PRELIMINARY RESULTS FROM THE N_2O CHAMBER INTERCOMPARISON CAMPAIGN

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ICOS | INTEGRATED CARBON OBSERVATION SYSTEM

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CONTENT

BACKGROUND AND MOTIVATION
MEASUREMENT SYSTEM
CHAMBER COMPARISON
CHAMBER DISTURBANCES

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BACKGROUND AND MOTIVATION

- Chamber method
  - Easy and simple?
  - Information of small scale variability in fluxes
  - Most common method to quantify N_2O emissions from soils
- Wide variety of static (non-steady-state non-flow-through, NT-NF) chambers differing in design, operation, gas analysis, flux calculation
- Errors and uncertainties often not recognized nor quantified

  → Inter-comparison of fluxes difficult

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BACKGROUND AND MOTIVATION

- Systematic errors
  - Disturbed soil conc.
  - Pressure disturbance
  - Chamber leakage
  - Sampling. storage. analysis
- Random errors
  - Spatial variability

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BACKGROUND AND MOTIVATION

- Systematic errors
  - Disturbed soil conc.
  - Pressure disturbance
  - Chamber leakage
  - Sampling. storage. analysis
  - Laser gas analyzers
- Random errors
  - Spatial variability

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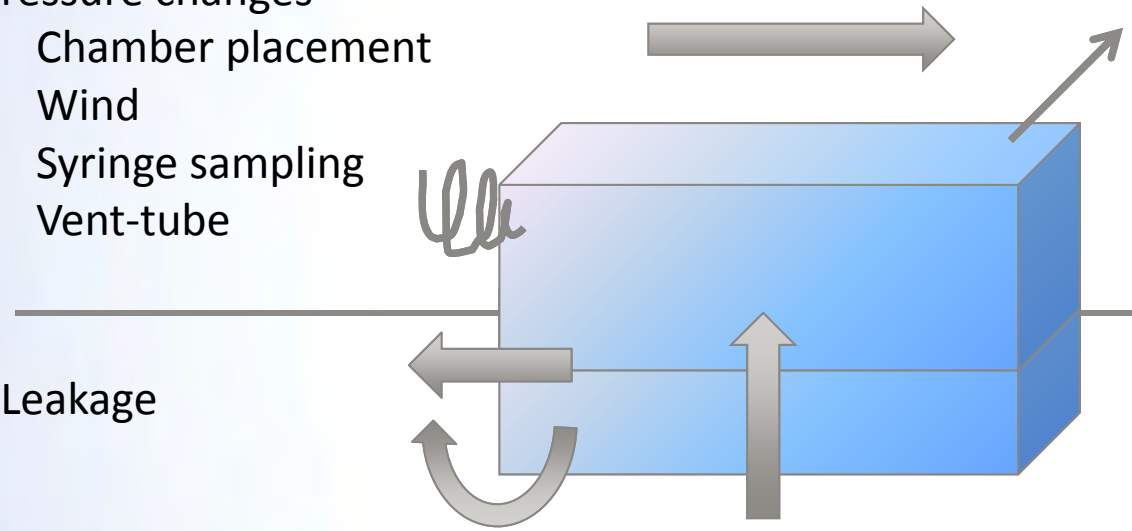
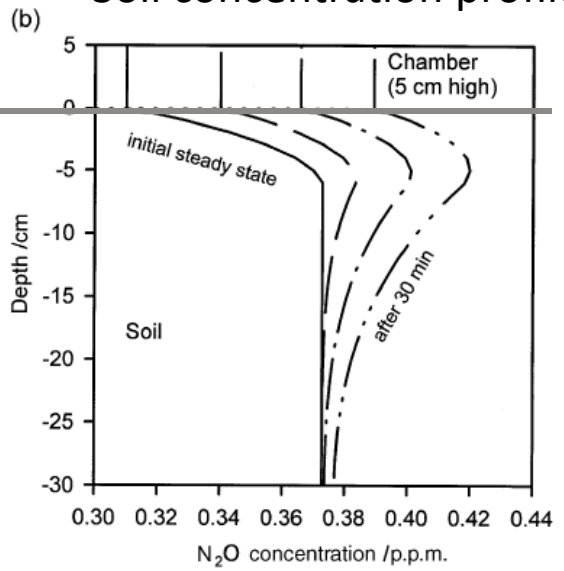
AIMS: TO QUANTIFY CHAMBER DISTURBANCES

