

Characteristics of 2018/2019 winter monsoon in Japan

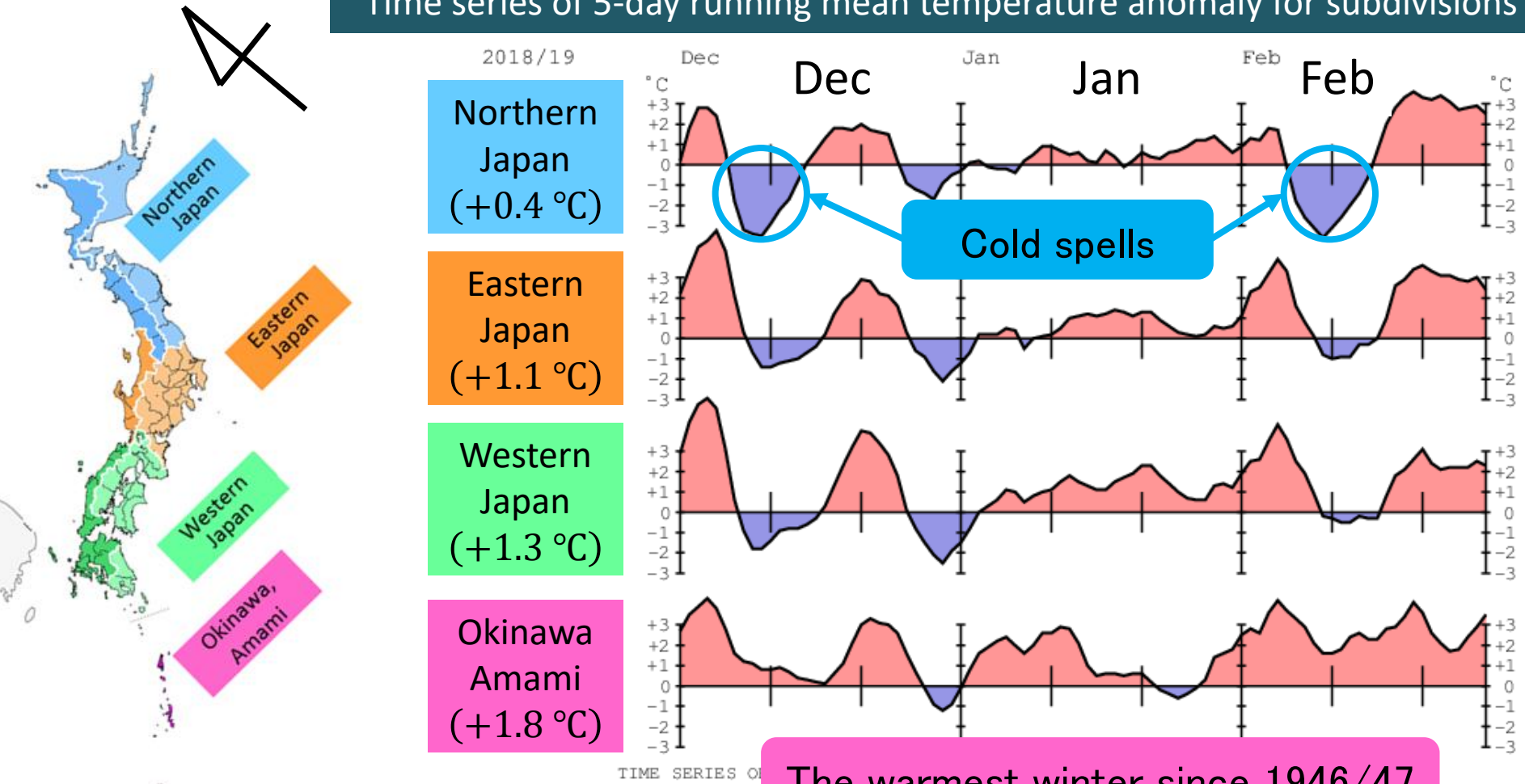
- Masashi Sumitomo
- Tokyo Climate Center
- Japan Meteorological Agency

Outline

- 1. Overview of winter climate over Japan**
2. Warm winter factors
3. Cold spells factors

Overview of Temperature Anomalies in this Winter

Time series of 5-day running mean temperature anomaly for subdivisions



- **Warm winter**

- In Okinawa / Amami, It was the warmest winter since 1946/47.

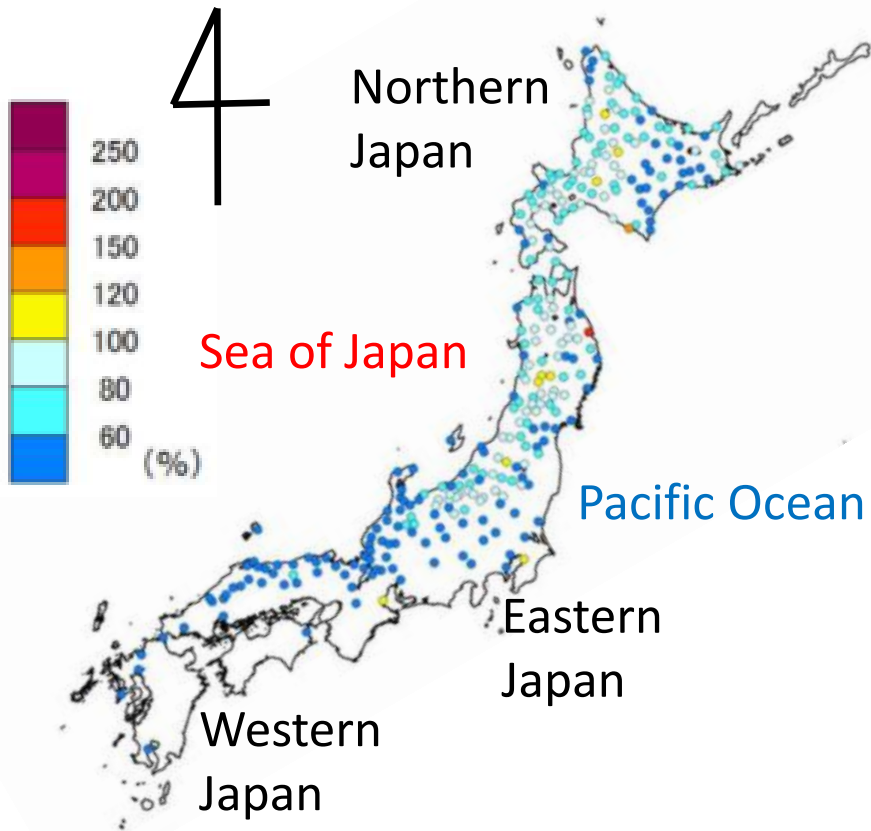
- **Cold spells (Northern Japan)**

- On early Feb, 850hPa temperature at Sapporo of -24.4°C was the lowest since 1957.

