Climate condition at extreme climate events

Akihiko Shimpo
Tokyo Climate Center (TCC)
Japan Meteorological Agency (JMA)

Introduction

- TCC monitors the global climate with CLIMAT and SYNOP reports from National Meteorological and Hydrological Services (NMHSs) through the Global Telecommunication System (GTS) of the World Meteorological Organization (WMO).

- This session briefly introduces monitoring reports on extreme climate events in the world and related products, which are regularly updated and available on the TCC website.

1. REPORTS ON GLOBAL EXTREME CLIMATE EVENTS

Reports on global extreme climate events

- TCC/JMA produces weekly, monthly, seasonal, and annual monitoring reports on extreme climate events with brief descriptions of disastrous events in the world.
- TCC/JMA uses conventional surface observation data to climate monitoring, such as CLIMAT and SYNOP reports
  - CLIMAT: for monthly, seasonal, and annual monitoring on extreme climate events and global mean temperature monitoring
  - SYNOP: For weekly monitoring on extreme climate events

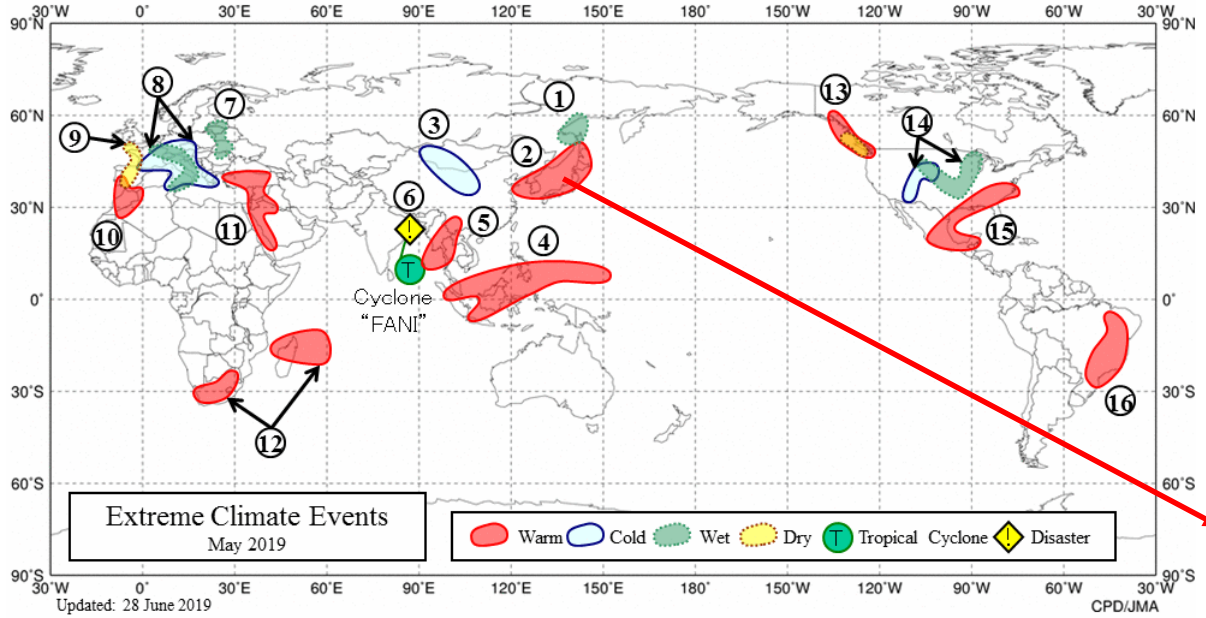
Exercise: Let's see the reports on the TCC website

(e.g.) Weekly Report on Global Extreme Climate Events
https://ds.data.jma.go.jp/tcc/tcc/products/climate/weekly/index.html

After seeing weekly reports, go to monthly, seasonal and annual reports

Monitoring of extreme climate events (Monthly)

(Example: May 2019)



	Type	Area	Remarks
1	Wet	The southern part of Eastern Siberia	
2	Warm	In and around the eastern part of East Asia	• The monthly mean temperature in northern Japan was the highest for May since 1946. • The monthly mean temperature in Korea was the second highest for May since 1973 (Korea Meteorological Administration).
3	Cold	From western Mongolia to central China	
4	Warm	From eastern Micronesia to the southwestern part of	

Highlight

Warm
- Monthly mean temperatures were extremely high in and around the eastern part of East Asia, from eastern Micronesia to the southwestern part of Southeast Asia, in and around the northwestern part of Southeast Asia, from the northwestern to western Middle East, from Mauritius to Comoro, in South Africa, from the southeastern USA to southern Mexico, and from eastern to southern Brazil.

Cold
- Monthly mean temperatures were extremely low from western Mongolia to central China, from central Europe to the northern part of Northern Africa, and from the Midwest to the western part of the USA.

Wet
- Monthly precipitation amounts were extremely high in the southern part of Eastern Siberia, in eastern Europe, from central Europe to the northern part of Northern Africa, and from the Midwest to the western part of the USA.

Dry
- Monthly precipitation amounts were extremely low from the southwestern UK to southern Spain and in and around southwestern Canada.

