日本の暖候期の豪雨に影響するAtmospheric Riverとその循環場の解析
Atmospheric Rivers and related atmospheric circulations associated with Japanese disastrous precipitation in warm season

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Atmospheric Rivers (ARs) refer to the flow of moisture like an elongated river that reach the mid-troposphere, and water vapor evaporated in the tropics is transported rapidly by subtropical jet streams and extends to mid-latitudes. ARs play an important role in the meridional moisture (i.e. energy) transport in the mid-latitudes; besides bringing down heavy rain on the west coast of North America and the western coast of Europe. Recently, it was found that ARs could emerge around Japan, and the AR occurrence in Hiroshima in August 2014 was reported as one of the factors of heavy rain. However, there are few studies about a relation between heavy precipitation and ARs occurred in Japan. However, previous studies counted the AR occurrence among the heavy precipitation events in entire Japan (longitude 123˚-146˚ and latitude 24˚-46˚). The result during the warm season (April-October) was approximately 70%, which was a high value. It was considered that it included the location of heavy rain did not coincide with the occurrence spot of ARs, because the AR occurrence rate was calculated over a wide range. Therefore, this study analyzed it by dividing Japan into sub-regions, calculating the rate of ARs for heavy rain days that cause disasters in each region, and clarifying the atmospheric circulation field of the day when ARs occurred on heavy rain days.

The target period was 35 years from 1980 to 2014, and a year was divided into two seasons, the warm season (April-October) and the cold season (November-March). This study extracted heavy rain days and detected ARs in the warm season after defined conditions for extracting heavy rain days that cause disasters and conditions for detecting ARs that pass through around Japan. Then, Japan was divided into 13 regions, and it was sorted out the extraction of heavy rain days and AR detection in each region. At this time, AR detection in each area was the detection area up to 100 km in four directions of the area targeted, considering the remote influence of ARs. Only the AR occurrence rate of the warm season was targeted to be analyzed.

The AR occurrence rate in each area was lower than the value calculated in entire Japan. The area with the highest AR occurrence rate was 64.6 % in North Kyushu Region, and the areas with many heavy rain days but a low AR occurrence rate were in Shikoku-Kii Peninsula Region (44.1 %) and South Kyushu Region (45.8%).
This study compared Shikoku-Kii Peninsula Region and North Kyushu Region, and investigated the circulation field. First, the monthly value of AR occurrence rate was the highest in September (61.9 %) in Shikoku-Kii Peninsula Region and in June (83.3 %) in North Kyushu Region. Although the month that took the highest value was different, what common for these two regions were that it was relatively low in July and August and high in rainy seasons.

Regarding the circulation field, the moisture flux in both regions converged on the target areas; however, it diverged over water in the east in Shikoku-Kii Peninsula Region and over water in the south in North Kyushu Region. Both moisture flow comes along the western periphery of the Pacific high where moisture diverges. It is found that there is a trough near the Korean Peninsula in Shikoku-Kii Peninsula Region.

Next, looking into the vertical cross section of the relative humidity and the wind field, the area with high specific humidity anomaly in both regions extended to the mid-troposphere. Also, looking into the specific humidity anomaly and the wind anomaly at the 2 pressure altitudes (500 hPa and 700 hPa) of the mid-troposphere, the areas with high in the specific humidity anomaly existed roughly at the same position as the moisture flux convergence, and the wind anomaly was similar to the flow of the moisture flux in the both regions. The flow of this wind and the moisture flux flown from the southwest to the northeast passing through the sea near Taiwan in Shikoku-Kii Peninsula Region, and from the west-southwest to the east-northeast passing through the mainland of China in North Kyushu Region.

Lastly, from the vertical cross section of the Omega (vertical p-velocity) anomaly, it was seen a strong ascending flow area that was narrow in the east and west and long in the north and south in Shikoku-Kii Peninsula Region, and that was wide in the east and west and narrow in the north and south.

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