Extreme Events: Observations and Modeling

- Started with JpGU-AGU 2020
- Expanded to AOGS, AGU, JgPU, CORDEX

- Special thanks to Prof. Dairaku and Dr. Sajay Sir
- Submitted to EGU 2024
- Considered all types of Extreme events related to Atmosphere

A Retrospective Analysis of Tropical Cyclones Approaching CORDEX East Asia over the Past 75 Years

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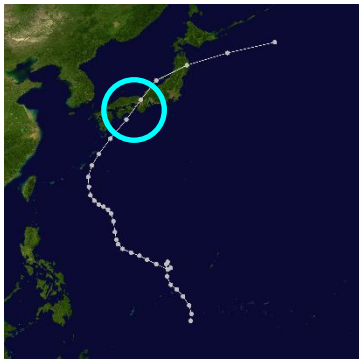
International Conference on Regional Climate (ICRC)-CORDEX conference, 25-29 of September 2023 in Trieste, Italy, and with a hub in Pune, India

Background & Motivation

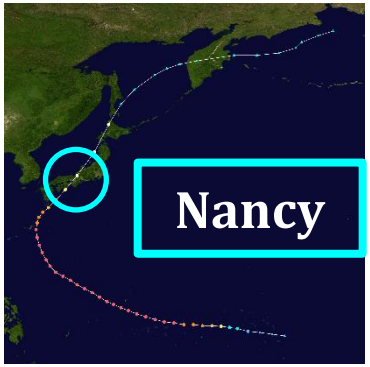
- Recent studies (e.g., IPCC 2014, 2015; Takemi et al., 2016; Kanada et al., 2017; Nayak and Takemi, 2019a, 2019b) suggest that the typhoons will be *more intense in future climate* and become a *severer threat to lives and properties*

1934



Damage:
At least $300 million

1961



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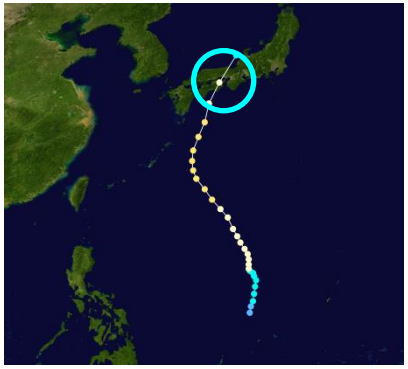
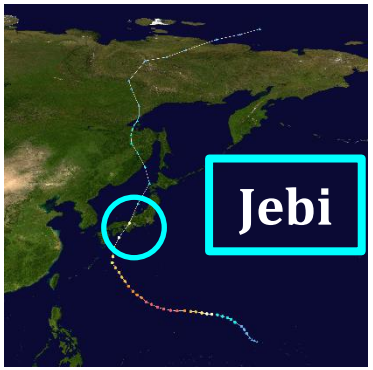
1987

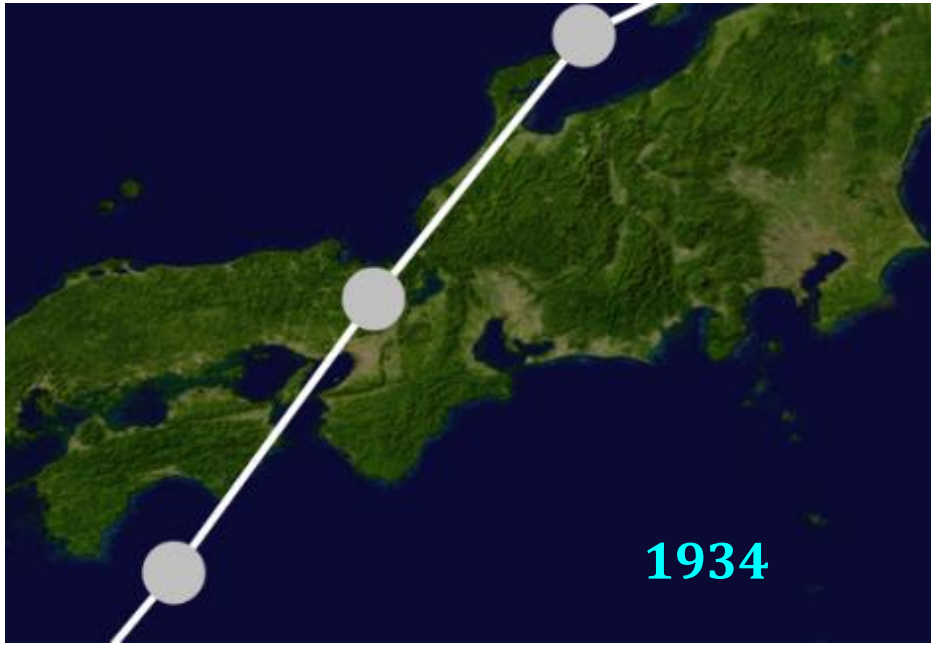


Damage:
$366 million

2018



Damage:
$3.4 billion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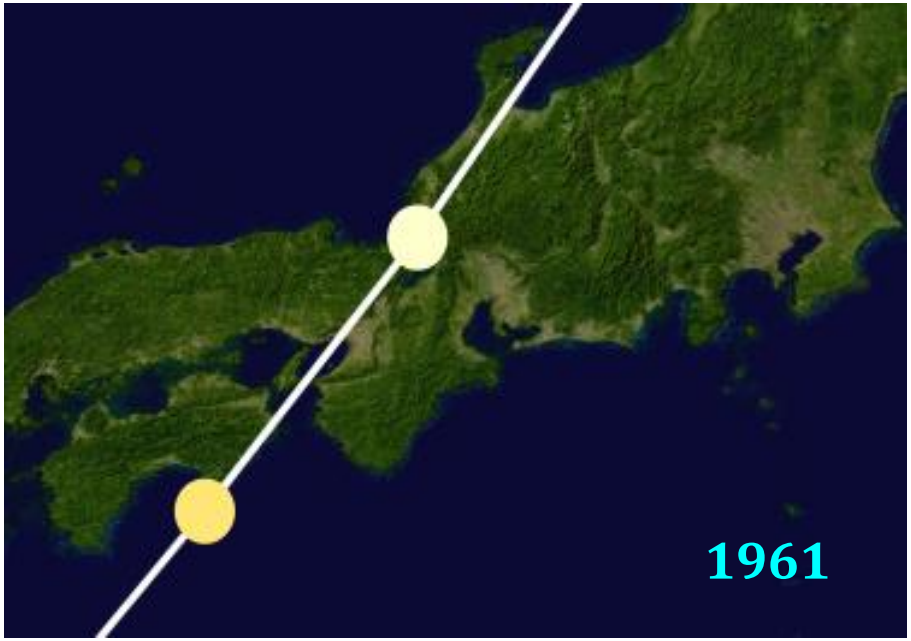
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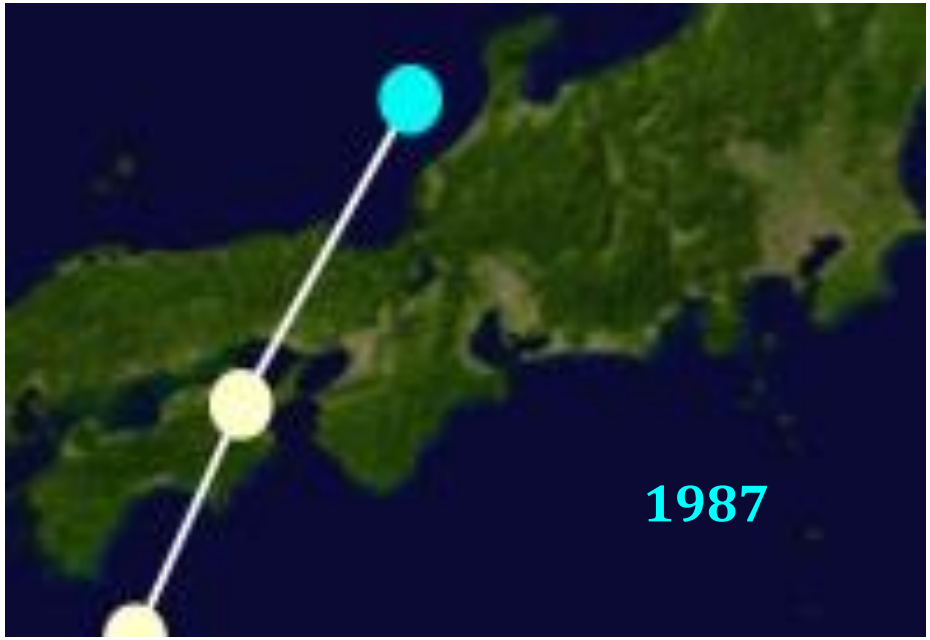
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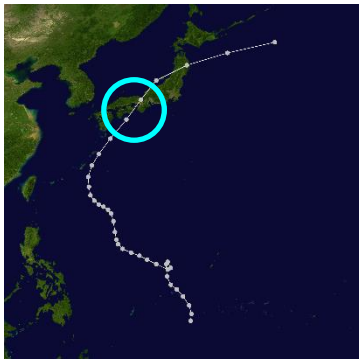

