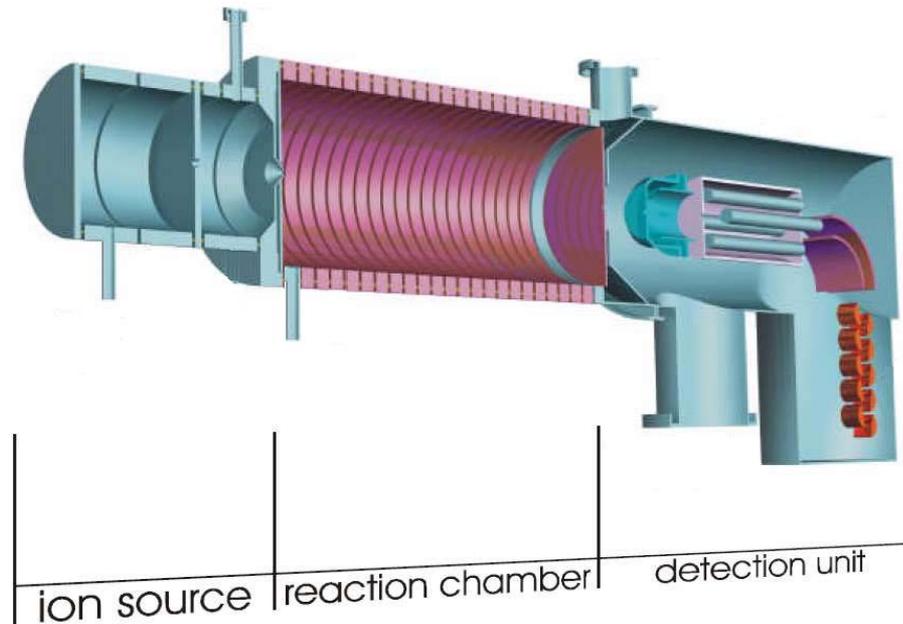


VOC measurements by PTR-MS

Armin Wisthaler
and
Tomáš Mikoviny

PTR-MS

Proton-Transfer-Reaction Mass Spectrometer



Set of routinely measured species

m/z	compound (interferant)
33	methanol
42	acetonitrile
45	acetaldehyde
59	acetone (propanal, glyoxal)
69	isoprene (furan)
71	MVK + MACR
79	benzene
93	toluene
107	C ₈ -aromatics (sum of isomers)
121	C ₉ -aromatics (sum of isomers)
135	C ₁₀ -aromatics (sum of isomers)
137	monoterpenes (sum of isomers)

others: formaldehyde, propene, acetic acid, DMS, MEK, PAN, C₁₀-aromatics,...

Instrument performance

- time resolution:
 - typically 0.5-1.0 s per compound (sequential measurement)
 - 10-12 compounds \rightarrow 10 s time resolution
 - trade off: time resolution vs. # of compounds measured
- detection limits: 10-100 ppt (2σ , 1s)
- accuracy: $\pm 10\%$ (externally calibrated)

