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ICON – a new In-situ Capability for O_2/N_2 Measurements from airborne Platforms

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High-precision measurements of atmospheric oxygen, in combination with CO_2-measurements, allow partitioning of global oceanic and terrestrial sinks of anthropogenic carbon. In addition, local source/sink patterns can be identified from O_2/CO_2 signals since different combustion processes have different oxidative ratios. Airborne measurements are an important complement to the global network of surface stations, providing access to different spatial and temporal scales. Aircraft data can be used for evaluating atmospheric transport models as well as for getting detailed information on regional budgets. However, detecting the relevant (ppm-level) variations in atmospheric O_2 relative to the large background ($\sim$21%) is quite a challenge. Only few methods are able to realize the necessary precision, most of them requiring heavy instruments (e.g. mass spectrometers) not suited for the use on research aircrafts. Here we present a newly developed instrument which can perform in-situ measurements of atmospheric O_2 with the sufficient precision of few ppm. Concentration changes are detected by absorption of vacuum ultraviolet (VUV) radiation. The device is based on a single cell instrument developed by B.Stephens (NCAR), but has a completely different design adapted for the requirements of airborne use: With a weight of $<$15 kg and dimensions of (44 x 36 x 23) cm^3, it can be used onboard small research aircrafts. Additionally, due to low sample flows ($\sim$10 sccm/min) only small external reference tanks are required. A two-cell design allows for simultaneous measurement of sample and reference gas. Directly connected cell outlets and a pressure control based on matching the two cell pressures instead of stabilizing the absolute pressure make it possible to avoid complicated gas handling. In this study, we show first results from laboratory measurements with the device, indicating its achievable precision and

accuracy, temporal stability, reproducibility and the necessary calibration sequences.