Heavy Snowfall by Moisture Advection under the Development of Low Pressure and Coastal Orography

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Using a 3D-non-hydrostatic, numerical Weather Research & Forecasting Model (WRF) version 2.2 with FNL initial data to the model, a numerical simulation of heavy snowfall caused vast economical loss from destruction of houses and traffic interruption at Gangneung city in the coastal region of Korea has been undertaken from 00 UTC, February 15 through 12 UTC, February 17, 2005. Before snowfall occurrence in the coastal region on February 15, a northwesterly wind of 3 to 6 m/s prevailed in the study area under the influence of a high pressure near Shanghai in the eastern coast of China in the left of north of the Korean peninsula. When snowfall occurred in Gangneung coast, the prevailing northwesterly wind changed to northeasterly wind at greater than 5 m/s in the coast and greater than 10m/s over the open sea. The northeast onshore wind and northerly wind became an upslope wind directed toward the top of Mt. Taegulyang (alt. 896 m) located west of the city. This upslope wind strongly lifted a lager amount of moisture from the eastern sea toward the mountain top, and resulted in condensation into cloud consisting of liquid water or snow flakes. This forced moisture to rise toward the mountain top and its western basin produced the formation of a thick layer of cloud from a height of 50 m to 2.8 km over the mountain extending to the lower atmosphere over the coastal sea. The cloud base along the eastern slope and at 50 m height over the city was below 0^0C in ambient air temperature and $-5 \sim 10^0$C at a height of 900m near the top of the mountain and consisted of both super saturated water droplets and ice particles. As a result, a maximum rainfall (snowfall) amount of 18.2 mm/3hr s (13.0 cm) with accumulated snow amount of 68.4 cm was recorded in Gangneung. A rain band was located in the same area as a band of snowfall and directly coincided with the area of relative humidity greater than 95 %. Areas of total cloud mixing ratio greater than 0.01 g/kg and relative humidity greater than 95 % in vertical profiles closely matched cloud areas on GOES-IR satellite imagery and also on radar images. The proportion of snowfall to rainfall was approximately 7.times. Under the influence of a north-westerly wind parallel to the coast, moisture advection became very weak, resulting in either a small amount of snow or none at all on the coast.

This work was funded by the Korea Meteorological Administration Research and development Program under Grant CATER 2006-2308 – “Generation mechanism and prediction of windstorm in the mountainous coast-for 2006~2009”

Keywords: Numerical prediction, Snowfall, Precipitation, WRF model, FNL data, GOES-IR satellite images,

References

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