Methane — Why to Observe?
— How to Observe?

The Franco-German Climate Mission **MERLIN**

A. Friker, DLR Space Administration

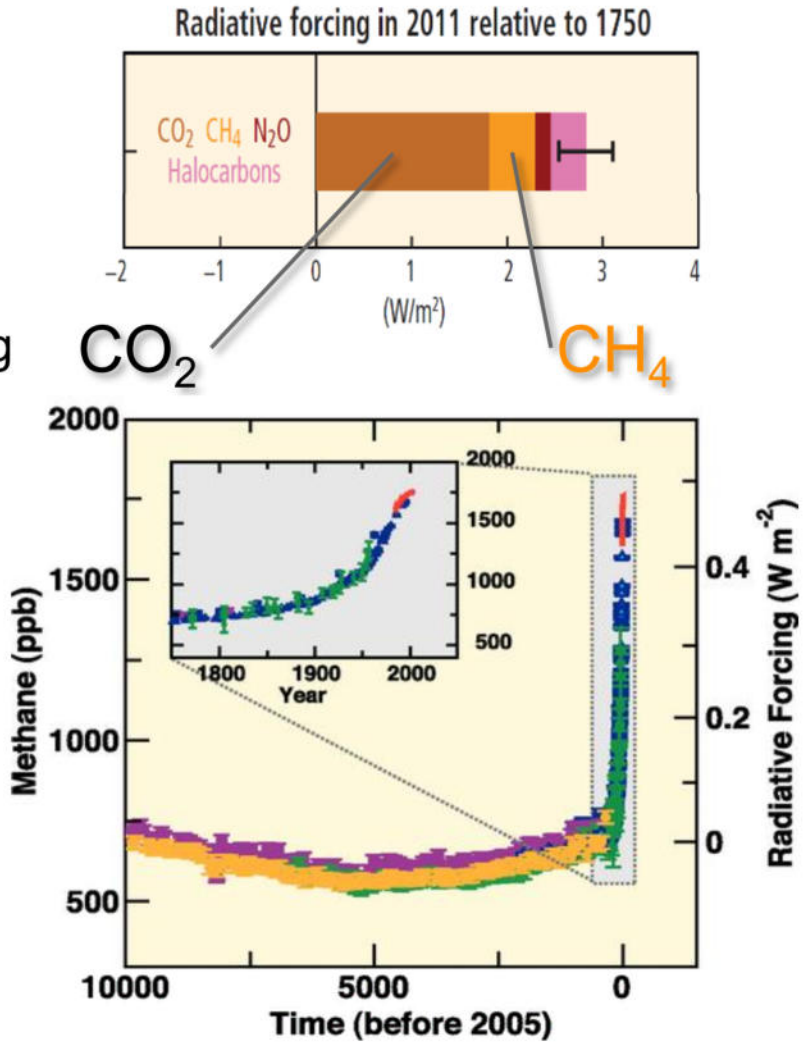
MERLIN

Atmospheric Methane Lidar Mission

Knowledge for Tomorrow

Greenhouse Gas Methane (CH_4)

- CH_4 is the second-most powerful anthropogenic greenhouse gas (after CO_2)
  - greenhouse effect per molecule CH_4 25 times stronger than CO_2
  - 200 times less abundant, but already responsible for 20 % of the global warming
- Rise within the last 100 years
  - CO_2: 280 ppm ↗ 370 ppm +30 %
  - CH_4: 0.7 ppm ↗ 1.8 ppm +150 %
- Methane Sources:
  - energy production loss
  - landfills
  - cattle farming, rice paddies
  - incomplete biomass burning
  - melting permafrost and submarine Methane hydrates
  - natural sources (wetlands, …)



Graphics: IPCC AR5, AR4

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Mission Layout

- Goal:
  Global investigation of
  Methane fluxes
  (sources and sinks)
- IPDA Lidar
  - self-calibrating
  - low systematic errors
- Small satellite
- French-German cooperation
- 3 years mission duration
- Open data policy

