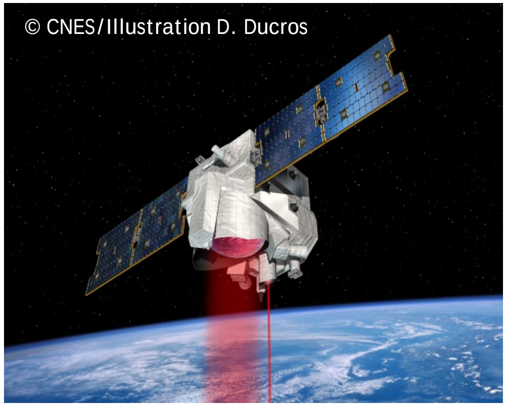

MEthane Remote sensing LIdar missioN

Status of MERLIN mission

Carole DENIEL, *CNES, Atmospheric Composition Programm*

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4 – Laboratoire de Météorologie Dynamique (LMD)

Introduction

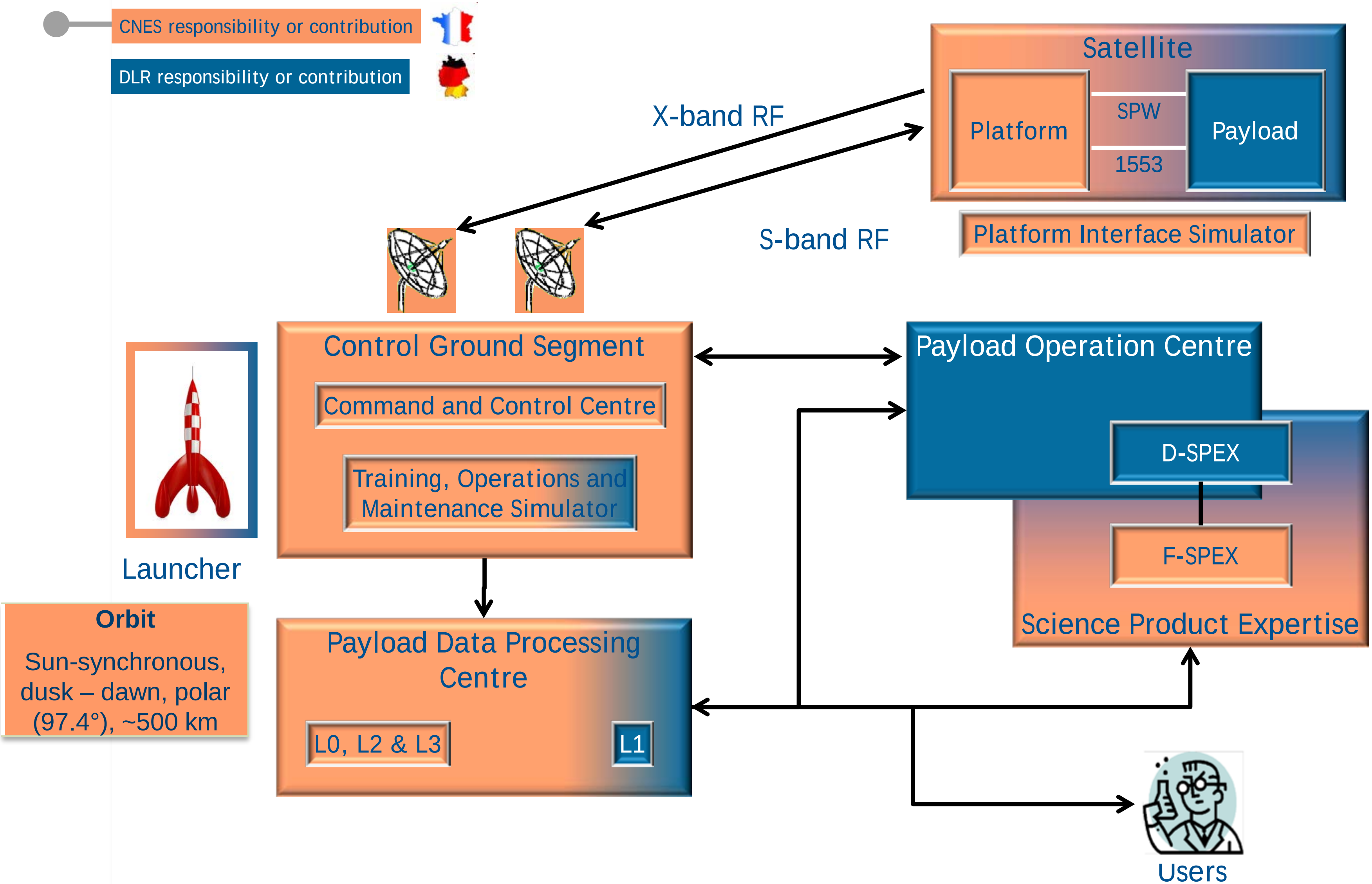
- MERLIN is a LIDAR satellite dedicated to the observation of the spatial and temporal gradients of atmospheric methane (CH_4) columns

