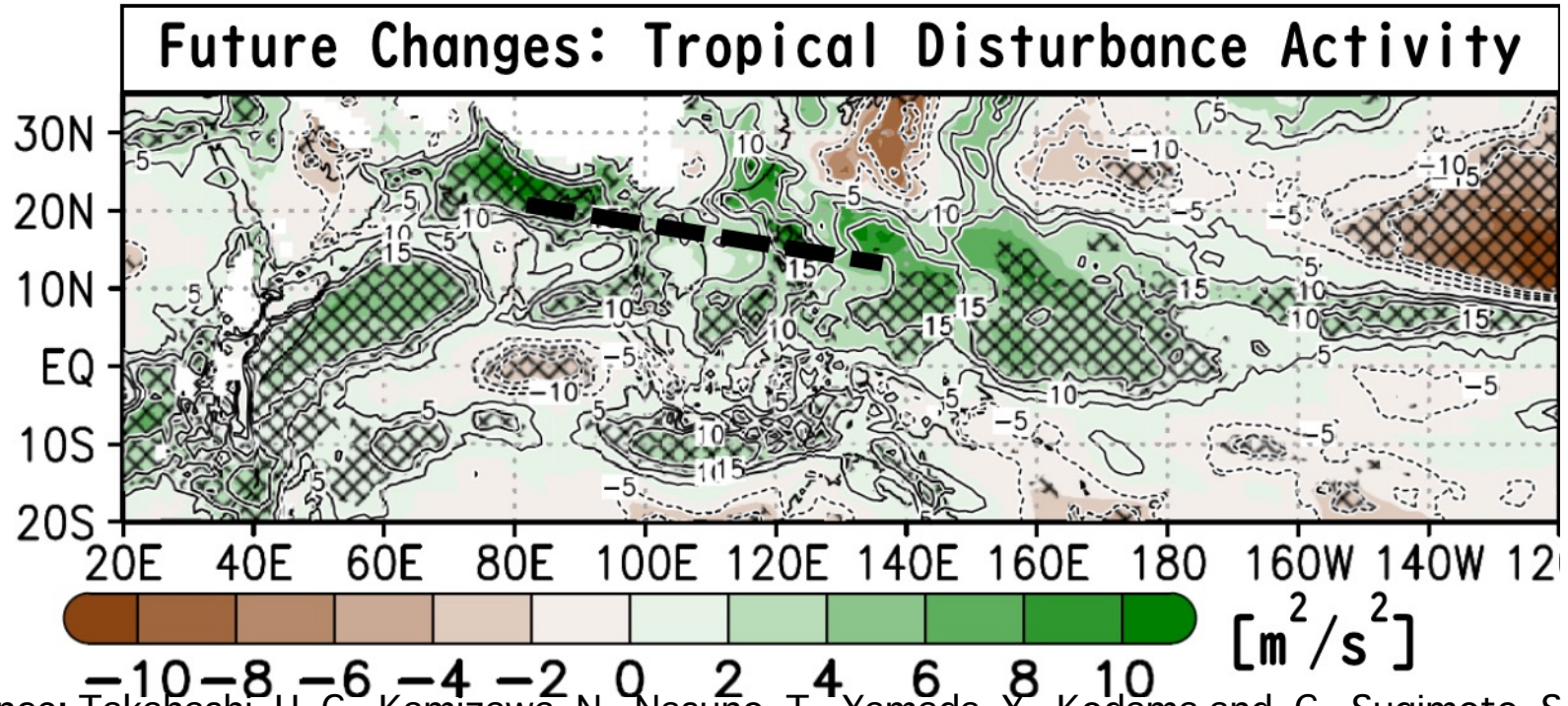
EGU21-13986:

Role of tropical cyclones along the monsoon trough in the future changes of the Asian monsoon precipitation by high-resolution models.

by Hiroshi G. Takahashi (Tokyo Metropolitan University, Japan)
Email: hiroshi3@tmu.ac.jp. [abstract link:EGU21-13986]

How is the cause the regional changes in precipitation??

- Precipitation increase along the monsoon trough (like CMIP5 models)
- The future changes in tropical disturbances (Tropical Storms + weaker tropical disturbances) can explain the regional changes in precipitation.



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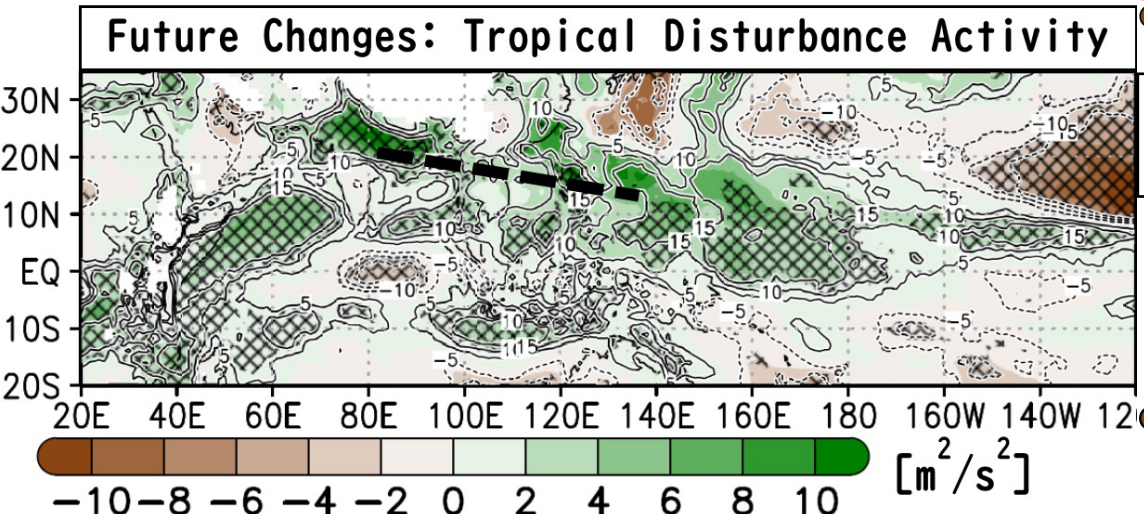

