

3.058 Contrasting winter- and summertime ozone and organic aerosol contributions from the oil/gas sector emissions in the western US.

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Abstract:

Rapid development of oil and natural gas production across the United States in recent years has been associated with significant amounts of methane and other volatile organic compounds (VOCs) released to the atmosphere. The highest ground level ozone (O₃) concentrations during 2013 year within the entire country were detected in winter over a remote area, the Uinta Basin (UB) in Utah, which is densely covered by oil and natural

gas wells. During these pollution episodes significant levels of organic aerosol (OA) were also observed. In this study, we contrast wintertime UB O₃ and OA formation with summertime conditions over several shale basins. We use a coupled meteorology-chemistry model, WRF-Chem, to simulate air quality impact of the oil/gas sector emissions in both winter- and summertime conditions. In situ observations from the January-February 2013 UBWOS and June-July 2013 SENEX field studies are used for the WRF-Chem model evaluation as well as for emissions specification for the top-down approach. This method derives VOC and nitrogen oxides (NO_x) emissions from the oil/gas sector using methane (CH₄) emissions calculated from mass-balance along with ratios of VOC and NO_x to CH₄ determined from linear regressions. We compare results using this top-down approach with model simulations using the U.S. EPA NEI-2011 (version 2 for the oil/gas sector) national inventory, focusing on O₃ and OA formation. The WRF-Chem model can simulate high O₃ and OA concentrations in the UB during winter of 2013 using the top-down emission estimates. The model shows that oil/gas emissions contribute as much as ~80 ppb to daytime O₃ mixing ratios in the UB during wintertime. However, the WRF-Chem model results show only a small impact on overall summertime O₃ levels from the oil/gas activity emissions. We also discuss the contribution of the oil/gas emissions to secondary OA levels.