Build your own CO_2 sensor

CO_2

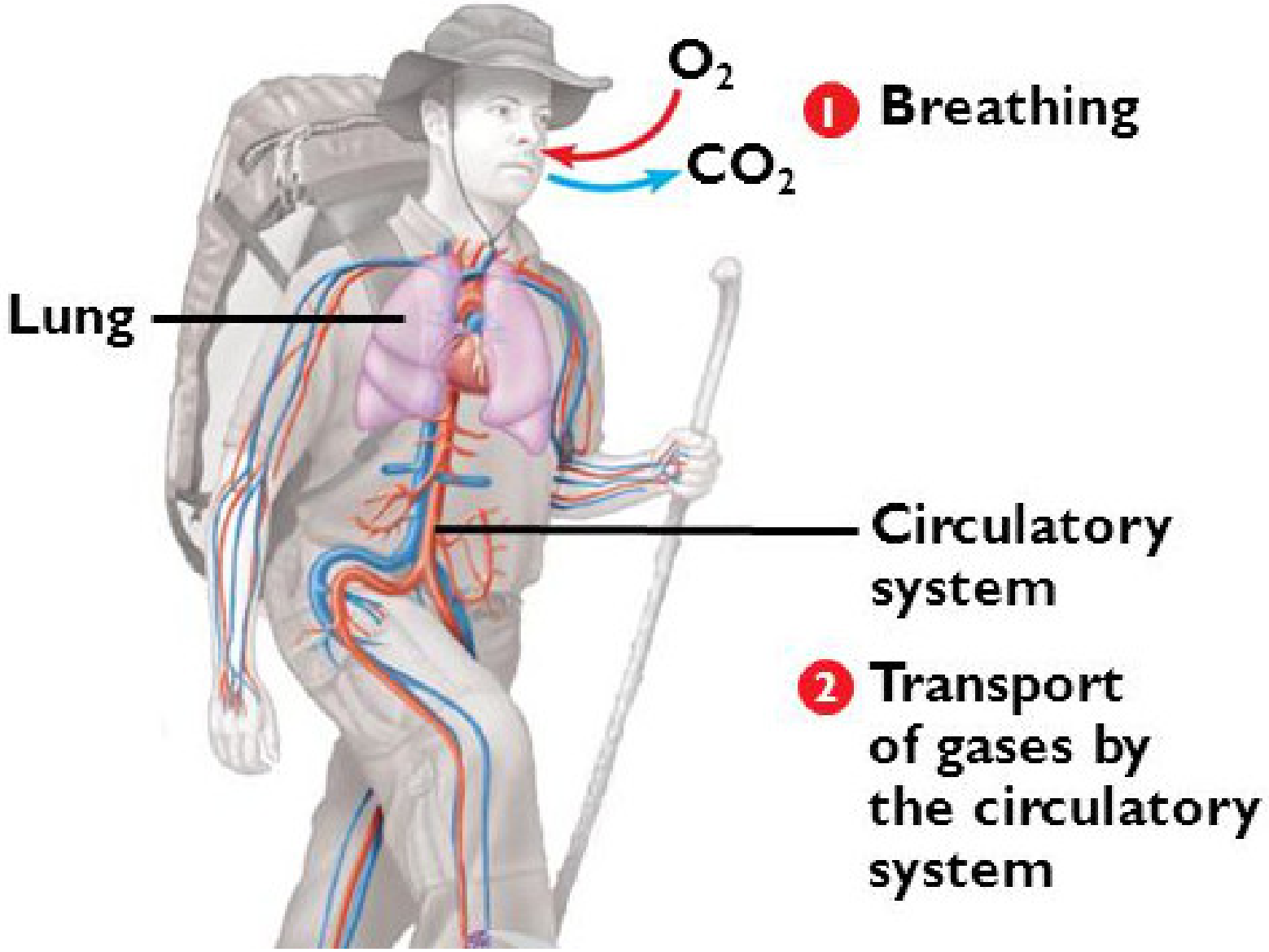
- Where does it come from?
- Effects/How dangerous is it?
- How to measure it
- Ventilation
- Own results

Where does it come from?

