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Interreg Sudoe
NanoSen-AQM
European Regional Development Fund

Key Facts

- Horizon 2020 funded & started in 2018
- 2 universities & 2 research Institutes + 4 companies
- Optical NDIR gas sensing approach for multiple gases
- Website: https://www.ulisses-project.eu/
- Three main challenges addressed:
  - IR light generation
  - Light-gas interaction
  - IR light detection

Motivation for CO2 measurements

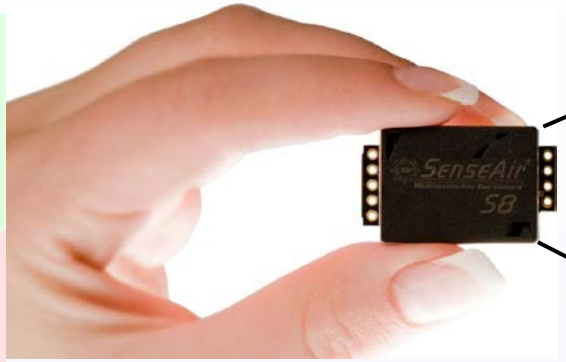
- Poor air quality is affecting negatively our health, well being and productivity
- CO2 is an indicator for air quality
- Smart on demand HVAC reduces energy consumption
- CO2 is a greenhouse gas and emissions need to be reduced

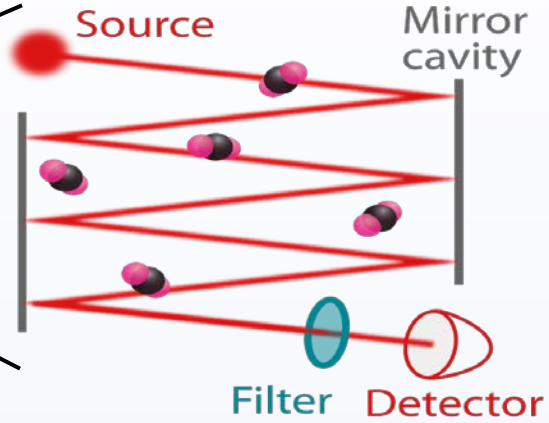
Our Starting Situation:

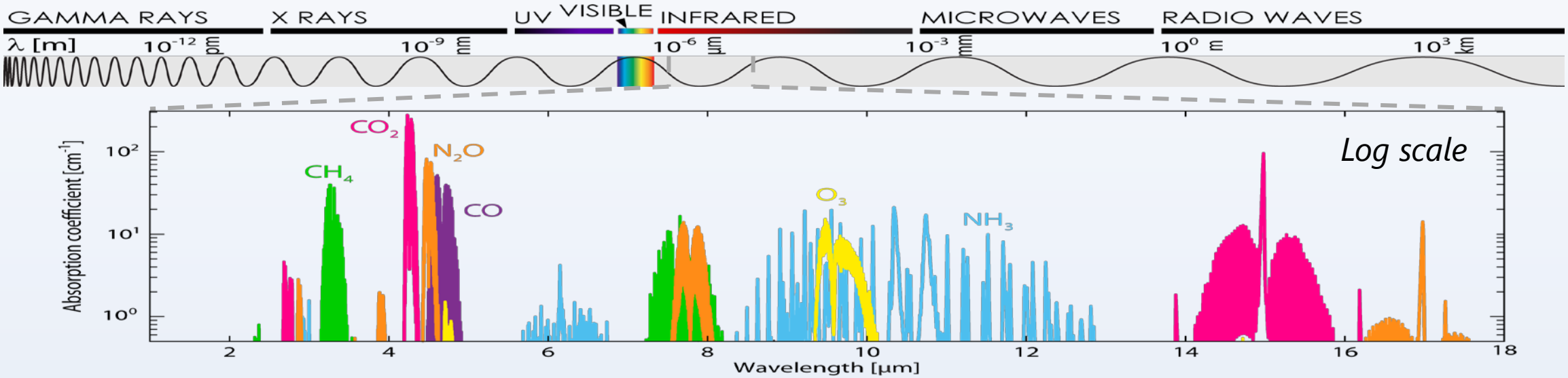
Classical free-space optical (NDIR) gas sensors

