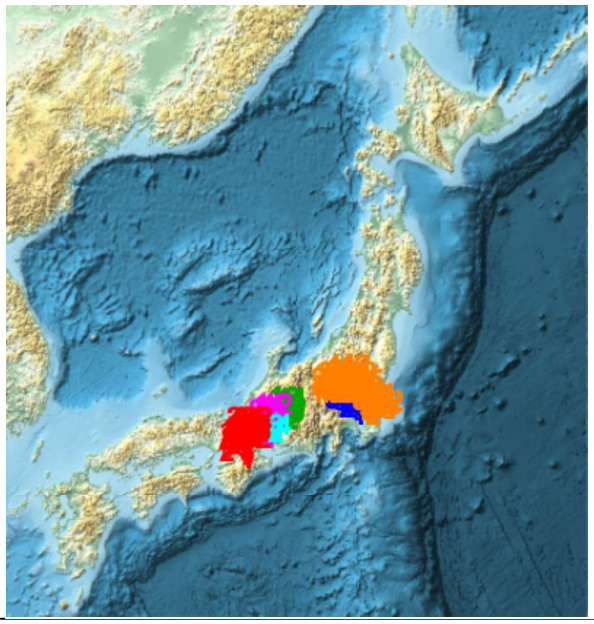
Interesting Statistical Characteristics of Precipitation Extremes in Major River Basins of Japan using a Large Ensemble of Climate Simulations “d4PDF”



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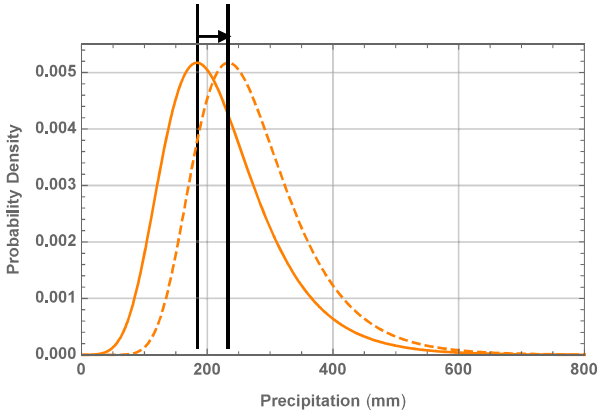
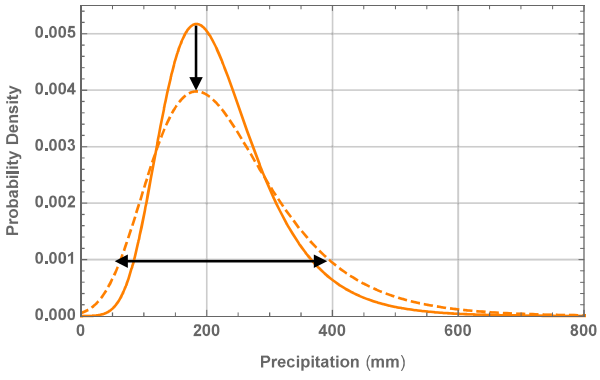
How will PDF of extreme change in future?

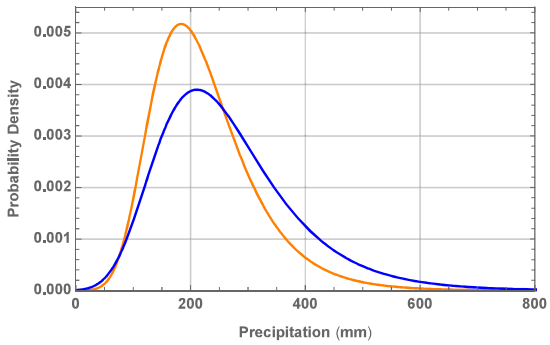
1. Slide upper



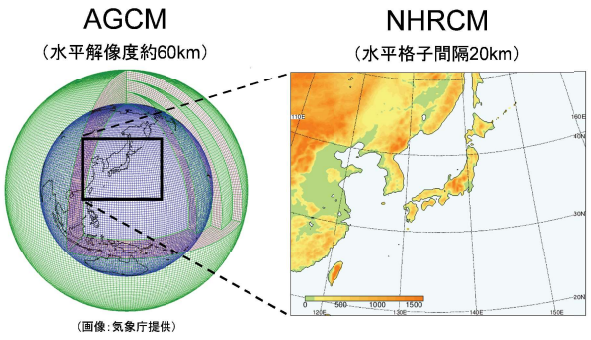
2. Widen



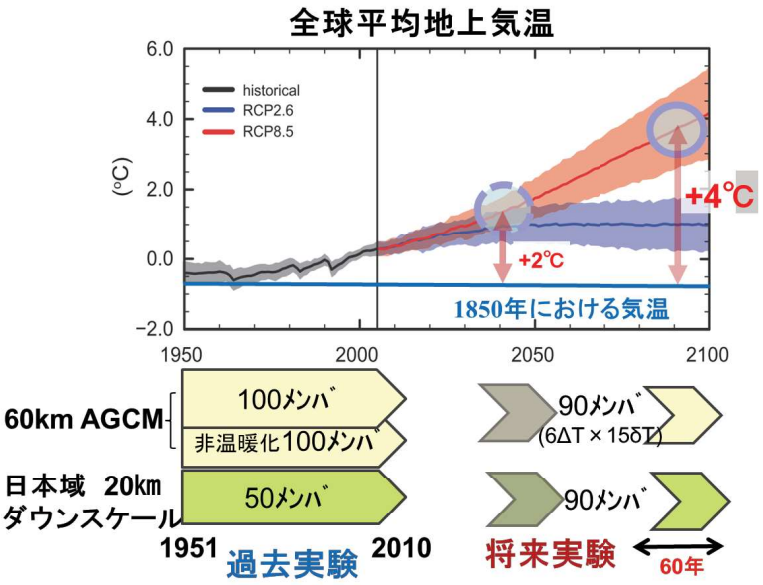
3. Slide upper and widen?