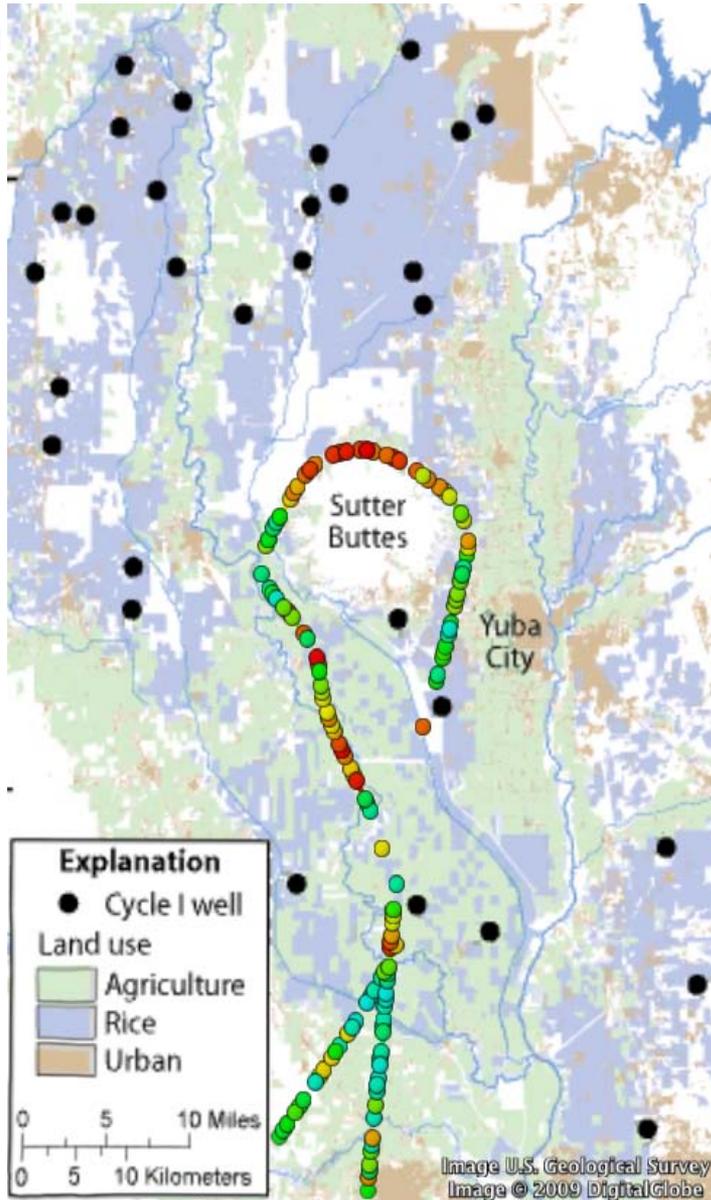


Methanol (agricultural)

Methanol

[pptv]

- 13000
- 12317
- 11634
- 10952
- 10269
- 9586
- 8903
- 8220
- 7538
- 6855
- 6172
- 5489
- 4807
- 4124
- 3441
- 2758
- 2075

