Supplementary Material to:

Low-cost electrochemical gas sensing of vertical differences in wintertime air composition (CO, NO, NO_2, O_3) in Fairbanks, Alaska

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Part S1: Estimation of NO_2 from measurements of NO_y and NO at the NCORE site.

During winter 2021, there were no DEC-EPA air quality measurements of NO_2 at the NCORE site. Instead, NO_2 is estimated from available air quality monitoring of NO_y and NO data, with $NO_2 = NO_y -$ NO, under the assumption that $NO_y \approx NO_x$. We justify this approach using DEC-EPA datasets of NO_x and NO_y from NCORE that are available for the period 2016-2019. Comparison of the reported NO_x and NO_y finds the R^2 is 0.99, and a linear regression on the three datasets yields $NO_y = 1.33+1.02{\times}NO_x$ (gray line), close to the 1:1 line (black), Figure S1. The strong agreement shows that NO_x can be largely approximated by NO_y in downtown Fairbanks, enabling to estimate NO_2 by NO_y-NO.

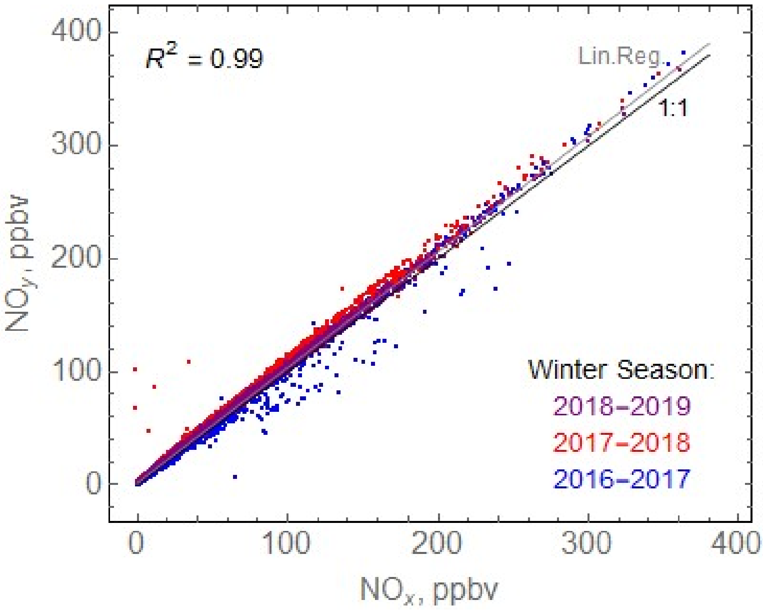

Figure S1: Scatter plot of NO_y versus NO_x measured by ADEC analysers at the NCORE site in Fairbanks during the winter seasons (November to February) of 2016-2017 (blue), 2017-2018 (red) and 2018-2019 (purple).

Part S2 : Ozone at the NCORE and CTC base site

The measurement of ozone at NCORE by the DEC analyser (Thermo 49iQ) exhibited some instabilities during winter 2021. To address this uncertainty and deliver an ozone dataset for sensor calibrations, we compared the NCORE dataset to concurrent ozone measurements made in February 2021 using a UV instrument (Dasibi 1008-RS O3 photometric analyzer) in a trailer at the CTC site. The two ozone monitoring datasets are highly correlated (R^2 = 0.93), but the NCORE dataset exhibits baseline drift and higher ozone maxima by about 5-10 ppbv during February. Linear correlation was used to provide a new ozone product using the CTC base ozone measurement as reference (with a potential 5-10 ppbv (20%) uncertainty), Figure S2. The approach delivers an improved ozone baseline stability than at NCORE and a more comprehensive time-coverage than the measurement at CTC base alone. This dataset is used as the air quality reference measurement for surface ozone at NCORE/CTC throughout the study.

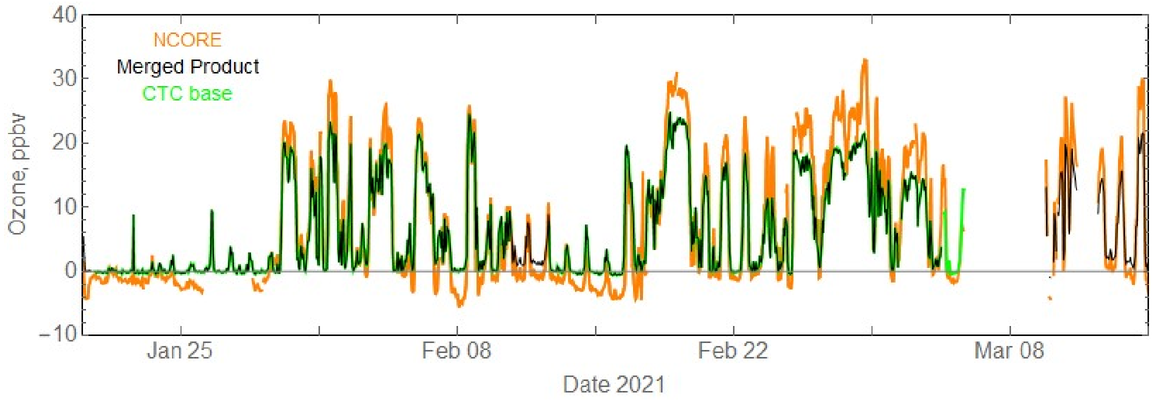

Figure S2 : Ozone measured by DEC using Thermo 49iQ at the NCORE site (orange) compared to ozone measured by Dasibi 1008-RS in a trailer at the CTC base site (green) during February 2021. These two datasets are used to derive a new ozone time-series (Merged product, black) with improved baseline stability compared to the NCORE measurement and larger time-coverage than the CTC base measurement.