What you see is H_2O (water)

Making CO_2 from CH_4 (Methane)

Humans


O_2
CO_2
1 Breathing
Lung
Circulatory system
2 Transport of gases by the circulatory system

Effects/How dangerous is it?

Effects CO

How can different levels of carbon monoxide affect me?	
35 ppm (0.0035%)	Headache and dizziness within six to eight hours of constant exposure
100 ppm (0.01%)	Slight headache in two to three hours
400 ppm (0.04%)	Frontal headache within one to two hours
1,600 ppm (0.16%)	Headache, increased heart rate, dizziness, and nausea within 20 min; death in less than 2 hours
6,400 ppm (0.64%)	Headache and dizziness in one to two minutes. Convulsions, respiratory arrest, and death in less than 20 minutes.
12,800 ppm (1.28%)	Unconsciousness after 2–3 breaths. Death in less than three minutes

Effects CO_2

How can different levels of carbon dioxide affect me?	
0,04% (400ppm)	This is the normal level of carbon dioxide in the atmosphere
1-1,5% (10.000-15.000ppm)	Slight effect on chemical metabolism after exposure of several hours
3% (30.000ppm)	Carbon dioxide is weakly narcotic at this level, resulting in deeper breathing, reduced hearing, headaches and increase in blood preasure and pulse rate
4-5% (40.000-50.000ppm)	Breathing becomes deeper and more rapid. Signs of intoxication becomes more evident after 30 minutes exposure
5-10% (50.000-100.000ppm)	Breathing becomes more laborious with headache and loss of judgement.
>10% (100.000ppm)	When CO2 concentration increases above 10%, unconciousness will occur in less than one minute. Unless prompt action is taken, futher exposure will eventually result in death.