+ Specific
+ Fast
+ Low drift
+ No hysteresis

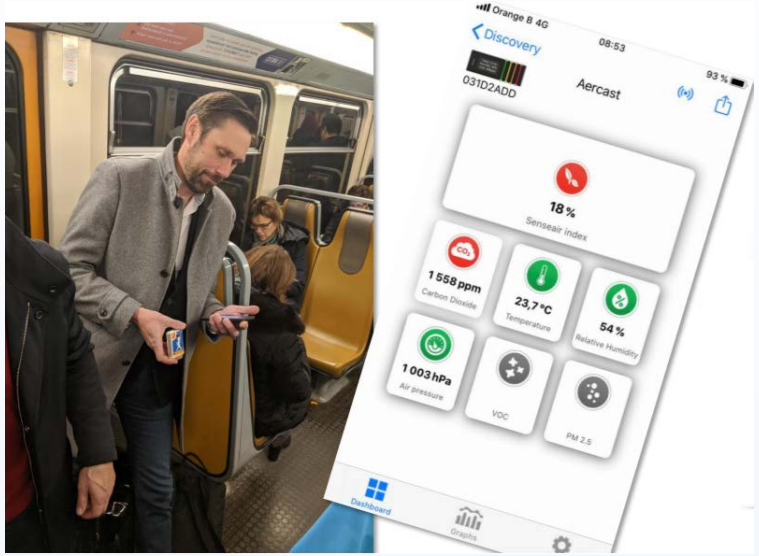
- Bulky
- Power-hungry
- Expensive



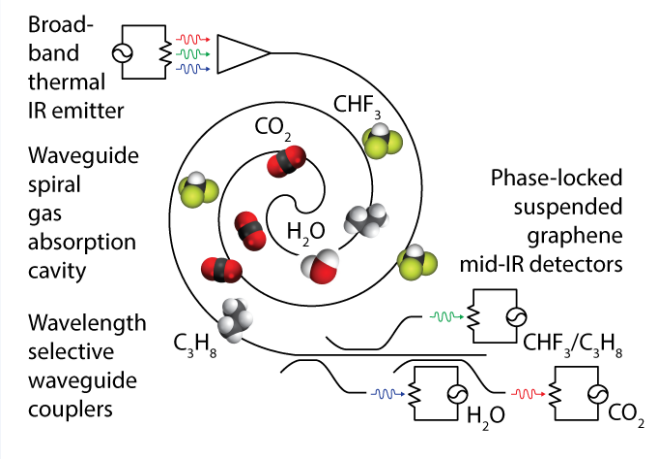




Our Vision: A highly miniaturized Gas Sensor for Air Quality Mapping

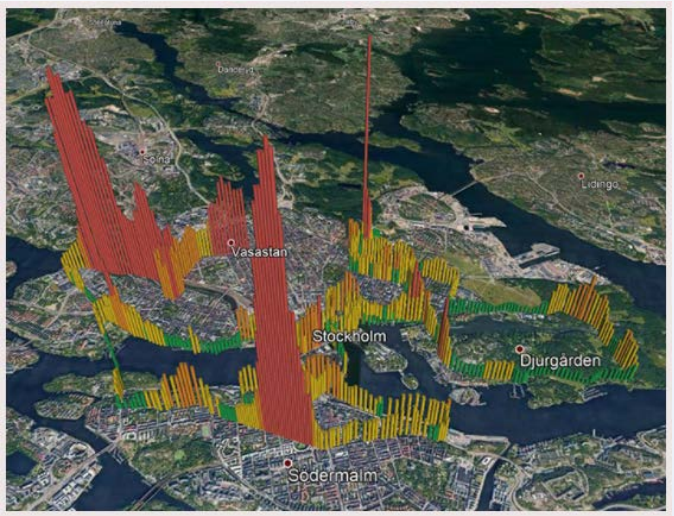


Schematic illustration of the integrated multi-channel gas sensor.