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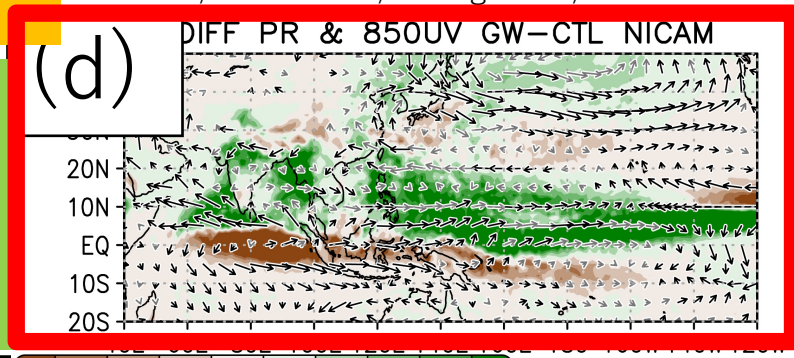
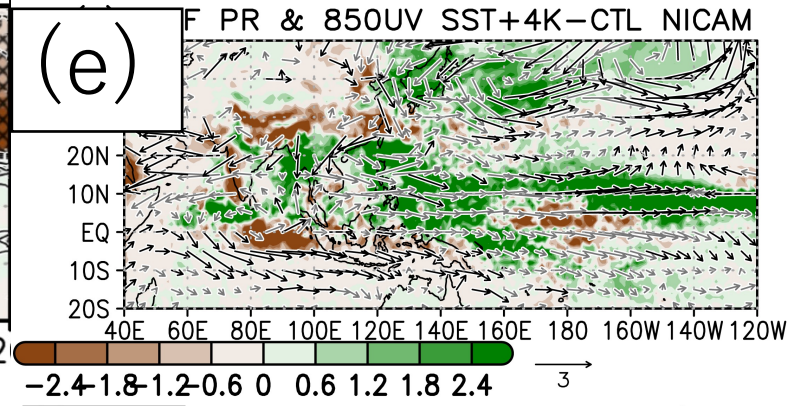
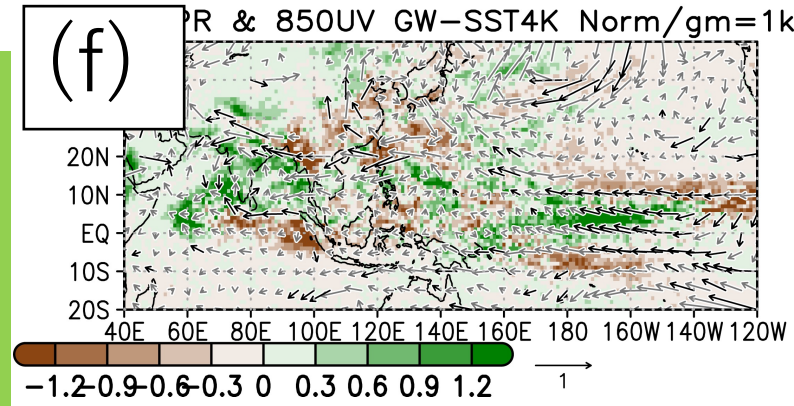






Monsoon Trough of the Asian monsoon

- Along the monsoon trough, tropical cyclones are developed in northern summer. Also, this tropical cyclone activity bring abundant precipitation there, which can control the precipitation variability over the Asian monsoon region.

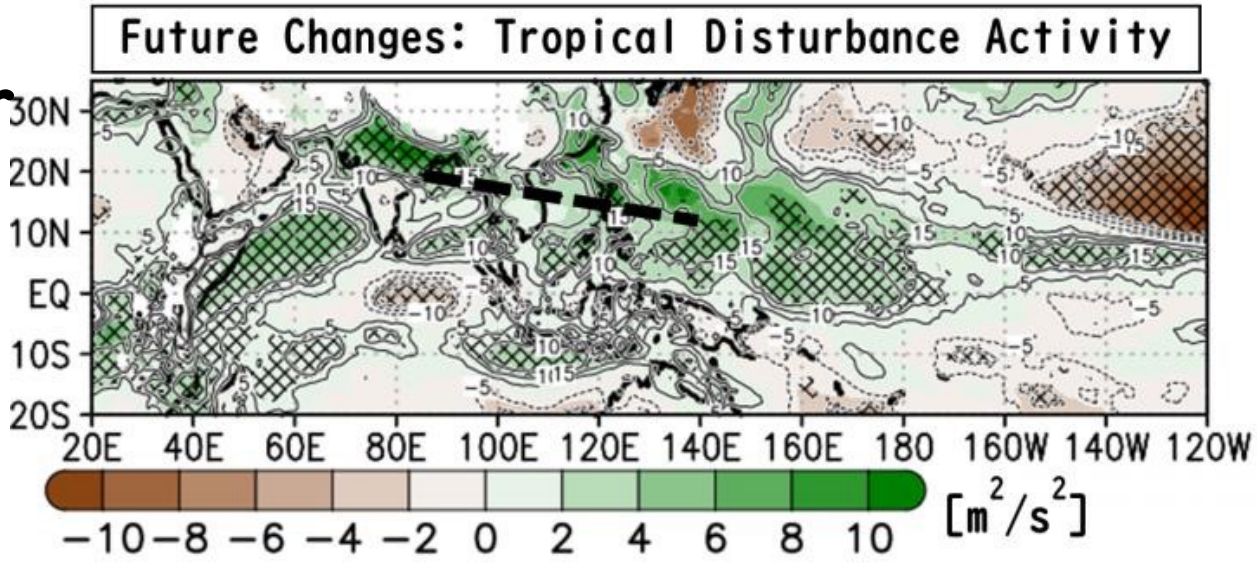


Fig. Future changes in the tropical cyclone activity (See detailed Takahashi et al. 2020)

- To understand the tropical cyclone activity over the western North Pacific, the monsoon trough of the Asian monsoon can be a key factor. For the tropical cyclone activity, the condition of the monsoon trough can be understood as the environmental factor.