- MERLIN is a cooperation between France and Germany space agencies:
  - CNES in charge of platform, satellite, system, launcher, and part of ground segments
  - DLR in charge of payload, and part of ground segments

- Planning:

MERLIN shall be the first active mission in space dedicated to GHG

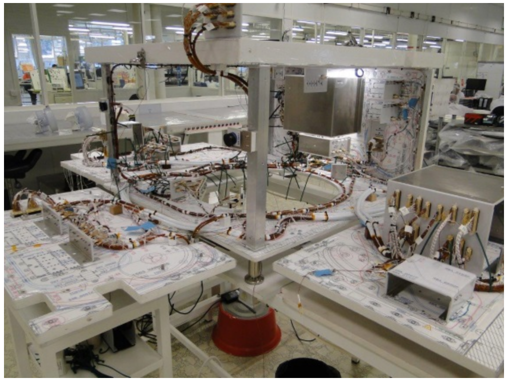
MERLIN System



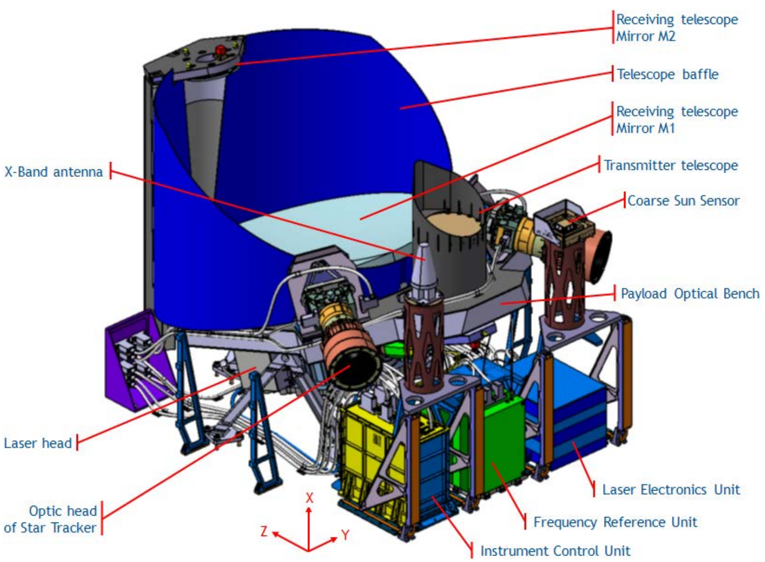
Measurement concept

- Platform: **MYRIADE Evolutions** line of product

Satellite (platform + payload)	
Mass	**430 kg**
Dimensions	**160 cm x 120 cm x 160 cm**
Power	**500 W**



- Payload: **IPDA Laser Instrument:** transmitter based on OPO and Future Laser (FULAS) concept, developed under ESA and DLR contracts



Payload	
Mass	**140 kg**
Power	**150 W**
On-line λon	**1645.552 nm**
Off-line λoff	**1645.846 nm**
Pulse energy	**9 mJ**
Pulse length	**20 ns**
Repetition rate	**20 Hz (double pulse)**
Telescope diameter	**690 mm**

