CU LED-CE-DOAS: a fast optical sensor for NO2, IO, glyoxal, water, aerosol extinction

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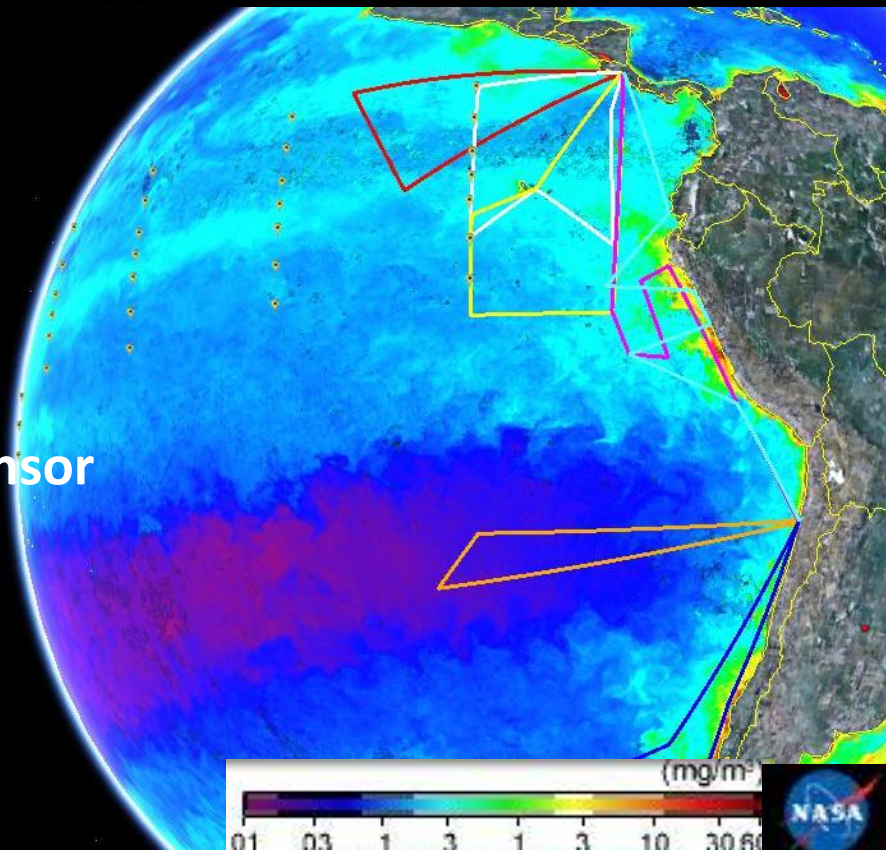
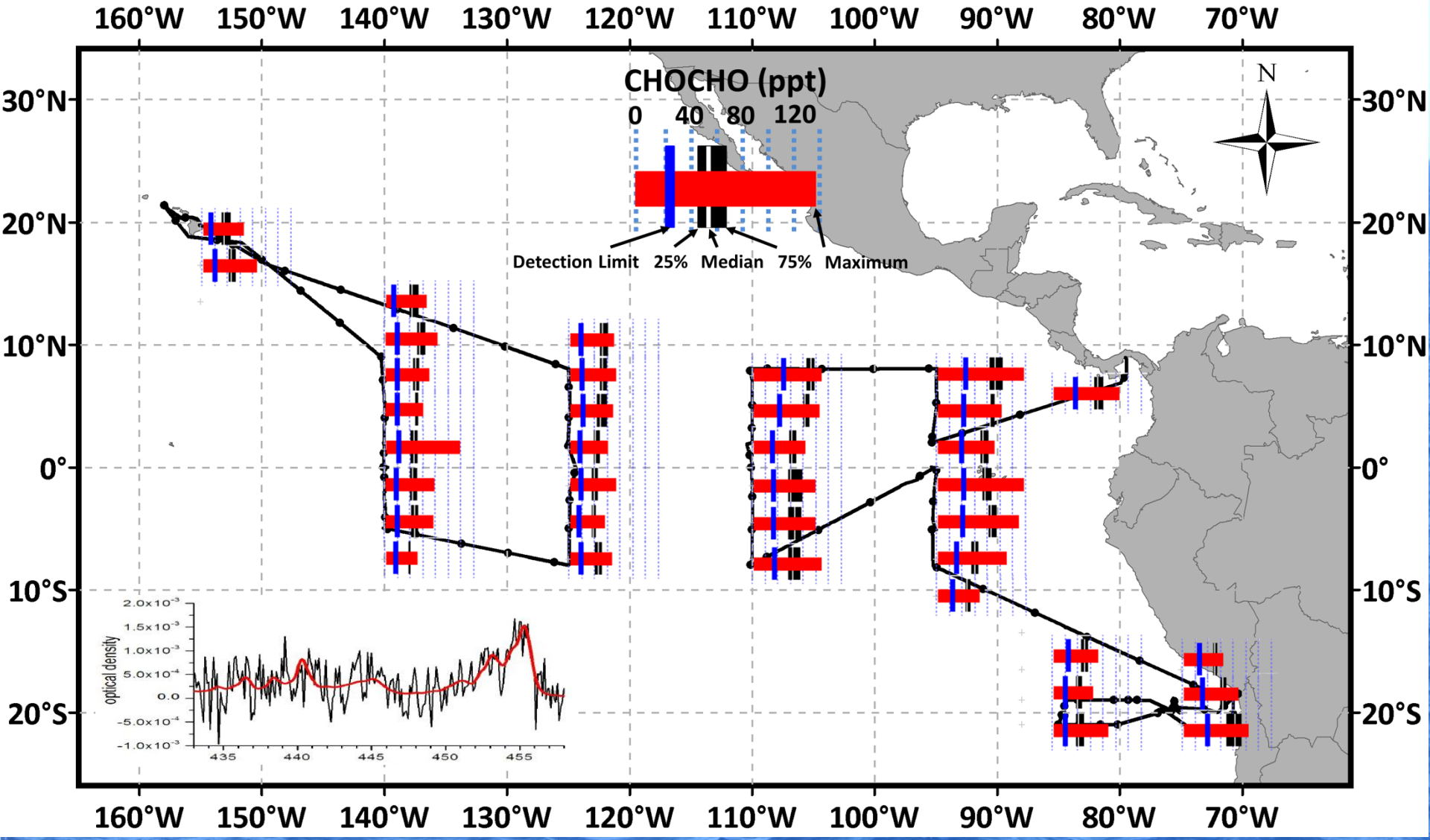
