The 8th Session of East Asia winter Climate Outlook Forum (EASCOF-8)
5 November 2020, Japan (Online)

The Characteristics of 2020 Summer Climate Conditions in Japan

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Outline

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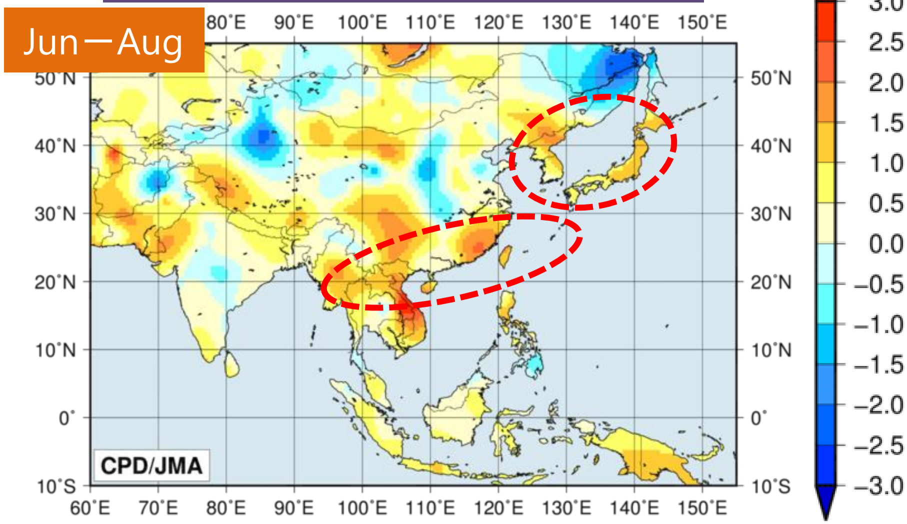
I. Overview 2020 summer monsoon in East Asia
II. July: Record-heavy rain and record-low sunshine durations in Japan
    - Based on the discussion by the JMA Advisory Panel on Extreme Climate Events*
    - See also the TCC/JMA's press release about this https://ds.data.jma.go.jp/tcc/tcc/news/press_20200916.pdf
III. August: Heatwave in Japan
IV. Summary
V. The situation so far this autumn (if we have time)

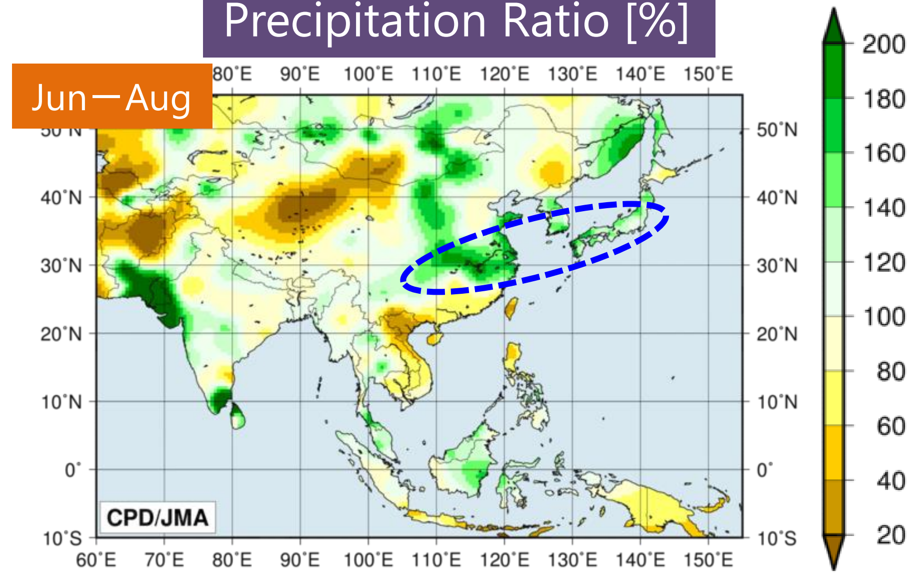
*The JMA Advisory Panel on Extreme Climate Events, consisting of prominent experts on climate science from universities and research institutes, was established in June 2007 by JMA to investigate extreme climate events based on up-to-date information and findings. The current chair is Prof. Hisashi Nakamura from the University of Tokyo.

Overview 2020 summer monsoon in East Asia

Temperature Anomaly [°C]



Precipitation Ratio [%]



Based on CLIMAT reports. Reference period for the anomaly and the ratio is 1981-2020.

- **Warm**:
  - Japan to the Korean Peninsula: extremely warm June and August
  - Okinawa/Amami of Japan to southern China: through the season
- **Wet**:
  - The Yangtze River basin to Japan: active and prolonged Meiyu-Baiu rainfall in July

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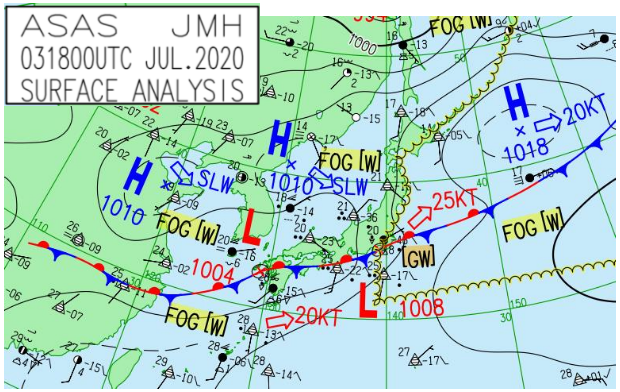
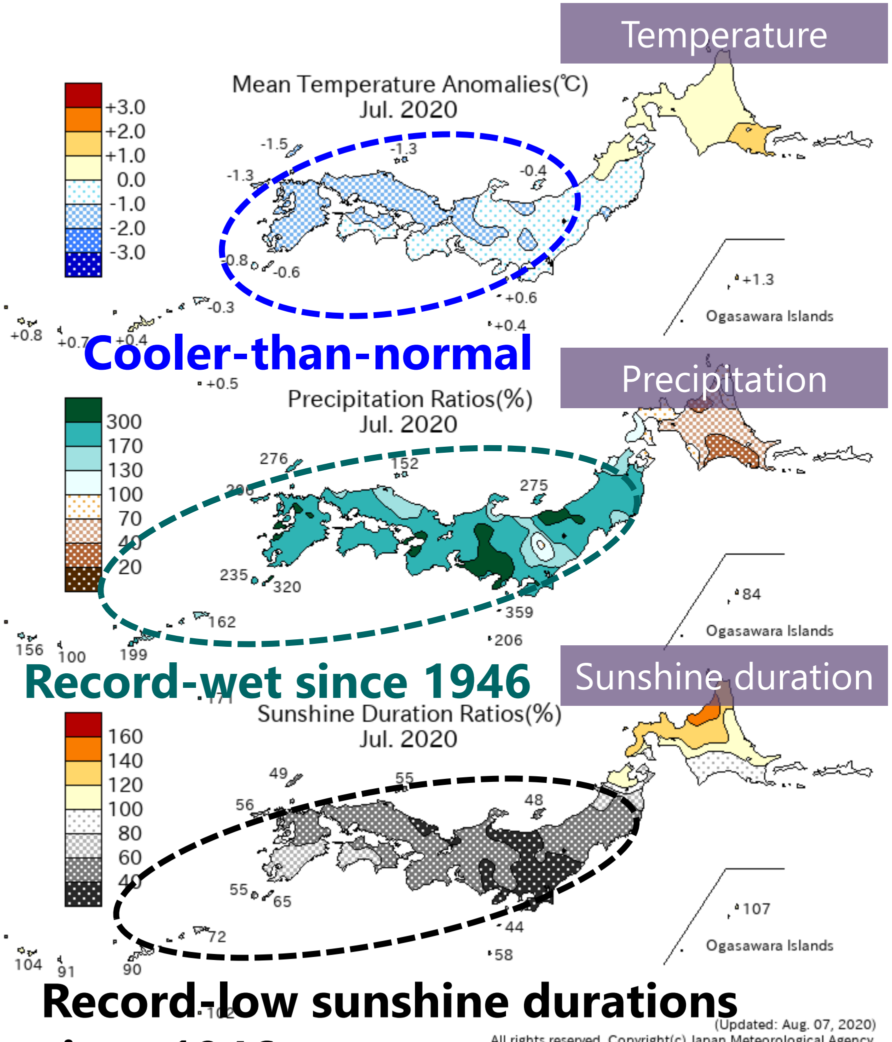
Record-wet and Record-cloudy July

