# Analysis of Meteorological Factors and Future Changes of Typhoon Hagibis 2019 Considering Topographic Rainfall in Chikuma River Basin and Tone River Basin Haruki Matsuoka<sup>1</sup>, Hiroki Okachi<sup>2</sup>, Tomohito J. Yamada<sup>3</sup>

## Introduction

### 1. Typhoon Hagibis 2019

Typhoon Hagibis, one of the strongest in Japanese history, made landfall on the Izu Peninsula, near Tokyo, on the night of October 12, 2019.

- **103 locations** nationwide:
- Maximum 24-hour precipitation
- Highest ever recorded



Fig.1 Observed by the weather satellite Himawari Typhoon Hagibis

Notable characteristics of Typhoon Hagibis 2.

**Typhoon Hagibis** caused not just **topographic rainfall**, but also brought heavy rainfall across the basin boundary to the leeward side.

10/12 950hPa

10/10 915hPa

Fig.2 Typhoon Hagibis

10/11 935hPa

path map



Fig.4 Elevation map around Chikuma and Tone River Basins



Fig.5 Distribution of rainfall across the basin boundary





## Purpose

1.	To analyze the meteorological factors that caused heavy rainfall in the Chikuma River Basin across the basin boundary
2.	To evaluate future changes in similar rainfall events using a large

ensemble dataset (d4PDF)

# Methods

1. Extraction of past typhoon cases with similar paths
<ul> <li>25 past typhoons with paths similar to Typhoon Hagibis</li> <li>Dataset: JMA best track data for typhoons in 1951-2019</li> </ul>
2. Selection of the time period with east/southeast wind blo on the basin boundary
Dataset: JMA 55-year reanalysis data (JRA-55) in 1958-2019
3. Calculation of inter-basin ratios of accumulated rainfall
> Dataset: Radar/Rain gauge-Analyzed Precipitation in 1988-2019

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milar paths to Typhoon Hagibis						
0 cases out of 25 total)						
	Time Period with East/Southeast Wind					
	Blowing on the Basin Boundary					
. 19	From 12 UTC on 10/10 to 06 UTC on 10/12					
. 11	From 00 UTC to 18 UTC on 8/9					
0.5						
. 15	From 00 01C on 9/8 to 00 01C on 9/11					
0.21	At 06 UTC on 10/1					
. 22	From 00 UTC to 18 UTC on 10/8					
5.7	From 12 UTC on 7/25 to 06 UTC on 7/26					
o. 11	From 00 UTC to 18 UTC on 8/25					
<b>b. 9</b>	From 00 UTC on 9/5 to 12 UTC on 9/6					
. 15	From 00 UTC to 18 UTC on 9/8					
across the basin boundary)						
		· _				
inas	s) 2007 Typhoon No. 9 (Fito	ow)				
	<b>50 · 100</b>					
	( 98.6 : 198.9 [mm])					
2001	RadarAMeDAS: 21UTC 04/SEP/2007 - 15UTC 06/SEP/2007					
List x						
-						

of similar events.





Fig.12 Typhoon paths follow Typhoon Hagibis in d4PDF

wing similar p	oaths to	Acc	0 5	50	100	150	200	250	300
· (60x60km) <sup>+)</sup>				Aco	cumula	ted rai	nfall in	Tone I	River
	Fig. and extr	13 Co Chiku acted	ompar uma F from	rison River d4P[	of ac Basir DF (5	cumu ns bro x5km	ulatec ought	l rain t by s day l	fall i simila CS)
e 3 Summary of analysis using a large ensemble dataset									
		P	AST					FL	JTU

Table 3 Summary of analysis using a large ensemble dataset						
Category	PAST	FUTURE +4K				
Number of typhoon cases with similar paths extracted from d4PDF (60x60 km)	399 Cases	477 Cases				
Number of typhoon cases included in d4PDF (5x5 km, 15-day DS)	163 Cases/ 399 Cases	224 Cases/ 477 Cases				
Rainfall scale of Typhoon Hagibis	Tone River Basin: <b>7th</b> Chikuma River Basin: <b>14th</b>					

Average rainfall amount from typhoon cases with similar paths [mm]

Tone River Basin: 131.1 Tone River Basin: 156.7 Chikuma River Basin: 86.0 Chikuma River Basin: 99.6

### Conclusion

- 1. Factors Contributing to Heavy Rainfall by Typhoon Hagibis
- Inflow of large amounts of water vapor from the southeast
- (past and +4K experiments).
- 3. Future Predictions (Predicted average rainfall amounts)
- > Tone River: **1.20 times** compared to the past
- Chikuma River: 1.16 times compared to the past

### References

- associated with typhoon track. Journal of JSCE, Ser.B1, 10(1), 534-544, 2020.
- December, 77-81, 2020.

Collision of dry cold air from the north with moist warm air from the southeast 2. Findings from Large Ensemble Dataset Analysis Typhoon Hagibis is extremely rare, ranking 7th in scale for the Tone River region

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