Experimental Design of d4PDF



20km Grid



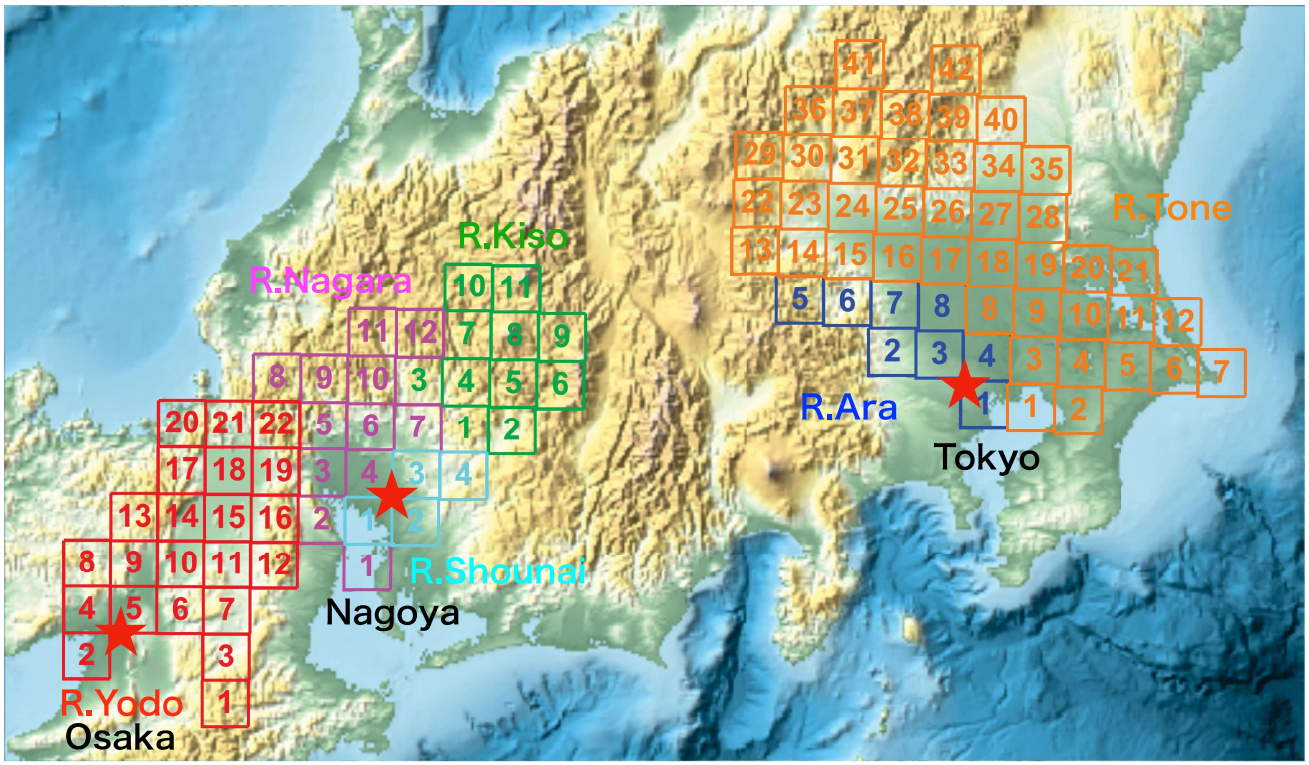
Historical 1950/9～2011/8×50members
Future (4℃) 2050/9～2111/8×90members

Use just annual max 1-3 day precipitation without BC

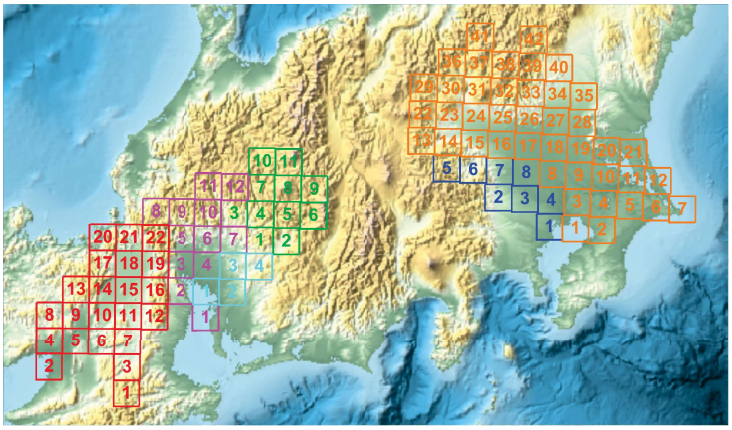
99 grids in major 6 river basins

R.Tone, R.Ara, R.Kiso, R.Nagara, R.Shounai, R.Yodo

Grids: 42, 8, 11, 12, 4, 22



d4PDF at the 6 River Basins



- 99 grids
- Historical (Past)
  - 1951-2010 60 years
  - 50 ensemble members
- Future
  - 2051-2110 60 years
  - 15 ensemble members @SST pattern
  - 6 SST(CC, GF, HA, MI, MR, MP)

Structure of used data

99 grids

50 ens.

15 ens.
15 ens.
15 ens.
15 ens.
15 ens.
15 ens.

