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Emissions from the Canadian oil sands: Merging aircraft and satellite observations to derive emissions of pollutants co-emitted with NO_x

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The Athabasca Oil Sands Region (AOSR) in Alberta, Canada is one of the largest sources of extractable oil in the world. To better understand its impact, Environment and Climate Change Canada led two intensive measurement campaigns, in 2013 (August to September) and 2018 (April to July). Each included airborne measurements in which dozens of species were measured using a variety of in situ instruments. In this presentation, a method is described in which these aircraft measurements were examined to find species that were well correlated with NO_x (the sum of NO and NO₂) in order to derive their annual emissions. The species found to have a good correlation with NO_x were black carbon, CO, HCN, HONO, CH₄, and SO₂. The annual emissions were found by applying individual species to NO_x ratios to the satellite-derived NO_x emissions from the TROPOspheric Monitoring Instrument (TROPOMI). The emissions derived in this way were compared with emissions reported to the National Pollutant Release Inventory (NPRI), as well as emissions derived from the aircraft measurements using the Top-down Emission Rate Retrieval Algorithm (TERRA). Additionally, Ozone Monitoring Instrument (OMI) NO_x emissions were used to estimate historical changes in species emissions over time, between 2005 and 2020.