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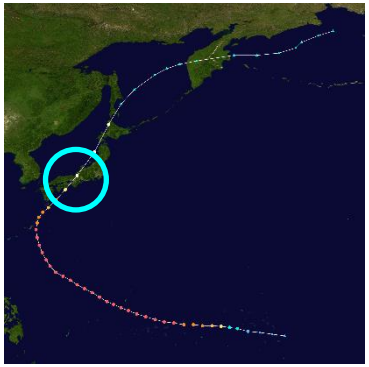

Damage:
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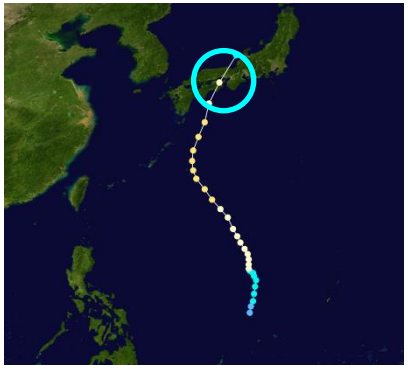

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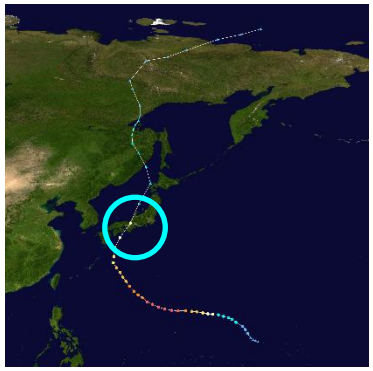

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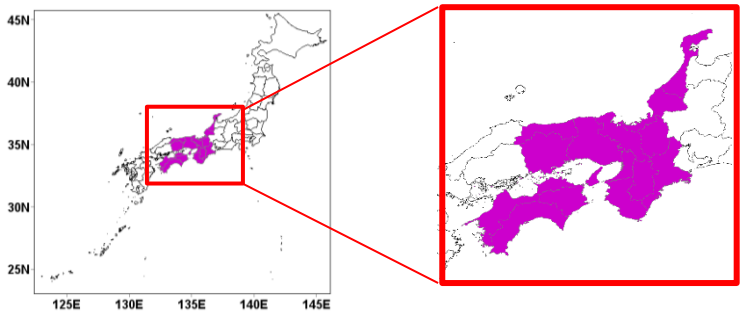
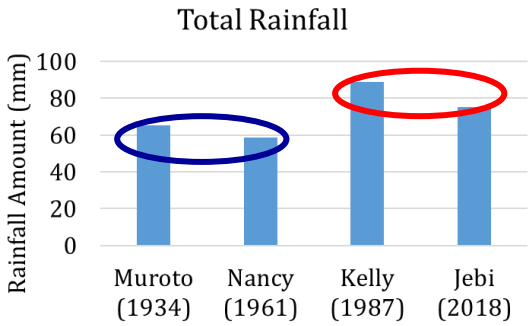
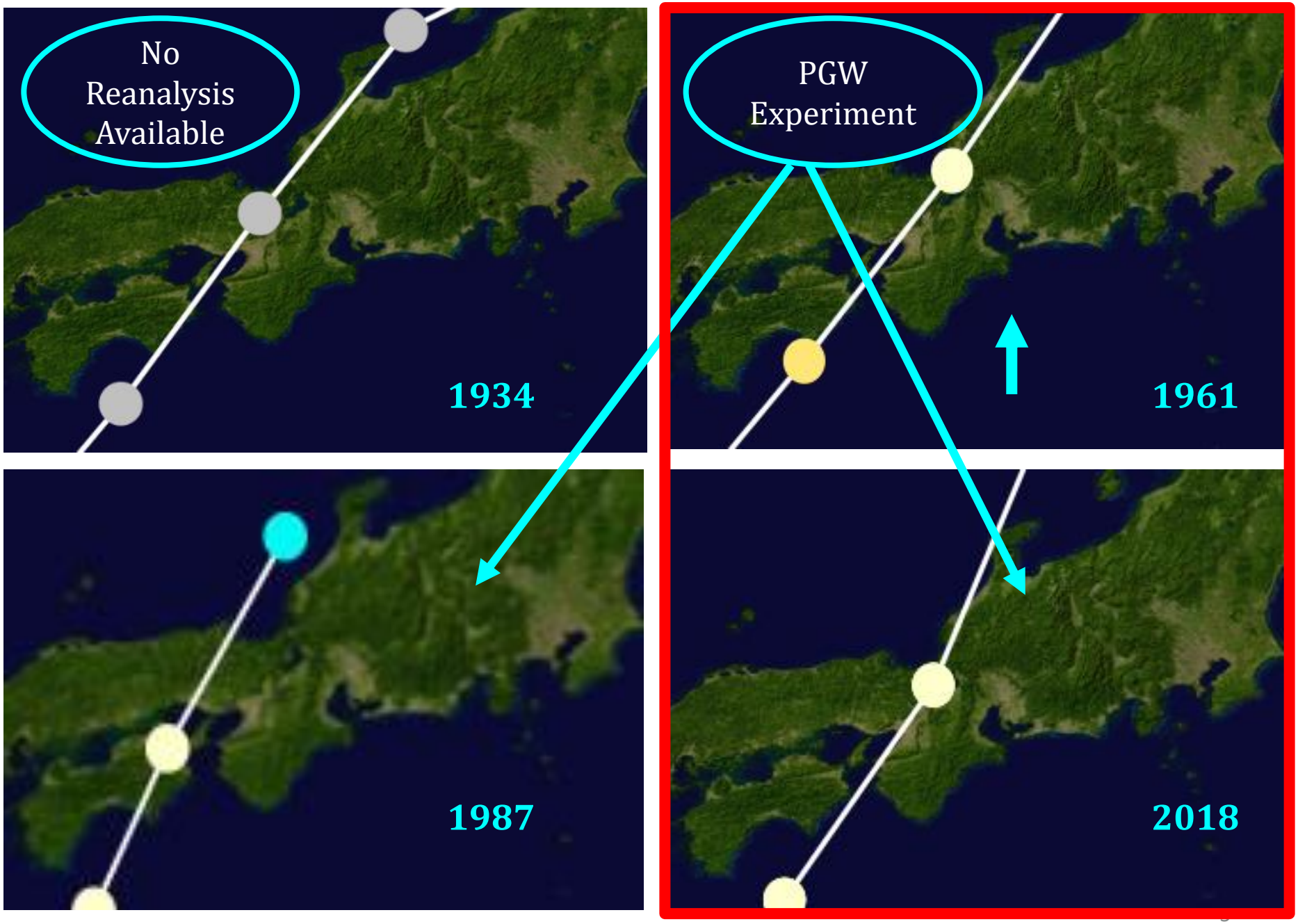


