



# Deployment of a GreenHouse Gases Laser Heterodyne Radiometer (GHG-LHR) for the FRM4GHG ESA campaign

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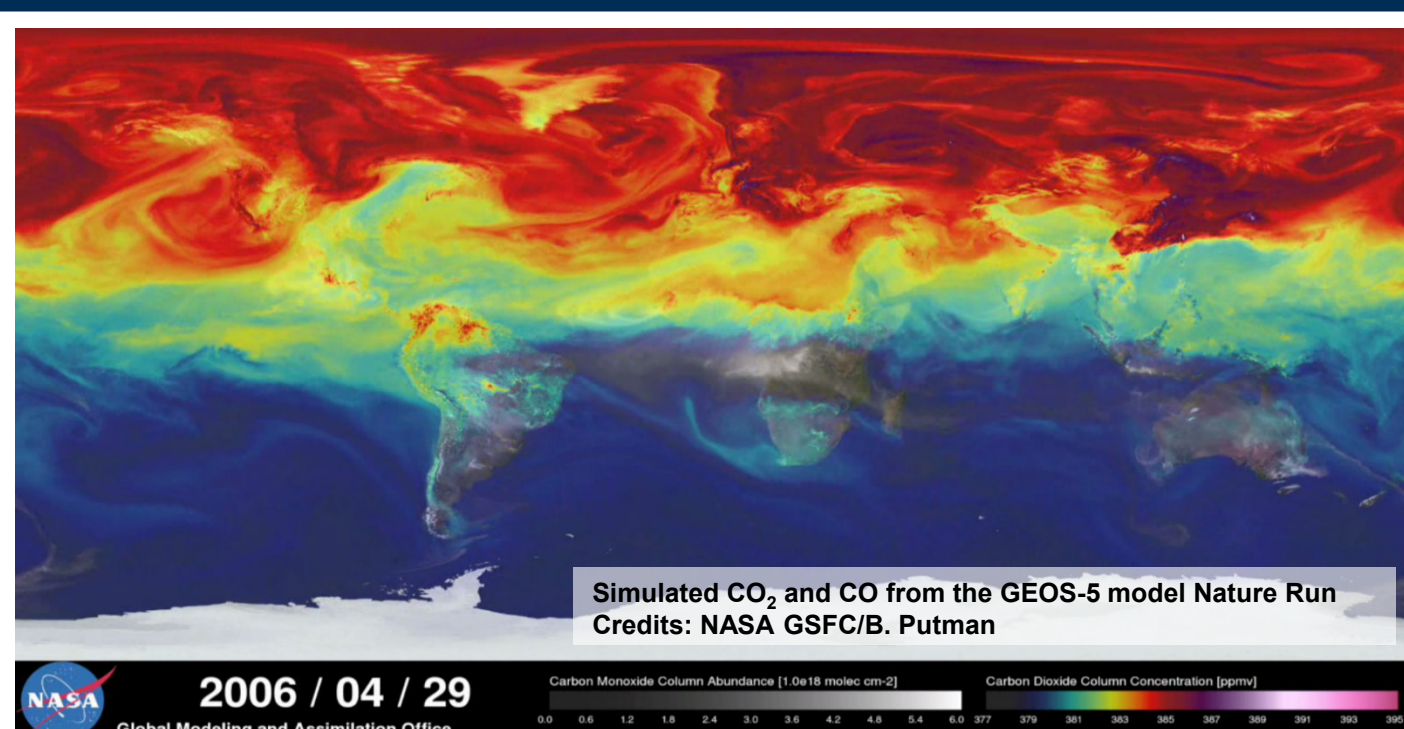
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## Fiducial Reference Measurements for GreenHouse Gases

