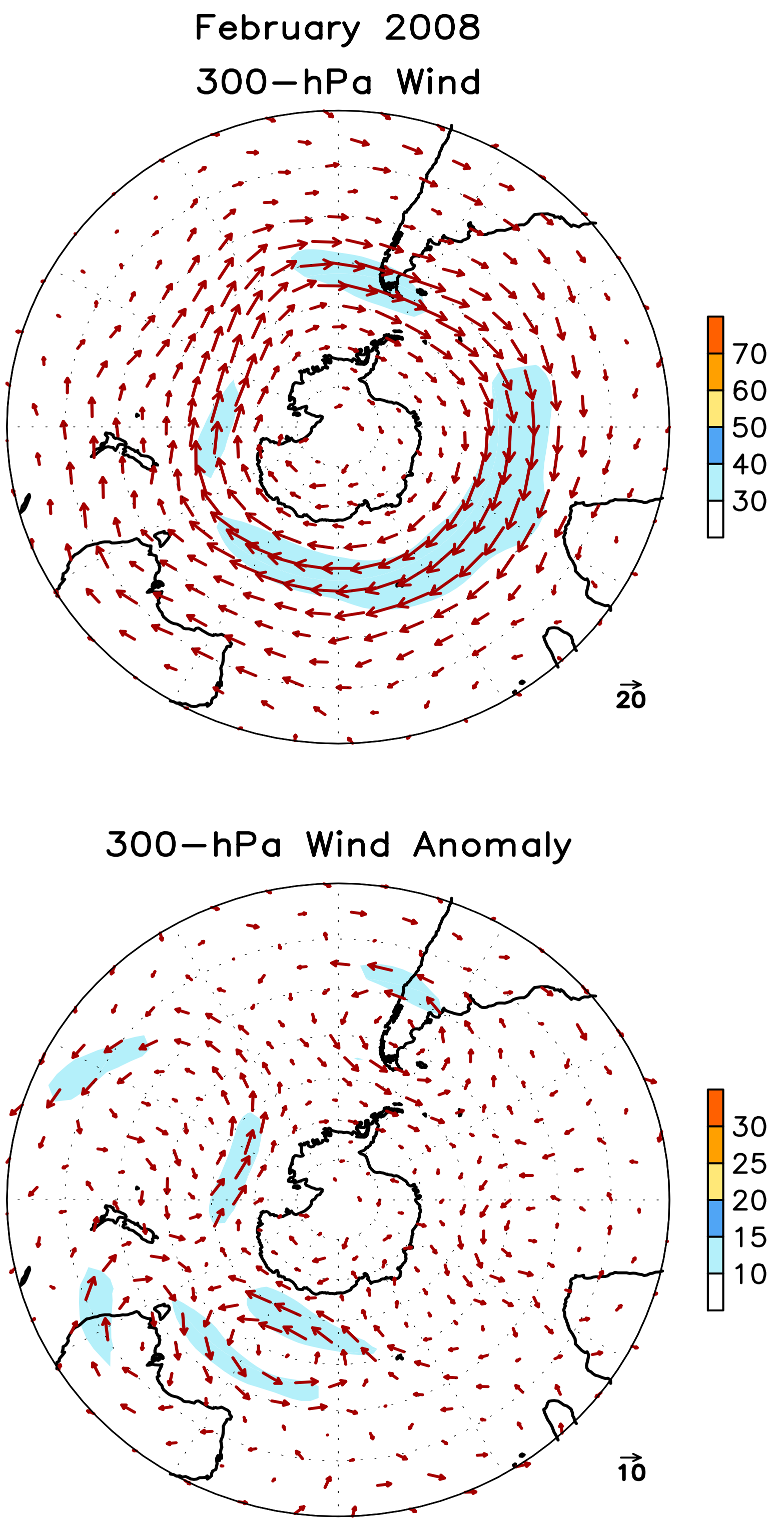



FIGURE E16. Southern Hemisphere mean (left) and anomalous (right) 300-hPa vector wind (CDAS/Reanalysis) for FEB 2008. Mean (anomaly) isotach contour interval is 10 (5) $ms^{-1}$. Values greater than 30 $ms^{-1}$ (left) and 10 $ms^{-1}$ (rights) are shaded. Anomalies are departures from the 1979-95 base period monthly means.

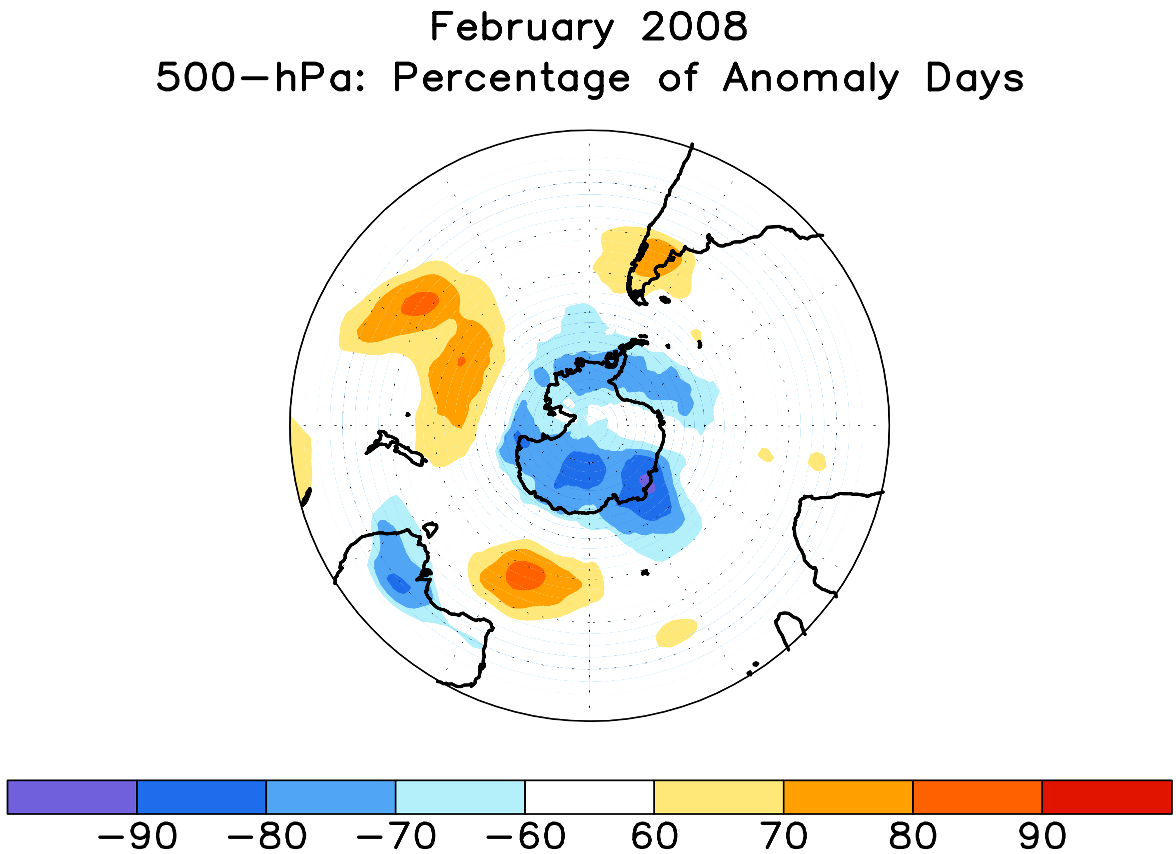



FIGURE E17. Southern Hemisphere percentage of days during FEB 2008 in which 500-hPa height anomalies greater than 15 m (red) and less than -15 m (blue) were observed. Values greater than 70% are shaded and contour interval is 20%.

