Summary of the 2012 Asian Summer Monsoon

16 November 2012

Tokyo Climate Center, Japan Meteorological Agency

1. Precipitation and temperature

Four-month total precipitation amounts based on CLIMAT reports during the monsoon season (June – September) were above 200% of the normal around southern Pakistan, and were below 60% of the normal around Java Island (Figure 10). Values were mostly consistent with the distribution of OLR anomalies (Figure 12).

Extremely heavy precipitation was seen around Mongolia in June and July and over Pakistan in September. In contrast, extremely light precipitation was seen in western India in June and around western Indonesia in August (figures not shown).

Four-month mean temperatures for the same period were 1°C above the normal in northern Japan and from western Mongolia to northeastern India, and were 1°C below the normal from northeastern China to eastern Mongolia and in northern Pakistan (Figure 11).

It was reported that heavy rains caused more than 130 fatalities in Bangladesh and more than 120 fatalities in northern India’s Assam region in June. It was also reported that heavy rains caused at least 100 fatalities in the Philippines due to typhoons and enhanced convective activity associated with monsoon in August. It was further reported that heavy rains from late August to September caused more than 450 fatalities in Pakistan.

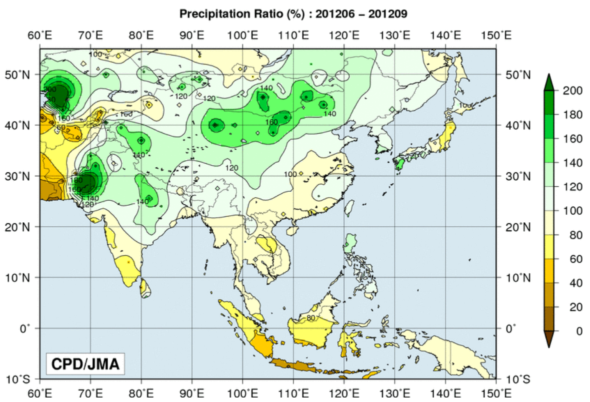


Figure 10 Four-month precipitation ratios (%) from June to September 2012
The base period for the normal is 1981 – 2010.

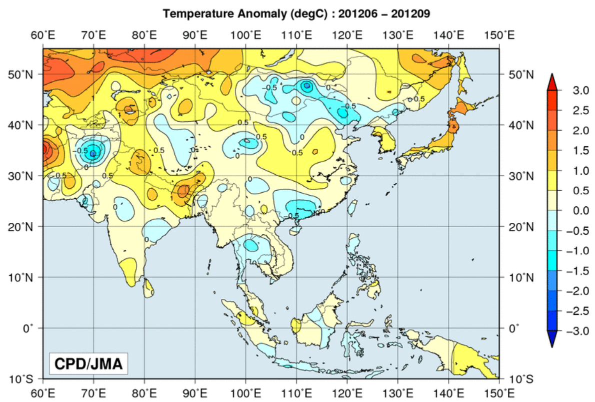


Figure 11 Four-month mean temperature anomalies (°C) from June to September 2012
The base period for the normal is 1981 – 2010.

2. Tropical cyclones

During the monsoon season, 16 tropical cyclones (TCs) of tropical storm (TS) intensity or higher formed over the western North Pacific (Table 1). The number of formations was the same as the 1981 – 2010 average of 16.0. A total of 8 among these 16 passed around the East China Sea and approached or hit China, the Korean Peninsula or Japan, while five approached or hit southern China or Viet Nam via the South China Sea. Two TCs hit the main islands of Japan.

Typhoon Saola caused more than 70 fatalities throughout China and the Philippines, and Typhoon Kai-tak caused more than 35 fatalities throughout the Philippines and Viet Nam.

Note: Disaster information is based on reports by governmental organizations (Bangladesh, China, India, Pakistan, the Philippines and Viet Nam).

Table 1 Tropical cyclones forming over the western North Pacific from June to September 2011

Number ID	Name	Date (UTC)	Category[1)]	Maximum wind[2)] (knots)
T1203	MAWAR	6/1 – 6/6	TY	75
T1204	GUCHOL	6/13 – 6/19	TY	100
T1205	TALIM	6/17 – 6/20	STS	50
T1206	DOKSURI	6/26 – 6/29	TS	40
T1207	KHANUN	7/16 – 7/18	STS	50
T1208	VICENTE	7/21 – 7/24	TY	80
T1209	SAOLA	7/28 – 8/3	TY	70
T1210	DAMREY	7/28 – 8/3	TY	70
T1211	HAIKUI	8/3 – 8/9	TY	65
T1212	KIROGI	8/6 – 8/10	STS	50
T1213	KAI-TAK	8/13 – 8/18	TY	65
T1214	TEMBIN	8/19 – 8/30	TY	80
T1215	BOLAVEN	8/20 – 8/29	TY	100
T1216	SANBA	9/11 – 9/17	TY	110
T1217	JELAWAT	9/20 – 10/1	TY	110
T1218	EWINIAR	9/24 – 9/29	STS	50