Effects CO_2

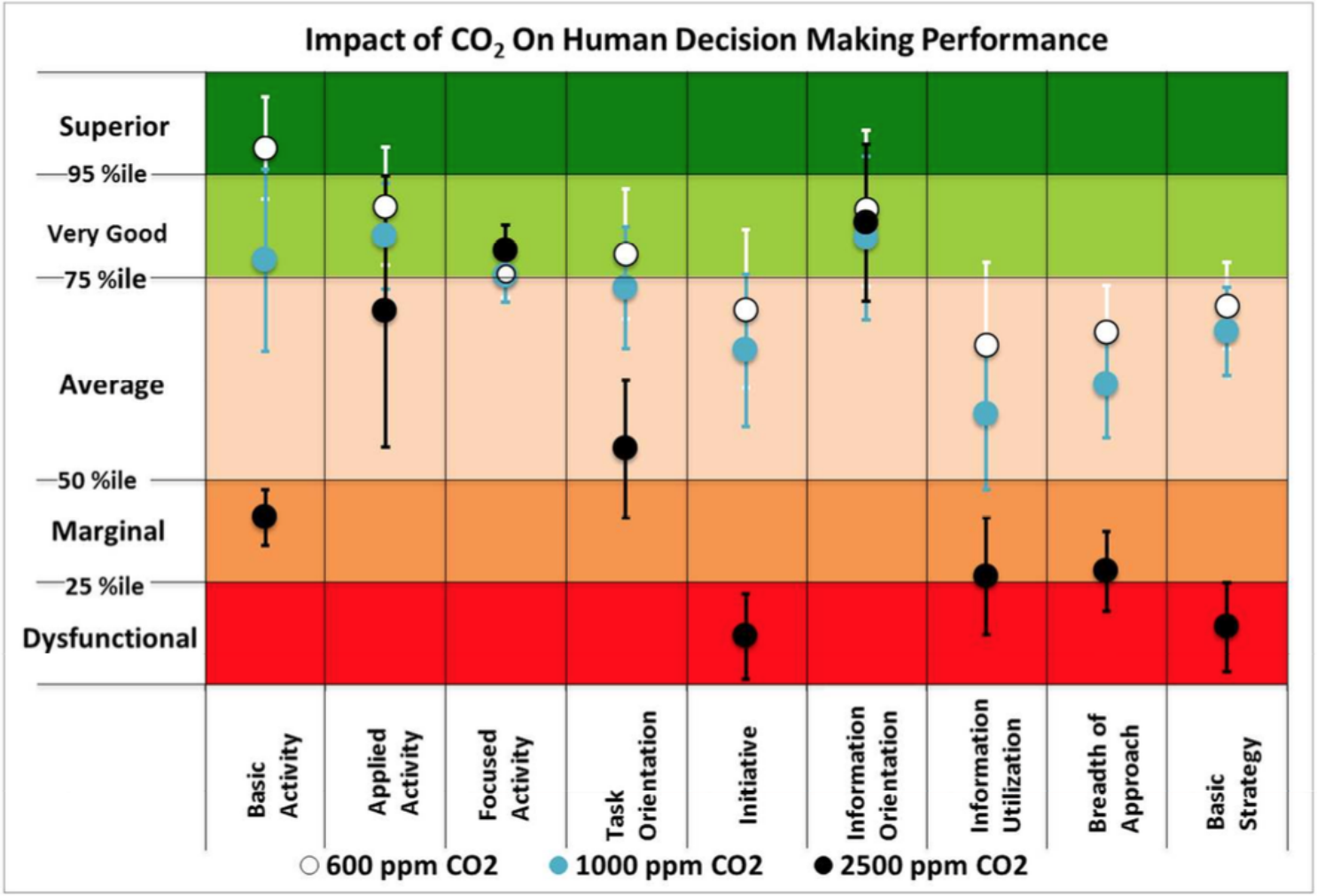


Figure 2

Effects

How to measure it

NDIR

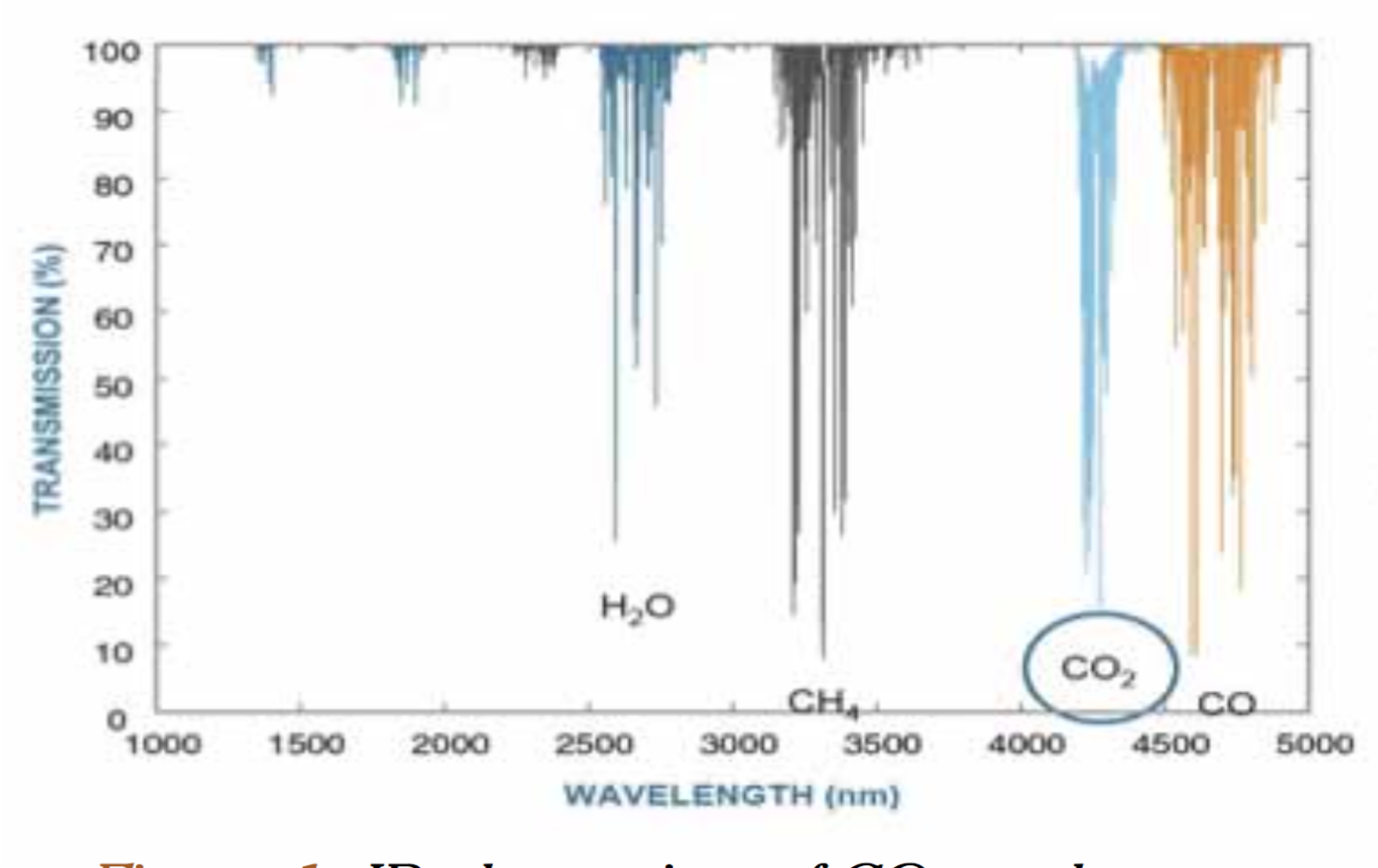


