

1.193 Regional to Hemispheric Atmospheric Impacts of Oil and Natural Gas Development in the U.S..

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Abstract:

The development of hydraulic fracturing drilling techniques ('fracking') for oil and natural gas (O&NG) extraction has triggered a steep rise in drilling activity and O&NG production in the United States. Atmospheric emissions from these operations, including those of methane, volatile organic compounds (VOC), and nitrogen oxides, have become a concern for local and regional air quality and climate forcing on regional, continental, and global scales. Data collected from a series of field campaigns and year-round continuous monitoring in and near O&NG basins has yielded a rich data set for characterizing O&NG related emissions. Large scale impacts are reflected in observations from the NOAA-INSTAAR global VOC monitoring program, as well as from continuous monitoring at remote sites, such as at Summit, Greenland. Observed regional and hemispheric changes in absolute O&NG VOC concentrations, of VOC ratios, and in the methane to ethane ratio (MER) are indicative of changes in the contribution of emission sectors and O&NG producing regions. In the Northern Hemisphere, declining trends of O&NG VOC halted during 2005-2010, reversed to increasing concentrations during the U.S. O&NG boom until 2014, and have since been more inconsistent, possibly due to fluctuations in new drilling and production driven by the global O&NG market. Increases in O&NG VOC emissions can have a profound impact on regional surface ozone, in part offsetting emission reductions of ozone precursors made in mobile source and power generation sectors. O&NG emissions can result in elevated ozone not only during the summer ozone season, but also in the winter, when emissions accumulate in the shallow surface layer, with upwelling solar radiation from the snow surface further facilitating ozone production. Through modeling research we assess the relative contribution of O&NG emissions to exceedances of the ozone air quality standard in and near O&NG basins and downwind regions.