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FIELD STUDY ON THE IMPACT OF SUSTAINABLE AVIATION FUELS ON HELICOPTER ENGINE EMISSIONS

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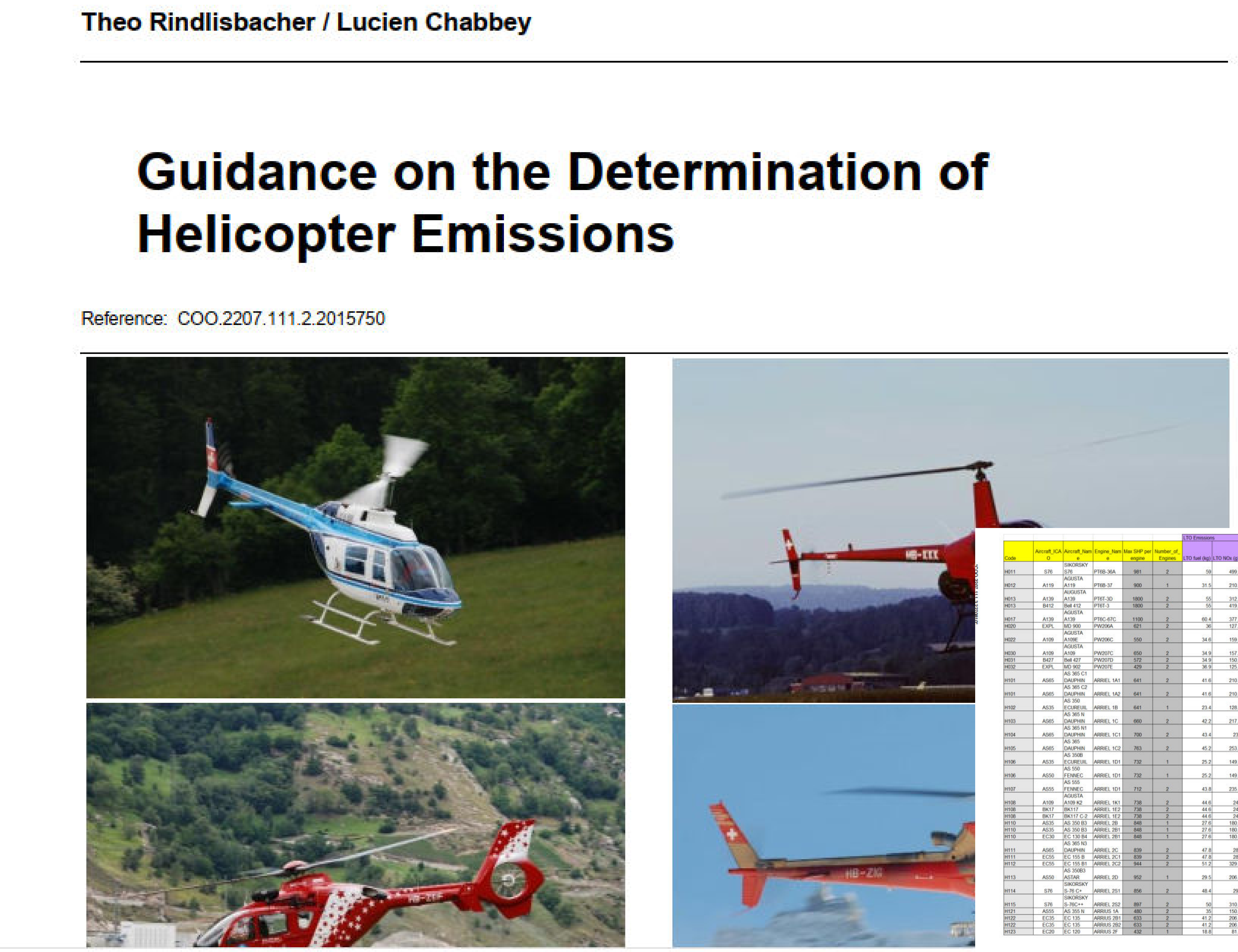
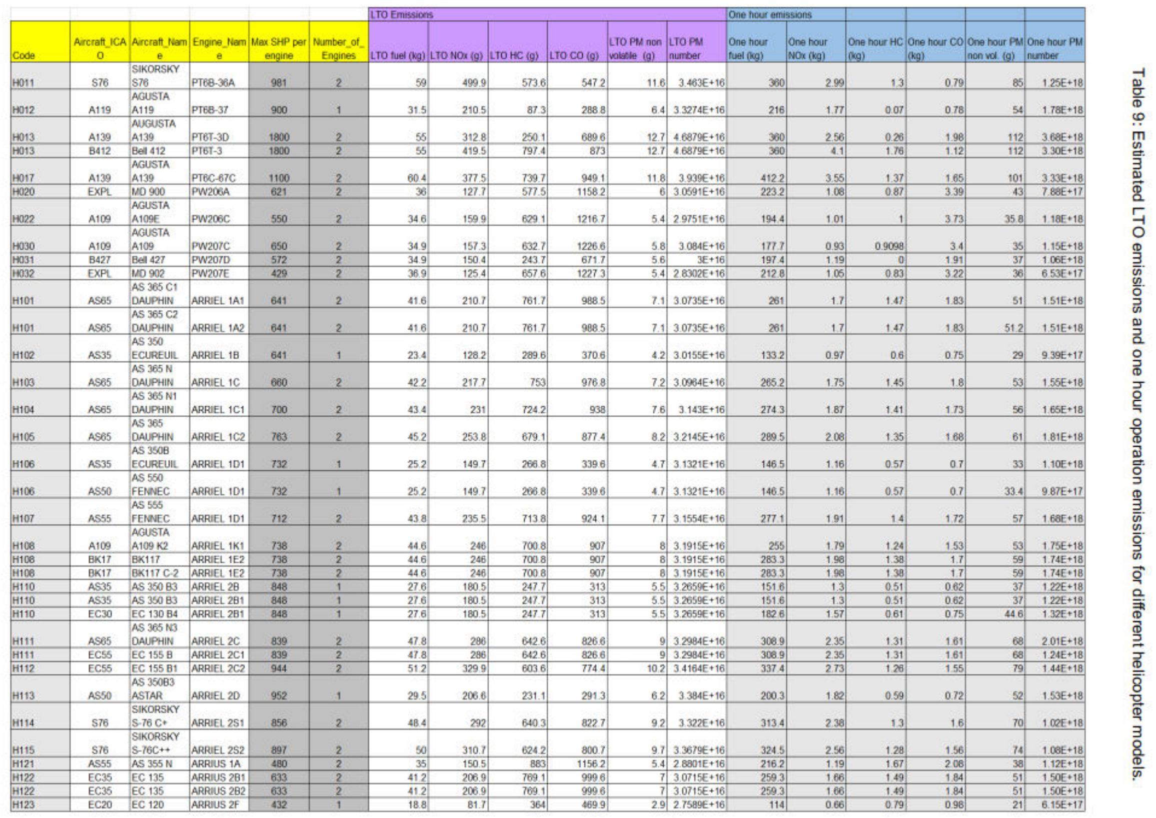
Emission data of helicopter engines

- ... are hard to find.


