Summary of the 2017 Asian Summer Monsoon

This report summarizes the characteristics of the surface climate and atmospheric considerations related to the Asian summer monsoon for 2017.

Note: The Japanese 55-year Reanalysis (JRA-55; Kobayashi et al. 2015) atmospheric circulation data was used for this report. The outgoing longwave radiation (OLR) data referenced to infer tropical convective activity were originally provided by NOAA. The base period for the normal is 1981 – 2010. The term "anomaly" as used in this report refers to deviation from the normal.

1. Precipitation and temperature

Four-month total precipitation amounts based on CLIMAT reports during the monsoon season (June – September) were more than 140% of the normal in and around India and from southern Philippines to the New Guinea Island. Conversely, the corresponding figures were less than 60% of the normal from the Korean Peninsula to northeastern China, in northwestern China and southwestern Pakistan (Figure 1). In August, monsoonal heavy rain causing flooding and landslides in Bangladesh, India and Nepal resulted in more than total 1,800 fatalities. From the Korean Peninsula to northeastern China, extremely low precipitation totals were observed in July and September, with South Korea recording the third-lowest July amount since KMA observation began in 1973.

Four-month mean temperatures for the same period were more than 1°C above normal in western Mongolia, eastern China and the Korean Peninsula, and slightly below normal in and around India, and in the western part of Indochina Peninsula (Figure 2). In mid and late July, China experienced extreme heatwave conditions from its central to eastern provinces, with temperatures reaching 42°C in parts of Hebei, Shaanxi, Shanxi and Xinjiang on July 13 according to CMA.

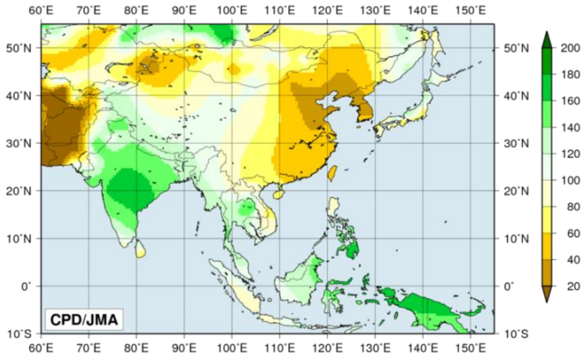


Figure 1 Four-month precipitation ratios (%) from June to September 2017

The base period for normal is 1981 – 2010. Note that the data in Vietnam, Thailand and Cambodia are interpolated due to the lack of CLIMAT report or climatological normal.

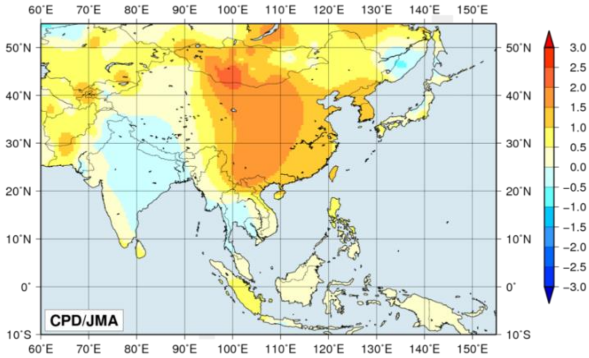


Figure 2 Four-month mean temperature anomalies (°C) from June to September 2017

The base period for normal is 1981 – 2010. Note that the data in Vietnam, Thailand and Cambodia are interpolated due to the lack of CLIMAT report or climatological normal.

2. Tropical cyclones

A total of 19 tropical cyclones (TCs[1]) had formed over the western North Pacific up to September 2017 as compared to the normal of 18.4. July's total of 8 represented a significant increase over the normal of 3.6 (Table 1). From June to September, a total 10 TCs hit the area from southern China to the Indochina Peninsula over the South China Sea. Among these, Typhoons Hato and Pakhar made landfall in series late August in almost the same location in southern China, resulting in more than 120 total fatalities (sources: Government of China, Government of Macau). Typhoon Noru had JMA's second-longest duration (19.0 days) since 1951, forming on July 20 near Minami Torishima Island and degrading to extratropical cyclone status on August 8 over the Sea of Japan. Noru drifted over a warm SST region southeast of Japan for most of its lifetime due to interaction known as the Fujiwara effect with Typhoon Kulap and weak steering flow from the Western North Pacific subtropical high located far to its east.