Envisioned smart gas sensor integrated in a wearable gadget.

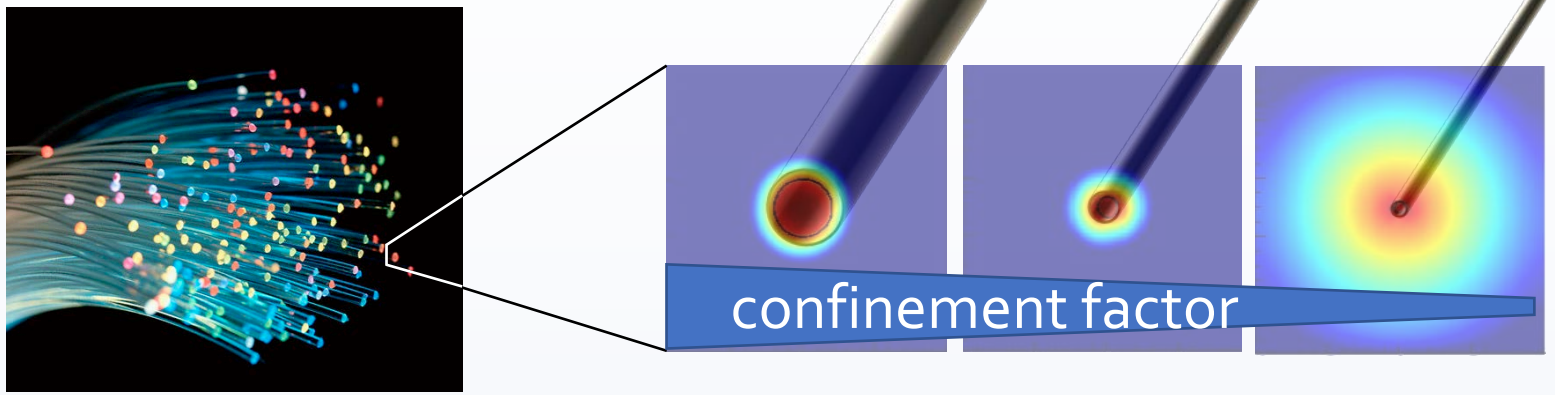
Miniaturized → power-efficient
integrated → cost-efficient
mid-IR → specific
optical
gas sensors



Geographical mapping of the CO2 concentration in Stockholm

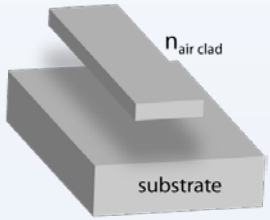
How small can we go?

