Observational and Numerical Study on Terrain-induced Heavy Rainfall in Mt. Jiri, Korea

*Dong-In Lee[1], Dong-Kyun Kim[2], Yunhee Kang[1], Jisun Lee[1,3]

1. Division of Earth Environmental System Science, Pukyong National University, Korea, 2. Department of Environmental Atmospheric Sciences, Pukyong National University, Korea, 3. HM&Co, Ecole des Ponts ParisTech, Marne-la Vallée, France

During a summer monsoon season every every, severe weather phenomena caused by front, storm, mesoscale convective systems (MCSs), or typhoons influence the Korean Peninsula. Especially mountains that cover a large part of the Korean territory play an important role in controlling formation, amount, and distribution of rainfall. As convective systems move over mountains, they tend to intensify more and produce locally heavy rainfall. Observation data in mountainous areas is essential for studying terrain effects on the rapid development of rainfall.

In order to understand developing and decaying mechanisms of precipitation systems that pass over the mountain, we performed Orographic Rainfall Experiment (OREX) around Mt. Jiri (1950 m above sea level) during summertime on June and July 2015-2016 in the southern Korean Peninsula. Observation data from seven Parsivel disdrometers, three ultrasonic anemometers (measuring winds), and radiosondes were analyzed during periods of Typhoon Chanhom on July, 2015 and the heavy rain event on 1 July 2016. A dual-Doppler analysis was also conducted to retrieve three-dimensional wind fields in this mountain area. Vertical structure of radar reflectivity and winds (especially vertical velocity) within the precipitation systems moving over Mt. Jiri was examined. For comparing with retrieved vertical velocities, we developed a technique to derive vertical velocities from fall velocity and drop size spectra measured by the Parsivel disdrometers. From the comparison of vertical velocities between the Parsivel and anemometer, we found that upward motions were dominant in the windward side and the areas of upward motions were nearly coincident to those of a large amount of rainfall accumulation. During the periods of updrafts, rainfall rates and mean drop diameter were larger than those during the periods of downdrafts. We digitized these updraft periods as percentage, dividing them by the total rainfall period and these percentage values would be useful for inducing an area of updrafts around the mountain. Also, variances of Parsivel-measured fall velocities per each diameter bin, which are related to turbulent air intensity, were found to be larger when surface winds were stronger.

To find important atmospheric factors affecting the orographic rainfall enhancement we performed numerical study by assimilating observation data to a model. For validating model results with better accuracy, surface measurements as well as rainfall data from the field observations were used.

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Keywords: Orographic rainfall, Atmospheric factors

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[1]Division of Earth Environmental System Science, Pukyong National University, Korea
[2]Department of Environmental Atmospheric Sciences, Pukyong National University, Korea
[3]HM&Co, Ecole des Ponts ParisTech, Marne-la Vallée, France.

Abstract

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