



Evaluation Study for Predictability of a Heave Localized Rainfall using WRF and Climate Change Database

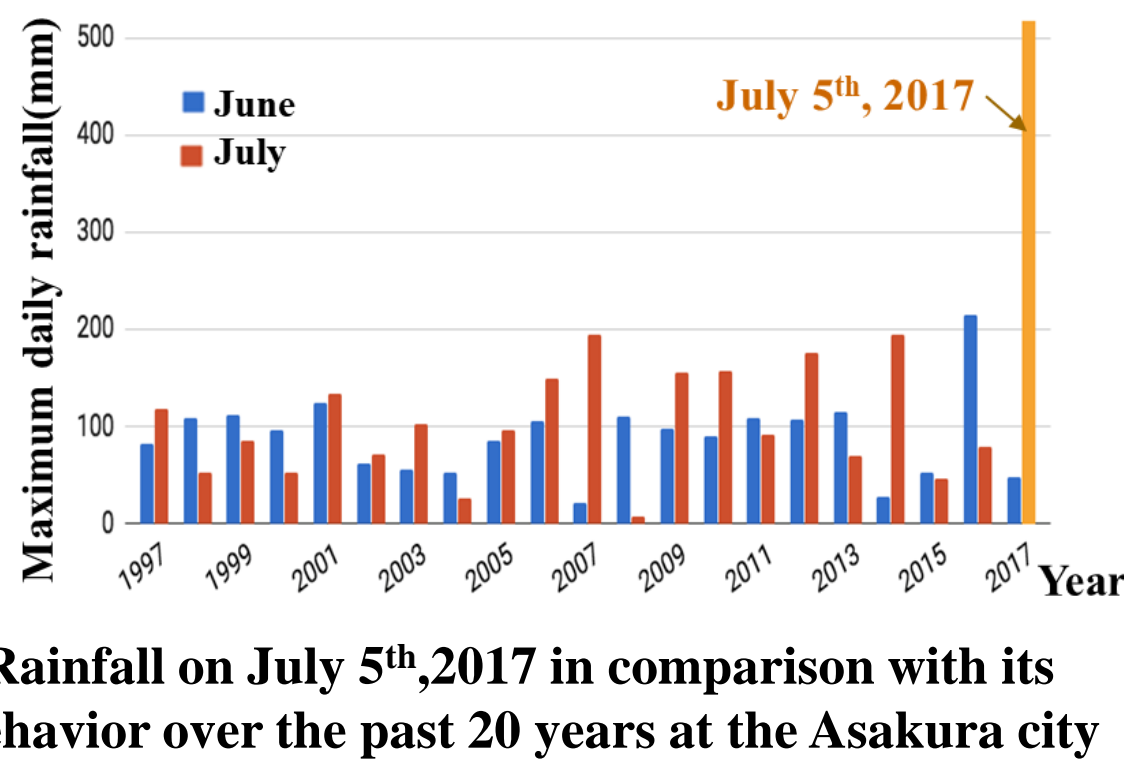
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Introduction