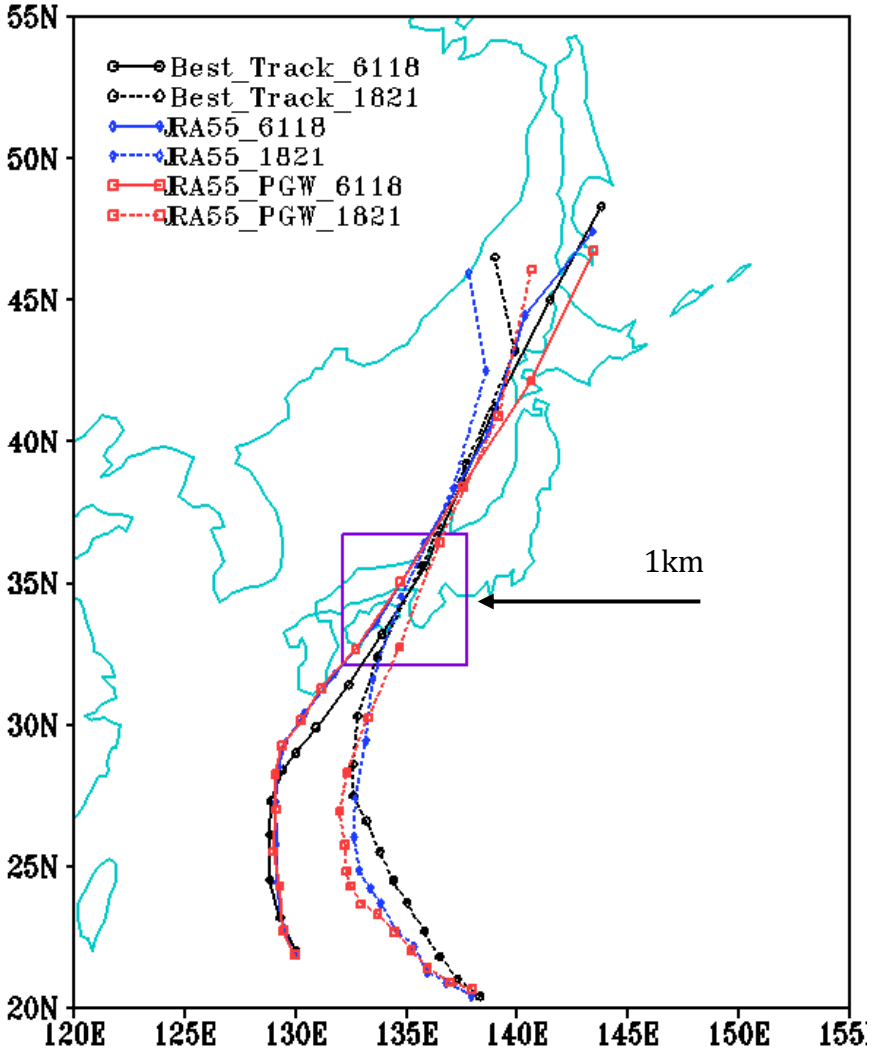


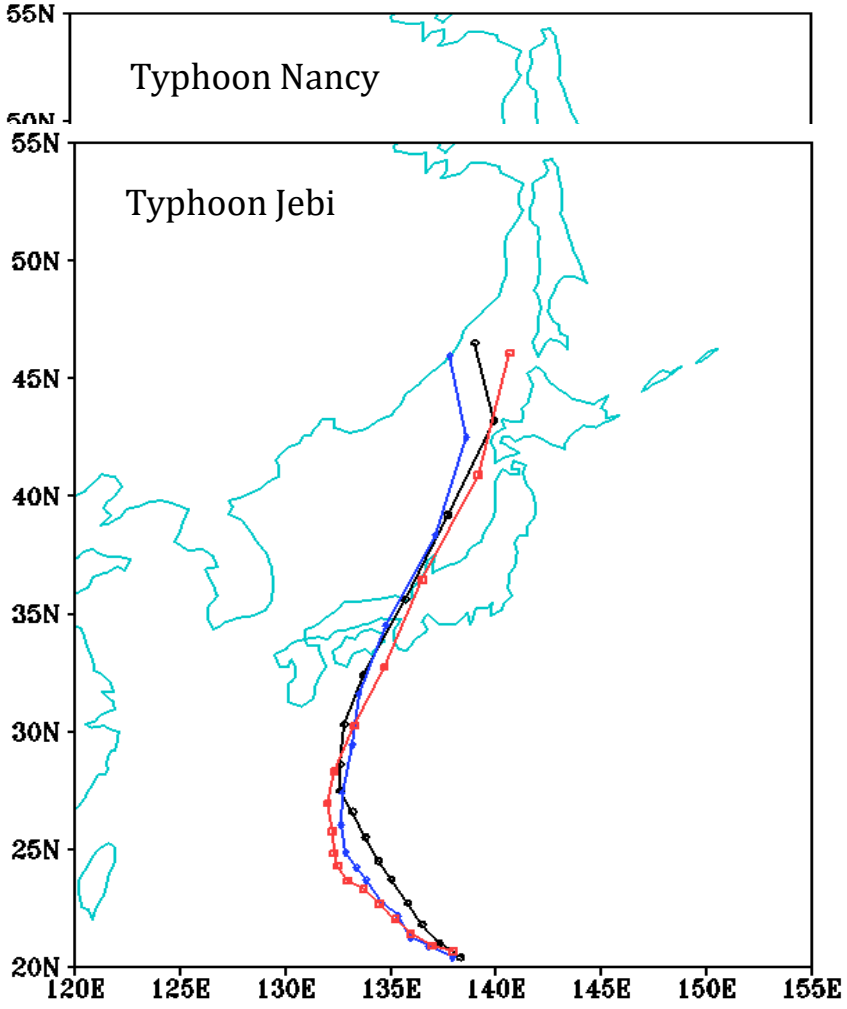
Recent Typhoons carry more precipitations

- Whether the precipitation amounts or wind speed brought by *Typhoon Jebi can be predicted from Typhoon Nancy* under future warming climate?


No
Reanalysis
Available
1934
PGW
Experiment
1961
1987
2018

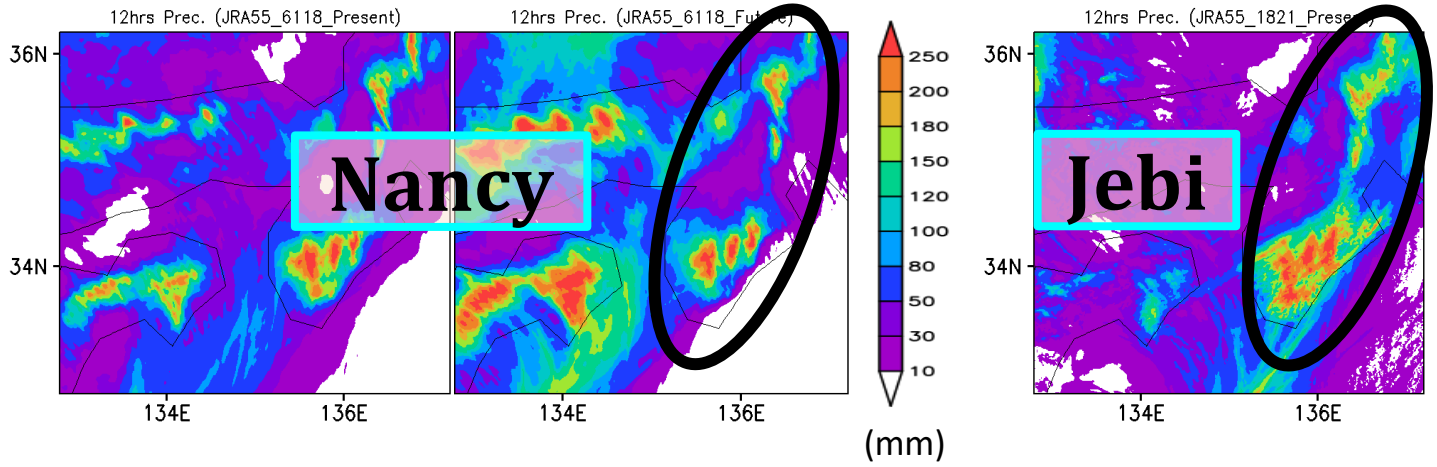
Typhoon Track





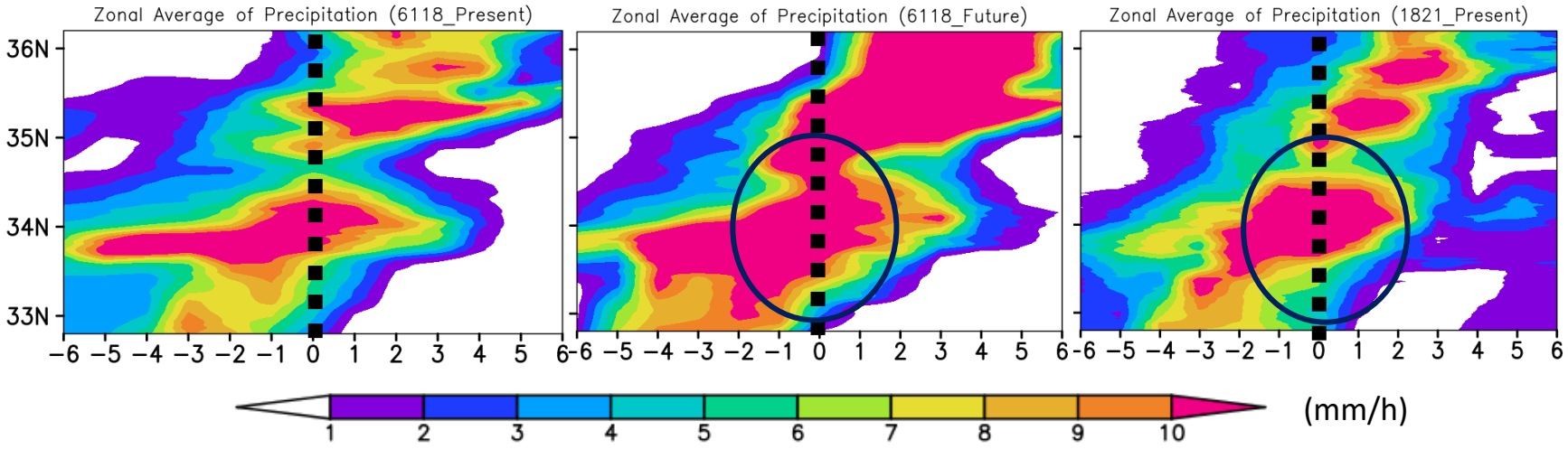
- WRF reproduce the track and intensity reasonably well
- Typhoon tracks in future warming climate remained same as of in present climate

12-hours Accumulated Precipitation (±6 hours of Landfall)

