UTAH BUREAU OF LAND MANAGEMENT'S AIR RESOURCE MANAGEMENT STRATEGY (ARMS) MODELING STUDY: POTENTIAL IMPACTS TO WINTER OZONE FORMATION USING FUTURE EMISSIONS SCENARIOS

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INTRODUCTION

The Bureau of Land Management (BLM), Utah State Office, conducted air quality modeling for the Uinta Basin to develop a landscape-scale Air Resource Management Strategy (ARMS). The Uinta Basin in northeastern Utah is an area with oil and gas extraction and production activities that are projected to continue into the foreseeable future. Elevated ozone levels have been measured during winter in the Uinta Basin since monitoring began in 2009. In order to assess potential benefits of oil and gas emissions control strategies, the ARMS Modeling Study:

- Developed estimates of future oil and gas emissions with On-the-Books Controls applied (referred to as "2021 OTB Controls") and three control scenarios, including assessment of co-pollutant benefits
- Determined potential ozone impacts using the CMAQ model (version 5.0 with albedo patch)
- Evaluated ozone response as related to indicator ratios, specifically for non-methane hydrocarbon (NMHC) to nitrogen oxides (NOx) ratios and formaldehyde (HCHO) to NOx ratios

CONTROL SCENARIO DEVELOPMENT

- Year 2021 Scenario 1 focuses exclusively on NOx controls
  - Assumed the Tier 4 emissions standards rule would penetrate 95 percent of the fleet in 2021 rather than the expected 35 percent of the fleet for drill rigs, workover rigs, and hydraulic fracturing pump engines.
- Year 2021 Scenario 2 focuses exclusively on volatile organic carbon (VOC) controls
  - Assumed combustion controls (rather than vapor capture) for all oil and condensate tanks and 95 percent of dehydrators. This increases combustion by-products relative to 2021 OTB Controls.
- Year 2021 Scenario 3 combines NOx and VOC controls
  - Combine Scenarios 1 and 2; however, rather than apply VOC combustion controls, VOC capture controls are applied for additional NOx reduction. This significantly decreases all combustion by-products relative to 2021 OTB Controls.

EMISSIONS TOTALS FOR EACH CONTROL SCENARIO

Scenario	NO_x (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
2010 Typical Year	16,529	109,705	48,875	32	601	601
2021 OTB Controls	26,167	138,775	80,060	63	1,998	1,998
2021 Scenario 1	20,527	138,343	80,060	63	1,768	1,768
2021 Scenario 2	26,777	120,096	89,083	78	2,461	2,461
2021 Scenario 3	19,701	119,664	60,218	56	703	703

OZONE RESULTS

2021 OTB CONTROL CASE: SPATIAL ANALYSIS

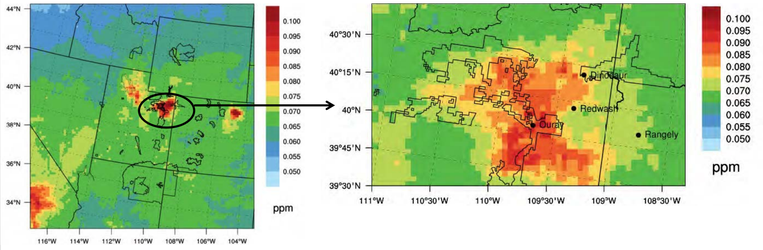

Figure 1: Spatial plots of the fourth highest daily maximum 8-hour average ozone concentrations in the 12-km domain (left) and in the Uinta Basin (right, using 4-km domain results) for the 2021 OTB Control case.