- However, the monsoon trough can also be understandable as the result of the tropical cyclone activity over the western North Pacific, which was explained by some previous studies (e.g., Takahashi et al. 2015).

- Also, the precipitation from the tropical cyclone activity can control the precipitation over the Asian monsoon regions.

- Thus, there may be an interaction among the Asian monsoon precipitation, the monsoon trough, and the tropical cyclone activity. This study discusses the interaction between them and their future changes under a warming climate.

Interannual variability associated with Precip. South Asia

- Interannual Precipitation variability over South Asia is not related to the that over the western North Pacific.

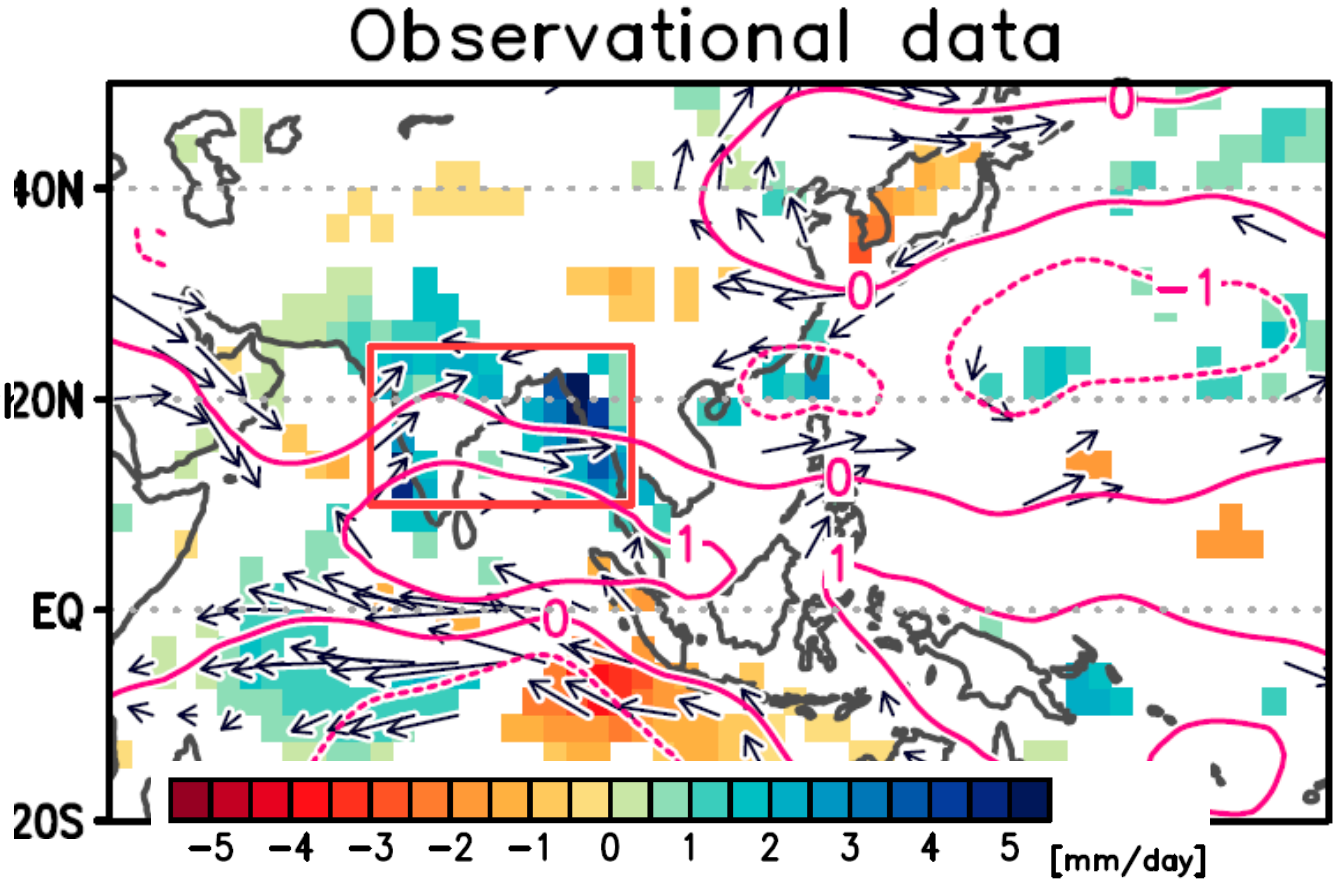


Fig. Atmospheric ciruclation related to t
interannual variability
precipitation of South
Asia in JJA (Kamizawa
Takahashi 2018)

Interannual variability associated with Precip. over WNP

- Interannual Precipitation variability over the western North Pacific (WNP) like to be related to the monsoon trough.

