

Benchmarking Combined Sewer Overflows management in practice

Alma Schellart a.schellart@sheffield.ac.uk

28th May 2025 EWA/NWA Spring Seminar

Acknowledgement: Liz Sharp, Jean-Luc Bertrand-Krajewski, Jörg Rieckermann, Jose Anta, Ulrich Dittmer, Günter Gruber, Frank Blumensaat, Francois Clemens, Boud Verbeien, Luca Vezzaro, Marius Møller Rokstad, Franz Tscheikner-Gratl, Simon Tait, Henriette Jensen, James Shucksmith, Isabel Douterelo, Yiqi Wu, Carlo de Vito, Antonio Moreno Ródenas



Co-UDlabs



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008626



University of
Sheffield



Sheffield
Water Centre

Overview of presentation

- Challenges
- Investigation of Combined Sewer Overflow (CSO) regulation and its implementation in several European countries
 - Through discussions between experts from 10 areas
 - Through questionnaire sent to sewer operator
- Emerging experience with open CSO data, its potential for transparency & some pitfalls
- Geospatial analysis of CSO event duration monitoring data from England and Wales
- Discussion & Conclusions

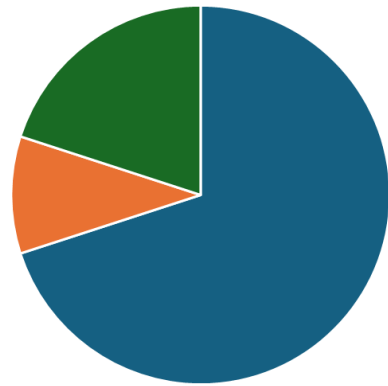


Challenges

- **Increasing scrutiny** of combined sewer overflows, changing legislation
- climate change, urban creep, ageing assets, emerging pollutants
- **Challenging Opportunities:** new sensing and data sharing developments, and **public interaction with open data**
- How much do we know about **practical implementation of regulation** around Combined Sewer Overflows (CSOs)?

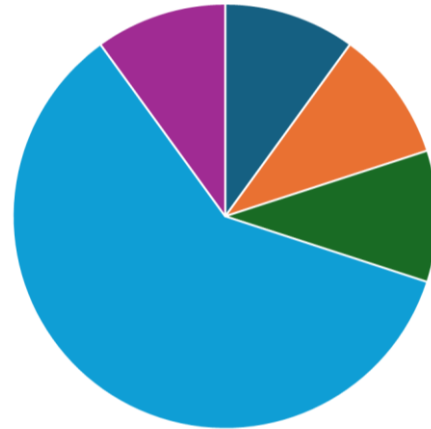
CSO data, regulation & compliance assessment, a comparison by 17 experts* for 10 European areas

How are existing CSO structures regulated?



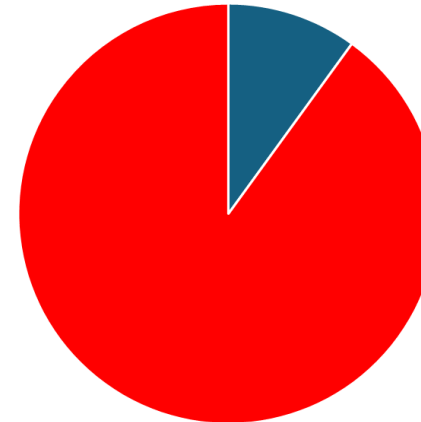
- Emission based
- Receiving water impact based
- Combination

How many CSO structures are currently monitored?



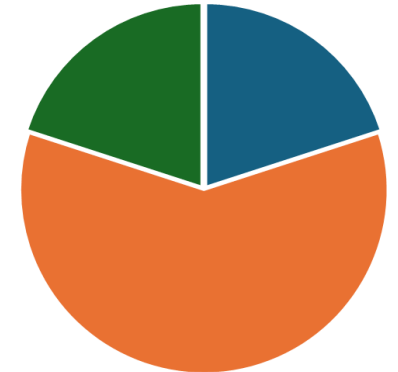
- Nearly all of them
- Most are simulated
- Upcoming
- unknown at national level
- Not widely done

Does assessing CSO compliance with data happen regularly?



- Yes
- No

What happens if illegal spills occur?