- Prolonged Baiu（梅雨）
  - The Baiu termination in 2020 was around the end of July and significantly later than normal in most regions in Japan.
- Catastrophic heavy rainfall events in various places
  - Deaths:84, Injured People: 30

According to FDMA, Japan (as of 1 Oct. 2020)
https://www.fdma.go.jp/disaster/info/items/201001_ooame52.pdf





Record-low sunshine durations since 1946

→What conditions of the atmos. circulation?

Near-stationary Meiyu-Baiu Front

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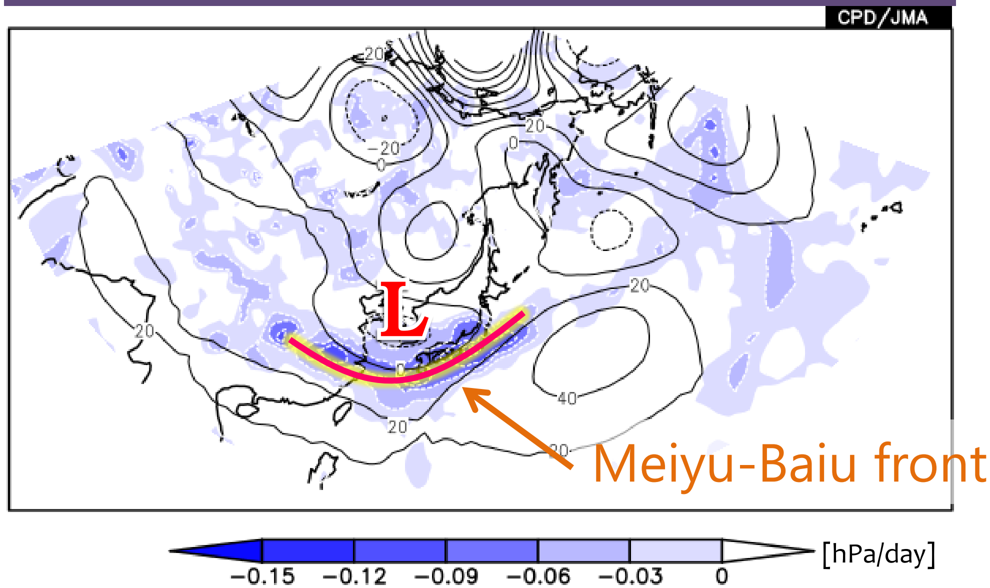
- Intensified and near-stationary Meiyu-Baiu front
- Persistent upper-level trough over the Yellow Sea
- Southwestward extension of the NPSH*

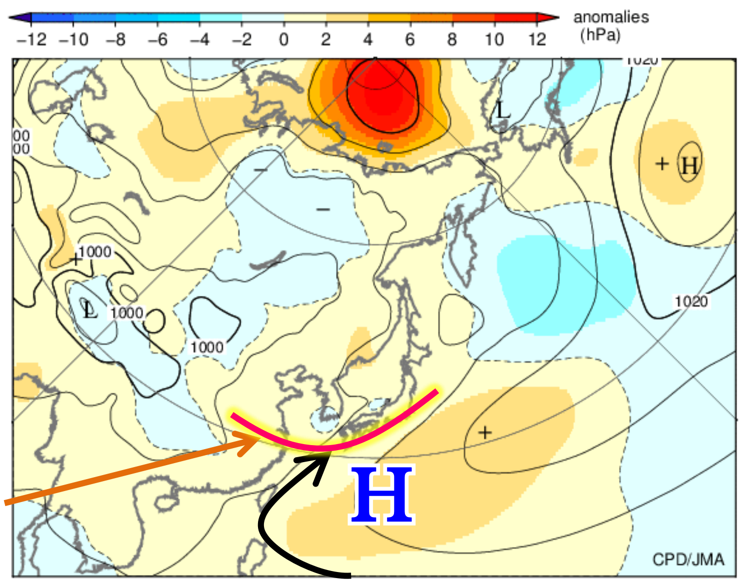
*North Pacific Subtropical High

z500 anom. (cont.) & ω500 anom. (colour) (Jul. 2020)



z500 contour interval is 60m.

SLP anom. (Jul. 2020)



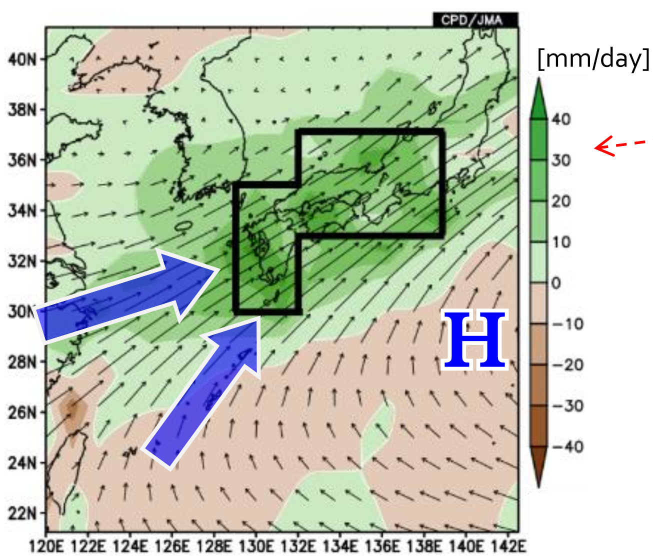
Monthly mean sea level pressure and anomaly around Japan (Jul.2020)
The contours show sea level pressure at intervals of 4 hPa.
The shading indicates sea level pressure anomalies.
Anomalies are deviations from the 1981–2010 average.

Vast Amounts of Moisture Inflow

- Two major moisture inflows to Japan
  1. From the west along the Meiyu-Baiu front
  2. From the south along the periphery of the NPSH
- Vast amounts of moisture flux convergence over Japan