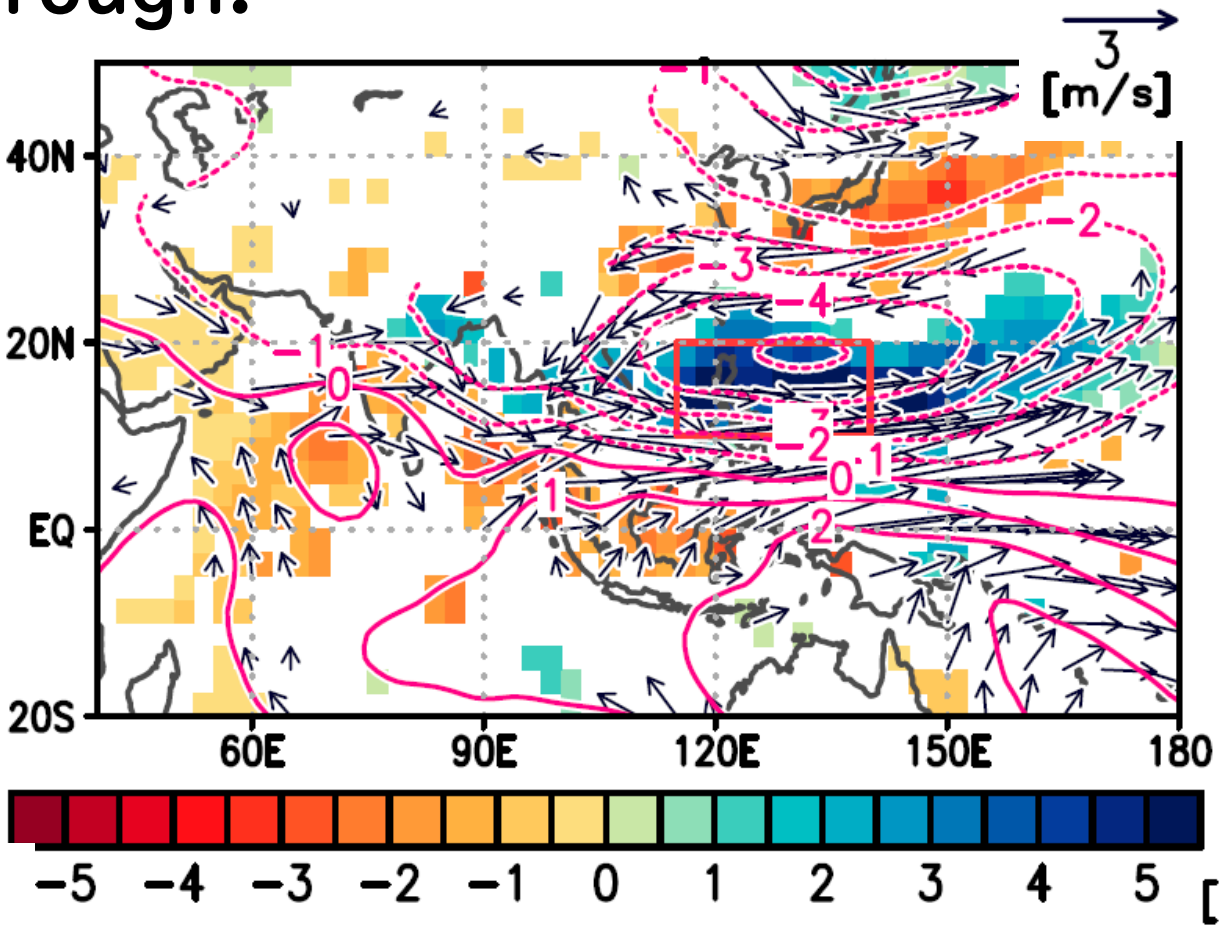


Fig. Atmospheric ciruclation related to the interannual variability of precipitation of the WNP in JJA (Kamizawa & Takahashi 2018)

Coherence of the interannual variability in precipitation

- Interannual Precipitation variability over the Asian monsoon precipitation is in phase along the monsoon trough.