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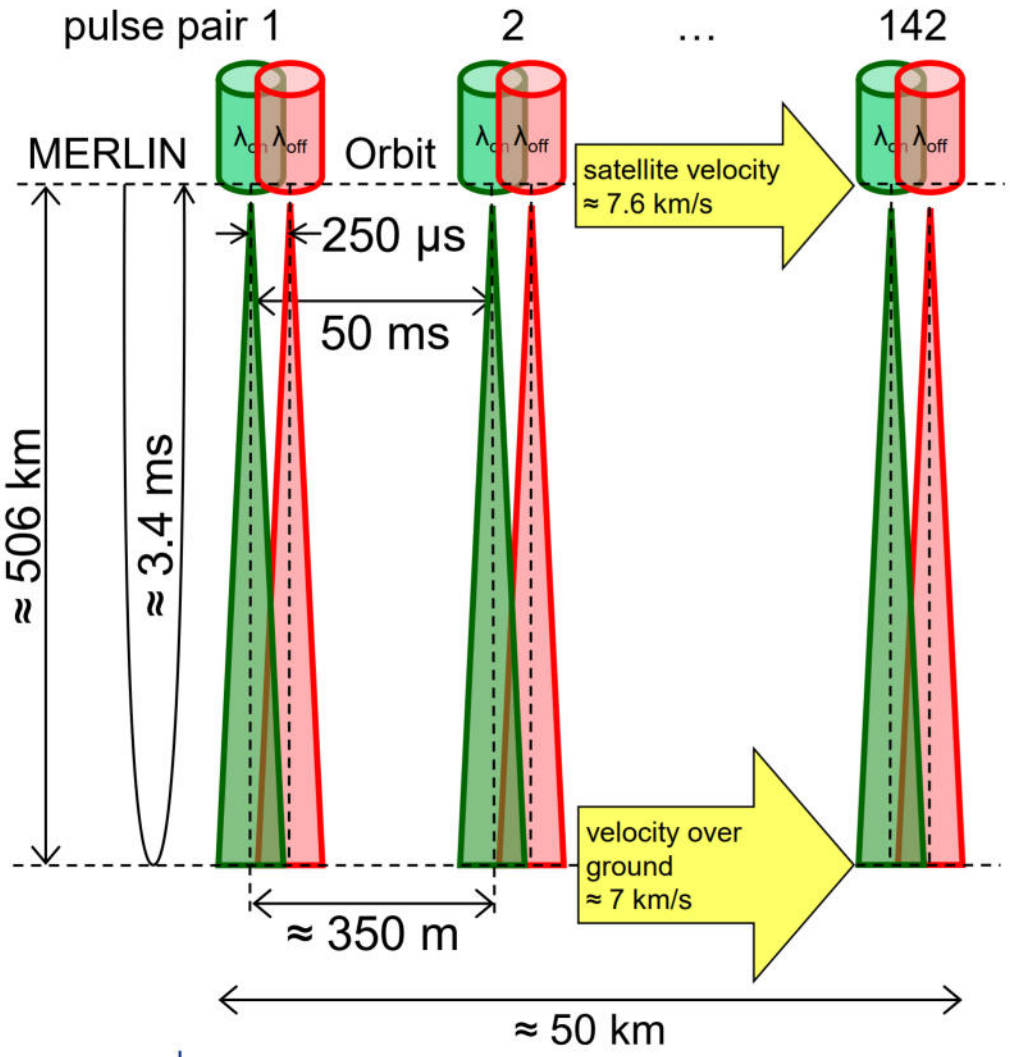
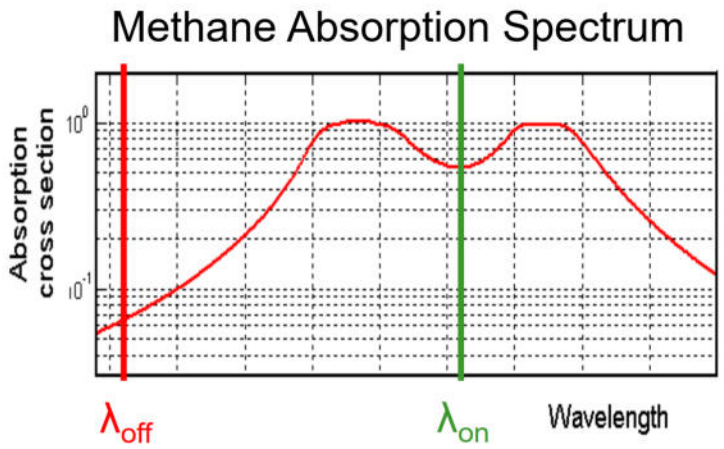
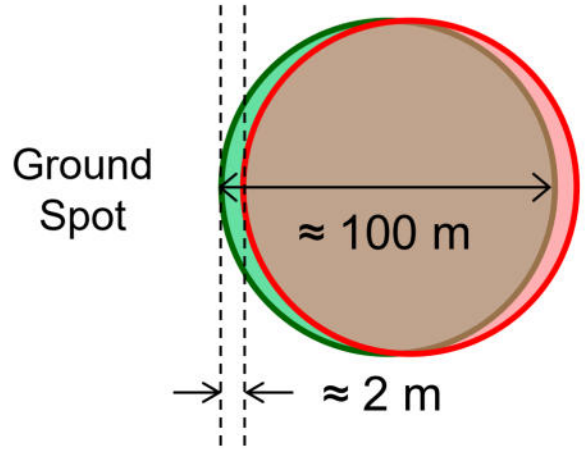
MERLIN „IPDA“-Lidar (Integrated Path Differential Absorption)





