3rd International Electronic Conference on Water Sciences (ECWS-3)

EFFECTS OF KEY PROPERTIES OF RAINFALL SERIES ON HYDROLOGIC DESIGN OF SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS)

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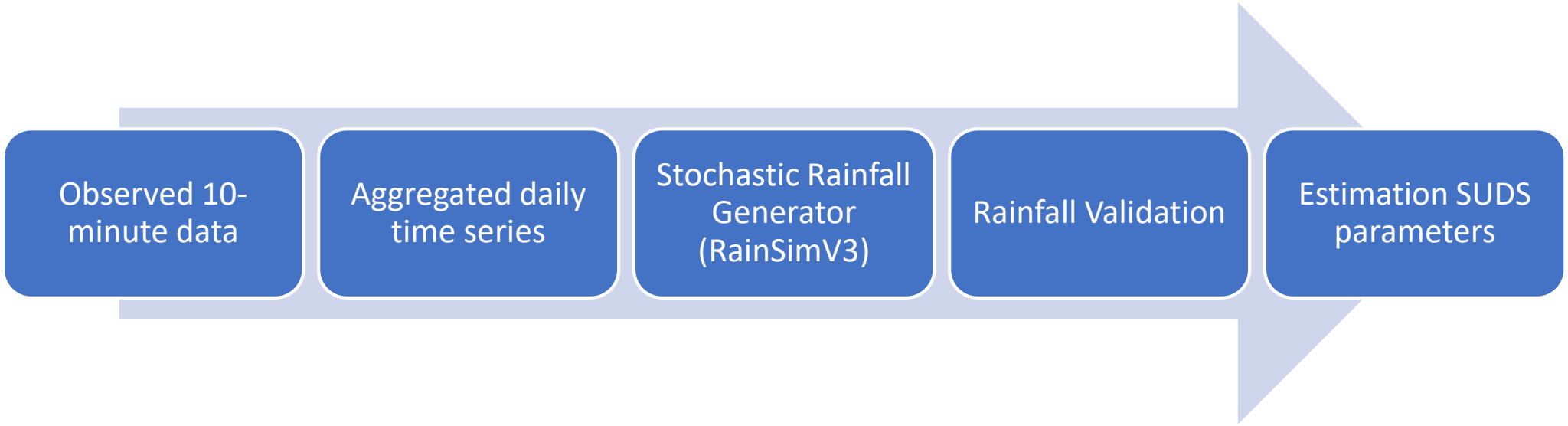
Introduction

- Human activity on the basins induced changes on the hydrological characteristics
- The design and implementation of sustainable urban drainage systems (SUDS) could contribute to mitigate this problem.
- The small size of the urban watersheds and short response time, make it necessary to consider the rainfall series at a sub-hourly time-step
- Different downscaling methodologies have been widely studied for urban applications but their application to SUDS design was not fully developed.

