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

NJDEP, Bureau of Air Monitoring, 2019
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
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