
# Interoperable Remote Sensing Instrumentation: Deployment of the GLORIA limb imaging FTSs on research aircraft and stratospheric balloons

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for the GLORIA-Team

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# GLORIA is a team effort


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Photo credit: Björn-Martin Sinnhuber, KIT

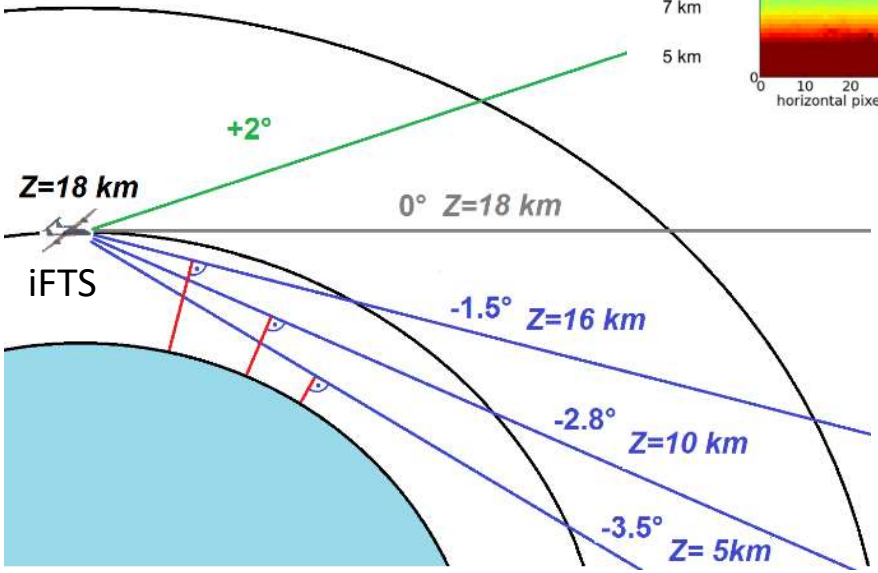
GLORIA

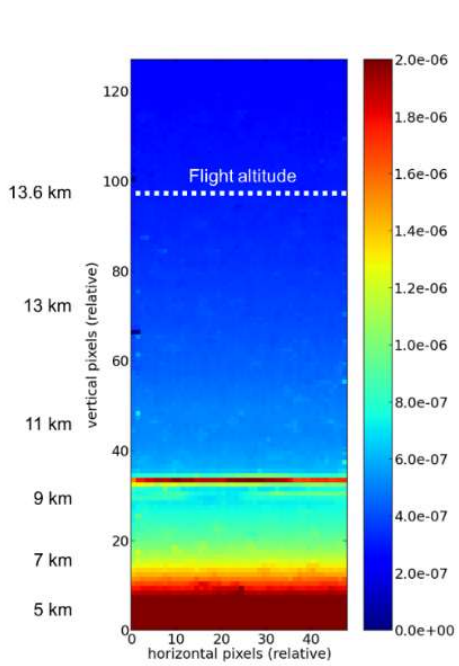
KIT HELMHOLTZ JÜLICH

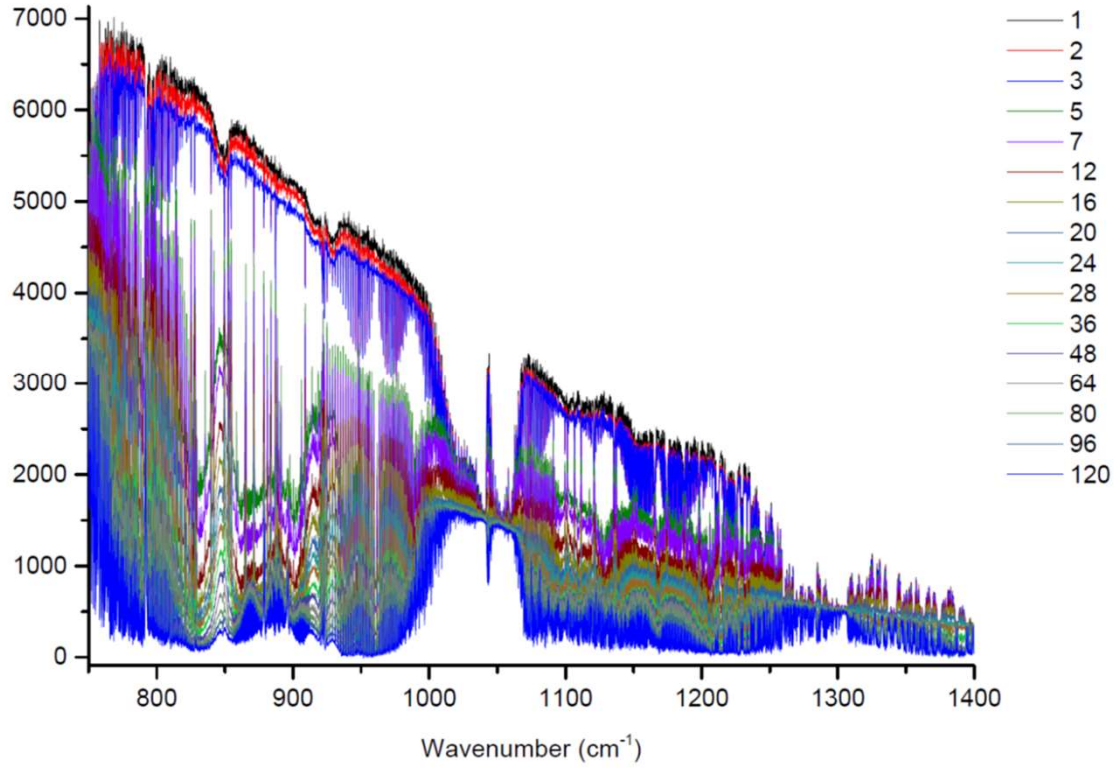
# Platforms:
# Geophysica, HALO, Balloon