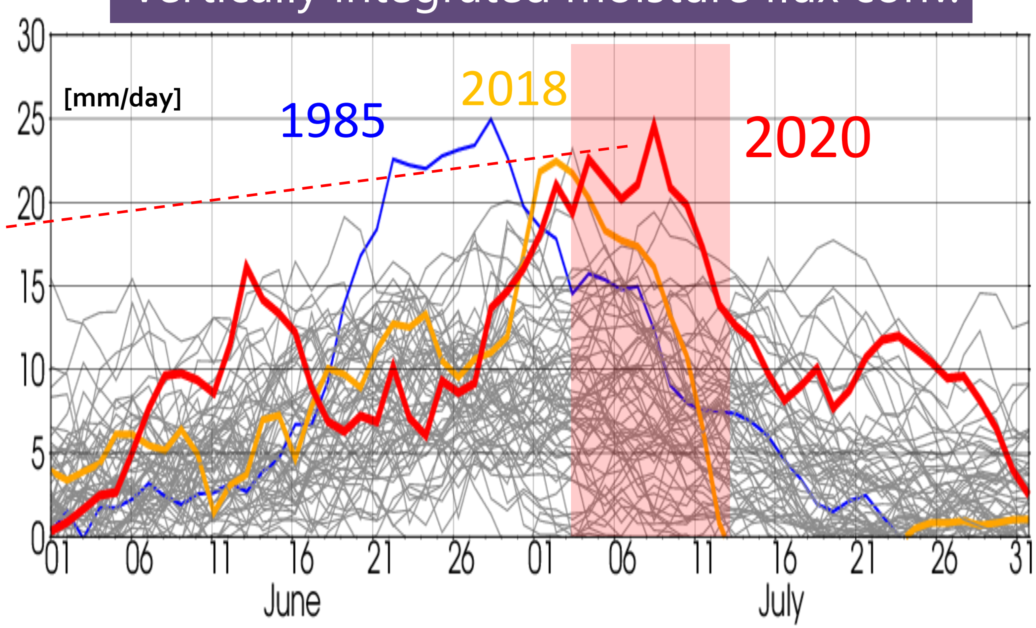
→What caused the prolonged Baiu?

Vertically integrated moisture flux and its convergence



Period: 3 - 13 Jul. 2020

Vertically integrated moisture flux conv.



11-day running mean of the 1000-300hPa vertically integrated moisture flux convergence in the black thick line-closed area in the left panel from June to July after 1958

Southward-shifted and Meandering STJ

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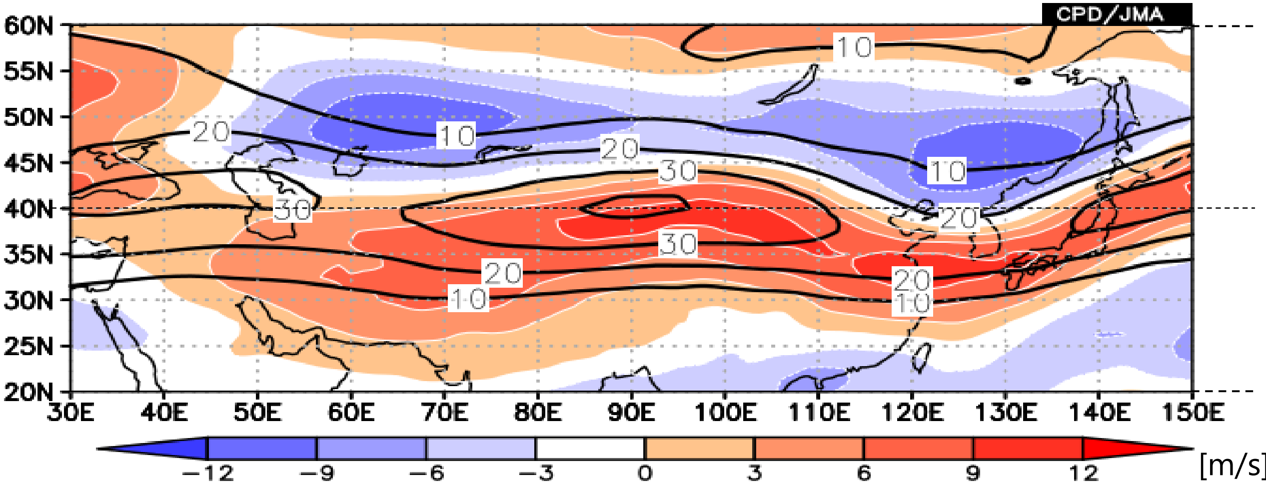
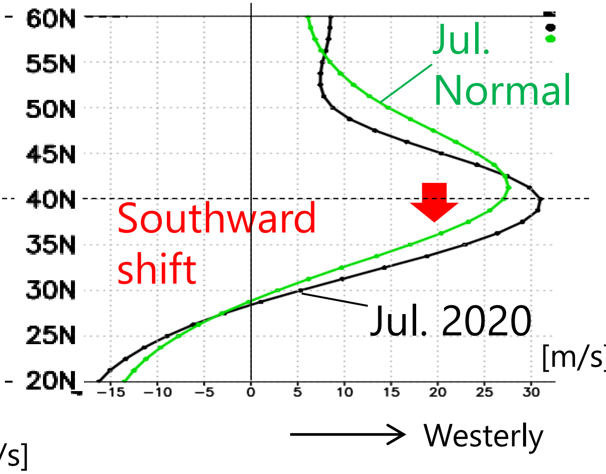
U200 (cont.) and its anom. (colour) (Jul. 2020)

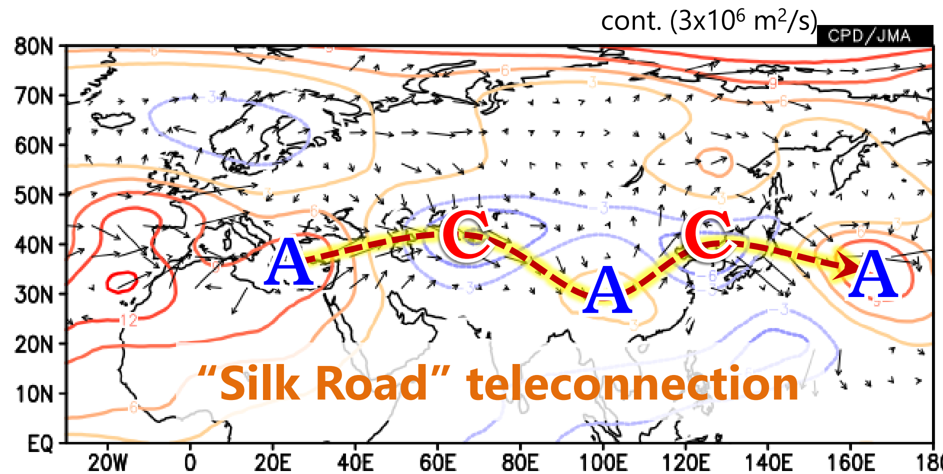


30-150E mean U200



- The subtropical jet (STJ) over Eurasia: southward shifted.
- "Silk Road" teleconnection (Enomoto et al, 2003; Kosaka et al, 2009)
  - What is the cause? Partly because the STJ's southward shift led a stationary wave forced by the Tibetan Plateau topography?

ψ200 anom. (cont.) and WAF200* (Jul. 2020)



*Takaya and Nakamura (2001)-wave activity flux

Impacts from the Warmer Indian Ocean (IO)

