JMA/WMO Workshop on Quality Management in Surface,
Climate and Upper-air Observations in RA II (Asia)
27-30 July 2010, Tokyo, Japan

Climate Services Perspective

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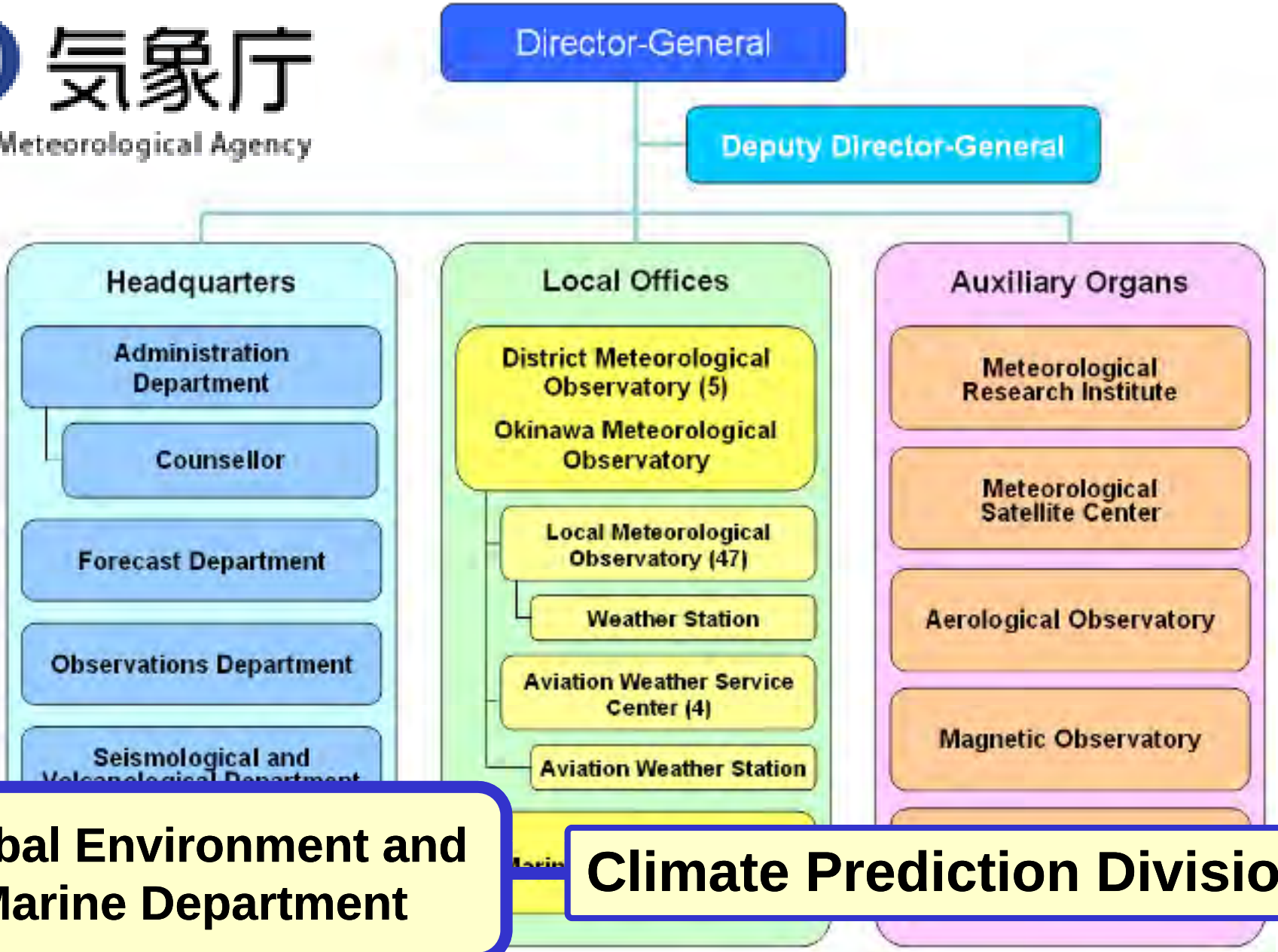
5. **Importance of in-situ observation from the viewpoint of Climate services**

1. Outline of climate services provided by CPD/JMA*

*** Climate Prediction Division/Japan Meteorological Agency**

JMA Organization

気象庁
Japan Meteorological Agency



Global Environment and Marine Department

Climate Prediction Division

Products of CPD/JMA

CPD: Climate Prediction Division

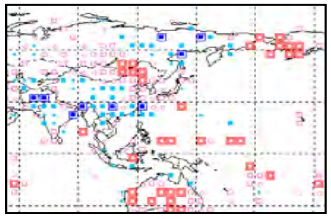
Climate Information

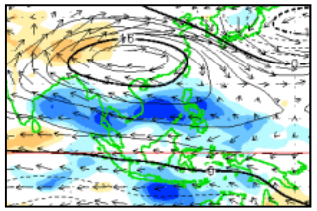
Monitoring

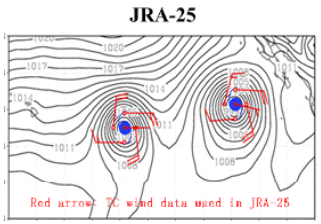
- Surface Climate
- Climate System
- Re-Analysis

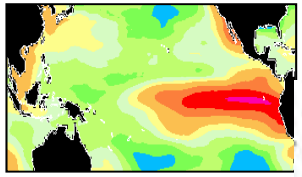
Prediction

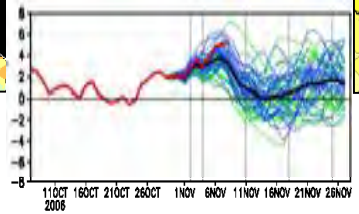
- El Nino
- Seasonal Forecast
- Global Warming

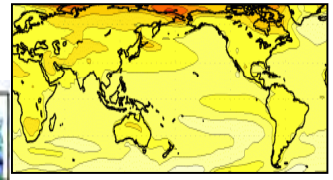




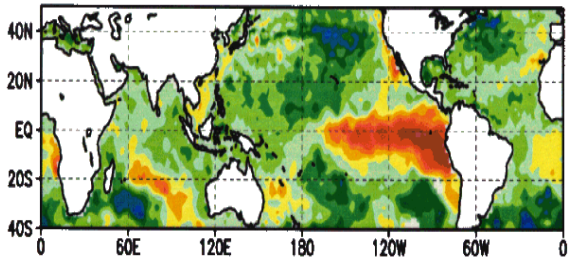




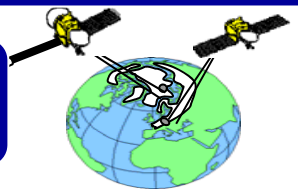




Tasks of TCC/JMA



Monitoring of Extreme Events



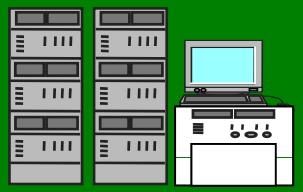
Monitoring of Global Climate System

Global Numerical Prediction

El Niño Outlook

Climate Information / Technical Transfer

NMHSs in the Asia-Pacific



Preparation and Provision of Basic Climate Information

Capacity Building

Tokyo Climate Center

Climate Data / Feedback

2.Surface climate monitoring

(1) Monitoring of extreme climate events

Aim of Global Surface Climate Monitoring

- **Detection of climate variability and change**
  e.g., Global warming, extreme events, El nino influence,…

- **Information for international activities**
  e.g., trading, transportation, disaster relief,…

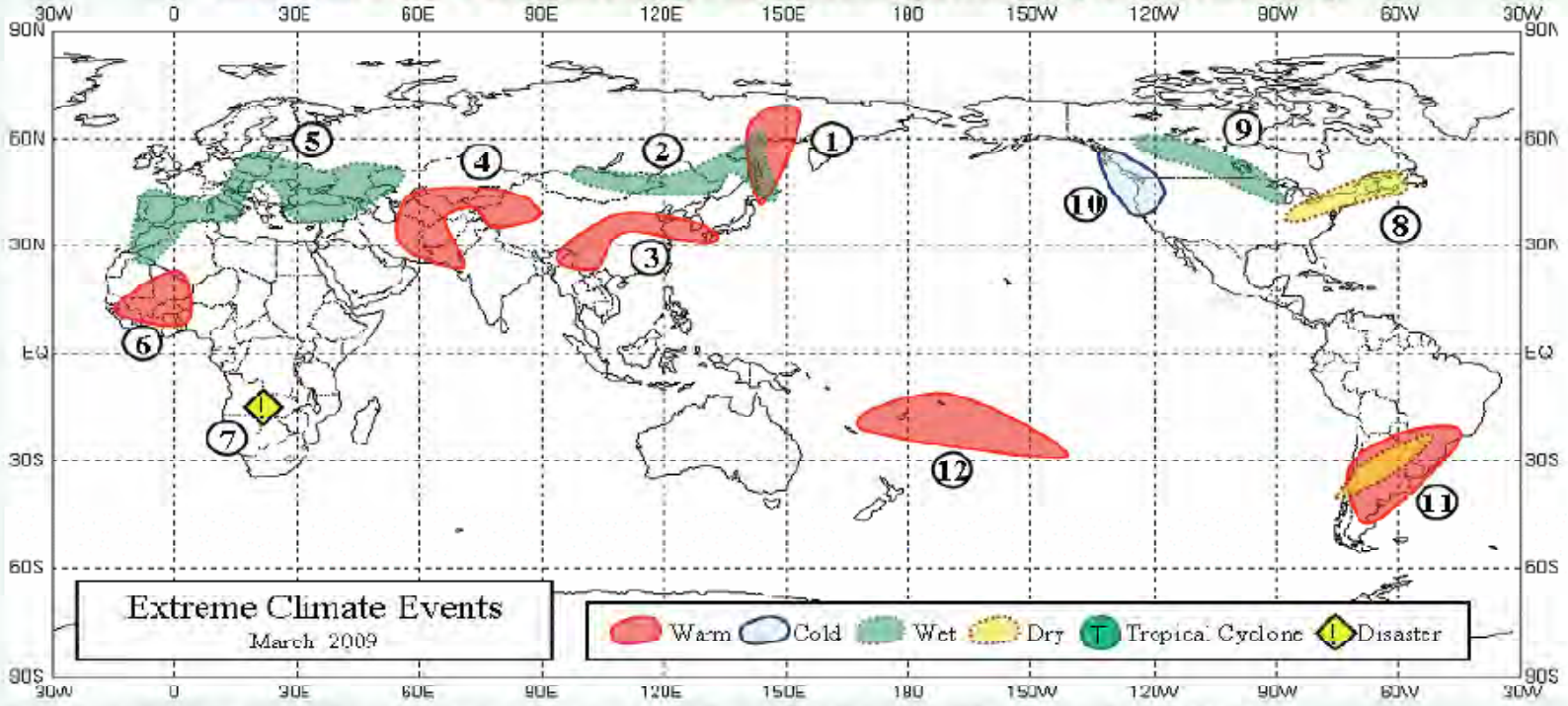
40% of food self-sufficiency

- Australia droughts ➔ Import of agricultural products in Japan
- Warmer winter in U.S. ➔ International oil price

Global Climate Monitoring (by TCC)

Weekly, Monthly, Seasonal and Annual Temperature/Precipitation
Hazardous Climatic Events (Flood / Drought / Tropical Cyclone)

Distribution of Monthly Extreme Climate (March 2009)



1. High temperatures from eastern Siberia to Northern Japan
2. Heavy precipitation from southeastern Siberia to northern Mongolia
3. High temperature from western Japan to southern China
4. High temperature from western China to eastern Iran
5. Heavy precipitation from western Kazakhstan to Morocco
6. High temperature around Mali
7. Torrential rain in southern Africa
8. Light precipitation around the northeastern USA
9. Heavy precipitation from central Canada to the west area of the Great Lakes
10. Low temperature from southwestern Canada to the northwestern USA
11. High temperature and light precipitation in southern South America
12. High temperature around southern Polynesia

http://ds.data.jma.go.jp/tcc/tcc/products/climate/index.html

Definition of “Extreme Climate”

- In general, “extreme climate (or event)” is recognized as
  - unusual severe or rare climate event
  - weather with disasters or socio-economic influence
- It includes heavy rainfall in a few hours, heat/cold wave in several days, drought in several months…
- In monitoring at JMA, “extreme climate” is defined as event with frequency once in 30 years or longer.

