CSO PROJECTIONS UNDER CLIMATE CHANGE IN THE CHESAPEAKE BAY WATERSHED

Modeling Workgroup Quarterly Review
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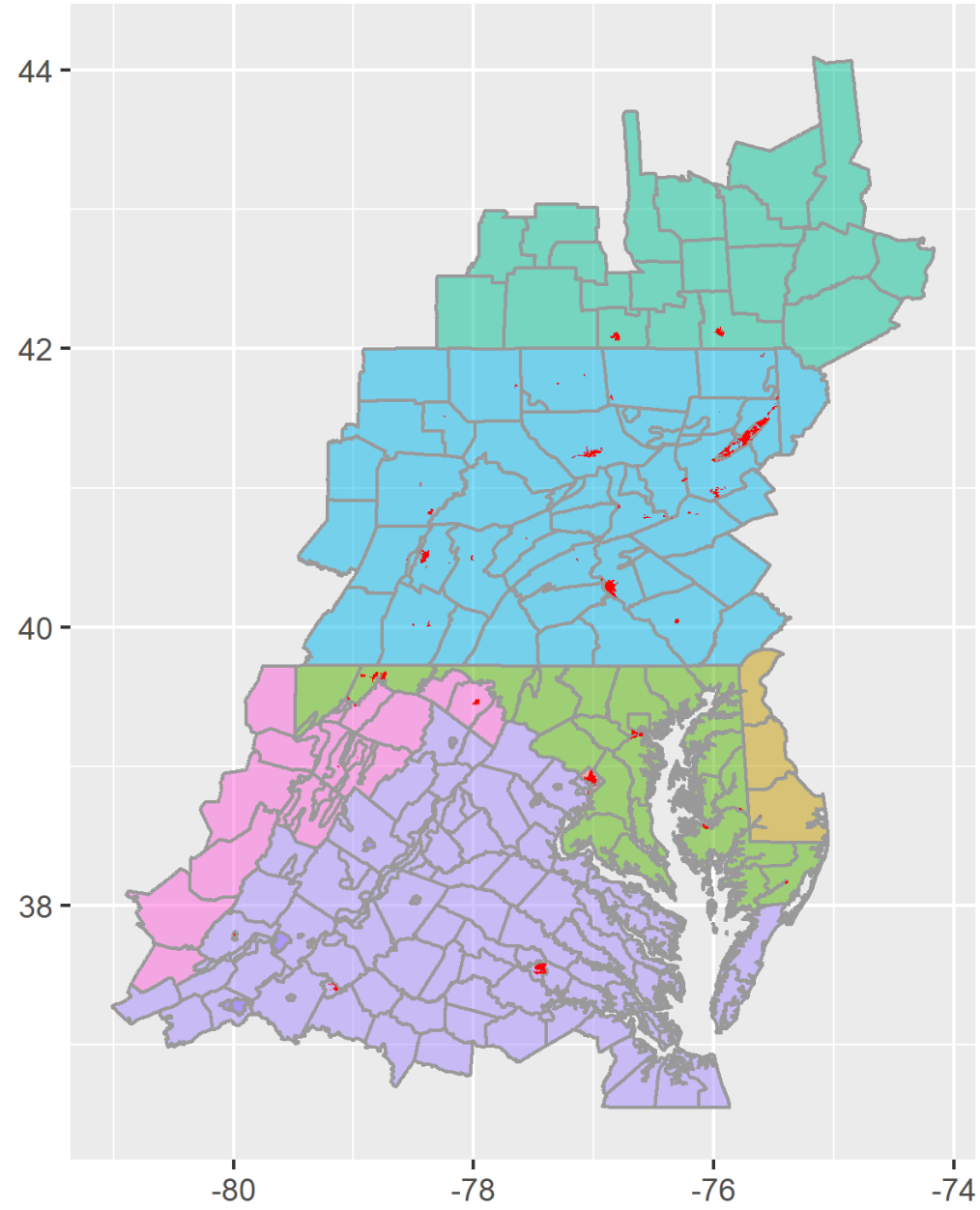
Presentation Outline