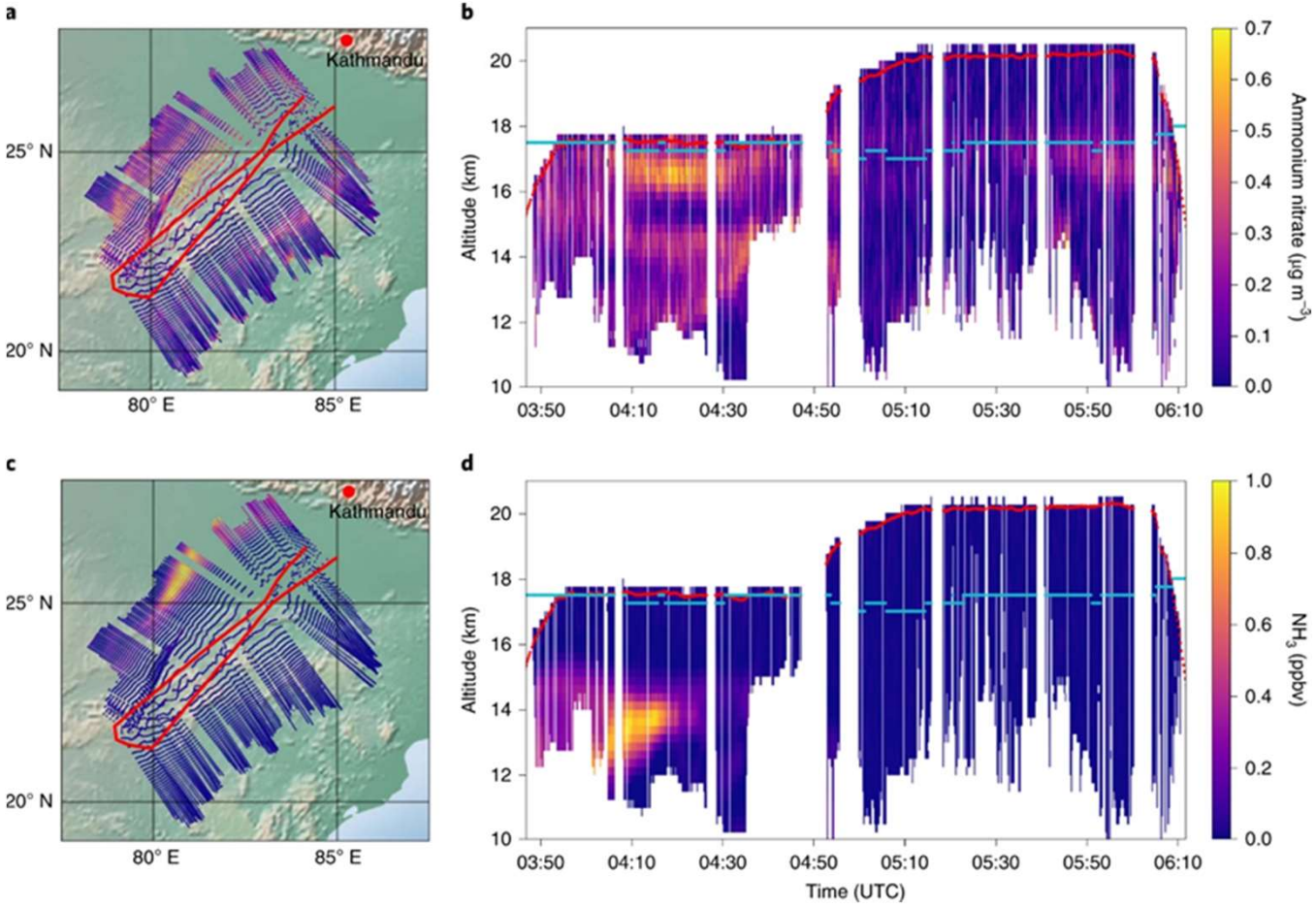
10 campaigns in 10 years
> 700 flight hours