Pressure changes
- Chamber placement
- Wind
- Syringe sampling
- Vent-tube

Leakage



Soil concentration profile



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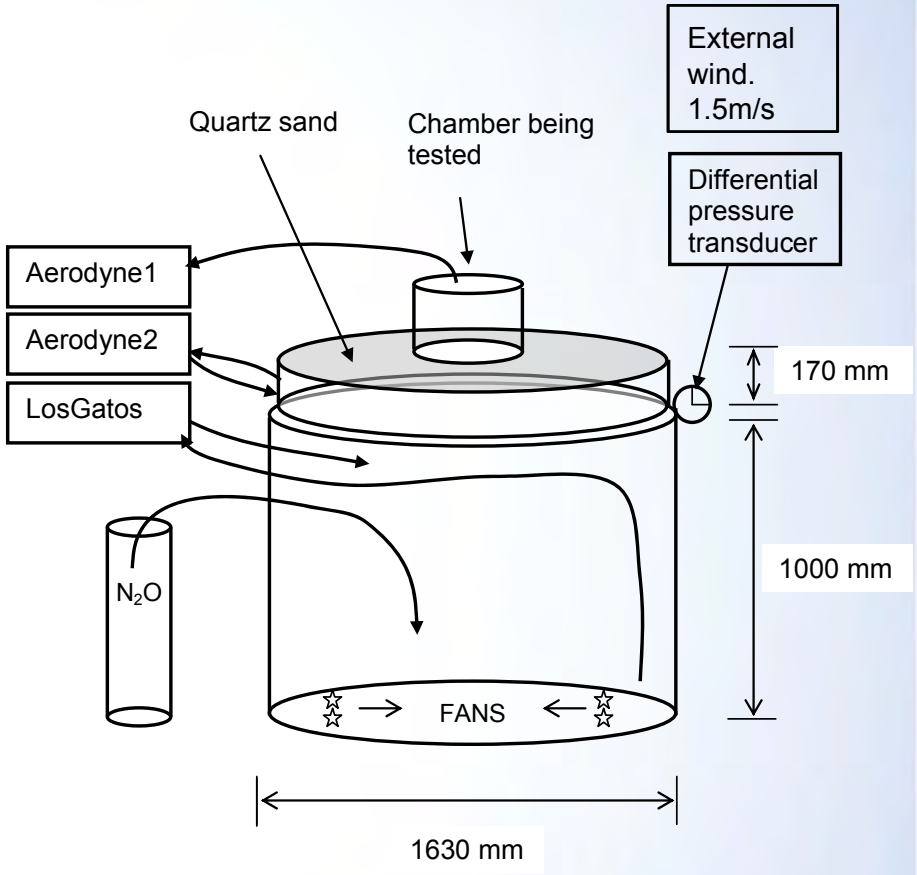
Conen & Smith. 2000. EJSS

MEASUREMENT SETUP



- 1000 ppb N_2O in the tank
- Reference flux is defined from the decrease in N_2O concentration over time

Figure 1.

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System and flux calculations:
Pumpanen et al., 2004;
Pihlatie et al., 2013

TESTED CHAMBERS

- 22 Non-Steady-State Flow-Through (NS-FT) chambers
  - High frequency data from chambers, tank and sand profile (1 Hz)
  - Size ranged from 0.003-0.38 m^3, round, rectangular
  - Attributes: fan (on/off), vent-tube (on/off/design/direction to wind)

  - Test the effects of wind speed and direction, vent-tube, headspace mixing, collar insertion depth, leakage, and manual sampling on N_2O fluxes

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TESTED CHAMBERS

PROTOCOL MEASUREMENTS

- 1000 ppm N_2O in the tank
- 3 replicate measurements without wind
- 3 replicate mearuements with wind (1.5 m/s)
- 3 replicate measurements without wind
- 3 replicate mearuements with wind (1.5 m/s)
- Leak test
- Special tests (manual sampling, vent-tube, wind direction)

- Chamber closure time 10 min. 20 min stabilization between
- Fluxes vary between 20 – 120 µg N m^{-2} h^{-1}

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LEAK TEST

- Chamber + collar in the water bath
- 1000 ppb N_2O in chamber headspace
- Flux measurement for 1 hour

Chamber	µg N m^{-2} h^{-1}
Uppsala large, Sweden	8.3
Uppsala small, Sweden	29.7
Czech small, Czech Republic	10.4
Czech large, Czech Republic	27.5
Roskilde, DK	7.3
Chunyan, CAS, China	4.5
Thunen, Germany	6.4
Poznan, Poland	24.0
Carolyn, Belgium	15.7
Shirley rubberseal, UK	18.3
Shirley waterseal, UK	8.8
Mark A, UK	35.5
Mark B, UK	7.9
Mike, AGH, Poland	21.3
Jason/LiCor, USA	58.8
IPNOA, Italy	13.1
Andreas, Germany	29.9
ZALF, Germany	25.8
Catchment, Hyytiälä, Fi	15.5
Elisa, Hyytiälä, Fi	3.1
Lutz A, Switzerland	17.6
Lutz B, Switzerland	64.1

