Exploring the uncertainty of Weather Generators' extreme estimates associated with the length of the input data series

By:

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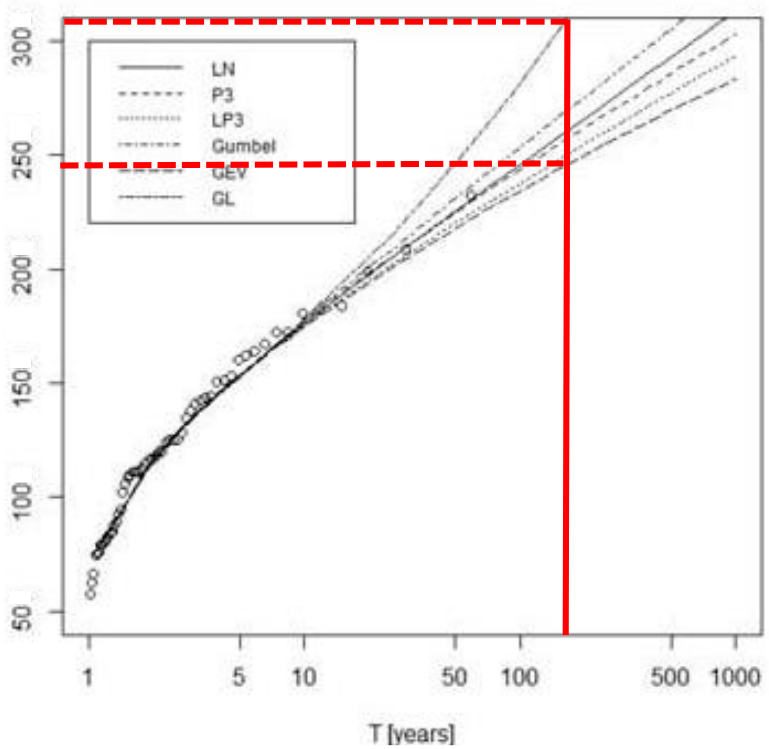
Introduction

- **Stochastic Weather Generators (WGs)**
  - Plan and manage natural resources
  - Climate Downscaling
  - Hydrological Modeling
  - Etc..

Produce synthetic time series of weather data of unlimited length for a location based on the statistical characteristics of observed weather at that location (*IPCC*)

- Therefore, strongly dependent upon the "quality" of the observed weather



Short available precipitation records

High Uncertainty for extreme estimates

Extra information

Beneyto et al. (2020)