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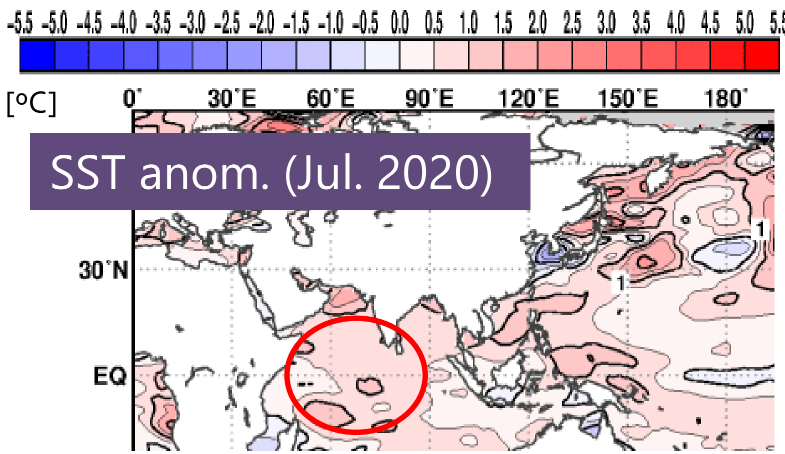
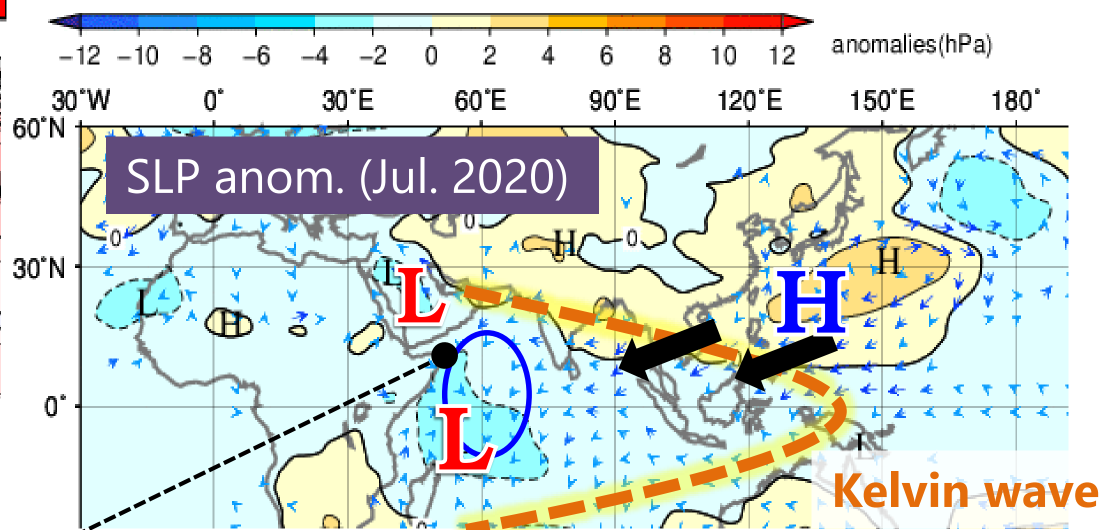
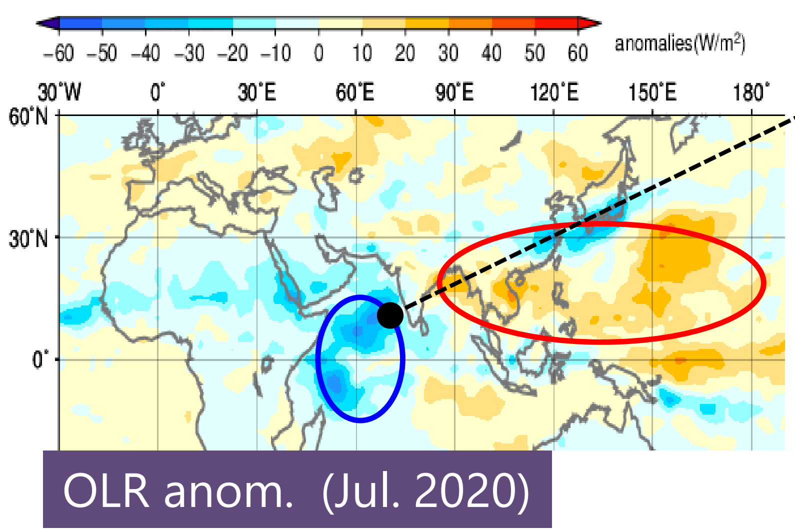
- Warm SST anom. in the IO and enhanced convection over the western IO.







- An equatorial Kelvin wave from the IO into the western Pacific
- In the NW Pacific, the Kelvin-wave induced low-level northeasterly anom. → low-level divergence ⇆ suppressed convection

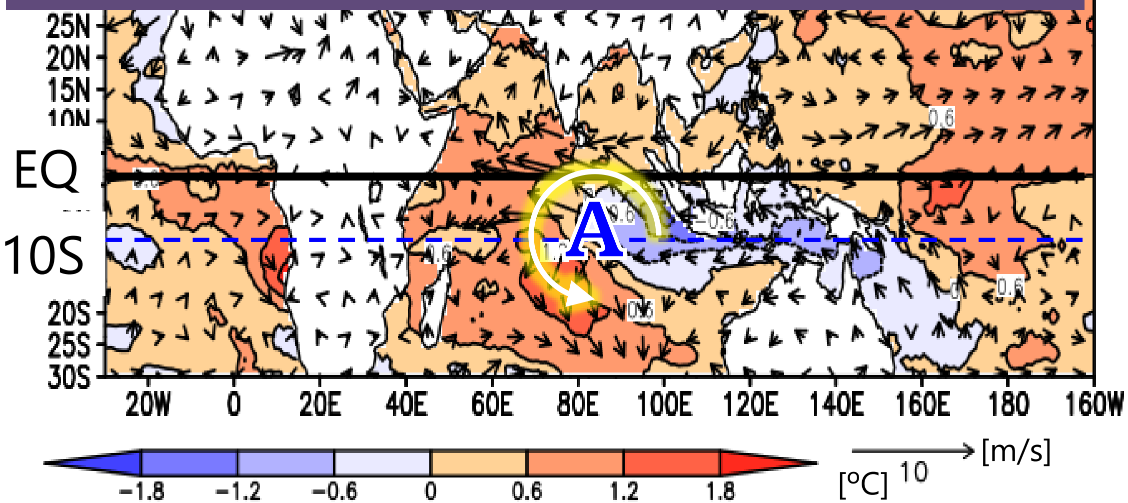
cf. Xie et al. (2016)

- The NPSH southwestward extension

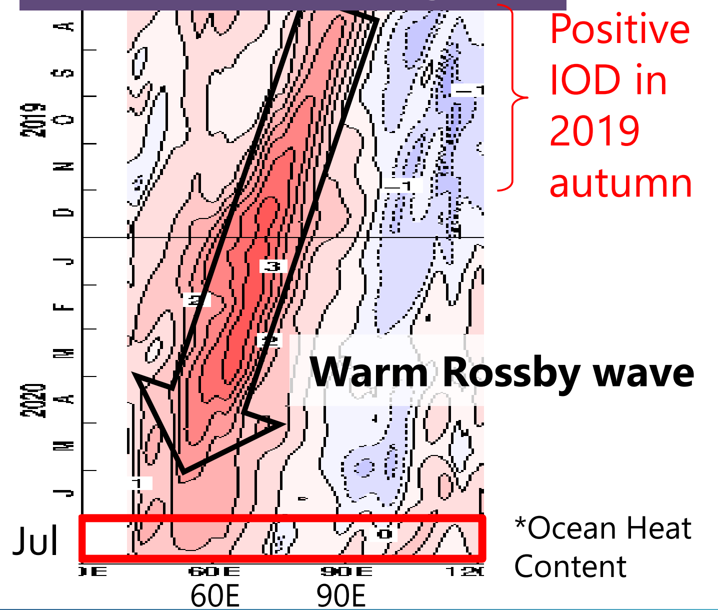
Cause of the Warmer IO

- Warmer SST anom. in the western IO can be traced back to the remarkably positive Indian Ocean Dipole (IOD) event in the previous autumn.
  - In the previous autumn: positive IOD → Easterly wind anom. around the EQ → Anti-cyclonic wind stress off the EQ → Warm Rossby wave
  - In this summer: warmer-than-normal SST in the western IO

SST anom. (color) and surface wind anom. (vector) (Sep.-Nov. 2019)