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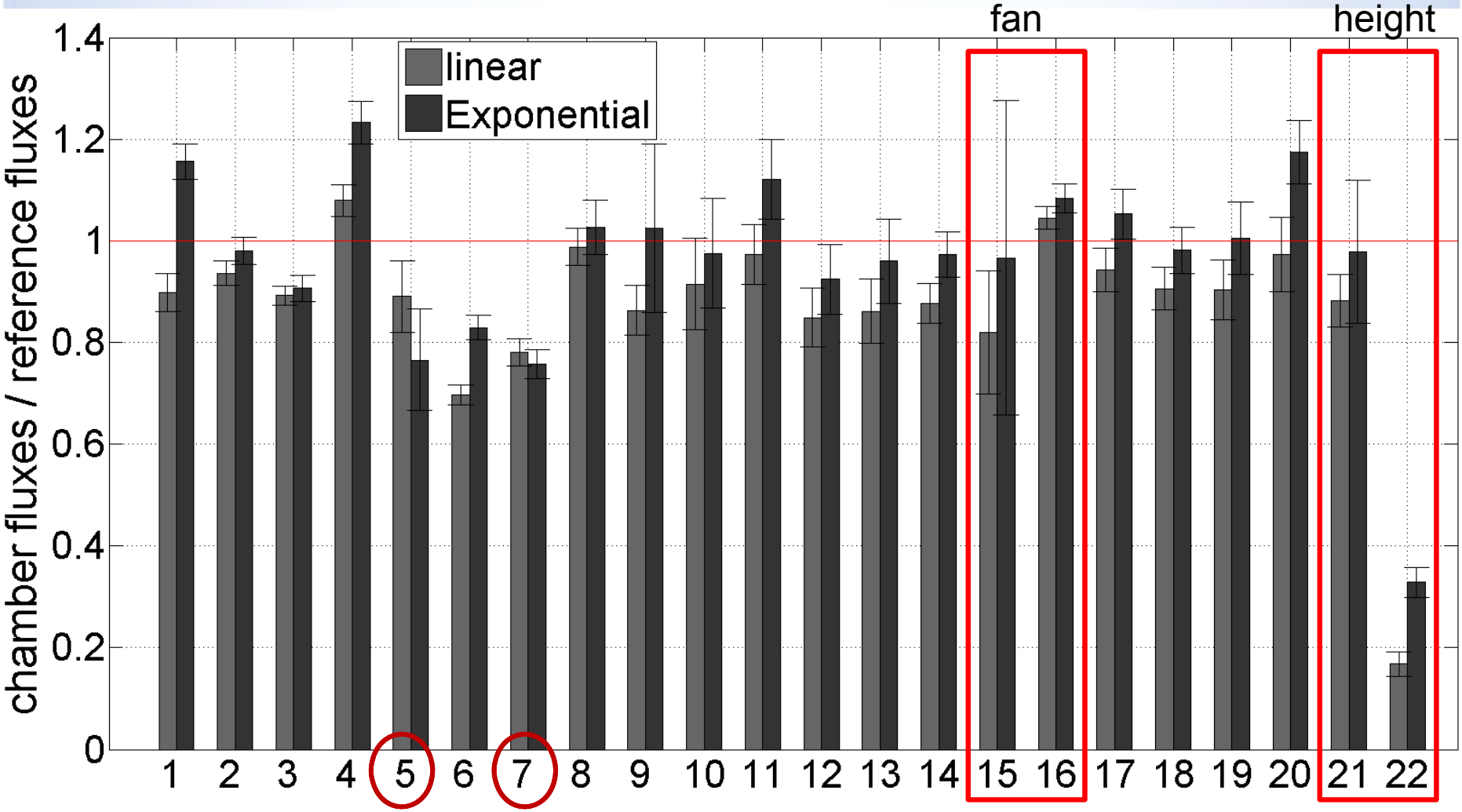
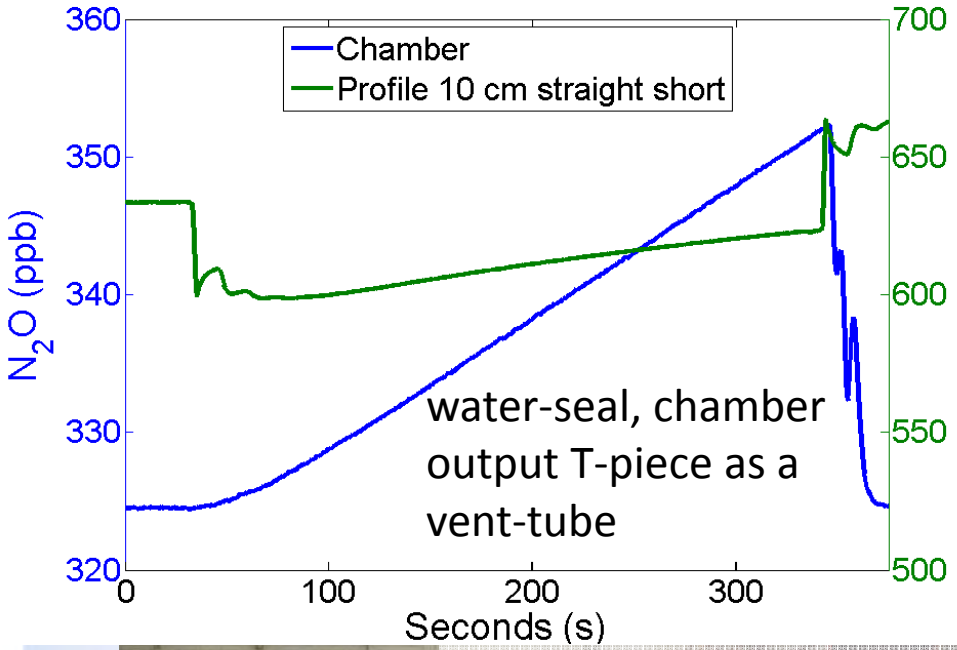
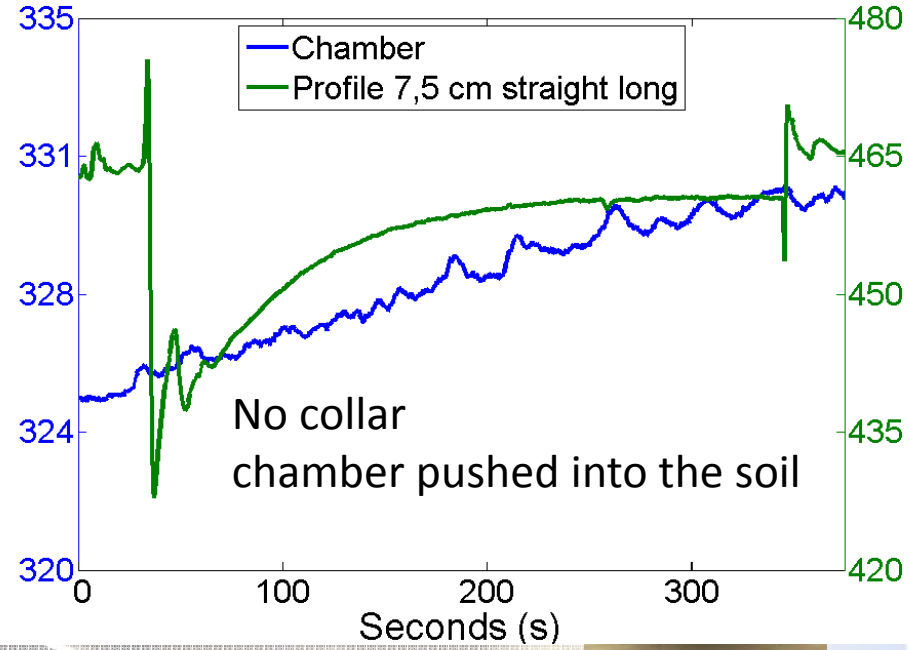
CHAMBER COMPARISON



