

# The Climatological Characteristics of the Landfall Typhoons on North Korea

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## I. Introduction

- Recently, meteorological disasters have frequently occurred because of climate changes, and socio-economic scale of the damage is getting increased (\*IPCC, 2007).
- According to UNISDR(UN International Strategy for Disaster Reduction), the cumulative damage(from 1991 to 2005) of North and South Korea was 5<sup>th</sup>, 17<sup>th</sup>, respectively, among the Top 50 countries.
- The world of natural disasters report in 2007 said,
  - ✓ The number of deaths caused by natural disasters in North Korea is ranked the world's, and
  - ✓ North Korea's annual Climate Risk Index (CRI) published by Germanwatch was ranked 2<sup>nd</sup>
- North Korea has been reported to have serious damages by disaster annually and still very weak for disasters.
- However, there are no studies on landfall or affected typhoons on the North Korea.
- In this study, the climatological characteristics of the landfall typhoons on North Korea are examined to estimate the frequency, the intensity, the track, and their damage.

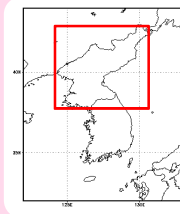
## II. Data and Methodology

### DATA

<b>Typhoon Information</b>	- Resources : TC(Tropical Cyclone) best-track data of the Regional Specialized Meteorological Centers (RSMC)-Tokyo Typhoon Center - Elements : Latitude, Longitude, and Central Pressure - Period : From 1951 to 2008
<b>Meteorological Analysis</b>	- Resources : 2.5° × 2.5° NCEP/NCAR (National Centers for Environmental Prediction/National Center for Atmospheric Research) Reanalysis - Elements : 500 hPa Geopotential Height - Period : From 1951 to 2008
<b>Typhoon Disaster</b>	- Resources : The OFDA/CRED International Disaster Database of EM-DAT (Emergency Events Data base) - Elements : Deaths number, Total affected number, Est. Damage - Period : From 1951 to 2008

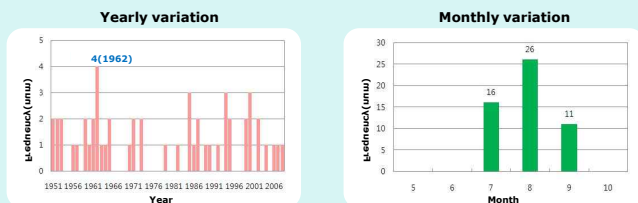
### Methodology

- Definition of "landfall typhoons on the NK"**
  - North Korea's territorial scope(Ministry of Education & Human Resources Development ,MEHRD, 2001)
  - Passed in 37.4°N ~43°N, 124.1°E~130.4°E
  - Grade of typhoons : Including typhoons to extra-tropical cyclone
- Characteristics analysis of typhoons landing on the NK**
  - Frequency and intensity changes of the landfall typhoons using RSMC data from 1951 to 2008
- Track pattern analysis of typhoons**
  - Track pattern is classified by Typhoon's track using RSME data from 1951 to 2008
  - Figure out the relation between the typhoon track and the expansion of North Pacific High (NPH)
- Damage analysis of typhoon disasters**
  - Using EM-DAT's disasters data from 1951 to 2008
  - Examination for deaths and total affected number and Est. Damage by the landfall on NK



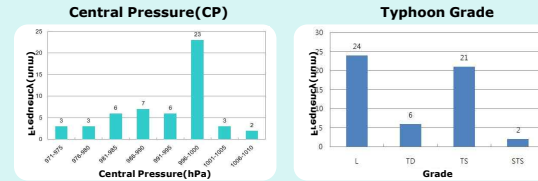
## III. Result

### Frequency of typhoons



- ✓ Total 53 for 58 years
- ✓ Average : 0.9 per a year
- ✓ Concentrating in July to September, the most landed in August

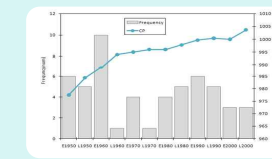
### Intensity of typhoons



- ✓ CP 996~1000 hPa : 23
- ✓ TS + STS : 23, TY : 0
- ✓ At the time of landfalling typhoons,
  - Most of typhoons were the weakened state by extra-tropical cyclones.
  - The impact of a strong storm could not have existed.

• The capital L means "Extra-tropical Cyclone".

### 5-year variations of Frequency and Intensity

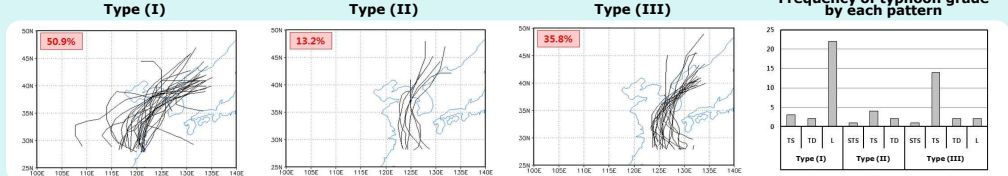


#### Result of F-test,

- The frequency was not statistically significant.
- However, the central pressure appears to be significant at the 95% confidence level.
- Intensity has getting weak gradually.

• The capital E and L mean "early" and "late", respectively.

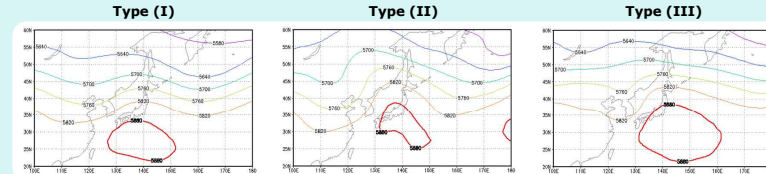
### Track patterns of the landfall typhoons on North Korea



#### Typhoon's tracks are classified into three types as follows:

- Type (I) : Landing on the west coast of North Korea through the mainland of China
- Type (II) : Landing on the west coast of North Korea directly
- Type (III) : Landing on a central/eastern part of the Korean peninsula through South Korea

### Composite map of 500 hPa geopotential height by each track pattern



Type (I) shows the westward expansion while both Type (II) and Type (III) show the northward expansion and development of NPH.

### Damage type in each case cause analysis of typhoon damage

Date	Typhoon name	Deaths Num.	Total Affected Num.	Est. Damage (US\$Million)
1993.8.8~10.8	Robyn(9307)	6	2,500	110
1997.8.18~8.19	Winnie(9713)			0.01
2000.8.31~9.4	Prapiroon(0012)	46	627,180	6,000
2002.8.31~9.6	Rusa(0215)	3	7,401	0.5
2007.9.17~9.25	Wipha(0712)		1,649	

✓ Only two cases are found among total five cases in EM-DAT, reportedly that North Korea was damaged.

## IV. Summary

- Even if a clear trend on the frequency of typhoon is not defined, it is noticeable the intensity has been weakened since the frequency of TS (Tropical Storm) decreased.
- More often than not, the characteristic of Type(I) is the case of a landfall after it becomes extratropical cyclone. Type(II) and Type(III) show a landfall as TS grade, by comparison.
- The intensity of a typhoon landfall on North Korea is variable depending on the development of NPH.
- The damage by the wind of Prapiroon and heavy rainfall with Rusa landing on North Korea was analyzed.

## V. Acknowledgement

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