- Fines, if breaches established
- Investigation sometimes attempted (difficult)
- Nothing

Emission based: Spill frequency, or spill volume, or spill pollutant load

Receiving water impact based: concentration, duration, frequency of pollutants in rivers

(NB following the Water Framework directive, it *should* be a combination of emissions and impact)

* Experts were Co-UDlabs researchers and their contacts, did not aim to be complete, but to illustrate the complexity of this

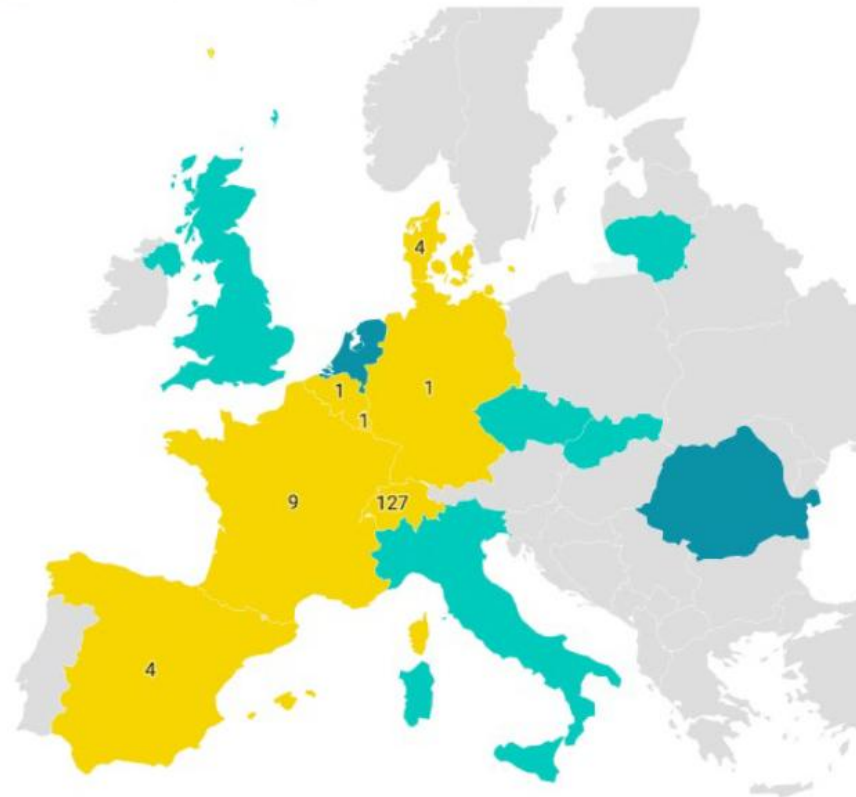
CoUDlabs Del. 6.4. Report on space distributed monitoring and data interpretation: <https://doi.org/10.5281/zenodo.14718051>

Journal manuscript under review

CSO data, regulation & performance assessment: Information from questionnaire to sewer operators

Reach of the Survey

■ complete response(s) available ■ partly filled questionnaire ■ link clicked



Questionnaire translated in 6 languages:
NOT straightforward, due to different regional contexts,
organisational & regulatory structures

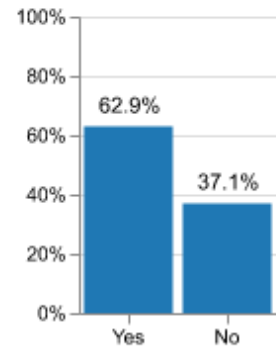
Questionnaire advertised during
International Conference Urban Drainage
Distributed by EWA
Distributed by Spanish, French & German wastewater
organisations

Couldn't statistically analyse results, e.g. Belgium, 1
response from Aquafin covers half the country vs 127
responses from Swiss operators

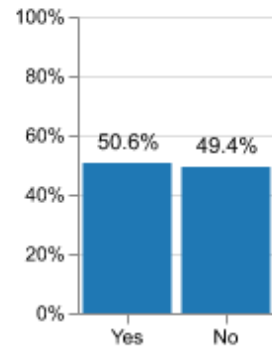
CSO data, regulation & performance assessment: Information from questionnaire to sewer operators

N = number of answers. Note that these answers were thus mostly from Swiss operators, but still very varied

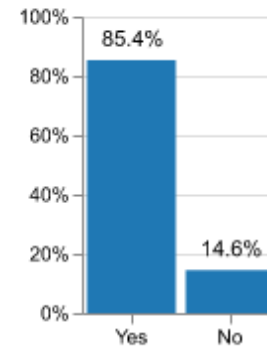
Is the legal basis available for performance monitoring of CSOs (law?)
N = 89



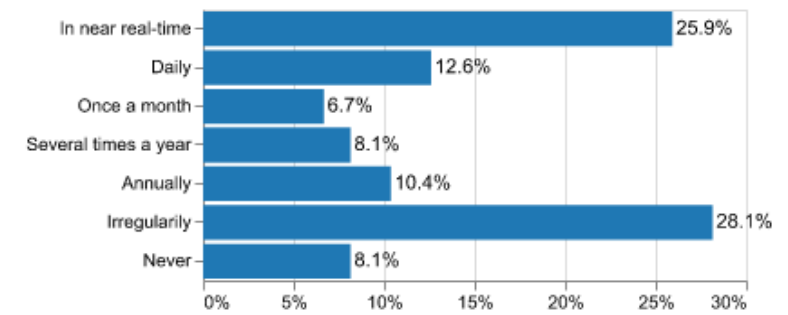
Is a legally binding implementing ordinance/ regulation available?
N = 83



