Simulation of Hydrocarbon Compositions from O&G in the Uinta Basin

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Winter Ozone pollution in Uinta Basin

- Ozone frequently exceeded the national standard under strong, multi-day wintertime temperature inversions during wintertime.
- Local oil and gas productions have been identified as the major contributors to ozone pollution.
- Earlier photochemical modeling studies have difficulties in capturing high ozone episode, Discrepancies are attributed to gaps in emission inventory among other reasons.

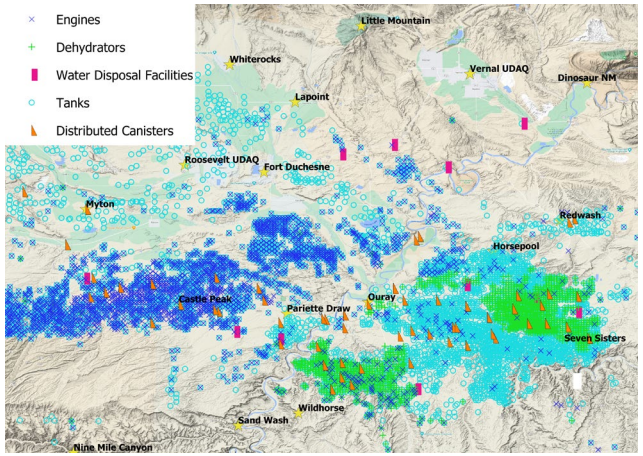
Not Enough Reactive Organics

- Comparison of model's estimated volatile organic compounds (VOC) to observed values showed that total emissions of VOC are the right ballpark but lack of reactive organics (i.e., compounds that make a lot of ozone, such as alkenes, carbonyls, and aromatics).

Distributed Canister Campaign

- There were 21 deployments of the distributed canisters in winters 2018 through 2021 to characterize the heterogeneity of VOC composition across the basin and provide insight to improve emission data.

Locations of all distributed canister deployments



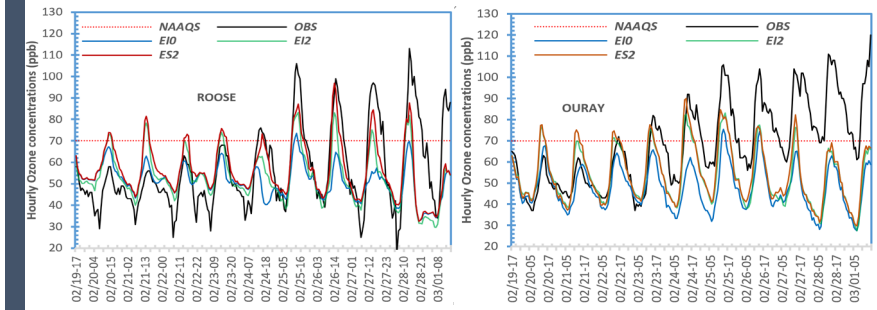
Changes in NOx and VOC emission estimates in the OGEI2017 with highlights

Description	NOx (tons/year)				VOC (tons/year)			
	EI0		EI2		EI0		EI2	
	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah
RICE & Engines	3,458	4,362	3,414	3,801	907	826	904	806
Sep. & Heaters	1,338	1,435	1,332	1,338	74	79	73	74
Tanks	19	13	19	13	2,470	5,870	3,571	10,534
Fugitives					3,163	14,220	3,228	15,021
Produced Water					595	7,226	1,592	23,452
Ctr. Effect. (Oil Tanks)					2,350	721	10,772	3,304
County Total	**6,718**	**6,273**	**6,668**	**5,615**	**12,710**	**53,475**	**25,052**	**78,671**