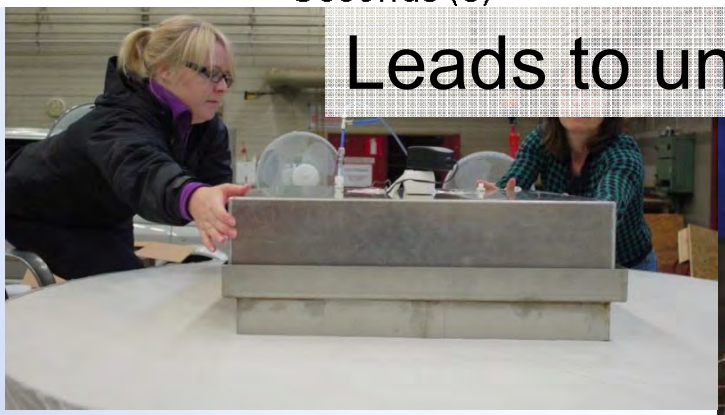
1=Forerunner, 2=Poznan, 3=Uppsala L, 4=Uppsala S, 5=CzechGlobe L, 6=CzechGlobe S, 7=Roskilde, 8=CAS, 9=Antwerp, 10=Uni London w, 11=Uni London r, 12=Scotland UK (A), 13=AGH Poland, 14=IPNOA, 15=Humboldt, 16=Thunen, 17=LiCor, 18=Hyytiälä (E), 19=Hyytiälä (Catch), 20=ZALF, 21=ETH A, 22=ETH B

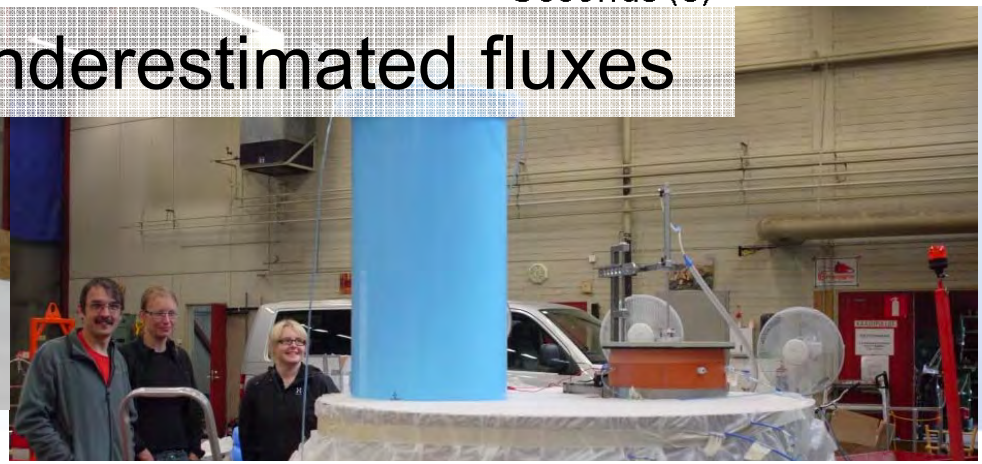
SOME CHAMBERS DISTURB SOIL CONCENTRATION