Ens_1: $AMS_1, AMS_2, AMS_3, ,, AMS_{60}$
Ens_2: $AMS_1, AMS_2, AMS_3, ,, AMS_{60}$
Ens_3: $AMS_1, AMS_2, AMS_3, ,, AMS_{60}$

Ens_{50}: $AMS_1, AMS_2, AMS_3, ,, AMS_{60}$
climate normals from 60 AMS

for 1day, 2day and 3 day precipitation

Block Size Issue

in estimating 100 year return level

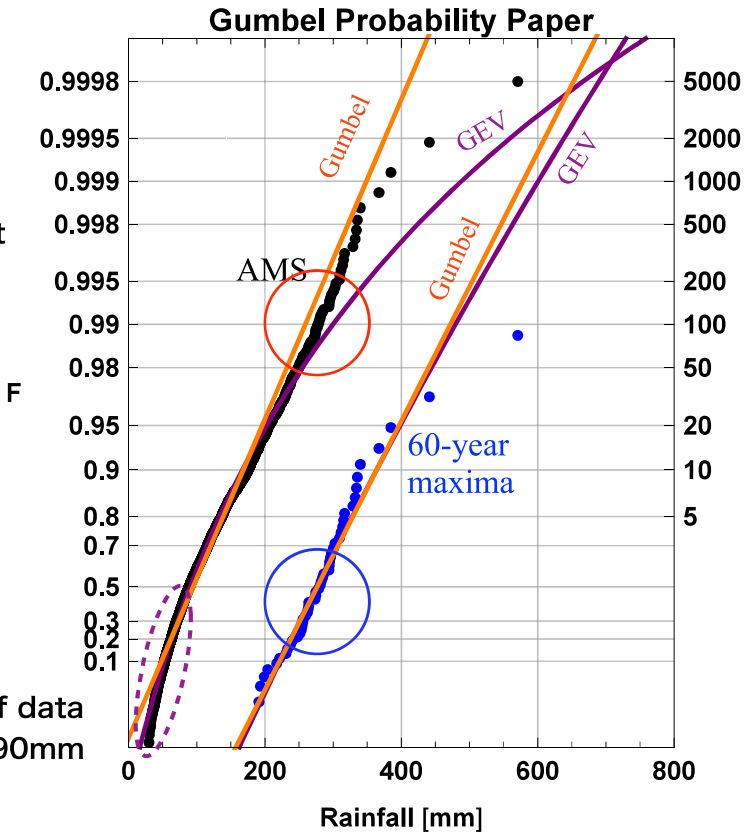
Using AMS

discrepancy between probability plot and Gumbel & GEV fit

Using 60-year maxima

agreement between probability plot and Gumbel & GEV fit

more than half data are less than 90mm



Gumbel distribution

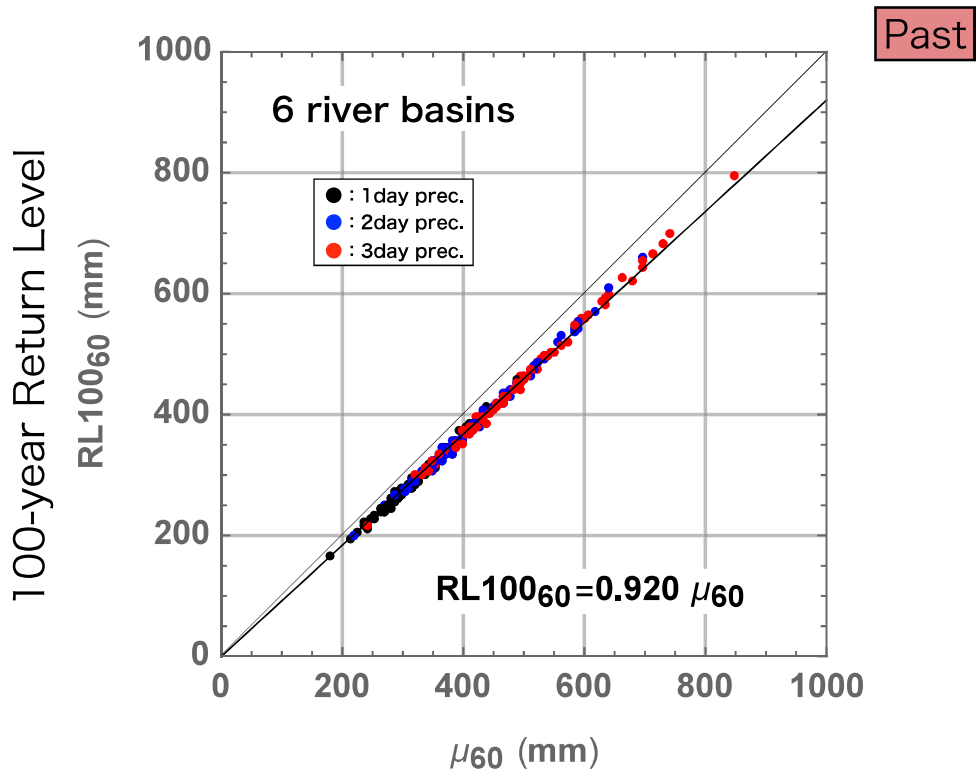
$$F(x) = \exp\left\{-\exp\left(-\frac{x-\xi}{\alpha}\right)\right\}$$

$$\begin{cases} \sigma^2 = \dfrac{\pi^2\alpha^2}{6} \\ \mu = 0.5772\,\alpha + \xi \end{cases} \quad \Rightarrow \quad \alpha = \frac{\sqrt{6}}{\pi}\sigma \ , \ \xi = \mu - 0.5772\alpha$$

$$x = \xi - \alpha \ \ln\left(-\ln F\right)$$

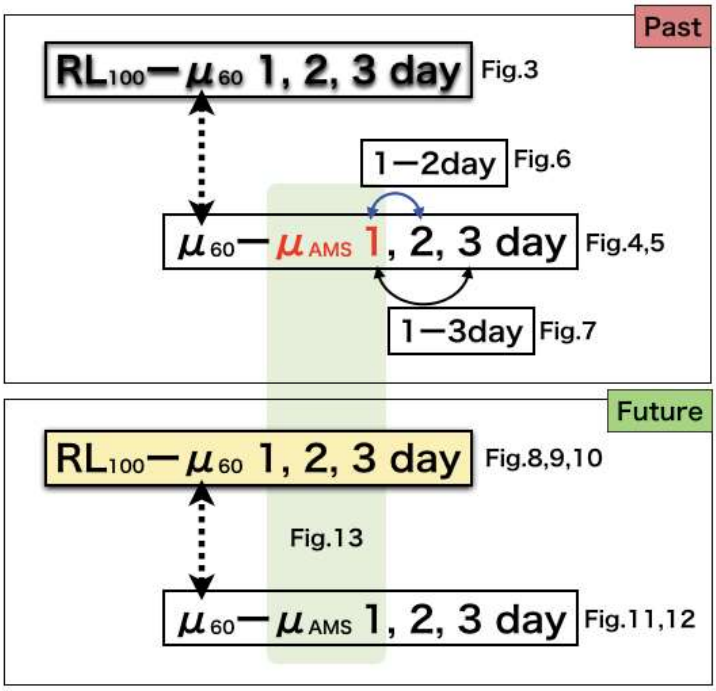
Basic statistics are important when Gumbel distribution is used.

