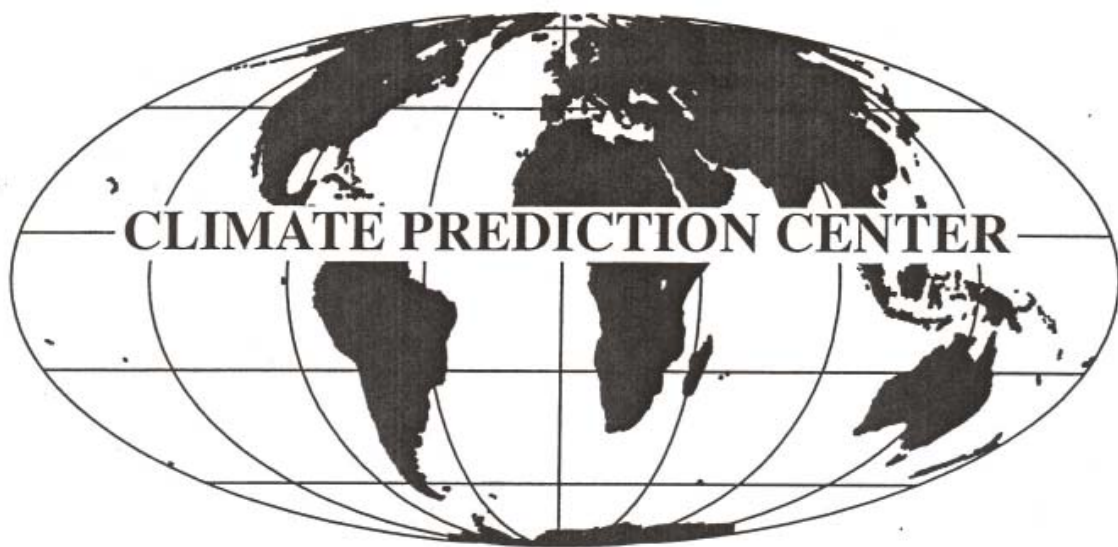


# CLIMATE DIAGNOSTICS BULLETIN



**AUGUST 2007**

**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



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## Tropical Highlights - August 2007

During August 2007, negative equatorial sea surface temperature (SST) anomalies in the eastern equatorial Pacific expanded westward, and now extend from the coast of South America to the date line (180°W) (**Fig. T18**). This pattern is reflected in negative values of the Niño 1+2 (-1.6), Niño 3 (-1.1), and Niño 3.4 (-0.5) region SST indices (**Table T2**). The equatorial oceanic thermocline during August, measured by the depth of the 20°C isotherm, featured a continuation of below-average depths over the eastern equatorial Pacific and near-average depths across the western and central equatorial Pacific (**Figs. T15, T16**). As a result, temperatures in the eastern equatorial Pacific remained generally 1-3°C below average at thermocline depth (**Fig. T17**).

During August 2007, low-level easterly anomalies (more than  $3.0 \text{ m s}^{-1}$ ) were observed over the central equatorial Pacific (**Fig. T20**). This anomaly pattern has persisted since February (**Fig. T13**), and is consistent with the shallower-than-average thermocline and cooler SSTs farther east. This wind pattern was also associated with enhanced convection (above-average rainfall amounts) across Indonesia, and a continuation of suppressed convection (below-average rainfall amounts) across the central and eastern equatorial Pacific (**Figs. T26, E3**). Consistent with these anomalies, the equatorial SOI remained positive (+1.2) (**Fig. T2**), although the Tahiti – Darwin SOI was near-average (+0.1) (**Table T1, Fig. T1**). This overall combination of oceanic and atmospheric conditions reflects the development of La Niña conditions.

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](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		
<b>AUG 07</b>	0.9	0.8	0.1	0.9	0.4	0.1	0.2	5N-5S 160E-160W 0.6
<b>JUL 07</b>	0.5	1.4	-0.5	1.1	0.1	-1.0	0.2	1.1
<b>JUN 07</b>	-0.5	-0.8	0.2	1.8	0.8	-0.1	1.2	0.6
<b>MAY 07</b>	0.3	0.9	-0.4	0.5	0.6	-0.5	-0.1	0.2
<b>APR 07</b>	0.5	1.2	-0.4	1.5	1.1	-0.6	0.4	0.1
<b>MAR 07</b>	-0.3	0.3	-0.4	0.8	1.2	0.1	0.9	0.8
<b>FEB 07</b>	0.0	0.7	-0.5	0.9	1.1	-0.5	-0.4	0.1
<b>JAN 07</b>	-1.2	0.5	-1.1	0.4	0.9	-0.7	0.2	-1.2
<b>DEC 06</b>	0.6	1.4	-0.5	1.6	0.7	-0.7	-1.3	-0.3
<b>NOV 06</b>	1.1	1.1	0.1	0.2	-0.2	-1.6	-1.2	-0.2
<b>OCT 06</b>	-0.4	2.3	-1.7	-1.2	-0.8	-0.9	-1.2	-0.8
<b>SEP 06</b>	0.3	1.4	-0.7	-0.5	0.1	-0.1	0.2	-0.2
<b>AUG 06</b>	-0.6	2.0	-1.6	-0.9	-0.5	-1.5	0.2	-0.3

\* 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	NIÑO 4 5°N-5°S 160°E-150- °W	N. ATL 5N-20N 60W-30W	S. ATL 0-20S 30W-10E								
<b>AUG 07</b>	-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
<b>JUL 07</b>	-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
<b>JUN 07</b>	-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
<b>MAY 07</b>	-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
<b>APR 07</b>	-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
<b>MAR 07</b>	-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
<b>FEB 07</b>	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
<b>JAN 07</b>	0.5	25.0	0.9	26.5	0.7	27.3	0.8	28.9	0.5	26.3	0.3	25.7	0.5	28.0
<b>DEC 06</b>	0.5	23.3	1.3	26.3	1.3	27.8	1.2	29.5	0.5	27.2	0.2	24.8	0.7	28.2
<b>NOV 06</b>	1.0	22.7	1.1	26.1	1.2	27.7	1.3	29.6	0.6	28.1	0.1	24.0	0.6	28.1
<b>OCT 06</b>	1.2	22.1	1.1	26.0	0.9	27.4	1.0	29.4	0.8	28.7	0.1	23.4	0.4	27.7
<b>SEP 06</b>	0.9	21.4	0.9	25.8	0.7	27.4	0.9	29.4	0.7	28.6	0.3	23.2	0.4	27.5
<b>AUG 06</b>	0.8	21.6	0.5	25.4	0.5	27.2	0.8	29.2	0.5	28.0	0.3	23.3	0.3	27.4

\* 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).



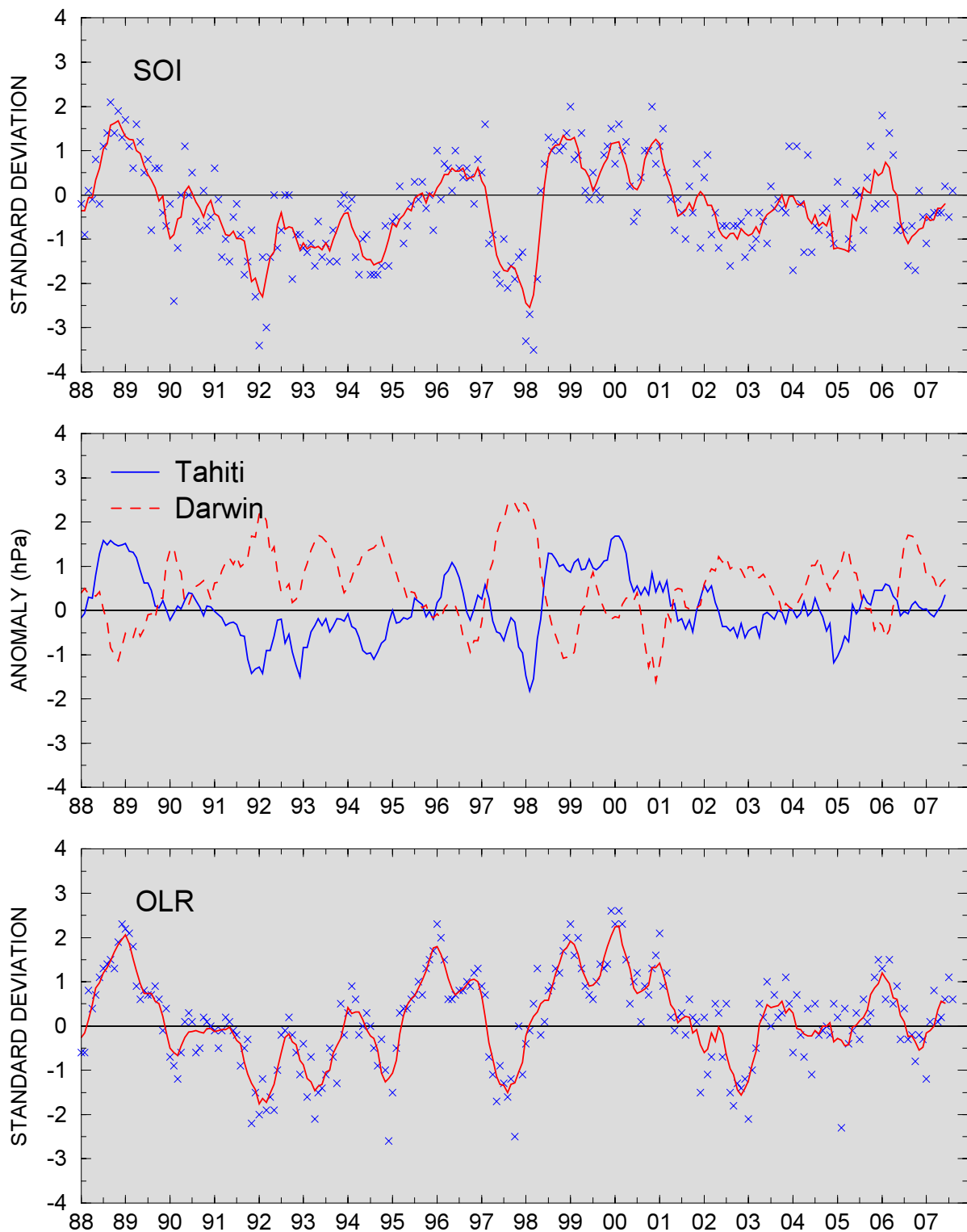


FIGURE T1. Five-month running mean of the Southern Oscillation Index (SOI) (top), sea-level pressure anomaly (hPa) at Darwin and Tahiti (middle), and outgoing longwave radiation anomaly (OLR) averaged over the area 5N-5S, 160E-160W (bottom). Anomalies in the top and middle panels are departures from 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.

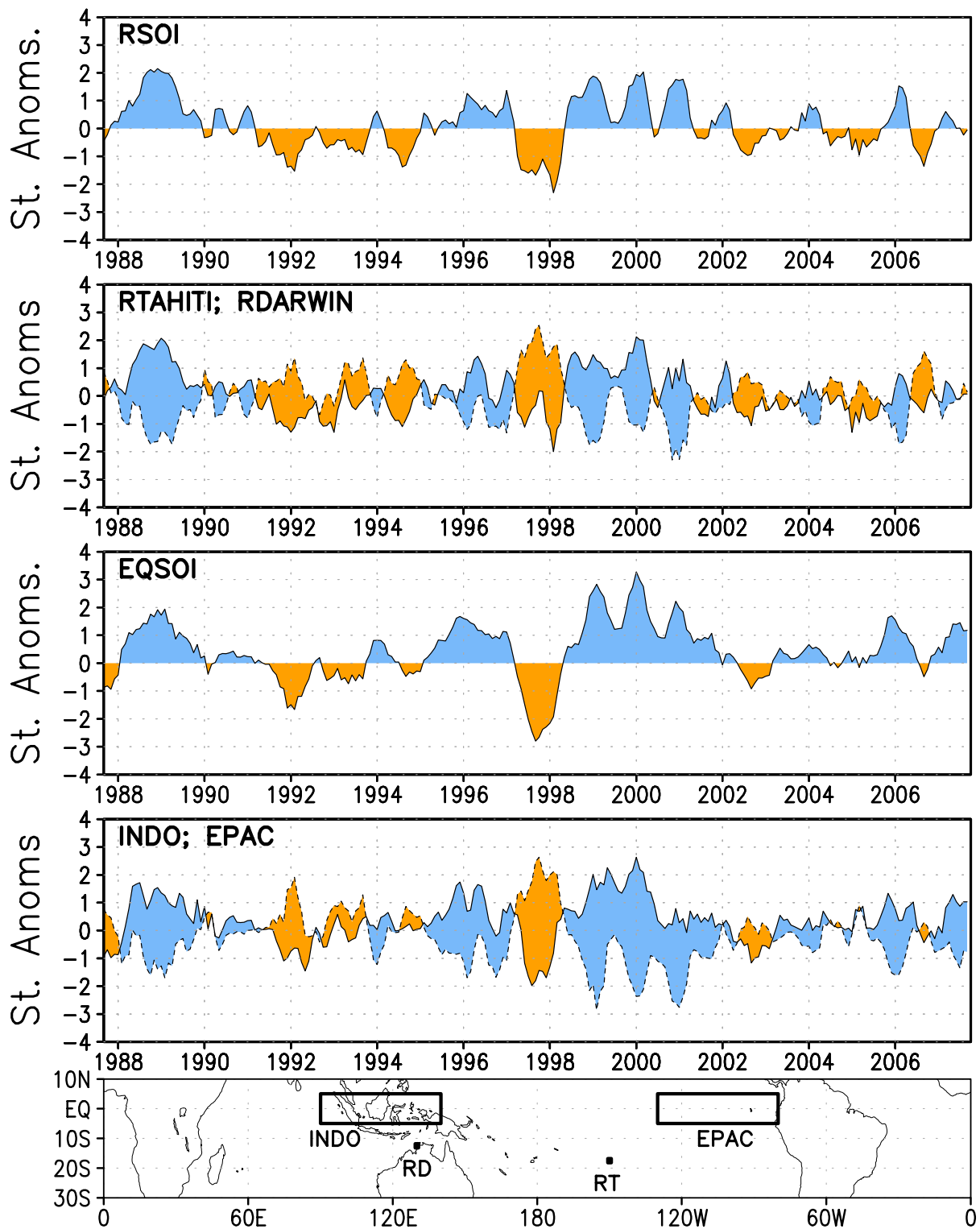


FIGURE T2. Three-month running mean of a CDAS/Reanalysis-derived (a) Southern Oscillation Index (RSOI), (b) standardized pressure anomalies near Tahiti (solid) and Darwin (dashed), (c) an equatorial SOI ([EPAC] - [INDO]), and (d) standardized equatorial pressure anomalies for (EPAC) (solid) and (INDO) (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).

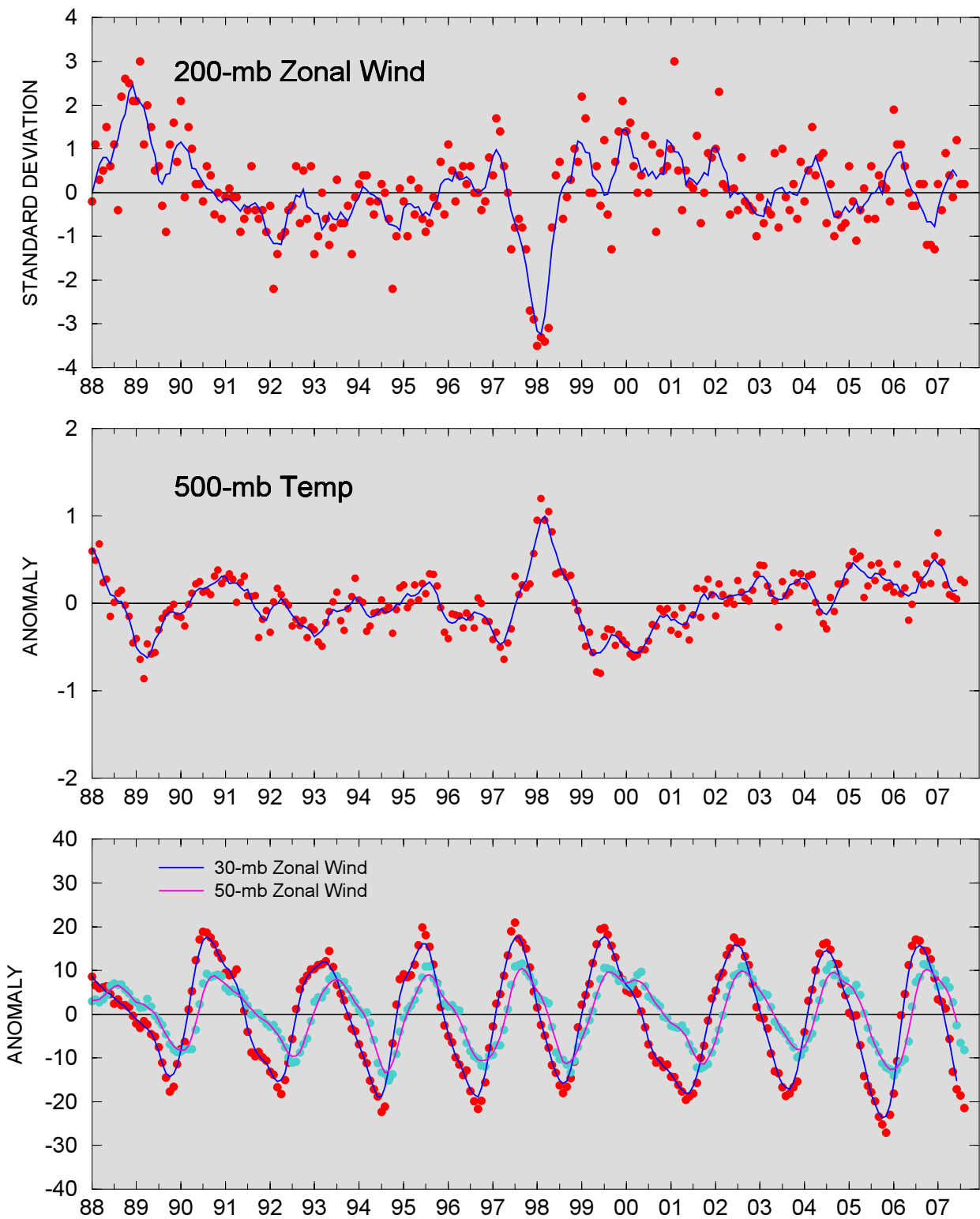
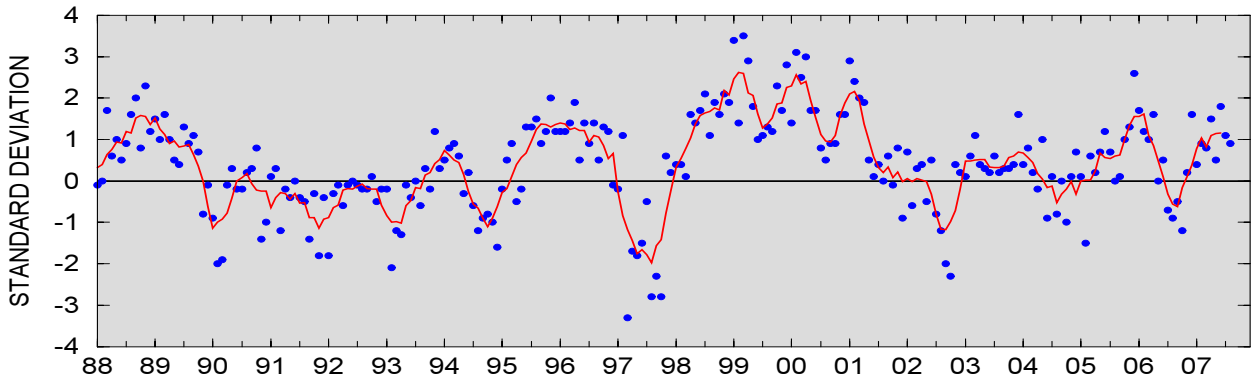
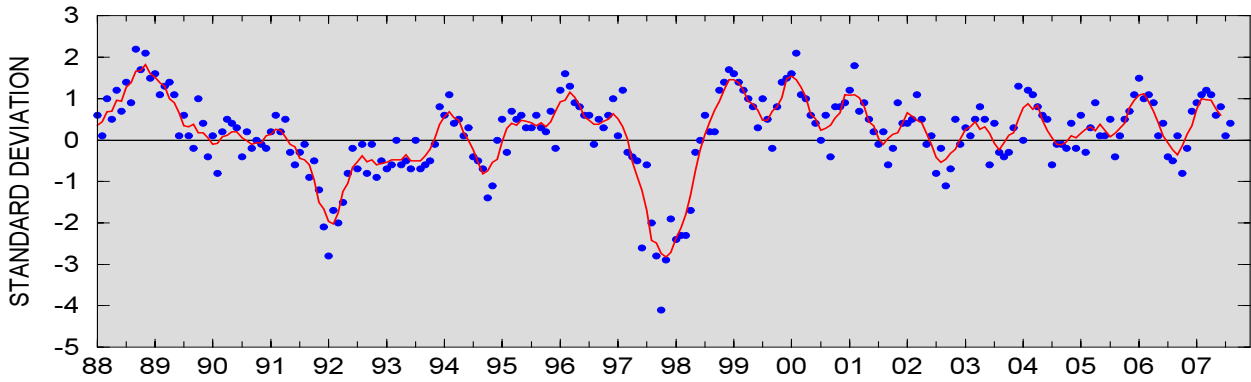


FIGURE T3. Five-month running mean (solid lines) and individual monthly mean (dots) of the 200-hPa zonal wind anomalies averaged over the area 5N-5S, 165W-110W (top), the 500-hPa virtual temperature anomalies averaged over the latitude band 20N-20S (middle), and the equatorial zonally-averaged zonal 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.

### 850-mb Zonal Wind Anomaly 135E-180



### 850-mb Zonal Wind Anomaly 175W-140W



### 850-mb Zonal Wind Anomaly 135W-120W

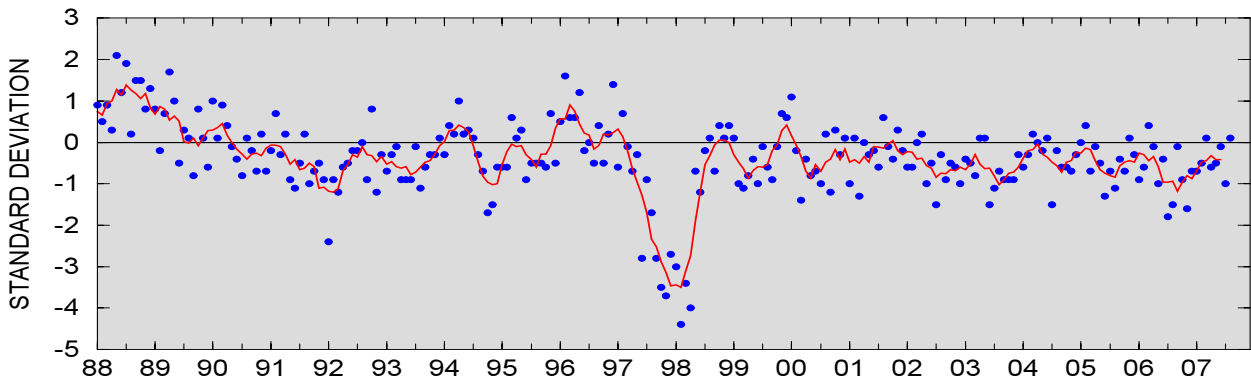


FIGURE T4. Five-month running mean (solid line) and individual monthly mean (dots) of the standardized 850-hPa zonal wind anomaly index in the latitude belt 5N-5S for 135E-180 (top), 175W-140W (middle) and 135W-120W (bottom). Anomalies are departures from the 1979-1995 base period means and are normalized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

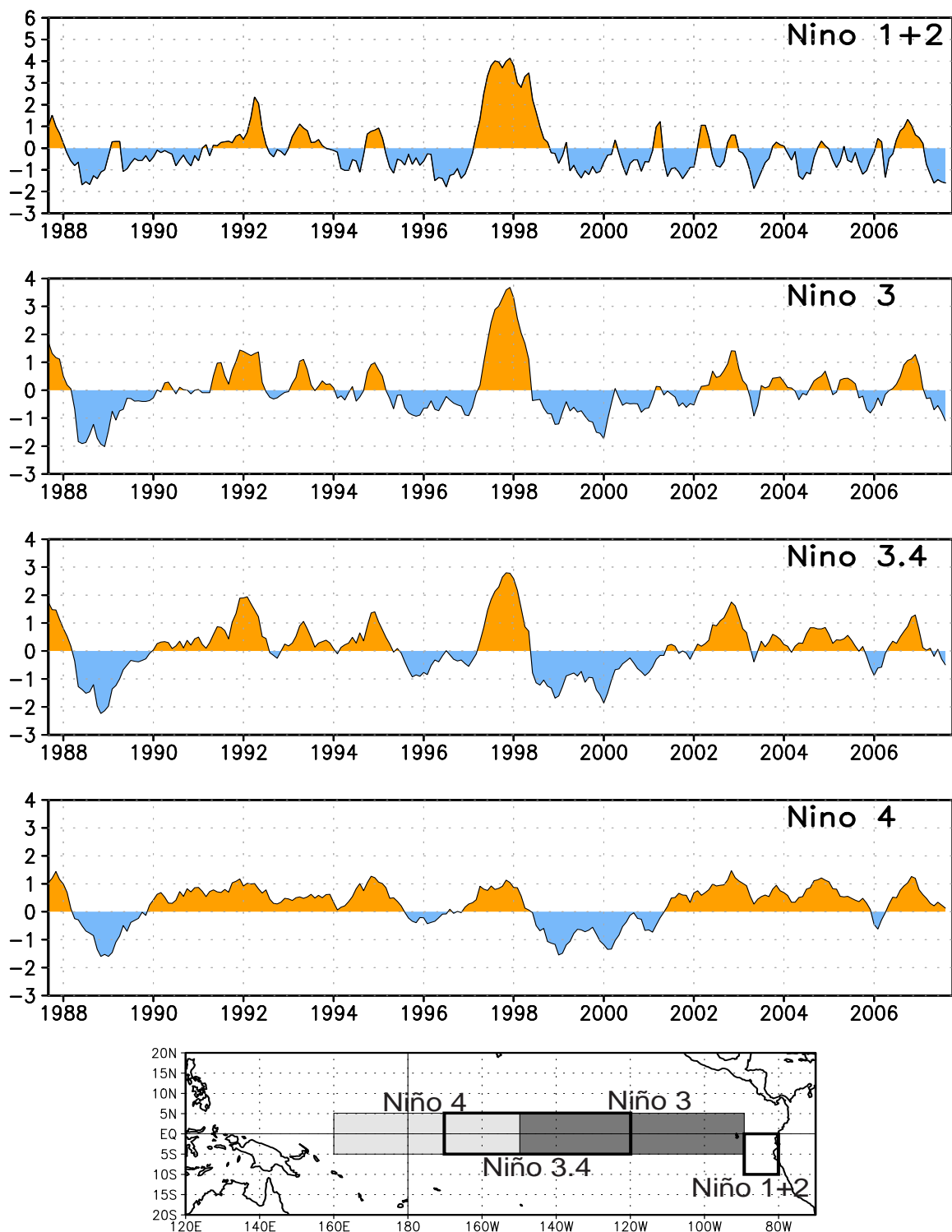


FIGURE T5. Niño region indices, calculated as the area-averaged sea surface temperature anomalies (C) for the specified region. The Niño 1+2 region (top) covers the extreme eastern equatorial Pacific between 0-10S, 90W-80W. The Niño-3 region (2nd from top) spans the eastern equatorial Pacific between 5N-5S, 150W-90W. The Niño 3.4 region (3rd from top) spans the east-central equatorial Pacific between 5N-5S, 170W-120W. The Niño 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](#).

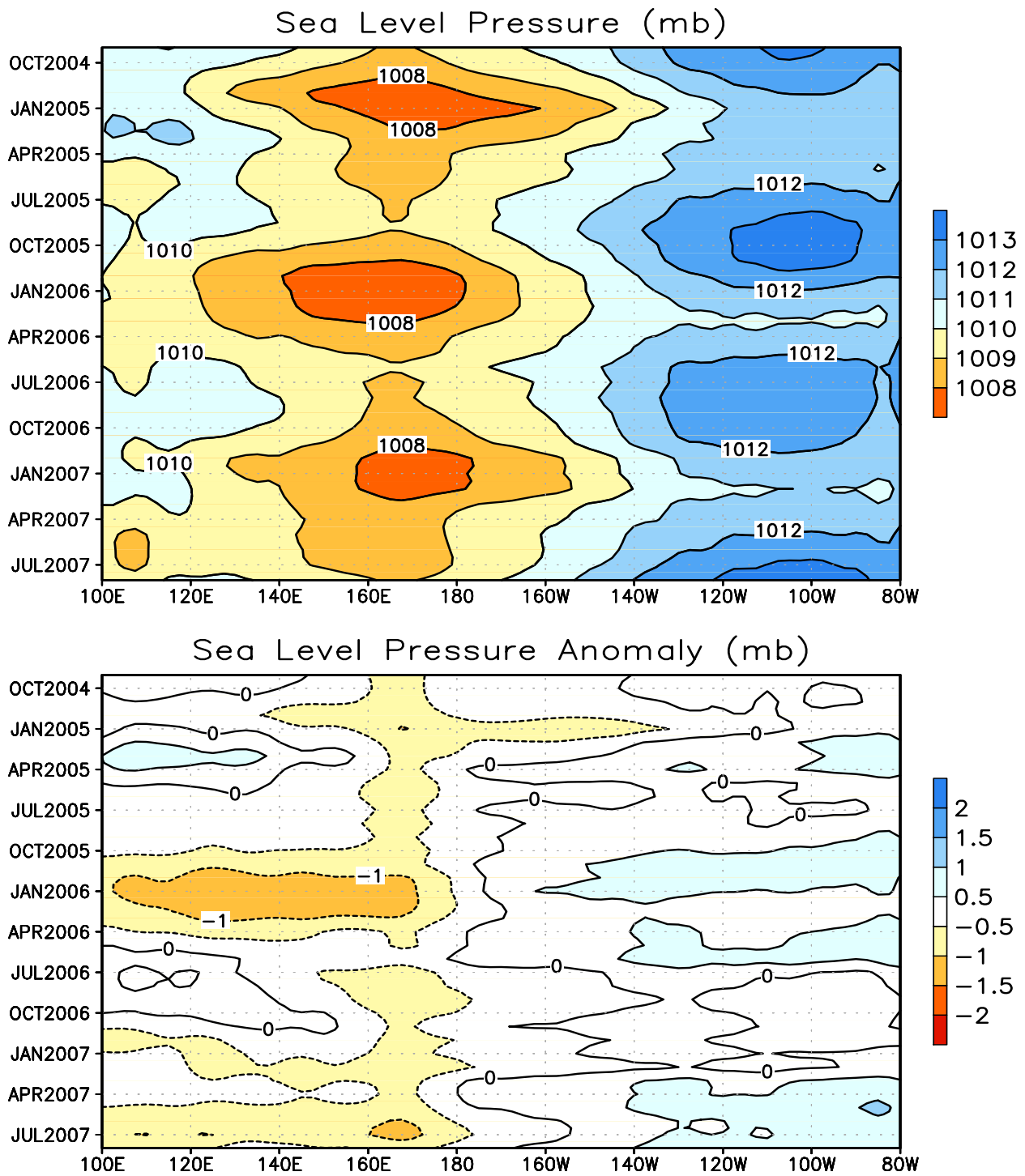


FIGURE T6. Time-longitude section of mean (top) and anomalous (bottom) sea level pressure (SLP) averaged between 5N-5S (CDAS/Reanalysis). Contour interval is 1.0 hPa (top) and 0.5 hPa (bottom). Dashed contours in bottom panel indicate negative anomalies. Anomalies are departures from the 1979-1995 base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

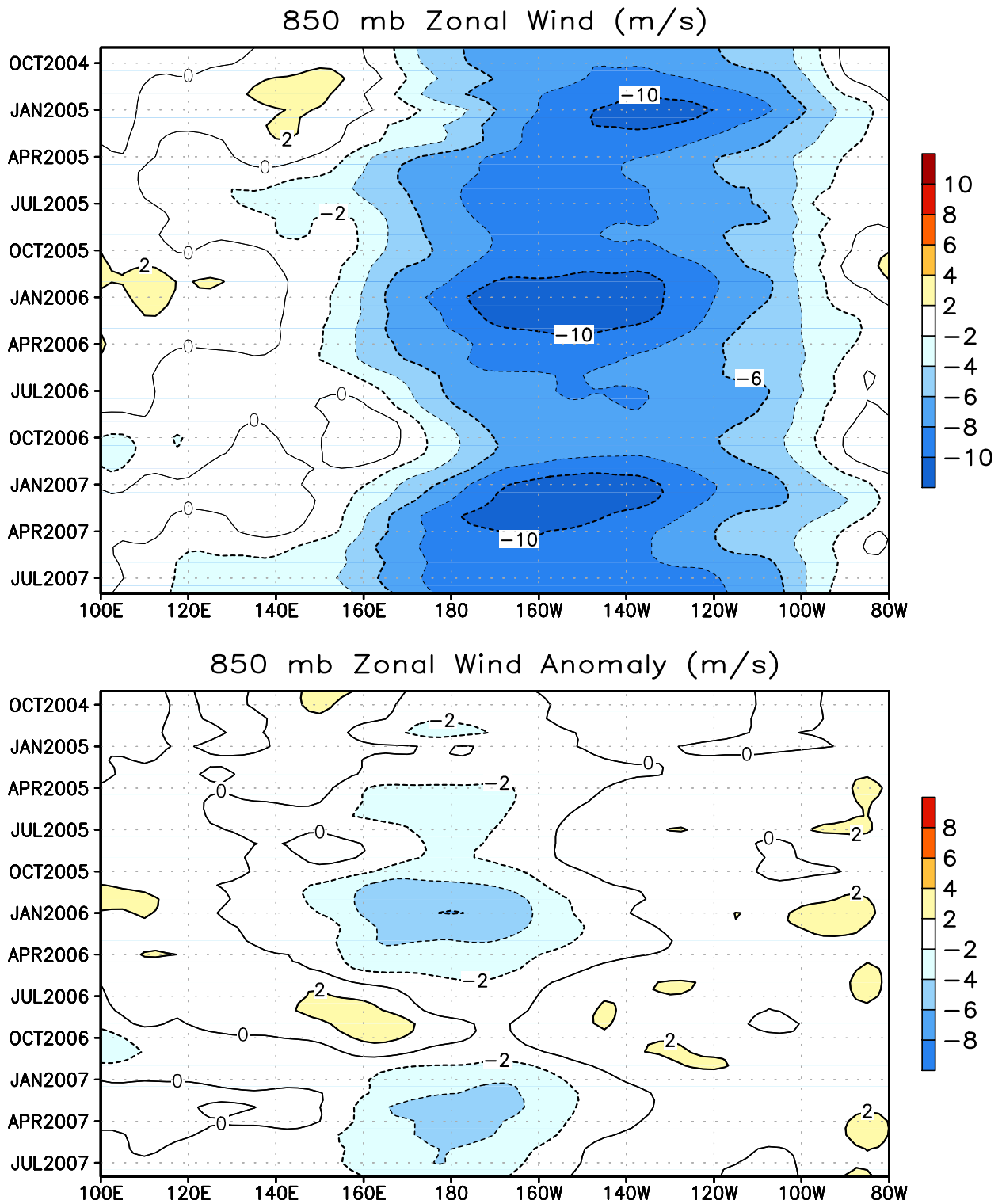


FIGURE T7. Time-longitude section of mean (top) and anomalous (bottom) 850-hPa zonal wind averaged between 5N-5S (CDAS/Reanalysis). Contour interval is  $2 \text{ ms}^{-1}$ . Blue shading and dashed contours indicate easterlies (top) and easterly anomalies (bottom). Anomalies are departures from the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

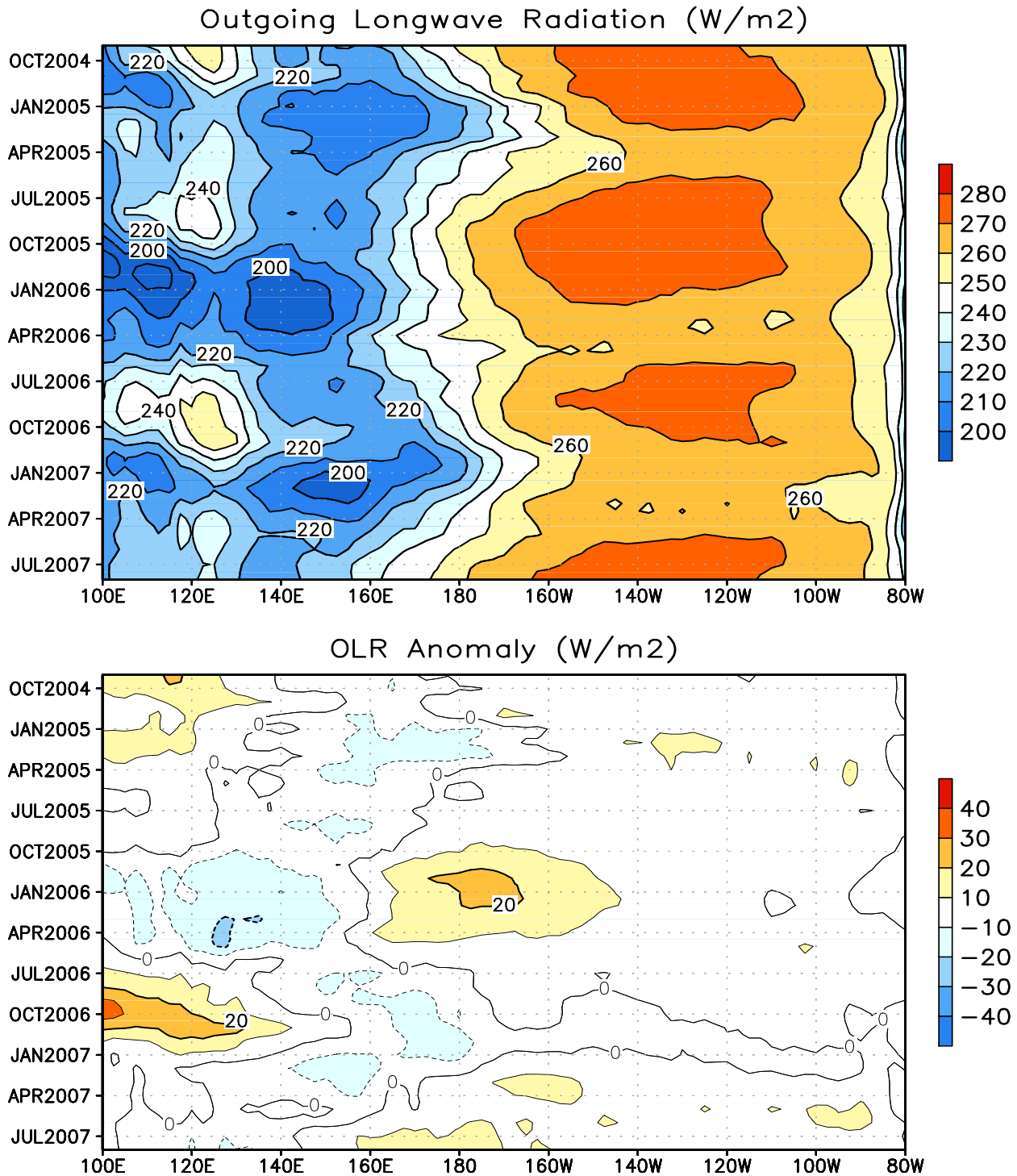


FIGURE T8. Time-longitude section of mean (top) and anomalous (bottom) outgoing longwave radiation (OLR) averaged between 5N-5S. Contour interval is 10 Wm<sup>-2</sup>. Dashed contours in bottom panel indicate negative OLR anomalies. Anomalies are departures from the 1979-1995 base period monthly means.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



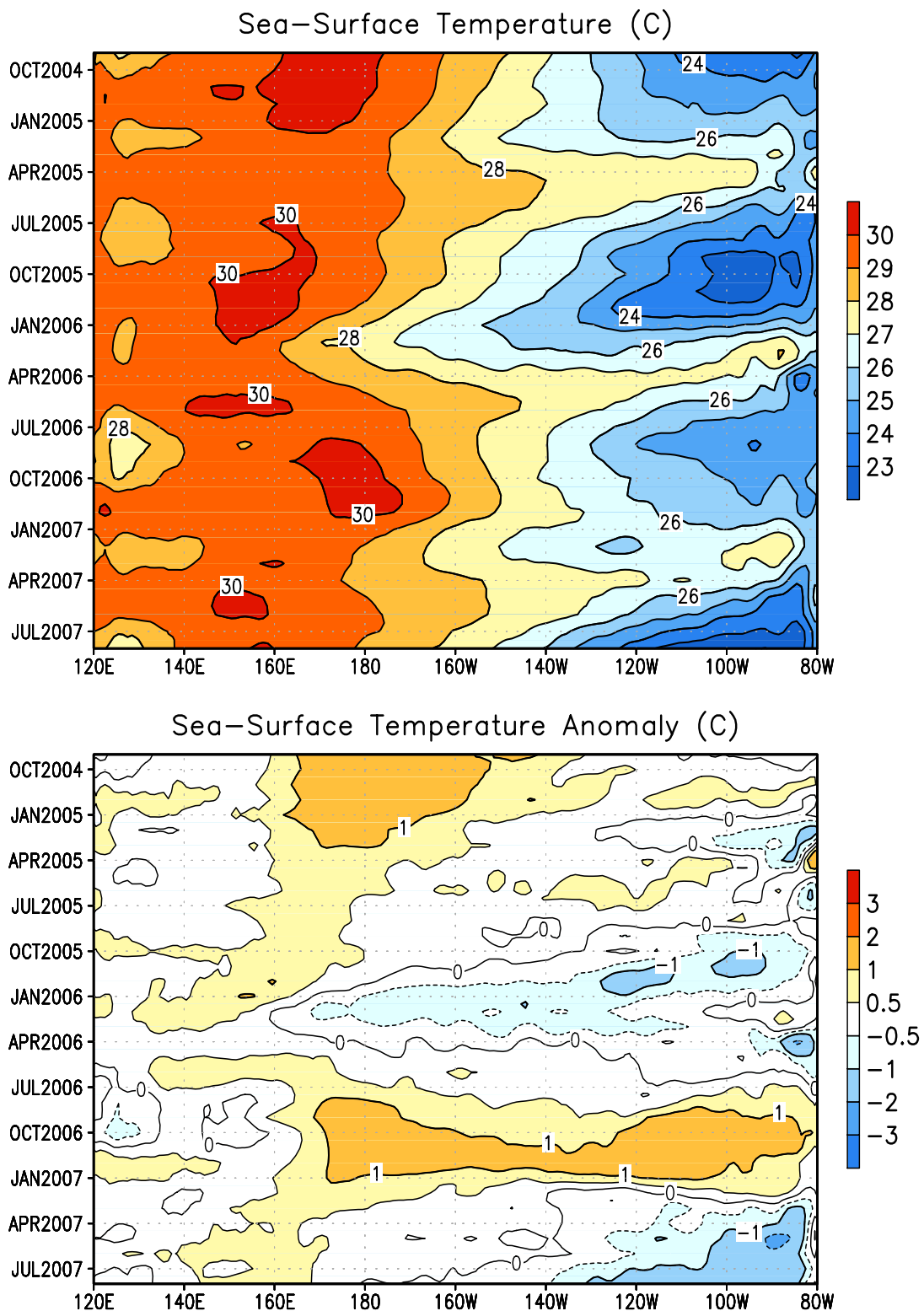


FIGURE T9. Time-longitude section of monthly mean (top) and anomalous (bottom) sea surface temperature (SST) averaged between 5N-5S. Contour interval is 1C (top) and 0.5C (bottom). Dashed contours in bottom panel indicate negative anomalies. Anomalies are departures from the 1971-2000 base period means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

