PREDICT In Situ Ozone: Instrument Perfromance, Data Status, and Preliminary Observations

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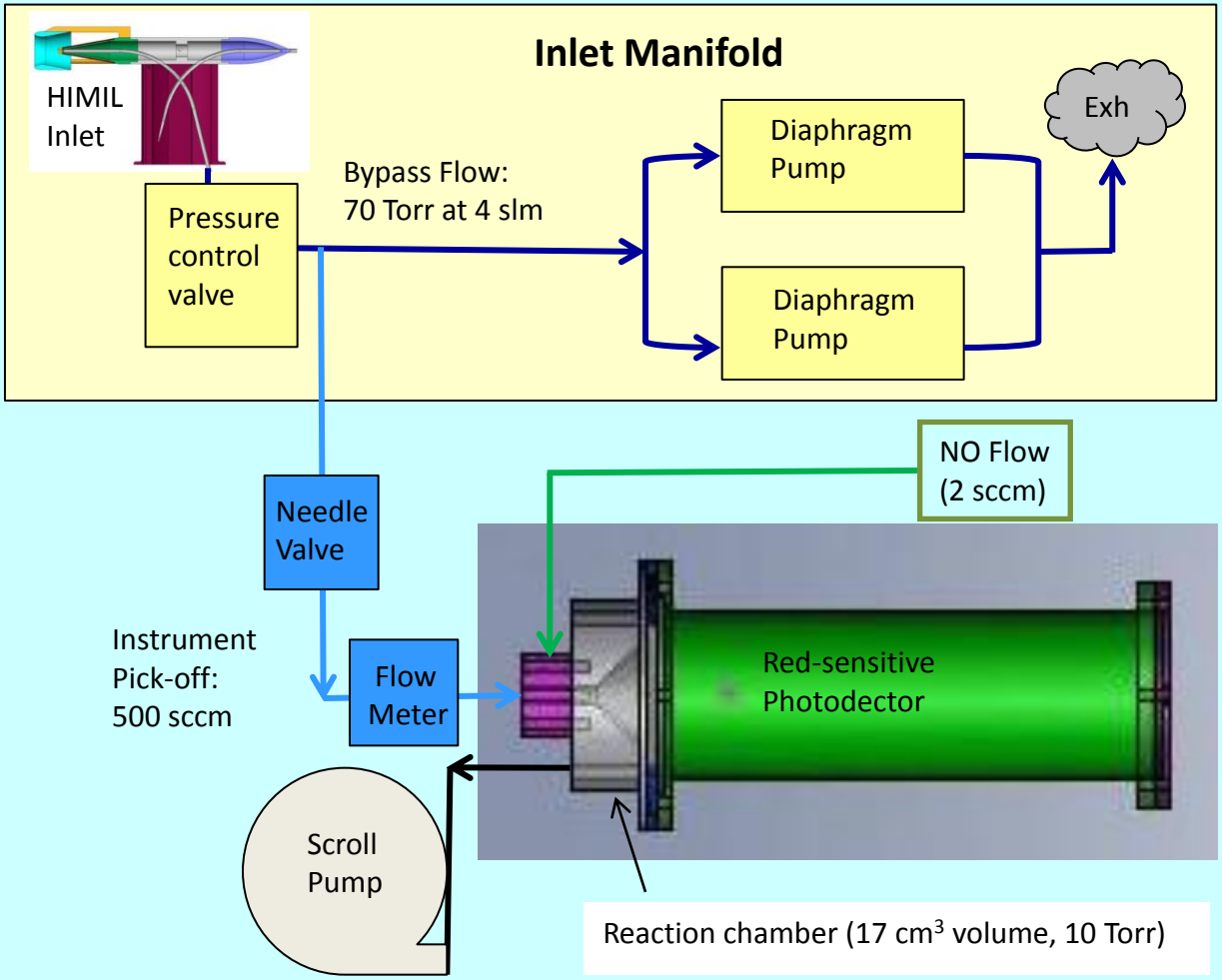
Instrument Configuration