# Method: Limb imaging with a FTS



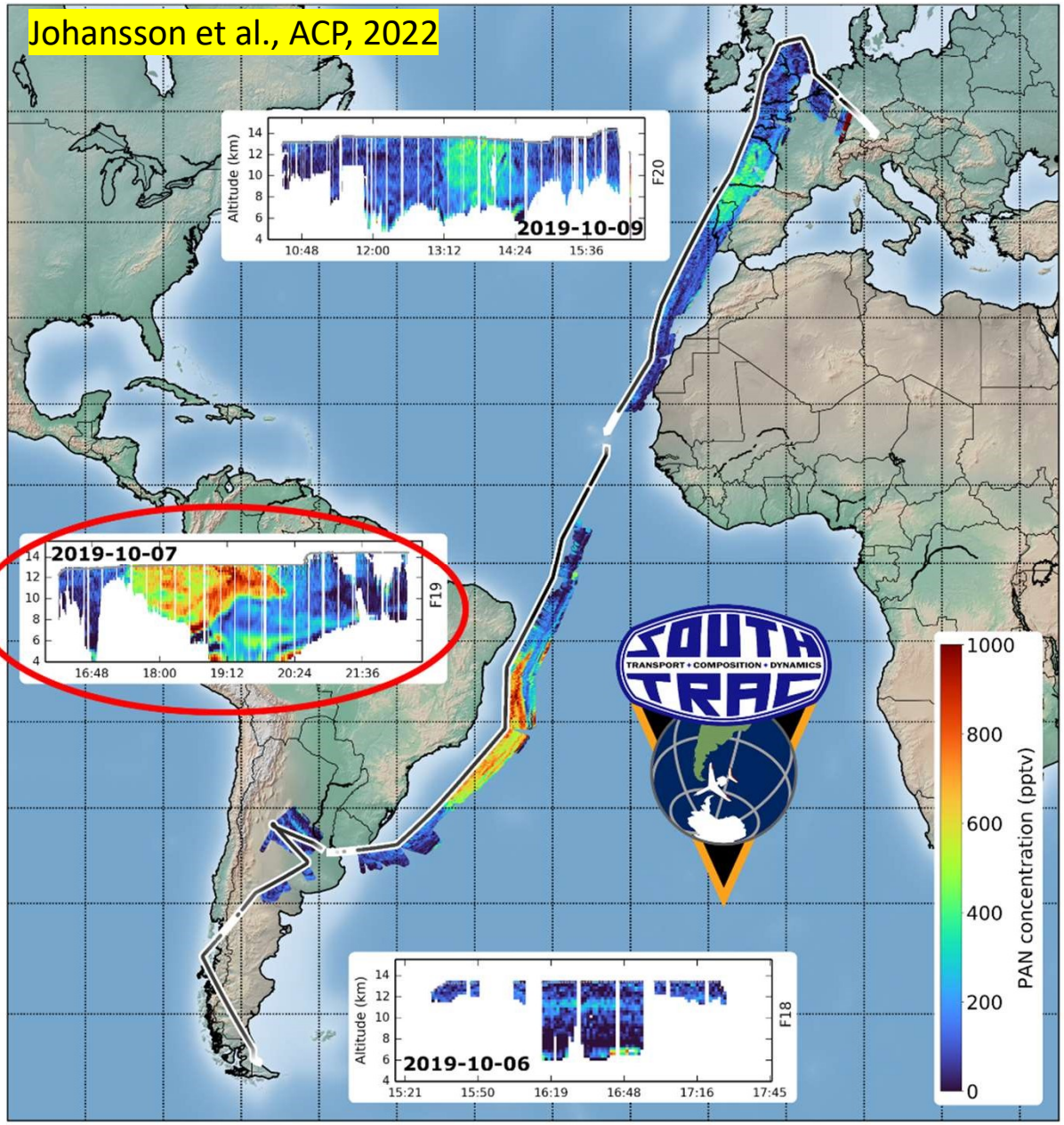






Höpfner et al., Nature Geoscience, 2019

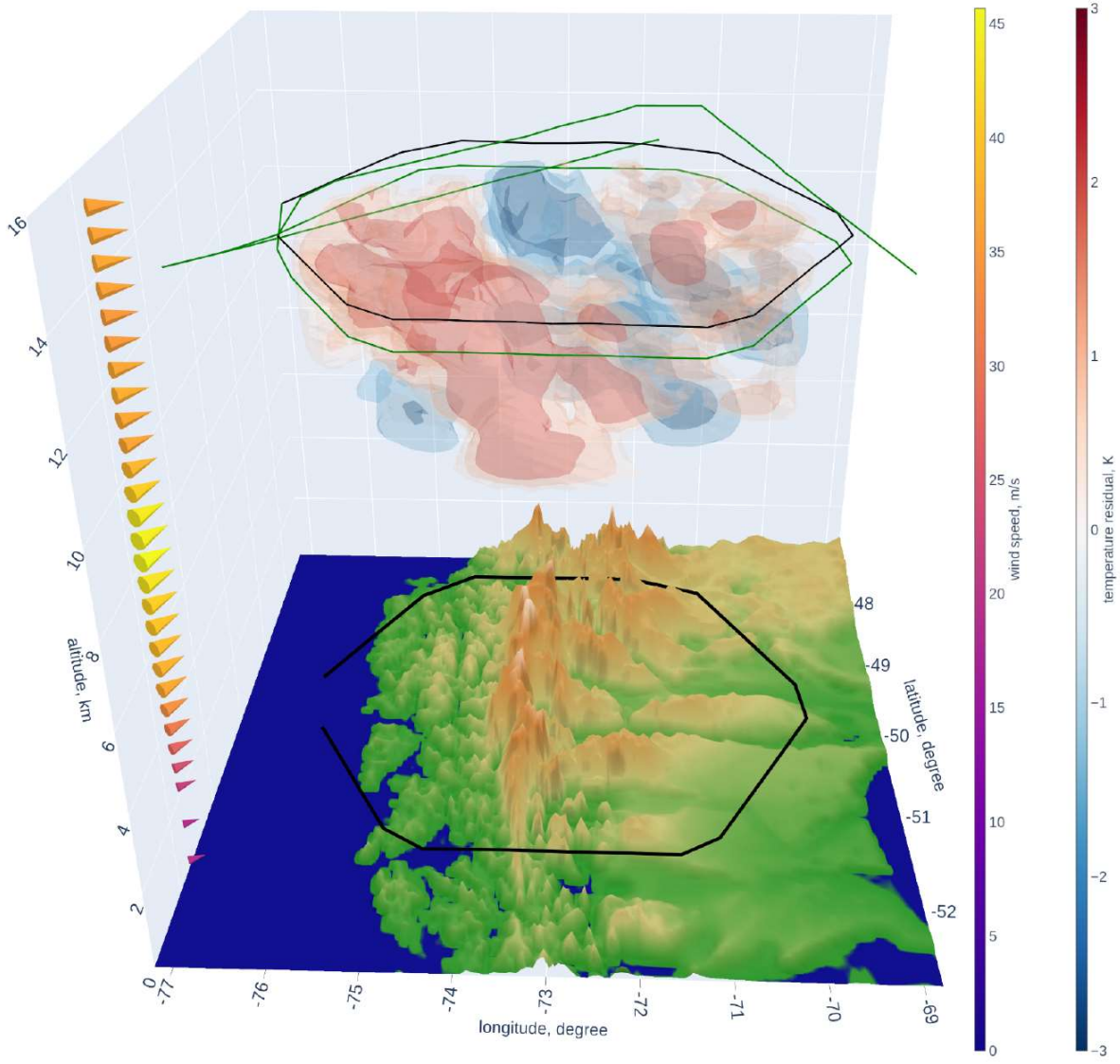
Geophysica
Stratoclim campaign 2017
Kathmandu

