A very weak state of the Oyashio in recent years:
its relationships with the subarctic gyre in the North Pacific

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How should we understand the current climate change under global warming?

Keywords

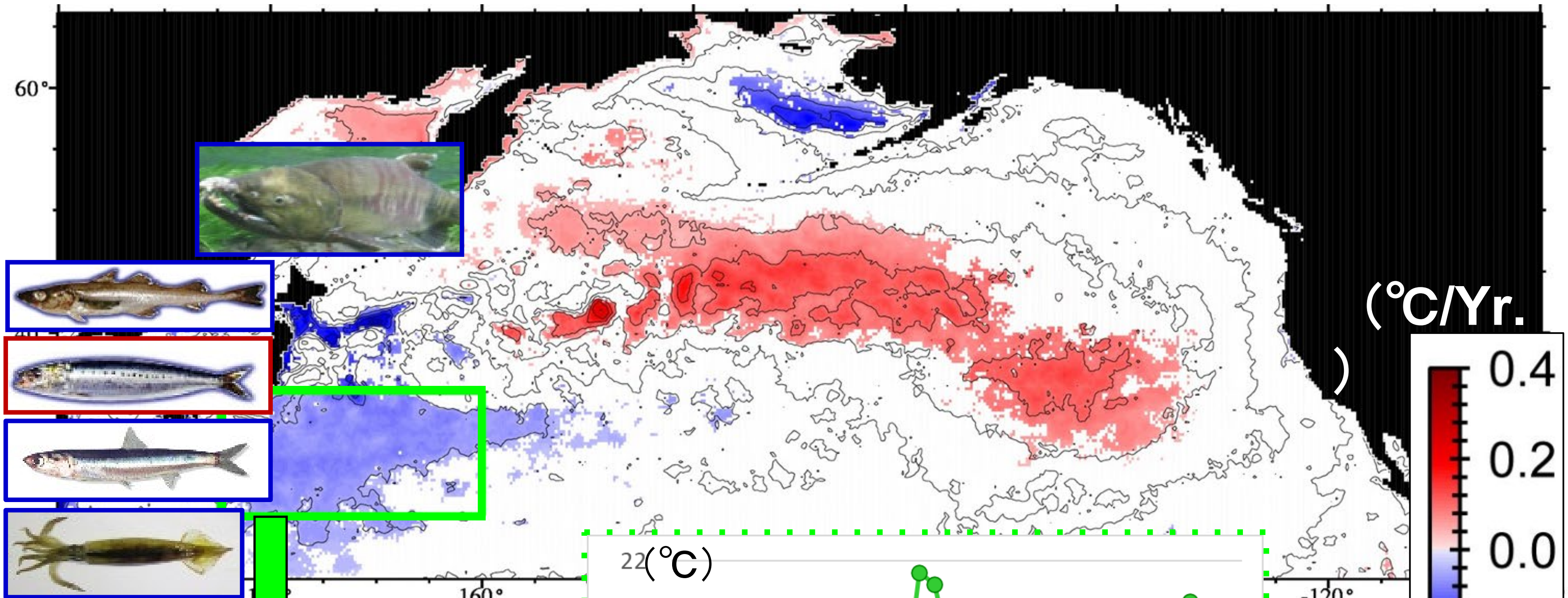
(1) Conventional/Stationary change

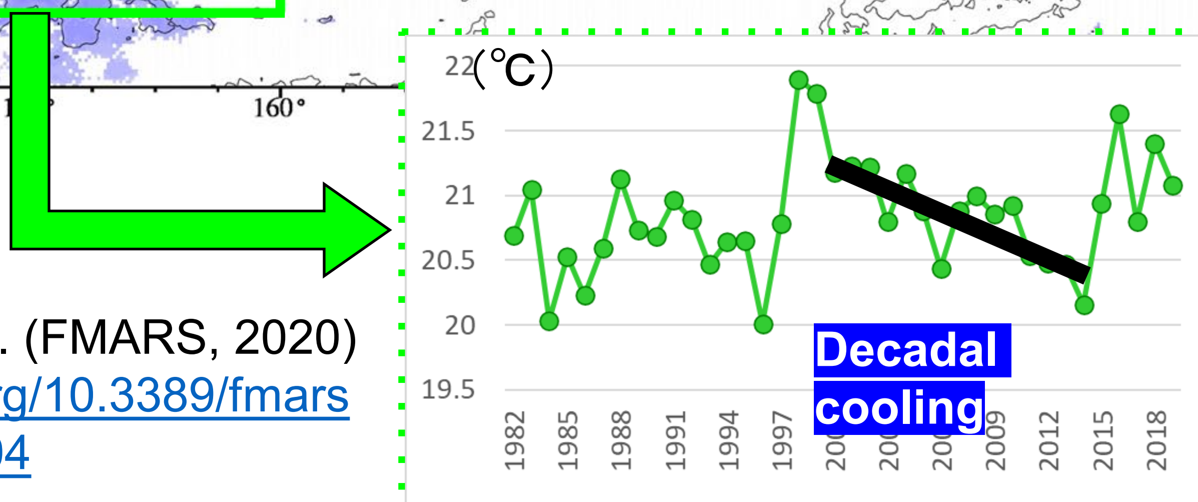
(1) Unconventional/Nonstationary change

Example of “unconventional change”