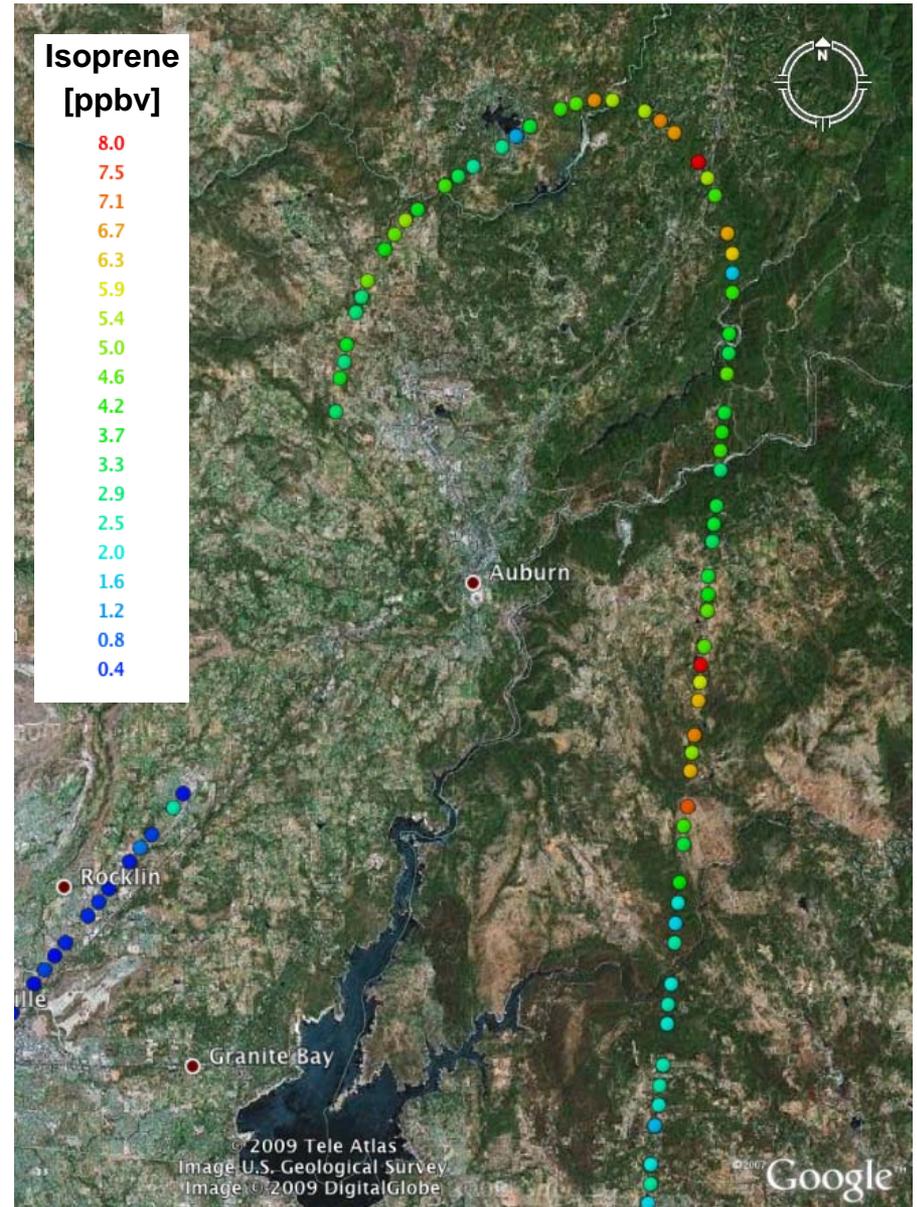


Isoprene (forests)

Isoprene

[ppbv]

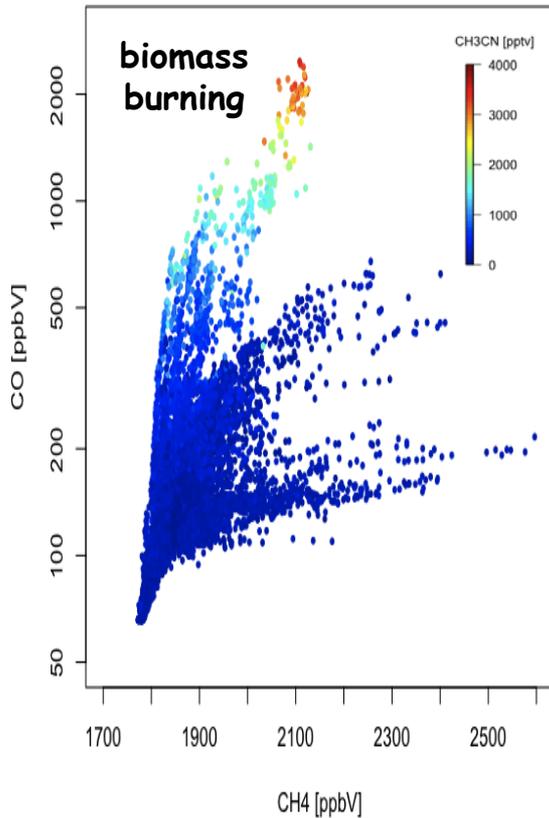
- 8.0
- 7.5
- 7.1
- 6.7
- 6.3
- 5.9
- 5.4
- 5.0
- 4.6
- 4.2
- 3.7
- 3.3
- 2.9
- 2.5
- 2.0
- 1.6
- 1.2
- 0.8
- 0.4