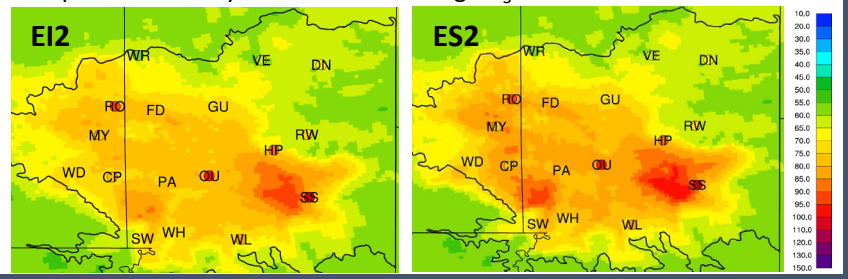
***EI0**: Original OGEI2017 released in Sep. 2019* ***EI2**: updated OGEI2017 released in Feb. 2021*

CAMx model ozone performance (20-28 Feb 2019 episode)

- Higher O_3 is simulated in the updated OGEI2017 (**EI2**)
- Applying engines' stack to horizontal, lower exhaust temperature and exit velocity, changing NO/NO_2 ratio to 0.4/0.6 as observed (**ES2**) further enhance simulated O_3



Comparisons of daily maximum 8h-average O_3 as simulated in 25 Feb 2019



Source Contributions (excluding Initial and Background)

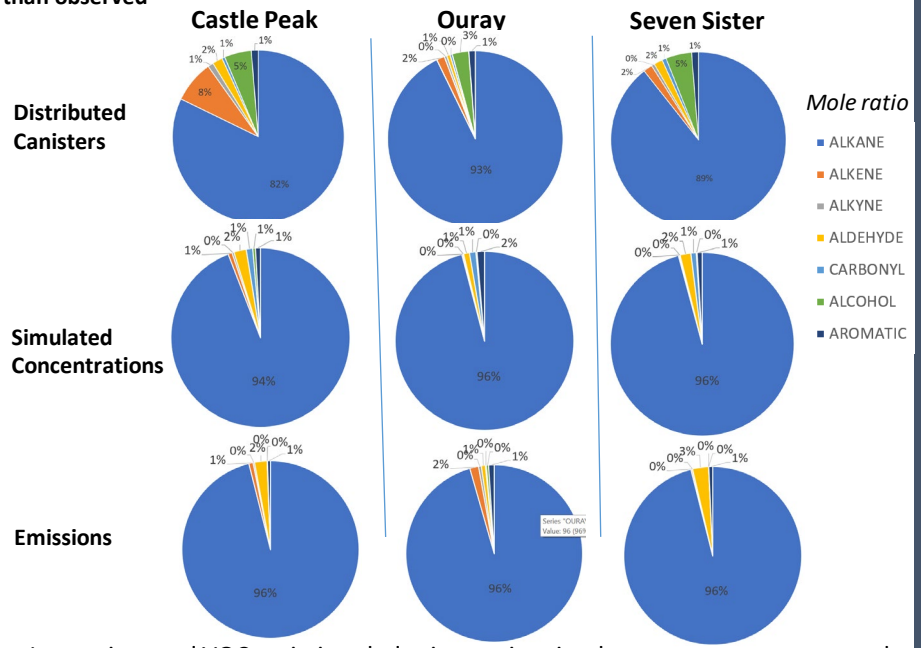
- Fugitives and Tanks' Emission Control Effectiveness are the largest contributors of total VOC and O_3
- RICE & Engines and Separator & Heaters has low contribution on total VOC but large contribution on O_3 implying NOx limited regime

Contribution (%)	Ozone					Total VOC				
	CP	OU	SS	RW	HP	CP	OU	SS	RW	HP
Heater	4	10	11	9	11	0	0	0	0	0
Dehydrator	1	2	3	2	2	1	4	4	2	3
Pneumatics	4	4	5	3	4	16	24	23	15	29
Tanks	6	5	5	5	4	20	12	13	32	16
RICE & Engines	41	30	33	27	32	12	3	3	1	1
Disposal	12	10	7	9	9	8	18	5	8	14
Others*	33	38	36	45	37	43	40	52	42	37

*Total of fugitives, Control effectiveness, well completions, and other gap filling sources

CP: Castle Peak OU: Ouray SS: Seven Sister RW: Redwash HP: Horsepool

Less reactive hydrocarbon compounds in emission inputs and simulated concentrations than observed



- Increasing total VOC emissions helps improving simulated ozone. However, such increases still need be ground-truth and the composition need improvements.