Theo Rindlisbacher / Lucien Chabbey

Guidance on the Determination of Helicopter Emissions

Reference: COO.2207.111.2.2015750



DLR-Project: ELK (emission map)

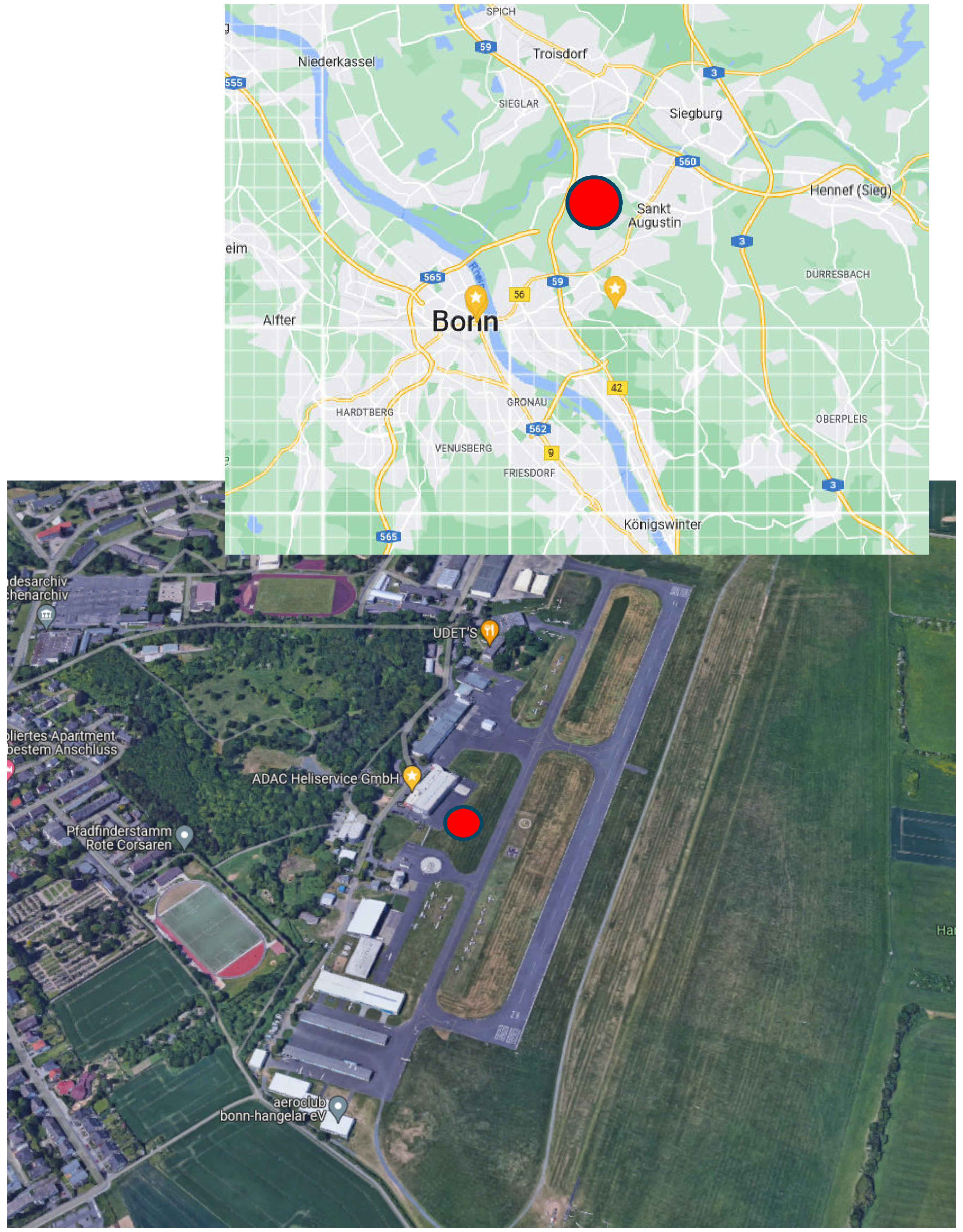
-> Engine emission inventory

https://verkehrsforschung.dlr.de/de/projekte/elk

Fuel-related emission indices are **not** available.

https://www.bazl.admin.ch/bazl/de/home/themen/umwelt/schadstoffe/triebwerkemissionen/anleitung-zur-abschaetzung-von-helikopteremissionen.html

