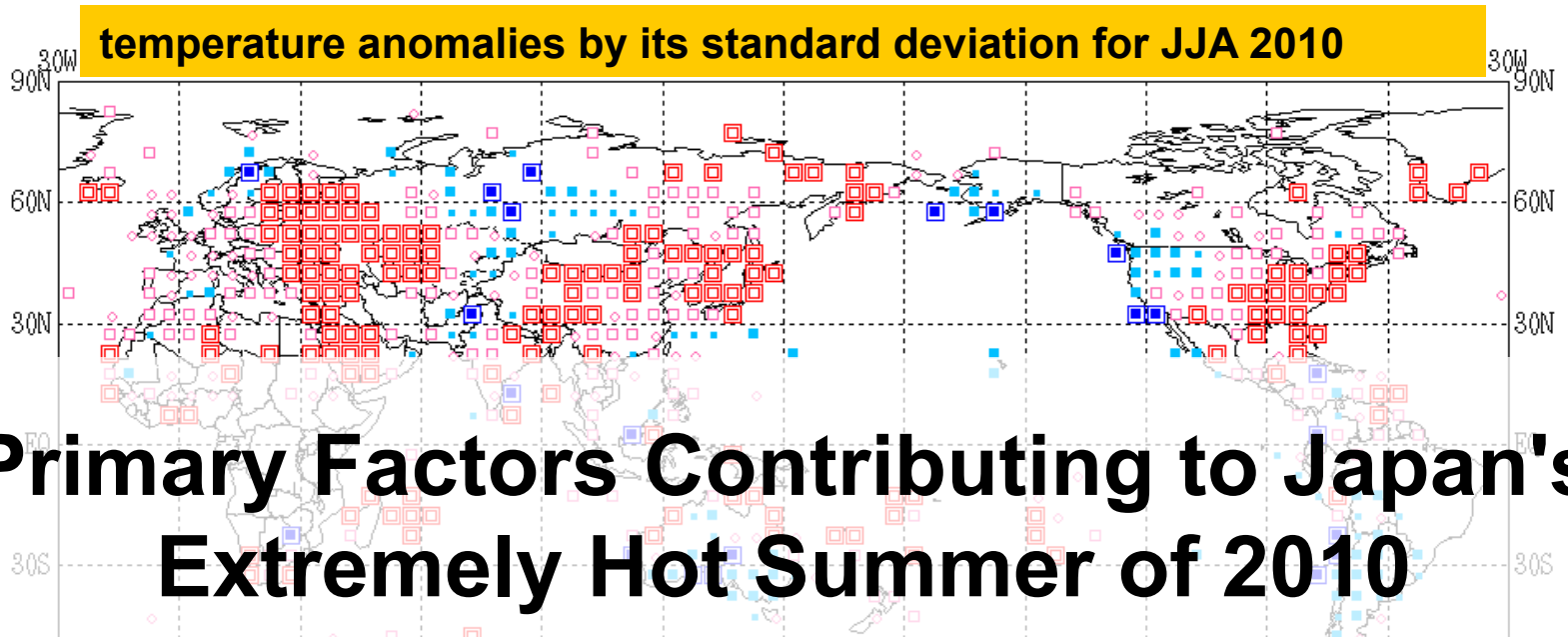

Primary Factors Contributing to Japan's Extremely Hot Summer of 2010

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(coworkers;Shotaro Tanaka, Singo Usida)

気象庁
Japan Meteorological Agency

Ft. Worth October 3, 2011

36th Climate Diagnostic and Prediction Workshop, Ft. Worth Hilton, Ft. Worth, TX, October 3-6, 2011

Outline

2-1.Temperature for summer 2010
2-2.Ocean conditions and convective activity
2-3.Characteristic atmospheric circulation
3. Conclusion

Data Set

SST(COBE-SST) ; The normal is the 1971 – 2000 average
JRA-25/JCDAS (re-analysis/operational analysis data)
;The normal is the 1979 – 2004 average

The Advisory Panel on Extreme Climate Events①

The Advisory Panel was established in 2007 by JMA to investigate extreme climate events based on the latest knowledge and findings.

The Advisory Panel

J M A

Collaboration

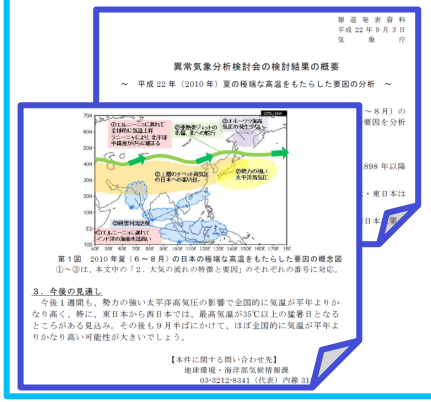
Research Community

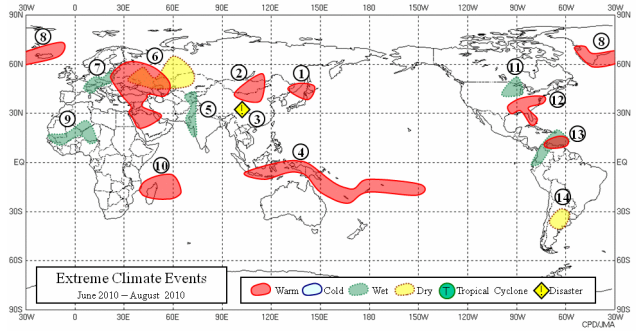
consisting of prominent experts on climate science from universities and research institutes

Extreme event!!