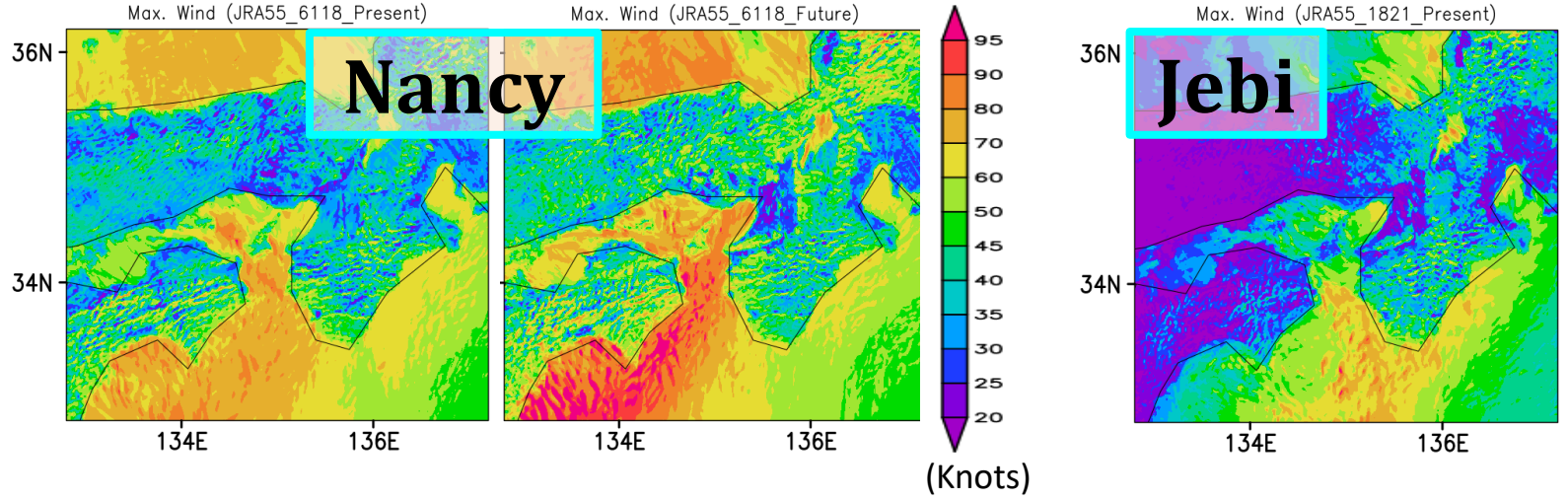


- Precipitation amounts associated with the typhoon Nancy is increased under PGW
- Precipitation amounts brought by Typhoon Jebi in present climate has a good agreement with that of by Typhoon Nancy in future climate

Zonal Average of Precipitation (±6 hours of Landfall)

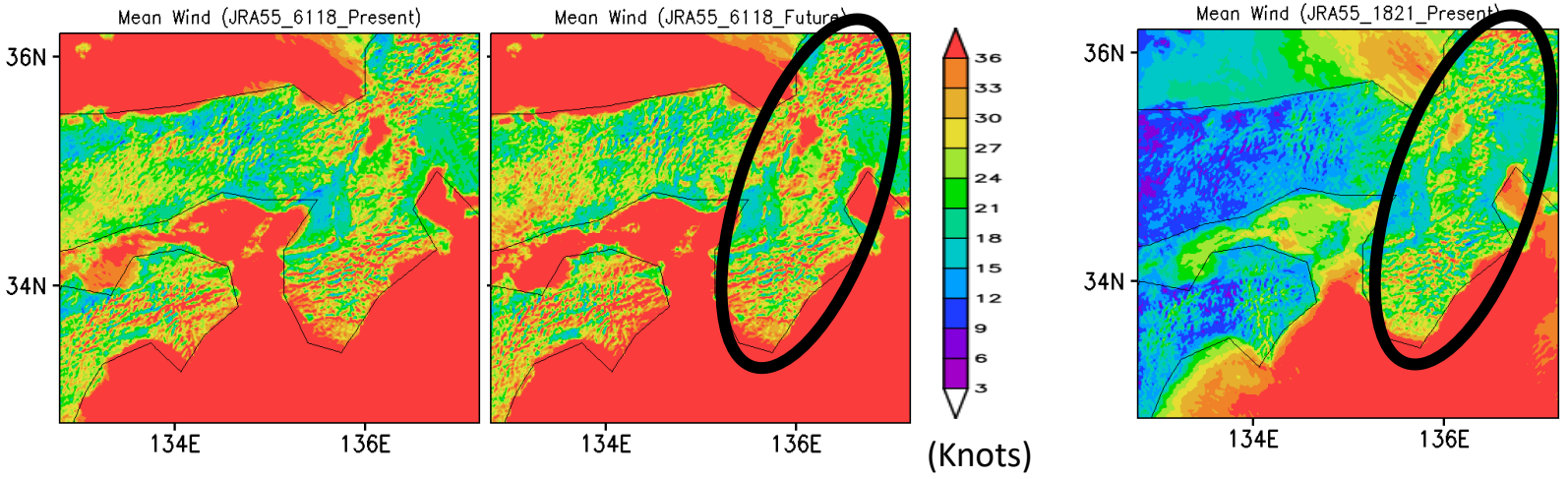


12-hours Max Wind (±6 hours of Landfall)



- Typhoon Nancy in future climate is expected to bring high winds to landfall areas

12-hours Mean Wind (±6 hours of Landfall)



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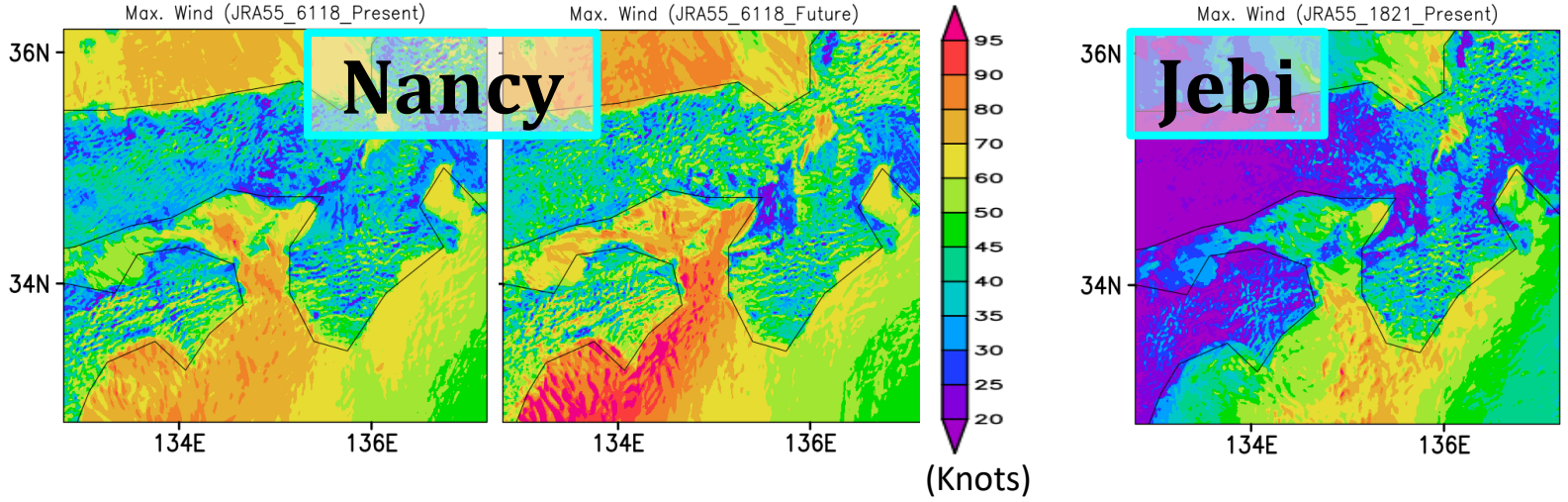

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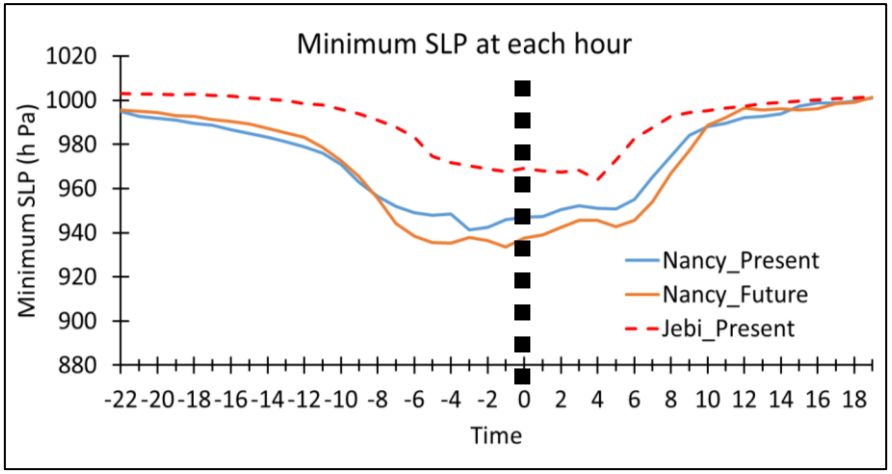
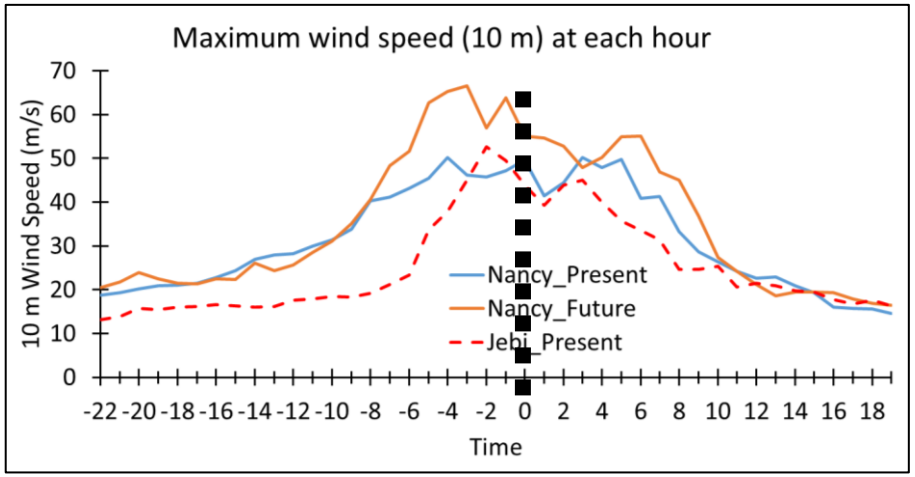