Decadal trend of winter–spring SSTs in 2000–2014

Red : Increase **Blue** : Decrease



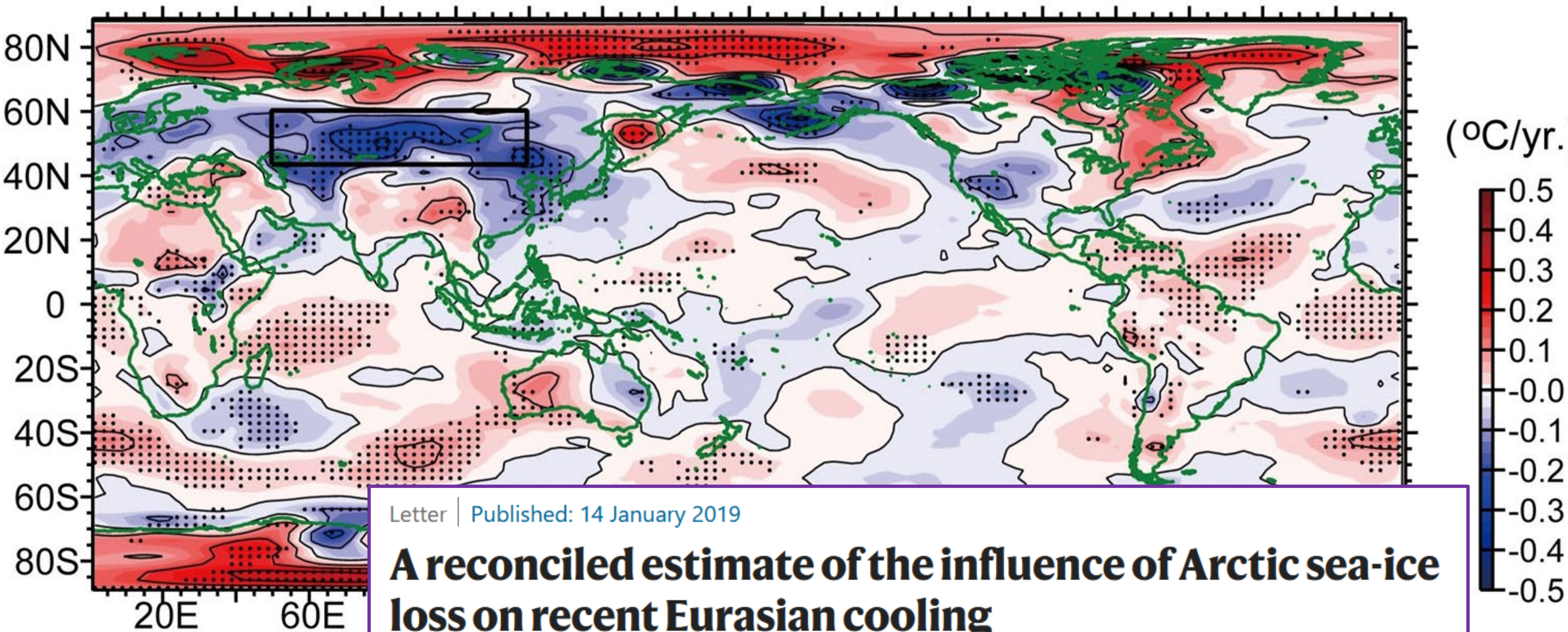


Kuroda et al. (FMARS, 2020)
https://doi.org/10.3389/fmars.2020.574904

Example of “unconventional change”

Decadal trend of winter–spring air temperatures in 2000–2013

Red：Increase　　Blue：Decrease



Letter | Published: 14 January 2019

A reconciled estimate of the influence of Arctic sea-ice loss on recent Eurasian cooling