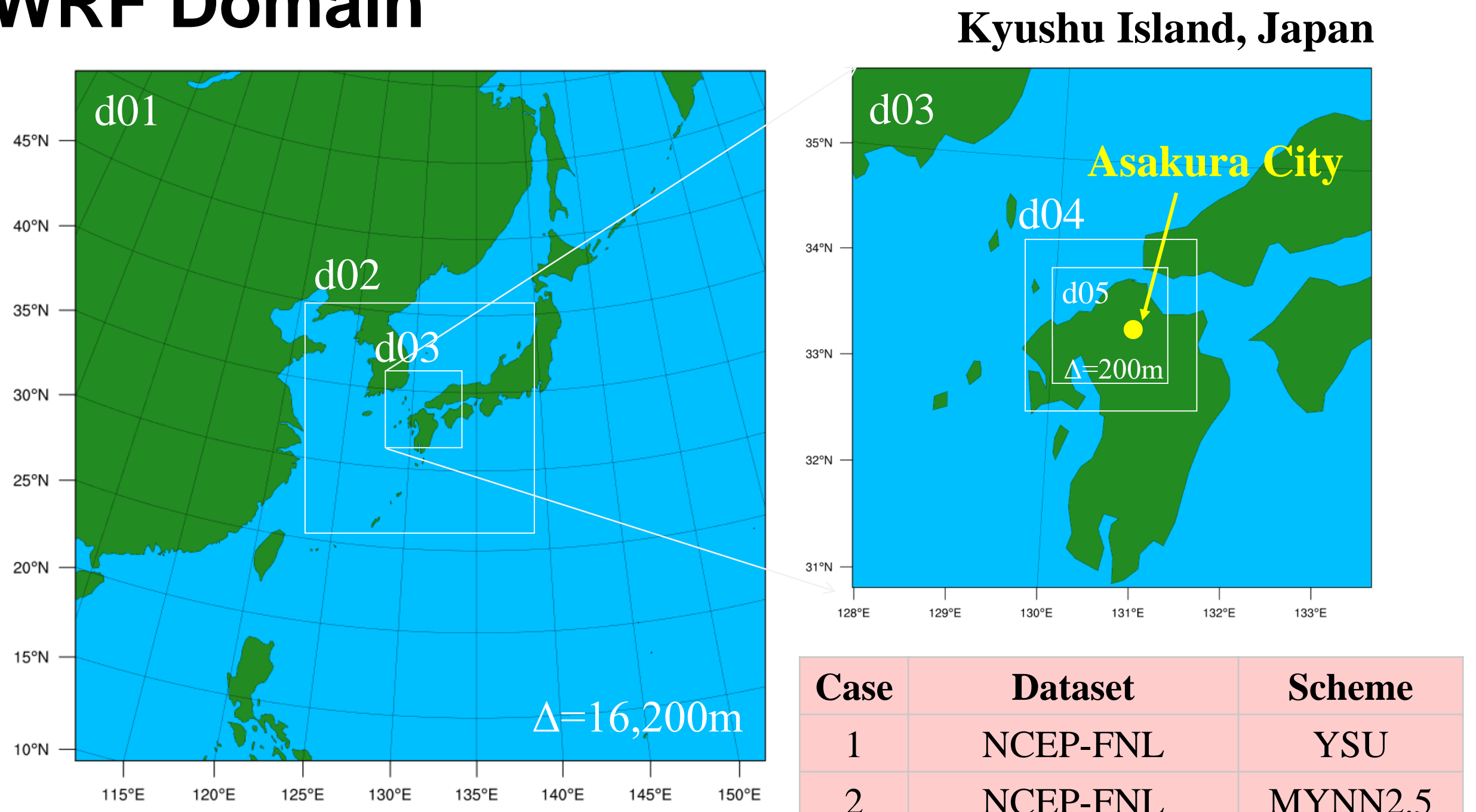
A heavy localized rainfall with maximum daily rainfall of **545.5mm** was historically recorded on July 5th, 2017, at **Asakura city, Kyushu, Japan**. It triggered landslide disasters that left 36 human fatalities and damaging more than 600 residential buildings. It strongly required better understanding of the meteorological processes as well as the predictability of the rainfall event.

In this study, sensitivity of the rainfall over this area was evaluated to investigate the physical schemes in the meteorological numerical model with a downscaled grid resolutions in the nesting method. The **WRF** model with **NCEP-FNL** and **NCEP-GDAS/FNL** datasets were used for the sensitivity analysis.