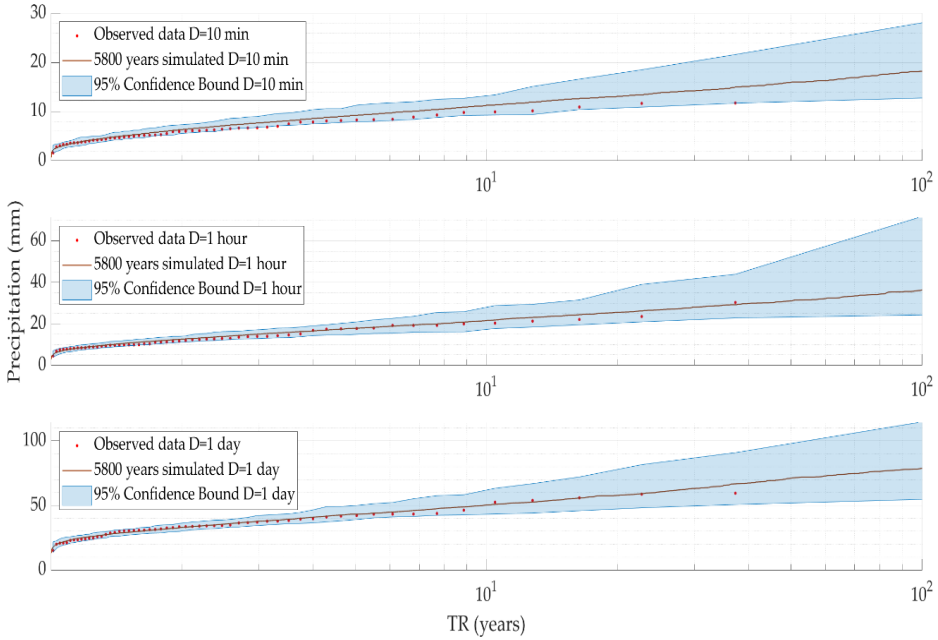
Materials and Methods

- 58 years of observed data (10-minute time step, from 1941 To 1998) from the Madrid Retiro gauge station.
- Stochastic rainfall at 10-minute time step.
- SUDS design parameters from the observed 10-minute rainfall series and from the stochastic series.