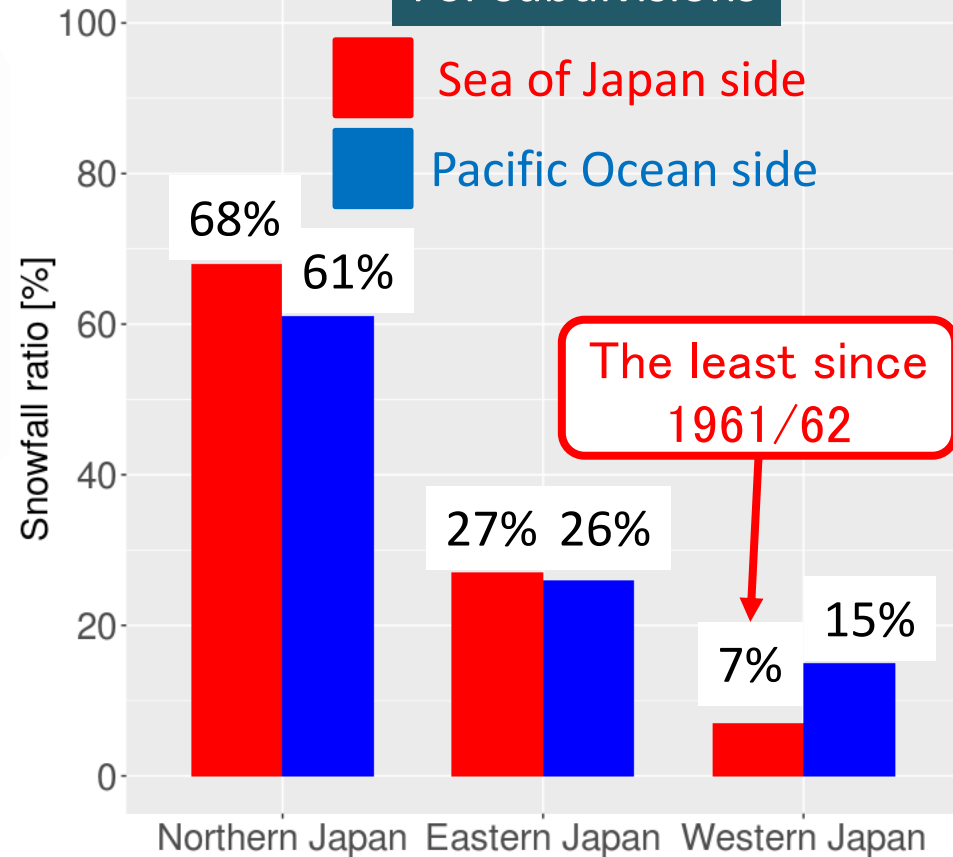
Overview of Snowfall Ratios in this Winter

Snowfall ratios in this winter

For observation stations



For subdivisions



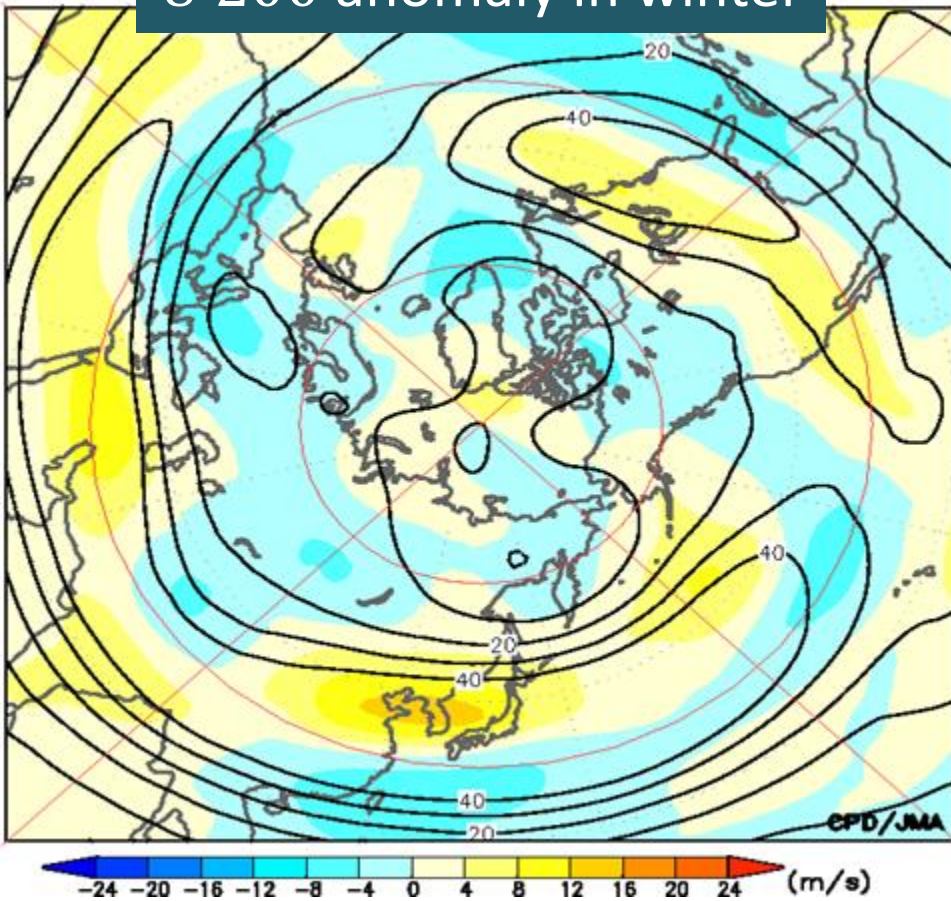
Snowfall was extremely below normal all over Japan.