Fig.3 Relationship between 100-year Return Level and Ensemble Mean of 60-year Maxima at 6 River Basins



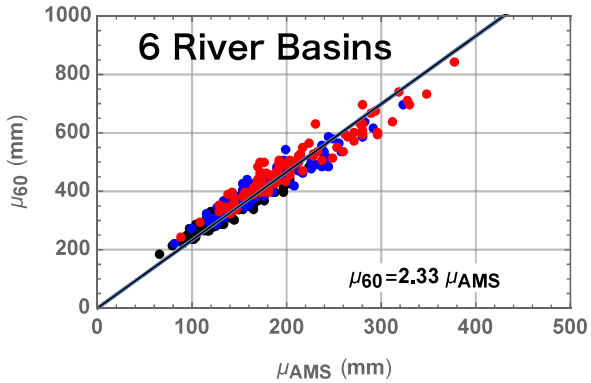
Generally, we use AMS for frequency analysis.
So, we need translation tool from AMS to 60-year maxima.

Fig.14



μ60 : μAMS

Fig.4



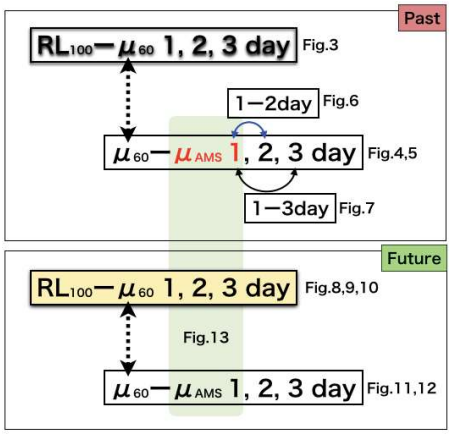


Fig.5

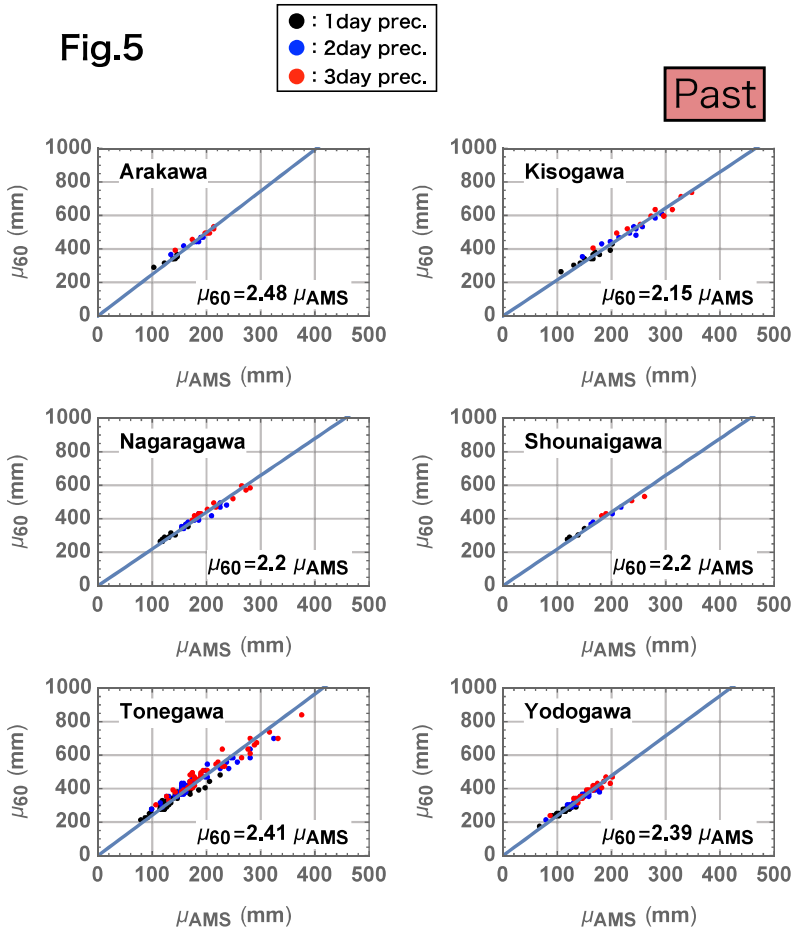


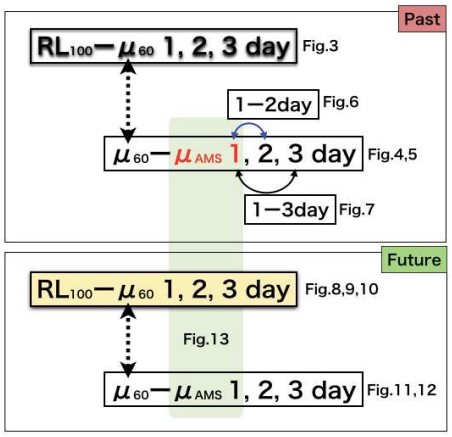
Fig.6 Relationship between Ensemble Mean of 2-day and daily Annual Maximum Precipitation at each River Basin