ATAL
Aerosol formation in
Asian Monsoon




HALO –
SouthTrac campaign
Patagonia, 2019

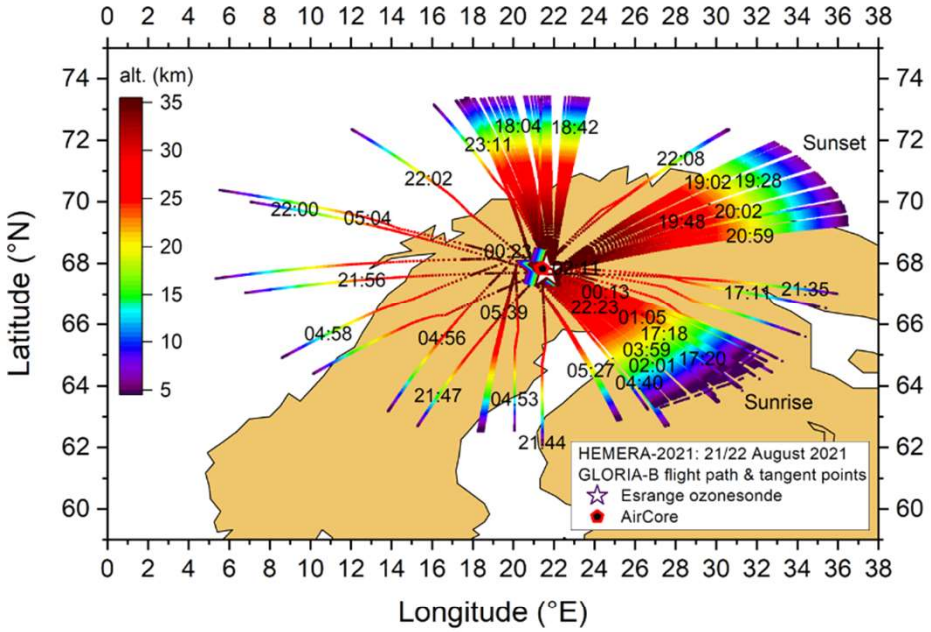
Biomass burning
PAN as example




M. Rapp et al., BAMS, 2021

HALO –
SouthTrac campaign
Patagonia, 2019

