Summary of the 2013 Asian Summer Monsoon

29 January 2014

Tokyo Climate Center, Japan Meteorological Agency

1. Precipitation and temperature

Four-month total precipitation amounts based on CLIMAT reports covering the monsoon season (June – September) were more than 160% of the normal from northeastern China to eastern Mongolia, around northern China, in eastern and central Kazakhstan, in northern and southern Pakistan, from western China to central India, and in southern Indonesia. The corresponding values were less than 60% of the normal around southeastern South Korea and in parts of eastern and northwestern China (Figure 10). The amounts were mostly consistent with the distribution of outgoing longwave radiation (OLR) anomalies (Figure 12).

Extremely heavy precipitation was seen from eastern India to Pakistan in June, from the Tohoku region of Japan to central China in July, and from northeastern China to eastern Kazakhstan in August. In contrast, extremely light precipitation was seen around the Kyushu region of Japan in July (figures not shown).

Four-month mean temperatures for the same period were more than 1°C above normal from Japan to South Korea and around eastern to central and western China, and were more than 1°C below normal around eastern Mongolia, northeastern Kazakhstan and central India (Figure 11).

Heavy rain is reported to have caused more than 600 confirmed fatalities and 5,700 presumed fatalities in India as well as more than 50 fatalities in Nepal in June. It was also reported that heavy rain caused more than 200 fatalities in Pakistan and more than 60 in Afghanistan in August.

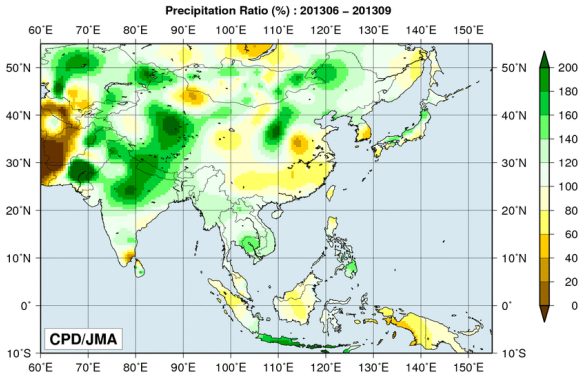


Figure 10 Four-month precipitation ratios (%) from June to September 2013
The base period for normal is 1981 – 2010. There were not data in Afghanistan.

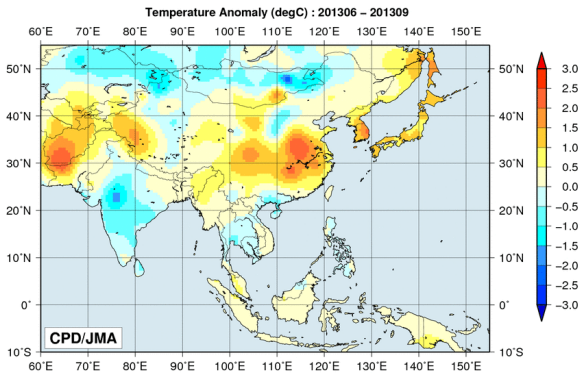


Figure 11 Four-month mean temperature anomalies (°C) from June to September 2013
The base period for normal is 1981 – 2010. There were not data in Afghanistan.

2. Tropical cyclones

During the monsoon season, 21 tropical cyclones (TCs) of tropical storm (TS) intensity or higher formed over the western North Pacific (Table 1). This was higher than the 1981 – 2010 average of 16.0. A total of 6 among these 21 passed around the East China Sea and approached or hit China or Japan, while 8 TCs approached or hit southern China or Viet Nam via the South China Sea. Two TCs also hit the main islands of Japan.

Typhoon Utor caused more than 10 fatalities in Viet Nam and 60 in China, and Typhoon Usagi caused more than 30 fatalities in China.

Note: Disaster information is based on reports by governmental organizations (China and Pakistan), OCHA and IFRC.