Experimental Overview



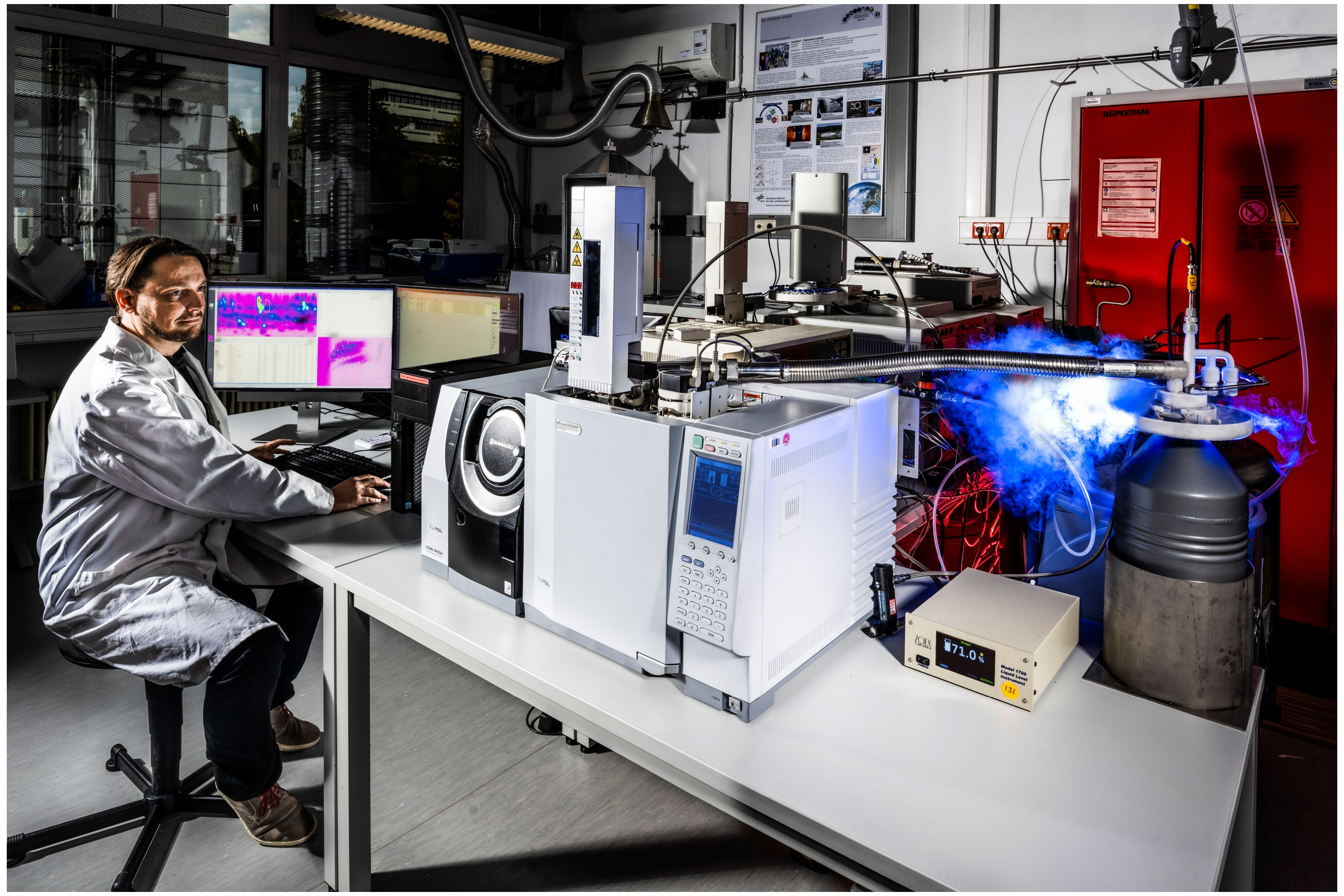
Emission measurements at ADAC hangar in Hangelar

03.11.2022 – Reference measurement, Jet A-1

09.11.2022 – SAF blend measurement

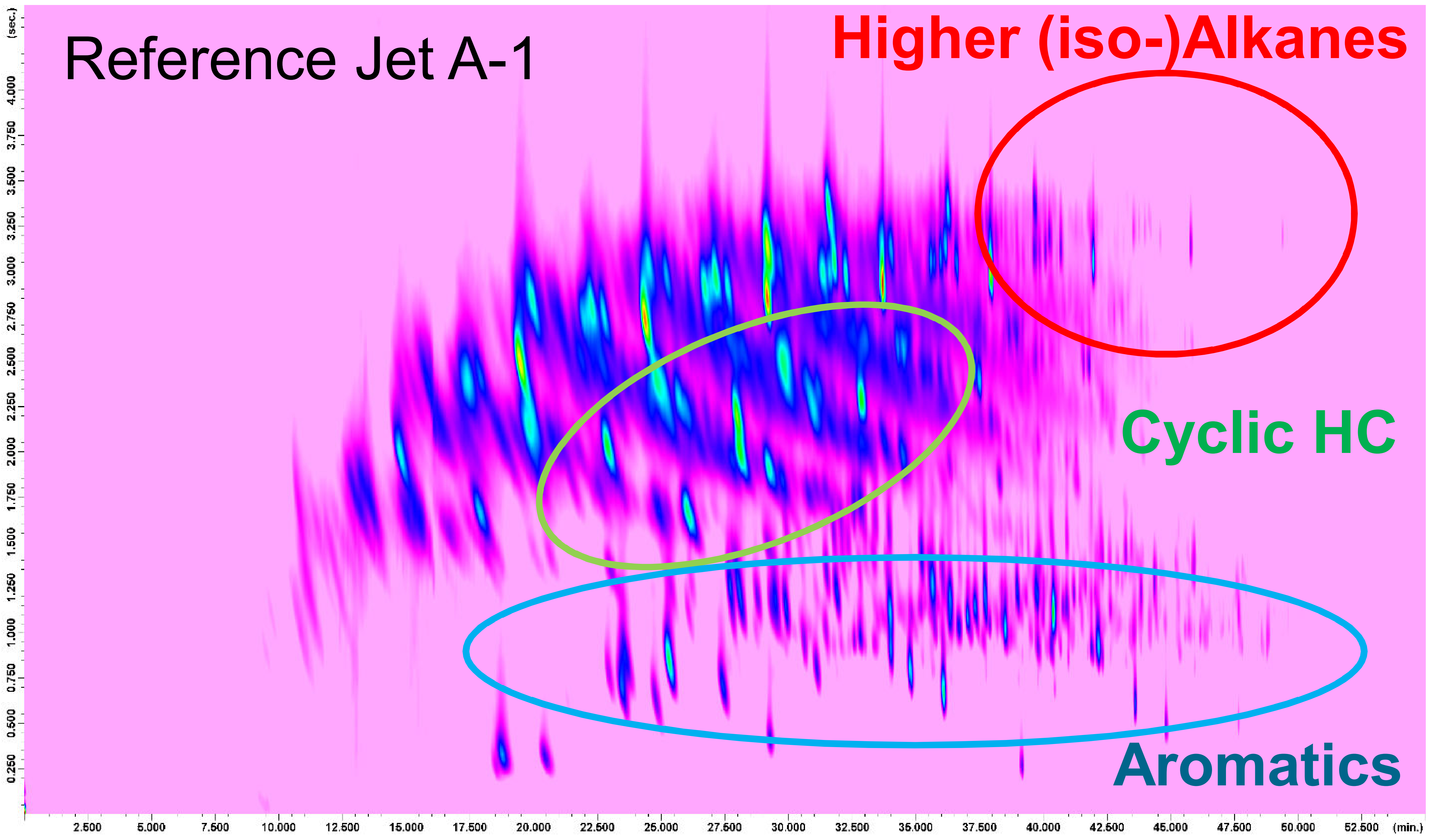
https://luftrettung.adac.de/first-rescue-helicopter-flies-on-sustainable-aviation-fuel/