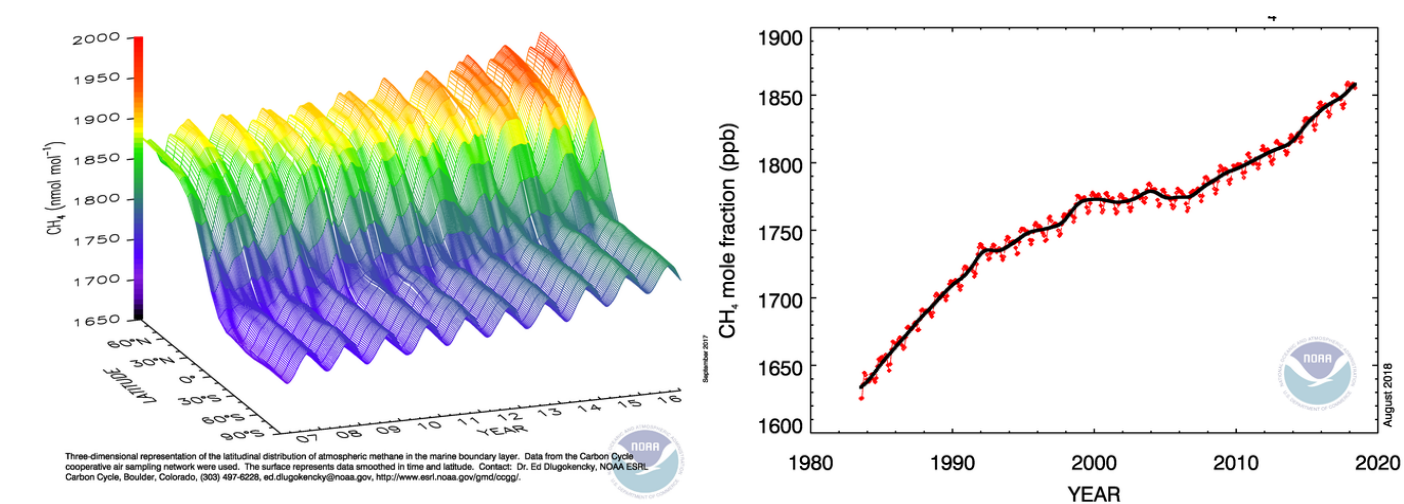
Finnish Meteorological Institute Artic Research Station, Sodankylä (67.37°N)

### Context



#### Scientific rationale and technology development objectives

- CO<sub>2</sub> major atmospheric component of terrestrial C-cycle and climate system, and best-known GHG. Strong PBL and seasonal variations and slow rising trend due to anthropogenic emissions. Large spatio-temporal differences, but (diurnal) variations in the total column amount typically <1 ppm on ~400 ppm background.



- CH<sub>4</sub> extremely potent GHG (GWP >> CO<sub>2</sub>) with a relatively short atmospheric lifetime (12.4 years). Large spatio-temporal, and seasonal variations (10's of ppb on ~1800 ppb background). Poorly understood rise due to anthropogenic emissions with apparent "pause" around 2000.

⇒ need for accurate, high-precision instrumentation, suitable for network deployment for source, sink & transport studies

### FRM4GHG objectives

#### FRM4GHG campaign aims

- Inter-compare co-located novel and established ground-based IR sounding spectrometers and associated retrievals for GHGs.
- Validate retrieved dry total column amounts against TCCON reference data and balloon-borne AirCore in-situ profiles.
- Collect reference datasets for validating (mostly C-based) global GHG satellite observations, in particular S5P, giving TC amounts.
- Instruments deployed at FMI Sodankylä, Finland:

- TCCON
- GHG-LHR
- Bruker EM27
- Bruker Vertex 70
- Bruker IR-Cube
- Aircore



- Principal species – CO<sub>2</sub>, CO, CH<sub>4</sub>, H<sub>2</sub>O.

⇒ evaluate potential of low-cost portable spectrometers for new GHG observing systems, complementing TCCON.