Outline

1. Overview of winter climate over Japan
- 2. Warm winter factors**
3. Cold spells factors

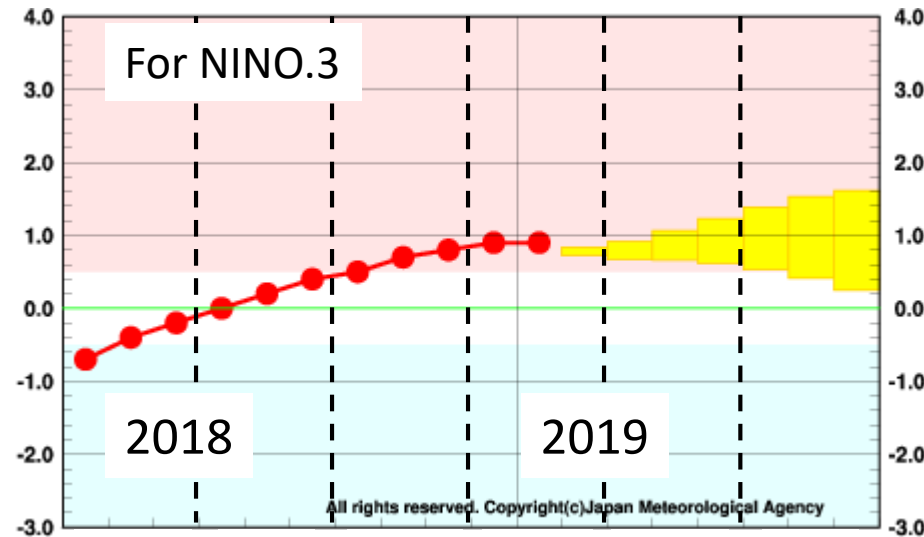
Warm winter factors

U 200 anomaly in winter



U 200 : Zonal wind at 200-hPa

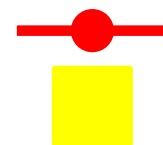
5-month running mean of SST deviation



Apr Jul Oct Jan Apr Jul

SST : Sea Surface Temperature

NINO.3 : 5°N~5°S, 150°W~90°W



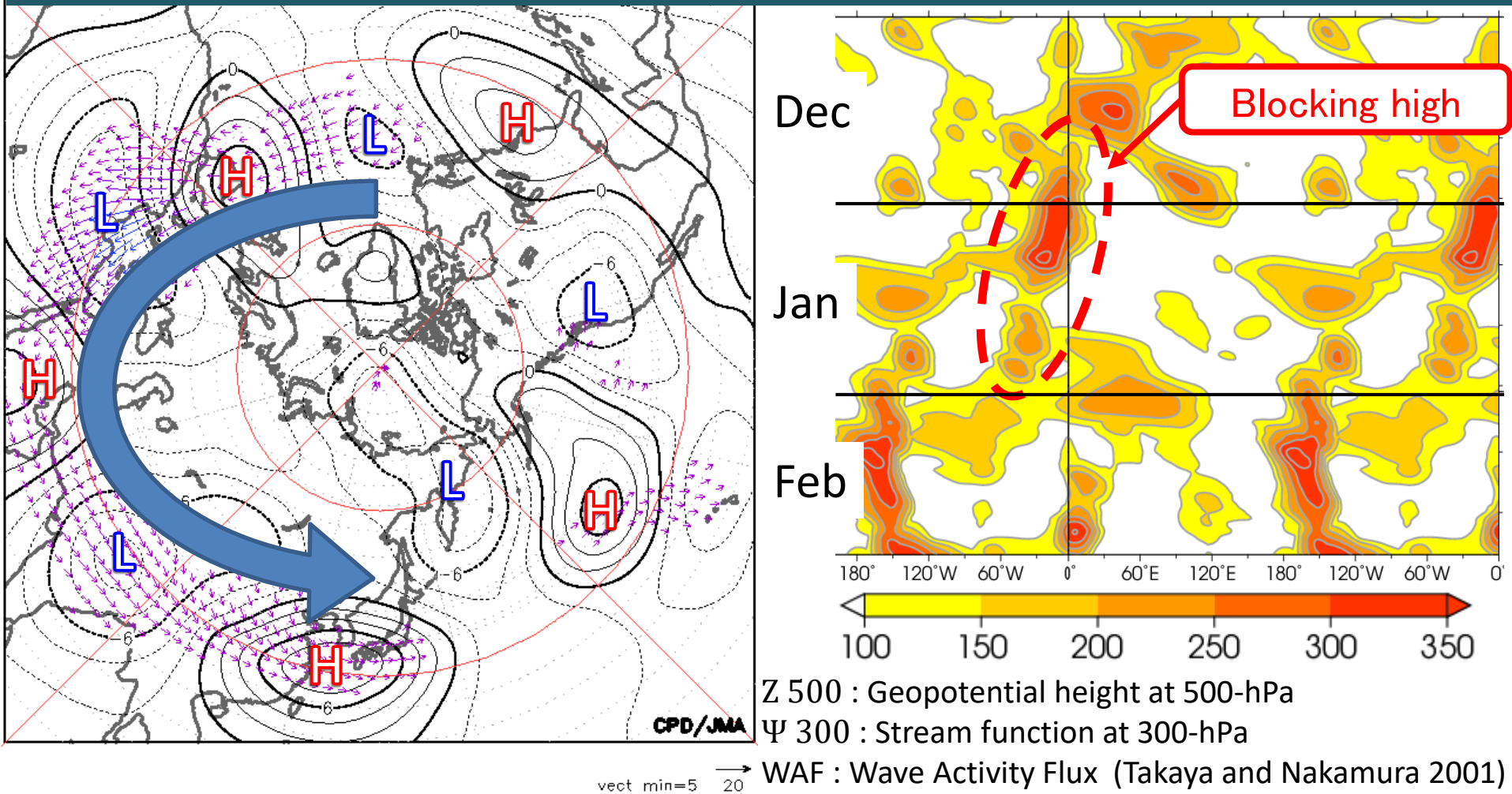
Observed values

Predictions by JMA/MRI-CGCM2

- Subtropical jet stream meandered **northward** around Japan.
- **El Niño** conditions have persisted from autumn 2018.