Mountain waves
above the Andes

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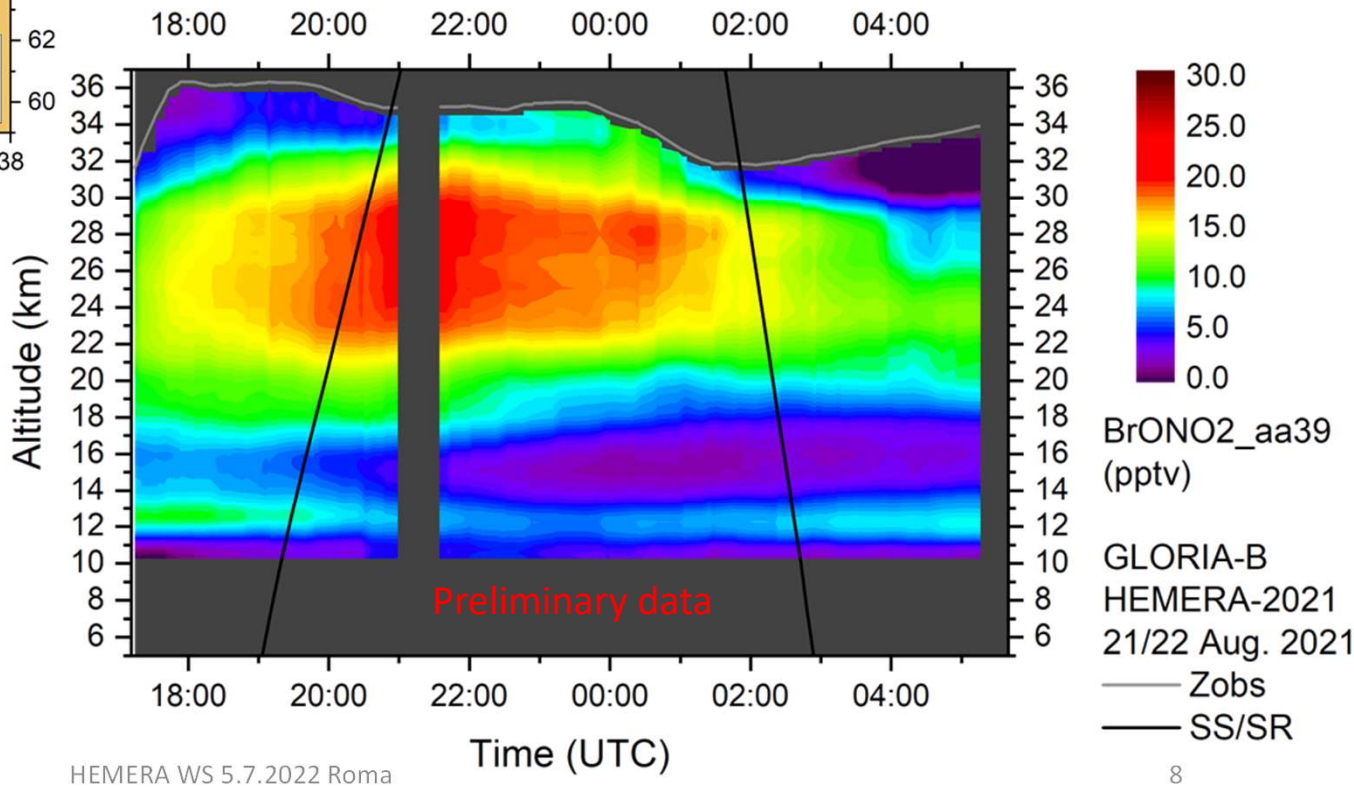
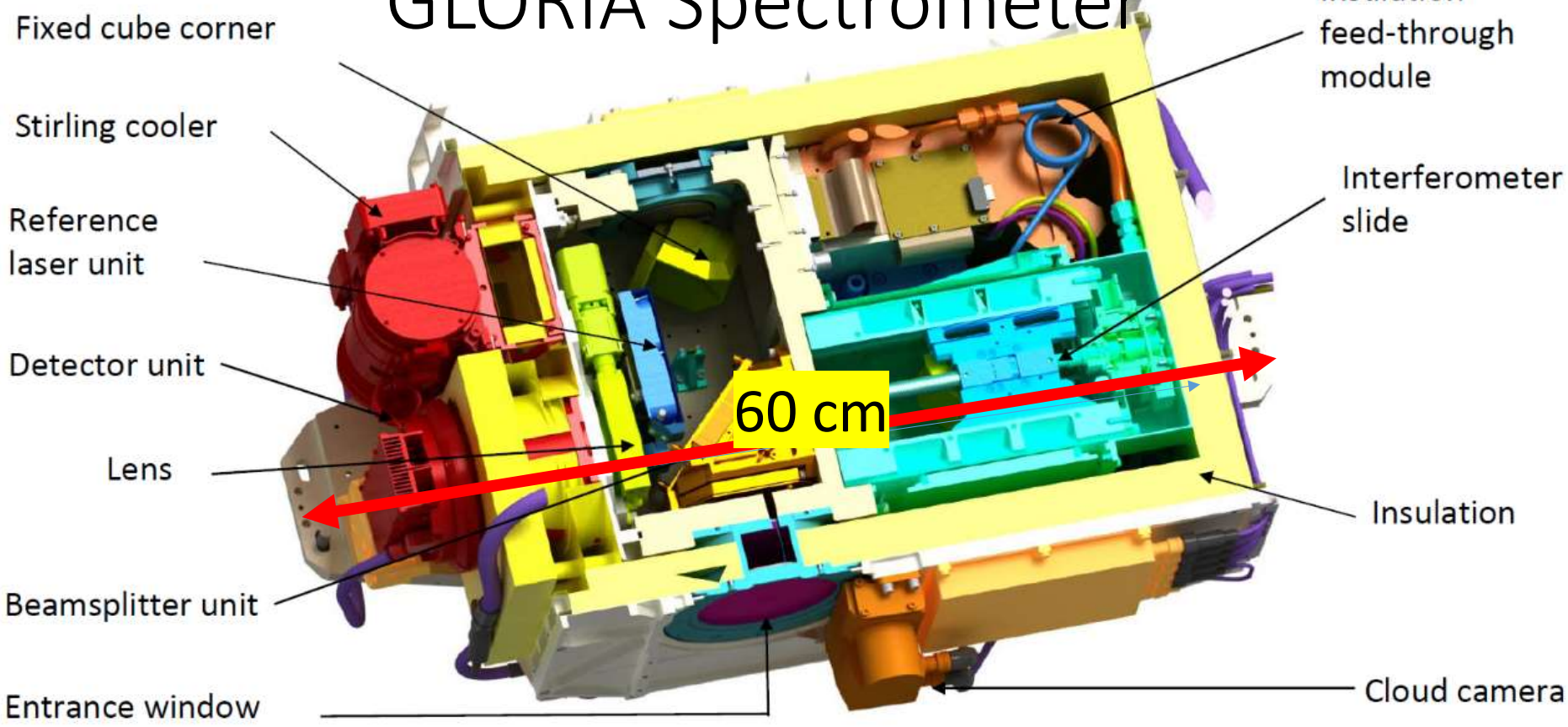
# Stratospheric Balloon: HEMERA campaign 2021 Bromine chemistry