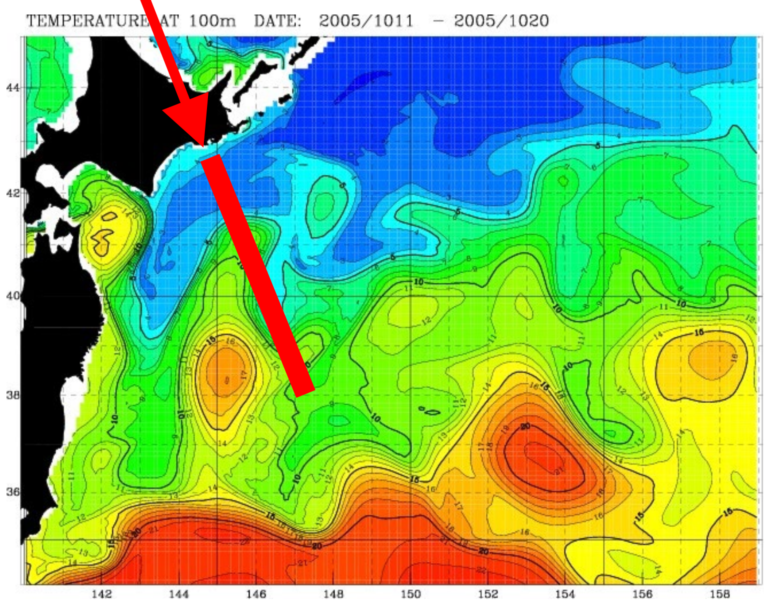
Masato Mori, Yu Kosaka, Masahiro Watanabe, Hisashi Nakamura & Masahide Kimoto

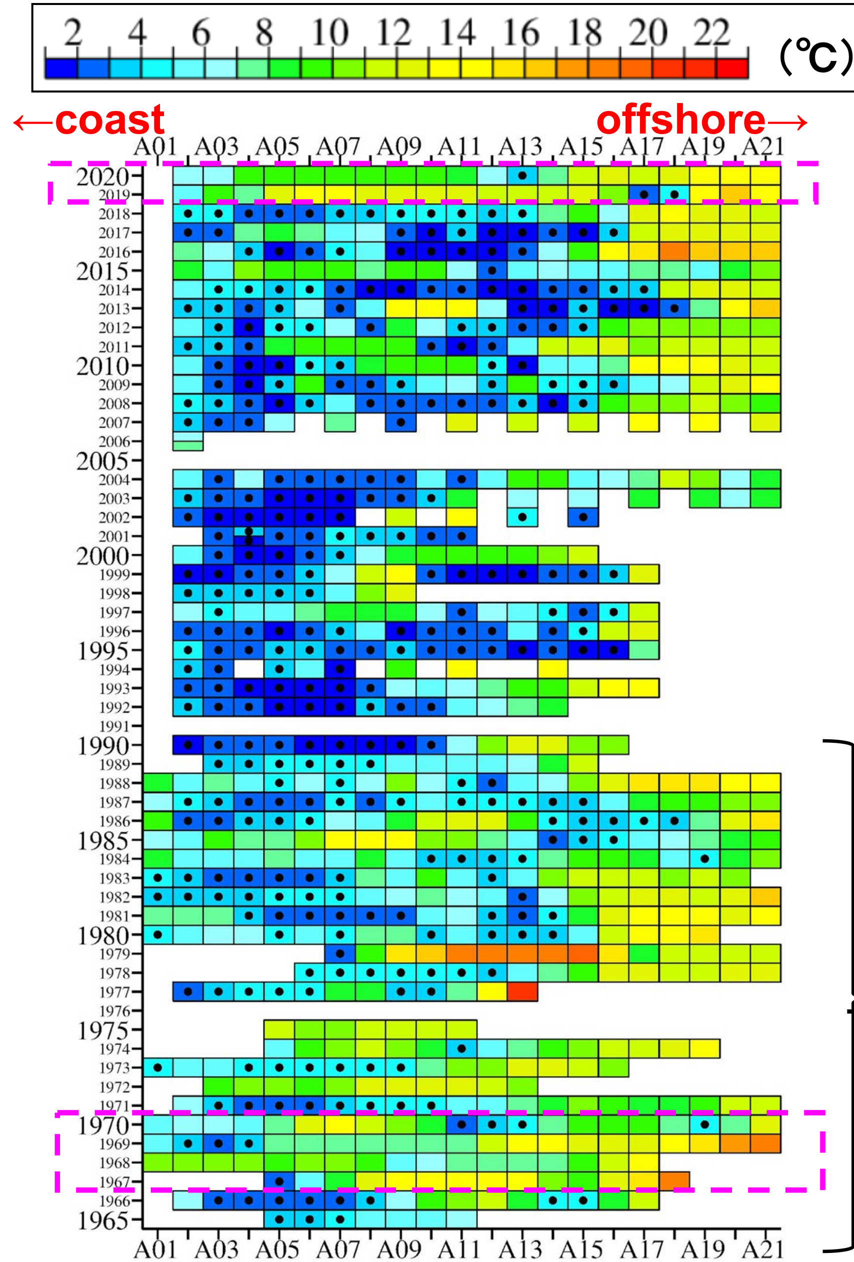
Nature Climate Change **9**, 123–129 (2019) | Cite this article

Conventional? or Unconventional?

