In Situ Measurements of NO, NO$_2$, NO$_y$, O$_3$

on the P3 in DISCOVER-AQ

Using the NCAR 4-channel Chemiluminescence Instrument

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Four sample flows, each employing the chemiluminescent reaction:

\[ \text{NO} + \text{O}_3 \rightarrow \text{NO}_2^* + \text{O}_2 \]

For NO, reagent O$_3$ is added to the flow of ambient air. Photons are counted.

For NO$_2$, ambient air flow through a photolysis cell to convert NO$_2$ to NO.

For NO$_y$, ambient air flows through a heated gold catalyst to convert NO$_y$ species to NO.

For O$_3$, reagent NO is added to flow of ambient air.
Detection limits 1-s, 1-sigma:
NO: 20 pptv
NO\textsubscript{2}: 30 pptv
NO\textsubscript{y}: 20 pptv
O\textsubscript{3}: 0.04 ppbv

Overall uncertainty, well above DL:
NO: 10%
NO\textsubscript{2}: 10-15%
NO\textsubscript{y}: 10%
O\textsubscript{3}: 5%

Time response:
NO\textsubscript{y}, O\textsubscript{3}: \sim 1 sec
NO, NO\textsubscript{2}: \sim 3 sec previously; better for DISCOVER-AQ

Data reported at 1 sec.
As flown on C130 for MIRAGE / INTEX-B. Similar for ARCTAS on DC-8.
Three modifications underway:

(1) Reconfigure to fit into 2 standard P3 racks. Necessary to fit through the door of the P3.

(2) Improved NO$_2$ photolysis with new LEDs. Will improve frequency response.

(3) Program for autonomous operation (as for prior use on B57).

Timeline:

• Start building up the racks in November

• Complete modifications then start testing February 1
Plans, concerns for integration:

• Intent is to install the pair of racks as a single unit, so as to avoid disconnections. Requires nothing sticking out front/back.

Plans for data analysis:

• Quick-look reduction hours after flight. Should be good when mixing ratios high. Final data n months later.

• Column NO$_2$, O$_3$ for comparison with satellites.
Thank You

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To advance understanding of weather, climate, atmospheric composition and processes;
To provide facility support to the wider community; and,
To apply the results to benefit society.

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