Warm winter factors (meandering of jet stream)

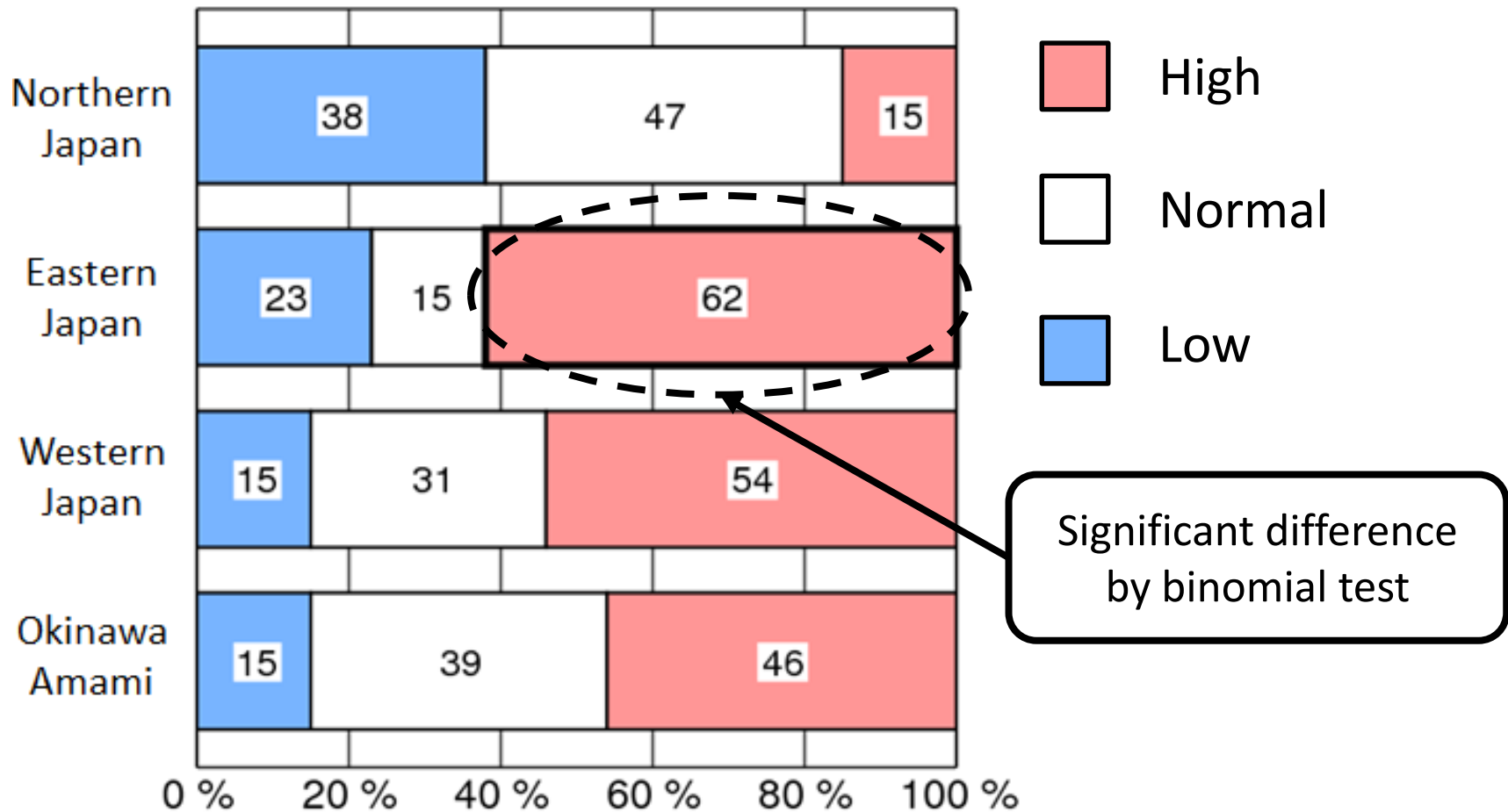
Ψ 300 anomaly and WAF in winter Max Z 500 anomaly at 40°N~80°N



- **Anticyclonic** circulation anomaly formed over the East China Sea.
- Blocking high formed over the North Atlantic Ocean.

Warm winter factors (influence of El Niño)

Percentage of mean temperature rank in El Niño events (winter 1958 - 2012)
Due to statistical result of area averaged temperature in past.

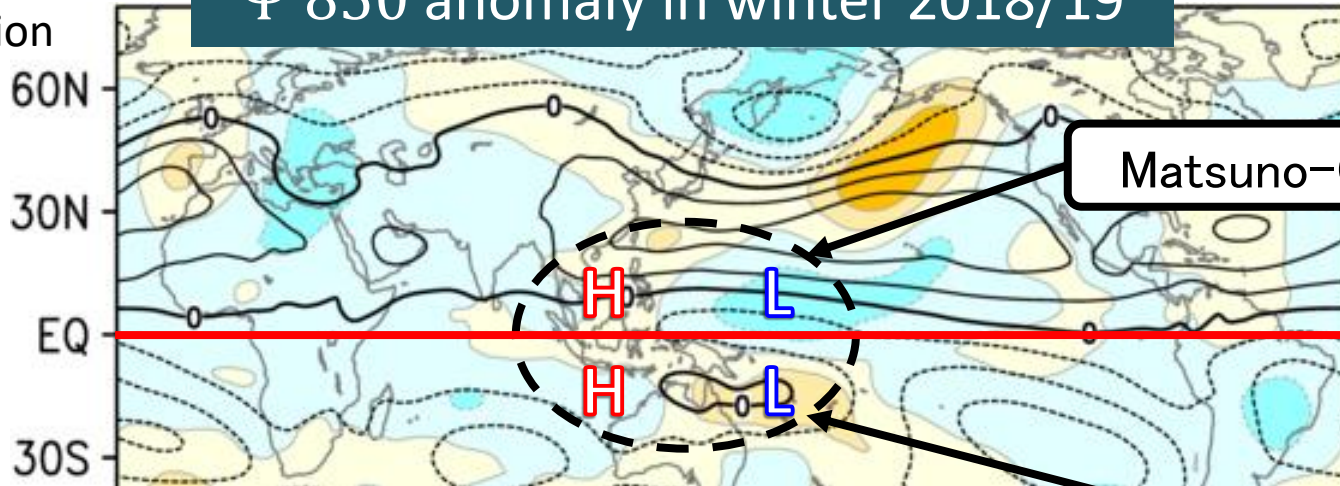


When El Niño events occur in winter, temperatures tend to be normal or **higher** except northern Japan.