Methods

WRF Domain



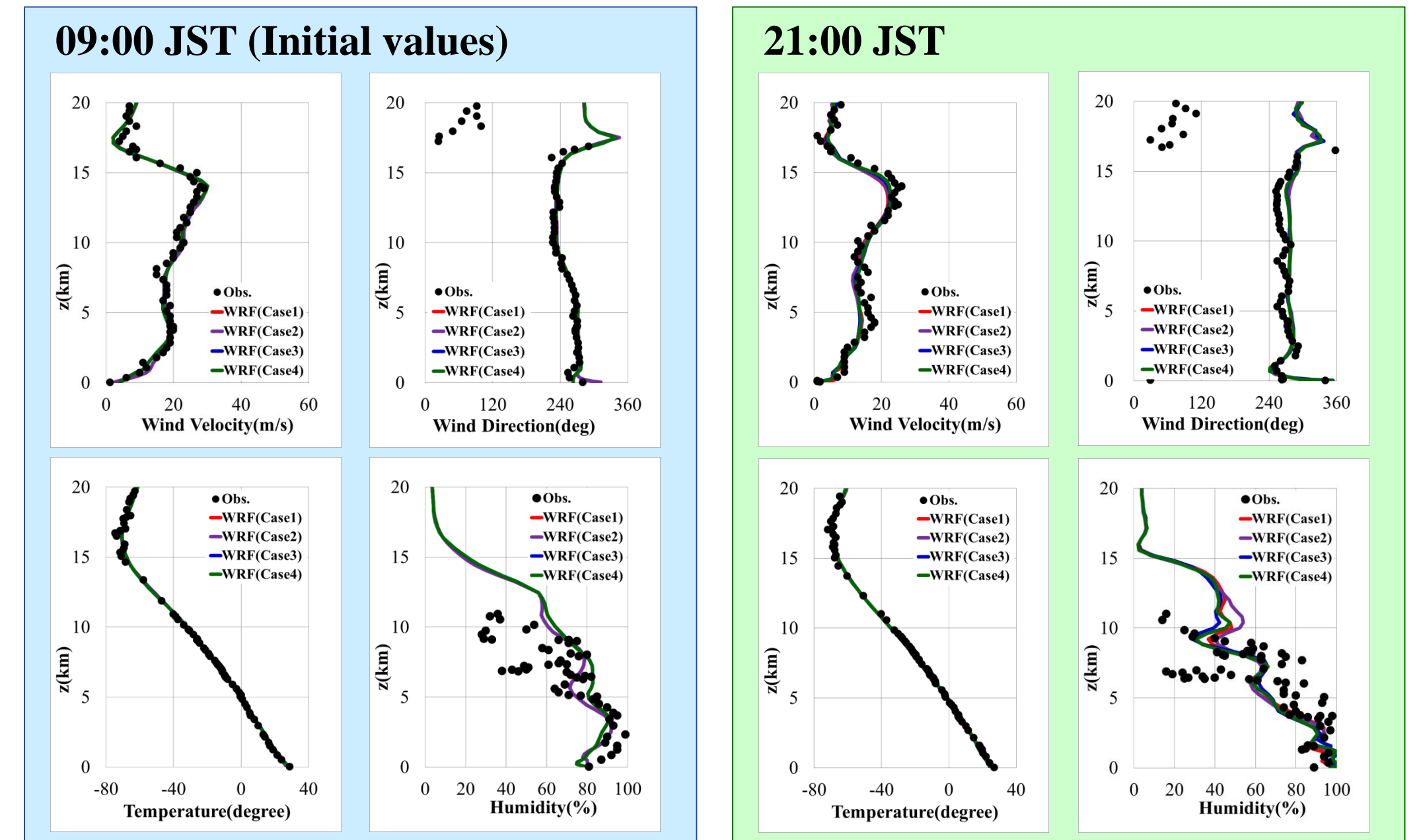
Model Configuration

Domain ID	1	2	3	4	5
Grid numbers	300x300	300x300	300x300	300x300	600x600
Horizontal size(m)	16,200	5,400	1,800	600	200
Topography data	USGS 10min	USGS 2min	USGS 30s	GSI 50m	GSI 50m
Time step(sec)	60	20	6.67	2.22	0.74
Vertical levels	60				
Parent-nest interaction	Two-way				
Microphysics	New Thompson et al. scheme				
Surface Layer Physics	Monin-Obukhov				
Land Surface Physics	Unified Noah LSM				
Planetary Boundary Layer (PBL)	YSU: Yonsei University scheme MYNN2.5: Mellor-Yamada Nakanishi and Niino Level 2.5				
Cumulus Param.	Kain-Fritsch (new Eta) scheme				
Initial & Boundary Condition	NCEP-FNL (1 degree), NCEP-GDAS/FNL (0.25 degree) July 5 th 09:00:00 - 6 th 09:00:00 JST				

