Operation of Teledyne T500U CAPS True-NO2 in 2019

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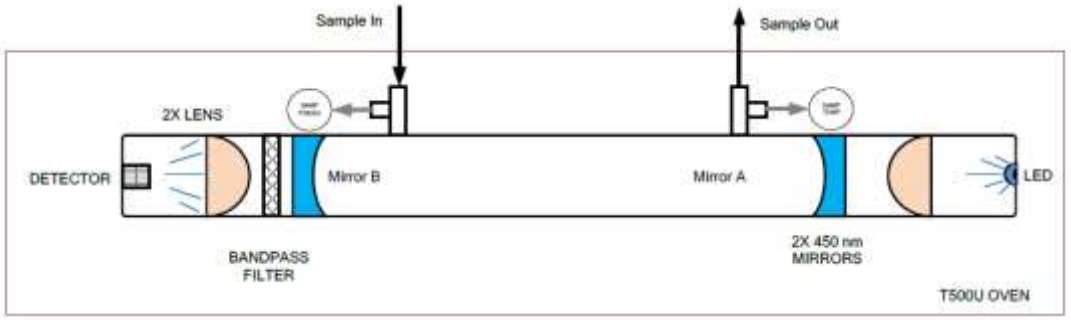
Disclaimer: Mention of trade names and manufacturers does not constitute endorsement or recommendation for use

Rutgers University Photochemical Assessment Monitoring Station (PAMS)