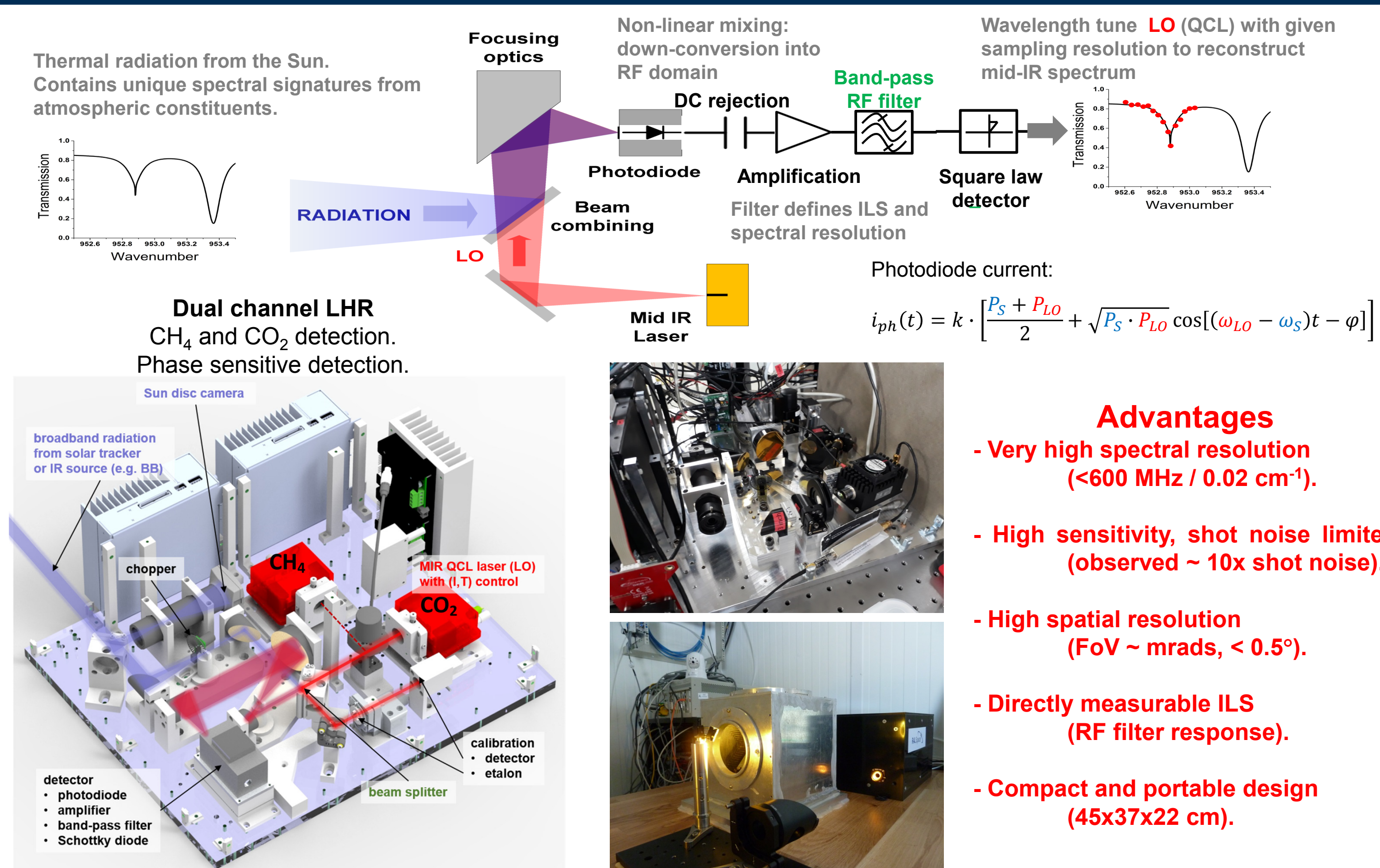
### Benefits of Cal-Val involvement

- Networking with EO scientists engaged in space missions.
- Exposure and ongoing interaction with ESA.
- Skills and expertise development.
- International visibility.
- High level science and scientific returns.
- Raising TRL of novel instrumentation.

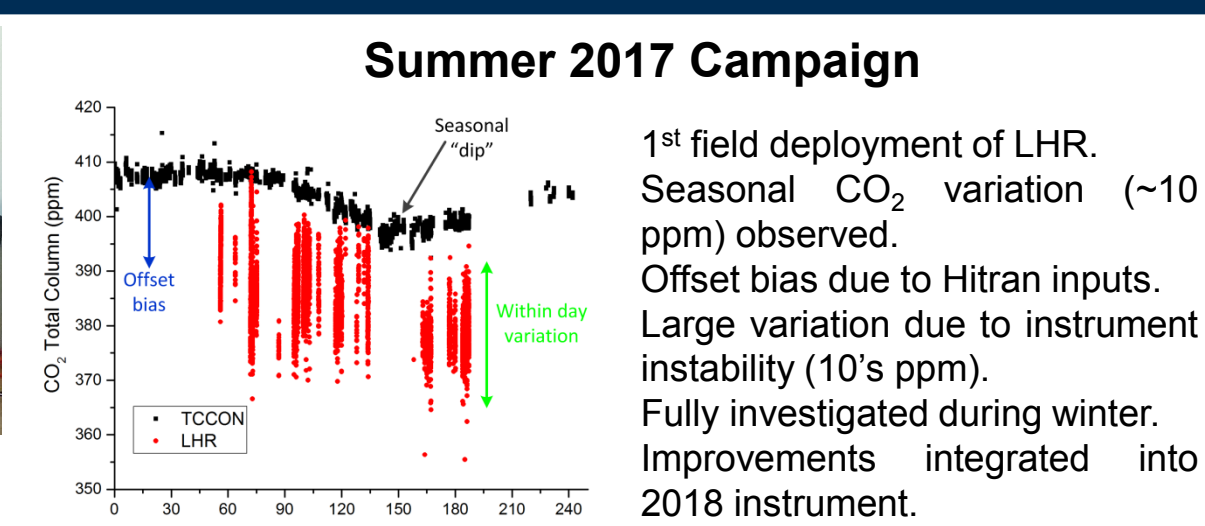
⇒ FRM4GHG provides an excellent opportunity for UK involvement in ESA supported Cal-Val campaign.