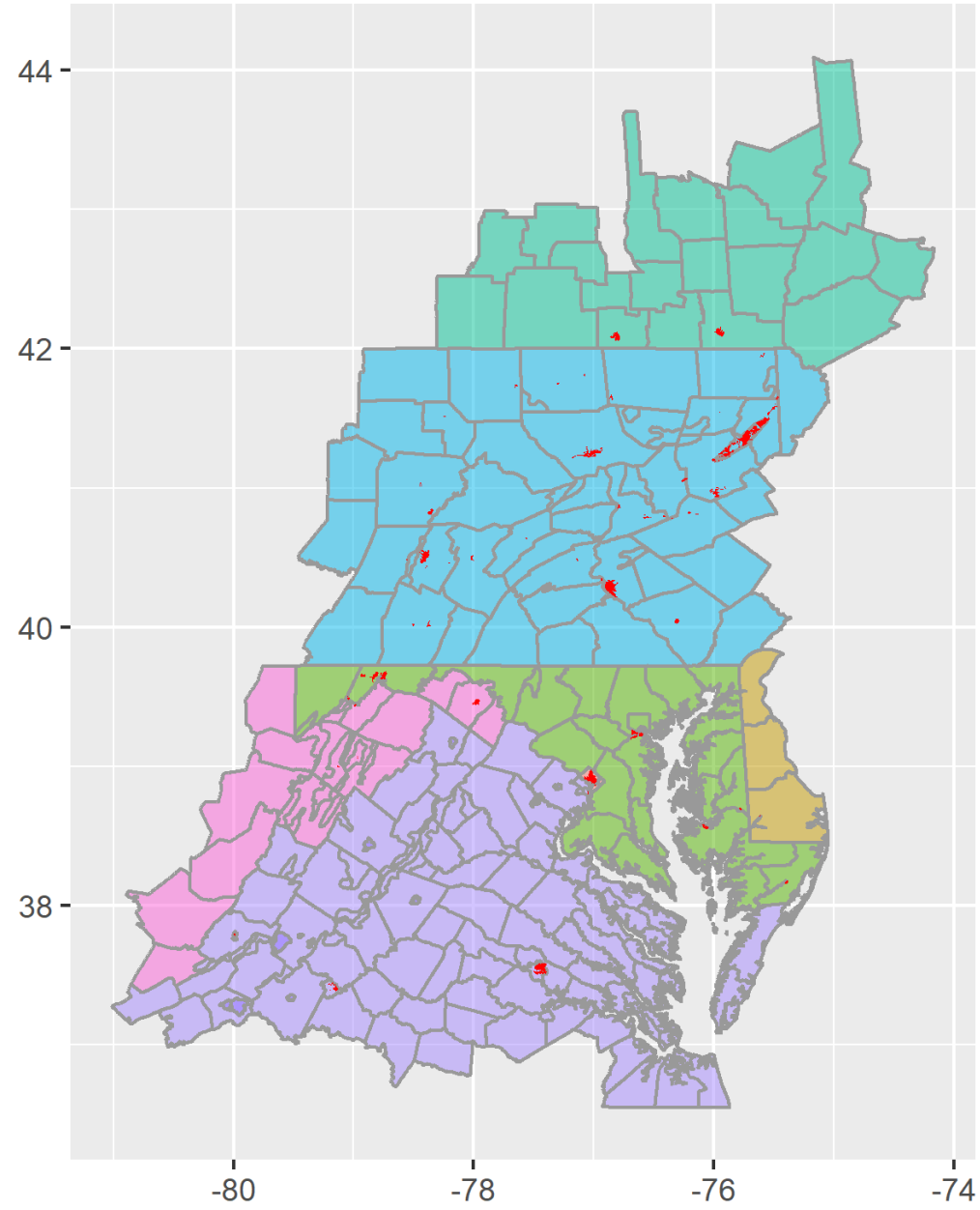
- Motivation for CSO projections under climate change
- Brief overview of how historical CSO volumes are obtained
- Method used to project CSO volumes under climate change-driven changes in rainfall
- Results

64 Combined Sewer Overflow (CSO) facilities



STATE	FACILITIES	1985 - 2015 MEAN ANNUAL VOLUME (MMGal/yr)
DC	1	2,261
DE	1	35
MD	10	427
NY	3	3,278
PA	40	25,882
VA	4	4,179
WV	5	1,165

64 Combined Sewer Overflow (CSO) facilities

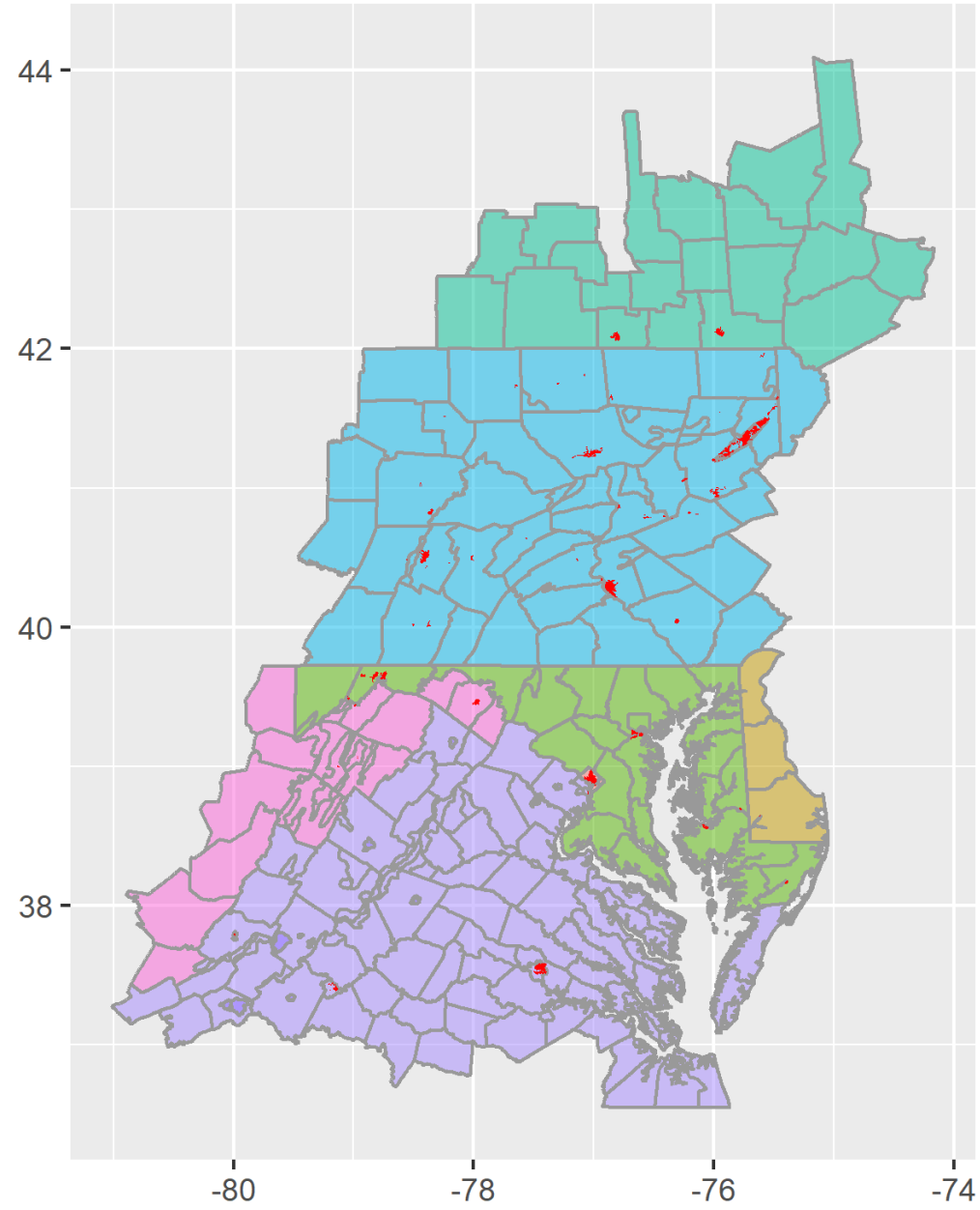


STAC Climate Change Workshop
9/24 - 25 2018

Recommendation:

"The current modeling for climate change does not consider the effect of climate on the frequency or severity of waste water overflows. In combined systems, ***overflows could be assessed through the existing combined sewer overflow model at the CBP****"*

64 Combined Sewer Overflow (CSO) facilities

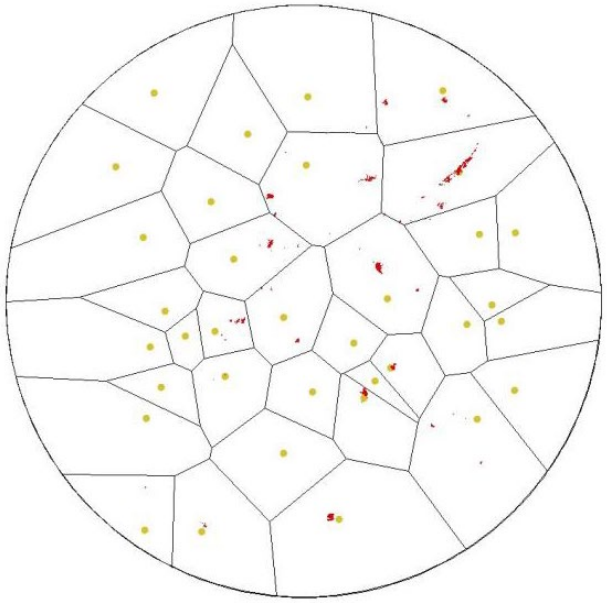


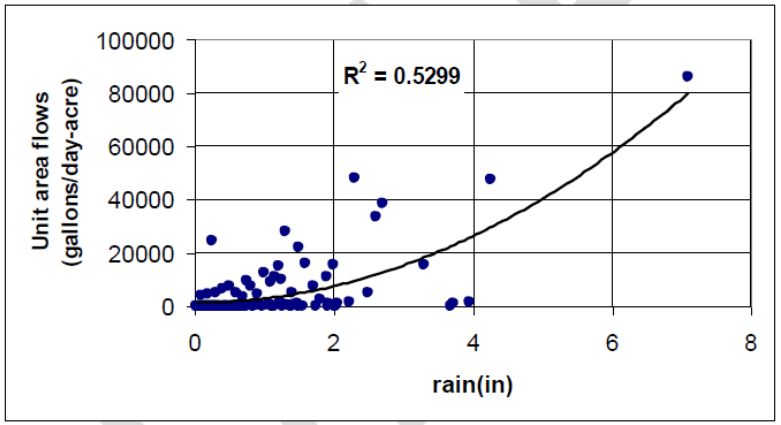
Two types of CSO datasets:

1. CSO volumes reported by jurisdictions

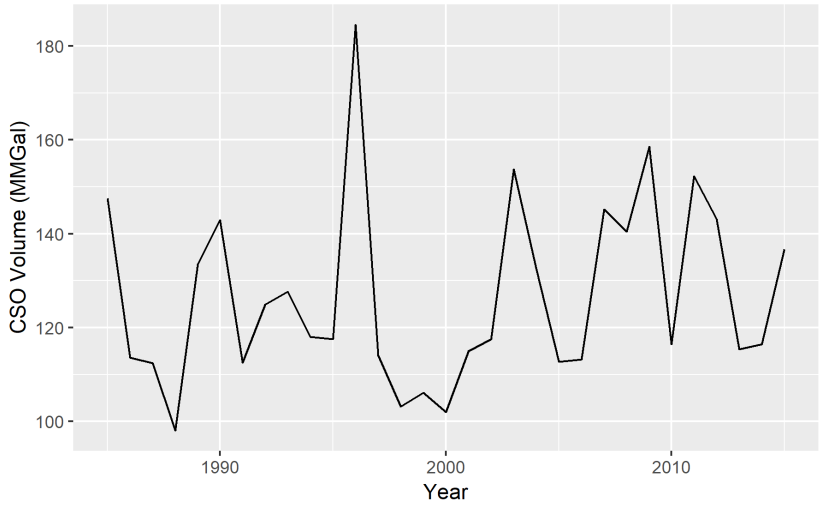
2. CSO volumes estimated using an empirical relationship with rainfall