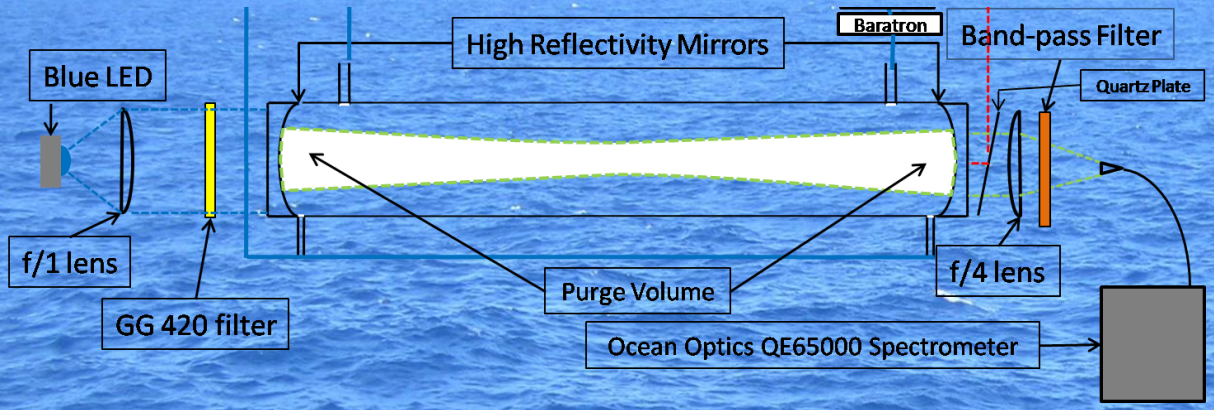
- **Instrument description**
- **KA-11-04 cruise preliminary data**
- **Laboratory characterization of fast sensor**
- **TORERO Hypothesis**