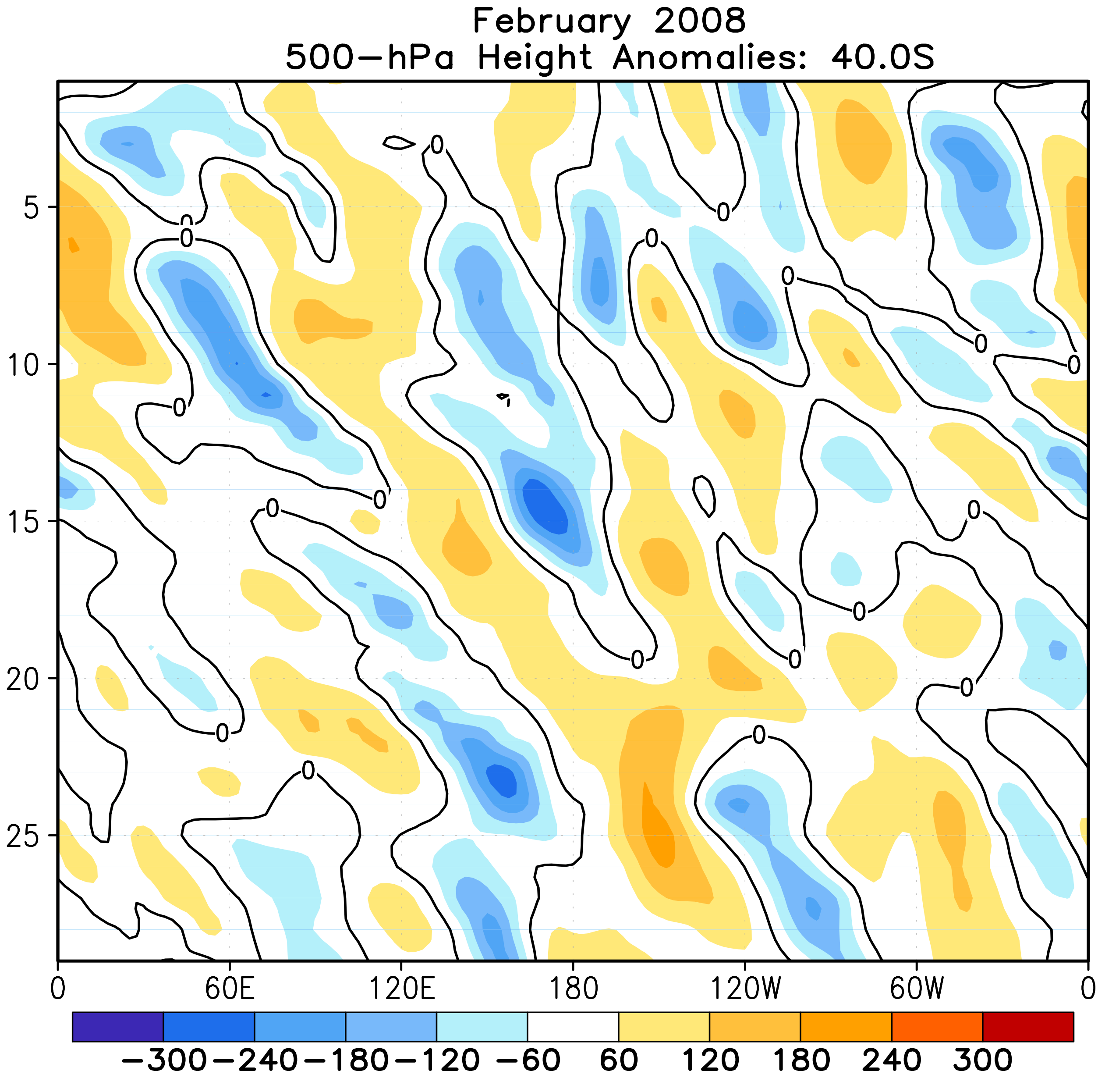



FIGURE E18. Southern Hemisphere: Daily 500-hPa height anomalies for FEB 2008 averaged over the 5° latitude band centered on 40°S. Positive values are indicated by solid contours and dark shading. Negative values are indicated by dashed coutours and light shading. Contour interval is 60 m. Anomalies are departures from the 1979-95 base period daily means.