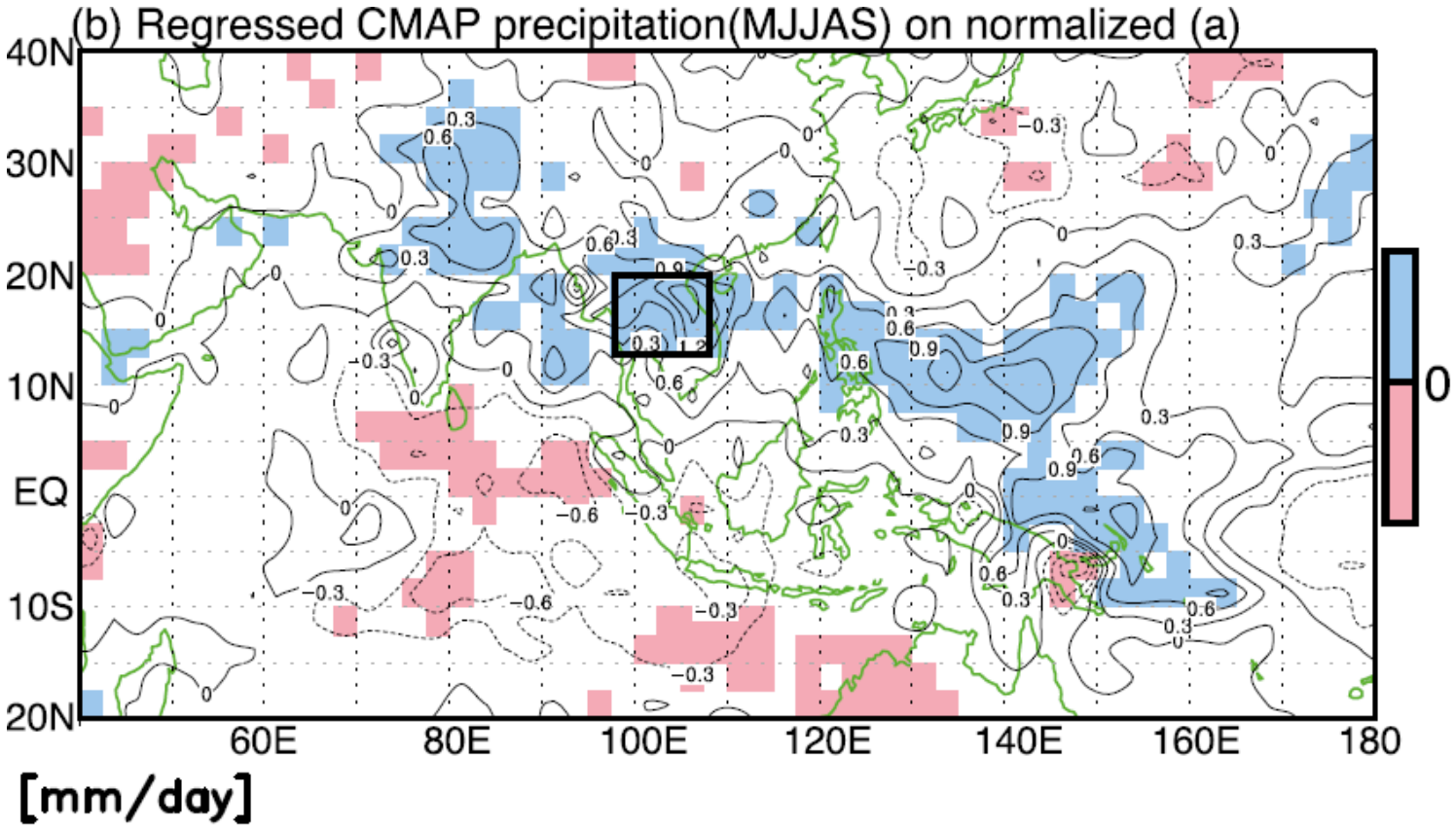


Fig. Regression map of precipitation showing similar interannual variation (Takahashi et al. 2015)

Related atmospheric circulations

- Interannual precipitation variability is related to the cyclonic circulation anomalies along the monsoon trough, but the intensification of the monsoon westerlies are unclear.

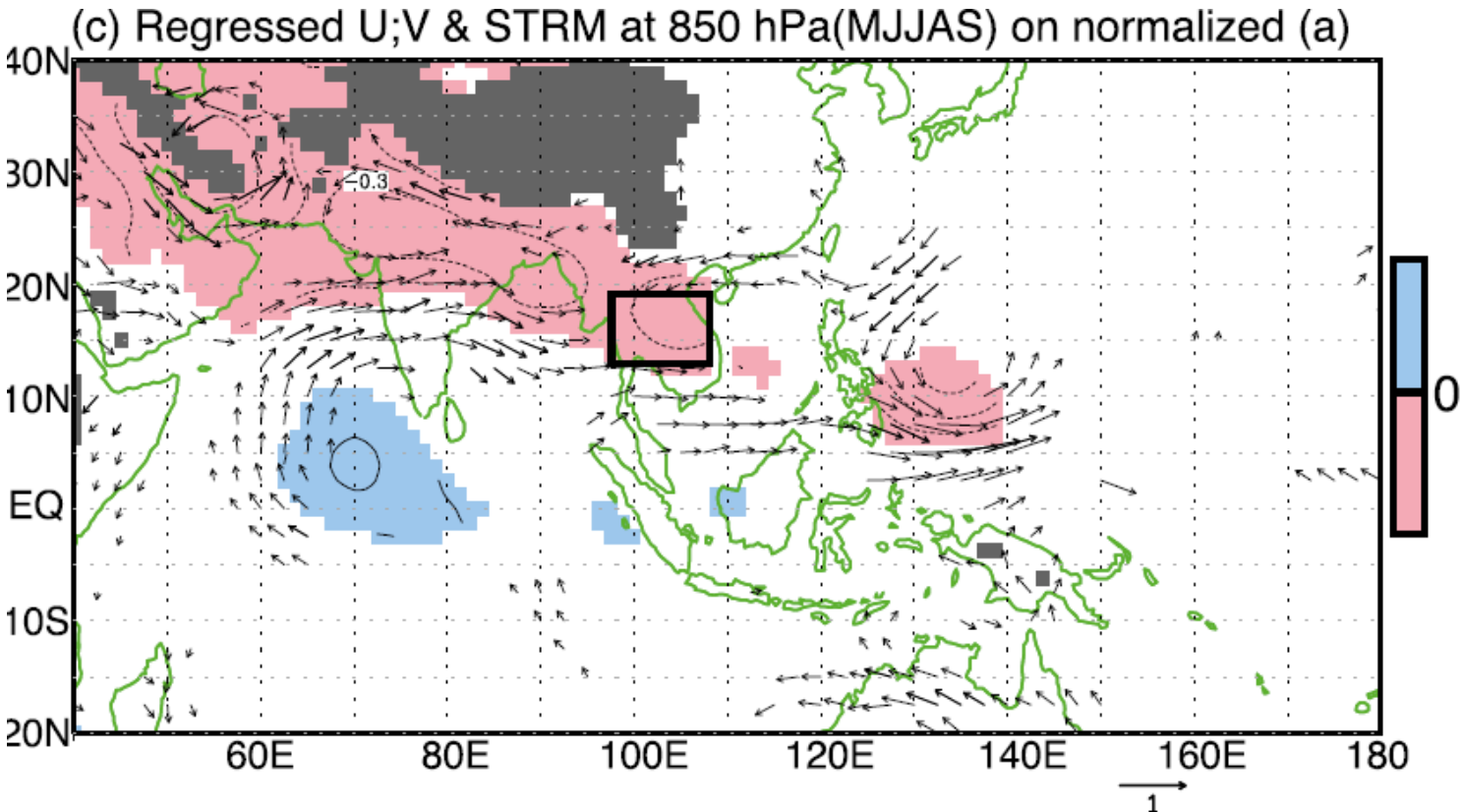


Fig. Regression map of 850-hPa winds showing similar interannual variation (Takahashi et al. 2015)

Regional characteristics of the interannual variability over the Asian monsoon precipitation

- Interannual Precipitation variability over the Asian monsoon has regional characteristics. One of the major regions is a tilting zonal band along the monsoon trough.

- Thus, to understand the precipitation variability, we should focus on the precipitation along the monsoon trough. The precipitation variability along the monsoon trough is associated with the tropical cyclone activity, including the many weaker tropical cyclones.

