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Can we assess Greenhouse Gas Emission trends in Canada's largest population center?

Felix Vogel (1), Doug Worthy (1), Stephanie Pugliese (2), Elton Chan (1), Douglas Chan (1), Jennifer Murphy (2), and Lin Huang (1)

(1) Environment and Climate Change Canada, CRD/CCMR, Toronto, Canada (felix.vogel@canada.ca), (2) University of Toronto, Department of Chemistry, Toronto, Canada

Globally, urban areas account for roughly two-thirds of global energy-related Greenhouse Gas (GHG) emissions and can be expected to further grow in importance in the future [IPCC, 2014]. These urban emissions are especially relevant for Canada, where over 60% of the population lives in a few large population centers and over 80% in urban areas [STATSCAN, 2017]. Understanding emission drivers and tracking future changes will be crucial if non-state actors like cities, as identified in the Paris-Lima action agenda, want to be efficient leaders in GHG mitigation action.
Despite the ambitious plans of the City of Toronto to reduce GHG emissions compared to 1990 levels by 30% in 2020 and 80% by 2050, the CDP-reported emissions have only decreased by 3% from 20.6MtCO_2e in 2013 to 20.0 MTCO_2e in 2017 [CDP, 2017], which highlights the need for precise long-term monitoring to track emission changes. Within the framework of the Integrated Global GHG information system (IG3IS) of WMO/UNEP researchers from academia and governments have come together to add the information provided by atmospheric measurements to this puzzle, to help improve GHG inventories and provide additional constraints on emission totals and trends [Decola et al., 2017].
We will present the results of our atmospheric observations of multiple GHGs and short-live climate pollutants that have been conducted in the Greater Toronto Area by ECCC over the past decade. Using the Radon tracer method [Levin et al., 1999] regional emission estimates for CH4 and N2O were calculated starting in 2006, which allow tracking annual and seasonal flux changes. Observations of carbon isotopes in CO_2 (13C and 14C) since 2008 reveal the importance of biospheric sources in this urbanized region as well as allows tracking the impact of different anthropogenic activities such as fuel burning in vehicles and natural gas burning typically for domestic heating. Trends and inter-annual changes of such combustion sources can also be constrained by ECCC's long-term black carbon monitoring program.
The interpretation of these observations is aided by using atmospheric transport models (FLEXPART and STILT) to assess the regions contributing to observed concentration enhancements. Furthermore, comparing observations to modelled concentrations of CO_2 using the same transport model, e.g. GEM-MACH with different emission prior maps (SOCE, FFDAS and EDGAR) can help reveal the strength and weaknesses of this emission data. An update on the progress towards a full data assimilation system for this region which will provide information to local stakeholders will also be given.

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