provide information based on latest research outcome, quickly

PUBLIC

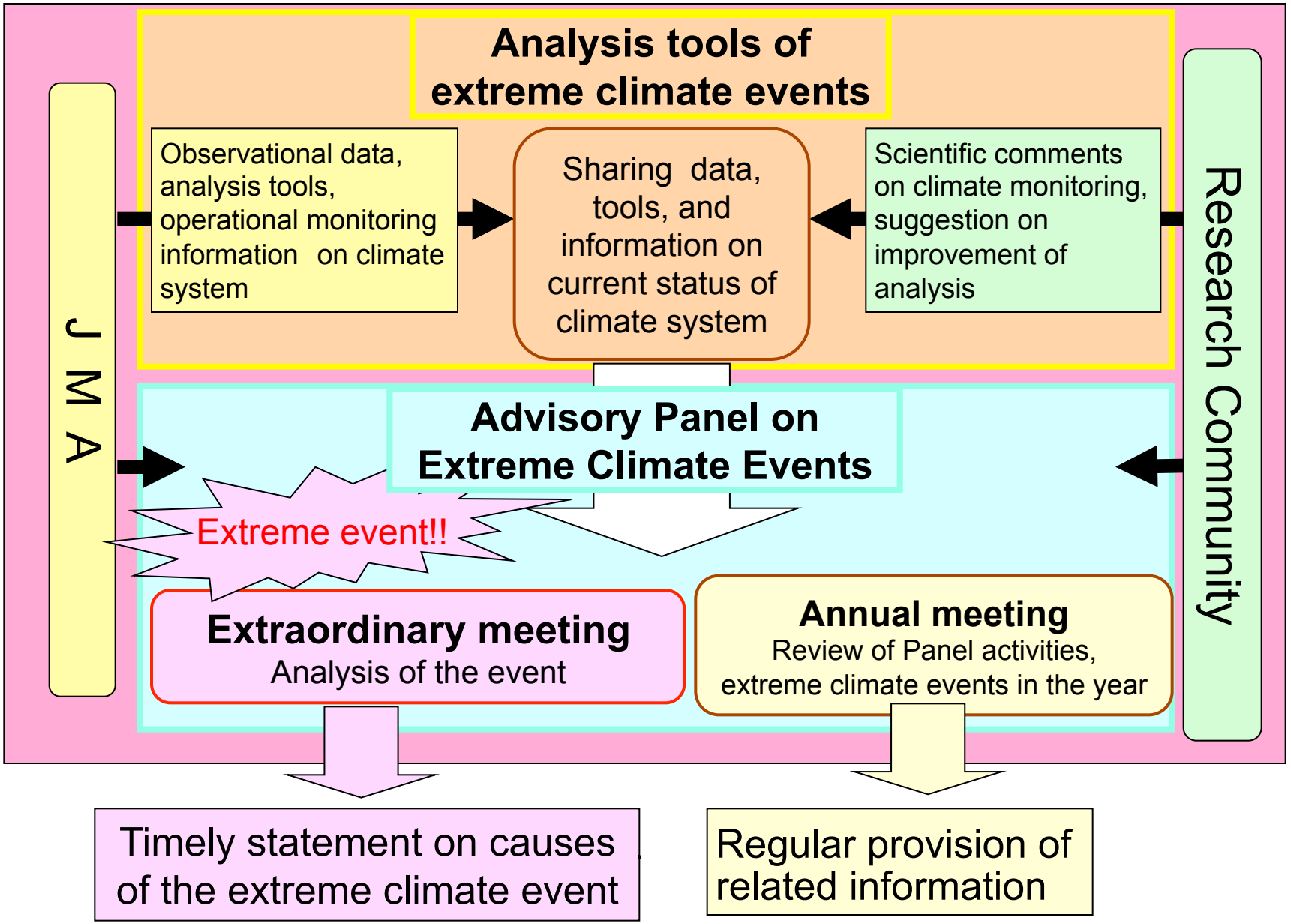




Extreme Climate Events JJA 2010 (TCC,JMA)

