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# Numerical simulations of fog extent in the Miyoshi basin, Japan.

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Context/Purpose
In the Miyoshi basin (in Hiroshima Prefecture, Japan), large fog extents were often found in autumn and winter. Although their fogs are considered as a radiation fog type by the past researches, how mechanism of the formation has ever been unknown well because one routine observation site of temperature exists in the center of basin. A typical fog scale in Miyoshi is about 30 km-square. Hence, in our study, using a high-resolved gridded atmospheric model, numerical simulations of the fog formation in the Miyoshi basin were executed to clarify an occurrence, movement, and development on complex topographies in the Miyoshi basin.

Methods
The weather research and forecasting model (WRF ver. 3.7.1) was used to simulate Miyoshi fogs. The horizontal spatial resolutions were assigned by three cases of 300 m, 500 m, and 1500 m. Then, these results were analyzed and compared with each other during the period of November 1-5, 2007 when special in-situ observations were multi-directionally conducted. Initial and boundary conditions of the model were assigned by the NCEP final analysis, JMA meso-analysis, and NCEP RTG_SST data. The land use (100-m resolution) and topographic data (50-m resolution) of the Geospatial Information Authority of Japan (GIAJ) were used in the model.

Results
We judged a radiation fog formation by using the existence of cloud water contents outputted in model calculations. The model simulated radiation fogs on the Miyoshi basin. In particular, large extents of the fog were found from the night to morning of November 2 and 3, which was broadly similar to results of in-situ top-down views with a thermo-camera and surface observations. A simulated fog density (cloud water contents) was the highest at heights of 200-300m above ground level, and the top height was found at about 400 m. These features also agreed with the result of vertical meteorological observations. On the other hand, at some sites with high altitude, surface air temperature during the night when the fog appeared was calculated higher than that of observation because the radiative cooling of ground surface was suppressed by the fog. Therefore, it was considered that excess fog extents were simulated for actually non-fog regions.

Interpretation
Simulated fogs were probably generated by not only radiative cooling effect on the Miyoshi basin but also in surrounding mountain regions. In addition, the mountain fogs were advected through above the Miyoshi basin. Fogs advected from outside regions of the basin can be actually observed with the thermo-camera viewing. Meanwhile, higher resolved model well simulated radiation fog within the basin.

Conclusion
Simulated fogs by the WRF were similar to observed those in the Miyoshi basin, Japan. Our model simulations suggested co-existence and development of the radiation fog generated within the basin and the fog advected from outside basin.