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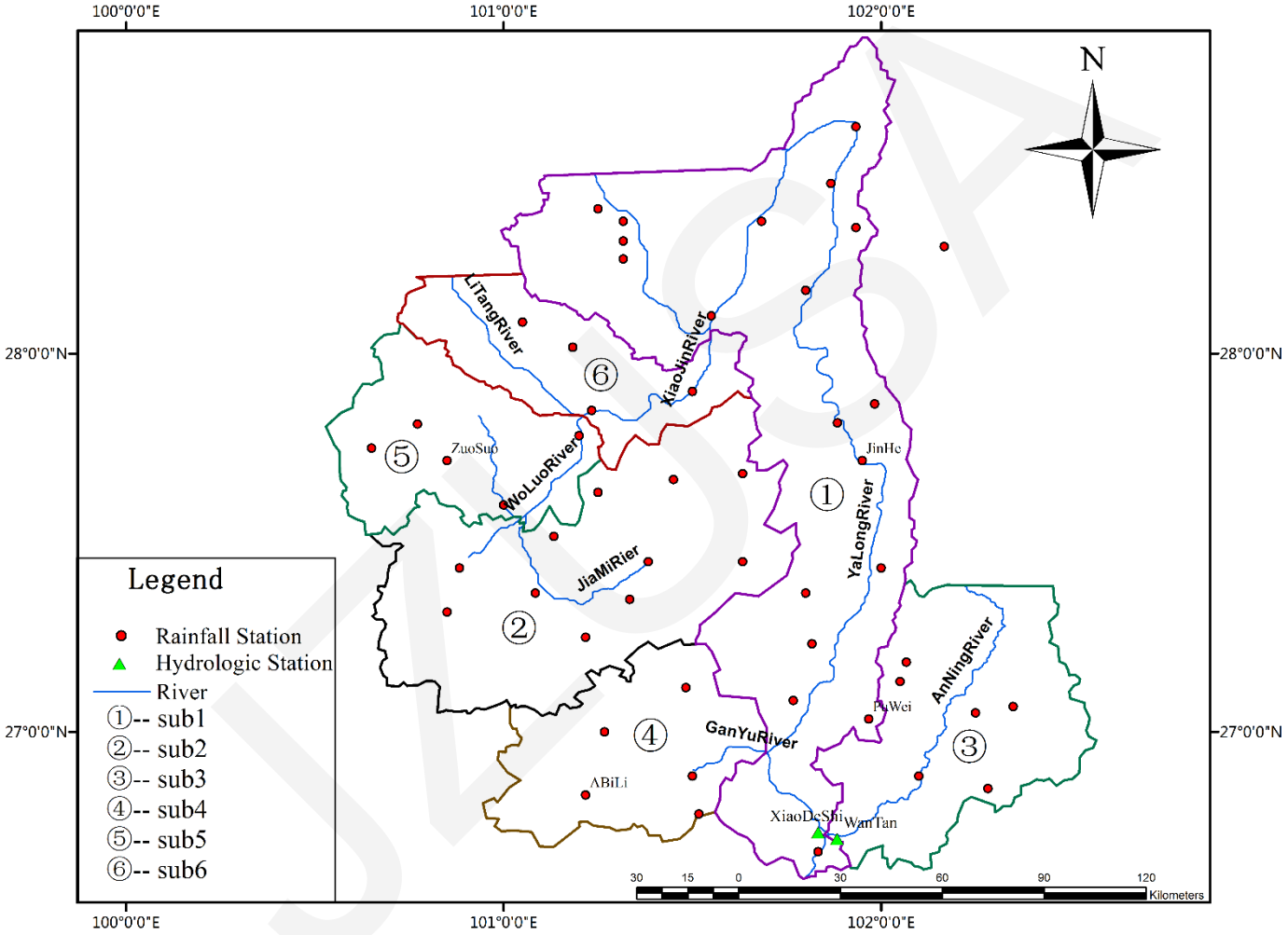
A WRF model evaluation for simulating heavy precipitation over the downstream area of the Yalong River Basin

Key words: WRF model, Yalong River Basin, Heavy precipitation, Precipitation simulation, Precipitation verification, Cumulus parameterization scheme, Microphysics scheme