Temperature : Anomaly $\geq \pm 1.83\ \sigma$

σ = Standard deviation in 1971-2000

Precipitation :

Extreme wet: >any values in 1971 - 2000

Extreme dry: <any values in 1971 - 2000

CLIMAT reports for temperature in May 2010

Sometimes no reports from some stations …

- **Some countries do not send reports sometimes.**
- **Other reports are deleted on GTS for various reasons. (“GTS problem”)**

All the CLIMAT reports are necessary for overall monitoring of the world climate!

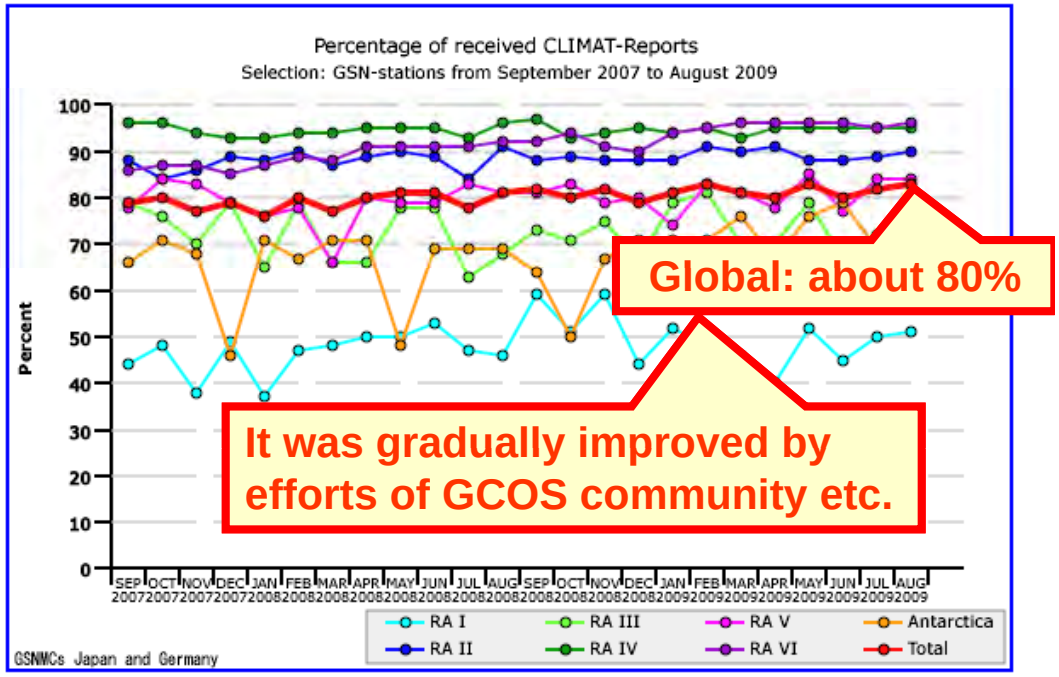
RBCN and GSN

➢**RBCN**: **Regional Basic Climatological Network is necessary to provide a good representation of climate on the regional scale, in addition to global scale (about 3,000 CLIMAT stations).**

➢**GSN**: **GCOS Surface Network is minimum configuration for global climate monitoring (about 1,000 CLIMAT stations).**

GSN is part of RBCN.

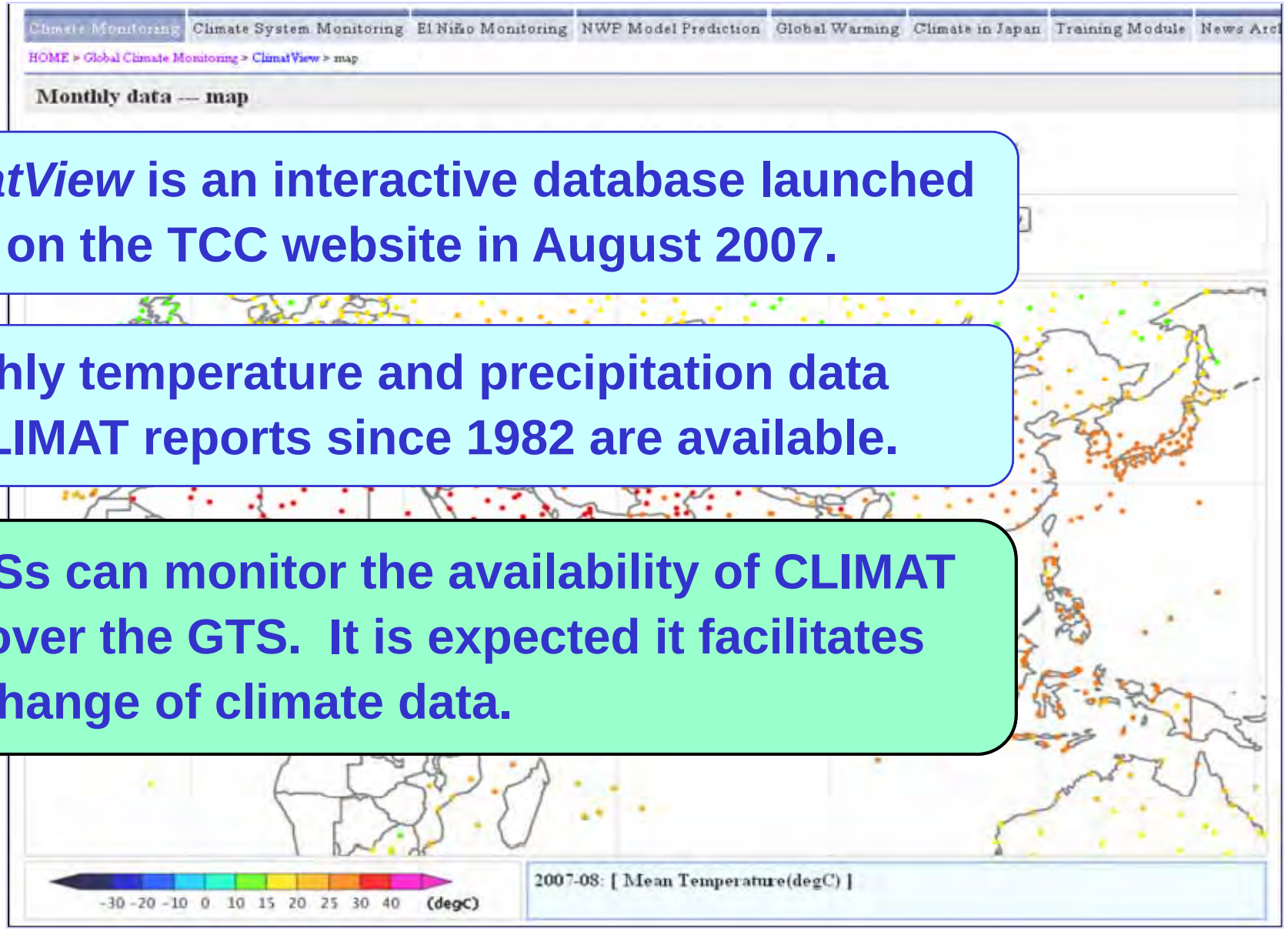
Percentage of received GSN-CLIMAT reports



Percentage of received RBCN-CLIMAT reports is still about 70%.

JMA's Climate Database *"ClimatView"*

TCC website - http://ds.data.jma.go.jp/gmd/tcc/climatview/



- ***ClimatView*** **is an interactive database launched by JMA on the TCC website in August 2007.**
- **Monthly temperature and precipitation data from CLIMAT reports since 1982 are available.**
- **NMHSs can monitor the availability of CLIMAT report over the GTS. It is expected it facilitates the exchange of climate data.**

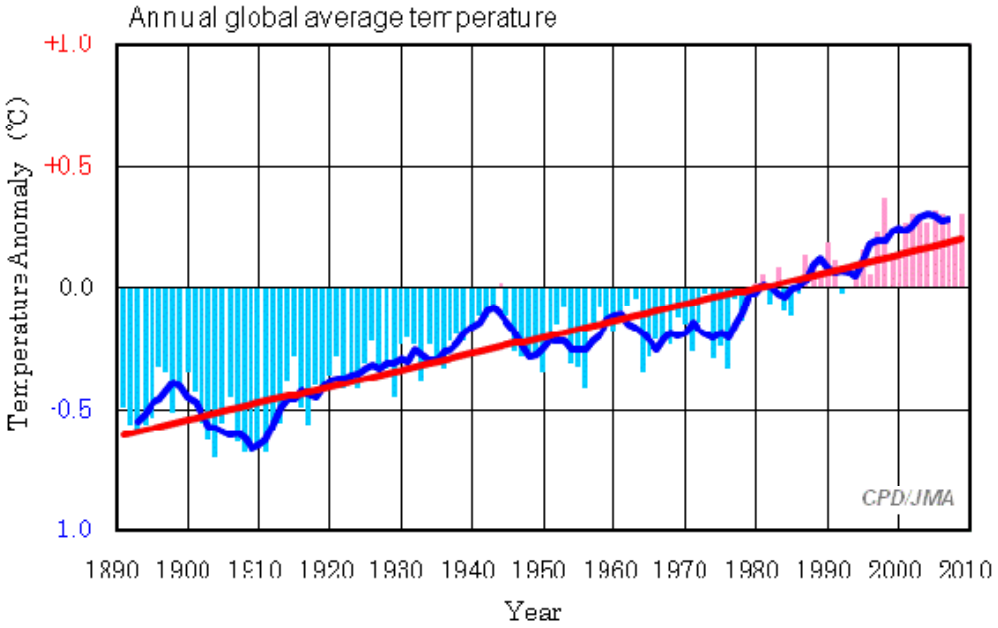
2.Surface climate monitoring

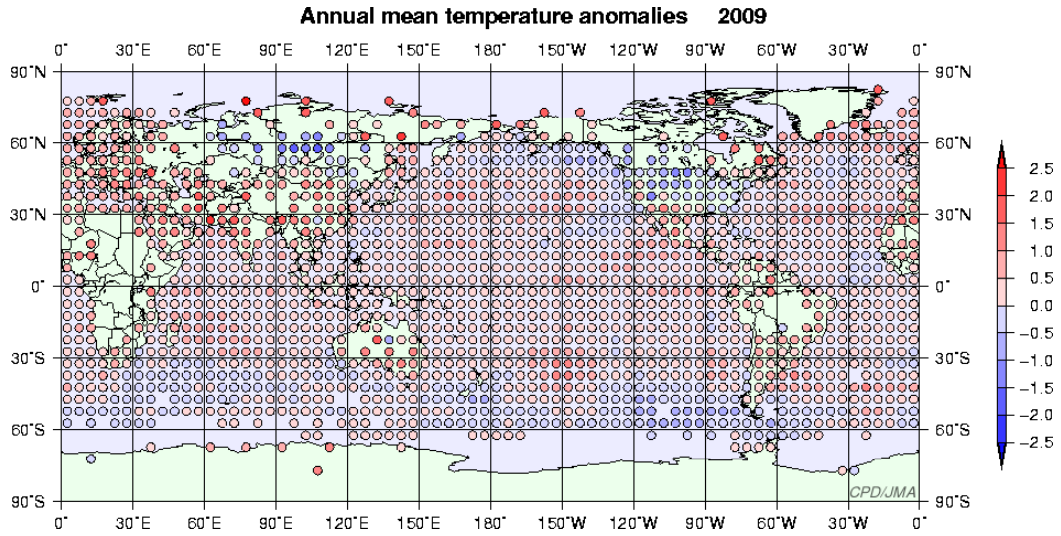
(2) Monitoring of global warming

Annual anomaly of surface temperature over the globe

(the combined temperature of near-surface air temperature over land, and sea surface temperature)

Annual anomaly of surface temperature over the globe is monitored to get hold of climate change caused by global warming.





The annual anomaly of the global average surface temperature in 2009 (i.e. the average of the near-surface air temperature over land and the SST) was +0.31 ° C above normal (based on 1971-2000 average), and was the 3rd highest since 1891. On a longer time scale, global average surface temperatures have been rising at a rate of about 0.68 ° C per century.