Verification & Results

1. Profiles

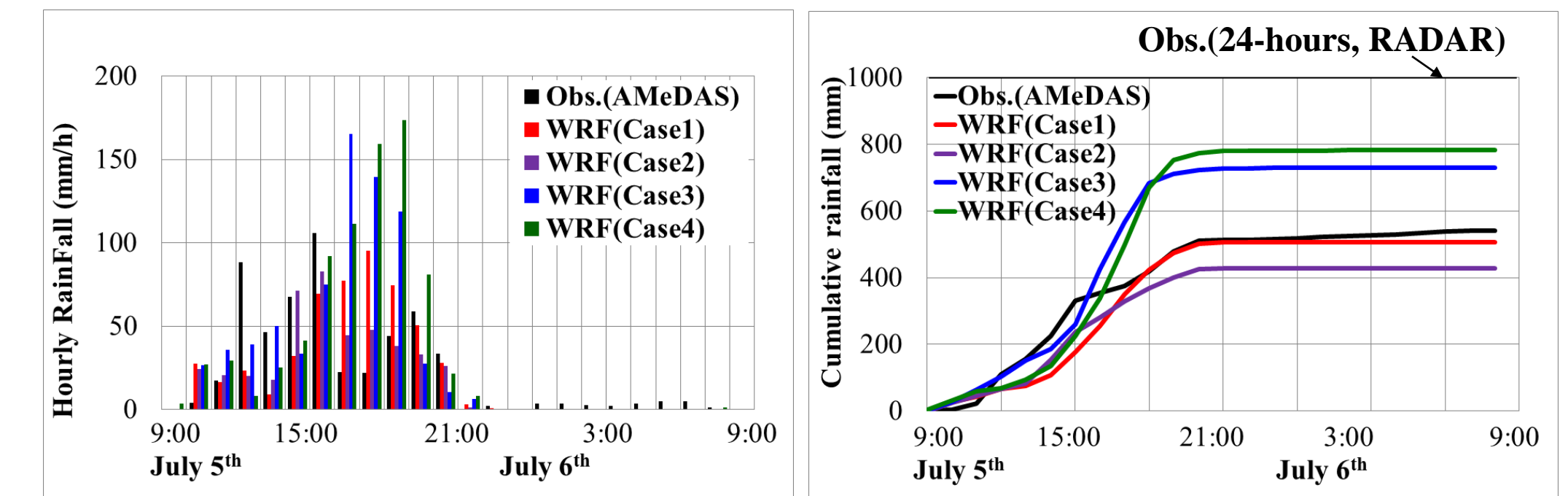
Simulated profiles of the meteorological parameters (wind velocity, wind direction, temperature, relative humidity) are agreed reasonably well with the observation results among the physical schemes.



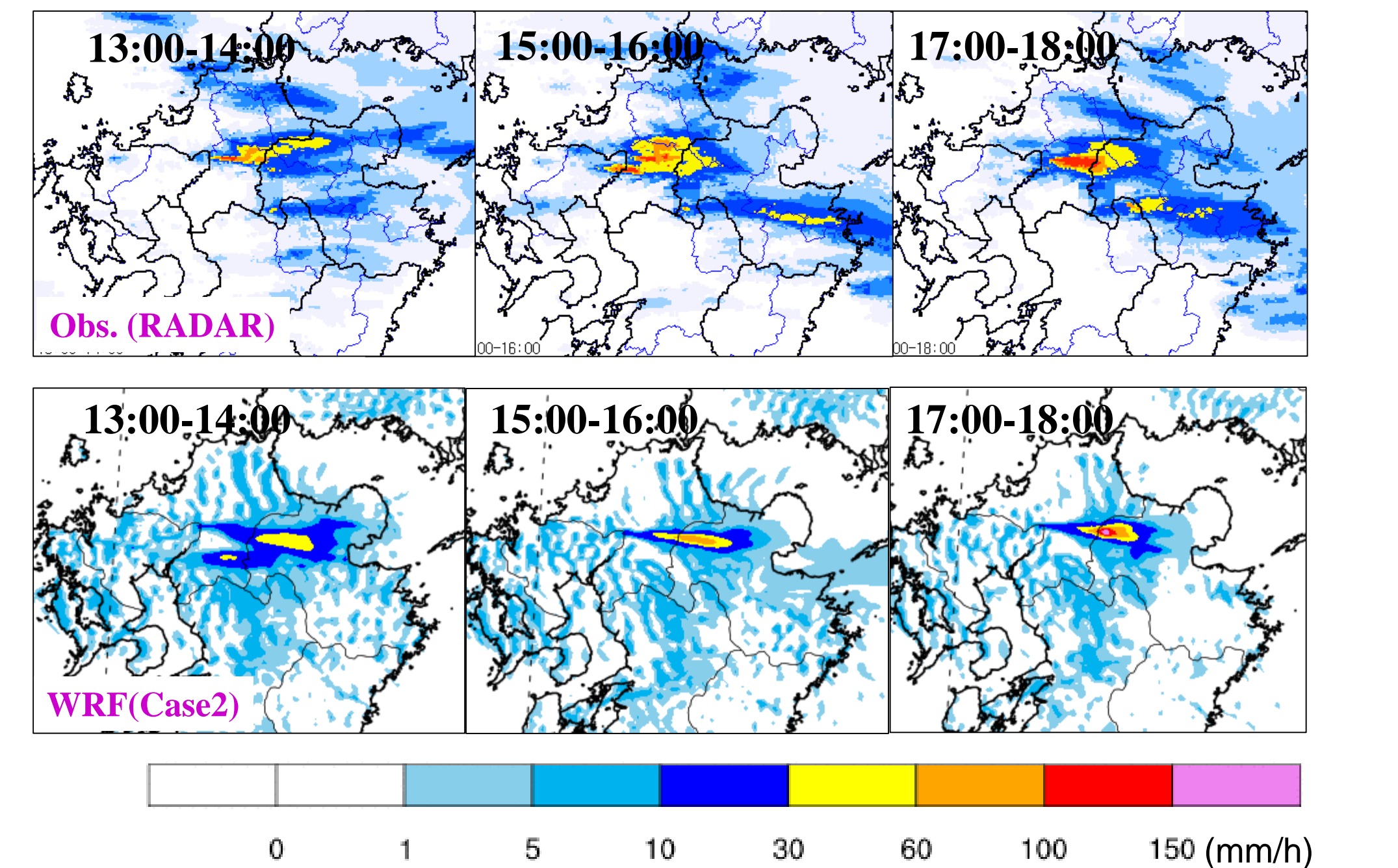
Comparison of the profiles of WRF and Aerological Observation