100-m temperature
in October
along the A-line
(● : Oyashio water <5℃)

A-line (our monitoring line)

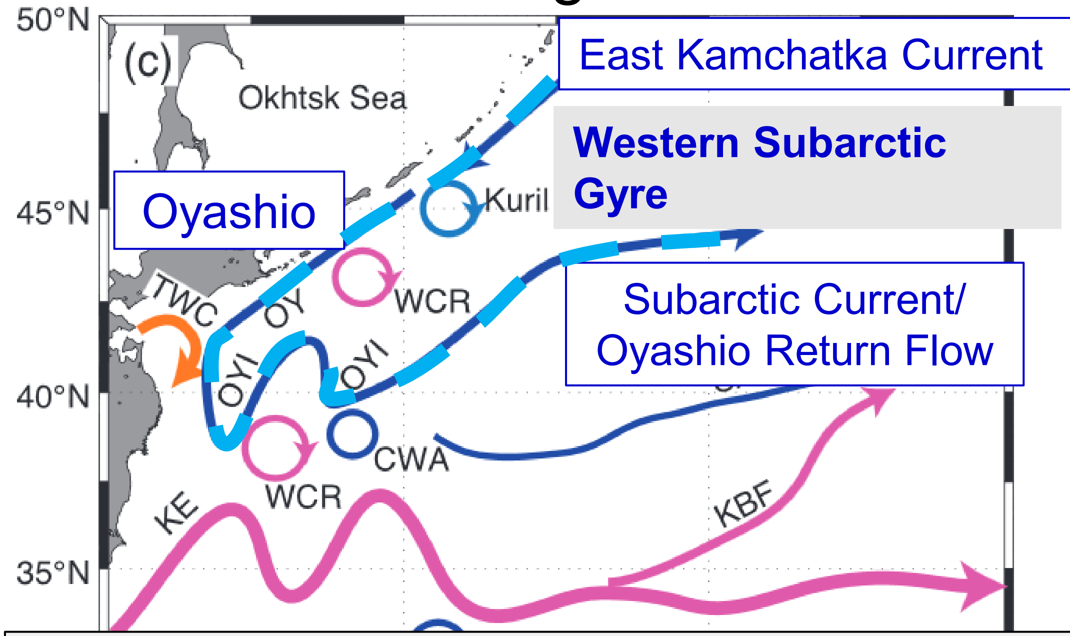


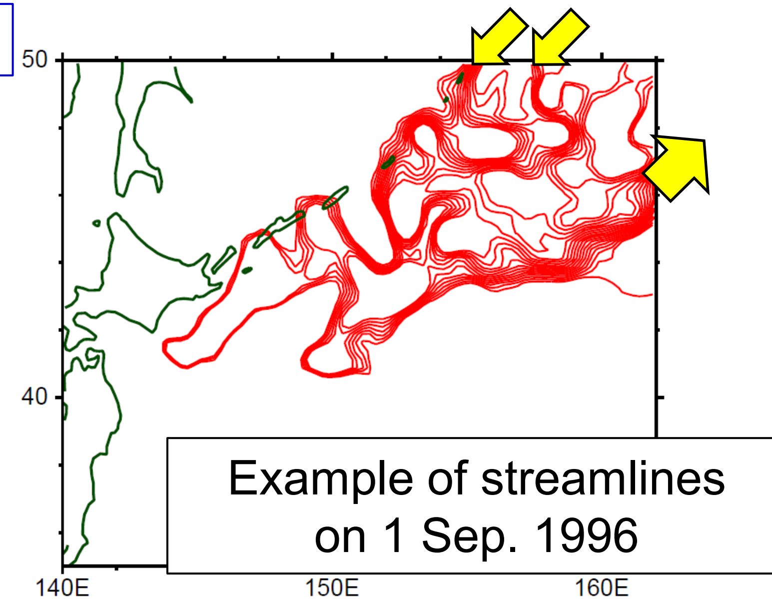


Temperatures digitized from analog maps

Conventional? or Unconventional?