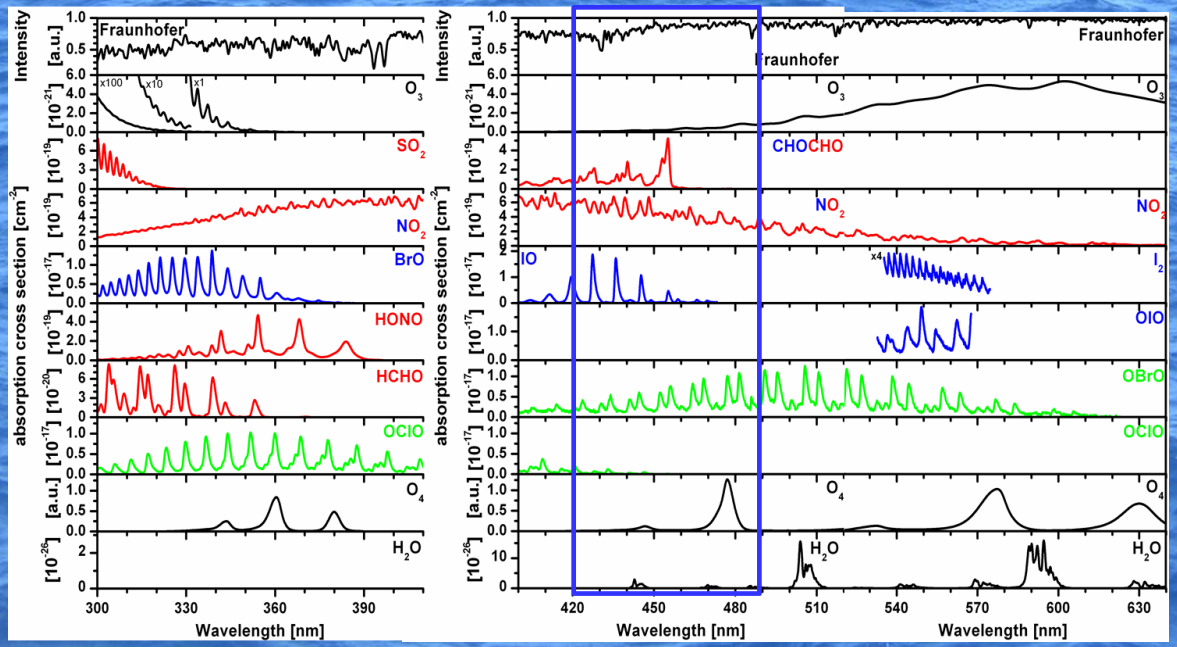




- MAX-DOAS data from four cruises in 2008-2009
- Sinreich et al., 2010, ACP: Daytime only data
- What is the diurnal cycle?

Light Emitting Diode Cavity Enhanced DOAS (CU LED-CE-DOAS)