Future changes in precipitation by a global non-hydrostatic model

- By using a global non-hydrostatic model (better representation of TCs), the Asian monsoon precipitation increased under the warming climate along the monsoon trough.

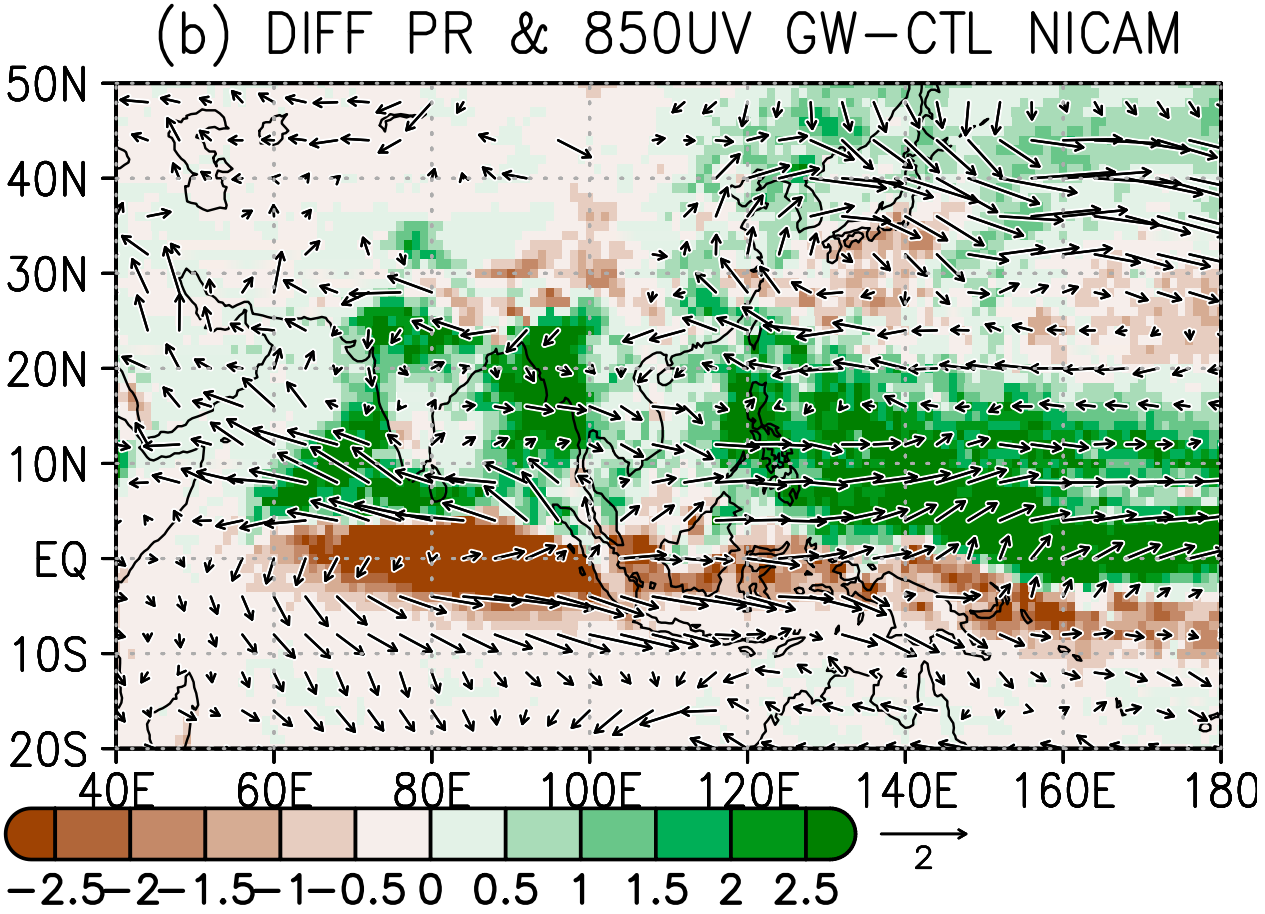


Fig. Future changes in JJA precipitation (Takahashi et al. 2020)

Future changes in TC activity including the weaker TCs

- Perturbation kinematic energy (PKE) increased under the warming climate along the monsoon trough.