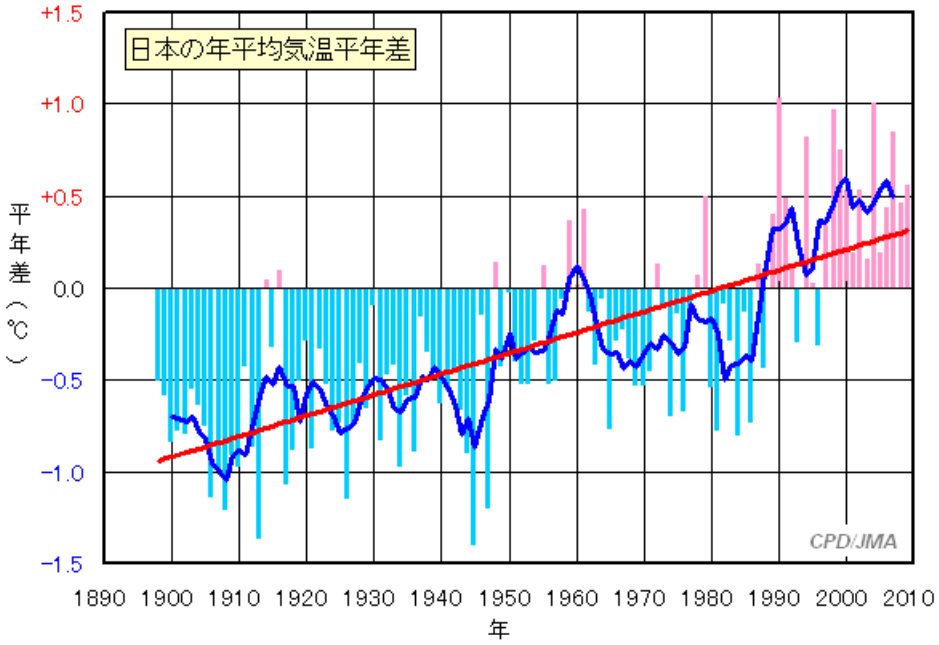
The year-to-year variation is around 0.1 ° C.

Not only land surface temperature data (CLIMAT, GHCN-Monthly) but also the result of sea surface temperature analysis (COBE-SST) are used for the global analysis.

Accurate measurements and precise analysis are necessary!

Monitoring of surface temperature in Japan

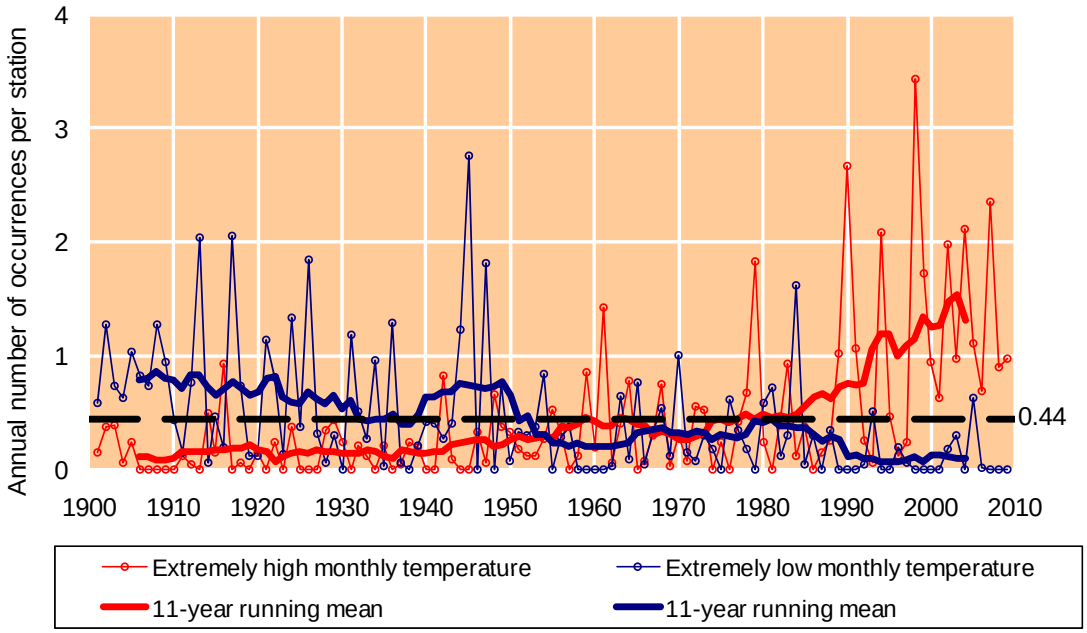
Annual surface temperature anomalies in Japan



The mean surface temperature in Japan for 2009 is estimated to have been 0.56 ° C above normal (i.e. the 1971 – 2000 average) and the seventh warmest on record since 1898. The temperature anomaly has been rising at a rate of about 1.13 ° C per century since the instrumental temperature records began in 1898.

* To calculate long-term temperature trends, JMA selected 17 stations that are considered not to have been highly influenced by urbanization and have continuous records from 1898 onwards.

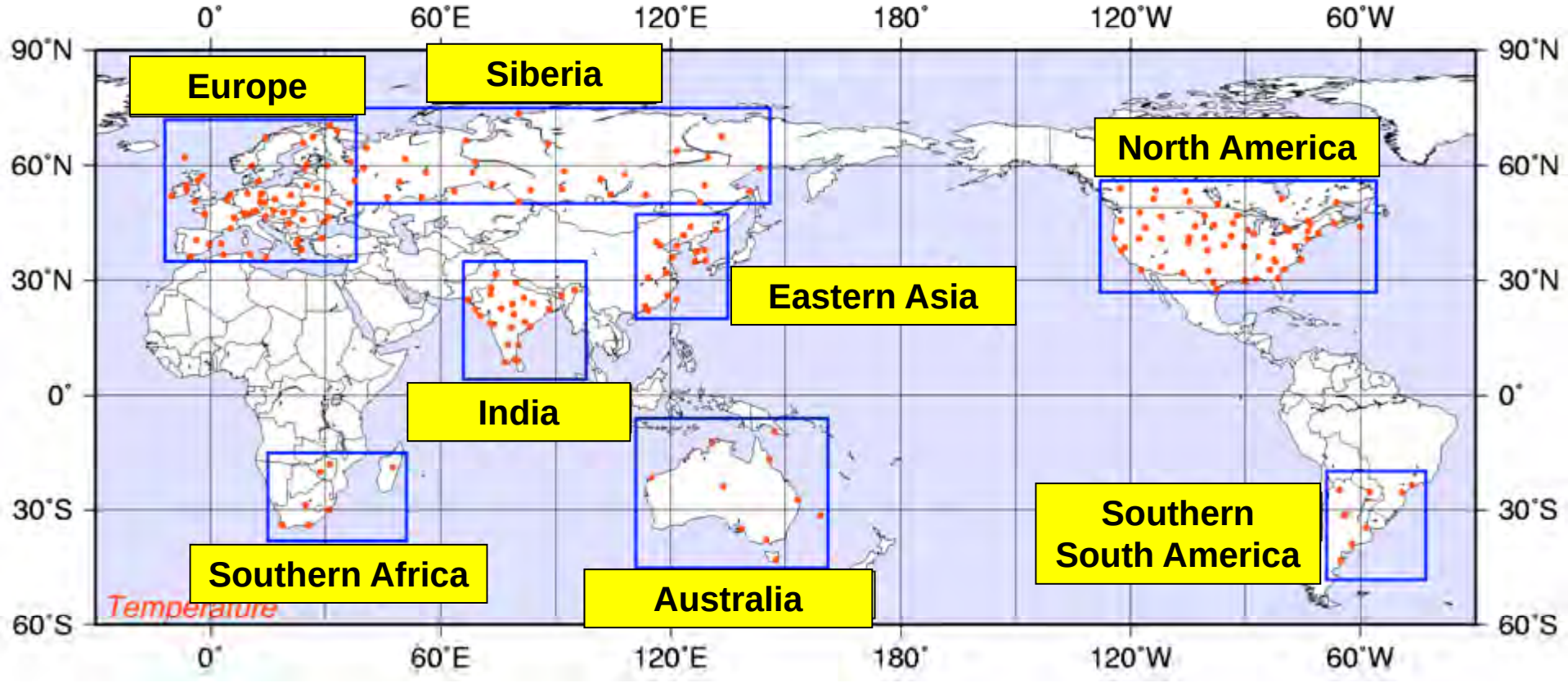
Annual number of occurrences of extremely high/low monthly mean temperatures



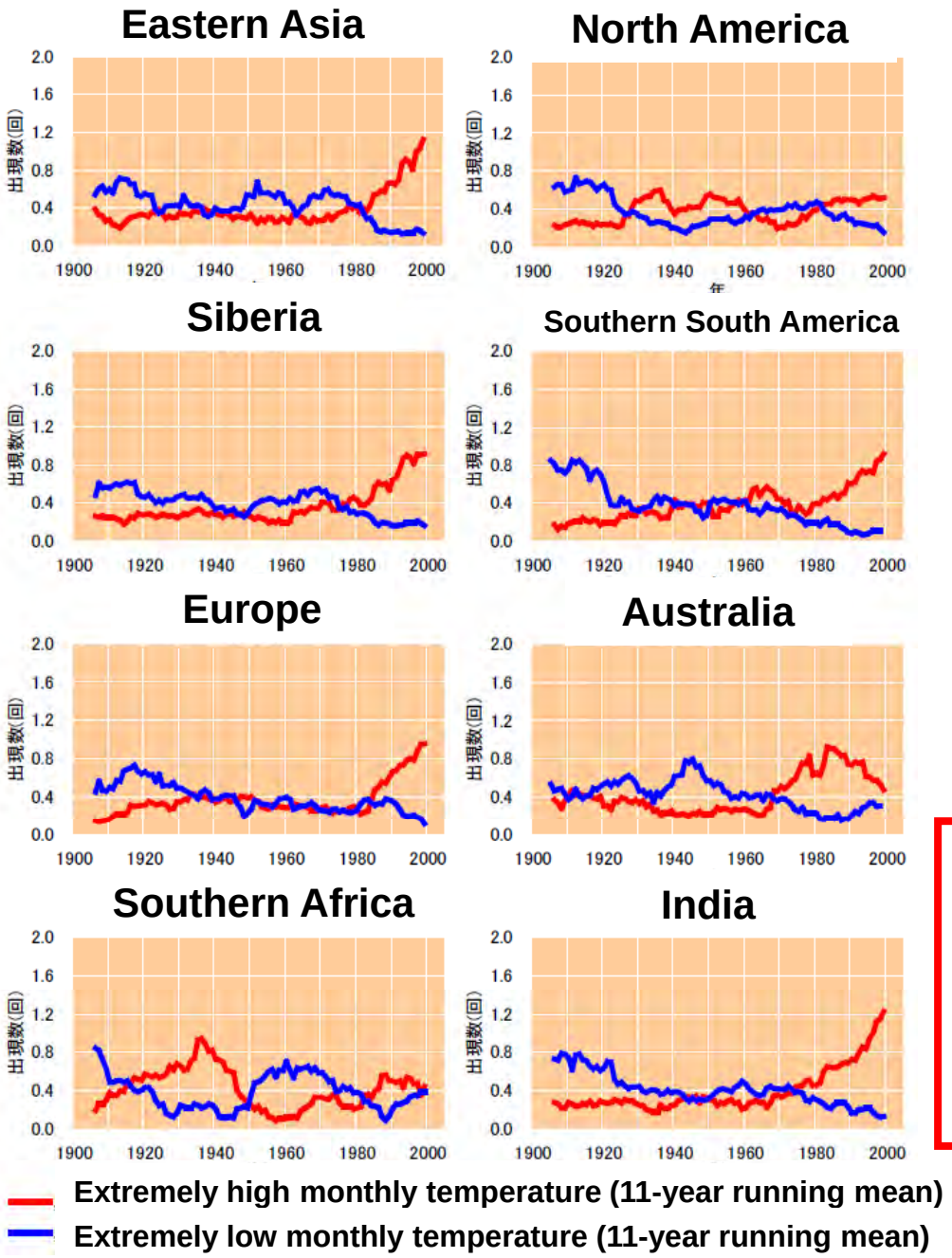
The occurrence of extremely high/low temperatures increased/decreased significantly during the period 1901 – 2009.The occurrence of extremely high temperatures increased remarkably from the 1980s onward.