OHC* anom. along 10S



*Ocean Heat Content

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Heatwave in August

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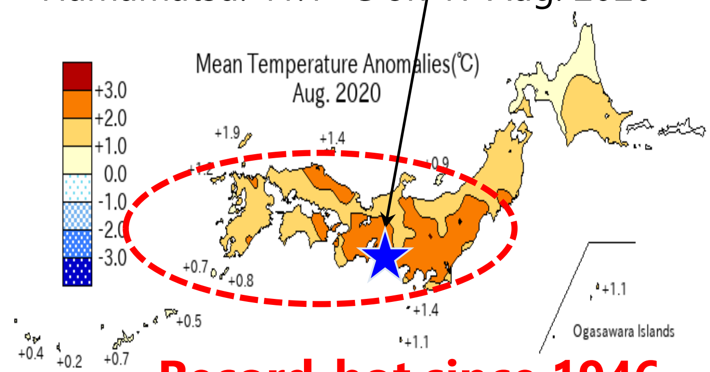
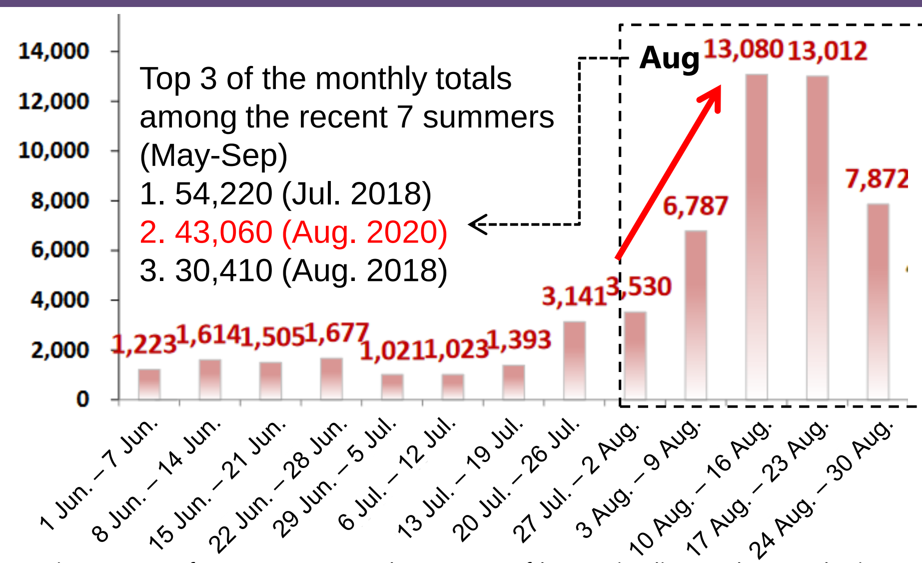
- Extremely warm anomaly + the climatological temp. peak
  - Max. temp. 41.1 °C at Hamamatsu on 17 Aug. tying with the national record
  - 81 deaths and 43,060 emergency transport due to heatstroke
    (according to FDMA, Japan)

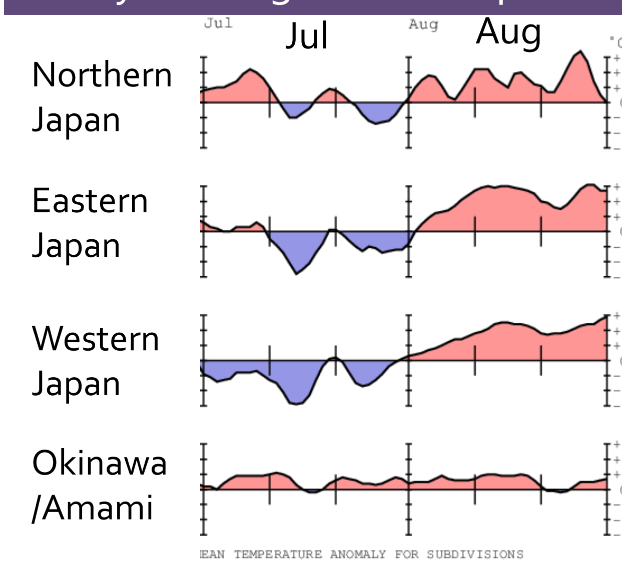


→What conditions of the atmos. circulation?

Num. of emergency transportation due to heatstroke



5-Day running mean temp. anom.



Created by processing a report from FDMA, Japan https://www.fdma.go.jp/disaster/heatstroke/items/heatstroke_geppou_202008.pdf

Equivalent Barotropic Ridge over Japan

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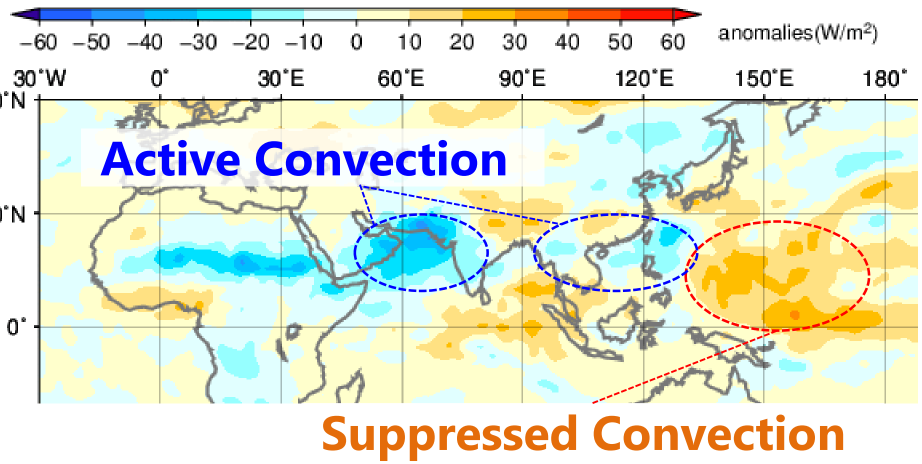
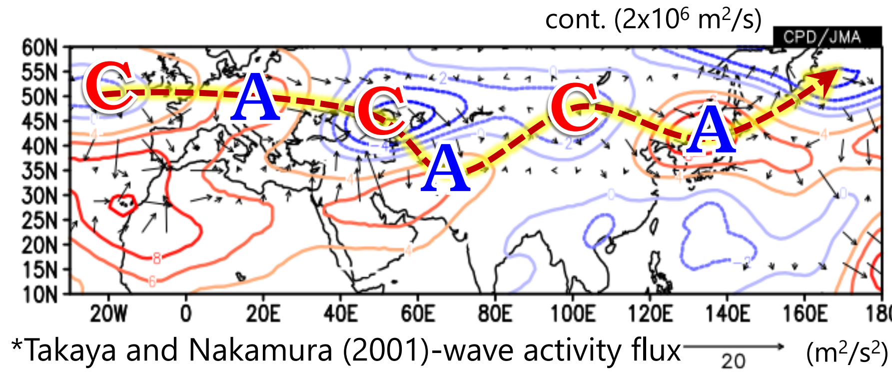
OLR anom. (Aug. 2020)



ψ200 anom. (cont.) and WAF200* (Aug. 2020)



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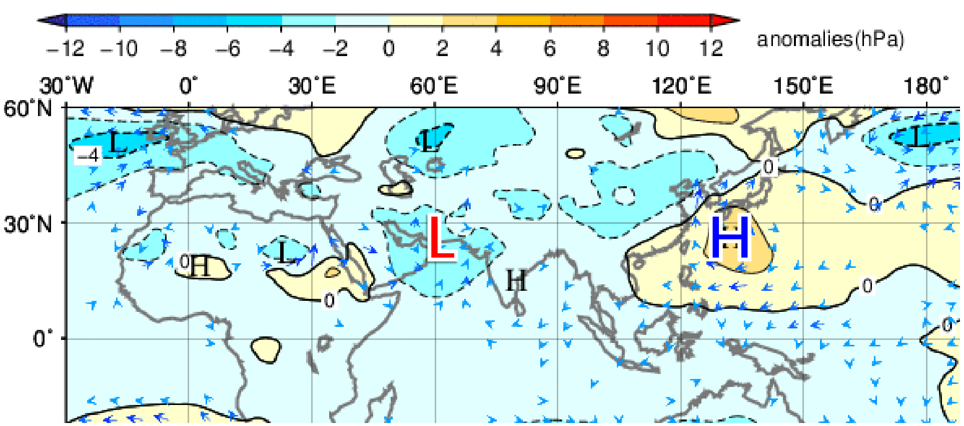

