# A Method to Select the Fittest Microphysics-model for a Rainfall Event through Wavelet Analysis

Nozomu TAKADA[1], Yuusuke TANAKA[2], Shuichi IKEBUCHI[1], Eiichi NAKAKITA[3]

[1]Meteorological Engineering Center Inc., Japan [2]Japan Agency of Marine-Earth Science and Technology, Japan [3]Disaster Prevention Research Institute Kyoto University, Japan

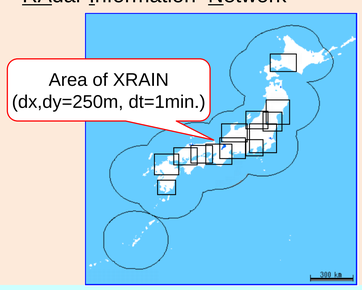
## 1. Introduction

- Recently, there are numbers of disasters caused by localized heavy rainfall in Japan. To prevent and reduce such disasters, it is very important to predict such localized heavy rainfall.
- Characteristics of precipitation distribution predicted by WRF depend on the selection of microphysics-model.
- We simulate severe local rainfall events with 5 microphysics-models, and compare the outputs from the models with the observed precipitation distribution through a new evaluation method with wavelet analysis.

## 2. Data and WRF Settings

### (1) Observed Data

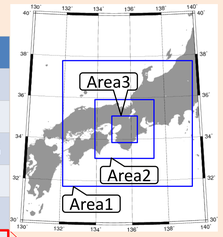
XRAIN* data provided by MLIT in Japan is used.
*X-band polarimetric (multi parameter) RAdar Information Network




### (2) WRF Settings

| | Area 1 | Area 2 | Area 3 |
|---|---|---|---|
| Model | WRF V3.4.1 | | |
| Horizontal resolution [km] | 9 | 3 | 1 |
| Number of horizontal mesh | 75 x 75 | 105 x 105 | 135 x 135 |
| Number of vertical layers | 28 | | |
| Cumulus convection | Kain-Fritsch | — | |
| Microphysics | — | 5 models | |
| Long wave radiation | RRTMG | | |
| Short wave radiation | RRTMG | | |
| Atmospheric boundary layer | Monin-Obkhov similarity theory | | |
| Ground surface | 5-layer thermal diffusion model | | |
| Planetary boundary layer | MYNN | | |

WRF Calculation Area




- Goddard
- Thompson
- Milbrandt-Yau
- Morrison
- WDM6

## 3. Methods

Flow of Data Analysis

Separate a precipitation distribution to a stratiform one and convective one through wavelet analysis

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Identify the cells in which rainfall intensity is over 2[mm/hr] in the convective distributions

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Trace the cells with correlation analysis, considering combining and separating

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Draw growth-decay diagram in which the cells' area and maximum rainfall intensity are plotted

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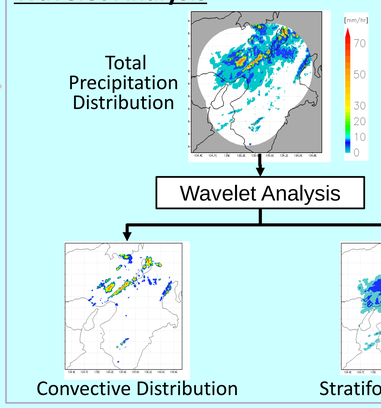
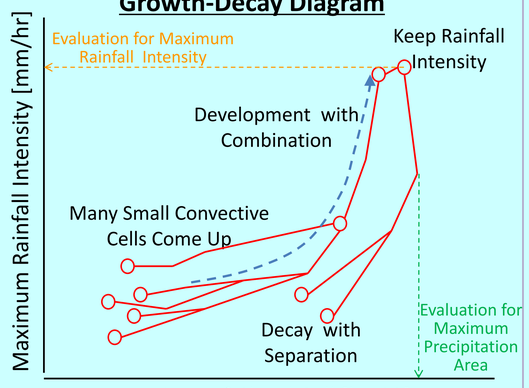
Compare the diagram of the WRF outputs with one of the observed

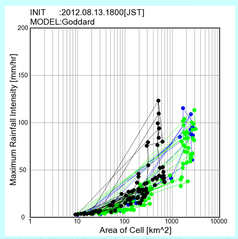
**Separation of Precipitation Distribution by Wavelet Analysis**




**Growth-Decay Diagram**




An Example of Growth-Decay Diagram



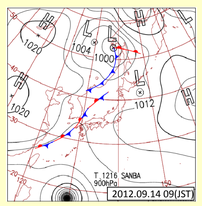

By comparing growth-decay diagrams of observation and WRF outputs, characteristics of meso-scale convective system simulated by WRF are evaluated appropriately.