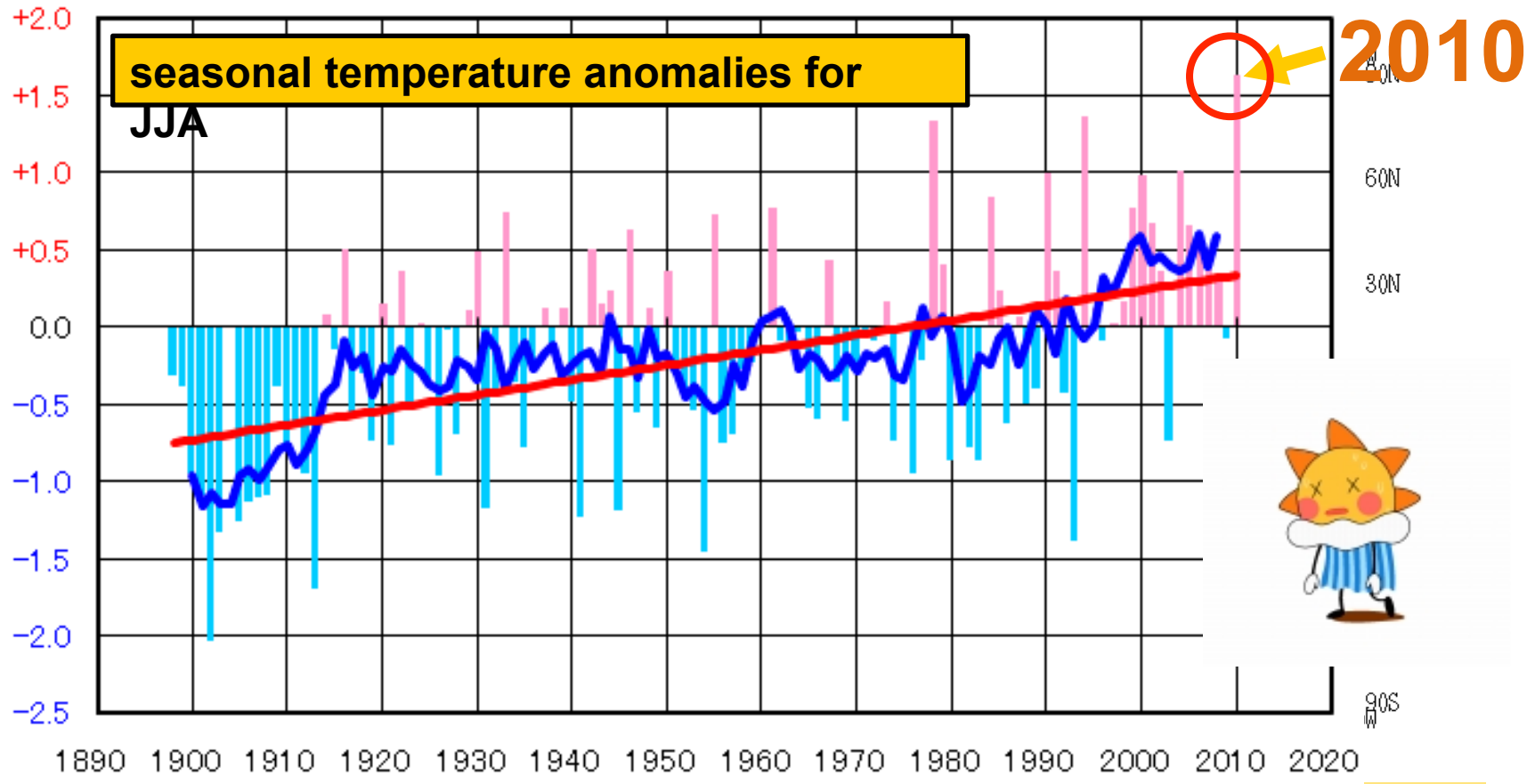
URL:http://ds.data.jma.go.jp/tcc/tcc/products/climate/seasonal.html

The Advisory Panel on Extreme Climate Events②



Temperature for summer 2010

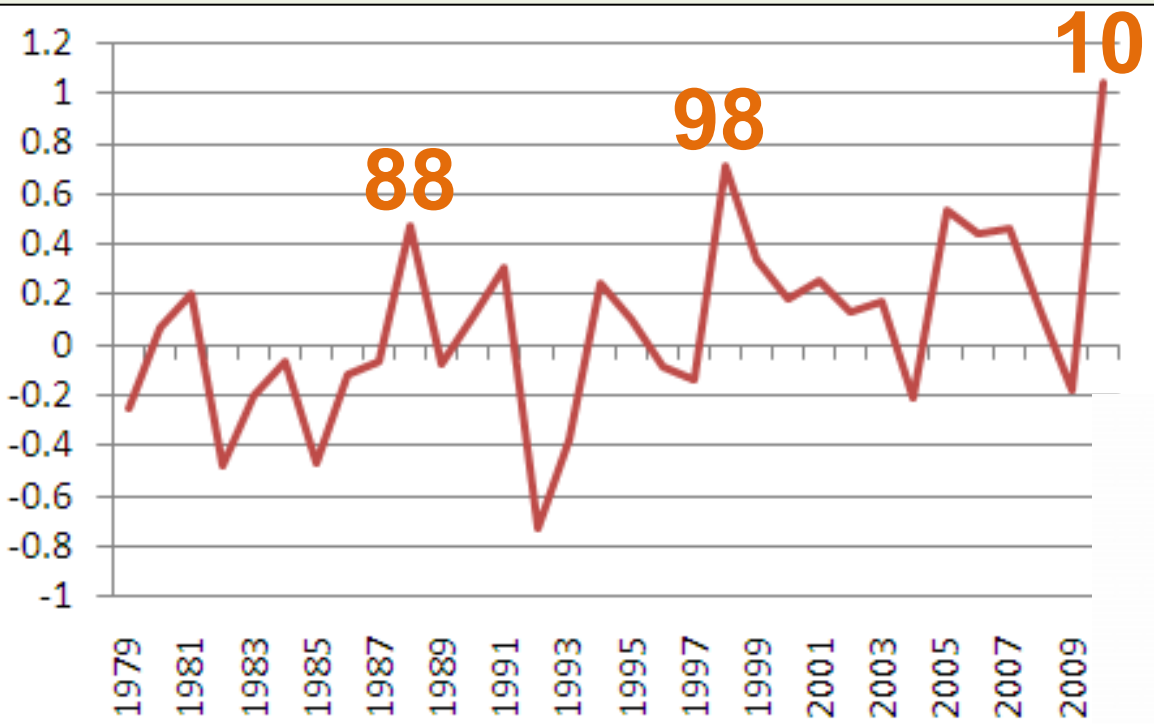
In summer 2010, many area of the world experienced high temperatures. In Japan, It is the highest since JMA's records began in 1898.



Long-term change in seasonal temperature anomalies for summer from 1898 to 2010 in Japan.

in the Northern Hemisphere

The values for 1998 and 1988 were the second and fourth highest, respectively.



60N)calculated from
60N)calculated from thickness (850–300 hPa).

Ocean Condition

In summer 2010, a La Niña event started, following the El Niño period that ended in spring 2010.