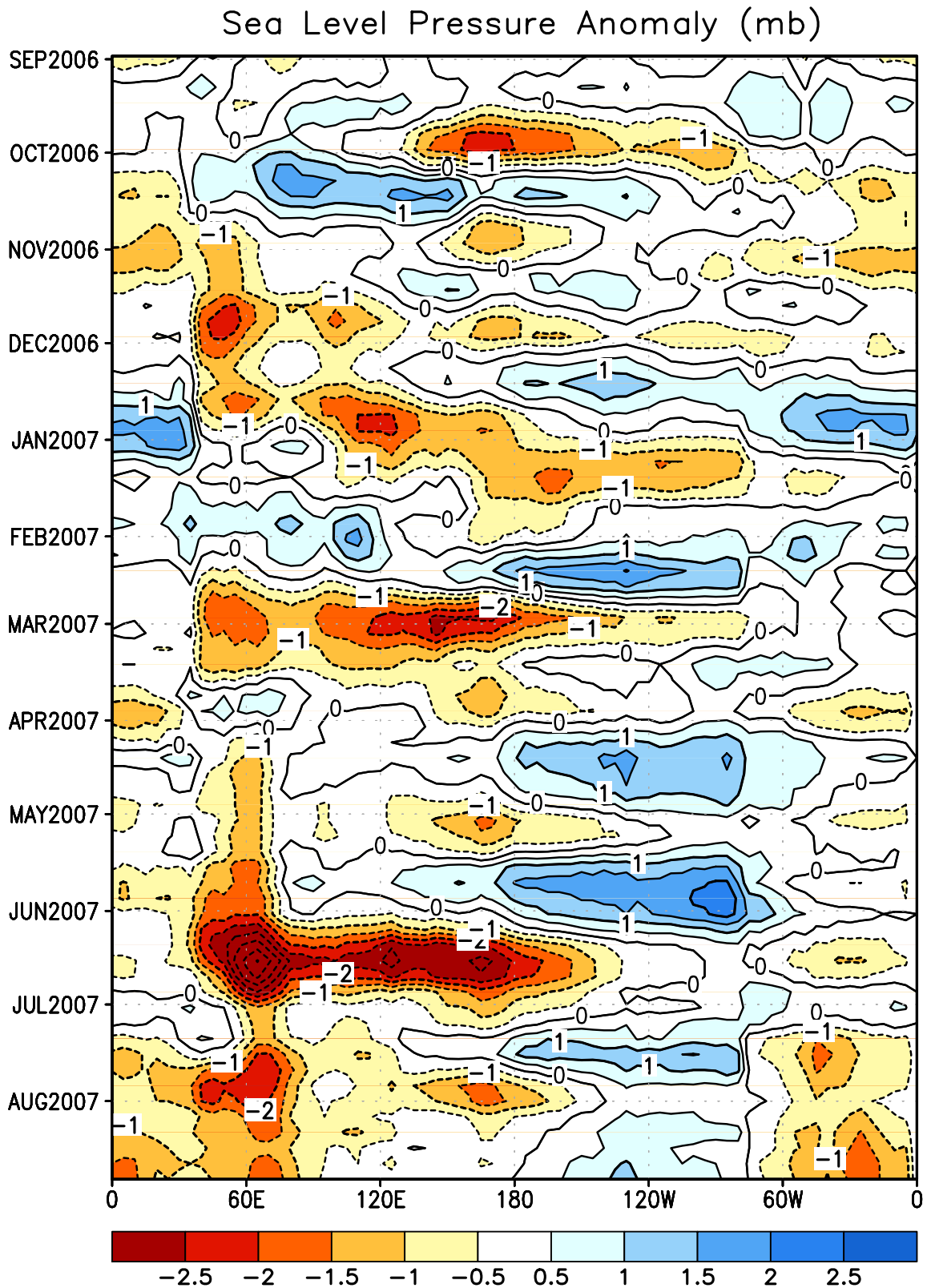


FIGURE T10. Time-longitude section of anomalous sea level pressure (hPa) averaged between 5N-5S (CDAS/Reanalysis). Contour interval is 1 hPa. Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally using a 3-point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

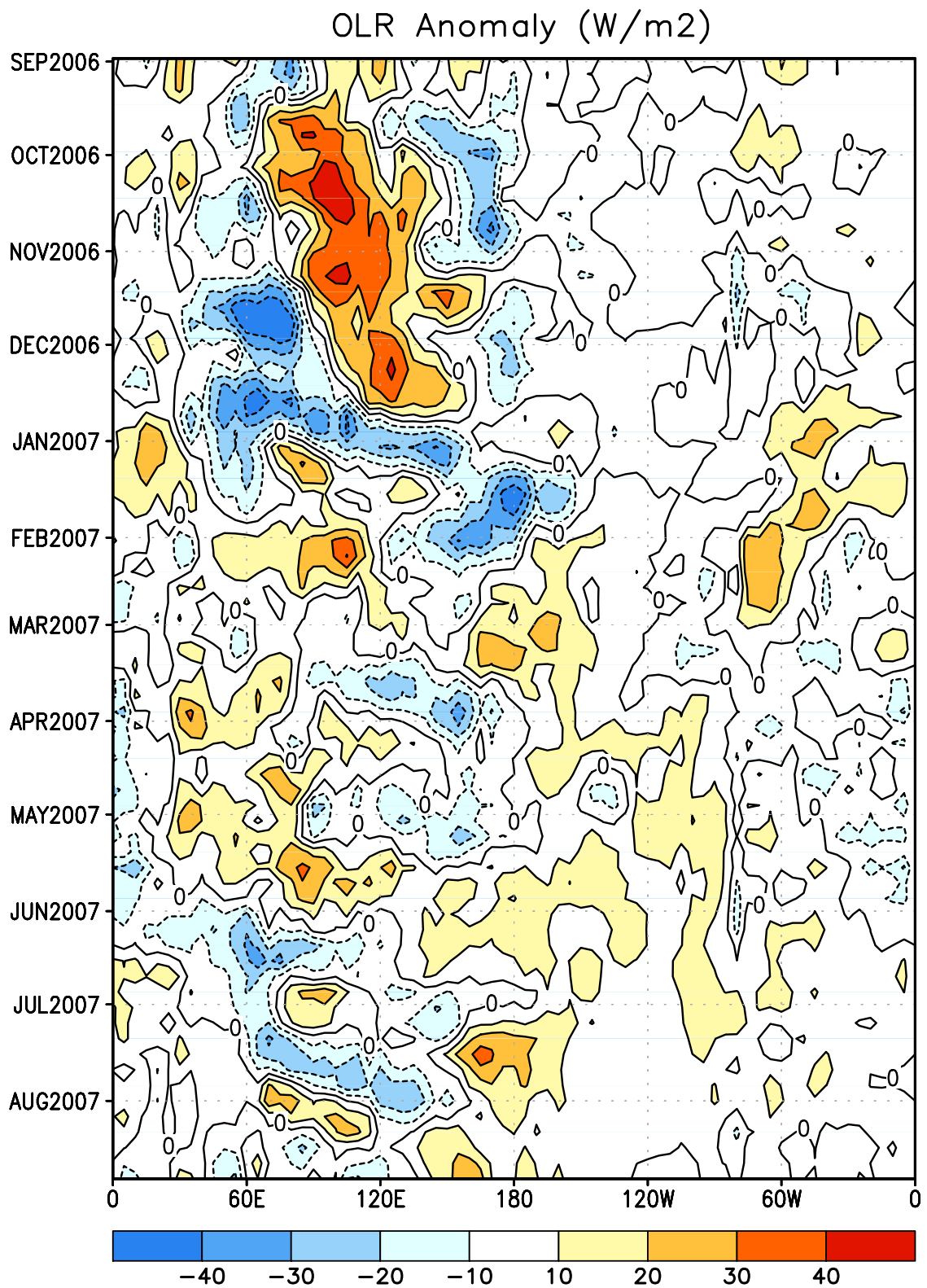


FIGURE T11. Time-longitude section of anomalous outgoing longwave radiation averaged between 5N-5S. Contour interval is  $15 Wm^{-2}$ . Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally using a 3-point running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

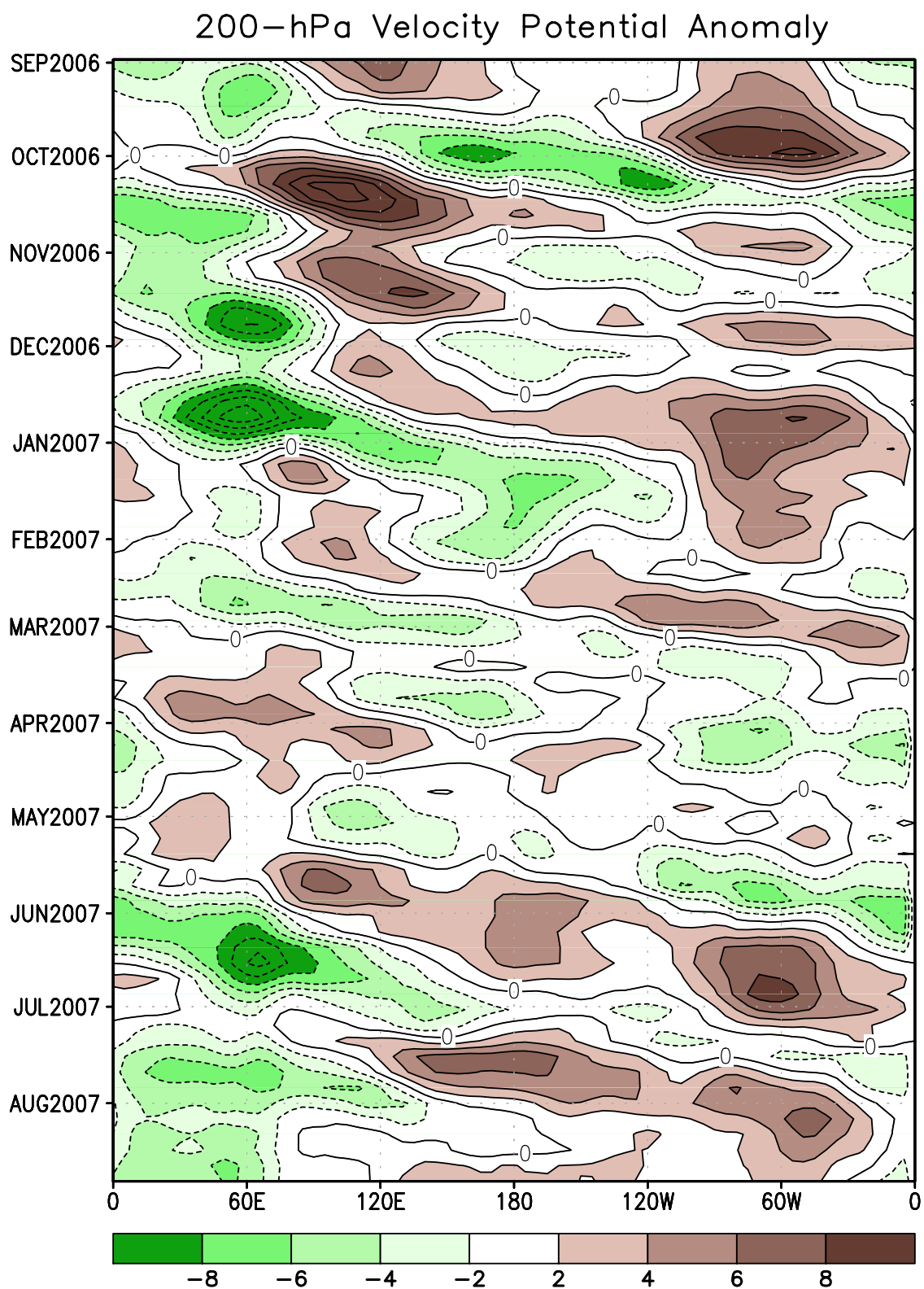


FIGURE T12. Time-longitude section of anomalous 200-hPa velocity potential averaged between 5N-5S (CDAS/Re-analysis). Contour interval is  $3 \times 10^6 \text{ m}^2 \text{ s}^{-1}$ . Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The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

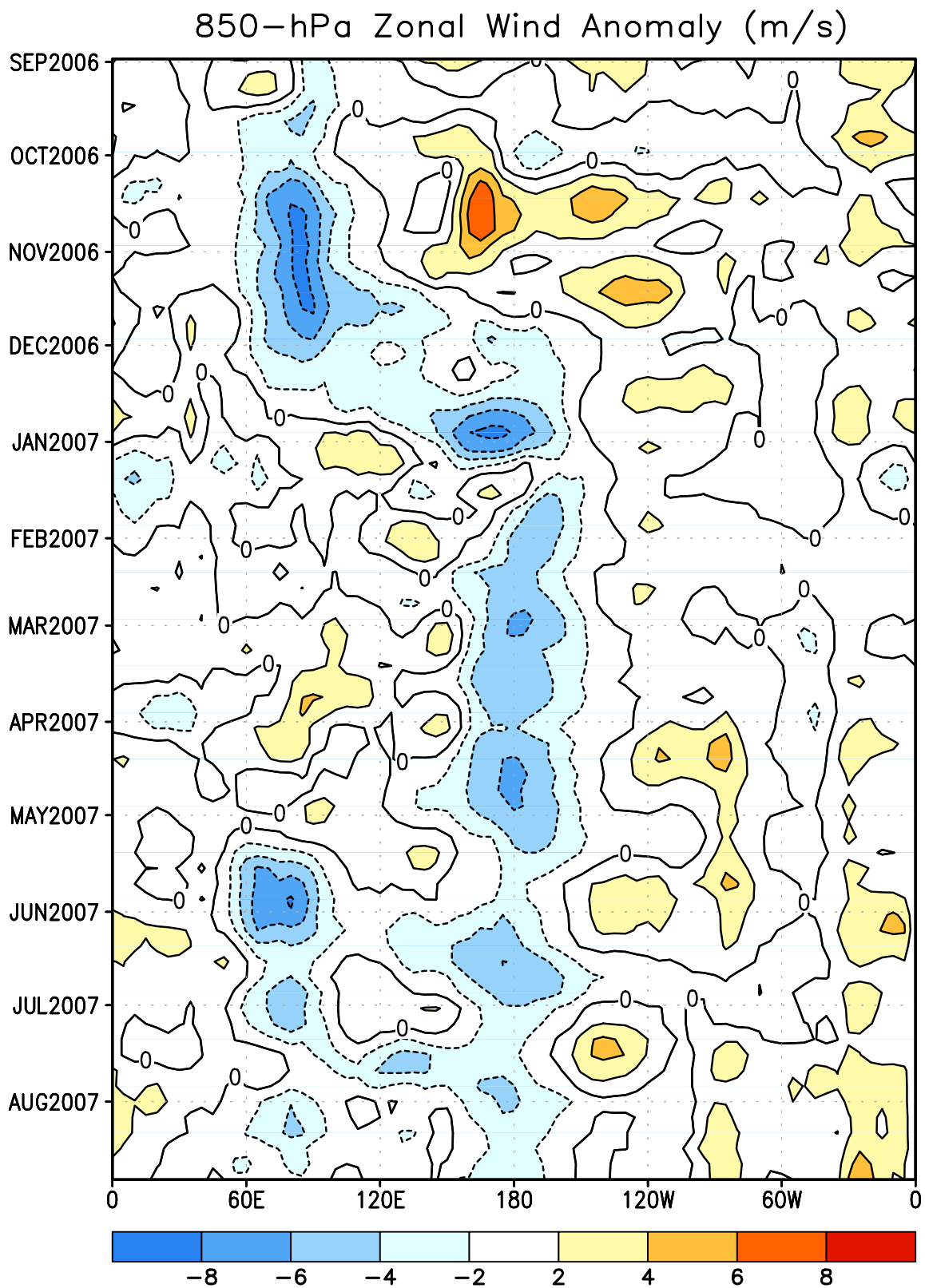


FIGURE T13. Time-longitude section of anomalous 850-hPa zonal wind averaged between 5N-5S (CDAS/Reanalysis). Contour interval is  $2 \text{ ms}^{-1}$ . Dashed contours indicate negative anomalies. Anomalies are departures from the 1979-1995 base period pentad means. The data are smoothed temporally by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

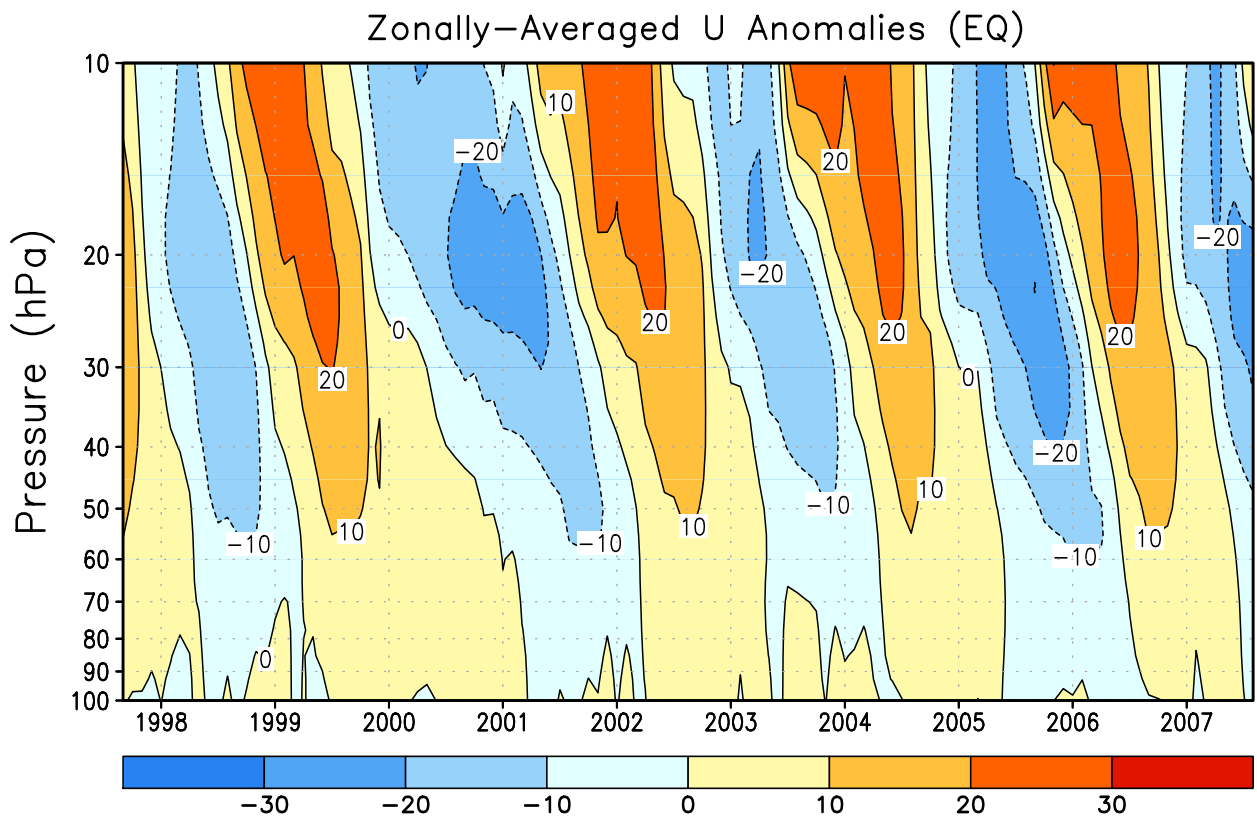
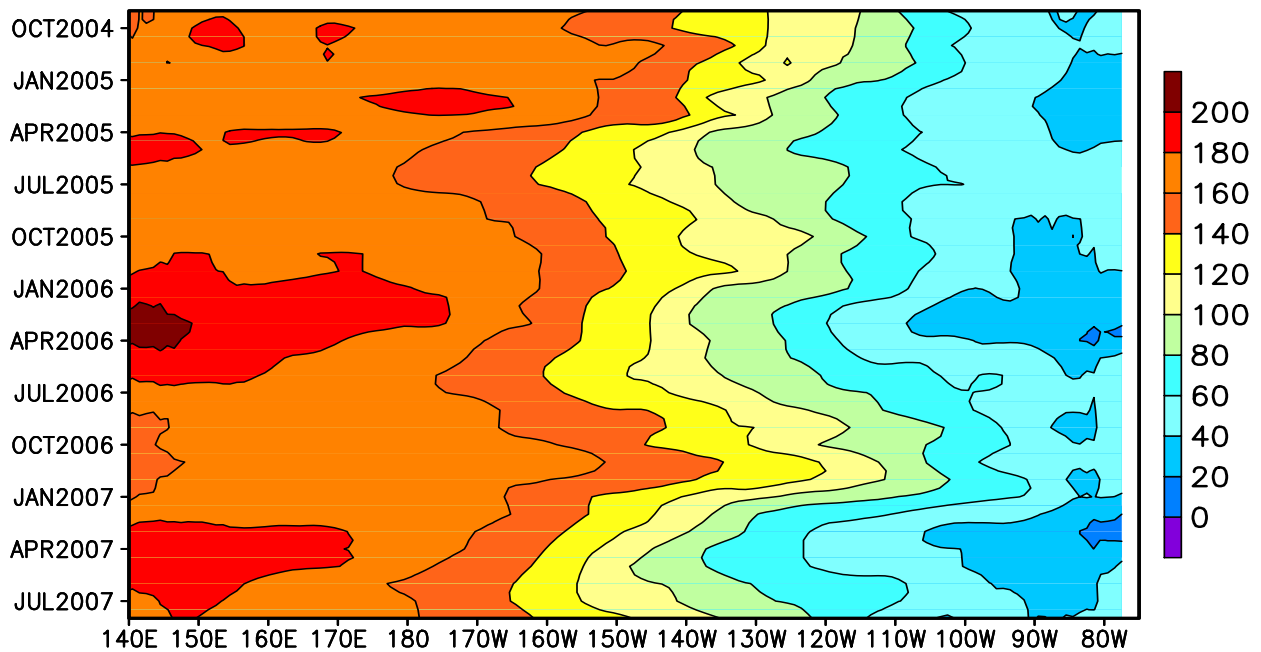


FIGURE T14. Equatorial time-height section of anomalous zonally-averaged zonal wind ( $\text{m s}^{-1}$ ) (CDAS/Reanalysis). Contour interval is  $10 \text{ m s}^{-1}$ . Anomalies are departures from the 1979-1995 base period monthly means.

## DEPTH OF THE 20C ISOTHERM



## ANOMALOUS DEPTH OF 20C ISOTHERM

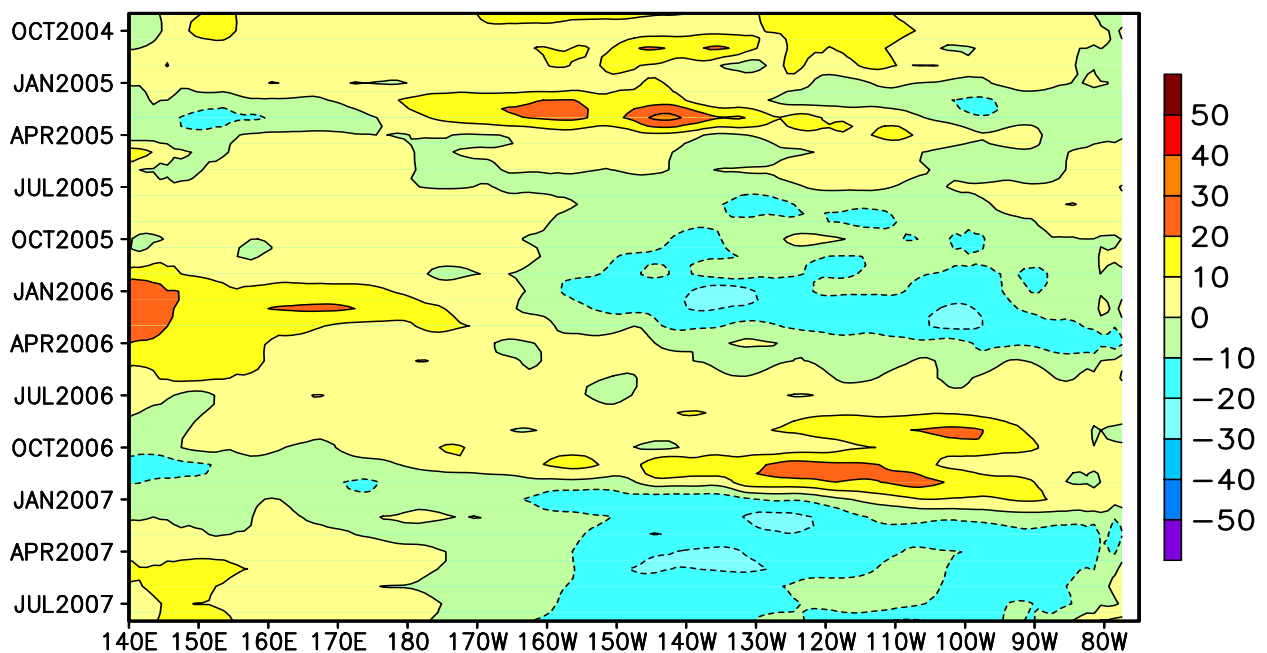
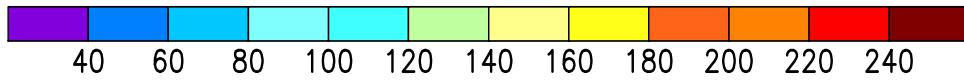
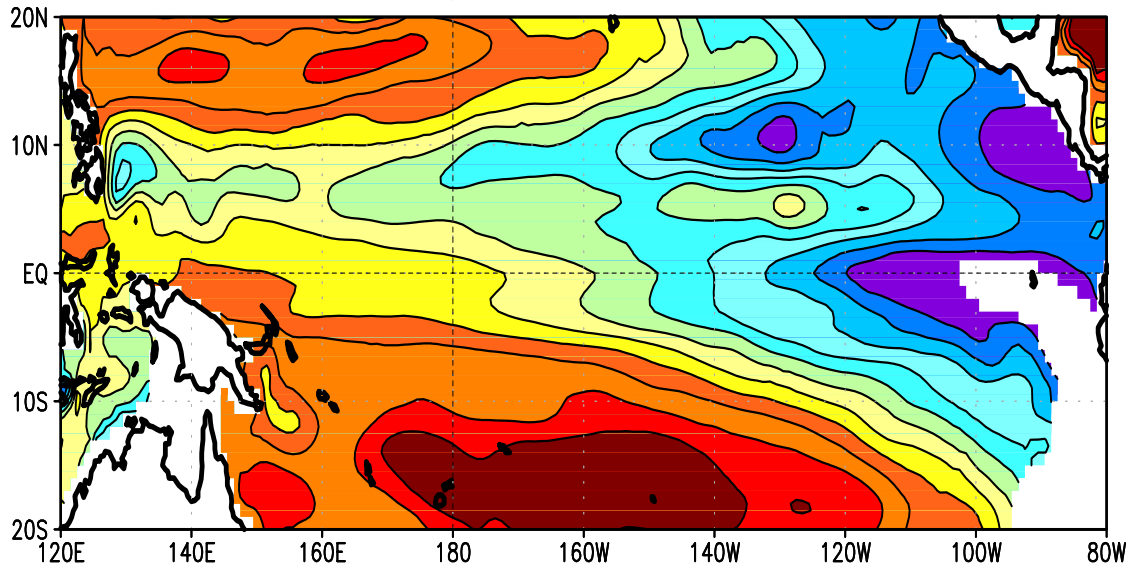


FIGURE T15. Mean (top) and anomalous (bottom) depth of the 20C isotherm averaged between 5N-5S in the Pacific Ocean. Data are derived from the NCEP's global ocean data assimilation system which assimilates oceanic observations into an oceanic GCM (Behringer, D. W., and Y. Xue, 2004: Evaluation of the 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.

## Mean Depth of 20C Isotherm



## Anomalous Depth of 20C Isotherm

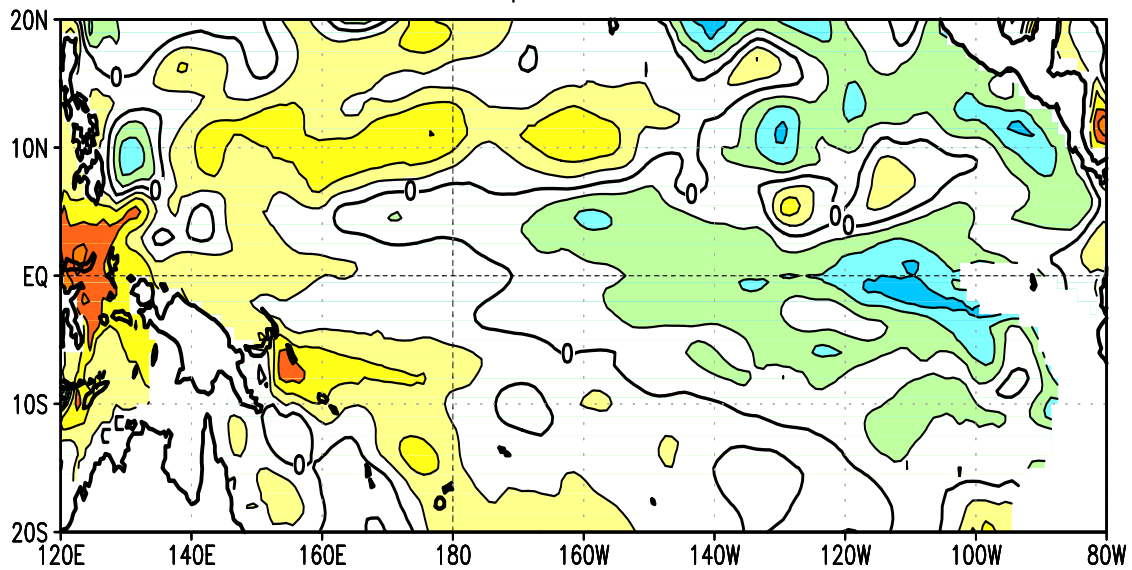
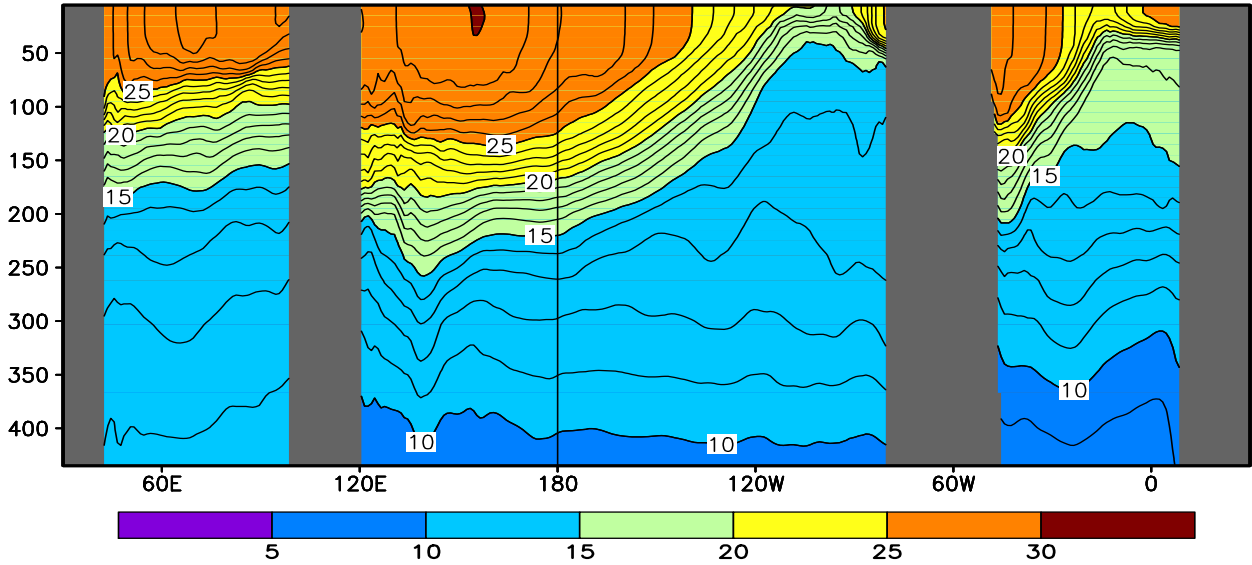


FIGURE T16. Mean (top) and anomalous (bottom) depth of the 20°C isotherm for AUG 2007. Contour interval is 40 m (top) and 10 m (bottom). Dashed contours in bottom panel indicate negative anomalies. Data are derived from the NCEP's global ocean data assimilation system version 2 which assimilates oceanic 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.



### Equatorial Depth–Longitude Section Ocean Temperature (C)



### Equatorial Depth–Longitude Section Ocean Temperature Anomalies (C)

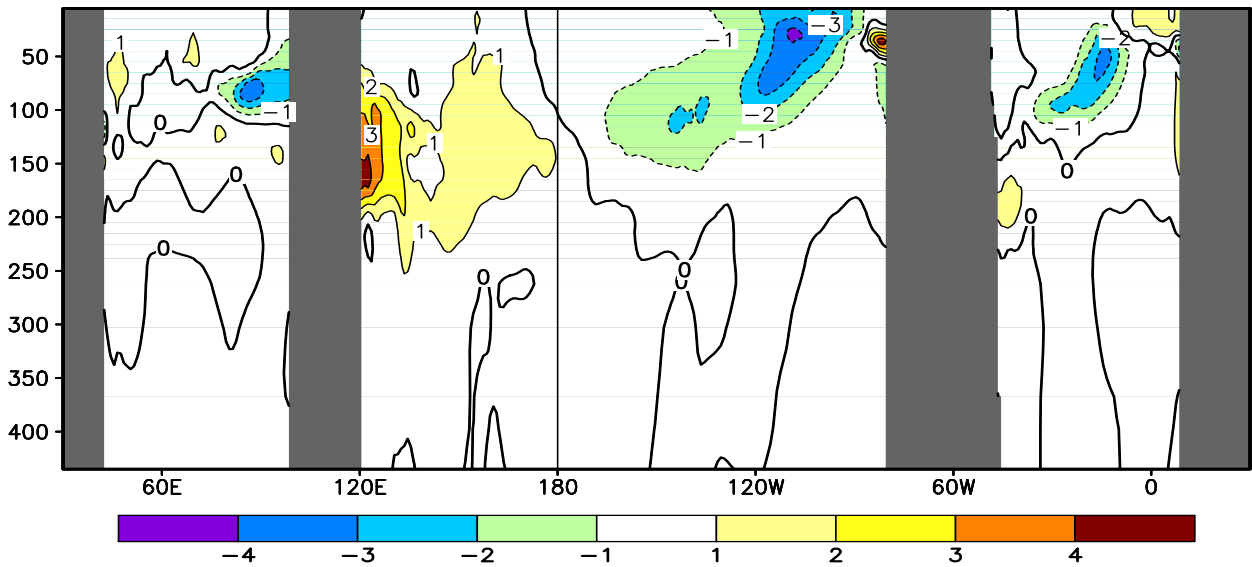


FIGURE T17. Equatorial depth-longitude section of ocean temperature (top) and ocean temperature anomalies (bottom) for AUG 2007. Contour interval is 1°C. Dashed contours in bottom panel indicate negative anomalies. Data are derived from the NCEP’s global ocean data assimilation system version 2 which 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.

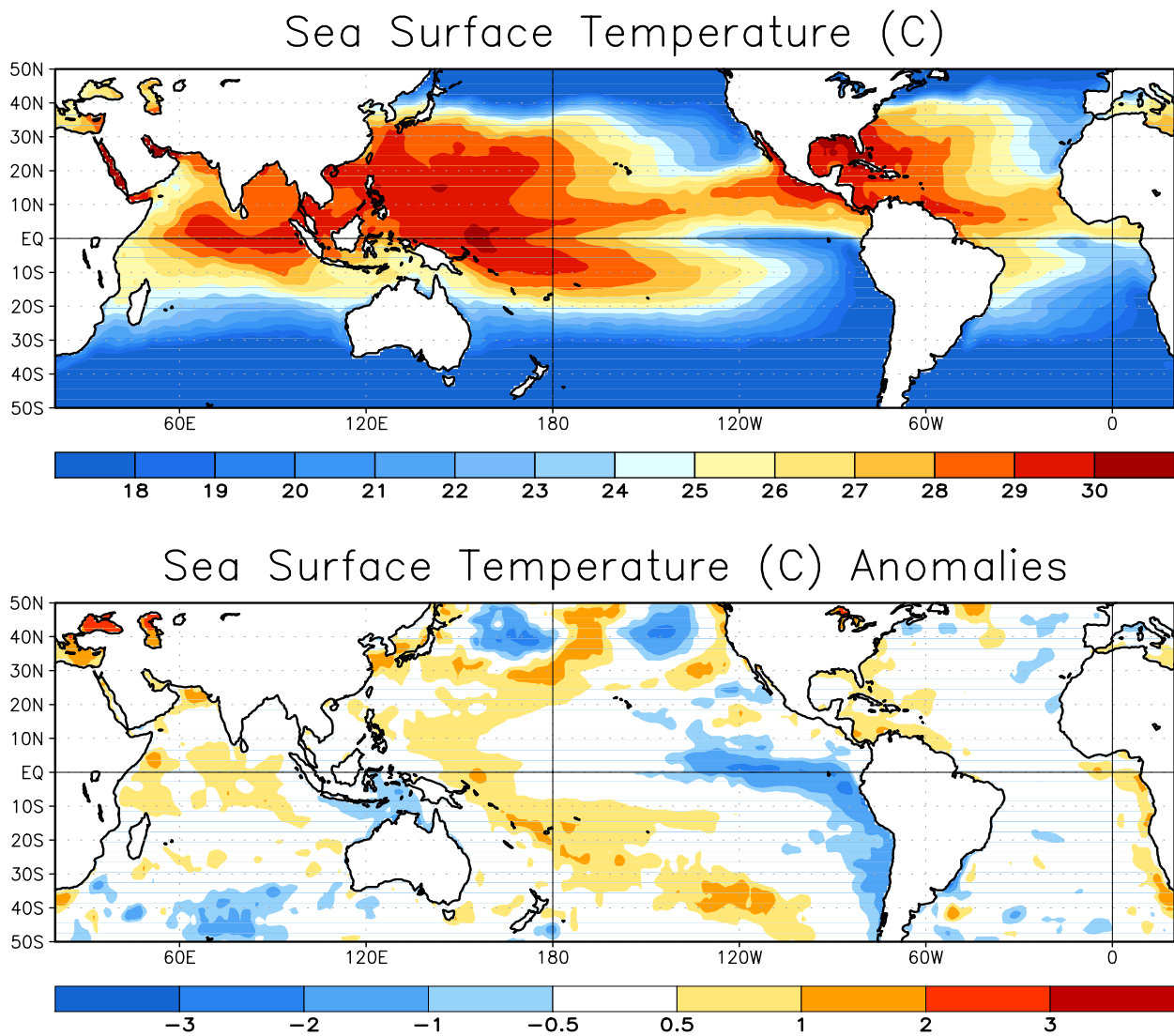


FIGURE T18. Mean (top) and anomalous (bottom) sea surface temperature (SST). Anomalies are departures from the 1971-2000 base period monthly means (Smith and Reynolds 1998, *J. Climate*, **11**, 3320-3323).

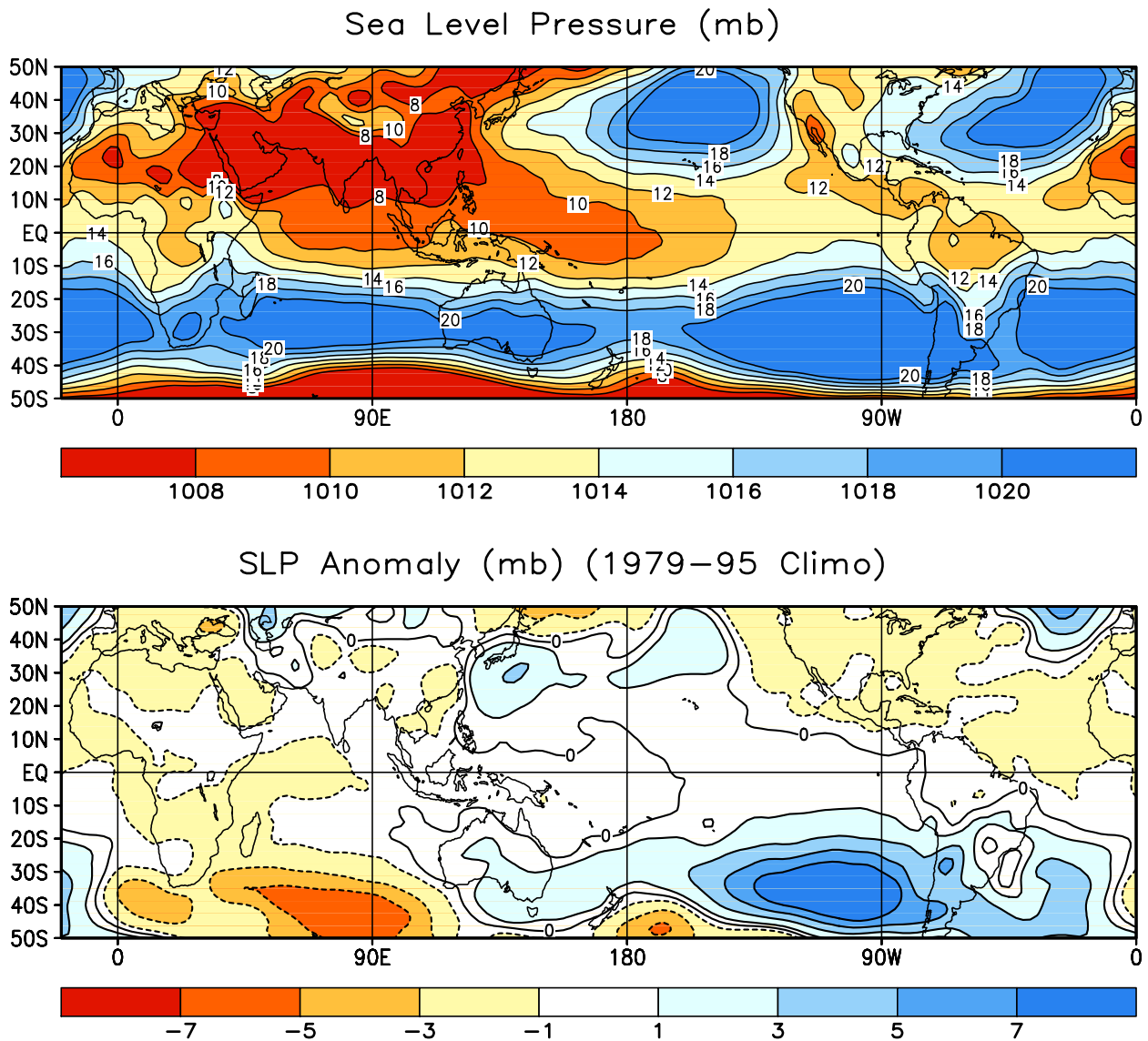


FIGURE T19. Mean (top) and anomalous (bottom) sea level pressure (SLP) (CDAS/Reanalysis). In top panel, 1000 hPa has been subtracted from contour labels, contour interval is 2 hPa, and values below 1000 hPa are indicated by dashed contours. In bottom panel, anomaly contour interval is 1 hPa and negative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

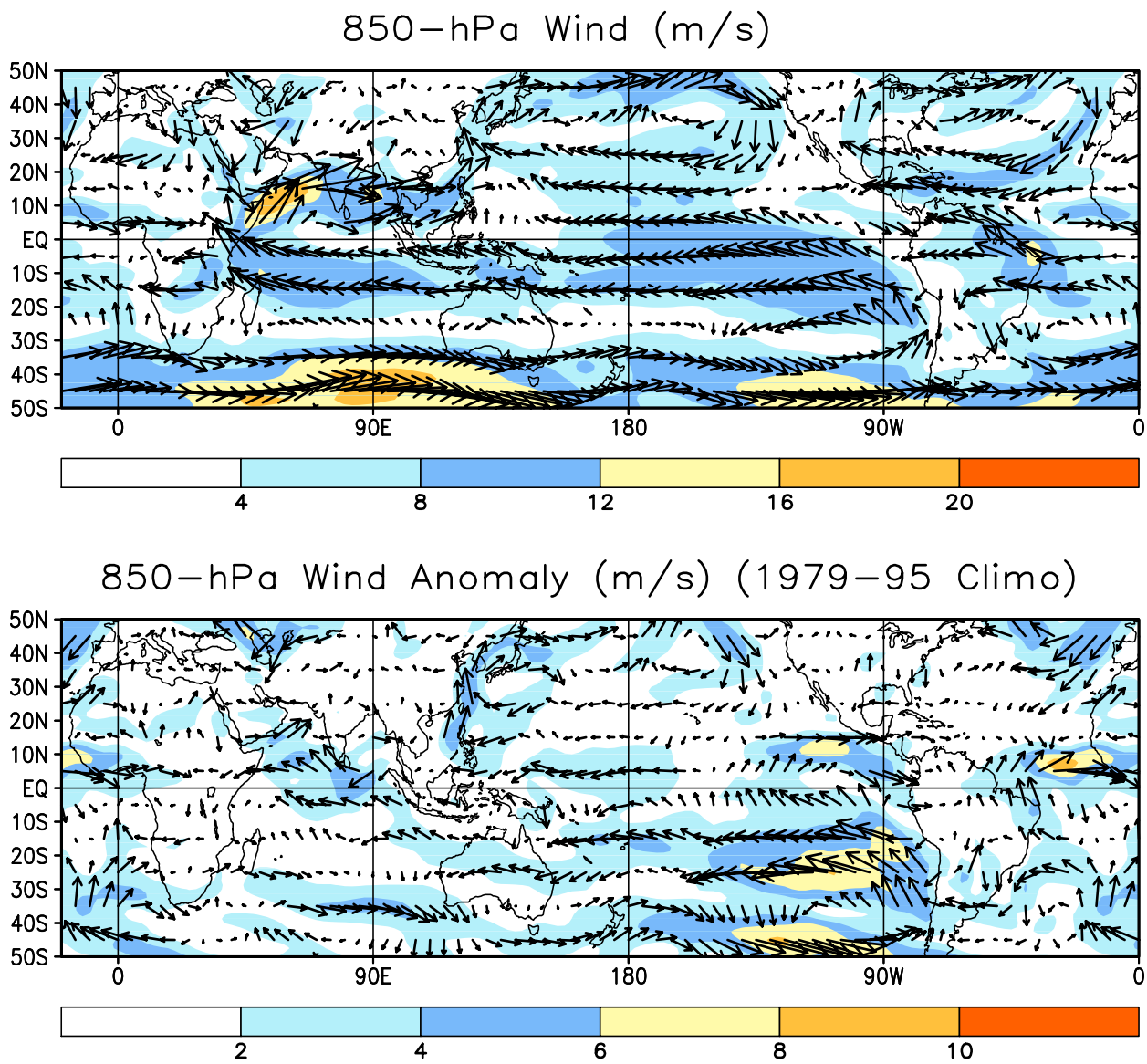


FIGURE T20. Mean (top) and anomalous (bottom) 850-hPa vector wind (CDAS/Reanalysis) for AUG 2007. Contour interval for isotachs is  $5 \text{ ms}^{-1}$  (top) and  $3 \text{ ms}^{-1}$  (bottom). Anomalies are departures from the 1979–95 base period monthly means.