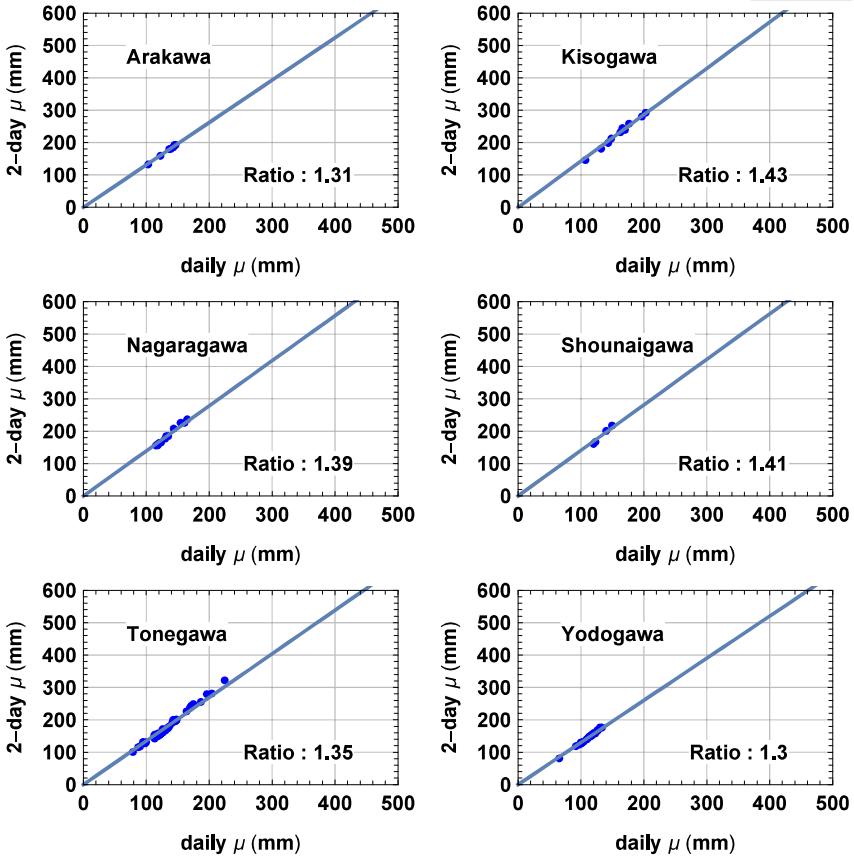
Fig. Title should be corrected!

Fig.6

Past

We can get ensemble mean of 2-day prec. from that of daily prep.





RL100 : μ60

Fig.8

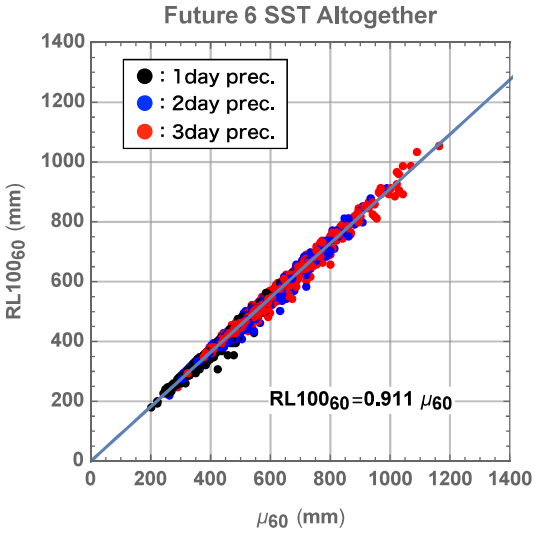
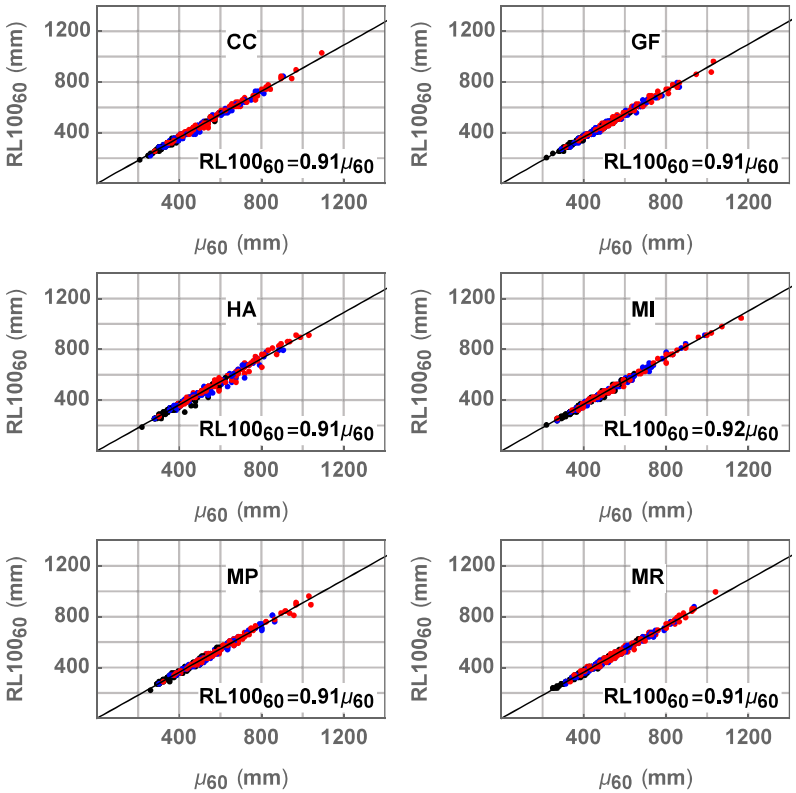