- Normal-to-active Asian Monsoon
- “Silk Road” teleconnection again
  - But different geographical phase from the pattern seen in July
  - Partly excited by the enhanced convection in the Arabian Sea
- Westward-extended NPSH
  - Suppressed convection to the east of the Philippines

Northward Migration of the STJ

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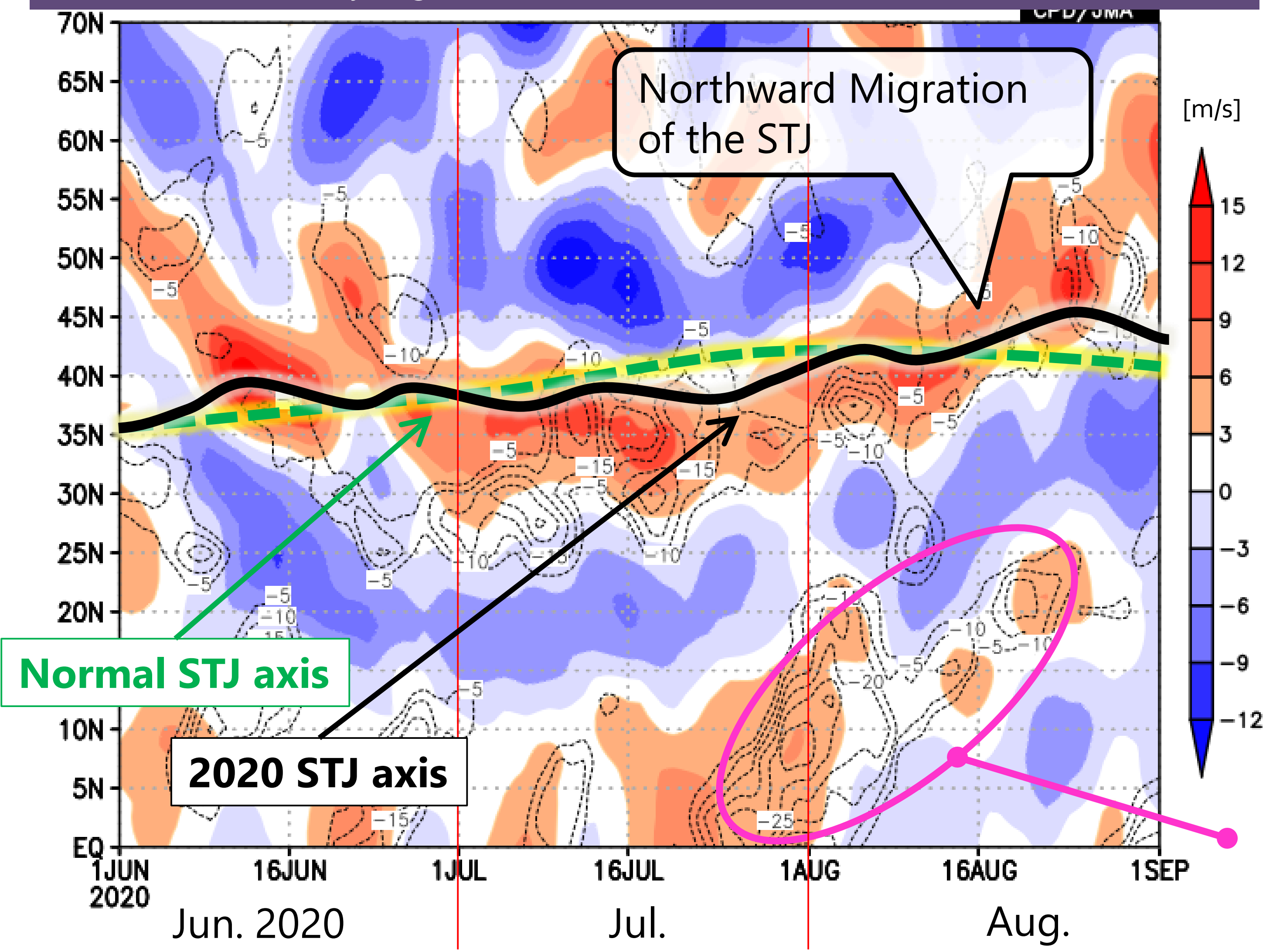
Lat.-time cross section of 70-140E average (5-day running mean)
Cont.:OLR anom. (only negative values are shown), Colour: U200 anom.