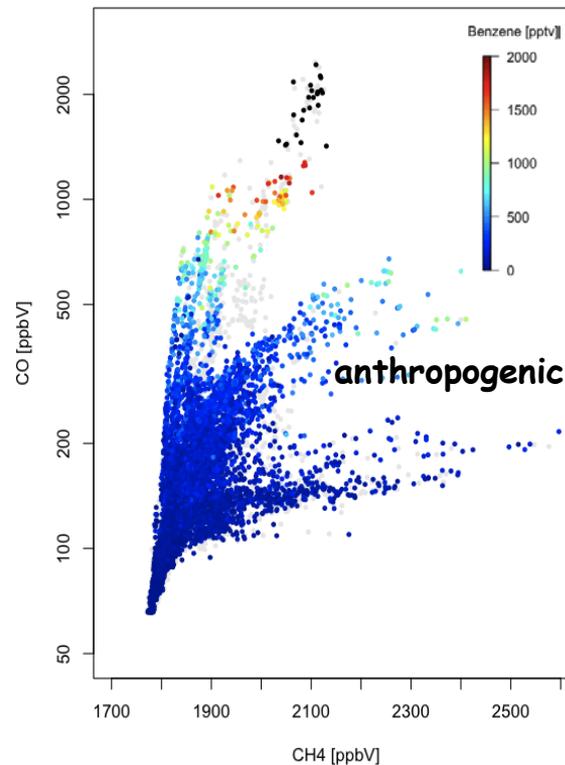
Air mass characterization

ARCTAS-CARB

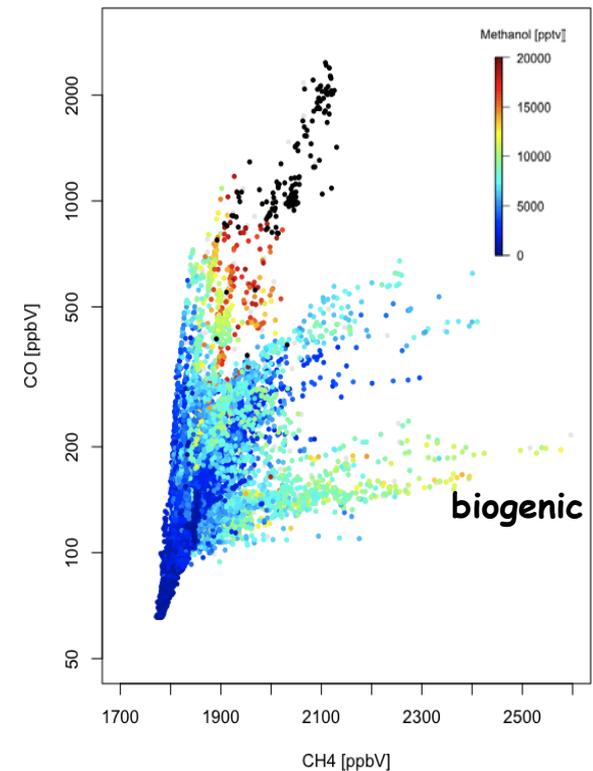
(acetonitrile)



(benzene)



(methanol)



CO vs. CH₄

(Diskin / Sachse)

A reviewer's suggestion

validate indirect isoprene emission mapping using satellite-derived HCHO

OMI HCHO: June–August 2006

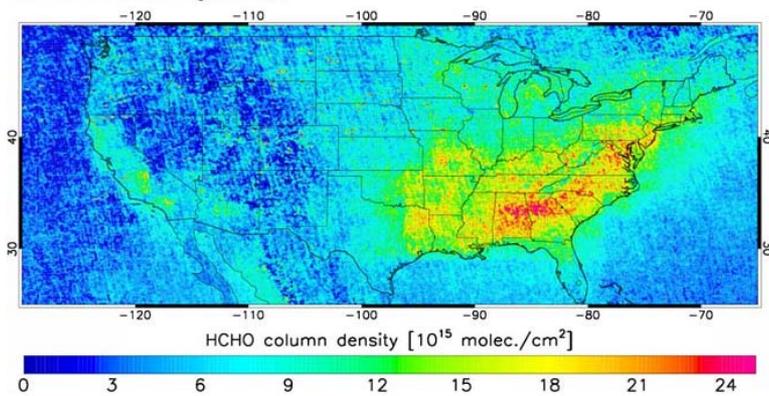


Figure 1. Mean OMI HCHO columns for June–August 2006 mapped on a 0.1° × 0.1° grid.

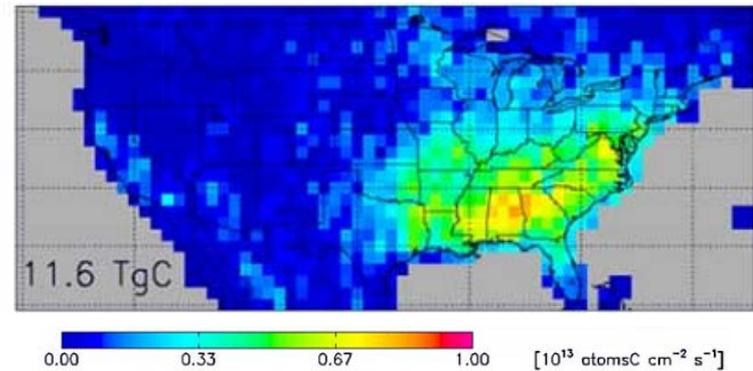
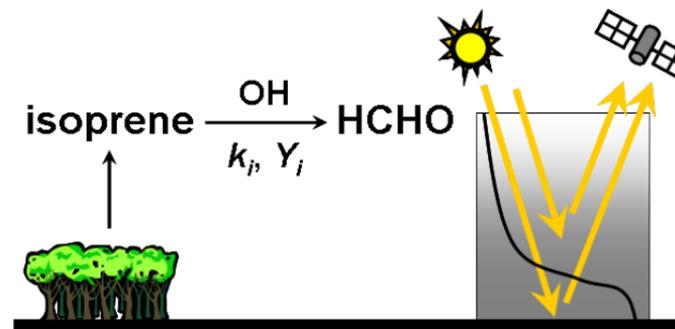


