Influence of regionally warm sea surface on moisture and extreme rainfall in Tsushima Strait during August 2013

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The present work investigated summertime atmospheric response to a regionally high SST in a narrow strait (*Yamamoto 2020, Atmos. Res. 238, id104876*) and highlighted as follows,

(1) Warm SST does not always enhance the maximum hourly rainfall. In some ensemble members, the warm SST lowers the maximum rainfall rate.

(2) Physical processes of rainfall increase/decrease caused by the warm SST are discussed.

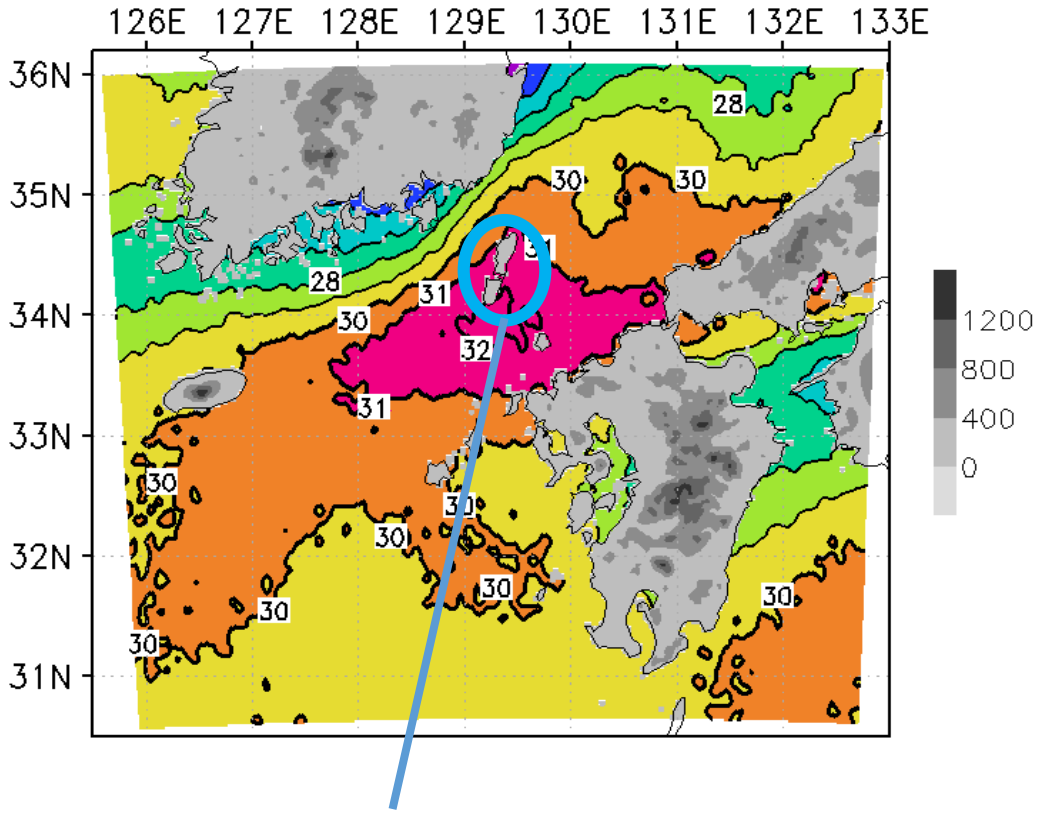
(3) Moisture variation by rainfall affects responses of subsequent rainfall to the SST.

The details of the model setup and atmospheric response to the SST are described in *Yamamoto (2020)*. https://doi.org/10.1016/j.atmosres.2020.104876 (open access)

Introduction

< Impact of warm/cold SST in East Asia marginal seas >

Sea Surface Temperature (K, color) in Tsushima Strait on 22 AUG 2013



Tsushima Islands, in which *Izuhara* town is located

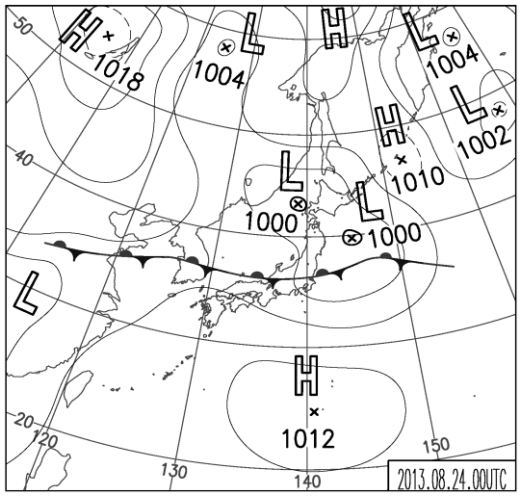
For wintertime precipitation, many works have been reported for East Asia marginal seas (e.g., Yamamoto et al. 2009, 2011; Xu et al. 2010).

