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The Characteristics of 2021/22 Winter Monsoon and Climate Conditions in Japan[1] & Seasonal Outlook for Summer 2022 over Japan[2]

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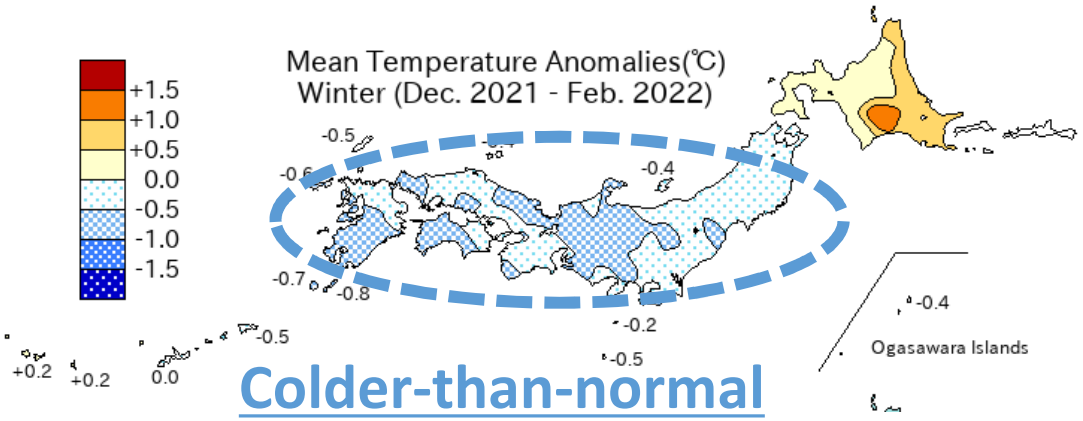
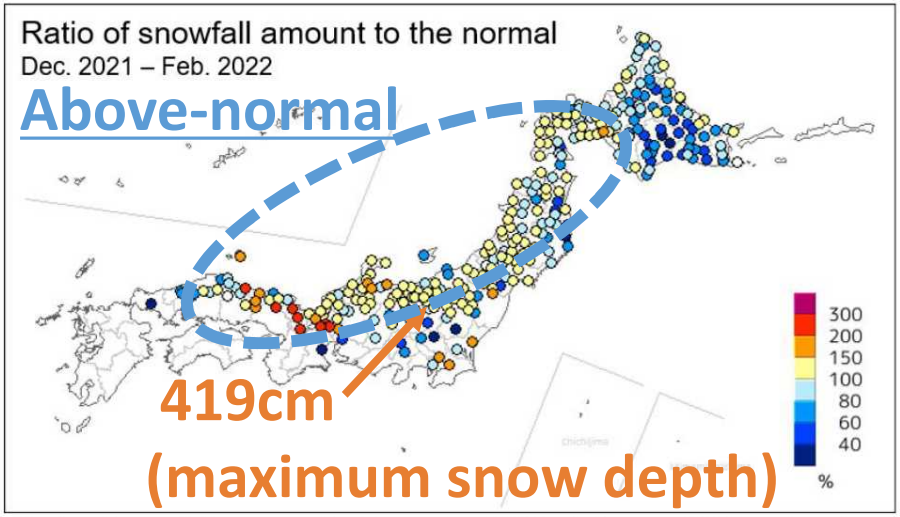
Climate Conditions



Distribution of mean temperature anomalies [°C] for December 2021 – February 2022

The base period for the normal is 1991-2020.

- ✓ Seasonal temperatures were **below normal** in eastern and western Japan
- ✓ **Frequent heavy snowfall** over northern to western parts of the country's Sea of Japan side