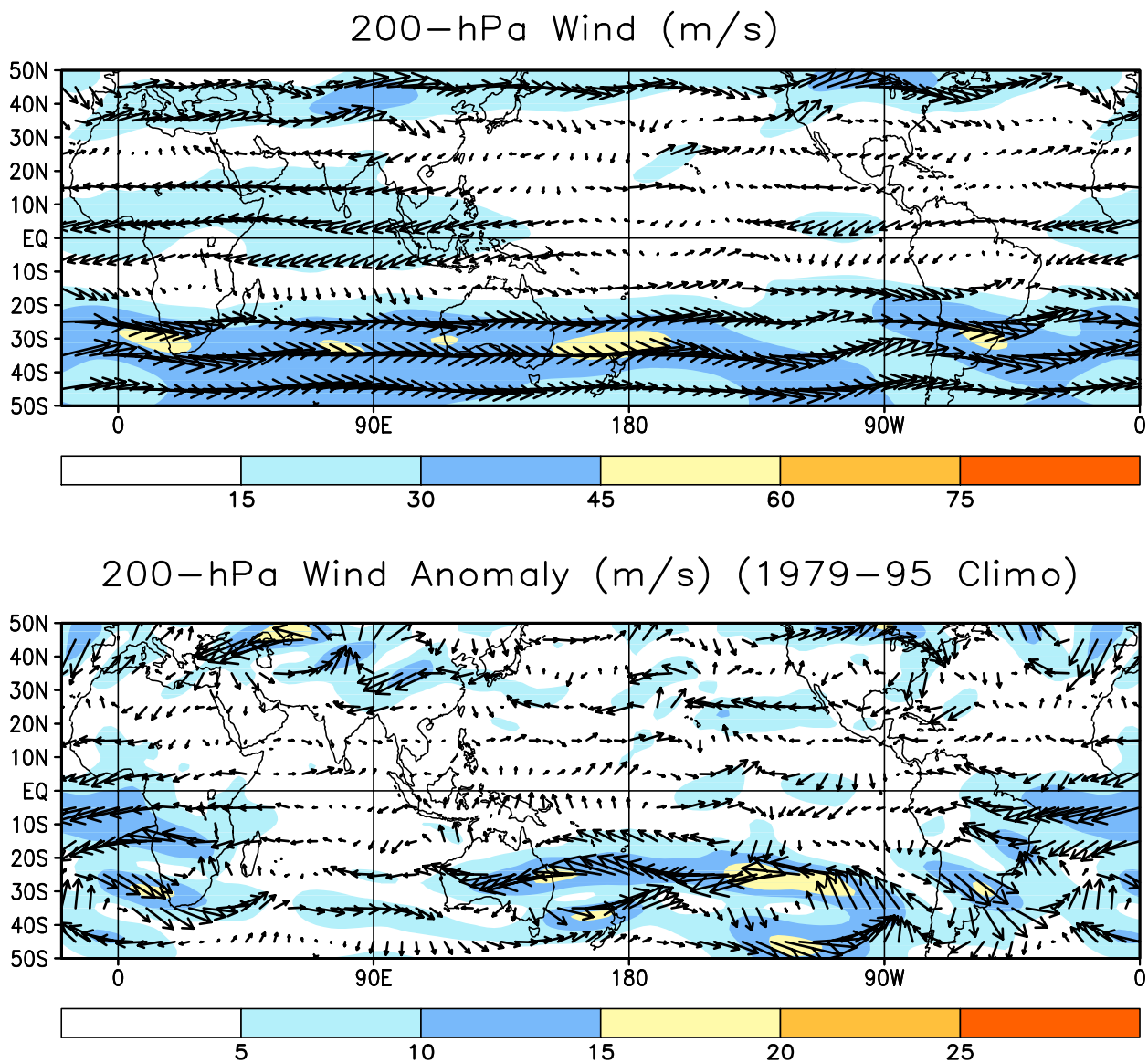


FIGURE T21. Mean (top) and anomalous (bottom) 200-hPa vector wind (CDAS/Reanalysis) for AUG 2007. Contour interval for isotachs is  $10 \text{ ms}^{-1}$  (top) and  $5 \text{ ms}^{-1}$  (bottom). Anomalies are departures from 1979–95 base period monthly means.

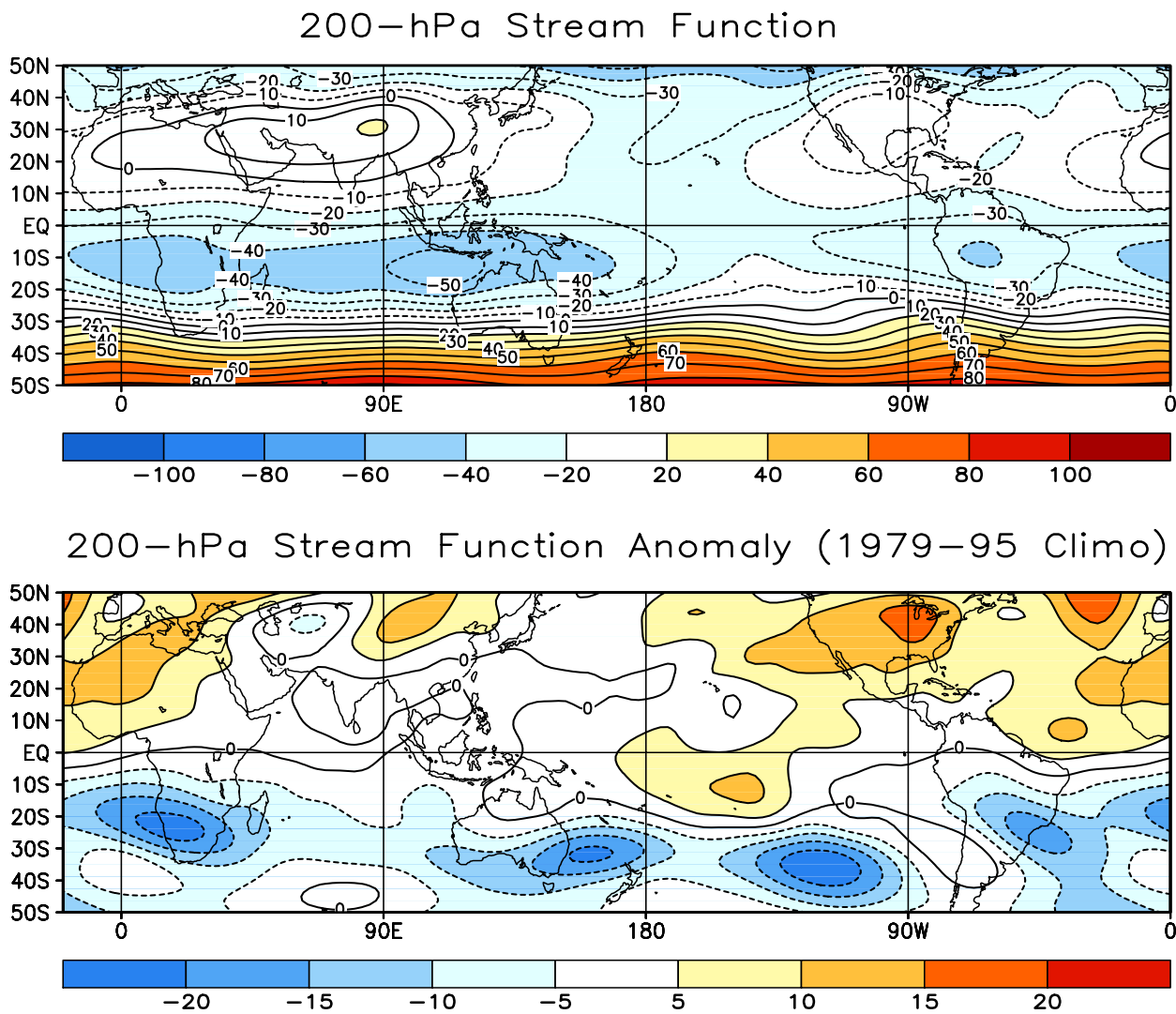


FIGURE T22. Mean (top) and anomalous (bottom) 200-hPa streamfunction (CDAS/Reanalysis). Contour interval is  $20 \times 10^6 \text{ m}^2\text{s}^{-1}$  (top) and  $5 \times 10^6 \text{ m}^2\text{s}^{-1}$  (bottom). Negative (positive) values are indicated by dashed (solid) lines. The non-divergent component 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.

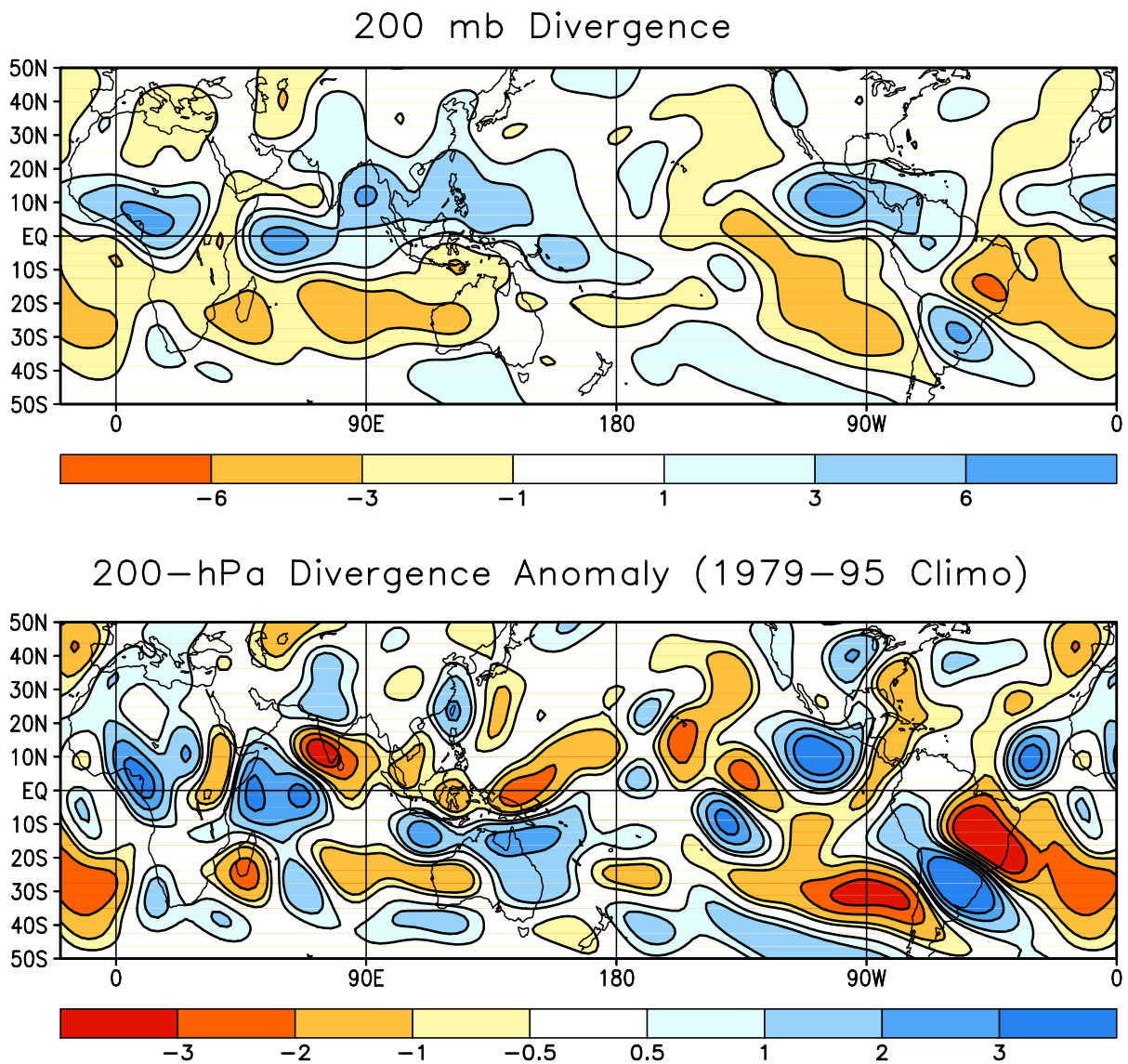
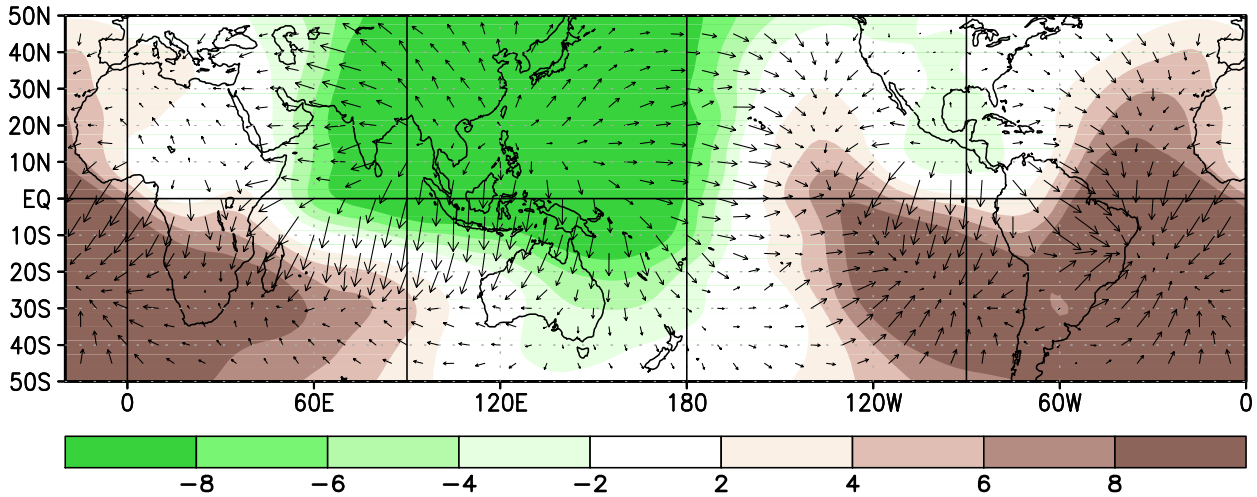


FIGURE T23. Mean (top) and anomalous (bottom) 200-hPa divergence (CDAS/Reanalysis). Divergence and anomalous divergence are shaded blue. Convergence and anomalous convergence are shaded orange. Anomalies are departures from the 1979-1995 base period monthly means.

### 200-hPa VPOT & Div. Wind



### 200-hPa VPOT & Div. Wind Anomaly

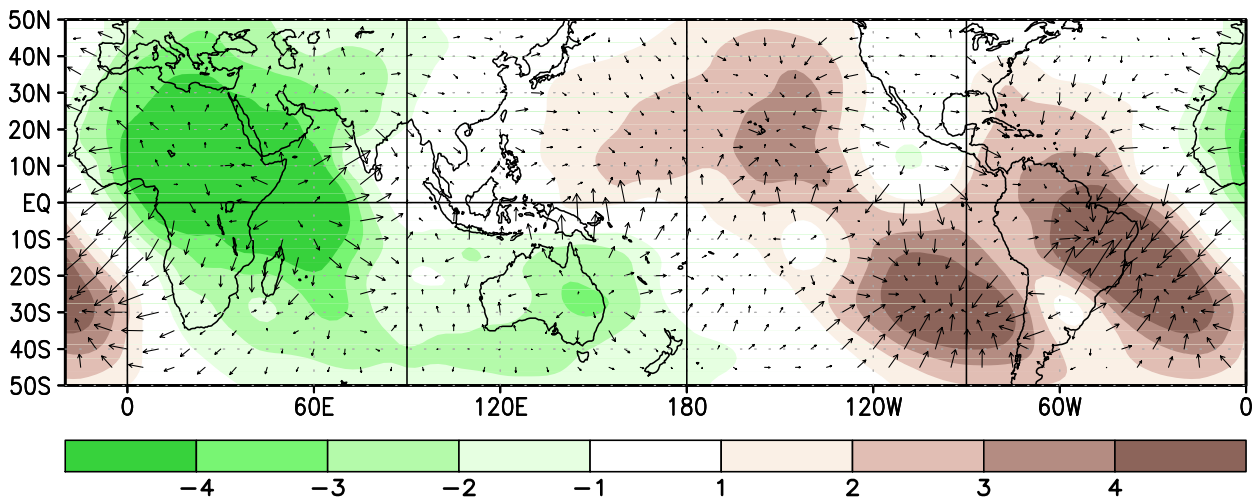
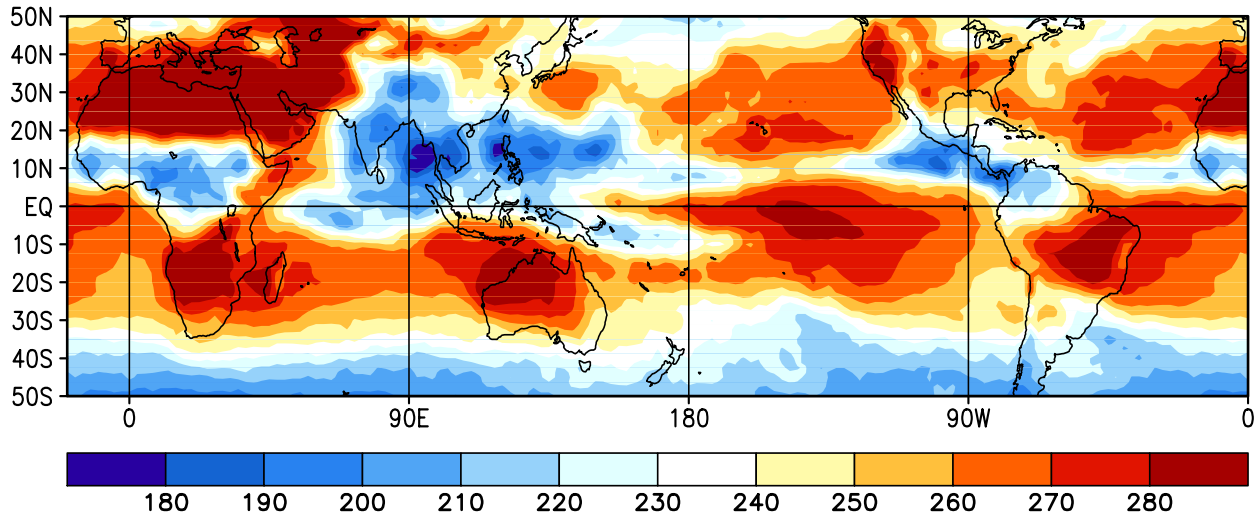


FIGURE T24. Mean (top) and anomalous (bottom) 200-hPa velocity potential ( $10^6\text{m}^2\text{s}$ ) and divergent wind (CDAS/ Reanalysis). Anomalies are departures from the 1979-1995 base period monthly means.



## Outgoing Longwave Radiation (W/m<sup>2</sup>)



## OLR Anomaly (W/m<sup>2</sup>) (1979–95 Climo)

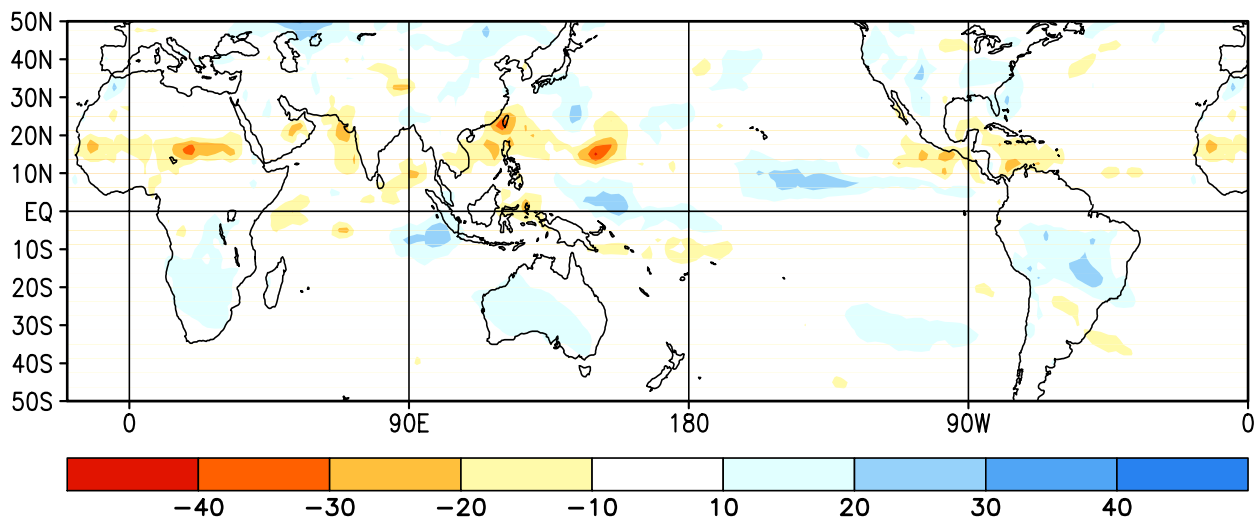
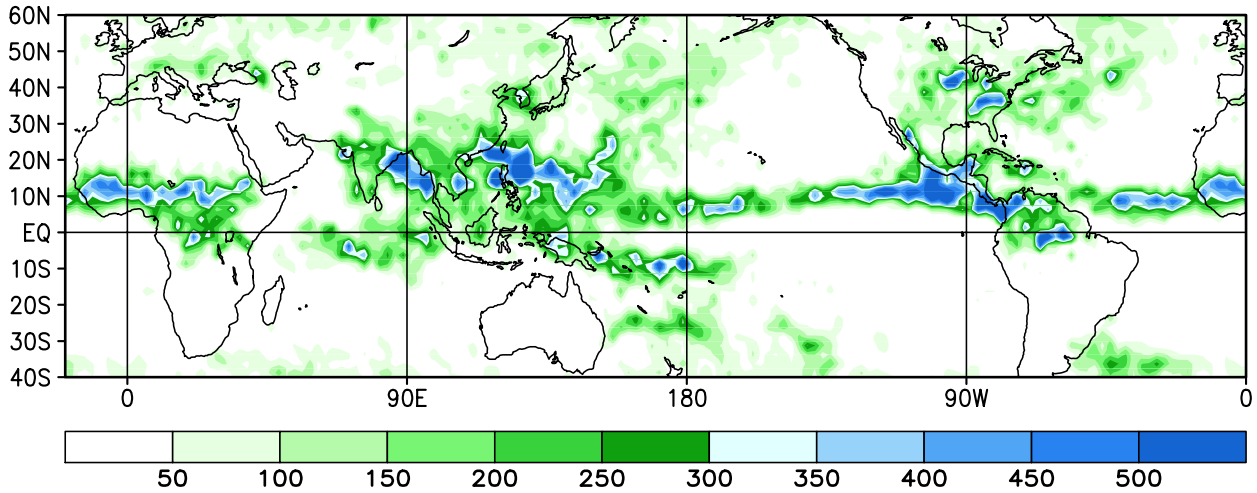


FIGURE T25. Mean (top) and anomalous (bottom) outgoing longwave radiation for AUG 2007 (NOAA 18 AVHRR IR window channel measurements by NESDIS/ORR). OLR contour interval is 20 Wm<sup>-2</sup> with values greater than 280 Wm<sup>-2</sup> indicated by dashed contours. Anomaly contour interval is 15 Wm<sup>-2</sup> with positive values indicated by dashed contours and light shading. Anomalies are departures from the 1979–95 base period monthly means.

### SSM/I Estimated Precip. (mm)



### SSM/I Precip Anomalies (mm)

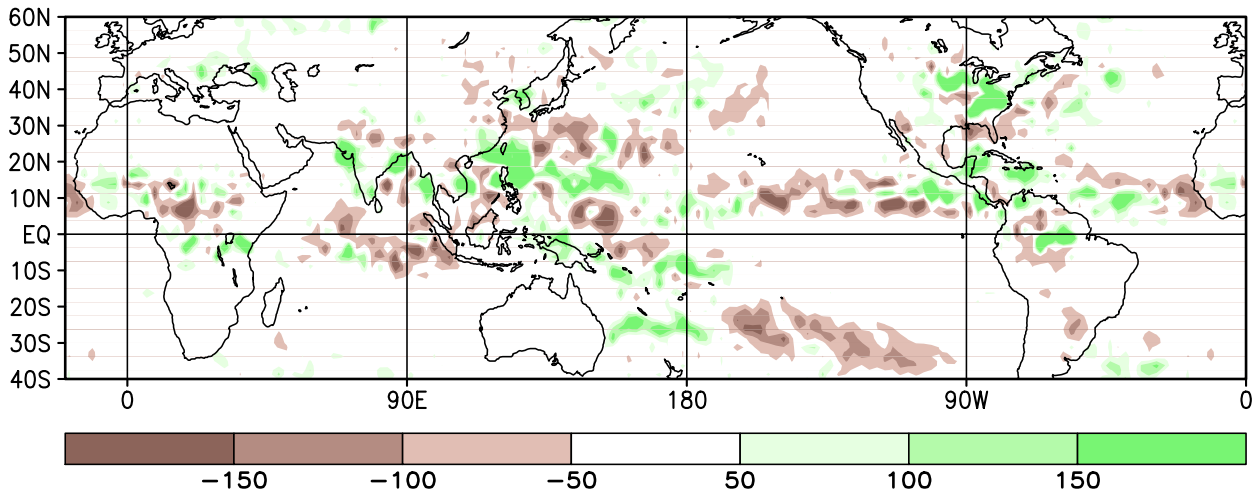


FIGURE T26. Estimated total (top) and anomalous (bottom) rainfall (mm) based on the Special Sensor Microwave/Imager (SSM/I) precipitation index (Ferraro 1997, *J. Geophys. Res.*, **102**, 16715-16735). Anomalies are computed from the 1987-2006 base period monthly means. Anomalies have been smoothed for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

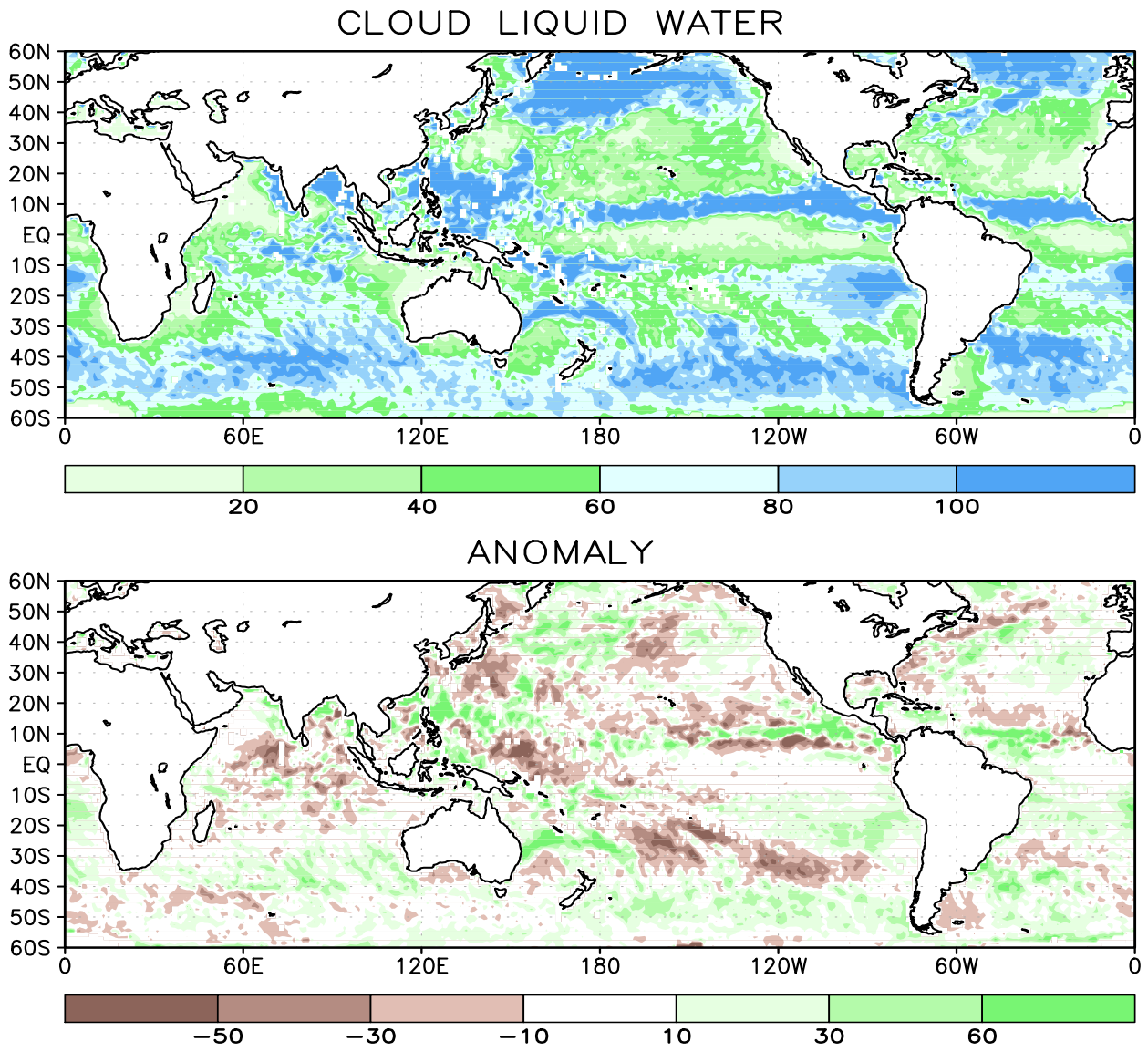


FIGURE T27. Mean (top) and anomalous (bottom) cloud liquid water ( $\text{g m}^{-2}$ ) based on the Special Sensor Microwave/Imager (SSM/I) (Weng et al 1997: *J. Climate*, **10**, 1086-1098). Anomalies are calculated from the 1987-2006 base period means.

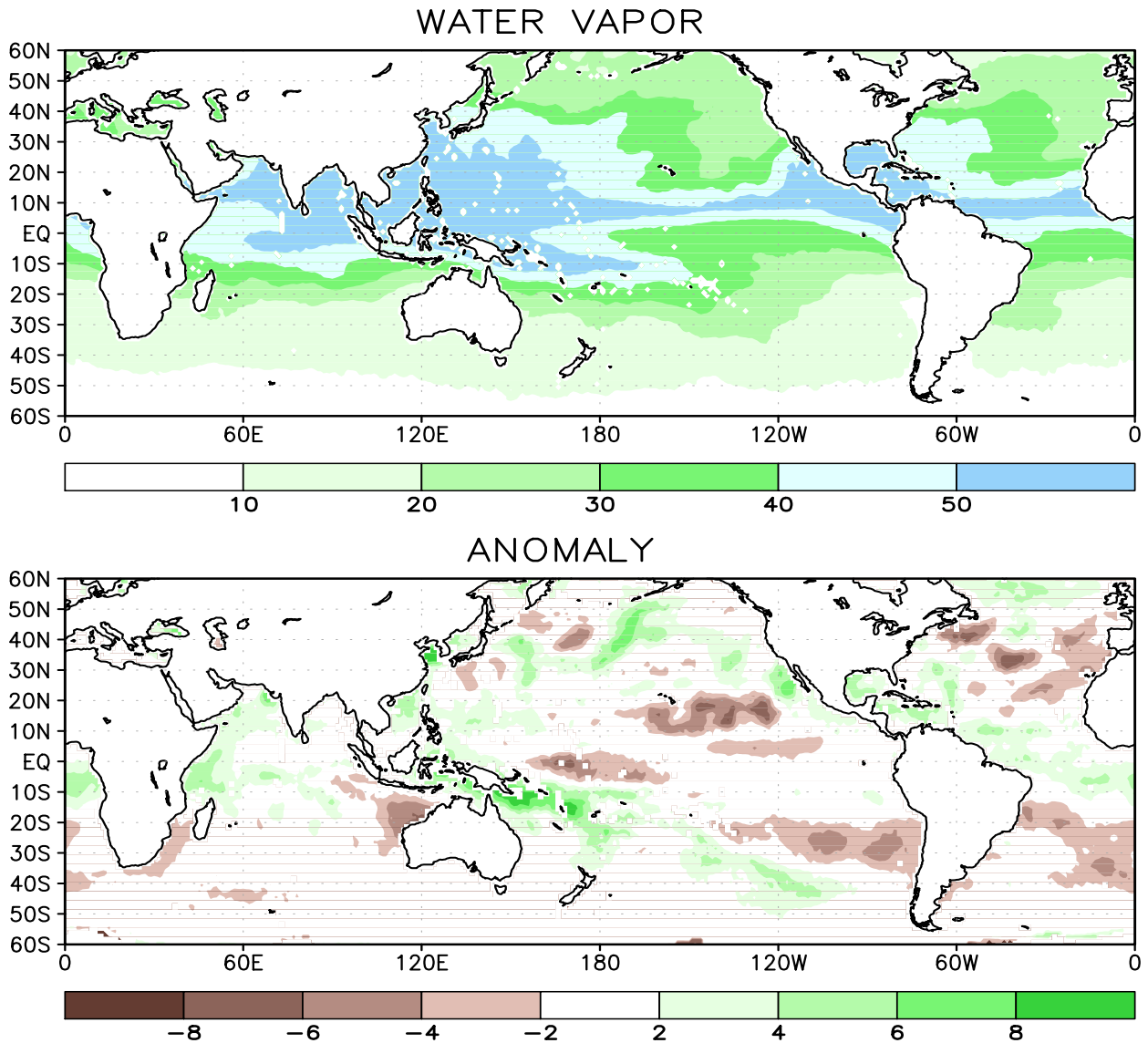


FIGURE T28. Mean (top) and anomalous (bottom) vertically integrated water vapor or precipitable water ( $\text{kg m}^{-2}$ ) based on the Special Sensor Microwave/Imager (SSM/I) (Ferraro et. al, 1996: *Bull. Amer. Meteor. Soc.*, **77**, 891-905). Anomalies are calculated from the 1987-2006 base period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

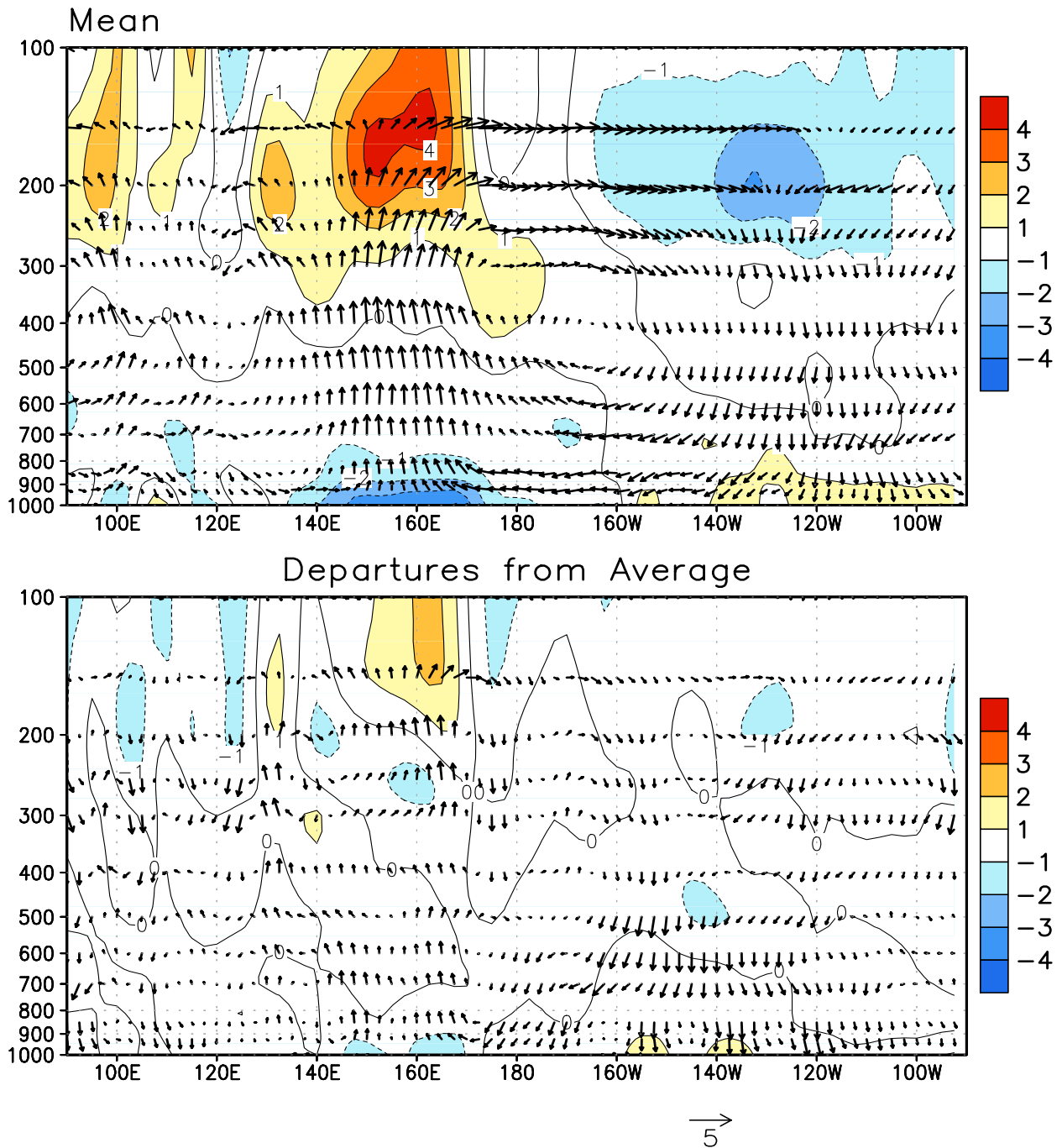


FIGURE T29. Pressure-longitude section (100E-80W) of the mean (top) and anomalous (bottom) divergence (contour interval is  $1 \times 10^{-6} \text{ s}^{-1}$ ) and divergent circulation averaged between 5N-5S. The divergent circulation is represented by vectors of combined pressure vertical velocity 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.

