Assessing the environmental impact of combined sewer overflows through a parametric study

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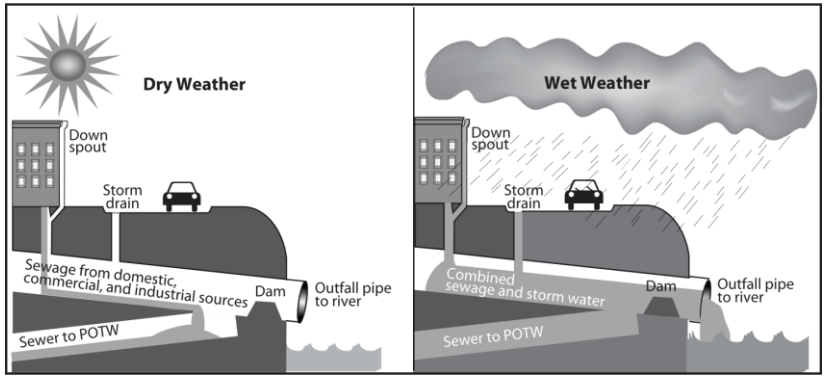
Introducing the problem



US EPA, 2004

Combined Sewer Overflows determine the **discharge** of polluted water into water bodies when

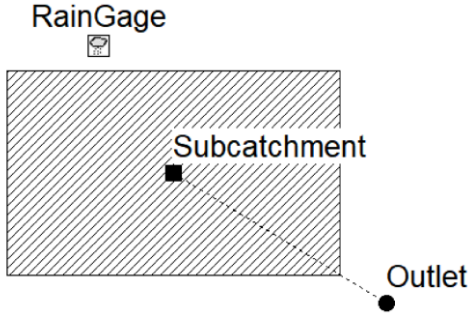
$$Q > \sim c \cdot Q_{mw}$$

Q	wastewater + stormwater discharge during wet weather
Q_{mw}	daily mean wastewater discharge during dry weather
c	dilution coefficient, often set equal to 5

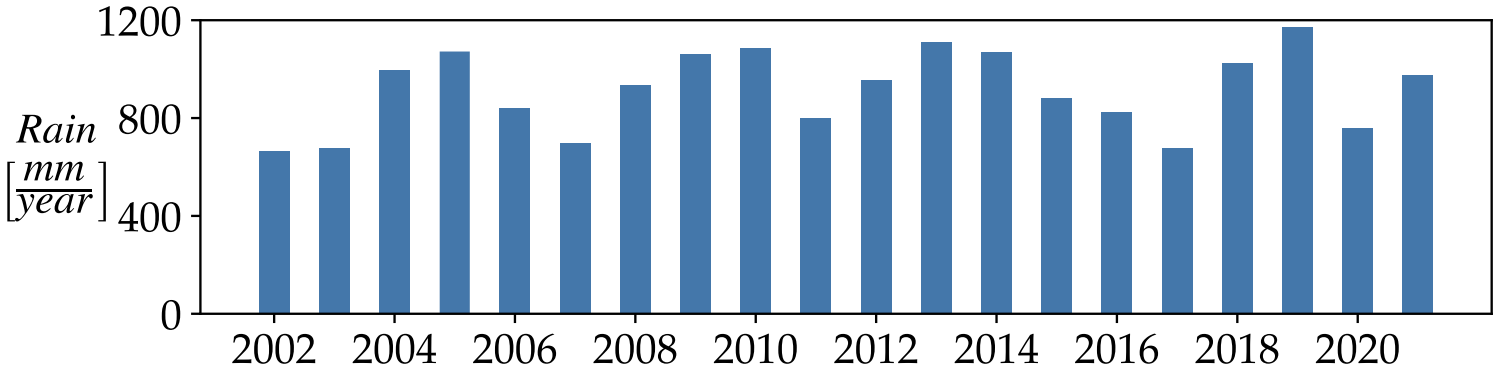
This approach does not consider
hydrological and water consumption characteristics of urban catchments.

Methodology of the study

A simplified urban catchment with $1\ km^2$ Area served as input model for **SWMM hydrological simulations**.