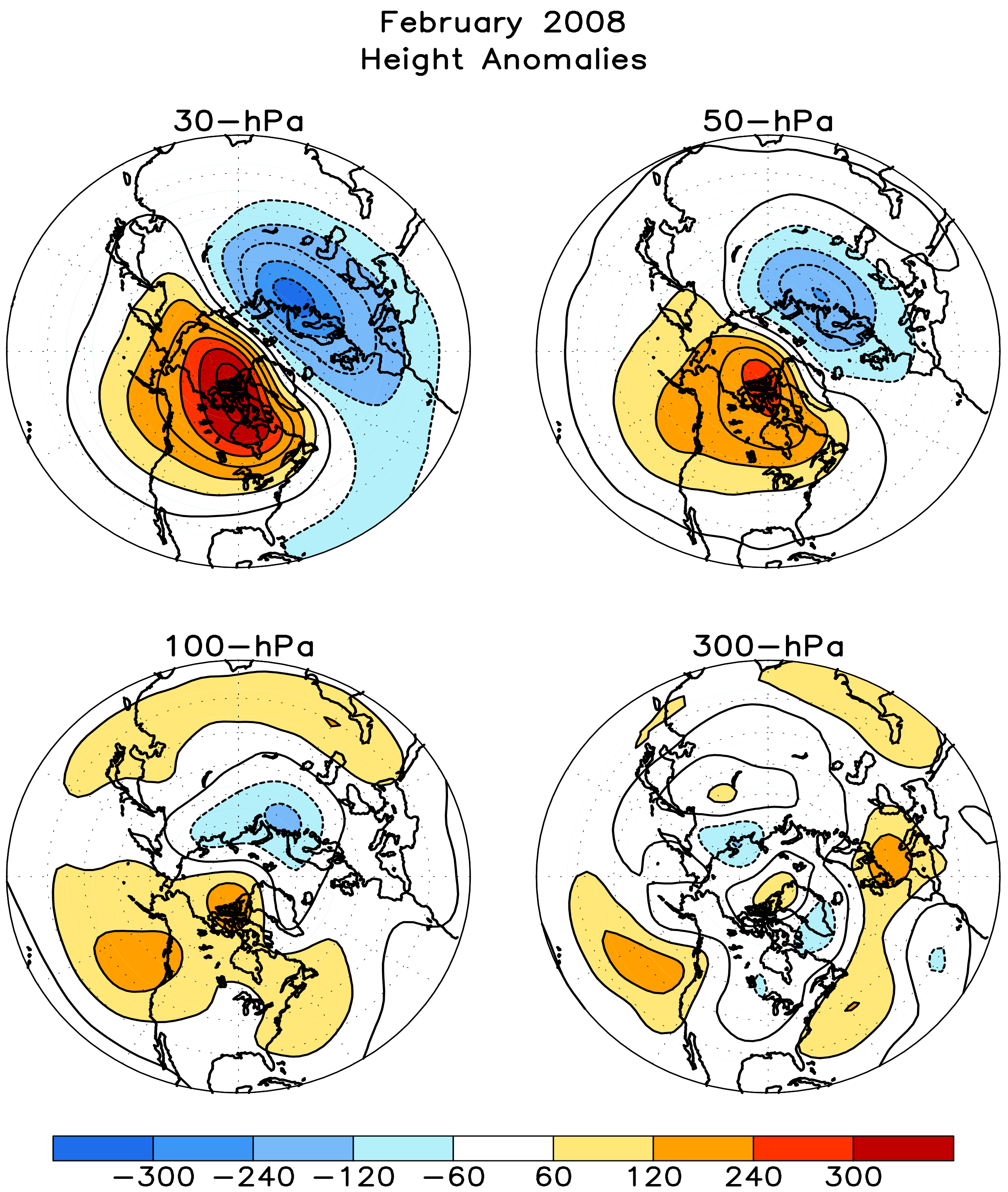



FIGURE S1. Stratospheric height anomalies (m) at selected levels for FEB 2008. Positive values are indicated by solid contours and dark shading. Negative values are indicated by dashed contours and light shading. Contour interval is 60 m. Anomalies are calculated from the 1979–95 base period means. Winter Hemisphere is shown.

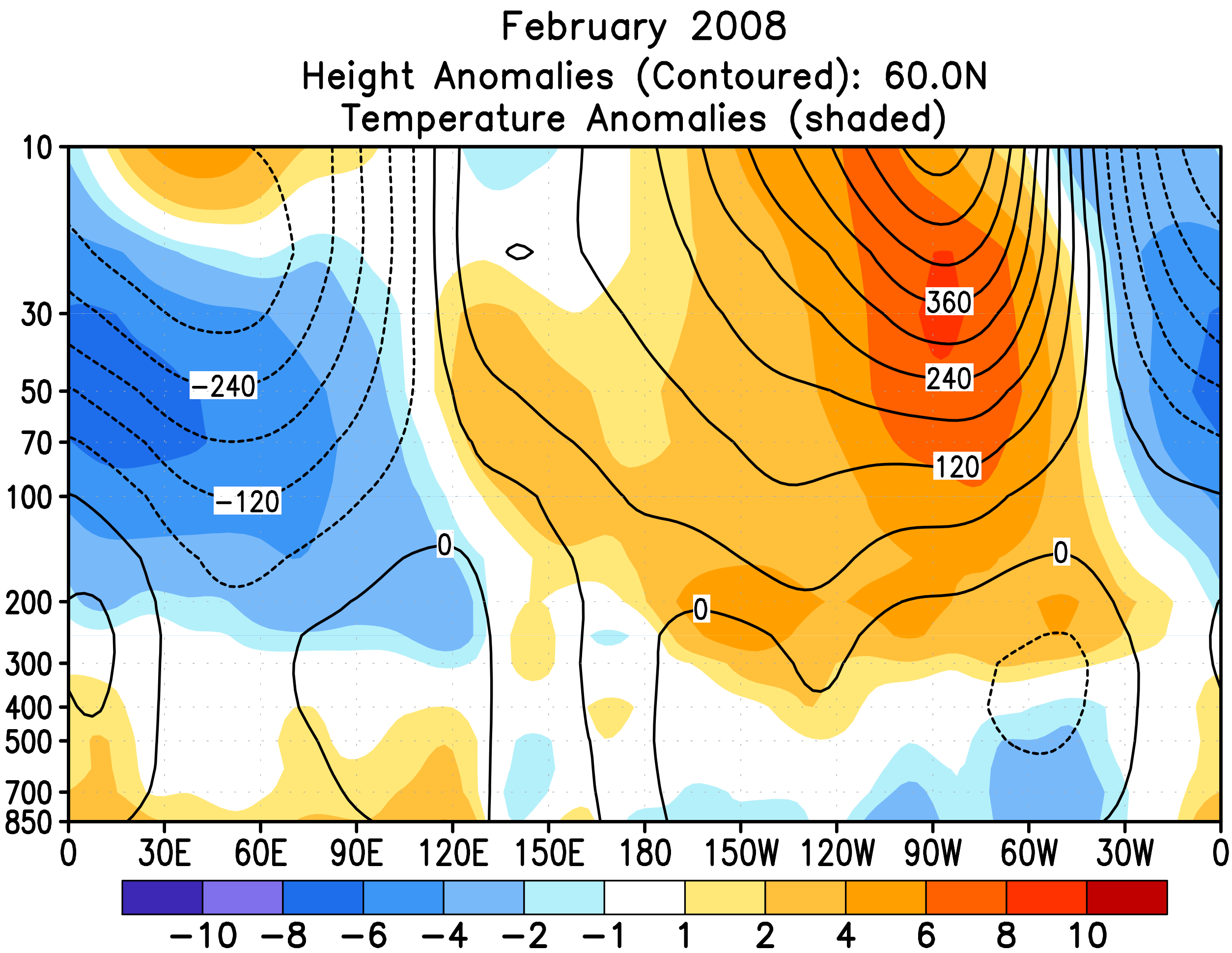



FIGURE S2. Height-longitude sections during FEB 2008 for height anomalies (contour) and temperature anomalies (shaded). In both panels, positive values are indicated by solid contours and dark shading, while negative anomalies are indicated by dashed contours and light shading. Contour interval for height anomalies is 60 m and for temperature anomalies is 2°C. Anomalies are calculated from the 1979–95 base period monthly means. Winter Hemisphere is shown.