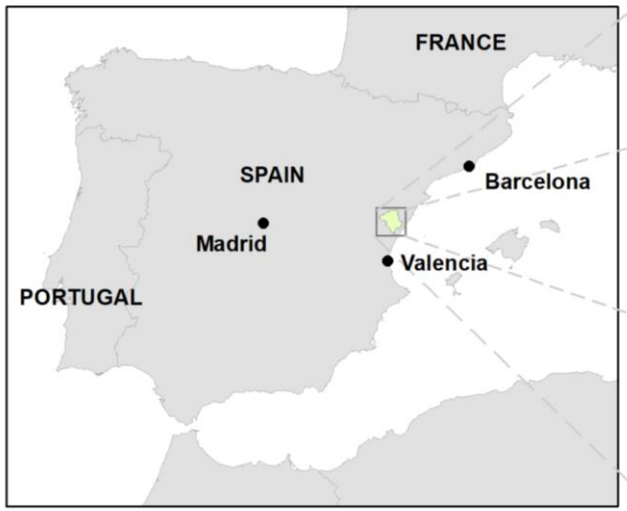
Objective

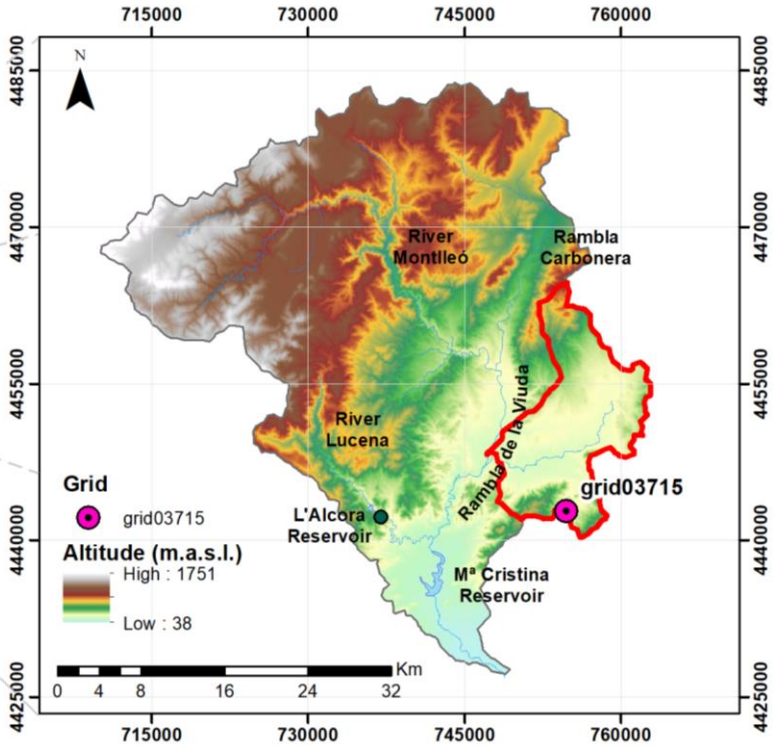
Estimate the uncertainty of WGs' extreme P_d estimates introduced by the sample length and the existence of a Regional Study through the analysis of the RRMSE, CV and the RB of a population and their estimated P_d quantiles

- Relative Root Mean Squared Error (RRMSE)
- Relative bias (RB)
- Coefficient of Variation (CV)

Case study: study area

- **Barranc de Cabanes**: ephemeral river
- 1 Pluviometer from Spain02-v5 (1950-2015) (*Herrera et al., 2016*)
- Semi-arid Mediterranean climate
- Annual mean prec.: 570 mm
- High precipitation variability
- >75% of dry days
- <u>High torrentiality</u>





Case study: Weather Generator

- **GWEX** *(Evin et al., 2018)*
  - Multisite Weather Generator focused on extreme events
  - Precipitation amounts: Extended Generalized Pareto Distribution (E-GPD) (*Papastathopoulos and Tawn, 2013*)
  - 3-day aggregation → Daily precipitation (Method of Fragments)

$$F(x;\lambda) = \left[1 - \left(1 + \frac{\xi x}{\sigma}\right)^{-1/\xi}\right]^{\kappa}$$

$\sigma \rightarrow$ Scale Parameter

$\kappa \rightarrow$ Transf. Parameter

$\xi \rightarrow$ Shape Parameter

(ξ directly affecting the right tail)

Methodology

One pluviometer
66 yrs of precipitation records

GWEX
{σ, κ} -> Obs.
ξ -> 0.11

15,000 yrs synthetic precipitation

Monte Carlo Simulation
- 50 Simulations
- Sample lengths: 30, 60, 90, 120,150, 200 and 300yrs

For each package

ξ -> set to 0.05 (Unknown)

ξ -> set to 0.11 (Known)

ξ -> Regional study (Q_{100} fit)

GWEX
{σ, κ} -> Obs.