2021 OTB CONTROL CASE: INDICATOR RATIOS

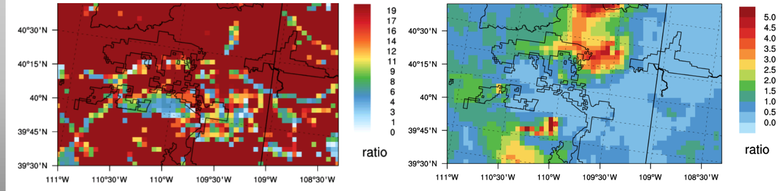

Figure 2: Spatial plots of NMHC:NOx (left) and HCHO:NOx (right) the Uinta Basin for the 2021 OTB Control case.

ALL SCENARIOS: WINTER CONCENTRATIONS

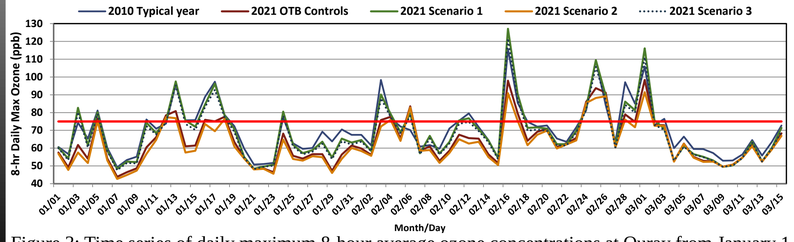

Figure 3: Time series of daily maximum 8-hour average ozone concentrations at Ouray from January 1 through March 15 for all model scenarios.

CHANGE RELATIVE TO 2021 OTB CONTROLS

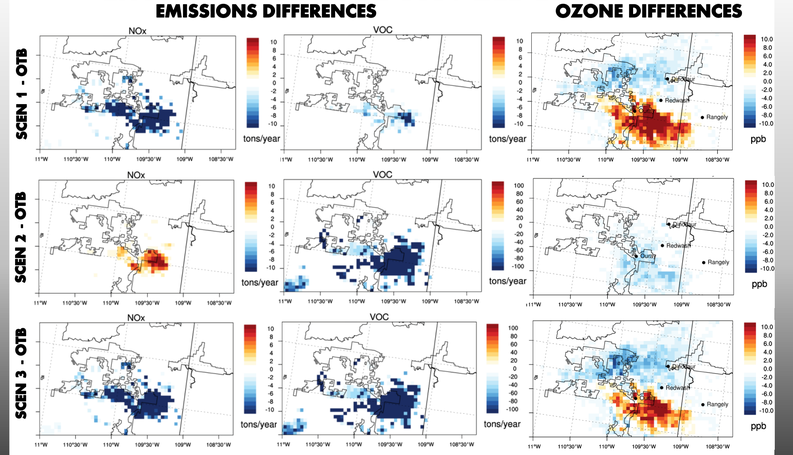

Figure 4: Spatial plots of NOx (left column) and VOC (middle column) emissions differences and the corresponding fourth highest daily maximum 8-hour ozone concentration differences (right column) relative to the 2021 OTB Controls for Scenario 1 (top row), Scenario 2 (middle row) and Scenario 3 (bottom row).

FINDINGS

- Depending on the emissions control scenario, the change in NOx emissions range from +2% to -25%, VOC emissions range from 0% to -13%, and other co-pollutants range from +23% to -65% relative to the 2021 OTB Controls scenario.
- Areas of elevated ozone concentrations (Figure 1) correspond with lower NMHC:NOx and HCHO:NOx ratios (Figure 2), indicating a radical-limited regime in 2021.
- Scenario 3 has the largest emissions reductions for all pollutants analyzed, but Scenario 2 has the largest reductions in ozone concentrations (Figures 3 and 4) relative to the 2021 OTB Controls scenario.
- Despite significant decreases in precursor emissions, the ozone response is quite low under Scenario 2 (3 ppb reduction) and ozone concentrations increase under Scenarios 1 and 3 (13 and 10 ppb, respectively) due to disbenefits from NOx controls as shown in Figure 4.
- All scenarios analyzed are predicted to exceed the ozone National Ambient Air Quality Standard if the level of development in the Uinta Basin continues as projected.