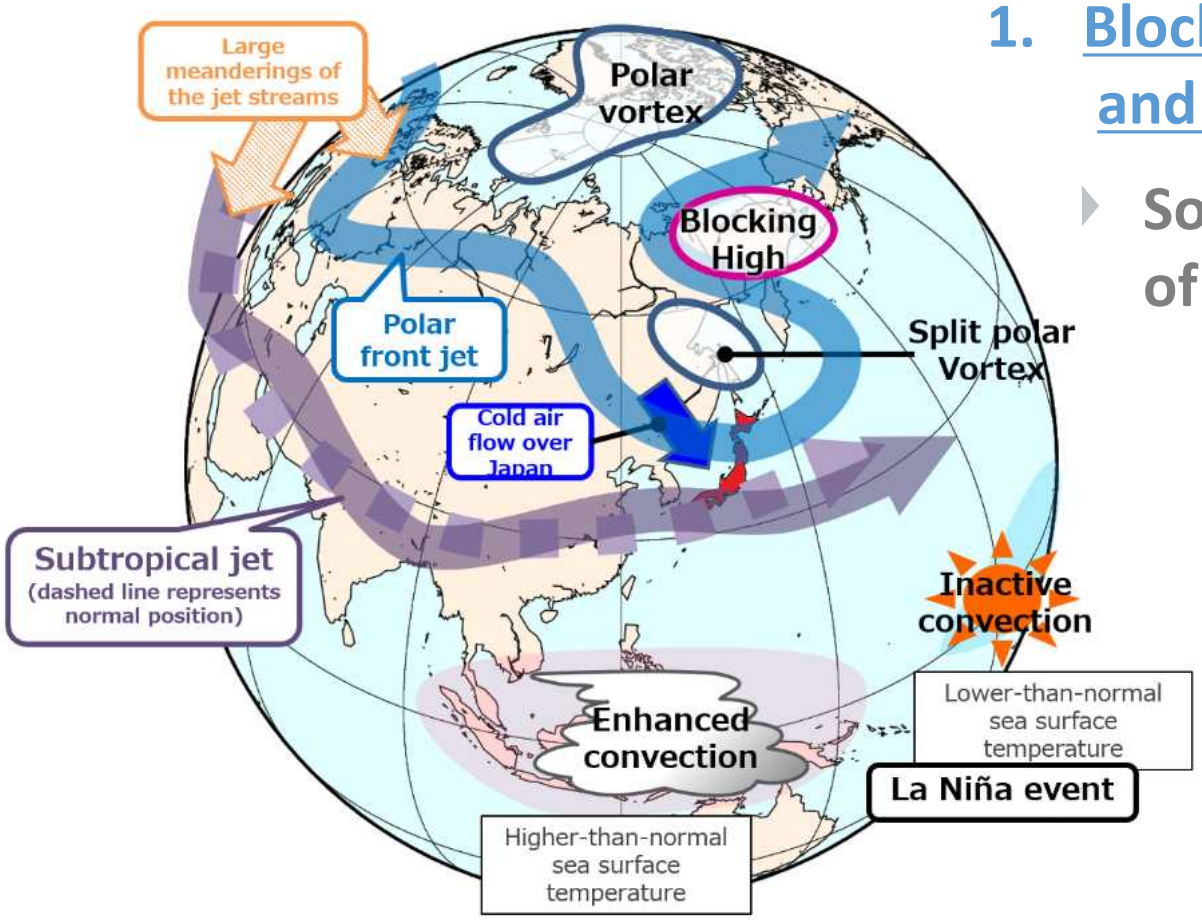


Ratio of snowfall amount for December 2021 – February 2022 to the climatological normal of winter snowfall amount [%]

The base period for the normal is 1991 – 2020. White dots indicate a ratio of 100%. Locations with amounts of 0 cm or normals less than 3 cm are not shown.

What the cause of these climate conditions is?

Primary Factors



Characteristics of atmospheric circulation from December 2021 to February 2022

1. Blocking High and Split Polar Vortex

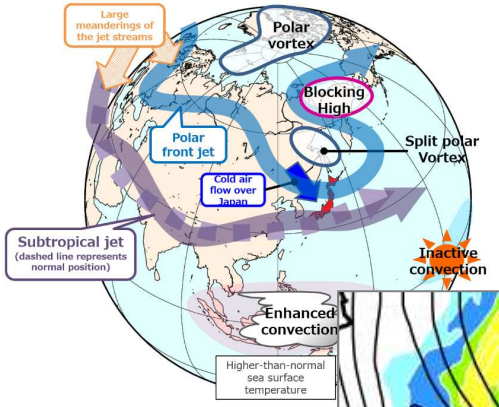
- **Southward shift of the PFJ (Polar front jet)**