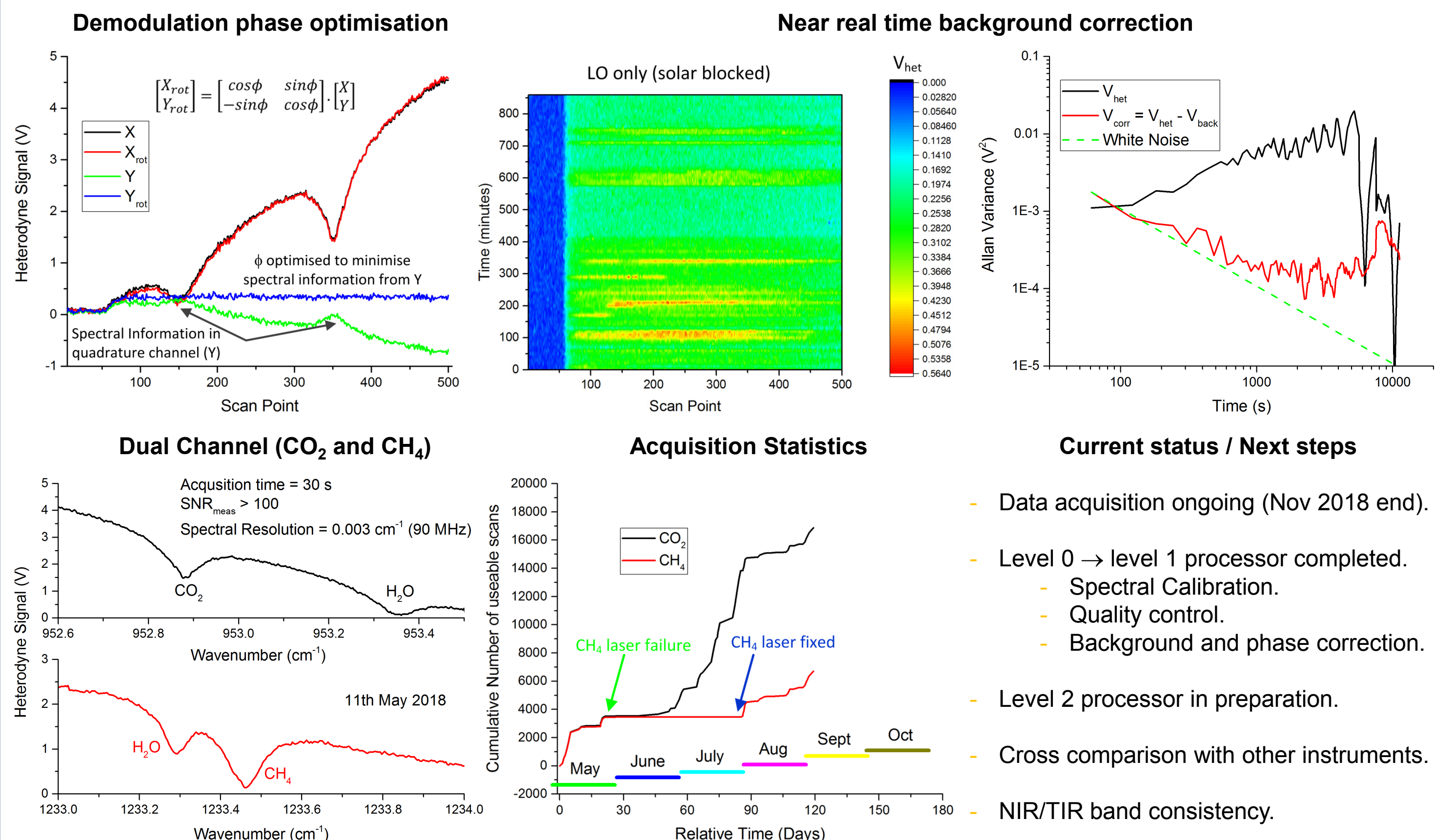
### Principles, prototype and performance of the LHR



### Field Deployment – CO<sub>2</sub> / CH<sub>4</sub> / H<sub>2</sub>O measurements



#### 2018 Campaign (ongoing)



**Acknowledgments:**  
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