2.Time Series

WRF showed good agreement with the AMeDAS and RADAR observed results, for the hourly and 24-hours accumulated rainfall.



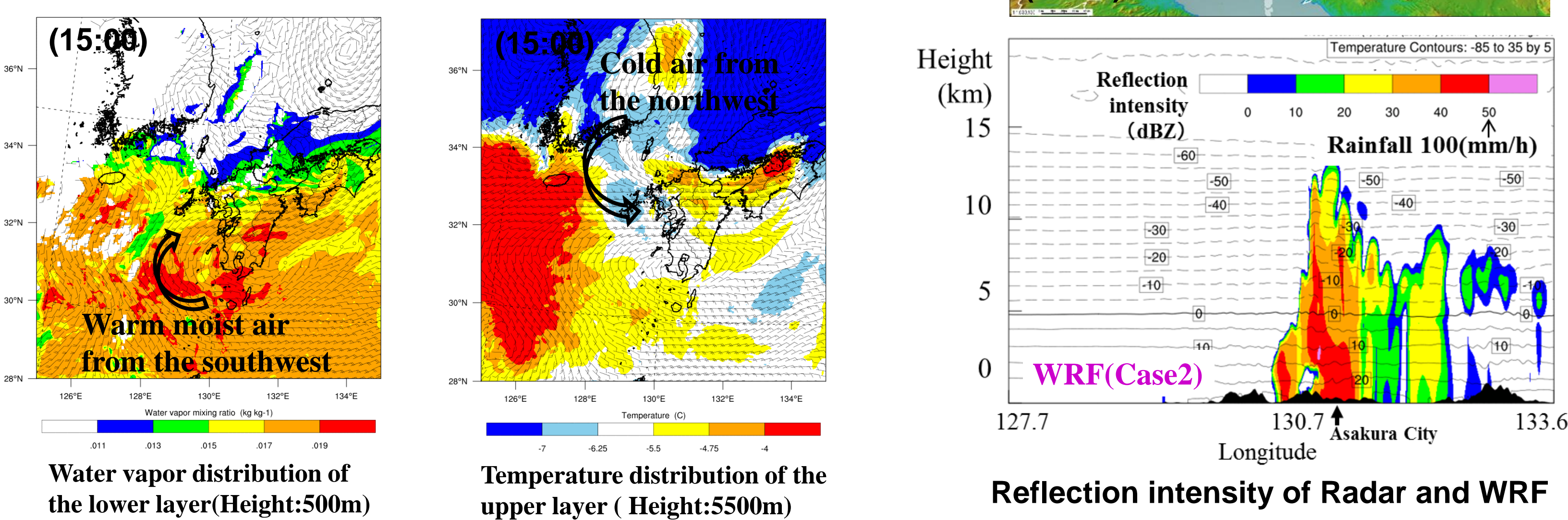
Comparison of the rainfall of WRF simulations and the observation