* The threshold of extremely high/low temperature is defined as the fourth-highest/lowest value for the month over 109 years.

Did the occurrence of extremely high/low temperatures increase/decrease in each area over the world?



Unfortunately, in JMA's database, long-term data are not available for every station over the world .



The occurrence of extremely high/low temperatures increased/decreased significantly for each area except for Southern Africa.

However, if you want to pinpoint your country's climate change, you should manage the long-term datasets of the stations in your country.

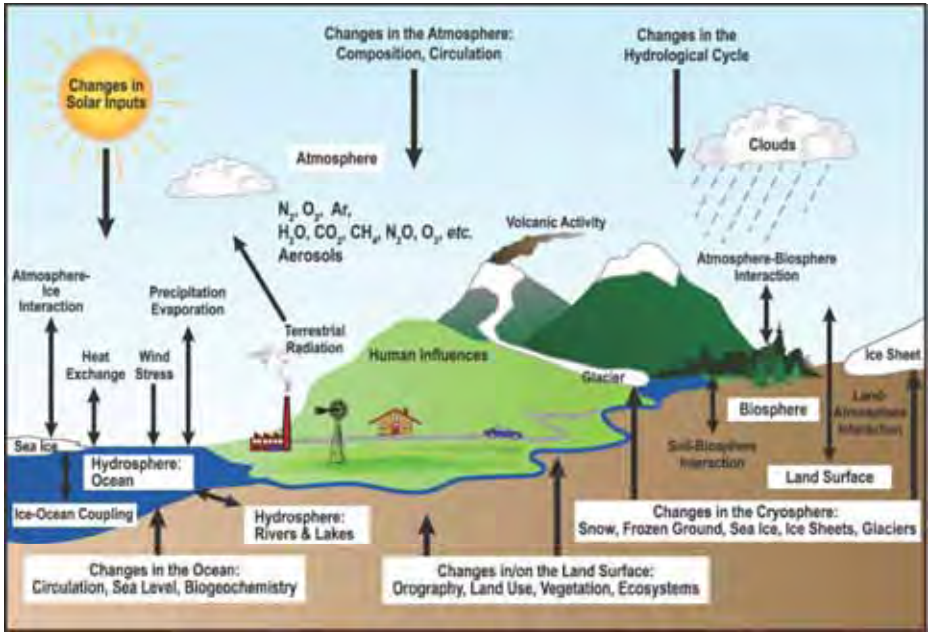
3. Climate system monitoring

What is the climate system?

- *Climate*: “The synthesis of the weather”
  - The statistical collection of weather conditions during a specified interval of time.
  - Several decades → normal condition
- Climate system consists of some subsystems, which are atmosphere, ocean, land, biosphere and so on.

In our climate monitoring section, atmospheric general circulation and boundary condition (SST, sea-ice, snow cover, etc.) are monitored.

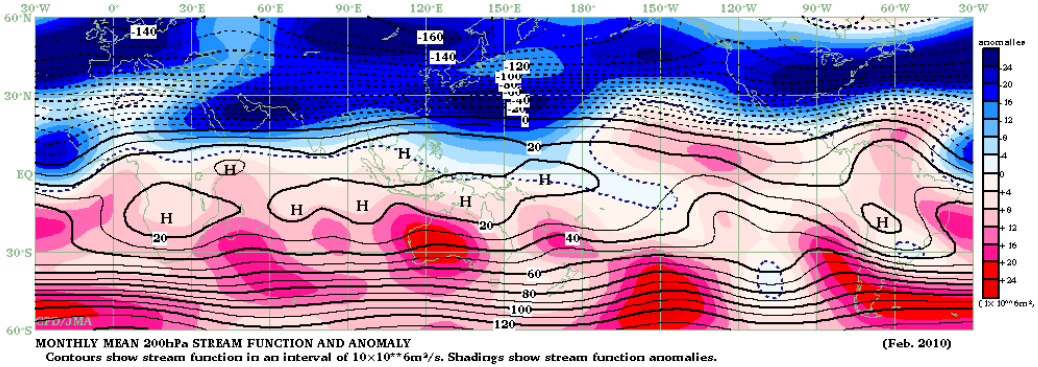
Time scale: seasonal, monthly, 5-days averaged field (mainly) to monitor large scale phenomena.



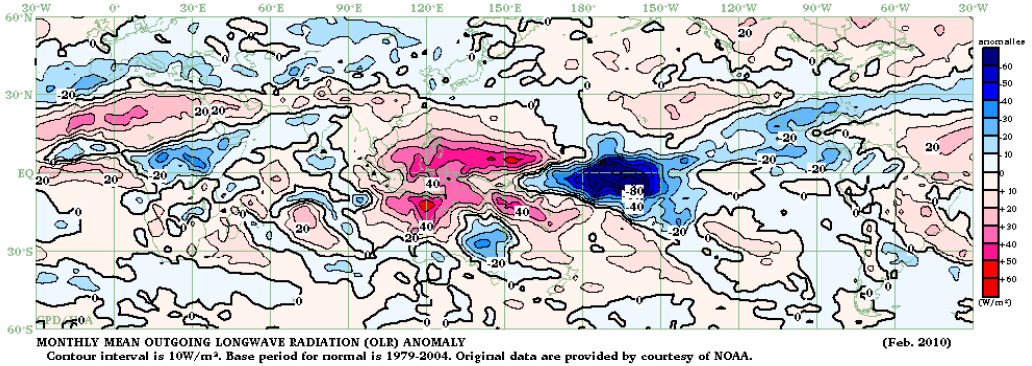
Components of climate system IPCC (2007)

Climate System Monitoring

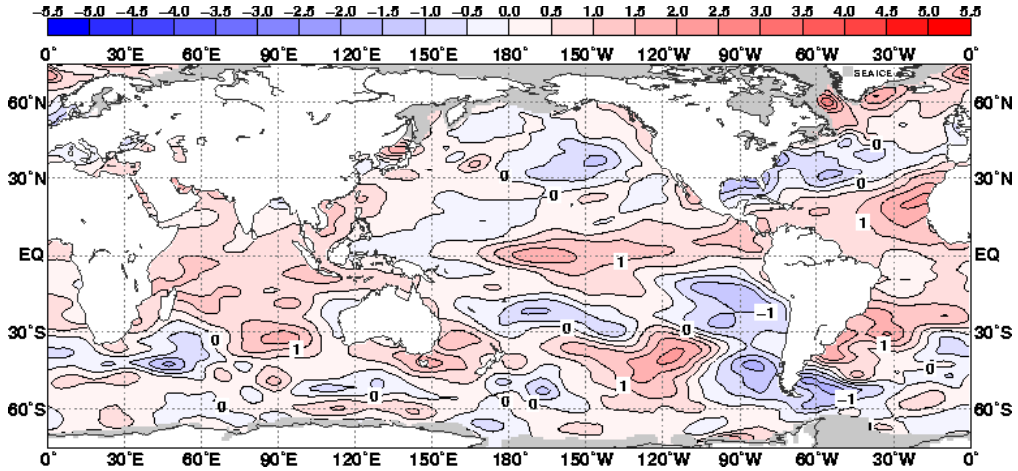
Atmospheric circulation (JRA/JCDAS data)
Tropical convective activity (satellites observations: NOAA data)
Sea surface temperature (COBE-SST)
Snow and sea ice (CLIMAT reports & satellite observations: DMSP-SSM/I data)



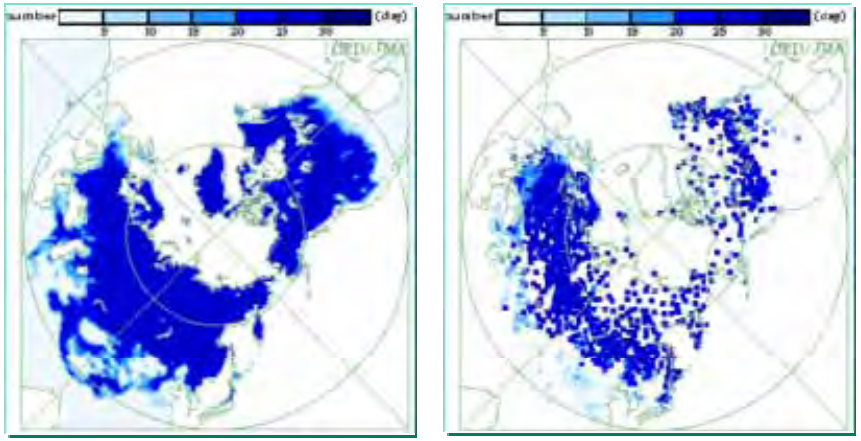
200hPa Stream Function & Anomaly (Feb. 2010)



OLR Anomaly (Feb. 2010)



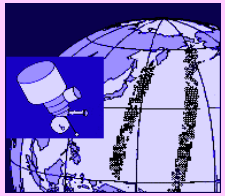
SST Anomaly (Feb. 2010)



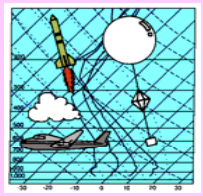
Snow & Sea Ice (Feb. 2010)
left: SSM/I right: CLIMAT/SYNOP

Japanese 25-year ReAnalysis (JRA-25) and JMA Climate Data Assimilation System (JCDAS)

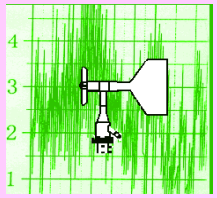
Historical Observational Dataset



Satellite

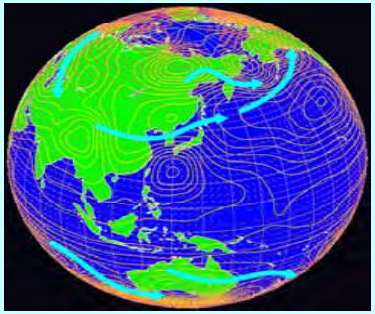


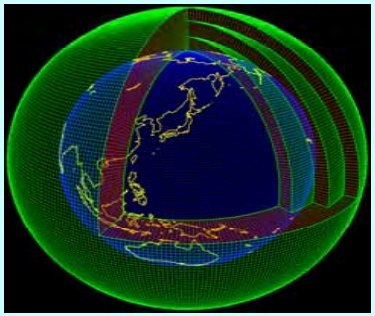
Upper Air



Surface

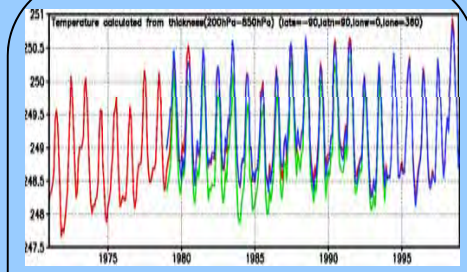
Ship



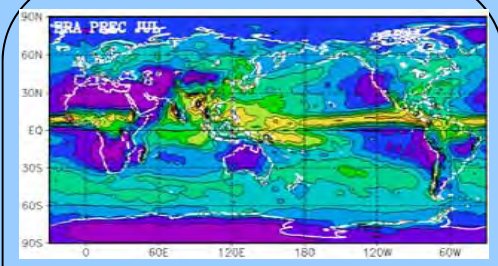


6-hourly Climate System Dataset from 1979 to 2004 was computed based on Past Observation and the Numerical Weather Prediction Technology by JMA and CRIEPI (JRA-25). JMA also operates a real-time climatic assimilation system known as the JMA Climate Data Assimilation System (JCDAS), for diagnosis of the present state of climate.

The Best Estimate of the State and Evolution of the Climate System



Physically Consistent Time- Series Data (No Artificial Gap)



Physically Consistent Gridded Data on the Globe (No Empty Area)

Wind, Air Temperature, Moisture, Precipitation, Evaporation, Soil Moisture, Snow Depth, Surface Fluxes, Radiation, Ground Temperature, etc.