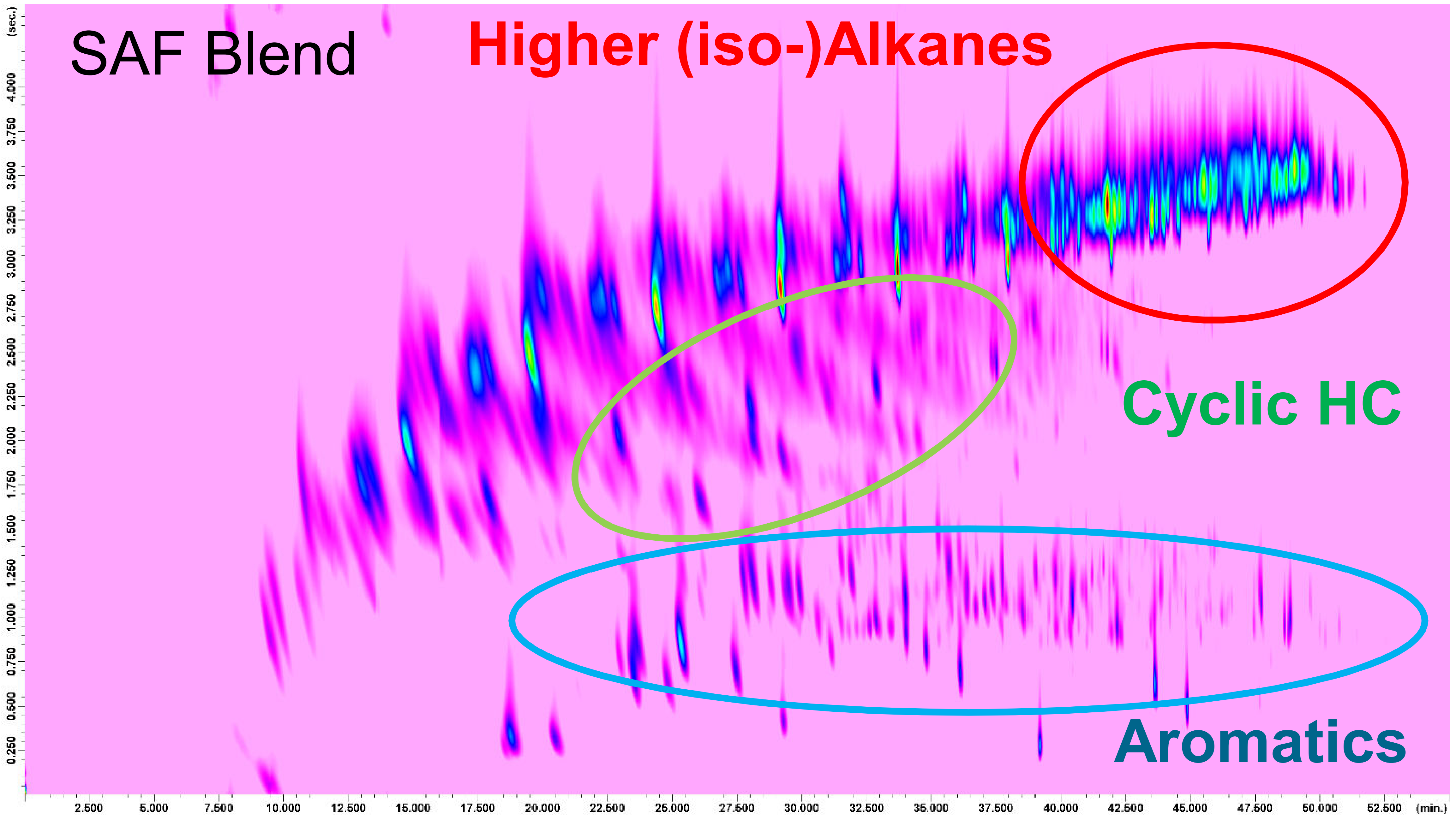
Fuel Properties



Regular Jet A-1 & Jet A-1/HEFA blend

- GCxGC analysis
- Hydrogen content (ASTM D7171)
  - Jet A-1 13.79 m%
  - SAF Blend 14.34 m%





Parameter and Instruments

- DMS500 (+ CS), 1 Hz — Particle number, -size distribution (total/nv)
- SMPS (+ CS), 75 s — Particle number, -size distribution (total/nv)
- Ecophysics CLD64/700, 1 Hz — NOx
- MKS Multigas FT-IR, 1 Hz — CO_2, CO, NOx
- LI-7200RS/LI-850, 1 Hz — CO_2, H_2O
- TSI 3776 CPC (ambient) — Particle number

Sampling challenges

Requirements

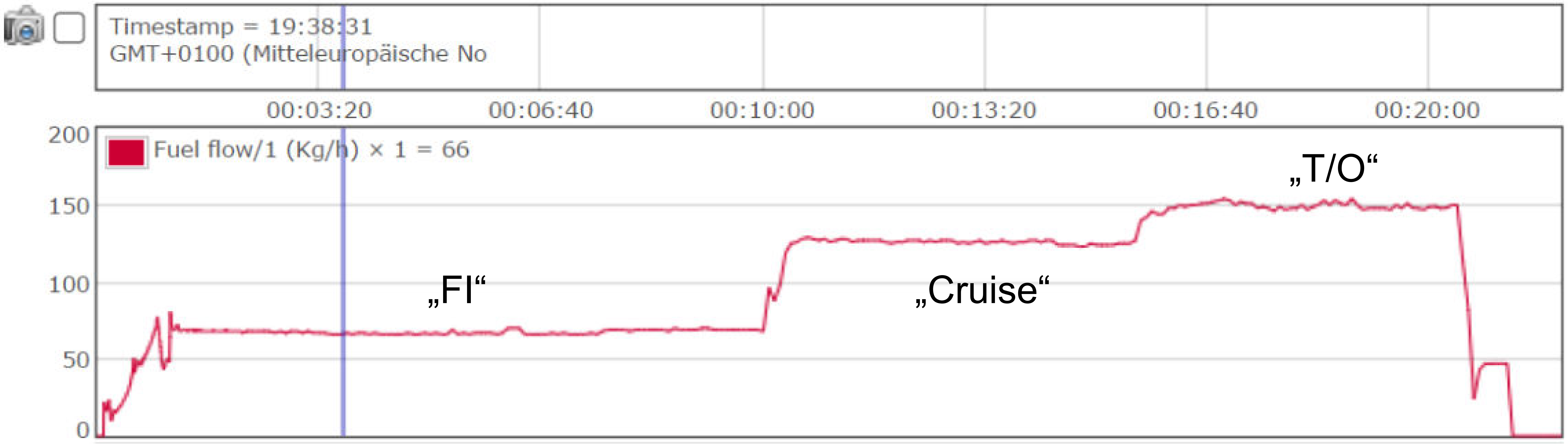
- Safe for the aircraft
- Fast removal
- No contact to helicopter
- Should not be affected by high power runs