2. Enhanced Convective Activity

association with the prevailing La Niña event

- **Southward shift of the STJ (Subtropical jet)**

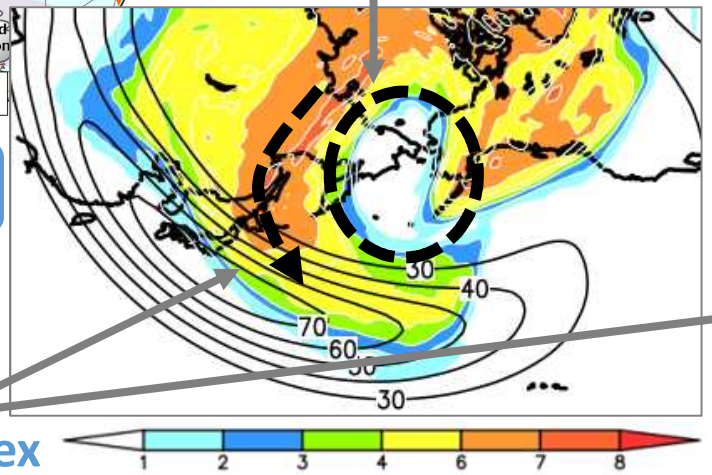
Primary Factors



Blocking high

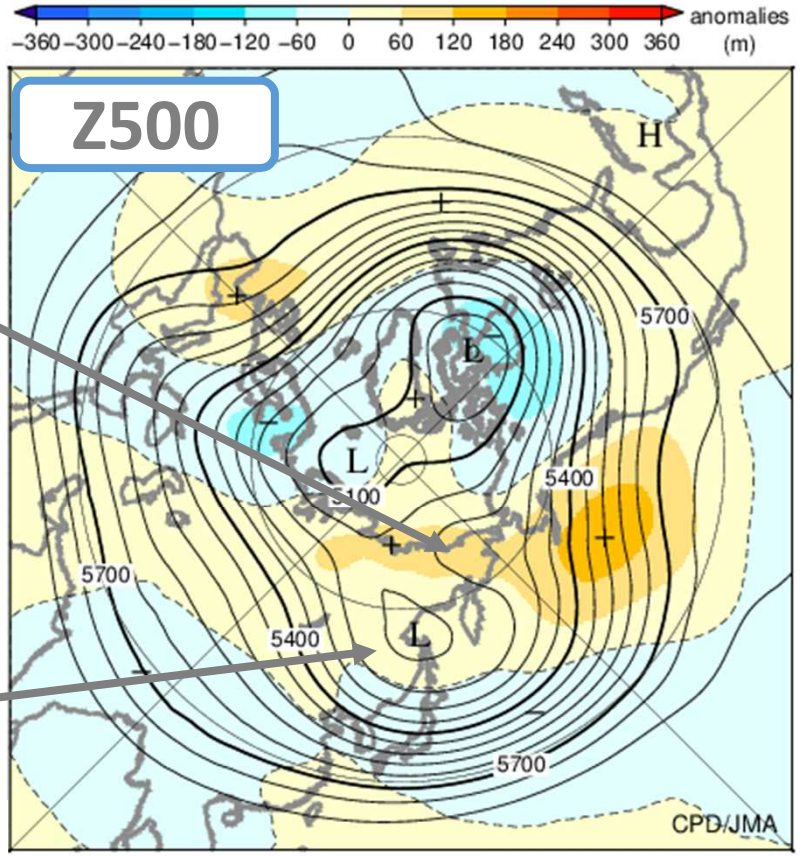
4 Jan. 2022

PV, U200



Split Polar Vortex

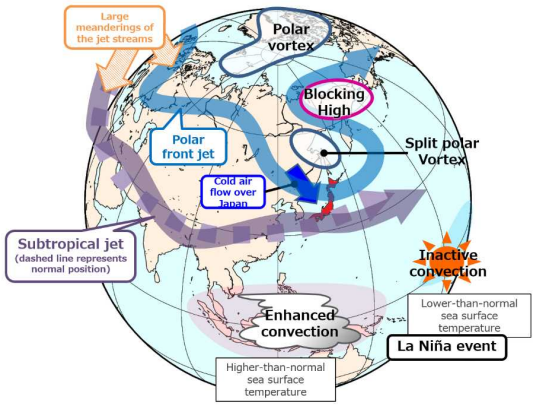
320-K Potential vorticity [PVU] and 200hPa climatological zonal wind [m/s] (4 Jan. 2022)
The shading indicates 320-K Potential vorticity.
The contours show 200hPa climatological zonal wind.

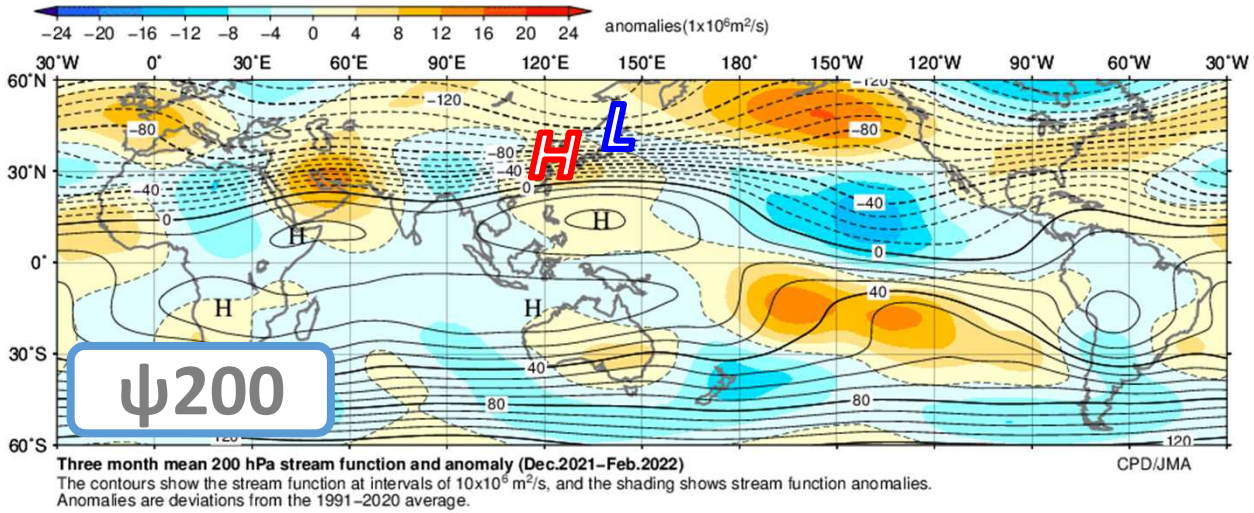


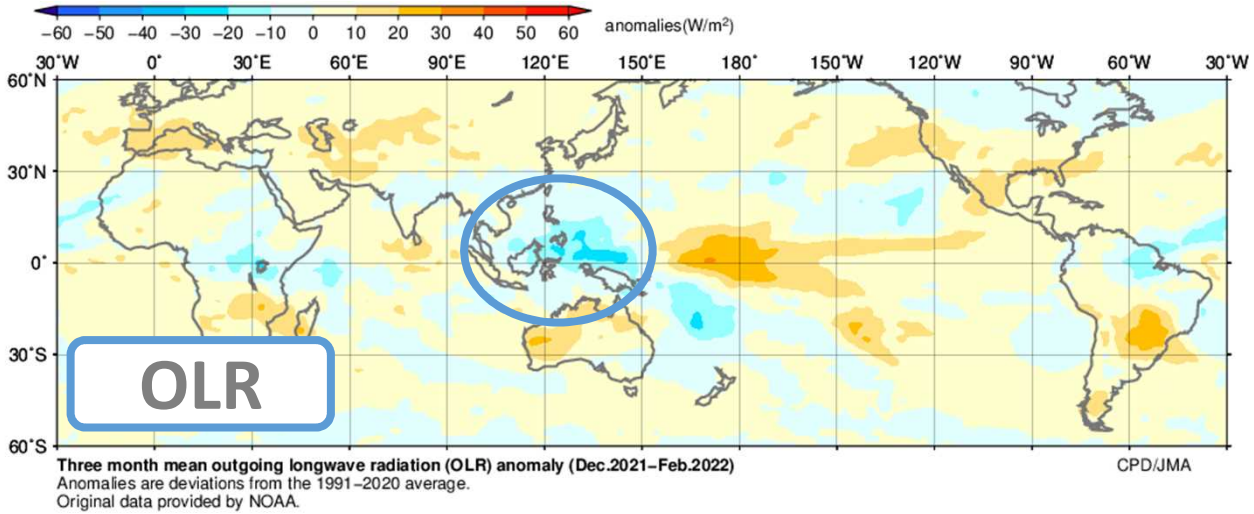
Three month mean 500 hPa height and anomaly in the Northern Hemisphere (Dec.2021–Feb.2022)
The contours show height at intervals of 60 m.
The shading indicates height anomalies.
Anomalies are deviations from the 1991–2020 average.

