別紙４

報告番号	※　　第　　号

主　論　文　の　要　旨

論文題目　A Study of Formation Mechanism of Stationary Line-shaped Precipitation Systems in Japan during the Warm Season

（暖候期の日本における線状降水帯の形成メカニズムに関する研究）

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論　文　内　容　の　要　旨

A stationary line-shaped precipitation system (SLPS), which is one of mesoscale convective systems (MCSs) type, is a typical heavy-rain-producing weather system formed during warm seasons in Japan. Since SLPSs prediction is difficult, it is important that the formation mechanism of SLPSs is clarified and their conceptual model is established. In this study, two SLPS cases were studied, using observational data and high-resolution numerical experiments: 1 September 2015 over the Kinki district and 7 July 2018 over highlands in Tokai district, respectively.

The first half of the study investigated the SLPS event that occurred on 1 September 2015 over the Kinki district. Although the Kinki district, western Japan, is known as a frequent occurrence region for SLPSs, their formation mechanisms in the region have not been sufficiently clarified yet because of their complex formation processes. Numerical sensitivity experiments were also performed with regard to the orography and initial time. During the SLPS event, the observational data showed that the relative humidity at lower levels was high. The southwesterly was dominant at middle levels over the Kinki district during the formation of the SLPS. The formation of the SLPS was associated with neither a mesoscale low-pressure system nor a synoptic-scale cold front, demonstrating that these were not necessary conditions for the formation of the SLPS. In the numerical experiments, the SLPS was formed in a low-level convergence zone of the westerly with the warm and humid south-southwesterly from the Kii Channel. New convective cells generated over the north of Awaji Island and are propagated northeastward by the middle-level southwesterly. This cell formation process was repeated and resulted in the formation of the SLPS. The sensitivity experiments for the orography around the occurrence area of the SLPS indicated that the orography was not an essential factor for the formation of the SLPS in this event.

The orography can alter the location of the SLPS.

The latter part of the study investigates the orographic effect for the formation and rainfall enhancement process of SLPS over the highlands in Tokai district, central Japan. In July 2018, a heavy rainfall event occurred in Tokai district in association with the stagnated Baiu front. The total precipitation amount was 1214.5 mm at the rain-gauge point during the heavy rainfall event and roughly a half (623 mm) of the amount was recorded from 6 to 7 July 2018. When the three-hour precipitation amount more than 80 mm was observed from 2300 UTC 6 to 0300 UTC 7 July, an SLPS formed over the highlands in Tokai district. To investigate the orographic effect for the formation and rainfall enhancement process of the SLPS, this study examined observed data and the simulation and sensitivity experiments. The simulation showed that a warm and humid southerly was present to the south of the Baiu front. The humid air was lifted by the orography of the highlands and convective cells developed. They were moved with developing to the northeast by the mid-level southwesterly. This process was maintained due to the stagnation of the Baiu front. In the sensitivity experiments of the orography of the highlands, this study found that the total precipitation amounts of the SLPS were less than a half of that of the simulation experiment. This indicates that the orography of the highlands plays an important role for the formation of the SLPS. The orography triggered and reinforced convective cells, which results in the formation and rainfall enhancement of SLPS.

In summary, the SLPS case on 7 July 2018 is influenced by terrain to determine its formation, location, and rainfall enhancement of the SLPS. However, the orographic effect was not essential in the SLPS case on 1 September 2015. It is expected that more studies of SLPS cases with these complex characteristics are necessary for further understanding and will help development of a conceptual model in the future for predicting SLPS during the warm seasons.