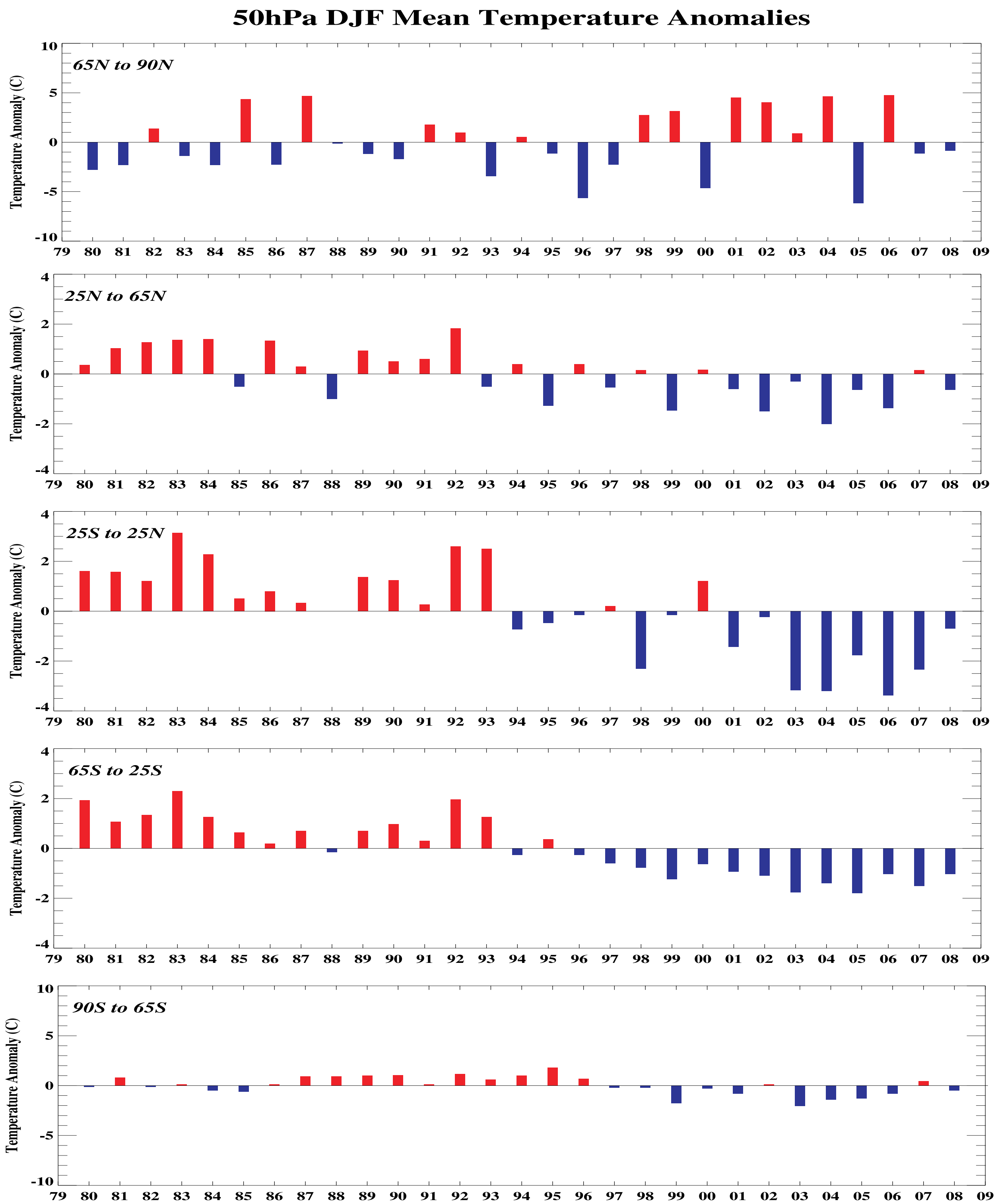



FIGURE S3. Seasonal mean temperature anomalies at 50-hPa for the latitude bands 65°–90°N, 25°–65°N, 25°N–25°S, 25°–65°S, 65°–90°S. The seasonal mean is comprised of the most recent three months. Zonal anomalies are taken from the mean of the entire data set.