Summary

- Analyzed two typhoons and the associated precipitation and wind during and after landfall by using WRF model
- The model reproduced the typhoon tracks reasonably well in present climate simulation
- The projected precipitation amounts and maximum wind from the past is found in present typhoon
- The Typhoon Jebi is found to be a possible projection of Typhoon Nancy

What next?

- Incorporate the lower atmosphere observation to the model to further improve the accuracy

JMC

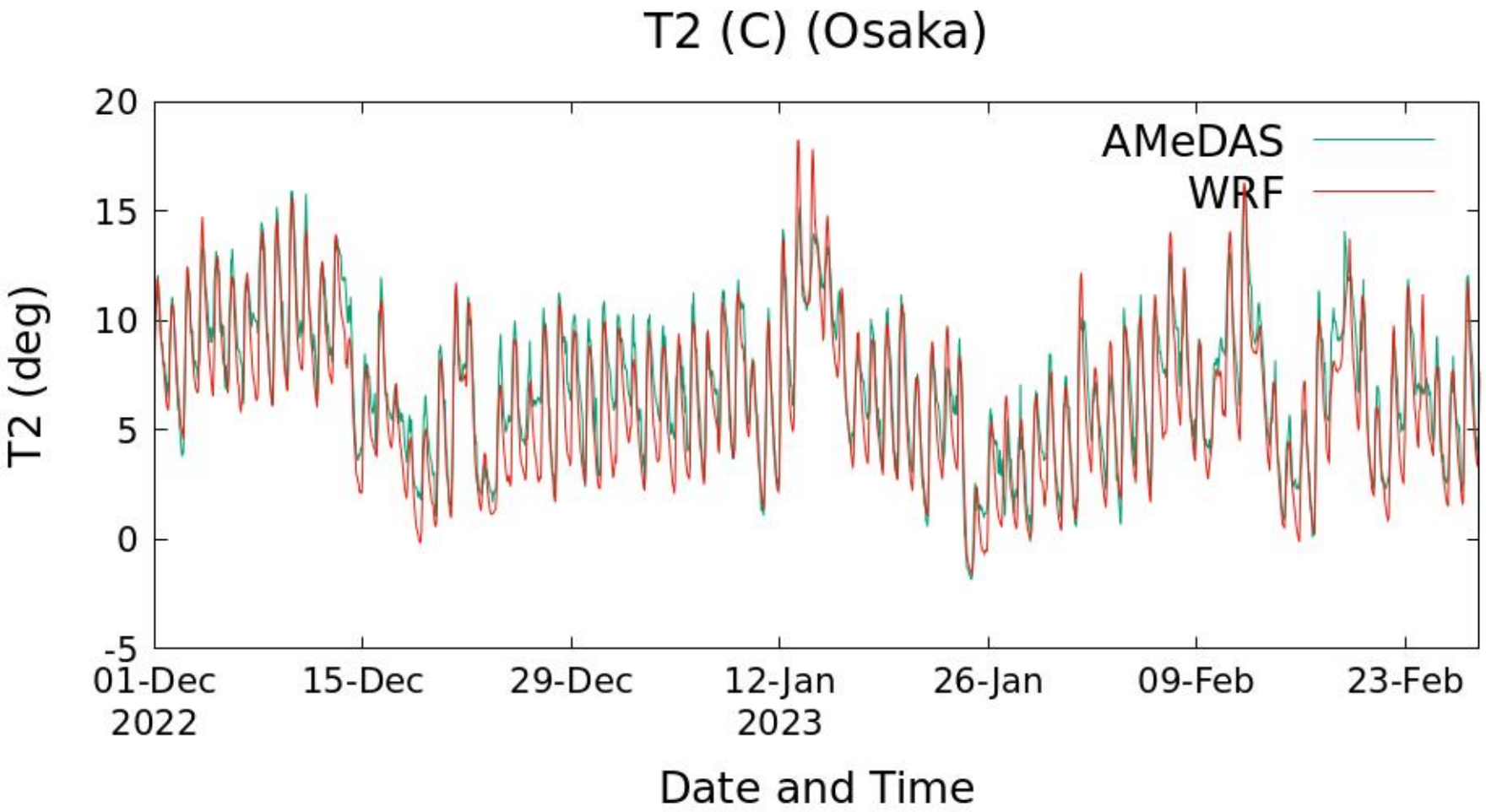
Doppler Lidar
「StreamLine」

JMC

Weather observation drone
「Meteodrone」

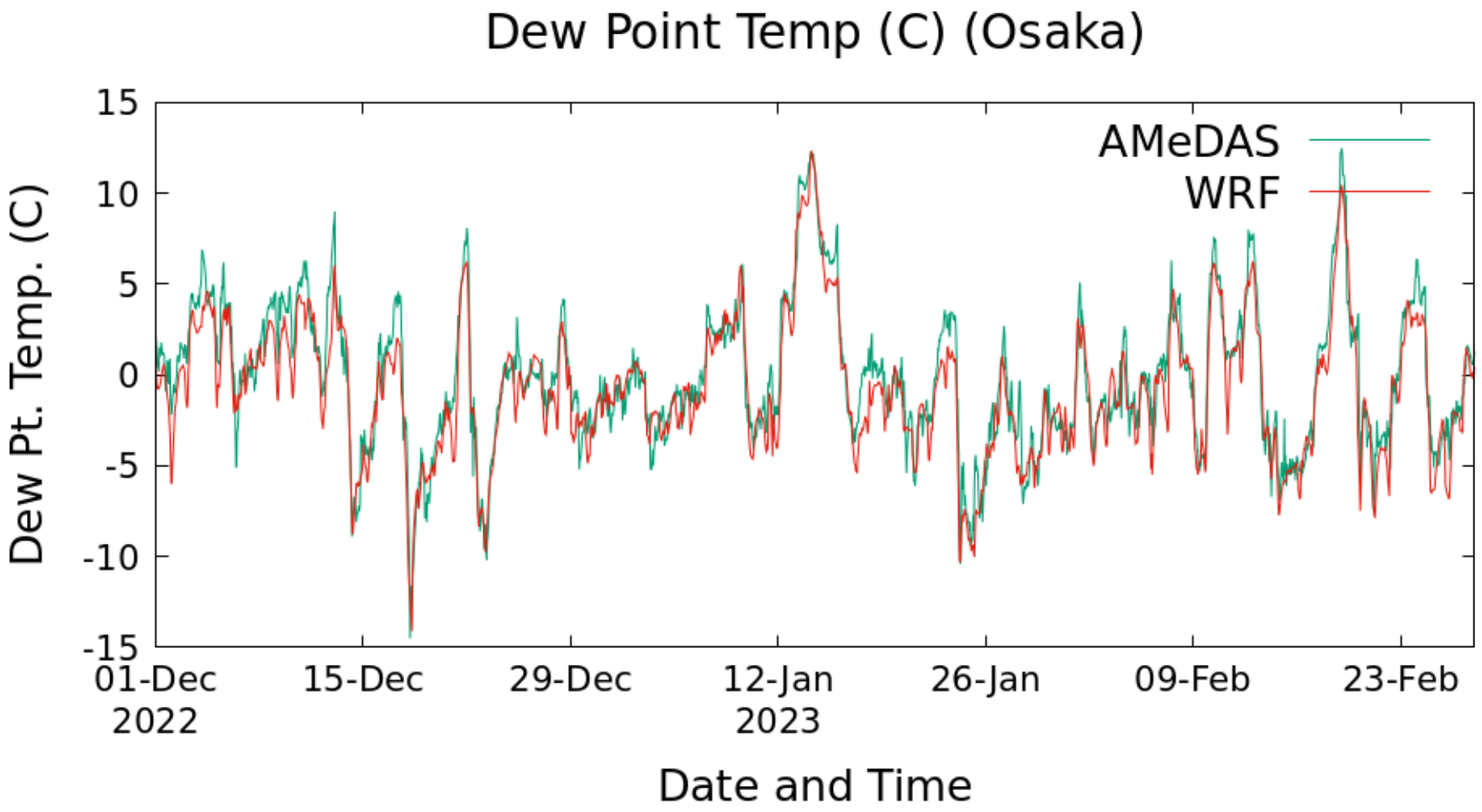
Results

Hourly Time Series



Results

Hourly Time Series



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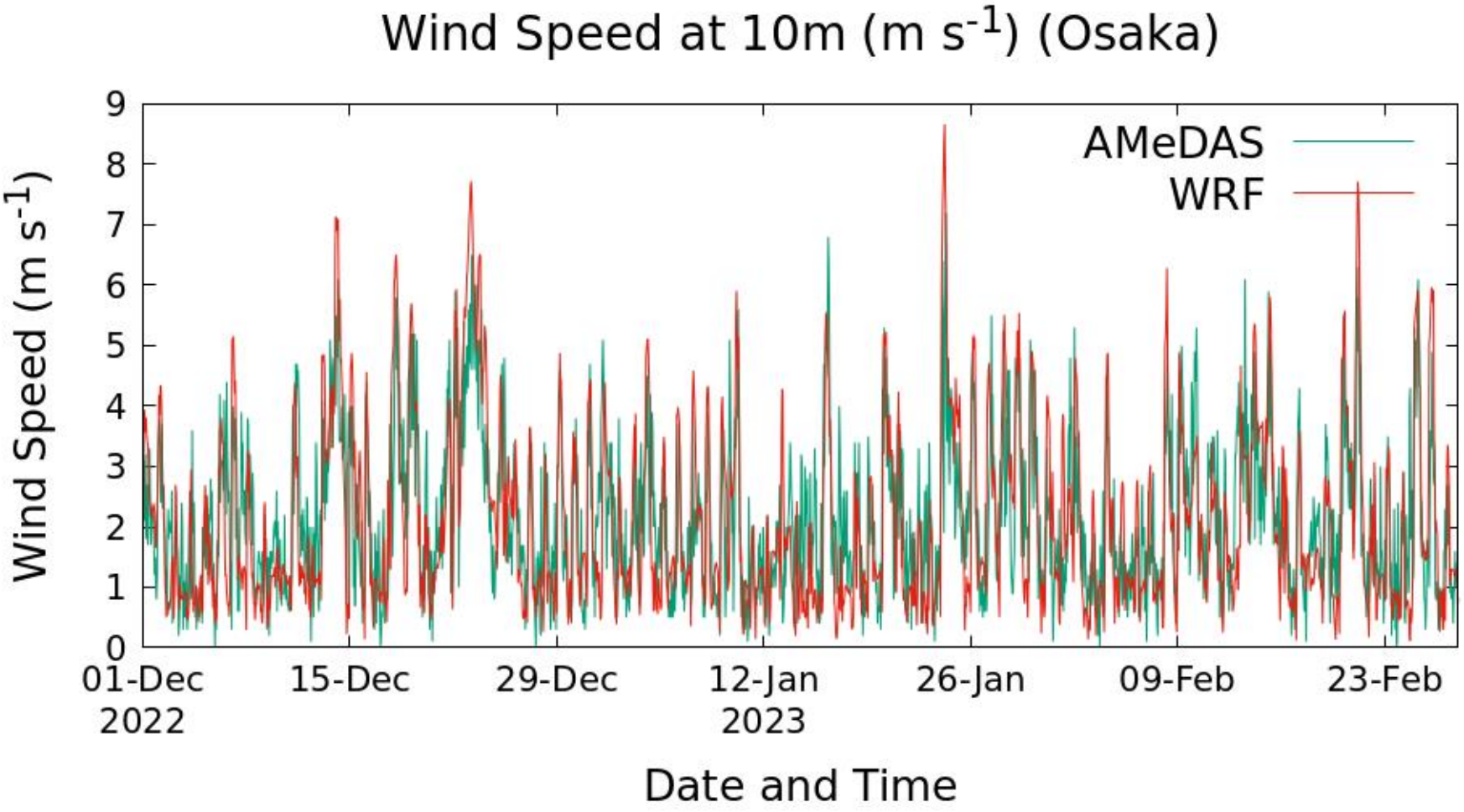

Results

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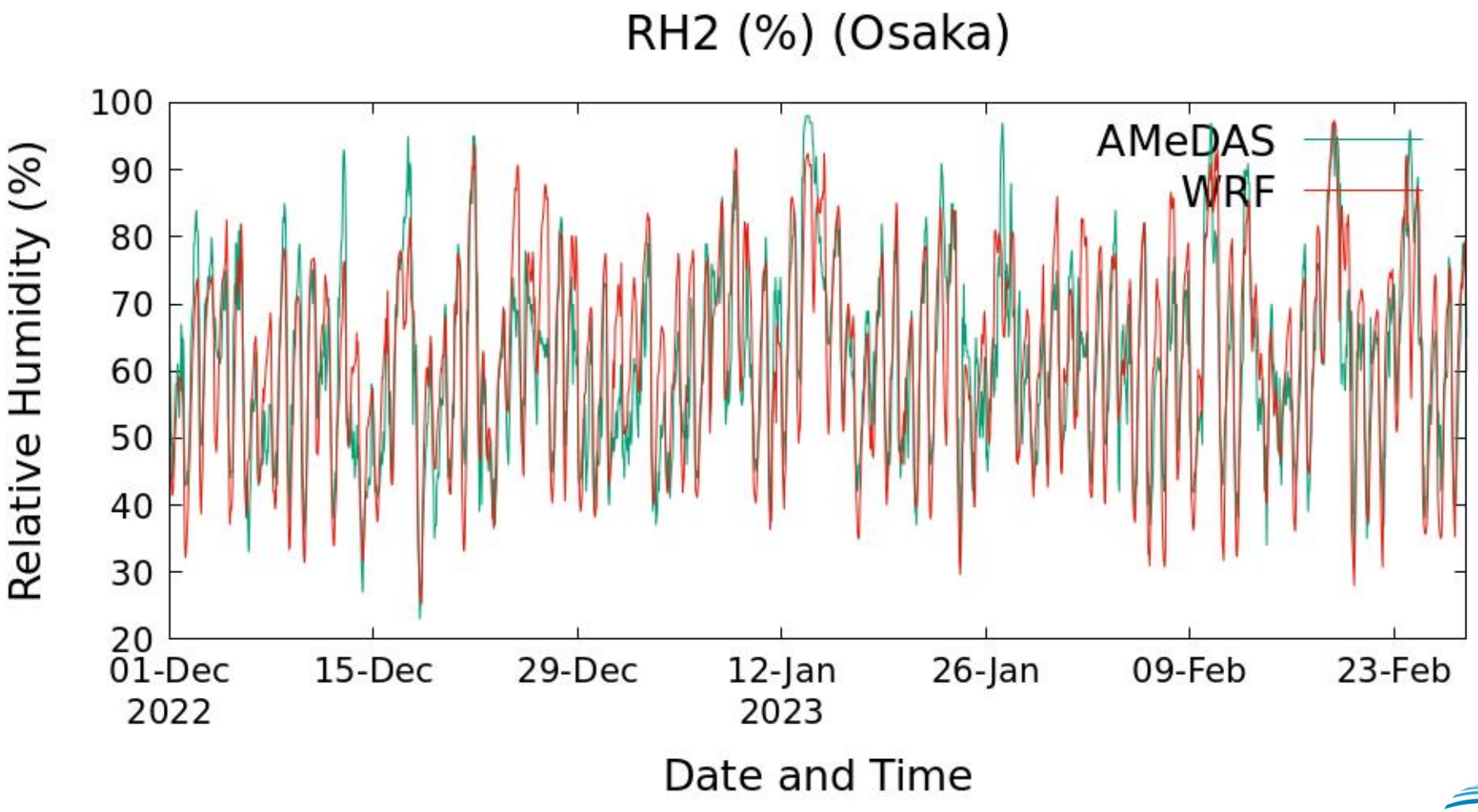
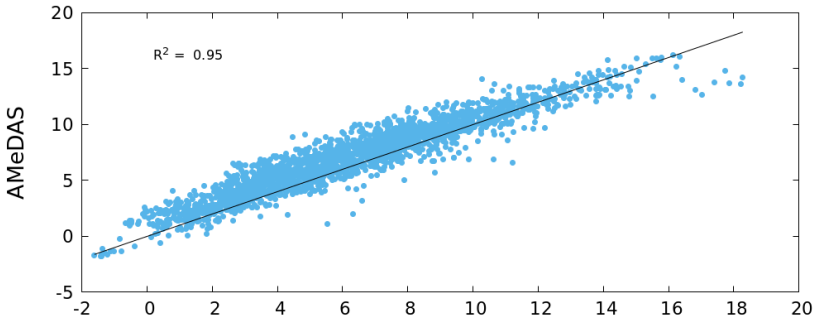