λ_{on}: 1645.552 nm (6076.988 cm^{-1})

λ_{off}: 1645.846 nm (6075.903 cm^{-1})



MERLIN Satellite — Platform and Orbit

Satellite platform: **MYRIADE Evolutions**

- Satellite mass: 430 kg
- Payload mass allocation: approx. 140 kg
- Satellite power: > 400 W
- Payload power allocation: 150 W
- Satellite GPS: 2 sensors
- Satellite star tracker: 2 opt. heads

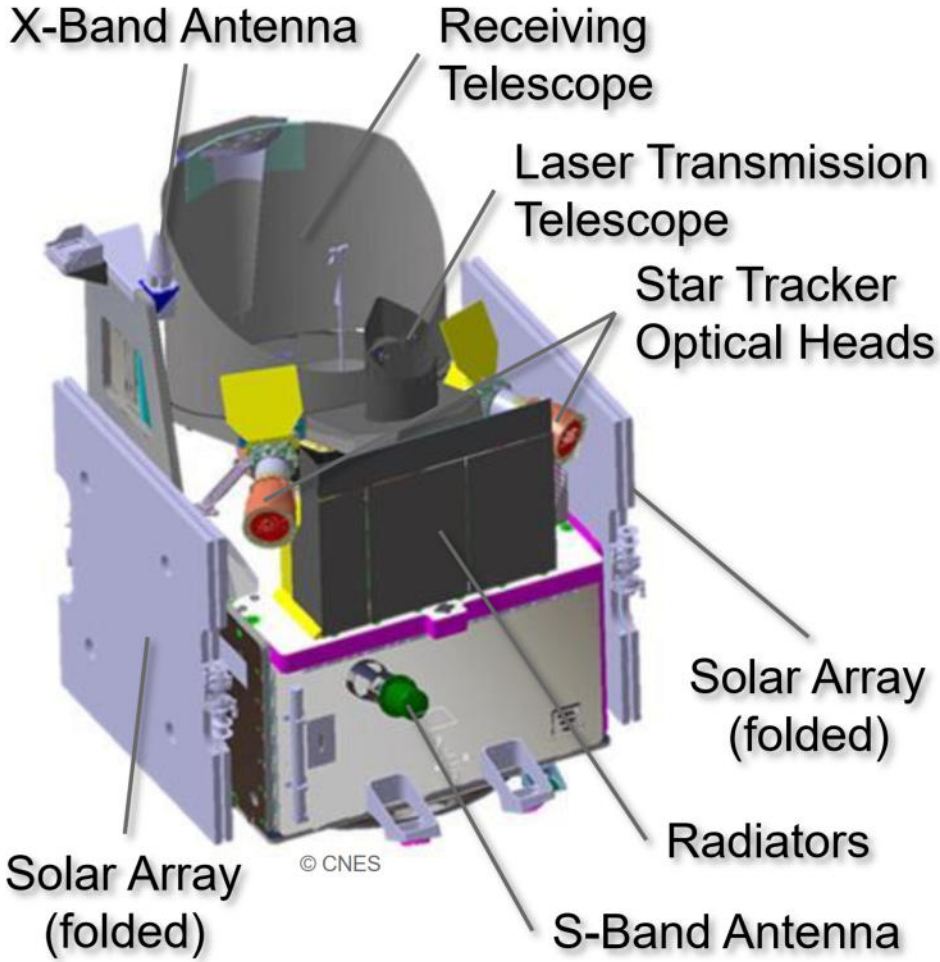
Orbit: **Sun-synchronous polar LEO**

- LTAN: 06:00 or 18:00
- Altitude: approx. 500 km

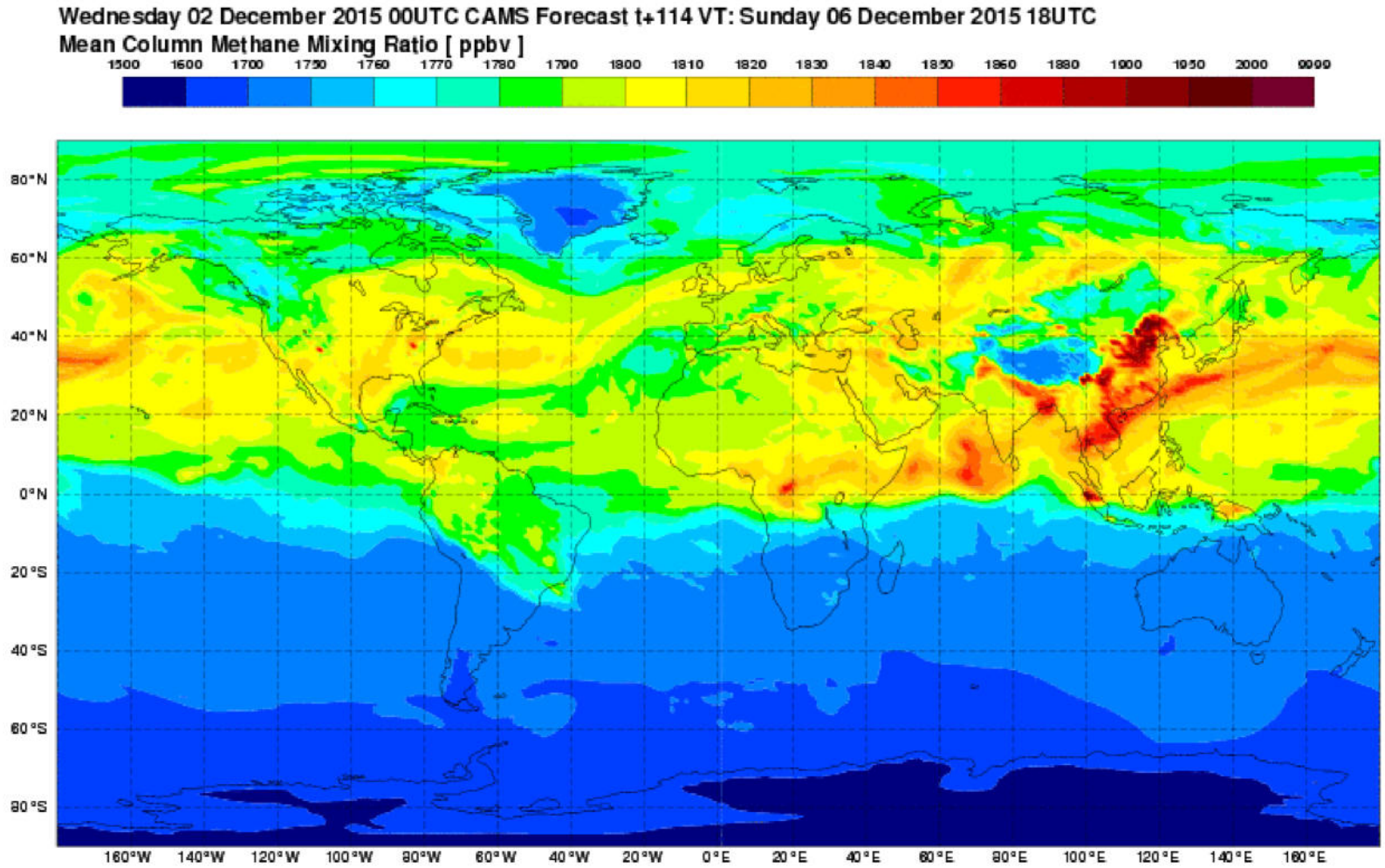
MERLIN Satellite — The Payload

Payload: **Methane IPDA LIDAR**

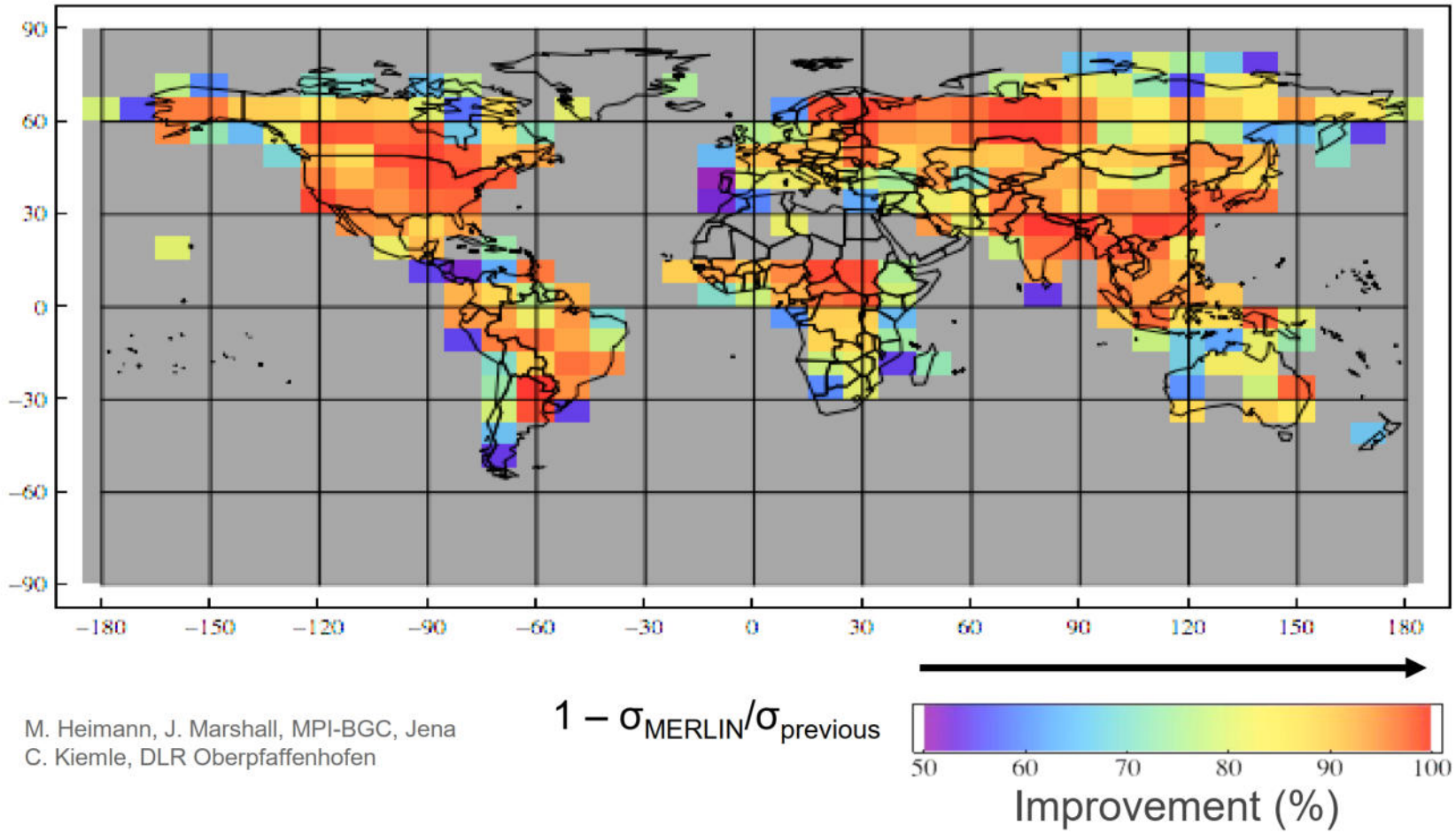
- CH_4 absorption line: 1.645 mm
- Laser emitter type: Nd:YAG pumped OPO
- OPO pulse energy: 9 mJ
- Laser pulse repetition frequency: 20 Hz
- Receiving telescope size: 69 cm
- Detector: APD pin diode



Methane Column Concentrations
Example: CAMS Model-based Forecast



MERLIN — Methane Fluxes
Expected Knowledge Improvement



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