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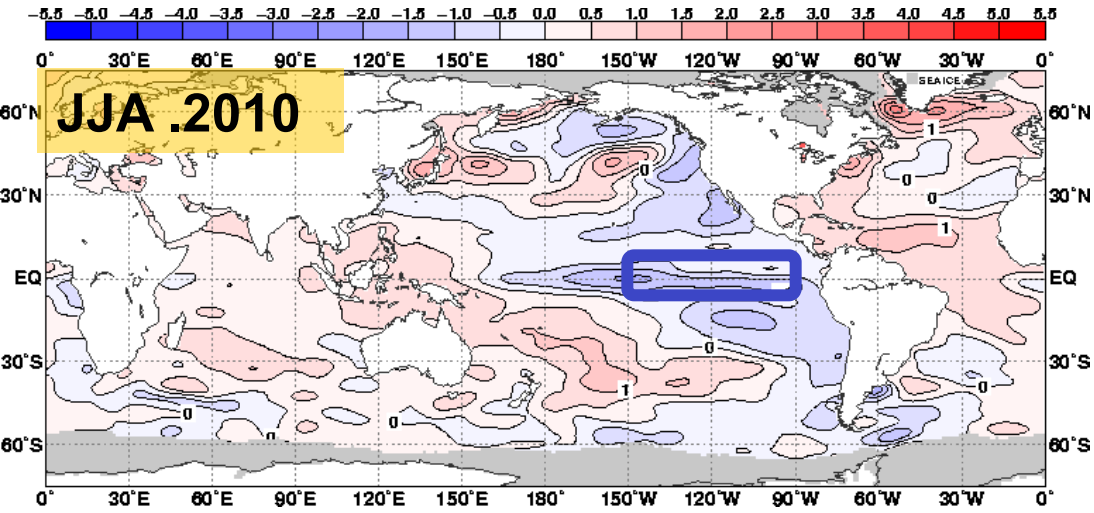
MAM. 2010



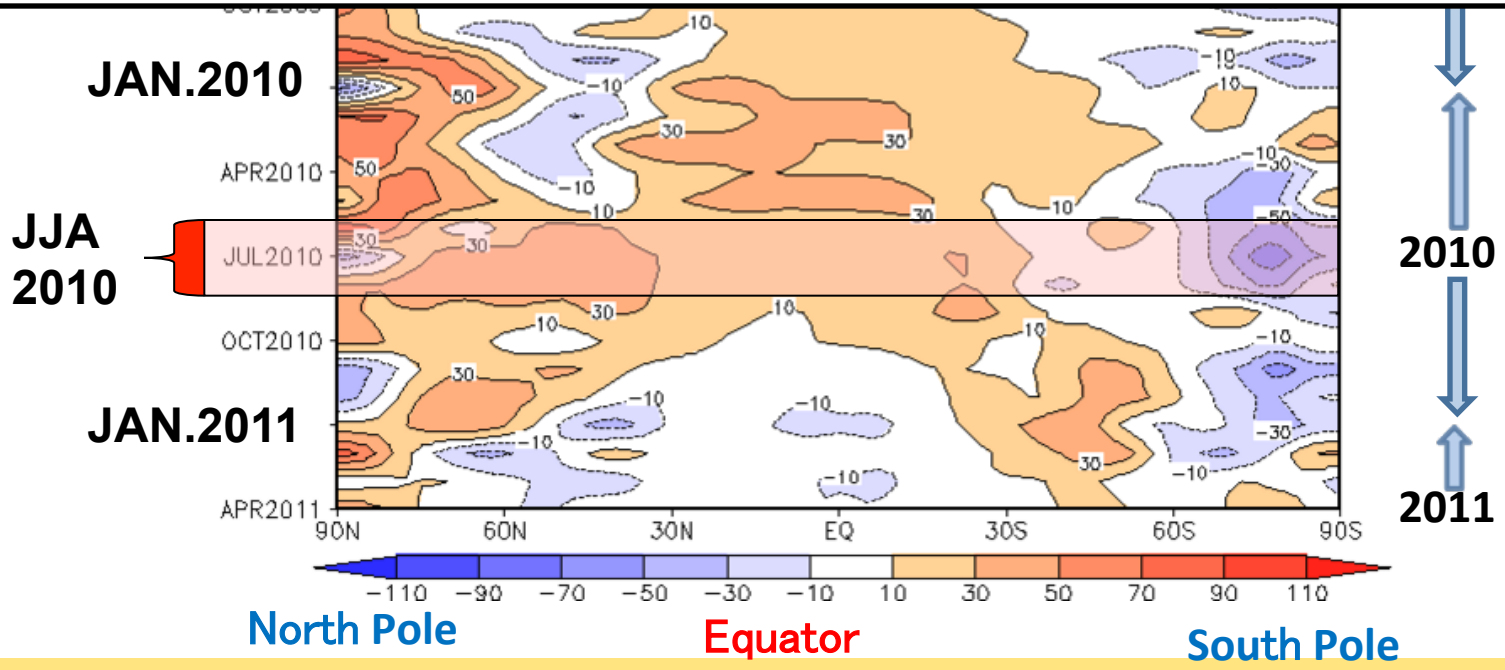
memo
This pattern echoed those of the La Niña events seen in 1988 and 1998

Three-month mean Sea Surface Temperature anomaly(K)

Time evolution of the tropospheric air thickness

- The El Niño period ended in spring 2010.
- In summer 2010, a La Niña event started.