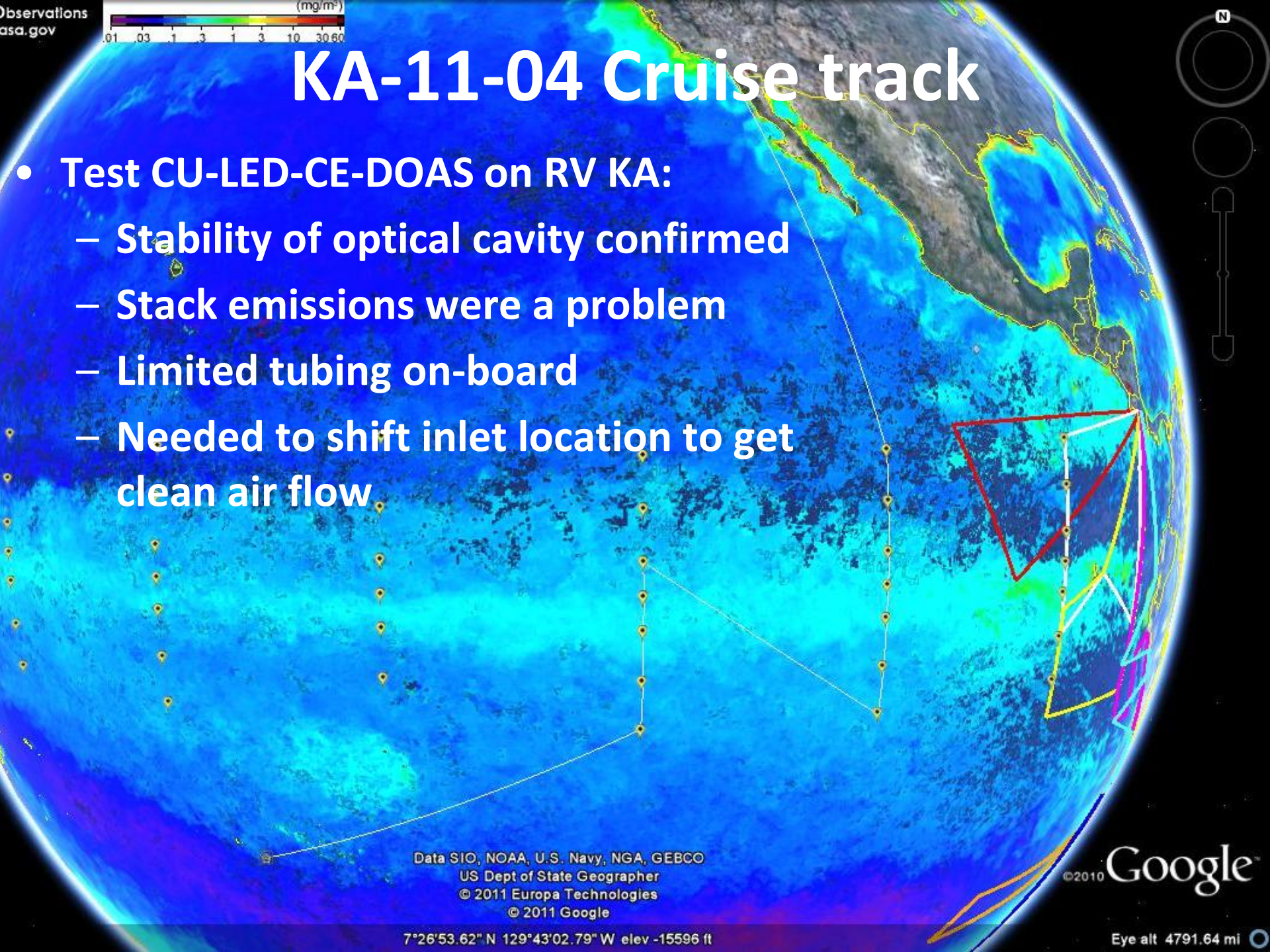


420-490nm,
R(460nm) =0.999965
L_{eff}= 13-17km
QE65000
0.5 nm FWHM

Thalman and Volkamer, 2010, AMT

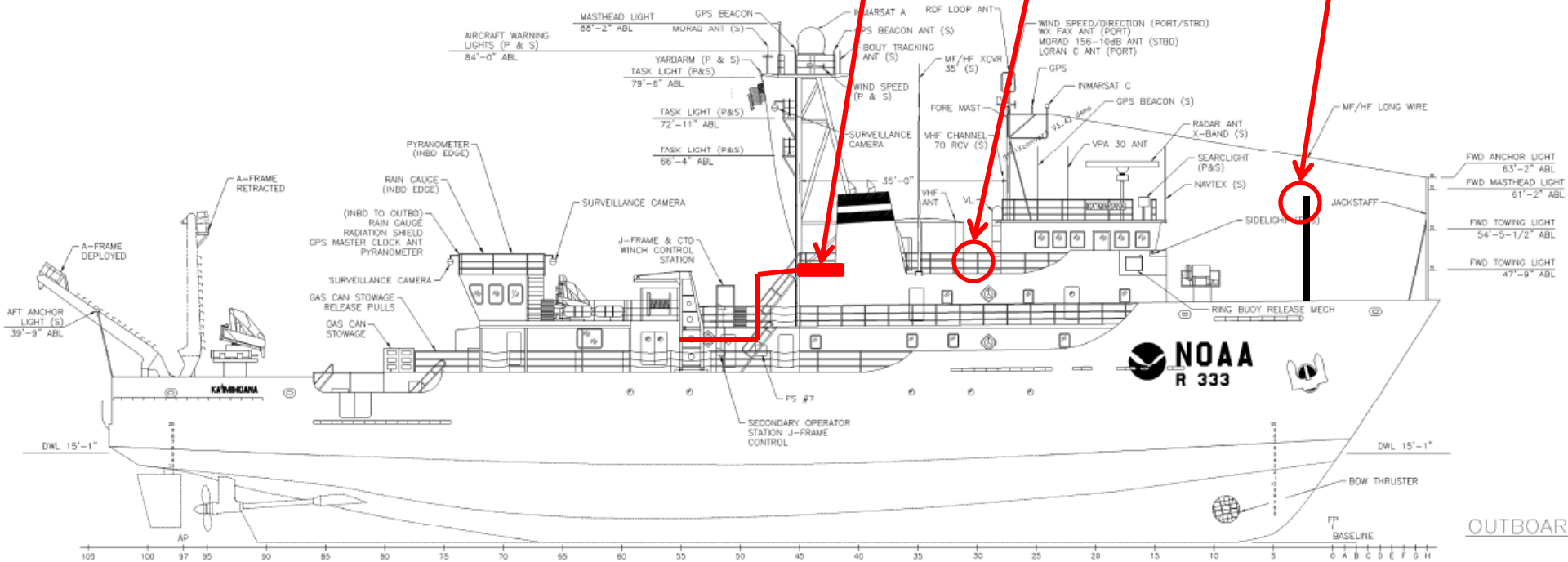
KA-11-04 Cruise track

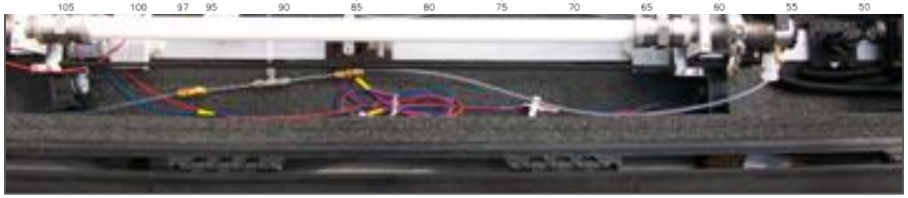
- Test CU-LED-CE-DOAS on RV KA:
  - Stability of optical cavity confirmed
  - Stack emissions were a problem
  - Limited tubing on-board
  - Needed to shift inlet location to get clean air flow