Table 1 Tropical cyclones forming over the western North Pacific from June to September 2013

Number ID	Name	Date (UTC)	Category[1)]	Maximum wind[2)] (knots)
T1303	Yagi	6/8 – 6/12	TS	45
T1304	Leepi	6/18 – 6/20	TS	40
T1305	Bebinca	6/20 – 6/24	TS	40
T1306	Rumbia	6/28 – 7/2	STS	50
T1307	Soulik	7/8 – 7/13	TY	100
T1308	Cimaron	7/17 – 7/18	TS	40
T1309	Jebi	7/31 – 8/3	STS	50
T1310	Mangkhut	8/6 – 8/7	TS	40
T1311	Utor	8/9 – 8/15	TY	105
T1312	Trami	8/18 – 8/22	STS	60
T1313	Pewa	8/18 – 8/24	STS	55
T1314	Unala	8/19 – 8/19	TS	35
T1315	Kong-rey	8/26 – 8/29	STS	55
T1316	Yutu	9/1 – 9/1	TS	35
T1317	Toraji	9/1 – 9/3	STS	50
T1318	Man-yi	9/13 – 9/16	TY	65
T1319	Usagi	9/16 – 9/23	TY	110
T1320	Pabuk	9/21 – 9/26	STS	60
T1321	Wutip	9/27 – 9/30	TY	65
T1322	Sepat	9/30 – 10/2	TS	40
T1323	Fitow	9/30 – 10/7	TY	75

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 OLR) averaged for June – September 2013 was enhanced over large parts of the Asian summer monsoon region including northwestern India, the Bay of Bengal, the South China Sea and the area around the Maritime Continent (Figure 12). According to 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 throughout the summer monsoon season, especially in June, July and September.

In the upper troposphere, the Tibetan High was pronounced as a whole and extended toward central China and Japan (Figure 13 (a)). In the lower troposphere, a monsoon trough was prominent from the Arabian Sea to the South China Sea, and westerly winds were stronger than normal from the Arabian Sea to the Bay of Bengal (Figure 13 (b)). Easterly vertical shear over the North Indian Ocean and southern Asia was stronger than normal throughout the monsoon season (Figure 14). These characteristics of anomalous circulation indicate enhanced large-scale circulation related to the monsoon. The Pacific High in the lower troposphere was significantly extended to southern China and Japan, bringing hot summer conditions there (Figure 13 (b)).

References

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

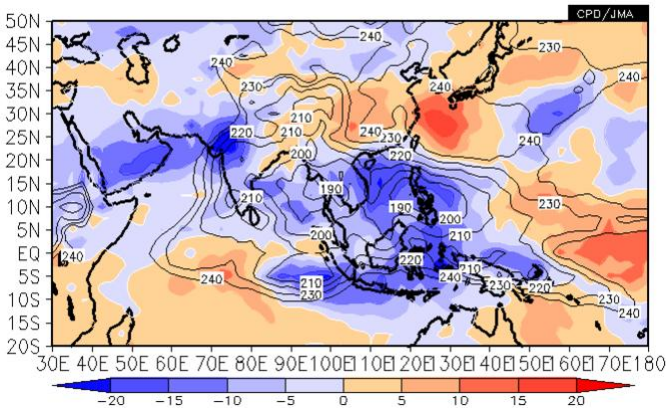


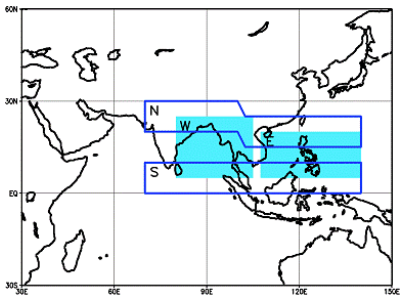
Figure 12 Four-month mean outgoing longwave radiation (OLR) and its anomaly for June – September 2013

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) values observed from May to October 2013

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 2013	0.8	-1.2	1.4
Jun. 2013	1.3	-0.1	-0.3
Jul. 2013	1.8	-0.7	0.5
Aug. 2013	0.9	0.1	-0.9
Sep. 2013	1.6	0.2	-0.1
Oct. 2013	0.4	1.4	0.2