Altimetry-derived geostrophic surface streamlines along the Western Subarctic Gyre





Example of streamlines on 1 Sep. 1996

Detection method

Isolines were detected from daily absolute dynamic topography (ADT)

Conditions of detected streamlines

①The isolines pass through the northern and eastern boundaries of a rectangular region of 140-162°E, 35-50°N (see upper-right panel)

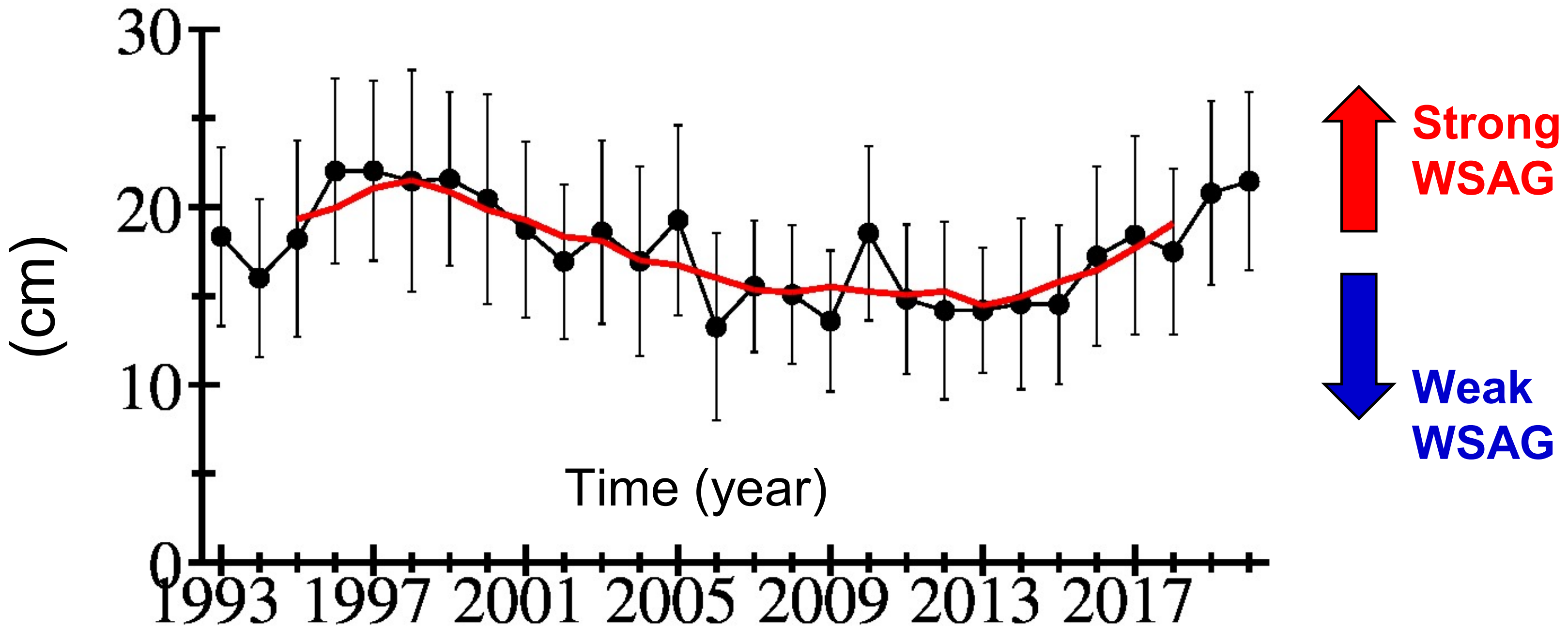
②The isolines do not intrude deeply into the Sea of Okhotsk

③The isolines do not contact with Japanese Islands

Kuroda et al. (2021, DSR-1, https://doi.org/10.1016/j.dsr.2020.103461)

Conventional? or Unconventional?

Intensity of the Western Subarctic Gyre (differences of ADT between the outermost and innermost GS streamlines)



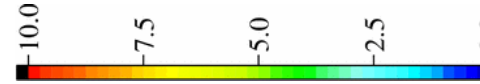
The long baroclinic Rossby waves of the first mode that were forced by basin-scale wind stress over the North Pacific could, to first approximation, account for the interdecadal sea level rises within the WSAG (not shown).

Updated from Kuroda et al. (DSR-1, 2021): https://doi.org/10.1016/j.dsr.2020.103461

Conventional? or Unconventional?