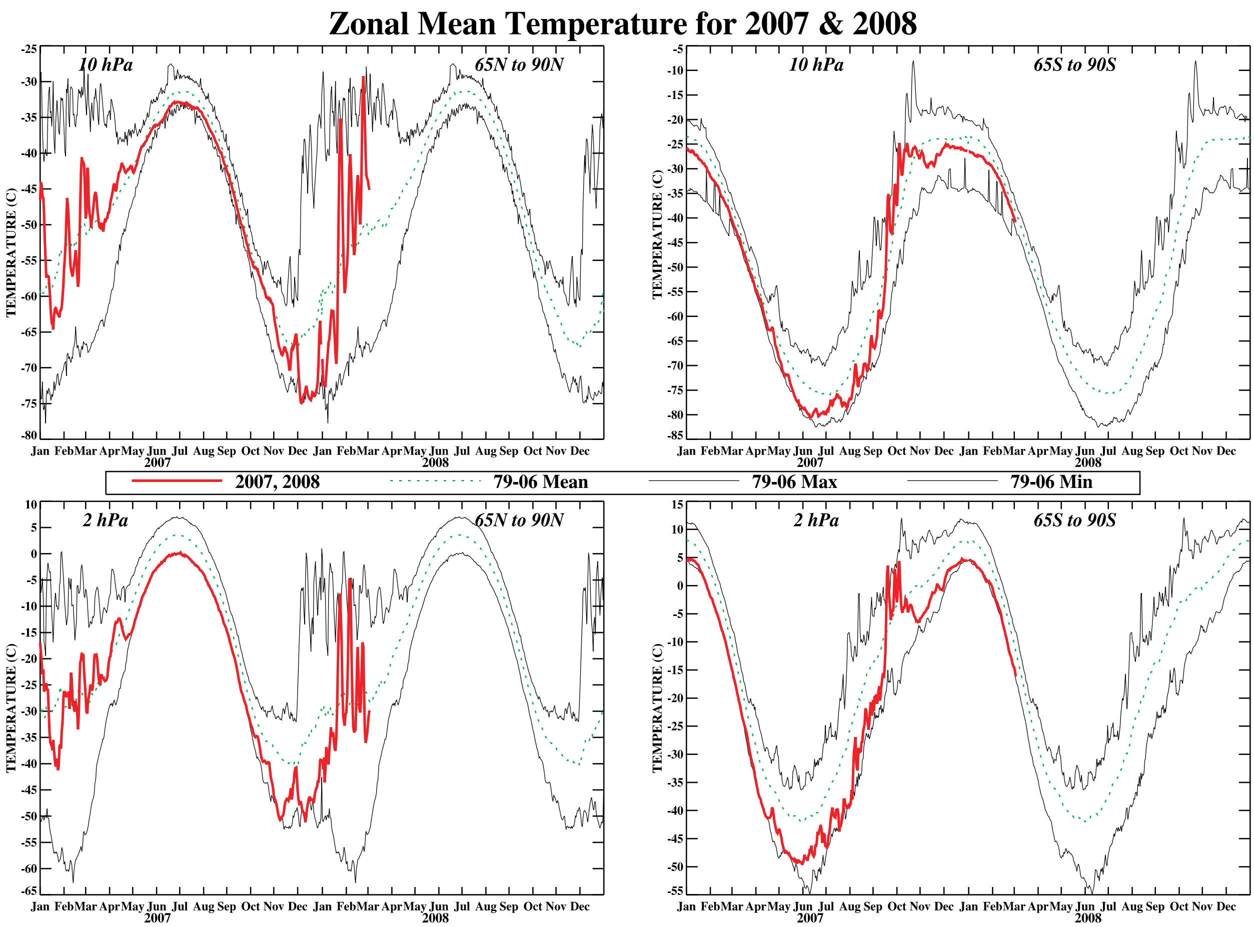



FIGURE S4. Daily mean temperatures at 10-hPa and 2-hPa (thick line) in the region 65°–90°N and 65°–90°S for the past two years. Dashed line depicts the 1979–99 base period daily mean. Thin solid lines depict the daily extreme maximum and minimum temperatures.

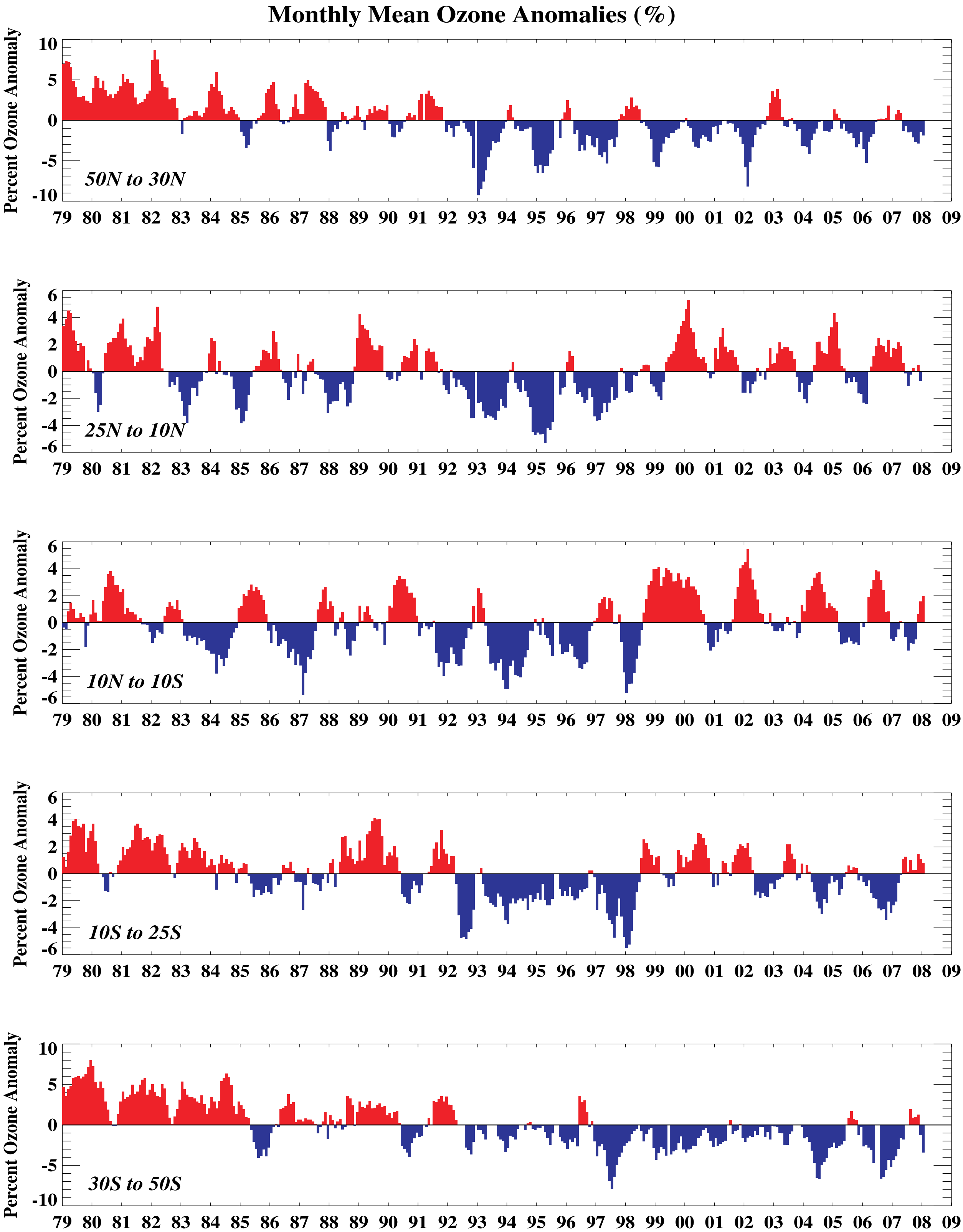



FIGURE S5. Monthly ozone anomalies (percent) from the long term monthly means for five zones: 50N-30N (NH mid-latitudes), 25N-10N (NH tropical surf zone), 10N-10S (Equatorial-QBO zone), 10S-25S (SH tropical surf zone), and 30S-50S (SH mid-latitudes). The long term monthly means are determined from the entire data set beginning in 1979.