20 years of rainfall in Ercolano (Naples, Italy) served as input rain for the simulations. The data have a resolution of **10 minutes**.



Methodology of the study

Parameter	Values
Daily Water use per Capita $DWC\left[\frac{L}{p \cdot day}\right]$	$[100 \dots 500]$
Population Density $PD\left[\frac{p}{km^2}\right]$	$[1000 \dots 8000]$
Impervious surface $I[\%]$	$[10 \dots 80]$
Width $W[m]$	$[250 \dots 4000]$
Average Slope $S[\%]$	$[0.1 \dots 0.5]$
n Manning of impervious surfaces $n_{imp}\left[\frac{s}{m^{\frac{1}{3}}}\right]$	$[0.01 \dots 0.02]$
n Manning of pervious surfaces $n_p\left[\frac{s}{m^{\frac{1}{3}}}\right]$	$[0.03 \dots 0.08]$
Depression Storage of impervious surfaces $d_s[mm]$	$[0.5 \dots 2]$

$N = n^m$ simulations
$n = 6$ number of values per parameter
$m = 6$ number of independent parameters

$Q_{mw} = (\varphi \cdot PD \cdot DWC) \sim I$ was used to bind dependent parameters ($\varphi = 0.8$).

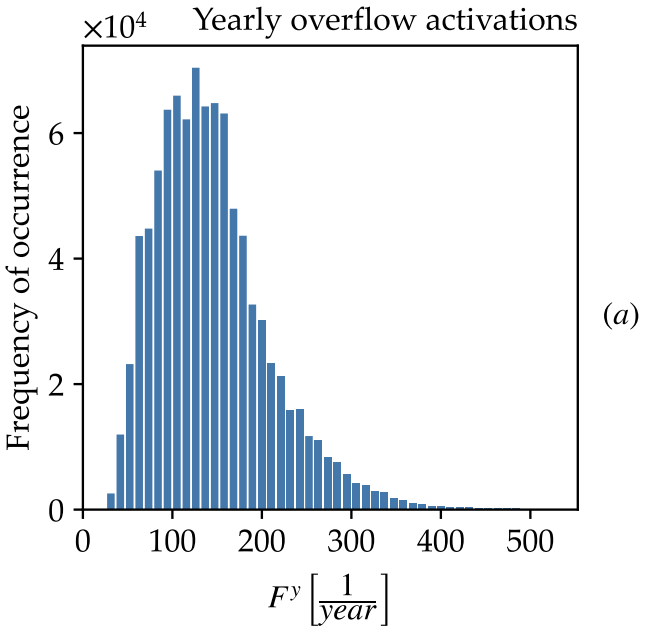
$c = 5$ was used as the dilution coefficient

EPA SWMM python **swmm-api 0.2.0.15**

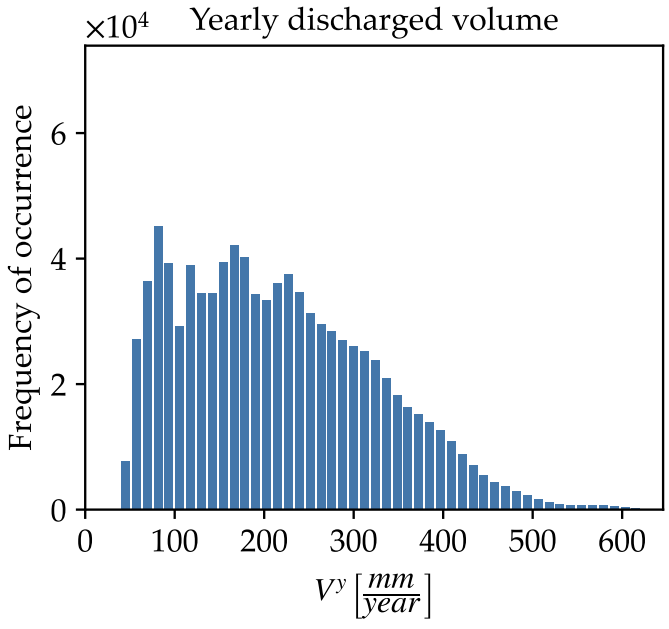
This software framework was set up to run $N = 46656$ hydrological simulations

Results

Yearly **Frequency** of overflow activations and yearly discharged **Volume** were investigated.