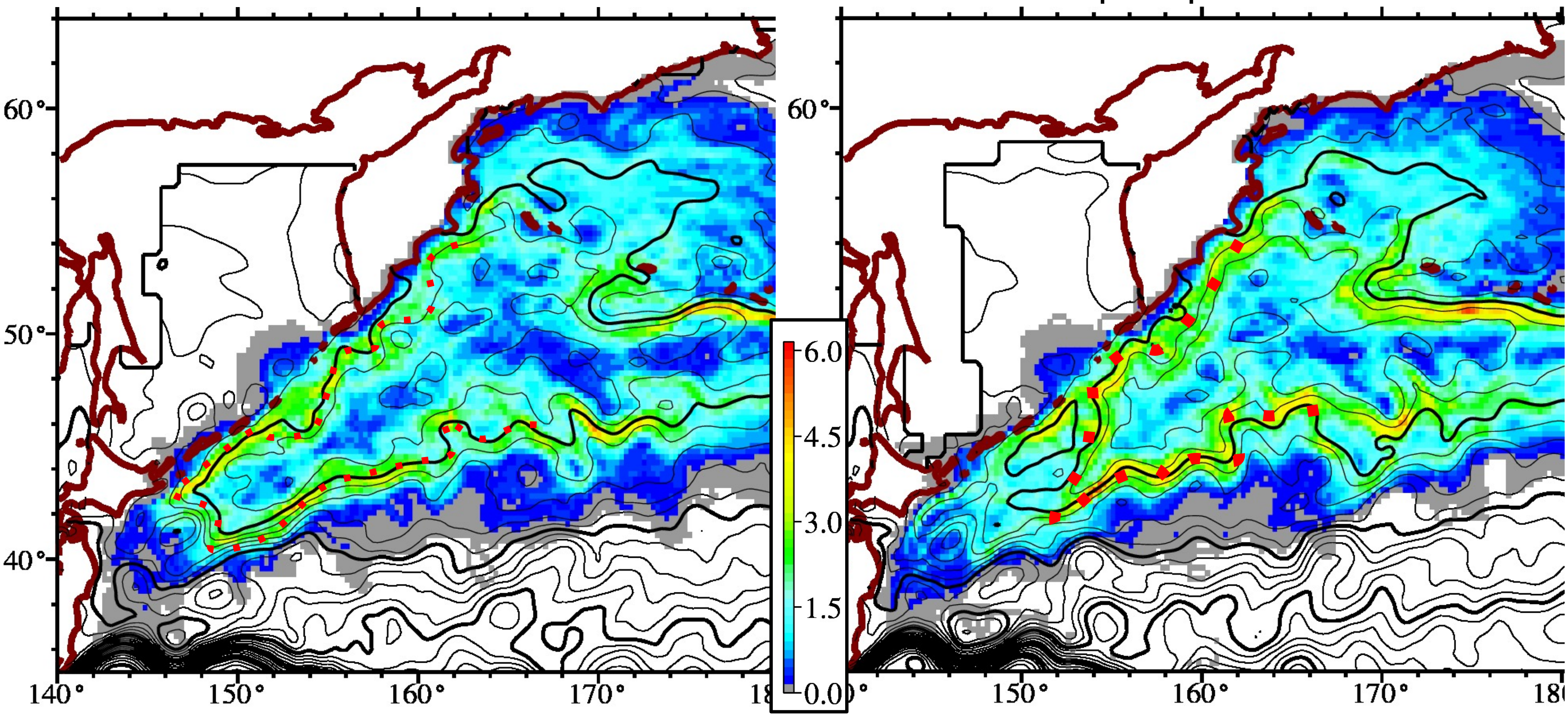
Density of streamlines（color）
&Absolute dynamic topography（coutor）

Density : the number of streamlines per day in each 0.25 °× 0.25° quadrat.