②

Type: **Warm**

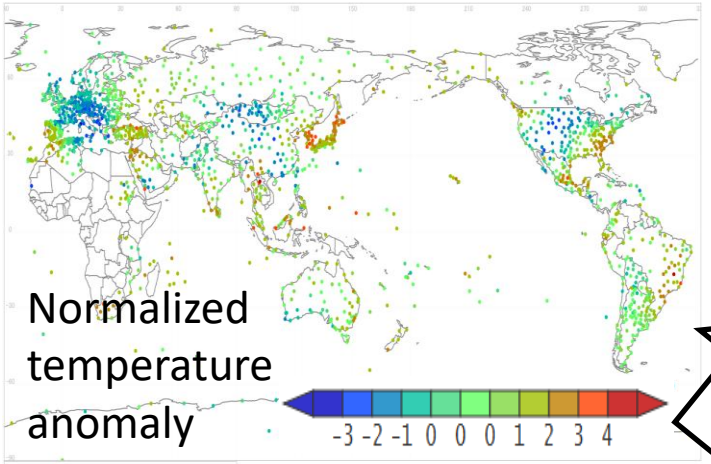
Area:
- In and Around the eastern part of East Asia

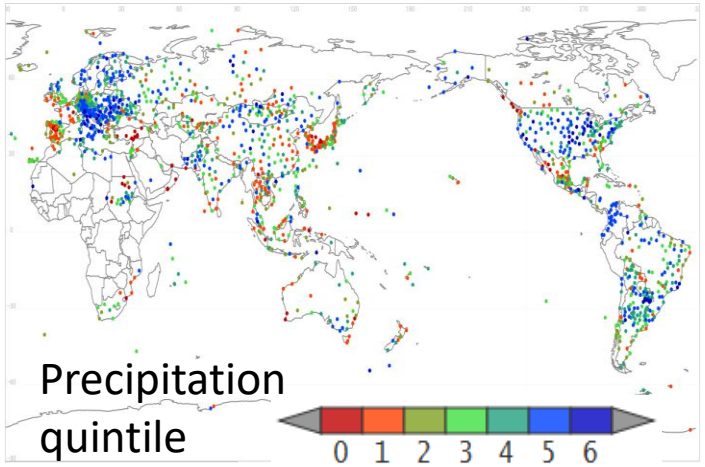
Remarks: (if available)
- The monthly mean temperature in northern Japan was the highest for May since 1946.
- The monthly mean temperature in Korea was the second highest for May since 1973 (Korea Meteorological Administration).

Monitoring method using CLIMAT (Monthly)

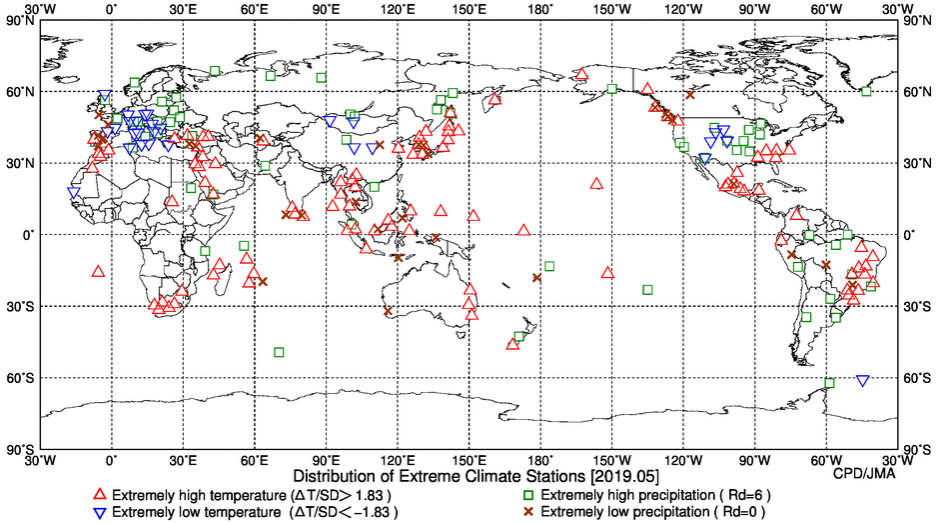
(Example: May 2019)

Values at stations

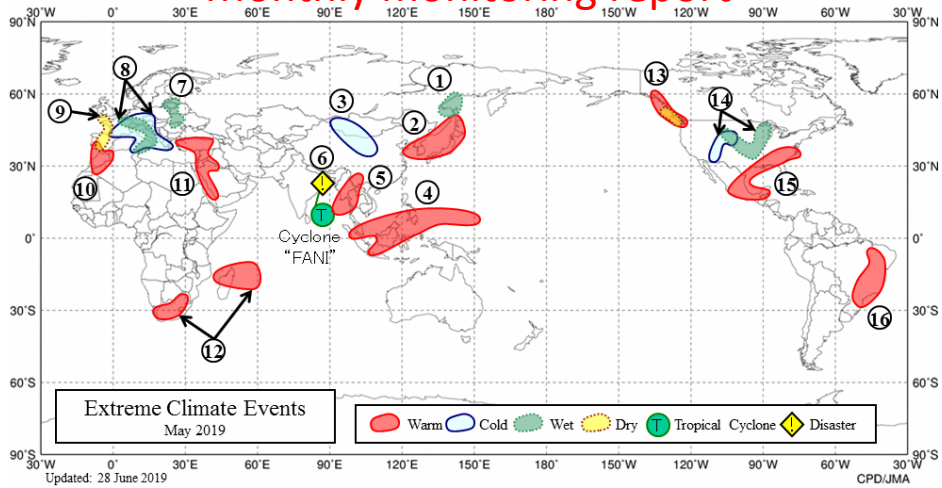




5˚x5˚ degrees grid box analysis



Monthly monitoring report



Reports on global extreme climate events

- In addition to these reports provided regularly, TCC provides special reports for specific extreme climate events with primary factors in terms of atmospheric and oceanic conditions related to the events, when these extreme climate events are considered to influence socio-economic activities.