Purpose

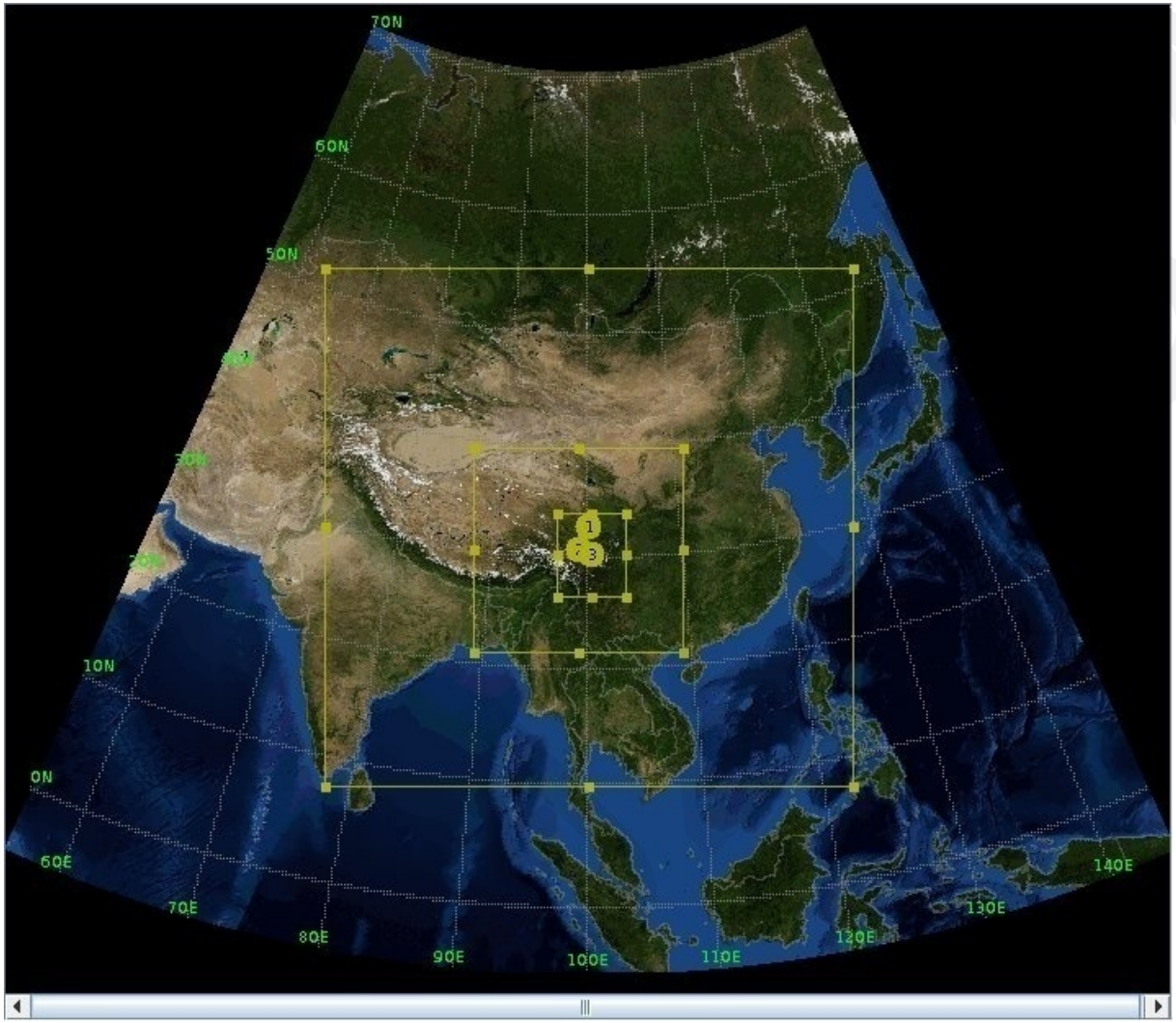
One purpose of this work is to evaluate the capability of WRF to simulate the heavy precipitation in the downstream area of the Yalong River Basin before applying the WRF model for basin flood prediction. Another purpose is to determine the optimum combination of the microphysics scheme and cumulus parameterization scheme for a model grid resolution of 3 km for developing an application in forecasting runs. A comparison between the precipitation simulated by WRF model and the precipitation observed by rain gauges was carried out across the downstream area of the Yalong River Basin as well as the individual sub-basin to examine the accuracy of rainfall locations and precipitation amounts. Furthermore, we investigated the time consumption of each case which is important when the computing resource is limited or the simulation period is fairly long.