- ✓ The formation of a **blocking high** over Eastern Siberia in the upper troposphere
- ✓ Along with the blocking high, the tropospheric **polar vortex** over the Arctic region split, with partial movement southward to just north of Japan
  - **Southward shift of the PFJ (Polar front jet)**

Primary Factors







- ✓ **Enhanced convective activity** in the area from the Philippines to eastern Indonesia in association with the prevailing La Niña event
- ✓ Northward shift of STJ to the west of Japan

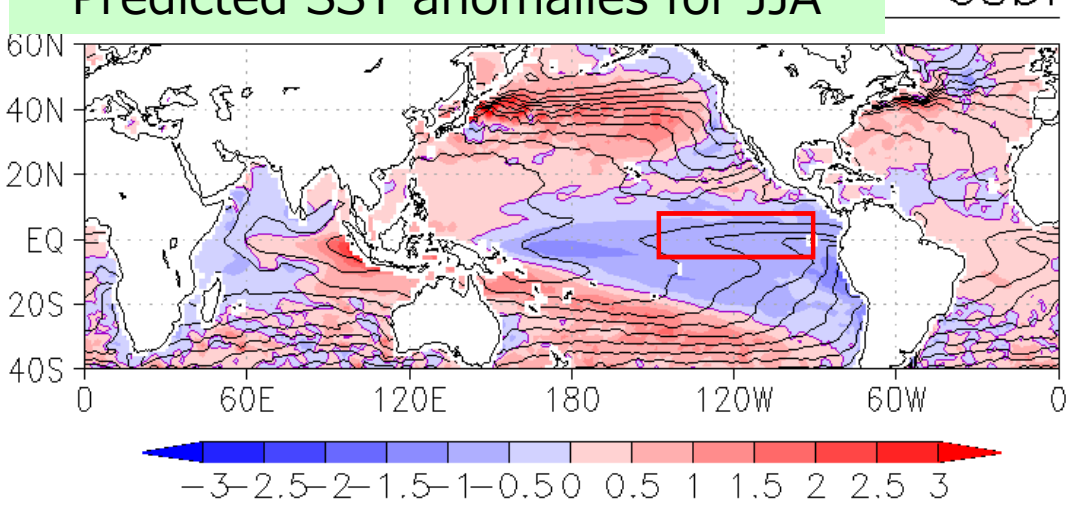
- **Southward shift of the STJ (Subtropical jet)**

Seasonal outlook for summer 2022 over Japan

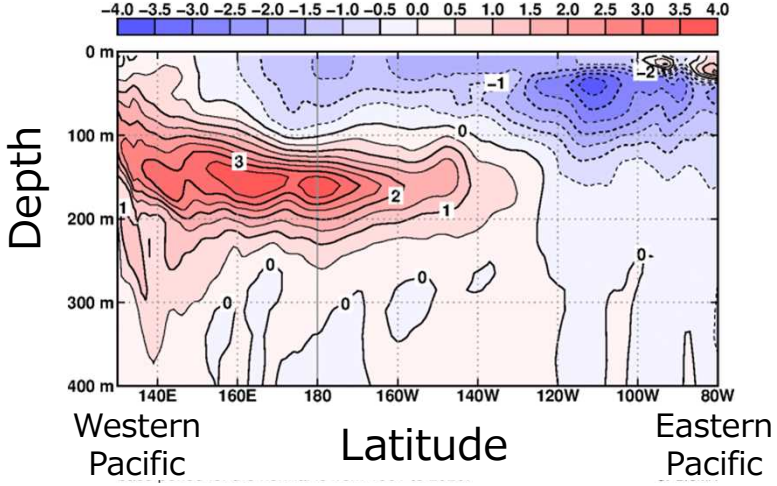
Expected conditions in the tropical ocean

- The ongoing La Niña event is likely cease to meet the definition by the end of summer.
- Despite that, impacts on global circulations are expected to remain through summer.

Predicted SST anomalies for JJA



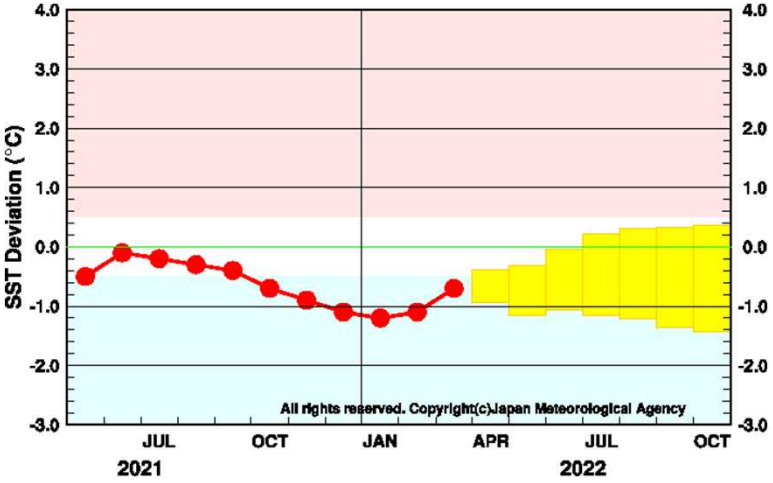
Subsurface water temperature anomaly analysis for early May



