28WAF/24NWP Poster Session 1: Weather Phenomena, Observations, and Forecasting #84

Use of Operational Data to Reveal the Morphology and Environmental Properties of Warm-Season Mesoscale Convective Systems in Japan

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Warm-season MCSs in Japan

Mesoscale convective systems (MCSs) develop over various regions of the world in any season and take various forms such as a circular shape and a linear shape. Previous studies on environmental conditions and morphological features depended on data from specially coordinated observations and/or the numerical simulations for specific cases. On the other hand, recent operational observations produce high-quality, long-term meteorological data, which enable us to investigate the climatological analyses on MCSs.

In Japan, slow-moving or stationary MCSs are major sources for heavy rainfall in warm season. This study focuses on such **quasi-stationary convective clusters (QSCCs)**.

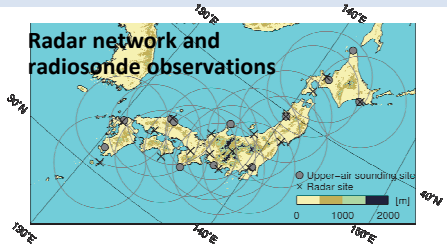
Data and analysis method

Data and analysis period

Weather radar of JMA: 2-km-height rain intensity; 1 km resolution and 10 min interval

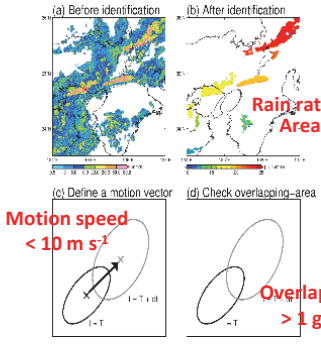
Upper-air observations of JMA: 0000 and 1200 UTC

Period: May – October from 2005 to 2012

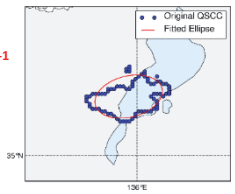


QSCCs identification from weather radar

Automatic detection and tracking of QSCCs (AITCC by Shimizu & Uyeda 2012)



Automatic shape determination for QSCCs (ellipse fitting by Fitzgibbon et al. 1999)



Elongated mode: major axis/minor axis ≥ 1.4

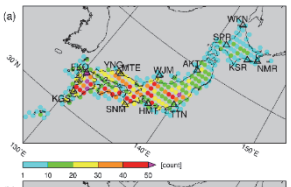
Circular mode: major axis/minor axis < 1.4

Environmental analysis from upper-air soundings

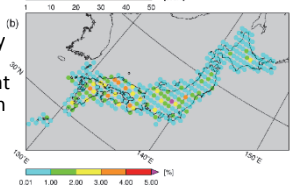
CAPE: convective available potential energy
CIN: convective inhibition
PW: precipitable water vapor
SSI: Showalter stability index
KI: K index
TLR: temperature lapse rate from 850 to 500 hPa
MS03: mean shear in the 0—3 km layer
EH03: environmental helicity in the 0—3 km layer

QSCCs and their environmental properties

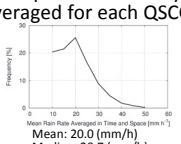
Number of the occurrence of QCSS in 50 km by 50 km area



Percentage of rainfall produced by QSCC against total precipitation amount during warm season

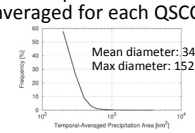


Precipitation intensity averaged for each QSCC



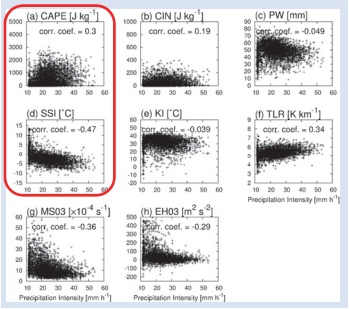
Mean: 20.0 (mm/h)
Median: 20.7 (mm/h)
Maximum: 69.9 (mm/h)

Precipitation area averaged for each QSCC

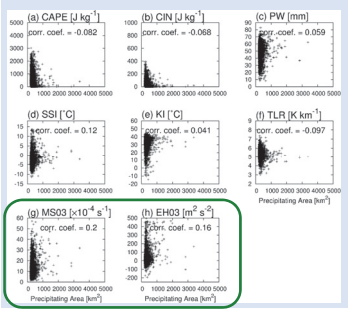


Mean diameter: 34 km
Max diameter: 152 km

Precipitation intensity vs environmental conditions



Precipitation area vs environmental conditions



Convective stability parameters have higher correlations with precipitation intensity.

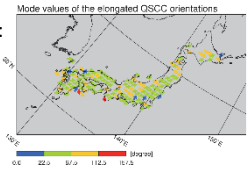
Convective instability determines the intensity of QSCCs.

Shear parameters have high correlations with precipitation

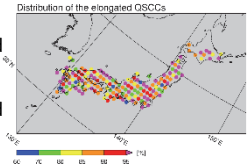
Shear determines the size of QSCCs.

Morphology of QSCCs

Orientation: SW-NE



Percentage of elongated mode: Prevalence of elongated mode



	Elongated	Circular
CAPE	**1104**	**1321**
CIN	18.3	19.5
PW	48.2	48.6
K Index	29.6	29.7
TLR	5.35	5.38
MS03	**27.5**	**22.9**
EH03	**43.8**	**26.7**
Bulk Ri	**32.8**	**47.8**

Summary

Convective instability determines the intensity of QSCCs, and shear determines the size of QSCCs. Low-level moisture content controls the stability condition for QSCCs.

The low-level vertical shear controls the shape of QSCCs: circular mode versus elliptical mode. A parameter combining shear and stability clearly distinguishes between the organization modes.

Unuma, T., and T. Takemi, 2016: *Quart. J. Roy. Meteor. Soc.*, **142**, 1232-1249, doi: 10.1002/qj.2726.
Unuma, T., and T. Takemi, 2016: *SOLA*, **12**, 111-115, doi:10.2151/sola.2016-025.