Exercise: Let's see the special reports on the TCC website

Press release

https://ds.data.jma.go.jp/tcc/tcc/news/index.html

JMA's Definition of extreme climate event

- In general, an extreme climate event is recognized as an unusually severe or rare climate event creating disaster conditions or exerting significant socio-economic influence.
- The definition includes severe weather conditions covering periods ranging from only a few hours (such as heavy rain or strong wind) to several months (such as drought or cold summer conditions).
- JMA defines extreme climate events as those occurring once every 30 years or longer.

Criteria to identify extreme climate events (Monthly, Seasonal)

- Target: Extreme Warm / Cold and Wet / Dry events
- Base period: 1981-2010 (30 years)
  - Climatological normal, standard deviation (σ), quintile
  - Statistics are calculated for each month with CLIMAT data and GHCN monthly data*
- Temp. and Precip. are calculated from CLIMAT data.

Warm Temperature anomaly > 1.83 σ

Cold Temperature anomaly < -1.83 σ

Wet Precipitation value > max. value in the base period (quintile = 6)

Dry Precipitation value < min. value in the base period (quintile = 0)

*GHCN: Global Historical Climatology Network monthly data by US NCEI

Criteria to identify extreme climate events (Weekly) (1)

- Target: Extreme **Warm** / **Cold** and **Wet** / **Dry** events
- Base period: 1981-2010 (30 years)
  - Climatological normal, standard deviation (σ), quintile
  - Statistics are calculated for each month with CLIMAT data and GHCN monthly data, and are estimated for each calendar day using interpolation.
- Temp. and Precip. are calculated from SYNOP data.

Warm Temperature anomaly averaged for the target week (7-day average) > 3 σ

Cold Temperature anomaly averaged for the target week (7-day average) < -3 σ

* σ is standard deviation in 31-day-period variability

Criteria to identify extreme climate events (Weekly) (1)

Wet

Precipitation total for the target week (7-day total)
> thresholds estimated from 29-day total precipitation as climatological normals

(e.g.) ~130 mm (7-day total; equivalent to ~ 350 % as precipitation ratio) for the point with 150 mm as 29-day total of climatological normal

Dry

Precipitation total for previous 30 days
at the end of the target week (30-day total)
< min. value in the base period

2. WORLD CLIMATE CHARTS USING CLIMAT/SYNOP REPORTS

Weekly maps

- Weekly and 30-day averaged/cumulative values are based on SYNOP reports from NMHSs around the world.
- Weekly mean values and anomalies are calculated for temperatures, and 7-day and 30-day totals and ratios are calculated for precipitation.
- Anomalies are deviations from the climatological normal, and ratios are derived by dividing precipitation totals for a certain period by the climatological normal for the corresponding period.

Exercise: Let's see the weekly maps on the TCC website

World Climate Chart (Weekly)

https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=weekly

Monthly maps (1)

- Monthly mean temperatures are based on CLIMAT reports from NMHSs around the world.
- Anomalies are deviations from the climatological normal. Monthly precipitation totals are also based on CLIMAT reports and are shown after area-averaged over each 5°x5° grid box.

Exercise: Let's see the monthly maps on the TCC website

World Climate Charts (Monthly)

https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=monthly

Monthly, seasonal and annual maps (1)

- Monthly , seasonal and annual mean temperature anomalies normalized by their standard deviations are shown after the application of averaging in 5°x5° grid boxes. The data used are from CLIMAT reports submitted by NMHSs around the world.
- Anomalies are deviations from the climatological normal, and standard deviations for normalization are based on interannual variability over the same 30 years as for climatological normals.
- The category thresholds are ±1.28, ±0.44, and 0. For example, a normalized anomaly magnitude exceeding 1.28 (0.44) represents the likelihood of its appearance once every 10 years (3 years) or less, where temperature frequency is assumed to follow Gaussian distribution. For seasonal and annual maps, no marks are shown if insufficient data are available for the period.

Monthly, seasonal and annual maps (2)

- Monthly, seasonal, and annual precipitation ratios to the climatological normals are shown after the application of averaging in 5°x5° grid boxes.
- The data used are from CLIMAT reports submitted by NMHSs around the world.
- The category thresholds are 70%, 100%, and 120%. For seasonal and annual maps, no marks are shown if insufficient data are available for the period.

Exercise: Let's see the monthly, seasonal and annual maps on the TCC website

World Climate Charts (Monthly, seasonal and annual)

https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=monthly
https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=seasonal
https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=annual

Monthly maps (2)

- For each 5°x5° grid box in extreme climate conditions (warm/cold and wet/dry), the weather station reporting the most extreme value is marked as per the legend in the chart.