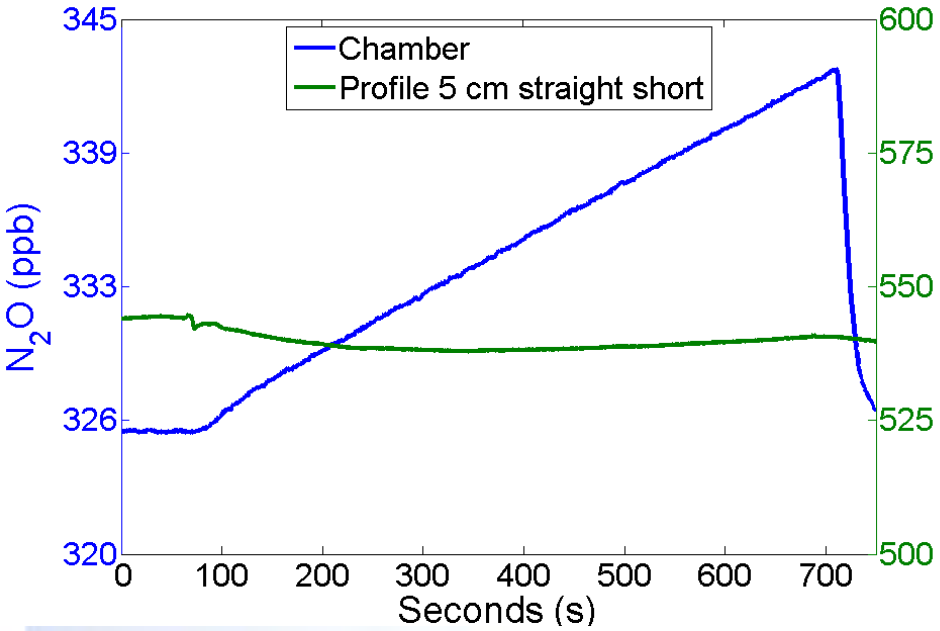


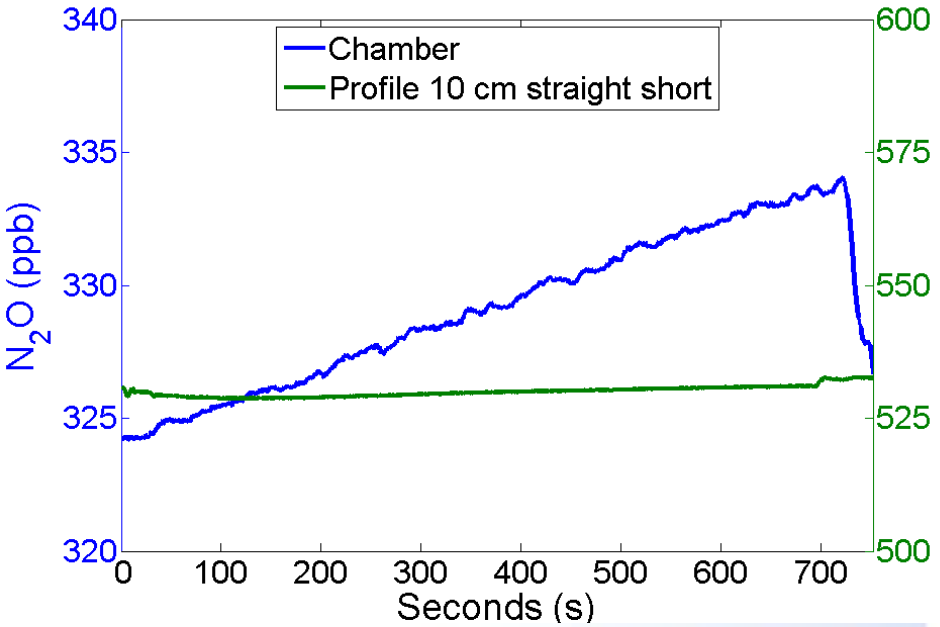
Leads to underestimated fluxes



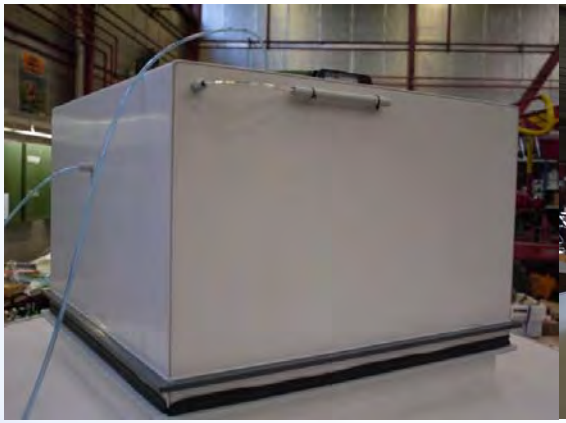


SOME CHAMBERS DISTURB LESS



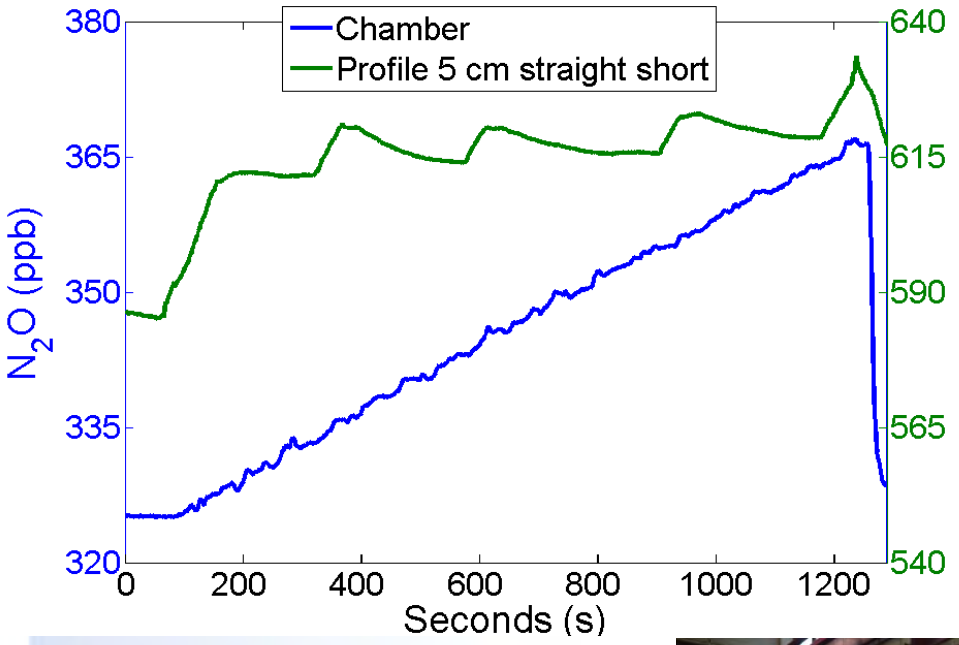


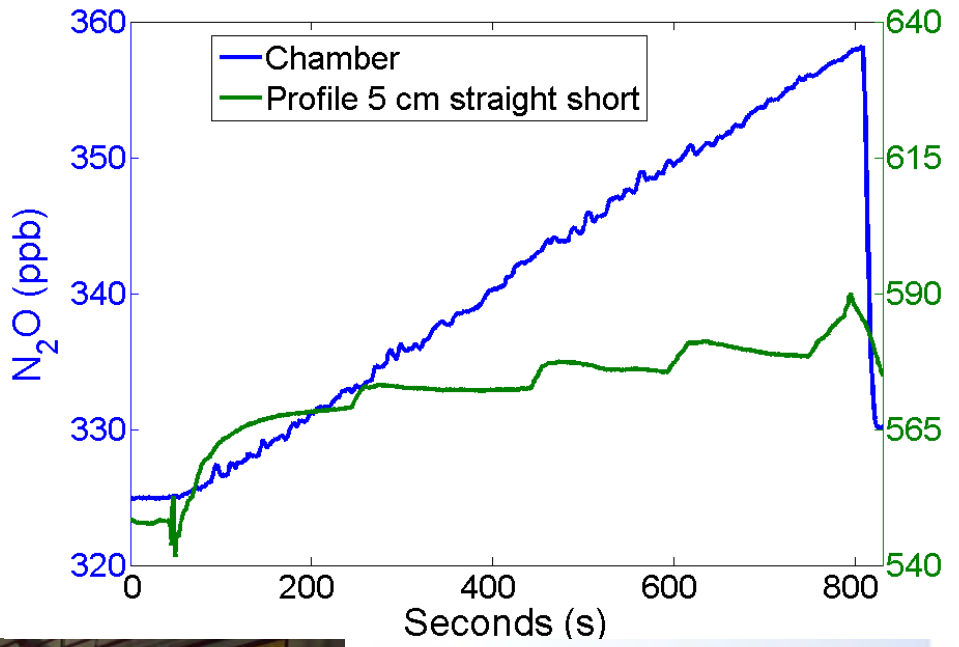