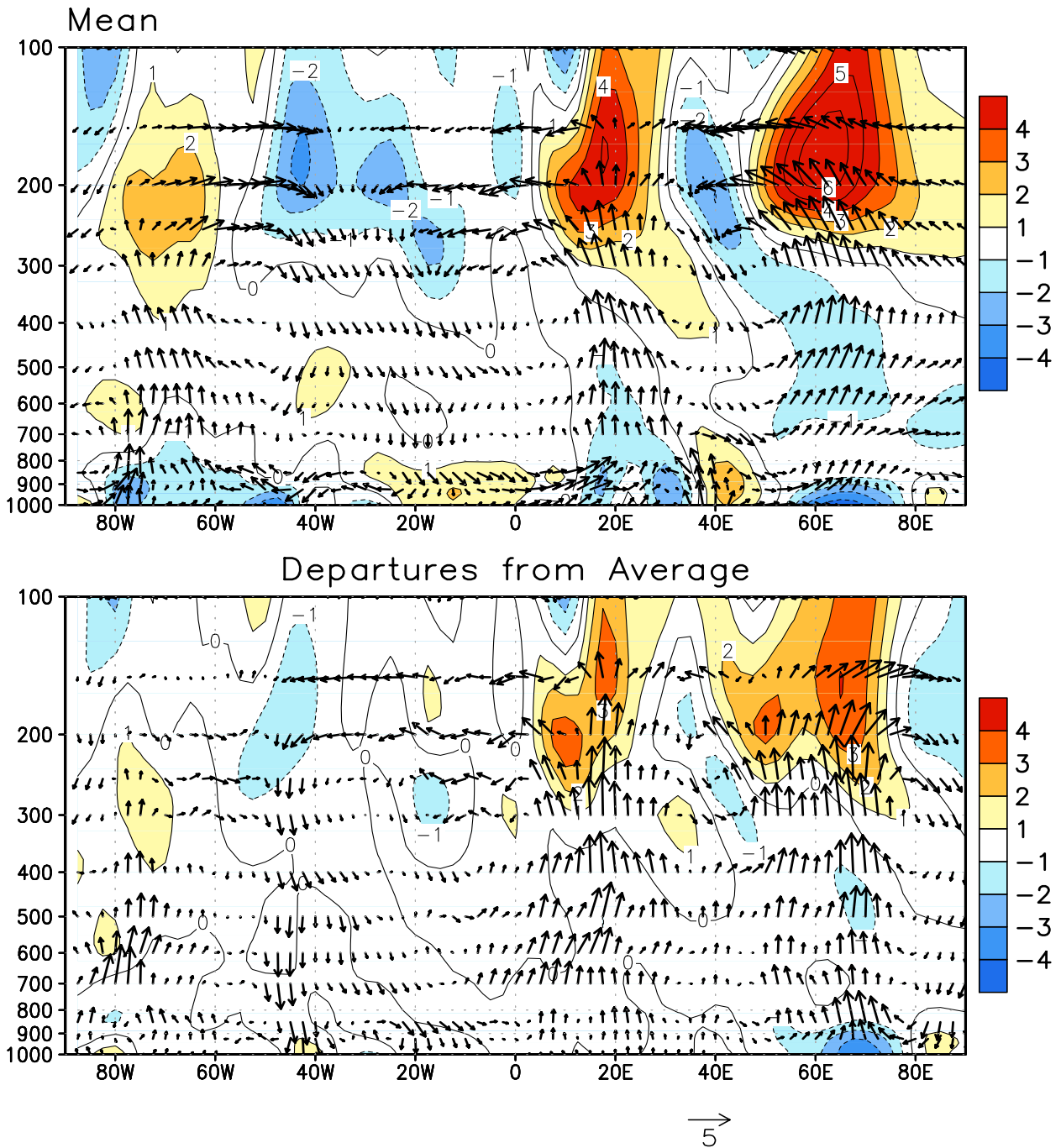


FIGURE T30. Pressure-longitude section (80W-100E) of the mean (top) and anomalous (bottom) divergence (contour interval is  $1 \times 10^{-6} \text{ s}^{-1}$ ) and divergent circulation averaged between 5N-5S. The divergent circulation is represented by vectors of combined pressure vertical velocity 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.

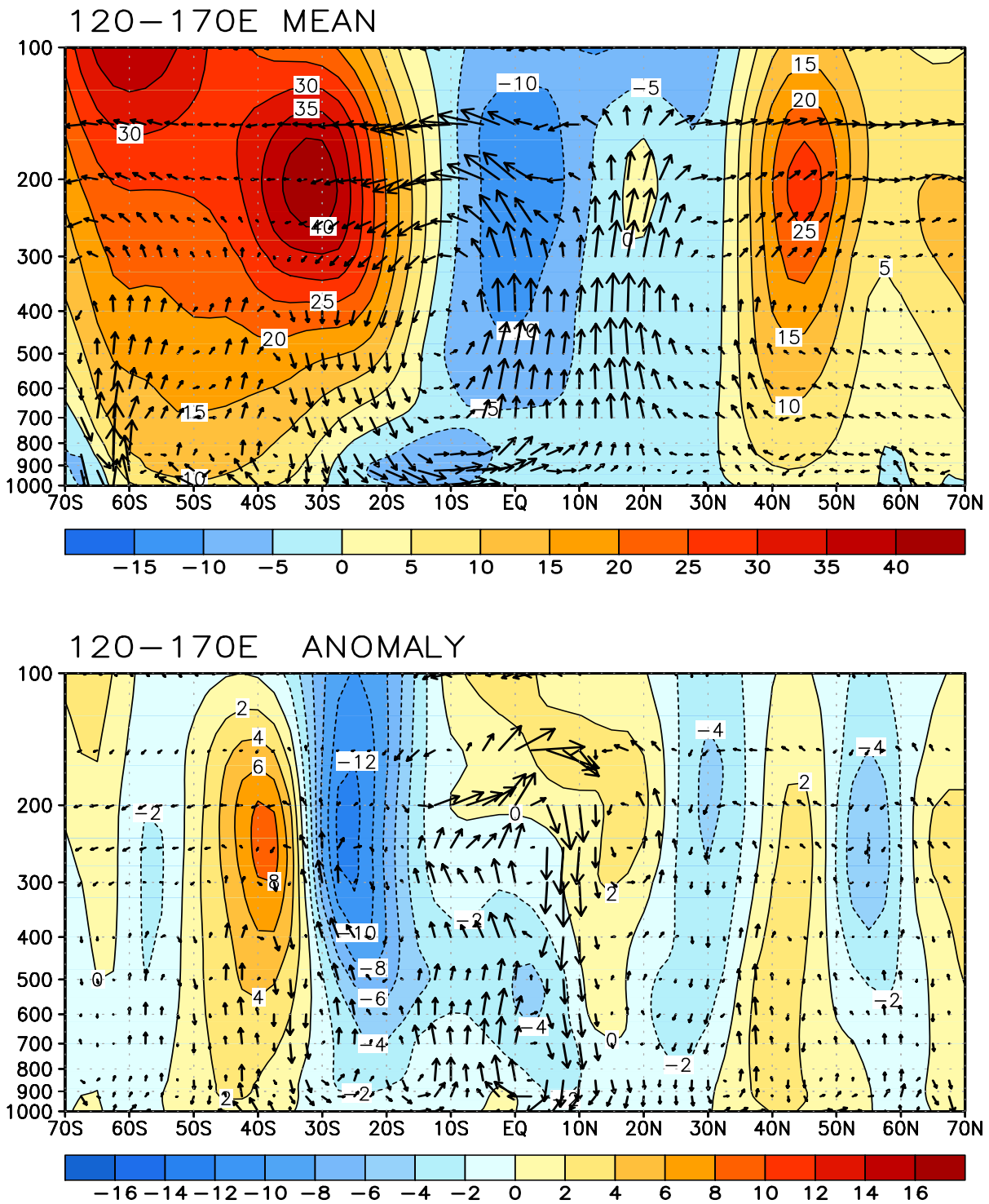


FIGURE T31. Pressure-latitude section of the mean (top) and anomalous (bottom) zonal wind ( $\text{m s}^{-1}$ ) and divergent circulation averaged over the west Pacific sector (120E-170E). The divergent circulation is represented by vectors of combined pressure vertical velocity and the divergent component 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.

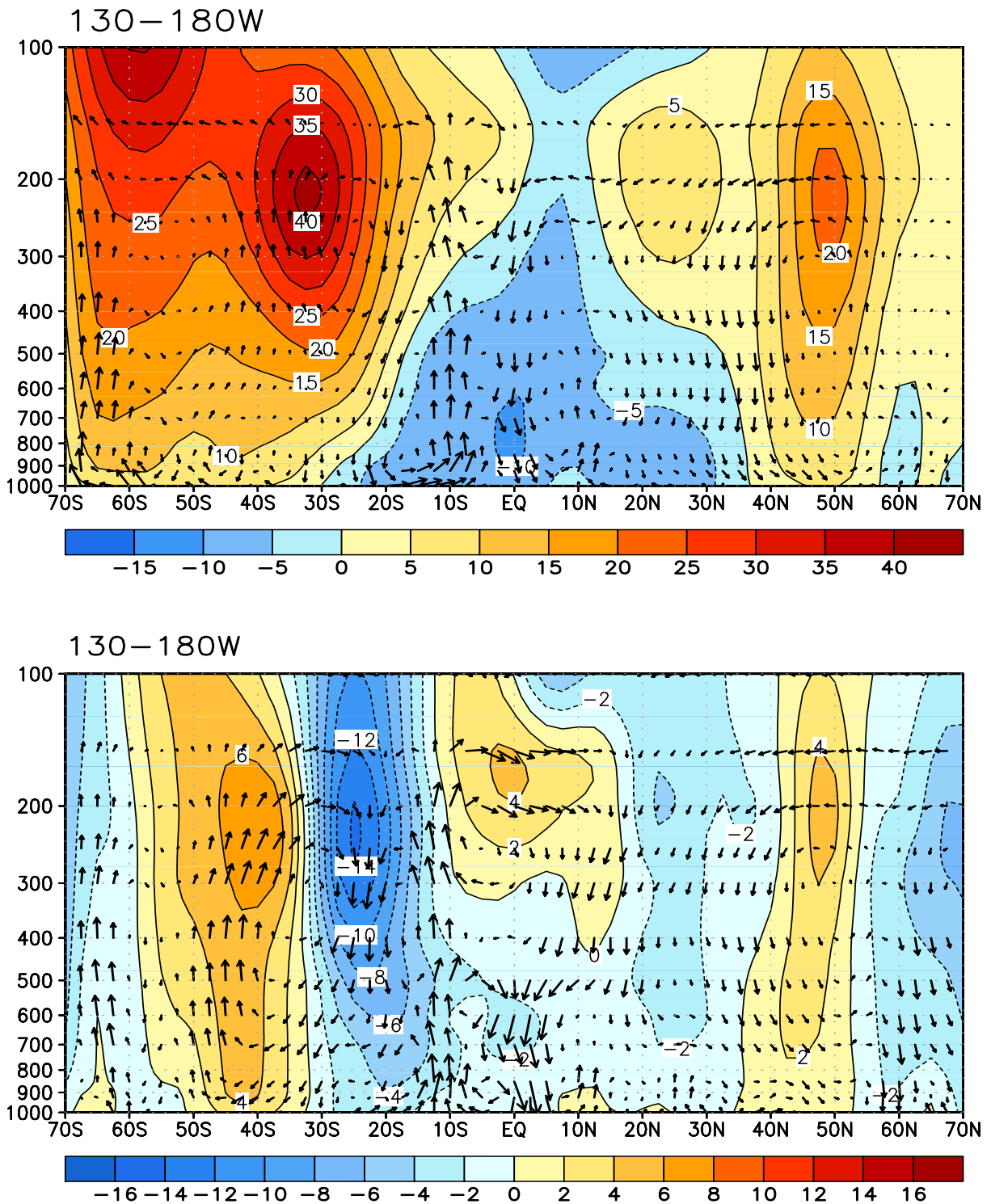
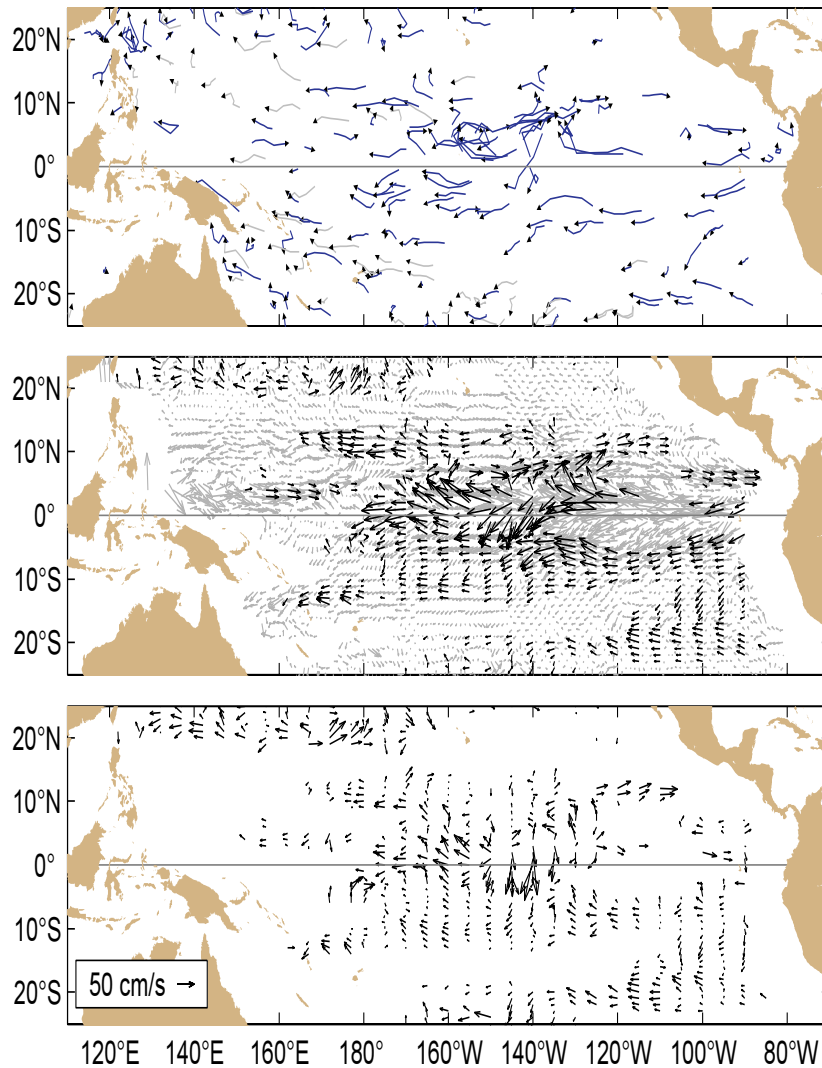


FIGURE T32. Pressure-latitude section of the mean (top) and anomalous (bottom) zonal wind ( $\text{m s}^{-1}$ ) and divergent circulation averaged over the central Pacific sector (130W-180W). The divergent circulation is represented by vectors of combined pressure vertical velocity and the divergent 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.



Tropical Pacific Drifting Buoys R. Lumpkin/M. Pazos, AOML, Miami

During August 2007, 303 satellite-tracked surface drifting buoys, 71% with subsurface drogues attached for measuring mixed layer currents, were reporting from the tropical Pacific. The strongest current anomalies were likely associated with the well-developed TIW train on and north of the equator. Weaker, but basin-wide, westward anomalies of 10-20 cm/s were measured between 10-20S. In the northern tropical Pacific, currents were near their climatological August strengths. Drifters west of 160W measured slightly warm SST, with anomalies of +0.5C to +1.5C common. East of 160W, SSTs were close to climatology (apart from very cold anomalies measured by drifters at 130-140W, 4-6N, associated with TIW advection of equatorial cold water).

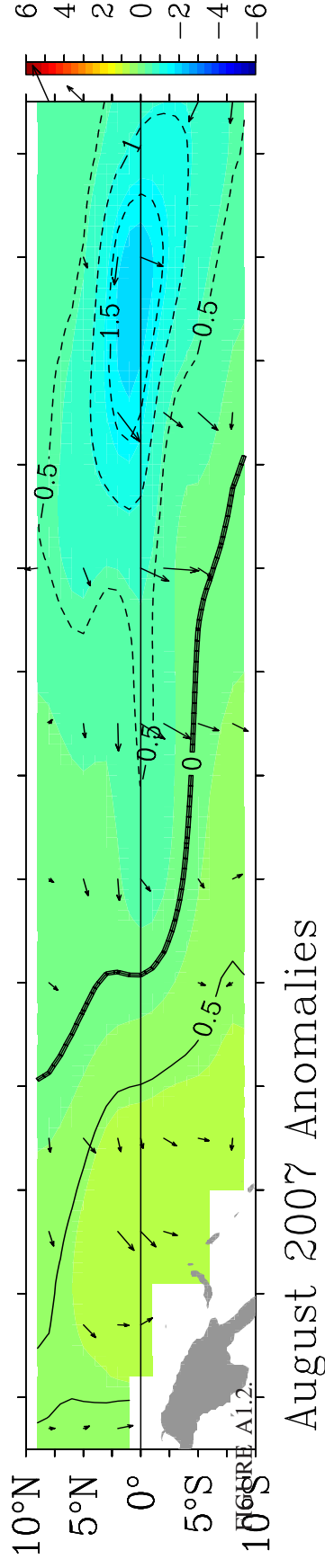
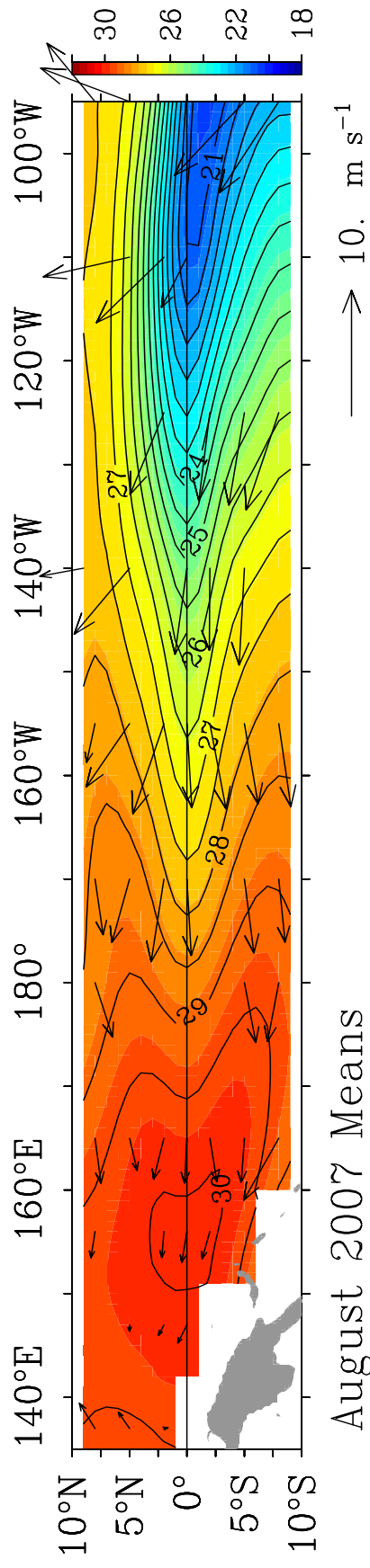


**Figure A1.1 Top:** Movements of drifting buoys in the tropical Pacific Ocean during August 2007. The linear segments of each trajectory represent a one week displacement. Trajectories of buoys which have lost their subsurface drogues are gray; those with drogues are black.

**Middle:** Monthly mean currents calculated from all buoys 1993-2002 (gray), and currents measured by the drogues this month (black) smoothed by an optimal filter.

**Bottom:** Anomalies from the climatological monthly mean currents for this month.

# TAO/TRITON Monthly Mean SST ( $^{\circ}\text{C}$ ) and Winds ( $\text{m s}^{-1}$ )



Wind vectors and sea surface temperatures (SSTs) from the TAO/TRITON mooring array for August 2007. 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 Michael J. McPhaden (NOAA/PMEL).

Five Day Zonal Wind, SST, and 20°C Isotherm Depth 2°S to 2°N Average

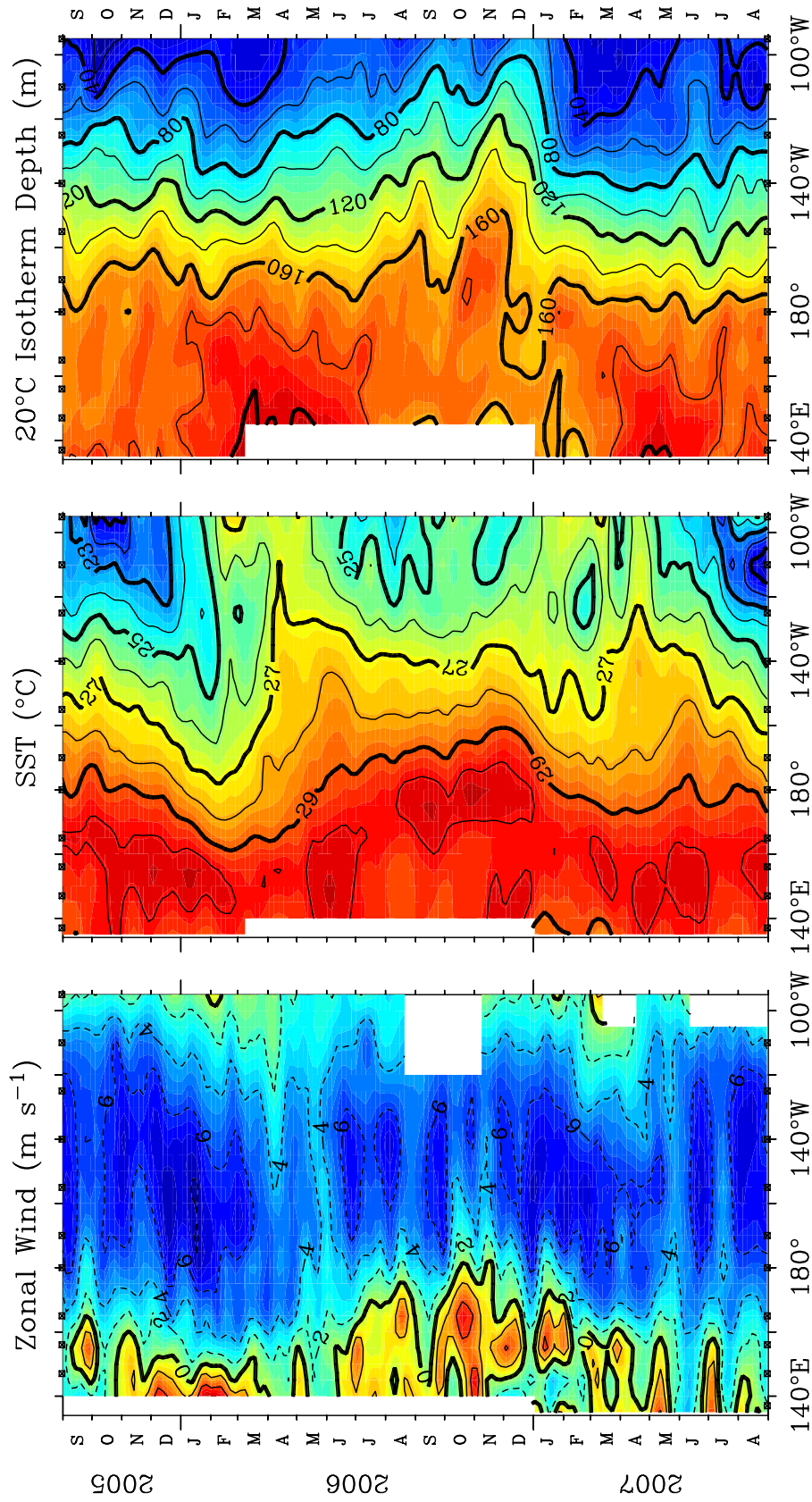


FIGURE A1.3.

Time/longitude sections of surface zonal winds (in  $\text{m s}^{-1}$ ), sea surface temperature (in  $^{\circ}\text{C}$ ) and 20°C isotherm depth (in 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 longitudes where data were available at the start of the time series (top) and the end of the time series (bottom). The TAO/TRITON Array is presently supported by the United States (NOAA), Japan (STFA), and France (IRD). Further information is available from Michael J. McPhaden (NOAA/PMEL).

Five Day Zonal Wind, SST, and 20°C Isotherm Depth Anomalies 2°S to 2°N Average

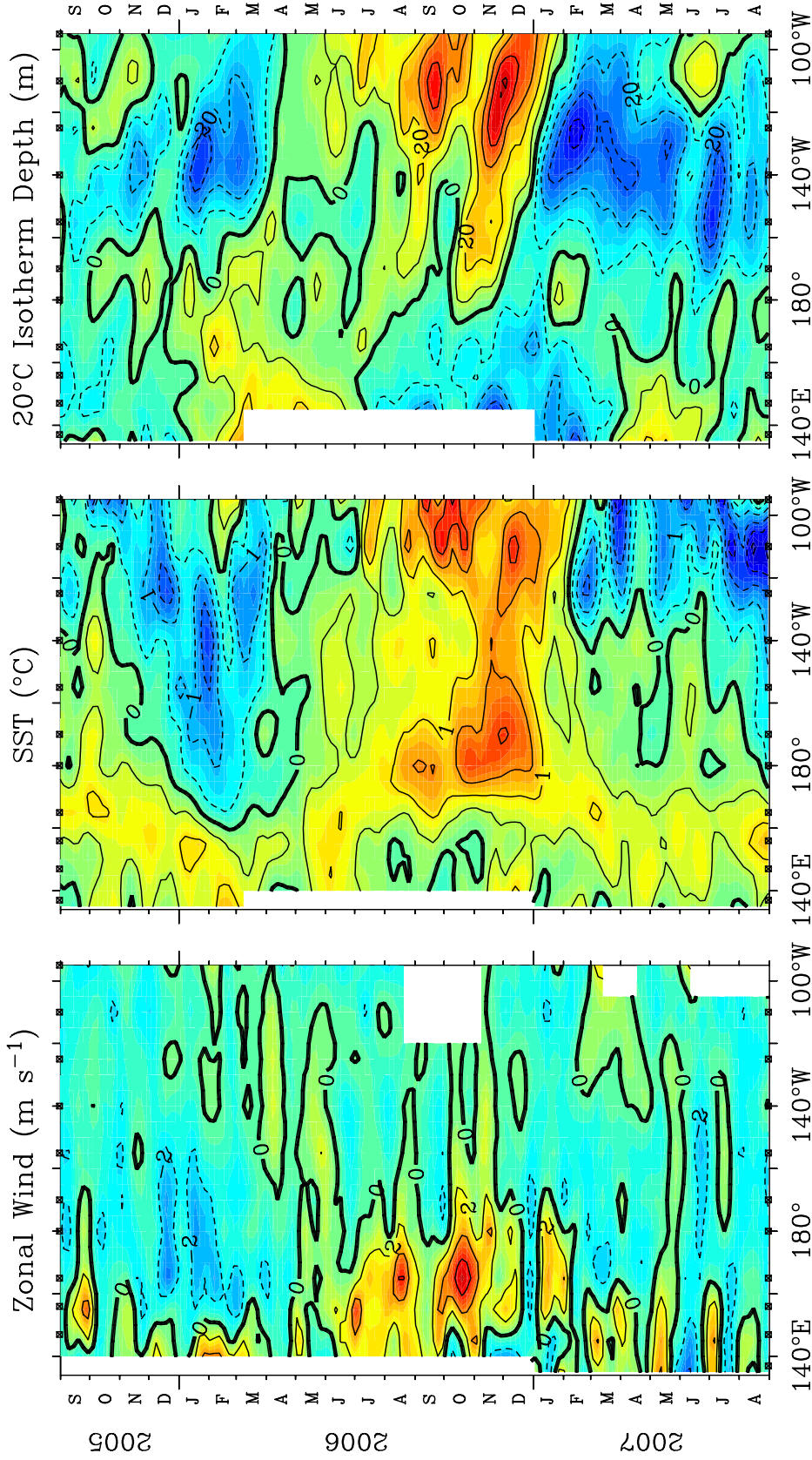
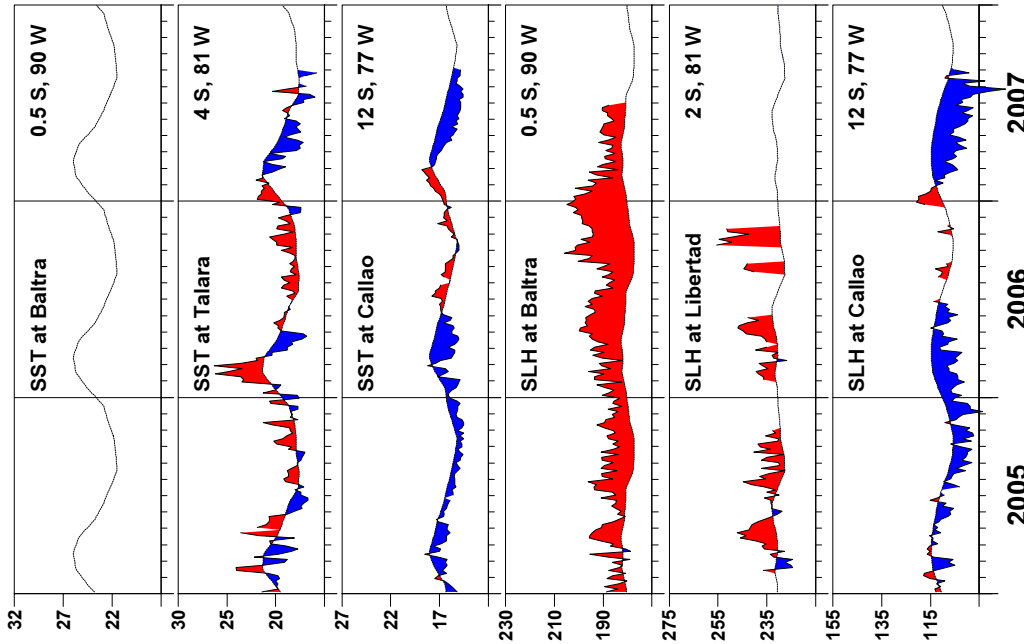
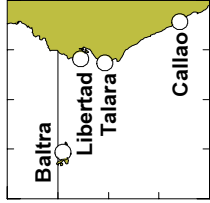


FIGURE A1.4. Time/longitude sections of anomalies in surface zonal winds (in  $\text{m s}^{-1}$ ), sea surface temperature (in  $^{\circ}\text{C}$ ) and 20°C isotherm depth (in m) for the past 24 months. Analysis is based on 5-day averages of moored time series data from the TAO/TRITON Array. Anomalies are relative to monthly climatologies cubic spline fitted to 5-day intervals (COADS winds, Reynolds SST, CTD/XBT 20°C depths). Positive winds are westerly. Squares on the abscissas indicate longitudes where data were available at the start of the time series (top) and the 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 Michael J. McPhaden (NOAA/PMEL).

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

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 Instituto Oceanográfico de la Armada, Guayaquil, ECUADOR  
 Dirección de Hidrografía y Navegación de la Marina, Callao, PERU



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.

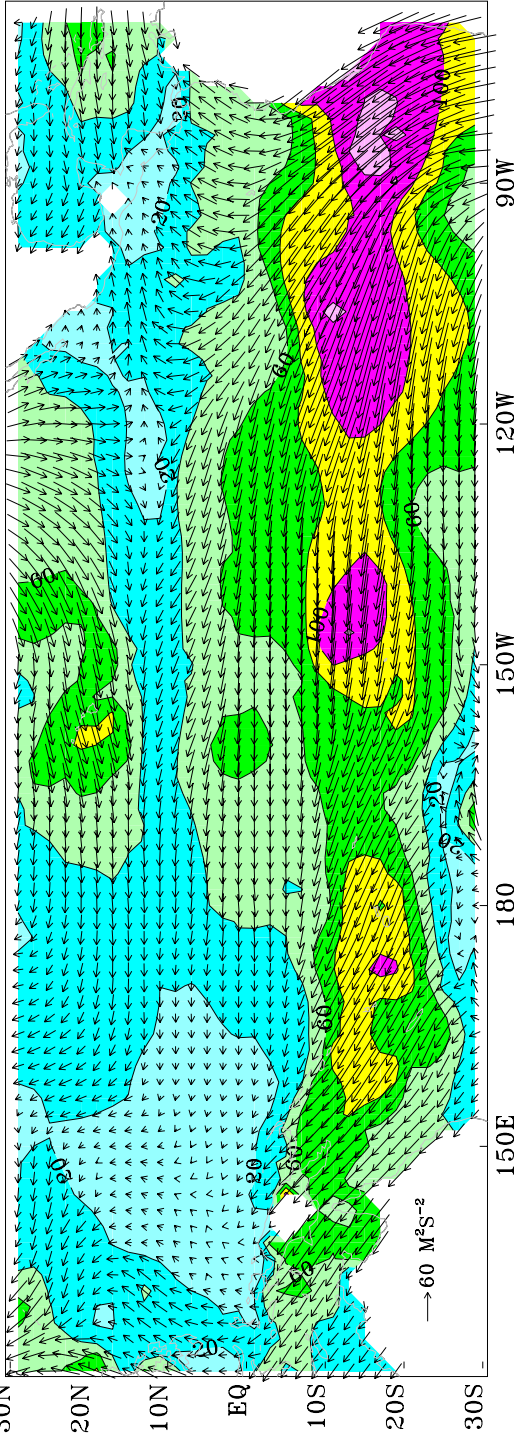
Conditions along the central Peru coast seem to have been trending toward normal during August, from the negative anomalies that have prevailed over the last half year. This is consistent with the trend that we see in the global SST fields for the coastal strip.

		Sea Sfc Temperature			Sea Level Height		
	AUG	Baltra	Talara	Callao	Baltra	Libertad	Callao
	1	**	16.9	14.9	**	**	98.9
	6	**	**	15.3	**	**	101.8
	11	**	**	15.2	**	**	92.6
	16	**	**	15.2	**	**	109.1
	21	**	17.0	14.9	**	**	108.4
	26	**	15.8	14.9	**	**	99.1
	31	**	**	14.8	**	**	105.1
					Anomalies		
	AUG	Baltra	Talara	Callao	Baltra	Libertad	Callao
	1	**	-0.7	-1.1	**	**	-9.9
	6	**	**	-0.6	**	**	-6.6
	11	**	**	-0.7	**	**	-15.4
	16	**	**	-0.6	**	**	1.5
	21	**	-0.6	-0.8	**	**	1.1
	26	**	-1.9	-0.8	**	**	-8.0
	31	**	**	-0.8	**	**	-1.7

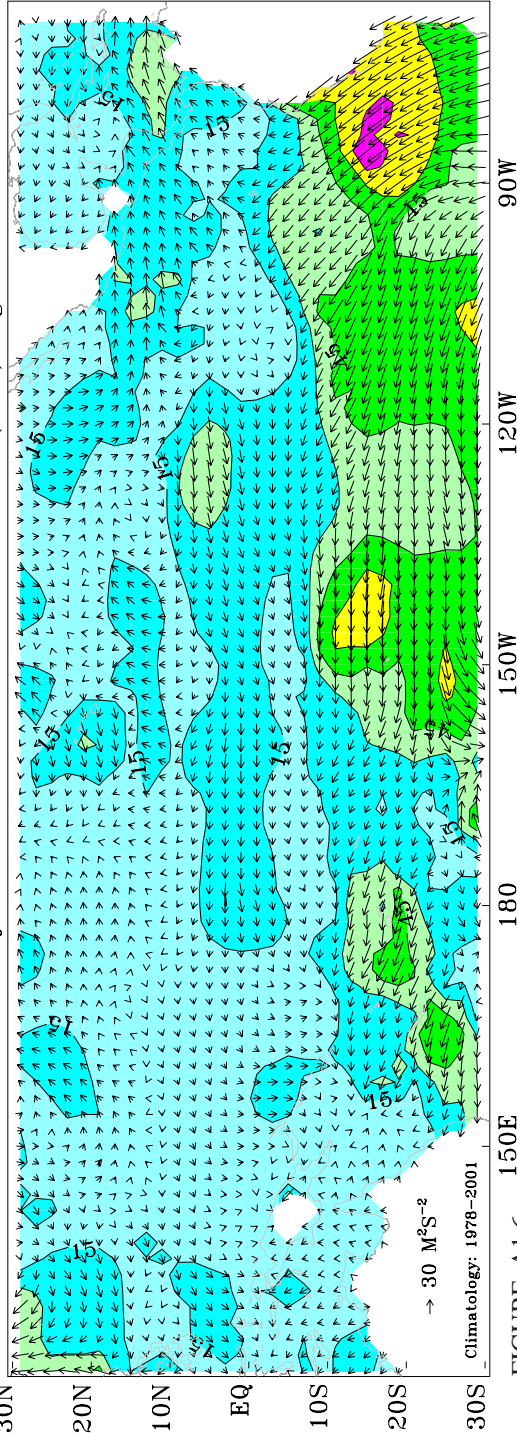
FIGURE A1.5. Five-day averages of sea surface temperature (SST, °C) and sea level height (SLH<sub>cm</sub>) from GOES receiving stations in Ecuador & Peru. Dashed line and shading show climatology, departures.

Email: David.Enfield@noaa.gov; Phone: (305) 361-4351; Fax: (305) 361-4392  
 \*\* - Data missing due to hardware failure

Near-real-time Objective FSU Pseudo-stress Magnitude and Vectors (10m) August 2007



Near-real-time Objective FSU Pseudo-stress Anomalies (10m) August 2007



Climatology: 1978-2001

FIGURE A1.6.

FSU SURFACE PSEUDO-STRESS VECTORS AND ANOMALIES: August 2007. Pseudo-stress vectors (top) are objectively analyzed from ship and buoy winds on a  $2^\circ$  grid. Ship and buoy data are independently weighted and the background field is created from the data. Contour interval of the vector magnitudes is  $20 \text{ M}^2\text{S}^{-2}$ . Anomalies (bottom) are departures from 1978-2001 mean. The contour interval is  $15 \text{ M}^2\text{S}^{-2}$ . 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.

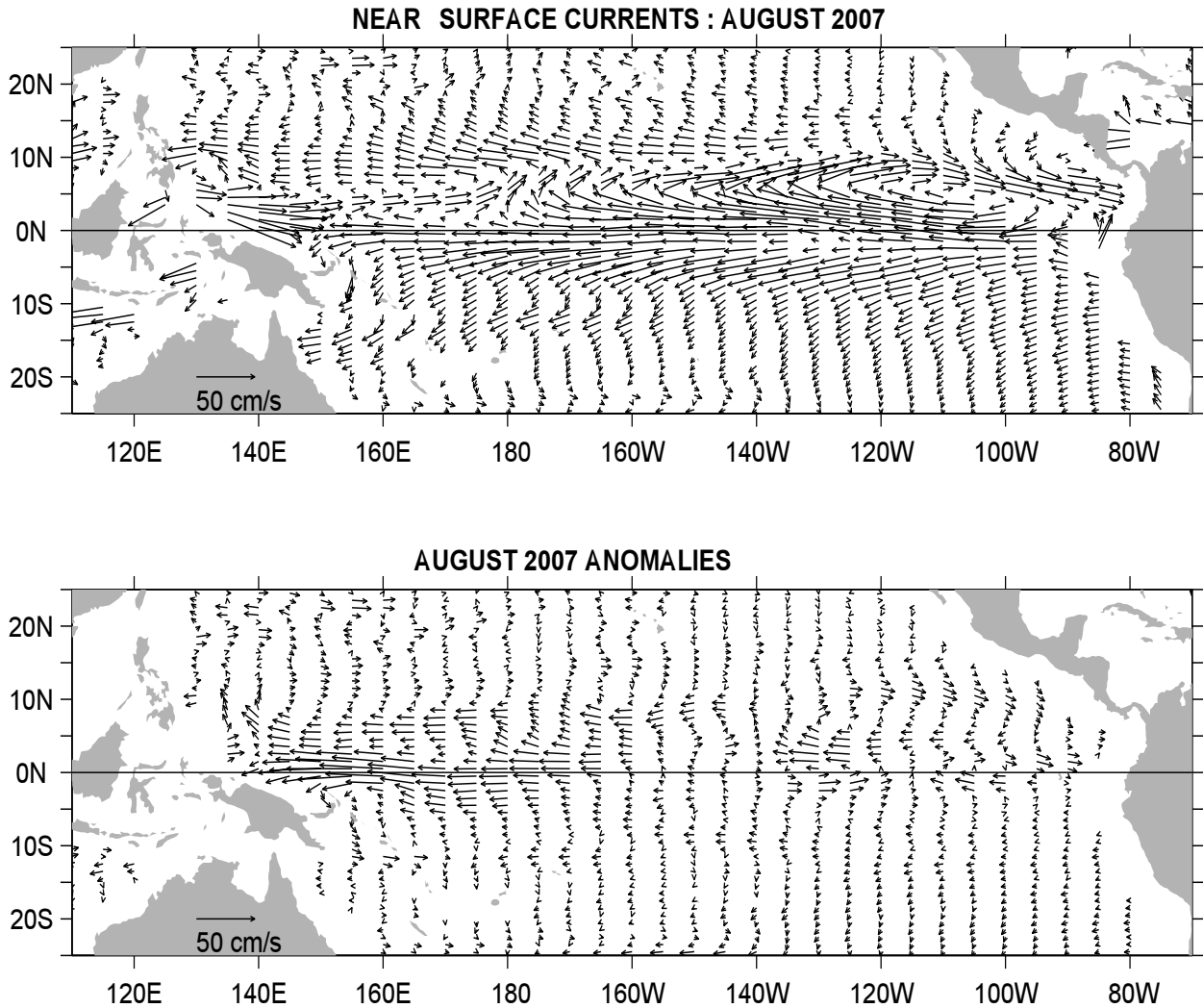


FIGURE A1.7. Ocean Surface Current Analysis-Real-time (OSCAR) for AUG 2007 (Bonjean and Lagerloef 2002, *J. Phys. Oceanogr.*, Vol. 32, No. 10, 2938-2954; Lagerloef et al. 1999, *JGR-Oceans*, 104, 23313-23326). (top) Total velocity. Satellite data included AUG 2007 Jason sea level anomalies and QuickScat winds. Data were smoothed with optimal filter ( $L_x \sim 10^\circ$ ,  $L_y \sim 2^\circ$ ). (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>.

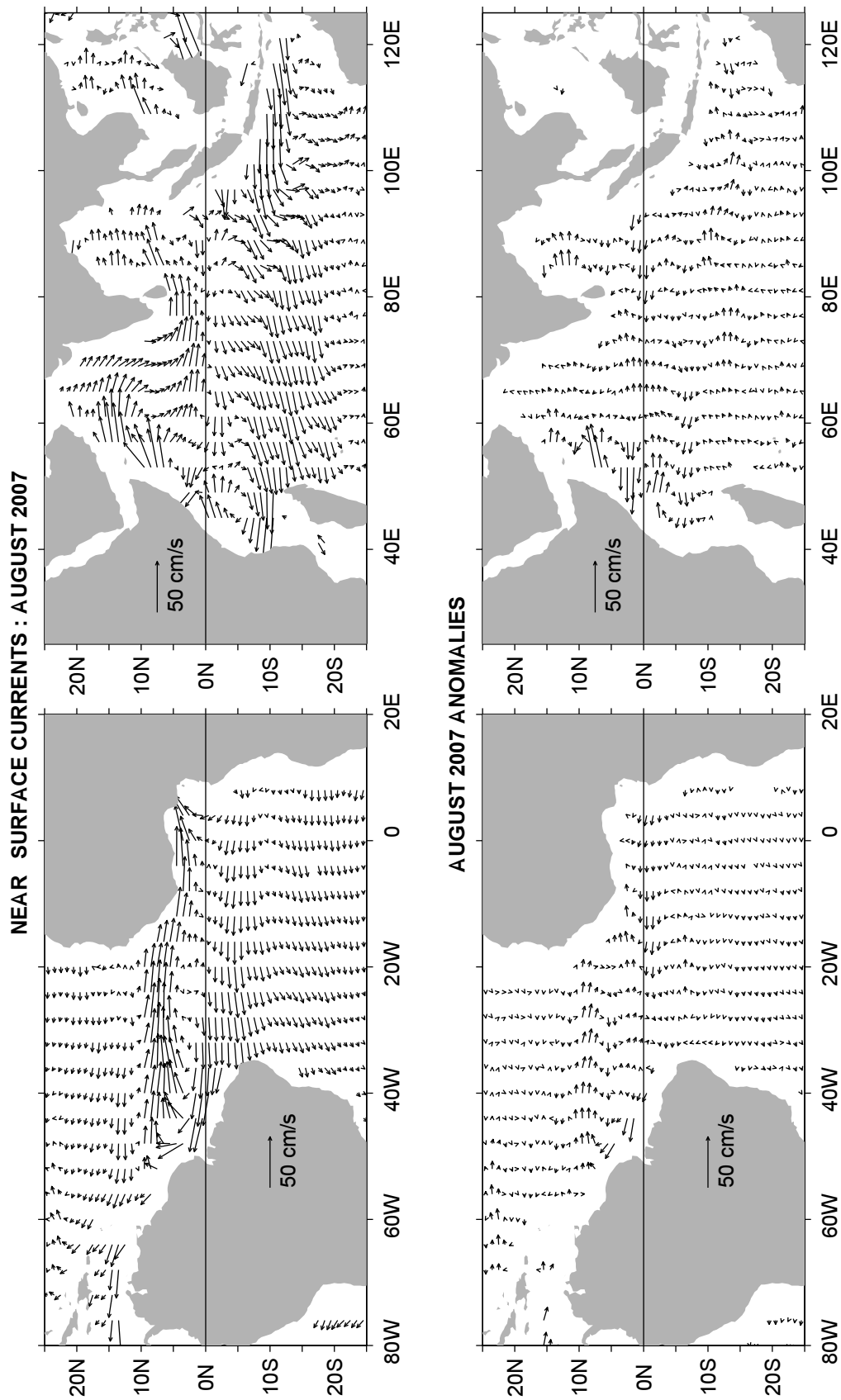


FIGURE A1.8. Ocean Surface Current Analysis-Real-time (OSCAR) for AUG 2007 (Bonjean and Lagerloef 2002, *J. Phys. Oceanogr.*, Vol. 32, No. 10, 2938-2954; Lagerloef et al. 1999, *JGR-Oceans*, 104, 23313-23326). (top) Total velocity. Satellite data included AUG 2007 Jason sea level anomalies and QuickScat winds. Data were smoothed with optimal filter ( $L_x \sim 10^\circ$ ,  $L_y \sim 2^\circ$ ). (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. Lett.*, **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 conditions will develop further during the next 3 months.