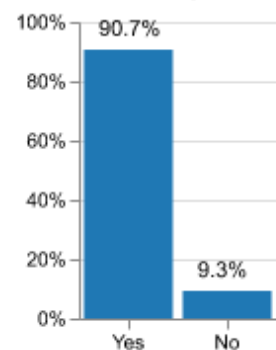
Are there technical standards and guidelines available?
N = 96



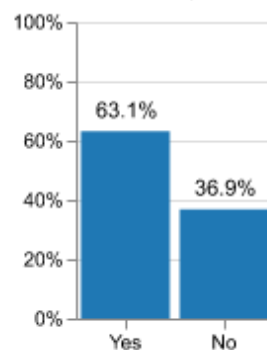
How often are the data evaluated for performance assessment?
N = 135



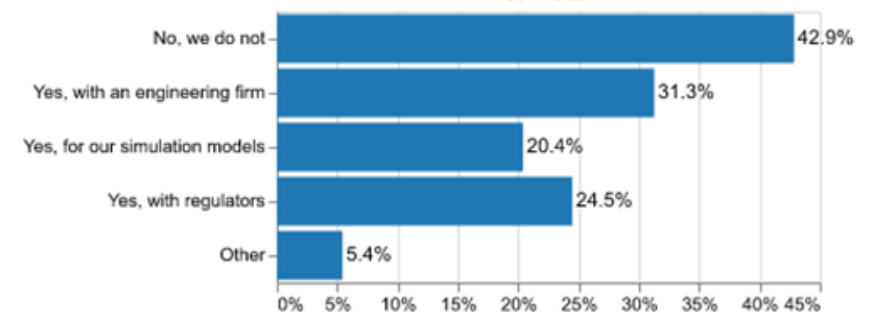
Are the existing regulations applied by the operator?
N = 97



Are the existing regulations enforced by all actors?
N = 84



Our organization shares the water level data with third parties ...
N = 147



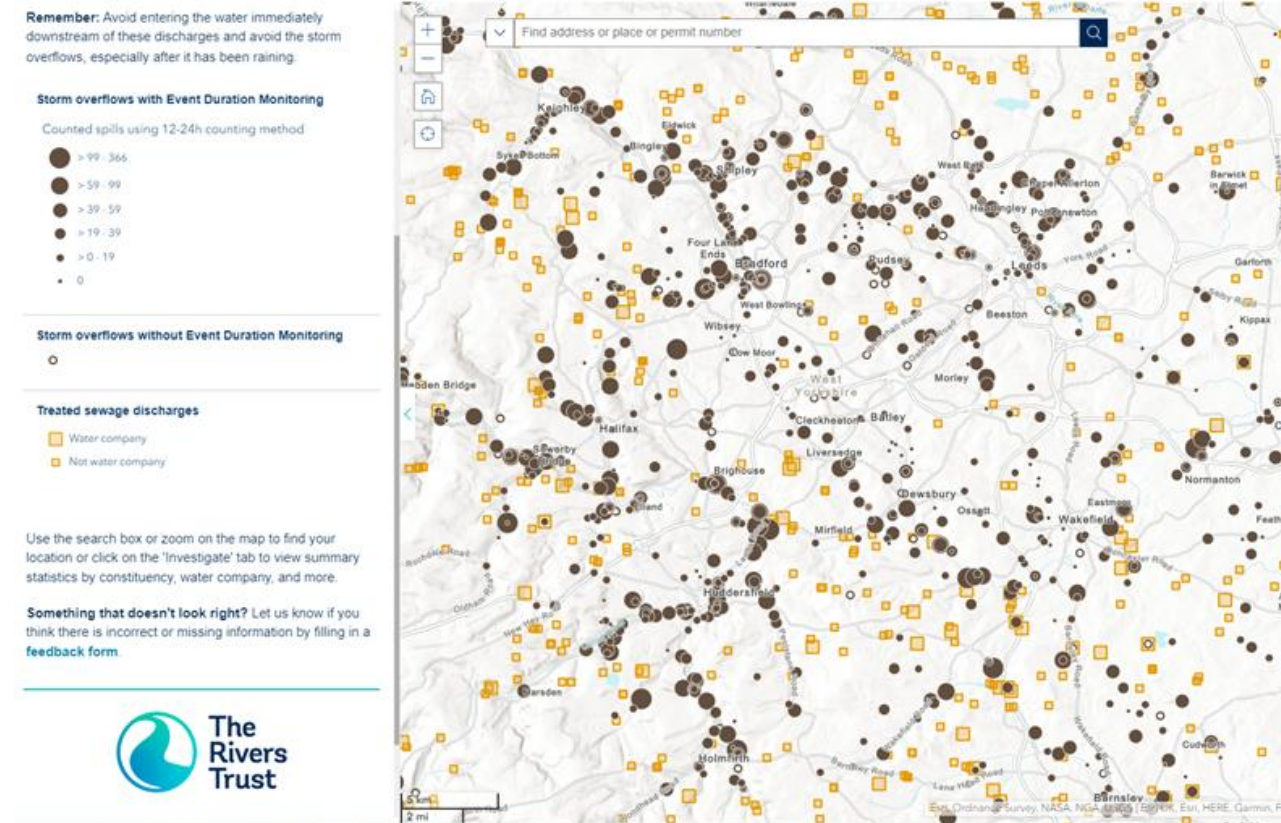
Analysis of annual CSO data England & Wales