# FEBRUARY PERCENT DIFF (2008 - AVG(79-86))

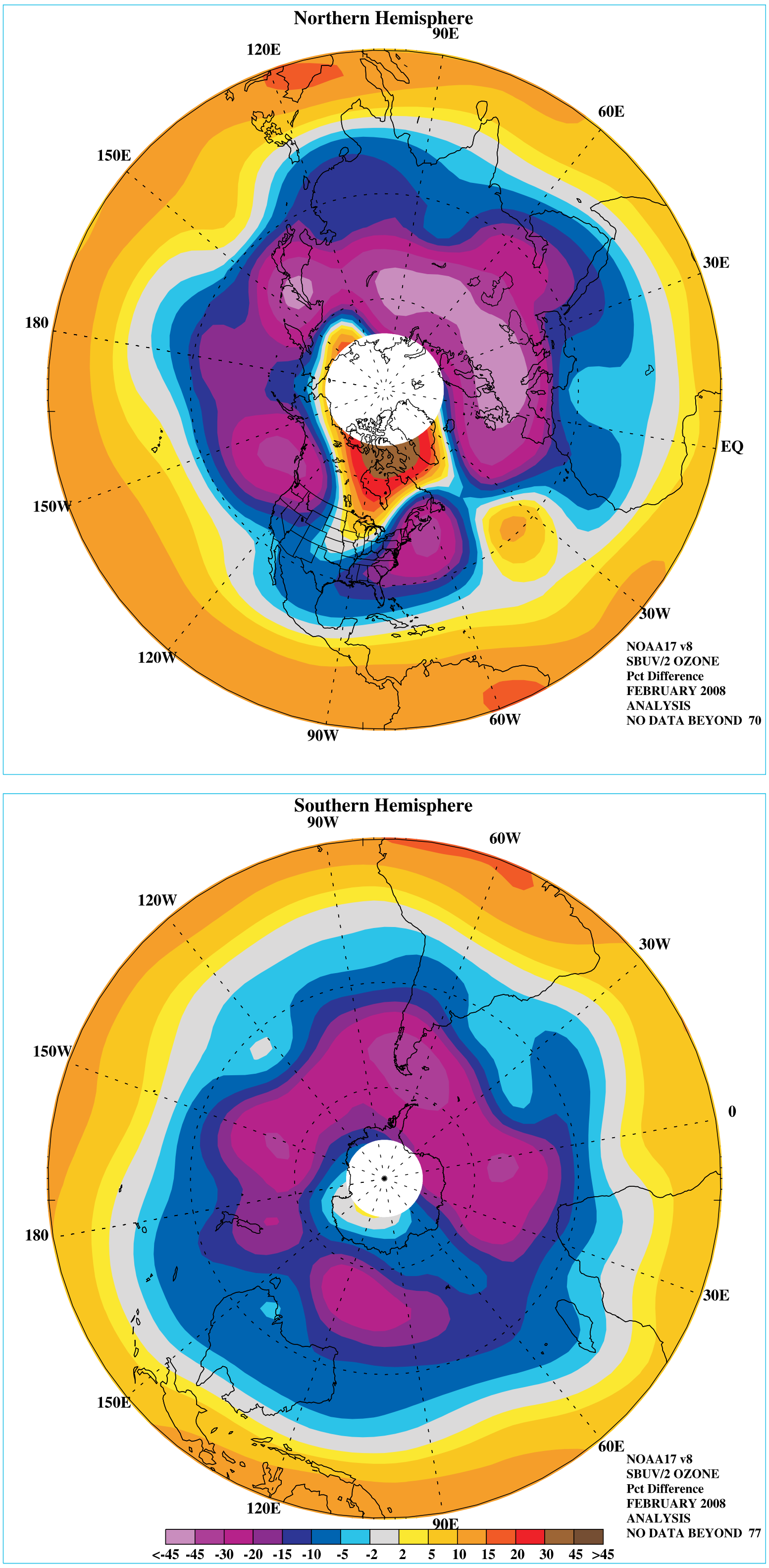



FIGURE S6. Northern (top) and Southern (bottom) Hemisphere total ozone anomaly (percent difference from monthly mean for the period 1979–86). The region near the winter pole has no SBUV/2 data.

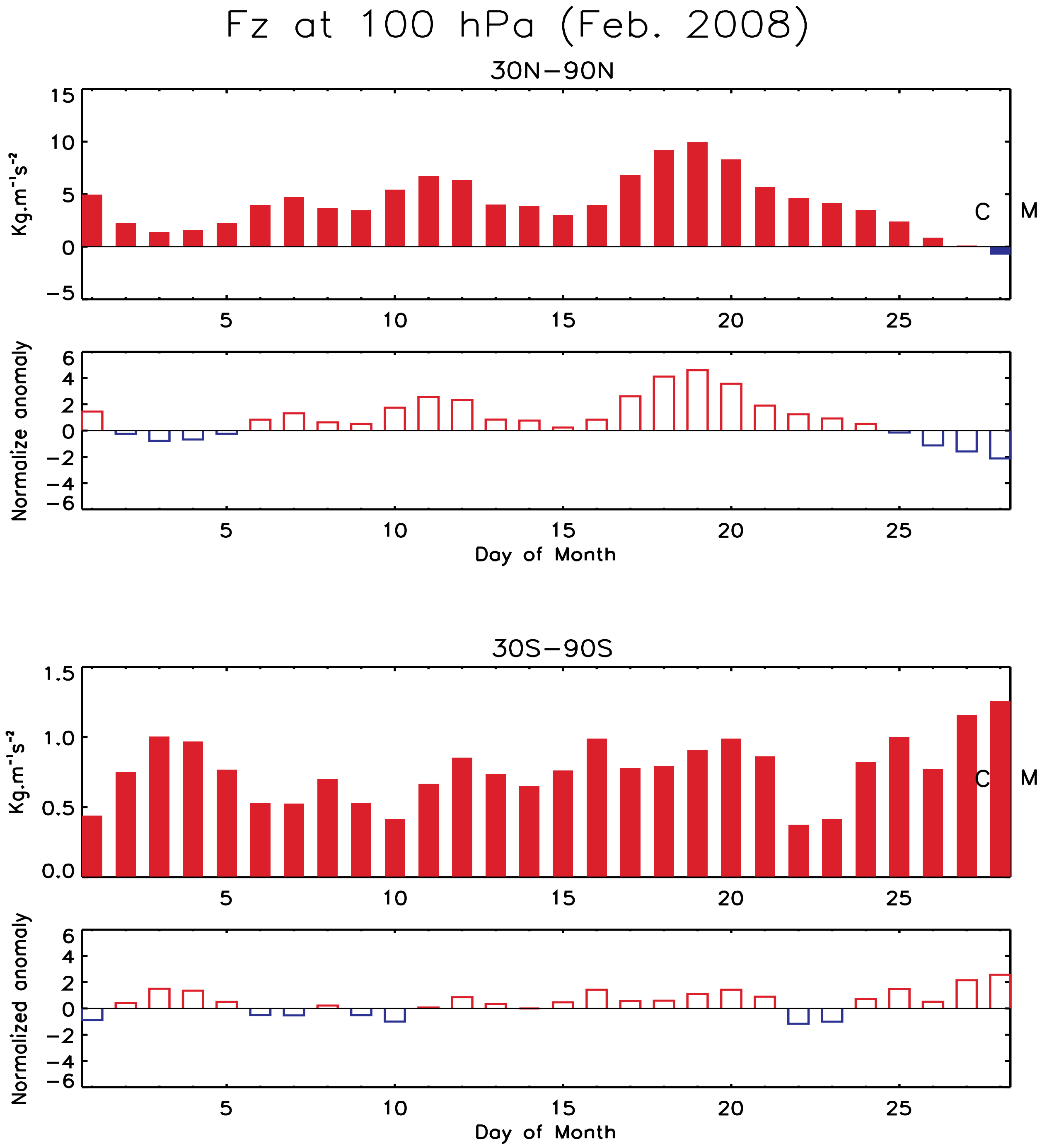



FIGURE S7. Daily vertical component of EP flux (which is proportional to the poleward transport of heat or upward transport of potential energy by planetary wave) at 100 hPa averaged over (top) 30°N–90°N and (bottom) 30°S–90°S for FEB 2008. The EP flux unit (kg $m^{-1}$ $s^{-2}$) has been scaled by multiplying a factor of the Brunt Vaisala frequency divided by the Coriolis parameter and the radius of the earth. The letter 'M' indicates the current monthly mean value and the letter 'C' indicates the climatological mean value. Additionally, the normalized departures from the monthly climatological EP flux values are shown.

