Summary of the 2015 Asian Summer Monsoon

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This report summarizes the characteristics of the surface climate and atmospheric/oceanographic considerations related to the Asian Sinter monsoon for 2015.

Note: Japanese 55-year Reanalysis (JRA-55; http://jra.kishou.go.jp/JRA-55/index_en.html; Kobayashi et al. 2015) atmospheric circulation data and COBE-SST (Ishii et al. 2005) sea surface temperature (SST) data were used for this investigation. 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 on the Pacific side of eastern to western Japan, in eastern China, in southern Mongolia and northwestern China, and in and around Pakistan. Conversely, the corresponding figures were less than 40% of the normal around the western part of the Korean Peninsula and in southern to western Indonesia (Figure 1). These amounts were mostly consistent with the distribution of four-month mean OLR anomalies (Figure 3).

Extremely heavy precipitation was seen from Kyushu region of Japan to central China in June. In contrast, extremely light precipitation was seen in Mongolia in August (figures not shown).

Four-month mean temperatures for the same period were more than 1°C above normal from the southern part of Central Siberia to northern Mongolia, on the central Korean Peninsula, on the northern Indochina Peninsula and in central and southwestern India, and were more than 1°C below normal around the middle Yangtze River basin (Figure 2).

It was reported that heavy rains often caused floods and landslides in eastern and western India and in northern and eastern Pakistan. Monsoon-season fatalities caused by floods and landslides reportedly exceeded 660 in India and 220 in Pakistan. Heat waves in June reportedly caused more than 1,220 fatalities in southwestern Pakistan.

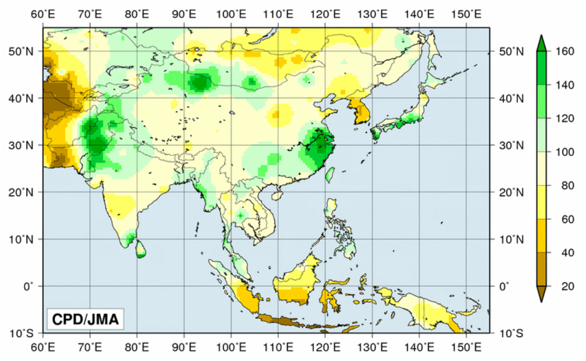


Figure 1 Four-month precipitation ratios (%) from June to September 2015
The base period for normal is 1981 – 2010. There were not data in Afghanistan.

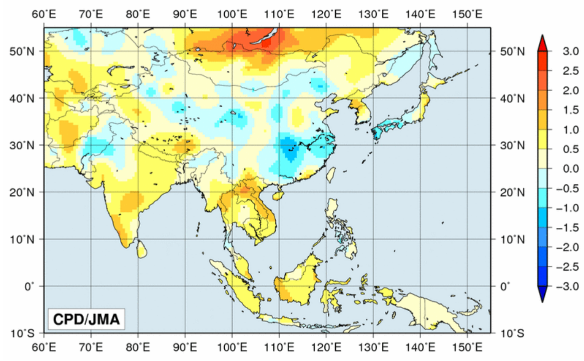


Figure 2 Four-month mean temperature anomalies (°C) from June to September 2015
The base period for normal is 1981 – 2010. There were not data in Afghanistan.

2. Tropical cyclones

During the monsoon season, 14 tropical cyclones (TCs) of tropical storm (TS) intensity or higher formed over the western North Pacific (Table 1). This was lower than the normal (1981 – 2010 average) of 16.0. The average position of TC formations was south and east of the normal. Four TCs hit the main islands of Japan, which was above the annual normal of 2.7.

Fatalities from Typhoon Soudelor reportedly exceeded 20 in China, and those from Typhoon Goni reportedly exceeded 30 in the Philippines.

Note: Disaster information is based on reports by governmental organizations (China, India, Pakistan and the Philippines) and EM-DAT[1].