Note: Based on information from the RSMC Tokyo-Typhoon Center.
1) Intensity classification for tropical cyclones
TS: tropical storm, STS: severe tropical storm, TY: typhoon
2) Estimated maximum 10-minute mean wind

3. Monsoon activity and atmospheric circulation

Convective activity (inferred from outgoing longwave radiation (OLR)) averaged for June – September 2012 was enhanced over the western Indian Ocean, Pakistan, northern India, the Bay of Bengal, the South China Sea and the tropical western Pacific, and was suppressed over western/southern India and the eastern Indian Ocean (Figure 12). According to the OLR indices (Table 2), convective activity averaged over the Bay of Bengal and in the vicinity of the Philippines (both core areas of monsoon-related active convection) was enhanced in the summer monsoon season except in August, and in particular, enhanced convective activity from the South China Sea to the area east of the Philippines persisted throughout the season (Figure 13). The large-scale active convection area of the monsoon showed a tendency to be shifted north and east of its normal position. The areas of active convection that were originally enhanced around the equatorial western Indian Ocean in the middle of August moved northward around India and reached Pakistan in early September (Figure 14 (a)).

In the upper troposphere, the Tibetan High was pronounced around its central part (Figure 15 (a)). In the lower troposphere, a prominent monsoon trough stretching from the South China Sea to the Philippines was observed, and westerly winds were stronger than normal from the Bay of Bengal to the vicinity of the Philippines (Figure 15 (b)). Easterly vertical shear over the North Indian Ocean and southern Asia was stronger than normal (Figure 16). These characteristics of anomalous circulation indicate enhanced large-scale circulation related to the monsoon. The Pacific High in the lower troposphere was significantly enhanced to the east of Japan, bringing hot summer conditions to the country (Figure 15 (b)).

References

Webster, P. J., and S. Yang, 1992: Monsoon and ENSO: Selectively interactive systems. *Quart. J. Roy. Meteor. Soc.*, **118**, 877-926.

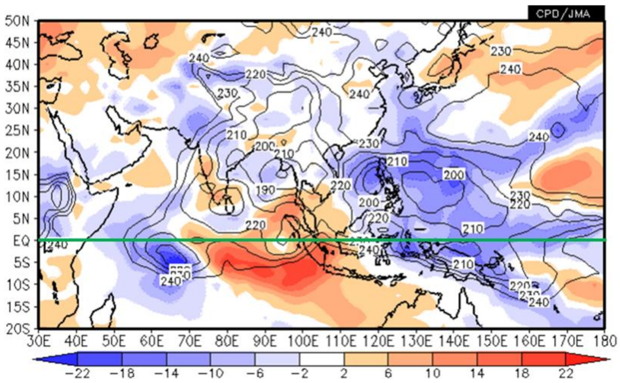


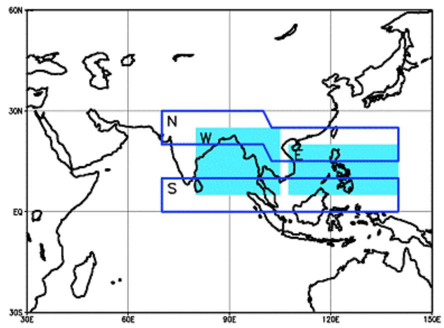
Figure 12 Four-month mean outgoing longwave radiation (OLR) and its anomaly for June – September 2012

The contours indicate OLR at intervals of 10 W/m^2, and the color shading denotes OLR anomalies from the normal (i.e., the 1981 – 2010 average). Negative (cold color) and positive (warm color) OLR anomalies show enhanced and suppressed convection compared to the normal, respectively. Original data provided by NOAA.

Table 2 Summer Asian Monsoon OLR Index (SAMOI) from May to October 2012

Asian summer monsoon OLR indices (SAMOI) are derived from OLR anomalies from May to October. SAMOI (A), (N) and (W) indicate the overall activity of the Asian summer monsoon, its northward shift and its westward shift, respectively. SAMOI definitions are as follows: SAMOI (A) = (–1) × (W + E); SAMOI (N) = S – N; SAMOI (W) = E – W. W, E, N and S indicate area-averaged OLR anomalies for the respective regions shown in the figure on the right normalized by their standard deviations.