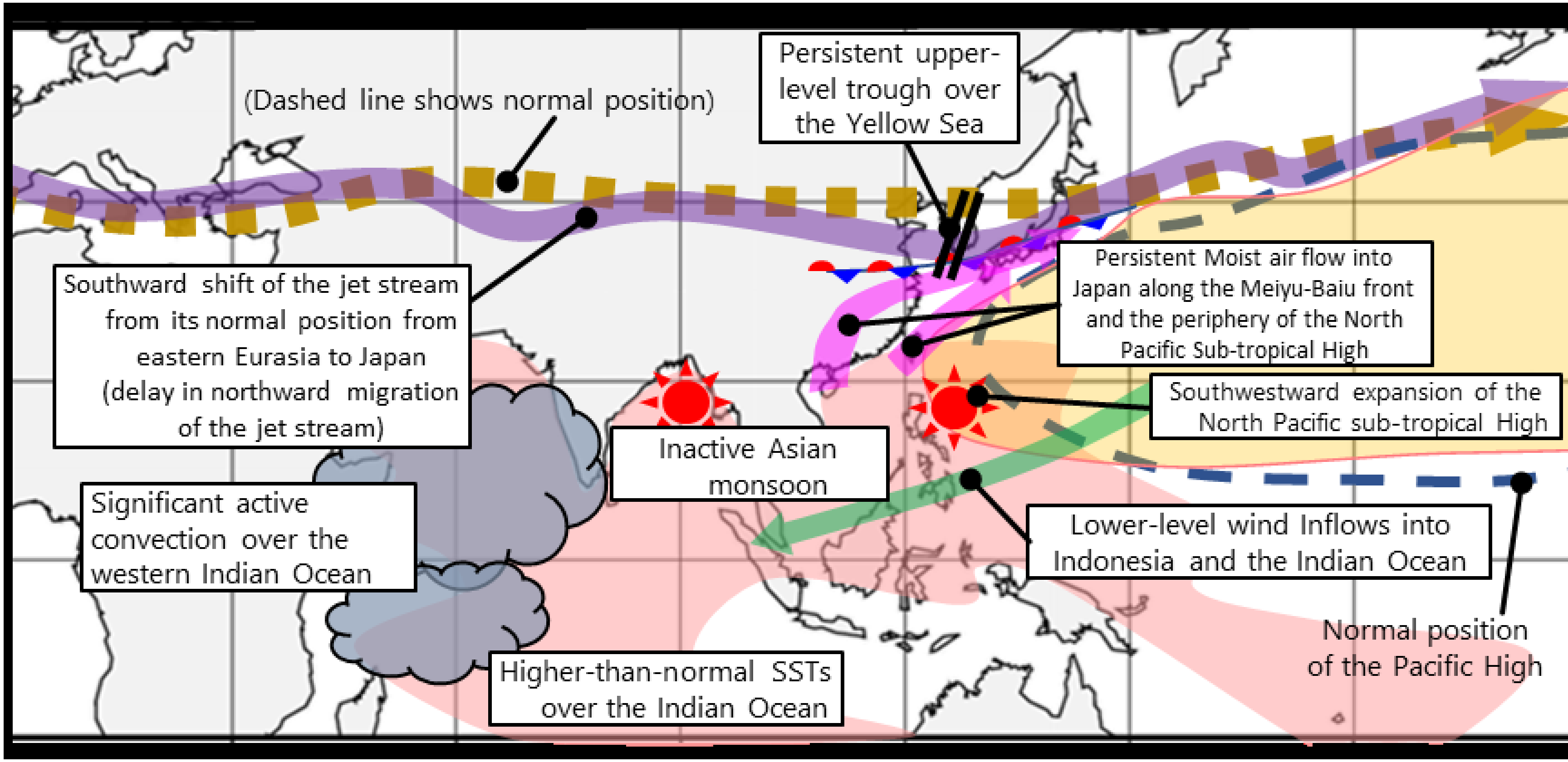


The STJ over Eurasia migrated northward

Active Asian monsoon. The enhanced convection anom. moved northward (BSISO).

Summary(1/2)

- Atmosphere and ocean conditions associated with the climate extremes in Jul. 2020



- Including this August, the climate extremes in Japan in 2020 summer were impacted from the IO and the Pacific anomalies.

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The ongoing La Niña and its impact

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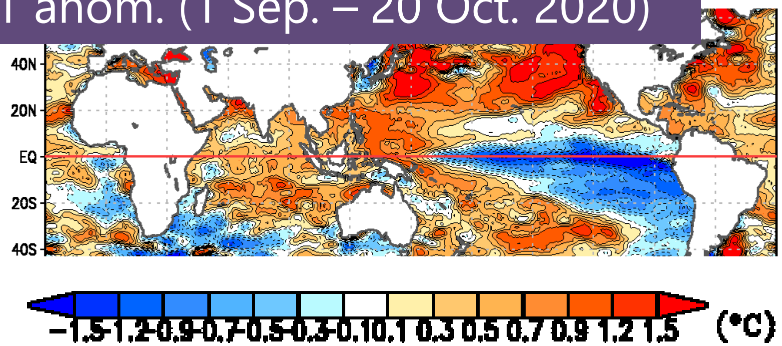
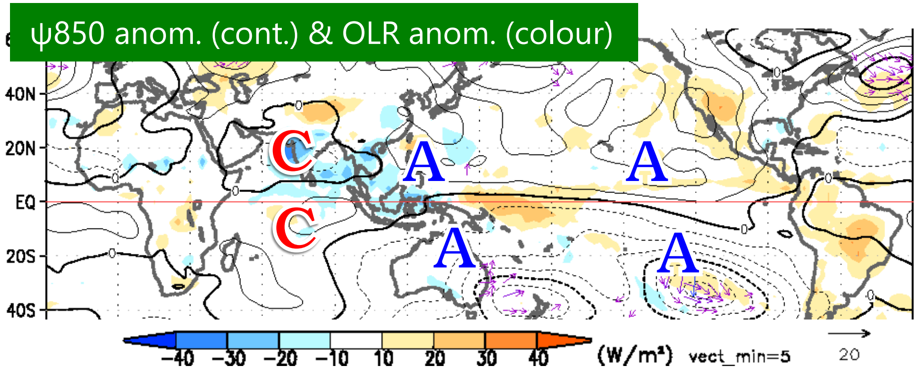
SST anom. (1 Sep. – 20 Oct. 2020)



- La Niña has been evolving since this summer.
- Warm SST anomalies in the IO has declined but still remained.

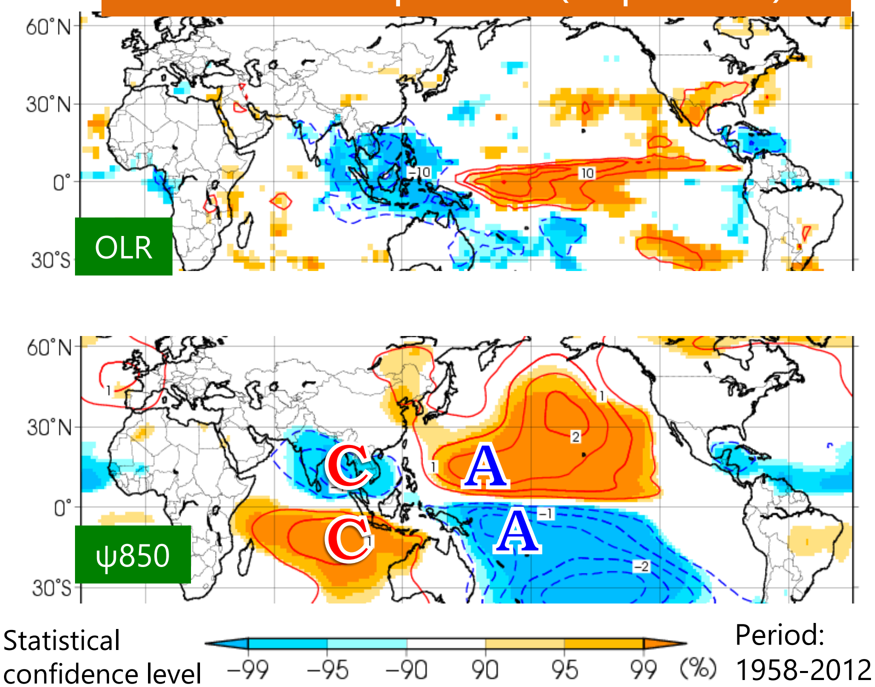
This autumn so far (1 Sep. – 20 Oct. 2020)

ψ850 anom. (cont.) & OLR anom. (colour)



- OLR and ψ850 anom. are similar to what were seen in the past La Niña, but slightly shifted westward.

La Niña Composites (Sep.-Nov.)



Impacts of the ongoing La Niña?

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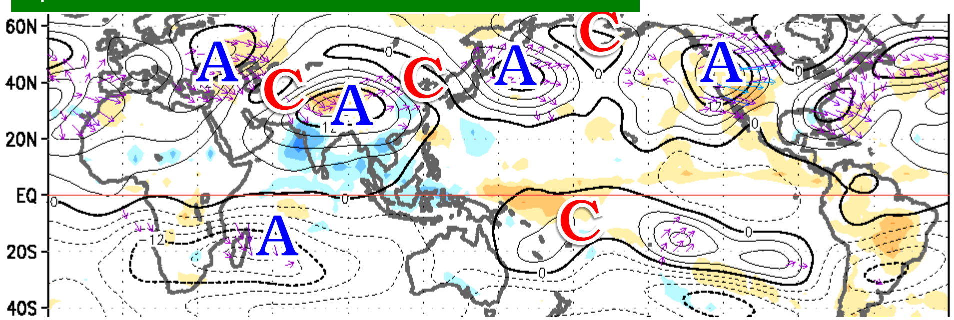
- ψ200 anom: A wave train in the N.H. mid-latitudes
- Zonal-mean U: STJs in both hemispheres weaken on their equatorward flanks. Impacted from the ongoing La Niña?