Table 1 Tropical cyclones forming over the western North Pacific from June to September 2017

Number ID	Name	Date (UTC)	Category[1)]	Maxumum wind[2)] (knots)
T1701	Muifa	4/25-4/27	TS	35
T1702	Merbok	6/11-6/12	STS	55
T1703	Nanmadol	7/2-7/4	STS	55
T1704	Talas	7/15-7/17	STS	50
T1705	Noru	7/20-8/8	TY	95
T1706	Kulap	7/21-7/25	TS	40
T1707	Roke	7/22-7/23	TS	35
T1708	Sonca	7/23-7/25	TS	35
T1709	Nesat	7/25-7/30	TY	80
T1710	Haitang	7/28-7/31	TS	45
T1711	Nalgae	8/2-8/5	TS	45
T1712	Banyan	8/11-8/17	TY	80
T1713	Hato	8/20-8/24	TY	75
T1714	Pakhar	8/24-8/27	STS	55
T1715	Sanvu	8/28-9/3	TY	80
T1716	Mawar	8/31-9/3	STS	50
T1717	Guchol	9/5-9/6	TS	35
T1718	Talim	9/9-9/17	TY	95
T1719	Doksuki	9/12-9/15	TY	80

Note: Based on information from the RSMC Tokyo-Typhoon Center.
Cyclones indicated in italic denote ones for which the post-analyses are not complete.
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 2017 was enhanced over the Maritime Continent, from east China to the Indochina Peninsula and India, and was suppressed over the equatorial Indian Ocean, over the Bay of Bengal and from southern China to the seas east of the Philippines (Figure 3). OLR index data (Table 2) indicate that the overall activity of the Asian summer monsoon (represented by the SAMOI (A) index) was below normal in June and was above normal in July and October. The most active convection area was shifted northward of its normal position in June and October (see the

[1] Here, a TC is defined as a tropical cyclone with a maximum sustained wind speed of 34 knots or more.

SAMOI (N) index.) and eastward in October (see the SAMOI (W) index.).

In the upper troposphere, the Tibetan High was stronger than normal (Figure 4 (a)). In the lower troposphere, the monsoon trough over Southeast Asia was weaker than normal and anti-cyclonic circulation anomalies straddling the equator were seen over the western Pacific (Figure 4 (b)).

Zonal wind shear between the upper and lower tropo-sphere over the North Indian Ocean and southern Asia (Figure 5) was stronger than normal from the second half of June to the first half of July and from September to the first half of October.

Convective activity over the Maritime Continent was enhanced throughout the summer monsoon season and suppressed over the Philippines from early to mid-August (Figure 6). During this period, the Pacific High did not exhibit its usual extension to mainland Japan and was shifted southward of its normal position, corresponding to the negative PJ (Pacific – Japan) pattern (Nitta 1987; Kosaka and Nakamura 2010) (Figure 7).