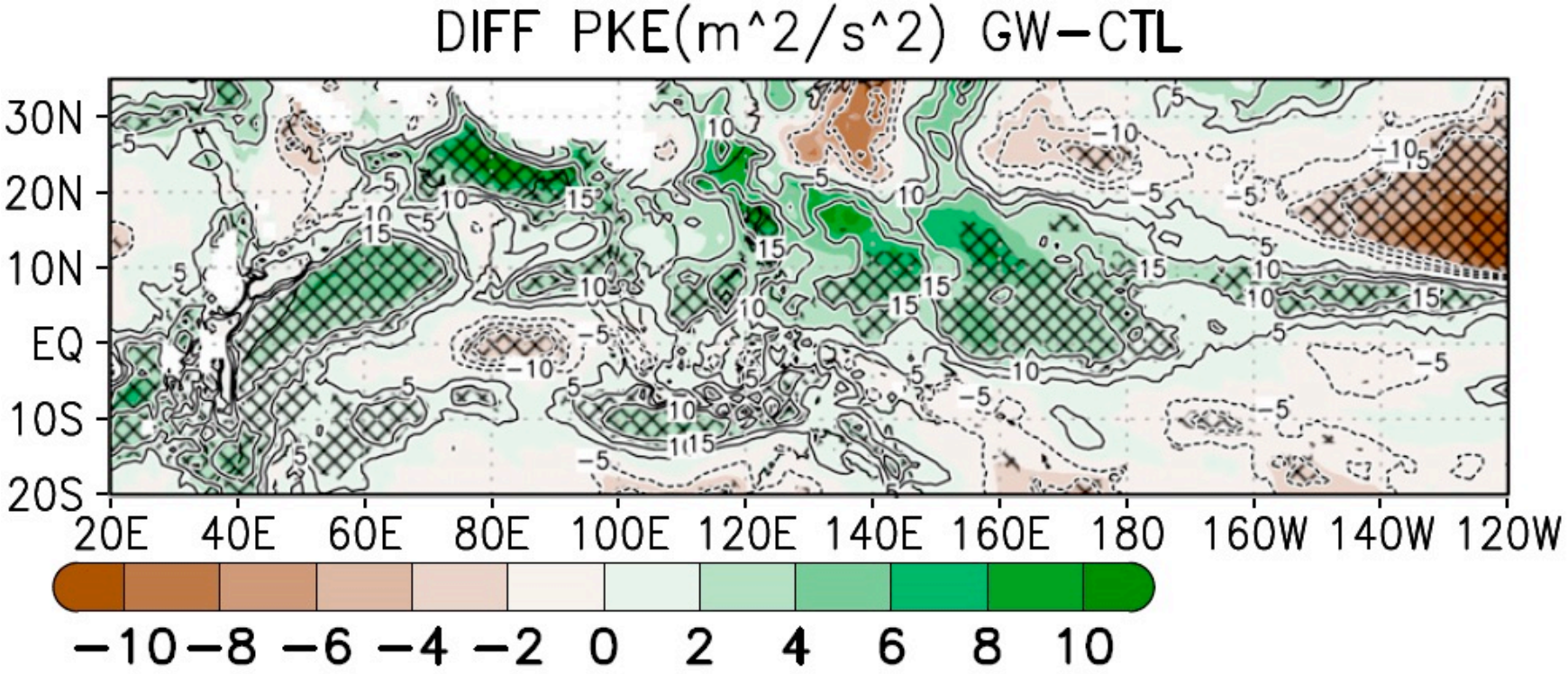
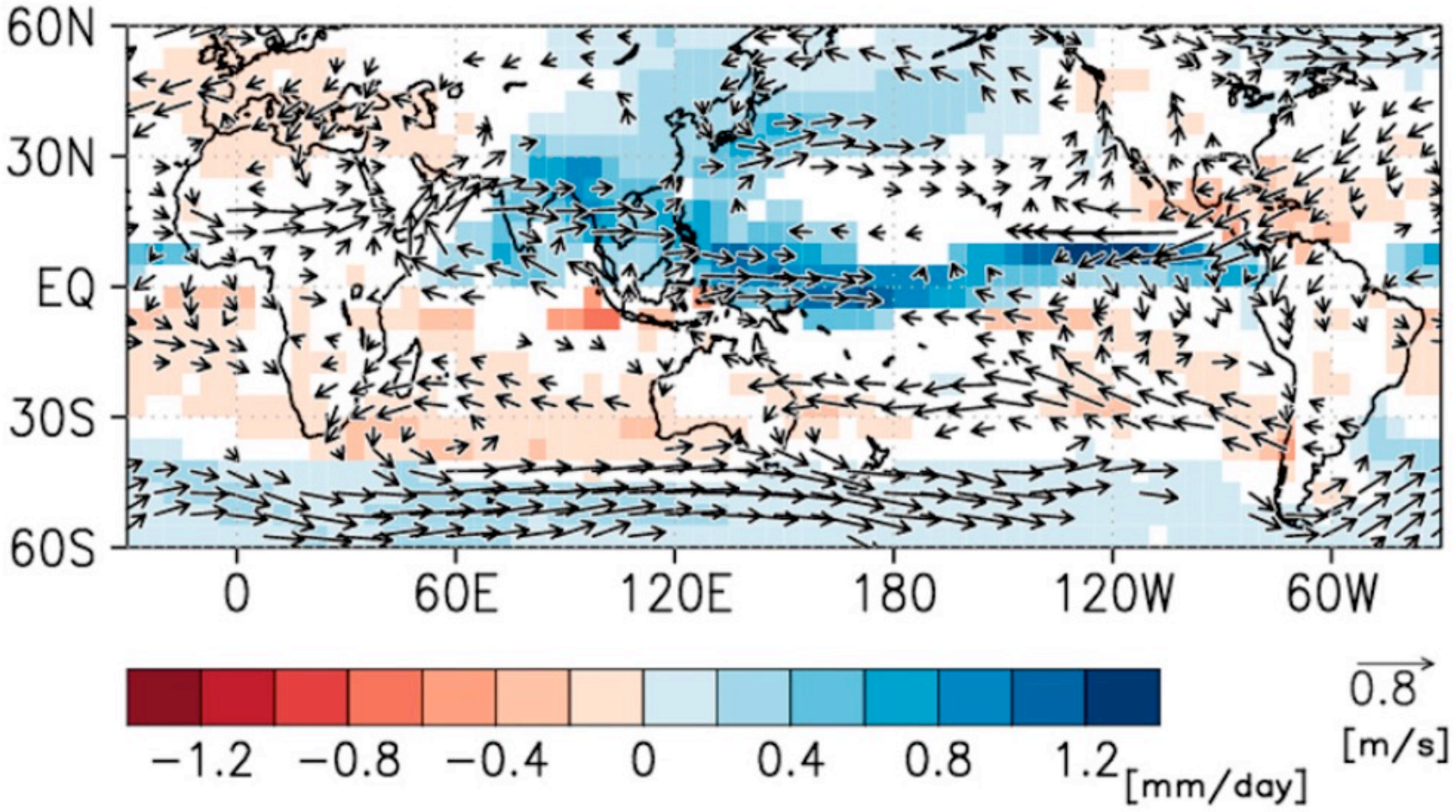


Fig. Future changes in the tropical cyclone activity (Takahashi et al. 2020)

Future changes in precipitation by CMIP5 climate models



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The precipitation variation over the Asian monsoon region

- In the context of climate change, the monsoon trough is one of the keys to understand the precipitation variability over the Asian monsoon not only the western North Pacific.