Annual summary of CSO spill event duration monitoring (EDM) data since 2020.

Data made open through Environment Agency & Government website

Latest figures (2024):

- 14,285 monitored CSO structures
- 450,398 spill events with a total duration of 3,614,428 hours
- An average of 31.8 spills per CSO structure and an average duration of 8 hours per spill event
- Around 70% of spills happen at CSO structures near the WWTWs



Data visualised by several NGOs: <https://theriverstrust.org/sewage-map>

Link to CSO EDM datasets <https://environment.data.gov.uk/dataset/21e15f12-0df8-4bfc-b763-45226c16a8ac>

Open CSO spill data Brussels & England

Example of different reactions

Number of overflows at Sainctelette:

2020:	2021:	2022:	
In the canal: 21 days In the Senne: 79 days	In the canal: 19 days In the Senne: 100 days	In the canal: 19 days In the Senne: 80 days	In the canal: 19 days In the Senne: 80 days
Precipitation: 753 mm	Precipitation: 1058 mm	Precipitation: 637 mm	Precipitation: 637 mm



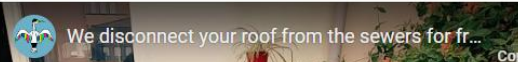
ProjectsGet involvedPhotosNewsDonateContact

Disconnect your roof: Be part of the solution

Do you live in Brussels with a terrace or a garden and want to install a rainwater harvesting tank or a rain garden to protect waterways?

Sign up now to be among the potential candidates for the free installation of a rainwater tank (with or without a swale)!

Registration form



We disconnect your roof from the sewers for fr...

WE CAN YOUR

Watch on YouTube

Tomorrow's water skills - how to tackle the silver tsunami

Water resilience balances how much water we have in the environment against how much water we use. Climate change and population growth are already reshaping that balance. But do we have the right people with the right skills to make water more resilient as these pressures grow? Joe Sanders and Matt Ascott report



One in three UK water workers verbally abused amid sewage fury, GMB finds

pollution affecting employee



**Feargal Sharkey** @FeargaL_Sharkey · May 30
So let me see if I've gotten this right.

@Ofwat (the most hopeless regulator in the UK), has taken £16,900,000 of your money, bill payers' cash and given it to a company teetering on the verge of bankruptcy and called it an "Innovation".

Gross act of stupidity more like. 🤡

**Thames Water** @thameswater · May 29

We've won £16.9 million from @Ofwat's £40 million Innovation Fund to invest in robotic pipe repairs, renewable energy and sustainable drainage systems.