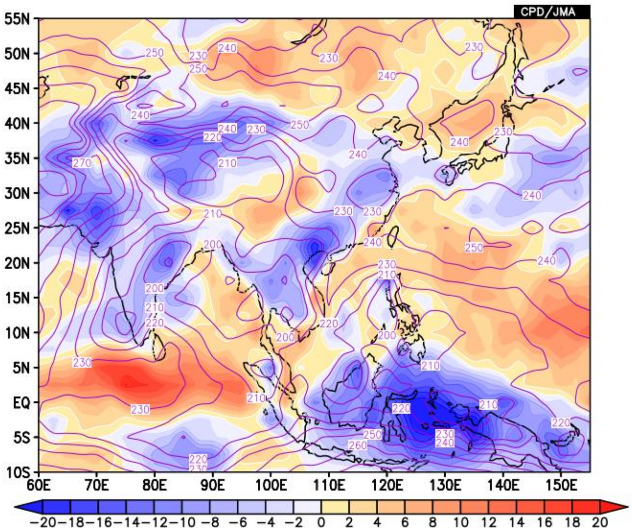


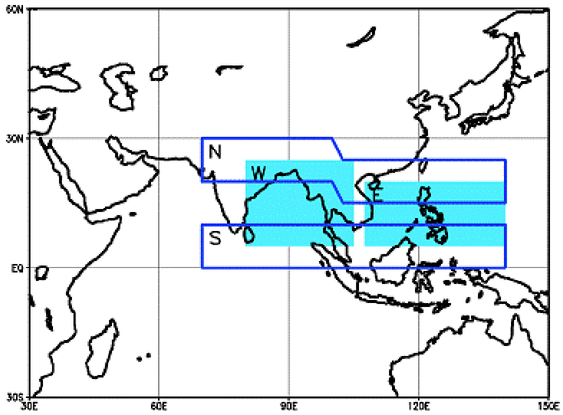
Figure 3 Four-month mean outgoing longwave radiation (OLR) and its anomaly for June–September 2017

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 are provided by NOAA.

Table 2 Summer Asian Monsoon OLR Index (SAMOI) values observed from May to October 2017

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 2017	0.7	-0.7	0.4
Jun. 2017	-1.1	1.0	0.3
Jul. 2017	1.7	0.8	-0.7
Aug. 2017	-0.8	-0.2	0.8
Sep. 2017	0.3	-0.9	0.2
Oct. 2017	1.2	1.4	-1.1



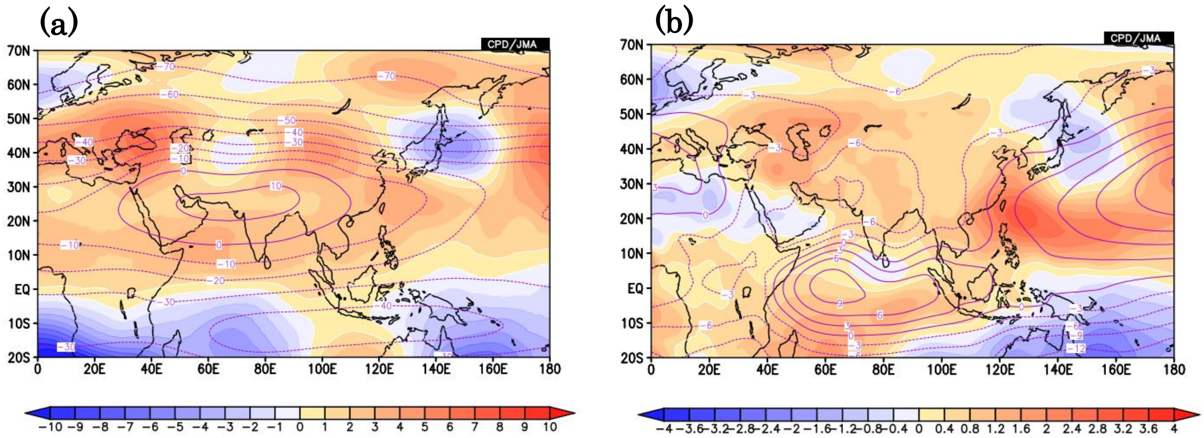


Figure 4 Four-month mean stream function and its anomaly for June – September 2017

(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.

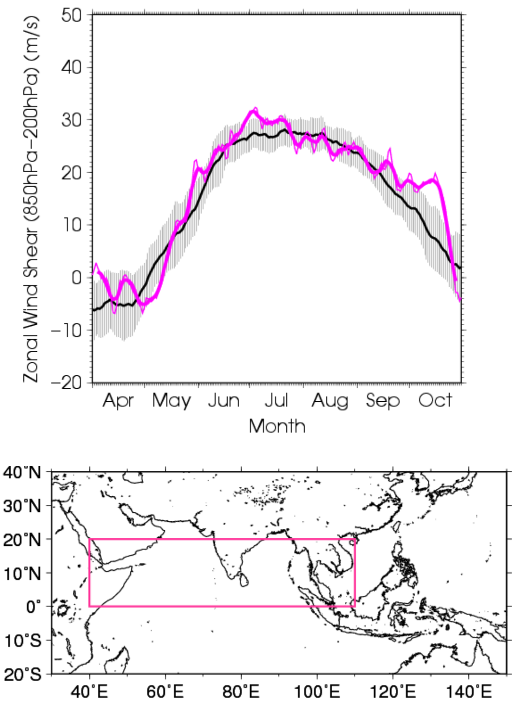


Figure 5 Time-series representation of the zonal wind shear index between 200-hPa and 850-hPa averaged over the North Indian Ocean and southern Asia (pink rectangle: equator – 20°N, 40°E – 110°E)

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.