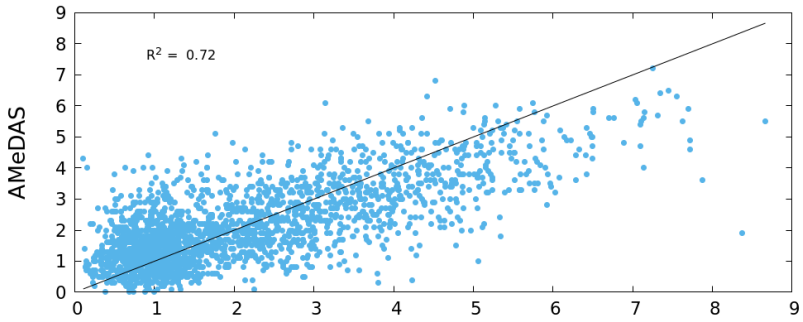
Results

Correlation

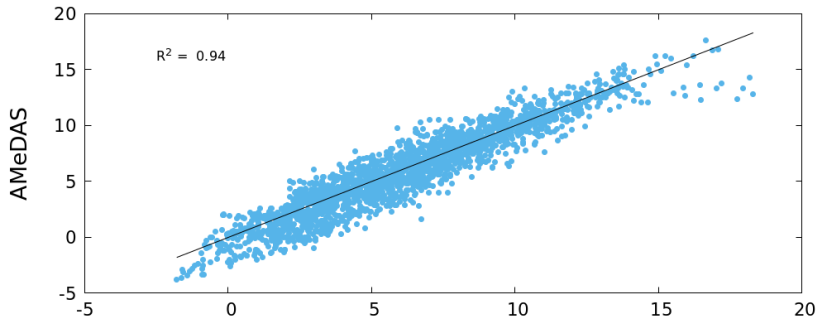
T2 (C) (Osaka)



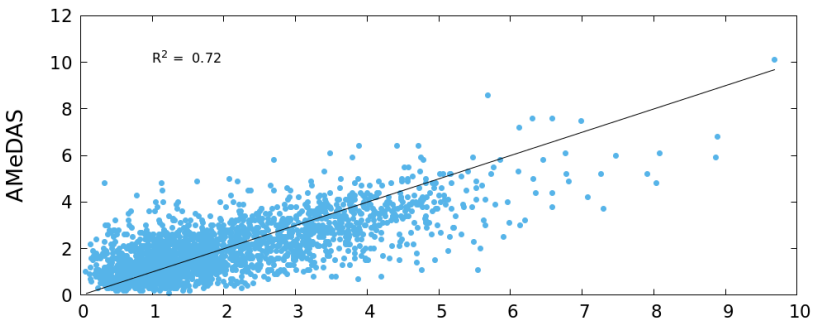
Wind Speed at 10m (m s^{-1}) (Osaka)



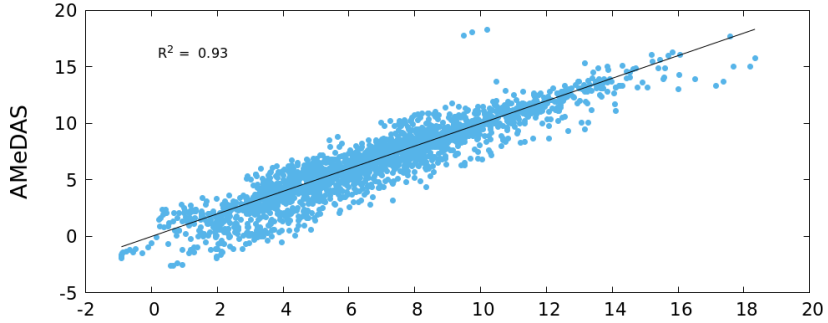
T2 (C) (Hirakata)



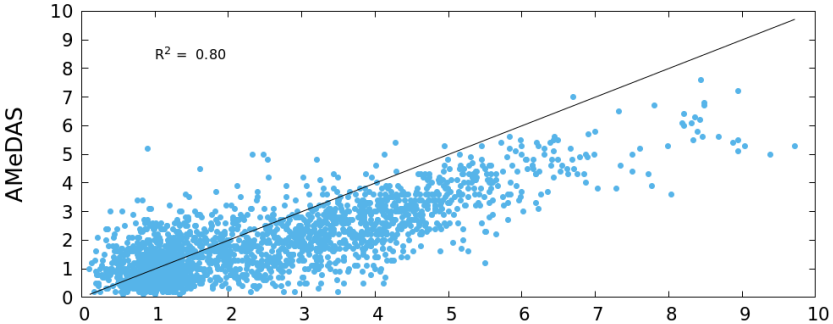
Wind Speed at 10m (m s^{-1}) (Hirakata)



T2 (C) (Sakai)



Wind Speed at 10m (m s^{-1}) (Sakai)



