

WB57 NO, NO_y, O₃ Instrument

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The instrument has four channels capable of simultaneous measurements of nitric oxide (NO), total reactive nitrogen (NO_y) and ozone (O₃). The basic detection scheme for each channel is the monitoring of the chemiluminescence from the reaction of NO and O₃ using dry-ice cooled red-sensitive photomultipliers. For NO detection excess O₃ generated in the instrument is the reagent gas while for O₃ detection excess NO from a moderately high pressure cylinder is the reagent gas. Total reactive nitrogen is detected as NO using a Au/CO converter operated at 300° C. The reactive nitrogen channels are calibrated in-situ using an on-board calibration gas cylinder of NO in N₂ and by near-complete titration of this NO calibrant to NO₂. The O₃ channel is calibrated on the ground using a UV absorption reference instrument. (See Ridley et al., *J. Geophys. Res.*, 101, 20985, 1996 for details of a similar instrument.) Data is accumulated at 1-sec intervals. The sensitivity of the channels to NO and NO_y is near 8 counts/sec/pptv and the precision of a 1-sec measurement is near ±15 pptv. The sensitivity of the O₃ channel is near 2000 counts/sec/ppbv and the precision is better than 0.1 ppbv. The overall estimated uncertainty of a 1-sec measurement of NO, NO_y, and O₃ is ±(15 + 7% of the mixing ratio) pptv, ±(15 + 9% of mixing ratio) pptv, and ±(0.1 + 5% of mixing ratio) ppbv, respectively. The instrument with vacuum pump, gas supplies, and data acquisition and control system occupies most of a standard WB57 pallet.

For the CRYSTAL FACE program the instrument is being modified to use one channel for NO, two detection channels to measure NO_y with a forward-facing and an aft-facing inlet similar to what we used during the NASA SUCCESS program (Weinheimer et al., *Geophys. Res. Lett.*, 25, 1725, 1998), and possibly the remaining channel for measurement of O₃. This configuration will provide a measurement of the reactive nitrogen content in ensembles of larger particles, for example cirrus cloud particles. The air sampling inlet is also being substantially modified to incorporate the forward and aft facing NO_y converter inlets and to provide sampling from below the bottom of the pallet.

The instrument was flown for the first time during the fall 1999 WB57 ACCENT missions from Ellington Field located south of Houston, Texas. Only two channels were operated for measurements of NO and NO_y. Figure 1 shows results from a flight from Texas south to 5° N and the landing in Costa Rica. After ascent, the aircraft flew south at constant altitude (~16 km), at nearly constant potential temperature and just below the tropopause. Very “clean” conditions were encountered for the first part of the flight, a result of encountering convection from the remote marine Pacific boundary layer. At latitudes farther south convection from continental sources to just below the tropical

tropopause caused substantial increases in the reactive nitrogen constituents and many other tracers (not shown) emitted from near the surface.

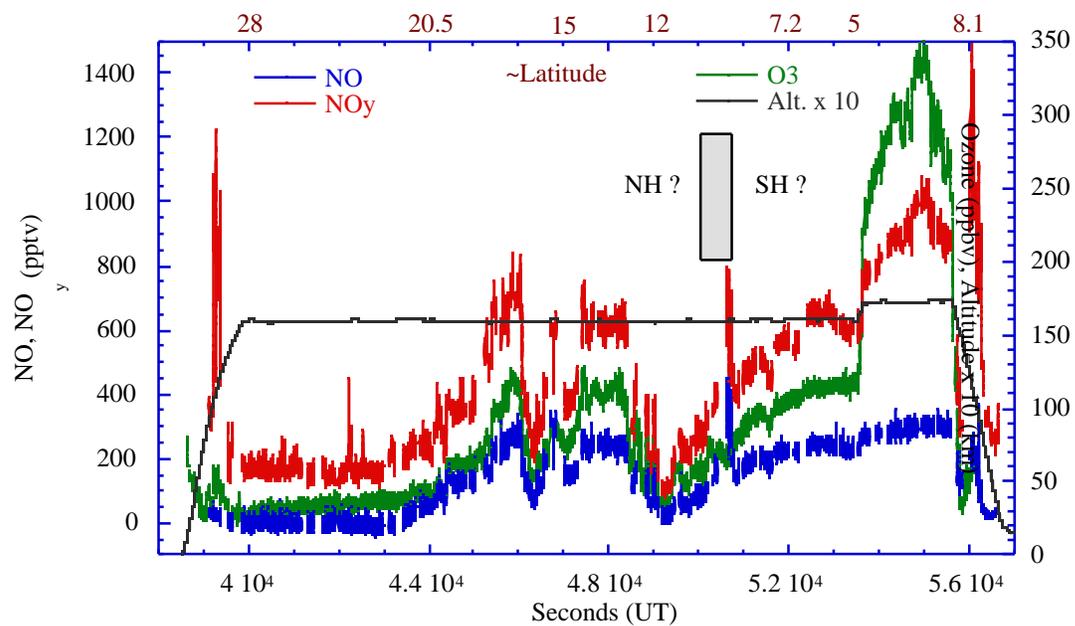


Fig 1 ACCENT flight 990920 from Texas to Costa Rica. The ozone data is from the NOAA UV instrument (E. Richard).