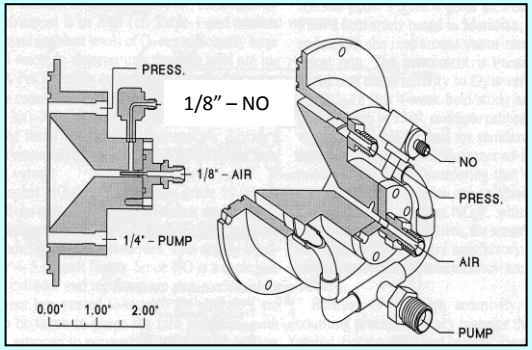
Relevant Chemical Reactions:

$O_3 + NO \rightarrow NO_2^* + O_2$

$\rightarrow NO_2 + O_2$

$NO_2^* \rightarrow NO_2 + h\nu$ (600 nm < λ < 2800 nm)

$NO_2^* + M_i \rightarrow NO_2 + M_i$



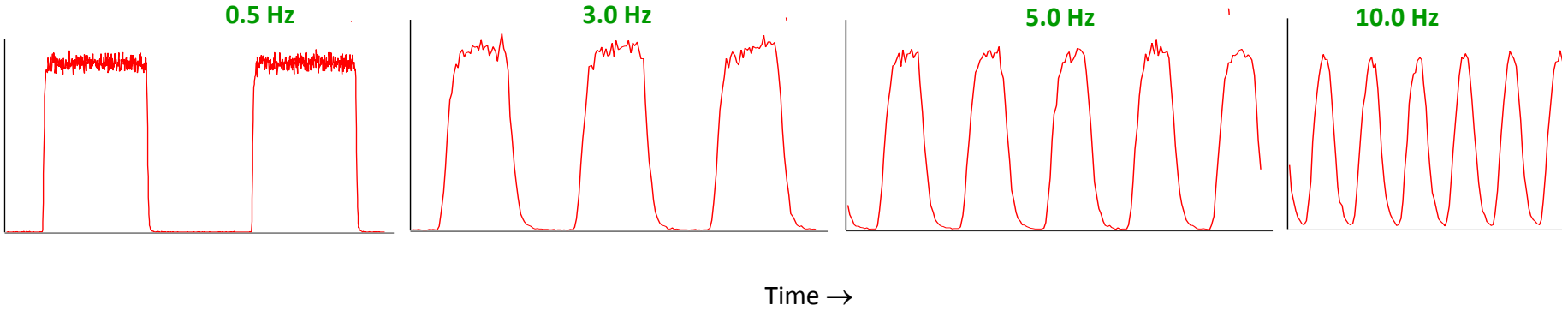
	1 Hz, Δt = 1 sec	5 Hz, Δt = 0.2 sec
Sample flow (sccm)	180	500
Reaction Vessel Press, Temp	10 torr, 35°C	10 torr, 35°C
Plug flow "Flush" frequency	15 Hz	42 Hz
Pure NO flow (sccm)	1.5	4
Background (counts per Δt)	<500	<100
Sensitivity (counts per Δt per ppbv)	2000	400
Signal/Noise (S/N) at 20, 100 ppbv O_3	900, 4500	400, 2000
Precision at 20, 100 ppbv	0.10, 0.22 ppbv	0.22, 0.50 ppbv