Results and Discussion

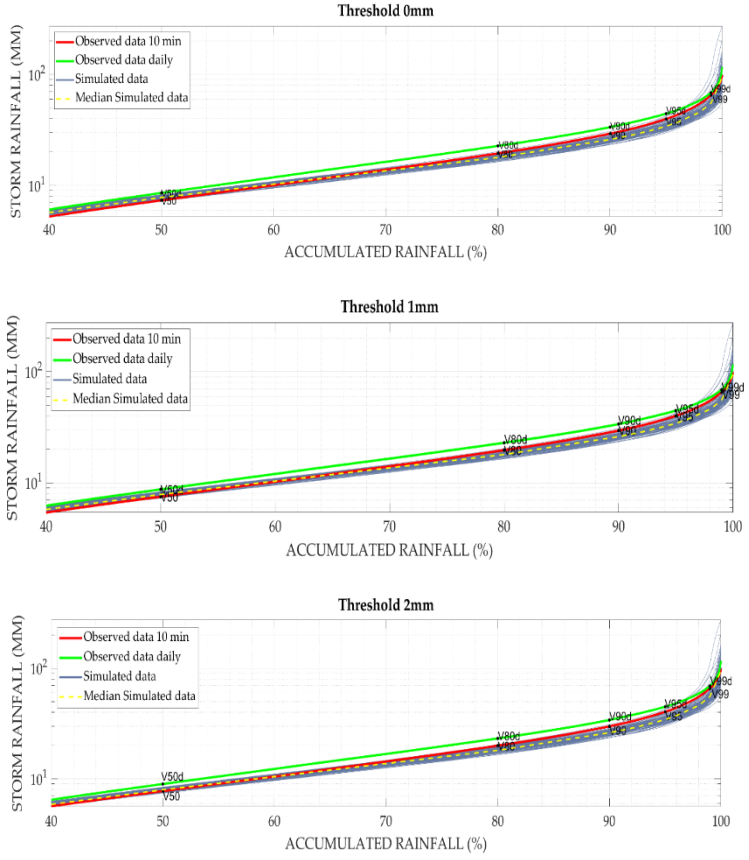
Rainfall frequency curves



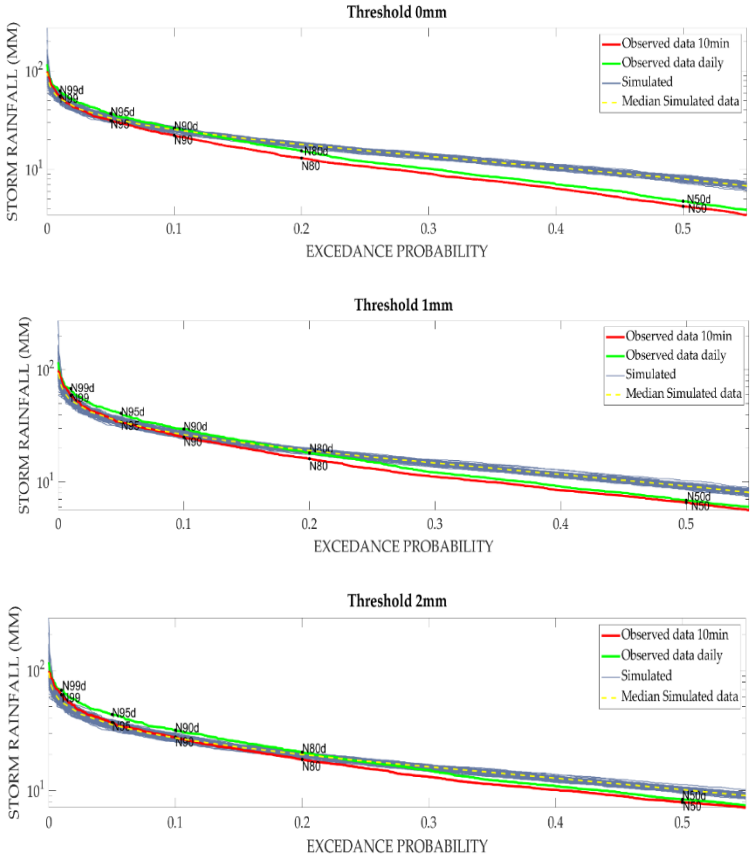
Comparison of IDF curves

	Observed IDF curves				Simulated IDF curves				AEMET (2003)				Casas-Castillo et al. (2016)				5.2-IC Retiro (MAXPLU)			
Dur/Tr	2	5	10	15	2	5	10	15	2	5	10	15	2	5	10	15	2	5	10	15
10	35.6	49.8	59.6	65.5	37.8	55.2	67.8	74.4	34.0	52.0	65.0	71.3	38.6	55.5	68.3	75.7	35.7	47.6	55.2	59.6
20	23.7	37.0	45.1	49.3	27.3	40.5	50.7	56.4	26.0	38.0	48.0	52.3	25.5	36.6	45.0	49.9	25.2	33.6	38.9	42.0
30	19.1	27.7	37.3	38.2	20.6	30.0	37.2	41.8	20.0	30.0	38.0	41.7	19.6	28.1	34.6	38.4	20.3	27.1	31.4	33.8
60	11.6	17.7	20.3	22.0	12.6	17.8	21.5	23.9	12.5	18.0	22.2	24.1	12.2	17.5	21.6	23.9	13.8	18.3	21.3	22.9
120	7.5	10.7	12.8	16.1	7.1	10.0	12.2	13.5	7.9	10.9	13.0	14.0	7.5	10.8	13.2	14.7	9.1	12.1	14.0	15.1
360	3.8	4.8	5.3	6.0	3.3	4.4	5.1	5.5	3.8	5.0	5.9	6.3	3.4	4.9	6.0	6.7	4.4	5.8	6.8	7.3
720	2.3	3.0	3.3	3.5	2.2	2.8	3.3	3.6	2.4	3.1	3.6	3.8	2.1	3.0	3.6	4.0	2.7	3.5	4.1	4.4
1440	1.4	1.8	2.2	2.3	1.4	1.8	2.1	2.3	1.5	1.9	2.2	2.3	1.2	1.8	2.2	2.4	1.6	2.1	2.4	2.6

SUDS parameters based on rainfall event volumes



SUDS parameters based on the number of rainfall events



Conclusions

- For the case study analyzed, the stochastic approach generates 10-minute rainfall series with IDF curves and rainfall frequency curves similar to observed data.
- The proposed approach allows the estimation of very useful rainfall characteristics for SUDS design
- This approach allows to quantify the associated uncertainty of the values adopted to the design of SUDS.

Acknowledgements

We acknowledge the financial support of the “Programa propio: ayudas a proyectos de I+D de investigadores posdoctorales” of the Universidad Politécnica de Madrid and the AEMET support for providing the rainfall data. The authors also acknowledge the funds from the Universidad Politécnica de Madrid in the framework of their Program “Ayudas para contratos predoctorales para la realización del doctorado en sus escuelas, facultad, centro e institutos de I+D+i” and the funds from Carlos Gonzalez Cruz Foundation.

Main References

Burton, A ; Kilsby, CG; Fowler, HJ; Cowpertwait, PSP; O'Connell, PE. RainSim: A spatial-temporal stochastic rainfall modelling system. Environ Modell Softw. 2008, 23, 1356-1369, 10.1016/j.envsoft.2008.04.003.

Cowpertwait, PSP. A spatial-temporal point process model with a continuous distribution of storm types. *Water Resour Res.* **2010**, *46*, 10.1029/2010WR009728.