Study Area



The sub river basins in the downstream area of the Yalong River. Filled circles indicate the positions of the rain gauges

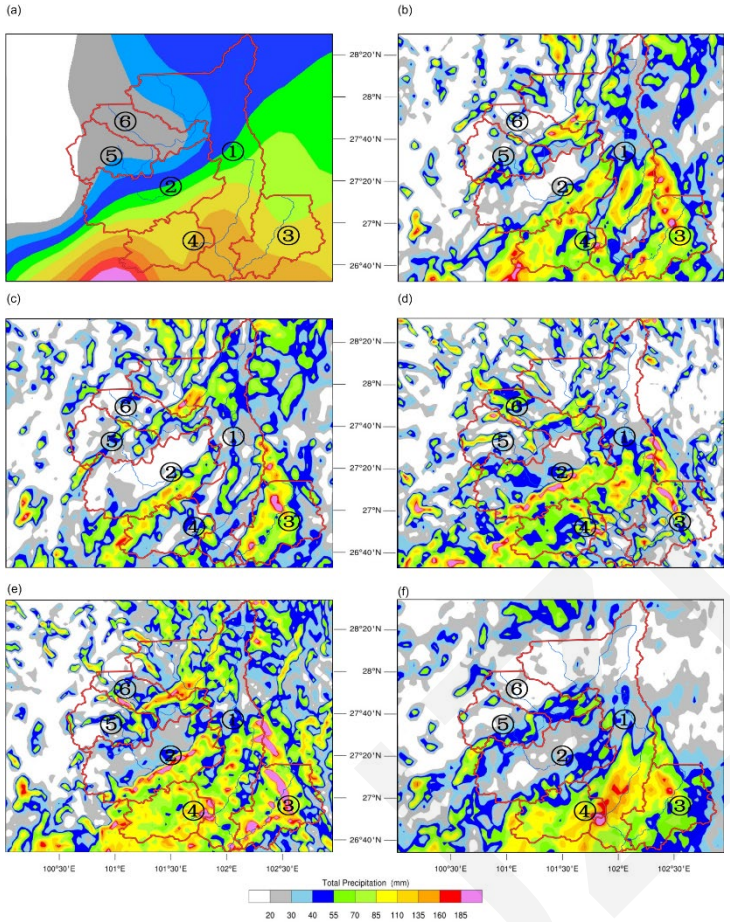
WRF Model Configuration



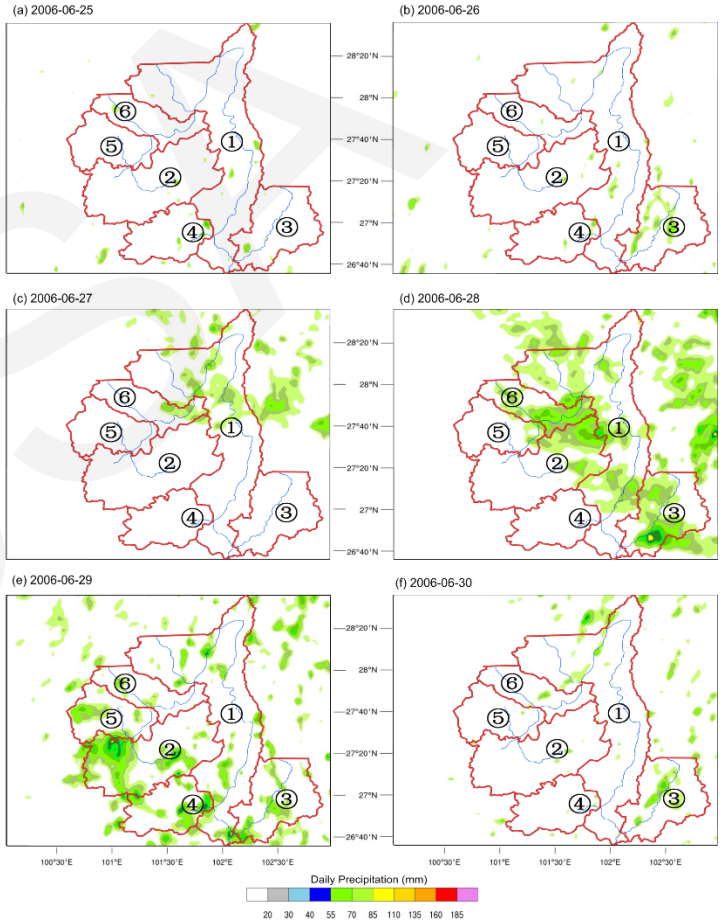
Microphysics:
1) Kessler scheme (Kessler)
2) Lin et al. scheme (Lin)
3) Single-Moment 3-class scheme (WSM3)
4) Single-Moment 5-class scheme (WSM5)
5) Ferrier scheme (Ferrier)
6) Single-Moment 6-class scheme (WSM6)
7) New Thompson et al. scheme (NTH)

Cumulus parameterization:
1) Kain-Fritisch (KF)
2) Betts-Miller-Janjic (BMJ)
3) Grell-Devenyi (GD)

