

# AS1.36 (EGU020-3083) D3194 On the Baiu frontal-scale rainfall characteristics and atmospheric conditions in the extremely heavy rainfall event around western Japan during 5-7 July 2018 with attention to the synoptic climatological viewpoint



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## 【 Background of the present study 】

In East Asia, a significant subtropical front called the Baiu/Meiyu front appears just before midsummer and brings the huge rainfall there, greatly influenced by the Asian summer monsoon. However, large-scale atmospheric features and rainfall characteristics (such as convective or stratiform rain) as well as the total rainfall amount around the front show rather great differences between the western and eastern portions (Fig. 1).

For example, in the western part of the Japan Islands (especially around Kyushu District, the most western part) and the Changjiang River Basin in Central China, the more frequent appearance of the heavy rainfall events due to the organized deep convective clouds than in the eastern Japan results in the larger climatological precipitation amount there (e.g. Ninomiya and Mizuno 1987). This is greatly related to the larger moisture transport toward the western part of the Baiu front (e.g., Ninomiya 1989; 2000).

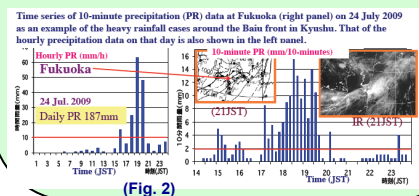
On the other hand, the rainfall characteristics around the front in the eastern Japan tend to be largely influenced by the cool Okhotsk air mass with rather stable stratification (e.g., Ninomiya 1989; Matsumoto et al. 2013, 2014). In addition, their year-to-year, intraseasonal and short-period variations including the diversity of the “heavy rainfall types” are also very large.

The extreme events in association with the Baiu/Meiyu activity are greatly reflected by the above variability of the frontal activity and the regional and seasonal diversity of the rainfall characteristics and relating large-scale fields. Furthermore, such viewpoint would be very important also for providing the scientific study materials in the disaster prevention education. Based on such concept, the present study will examine the frontal-scale rainfall features and the atmospheric conditions for the extremely heavy rainfall event around the Baiu front in the western to central Japan during 5-7 July 2018, although the many studies on this event have been made so far such as Yokoyama et al. (2020, JMSJ).

## 【 Main data used in this study 】

In this study the 10-minute precipitation data at the stations of the Japan Meteorological Agency, JMA, and the NCEP/NCAR re-analysis data at every  $2.5^\circ \times 2.5^\circ$  lat./long. grid point were mainly used.

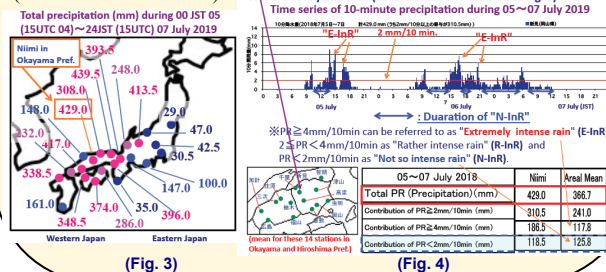
While the rainfall accompanied by an extratropical cyclone or front around Japan is characterized by the continuation of the stratiform “moderate rain” with around  $0.5 \sim 1.0$  mm/10 minutes in general (a few mm/h), the heavy rainfall on the Baiu front in western Japan is brought mainly by the rainfall with intermittent enhancement of the rainfall intensity (with more than  $\sim 4$  mm/10 minutes) in association with the meso-scale convective systems (e.g., Fig. 2 for another case around Northern Kyushu).



(Fig. 2)

## 【 Precipitation characteristics of the heavy rainfall during 5-7 July 2018 (1) 】

As reported by many Japanese meteorologists, the area with extremely large total rainfall around  $200 \sim 400$  mm/3days Japan (stations colored with red or pink in Fig. 3) distributed more widely eastward than in the usual Baiu heavy rainfall situation in the western. Besides, although the “extremely intense rain” with more than 4mm/10minutes (referred to as E-InR) contributed greatly to the huge total precipitation in Western Japan as shown in Fig. 4, for example, the considerable contribution of the long-persistent “not-so-intense rain” (N-InR) to that was also found there, as often found in the heavy rainfall in Eastern Japan (Matsumoto et al. 2013).