- Improving Initial Conditions for Seasonal Prediction
- Analyzing the mechanisms of Unusual Climate
- Monitoring Global Climate Change

4. Diagnostic information on the climate system as background to extreme climate events

TCC News No.18 (Autumn 2009)

“Heavy precipitation in the Philippines and India from late September to early October 2009”

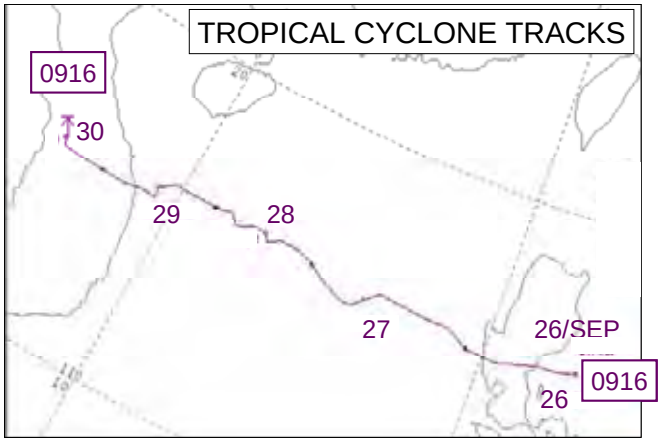


Figure 17 Track of the typhoon Ketsana (26–30 September, 2009)

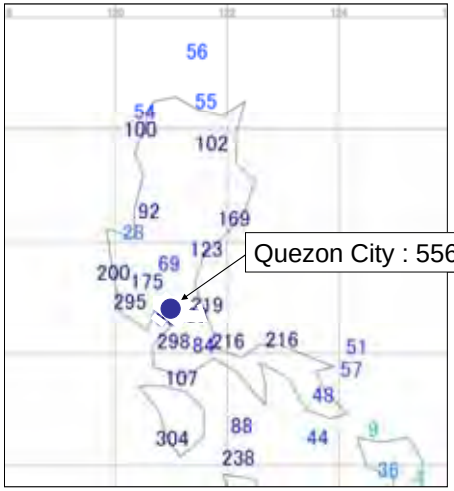


Figure 19 6-day precipitation amount around Luzon Island (25-30 September, 2009, unit: mm)

Typhoon Ketsana moved slowly westward from Luzon Island in the Philippines to Vietnam in late September (Figure17), and heavy precipitation was observed around the south of Luzon Island (Figure 19). According to the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the 410.6 mm of precipitation within nine hours recorded in Metro Manila was the capital’s largest rainfall since 7 June 1967 (a 42-year period). It was reported that the resultant flood disaster caused more than 460 fatalities (National Disaster Coordinating Council of the Philippines: NDCC).

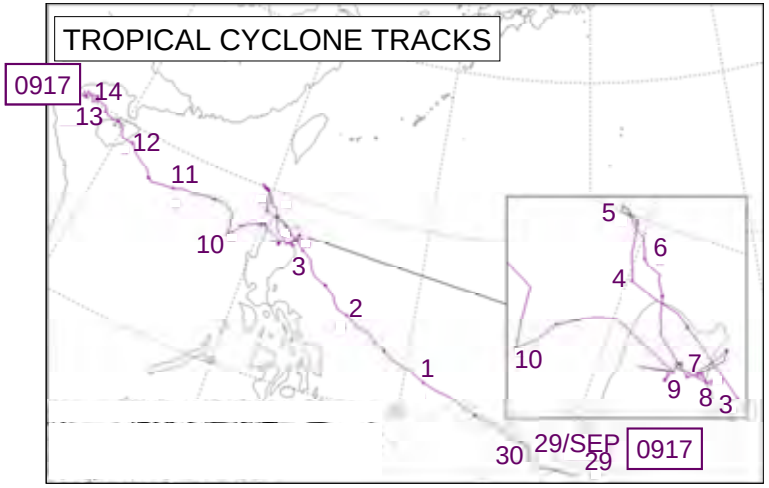


Figure 18 Track of the typhoon Parma (29 September-14 October, 2009)

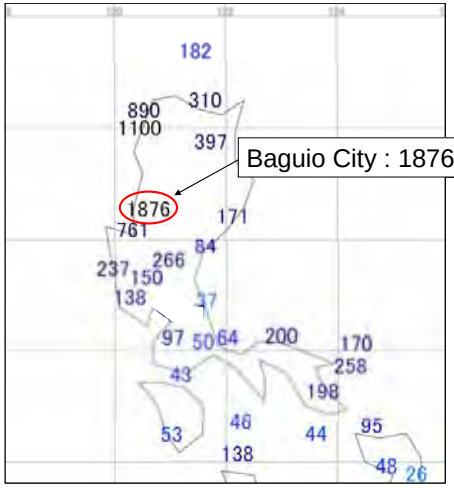


Figure 20 9-day precipitation amount around Luzon Island (1-9 October, 2009, unit: mm)

Typhoon Parma moved around northern Luzon Island very slowly (Figure 18), and caused heavy precipitation there in early October (Figure 20). Nine days of rainfall from 1 to 9 October amounted to more than 1,870 mm of precipitation (around 1,160% of the normal) in Baguio City. It was reported that the heavy precipitation caused more than 460 fatalities (NDCC).

TCC News No.18 (Autumn 2009)

“Heavy precipitation in the Philippines and India from late September to early October 2009”

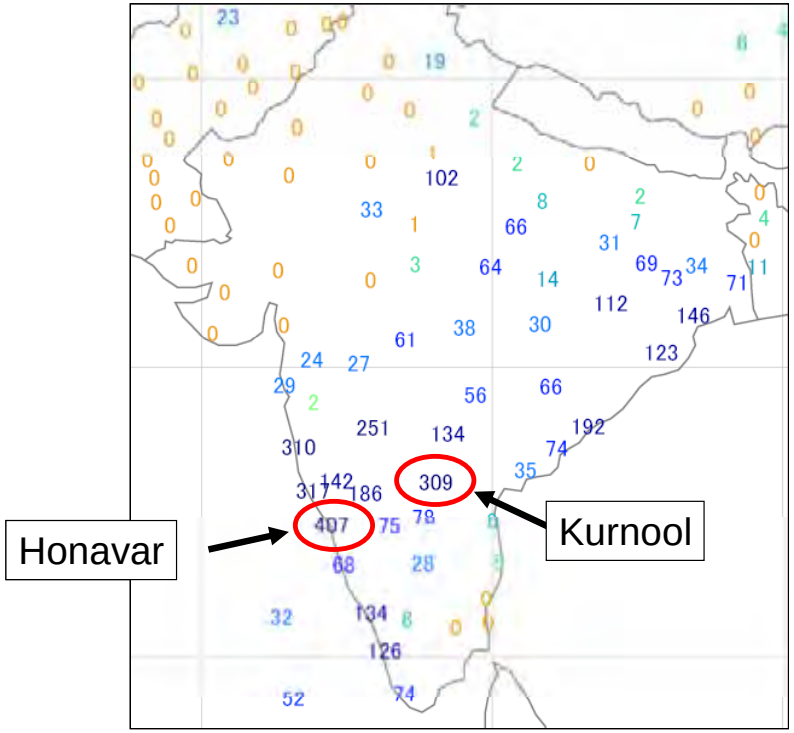


Figure 21 6-day precipitation amount in India (28 September-3 October, 2009, unit: mm)

A low-pressure area that formed on 28 September became well marked the following day, and remained around the western central Bay of Bengal until early October. Heavy precipitation was observed in southern India, and six days of rainfall from 28 September to 3 October produced 309 mm of precipitation in Kurnool (around 1,290% of the normal) and 407 mm in Honavar (around 1,040% of the normal) (Figure 21). It was reported that the heavy precipitation caused more than 320 fatalities in India (Indian Ministry of Home Affairs).

TCC News No.18 (Autumn 2009)

"Heavy precipitation in the Philippines and India from late September to early October 2009"

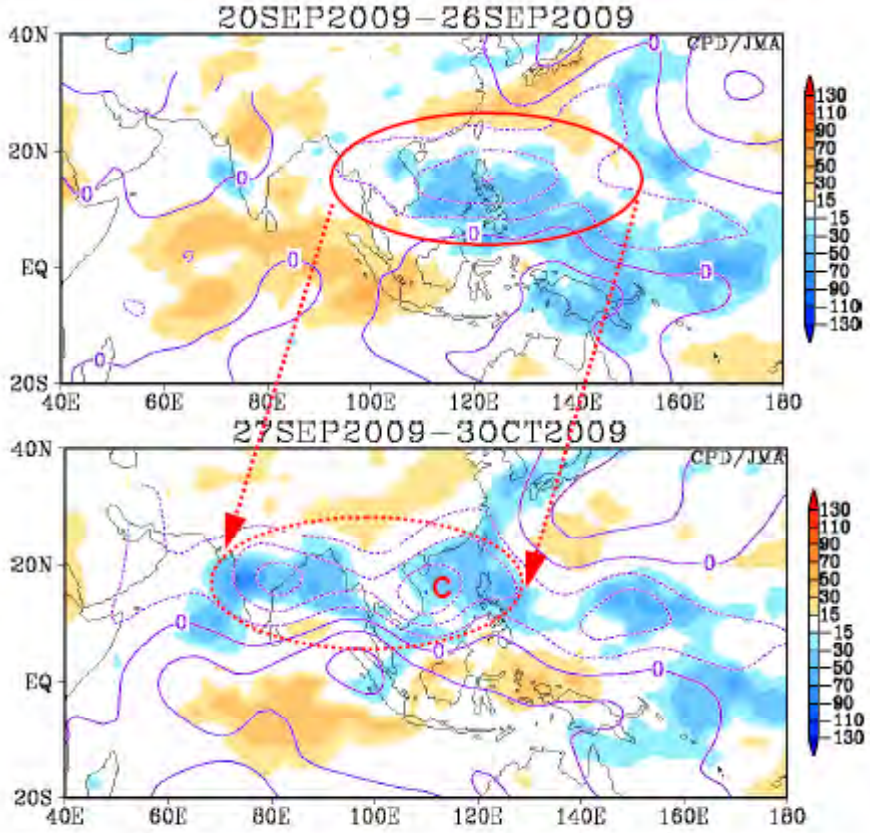


Figure 22 Seven-day mean OLR anomalies (shading) and 850-hPa stream function anomalies (contours)
Shading shows OLR anomalies in units of W m^{-2}. Contours show 850-hPa stream function anomalies at intervals of 2.5×10^6 m^2 s^{-1}. Upper panel: 20 – 26 September 2009; Lower panel: 27 September – 3 October 2009.

- From late September to early October, the pattern of anomalous cyclonic circulation propagated westward.
- This westward propagating phenomenon is called "equatorial Rossby wave" in meteorology.
- At the end of September, this equatorial Rossby wave finally reached India and enhanced cumulus cloud activity in the region.

- Moreover, smaller-scale and remarkable cyclonic circulation anomalies formed over the northern part of the South China Sea (the red "C" in the lower figure), indicating the development of Typhoon Ketsana.
- In addition, Typhoon Parma developed in the region of the westward propagation of the equatorial Rossby wave afterwards (not shown).

The results of the climate system monitoring indicate that the extreme events in the Philippines and India were caused by the common phenomenon (equatorial Rossby wave).

5. Importance of in-situ observations from the viewpoint of climate services

- **Surface monthly data are important to detect not only extreme climate events but also global warming.**
  - CLIMAT reports of around 3,000 RBCN stations (including around 1,000 GSN stations) should be produced and circulated through GTS more certainly.
  - Past long-term monthly data sets are also important to calculate climatological normals, standard deviations, and long-term trends.
  - Accurate measurements and precise analysis are necessary to calculate the global surface temperature anomaly (its year-to-year variation is around 0.1 °C).