$$RRMSE(\hat{X}_T) = \frac{\sqrt{1/n \sum(\hat{X}_{T,i} - X_T)^2}}{X_T}$$

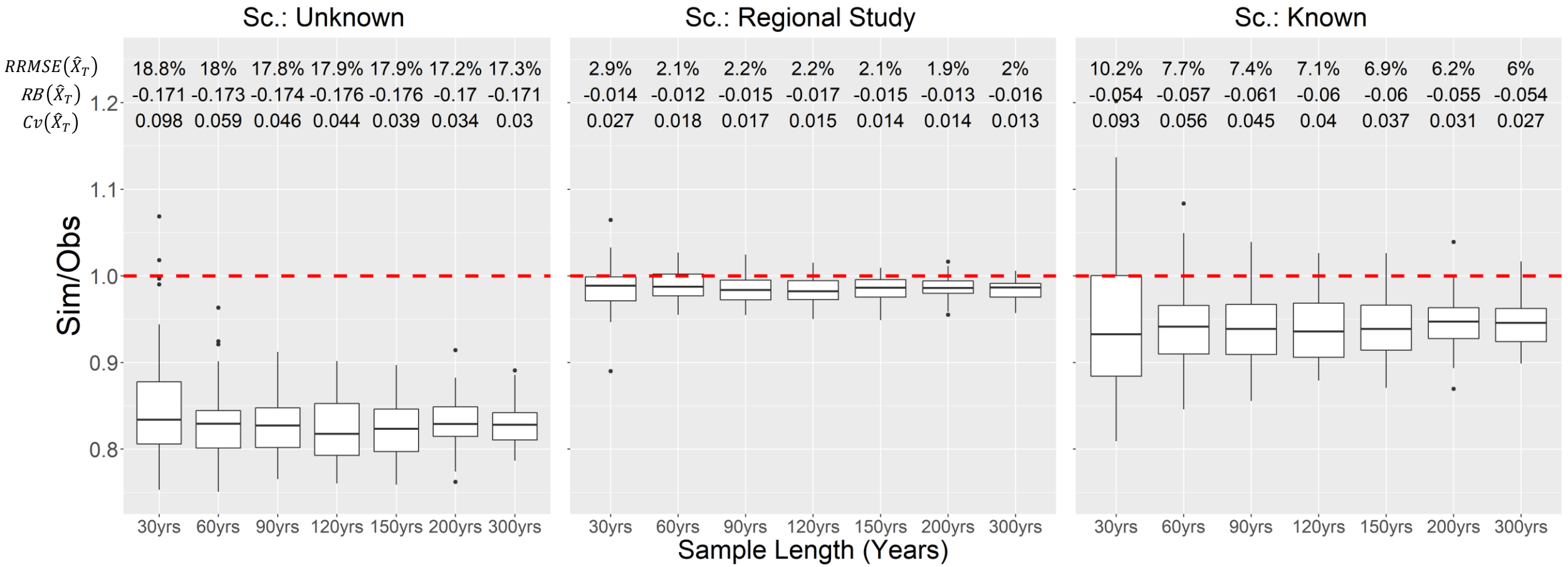
$$RB(\hat{X}_T) = \frac{1/n \sum(\hat{X}_{T,i} - X_T)}{X_T}$$

$$Cv(\hat{X}_T) = \frac{\sqrt{1/n \sum(\hat{X}_{T,i} - \overline{X_T})^2}}{\overline{X_T}}$$

T	Prec (mm)	T	Prec (mm)
T = 2 yrs	55.7	T = 2 yrs	53.2
T = 5 yrs	81.3	T = 5 yrs	78.2
T = 10 yrs	100.7	T = 10 yrs	105.2
T = 25 yrs	125.8	T = 25 yrs	126.4
T = 50 yrs	146.7	T = 50 yrs	151.3
T = 75 yrs	158.8	T = 75 yrs	160.8
T = 100 yrs	168.4	T = 100 yrs	165.6
T = 200 yrs	192.0	T = 200 yrs	198.9
T = 500 yrs	238.1	T = 500 yrs	235.1
T = 1,000 yrs	262.8	T = 1,000 yrs	254.6