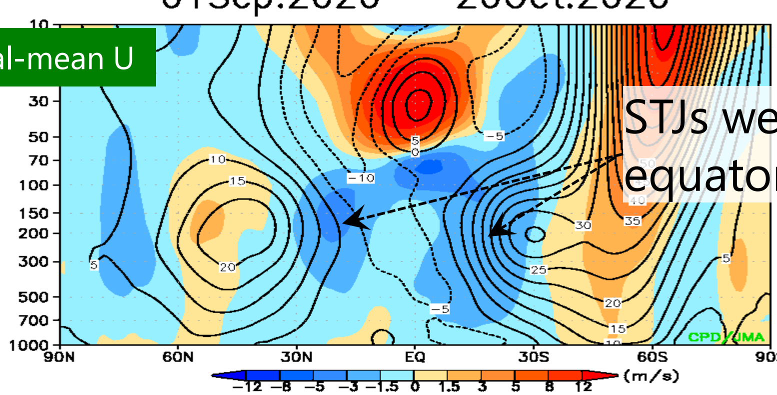
This autumn so far (1 Sep. – 20 Oct. 2020)

ψ200 anom. (cont.) & OLR anom. (colour)



01Sep.2020 – 20Oct.2020

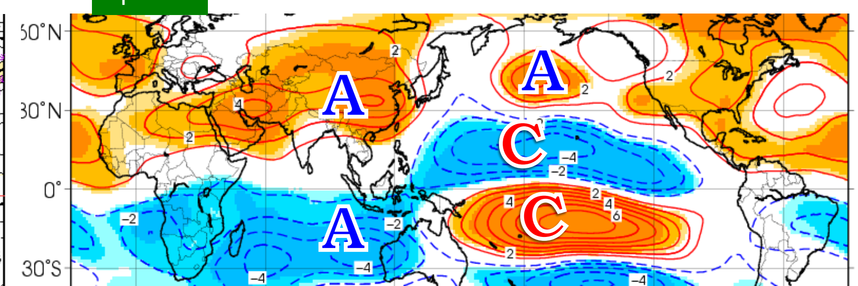
zonal-mean U



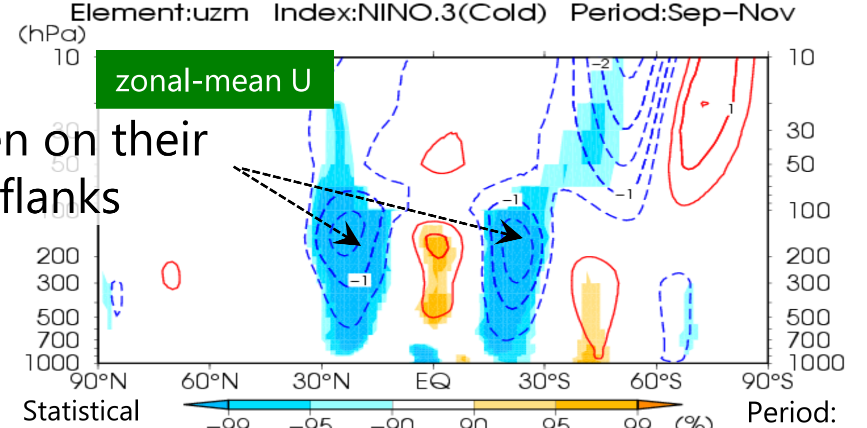
STJs weaken on their equatorial flanks

La Niña Composites (Sep.-Nov.)

ψ200



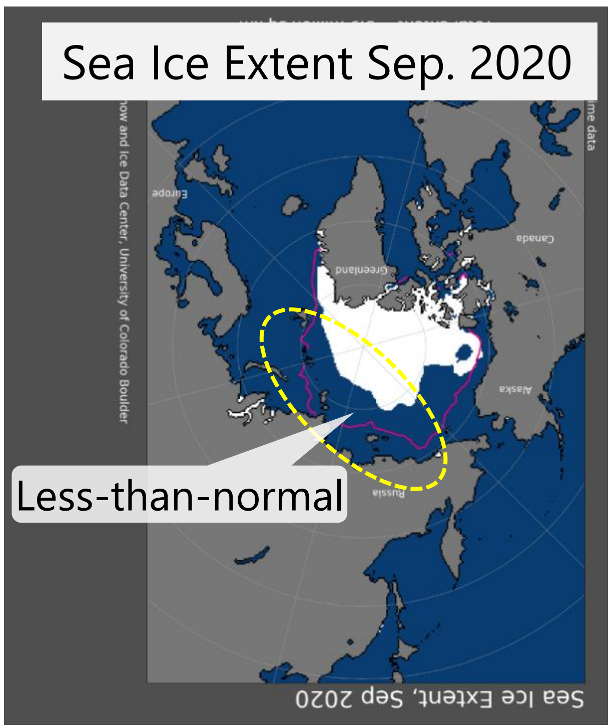
zonal-mean U



Period: 1958-2012

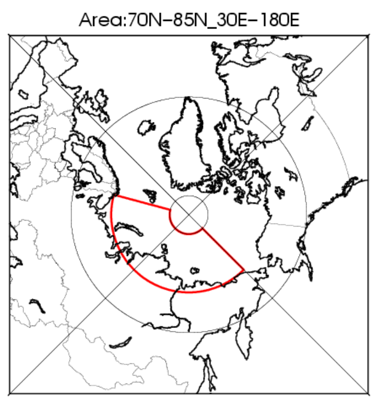
Other remarkable features: Arctic Sea ice

- Arctic sea Ice: Remarkably less-than-normal extent in the northern-Eurasian marginal seas
  - Less arctic-sea ice - Cold Eurasian winter
  - cf. “Warm Arctic and Cold Eurasia” (WACE) pattern (Mori et al.,2014)

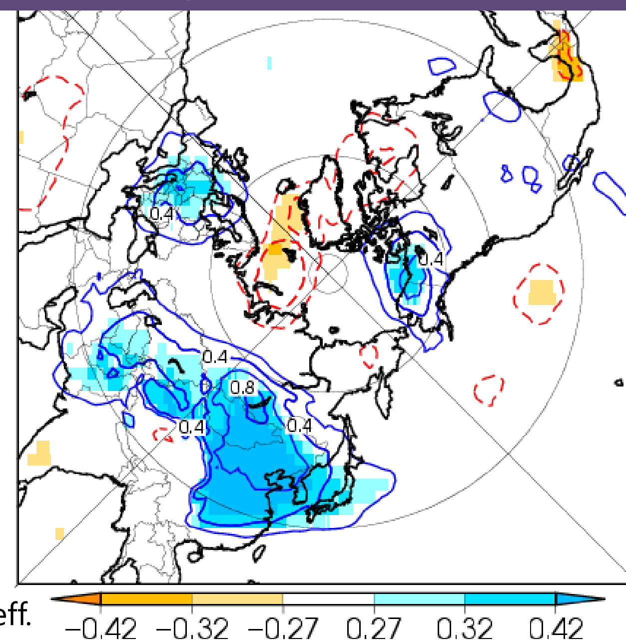


Source NSIDC/NOAA https://nsidc.org/arcticseaicenews/

Dec.-Feb. T850 regressed on Sep.-Nov. sea ice extent in the northern-Eurasian marginal seas (red closed area)



Period: 1979-2015



Summary(2/2)

- In this autumn, warm SST anomalies in the IO has declined (but still remained) while the new La Niña condition has been evolving since this summer.
- Atmosphere circulation anom. in the lower-latitude are becoming gradually like typical ones as seen in the past La Niña events. It would be more important to monitor the ongoing La Niña and its impact.
- In addition to the ongoing La Niña, the arctic sea ice extent will be also important in terms of predictability source, given the current remarkably less-than-normal condition.
  - And of course, but has not mentioned, the polar vortex in the stratosphere is also crucial.

Reference

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  - El Niño Monitoring http://ds.data.jma.go.jp/tcc/tcc/products/elnino/index.html
  - World Climate http://ds.data.jma.go.jp/tcc/tcc/products/climate/index.html
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