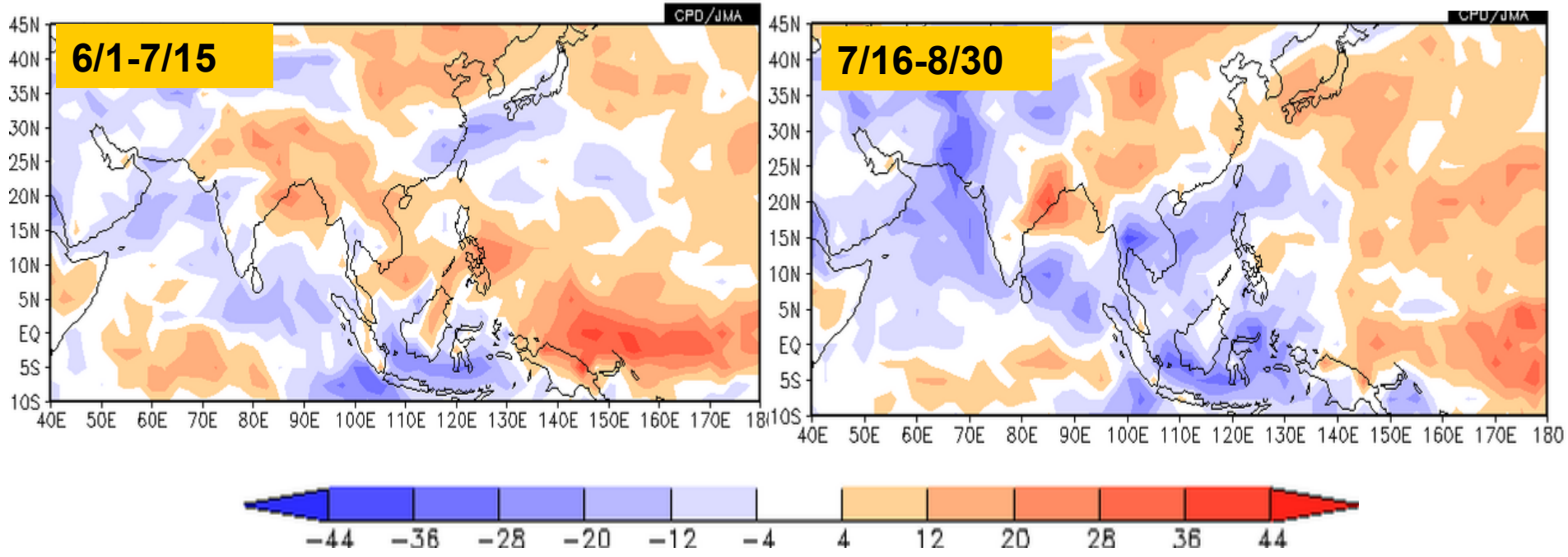
in the mid-latitudes of the Northern Hemisphere were extremely high in summer 2010 from the influence of the El Niño event and partly due to the effects of the La Niña event.



Time-latitude cross section of monthly, zonally averaged thickness (850-300hPa) anomaly (unit: m)

Convective activity

Asian summer monsoon is active in second half of summer

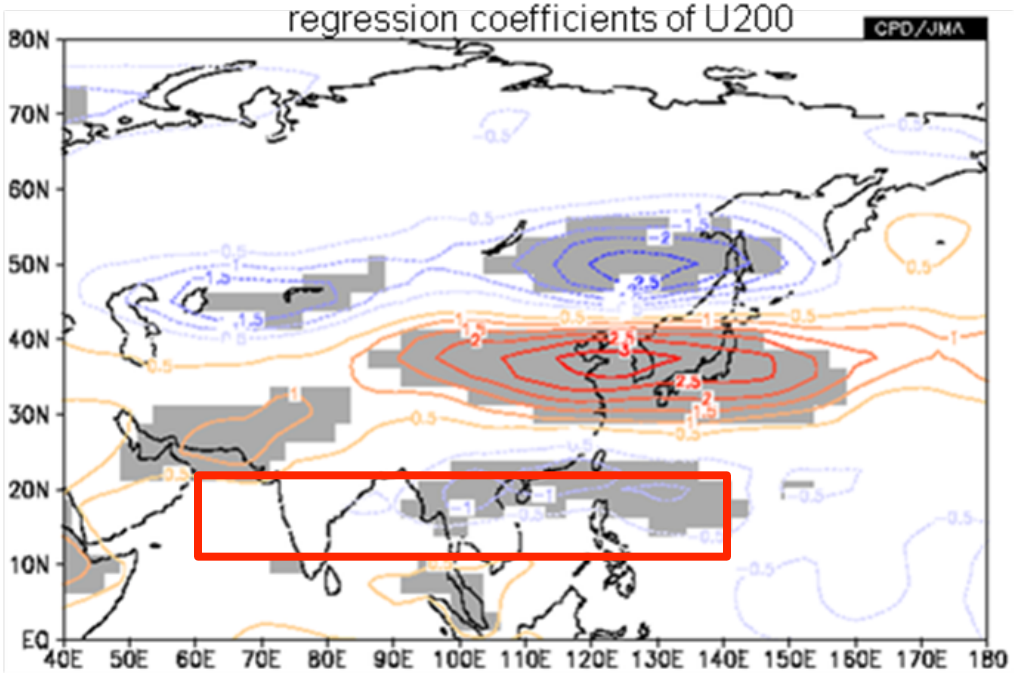


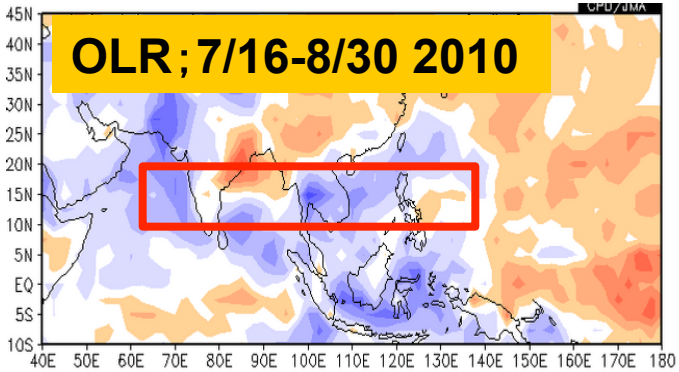
Outgoing longwave radiation (OLR) anomaly (unit: W/m2)

Cold and warm shading indicates enhanced and suppressed convective activity, respectively, in relation to the normal.