CSO volume estimates for facilities without sufficient data





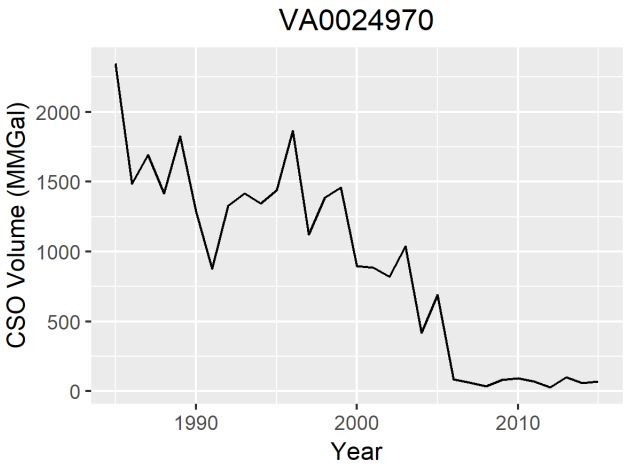
WV0105279

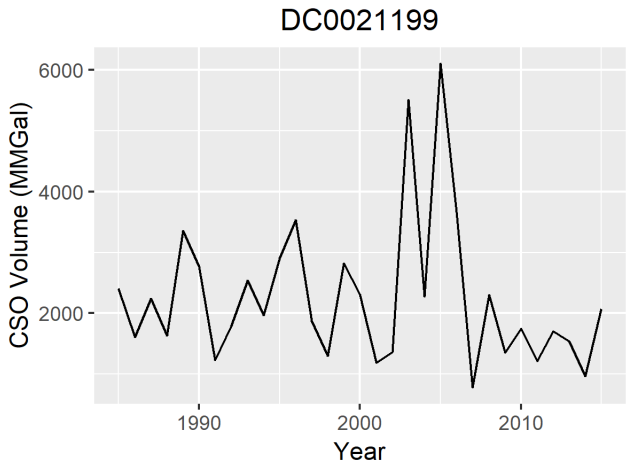


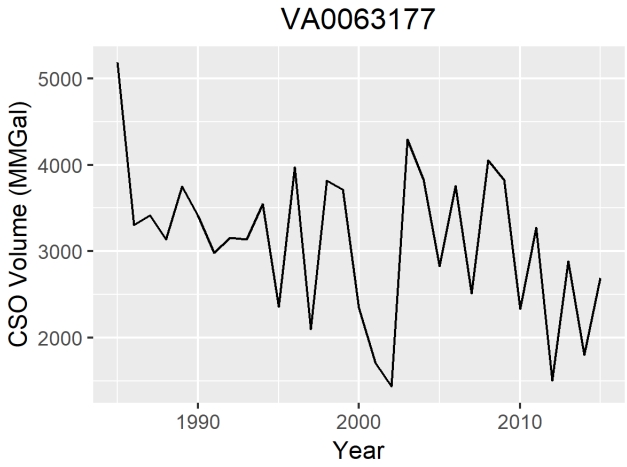
Daily CSO volumes estimated using a relationship with daily rainfall

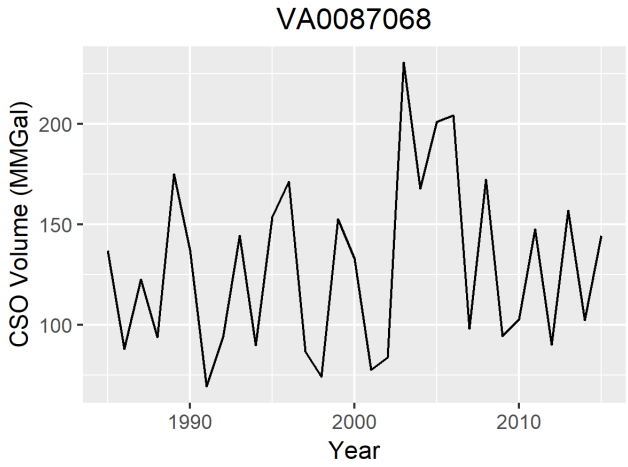
Facilities that provided daily flow data

FACILITY	YEARS WITH DATA
DC0021199	1985 – 2015
VA0024970	1985 – 2015
VA0063177	1985 – 2015
VA0087068	1985 – 2015
MD0020249	2005 – 2015
MD0021571	2005 - 2015
MD0021598	2005 - 2015
MD0021601	2005 - 2015
MD0021636	2005 - 2015
MD0022764	2005 - 2015
MD0067384	2005 - 2015
MD0067423	2005 - 2015
MD0067547	2005 - 2015
NY0024406	2007 - 2015
NY0023981	2007 - 2015