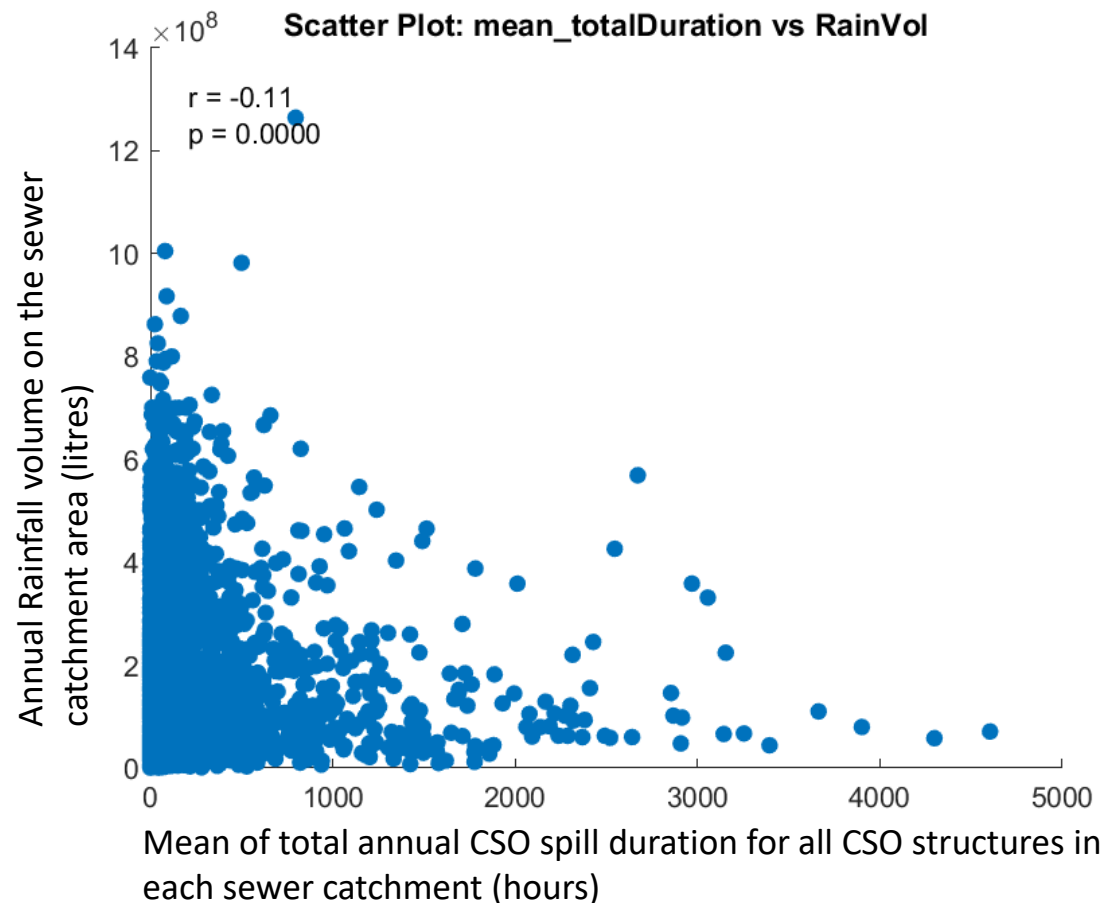
Read all about it at spkl.io/60154f1px

<https://www.citytooocean.org/en/sainctelette-sewage-overflow/>

CoUDlabs spatial Analysis of annual CSO EDM data England & Wales

Correlation between annual CSO duration and frequency data on sewer-catchment scale and other parameters: radar rainfall (1km² grid), Lower Super Output Area population data & associated statistics, Ordnance Survey data

One at a time correlation analysis does not show clear correlations → multiple parameter correlation analysis