Exercise: Let's see the monthly maps on the TCC website

World Climate Charts (Monthly)

https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=monthly

Annual maps

- Frequencies of extremely high/low temperature or heavy/light precipitation months based on monthly observation data.
- The frequencies are calculated by dividing the total number of extremely warm/cold months by the total number of data-available months in each 5°×5° grid box.
- Frequencies are indicated by semicircle scale. Given that extreme climate events are defined as phenomena occurring every 30 years or less, frequencies are normally expected to be about 3% and values exceeding 10-20% are considered to be above normal.

Exercise: Let's see the annual maps on the TCC website

World Climate Charts (annual)

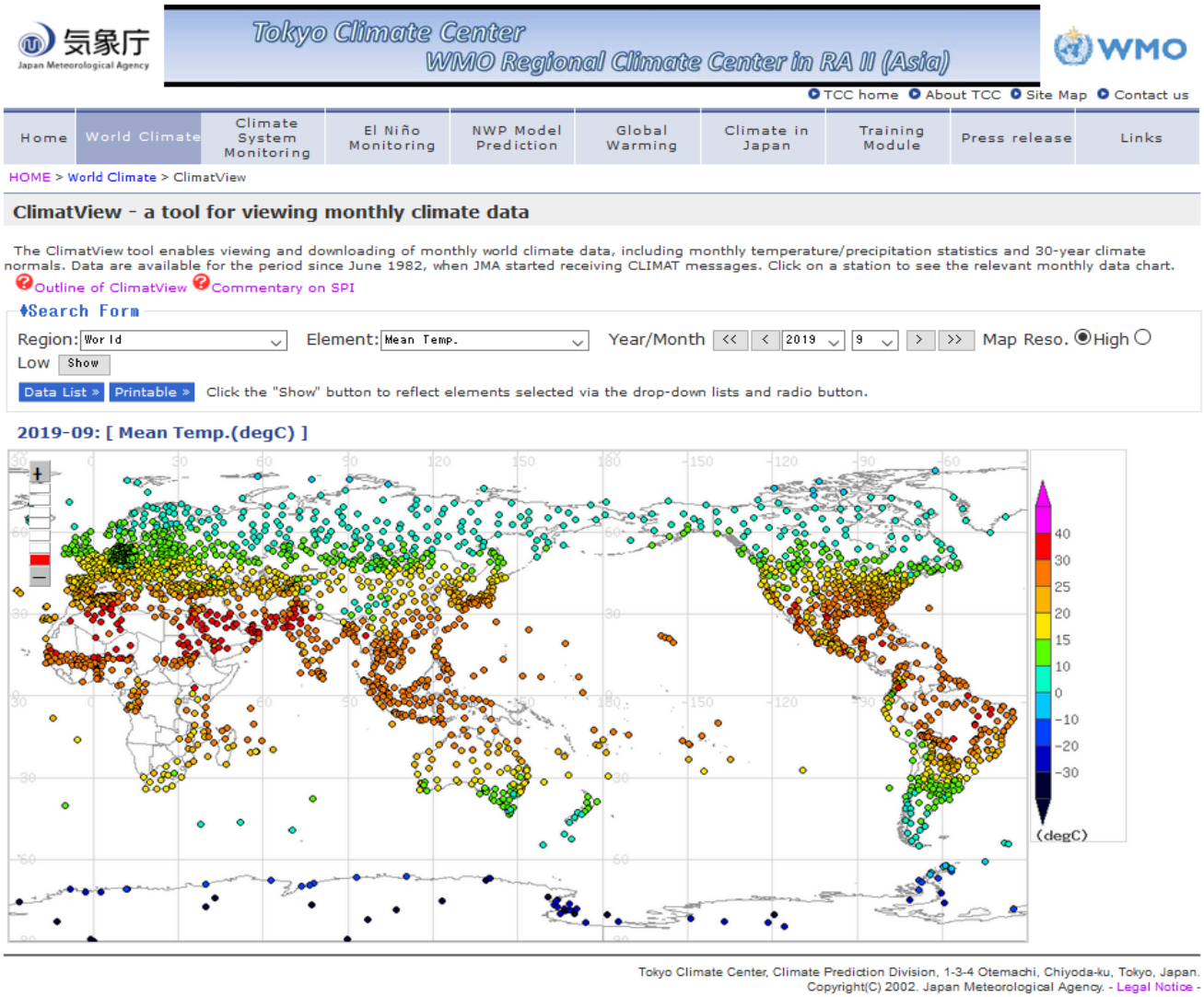
https://ds.data.jma.go.jp/tcc/tcc/products/climate/climfig/?tm=annual

3. CLIMATVIEW – A TOOL FOR VIEWING MONTHLY CLIMATE DATA

ClimatView

- The ClimatView tool enables viewing and downloading of monthly world climate data, giving users access to statistics on monthly mean temperatures, monthly total precipitation amounts and related anomalies or ratios for all stations where such data are available.
- Statistics on monthly means of daily maximum/minimum temperatures and Standardized Precipitation Index (SPI) are also provided.
- These data are derived from CLIMAT messages reported via the GTS line from WMO Members around the world.