Rubber-seal vent-tube, fan on



Rubber-seal vent-tube, fan off

DISTURBANCE FROM MANUAL SAMPLING

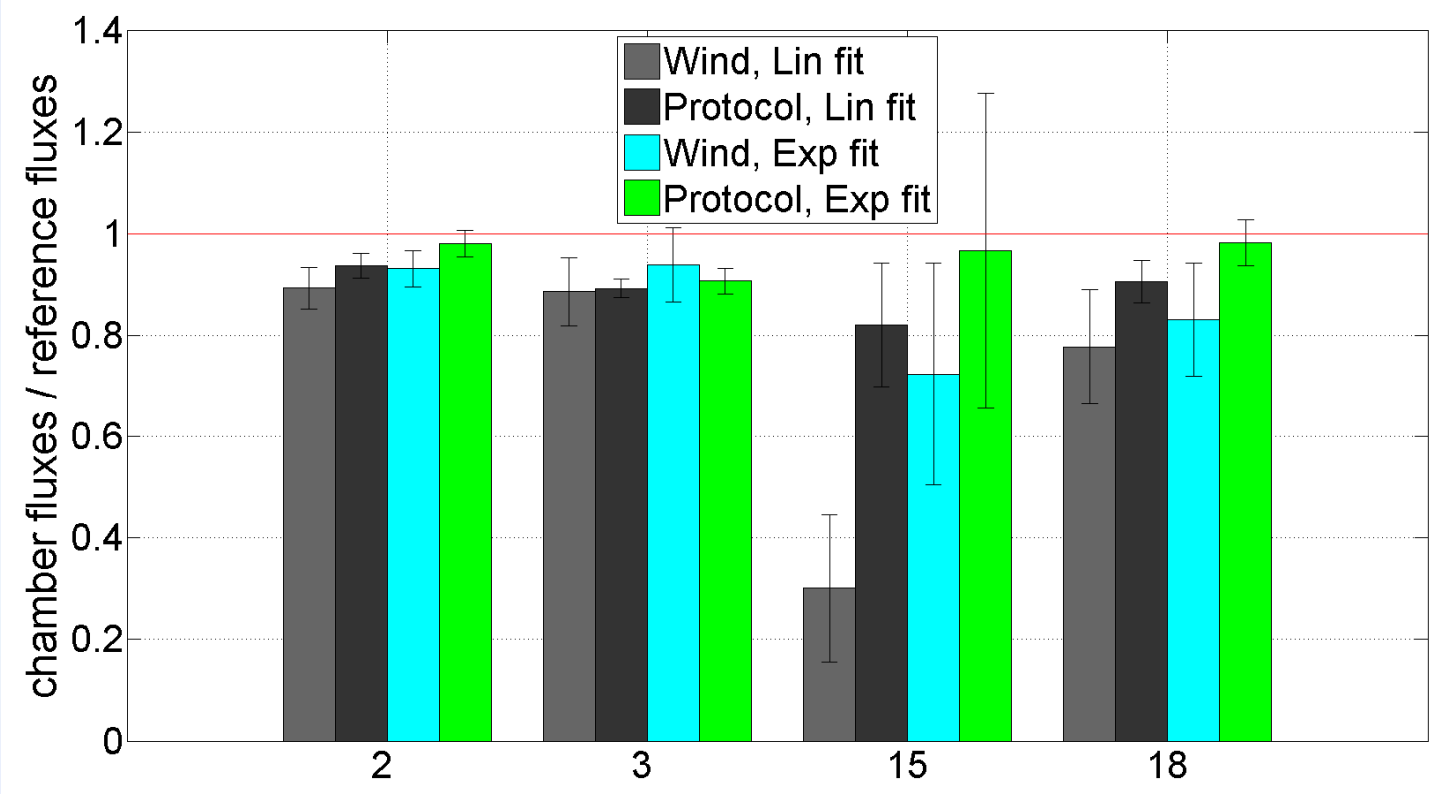




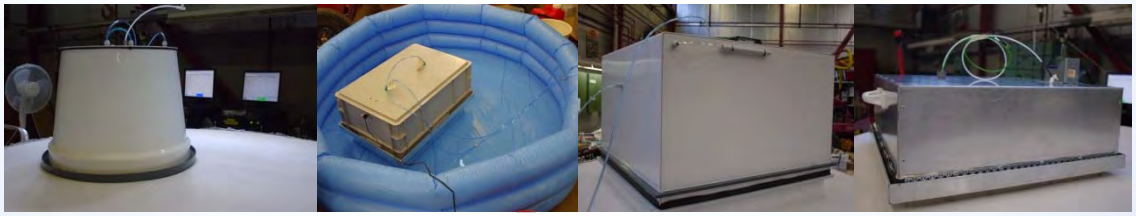
Manual sampling (30 ml)
3.5 cm collar depth
Vent-tube closed during sampling