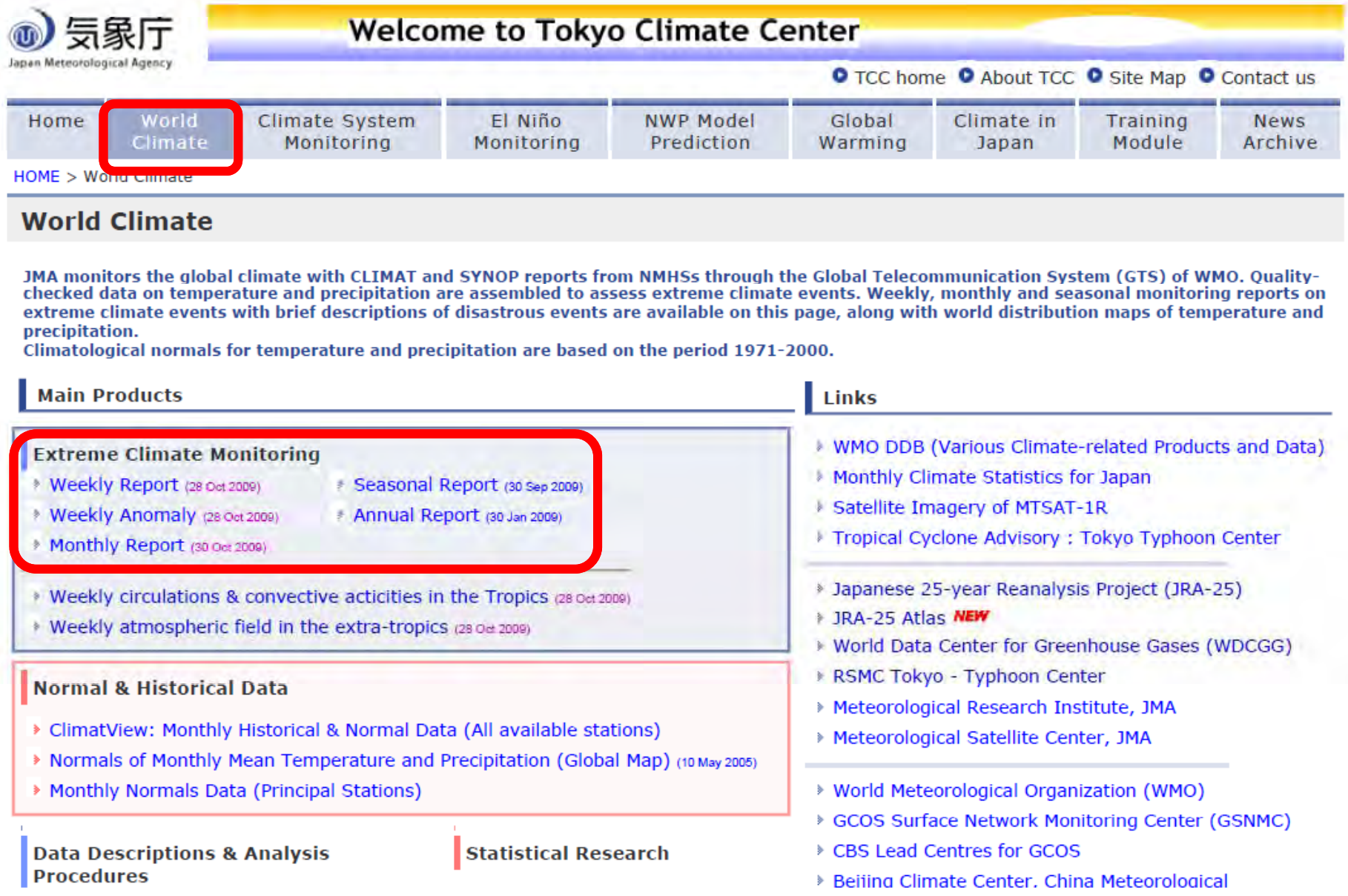
  Managing your country's long-term datasets will lead to providing information on your country's climate change.
- **Surface and upper air daily data are important for monitoring and prediction of climate system.**
  - All daily SYNOP and TEMP reports are necessary for climate data assimilation and prediction systems.
  - Past long-term daily data sets are also important for re-analysis projects.

  Climate system monitoring over the world is very important for precise and useful climate services, and such monitoring is supported by your daily observation and reporting.

Thank you!

JMA Mascot Character ‘Hare-run’
‘Hare’ means sunny weather in Japanese
‘Hare-ru’ means ‘it becomes sunny’.
‘Run-run’ means happiness feeling.

http://ds.data.jma.go.jp/tcc/tcc/products/climate/index.html



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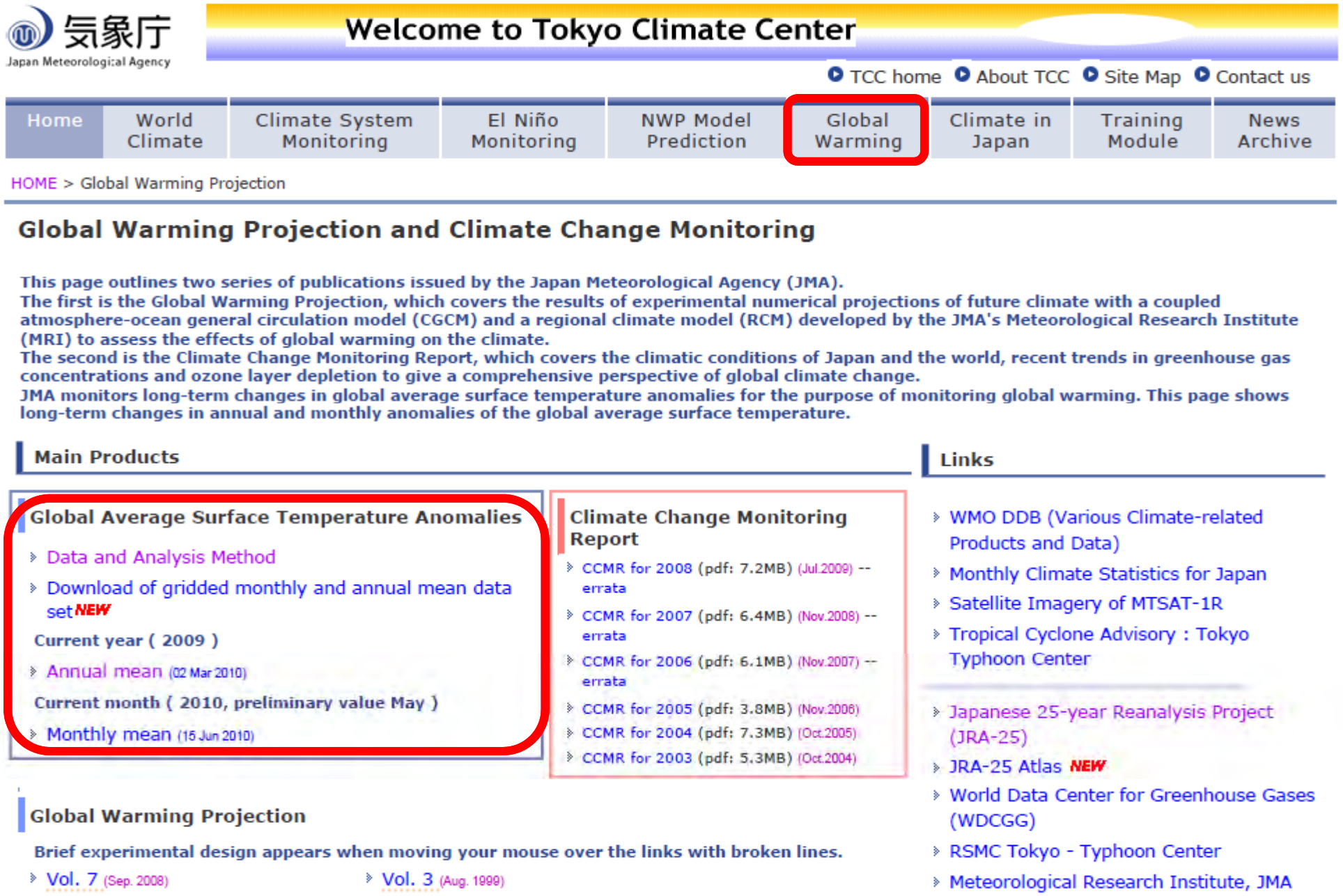

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気象庁 Japan Meteorological Agency

Welcome to Tokyo Climate Center

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HOME > Climate System Monitoring

Climate System Monitoring

JMA monitors the present state of the global atmospheric, oceanic and terrestrial climate system focusing on atmospheric circulation, convection, ocean conditions and snow/ice coverage based on numerical objective analyses and satellite observations. These monitoring results provide useful information for interpretation of the present climate including extreme events and long-term trends, and for long-range forecasts and scientific research.
Noting that homogeneous and consistent data is necessary for reliable monitoring of the global climate system, JMA conducted the Japanese Reanalysis Project (JRA-25) in cooperation with the Central Reasearch Institute of Electric Power Industry (CRIEPI). The project was completed in March 2006, and long-term, homogeneous global analysis data for the period 1979-2004 was finalized and released to users in July 2006. JMA has operated the JMA Climate Data Assimilation System (JCDAS), which is the same data assimilation system used in JRA project, on a near-real-time basis since March 2006.

The normal was replaced by a new one based on JRA-25 from the December 2006 issue. For detailed information on the new normal, please refer to MRCS Separated Volume No.13 published in January 2007.
>> Outlines of the New Atmospheric Circulation Climatological Normals based on the JRA-25 data (PDF:280KB)

Main Products

Report on Climate System

Monthly features of extratropical circulation&, tropical circulation and convection, conditions of ocean are described with figures and tables.

- Monthly Highlights on Climate System
- Explanation of figures
- New Climatological Normals based on the JRA-25- Monthly Report on Climate System Separated Volume No.13 -

Current Month (May 2010)

- Report on Climate System Top
- Extratropics (Highlights and Figures)

Links

- WMO DDB (Various Climate-related Products and Data)
- Monthly Climate Statistics for Japan
- Satellite Imagery of MTSAT-1R
- Tropical Cyclone Advisory : Tokyo Typhoon Center

- Japanese 25-year Reanalysis Project (JRA-25)
- JRA-25 Atlas NEW

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

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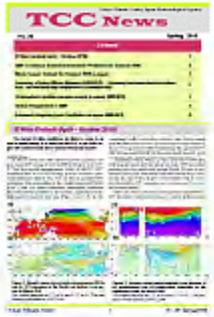
printable version

- No. 20 (Spring 2010: 2636KB)



Contents

- El Niño Outlook (April- October 2010)
- JMA's Seasonal Numerical Ensemble Prediction for Summer 2010
- Warm Season Outlook for Summer 2010 in Japan
- Summary of Asian Winter Monsoon 2009/2010
- Stratospheric sudden warming events in winter 2009/2010
- Global Temperature in 2009
- Extremely Negative Arctic Oscillation in winter 2009/2010

- No. 19 (Winter 2010: 2015KB)

Press Release

17 June 2010 NEW

- The Warmest Global Mean Surface Temperature Observed for March to May 2010

14 April 2010

- The Warmest Global Surface Temperature for March in 2010

15 December 2009

- Third Highest Global Surface Temperature in 2009 (Preliminary, from January to November)

9 October 2009

- Record-tying High Global Surface Temperature in September 2009

21 July 2009

- Tokyo Climate Conference, Tokyo, 6-8 July 2009

22 June 2009

- Climate Change Monitoring Report for 2008

28 May 2009

- Announcement: Tokyo Climate Conference, Tokyo, 6-8 July 2009

28 May 2009

What's New in TCC Website

15 July 2010 NEW

- New Release: Monthly Highlights on Climate System (June 2010)

15 July 2010 NEW

- Updated Information: Global Average Surface Temperature Anomaly (June 2010)

14 July 2010 NEW

- New Release: Introduction to Interactive Tool for Analysis of the Climate System(ITACS)

14 July 2010 NEW

- Updated Information: World Climate - Monthly Report (June 2010)

14 July 2010 NEW

- Updated Information: Climate in Japan - Monthly Report (June 2010)

9 July 2010 NEW

- Updated Information: El Niño Outlook (July 2010 - January 2011)

25 June 2010 NEW

- Grounds for Three-month Outlook (July -

Weekly monitoring using SYNOP data

Historical daily data are needed to calculate weekly normals, but in JMA's database, they are available only in a few areas of the world .

➔The thresholds of weekly extreme climate events are estimated empirically. Statistical relationships are obtained between weekly and monthly values by using data in the areas mentioned above.

(e.g., 1.83σ for 7-day mean temperature ≈ 3σ for monthly mean temperature.)