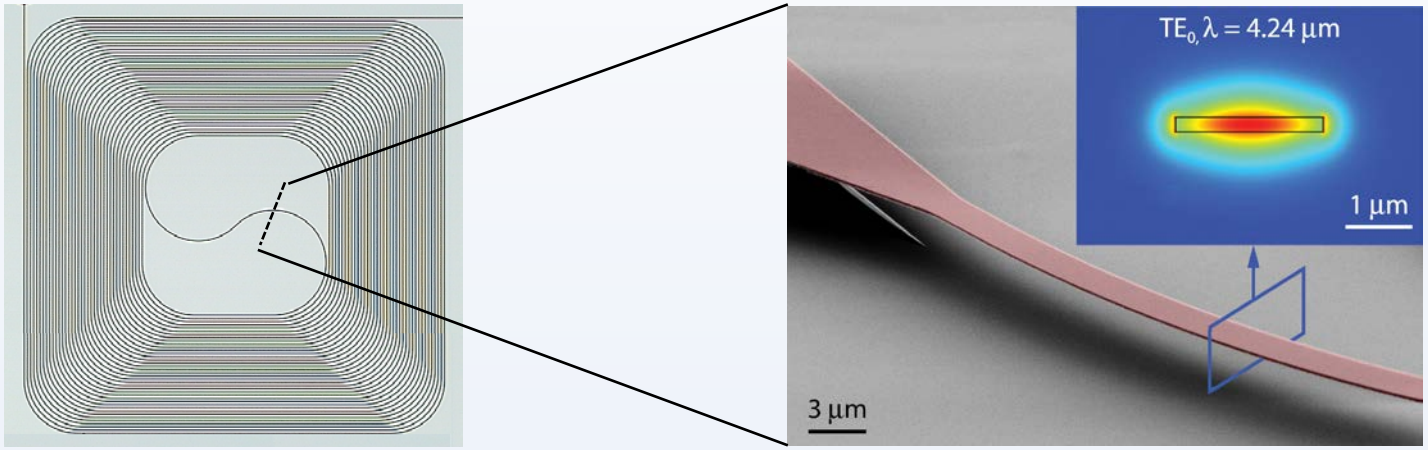
classical optical fibre



Simulation of the electromagnetic field distribution with decreasing optical fibre core diameter