## Discussion

During August 2007, negative sea surface temperature (SST) anomalies in the eastern equatorial Pacific expanded westward, and now extend from the coast of South America to the date line (180°W) (**Fig. T1**). Consistent with this additional cooling, three of the Niño indices remained cooler than “0.5 °C throughout August, with only Niño 4 remaining average (August monthly values: Niño 1+2 (“1.6°C), Niño 3 (“1.1°C), Niño 3.4 (“0.5°C), Niño 4 (+0.1°C)) (**Table T2**). The upper-ocean heat content (average temperatures in the upper 300 m of the ocean) in the central and east-central equatorial Pacific also remained below average (Fig. 3), with temperatures at thermocline depth ranging from 1°C to 3°C below average (**Fig. T17**). While not as pronounced as in previous months, the low-level easterly winds remained stronger than average in the west-central equatorial Pacific (**Fig. T20**), convection was suppressed throughout the central and eastern equatorial Pacific, and an area of slightly enhanced convection again covered parts of Indonesia and the far western Pacific (**Fig. T25**). Collectively, the oceanic and atmospheric conditions reflect La Niña conditions.

The recent SST forecasts for the Niño 3.4 region range from ENSO-neutral to La Niña (**Figs. F1-F13**). Nearly all of the dynamical ENSO models forecast the continuing development of La Niña during

the next couple of months, and several of the statistical models also indicate the continuation of La Niña conditions through the end of the year. Therefore, current atmospheric conditions (stronger than average easterlies over the west-central Pacific) and observed oceanic trends indicate that La Niña conditions will develop further and possibly strengthen during the next 3 months.

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

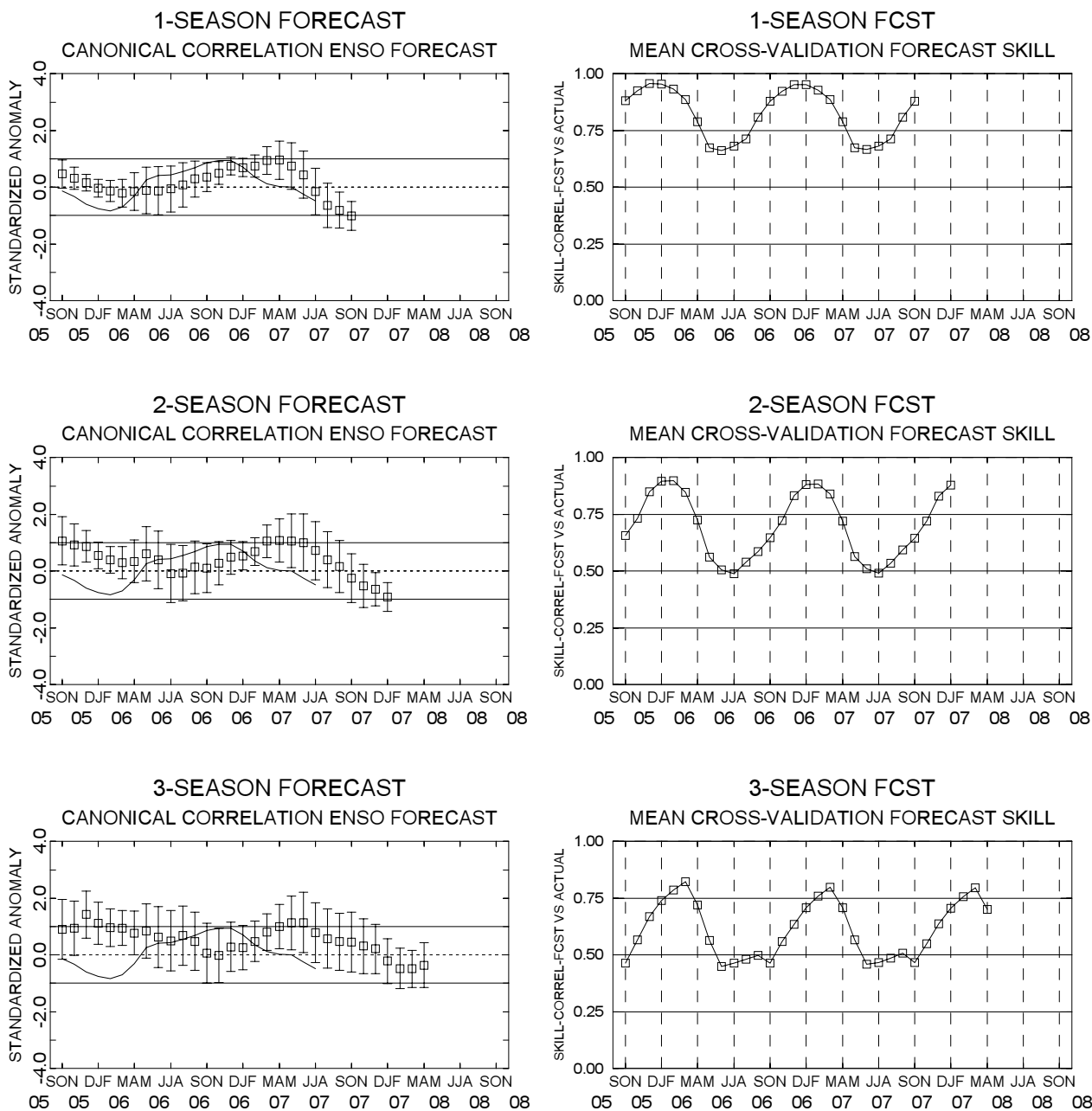


FIGURE F1. Canonical correlation analysis (CCA) sea surface temperature (SST) anomaly prediction for the central Pacific (5°N to 5°S, 120°W to 170°W (Barnston and Ropelewski, 1992, *J. Climate*, **5**, 1316-1345). The three plots on the left hand side are, from top to bottom, the 1-season, 2-season, 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.

## 0-4 SEASON LEAD FORECAST CANONICAL CORRELATION ENSO FORECAST

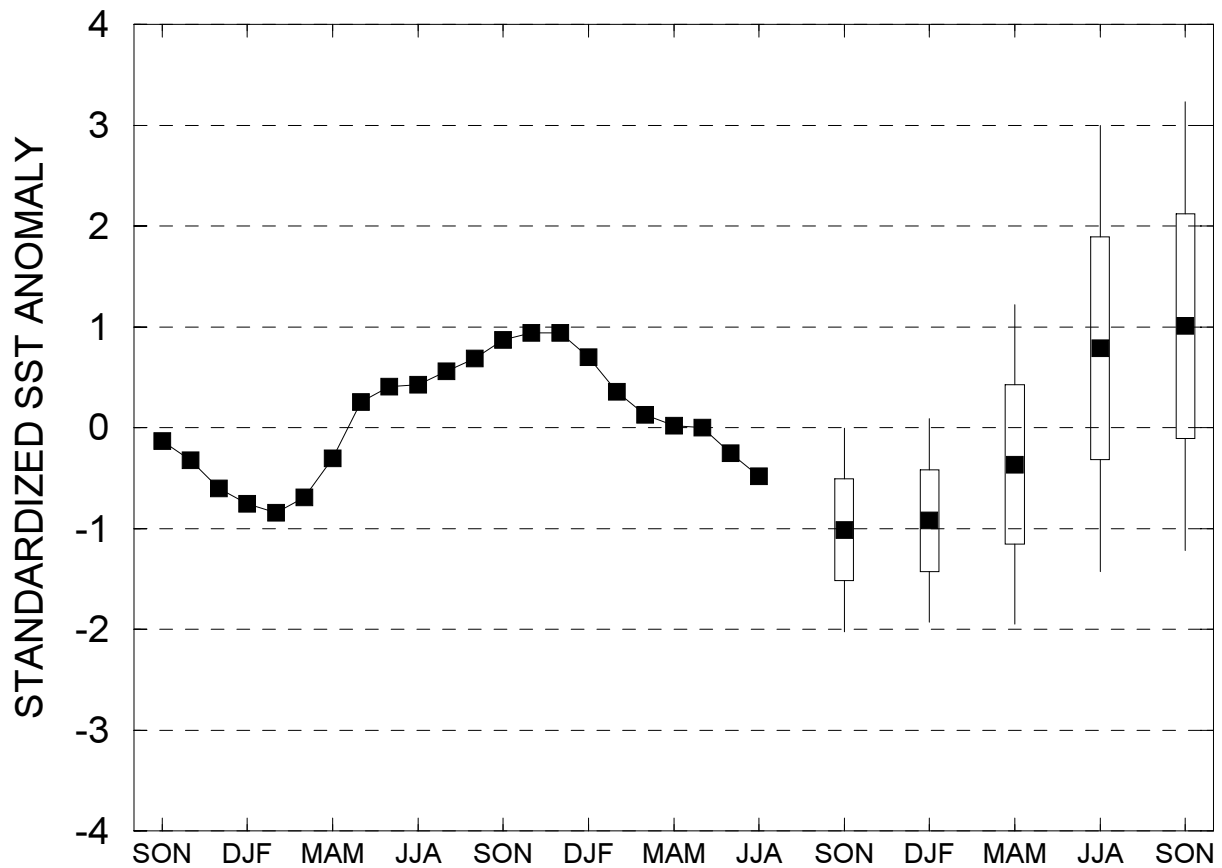


FIGURE F2. Canonical Correlation Analysis (CCA) forecasts of sea-surface temperature anomalies for the Niño 3.4 region (5N-5S, 120W-170W) for the upcoming five consecutive 3-month periods. Forecasts are expressed as standardized SST anomalies. The CCA predictions are based on anomaly patterns of SST, 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 Niño 3.4 region up to the most recently available data.

Last update: Sun Sep 9 2007

Initial conditions: 13Aug2007-01Sep2007

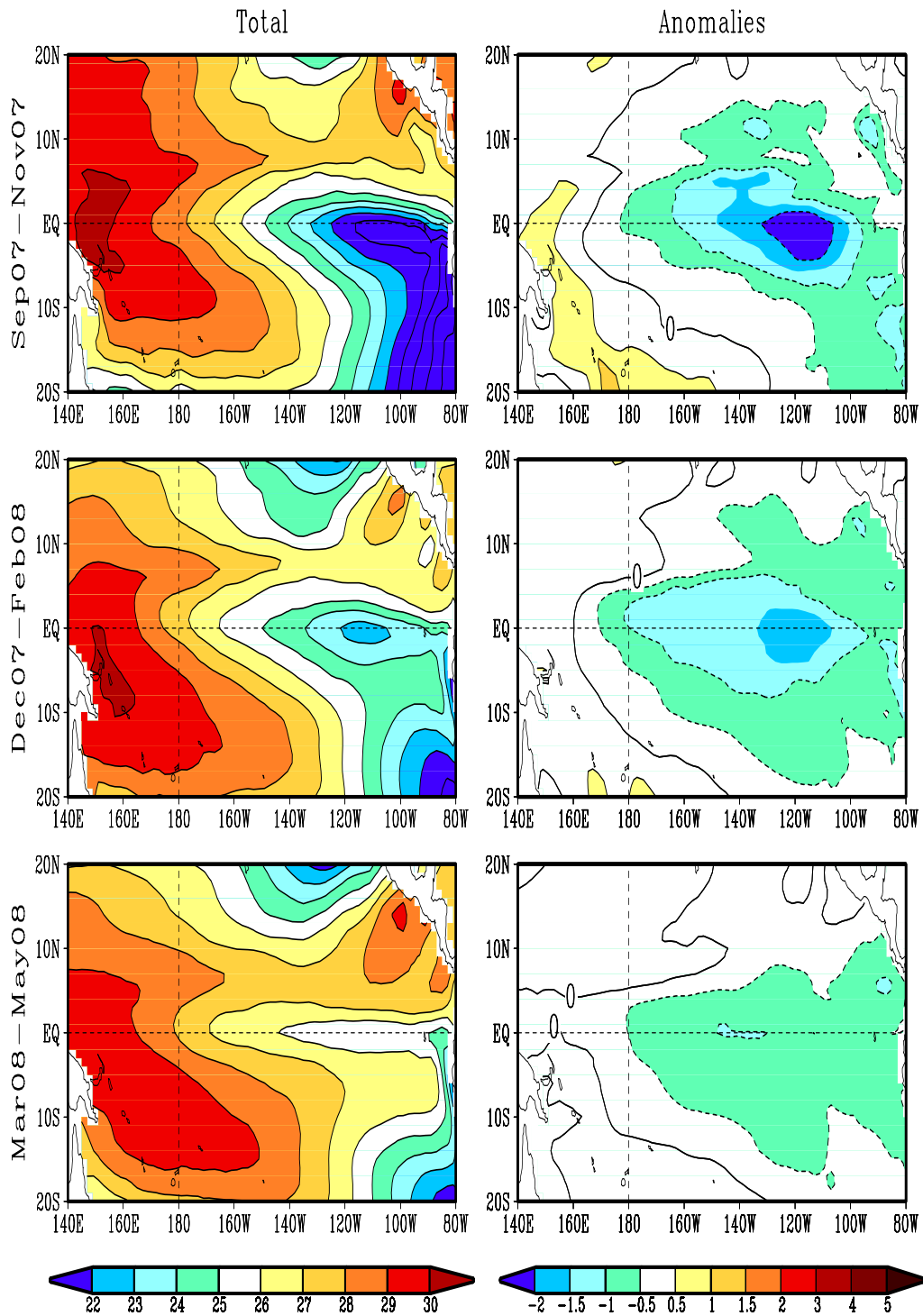


FIGURE F3. Predicted 3-month average sea surface temperature (left) and anomalies (right) from the NCEP Coupled Forecast System Model (CFS03). The forecasts consist of 40 forecast members. Contour interval is 1°C, with additional contours for 0.5°C and -0.5°C. Negative anomalies are indicated by dashed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

Last update: Sun Sep 9 2007  
Initial conditions: 13Aug2007-01Sep2007

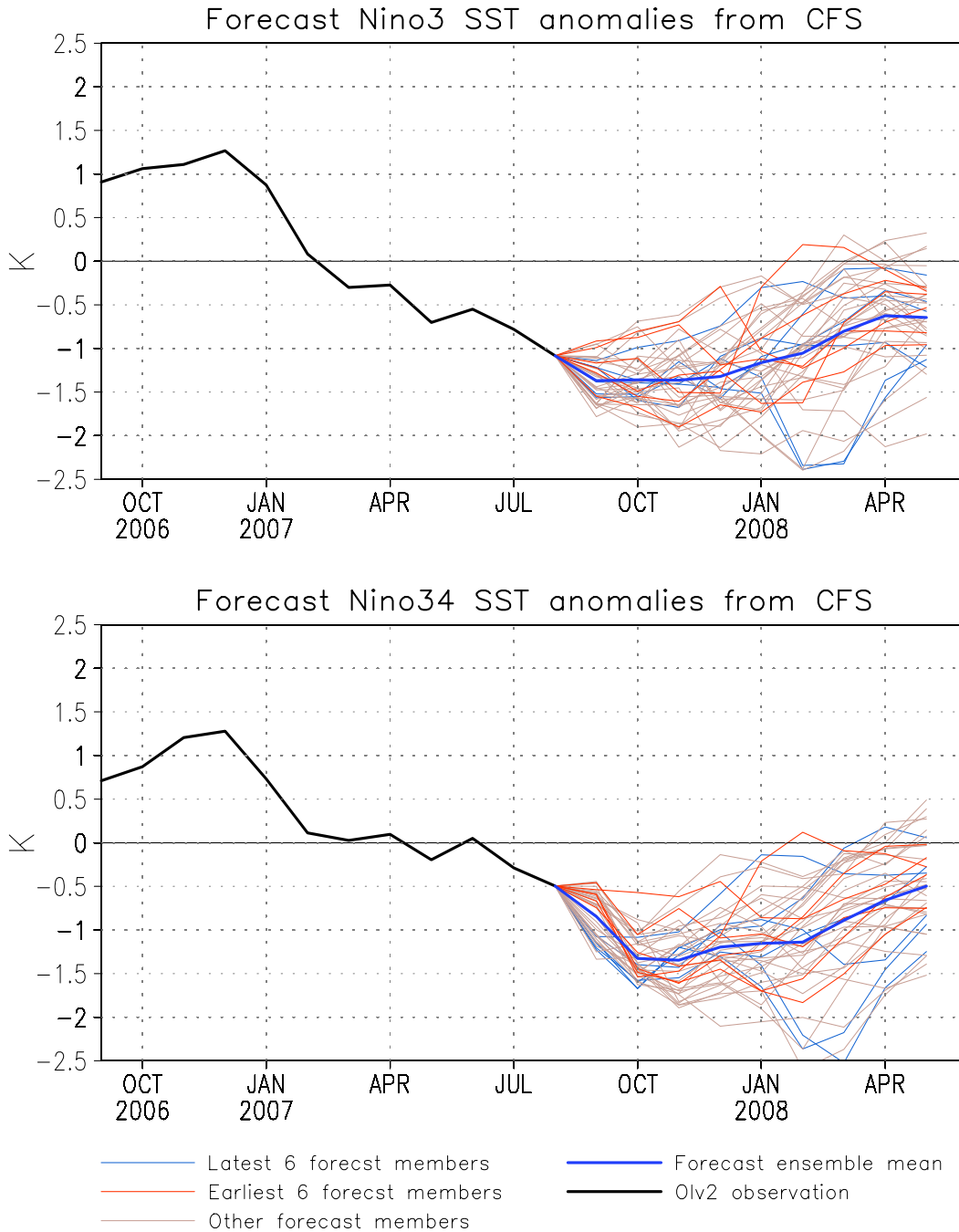


FIGURE F4. Predicted and observed sea surface temperature (SST) anomalies for the Nino 3 (top) and Nino 3.4 (bottom) regions from the NCEP Coupled Forecast System Model (CFS03). The forecasts consist of 40 forecast members. The ensemble mean of all 40 forecast members is shown by the blue line, individual 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.

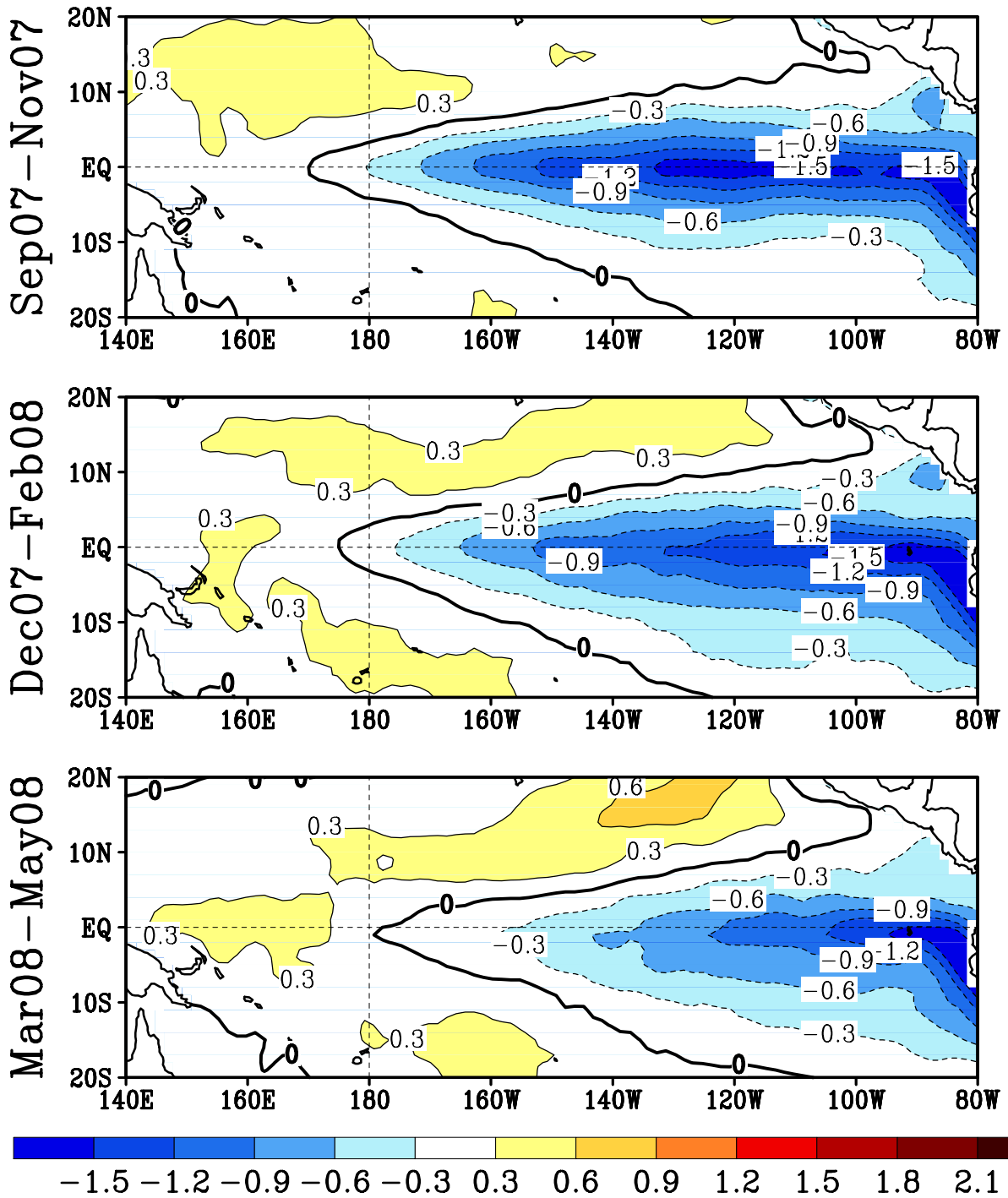


FIGURE F5. Predicted 3-month average sea surface temperature anomalies from the NCEP/CPC Markov model (Xue et al. 2000, *J. Climate*, **13**, 849-871). The forecast is initiated in AUG 2007 . Contour interval is 0.3C and negative anomalies are indicated by dashed contours. Anomalies are calculated relative to the 1971-2000 climatology.

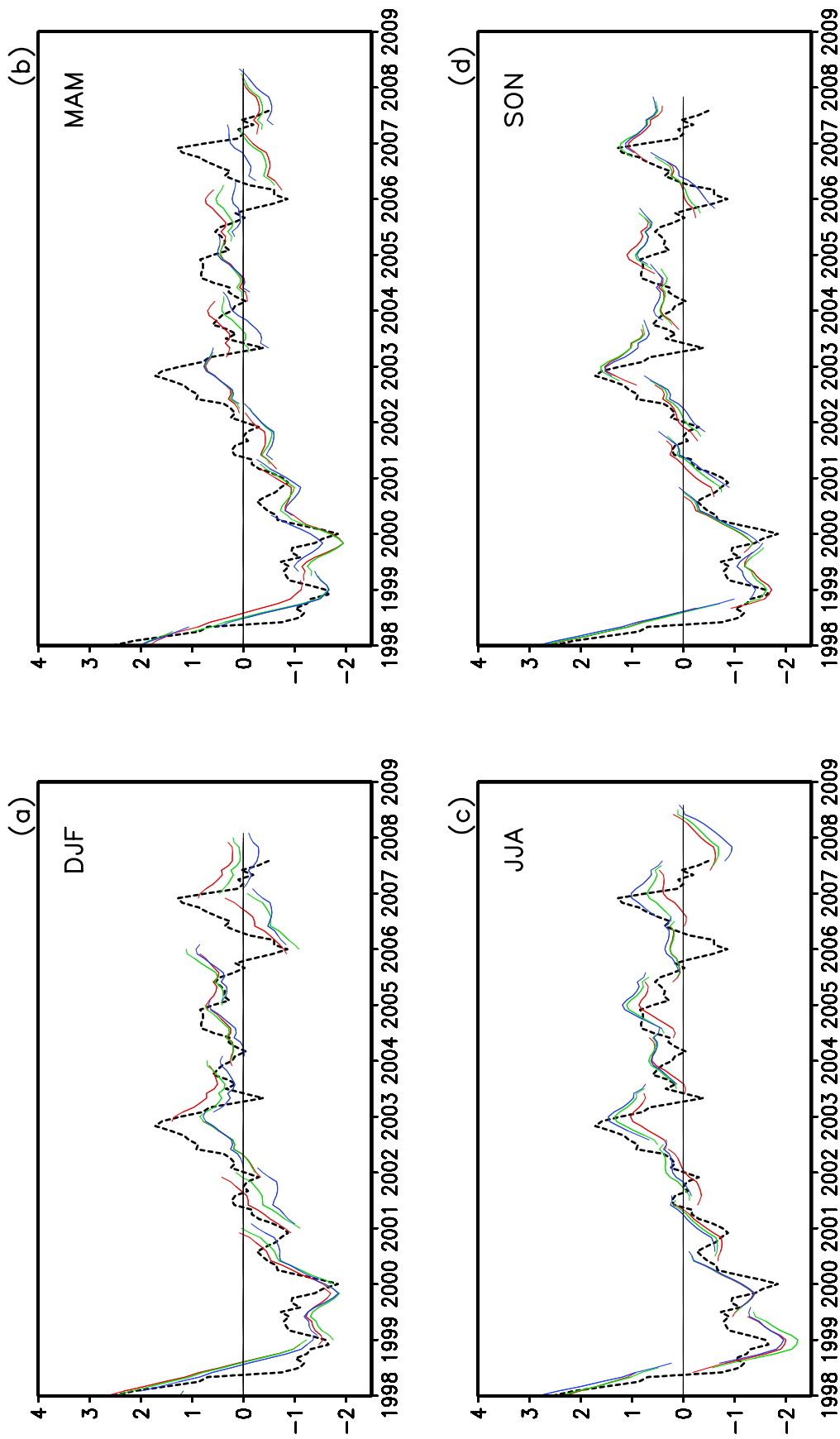
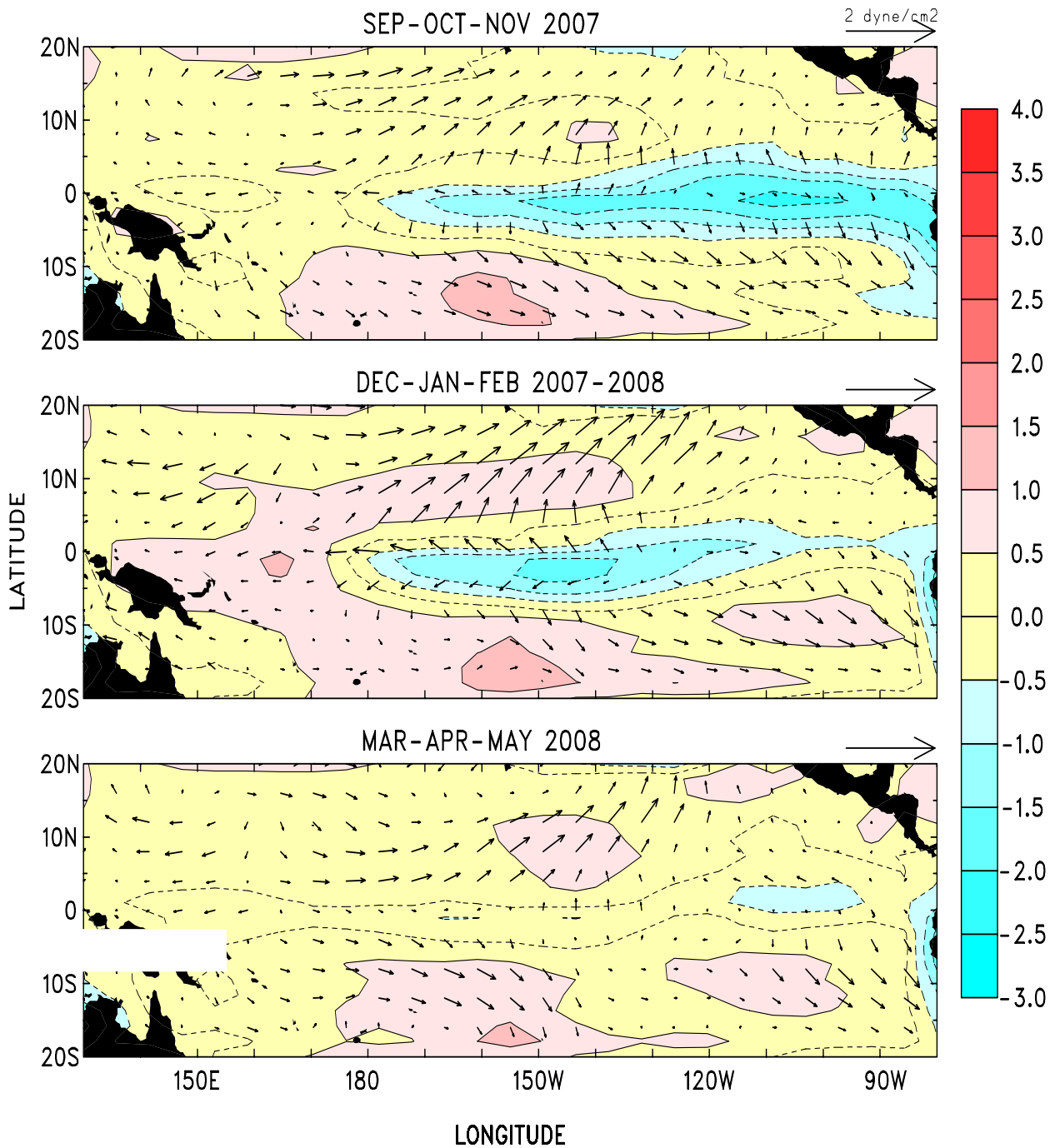


FIGURE F6. Time evolution of observed and predicted SST anomalies in the Niño 3.4 region (up to 12 lead months) by the NCEP/CPC Markov model (Xue et al. 2000, *J. Climate*, **13**, 849-871). Anomalies are calculated relative to the 1971-2000 climatology. Shown in each panel are the forecasts grouped 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 Niño 3.4 SST anomalies are indicated by the black dashed lines. The Niño 3.4 region spans the east-central equatorial Pacific between 5N-5S, 170W-120W.

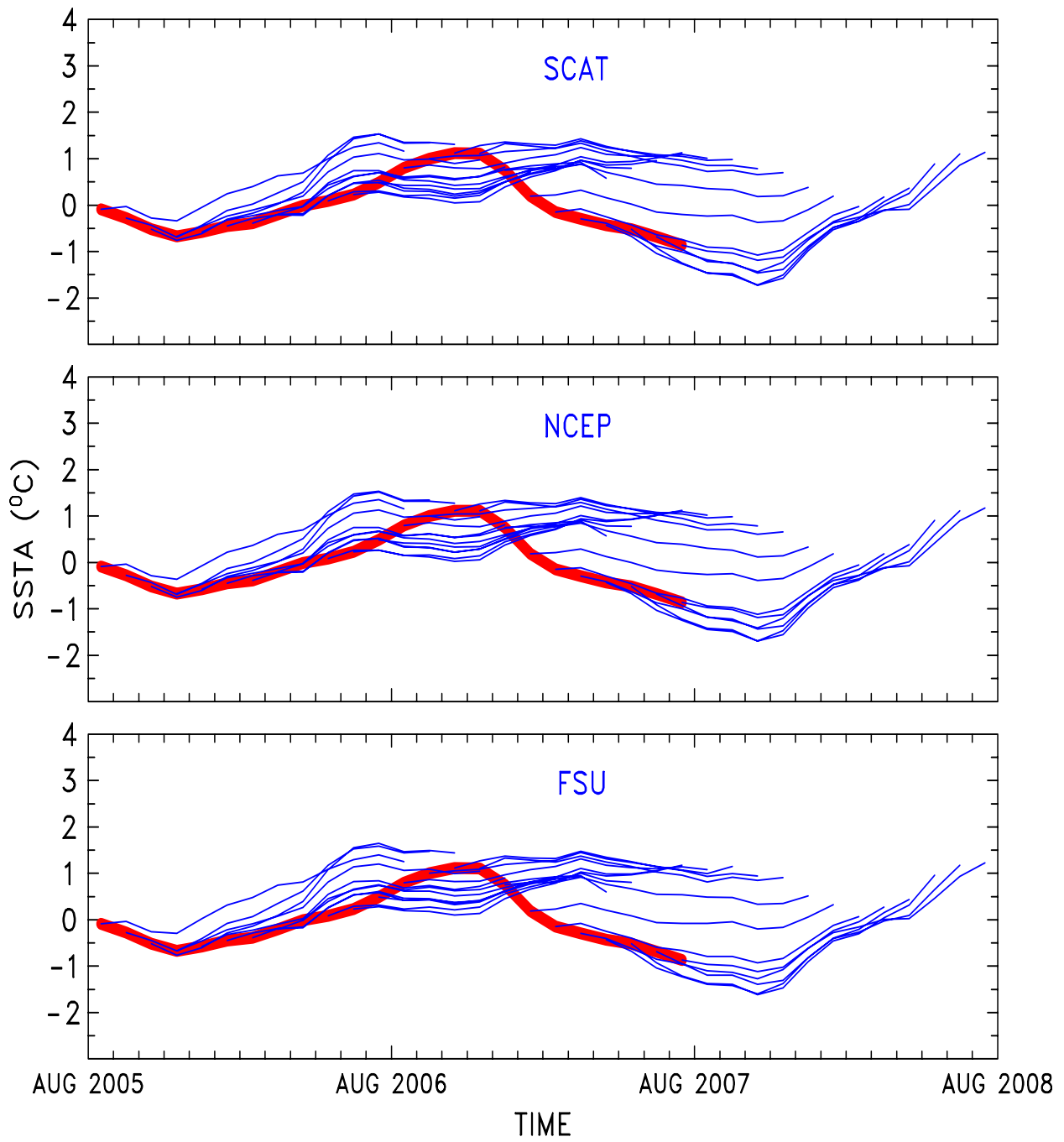


# LDEO FORECASTS OF SST AND WIND STRESS ANOMALIES



**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).

## LDEO FORECASTS OF NINO3



**FIGURE F8.** LDEO forecasts of SST anomalies for the Niño 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 Niño-3 region spans the eastern equatorial Pacific between 5N-5S, 150W-90W.

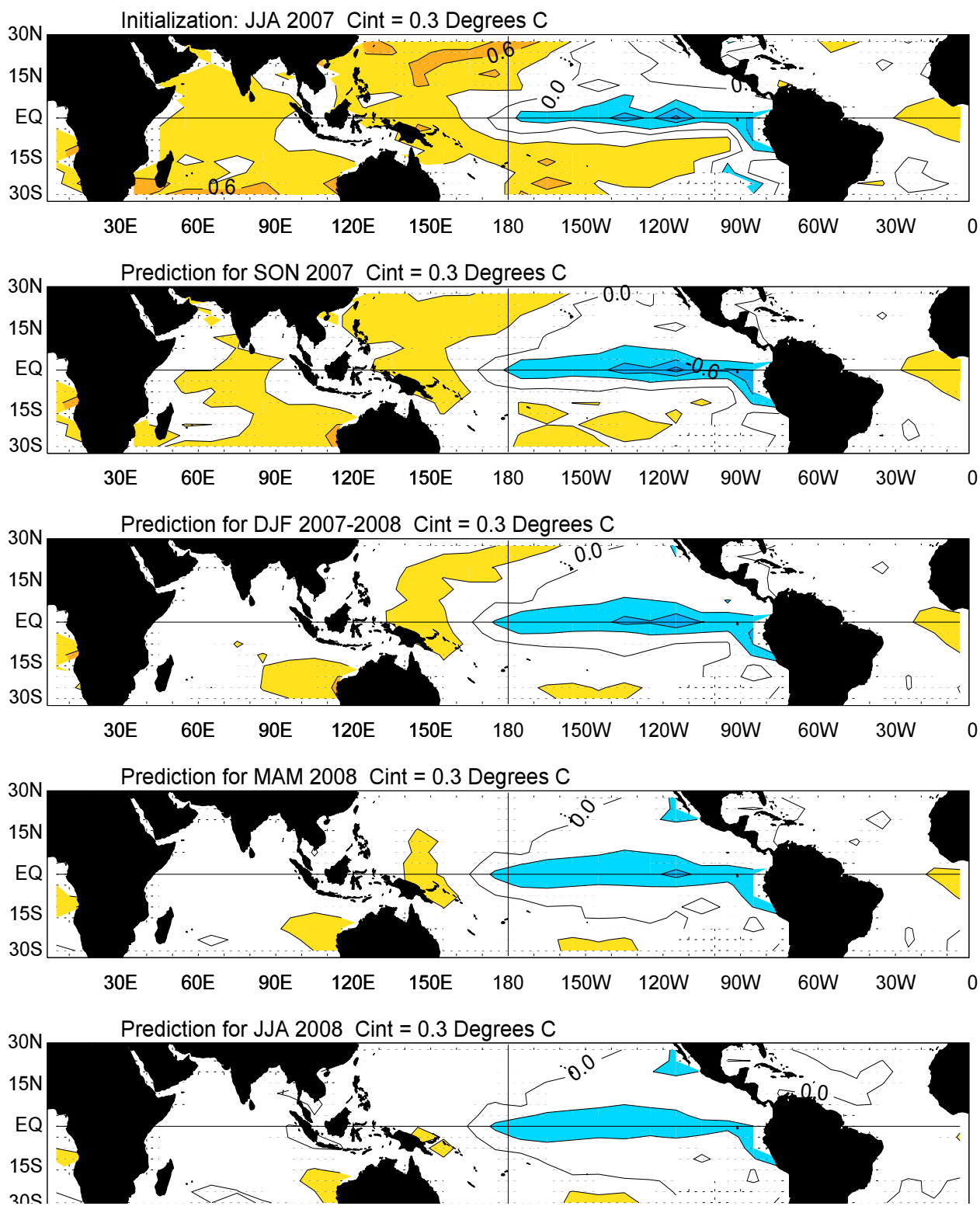


FIGURE F9. Forecast of tropical SST anomalies from the Linear Inverse Modeling technique of Penland and Magorian (1993: *J. Climate*, 6, 1067-1076). The contour interval is 0.3C. Anomalies are calculated relative to the 1951-2000 climatology and are projected onto 20 leading EOFs.

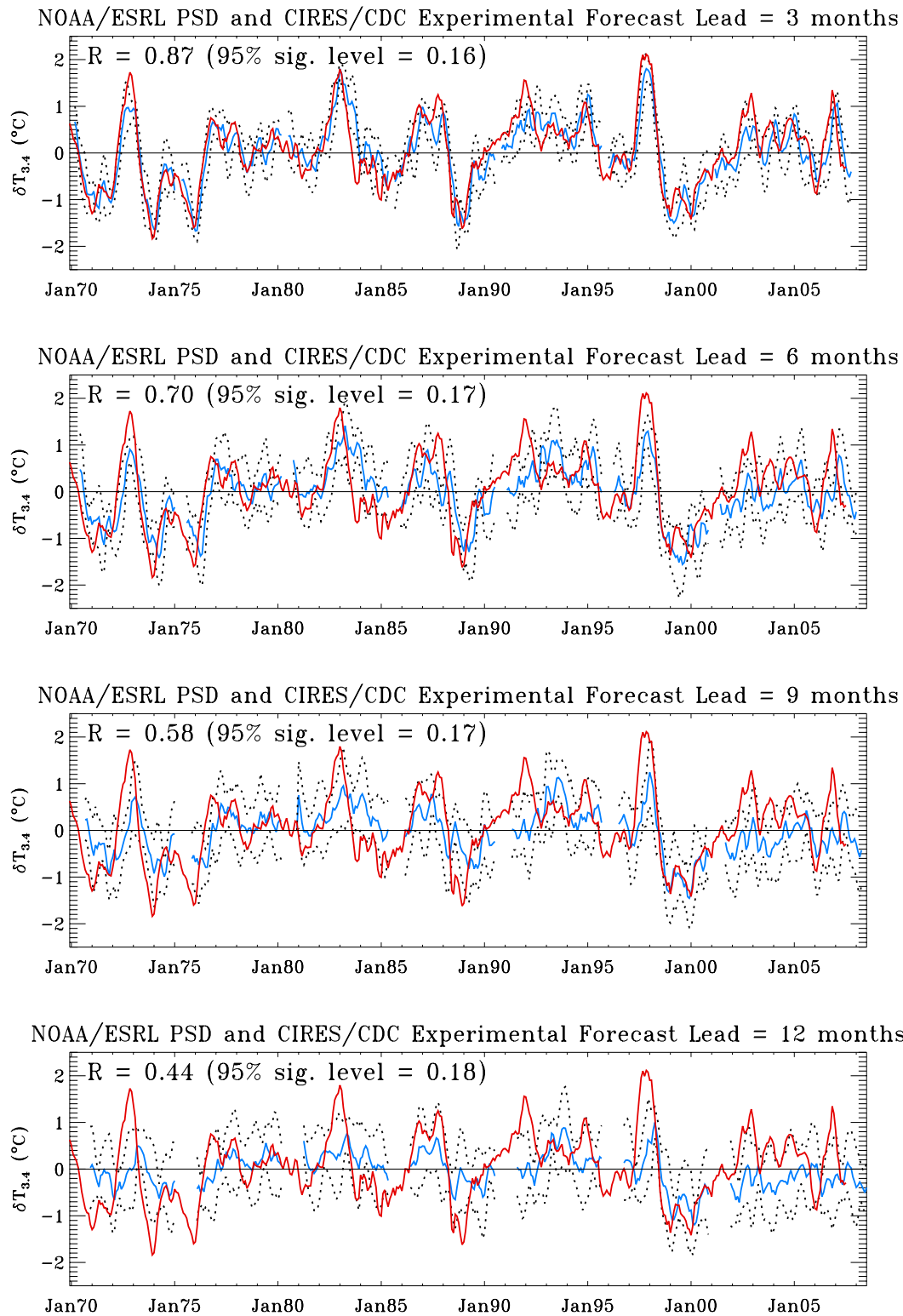


FIGURE F10. Predictions of SST anomalies in the Niño 3.4 region (blue line) for leads of three months (top) to 12 months (bottom), from the Linear Inverse Modeling technique of Penland and Magorian (1993: *J. Climate*, **6**, 1067-1076). Observed SST anomalies are indicated by the red line. Anomalies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

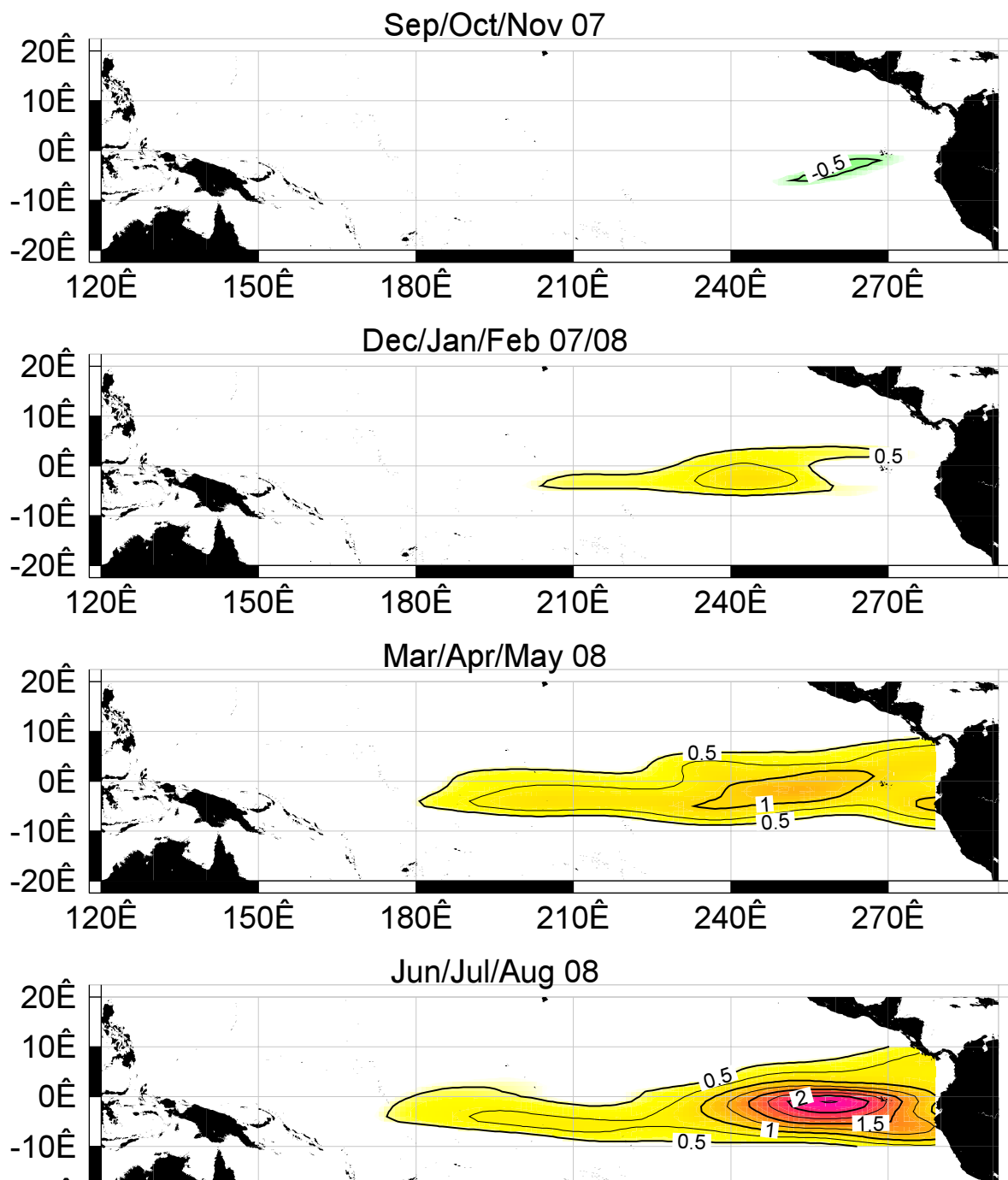


FIGURE F11. SST anomaly forecast for the equatorial Pacific from the Hybrid Coupled Model (HCM) developed by the Scripps Institution of Oceanography and the Max-Planck Institut fuer Meteorologie.