- **Extreme temperature**

  Anomaly of 7-day mean temperature ≥ ±3σ

  σ: Standard deviation for 30-day mean temperature

- **Extreme precipitation** :

  WET : 7-day total precipitation ratio above the threshold

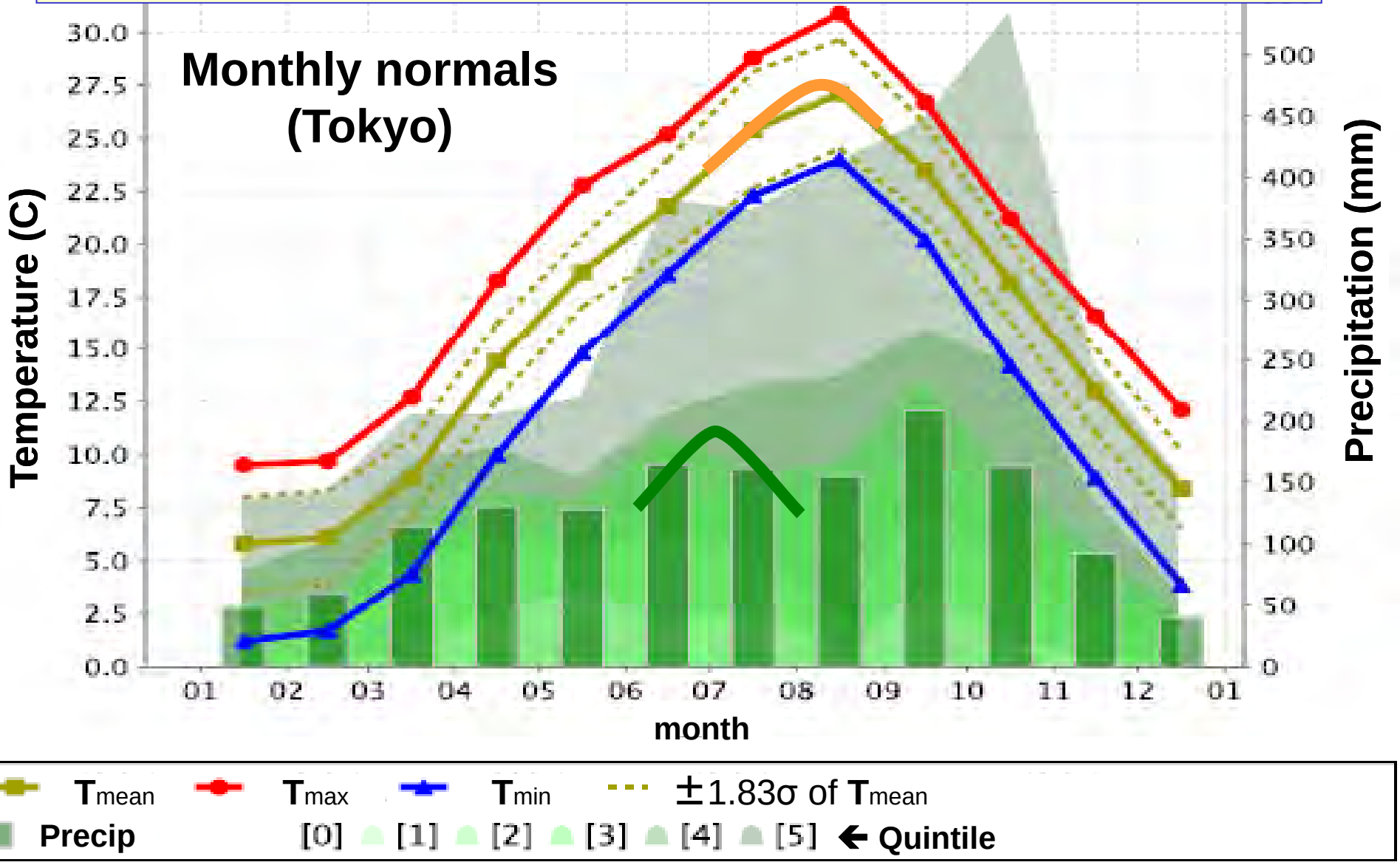
  e.g. 30-day normal =100mm, the threshold is 98% of 30-day normal

  200mm, 81%

  DRY : 30-day precipitation below quintile 1

Monthly Normals ➔ Daily normals

7-day normal, 30-day standard deviation, 30-day quintile are estimated by interpolating of monthly values. But they are not always suitable in the season of peak.



Monthly products of Beijing Climate Center

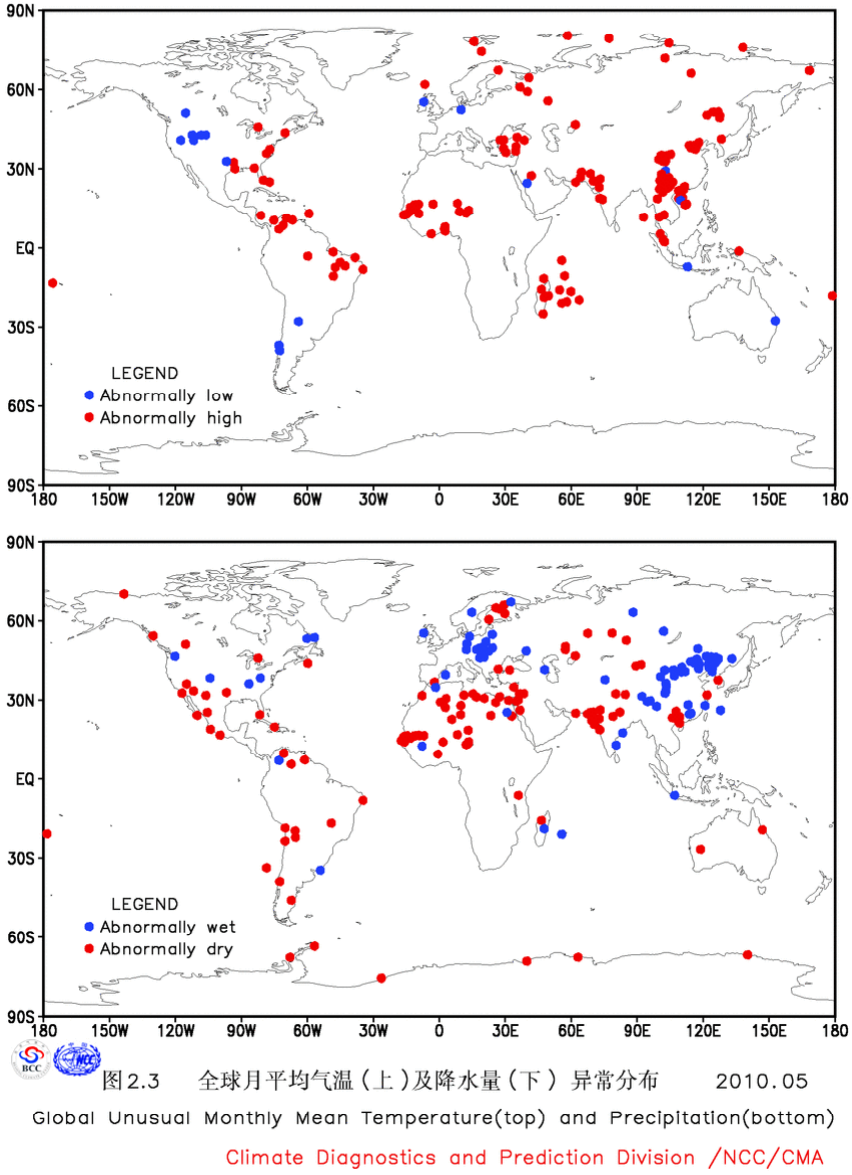


图2.3 全球月平均气温（上）及降水量（下）异常分布 2010.05

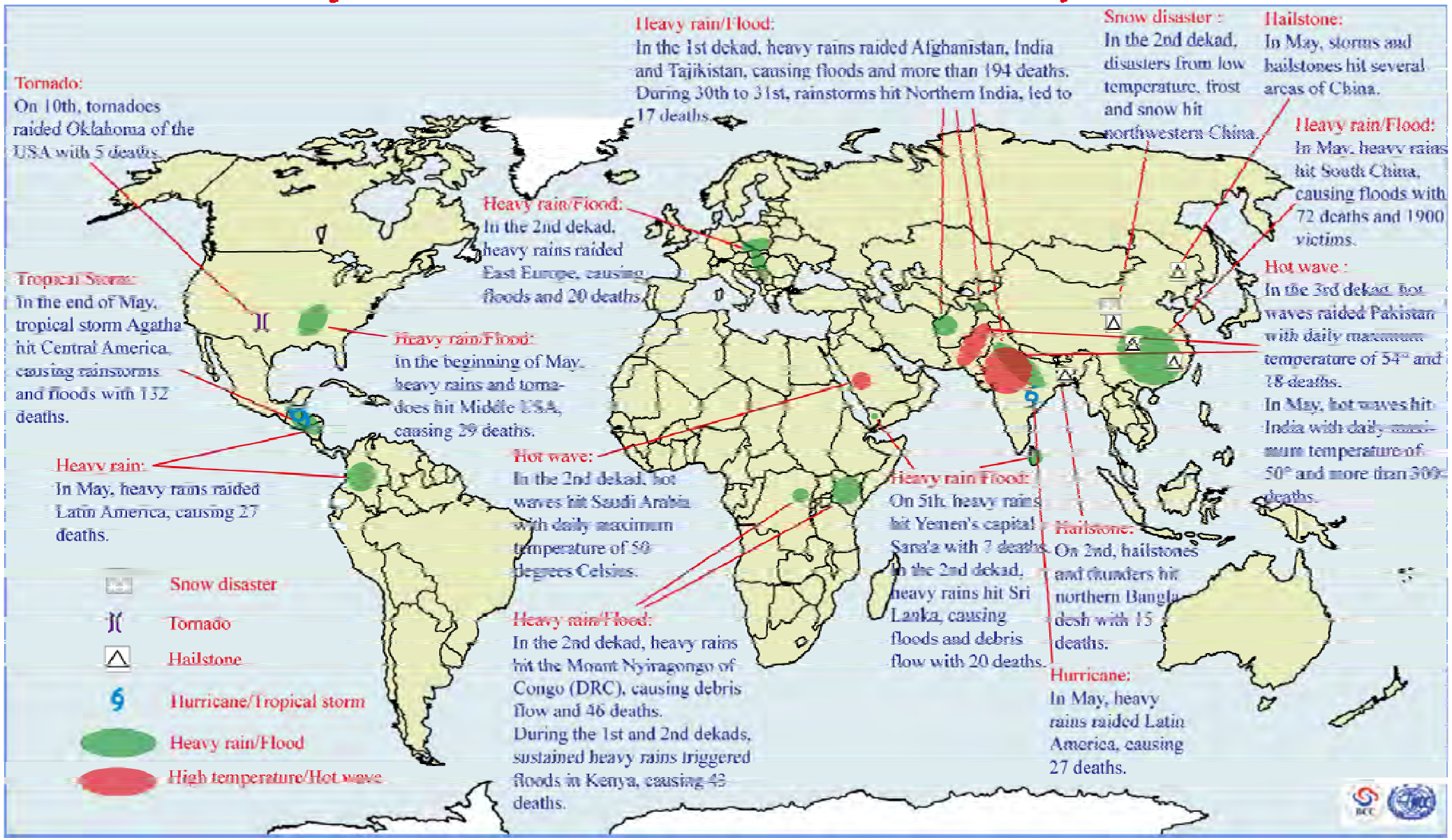
Global Unusual Monthly Mean Temperature(top) and Precipitation(bottom)

Climate Diagnostics and Prediction Division /NCC/CMA

http://bcc.cma.gov.cn/en/

Monthly products of Beijing Climate Center

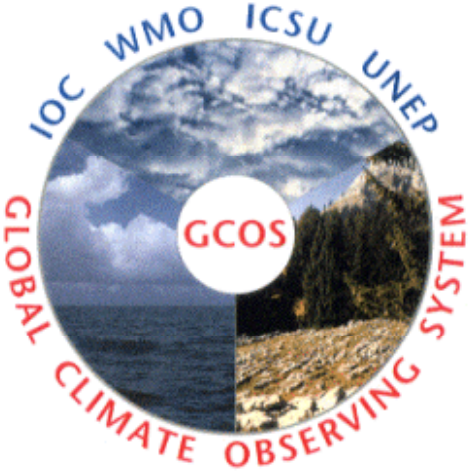
Major weather and climate events in the world in May 2010



http://bcc.cma.gov.cn/en/

What is GCOS ?