Drawbacks

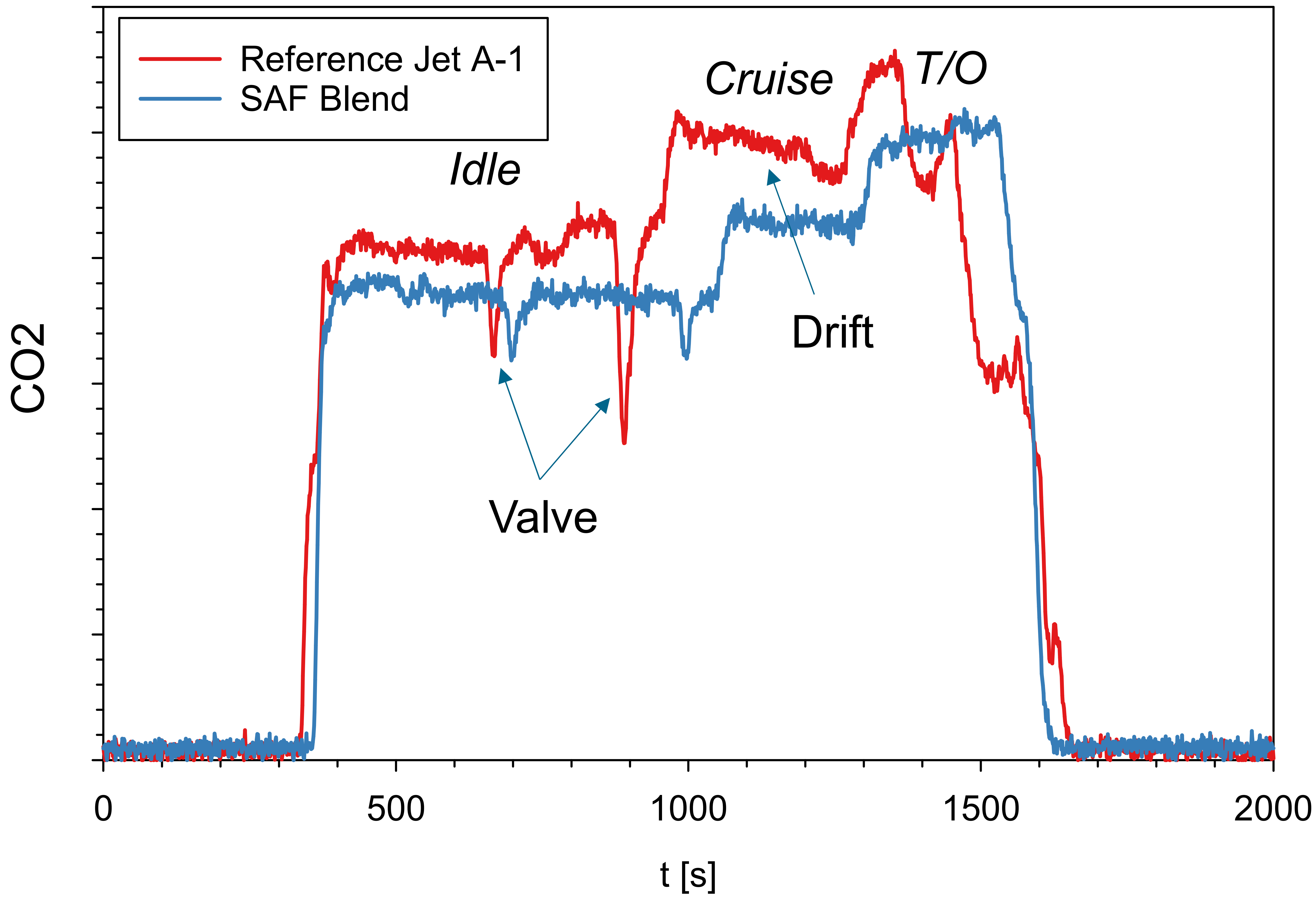
- No heated inlet
- No probe-tip dilution
- „Long“ sampling line (20 m)

Experimental Setup – Test Matrix

- Three different power settings (FF 66 kg/h, FF 125 kg/h, FF 150 kg/h)
- Ground run for 10 min, 5 min and 5 min
- Similar fuel flow and torque conditions between reference and SAF experiment
- Comparable ambient conditions (cold, humid)