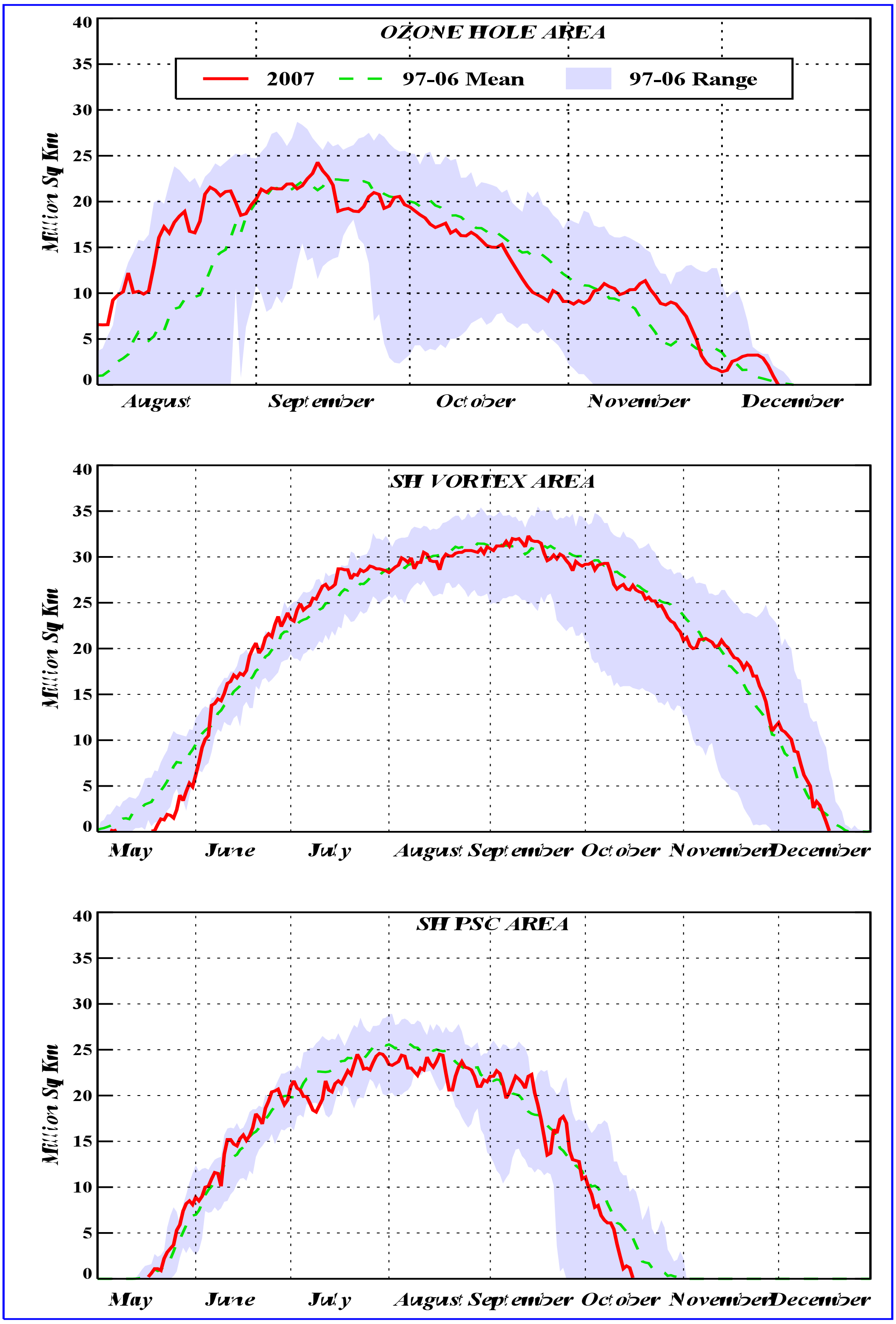



FIGURE S8. Daily time series showing the size of the NH polar vortex (representing the area enclosed by the 32 PVU contour on the 450K isentropic surface), and the areal coverage of temperatures < -78C on the 450K isentropic surface.