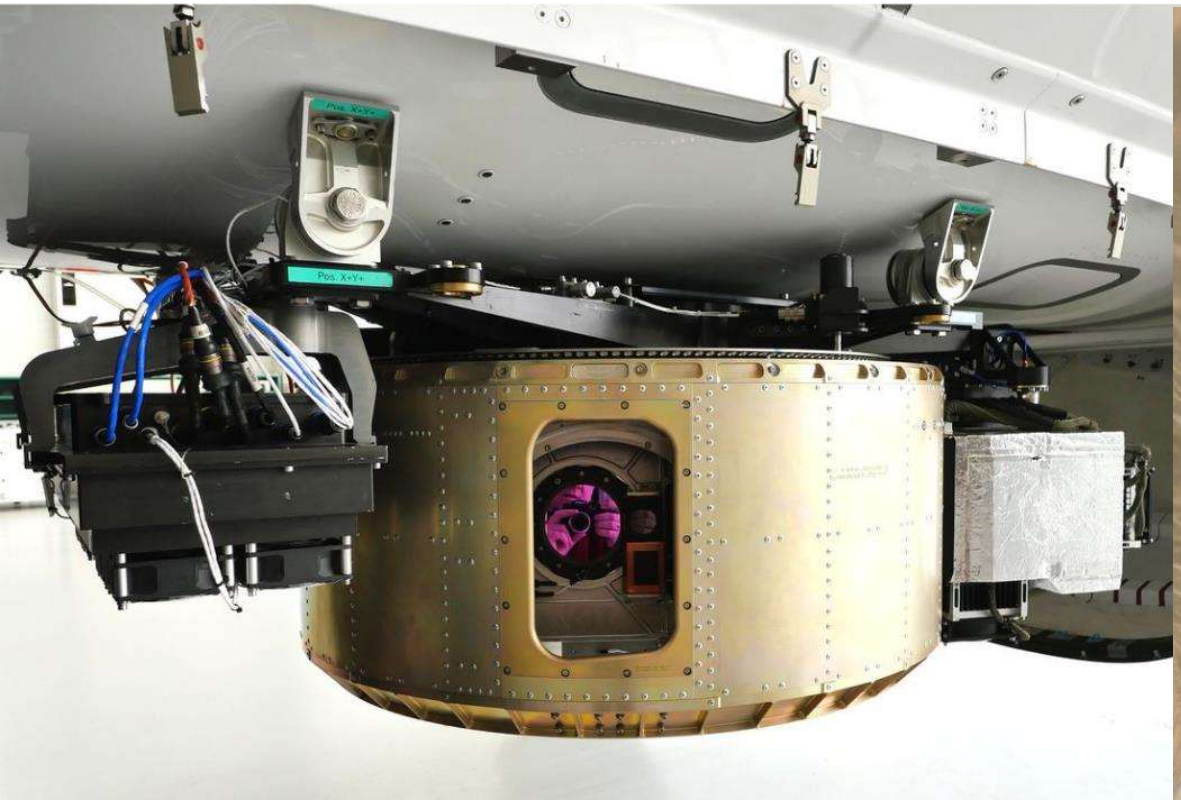

Details: Talk by Gerald Wetzel later today

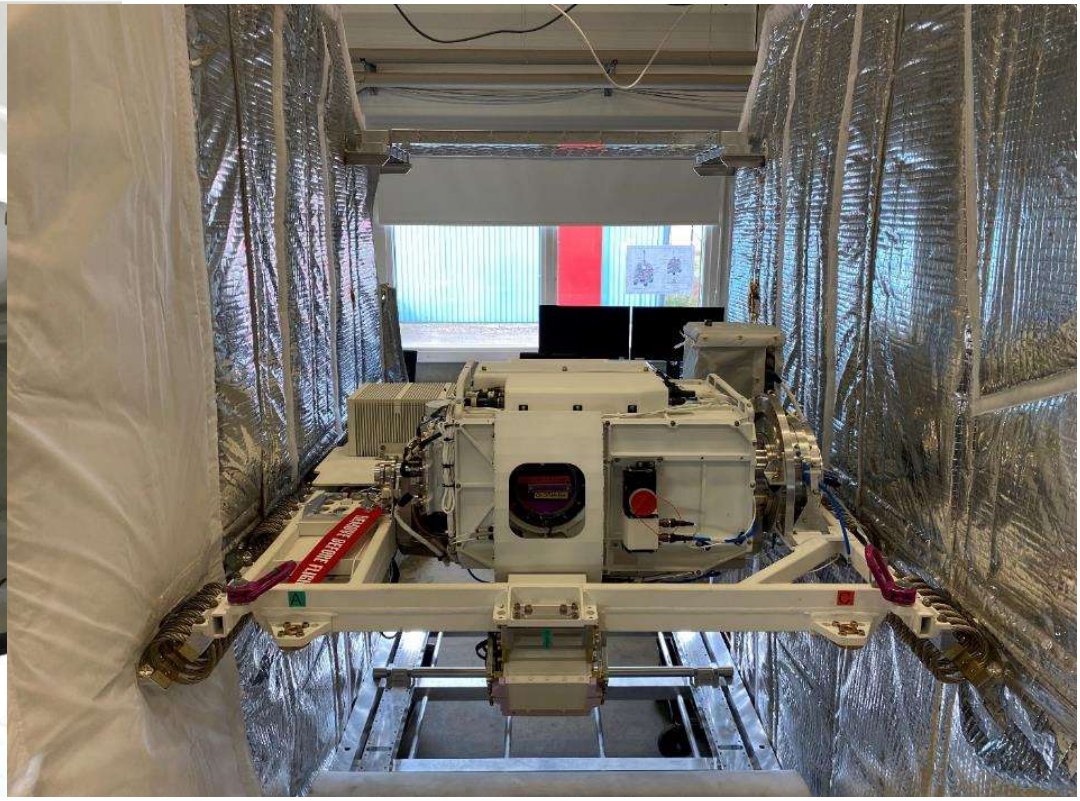
# GLORIA Spectrometer

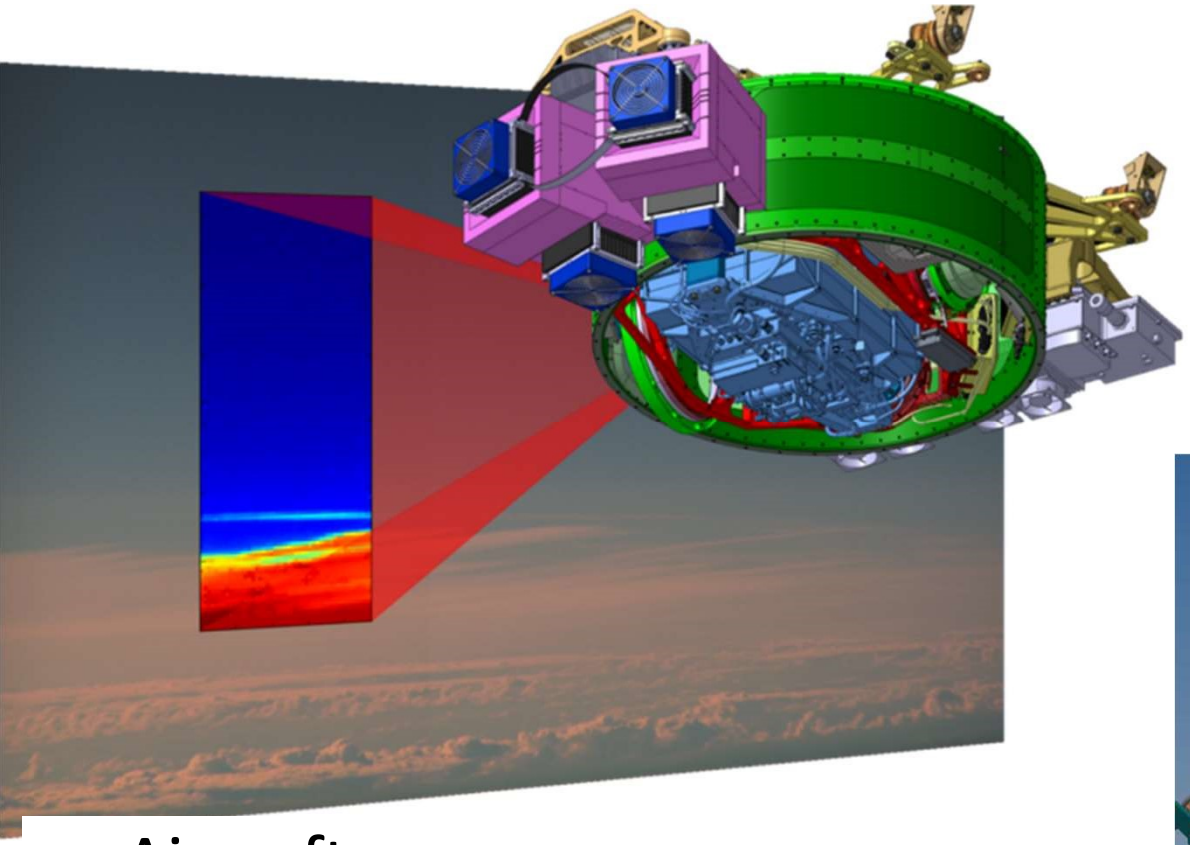



**Classical Michelson Interferometer** - linear slide design - OPD / sampling: up to 8 cm / 0.0625 $cm^{-1}$
VLWIR MCT LFPA (AIM) - 48 x 128 used pixel - 6.3 kHz read out - Spectral coverage: 780-1400 $cm^{-1}$
Nominal operation temperature: 215 K, m = 48 kg including electronics