Warm winter factors (influence of El Niño)

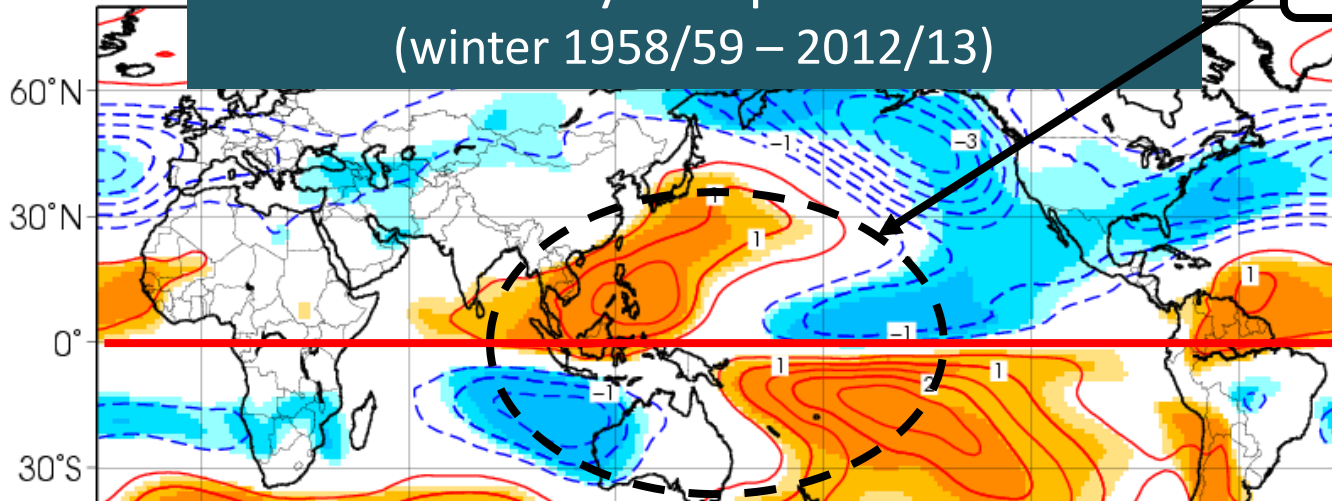
Ψ 850 :
Stream function
at 850-hPa

Ψ 850 anomaly in winter 2018/19



Matsuno-Gill pattern

Ψ 850 anomaly composite of El Niño
(winter 1958/59 – 2012/13)



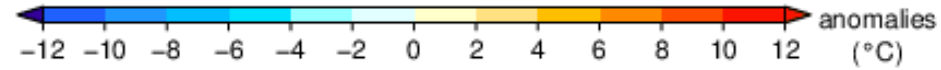
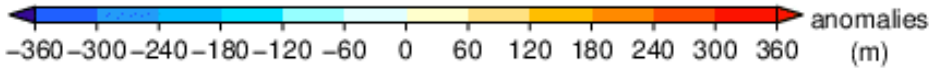
Consistent

- **Anticyclonic** circulation anomaly formed around the Philippines.
- **Warm and moist air** often flowed into Okinawa and Amami.

Cold spells factors

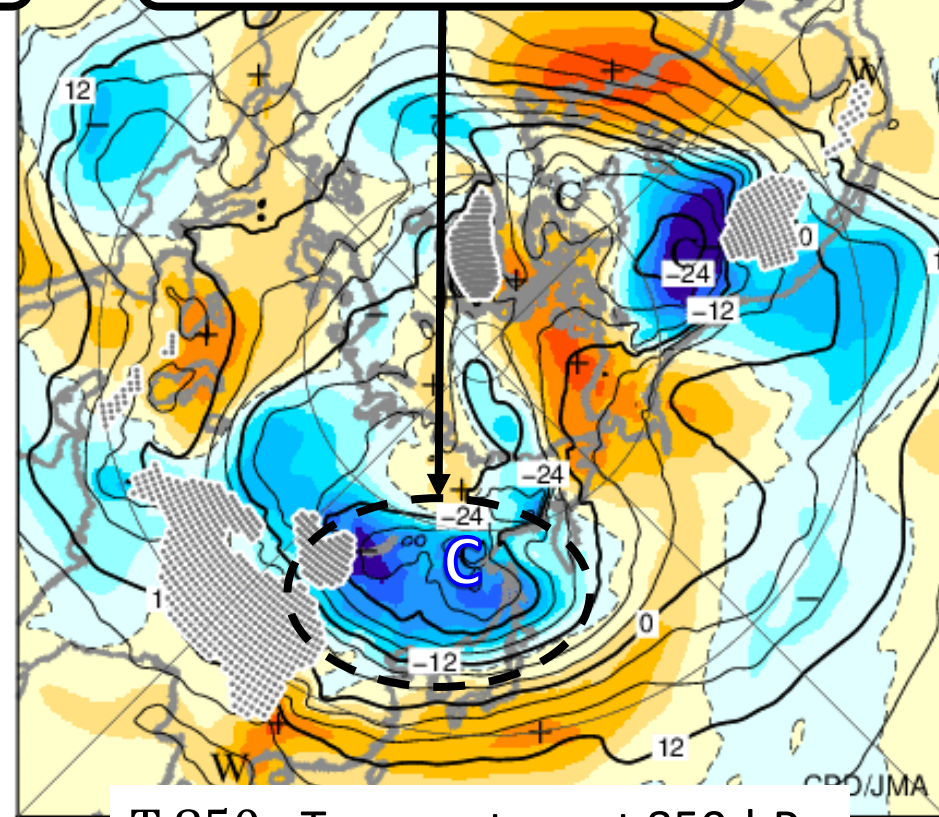
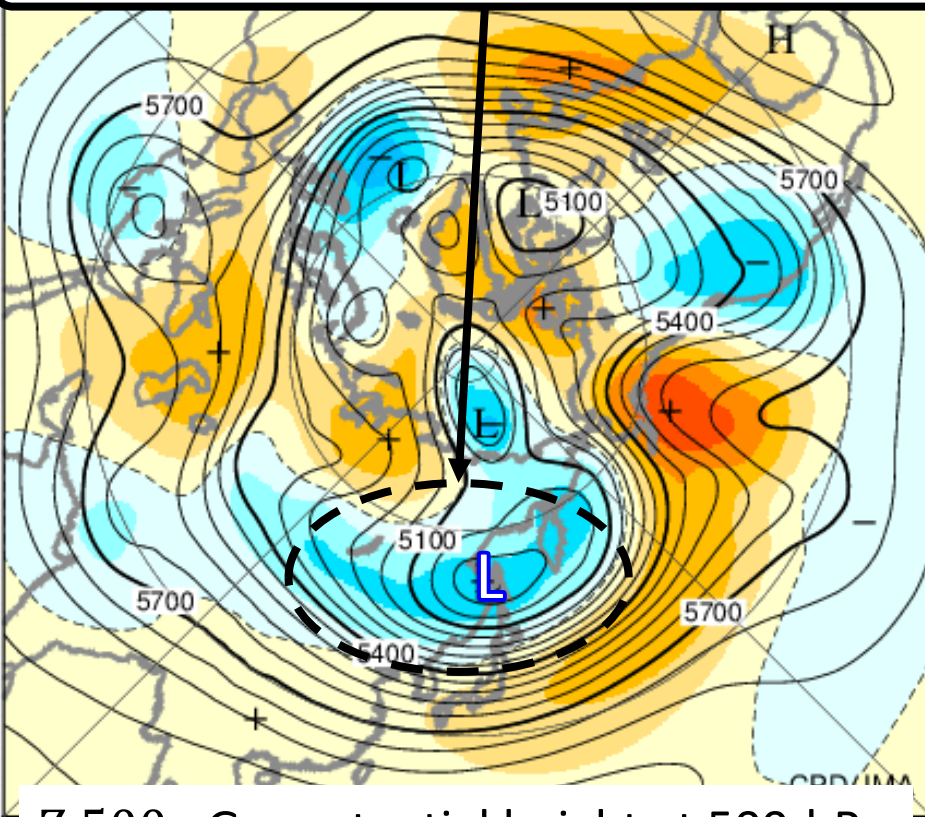
Z 500 anomaly (5th - 9th Feb)