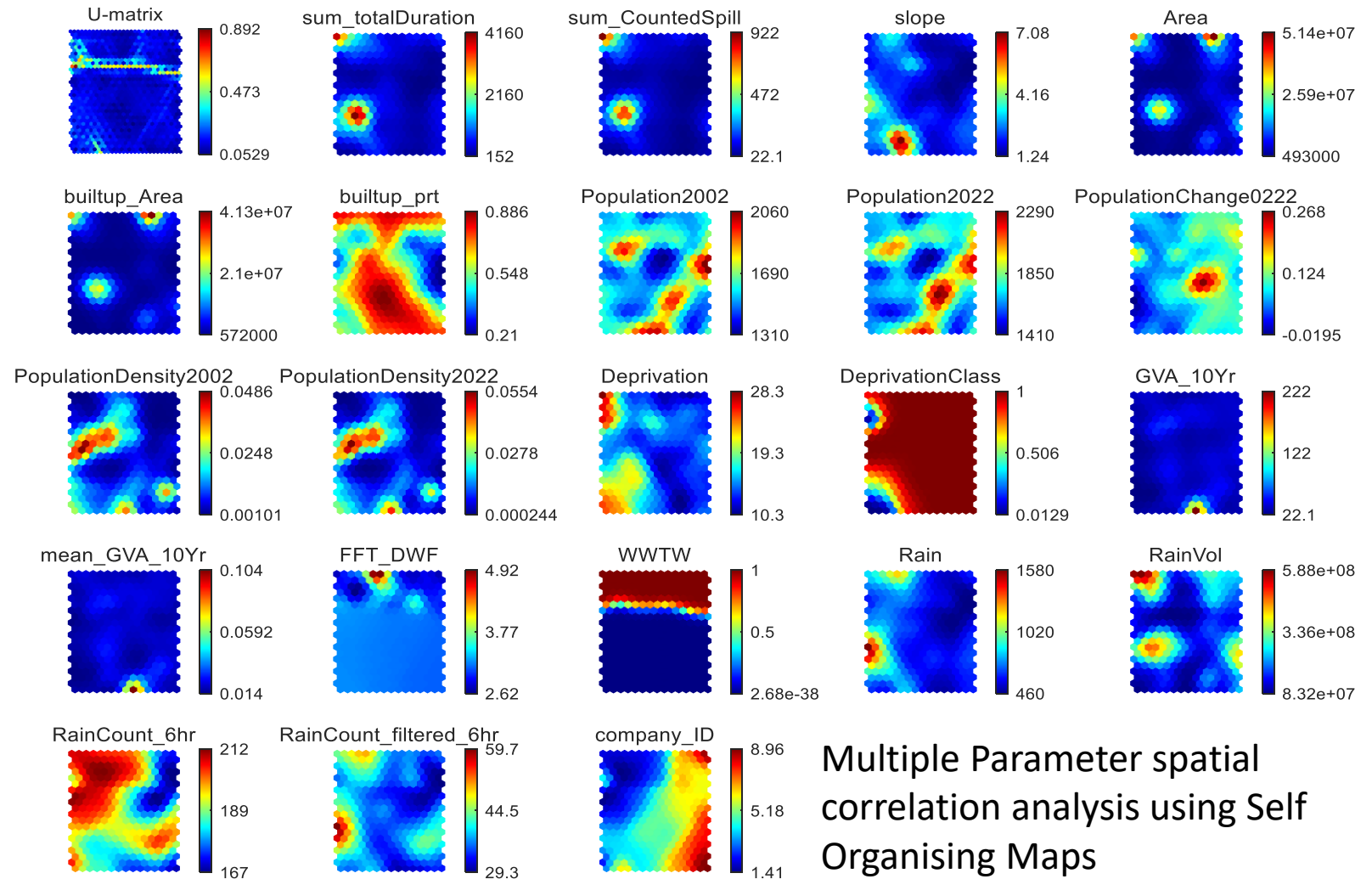


Parameters	Mean Duration of CSO spill per wastewater cathment	
	Correlation Coefficient	P Value
slope	0.107	1.0E-08
Area	-0.106	7.5E-09
builtup_Area	-0.107	3.3E-07
builtup_prt	0.016	4.5E-01
Population2002	-0.097	1.6E-06
Population2022	-0.075	4.4E-05
PopulationDensity2002	-0.025	2.3E-01
PopulationDensity2022	-0.021	2.6E-01
PopulationChange0222	-0.101	5.2E-07
Deprivation	-0.032	1.5E-01
GVA_10Yr	-0.036	7.6E-02
mean_GVA_10Yr	0.017	4.1E-01
FFT_DWF	-0.071	3.4E-02
Rain	0.264	4.2E-48
RainVol	-0.112	1.2E-09
RainCount_6hr	0.004	8.3E-01
RainCount_filtered_6hr	0.175	8.6E-22
company_ID	0.157	7.4E-18

Spatial correlation CSO spills England & Wales (2022)

Very weak to no correlations between CSO duration/spill count and potential or 'expected' explanatory parameters!

Other causes of CSO spills: local capacity bottlenecks, blockages, general lack of capacity, WWTW operation,?

