Future changes of precipitation associated with typhoons around Japan simulated by a 5-km-mesh regional climate model

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Experimental design



Present-day: 1979-2003 : HadISST

Future: 2075-2099

Annual variation from HadISST + Trend + difference (F-P)

(Mizuta et al.2008)

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Introduction

Disasters by TY-related precipitation

- Floods
 land slides
 debris flow
 Amount
 Intensity
 - •Duration



After passage of Typhoon Tokage (2004) in Toyo-oka city, Hyogo http://www.city.toyooka.lg.jp/www/contents/114 0145261640/index.html

Non-negligible indirect effect



Aim

- Future changes of TY related precipitation is examined
 - direct precipitation
 - indirect precipitation
 - no-TY precipitation

Amount, Intensity, and duration

Specification of NHM-5km

Basic Equations	Full compressible system
Advection	Flux form forth-order with advection correction
Turbulent closure	Improved Mellor-Yamada(MYNN) Level3
Cloud in radiation process	Partial condensation scheme
Land surface flux	Beljaars and Holtslag(1991)
Grid points	669 x 594 (527) x 50 (Top 21.8 km)
Cumulus parameterization	Kain-Fritsch
Cloud Physics	3-ice bulk scheme (Murakami 1990)
Spectral coupling	SN (improved from SBC; Kida et al. 1991) above 7km height

Direct, indirect, no-TY precipitation



No TY precipitation: precipitation during the periods when no TY is in the NHM-5km domain

Verification by Perfect Boundary Condition Experiments



5 warm seasons: 2002-2006

Nakano et al., 2010: Hydrological Research Letters, 4, 6-10

Track and position error



TYs came from outside the domain —— Average Error
 TYs generated in the domain 130km at t=72h

Minimum central pressure



Approaching Japan Typhoons



Passing through the orange region && duration time in the NHM-5km is > 24 hours

Direct precipitation



total TY direct precipitation / 143 days (number of days when a TY exists in the domain)

Indirect precipitation



Total TY indirect precipitation / 143 days (number of days when a TY exists in the domain)

Hourly precipitation intensity PDF



Climate Experiments



Present-day climate : 1979-2003 Future climate : 2075-2099

TY frequency (/year)





Direct precipitation amount (mm/year)





Precipitation amount per 1 typhoon

5kmNHM PREC TYbody/masktotal SPA num)12.5



Direct precipitation amount per 1 typhoon



Hourly precipitation intensity PDF



Summary

- Reproducibility of TY-related precipitation by NHM-5km is fairly good.
- Precipitation amount per 1 TY will increase by 40% around Taiwan, 20% around Japan.
- Precipitation intensity will be more intense (Esp. direct precipitation ; +100% for 40-60 mm/h)