Warm SST ⇒ High precipitation

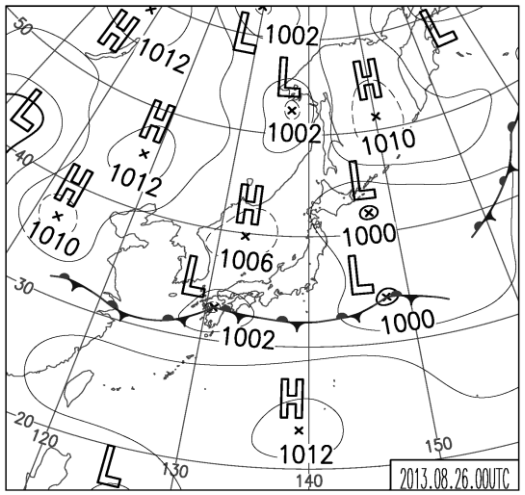
For summertime precipitation, although a few works have been reported (Yamamoto 2014, Iizuka & Nakamura 2019), **atmospheric response to mesoscale warm SST core has not fully been understood.**

This study investigates a case of a warm SST core in Tsushima Strait and heavy rainfalls at *Izuhara* on late August 2013.

Overview in late August 2013

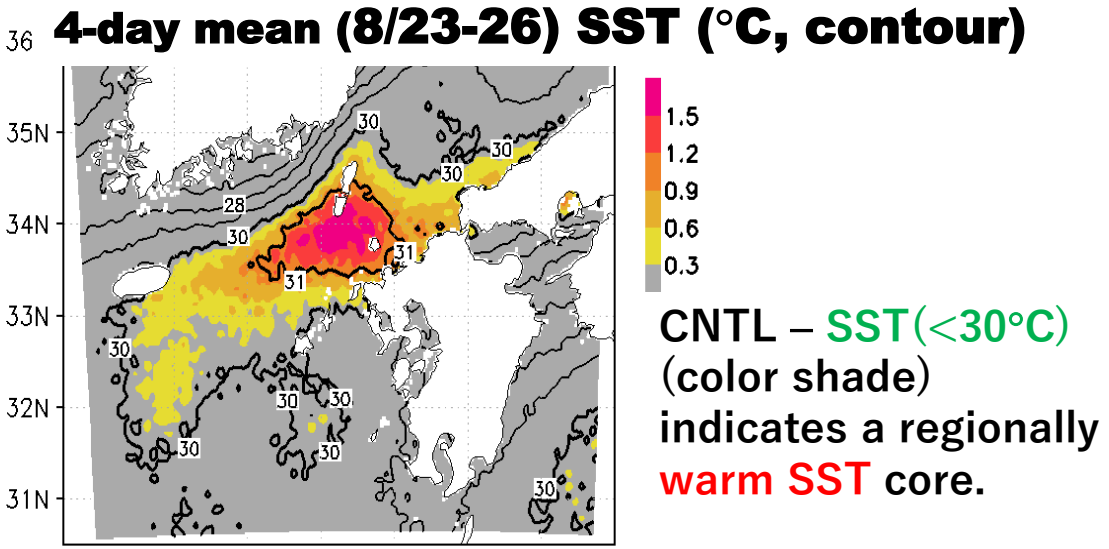


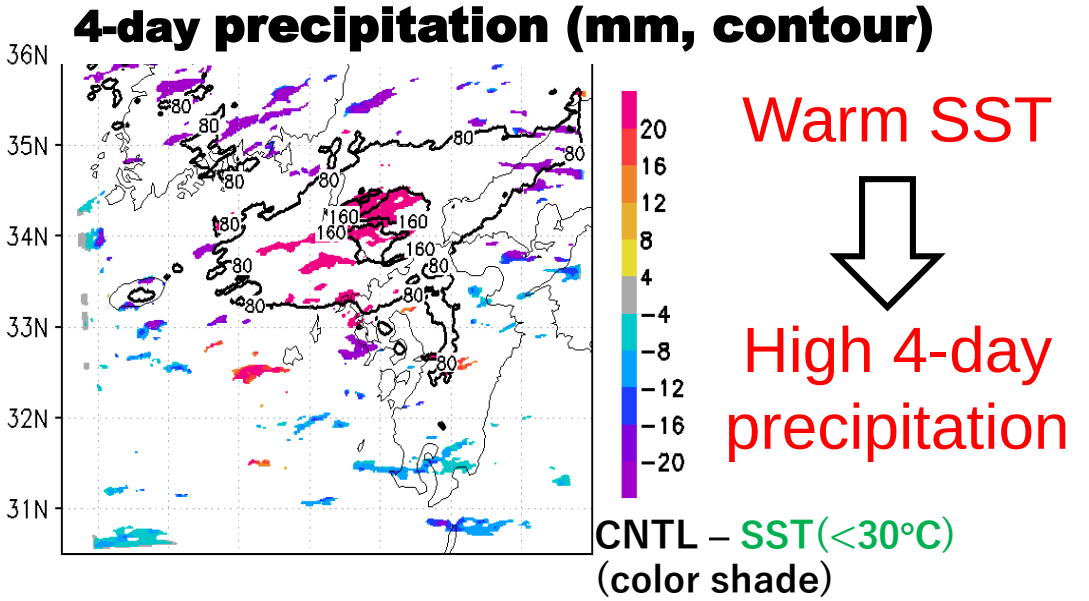
This presentation focusses on extreme rainfalls caused by a stationary front slowly passing through the Tsushima Strait (left panels of weather charts).



The ensemble WRF-ARW (Skamarock et al. 2008) simulations with nine different initial times were performed in the presence and absence of a regionally warm sea surface (>30 °C) around the Tsushima Islands (upper-right RTG SST map).