<Source>

Monthly El Niño outlook issued on Apr.11

NINO.3 SST deviations



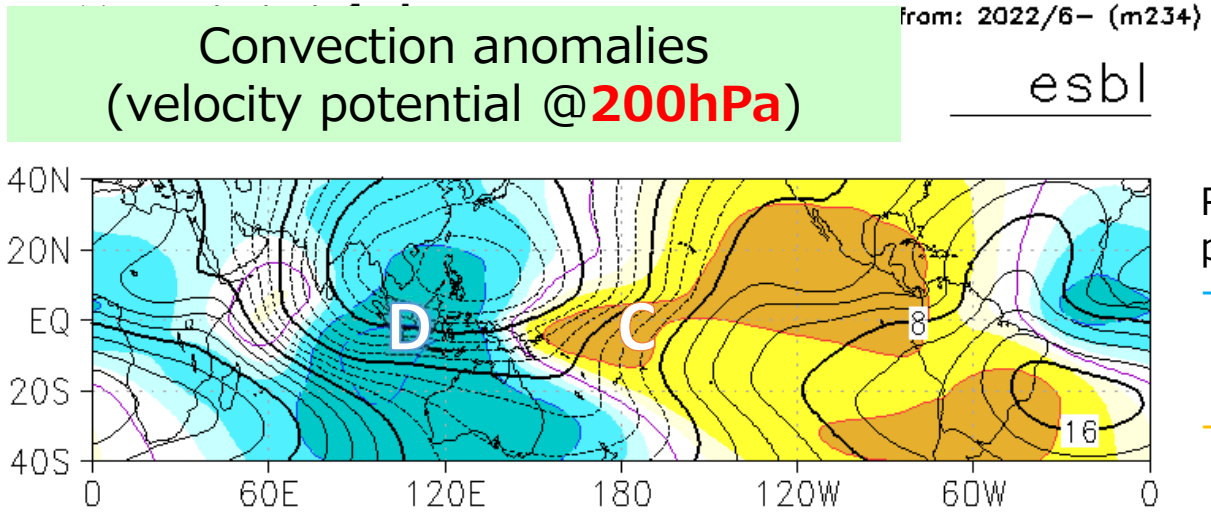
ENSO probability forecasts

YEAR	MONTH	mean period	El Niño	ENSO neutral	La Niña
2022	FEB	DEC2021–APR2022		100	
	MAR	JAN2022–MAY2022		100	
	APR	FEB2022–JUN2022		20	80
	MAY	MAR2022–JUL2022		40	60
	JUN	APR2022–AUG2022		70	30
	JUL	MAY2022–SEP2022		70	30
	AUG	JUN2022–OCT2022		70	30

Bars indicate probabilities for 5-month periods centered on FEB to AUG

Upper troposphere circulations

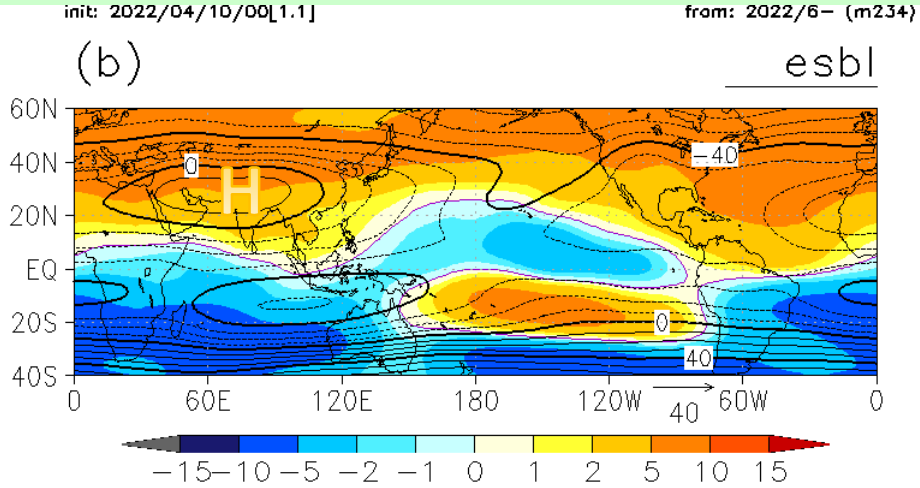
Convection anomalies (velocity potential @**200hPa**)



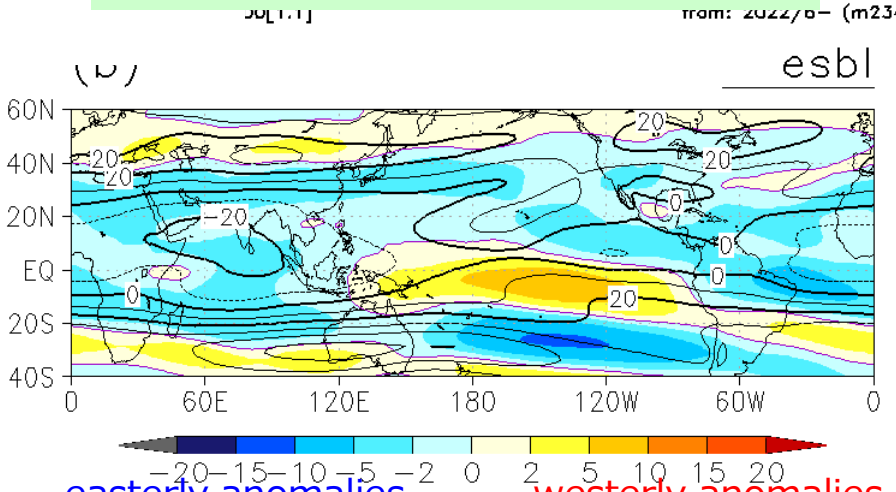
Responding to SST anomalies, i.e., prolonged La Niña conditions,

- Enhanced convective activity is predicted over and around the Maritime Continent
- Suppressed convective activity over central to eastern Pacific