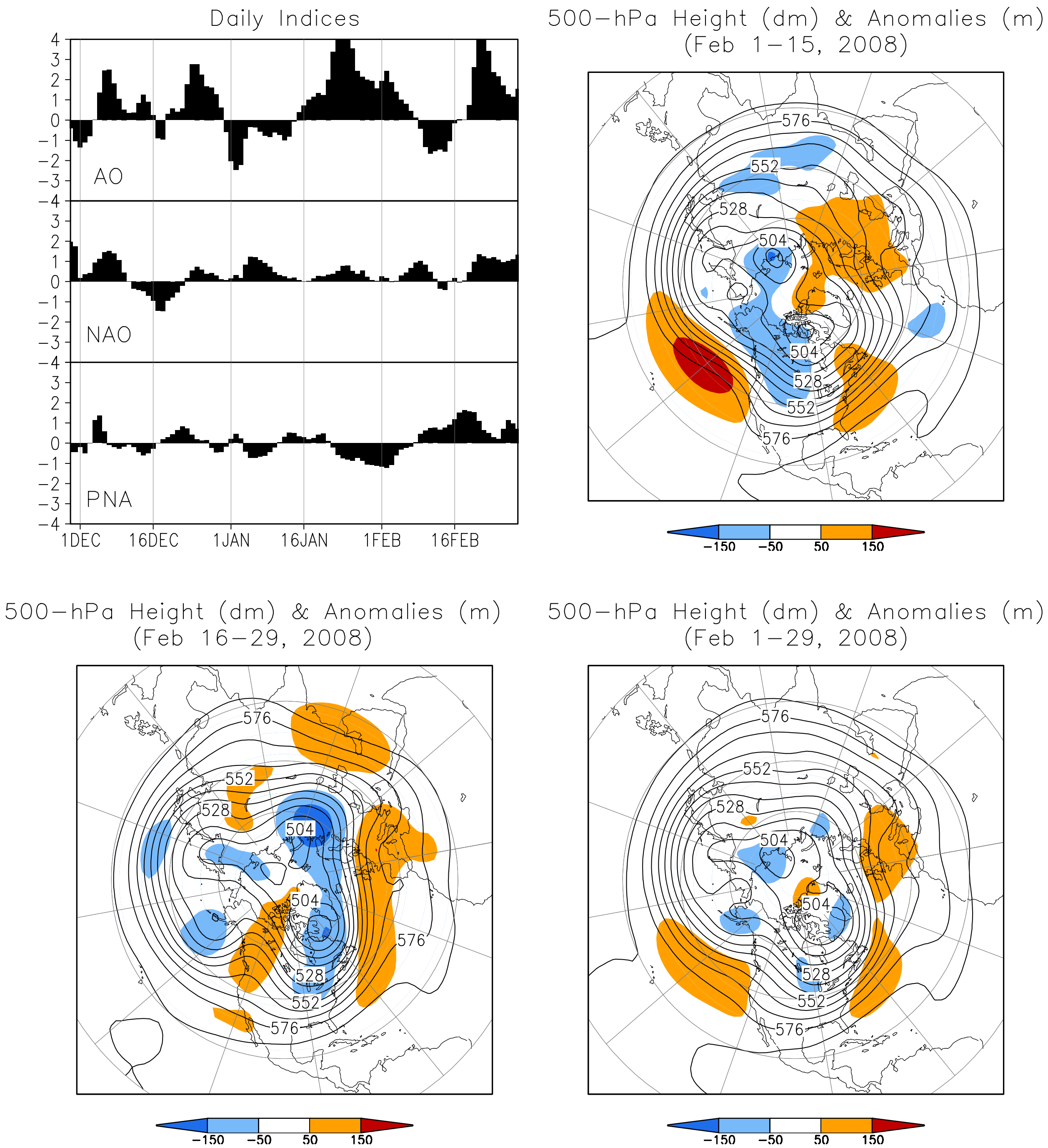



FIGURE A2.1. (a) Daily amplitudes of the Arctic Oscillation (AO) the North Atlantic Oscillation (NAO), and the Pacific-North American (PNA) pattern. The pattern amplitudes for the AO, (NAO, PNA) are calculated by projecting the daily 1000-hPa (500-hPa) height anomaly field onto the leading EOF obtained from standardized time- series of daily 1000-hPa (500-hPa) height for all months of the year. The base period is 1979–2000.

(b-d) Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis) for selected periods during FEB 2008 are shown in the remaining 3 panels. Mean heights are denoted by solid contours drawn at an interval of 8 dam. Dark (light) shading corresponds to anomalies greater than 50 m (less than -50 m). Anomalies are calculated as departures from the 1979–95 base period daily means.

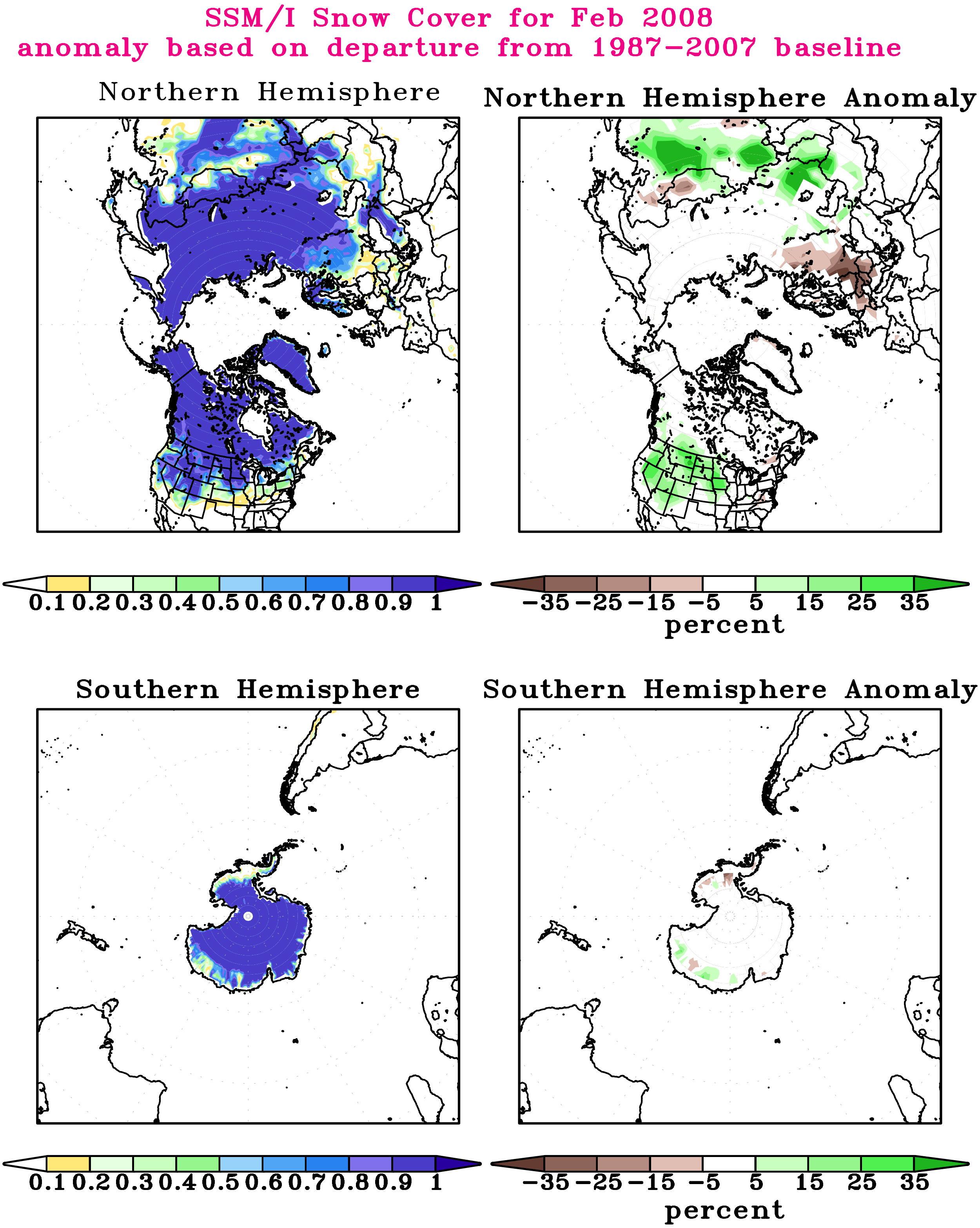



FIGURE A2.2. SSM/I derived snow cover frequency (%) (left) and snow cover anomaly (%) (right) for the month of FEB 2008 based on 1987 - 2006 base period for the Northern Hemisphere (top) and Southern Hemisphere (bottom). It is generated using the algorithm described by Ferraro et. al, 1996, Bull. Amer. Meteor. Soc., vol 77, 891-905.