Statistic analysis for the subtropical jet stream near Japan

When convective activity is enhanced over Asian monsoon region, the subtropical jet stream near Japan tends to shift northward of its normal position.



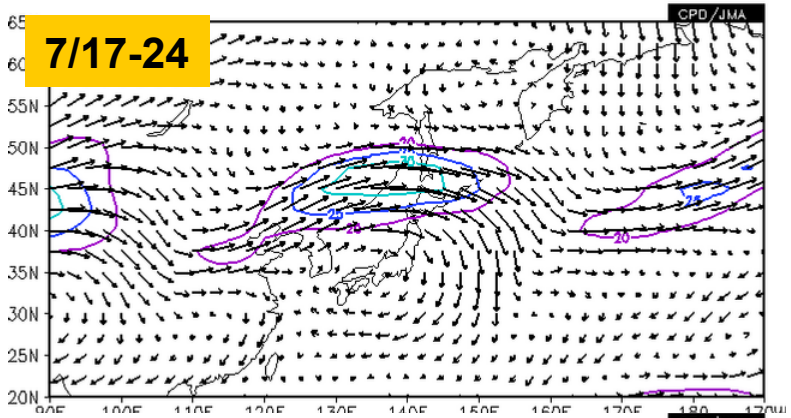


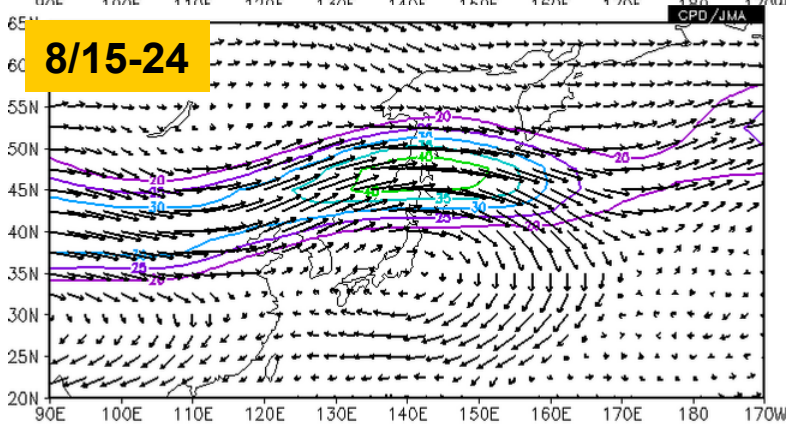
Linear regression coefficients of OLR(10–20N,60–140E) and 200-hPa zonal wind speed for July and August

The shading shows a 95% confidence level based on F-testing.

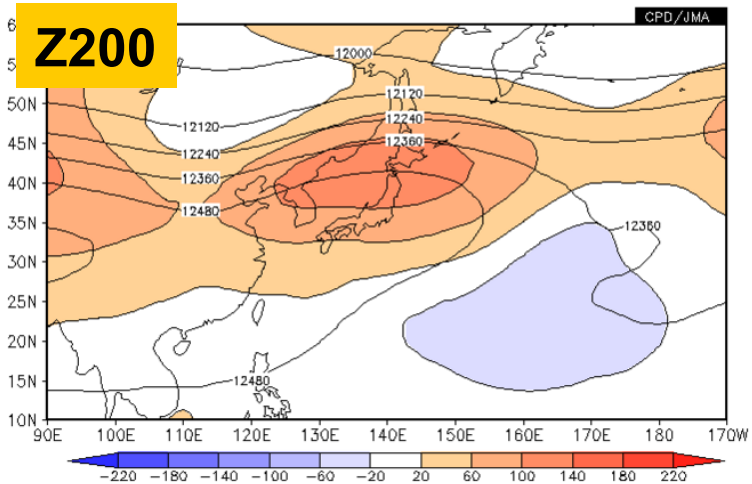
Characteristic atmospheric circulation
Pronounced anticyclone over Japan in second half

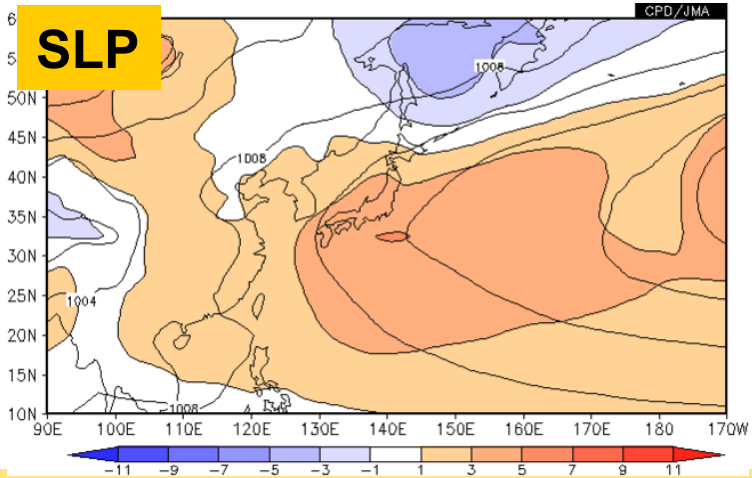
The jet stream was often shifted northward of its normal position with a frequent northward meander and equivalent-barotropic highs developed and persisted over Japan in the second half.