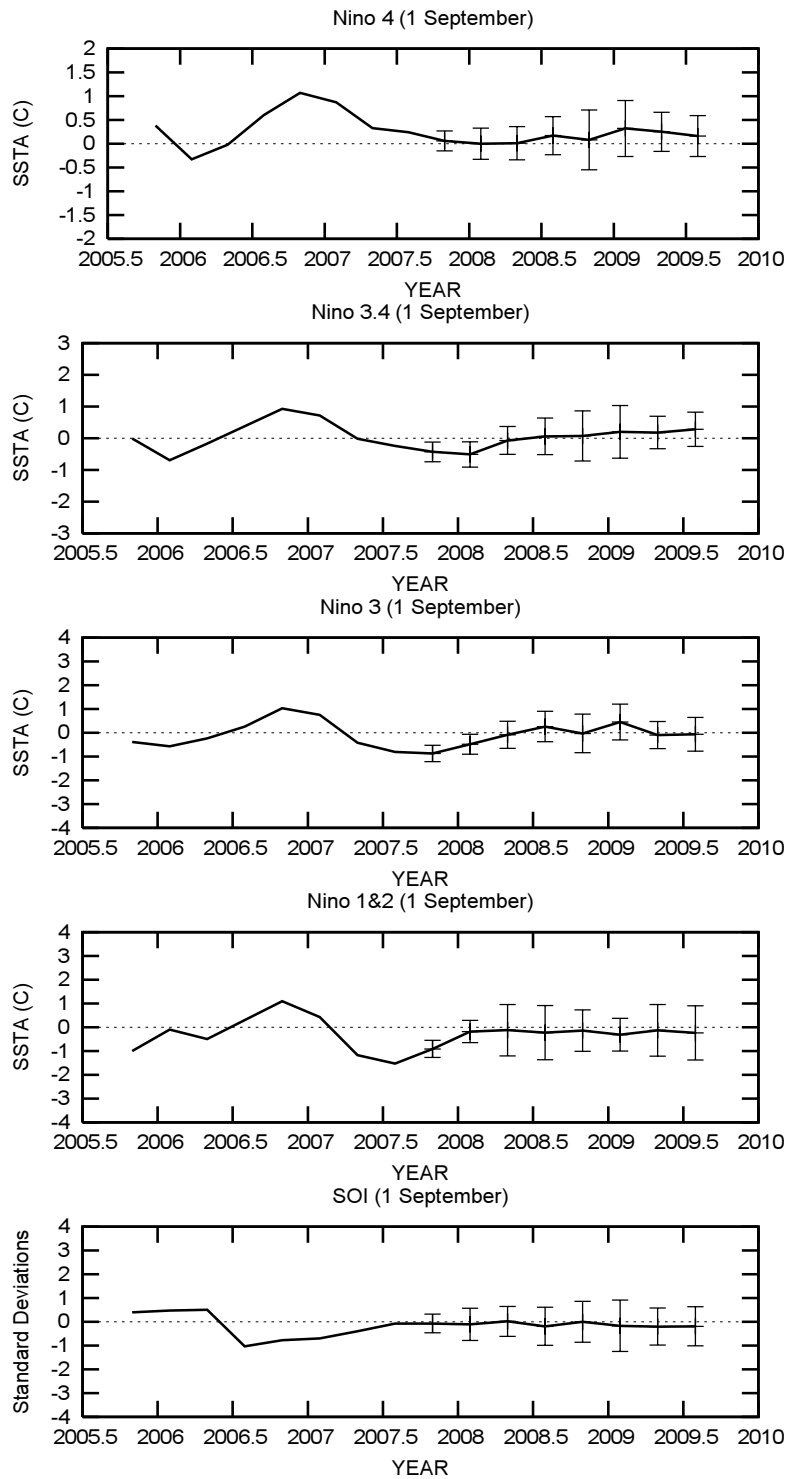


FIGURE F12. ENSO-CLIPER statistical model forecasts of three-month average sea surface temperature anomalies (green lines, deg. C) in (top panel) the Nino 4 region (5N-5S, 160E-150W), (second panel) the Nino 3.4 region (5N-5S, 170W-120W), (third panel) the Nino 3 region (5N-5S, 150W-90W), and (fourth 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.

### Model Forecasts of ENSO from Aug 2007

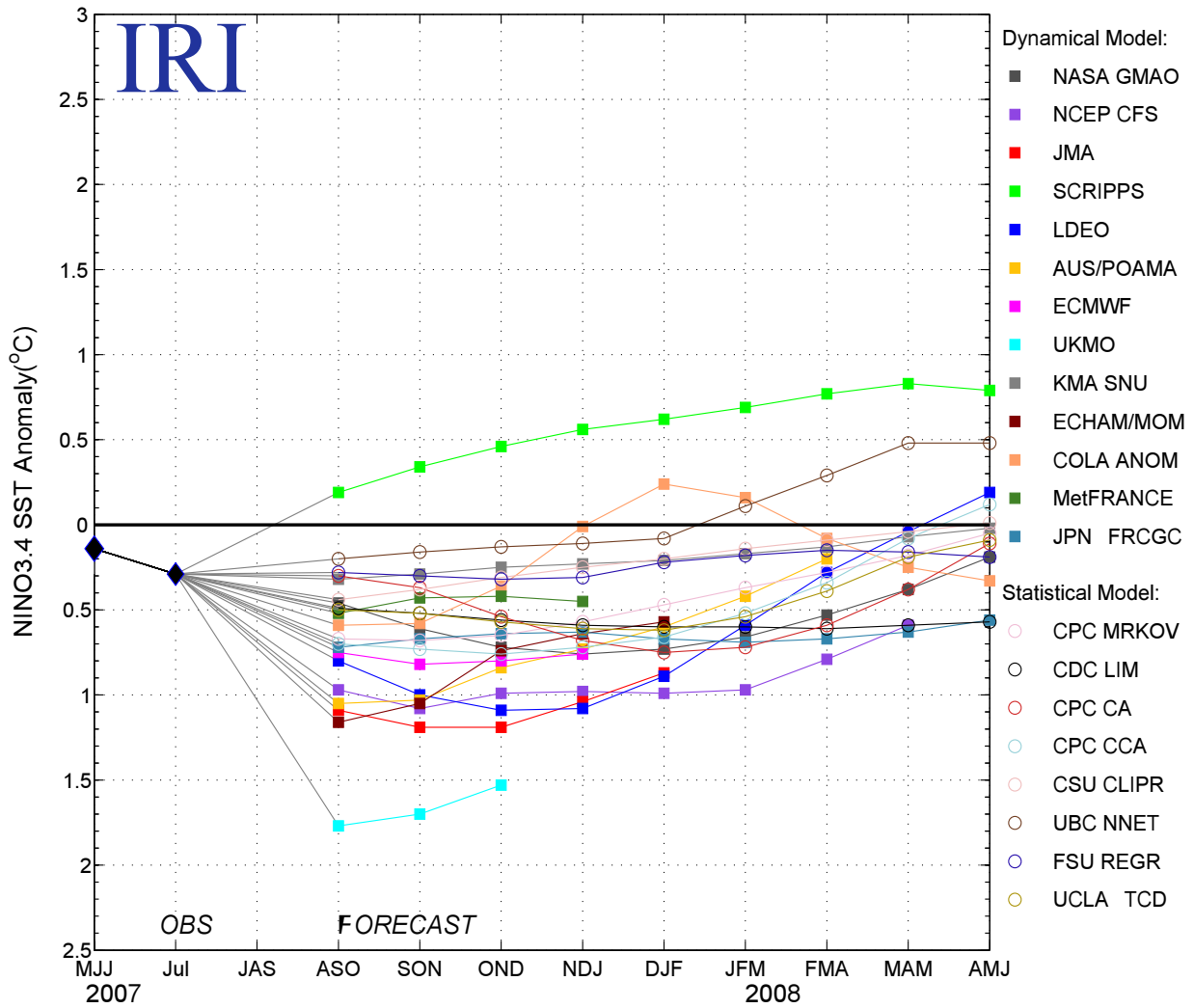


FIGURE F13. Time series of predicted sea surface temperature anomalies for the Nino 3.4 region (deg. C) from various dynamical and statistical models for nine overlapping 3-month periods. The Nino 3.4 region spans the east-central equatorial Pacific between 5N-5S, 170W-120W. Figure provided by the International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

# Extratropical Highlights – August 2007

## 1. Northern Hemisphere

The 500-hPa height pattern during August featured positive anomalies over the eastern United States, the central North Atlantic, western Russia, Greenland, and Alaska, and negative anomalies over western Canada and central Siberia (**Figs. E9, E11**). At 200-hPa, the streamfunction field indicated an extensive area of positive anomalies (reflecting anticyclonic circulation anomalies) spanning the U.S., the North Atlantic, and most of Europe and northwestern Africa (**Fig. T22**). A strong inter-hemispheric symmetry of this pattern is also evident, suggesting links to the distribution of anomalous tropical convection. In particular, this circulation pattern likely is consistent with 1) the continuation of conditions that have been in place since the current active Atlantic hurricane era began in 1995 (Bell and Chelliah, 2006, *J. Climate*, **19**, 590-612), and 2) the ongoing La Niña-related pattern of anomalous tropical convection. The eastern portion of this streamfunction anomaly pattern has been a mainstay of the August-October circulation since 1995. These anomalies are partly related to the combination of an enhanced West African monsoon system and suppressed convection over the Amazon Basin. This combination was again pronounced during August 2007 (**Fig. T24**).

The main surface temperature departures during August reflected warmer than average conditions across the United States, Alaska, western Russia, and central China, and cooler than average conditions in western Canada (**Fig. E1**). The main precipitation anomalies included above average totals in the mid-western U.S., and below average totals in the southeastern and Ohio Valley regions of the U.S., and in the area north of the Caspian Sea (**Figs. E3, E6**).

### a. North America

The 500-hPa circulation pattern during August featured above-average heights over the eastern U.S. and much of Alaska, and below-average heights across the western half of Canada (**Fig. E9**). The surface temperature anomalies were very consistent with this pattern. The most significant anomalous warmth ( $+1^{\circ}$ - $3^{\circ}$ C above average) was recorded in the southwestern and southeastern states, and in western Alaska, where temperatures were generally in the upper 90<sup>th</sup> percentile of occurrences.

In the continental U.S., the main precipitation departures reflected above-average totals in the Midwest, and below-average totals in the southeastern and Ohio Valley regions (**Fig. E3, E6**). Long-term precipitation deficits have resulted in severe drought in both regions.

### b. Eurasia/western Russia

The 500-hPa circulation pattern during August featured an anomalous wave pattern extending from the central North Atlantic Ocean to central Russia (**Fig. E9**). This pattern featured strong ridges over the central North Atlantic and central Russia, and a deep trough over Europe. The persistent ridge in western Russia contributed to exceptionally warm and dry conditions throughout the region.



## 2. Southern Hemisphere

The 500-hPa height anomalies during August exhibited a pronounced zonal wave-1 pattern, with above-average heights from Australia to South America, and below-average heights across the southeastern South Atlantic and southern Indian Oceans (**Fig. E15**). Below-average heights were also observed over the high latitudes of the central South Pacific Ocean, and over southern South America. In the subtropics, negative (anticyclonic) streamfunction anomalies at 200-hPa extended from southeastern Brazil to southern Africa, and from Australia to the eastern South Pacific (**Fig. T22**). Over the South Pacific Ocean, the anticyclonic anomalies were centered along the axis of the wintertime South Pacific jet stream, and reflected a pronounced weakening and westward retraction of the jet core (**Fig. T21**). This jet structure is consistent with La Niña conditions.

In southern Australia, the anomalous anticyclonic circulation was associated with exceptionally warm and dry conditions. In portions of the southeast, temperatures were in the highest 90<sup>th</sup> percentile of occurrences and rainfall totals were in the lowest 10<sup>th</sup> percentile of occurrences.

Extratropical South America was influenced by a strong upper-level trough during August, with a substantial southeastward transport of cold air evident upstream of the trough axis. These conditions contributed to well below-average temperatures across the southern half of the continent, with many areas recording values in the lowest 10<sup>th</sup> percentile of occurrences. This pattern reflects a continuation of the exceptionally cold temperatures observed during July.

**TELECONNECTION INDICES**

**NORTH ATLANTIC      NORTH PACIFIC      EURASIA**

MONTH	NAO	EA	WP	EP-NP	PNA	TNH	EATL/ WRUS	SCAND	POLEUR
<b>AUG 07</b>	-0.1	0.7	-0.3	-1.5	2.0	---	-1.6	-0.4	2.0
<b>JUL 07</b>	-0.6	0.6	-0.7	0.4	2.2	---	-0.5	-0.2	-0.3
<b>JUN 07</b>	-1.3	0.7	-0.4	0.2	-0.4	---	-0.3	0.8	-0.4
<b>MAY 07</b>	0.7	1.3	-1.2	-0.6	-0.1	---	0.0	0.3	-0.2
<b>APR 07</b>	0.2	-0.6	-1.9	0.0	1.2	---	1.7	-1.5	-0.3
<b>MAR 07</b>	1.4	0.5	-1.1	-1.1	0.2	---	-0.1	0.4	-0.4
<b>FEB 07</b>	-0.5	1.7	0.6	1.2	-0.1	0.9	0.9	0.6	-1.3
<b>JAN 07</b>	0.2	1.9	1.9	-1.3	0.7	1.2	-0.1	-2.7	-0.4
<b>DEC 06</b>	1.3	1.1	1.3	---	1.9	0.5	1.6	-0.2	0.1
<b>NOV 06</b>	0.4	2.1	-2.1	-0.3	-1.4	---	-0.1	-0.7	-1.0
<b>OCT 06</b>	-2.2	1.1	0.3	1.0	-0.8	---	0.1	0.7	-0.8
<b>SEP 06</b>	-1.6	2.1	0.2	0.0	0.4	---	0.0	0.5	2.5
<b>AUG 06</b>	-1.7	0.1	-0.4	-0.6	-1.4	---	-1.1	1.5	0.4

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); Scandinavia 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.

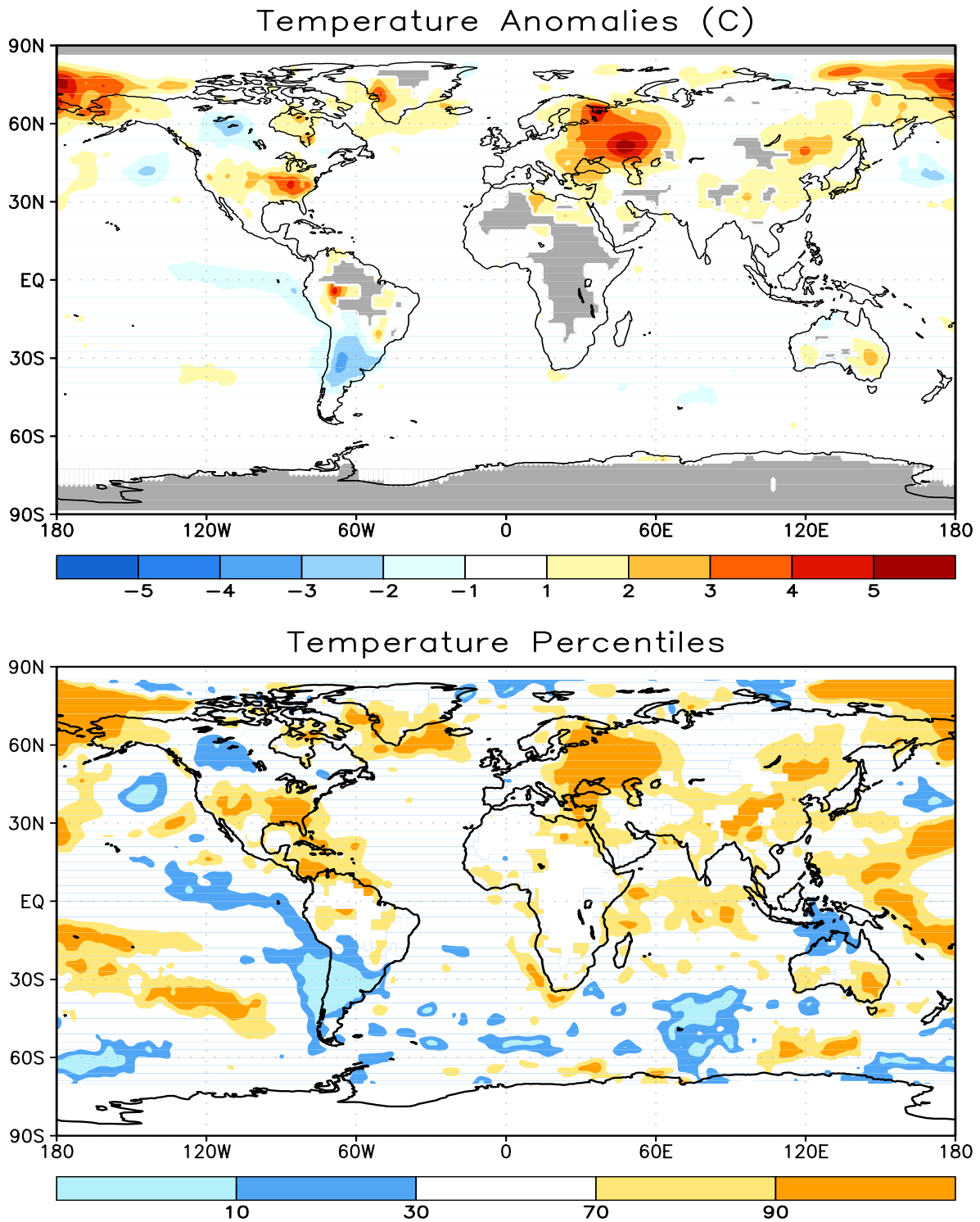


FIGURE E1. Surface temperature anomalies ( $^{\circ}\text{C}$ , top) and surface temperature expressed as percentiles of the normal (Gaussian) distribution fit to the 1971–2000 base period data (bottom) for AUG 2007. Analysis is based on station data over land and on SST data over the oceans (top). Anomalies 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.

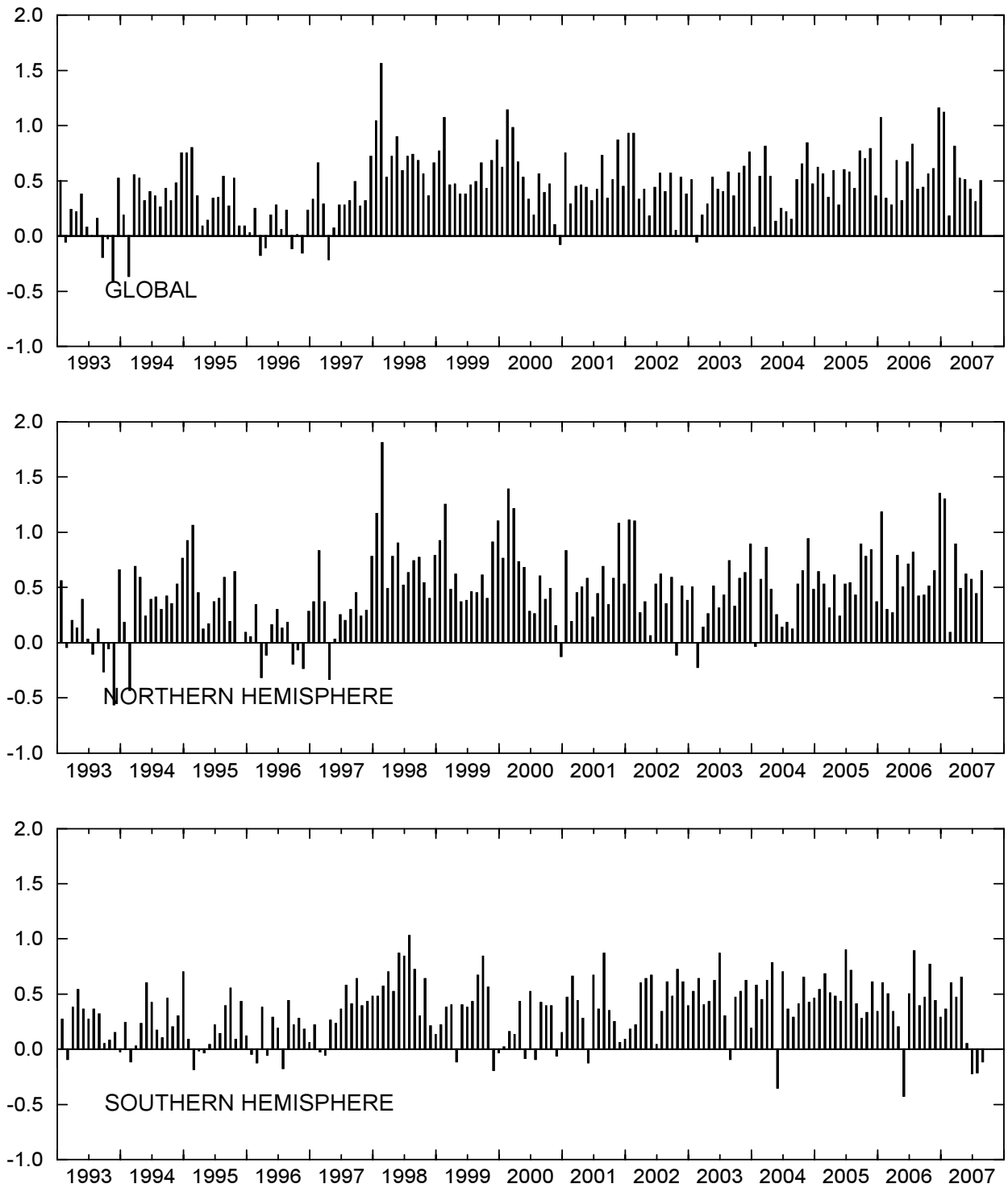


FIGURE E2. Monthly global (top), Northern Hemisphere (middle), and Southern Hemisphere (bottom) surface temperature anomalies (land only, °C) from January 1990 - present, computed as departures from the 1971–2000 base period means.

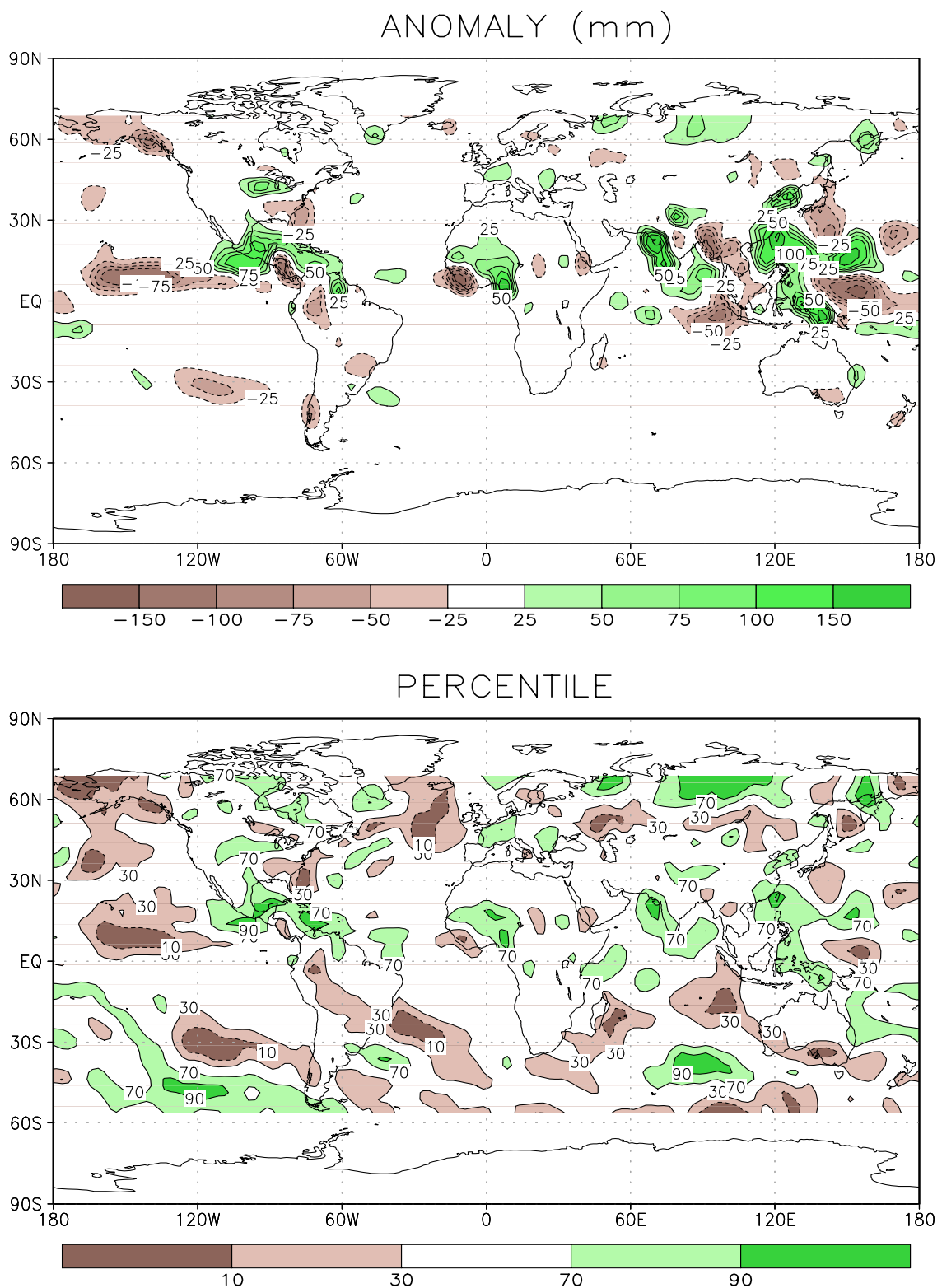


FIGURE E3. Anomalous precipitation (mm, top) and precipitation percentiles based on a Gamma distribution fit to the 1979–2000 base period data (bottom) for AUG 2007. Data are obtained from a merge of raingauge observations and satellite-derived precipitation estimates (Janowiak and Xie 1999, *J. Climate*, **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.

## AREAL MEAN PRECIPITATION AMOUNTS (MM) AND PERCENTILES (%)

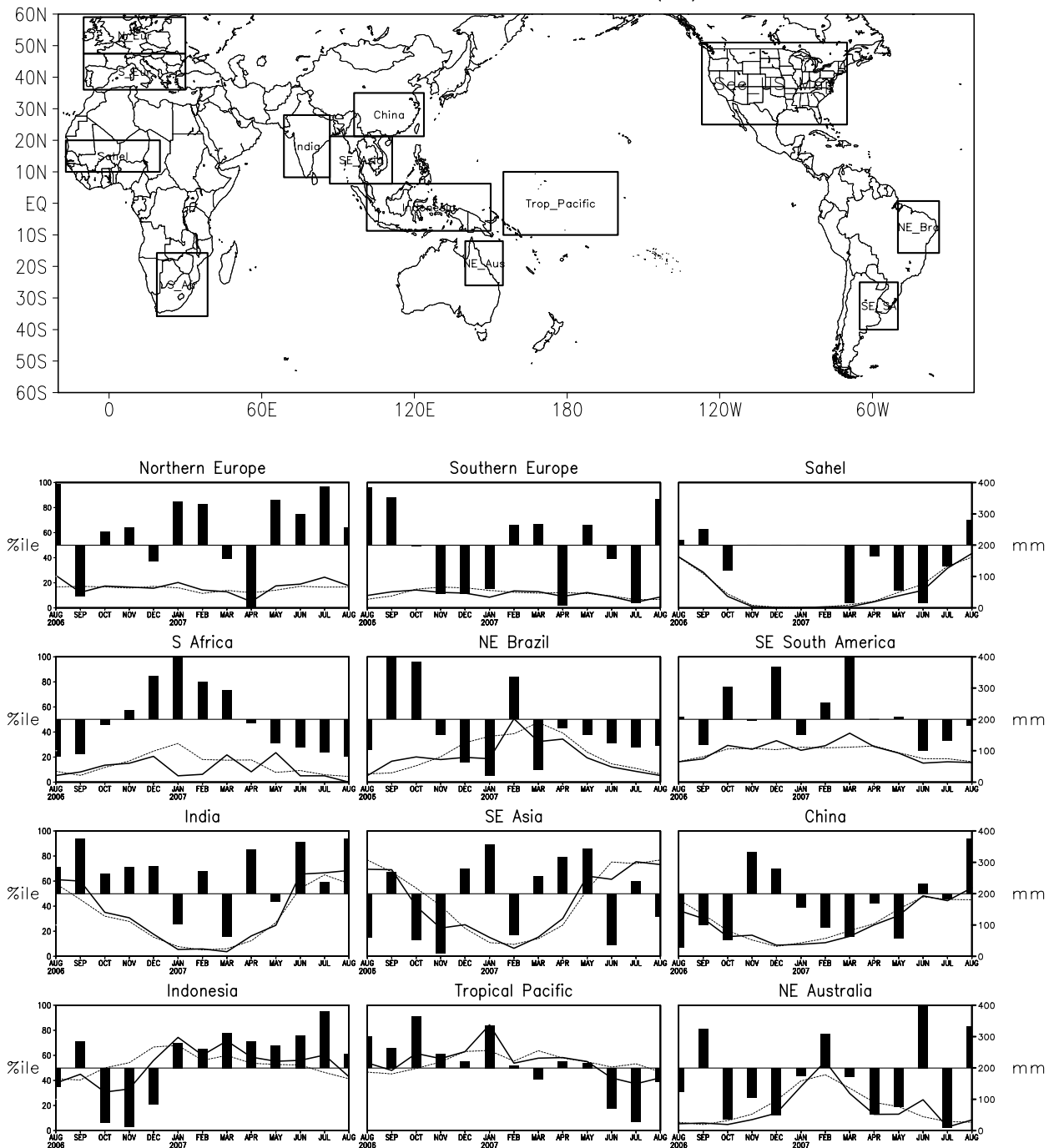


FIGURE E4. Areal estimates of monthly mean precipitation amounts (mm, solid lines) and precipitation percentiles (% , bars) for the most recent 13 months obtained from a merge of raingauge observations and satellite-derived precipitation estimates (Janowiak and Xie 1999, *J. Climate*, **12**, 3335–3342). 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.

## AREAL MEAN PRECIPITATION AMOUNTS (MM) AND PERCENTILES (%)

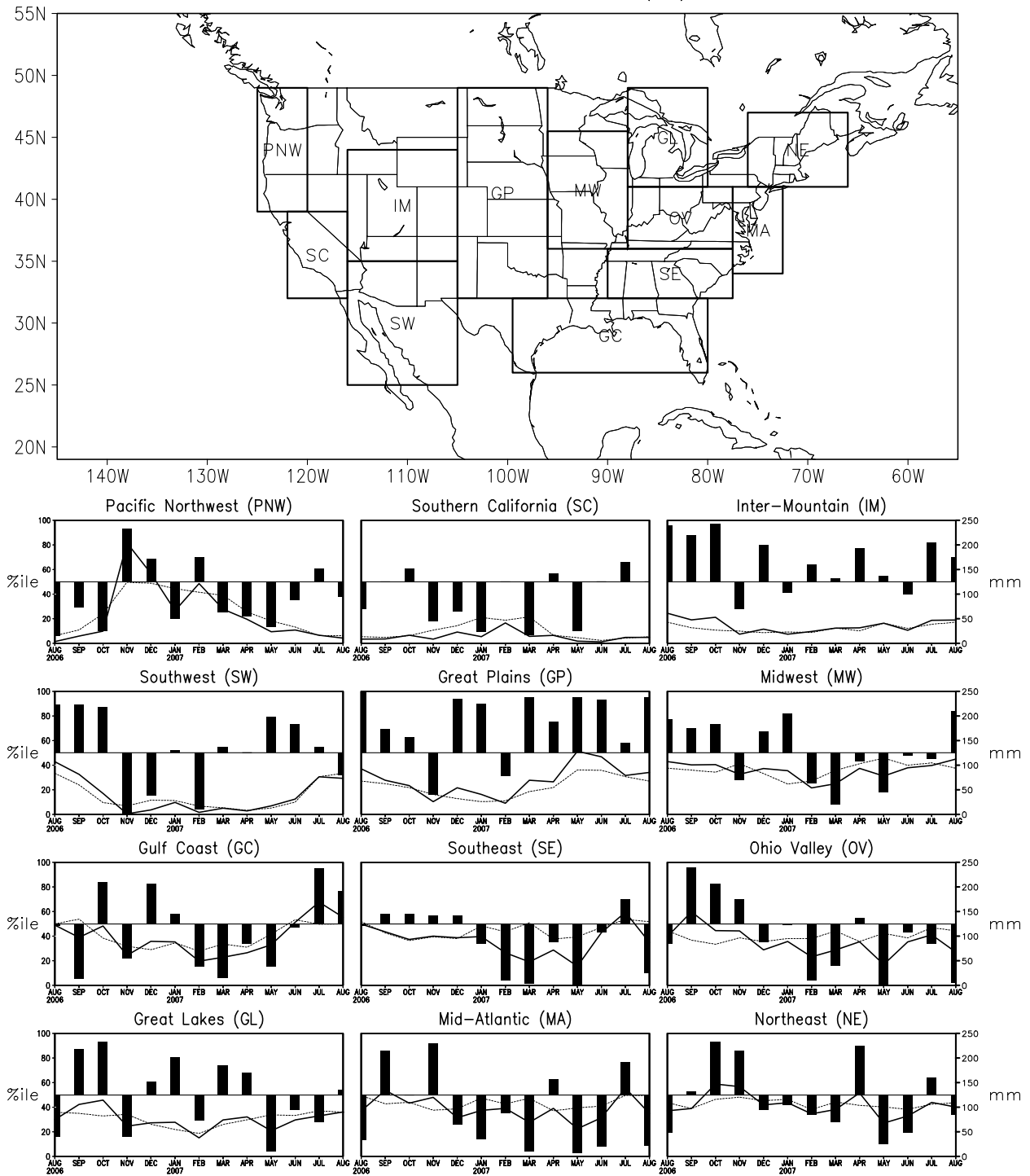


FIGURE E5. Areal estimates of monthly mean precipitation amounts (mm, solid lines) and precipitation percentiles (%) for the most recent 13 months obtained from a merge of raingauge observations and satellite-derived precipitation estimates (Janowiak and Xie 1999, *J. Climate*, **12**, 3335–3342). The 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.

Monthly Accumulation -- August, 2007

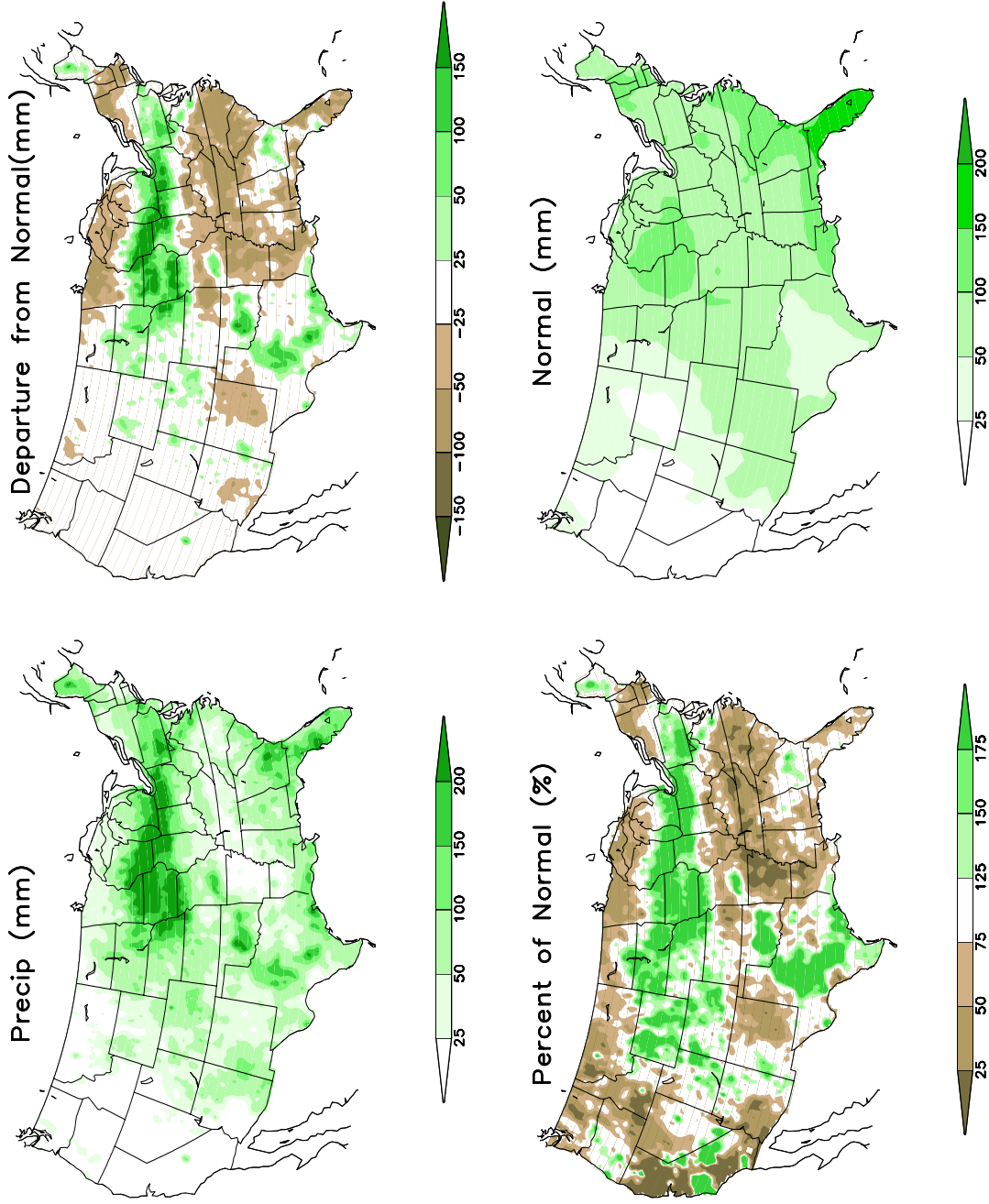
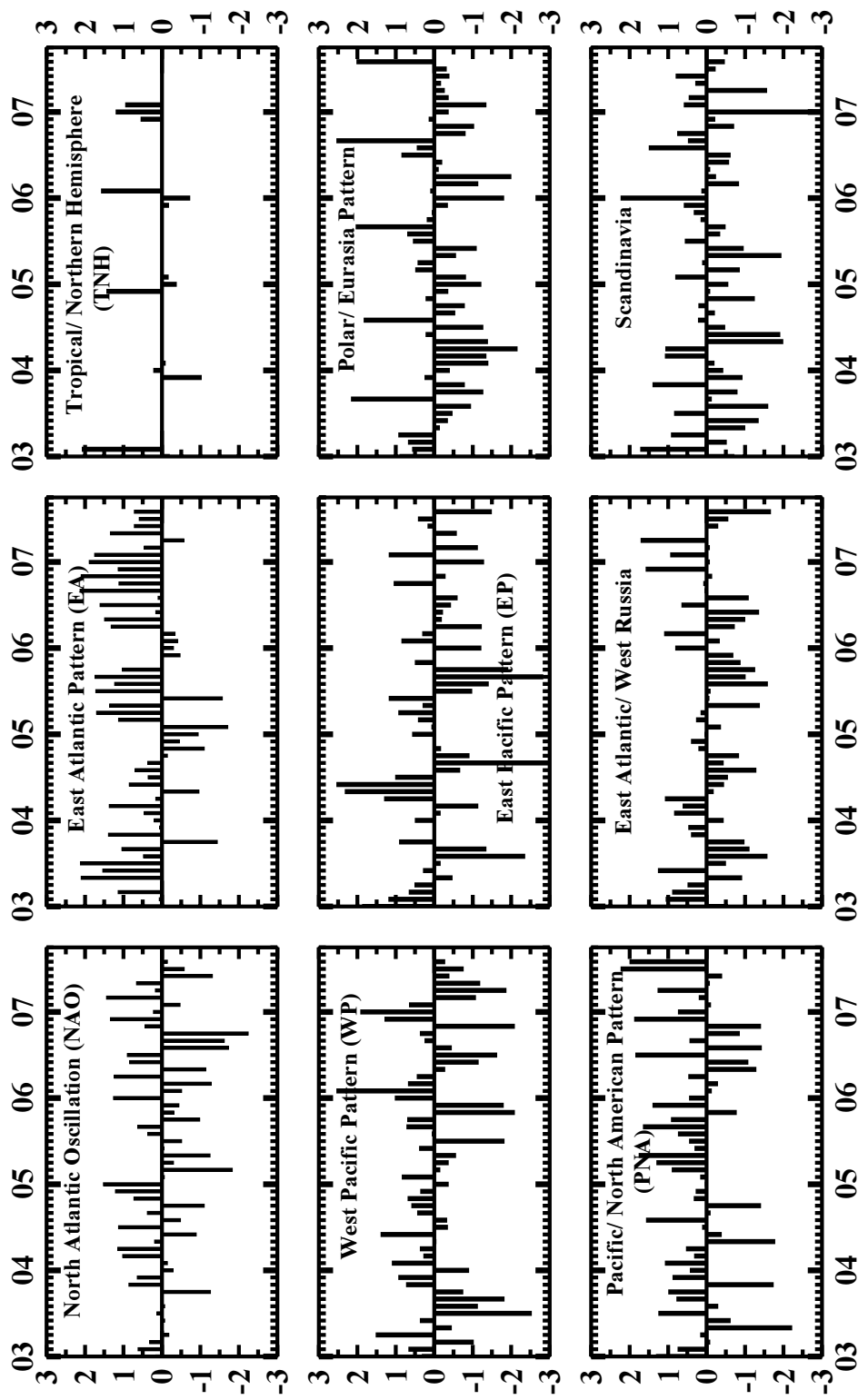


FIGURE E6. Observed precipitation (upper left), departure from average (upper right), percent of average (lower left), and average precipitation (lower right) for AUG 2007. The units are given on each panel. Base period for averages is 1971–2000. Results are based on CPC’s U. S. daily precipitation analysis, which is available at <http://www.cpc.ncep.noaa.gov/products/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.