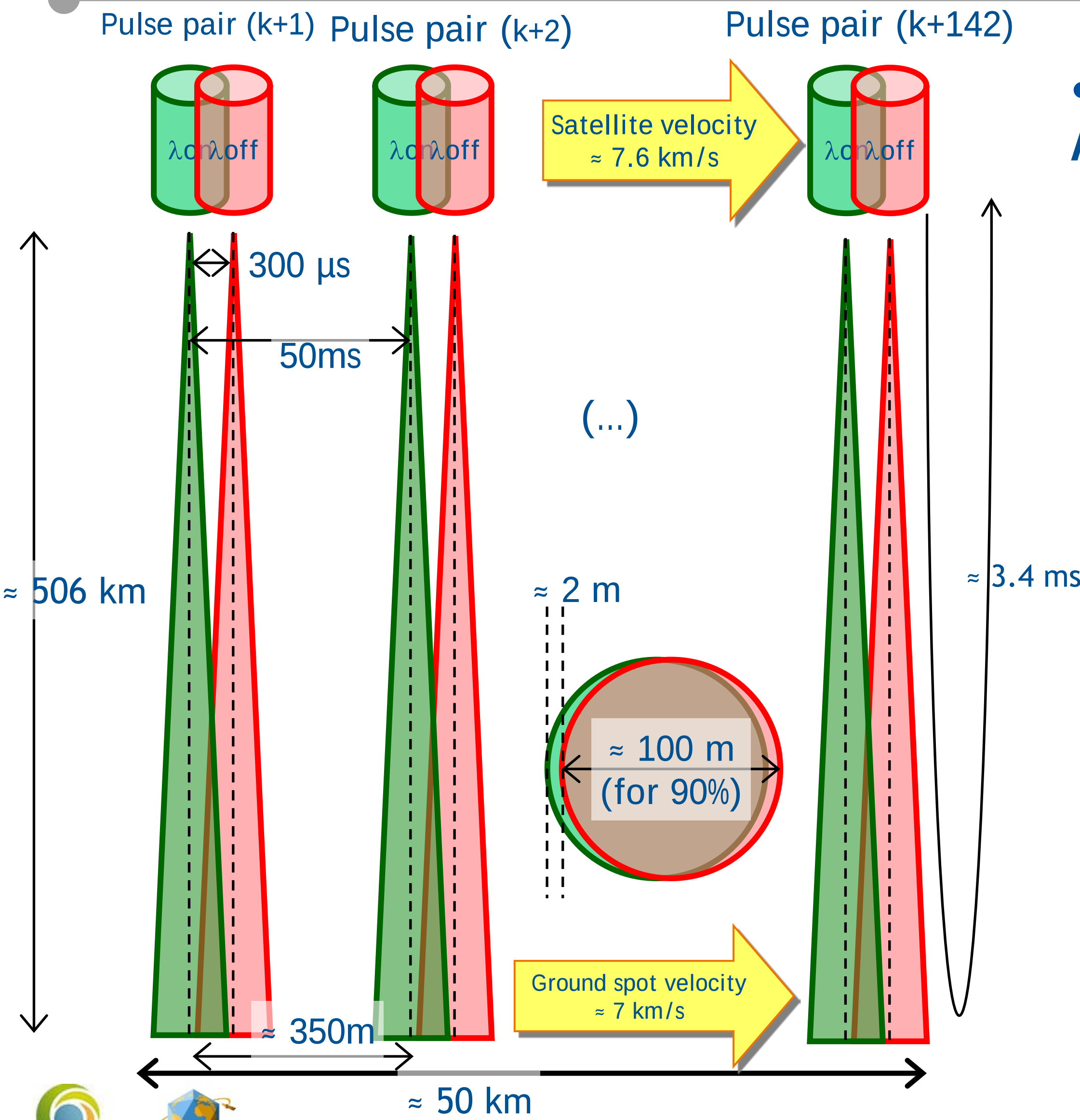
Science objectives

- Methane observing Key regions :
  - Arctic regions (boreal forest, permafrost)
  - Eurasia (anthropogenic emissions)
  - the tropical regions (forest, wetlands).