ClimatView (top page)

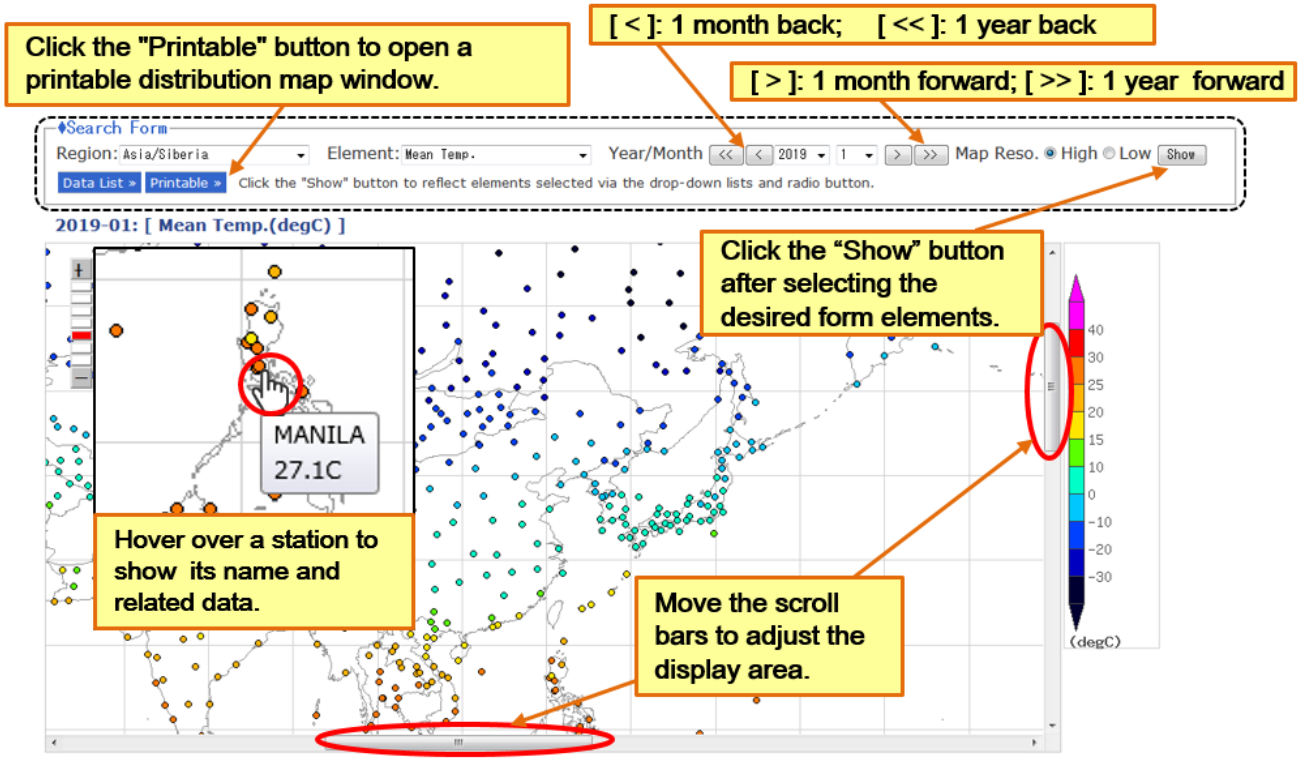


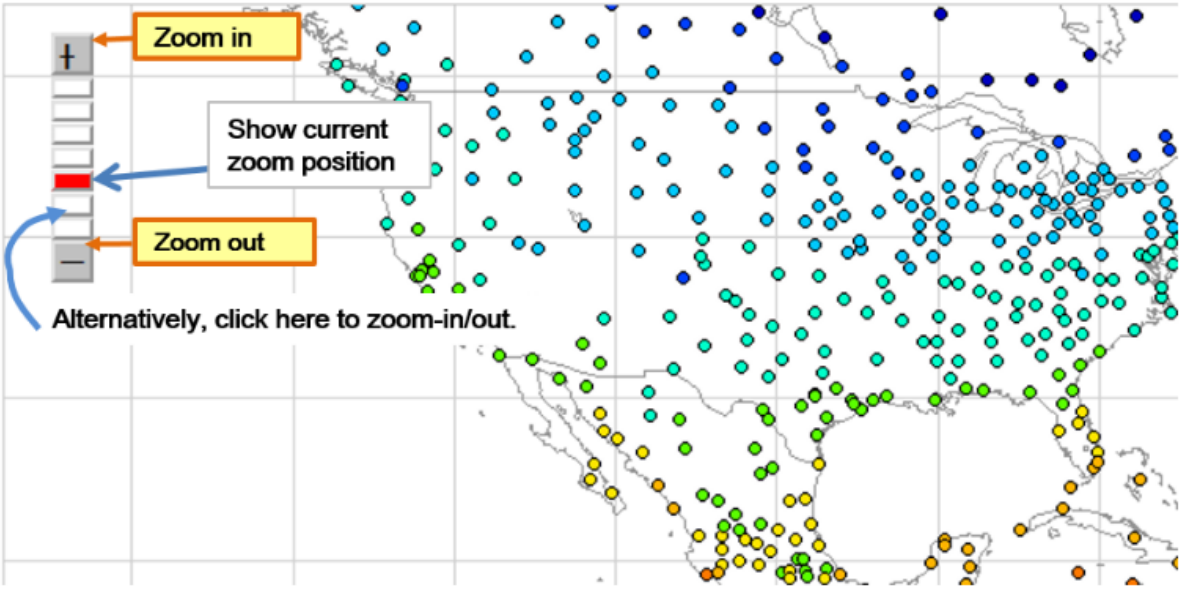
Exercise: Let's use ClimatView on the TCC website