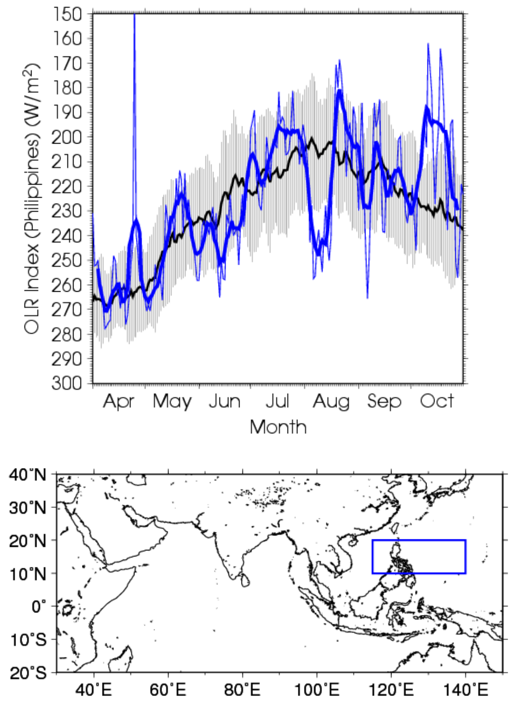


Figure 6 Time-series representation of OLR (W/m^2) averaged over the Philippines (blue rectangle: 10°N - 20°N, 115°E - 140°E)

The OLR index is calculated after Wang and Fan (1999). The thick and thin blue 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.

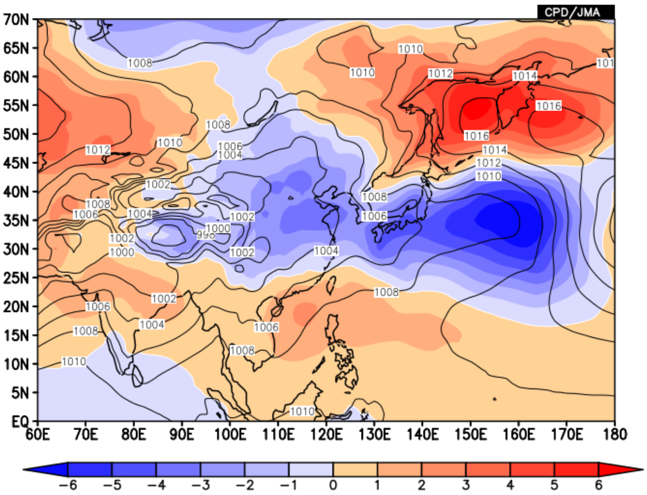


Figure 7 Sea level pressure (contour) and anomaly (shade) for 1-20 August 2017
The contours indicate sea level pressure at intervals of 2 hPa, and the color shading denotes sea level pressure anomalies from the normal (i.e., the 1981–2010 average).

References

Kobayashi, S., Y. Ota, Y. Harada, A. Ebita, M. Moriya, H. Onoda, K. Onogi, H. Kamahori, C. Kobayashi, H. Endo, K. Miyaoka, and K. Takahashi, 2015: The JRA-55 Reanalysis: General Specifications and Basic Characteristics. *J. Meteorol. Soc. Japan*, **93**, 5 - 48.

Kosaka, Y., and H. Nakamura, 2010: Mechanisms of meridional teleconnection observed between a summer monsoon system and a subtropical anticyclone. Part I: The Pacific-Japan pattern. *J. Clim*., **23**, 5085 - 5108.

Nitta, T., 1987: Convective activities in the tropical western Pacific and their impact on the Northern Hemisphere summer circulation. *J. Meteor. Soc. Japan*, **65**, 373 - 390.

Wang, B., and Z. Fan, 1999: Choice of South Asian Summer Monsoon Indices. *Bull. Amer. Meteor. Sci.*, **80**, 629 - 638.

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