	Summer Asian Monsoon OLR Index (SAMOI)		
	SAMOI (A): Activity	SAMOI (N): Northward-shift	SAMOI (W): Westward-shift
May 2012	0.7	-0.9	-0.8
Jun. 2012	0.7	1.2	-1.5
Jul. 2012	1.0	0.3	-1.4
Aug. 2012	-0.1	1.5	-1.0
Sep. 2012	1.6	0.2	0.2
Oct. 2012	-0.7	-1.2	-1.2



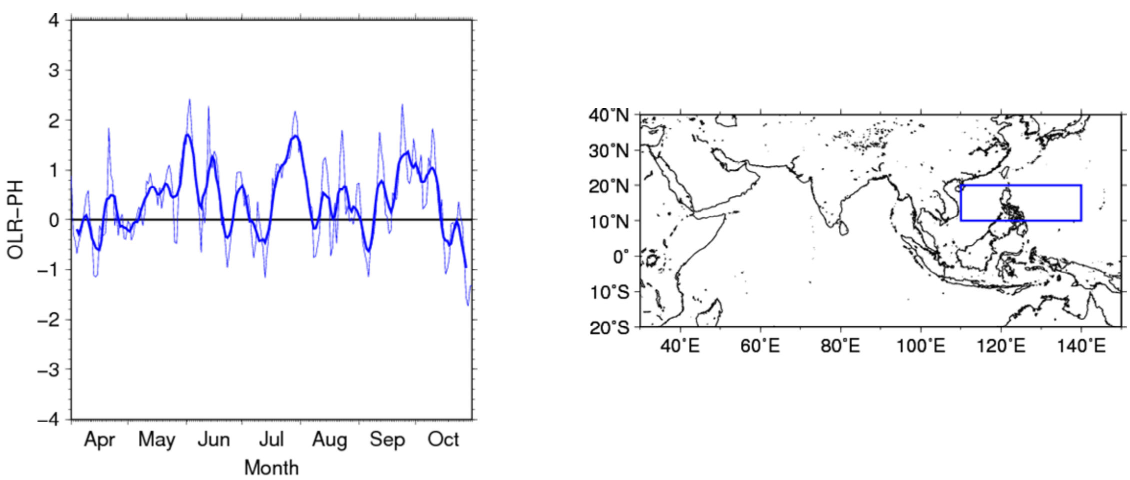


Figure 13 Time-series representation of the area-averaged OLR index (OLR-PH) around the Philippines (shown by the blue rectangle on the right: 10°N – 20°N, 110°E – 140°E)

The OLR index (OLR-PH) consists of reversed-sign area-averaged OLR anomalies for the area around the Philippines normalized by the standard deviation. Positive and negative OLR index values indicate enhanced and suppressed convective activity, respectively, compared to the normal (i.e., the 1981 – 2010 average). The thick and thin blue lines indicate seven-day running mean and daily mean values, respectively.

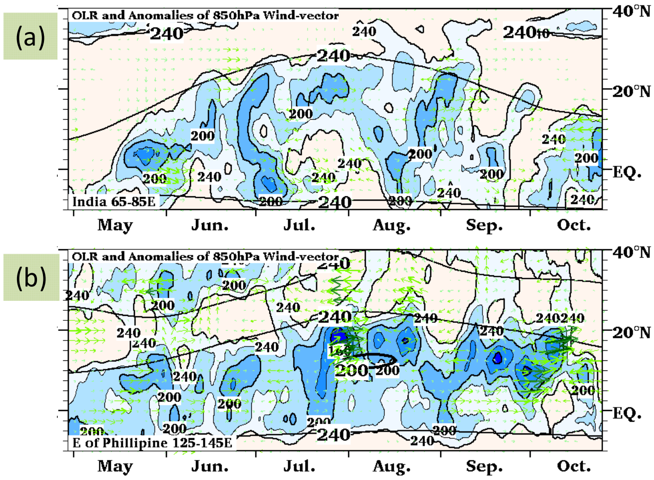


Figure 14 Latitude-time cross section of the five-day running mean OLR from May to October 2012 ((a) India (65°E – 85°E mean), (b) area east of the Philippines (125°E – 145°E mean))

The thick black lines indicate the climatological mean OLR (W/m^2) for the period from 1981 to 2010, and the shading denotes the OLR for 2012.