Stream function & anomalies @**200hPa**



Zonal wind anomalies @**200hPa**



easterly anomalies westerly anomalies

Responding to convection anomalies,

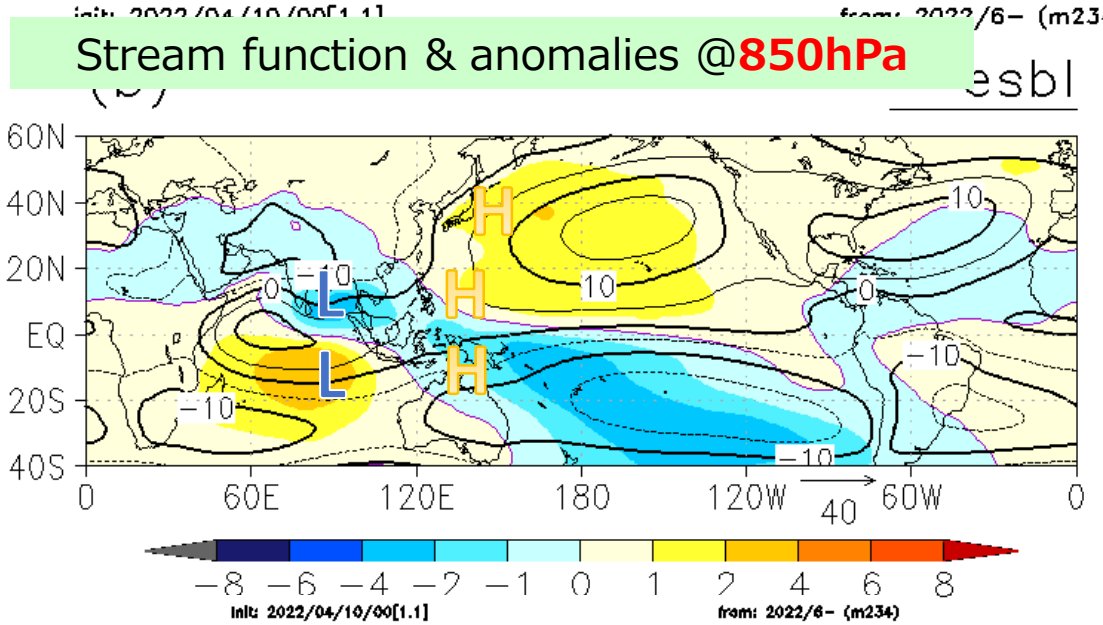
- South Asian Anticyclone (Tibetan High) is predicted to extend northward

Or equivalently,

- Subtropical Jet Stream is displaced northward of its normal latitude

Lower troposphere circulations

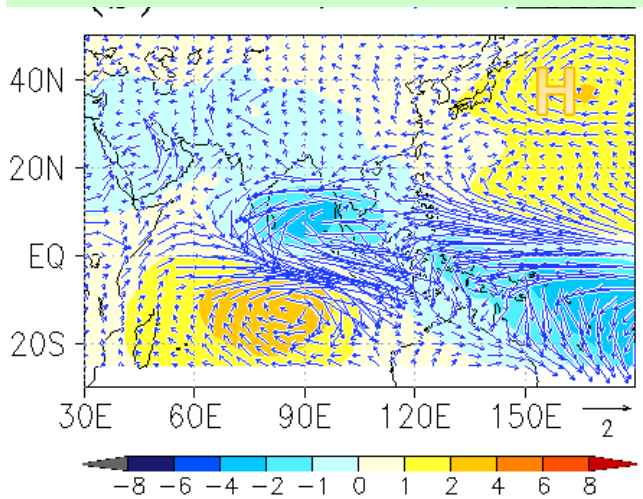
Stream function & anomalies @**850hPa**



Responding to convection anomalies,

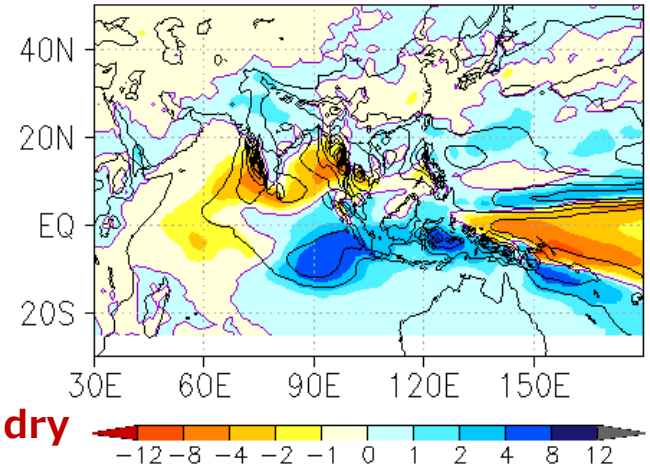
- "Twin-cyclone" anomaly structure is predicted in the eastern Indian Ocean
- Anti-cyclonic anomalies are predicted over the tropical Pacific
- In mid-latitudes, the WNPSH is predicted to extend northward, consistent with the SJS displacement

Wind anomalies @**850hPa**



- Above-normal warm air inflow associated with enhanced circulation around the WNPSH

