(60-220422-C) **Progress Toward A NOAA Greenhouse Gas Commercial Aircraft Program**

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Over the last 15 years, NOAA's Global Monitoring Laboratory (GML) has been working to build a commercial aircraft greenhouse gas (GHG) measurement program, leveraging the work of existing analog programs from Japan [Comprehensive Observation Network for Trace gases by Airlines (CONTRAIL)] and Europe [In-service Aircraft for a Global Observing System (IAGOS)]. GML's recent participation in the 2021 Boeing ecoDemonstrator program led to several significant advancements toward solidifying the instrumentation, calibration system, inlet configuration and likely location of the instrumentation on the Boeing 737 aircraft. During this program, three Picarro 2401-m analyzers were flown in parallel pulling air samples from three different candidate inlet configurations, two of which have been used by the IAGOS and CONTRAIL programs. A third inlet used by NOAA's Water Vapor Sensing System (WVSS II) was also tested offering a robust alternative to the two other inlets because it is flush mounted on the fuselage eliminating the need for heating and the potential for damage during regular operations. After 260 hours of flying during 68 different flights, the three different inlets showed remarkable compatibility throughout the normal flight profiles. Major differences were shown from the engine bleed air configuration used by CONTRAIL for water vapor and carbon monoxide (CO) measurements, as expected. Smaller differences were shown during profiles between ground level and 12000 m above sea level between the flush mounted and Rosemount inlets. Identifying a viable inlet design is a critical step in the long-term effort by NOAA to build a commercial aircraft measurement network focused on constraining natural and anthropogenic emissions of CO_2 and CH_4 as well as developing a dataset that can be used to evaluate the fidelity of satellite retrievals and model simulations of GHGs. The NOAA commercial aircraft network will have three initial foci: 1) Constraining changes in the Arctic carbon cycle; 2) Evaluation of emissions from metropolitan regions serviced by mid-sized aircraft and 3) the tropics where a lack of data and significant human impact on the biosphere has resulted in large uncertainties in present and future emissions estimates.

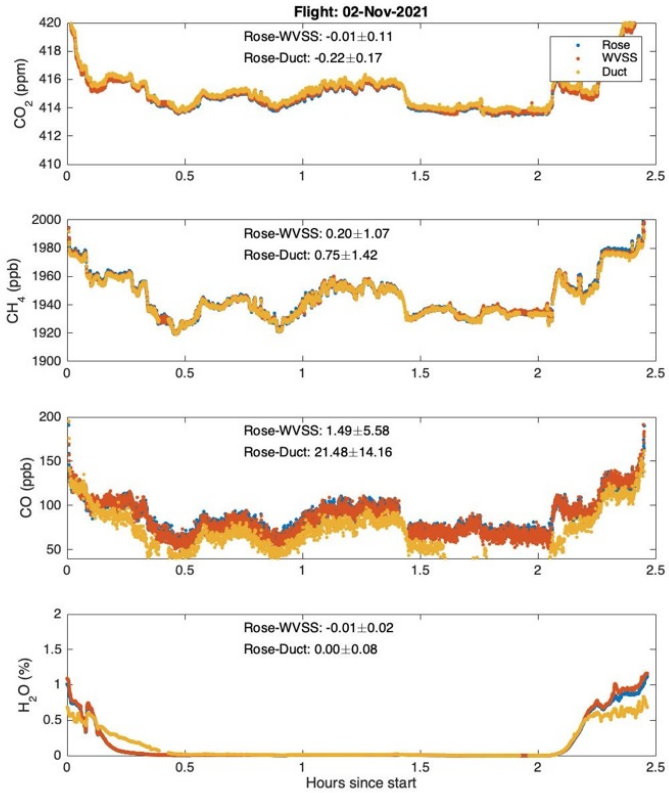

Figure 1. Inlet comparison on EcoDemostrator project - Carbon dioxide and methane being pulled from Rosemount (blue), flush mount (red) and engine bleed air (yellow) inlets show a very good match during flight on November 2, 2021 (average bias of <0.22 ppm for CO_2 and <0.75 ppb for CH_4). Carbon monoxide and water vapor measurements comparison between inlets was not as good between Rosemount and engine bleed air showing significant offsets relative to the comparison between Rosemount and flush mounted inlet.