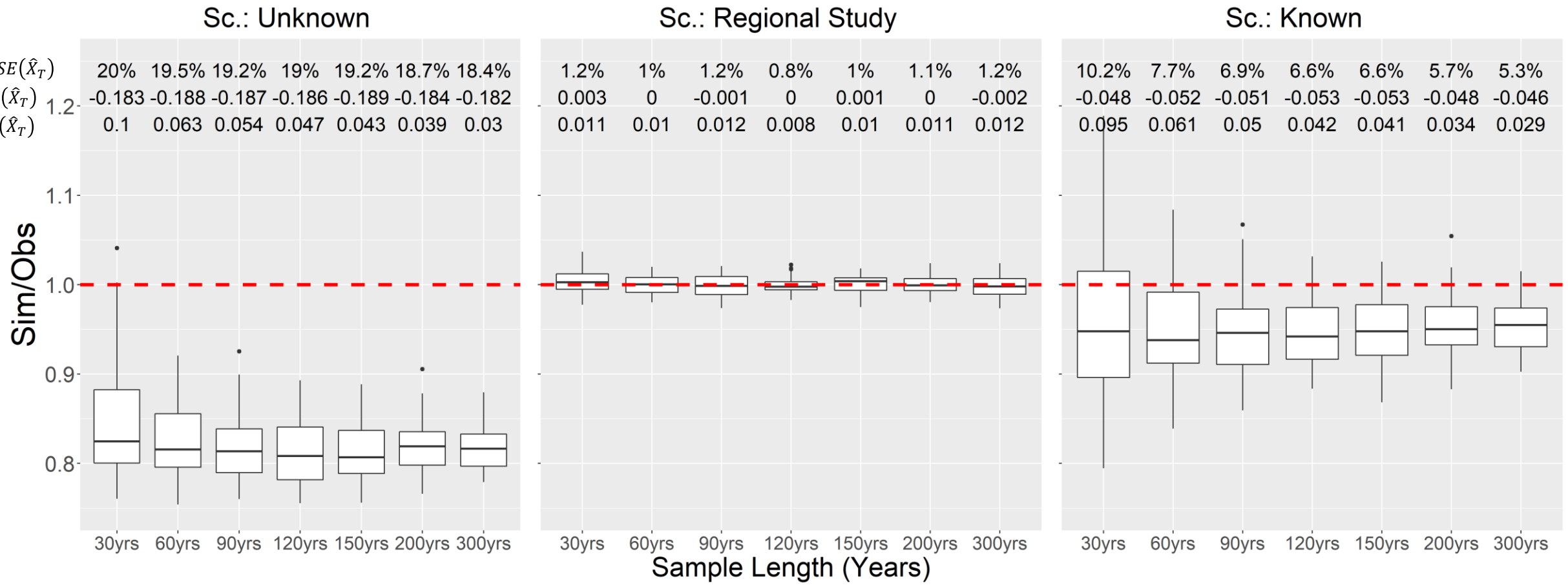
Results

T = 50 years



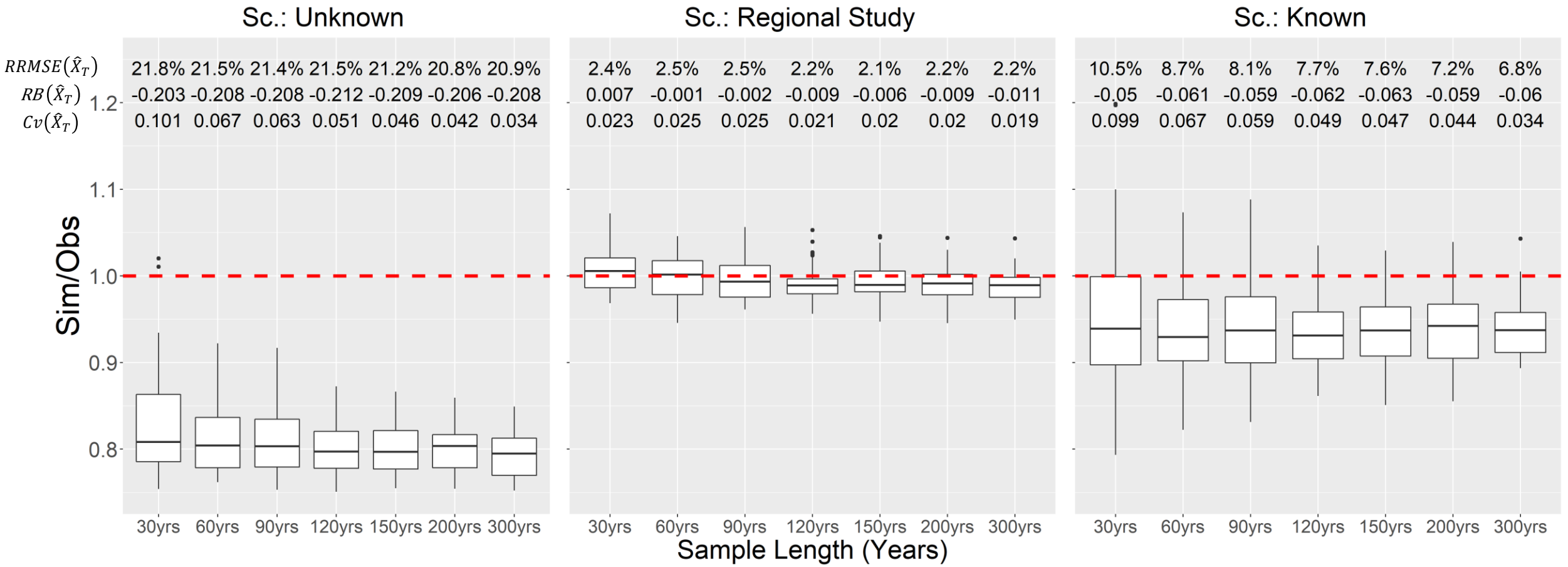
Results

T = 100 years (regional study fit)