Figure 12. OMI isoprene emissions (June–August 2006) at 12:00–15:00 local time

Millet et al., 2008



consider in
flight planning

M. Barkley, Edinburgh

The instrument

(as flown during ARCTAS-2008)

Power supplies & controllers:

- drift tube
- mass flow controllers
- heaters

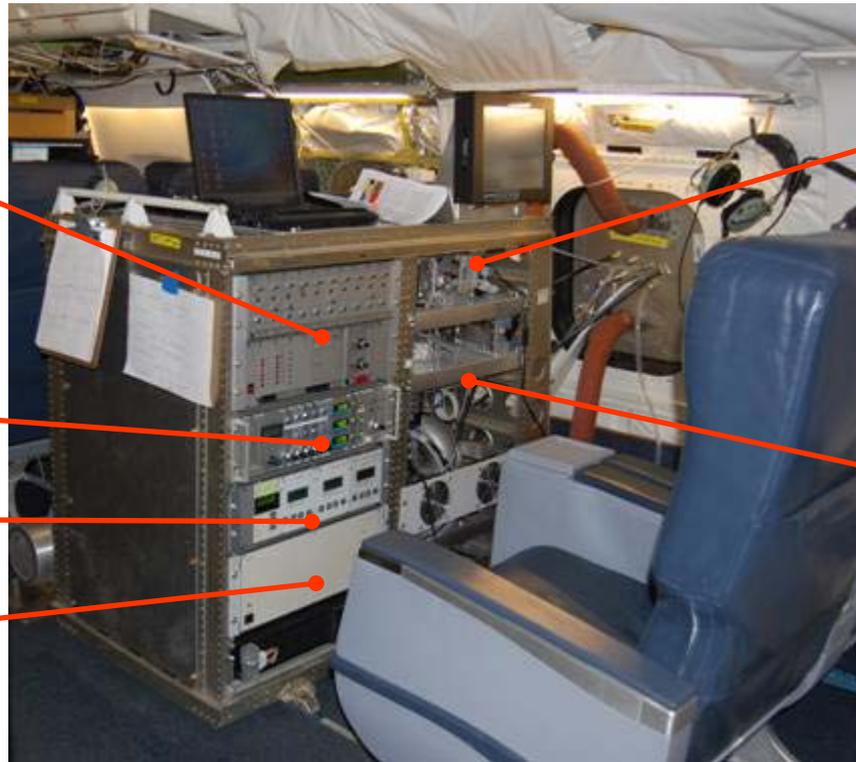
turbo controllers

QMS control unit

UPS

inlet / calibration /
zeroing system

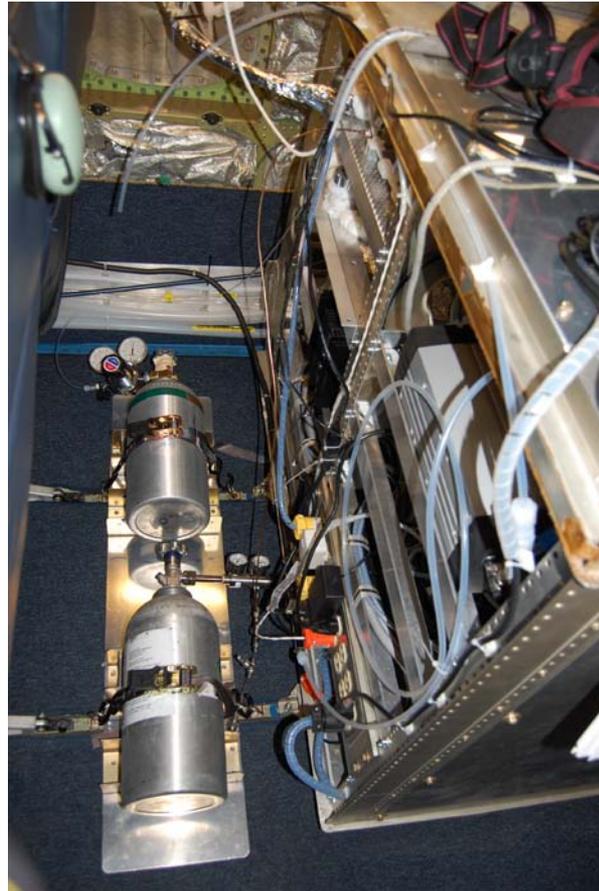
vacuum system



487 lbs / 115 V / 60 Hz / 10 A (12 A peak)

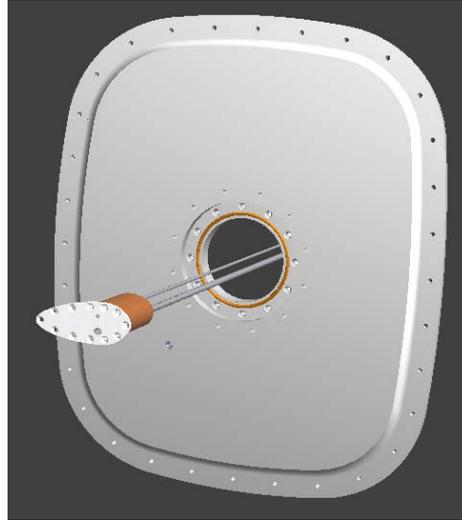
- 2011 mission will be flown in this or similar configuration
- **need new rack asap** (shipment, integration, testing, shipment, customs, etc.)

Gas supplies



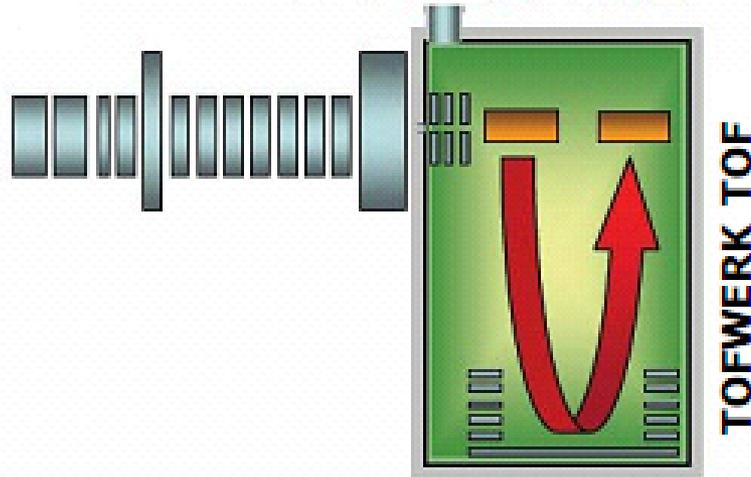
- two N033 aluminum cylinders (30 cu ft., 2000 psi, pure N₂, VOC mix in N₂)

Inlet



- 44 cm winglet, (tubings extend extra 2.5 cm)
- copper block with two 150 W cartridge heaters for inlet heating (winter mission)
- 1/8" passivated SS (inlet) , 1/4" passivated SS (zero air)
- 3/8" exhaust (need separate exhaust, or 100 % oil free)
- inlet position: our measurements are very sensitive to aircraft exhaust (aromatics)
 - backflush inlet at ground, during take-off and landing

Upgrades / Modifications



- replace QMS by TOF-MS
 - full mass spectrum at 1-sec time resolution
- no funding yet
 - not 2011; hopefully at later stage of DISCOVER-AQ

Other issues

- power:
 - minimum 2.5h before take-off (the more the better !)
 - 1 h after landing
- no open solvents (methanol, acetone, acetonitrile) in the cabin; use well-sealed vessels for any organics !!
- no flight constraints (pressure- and temperature controlled inlet)

Data analysis plans

- | | |
|----------------------|----------|
| • raw data: | on-line |
| • field phase data*: | 48 hours |
| • preliminary data*: | 3 months |
| • final data: | 6 months |

* not all compounds (e.g. CH_3CHO)

Constraints:

- only one full-time equivalent staff (at the moment):
field campaign execution, QA/QC