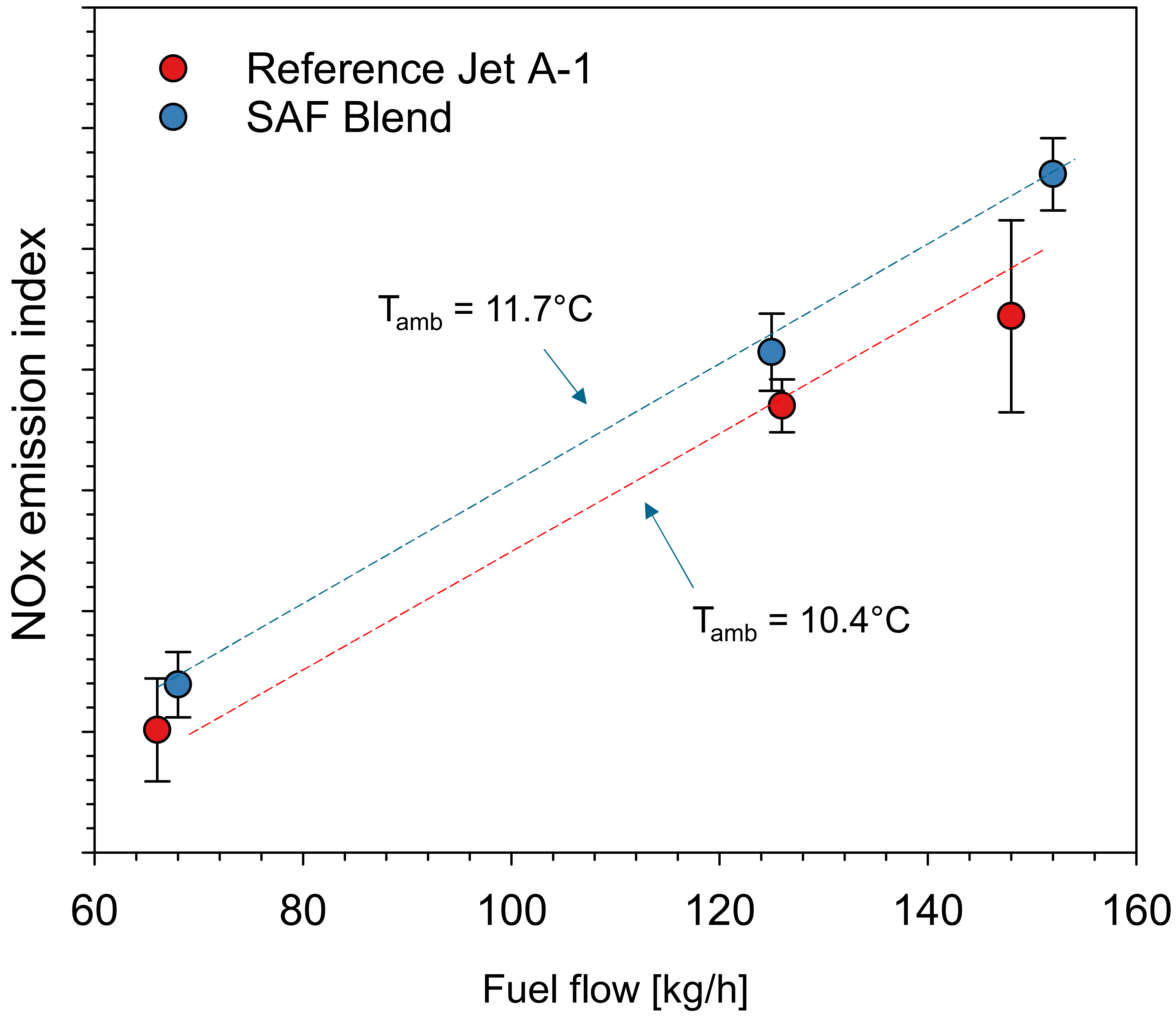


Comparability between reference and SAF measurement



- Both runs were repeated in an excellent manner
- The probe alignement was comparable between both runs
- The weather conditions of the reference run could have been better (variation at higher power settings)