Manual sampling (30 ml)
3.5 cm collar depth
Vent-tube open & careful sampling

EFFECT OF WIND AND VENT-TUBES

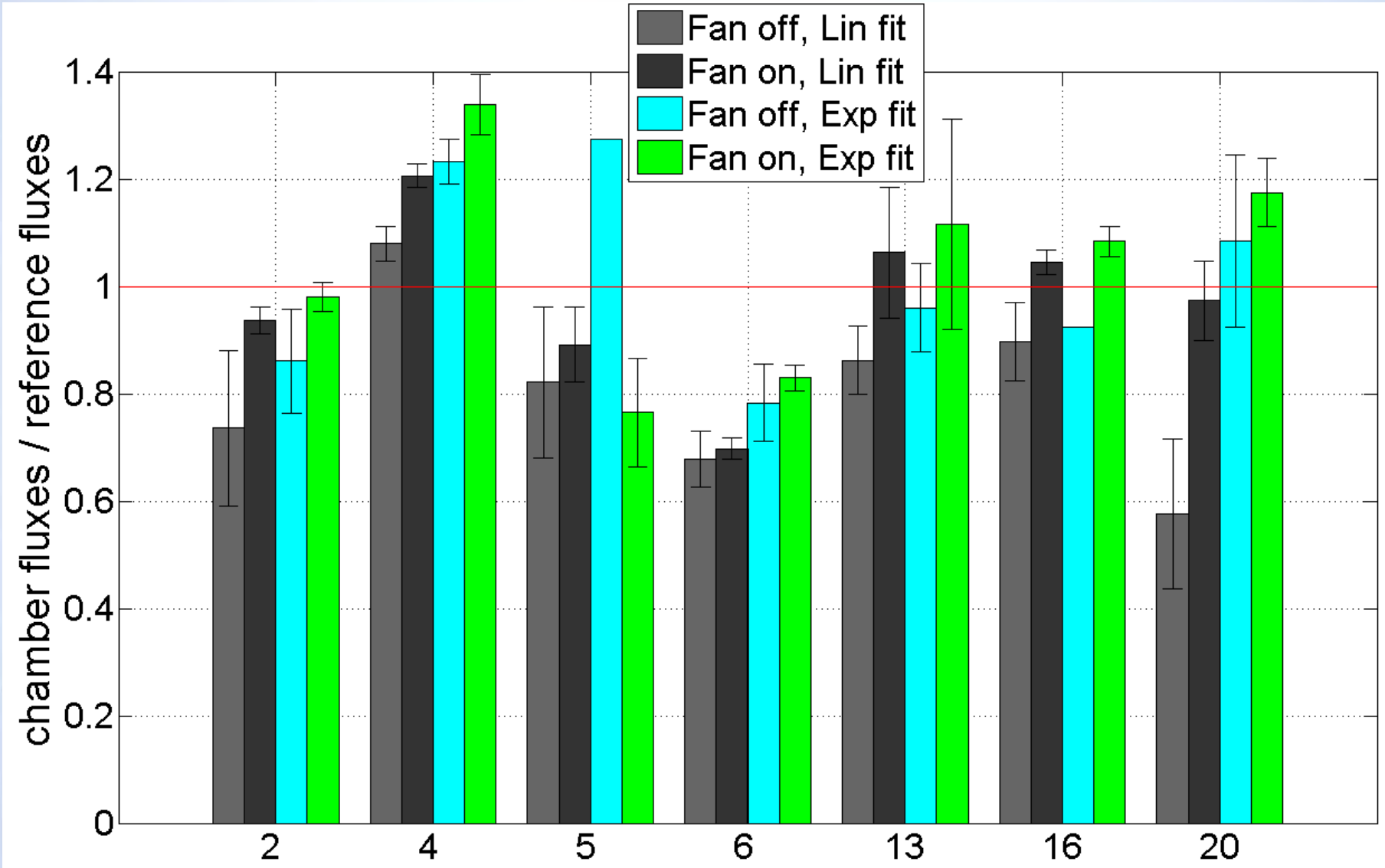


Wind = towards wind
Protocol = side wind, 90˚



2=Poznan, 3=Uppsala L, 15=Humboldt, 18=Hyytiälä (E)