Response to a warm SST

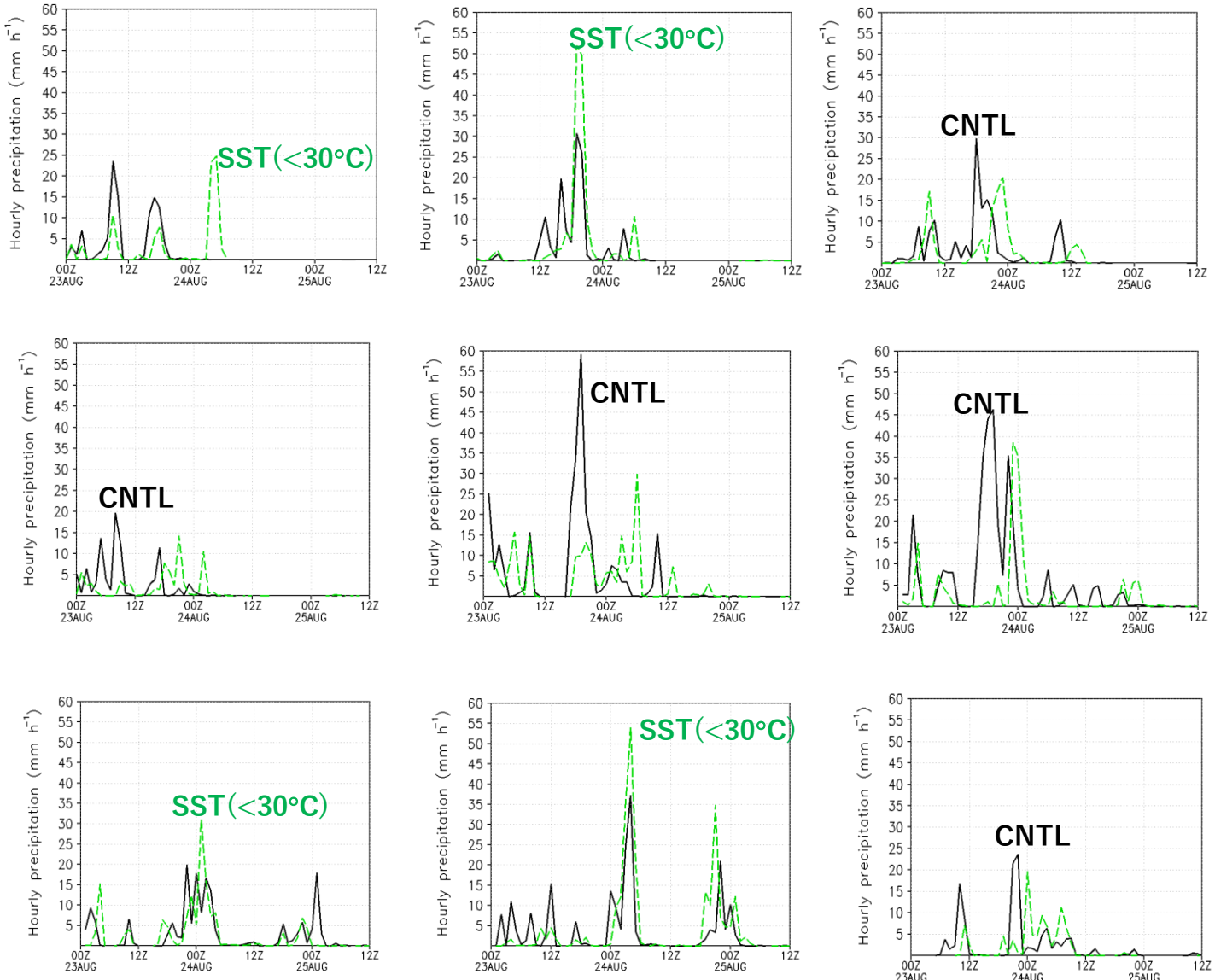




Model precipitation at Izuhara

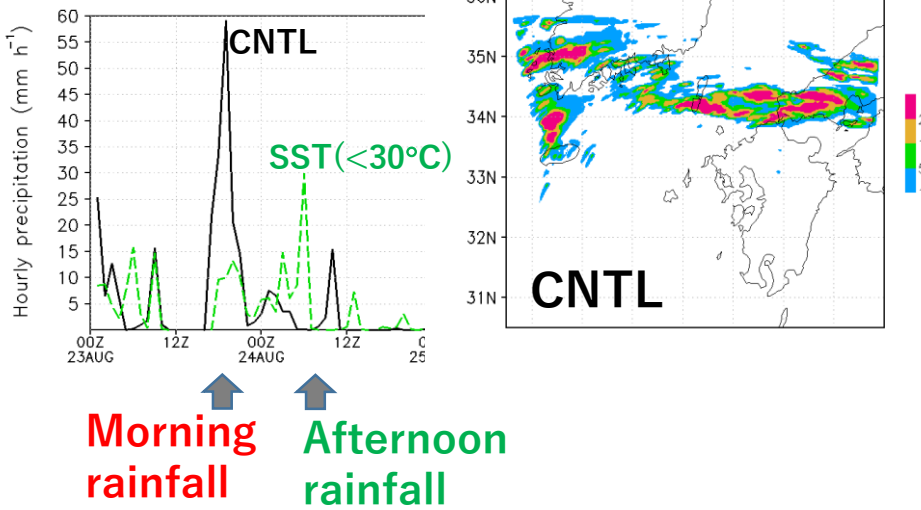
Warm SST does not always lead to high hourly precipitation.