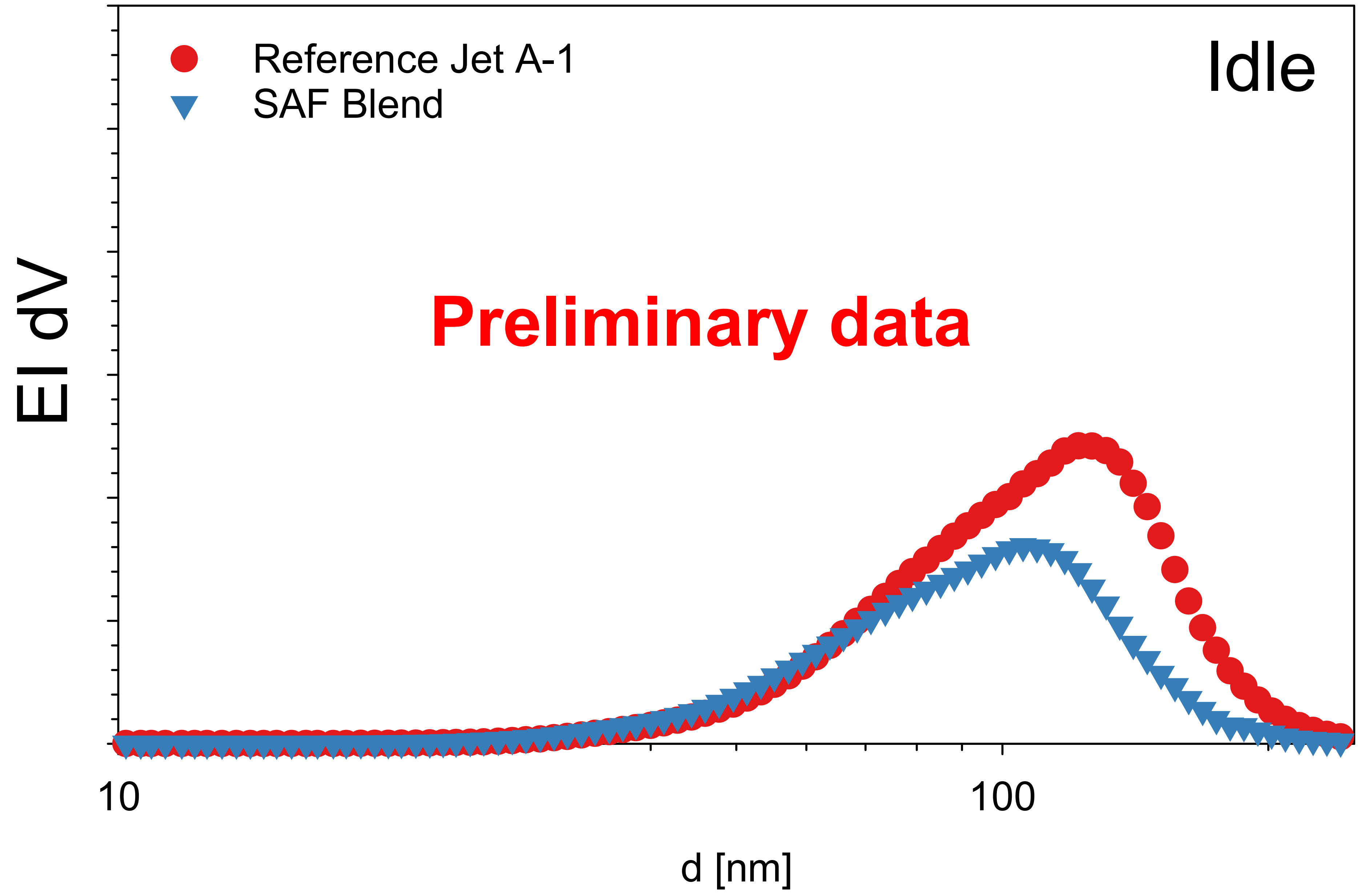
NO_x Emission Index

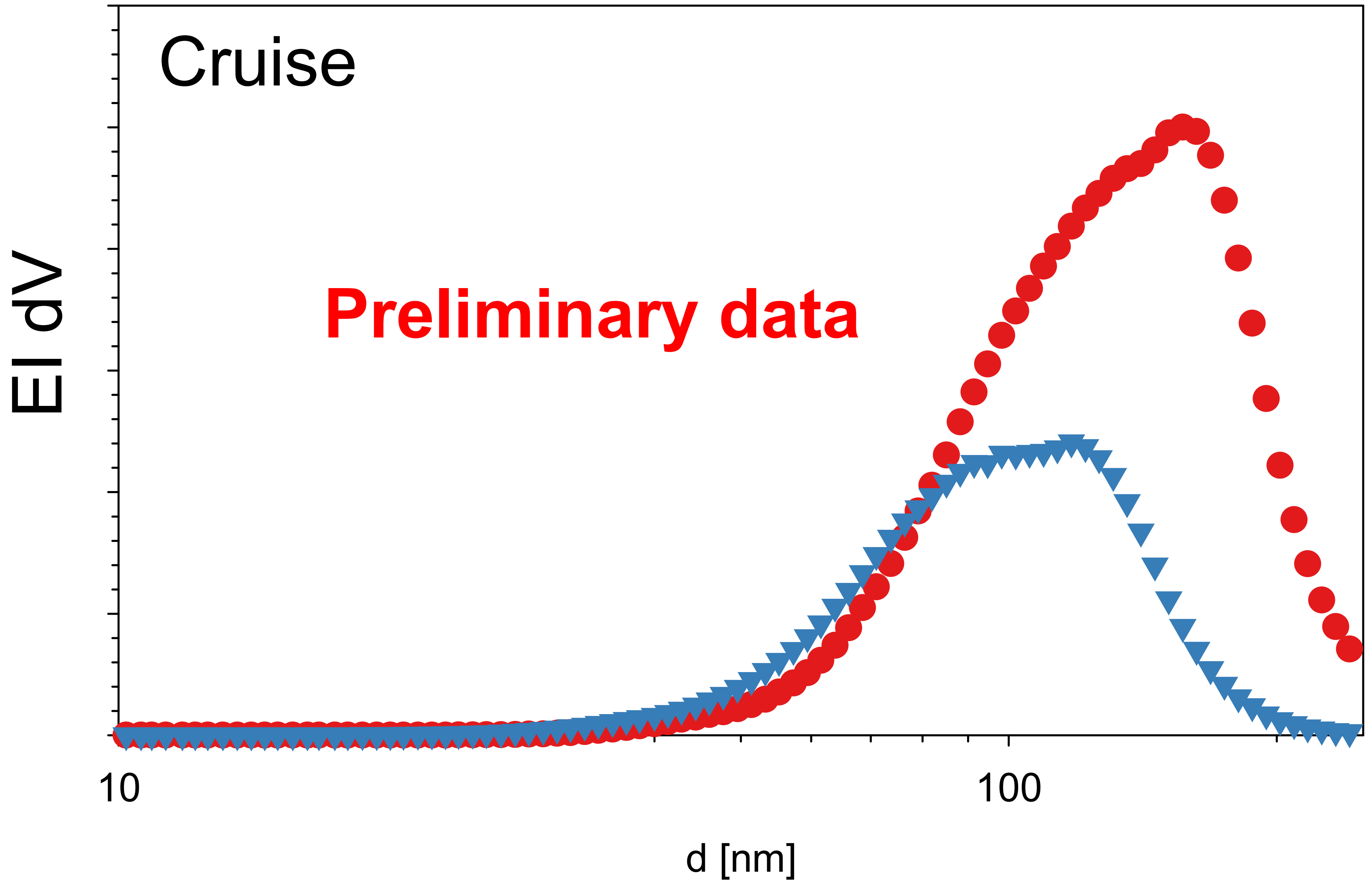


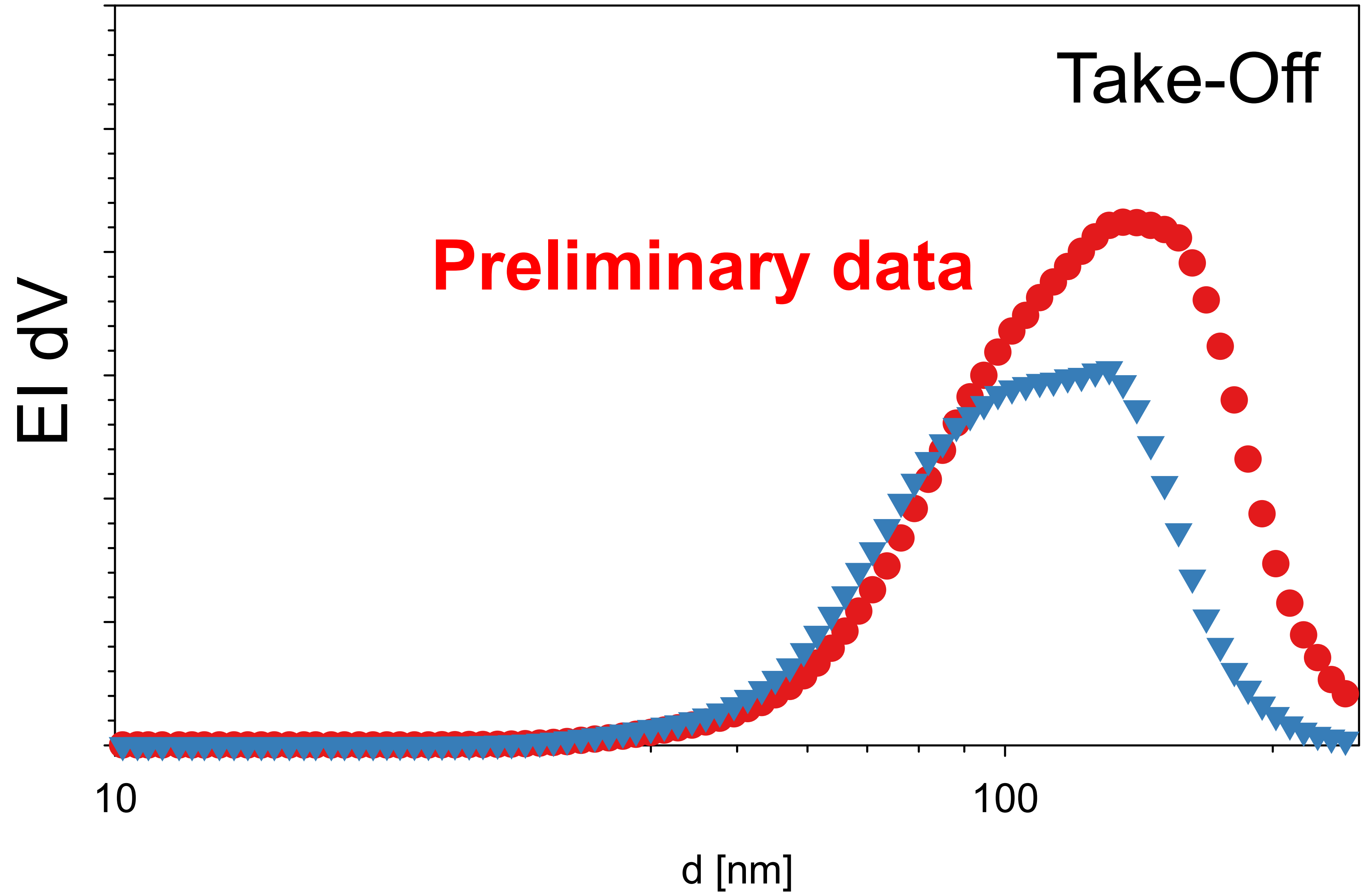
- NOx emission between the two different runs deviate by approx. 5% (9% max.)
- The ambient temperature was not very different (approx. 2°C) but the reference run was accompanied by rain
- The difference is not significant to account for a possible fuel effect