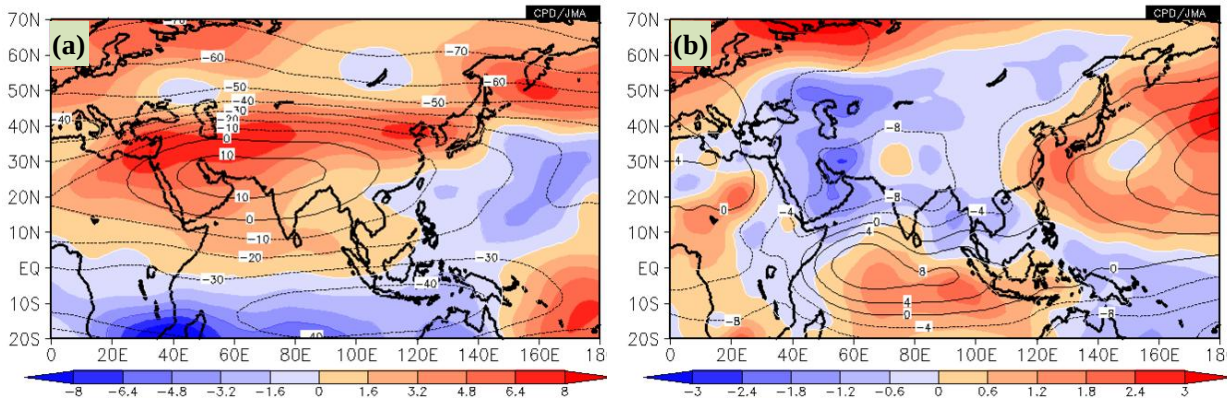


Figure 13 Four-month mean stream function and its anomaly for June – September 2013

(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.

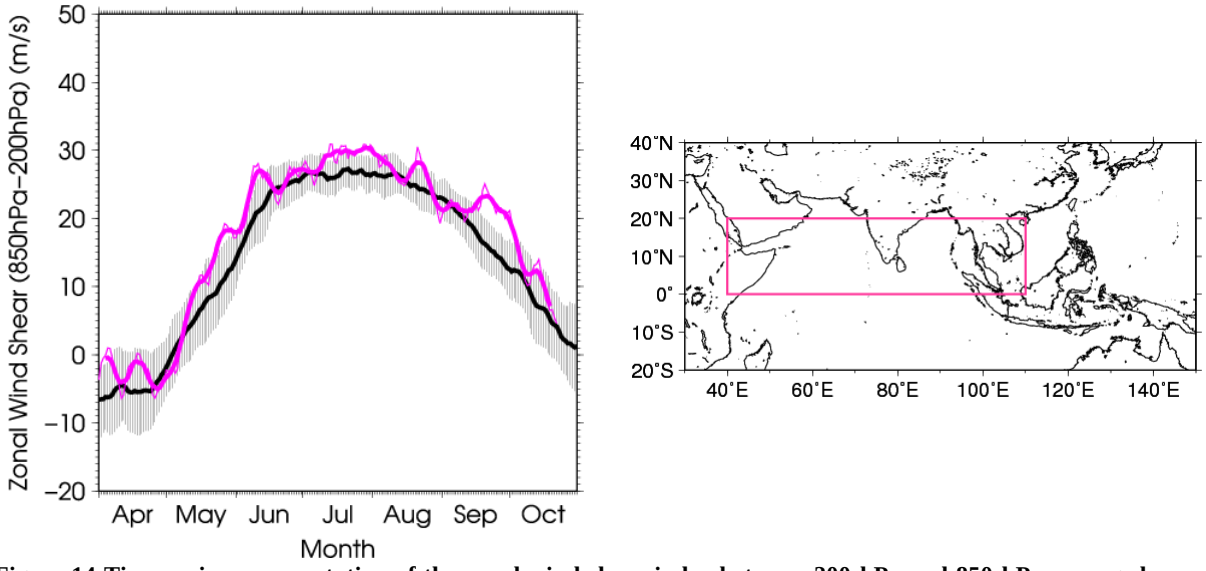


Figure 14 Time-series representation of the zonal wind shear index between 200-hPa and 850-hPa averaged over the North Indian Ocean and southern Asia (pink rectangle in the bottom figure: equator – 20°N, 40°E – 110°E)

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.