T 850 anomaly (5th - 9th Feb)



Polar vortex shifted **southward**.

Cold spell covered.



Z 500 : Geopotential height at 500-hPa

T 850 : Temperature at 850-hPa

On 8th Feb, observed 850-hPa temperature at Sapporo was **-24.4 °C**.

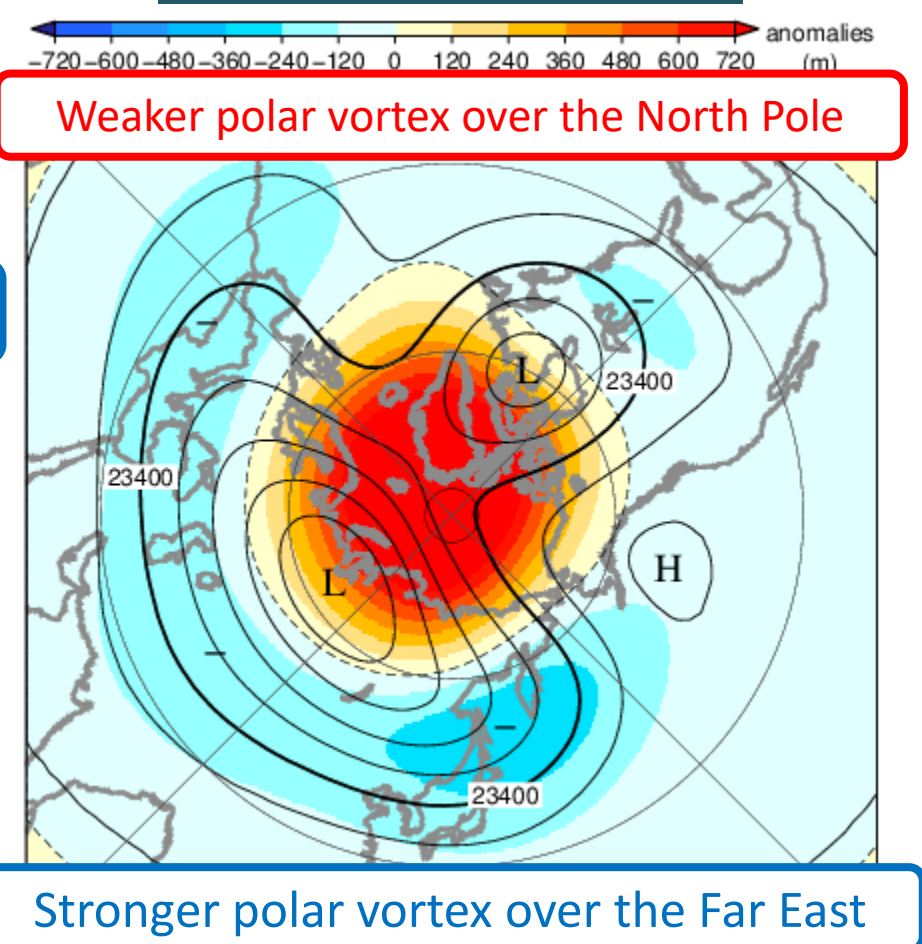
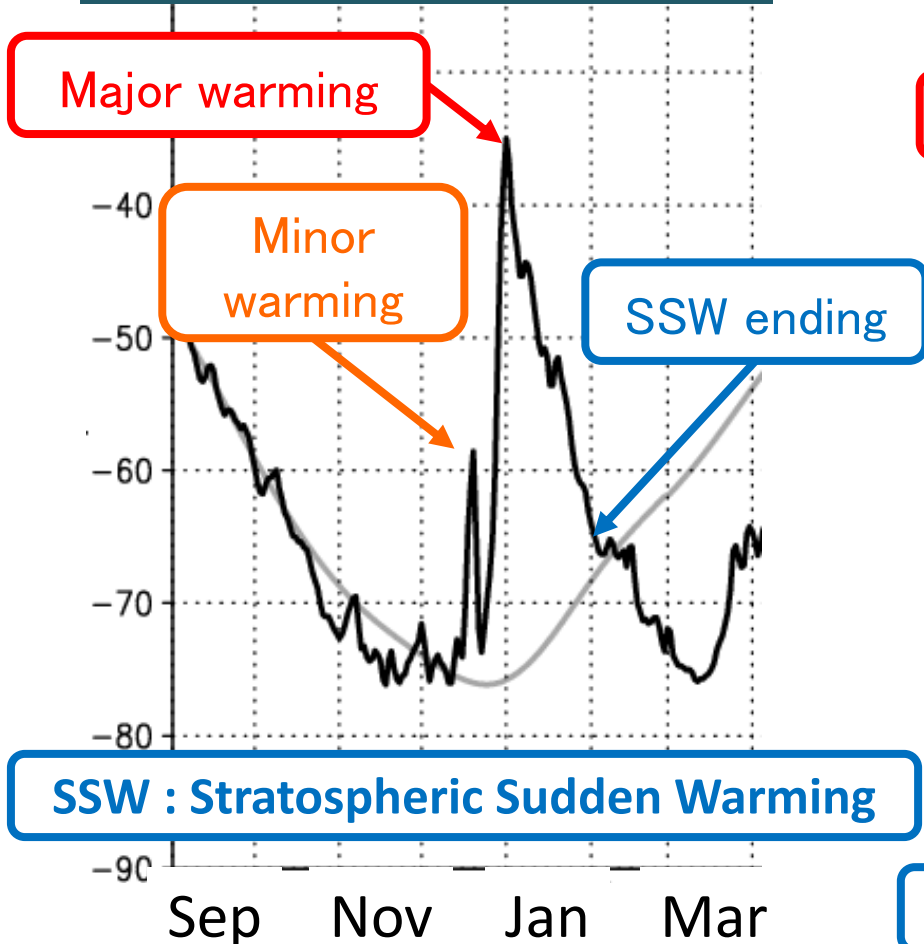
Cold spells factors