suspended waveguide solution



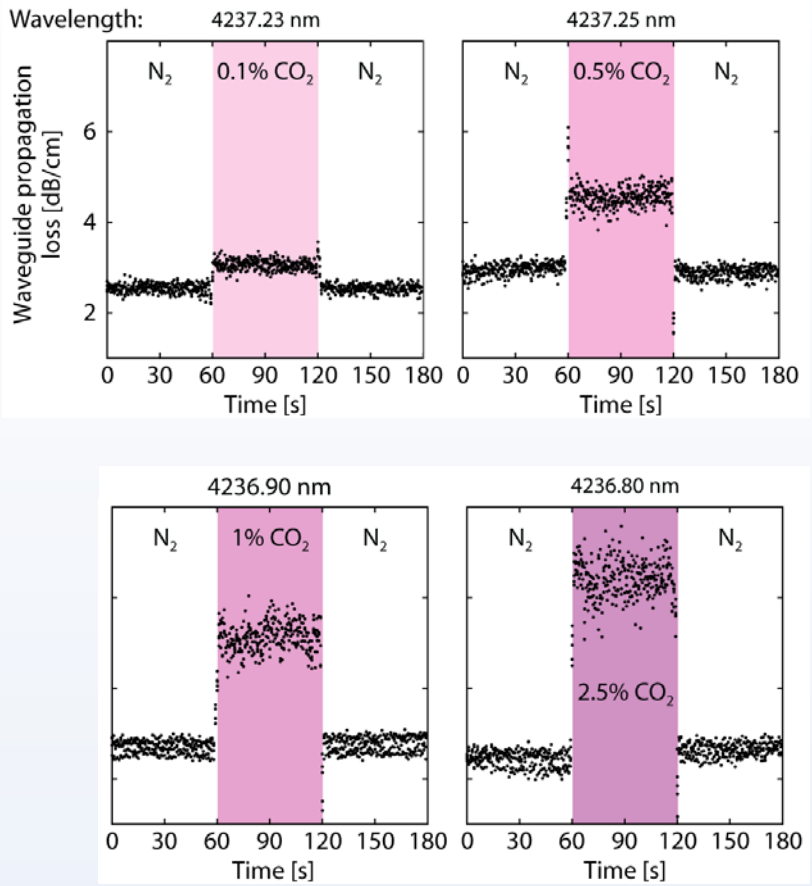


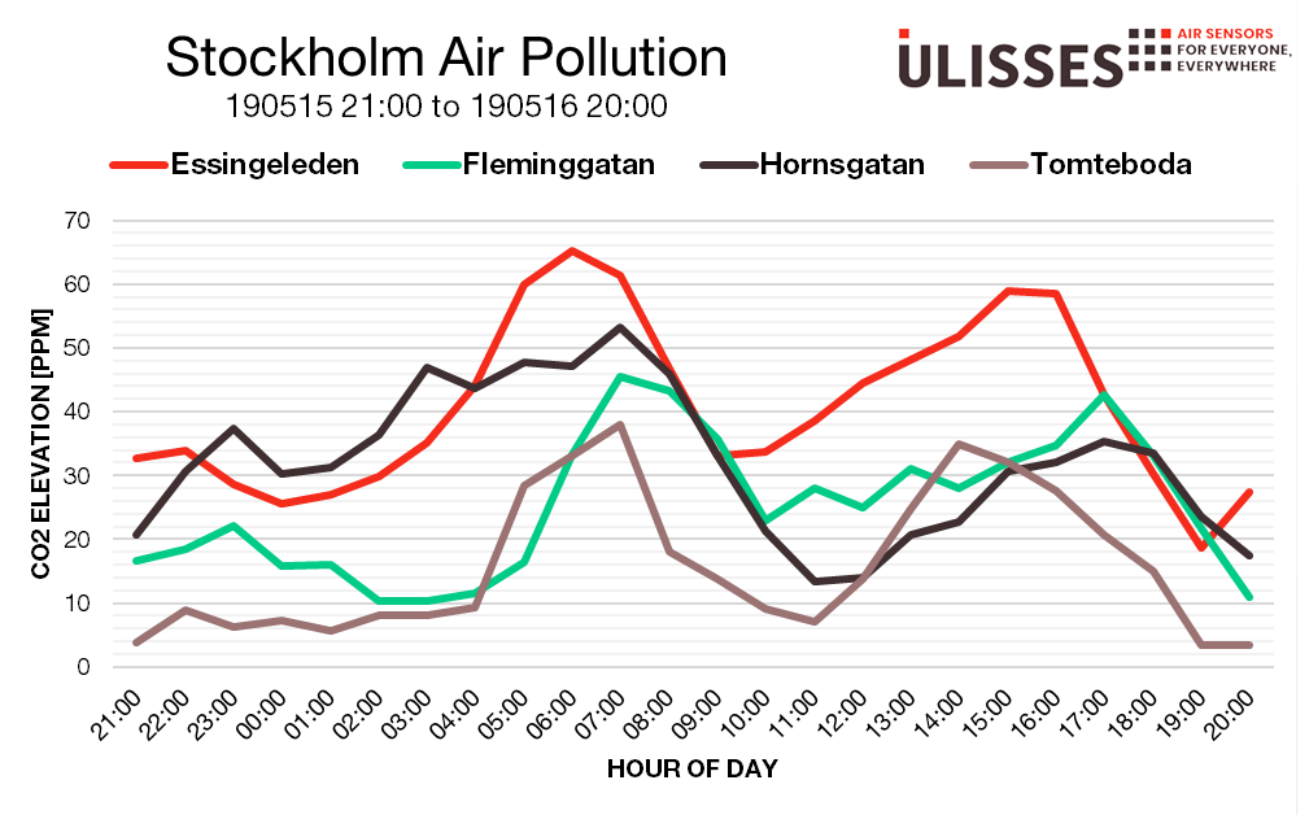
One suspended waveguide forming a spiral for realizing a compact 20 cm long guided optical path.

Colour enhanced SEM image showing the suspended optical waveguide and its low confined electromagnetic field distribution*.

*Source: Ottonello-Briano, Floria, et al. "Carbon dioxide absorption spectroscopy with a mid-infrared silicon photonic waveguide." Optics Letters 45.1 (2020): 109-112.

CO_2 Measurements





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Sensor Fusion & Self-Calibration

- Use machine learning based on data uploaded to the cloud.
- Each sensor can learn from its history and self-estimate its reliability.
- The reported measurement is not just a single ppm-value, but a self-estimated belief function with a probability distribution over a range of ppm-values.
- Geometrical methods can be used to achieve more accurate data from several sensor in the same area. This is used for calibration, and improves the self-belief!

Thank you from the ULISSES Consortium

AIR SENSORS FOR EVERYONE, EVERYWHERE

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