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NOx emissions from U.S. oil and gas production using TROPOMI NO_2 and the divergence method

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The development of horizontal drilling and hydraulic fracturing has led to a steep increase in the U.S. production of natural gas and crude oil from shale formations since the mid 2000s. Associated with this industrial activity are emissions of ground-level ozone precursors such as nitrogen oxides (NOx). Satellite data are important in this context, because surface measurements are limited or non-existent in rural regions, where most U.S. oil and gas production operations take place. Here we use TROPOMI NO_2 observations to study NOx emissions coming from oil and natural gas production sites. Applying the divergence method we quantify basin wide emissions from well pad fields and aim to push spatial and temporal resolution of this technique. The divergence was method introduced by Beirle et al. (Science Advances 2019) to quantify point source emissions. It relies on calculating the divergence of the NO_2 flux to derive NOx sources and estimating the NO_2 lifetime to quantify sinks. Our analysis will include an assessment of different methods to constrain the NO_2 lifetime, which becomes particularly important when applying this method to larger areas. Further we will compare our results with bottom-up derived emissions. Here we use the Fuel-based Oil & Gas (FOG) inventory that calculates NOx emissions based on fuel consumption. Initial results show good agreement for the Permian Basin (NM, TX) and we will expand our analysis to other U.S. basins.