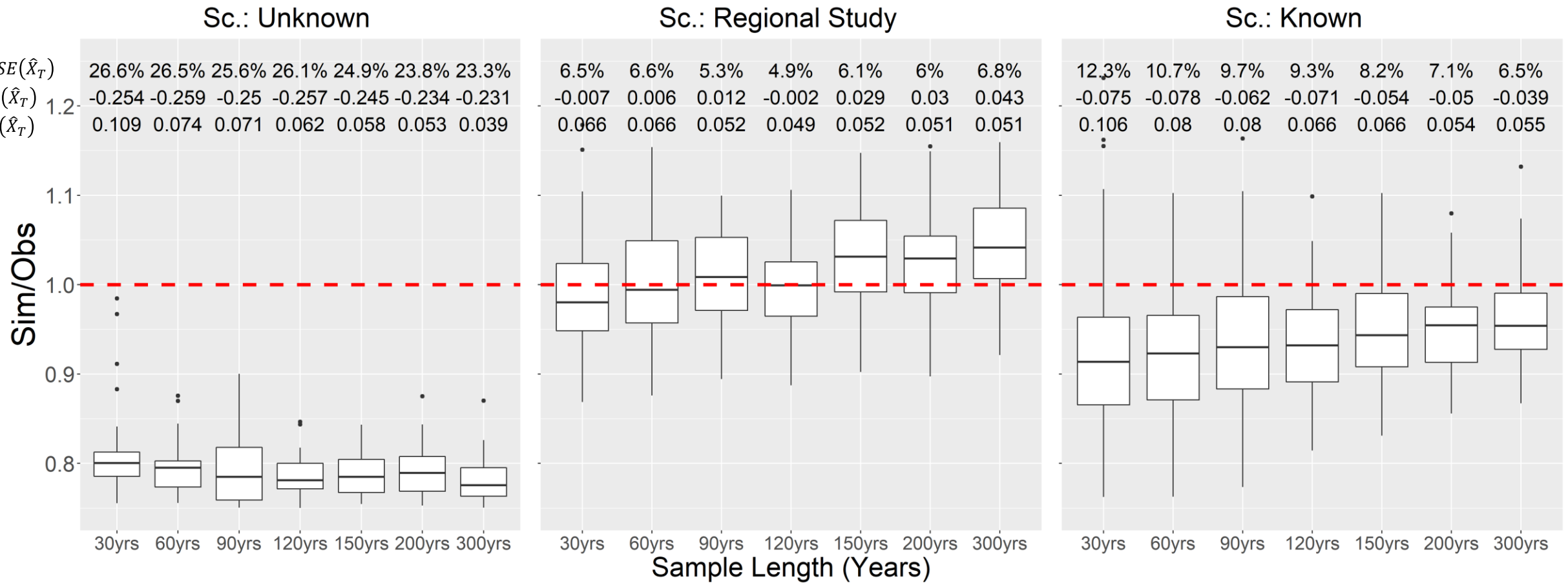
Results

T = 200 years



Results

T = 500 years



Conclusions

- CV decreases with the sample length
- However, both RRMSE and RB do not significantly change with the sample length, which means that:
  - **The incorporation of a Regional Study for the implementation of a Weather Generator adds more information than a larger sample length and, therefore, reduce the uncertainty of the extremes estimates**
- Moreover, knowing information of just one quantile (e.g. Q_{100}), it is possible to obtain satisfactory estimates for the higher quantiles

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Thanks for your attention!

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This study has been supported by the Ministry of Science, Innovation and Universities of Spain through the Research Projects TETISCHANGE (RTI2018-093717-B-100).