Table 1 Tropical cyclones forming over the western North Pacific from June to September 2015

Number ID	Name	Date (UTC)	Category[1)]	Maximum wind[2)] (knots)
T1508	Kujira	6/21 – 6/24	TS	45
T1509	Chan-Hom	6/30 – 7/12	TY	90
T1510	Linfa	7/2 – 7/9	STS	50
T1511	Nangka	7/3 – 7/17	TY	100
T1512	Halola	7/12 – 7/16, 7/19 – 7/26	TY	80
T1513	Soudelor	8/1 – 8/9, 8/11 – 8/11	TY	115
T1514	Molave	8/7 – 8/13	TS	45
T1515	Goni	8/14 – 8/25	TY	100
T1516	Atsani	8/14 – 8/25	TY	100
T1517	Kilo	9/2 – 9/11	TY	80
T1518	Etau	9/7 – 9/9	STS	50
T1519	Vamco	9/13 – 9/14	TS	35
T1520	*Krovanh*	*9/15 – 9/20*	*TY*	*85*
T1521	*Dujuan*	*9/22 – 9/29*	*TY*	*110*

1 D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

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 2015 was enhanced from eastern China to eastern Japan, and was suppressed over large parts of the Asian summer monsoon region, especially over the area around the Maritime Continent and east of the Philippines (Figure 3). According to the OLR indices (Table 2), the overall activity of the Asian summer monsoon (represented by the SAMOI (A) index) was below normal throughout the summer monsoon season, especially in August.

In the upper troposphere, the Tibetan High was generally weaker than normal (Figure 4 (a)), which was consistent with the subtropical jet stream flowing southward of its normal position. In the lower troposphere, monsoon circulation over the Indian Ocean was weaker than normal and the Somali jet was weaker than normal. Zonal wind shear between the upper and lower troposphere over the North Indian Ocean and southern Asia (Figure 5) remained weaker than normal after July. The northwestward extension of the Pacific High was weaker than normal, contributing to cool wet summer conditions around western Japan (Figure 4 (b)).

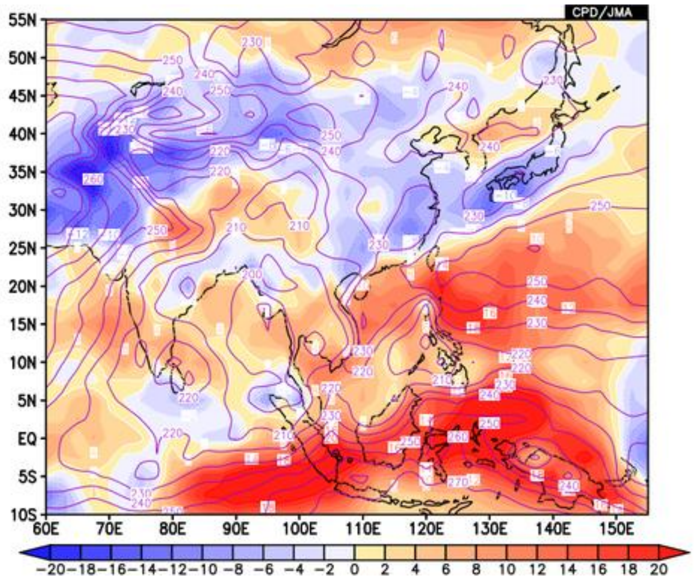
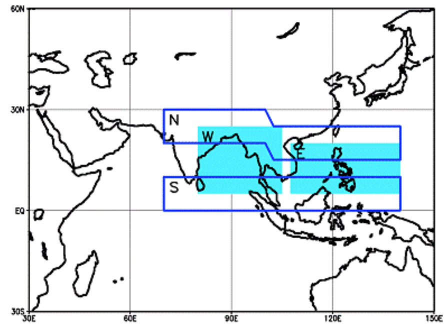


Figure 3 Four-month mean OLR and its anomaly for June–September 2015
The contours indicate OLR at intervals of 10 W/m^2, and the color shading denotes OLR anomalies from the normal (i.e., the 1981–2010 average). Negative (cold color) and positive (warm color) OLR anomalies show enhanced and suppressed 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 2015
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 2015	-1.2	0.4	2.0
Jun. 2015	-1.2	-1.5	0.6
Jul. 2015	-0.7	2.0	0.4
Aug. 2015	-1.9	0.2	0.6
Sep. 2015	-1.0	-0.4	1.4
Oct. 2015	-1.4	1.8	0.6