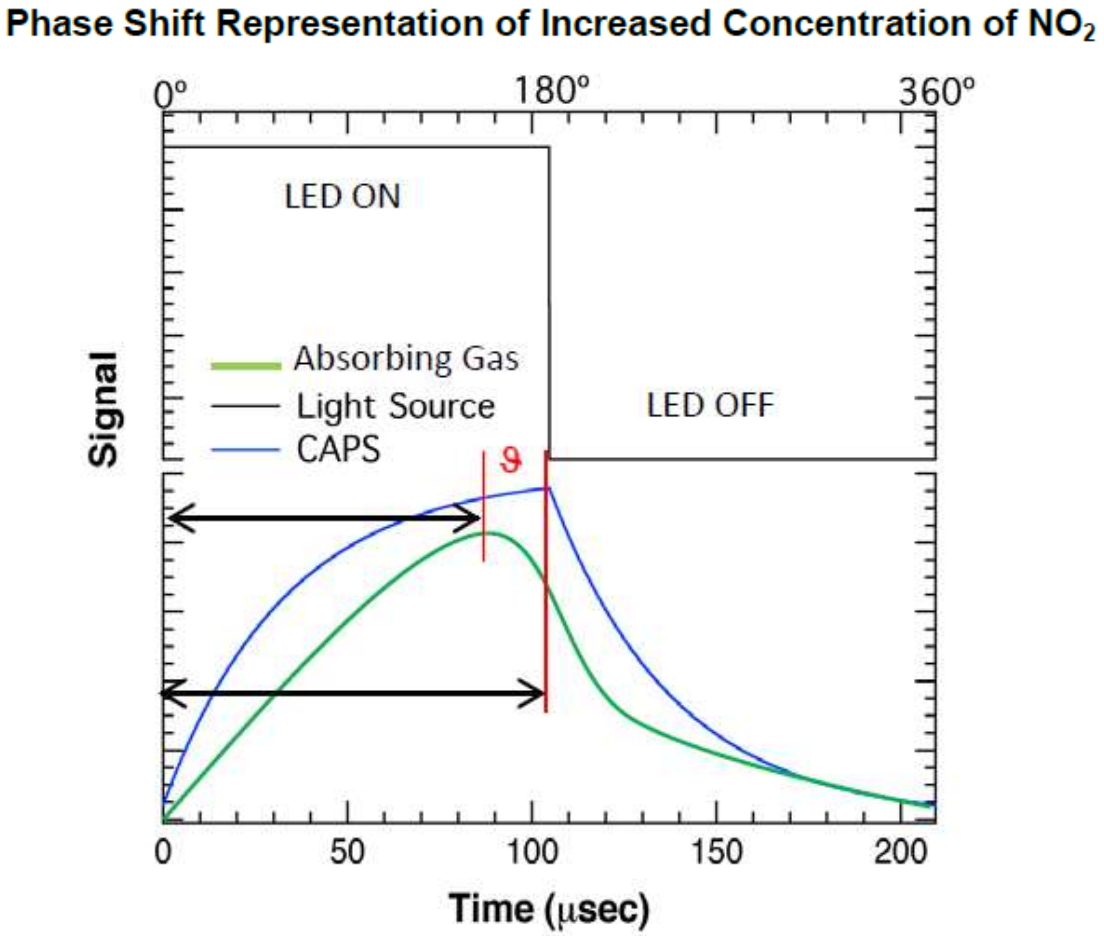
Teledyne T500U CAPS True-NO2 Analyzer

- Cavity Attenuated Phase Shift (CAPS)
- Optical absorption spectrometer
- Source UV LED at 450 nm
- Optical cell in 45 deg C oven
- High reflectivity mirrors to provide very long optical path length



CAPS principle

- Measures changes in frequency of light, not intensity of light
- Prominent absorption band for NO2 at 450 nm
- LED and detector are modulated ON and OFF, called “heterodyning”
- Analyzer translates phase shift to NO2 concentration



Operation

- Similar to other Teledyne analyzers
- NUMMA-view display
- Envidas Ultimate to log data
- Thermo 146i multi-gas calibrator and Thermo 49iPS ozone primary calibrator available at the station
- O3 and NOy analyzer

Calibration

- Option 1: Regular gas phase titration (GPT)
  - Same procedure for NO2 and NOy
  - NO cylinder, Thermo 146i multi-gas calibrator, zero air supply
  - Still need to combine calibration procedure with NO2 or NOy analyzer in order get NO concentration needed for actual NO2 concentration calculation
  - Cumbersome to automate calibrations in combination with NOy analyzer

Calibration - continued

- Option 2: Titration of known NO concentration with excess ozone
  - Assume all NO concentration becomes NO2
  - Initial tests show lower NO2 than expected
  - Excess ozone is also titrating NO2?
- Option 3: Titration of known NO concentration with same ozone concentration
  - Ozone is not in excess
  - Initial tests show good agreement of O3 concentration and expected NO2 concentration

Calibration - continued

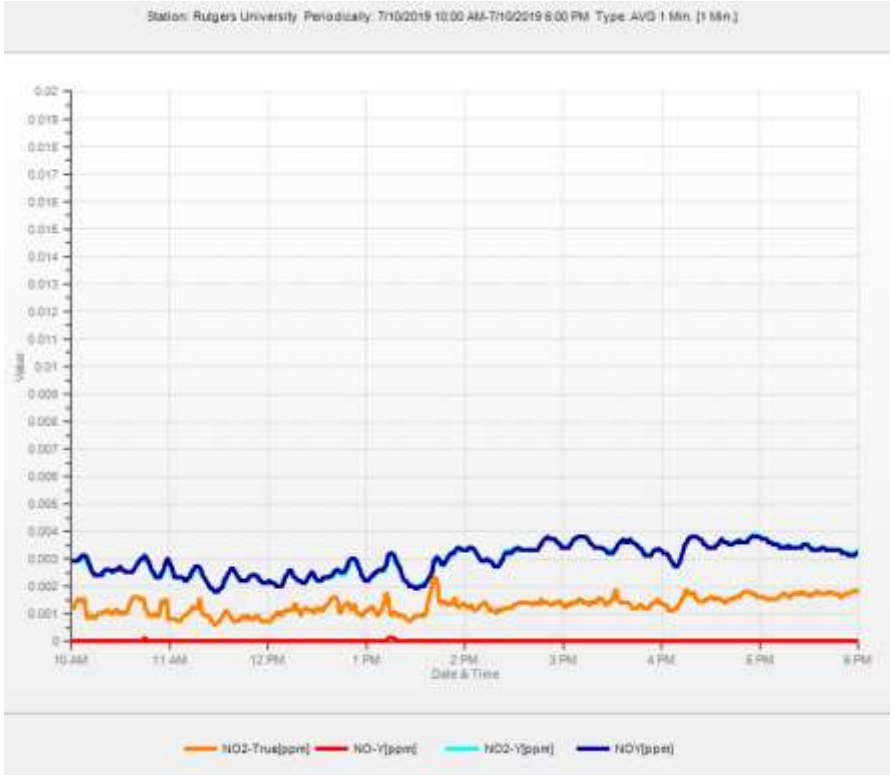
- Option 4: Dilution of NO2 cylinder
  - Purchased NO2 cylinder from Praxair
  - Initial tests show NO2 cylinder concentration was 12% less than manufacturer's tag concentration
  - Subsequent tests show NO2 cylinder concentration continuing about 10% less than manufacturer tag concentration
  - Need to purge NO2 cylinder before each calibration
  - EPA Region 2 does not verify NO2 cylinders
  - Need more tests