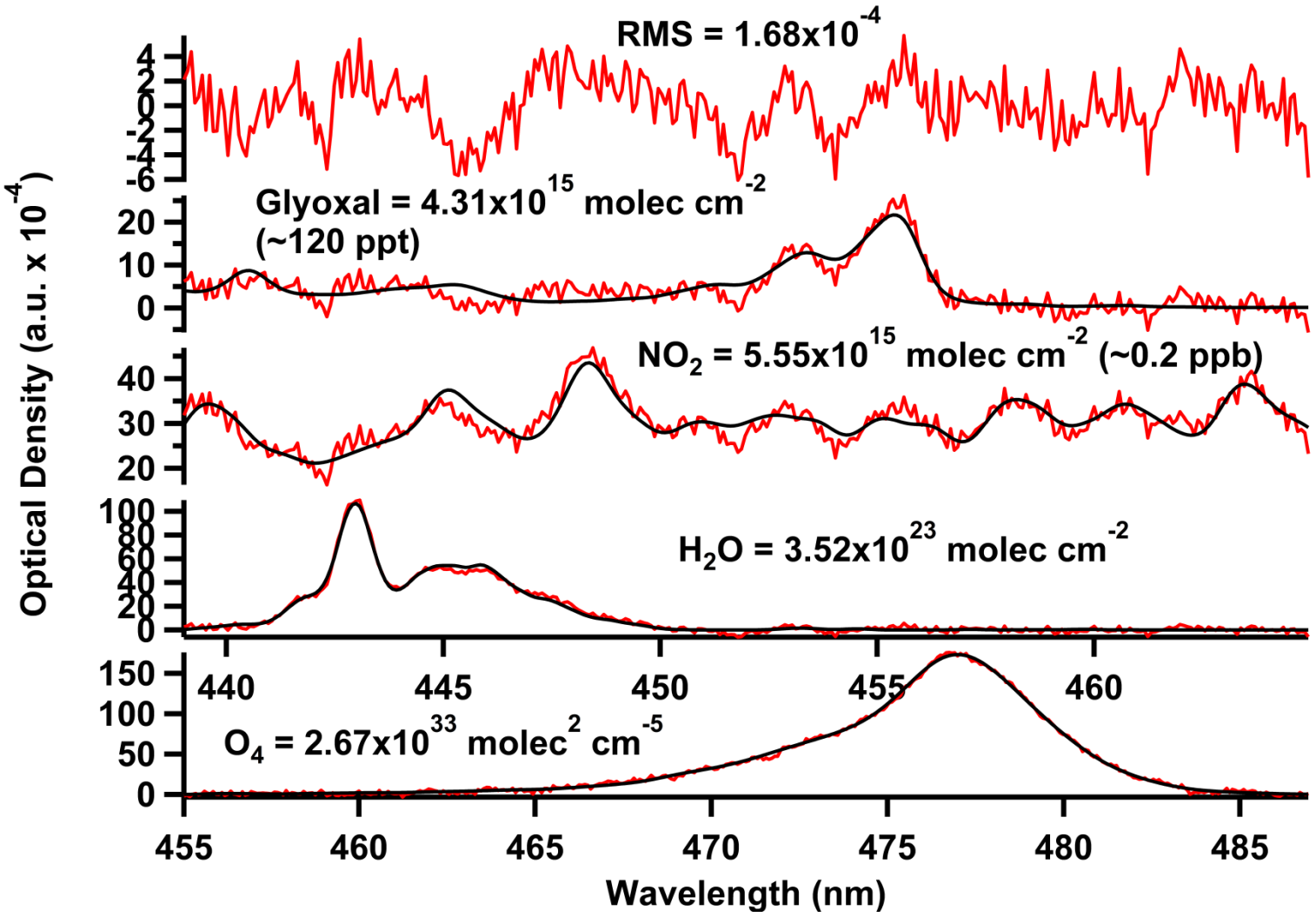
Setup on KA


Cavity
Inlet KA-11-04
Inlet KA-12-01

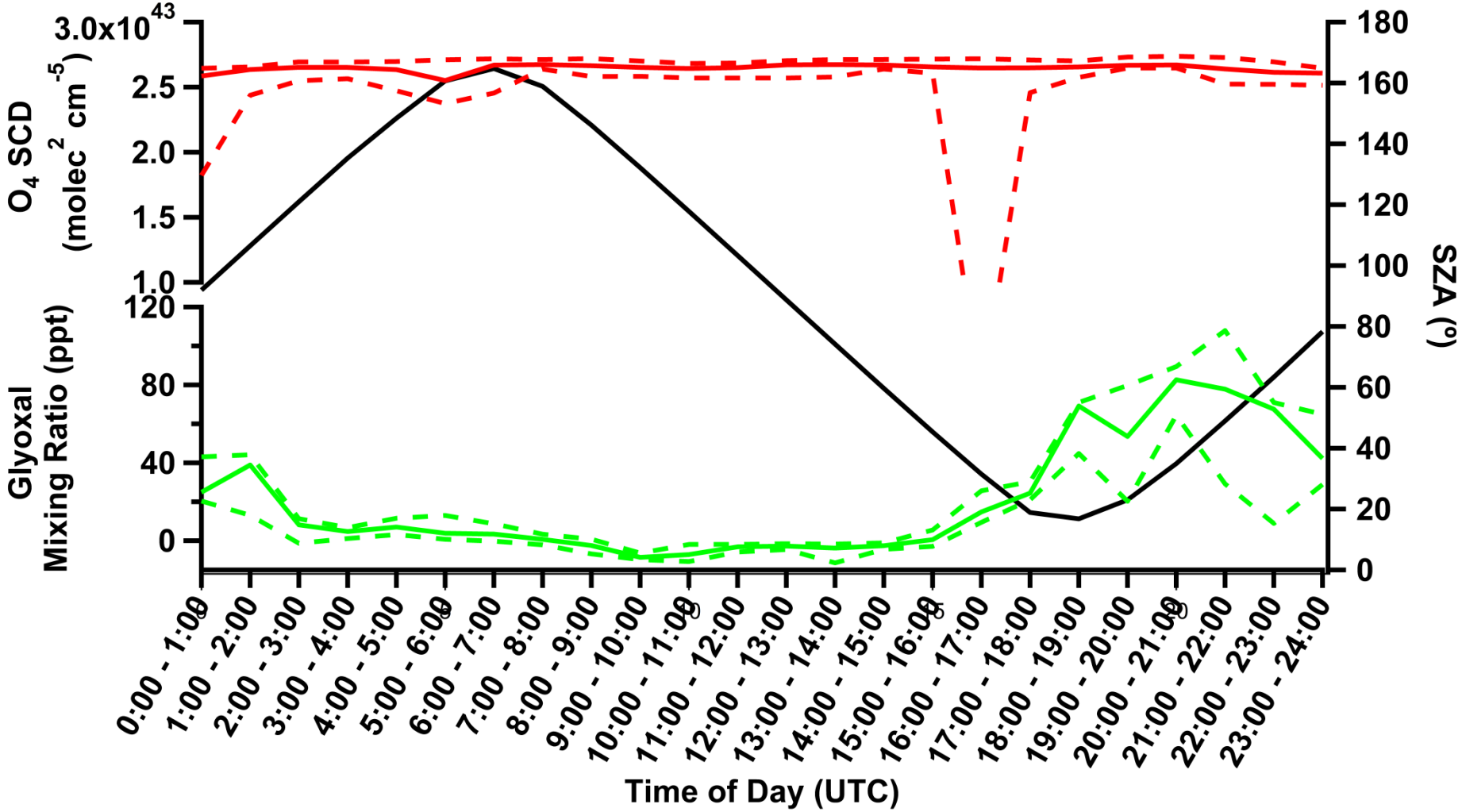

MASTHEAD LIGHT
86'-2" ABL
GPS BEACON
AIRCRAFT WARNING LIGHTS (P & S)
84'-0" ABL
YARDARM (P & S)
TASK LIGHT (P&S)
79'-6" ABL
TASK LIGHT (P&S)
72'-11" ABL
TASK LIGHT (P&S)
66'-4" ABL
INMARSAT A
RDF LOOP ANT
GPS BEACON ANT (S)
BUOY TRACKING ANT (S)
MF/HF XCVR
35' (S)
WIND SPEED (P & S)
SURVEILLANCE CAMERA
FORE MAST
VHF CHANNEL 70 RCV (S)
35'-0"
VHF ANT
VL
WIND SPEED/DIRECTION (PORT/STBD)
WX FAX ANT (PORT)
MORAD 156-10dB ANT (STBD)
LORAN C ANT (PORT)
GPS
INMARSAT C
GPS BEACON (S)
RADAR ANT X-BAND (S)
VPA 30 ANT
SEARCHLIGHT (P&S)
NAVTEX (S)
MF/HF LONG WIRE
JACKSTAFF
SIDELIGHT (S)
FWD ANCHOR LIGHT
63'-2" ABL
FWD MASTHEAD LIGHT
61'-2" ABL
FWD TOWING LIGHT
54'-5-1/2" ABL
FWD TOWING LIGHT
47'-9" ABL
A-FRAME RETRACTED
A-FRAME DEPLOYED
AFT ANCHOR LIGHT (S)
39'-9" ABL
PYRANOMETER (INBD EDGE)
RAIN GAUGE (INBD EDGE)
(INBD TO OUTBD) RAIN GAUGE RADIATION SHIELD GPS MASTER CLOCK ANT PYRANOMETER
SURVEILLANCE CAMERA
GAS CAN STOWAGE RELEASE PULLS
GAS CAN STOWAGE
SURVEILLANCE CAMERA
J-FRAME & CTD WINCH CONTROL STATION
RING BUOY RELEASE MECH
NOAA
R 333
KA'IMIMOANA
FS #7
SECONDARY OPERATOR STATION J-FRAME CONTROL
DWL 15'-1"
DWL 15'-1"
BOW THRUSTER
AP
FP
BASELINE
OUTBOAR