Z 30 : Geopotential height at 30-hPa

T 30 : Temperature at 30-hPa

T 30 over the North Pole

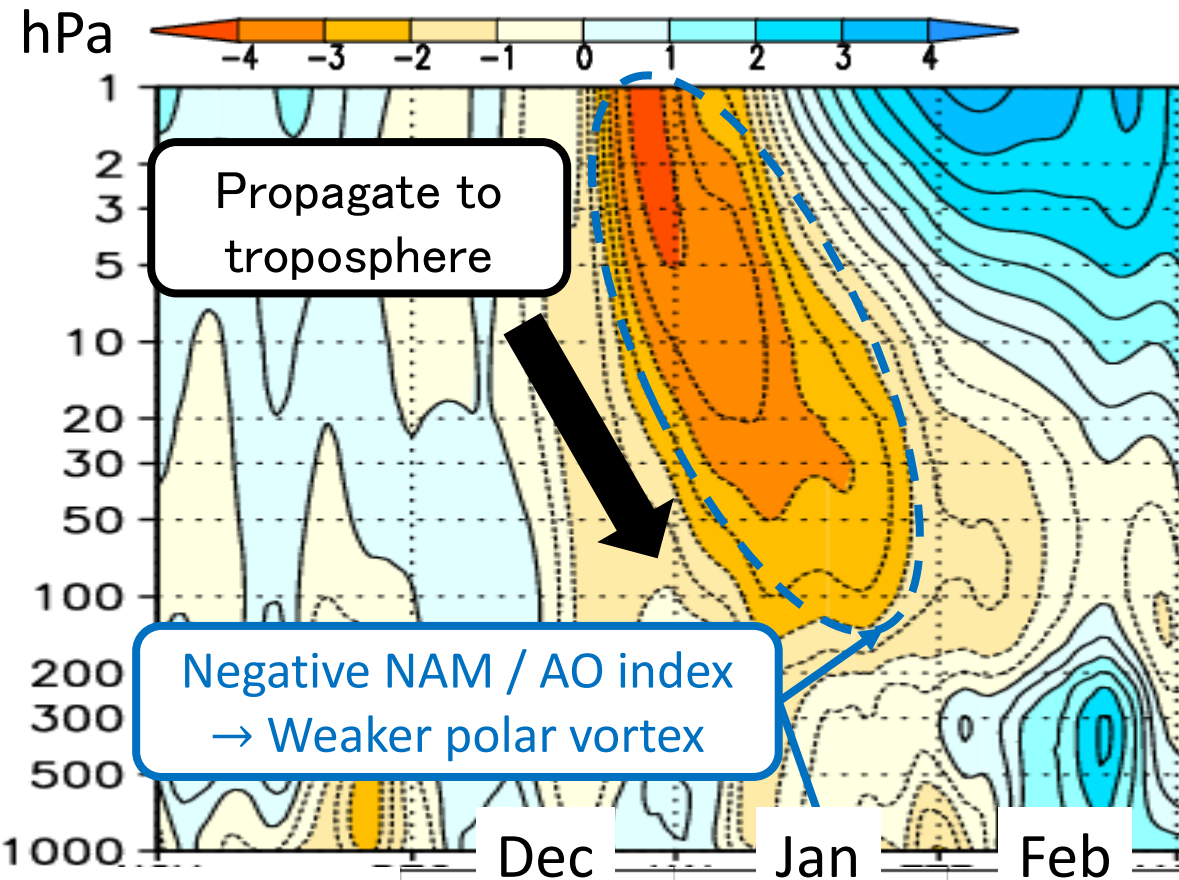
Z 30 in January 2019



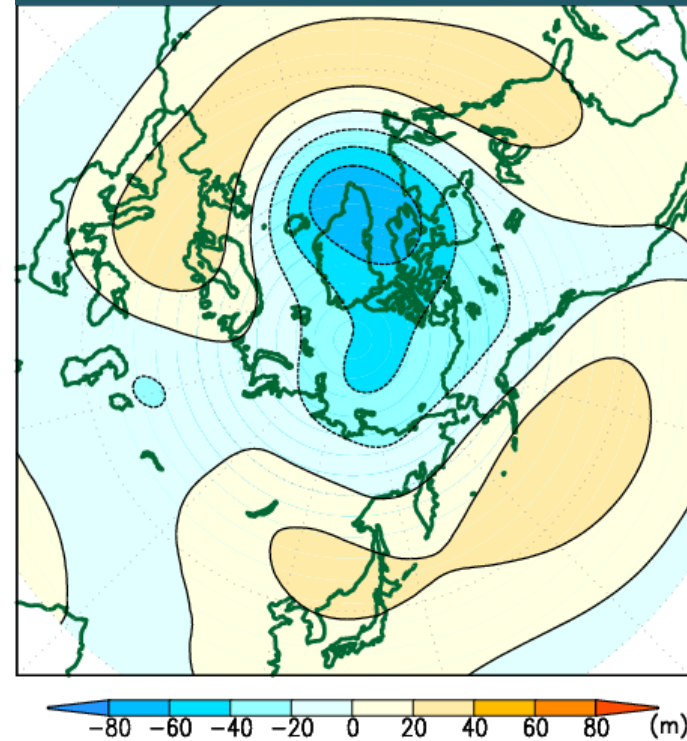
- **SSW** conditions had persisted from mid December to late January.
 - Polar vortex sometimes shifted **southward of the Far East**.
 - **Cold spells** sometimes covered northern Japan.

How does the SSW affect tropospheric circulation ?

NAM index NAM : Northern Annular Mode