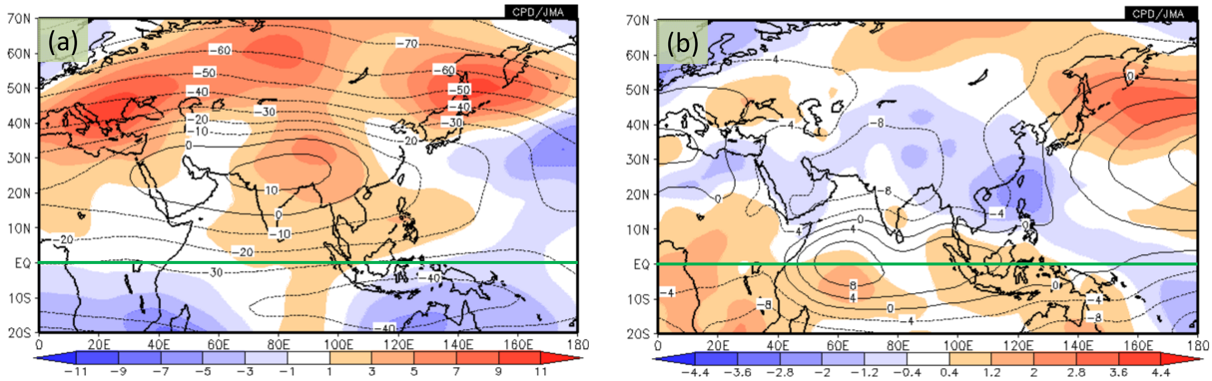


Figure 15 Four-month mean stream function and its anomaly for June – September 2012

(a) The contours indicate the 200-hPa stream function at intervals of 10 × 10^6 m^2/s, and the color shading indicates 200-hPa stream function anomalies from the normal. (b) The contours indicate the 850-hPa stream function at intervals of 4 × 10^6 m^2/s, and the color shading indicates 850-hPa stream function anomalies from the normal. The base period for the normal is 1981 – 2010. Warm (cold) shading denotes anticyclonic (cyclonic) circulation anomalies in the Northern Hemisphere, and vice-versa in the Southern Hemisphere.

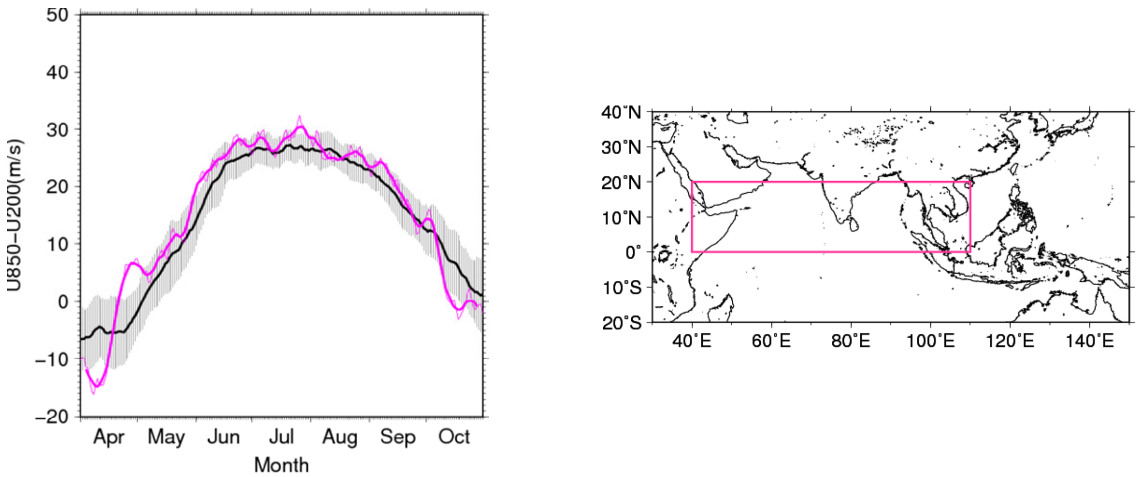


Figure 16 Time-series representation of the zonal wind shear index between 200 hPa and 850 hPa averaged over the North Indian Ocean and southern Asia (pink rectangle on the right: equator – 20°N, 40°E – 110°E)

The zonal wind shear index is calculated after Webster and Yang (1992). The thick and thin pink lines indicate seven-day running mean and daily mean values, respectively. The black line denotes the normal (i.e., the 1981 – 2010 average), and the gray shading shows the range of the standard deviation calculated for the time period of the normal.