Preliminary Data

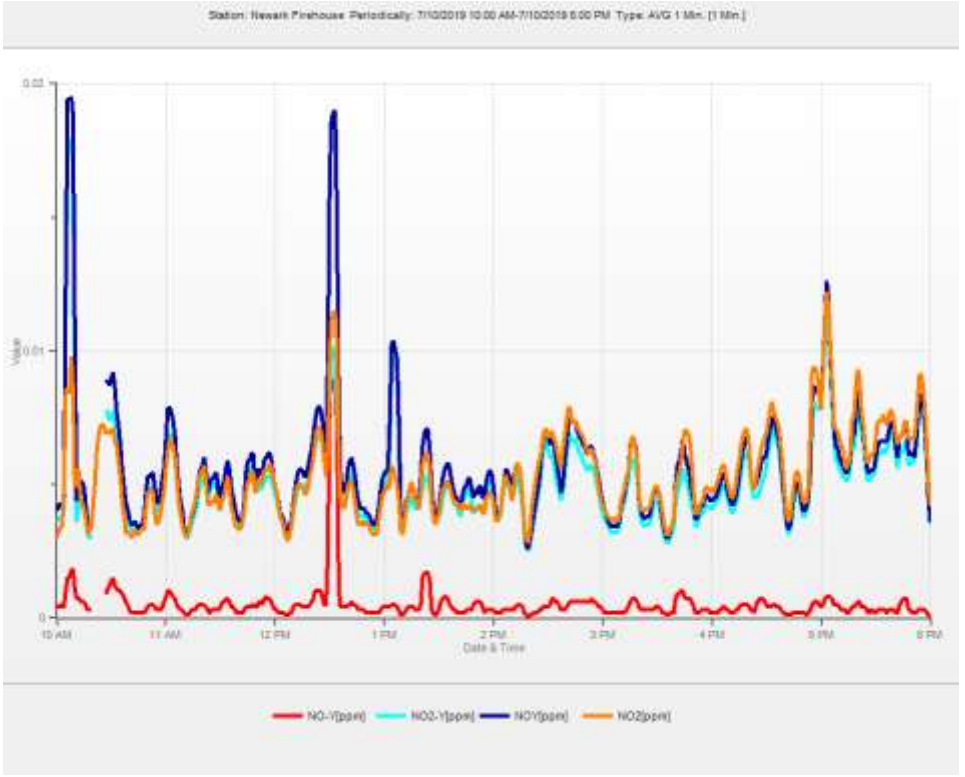
- Running since March 2019
- At Rutgers, concentrations of NOy > DIF > true-NO2 at Rutgers
- At Newark Firehouse, NOy > NO2 (chemiluminescent) > DIF
- Newark is urban, Rutgers is suburban/rural
- Larger difference between true NO2 and DIF values at Rutgers

Rutgers versus Newark Firehouse

Rutgers with True-NO2 + NOy



Newark with Chemi-NO2 + NOy



Other Issues

- Still need to determine procedures for quality control and performance audits
- No spare true-NO2 analyzer

Questions, Comments?

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- Questions
- Comments
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