200-hPa zonal wind (vector) and anomaly (line)

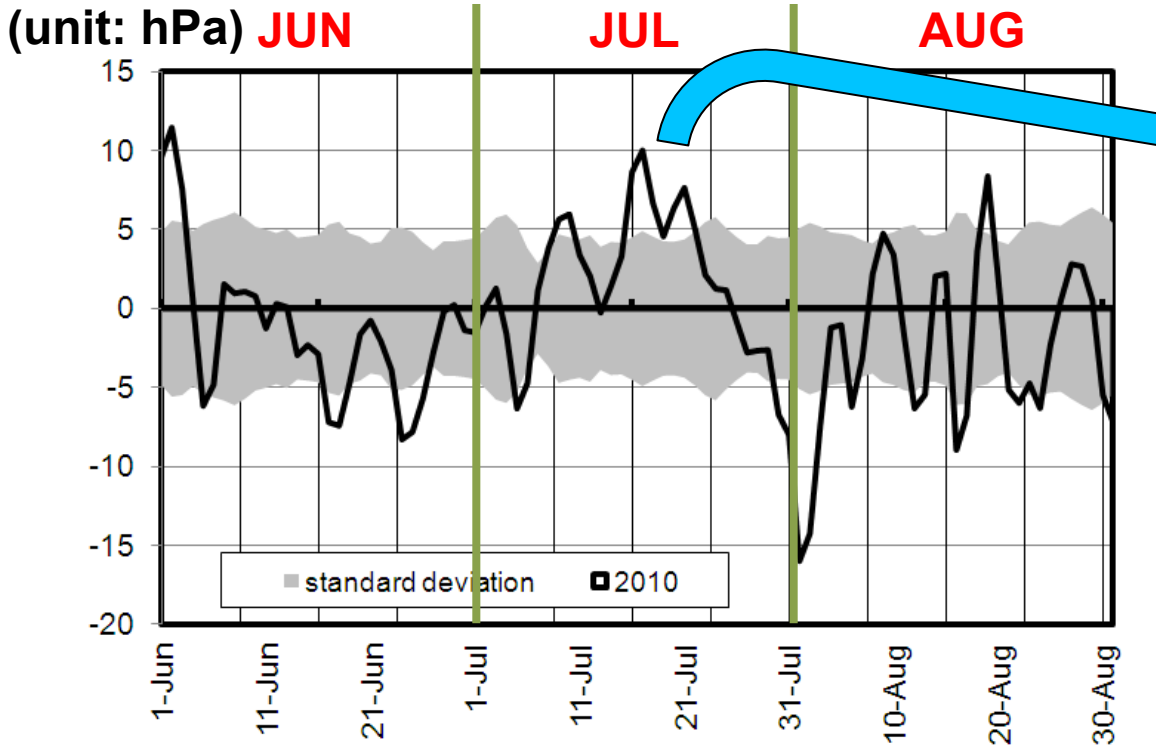


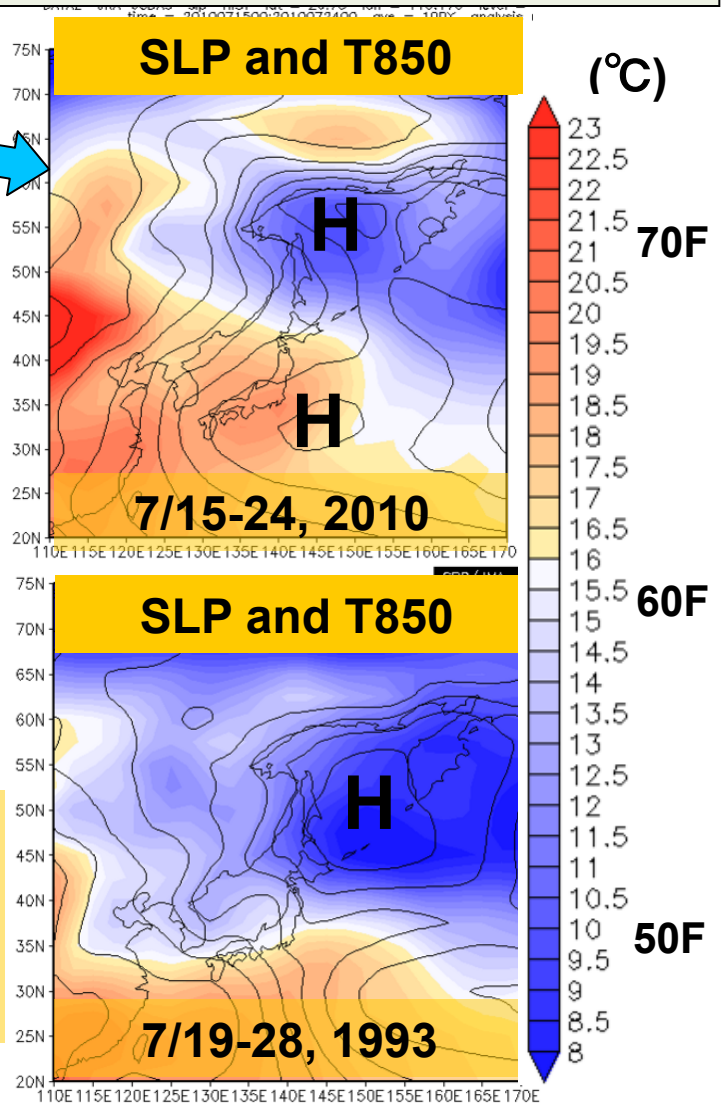


Atmospheric circulation (Aug)

Okhotsk High (cool semi-stationary anti-cyclone)

The Okhotsk High was less developed than in past years
In the second half of July, the phenomenon temporarily appeared but influenced Japan little due to the strong Pacific High.