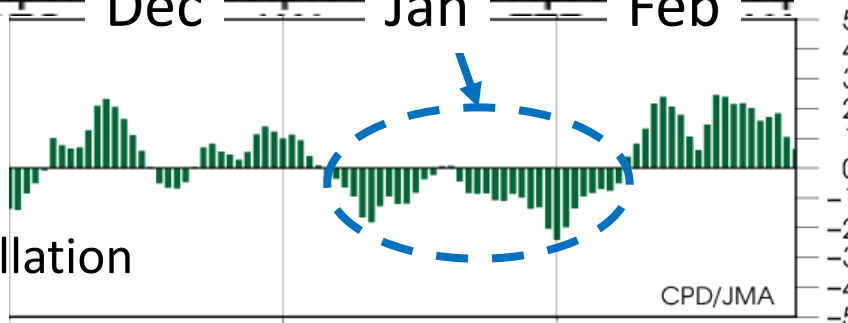


NAM Pattern at 500-hPa



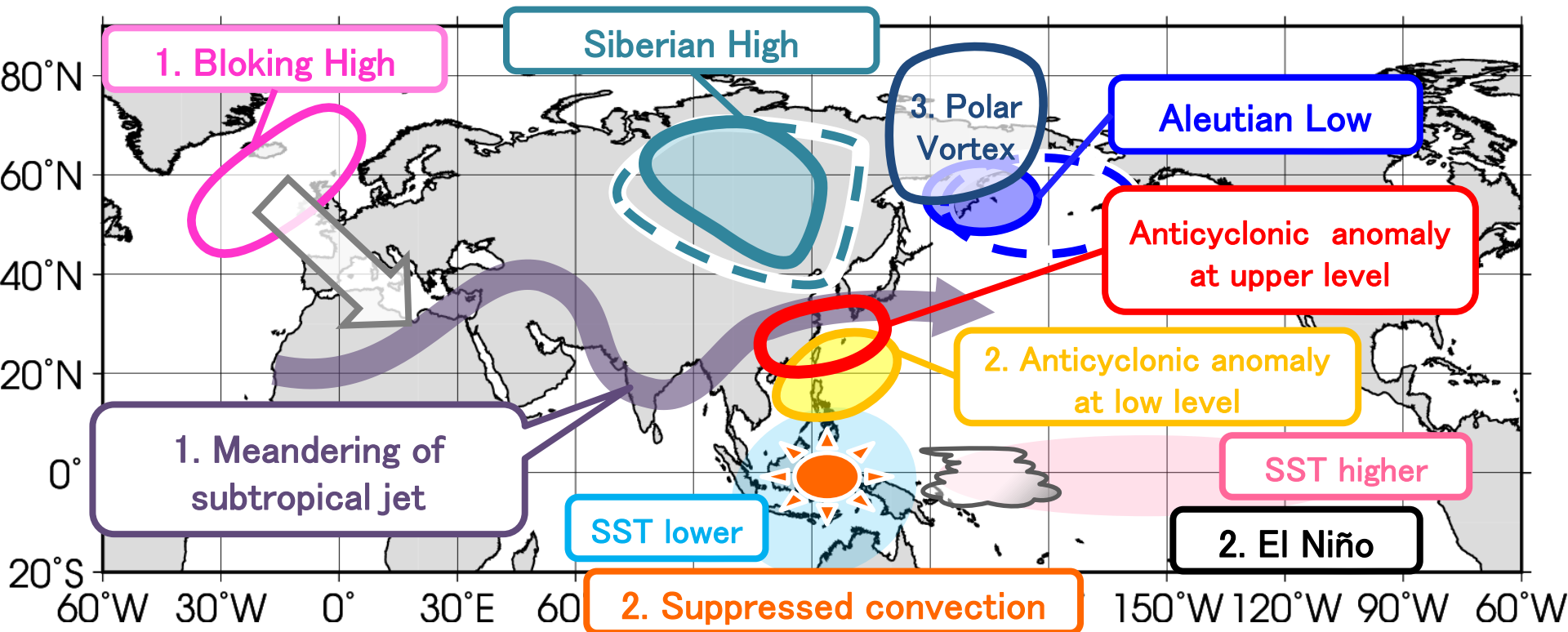
AO index

AO : Arctic Oscillation



NAM pattern :
EOF-1 of monthly average
geopotential height
in Nov-Apr, 1985-2010

Summary



- **Warm air** often covered Japan.
 - Wave trains
- **Warm and moist air** often flowed into Okinawa /Amami.
 - El Niño
- **Cold spells** sometimes covered northern Japan.
 - Stratospheric Sudden Warming (SSW)

Thank you for your attention.