- MERLIN will provide methane measurements :
  - **not dependent on sunlight** → will allow global coverage, including high latitude during winter
  - small footprint + possibility to get column over dense clouds → observations in tropical regions and other areas that are frequently cloud covered (ex: tropical forest)
  - **Auto-calibrated** → no bias from scattering by aerosol or thin cirrus layers, (which is mandatory for regions with biomass burning, ex: boreal forest)

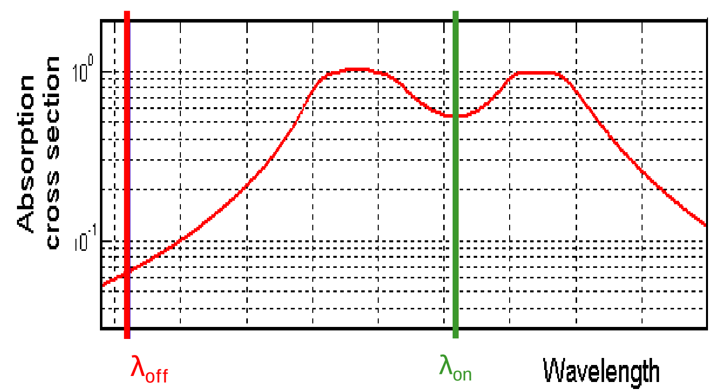
MERLIN will provide truly global and high accuracy measurements of XCH_4 to estimate CH_4 fluxes at regional to continental scale.

Measurement concept



- **Integrated Path Differential Absorption (IPDA) lidar**

λ_{on}: 1645.552 nm = 6076.988 cm-1
λ_{off}: 1645.846 nm = 6075.903 cm-1



- **acquisition**: all over the orbit, without interruption (20Hz)
- **averaging** of the data along track on 50 km for SNR purpose

Expected performances (1/3)

- MERLIN mission requirements (for a reference value of 1780 ppb):

MERLIN System Requirements:	
Random error:	< 22 ppb (for surface reflectivity 0.1 sr^{-1})
Systematic error:	< 3 ppb
Horizontal sampling accumulation:	50 km
Objectives:	• Seasonal and annual budgets on country scale • Resolves country scale gradients

- random error: high frequency, uncorrelated errors
- systematic error: slowly varying component, (e.g. orbital variations, or scene dependent errors).

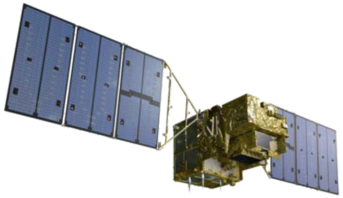
The very low level of systematic error aims at avoiding geographical biases in the XCH4 fields that could lead to uncertainties in fluxes.

Key Instrumentation for MERLIN Validation

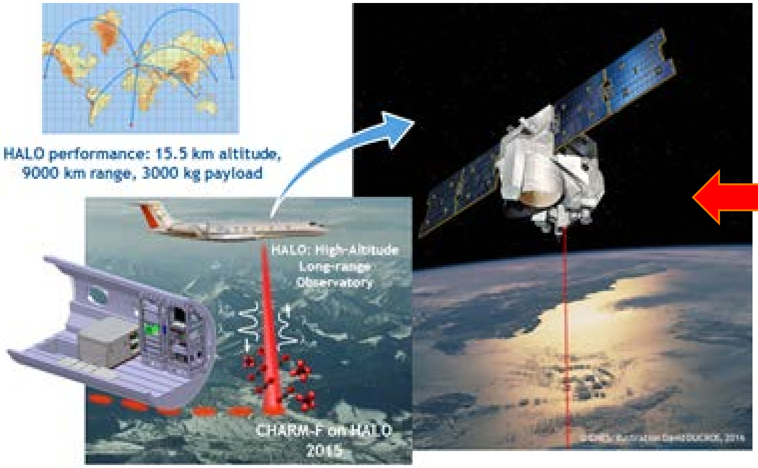
Validation by AirCore sensors on Balloons

- **Profile information** for validation of XCH4 (L2) and DAOD (L1) products

Validation by operational GHG network



Validation by satellites (GOSAT-2, Sentinel 5, IASI)



Validation by CHARM-F on HALO and/or French Falcon

- Correlative measurements of **XCH4 (L2)** and **DAOD (L1)** due to **similar weighting function**
- **CoMET campaign now** in spring 2018
- reservation of German HALO aircraft for **MERLIN validation** in the **2021/22 timeframe**

Conclusion and references

DLR and CNES look forward to launch MERLIN satellite to provide the science community with unprecedented all-latitude coverage measurements of methane concentration

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Thanks for your attention!