(a)

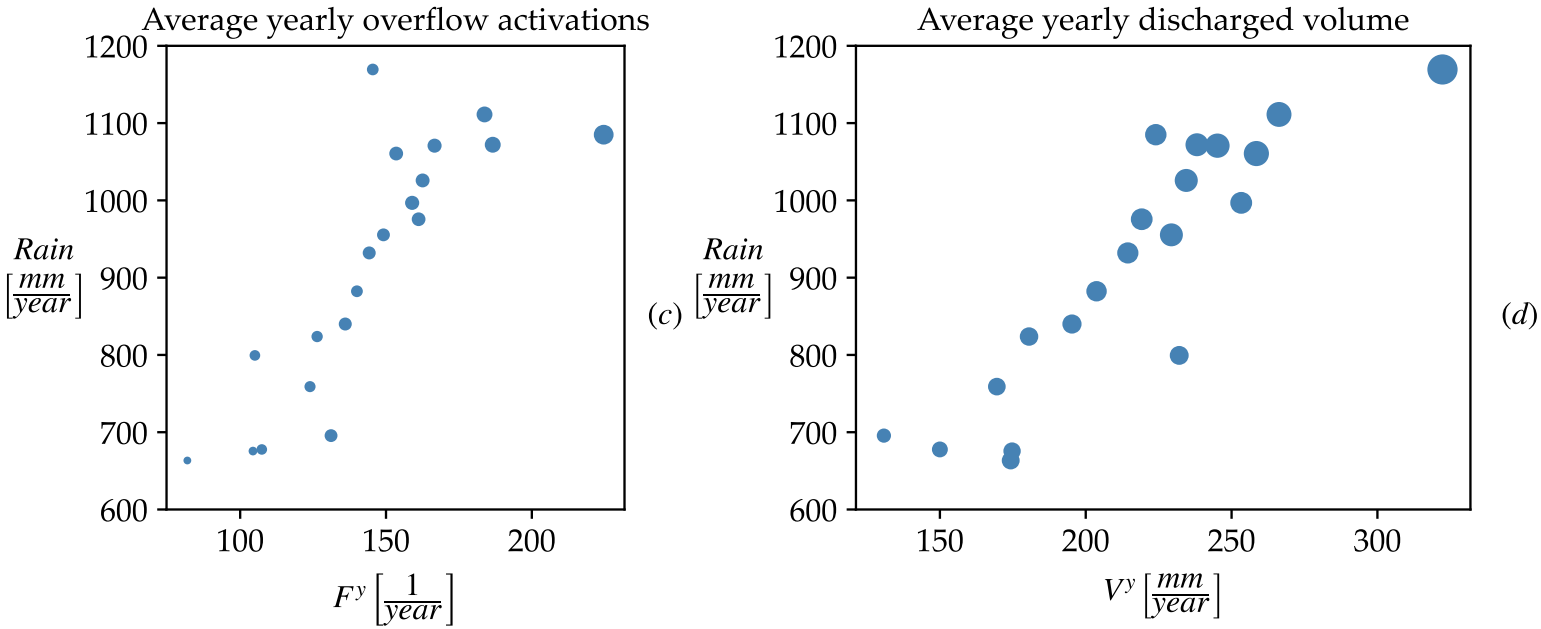


(b)

Frequency shows a more dense distribution of values compared to **Volumes**. High variations of both variables are explained by the **different hydrological and water demand parameters** of the urban catchment.

Results

Correlation between yearly **Frequency** and **Volume**, and yearly **Rain** was searched.



Frequency and Volume **values are averaged year by year** over all the hydrological and water demand different parameters of the urban catchment.
The size of the points is proportional to the **standard deviation**.

“Water is the driving force of all nature”

LEONARDO DA VINCI

Do you have any questions?

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