Average over 2014-2016
（The weakest state of WSAG）

Average over 2017-2019
（Spin-up of WSAG）



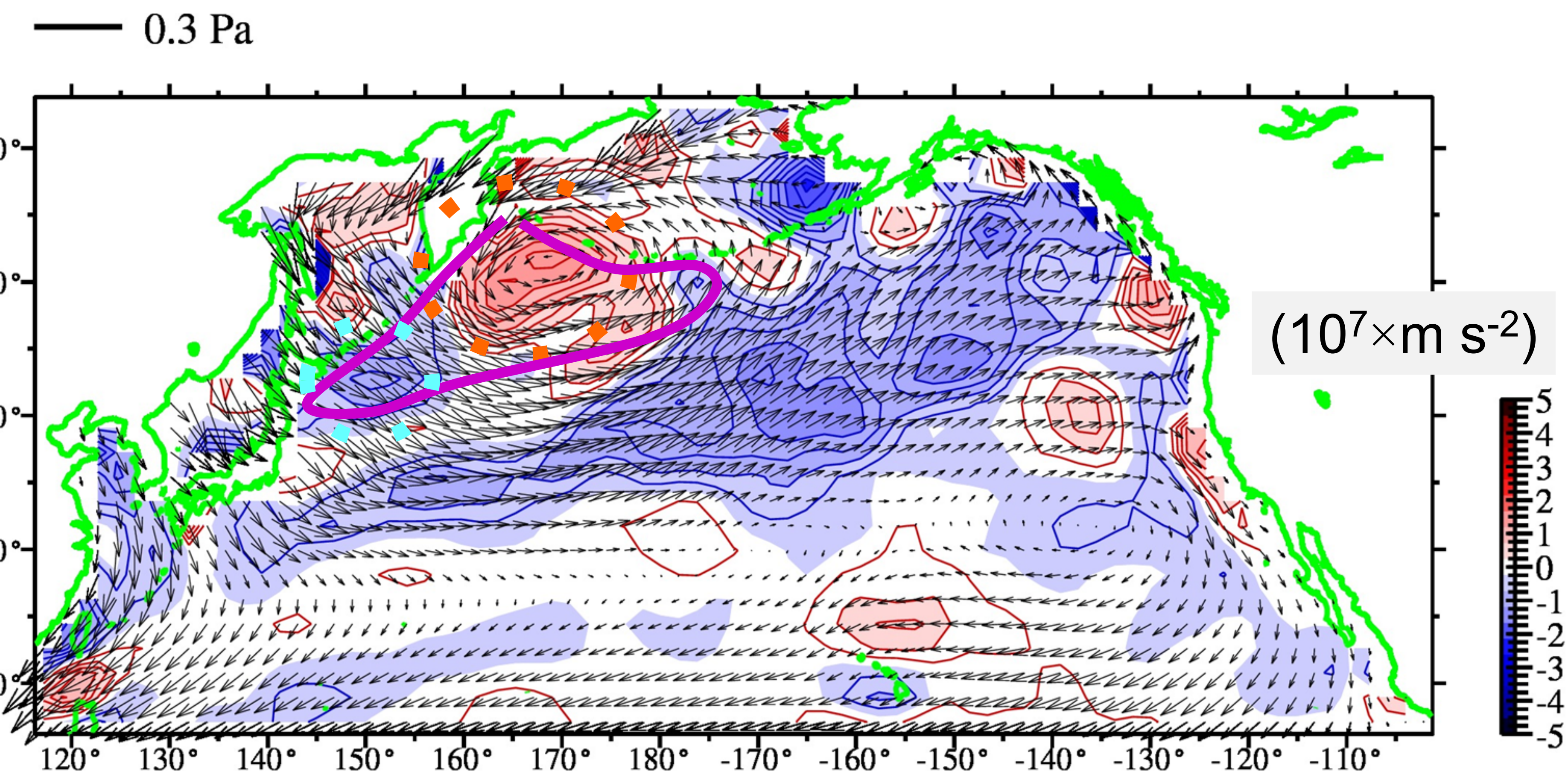
Weakest Oyashio stream reached Hokkaido

Accelerating Oyashio stream returned (shortcut) before reaching Hokkaido

Kuroda (2021, in preparation)

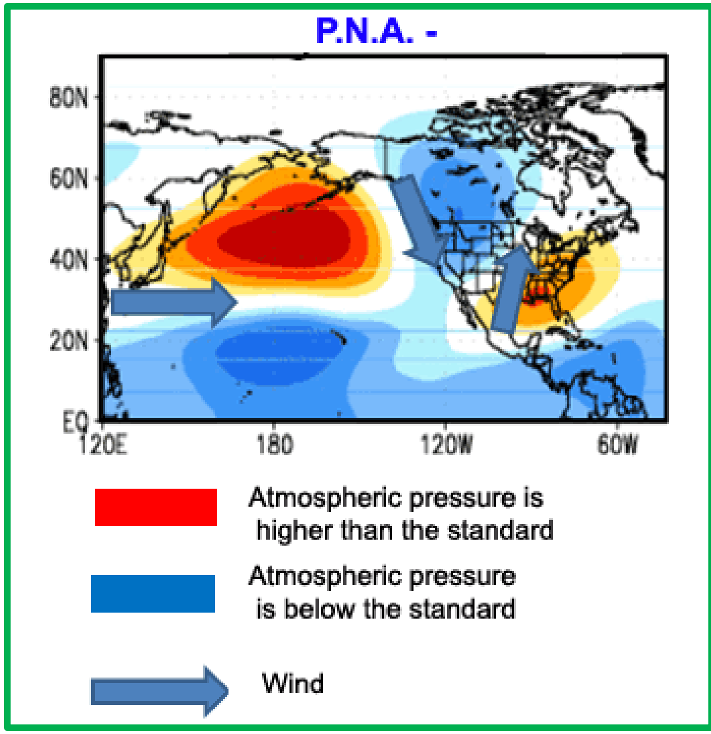
Conventional? or Unconventional?

Anomalies of wind stress (vectors) &
Anomalies of wind stress curl (contours and shading)



Kuroda (2021, in preparation)

Conventional? or Unconventional?