S/N = (signal-background)/2(background)$^{1/2}$

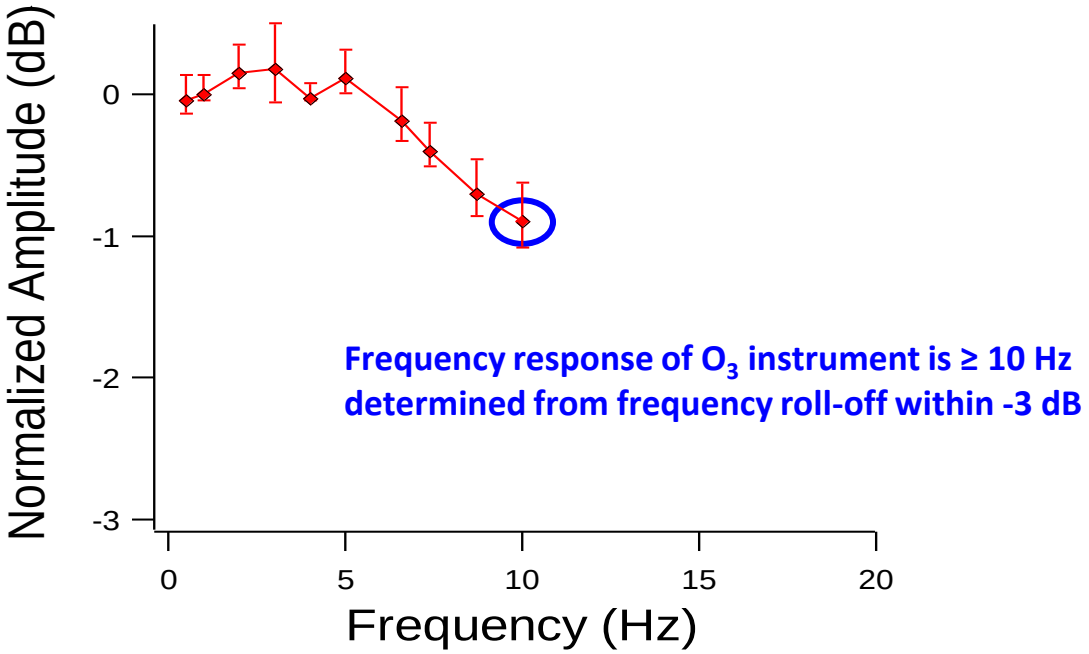
Accuracy and Overall Uncertainty:

- Multipoint calibrations
  - 5-7 repetitions over the course of the 6-week field phase
  - linear regression parameters have a 2% standard deviation normally distributed about their mean
- TEI UV absorbance calibrator
  - uncertainty of ±1 ppbv