- For understanding the precipitation variability along the monsoon trough, the many weaker tropical cyclones may also quantitatively contribute to the precipitation variability (Kamizawa & Takahashi 2018; Takahashi et al. 2020).

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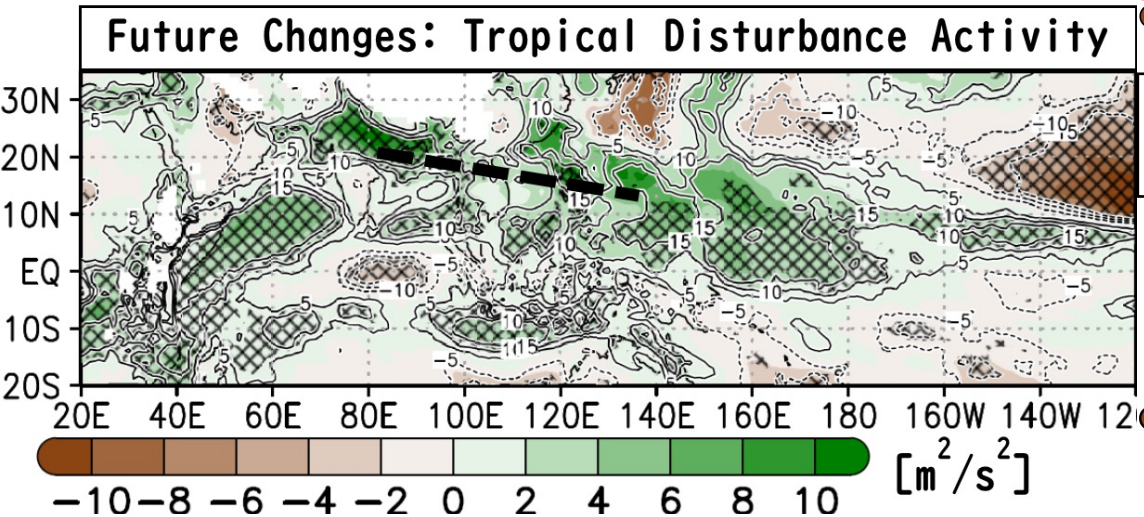

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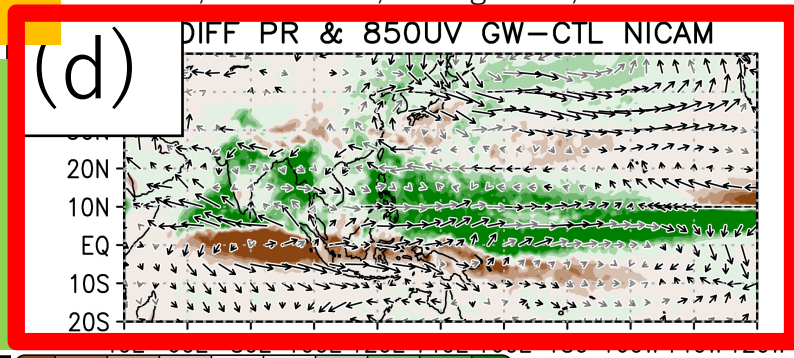

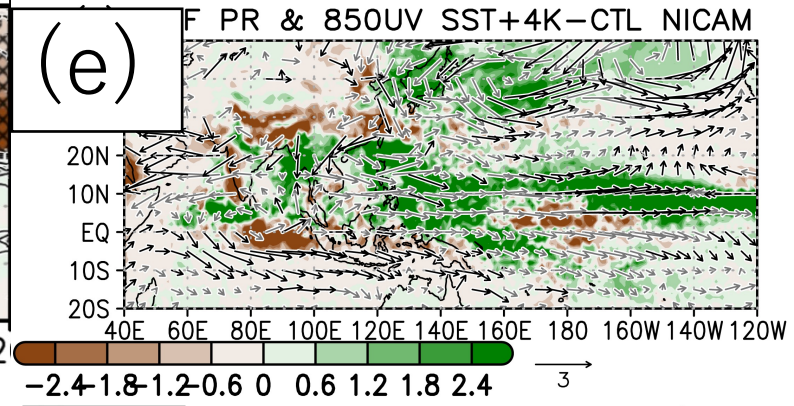

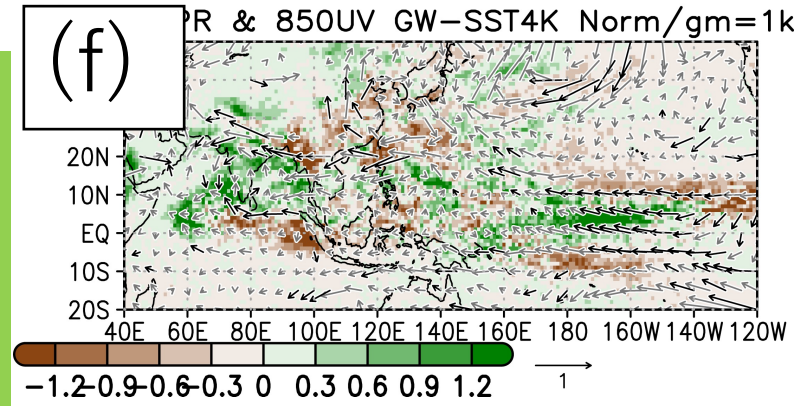

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- Kamizawa, N., and H. G. Takahashi, 2018: Projected Trends in Interannual Variation in Summer Seasonal Precipitation and Its Extremes over the Tropical Asian Monsoon Regions in CMIP5. *J. Climate*, **31**, 8421-8439, doi:10.1175/JCLI-D-17-0685.1.
- Takahashi, H.G., H. Fujinami, T. Yasunari, J. Matsumoto, and S. Baimoung, 2015: Role of tropical cyclones along the monsoon trough in the 2011 Thai flood and interannual variability. *J. Climate*, **28**, 1465-1476, doi:10.1175/jcli-d-14-00147.1.