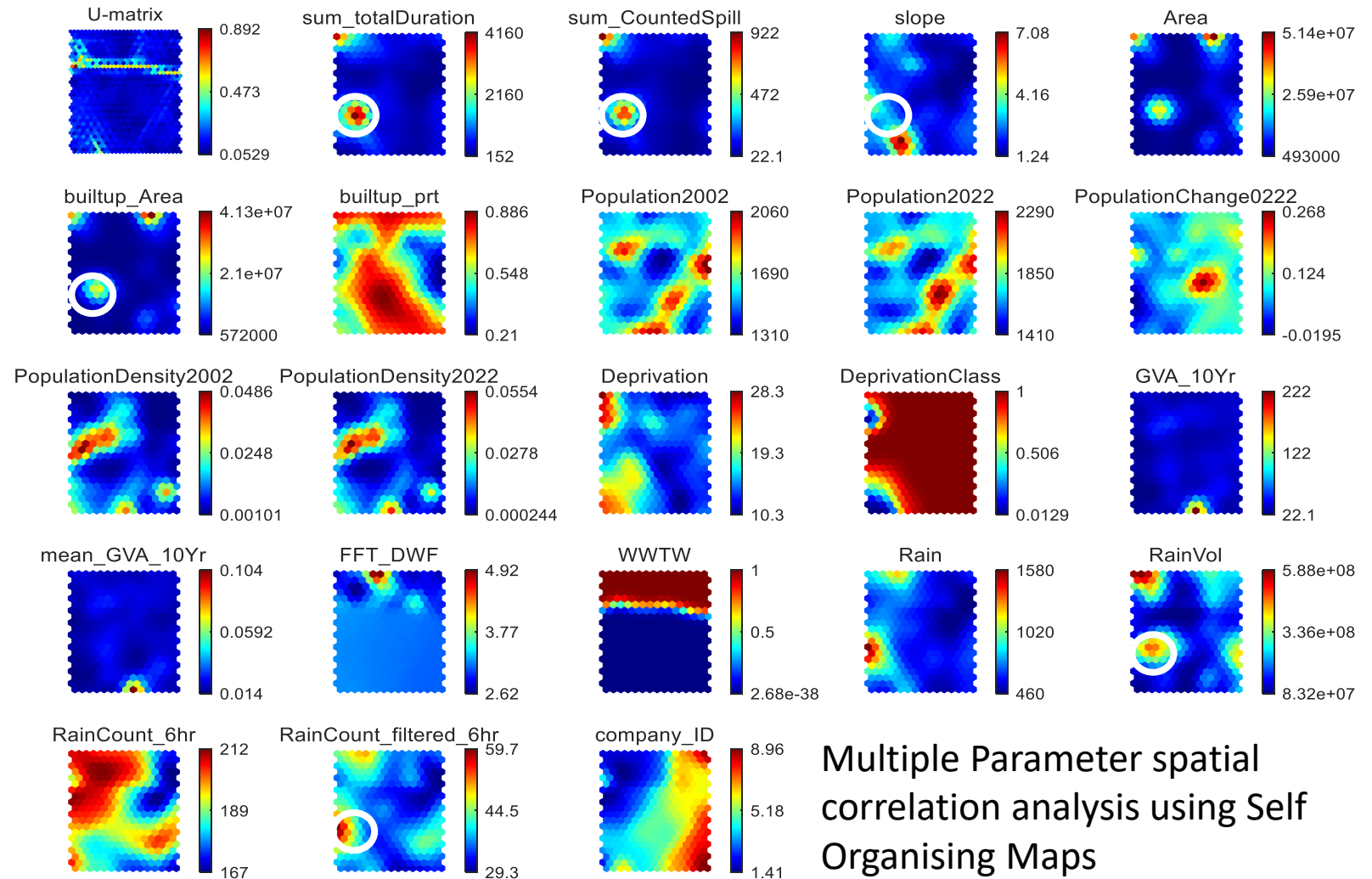


Multiple Parameter spatial correlation analysis using Self Organising Maps

Spatial correlation CSO spills England & Wales (2022)

Very weak to no correlations between CSO duration/spill count and potential or 'expected' explanatory parameters!

Other causes of CSO spills: local capacity bottlenecks, blockages, general lack of capacity, WWTW operation,?



Multiple Parameter spatial correlation analysis using Self Organising Maps

Discussion & conclusions – CSO data availability

Lack of European wide monitored data on amount of CSO spills

Information reliant on modelling → can miss a considerable proportion of spills, as causes are varied

Emerging evidence open CSO monitoring network in England & Wales

- **Despite being heavily regulated for decades, far more CSO spills than expected**
- Press attention and increasing public scrutiny of CSOs and surface water quality.
- **Public lobbying** lead to implementation of Environment Act 2021 being much more strict
 - Water quality monitoring being installed upstream and downstream of every CSO structures
 - Estimated costs of Storm Overflow Discharge Reduction Plan £40 Billion

Discussion & conclusions – CSO benchmarking & regulation

- Emissions based is ‘simpler’ but doesn’t tell full story of river impact.
- Receiving water impact-based regulation is complicated → the process of checking compliance with regulation becomes very opaque
- Publicly open CSO data a more transparent way to help implementation of regulation.
- Open CSO data has to be FAIR and made open with involvement of trusted local organisations.
- Discussions needed around citizens’ expectations of water quality, and willingness to pay/change behaviour. Open data crucial for this discussion

CoUDlabs policy brief: Assessing CSO Spills <https://doi.org/10.5281/zenodo.15081106>

Discussion & Conclusions

Spatial analysis CSO data England & Wales

- **CSO spills not very well correlated with rainfall → implications for solutions!**
- Building more SuDS & storage tanks should help but will not avoid all CSO spills.
- Also need other solutions: blockage/dry weather spill warning systems, solving local bottlenecks in the pipe network, and/or larger WWTW
- Concerns regarding impact of extensive building of storage tanks on efficiency WWTW
- Extensive existing open datasets, various difficulties linking the data

Questions?