- Overall uncertainty of fast-O_3 estimate:
  - ± (1 ppbv + 2% * O3MR)

Laboratory Evaluation of Frequency Response



Time series plots of the observed O_3 square wave with the wave generator set at 0.5, 3.0, 5.0, and 10.0 Hz



Data Coverage and Processing Plan

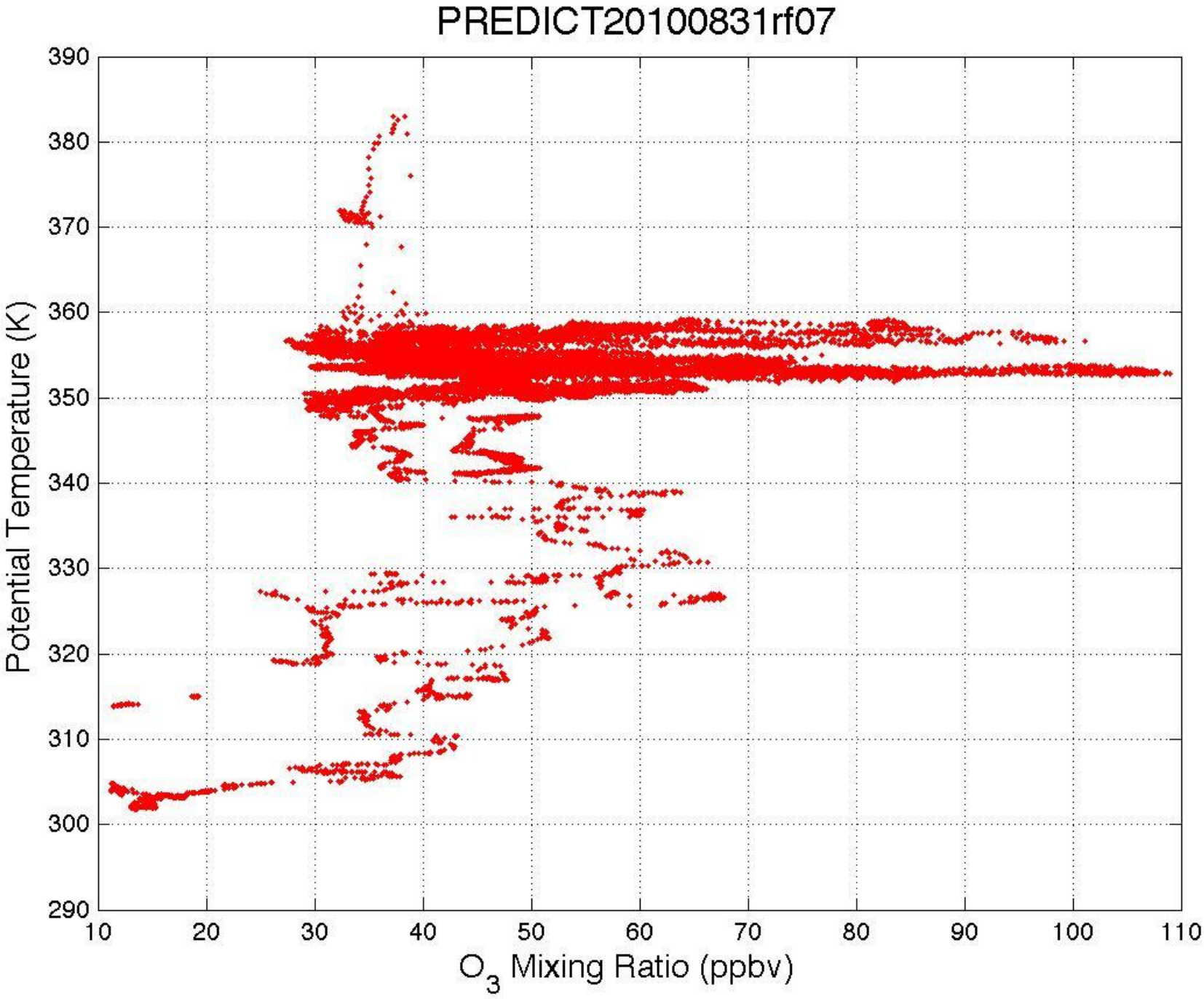
- High Quality data obtained for 25 of 26 research flights
  - Inoperative during RF19, September 14, 2010