< 9 ensemble members >



< Most accurate run >

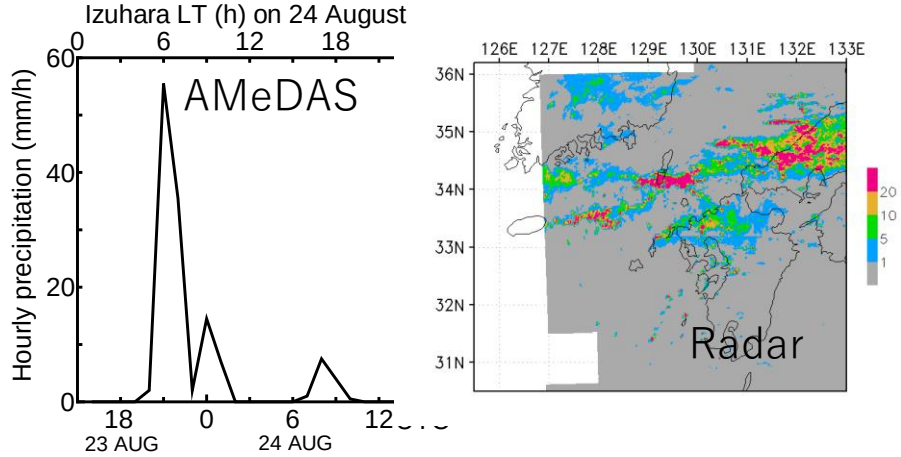
MODEL



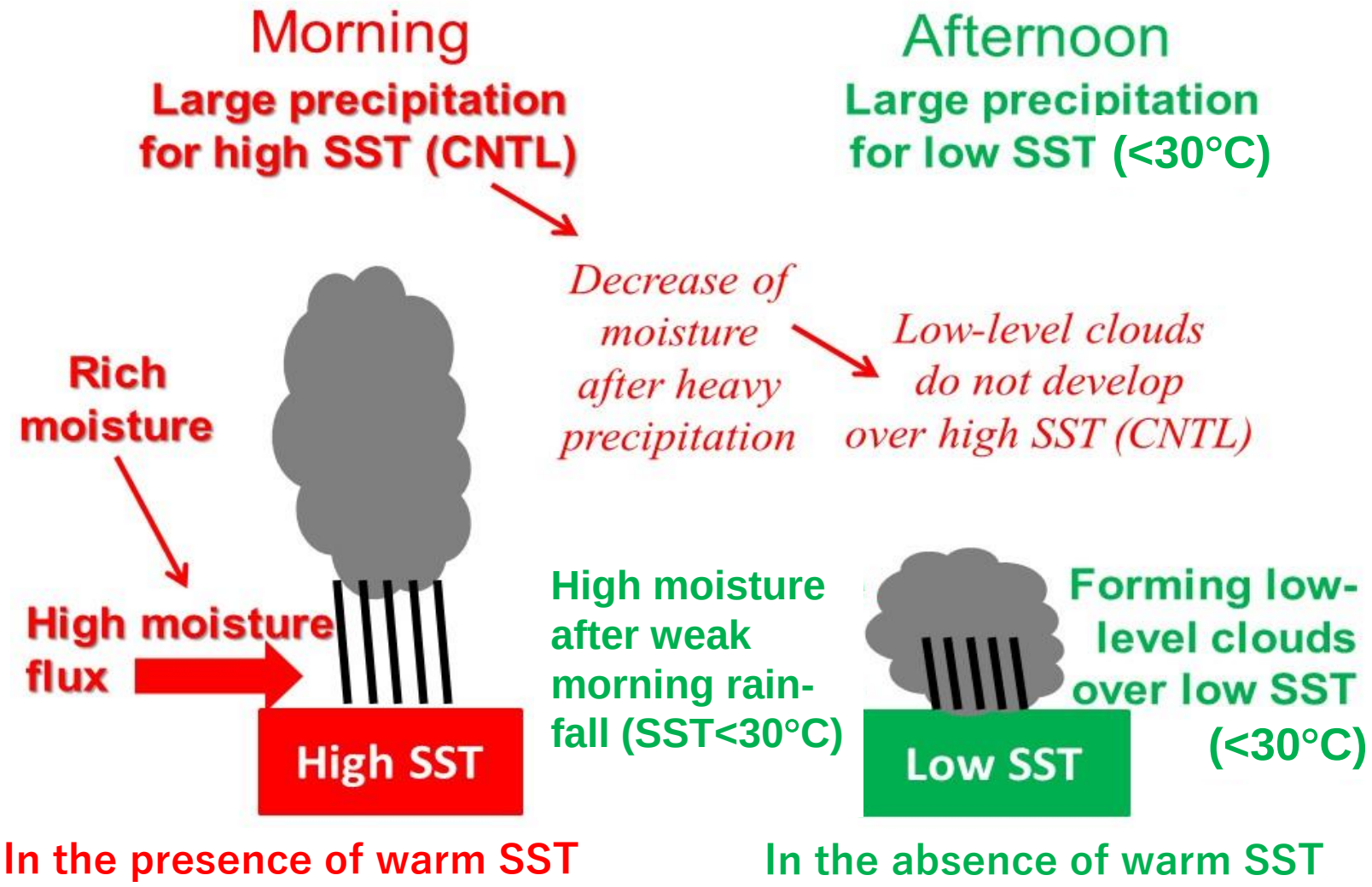
Morning rainfall

Afternoon rainfall

OBS



Increase/decrease of rainfall by warm SST core



Based on the moisture analyses in the most accurate run (Figs. 9-12 in Yamamoto (2020))

Summary

- The high SST resulted in locally enhanced precipitation in the central area of the warm core. Unlike the response of the 4-day precipitation to the SST, the ensemble experiment shows that warm SSTs do not always enhance hourly rainfall because of SST-related changes in moisture from prior rainfall events.

- In a simulation that performs well in reproducing precipitation at Izuhara, high SSTs resulted in enhanced precipitation in the morning. Subsequently, water vapor decreased, leading to lower precipitation in the afternoon. In contrast, a low-SST experiment with the warm-SST core removed produced moisture concentrations that were higher than those in the high-SST experiment after weak rainfall during the morning. As a result, low SST led to greater precipitation in the afternoon.

- Responses of hourly precipitation to SST should be carefully investigated by considering transient moisture variations during each rainfall event and related uncertainties in ensemble simulations.

Yamamoto, M. (2020). Ensemble simulations of the influence of regionally warm sea surface on moisture and rainfall in Tsushima Strait during August 2013. Atmospheric Research, 238, id104876.