- **GCOS (Global Climate Observing System) was established in 1992 by WMO,UNESCO,UNEP and ICSU to ensure that the climate observation data are obtained and made available to all potential users.**
- **GCOS is intended to meet the needs for**
  - **# Climate system monitoring, climate change detection**
  - **# Research toward improved understanding, modeling and prediction of climate system**



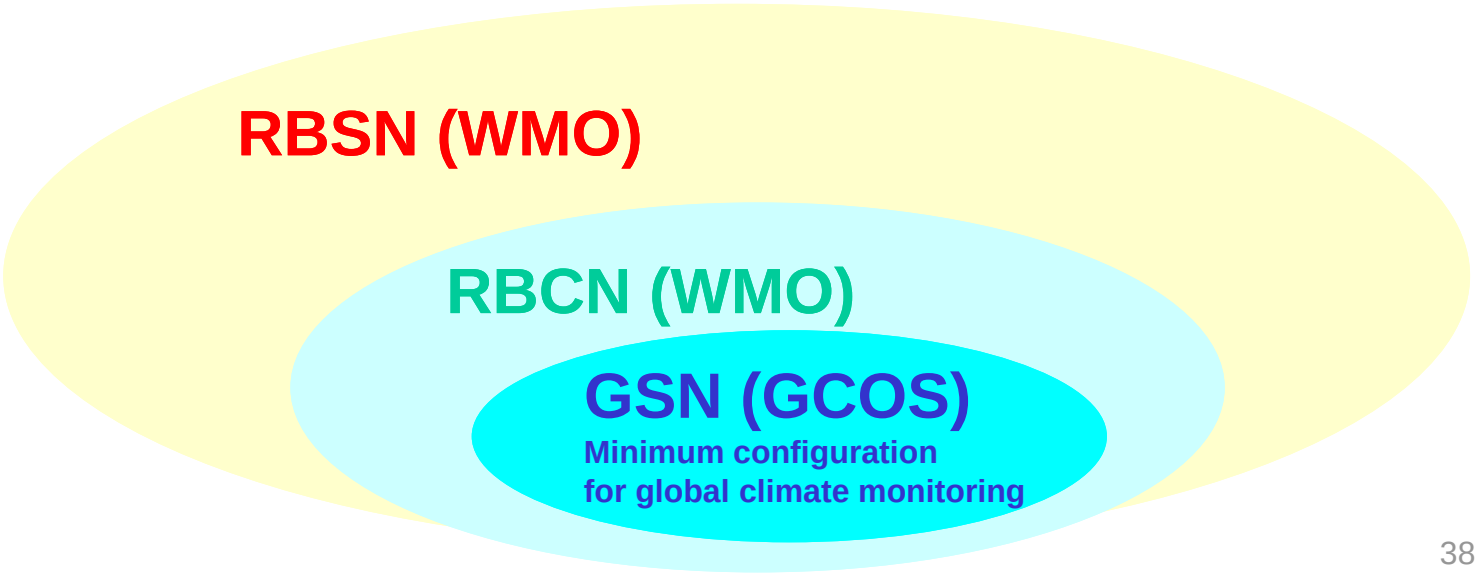
http://www.wmo.int/pages/prog/gcos/index.php

GSN and RBCN, RBSN

SYNOP and TEMP reports

- **RBSN**: **Regional Basic Synoptic Network** of surface and upper-air stations adequate to meet the requirements of WMO Members and of the World Weather Watch
- **RBCN**: **Regional Basic Climatological Network** necessary to provide a good representation of climate on the regional scale, in addition to global scale (**GSN**)

CLIMAT report



Role of GSNMC and CBSLC

GSN Monitoring Centres

To monitor the performance of the CLIMAT reports from GSN stations (JMA,DWD)

Since 1999

http://www.gsnmc.dwd.de/

CBS Lead Centres for GCOS Data

To contact with NMHSs about missing CLIMAT reports on the basis of GSNMC monitoring results (9 centres in each region)

CBS: Commission for Basic Systems (WMO)

CBSLCs was established in 2007

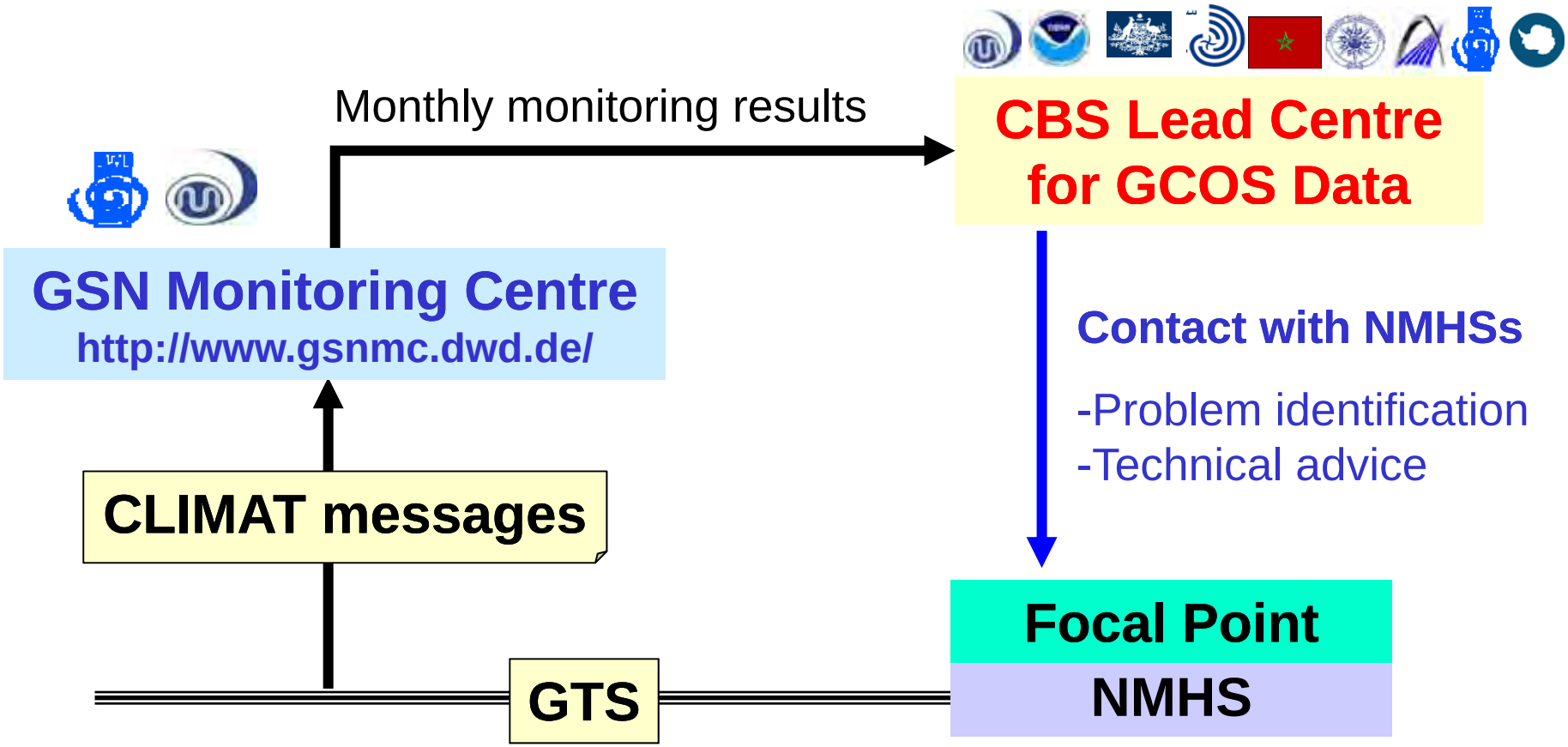
CBS Lead Centres and FPs

- RA I northern parts: **Morocco**
- RA I southern parts: **Mozambique**
- RA II eastern parts + SE Asia: **Japan**
- RA II western parts: **Iran**
- RA III: **Chile**
- RA IV + Hawaiian Islands: **NCDC/NOAA**
- RA V except for SE Asia: **Australia**
- RA VI: **Germany**
- Antarctica: **British Antarctic Survey**

- Focal point for GCOS and climate data
  http://www.wmo.int/pages/prog/gcos/index.php?name=CBSLeadCentres

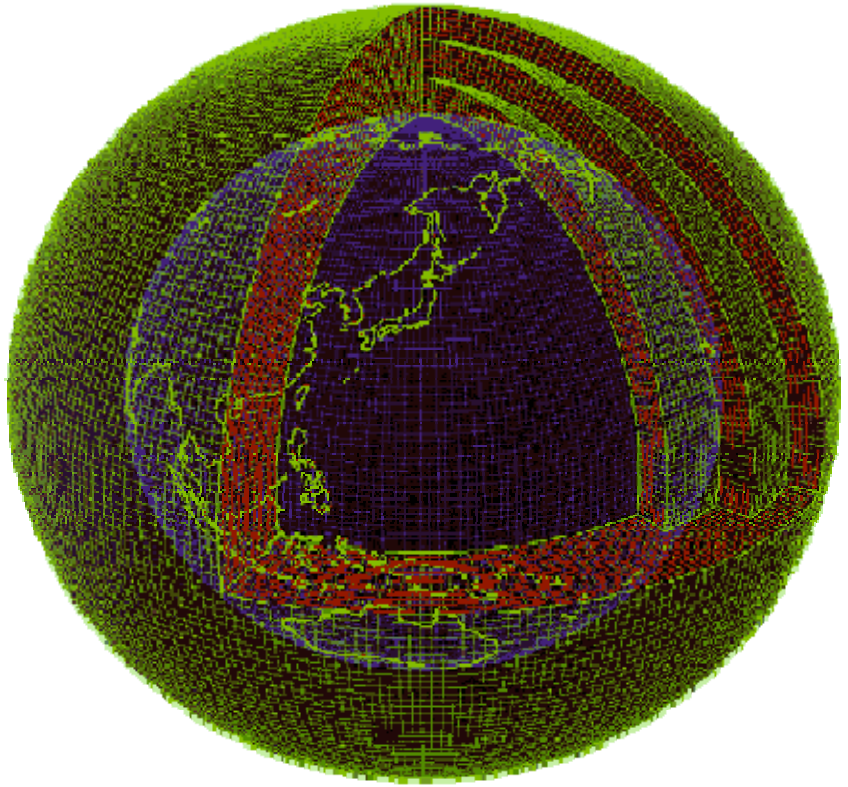
Relationship between GSNMC and CBSLC

Based on the monitoring by GSNMC, CBSLCs aim to improve the quantity and quality of GSN-CLIMAT over the GTS by contacting with the FP in NMHS.



Overview of a Numerical Model

Super Computer



3D grid

- Dividing the Earth's atmosphere into a 3D grid with discrete grids. (see right figure)
- The forecasts are computed using mathematical equations that describe the physics and dynamics of the atmosphere. The model calculates how the atmosphere will change in each grid with time, and how each grid affects its neighbors, making a forecast.

Overview of JRA-55

60-km resolution global climate data set

Phase 1 (2009~2012)

JRA-55 (1958~2012)

Reanalysis of past observations using a constant state-of-the-art data assimilation system

Boundary fields

Phase 2 (2013~2015)

Regional downscaling over Japan (1958~2012)

Details to be determined

High-resolution (~5 km) climate data set over Japan

providing a fundamental data set for

- researches on climate change and decadal variability in the last half century
- real-time climate monitoring
- verification of seasonal forecast and climate models
- atmospheric forcing fields for ocean data assimilations
- chemical transport simulations
- carbon cycle simulations
- water resource management
- estimation of renewable energy resources
- severe weather risk assessment

and much more

Specifications of data assimilation system

	JRA-25 (1979~2004)	JRA-55 (1958~2012)
Resolution	T106L40 *(top layer at 0.4 hPa)*	TL319L60 *(top layer at 0.1 hPa)*
Time integration	Eularian	Semi-Lagrangian
Long-wave radiation	*Line absorption* Statistical band model *Water vapor continuum* e-type	*Line absorption* Table lookup + K-distribution *Water vapor continuum* e-type + p-type
Assimilation scheme	3D-Var	4D-Var *(with T106 inner model)*
B matrix	Constant	Different **B** matrices for pre-satellite and satellite eras
Bias correction (radiosonde)	Radiation bias only (Andrae *et al.*, 2004)	RAOBCORE v1.4 (Haimberger, 2007, *J. Climate*)
Bias correction (radiances)	Offline	Variational Bias Correction

http://www.cawcr.gov.au/staff/pxs/wmoda5/Oral/Kobayashi.pdf

QC process of CLIMAT temperature