World Climate Charts (Monthly)

https://ds.data.jma.go.jp/tcc/tcc/products/climate/climatview/frame.php

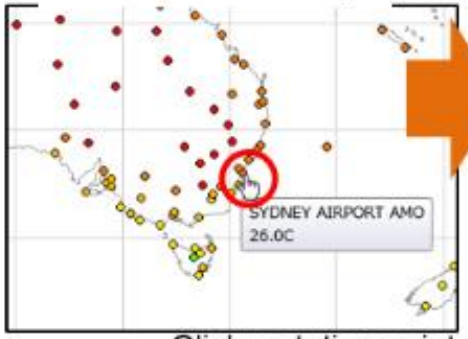
ClimatView (distribution map)





ClimatView (graph, data list)

A distribution map



Click a station point

The graph period can be changed.

SPI time scale can be changed.

Click this button to download the data in csv file format.

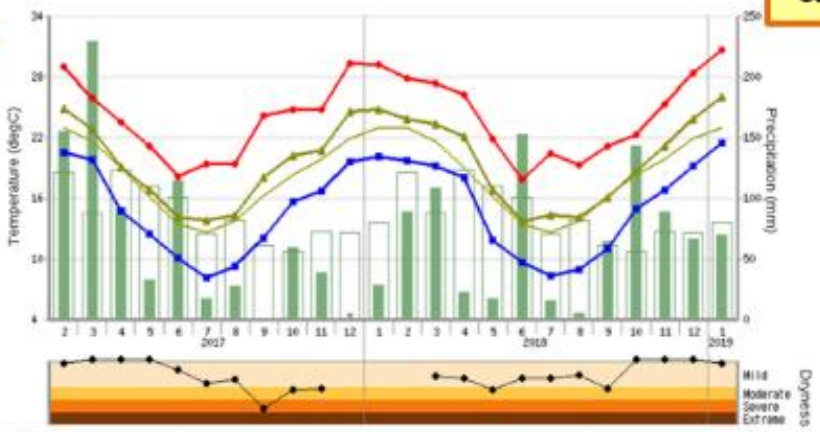
Monthly data --- chart/table

#Search Form

Year/Month: 2018 1 Term: 2 years SPI time scale: 3-Month Show

« Map

SYDNEY AIRPORT AMO [AUSTRALIA]