93-95%

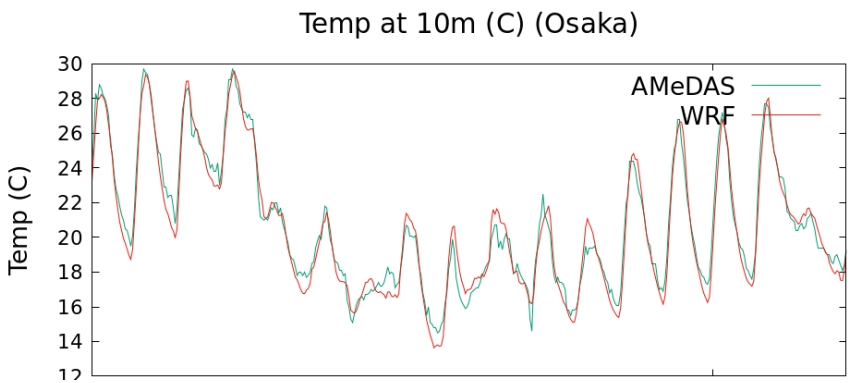
WRF

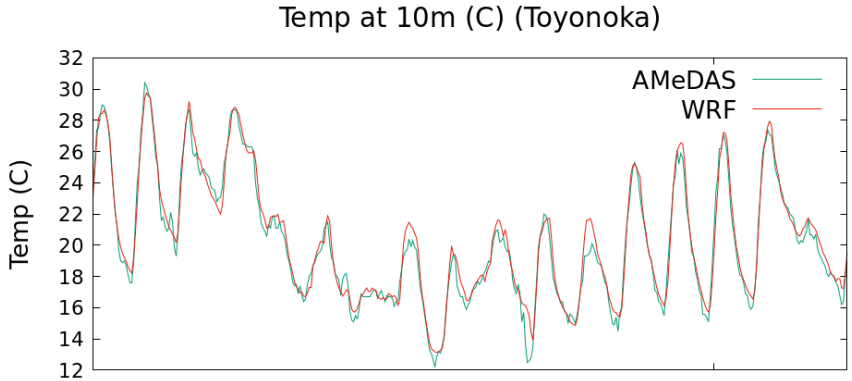
72-80%

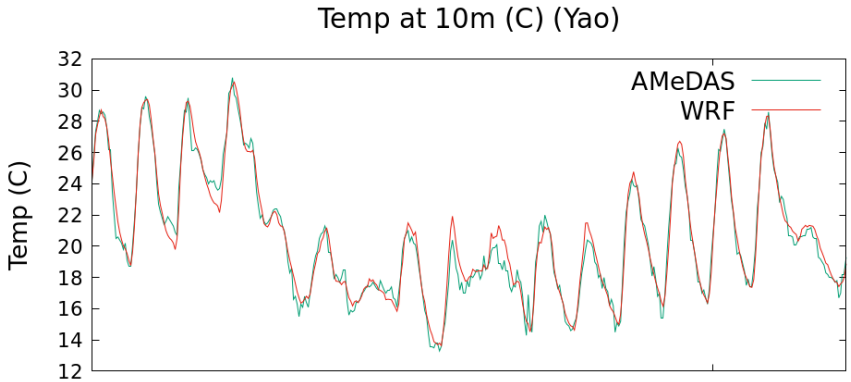
WRF

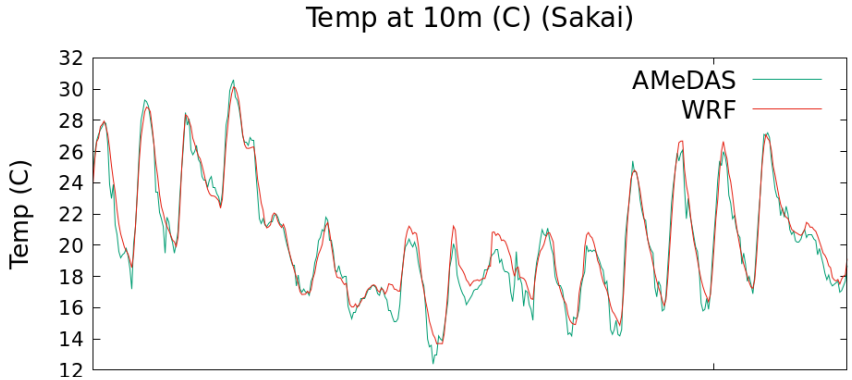
JMC

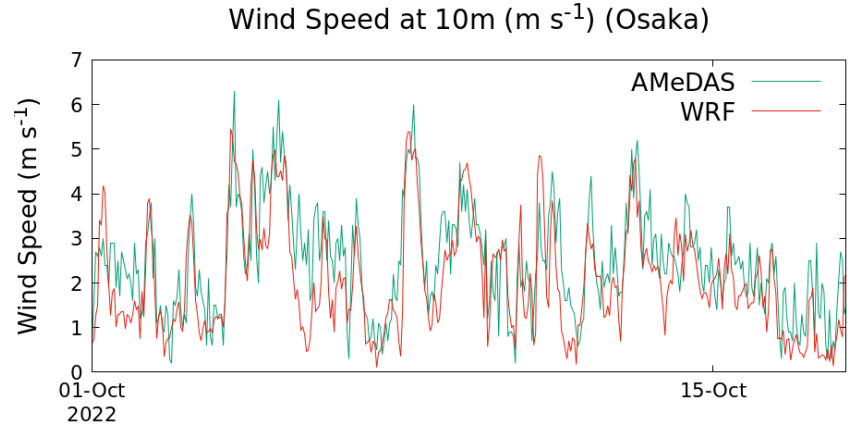
Results with LFM at 300 m

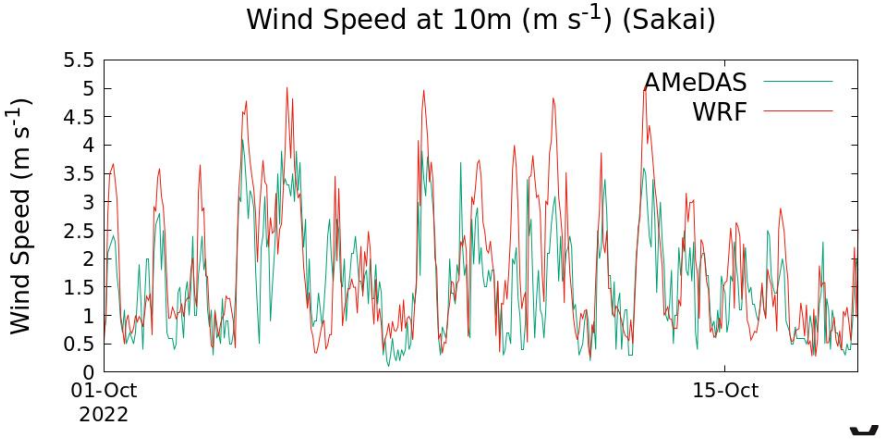






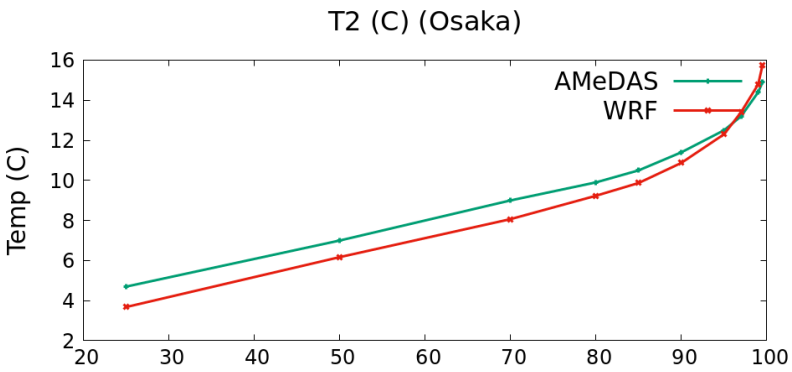


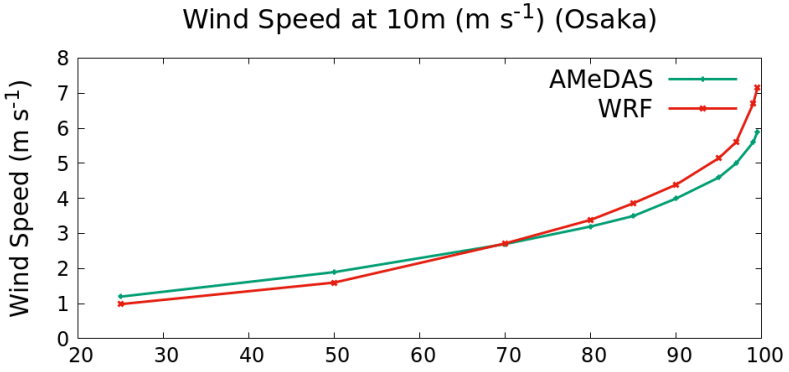


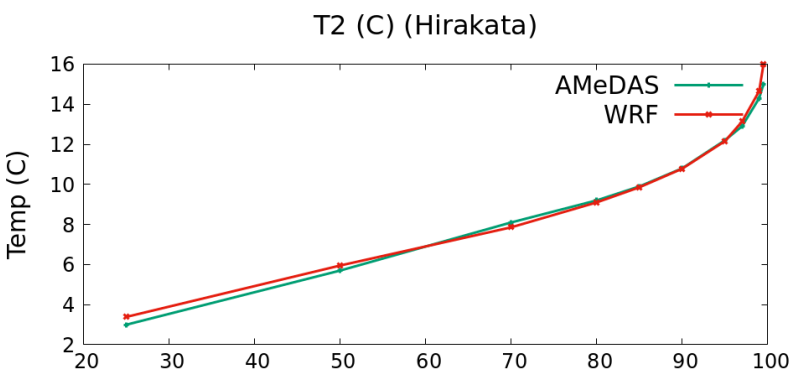


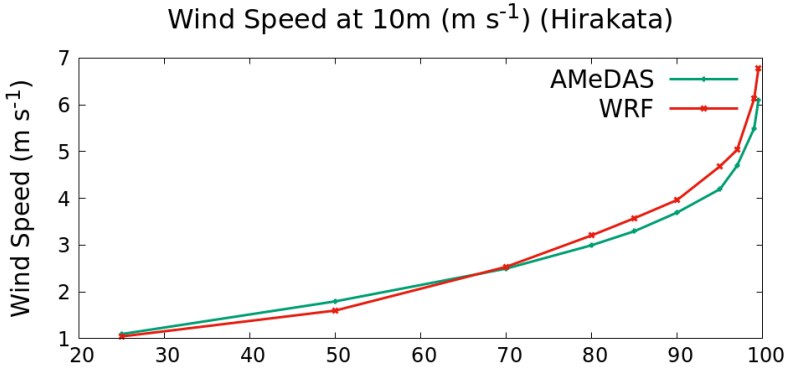
Results

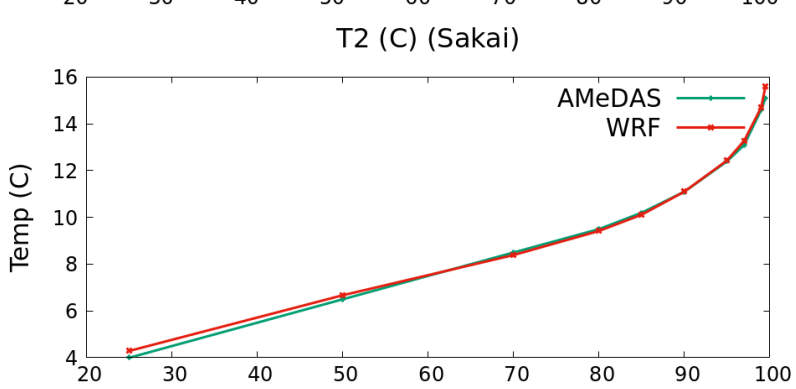
Extremes

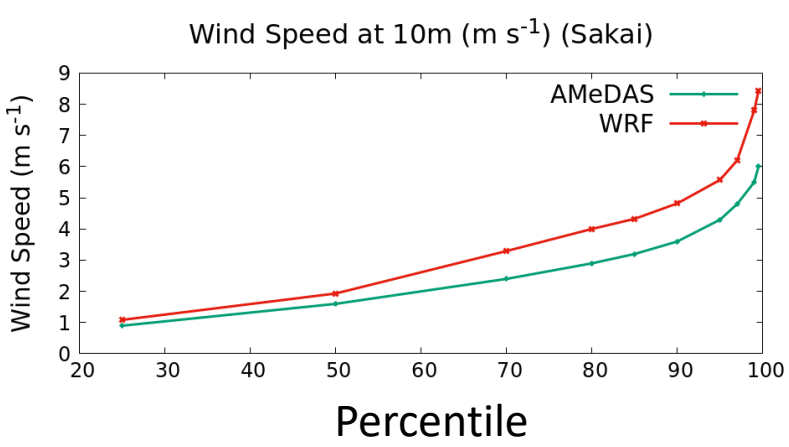












Thank you for your attention.

Inquiries

Osaka head office representative:
06-6567-2222
https://n-kishou.com