Fig.9 Future 6 river basin

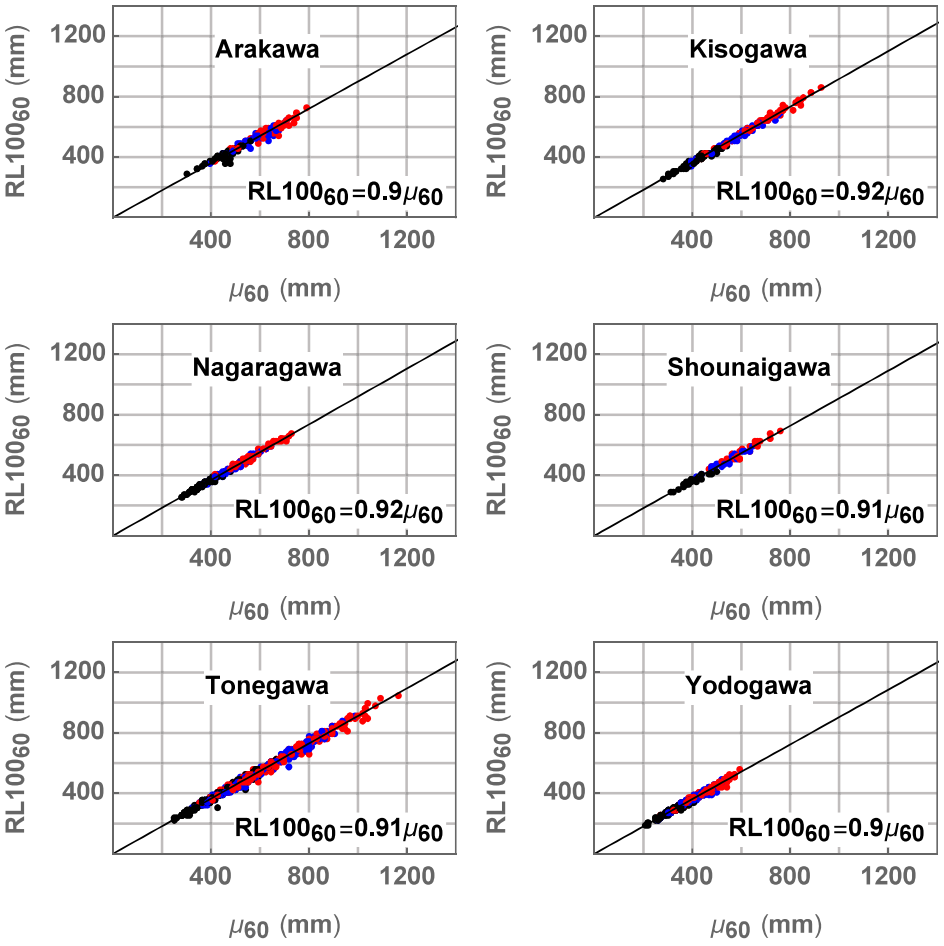


RL_{100} : μ_{60}

Fig.10

Future

all SST pattern



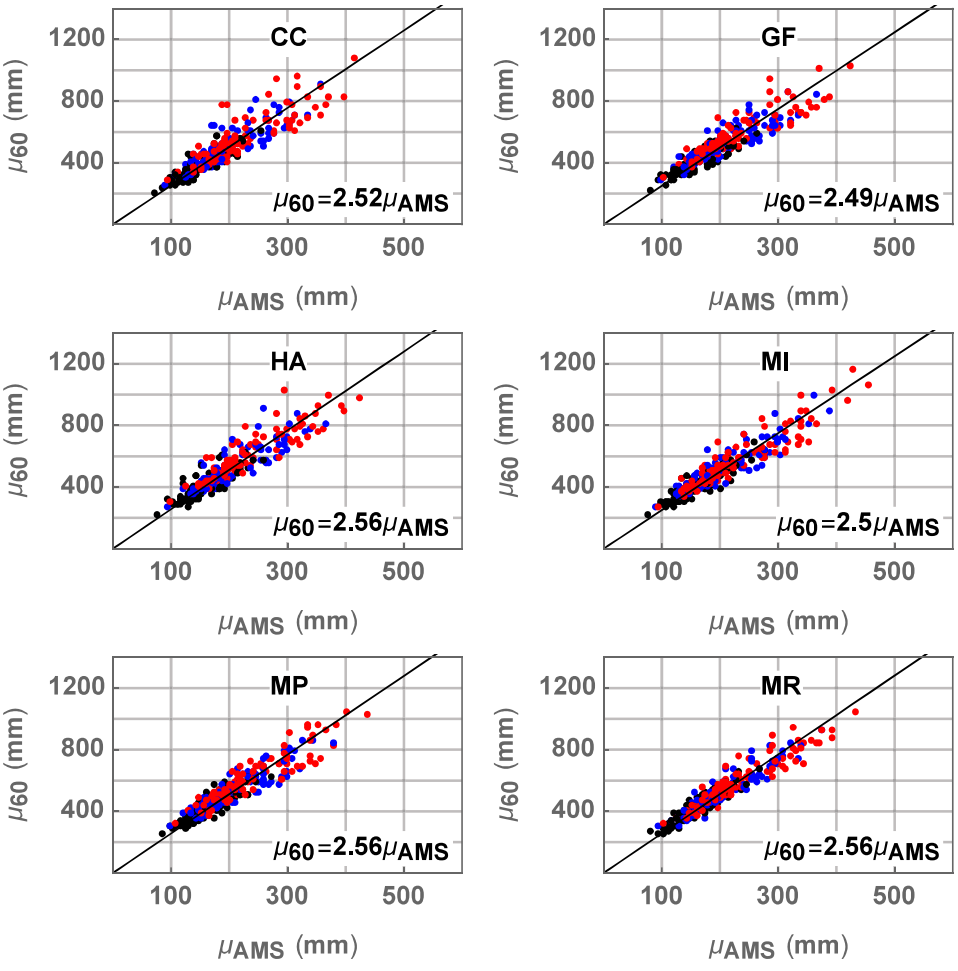
● : 1day prec.
● : 2day prec.
● : 3day prec.

μ_{60} : μ_{AMS}

Fig.11

Future

6 river basin



● : 1day prec.
● : 2day prec.
● : 3day prec.

μ_{60} : μ_{AMS}

● : 1day prec.
● : 2day prec.
● : 3day prec.