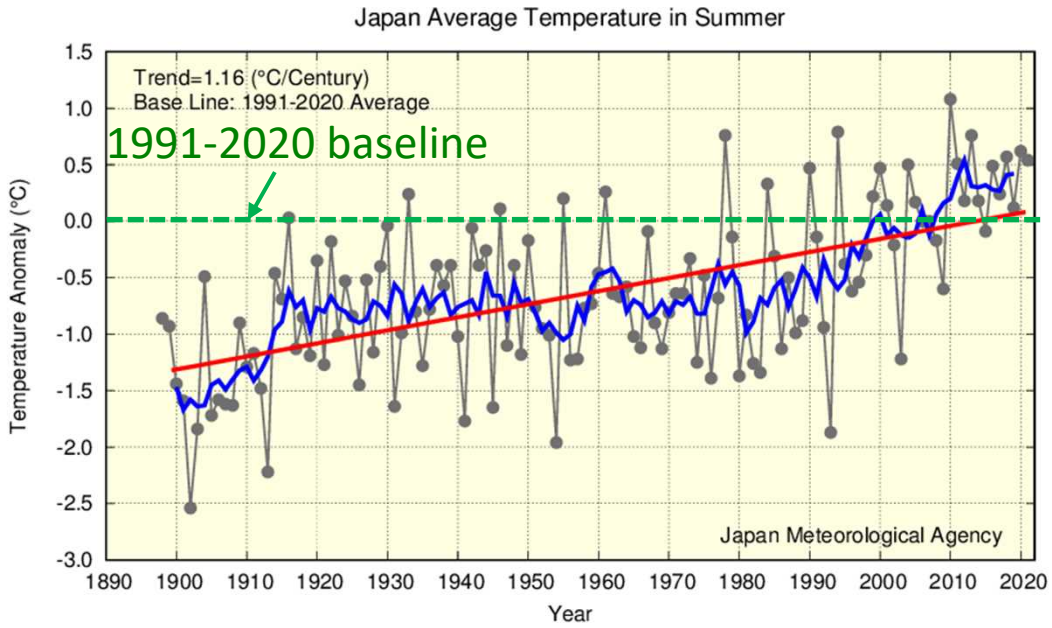
Precipitation anomalies



- Above normal precipitation is predicted for **the northern part** of Asian monsoon region and to the east of the Philippines