Part S3:

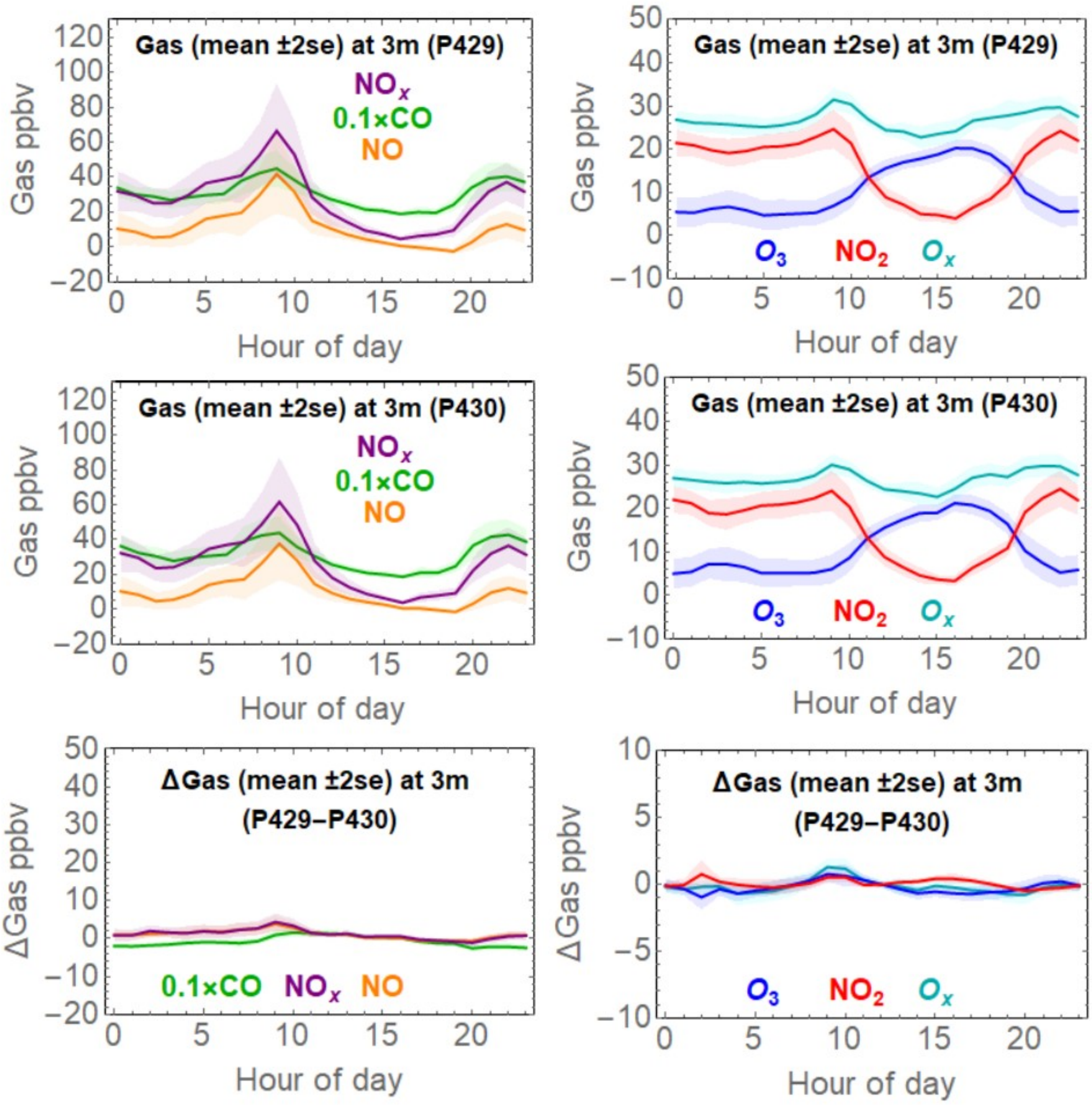

Figure S3. Same as Figure 6 but for the cross-calibration period 9March – 31 March when the low-cost electrochemical sensors were co-deployed next to each other at NCORE (both at 3m, measuring the same air mass). The first two rows show the air composition measurements by the two Praxis instruments containing the sensors (P429, P430). The final row shows the difference between the two instruments. Any observed ΔGas differences are small and reflect low (few ppbv) uncertainties in the low-cost sensor measurements.