Fig.5 Past

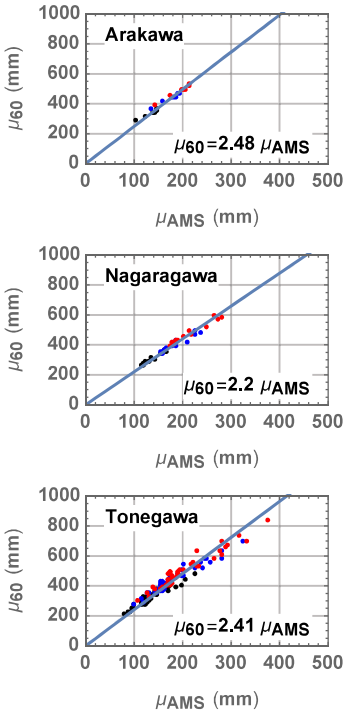
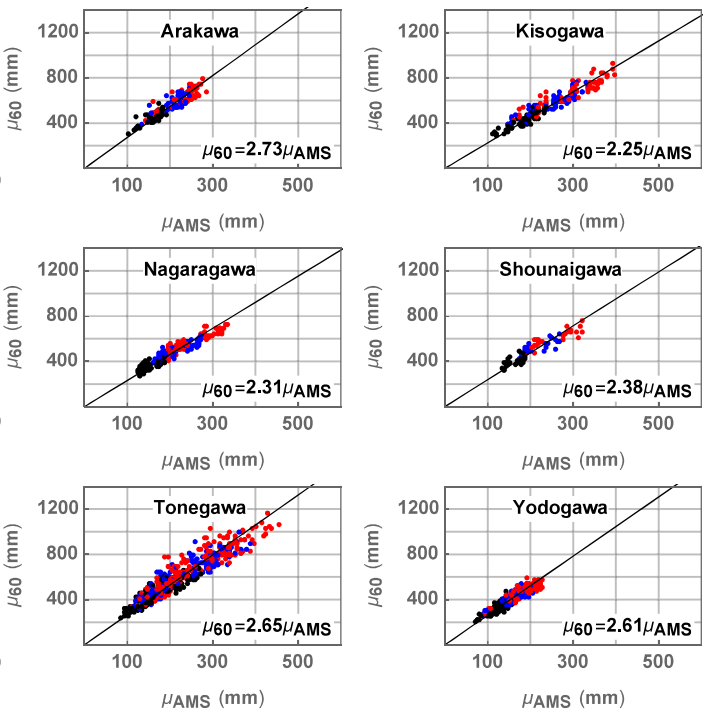