HEADSPACE MIXING BY FANS



2=Poznan, 4=Uppsala S, 5=CzechGlobe L, 6=CzechGlobe S, 13=AGH Poland, 16=Thunen, 20=ZALF

TO CONCLUDE

- Fluxes underestimated slightly (linear fit, 13%), much less than in previous campaign (Pihlatie et al., 2013)
  - **Less systematic errors**: shorter closure time, improved accuracy in gas analysis, better chamber designs
- Few **strong underestimations** can be explained by **pressure** effects and/or chamber **leakage**?
- Sand profile easily disturbed from chamber placement, syringe sampling
- Many disturbances point to the **pressure effects**, which can be avoided by careful chamber operation and sufficient vent-tube
- 3D modeling of the system coming

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THANK YOU AND THE TEAM

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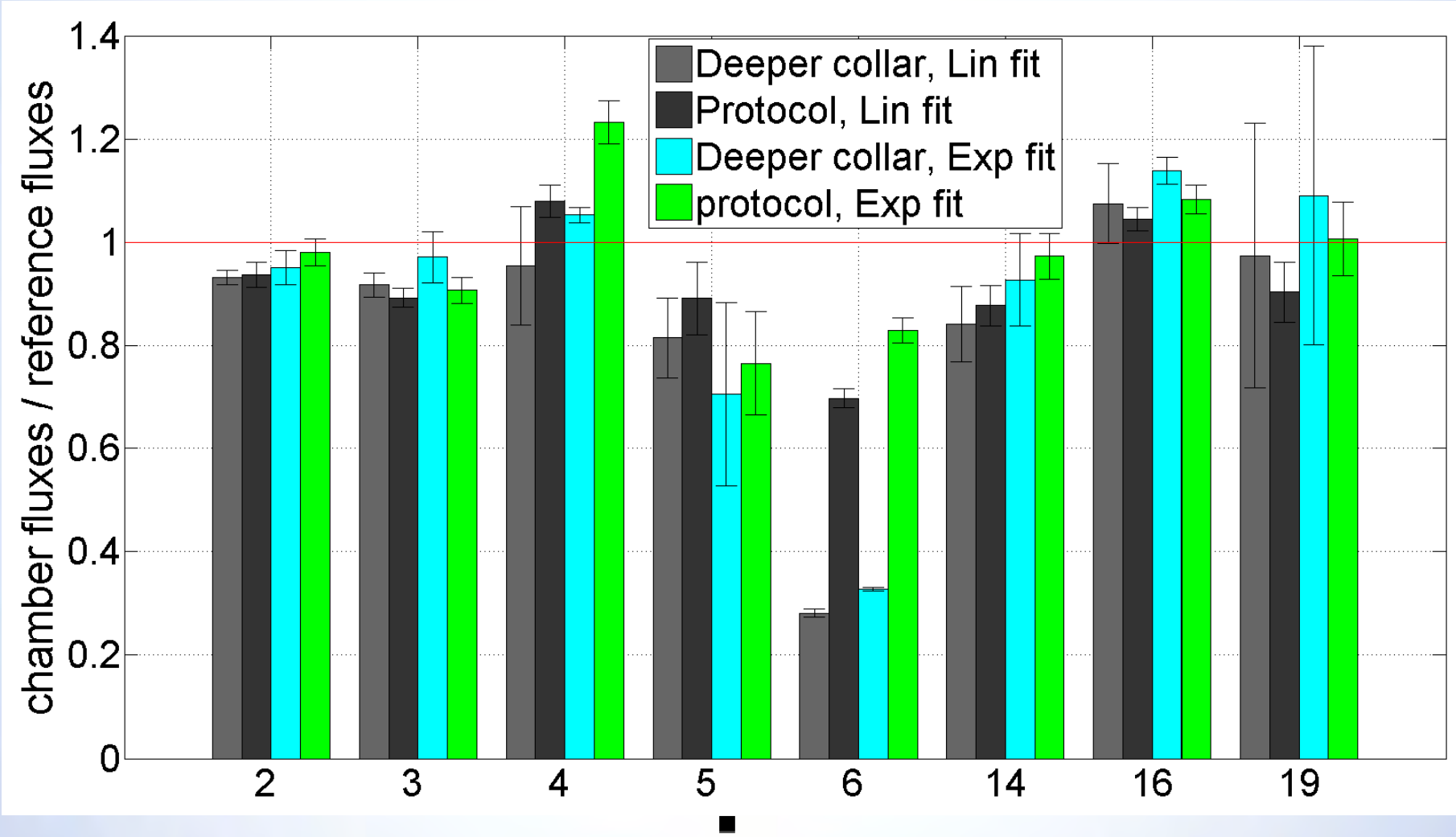
COLLAR INSERTION DEPTH



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