## Sea-Level Pressure and Anomaly (1979–95 Climo)

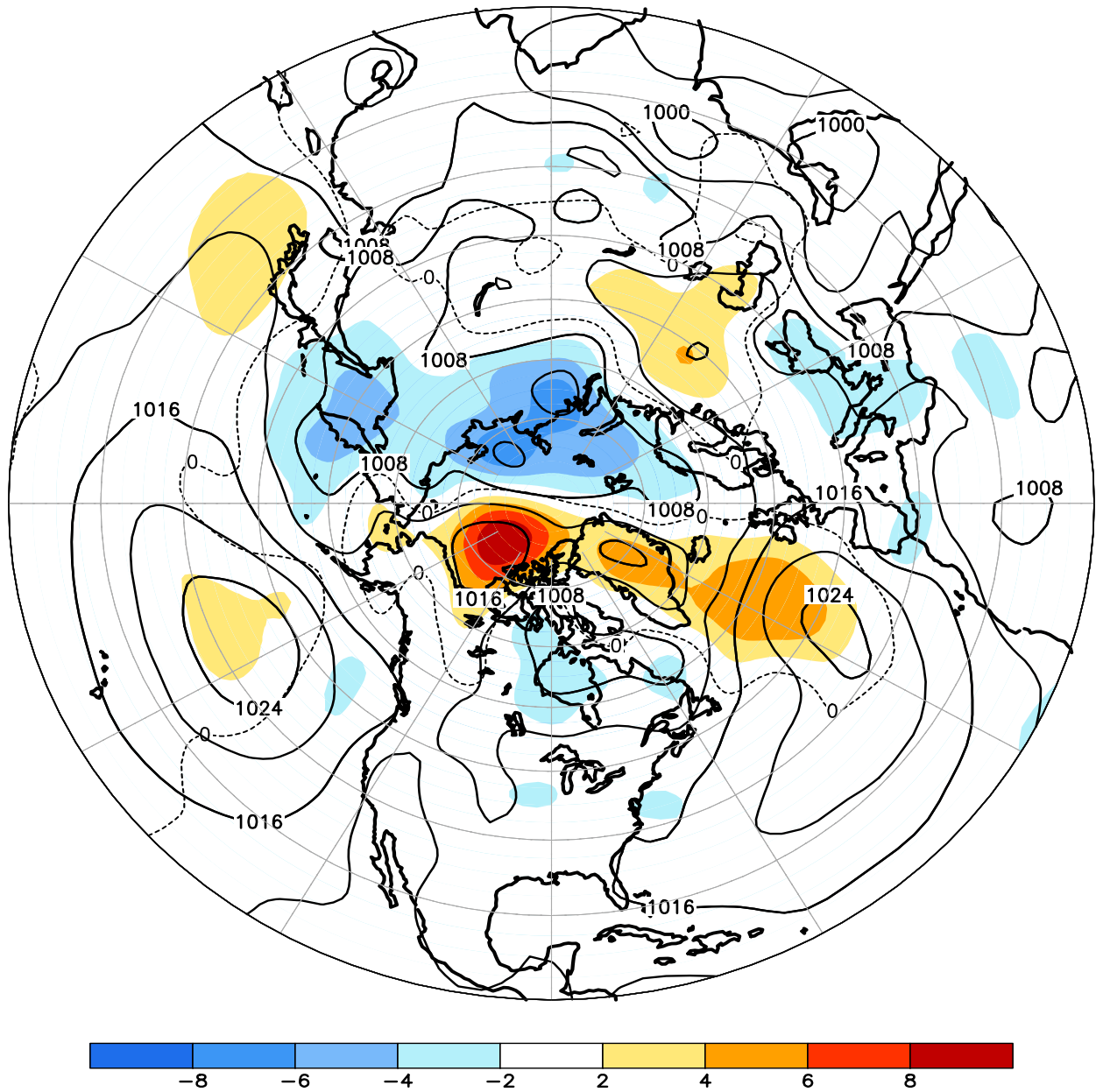


FIGURE E8. Northern Hemisphere mean and anomalous sea level pressure (CDAS/Reanalysis) for AUG 2007. Mean values are denoted by solid contours drawn at an interval of 4 hPa. Anomaly contour interval is 2 hPa with values less (greater) than -2 hPa (2 hPa) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.

## 500 mb Height and Anomalies

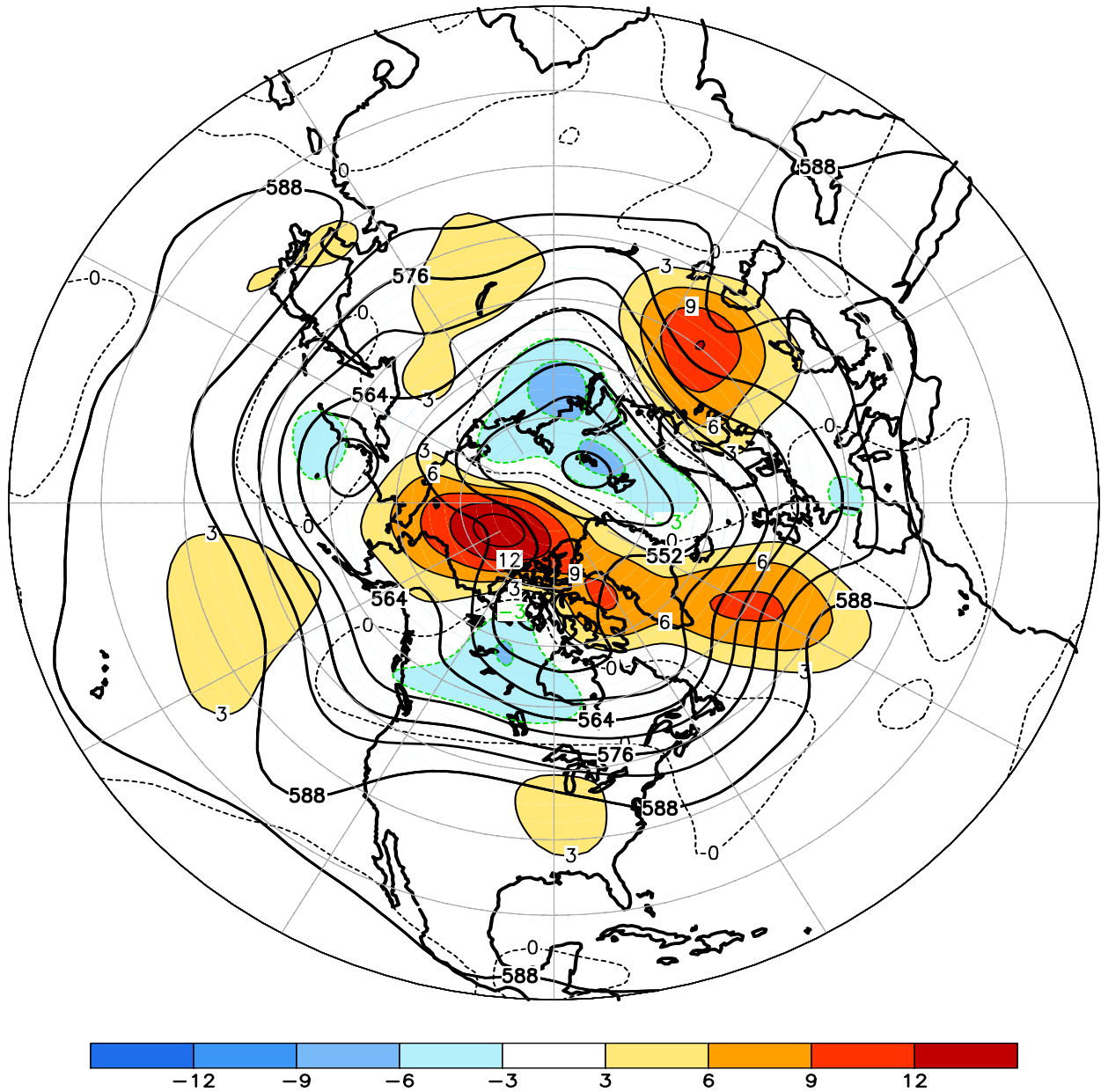
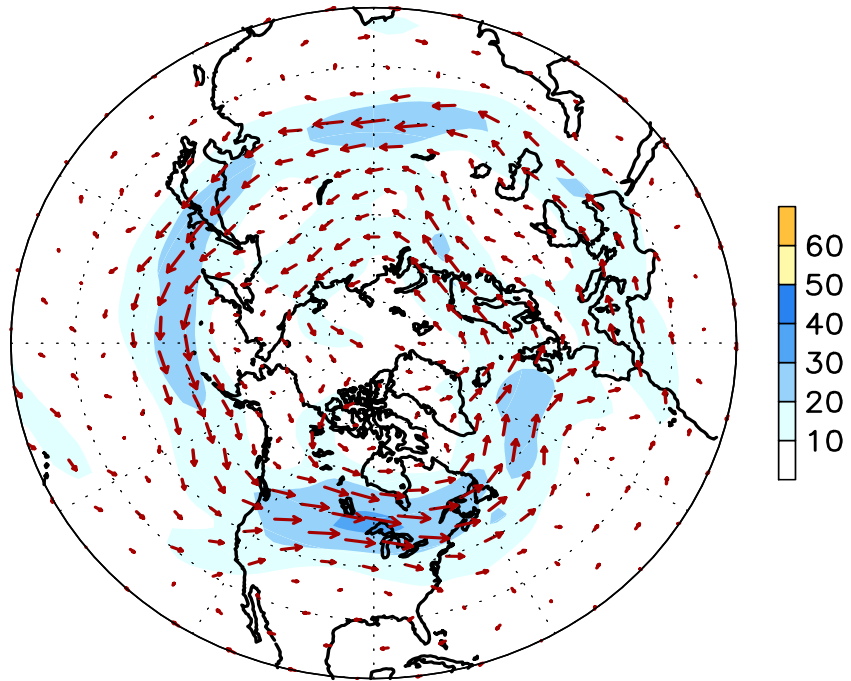


FIGURE E9. Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis) for AUG 2007. Mean heights are denoted by solid contours drawn at an interval of 8 dam. Anomaly contour interval is 3 dam with values less (greater) than -3 dam (3 dam) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.

### 300 mb WINDS



### 300 mb Wind Anomaly (1979–95 Climo)

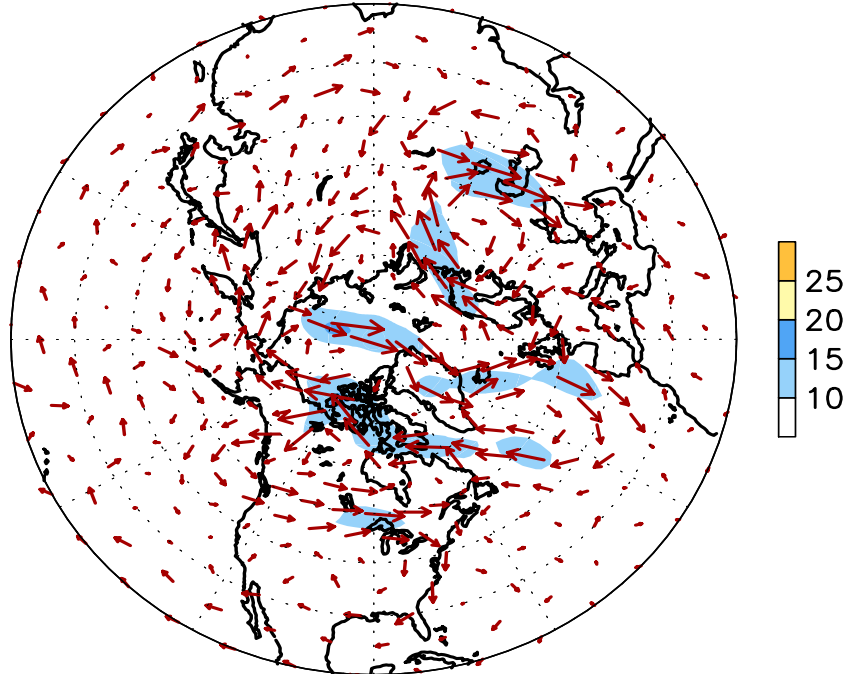
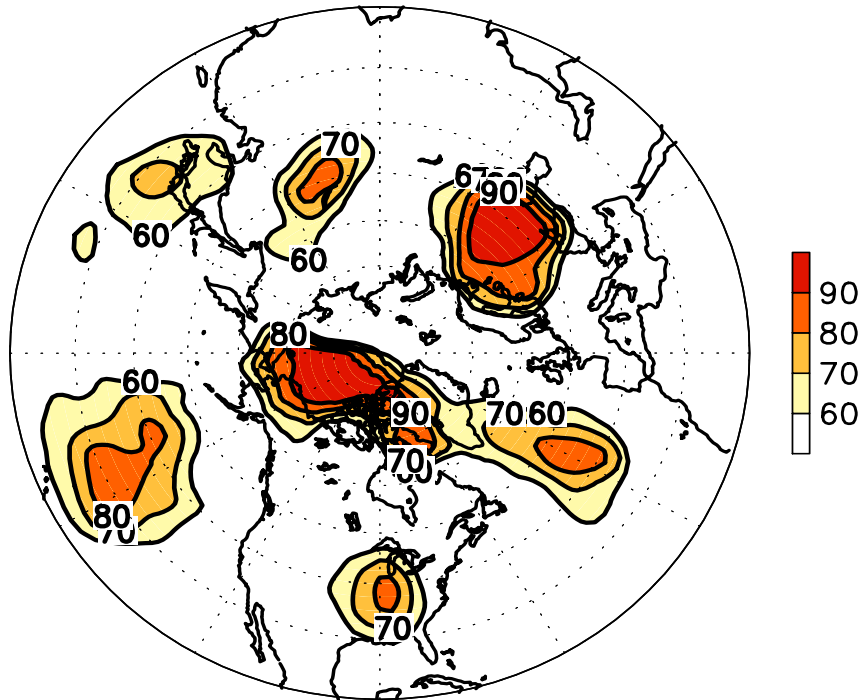


FIGURE E10. Northern Hemisphere mean (left) and anomalous (right) 300-hPa vector wind (CDAS/Reanalysis) for AUG 2007. Mean (anomaly) isotach contour interval is 10 (5)  $\text{ms}^{-1}$ . Values greater than  $30 \text{ ms}^{-1}$  (left) and  $10 \text{ ms}^{-1}$  (rights) are shaded. Anomalies are departures from the 1979-95 base period monthly means.

## Percent Positive Anomaly Days



## Percent Negative Anomaly Days

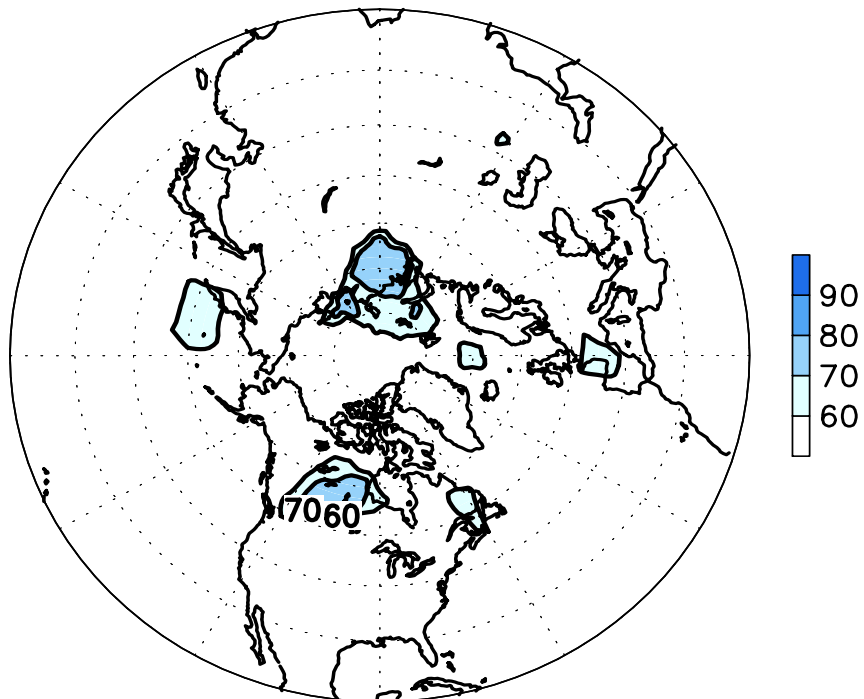


FIGURE E11. Northern Hemisphere percentage of days during AUG 2007 in which 500-hPa height anomalies greater than 15 m (left) and less than -15 m (right) were observed. Values greater than 70% are shaded and contour interval is 20%.

### 500-hPa Height Anomalies: 40.0N

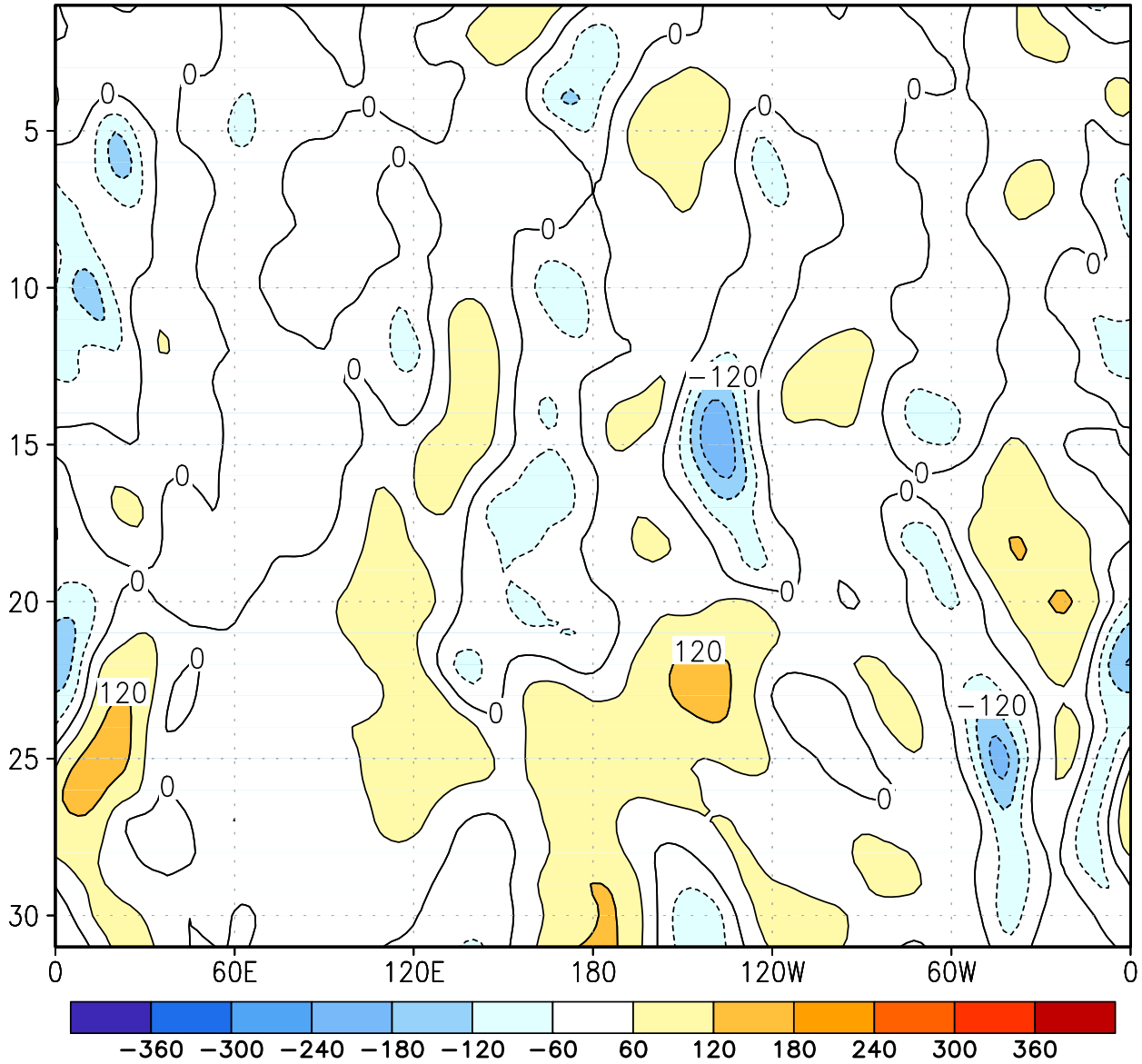
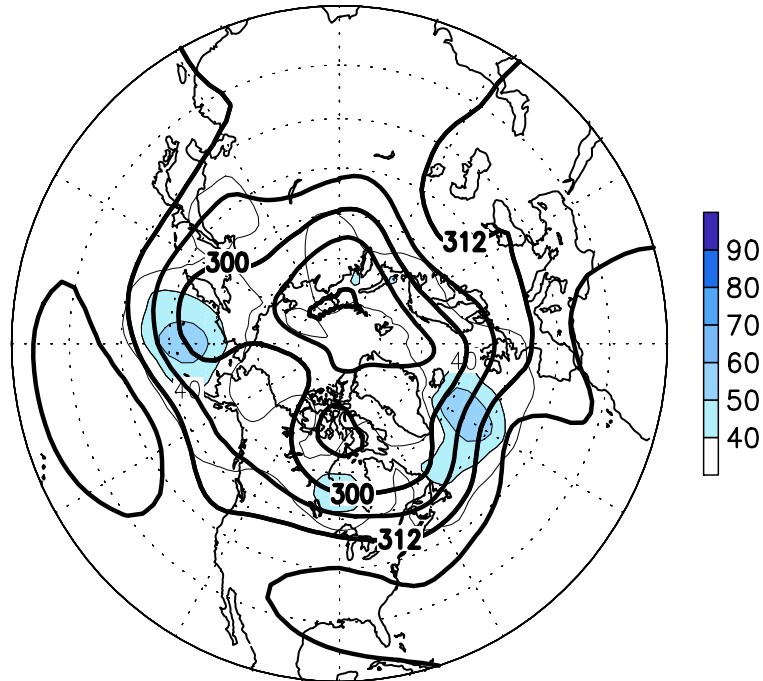


FIGURE E12. Northern Hemisphere: Daily 500-hPa height anomalies for AUG 2007 averaged over the 5° latitude band centered on 40°N. Positive values are indicated by solid contours and dark shading. Negative values are indicated by dashed contours and light shading. Contour interval is 60 m. Anomalies are departures from the 1979-95 base period daily means.

## HIGH FREQUENCY STANDARD DEVIATION



## NORMALIZED VARIANCE

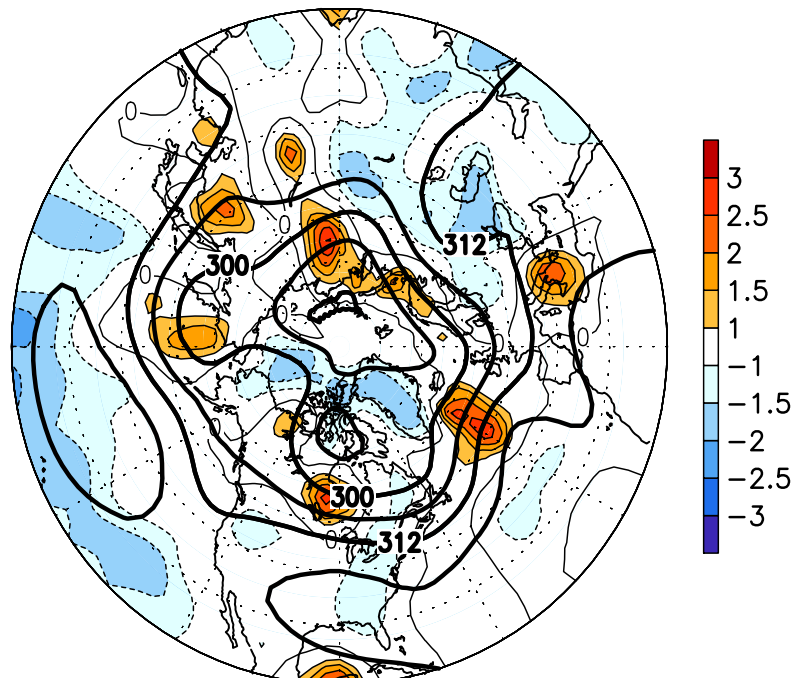


FIGURE E13. Northern Hemisphere: 700-hPa heights for AUG 2007 overlaid with standard deviation of high-pass filtered height (left) and normalized anomalous variance of high-pass filtered height (right). Heights are indicated by thick solid contours in both panels (interval is 60 m). High-pass filtered 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.

## Sea-Level Pressure and Anomaly (1979–95 Climo)

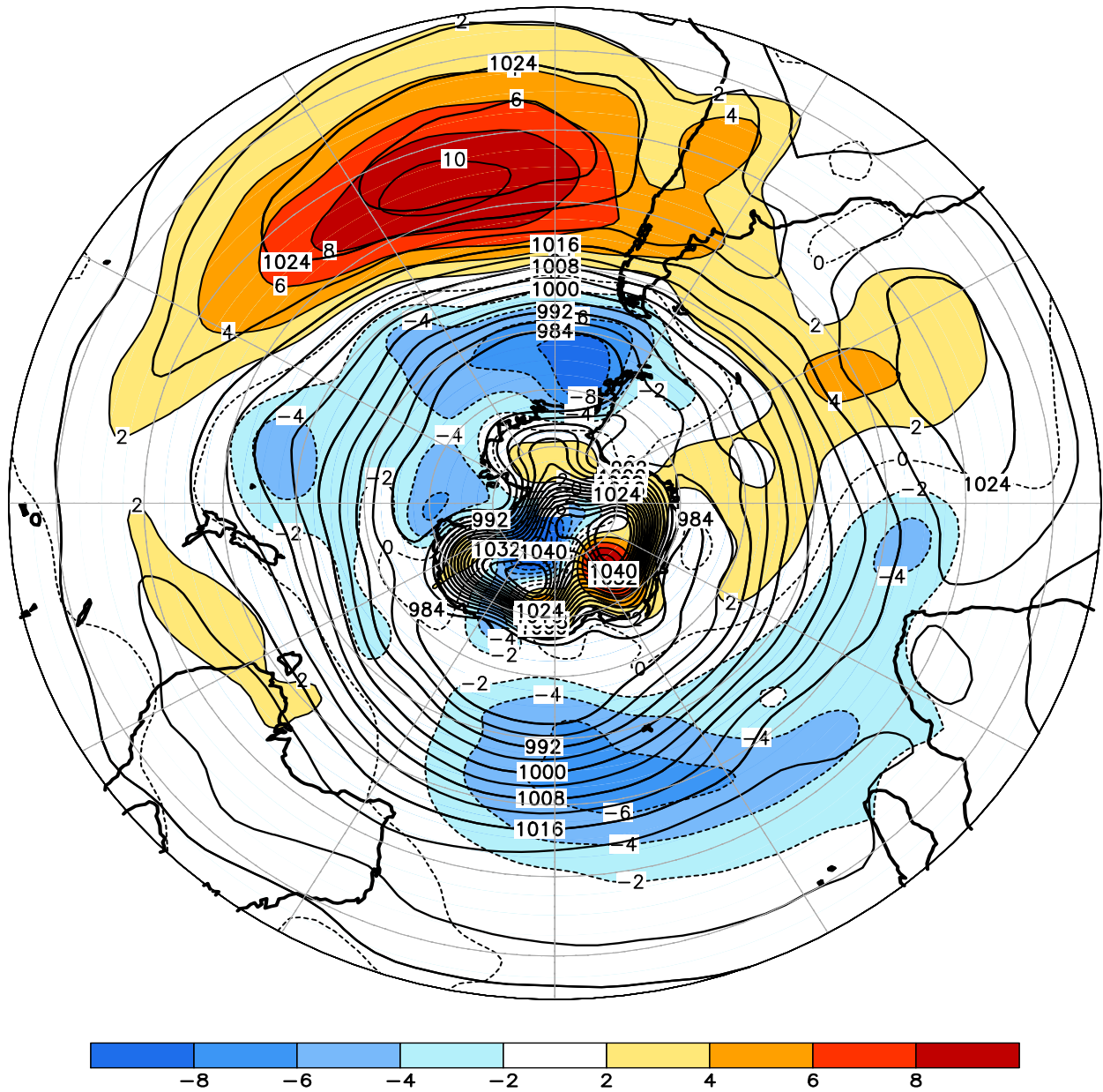


FIGURE E14. Southern Hemisphere mean and anomalous sea level pressure (CDAS/Reanalysis) for AUG 2007. Mean values are denoted by solid contours drawn at an interval of 4 hPa. Anomaly contour interval is 2 hPa with values less (greater) than -2 hPa (2 hPa) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.



## 500 mb Height and Anomalies

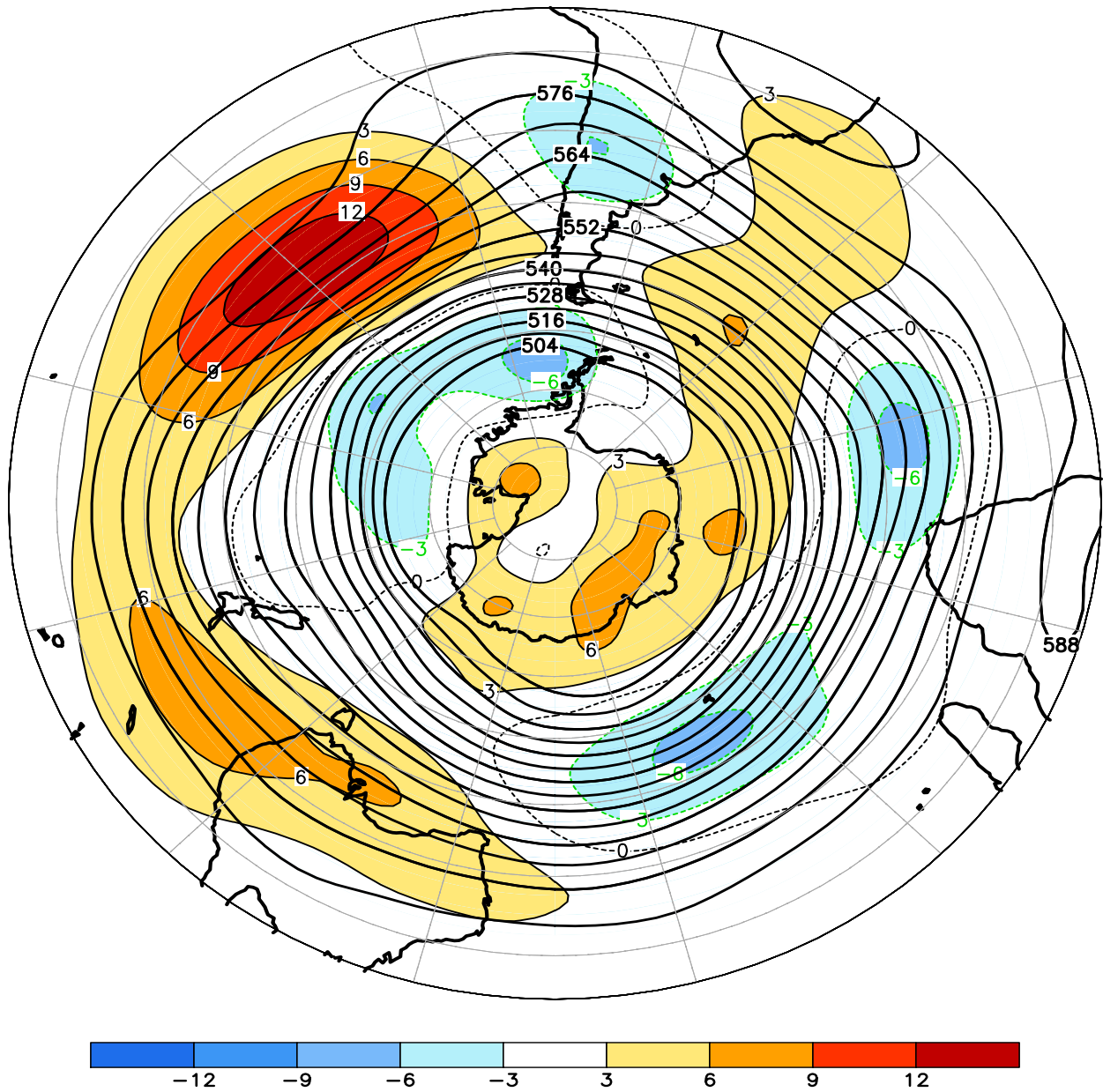
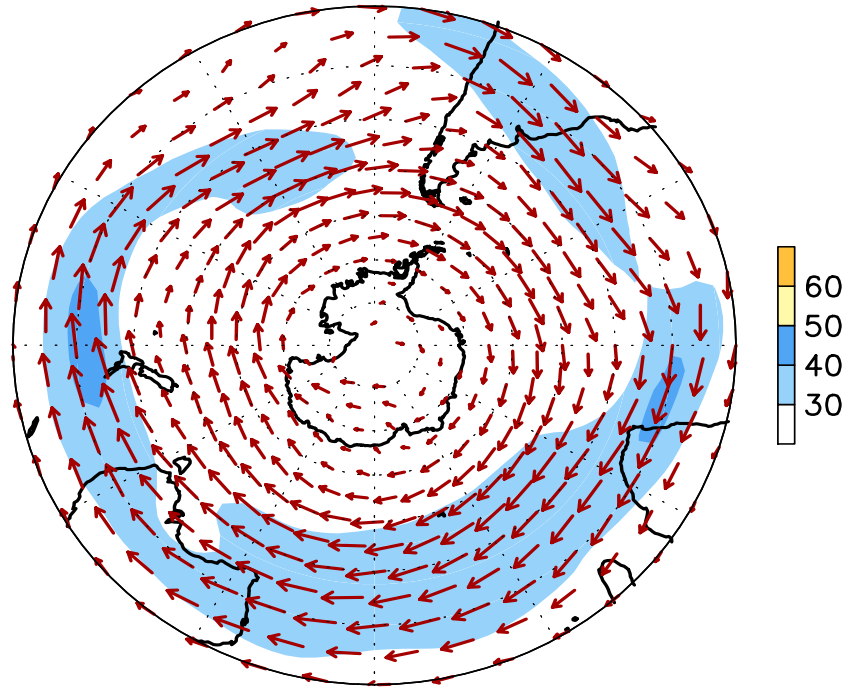


FIGURE E15. Southern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis) for AUG 2007. Mean heights are denoted by solid contours drawn at an interval of 8 dam. Anomaly contour interval is 3 dam with values less (greater) than -3 dam (3 dam) indicated by dark (light) shading. Anomalies are calculated as departures from the 1979-95 base period monthly means.

### 300 mb WINDS



### 300 mb Wind Anomaly (1979–95 Climo)

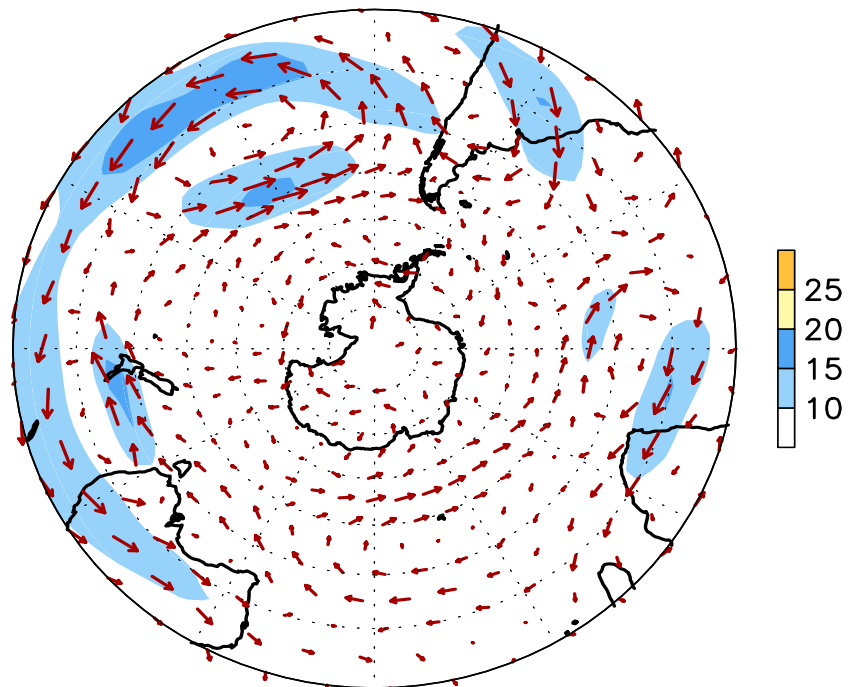
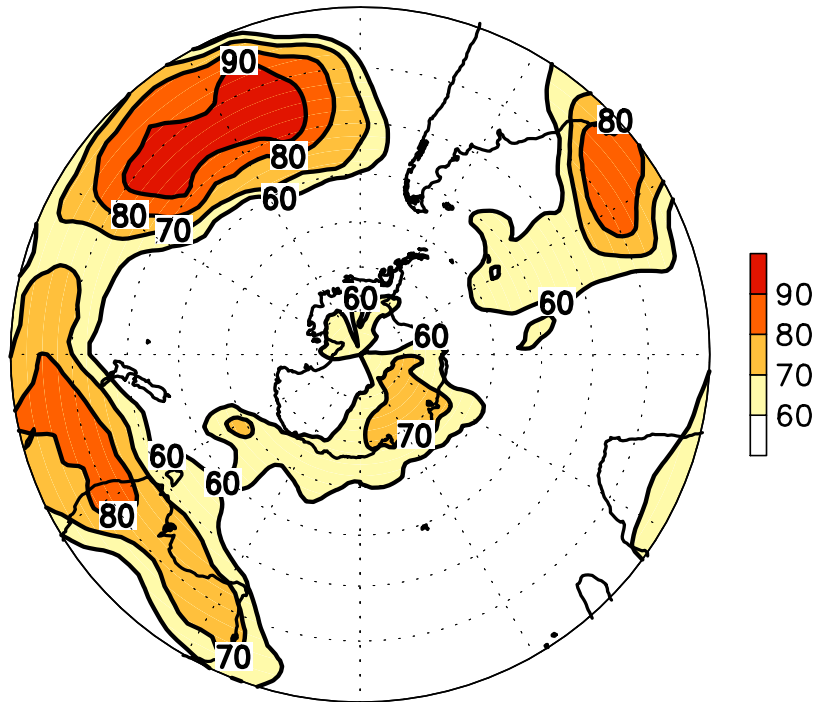


FIGURE E16. Southern Hemisphere mean (left) and anomalous (right) 300-hPa vector wind (CDAS/Reanalysis) for AUG 2007. Mean (anomaly) isotach contour interval is 10 (5) ms<sup>-1</sup>. Values greater than 30 ms<sup>-1</sup> (left) and 10 ms<sup>-1</sup> (rights) are shaded. Anomalies are departures from the 1979-95 base period monthly means.

## Percent Positive Anomaly Days



## Percent Negative Anomaly Days

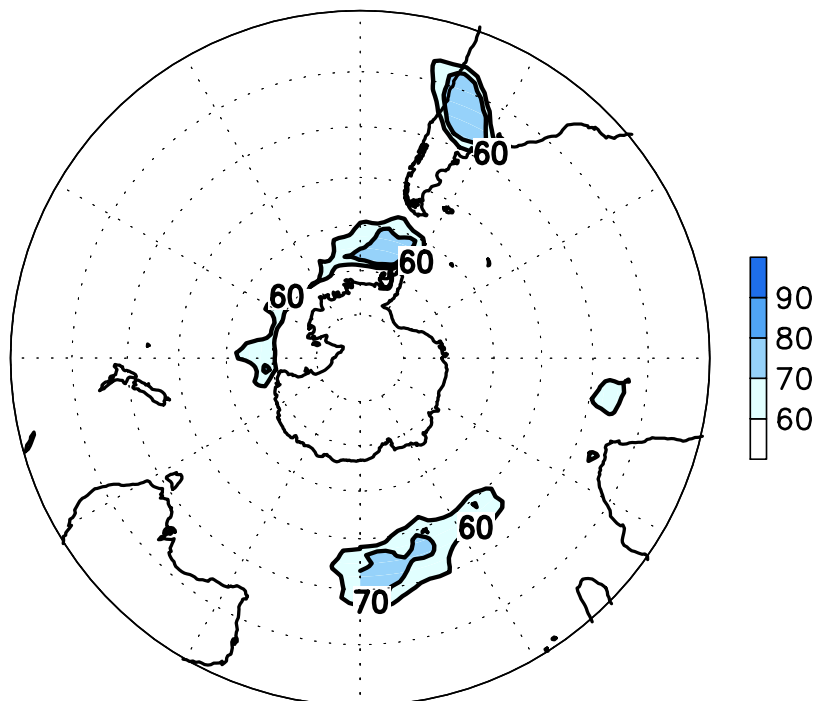


FIGURE E17. Southern Hemisphere percentage of days during AUG 2007 in which 500-hPa height anomalies greater than 15 m (left) and less than -15 m (right) were observed. Values greater than 70% are shaded and contour interval is 20%.