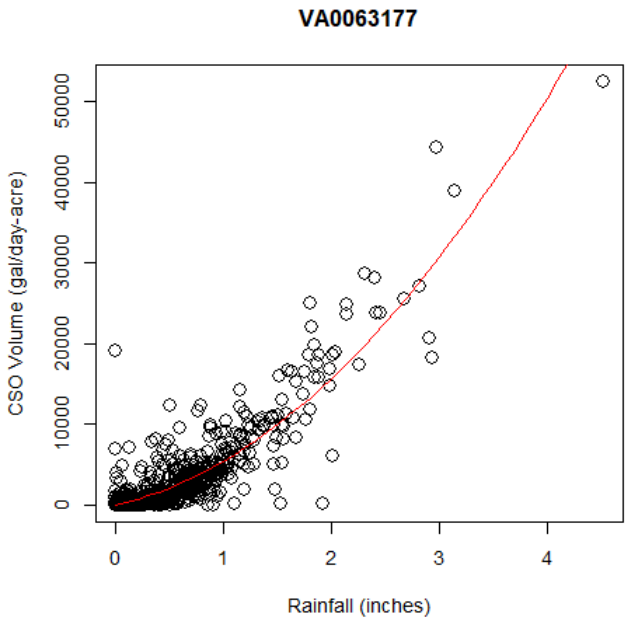


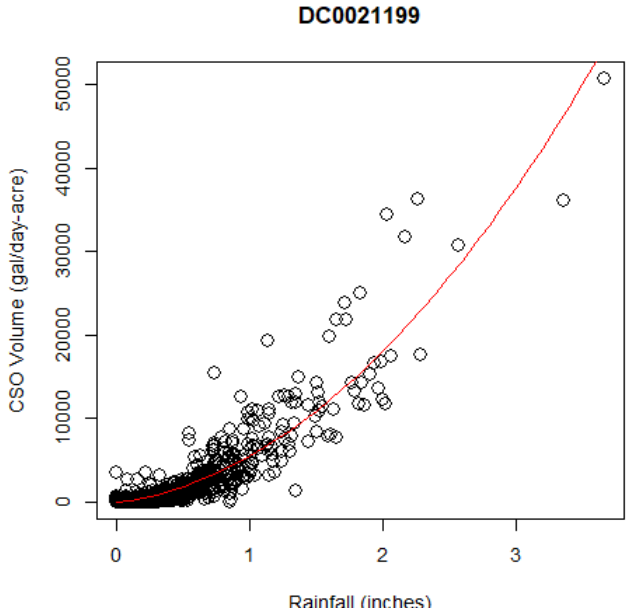


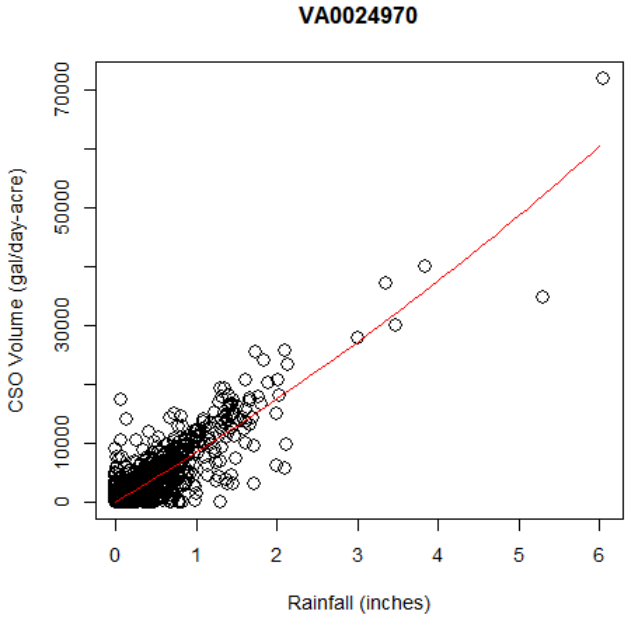


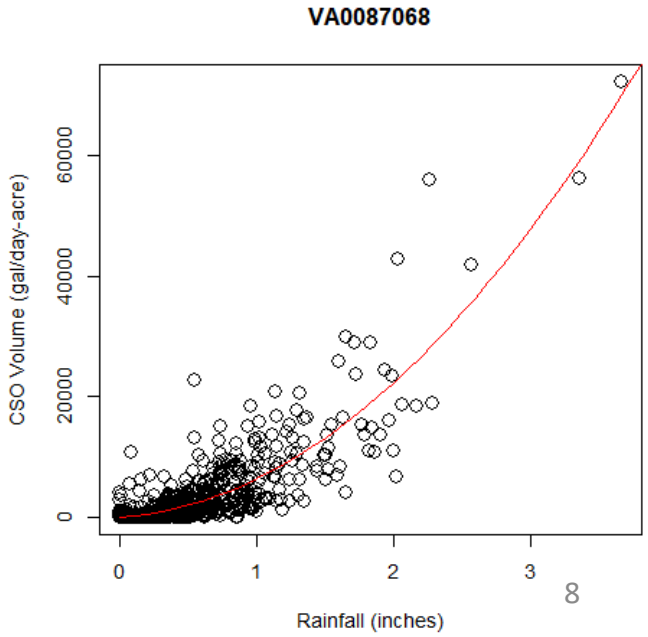
Facilities that provided daily flow data in 1991-2000

Reported CSO volume vs. rainfall









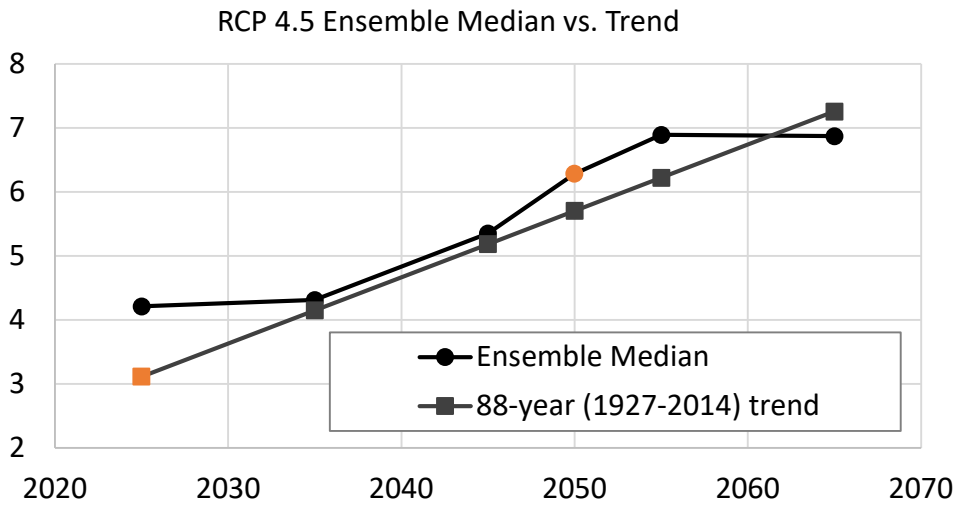
Estimated changes in rainfall under future climate scenarios

Two sources of information:

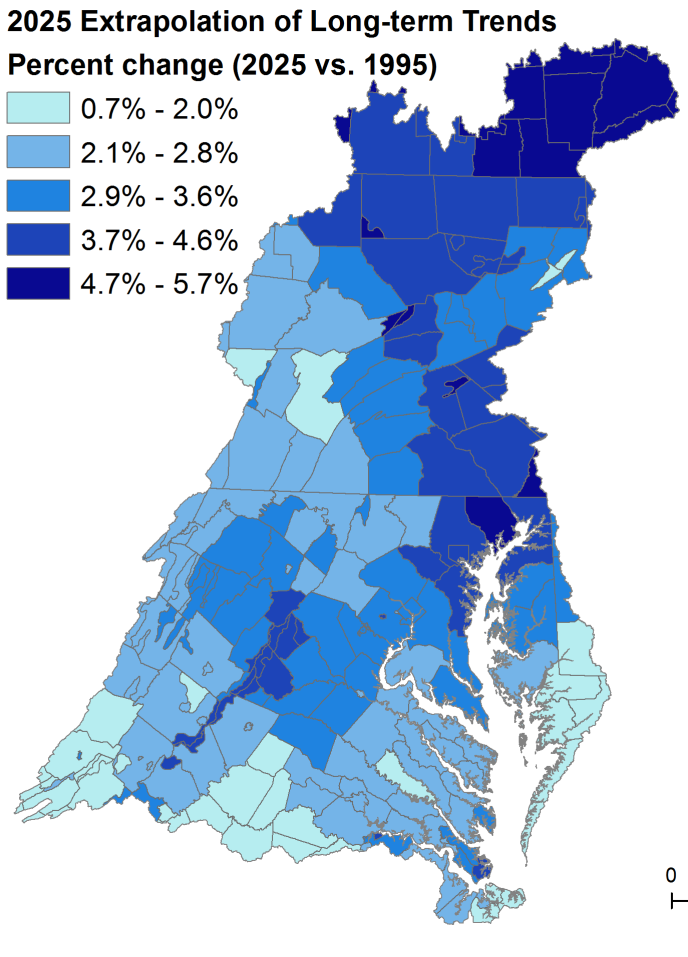
Long-term (88-year) historical trends
31-member ensemble of **RCP4.5 GCMs**

Modeling WG Recommendation:

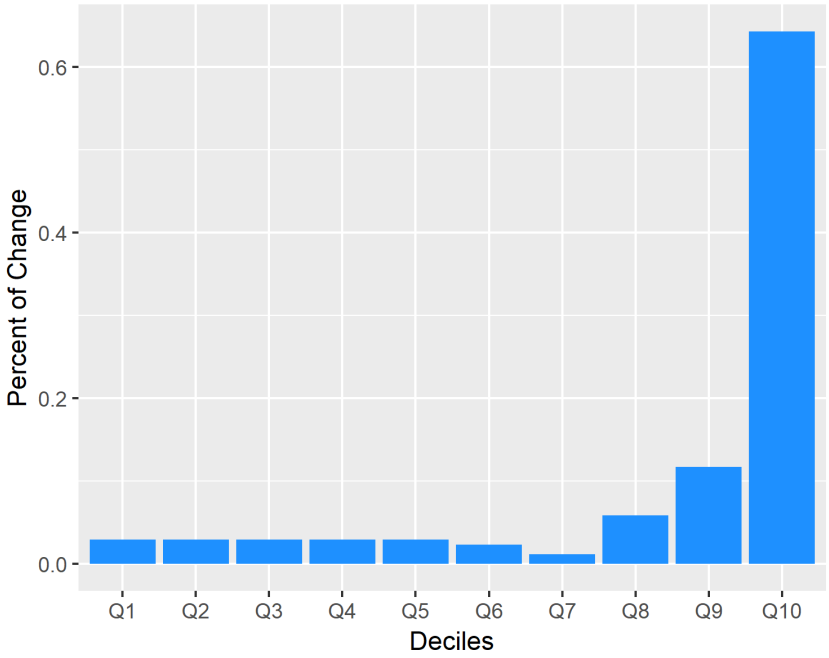
<u>Hybrid approach</u>

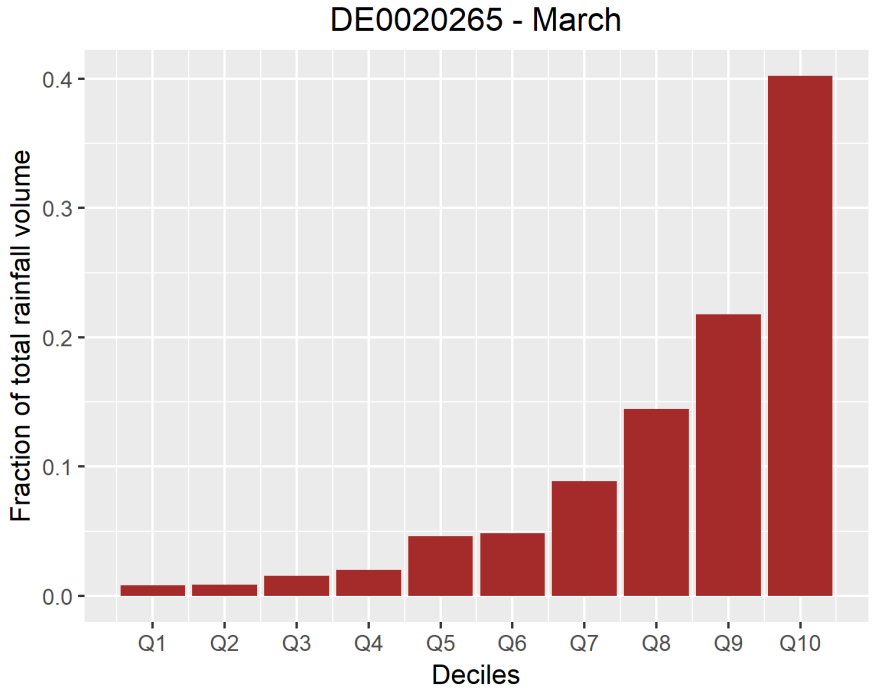


Example of spatial variability in rainfall change - 2025



Applying rainfall volume change to 1991 – 2000 daily rainfall data





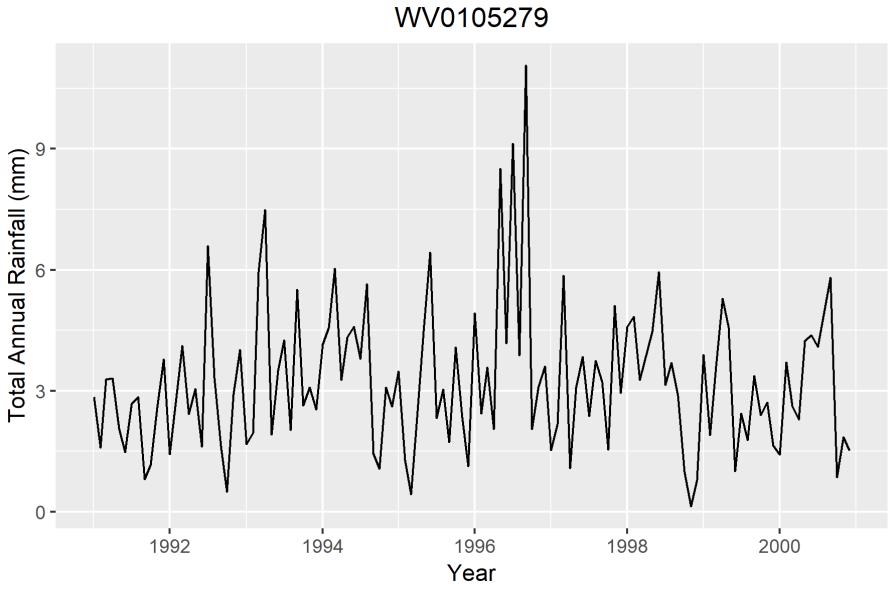
Modified from Groisman et al. 2004

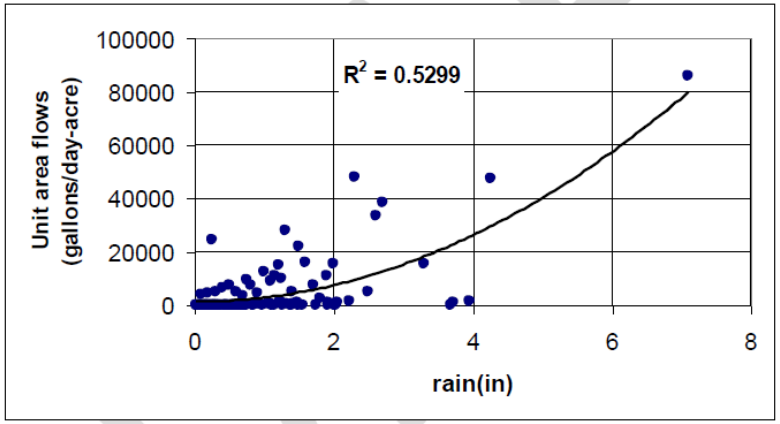
Rainfall events in each month are split into deciles

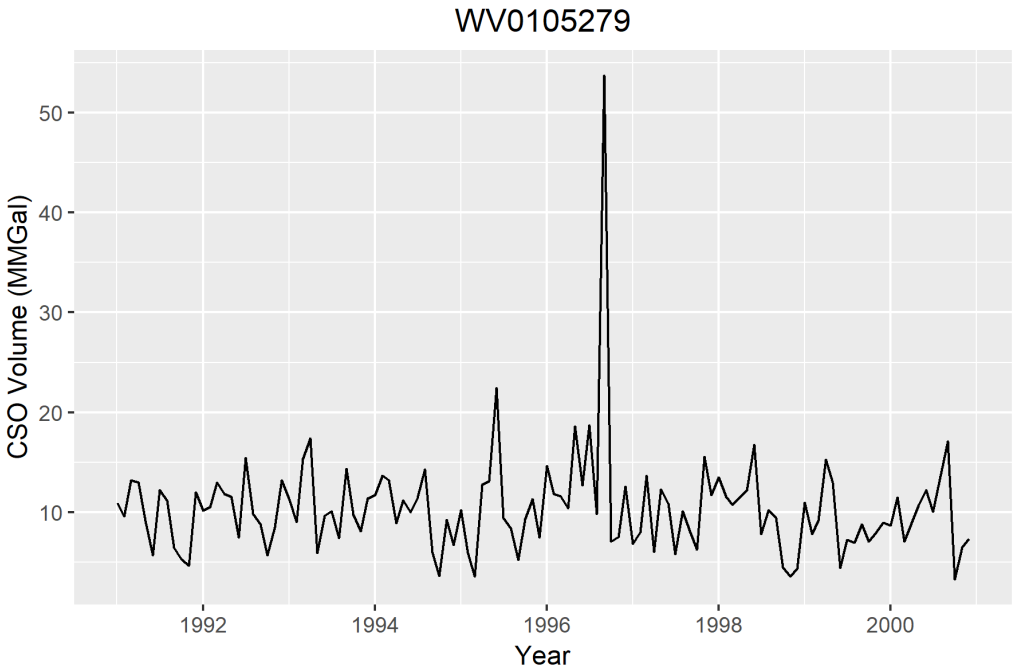
The overall model-predicted volume change in rainfall for each month is distributed across deciles unevenly (based on historical observations – rainfall increases have been occurring more frequently in higher deciles)

-> rainfall events in the higher deciles increase more

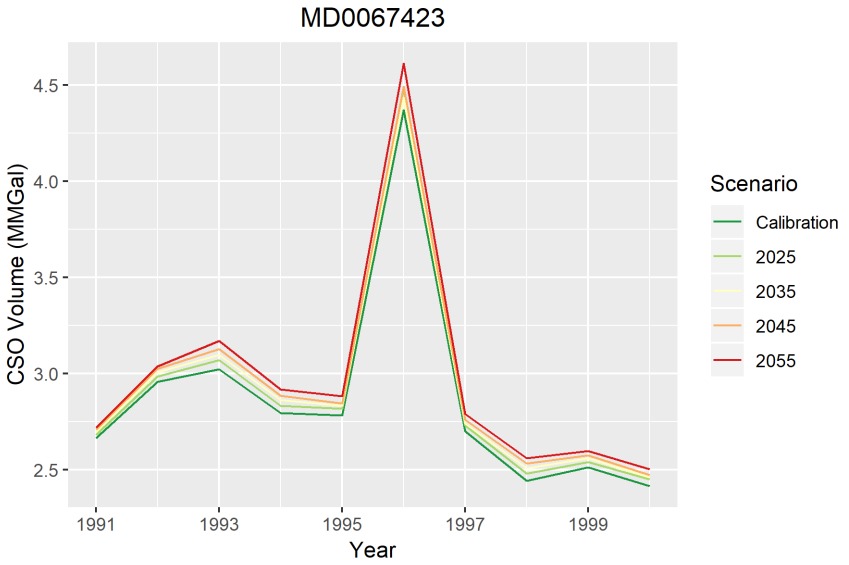
Estimating CSO volumes under climate change