- Real-time data has level one quality, accurate to within about 10% percent

- Final data processing tasks:
  - application of final calibrations
  - synchronization with other in situ variables (VCSEL hygrometer likely)
  - correction for water vapor (up to 10% in the marine boundary layer)
  - removal in-flight zeroes

- Completion of 1-second time resolution data processing is scheduled for September 1, 2011

- High rate data (25 sps) can be made available on request and likely ready by end of the calendar year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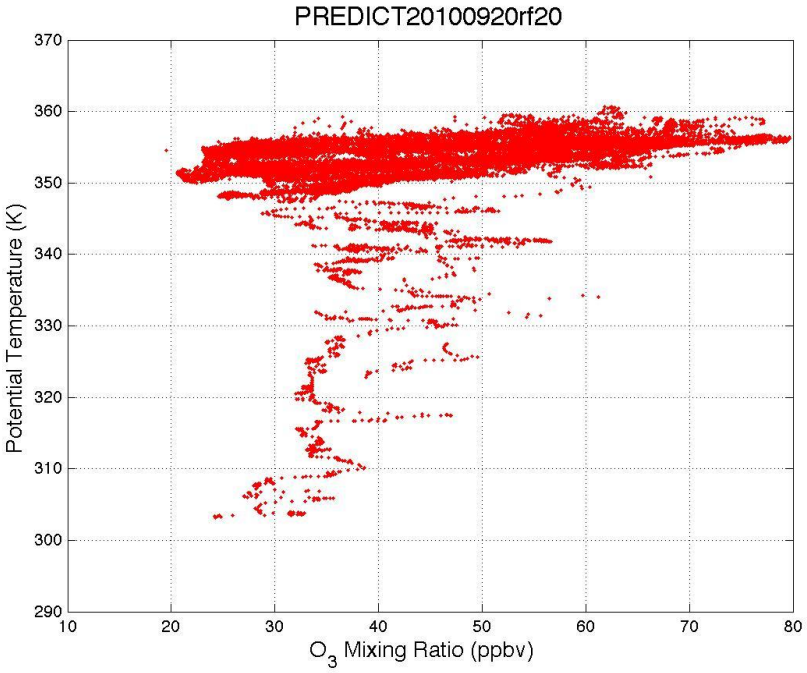
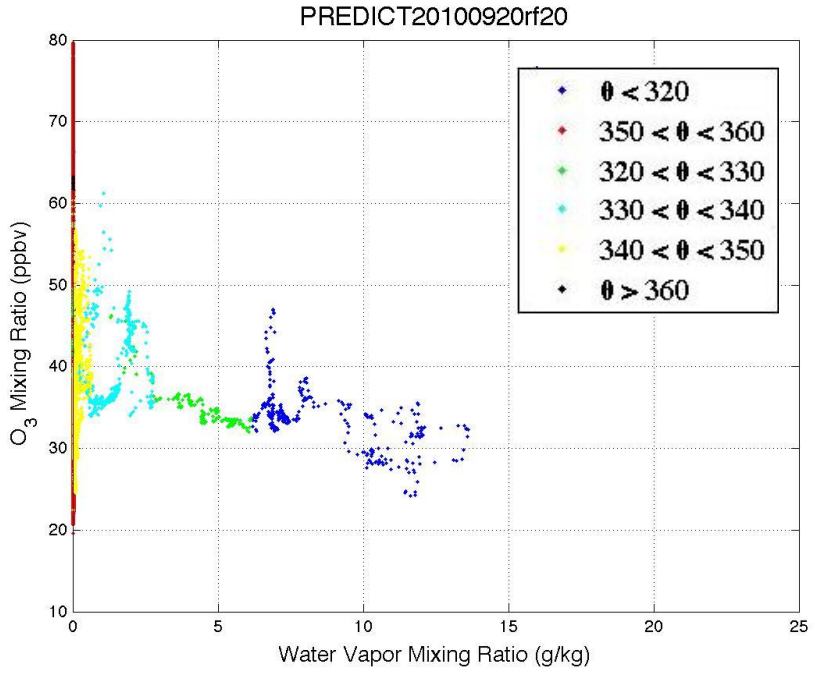
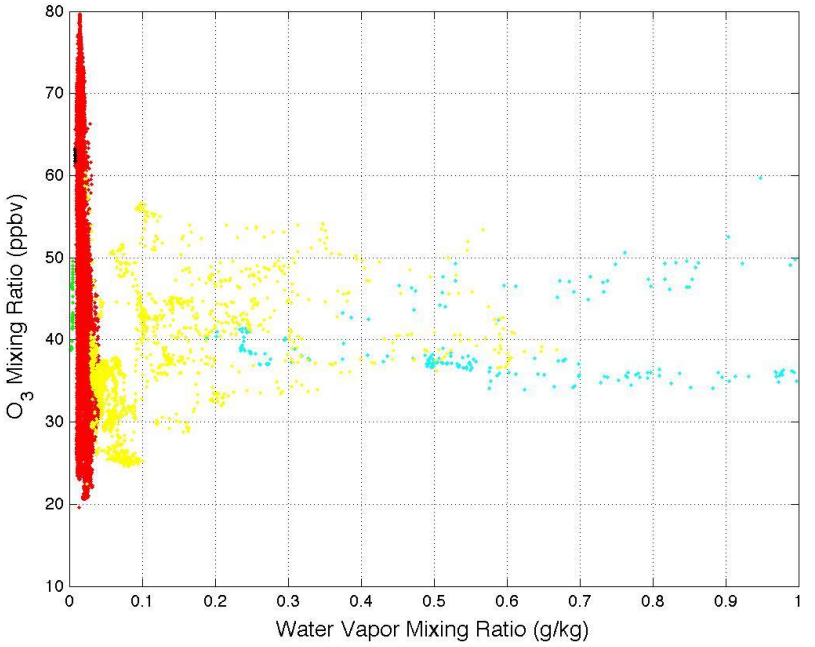
Potential Temperature (K)
390
380
370
360
350
340
330
320
310
300
290
10
20
30
40
50
60
70
80
90
100
110
O3 Mixing Ratio (ppbv)

Preliminary Observations: Vertical Profiles and $O_3 - H_2O$ Correlations







Preliminary Observations: Vertical Profiles and O_3 – H_2O Correlations