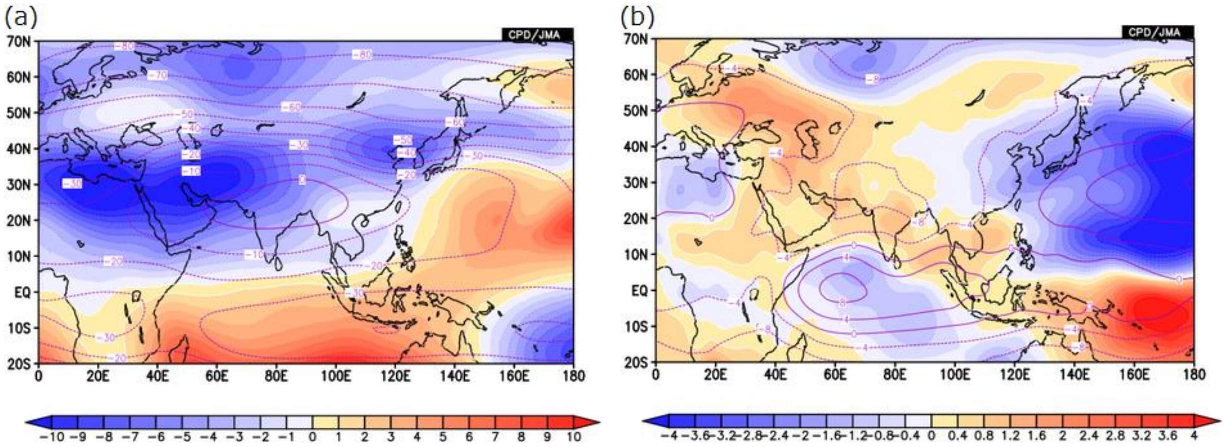
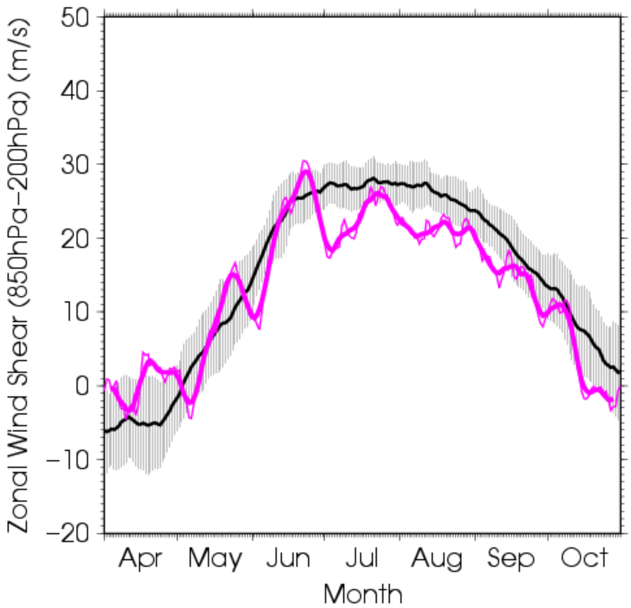


Figure 4 Four-month mean stream function and its anomaly for June – September 2015
(a) The contours indicate the 200-hPa stream function at intervals of 10 × 10^6 m^2/s, and the color shading indicates 200-hPa stream function anomalies from the normal. (b) The contours indicate the 850-hPa stream function 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.



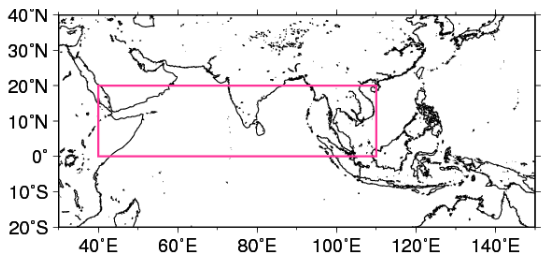


Figure 5 Time-series representation of the zonal wind shear index between 200-hPa and 850-hPa averaged over the North Indian Ocean and southern Asia (the region enclosed by the pink rectangle in the right figure: equator – 20°N, 40°E – 110°E)

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.

References

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

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