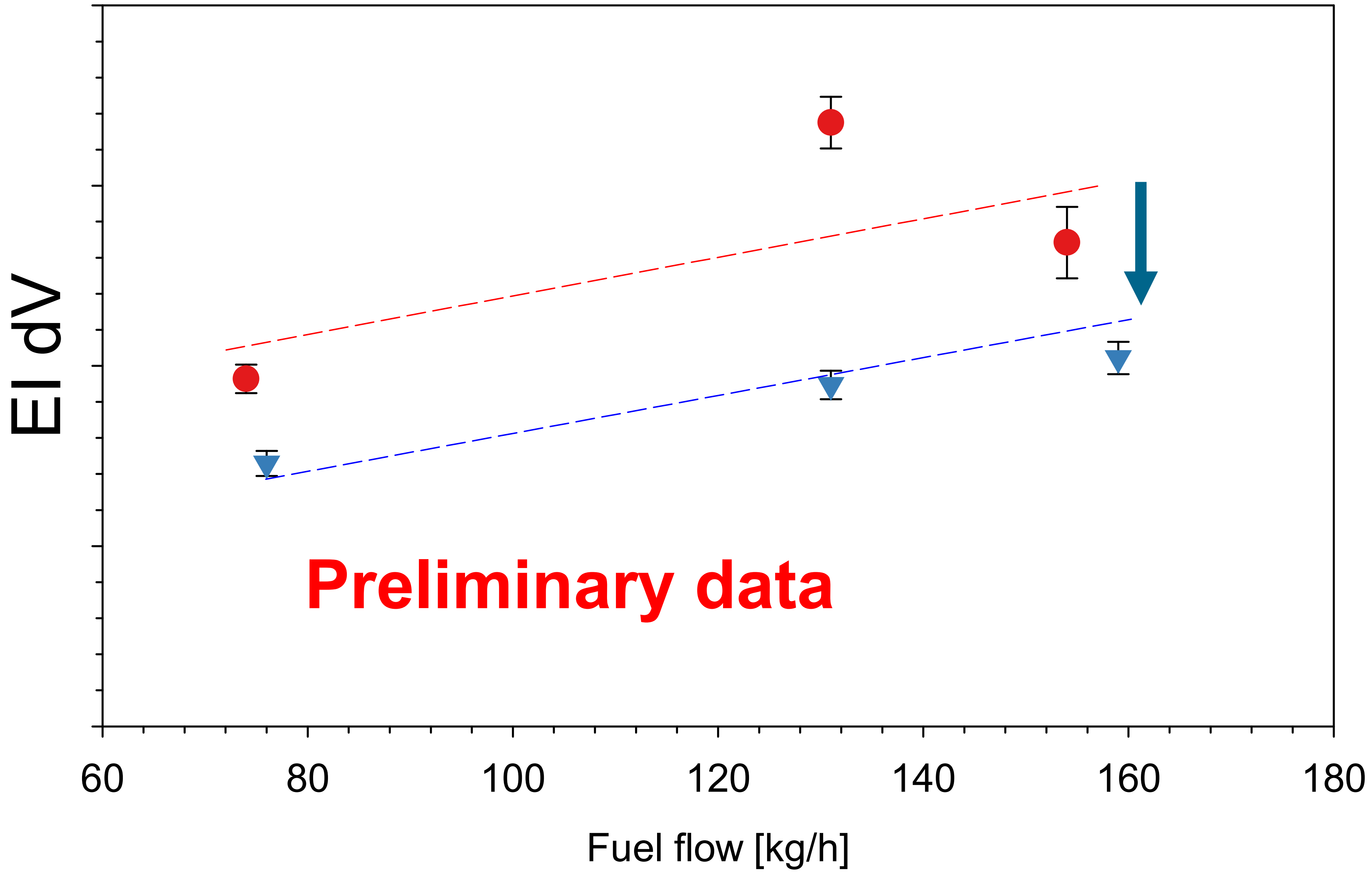
-> Comparable engine conditions

Particle Volume Size Distribution (nvPM)









Summary and Outlook

- Sucessful in-field measurement of a helicopter engine with good interday reproducibility
- Shift in particle number size distribution (agglomeration) allows no direct comparison of emission indices
- Reduction in nvPM particle volume emission when switching from fossil Jet A-1 to SAF blend has been observed
- The reduction in emitted particle volume is quite stable over power settings („cruise“ reference elevated/drifting)
- No other trade-off effects (e.g. NOx) have been observed
- These results are relevant for improving local air quality at/near airports
- Future experiments need to cover oil emissions from the engine

THANK YOU FOR YOUR ATTENTION

Impressum

Topic:	Field Study on the Impact of Sustainable Aviation Fuels on Helicopter Engine Emissions
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