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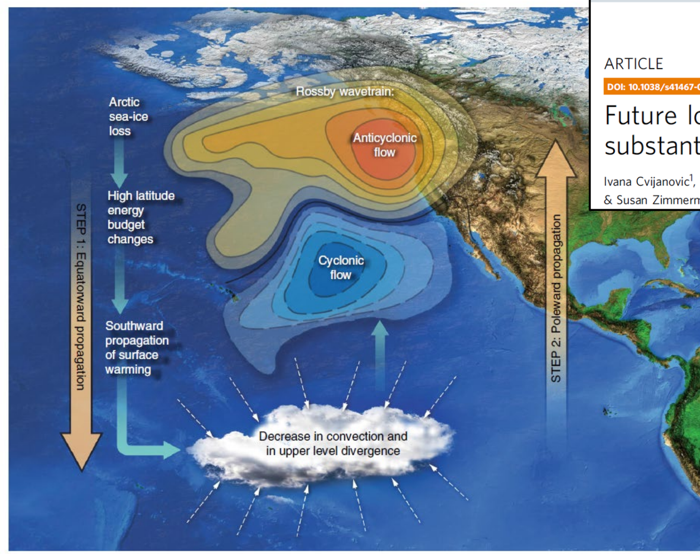
ARTICLE

DOI: 10.1038/s41467-017-01907-4 OPEN

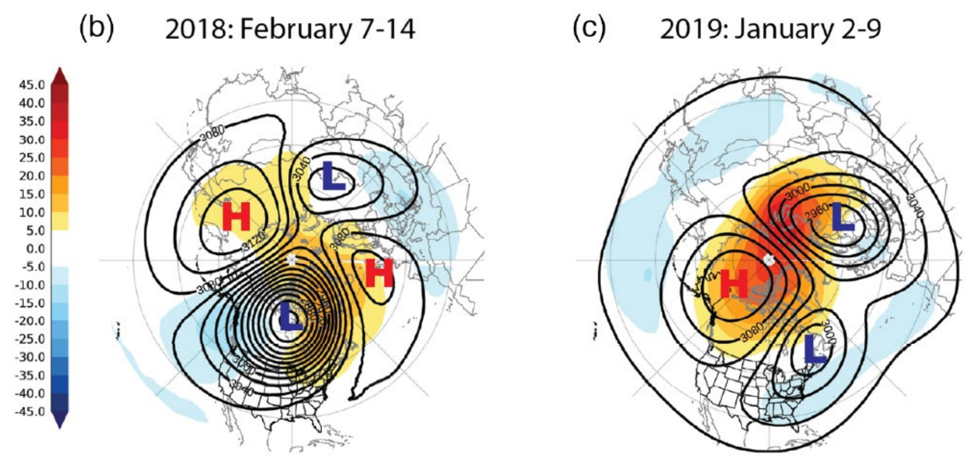
Future loss of Arctic sea-ice cover could drive a substantial decrease in California's rainfall

Ivana Cvijanovic[1], Benjamin D. Santer[1], Céline Bonfils[1], Donald D. Lucas[1], John C.H. Chiang[2] & Susan Zimmerman[3]



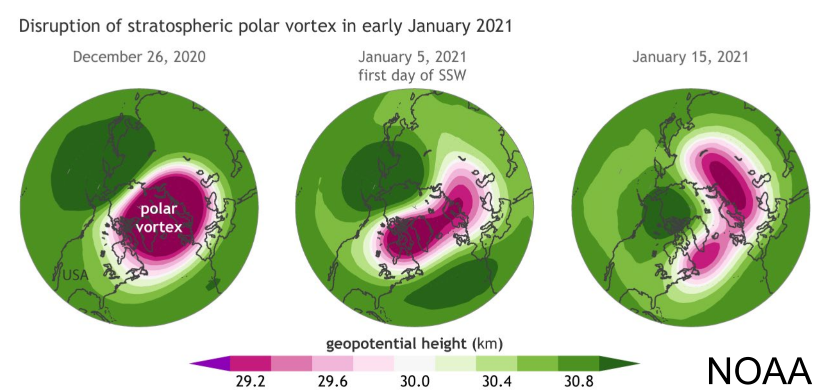
matics of the two-step teleconnection. In step 1 (equatorward propagation), Arctic sea-ice loss induced high-latitude changes propagate into gering tropical circulation and convection response. Decreased convection and decreased upper-level divergence in the tropical Pacific in turn hward-propagating Rossby wavetrain with anticyclonic flow forming in the North Pacific. This ridge is responsible for steering the wet tropical away from California

Polar Vortex split (2018 & 2019)



Butler et al. (2020, QJ)

Polar Vortex collapsing (2021 Jan.)



NOAA

Summary

(1) Decadal cooling of SSTs around Japan in 2000−2014
with a regionality and seasonality

maybe, unconventional changes

(2) Very weak state of the Oyashio off Japan
after 2010, particularly after the late 2010s

still unclear, unconventional or conventional changes