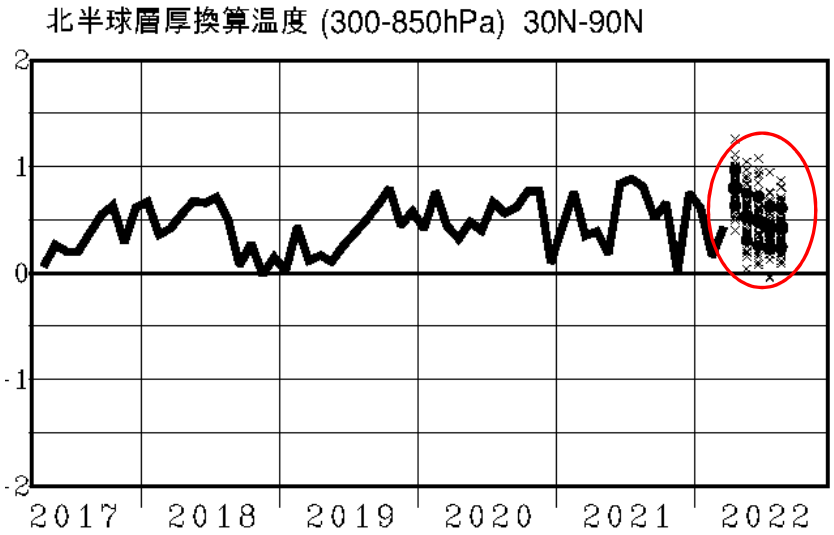
Long-term and large-scale trends

Long-term trend for Japan national surface temperature for summer

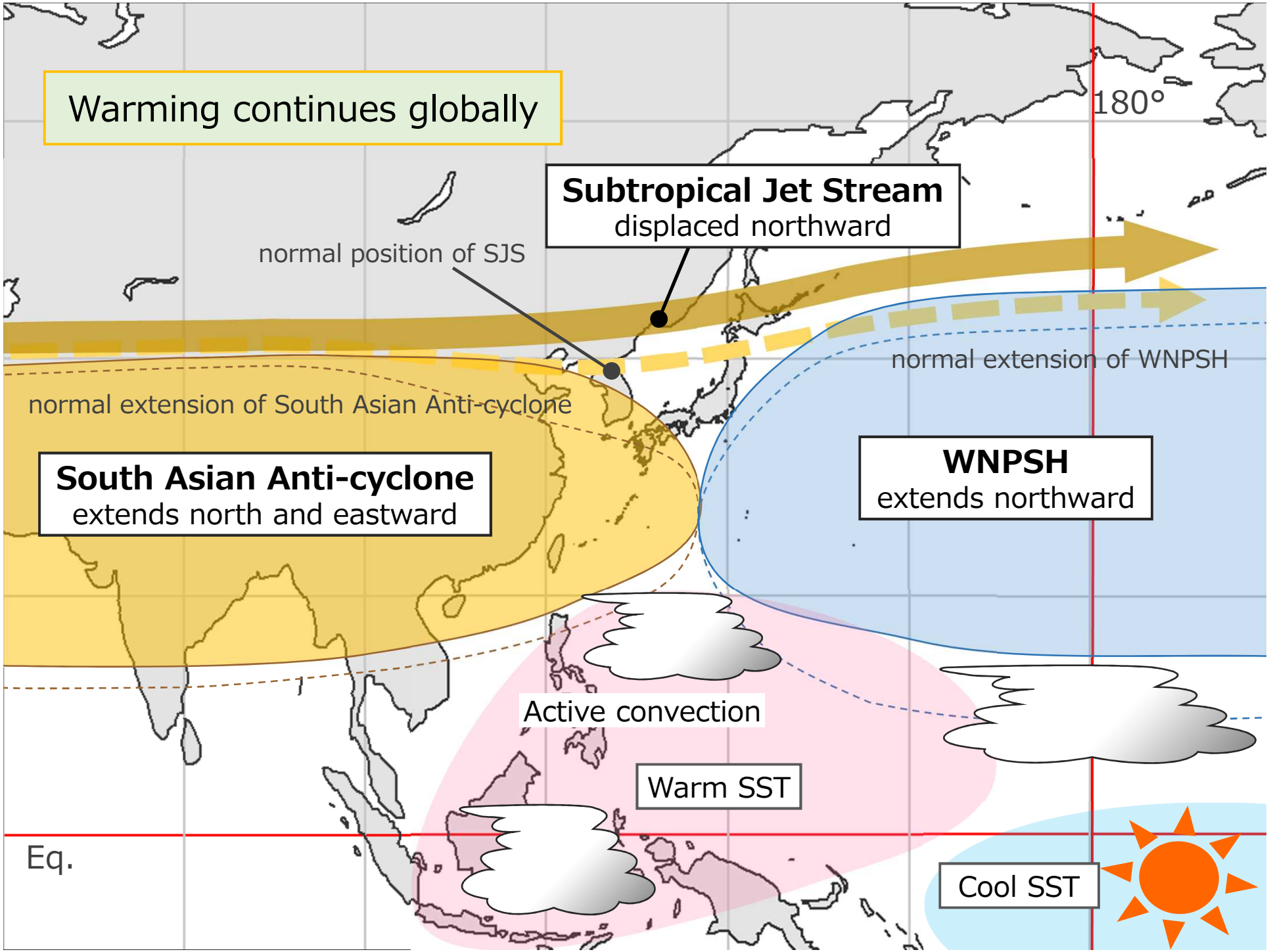


- National average temperatures over Japan have been rising at 1.2 °C / century.
- In most of recent summers, temperatures were about 0.5 °C above normal

Predicted temperature anomalies for the troposphere of 30-90N

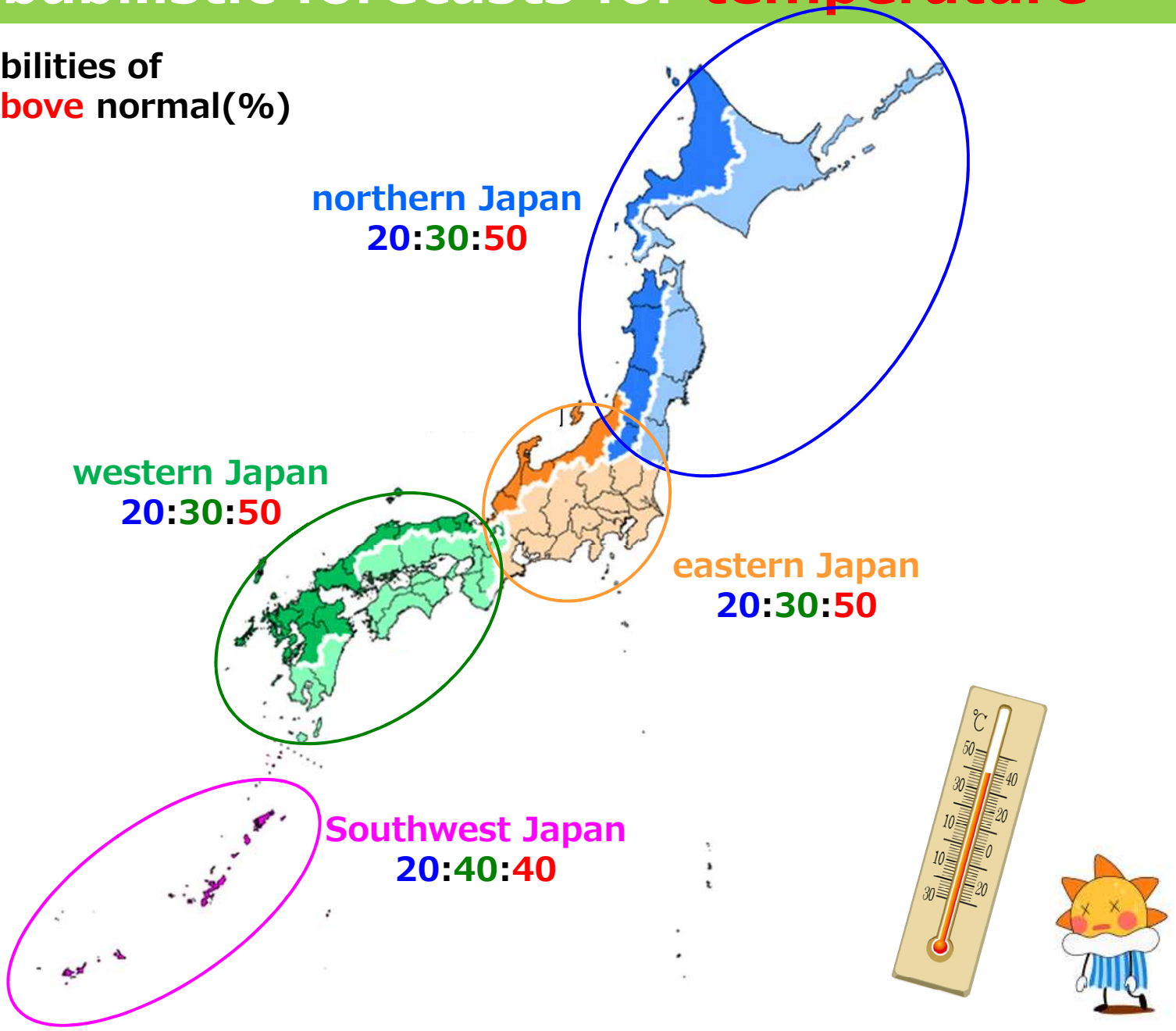


- On large-scale, temperatures are predicted about 0.5 °C above normal for the coming summer


Warming continues globally
180°
Subtropical Jet Stream
displaced northward
normal position of SJS
normal extension of WNPSH
normal extension of South Asian Anti-cyclone
South Asian Anti-cyclone
extends north and eastward
WNPSH
extends northward
Active convection
Warm SST
Cool SST
Eq.

Probabilistic forecasts for temperature

Probabilities of
below:near:above normal(%)



Probabilistic forecasts for precipitation

Probabilities of below:near:above normal(%)