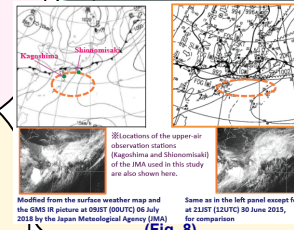
(Fig. 3)

(Fig. 4)

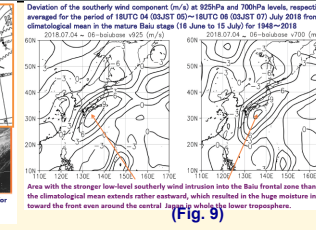
## 【 Precipitation characteristics of the heavy rainfall during 5-7 July 2018 (2) 】

As illustrated in Fig. 5 which presents the time series for the other stations in Hiroshima and Okayama Prefectures (in the eastern part of “Western Japan”), the similar rainfall features to that at Niimi (Fig. 4) were commonly found in all these stations. Furthermore, the area with the huge total rainfall amount due to such rainfall characteristics extended further eastward to Central Japan as shown in Fig. 6 (see also Fig. 3), although the time series at the respective stations there are not shown here, i.e., not only the large contribution of the E-InR but also considerable one of the N-InR.

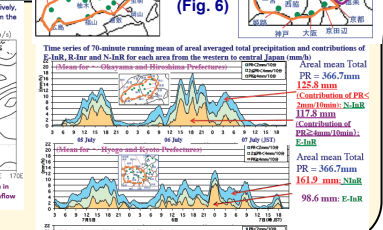
Time series of the areal mean total precipitation in these regions together with the contributions of the E-InR, R-InR and N-InR show that the considerable contribution of the N-InR to the total areal mean precipitation persisted throughout these three days, although intermittent increase in the total rainfall due to that in the E-InR sometimes occurred. As such, the strong mixture of the rainfall features as often found in the Eastern Japan heavy rainfall events in the Baiu season (Matsumoto et al. 2013) into the Western Japan type heavy rainfall base seems to have characterized this 5-7 July 2020 events.



(Fig. 5)



(Fig. 6)

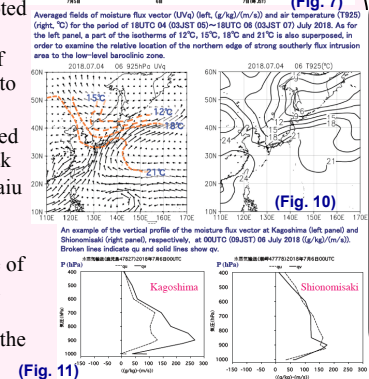


(Fig. 7)

## 【 Remarks on the large-scale atmospheric features 】

As reported by many Japanese studies, the southerly moisture flux toward the Baiu front was rather greater than usual. It should be noted that the huge southerly flux inflow area extended further eastward (Figs. 8 to 11). In other word, the large-scale atmospheric factors of Western Baiu character relating to the huge moisture inflow seems to have spread more eastward than in the normal Baiu.

On the other hand, although the detailed further analyses are needed in the future, the low-level cooler area corresponding to the Okhotsk air mass extending to more westward to the northern area of the Baiu precipitation zone in Western Japan. The northern edge of the huge northward moisture flux area was located within the low-level baroclinic zone around Japan (Fig. 10). As such, the strong mixture of the factors for activating the “western Japan Baiu” and the “eastern Japan Baiu” was also suggested also for the large-scale fields. However, further studies are needed on climatological analyses of the many heavy rainfall events, together with the relation to the other processes in this event as Yokoyama et al. (2020) revealed.



(Fig. 8)

※ The huge southerly moisture inflow below ~700hPa level (with relatively thick moisture transport level) extends rather eastward from Kyushu District, as found at Shimonisaki.