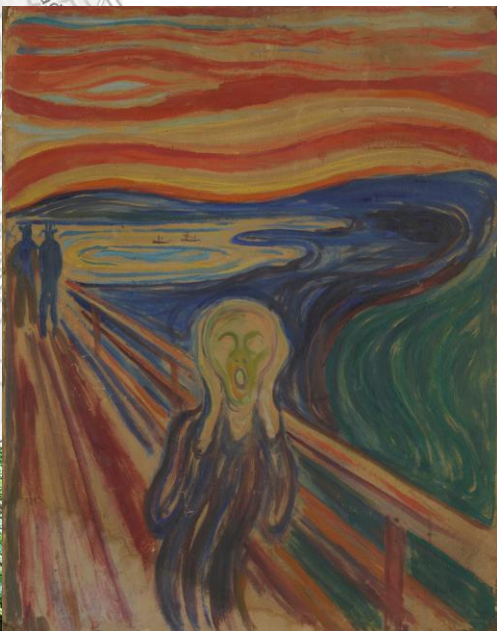
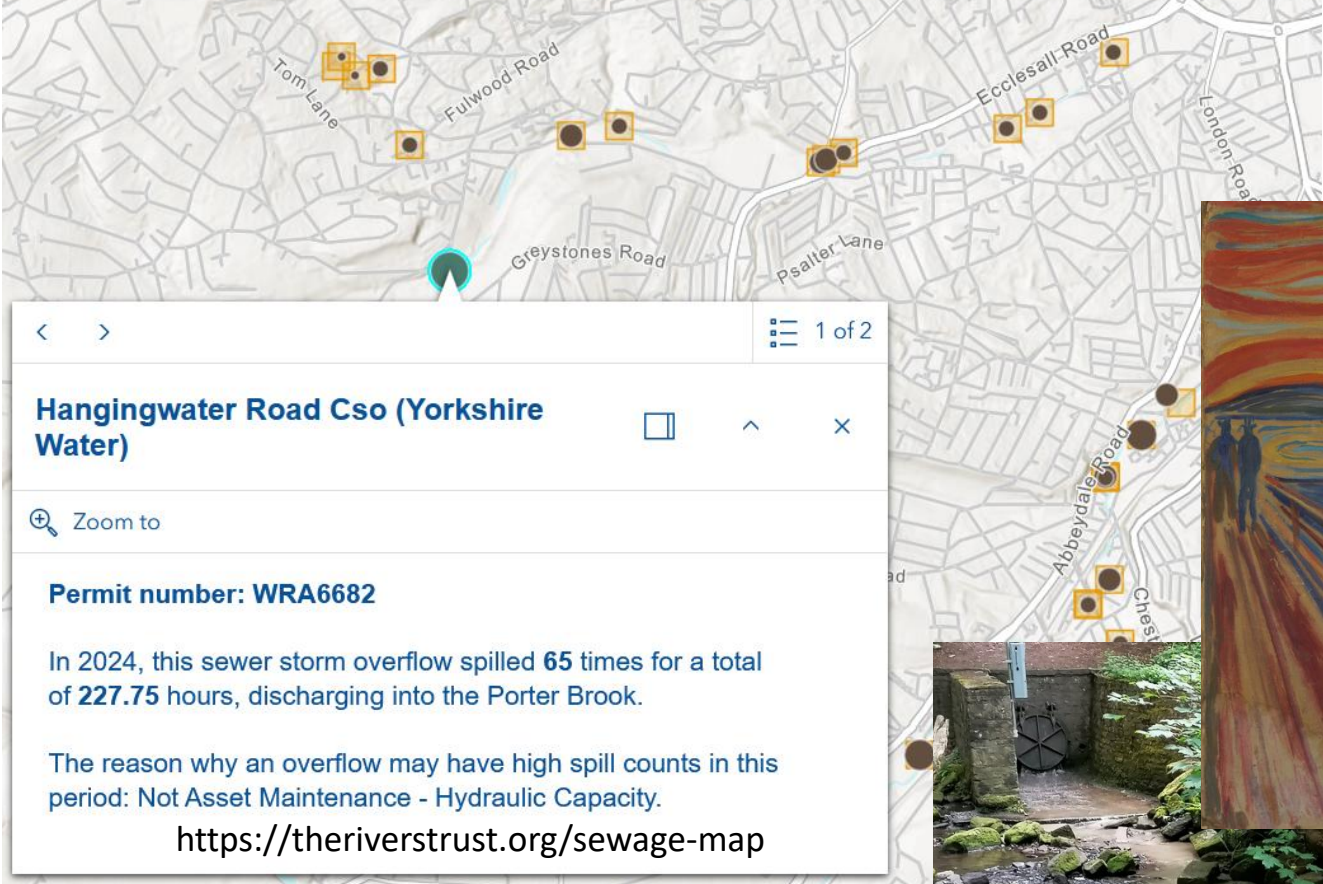
CoUDlabs policy brief
Assessing CSO Spills



Co-UDlabs



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008626



River Porter CSO spill, Dr J. Shucksmith
(during very light rain in Sheffield)



River Porter Duck Race

<https://www.munchmuseet.no/en/our-collection/5-things-you-should-know-about-the-scream/>