# Deployment of spectrometer on different platforms

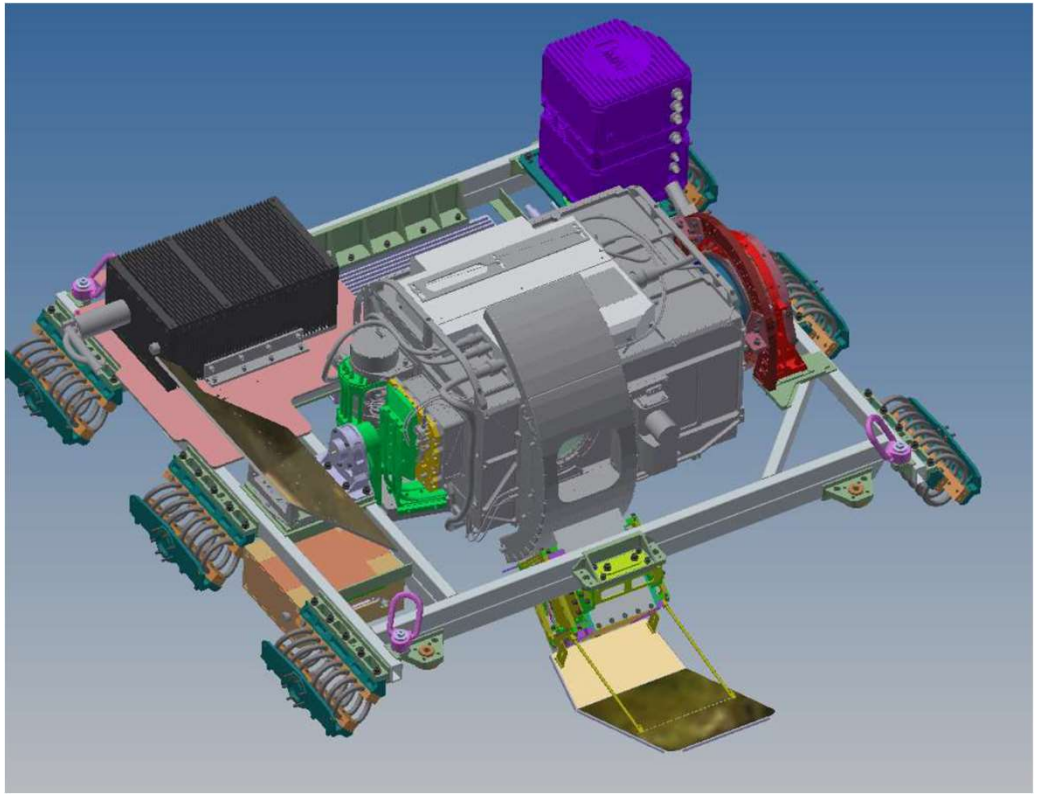






## Balloon

- Elevation control through rotation of spectrometer
- Azimuth control through rotation of gondola
- Lighthouse scan possible
- ~300 mm spatial sampling at tangent point
- Total mass ca. 125 kg



## Aircraft:

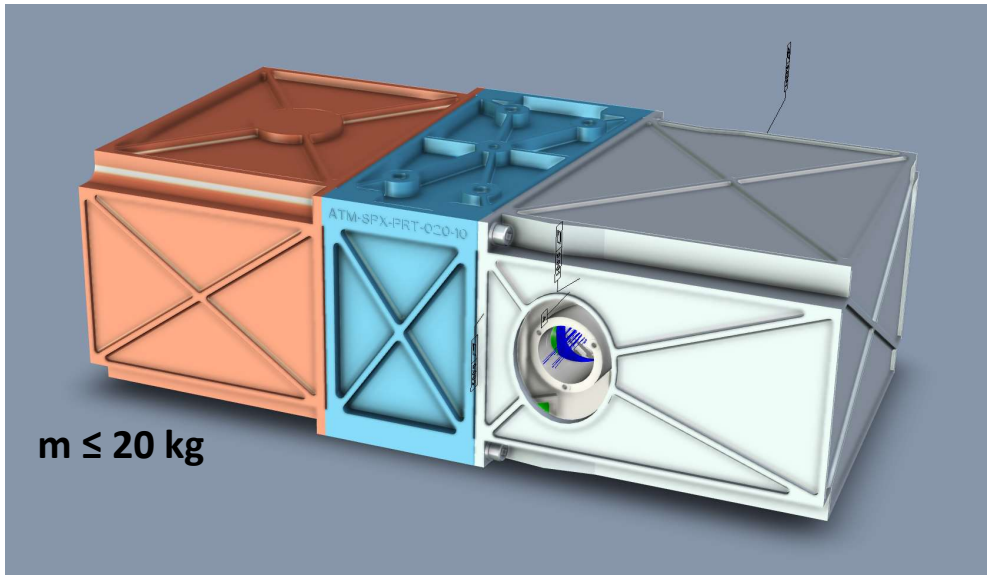
- gimbaled frame
- carrier movements are compensated
- tomographic measurements possible
- ~150 mm spatial sampling at tangent point
- Total mass ca. 220 kg

# Current situation:


- GLORIA can reliably operate from various aircraft and balloon
- Spectrometer is identical on all platforms
- Mechanical, thermal and electrical environment is completely different
  → Significant differences in mechanical and thermal design of embedding structure
  → Significant differences in operational constraints (flight duration, sunlight,…)
- Ground station, operation software, processing algorithms and software are identical
  - Parametrisation has to be adapted to platform and flight situation

# Next generation: GLORIA LITE

- Reduction of ressource needs:
  - Smaller instrument at ambient temperature (no more cryogenics)
  - Athermal full metal optical design that works in wider temperature range
  - Drastically reduced power needs
- Thermal design that works in all pressure regimes
- Mechanical design that allows simple integration on all platforms:
  - Generic mechanical/thermal interface
  - Line of sight control through dedicated adapted units (miniaturized IMU)
- Operational and processing SW inherited from GLORIA-AB/B

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|---|---|
| Current status: | Optical design and mechanical concept completed |
| Fall 22: | Delivery of engineering model and infrared detectors |
| Summer 23: | Delivery of flight model |
| Summer 24: | First possible flight (BSO) |

# GLORIA-LITE: Goals


- Improved interoperability by considering constraints of all platforms in initial design
- Same instrument can fly with interface modifications only on
  - BSO (short and long duration)
  - Various research aircraft
- Instrument can be adapted with limited effort to
  - LDBs/ULDBs (further mass reduction)
  - Micro-Satellites (component selection)
- Reduction of ressources (personnel, energy, cryogens) and constraints for operation of instrument on all platforms
- Frequent deployment of several operational instruments
  → significant improvement of number of observations
  → more scientific value for less effort and cost