Comparison of the hourly rainfall of WRF simulations and Radar Observation

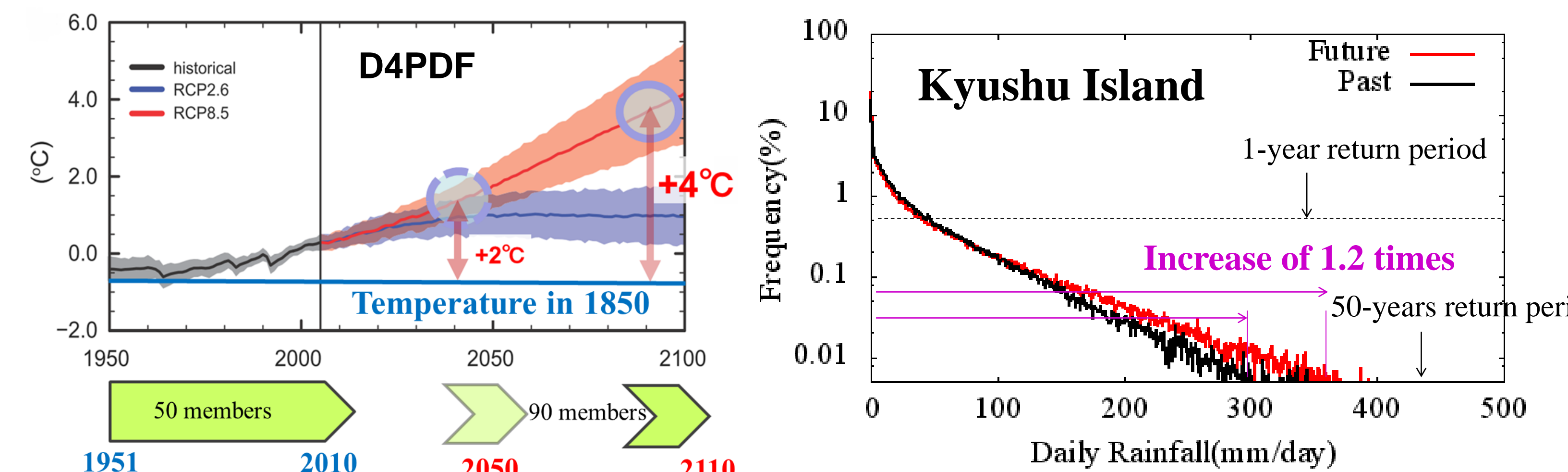
3. Phenomena

It is found that the warm moist air from the southwest and the cold air from the northwest flowed into the location of localized rainfall. In here, the cumulonimbus clouds are repeatedly generated and developing furiously from the west to east, in a phenomenon known as back-building storm.



Climate Change Effect

Climate Change database "Database for Policy Decision-Making for Future Climate Change" (d4PDF, +4°C) was also used to investigate the changing of precipitation in the area under global warming effects. Although the future daily rainfall of the area is found to be increased under global warming, but its value is smaller than the precipitation which was recorded from this heave localized rainfall event. It could be resulted from the insufficient resolution of grid spacing of 20km which is used in the d4PDF.



Regional downscaling simulations covering Japan area by a regional climate model with 20 km grid

Frequency of daily rainfall over Kyushu Island obtained from d4PDF for the past and future

Summary

Meteorological simulation using the **WRF** model has been carried out to investigate the sensitivity of the rainfall over the **Asakura** city with a downscaled grid resolutions in the nesting method. **YSU** and **MYNN2.5** showed good agreement with observation results. Climate change database **d4PDF** was used to investigate the daily precipitation to found the increase under global warming.

Acknowledgements

Part of the results was obtained by using the **TSUBAME** supercomputer of **Tokyo Institute of Technology**. The **d4PDF** has been provided by the **Program for Risk Information on Climate Change (SOUSEI)** and the **Data Integration and Analysis System (DIAS)**, Japan.