Evaluation

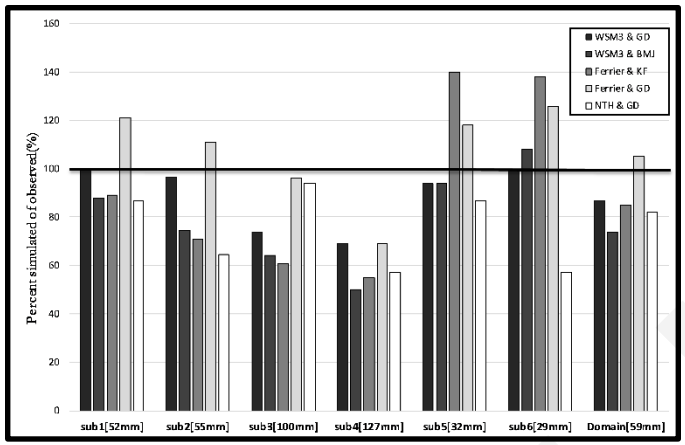


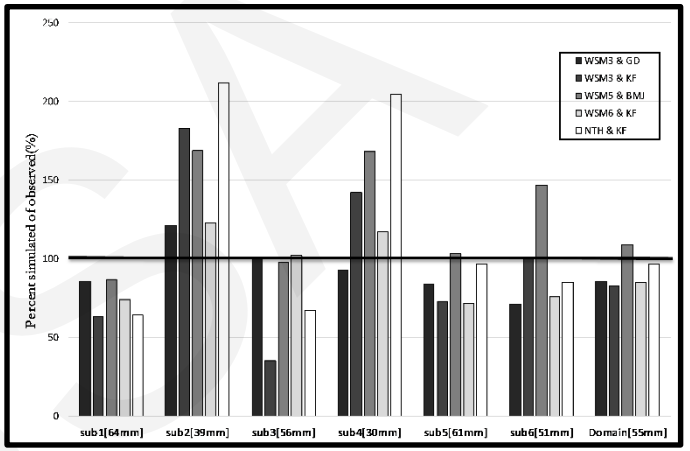
Total precipitation amounts of Event A for (a) the observed precipitation, and the simulations obtained with the following cloud microphysics and cumulus schemes: (b) WSM3 &GD, (c) WSM3 &BMJ, (d) Ferrier &KF, (e) Ferrier &GD, and (f) NTH &GD

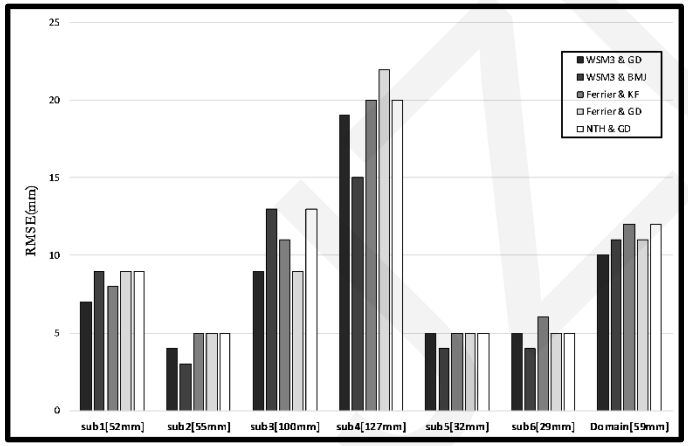


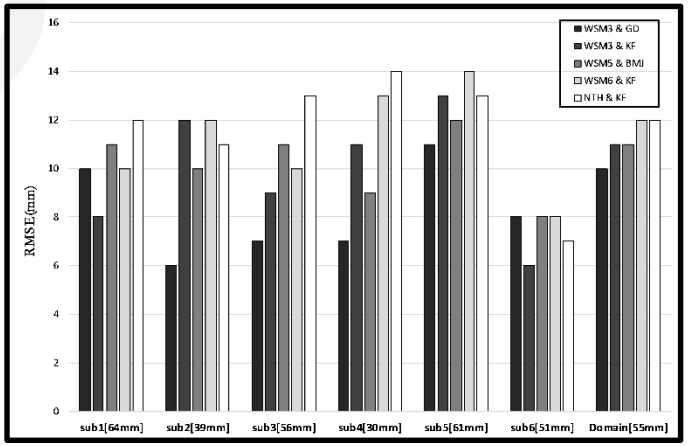
The simulated daily precipitation amount distribution of WSM3 & GD for Event C in the period from two days before the single storm to one day after the storm

Evaluation









Event A

Event C

Conclusions

We conclude that the WRF model is capable of simulating heavy precipitation events with high spatial resolution in the downstream area of the Yalong River Basin. Furthermore, the scheme combination of WSM3 and GD holds a stable performance in the accuracy and computation efficiency for the heavy precipitation prediction. This finding is very important for the runoff simulation and forecast in the Yalong River Basin, especially when the computation resources are limited, because the outputs of the NWP models with a relatively long lead time can be used as valuable inputs of the hydrologic models to predict floods.