Time series of average SLP anomaly over the Sea of Okhotsk (45–60N,140–155E) summer 2010.

The thick line indicates daily mean values of the area-averaged sea level pressure anomaly over the region. The gray shading denotes the range of one standard deviation.

Conclusion

the Advisory Panel on Extreme Climate Events (3th September 2010)

「エルニーニョとラニーニャの相乗効果」

気象庁が猛暑原因を分析

今夏の高温の原因について、気象庁の一異常気象分析検討会」（会長、木本昌秀東大大気海洋研究所教授）が3日、見解をまとめた。春まで継続したエルニーニョと、夏に発生したラニーニャ両現象の相乗効果や、日本上空付近を吹く偏西風の蛇行などの複合要因を指摘した。

木本会長は会見で「今後1週間は厳しい残暑が続く」とした上で、「今年のような猛暑が頻繁に起こる可能性は低いと思うが、地球温暖化の長期的な気温上昇傾向は続いており、（今夏に）似たケースは増える」と予想される」と述べた。

今夏の高温の原因（気象庁資料から作成）

エルニーニョ現象終了後ラニーニャが加わって北半球の気温上昇 1

偏西風が北に偏り蛇行。太平洋高気圧が北に張り出す 2

大陸からチベット高気圧が太平洋高気圧に重なるように張り出す 3

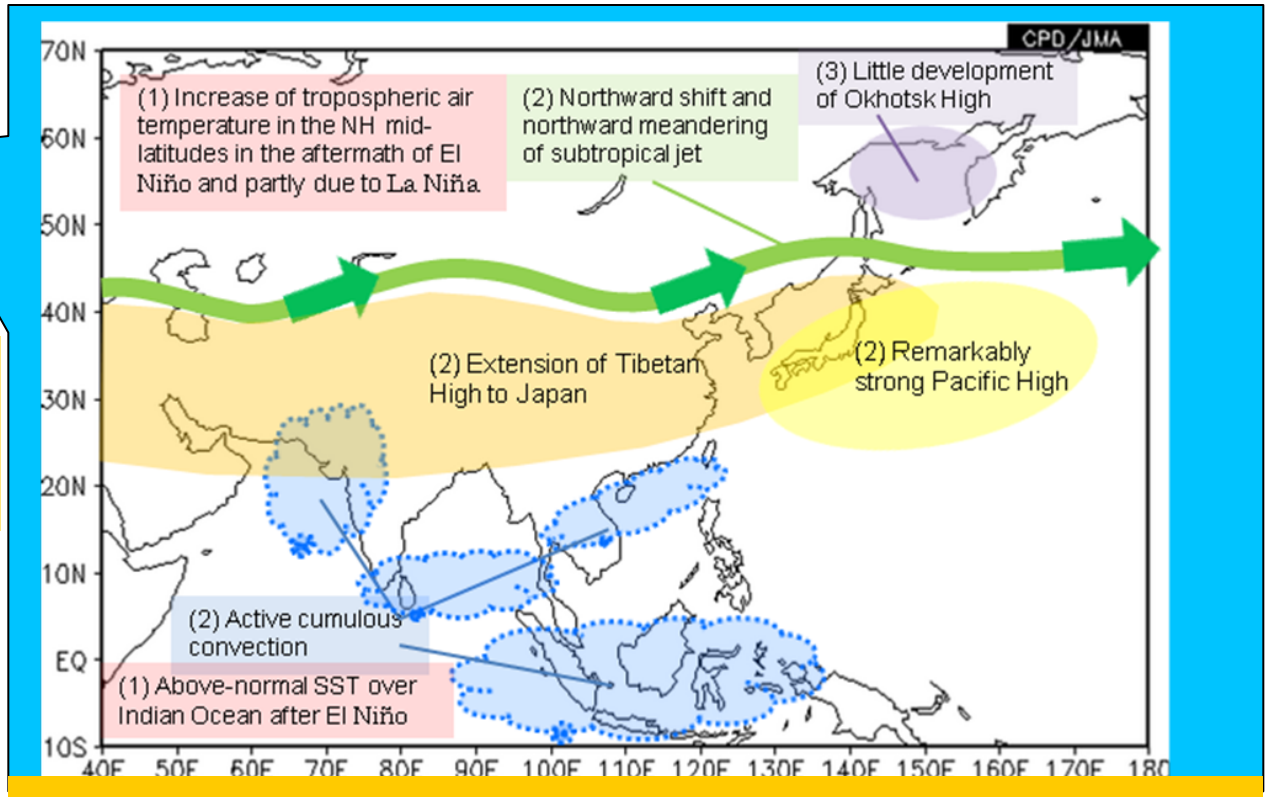
涼しいオホーツク海高気圧の発生ほとんどなし 4

偏西風

チベット高気圧

太平洋高気圧

Japanese major newspaper (4thSep. 2010)



Schematic chart of primary factors of extremely hot summer 2010 in Japan

By The Advisory Panel on Extreme Climate Events, the attribution analysis based on the newest scientific knowledge was made promptly.

Thank You
For Your Attention