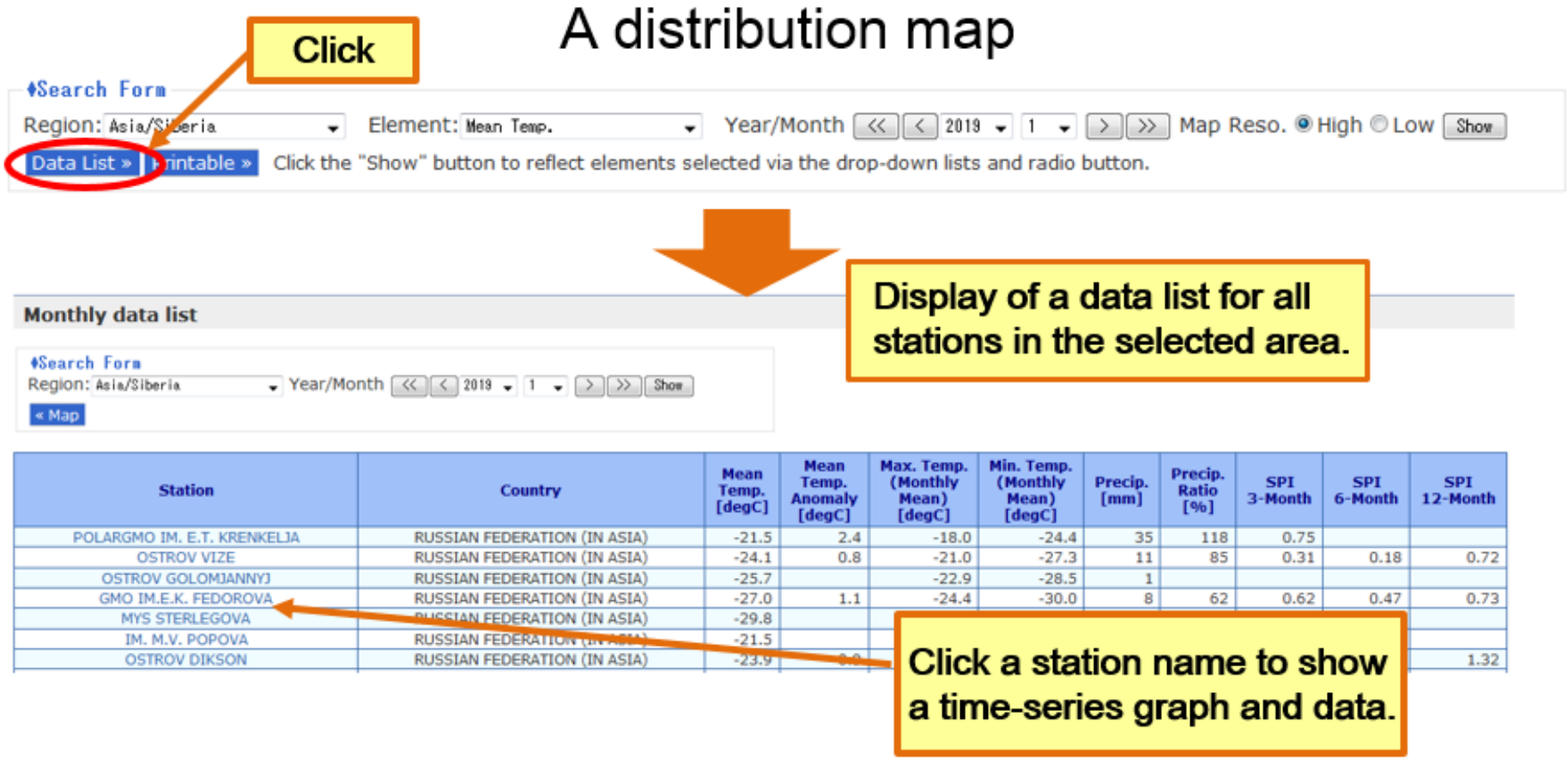


SYDNEY AIRPORT AMO -AUSTRALIA
Lat.: 33.946 °S / Lon.: 151.173°E Height: 6.40(m)

download ---download in csv file

Year/Month	Observation				Normal		SPI		
	Mean Temp. [degC]	Max. Temp. (Monthly Mean) [degC]	Min. Temp. (Monthly Mean) [degC]	Precip. [mm]	Mean Temp. [degC]	Precip. [mm]	3-Month	6-Month	12-Month
2017-02	24.8	29.0	20.5	155	22.9	121.1	-0.09	-0.61	0.22
2017-03	22.8	25.9	19.8	229	21.5	87.4	0.60	-0.01	0.47
2017-04	19.1	23.5	14.7	92	18.9	123.1	0.80	0.13	0.54
2017-05	16.8	21.1	12.4	32	16.1	109.7	0.36	0.09	0.59
2017-06	14.1	18.1	10.1	114	13.4	100.1	-0.34	0.13	0.09

ClimatView(data list)



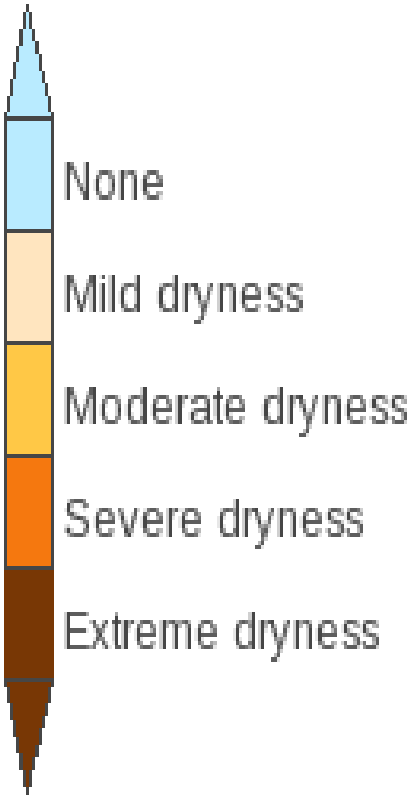
Station	Country	Mean Temp. [degC]	Mean Temp. Anomaly [degC]	Max. Temp. (Monthly Mean) [degC]	Min. Temp. (Monthly Mean) [degC]	Precip. [mm]	Precip. Ratio [%]	SPI 3-Month	SPI 6-Month	SPI 12-Month
POLARGMO IM. E.T. KRENKELJA	RUSSIAN FEDERATION (IN ASIA)	-21.5	2.4	-18.0	-24.4	35	118	0.75		
OSTROV VIZE	RUSSIAN FEDERATION (IN ASIA)	-24.1	0.8	-21.0	-27.3	11	85	0.31	0.18	0.72
OSTROV GOLOMJANNYJ	RUSSIAN FEDERATION (IN ASIA)	-25.7		-22.9	-28.5	1				
GMO IM.E.K. FEDOROVA	RUSSIAN FEDERATION (IN ASIA)	-27.0	1.1	-24.4	-30.0	8	62	0.62	0.47	0.73
MYS STERLEGOVA	RUSSIAN FEDERATION (IN ASIA)	-29.8								
IM. M.V. POPOVA	RUSSIAN FEDERATION (IN ASIA)	-21.5								
OSTROV DIKSON	RUSSIAN FEDERATION (IN ASIA)	-23.9								1.32

SPI: What is SPI?

- The Standardized Precipitation Index (SPI) is commonly used for operational drought monitoring by NMHSs around the world to quantify precipitation deficits on multiple timescales. Related calculation for specific locations is based on long-term precipitation records for the target period.
- The ability to compute index values on numerous time scales makes this metric useful in the quantification of risk regarding various types of droughts (e.g., meteorological, agricultural and hydrological). The need for only precipitation data as an input parameter facilitates SPI computation.
- However, it should be noted that no evapotranspiration effect is considered.

SPI: What is SPI?

- On the ClimatView, dry condition for each station is categorized as Table. 1. Refer to the WMO's SPI User Guide (WMO, 2012) for details of the background of the index, its introduction and a related description.