## 4. Results

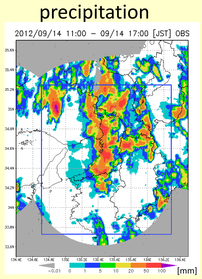
### (1) Applied Rainfall Cases

Case A) Sep. 14th 2012 ( Atmospheric Instability )

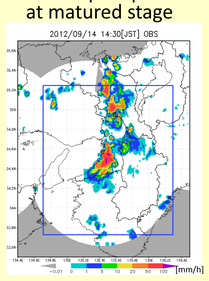
Weather Map




Total observed precipitation

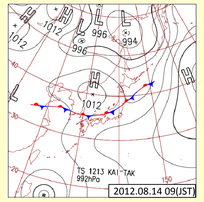



Observed precipitation at matured stage

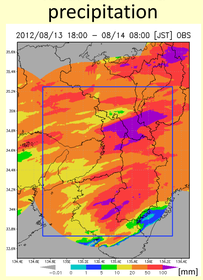



Case B) Aug. 14th 2012 ( Stationary Front )

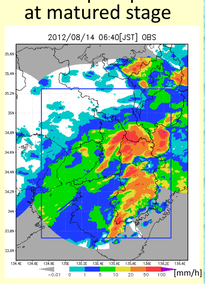
Weather Map




Total observed precipitation




Observed precipitation at matured stage

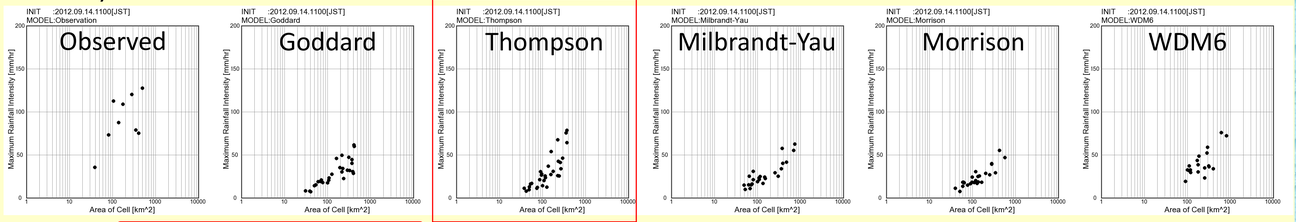



### (2) Comparison between Observation and WRF Outputs

For the most developed stage of each cell's life cycle in terms of rainfall intensity, area and maximum rainfall intensity in a cell area are plotted.

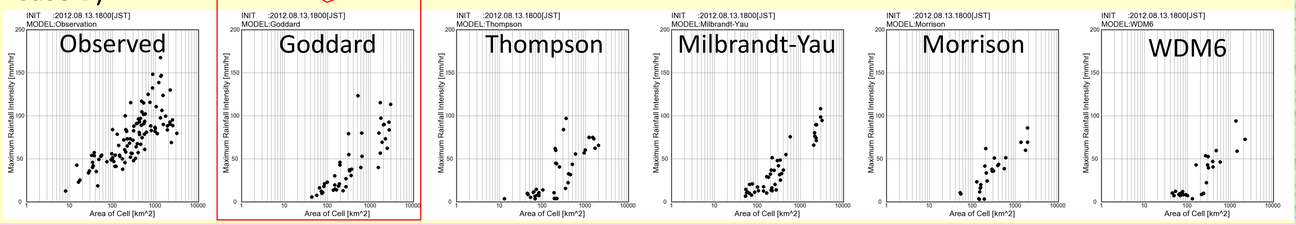
Case A)

Better Agreement With Observed




Case B)

Better Agreement With Observed




## 5. Conclusions and Future Works

- We proposed a new method to evaluate meso-scale convective system simulated by WRF through wavelet analysis, and applied to rainfall events occurred in Kinki region of Japan.
- For a rainfall event caused by atmospheric instability (Case:A), calculated results with **Thompson-scheme** have better agreement with the observed precipitation.
- For a rainfall event caused by stationary front (Case:B), calculated results with **Goddard-scheme** have better agreement with the observed precipitation.
- We are going to develop an operational prediction system through WRF with several microphysics-models and continue the evaluation, and finally select effectual models to build microphysics-model ensemble system.