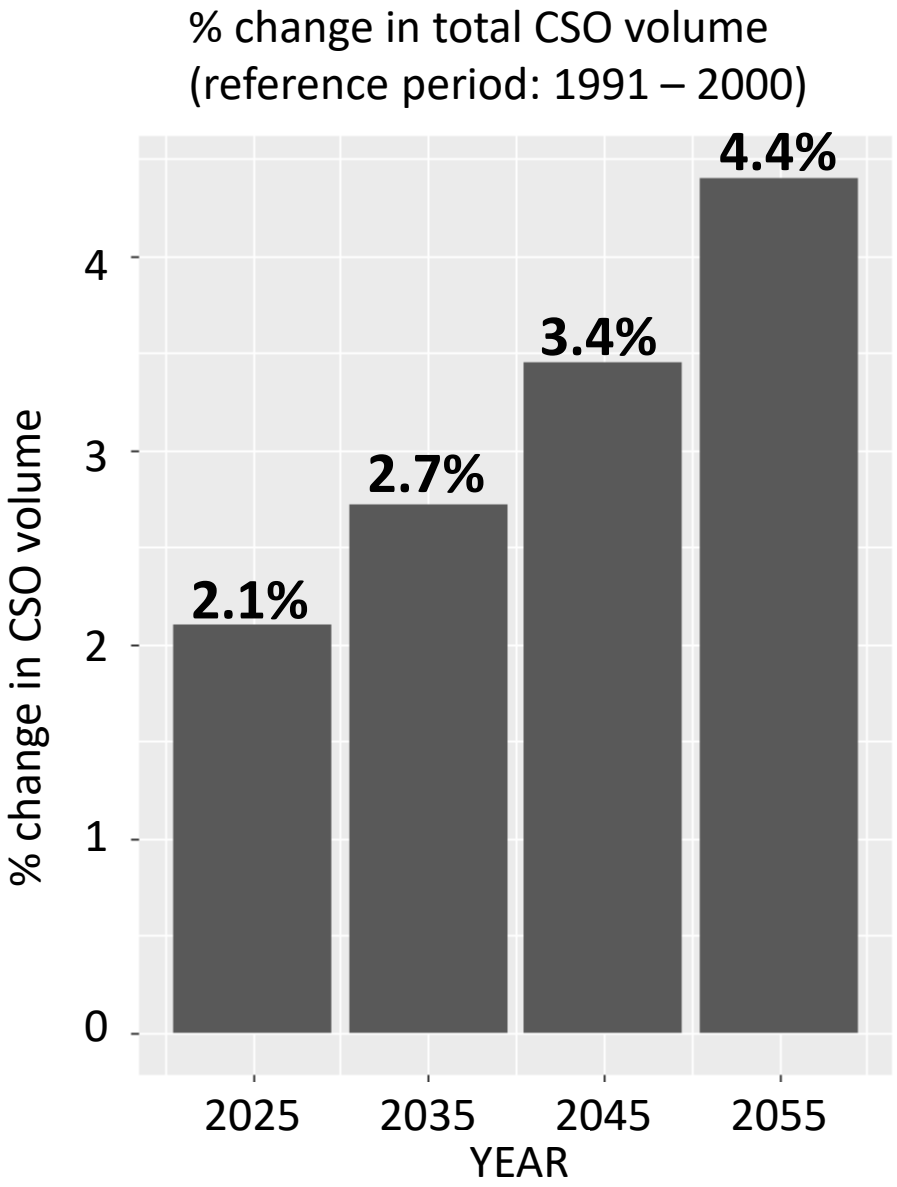




Estimated changes in CSO volumes under future climate change scenarios – Examples of individual facilities



Estimated changes in CSO volumes under future climate change scenarios



Summary of estimated changes in CSO nutrient loads

		MEAN ANNUAL TN LOAD (Lbs/yr)				
STATE	FACILITIES	1991 – 2000	2025 conditions	2035 conditions	2045 conditions	2055 conditions
DC	1	87,414	92,182	93,453	94,890	97,651
DE	1	2,318	2,348	2,350	2,375	2,411
MD	10	31,072	31,675	31,828	32,035	32,465
NY	3	212,015	216,215	217,159	217,419	217,976
PA	40	1,629,861	1,657,892	1,664,987	1,671,681	1,682,526
VA	4	307,901	317,311	322,045	329,372	335,453
WV	5	62,752	63,879	64,317	64,888	65,570
TOT	**64**	**2,333,333**	**2,381,502**	**2,396,139**	**2,412,660**	**2,424,052**

Summary of estimated changes in CSO nutrient loads

		MEAN ANNUAL TP LOAD (Lbs/yr)				
STATE	FACILITIES	1991 – 2000	2025 conditions	2035 conditions	2045 conditions	2055 conditions
DC	1	18,599	19,613	19,884	20,189	20,777
DE	1	290	293	294	297	301
MD	10	3,609	3,680	3,698	3,722	3,772
NY	3	26,502	27,027	27,145	27,177	27,247
PA	40	257,694	261,753	262,907	264,028	265,594
VA	4	38,532	39,711	40,303	41,220	41,982
WV	5	7,844	7,985	8,040	8,111	8,196
TOT	**64**	**353,070**	**360,062**	**362,271**	**364,744**	**367,869**