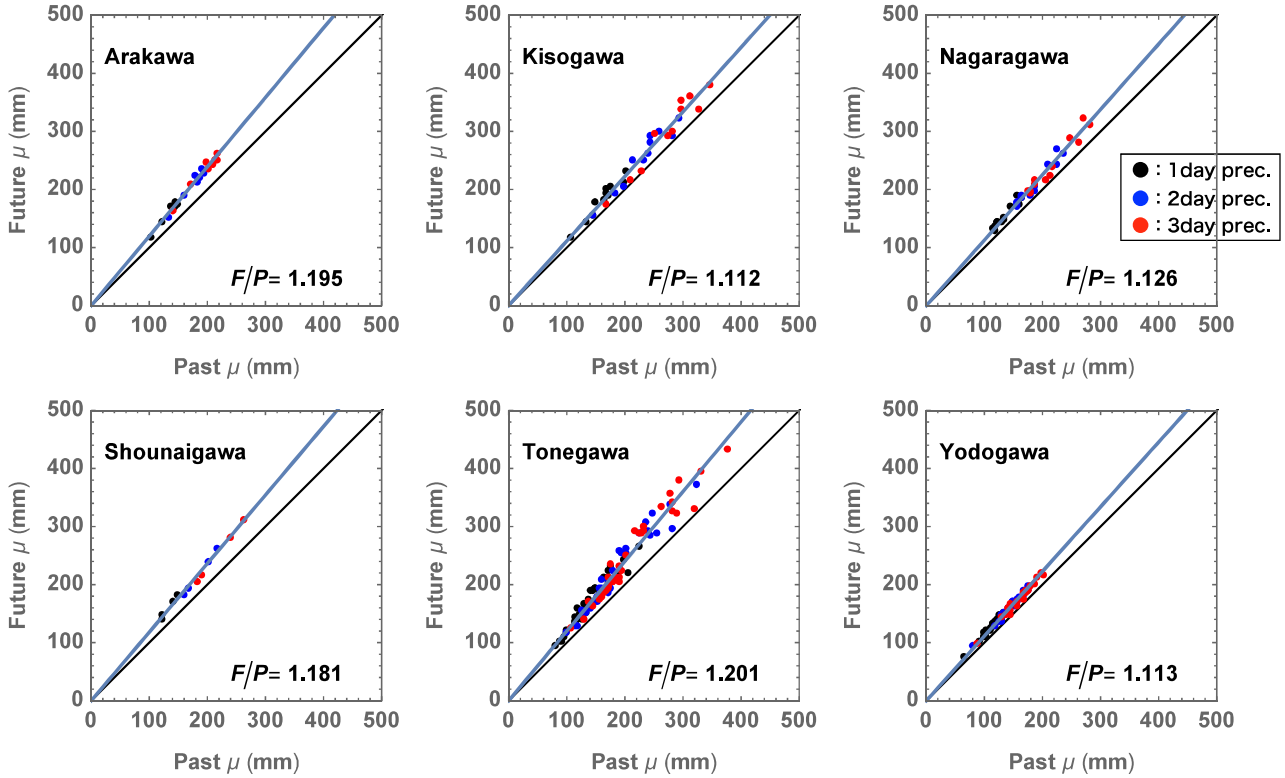
Fig.12 Future all SST pattern



μ_{AMS_F} : μ_{AMS_P}

all SST pattern

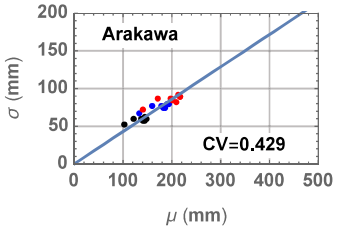
Fig.13 Future vs Past

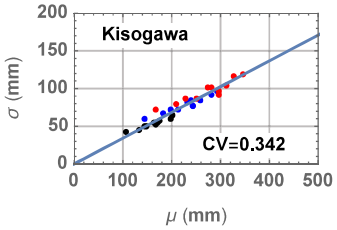


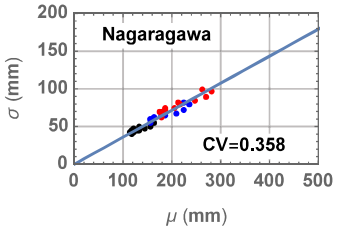
CV change

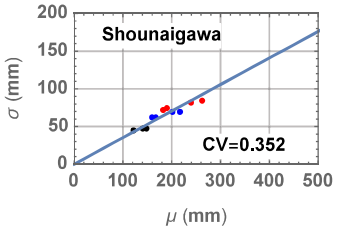
Past **AMS** Future all SST pattern

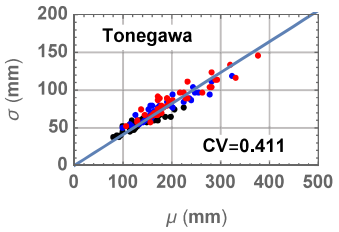
6 RB all : CV=0.389

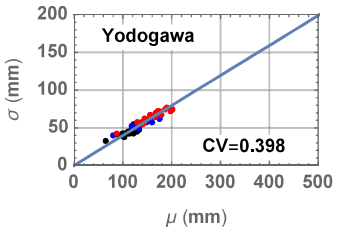




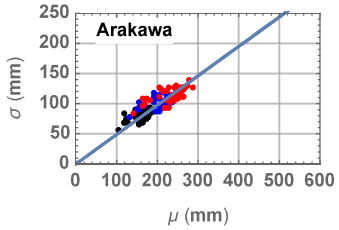


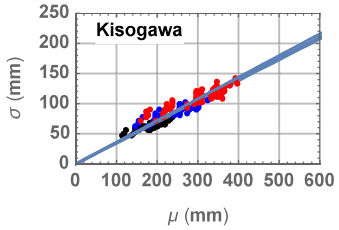


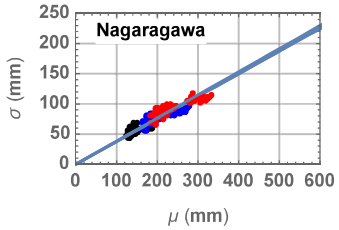


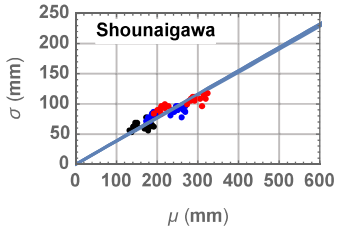


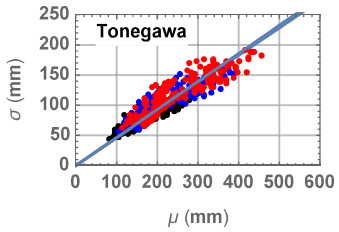
6 RB all : CV=0.429

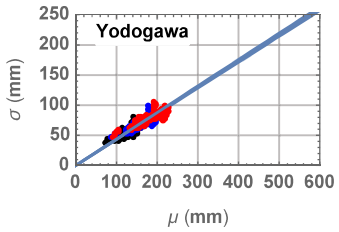






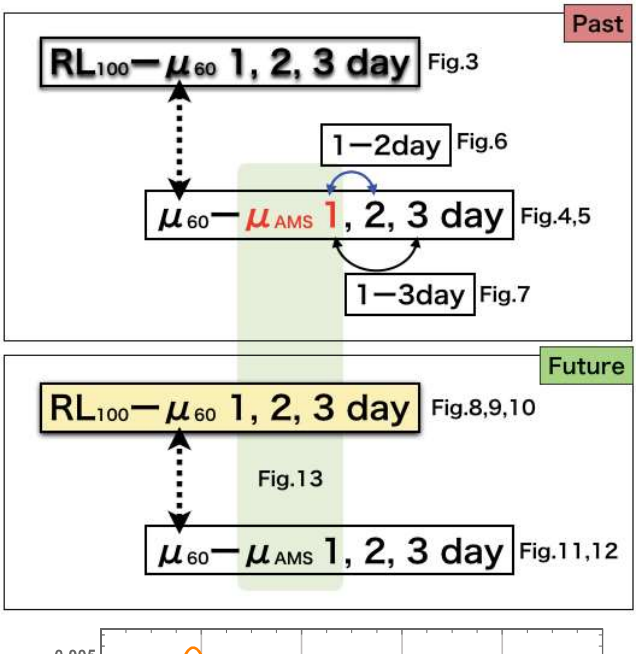


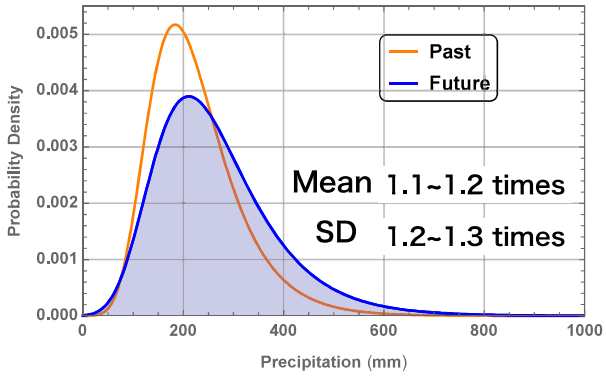




Conclusion

- RL_{100} are almost proportional to μ_{60} regardless duration and locations.(Fig.3,8,9,10)
- It is necessary to prepare relationship between μ_{60} and μ_{AMS} for each duration and location.(Fig.4,5,11,12)
- Future to Past ratio of Ensemble mean of AMS are 1.1~1.3 depending on RB (Fig.13)
- Future PDF will shift larger and become wider distribution than Past





統合的気候モデル高度化研究プログラム
Integrated Research Program for Advancing Climate Models (TOUGOU)

d4PDF

μ-σ relationships

Past

- μ-σ relationships are linear for each river basin regardless of duration.
- CV value varies from river basins.