Connecting the dots: NOx emissions along a West Siberian natural gas pipeline.

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New TROPOMI (Sentinel 5P) high quality satellite measurements of nitrogen dioxide (NO\textsubscript{2}) over snow-covered regions of Siberia reveal previously undocumented but significant nitrogen oxides (NO\textsubscript{x} = NO + NO\textsubscript{2}) emissions associated with the natural gas industry in Western Siberia. Besides gas drilling and natural gas power plants, also gas compressor stations for the transport of natural gas are sources of high amounts of NO\textsubscript{x} emissions, which are emitted in otherwise pristine regions. The emissions from these remote gas compressor stations are at least an order of magnitude larger than those reported for North American gas compressor stations, possibly related to less stringent environmental regulations in Siberia compared to the United States. This discovery was made possible thanks to a newly developed technique for discriminating snow covered surfaces from clouds, which for the first time allows for satellite measurements of tropospheric NO\textsubscript{2} columns over large boreal snow-covered areas. This results in 23% more TROPOMI observations on an annual basis. Furthermore, these observations have a precision four times better than nearly any TROPOMI observation over other areas and surfaces around the world. These new results highlight the potential of TROPOMI on Sentinel 5P as well as future satellite missions for monitoring small-scale emissions.