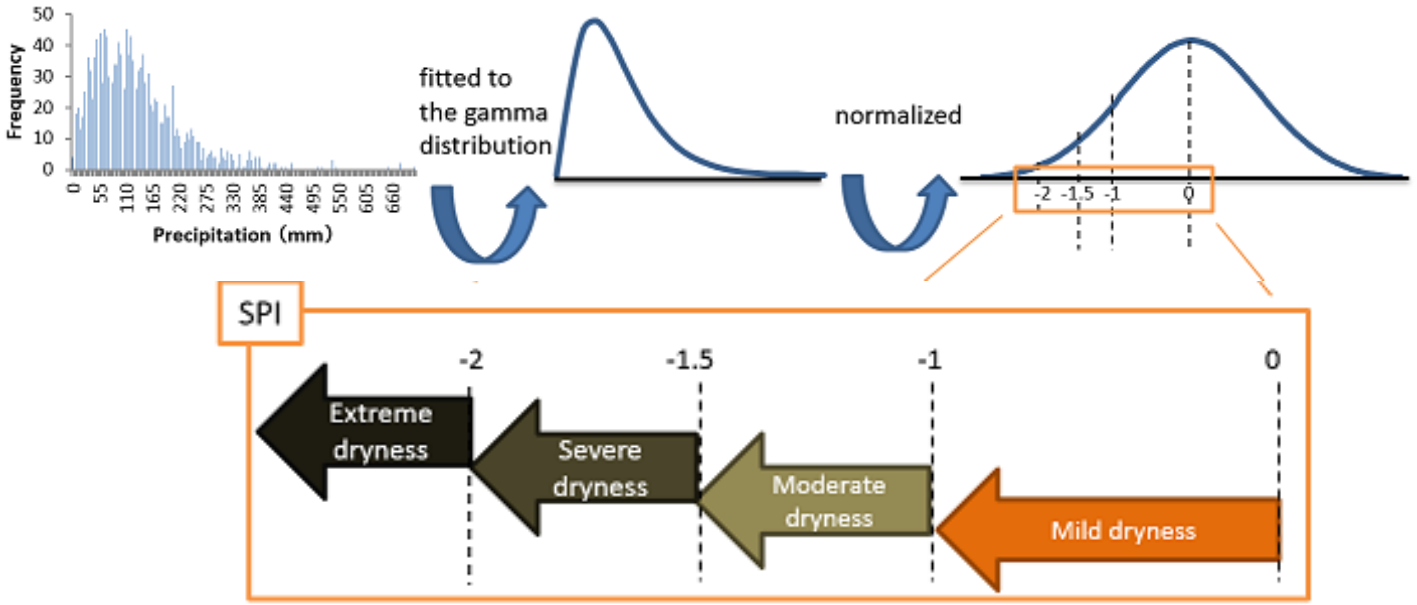
SPI	Category	Severity of event
0 ~ -0.99	Mild dryness	1 in 3 years
-1.00 ~ -1.49	Moderate dryness	1 in 10 years
-1.5 ~ -1.99	Severe dryness	1 in 20 years
< -2.0	Extreme dryness	1 in 50 years

SPI: Data and method

- Calculation of the SPI indices shown in the ClimatView tool is based on monthly precipitation totals from CLIMAT data for states worldwide and on GHCN data provided by the NCEI/NOAA.
- Both sets of data are based on observations conducted at surface weather stations worldwide, but CLIMAT data are available only as far back as June 1982.
- Where both are available for the same station, CLIMAT data are applied. To derive probability distribution for past precipitation amounts, monthly precipitation data are used wherever possible for the period from 1950 to 2010.
- SPI values are not calculated if the available data span is shorter than 30 years. The ClimatView tool shows SPI values only as far back as June 1982.
- TCC uses the SPI calculation program provided by Colorado State University in the USA.

SPI: Data and method

- In SPI computation, the long-term record of past precipitation is fitted to probability distribution before transformation to normal distribution. Accordingly, the mean SPI for the location and desired period is zero (Edwards and McKee, 1997).
- Negative SPI values indicate precipitation below the median value. Drought events may occur when the SPI is continuously negative and reaches a certain value, such as -1.0 or less (McKee et al., 1993).



4. COMPOSITE MAPS
– IMPACTS OF TROPICAL SST VARIABILITY ON THE GLOBAL CLIMATE

Composite maps – impacts of tropical SST variability on the global climate

- Sea surface temperature (SST) variability in the tropics can significantly impact on the global climate through atmospheric circulation.
- El Niño/La Niña events, which are identified by SST fluctuations from the central to the eastern equatorial Pacific (NINO.3), are widely-known examples of this.
- In addition, SST variability in the western tropical Pacific (NINO.WEST) and the tropical Indian Ocean (IOBW) may also have significantly affect climate conditions around the world.
- JMA surveyed these impacts and summarized them in schematic chart form.

Composite maps – impacts of tropical SST variability on the global climate

- Schematic charts indicate typical anomaly patterns of surface temperature and precipitation for each season (boreal spring, summer, autumn and winter) as seen in past warmer/cooler SST events in the area of NINO.3 (corresponding to El Niño/La Niña events), NINO.WEST and IOBW.

Exercise: Let's see composite maps on the TCC website

Impacts of Tropical SST Variability on the Global Climate
https://ds.data.jma.go.jp/tcc/tcc/products/climate/ENSO/index.htm