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Inter-comparison of MAX-DOAS Retrieved Vertical Profiles of Aerosol Extinction, SO_2 and NO_2 in the Alberta Oil Sands with LIDAR Data and GEM-MACH Air Quality Model.

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Understanding industrial emissions of trace gas pollutants in the Alberta oil sands is essential to maintaining air quality standards and informing public policy. Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measurements of trace gases can improve knowledge of pollutant levels, vertical distribution and chemical transformation. During an intensive air measurement campaign to study emissions, transport, transformation and deposition of oil sands air pollutants from August to September of 2013, a MAX-DOAS instrument was deployed at a site north of Fort McMurray, Alberta to determine the vertical profiles of aerosol extinction, NO_2 and SO_2 through retrieval from the MAX-DOAS spectral measurements using an optimal estimation method.
The large complement of data collected from multiple instruments deployed during this field campaign provides a unique opportunity to validate and characterize the performance of the MAX-DOAS vertical profile retrievals. Aerosol extinction profiles determined from two Light Detection and Ranging (LIDAR) instruments, one collocated and the other on a Twin Otter aircraft that flew over the site during the study, will be compared to the MAX-DOAS aerosol extinction profile retrievals. Vertical profiles of NO_2 and SO_2 retrieved from the MAX-DOAS measurements will be further compared with the composite vertical profiles measured from the flights of a second aircraft, the NRC-Convair 580, over the field site during the same measurement period. Finally, the MAX-DOAS retrieved tropospheric vertical column densities (VCDs) of SO_2 and NO_2 will be compared to the predicted VCDs from Environment and Climate Change Canada's Global Environmental Multi-scale - Modelling Air quality and Chemistry (GEM-MACH) air quality model over the grid cell containing the field site. Emission estimates of SO_2 from the major oil mining facility Syncrude Mildred Lake using the MAX-DOAS VCD results, validated through the detailed characterization above, will also be presented.