### 500-hPa Height Anomalies: 40.0S

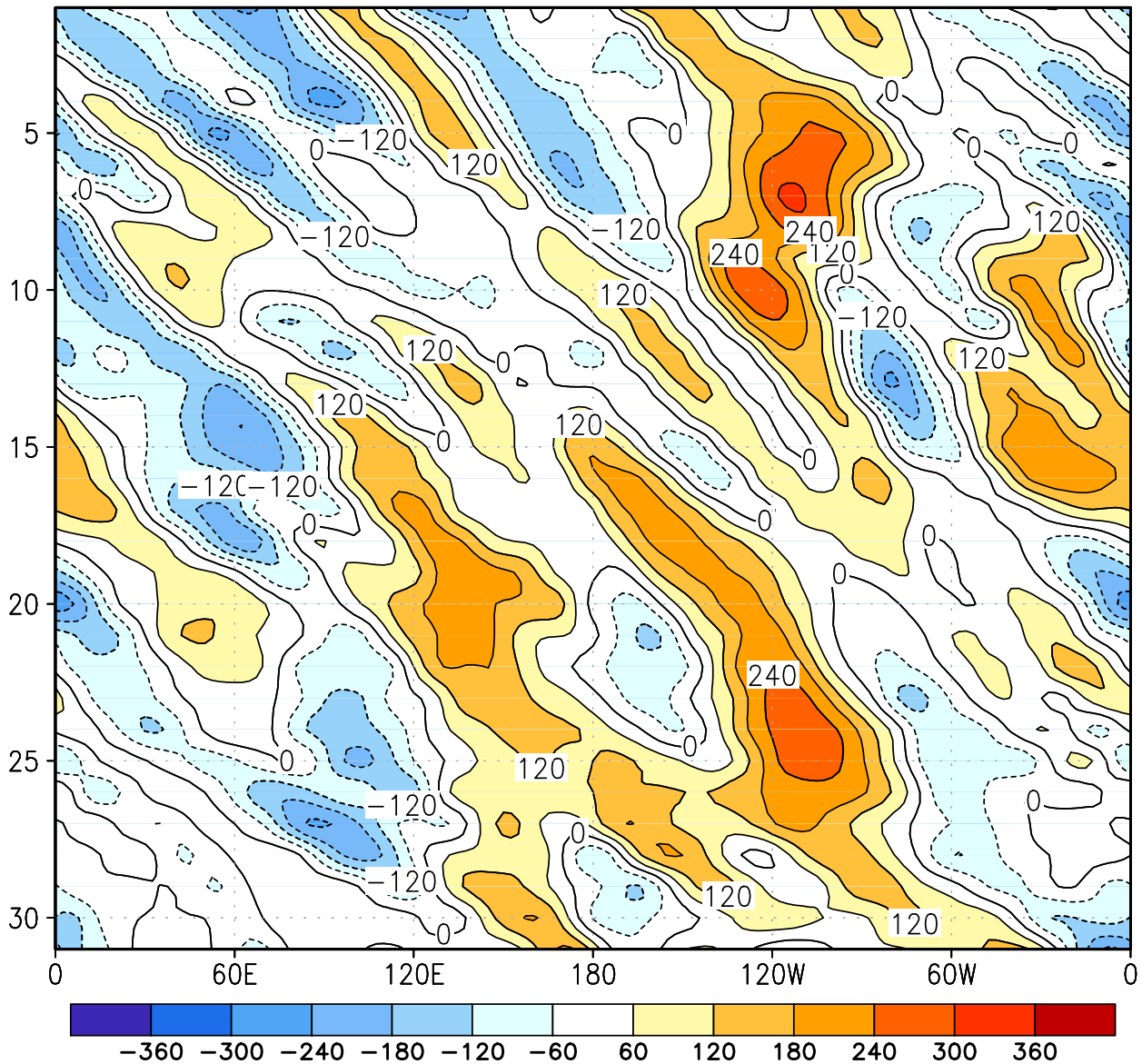


FIGURE E18. Southern Hemisphere: Daily 500-hPa height anomalies for AUG 2007 averaged over the 5° latitude band centered on 40°S. Positive values are indicated by solid contours and dark shading. Negative values are indicated by dashed contours and light shading. Contour interval is 60 m. Anomalies are departures from the 1979-95 base period daily means.

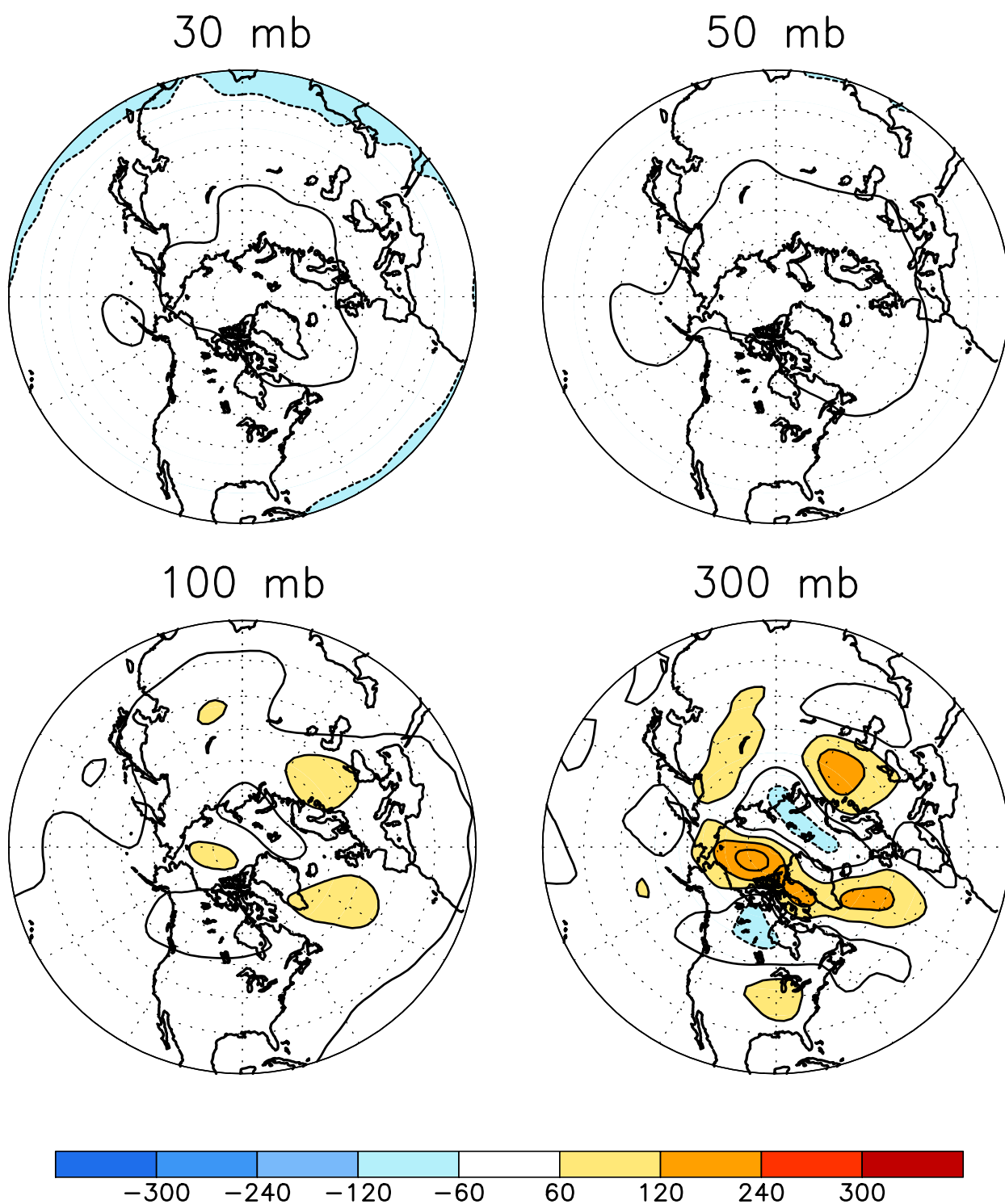


FIGURE S1. Stratospheric height anomalies (m) at selected levels for AUG 2007. Positive values are indicated by solid contours and dark shading. Negative values are indicated by dashed contours and light shading. Contour interval is 60 m. Anomalies are calculated from the 1979–95 base period means. Winter Hemisphere is shown.

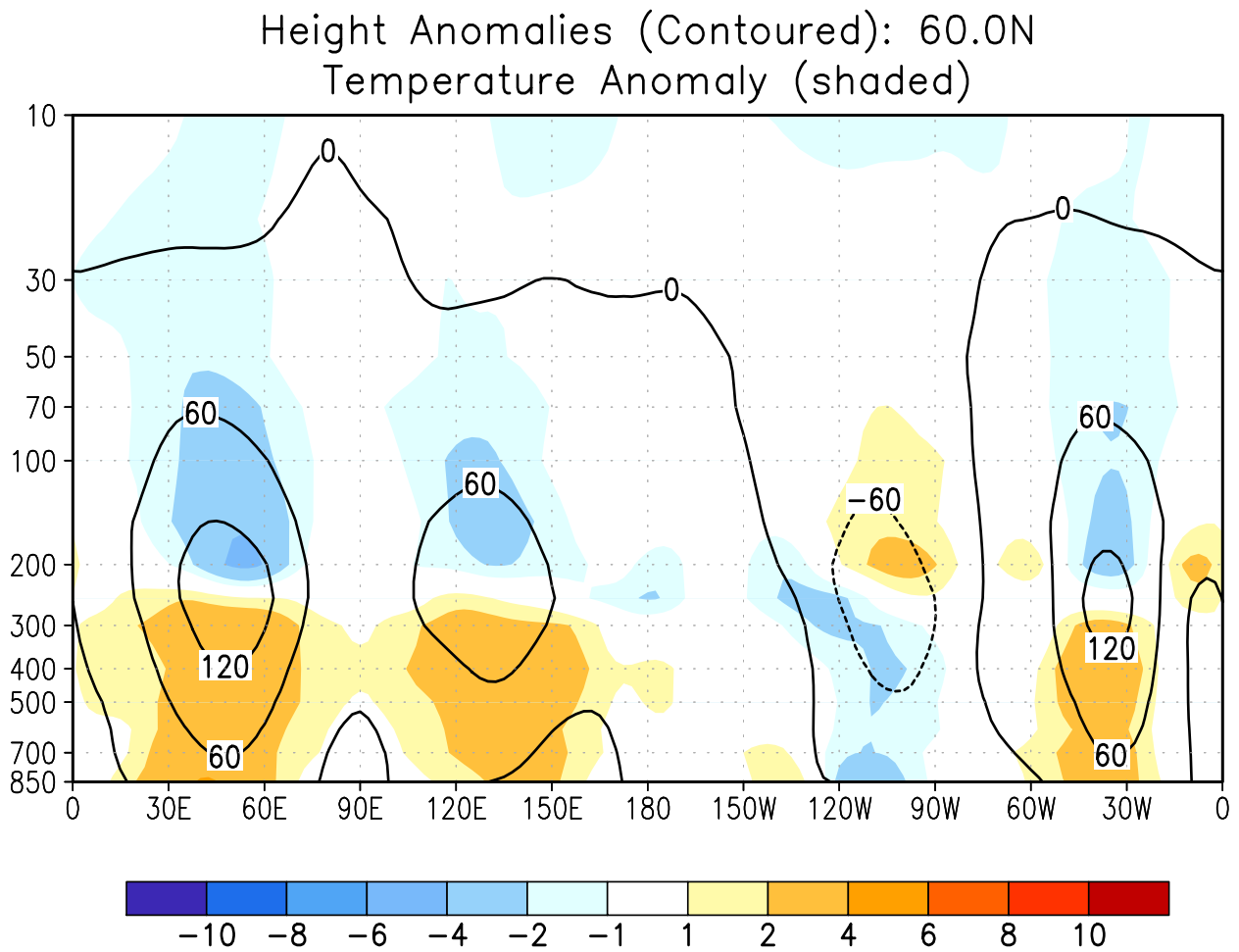


FIGURE S2. Height-longitude sections during AUG 2007 for height anomalies (contour) and temperature anomalies (shaded). In both panels, positive values are indicated by solid contours and dark shading, while negative anomalies are indicated by dashed contours and light shading. Contour interval for height 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.

### 50hPa Monthly Mean Temperature Anomalies

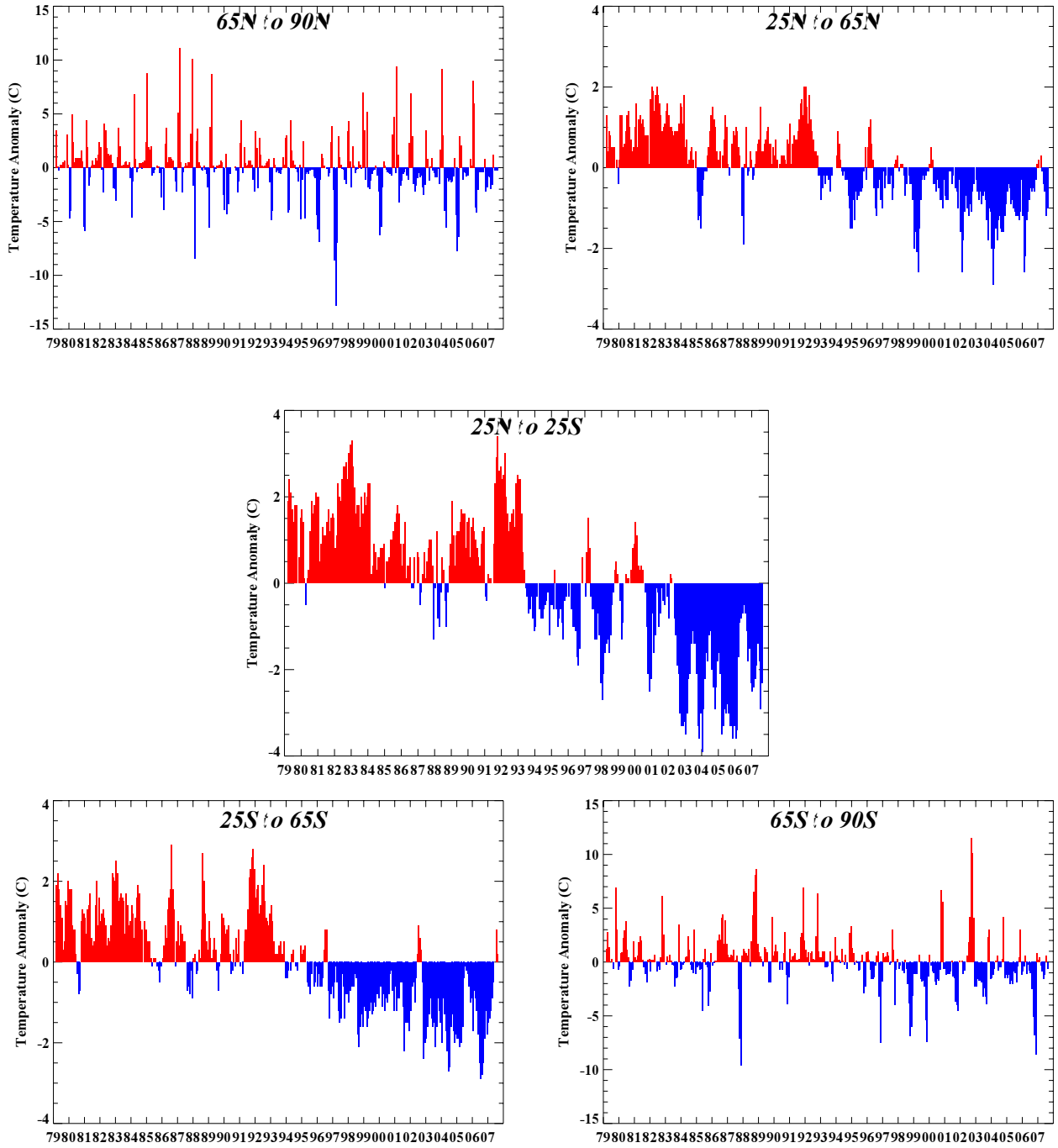


FIGURE S3. Monthly mean temperature anomalies at 50-hPa for the latitude bands 65°–90°N, 25°–65°N, 25°N–25°S, 25°–65°S, 65°–90°S. Anomalies are departures from the 1979–99 base period means.

### Zonal Mean Temperature for 2006 & 2007

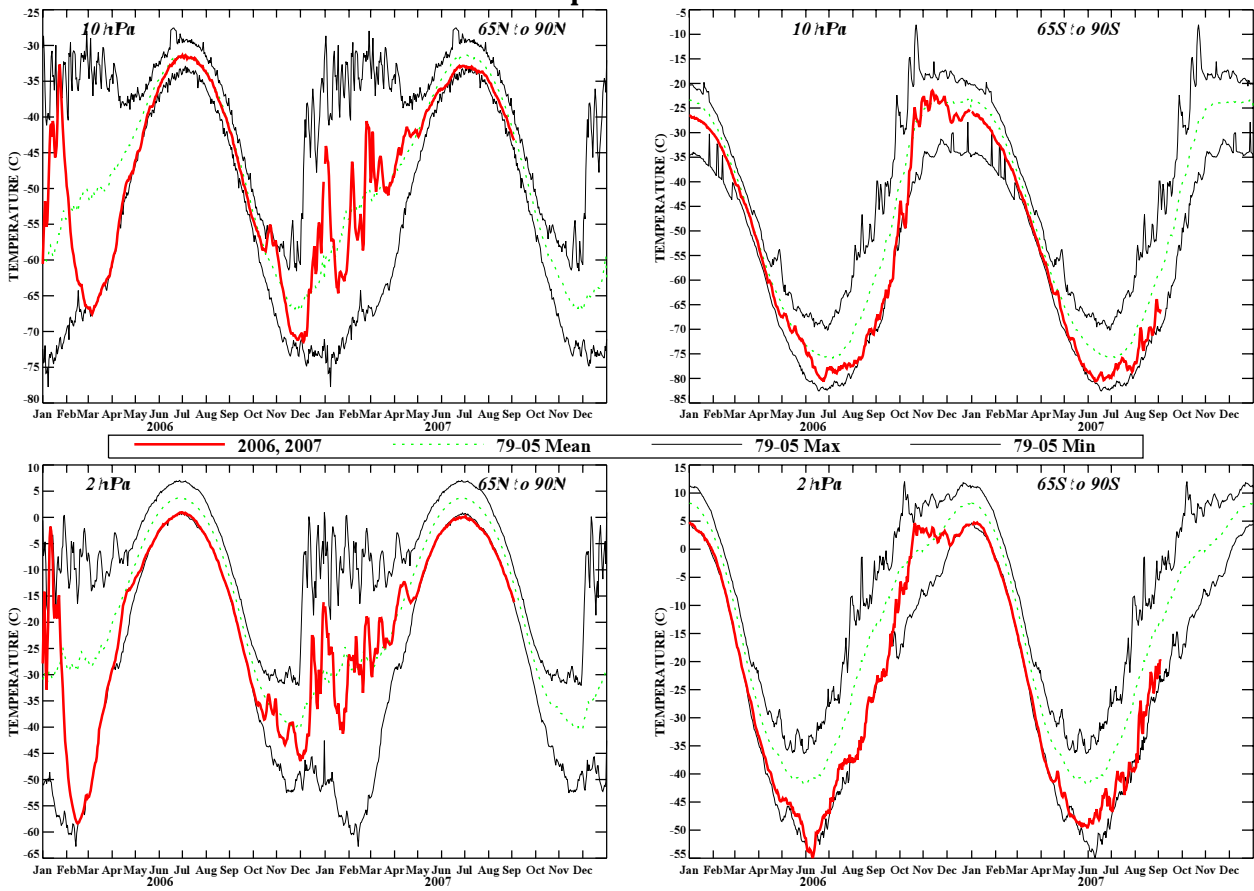


FIGURE S4. Daily mean temperatures at 10-hPa and 2-hPa (thick line) in the region 65°–90°N and 65°–90°S for the past two years. Dashed line depicts the 1979–99 base period daily mean. Thin solid lines depict the daily extreme maximum and minimum temperatures.



### Monthly Mean Ozone Anomalies

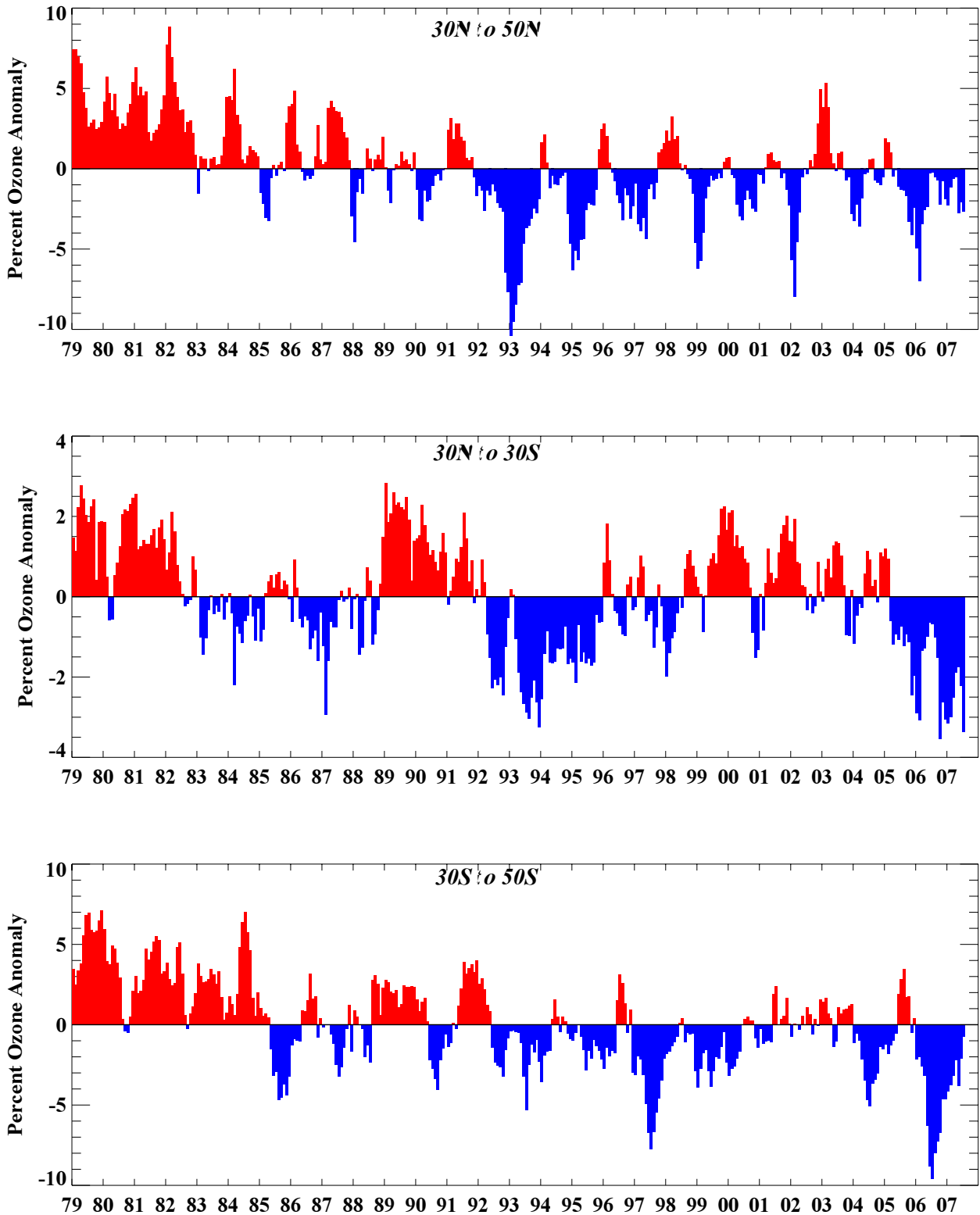


FIGURE S5. Bar graph of total ozone monthly mean percent anomaly (difference of each monthly value from the average for that month for the entire record since 1979), for latitude zones 50°N-30°N, 30°N-30°S, 30°S-50°S.

**AUGUST PERCENT DIFF (2007 - AVG(79-86))**

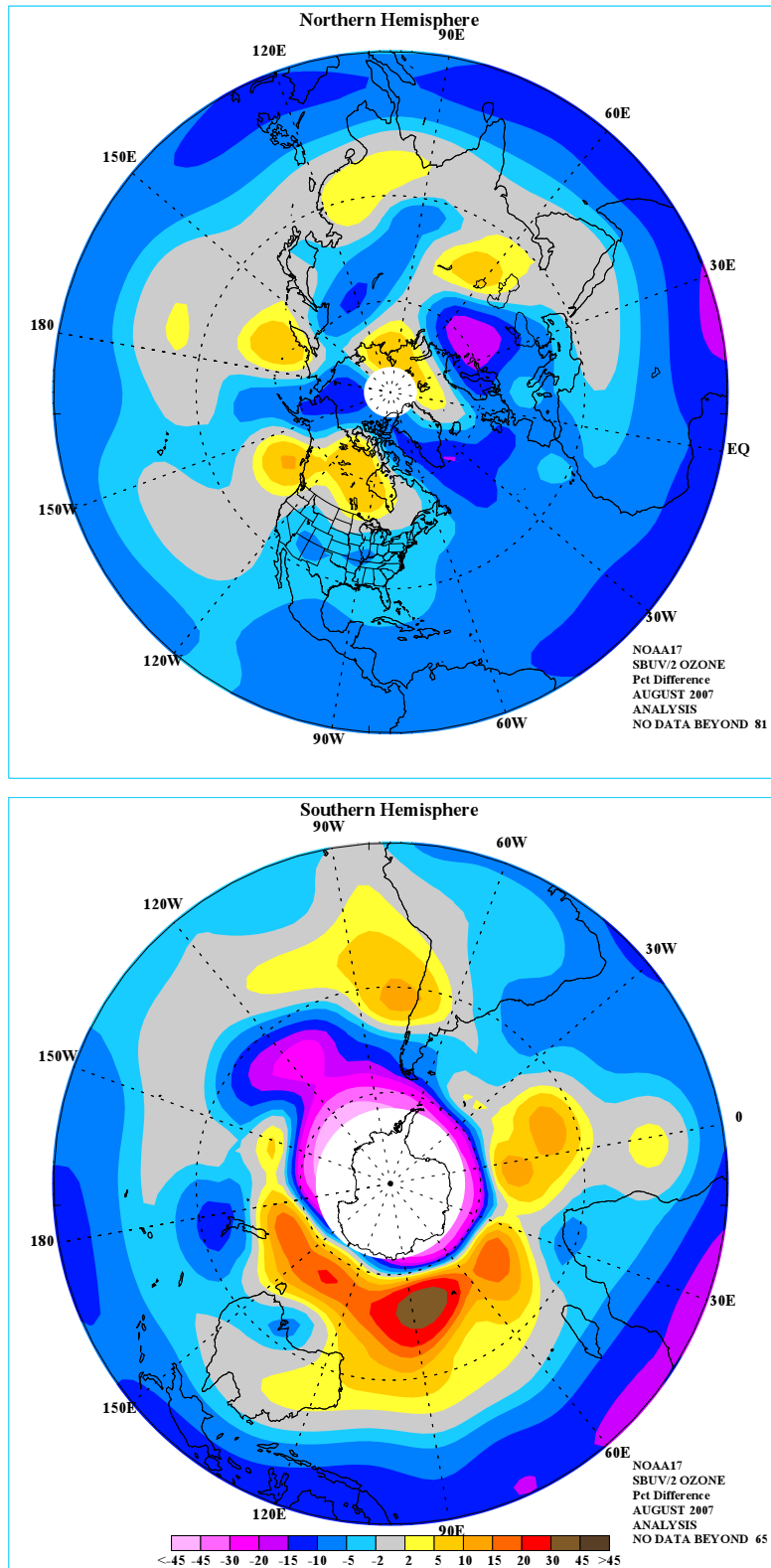


FIGURE S6. Northern (top) and Southern (bottom) Hemisphere total ozone anomaly (percent difference from monthly mean for the period 1979–86). The region near the winter pole has no SBUV/2 data.

# Fz at 100 hPa (Aug. 2007)

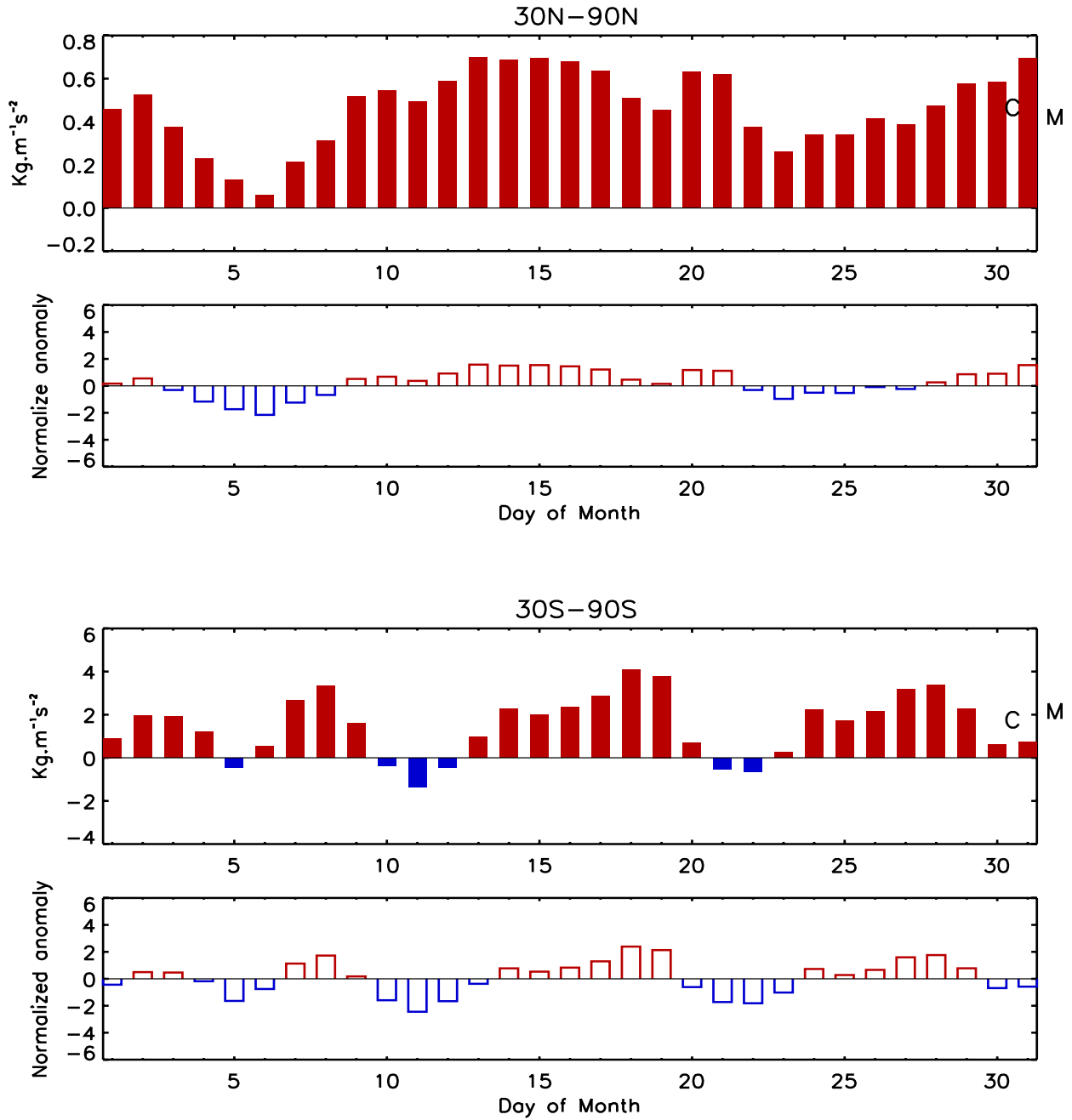


FIGURE S7. Daily vertical component of EP flux (which is proportional to the poleward transport of heat or upward transport of potential energy by planetary wave) at 100 hPa averaged over (top) 30°N–90°N and (bottom) 30°S–90°S for AUG 2007. The EP flux unit ( $\text{kg m}^{-1} \text{s}^{-2}$ ) has been 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.

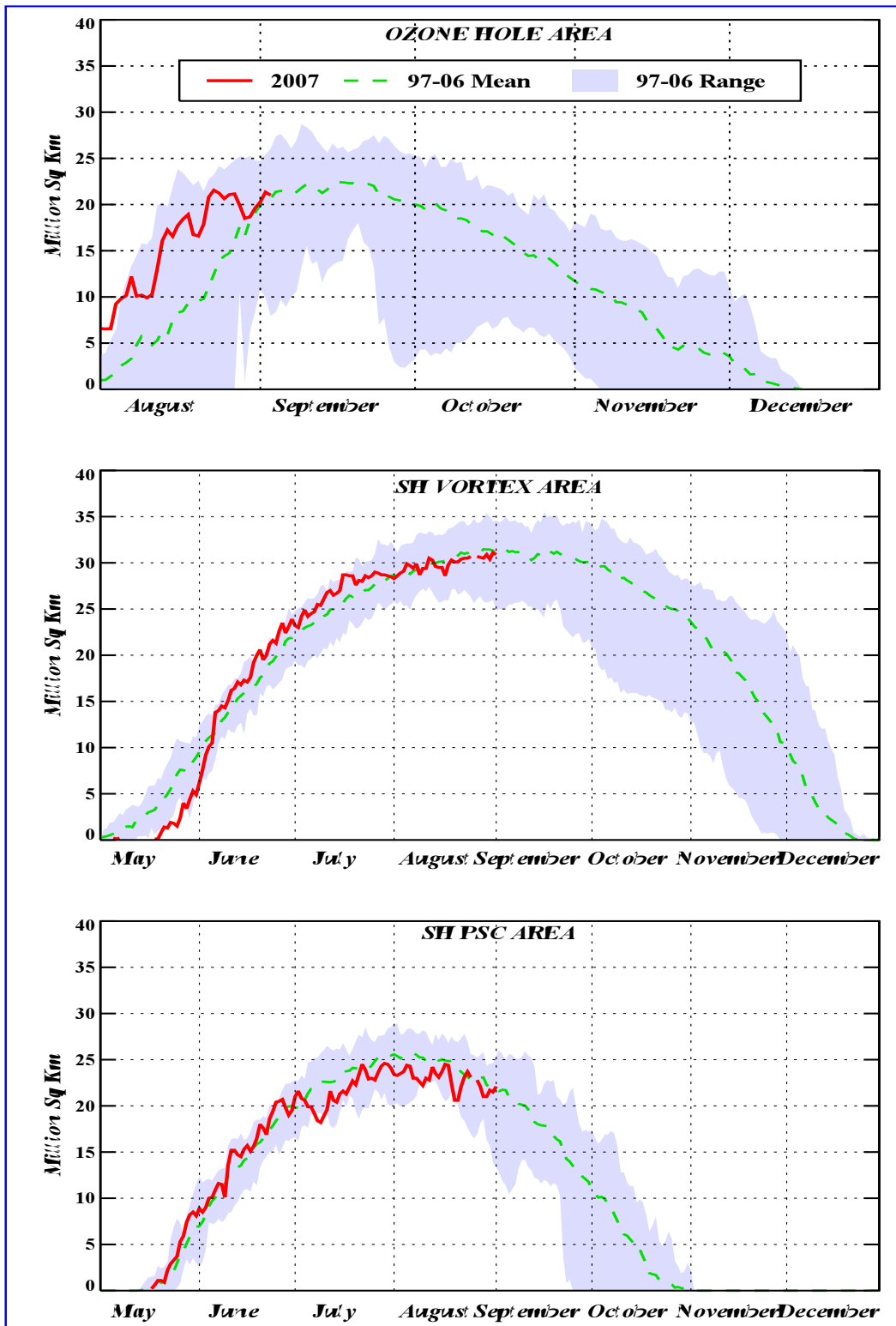


FIGURE S8. Daily time series showing the size of the NH polar vortex (representing the area enclosed by the 32 PVU contour on the 450K isentropic surface), and the areal coverage of temperatures <-78C on the 450K isentropic surface.

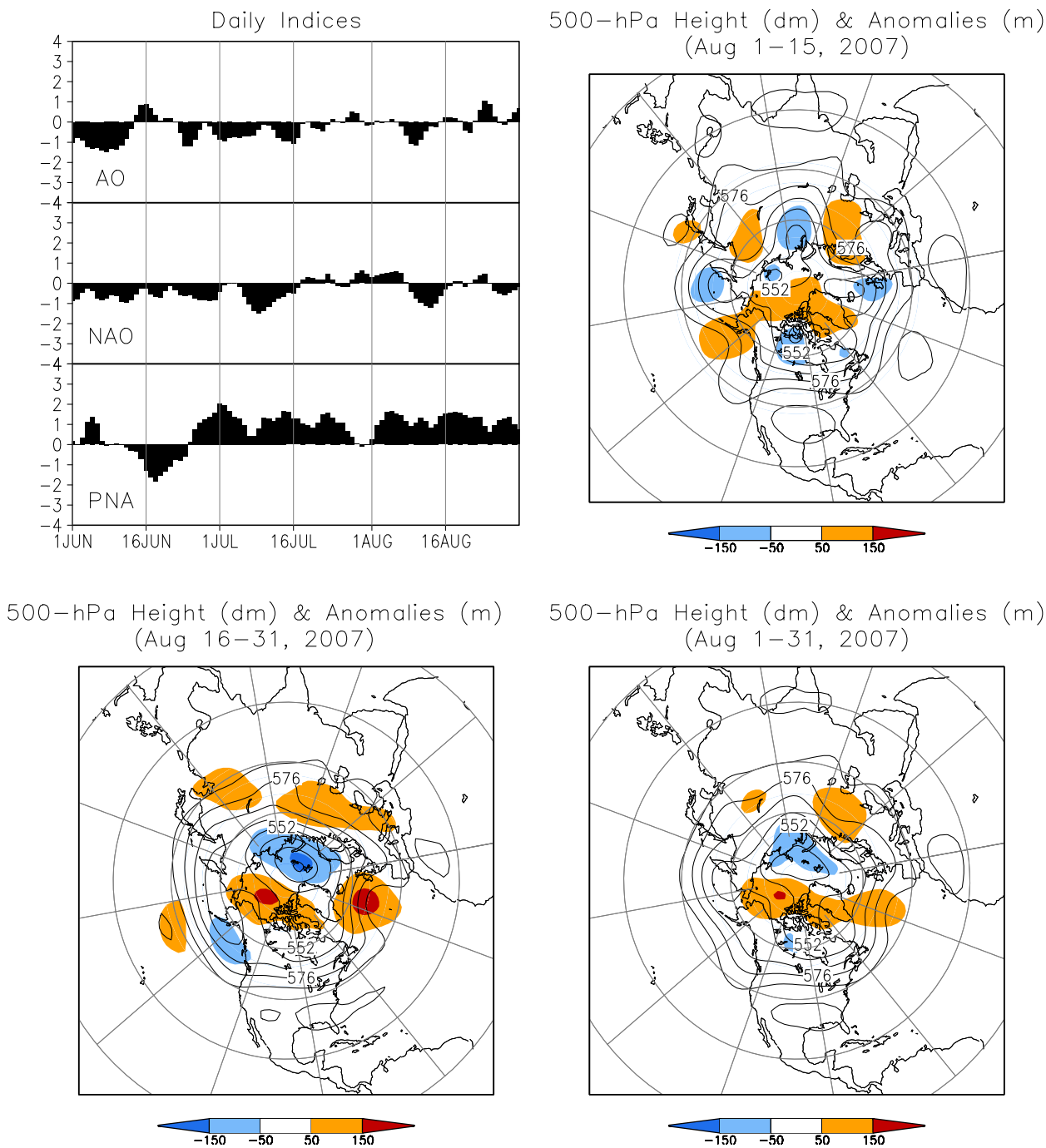


FIGURE A2.1. (a) Daily amplitudes of the Arctic Oscillation (AO) the North Atlantic Oscillation (NAO), and the Pacific-North American (PNA) pattern. The pattern amplitudes for the AO, (NAO, PNA) are calculated by projecting the daily 1000-hPa (500-hPa) height anomaly field onto the leading EOF obtained 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 AUG 2007 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.

**SSM/I Snow Cover for Aug 2007  
anomaly based on departure from 1987–2006 baseline**

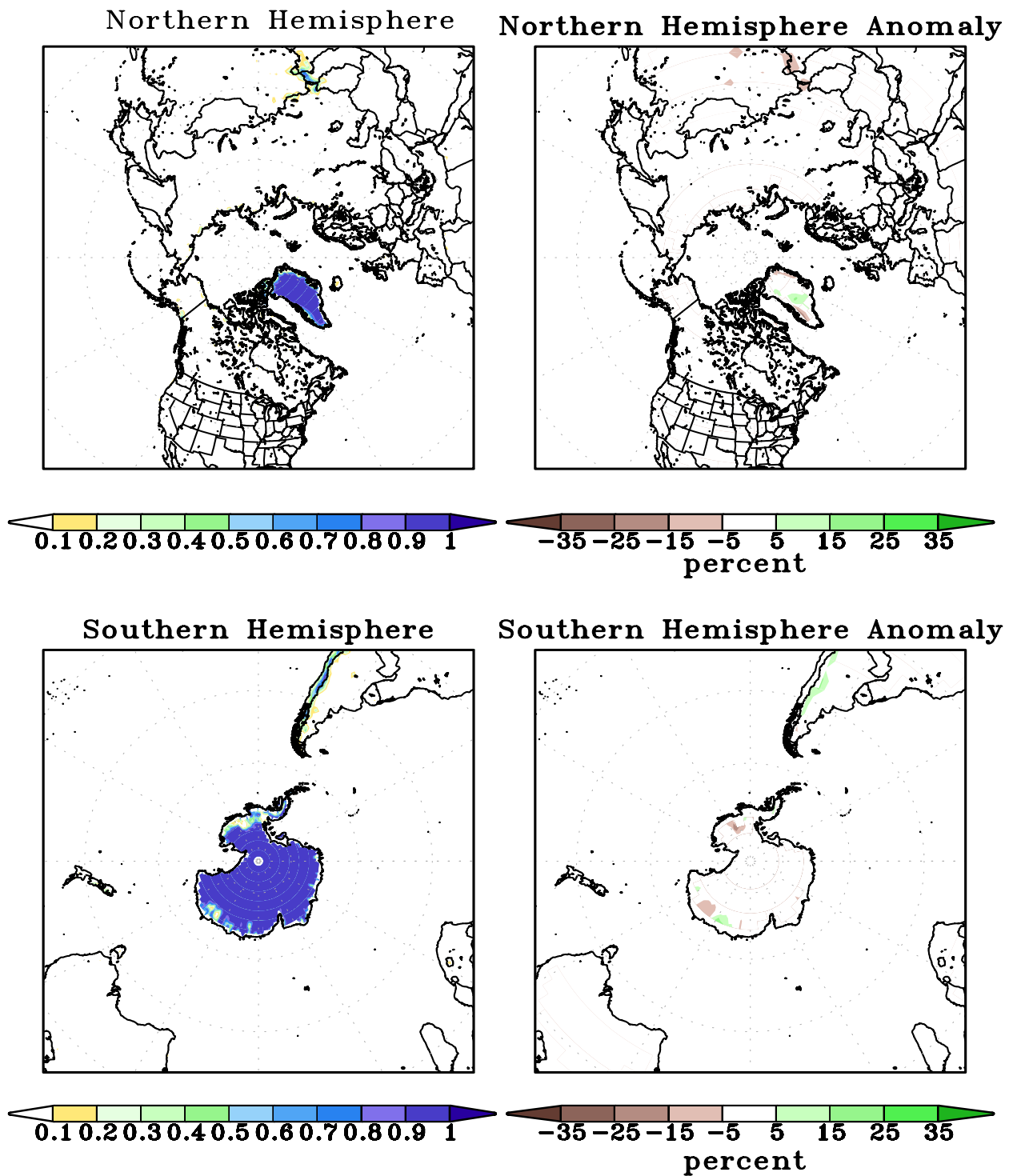


FIGURE A2.2. SSM/I derived snow cover frequency (%) (left) and snow cover anomaly (%) (right) for the month of AUG 2007 based on 1987 - 2006 base period for the Northern Hemisphere (top) and Southern Hemisphere (bottom). It is generated using the algorithm described by Ferraro et. al, 1996, Bull. Amer. Meteor. Soc., vol 77, 891-905.