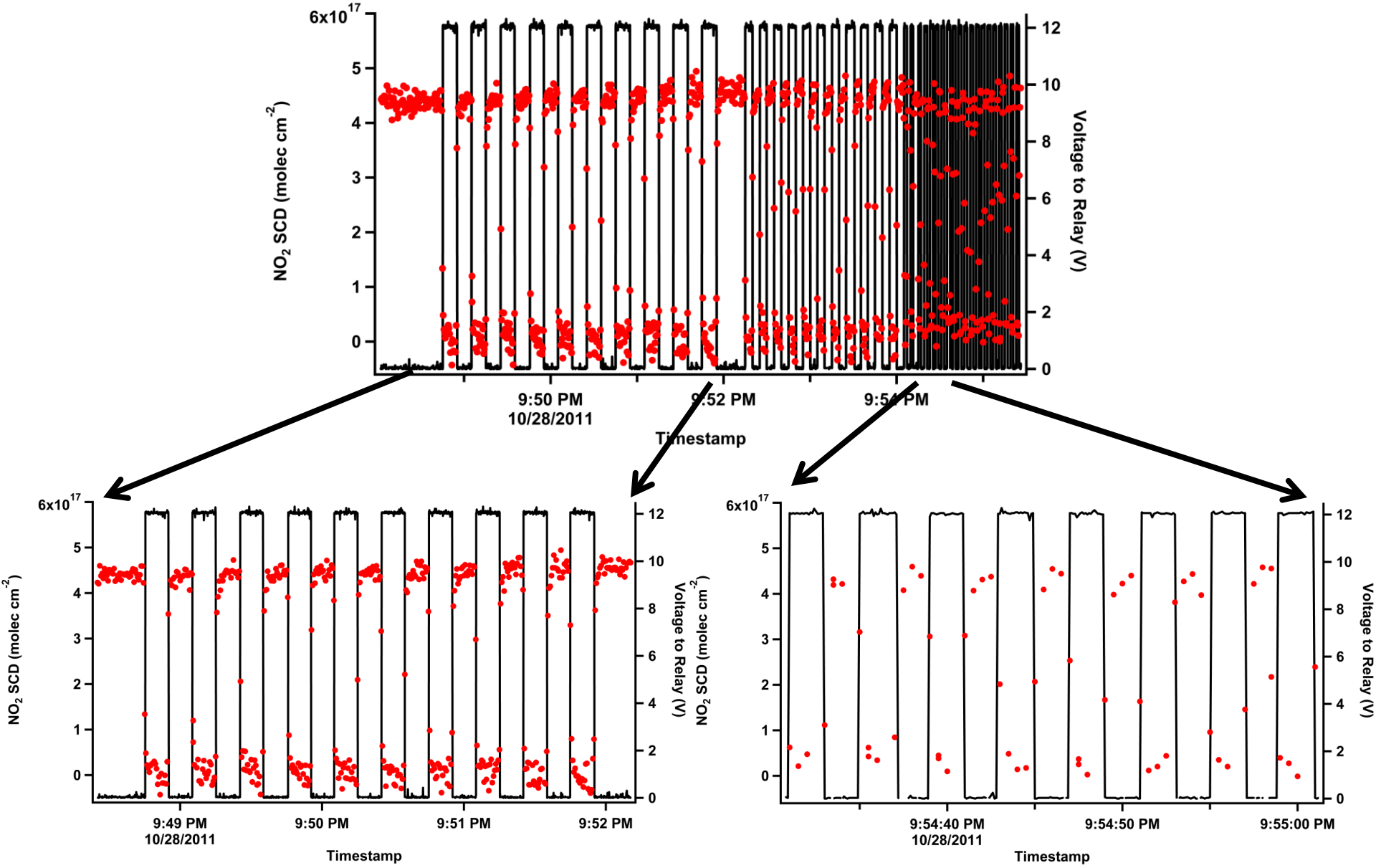
Spectral proofs



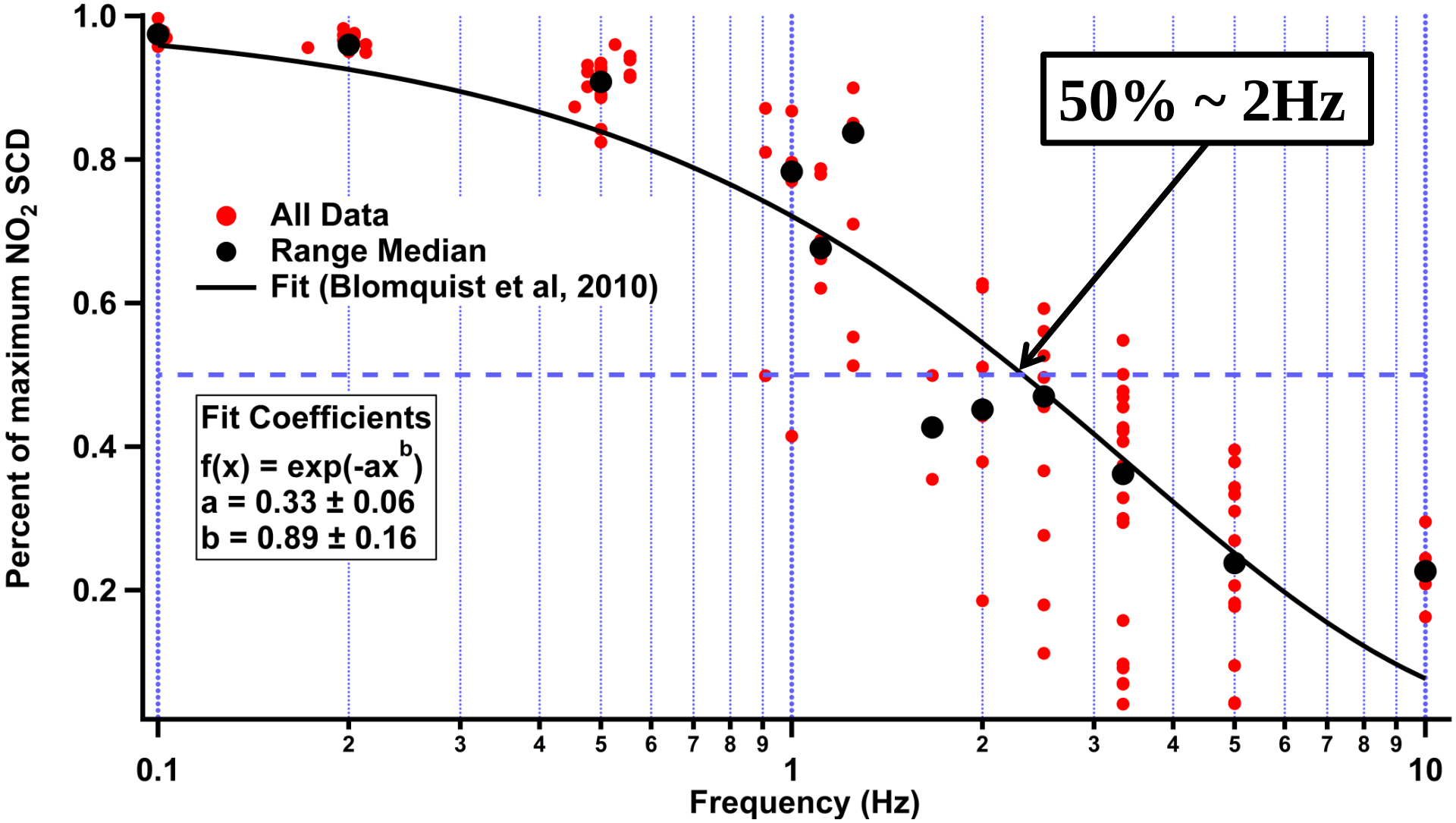
Diurnal profiles



Laboratory tests



Fast sensor: Time constant



Conclusion

- KA-11-04 identified challenges with ship exhaust:
  - Need to sample from bow (distance to wetlab ~ 65m)
- CU LED-CE-DOAS fast sensor development – remaining challenges:
  - Pressure drop in cavity
  - At 120 SLPM expect time delay of 2-3 sec to cavity (longer into the wetlab)
  - Nyquist sampling frequency goal: 2 Hz or 4Hz data?
- CU SMAX-DOAS: O_4,NO_2,CHOCHO,HCHO,IO, BrO
- In-situ Ozone monitor