Figure 1. IR absorption of CO_2 and some other gases.

Different NDIR methods

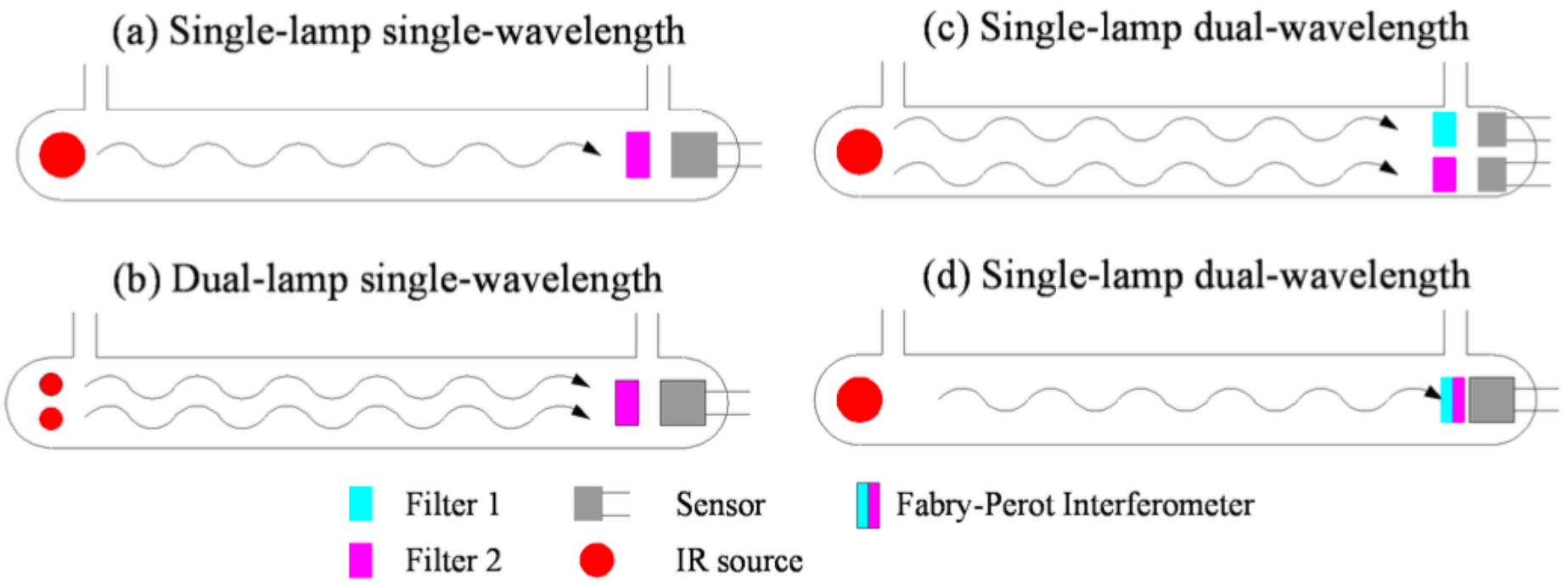
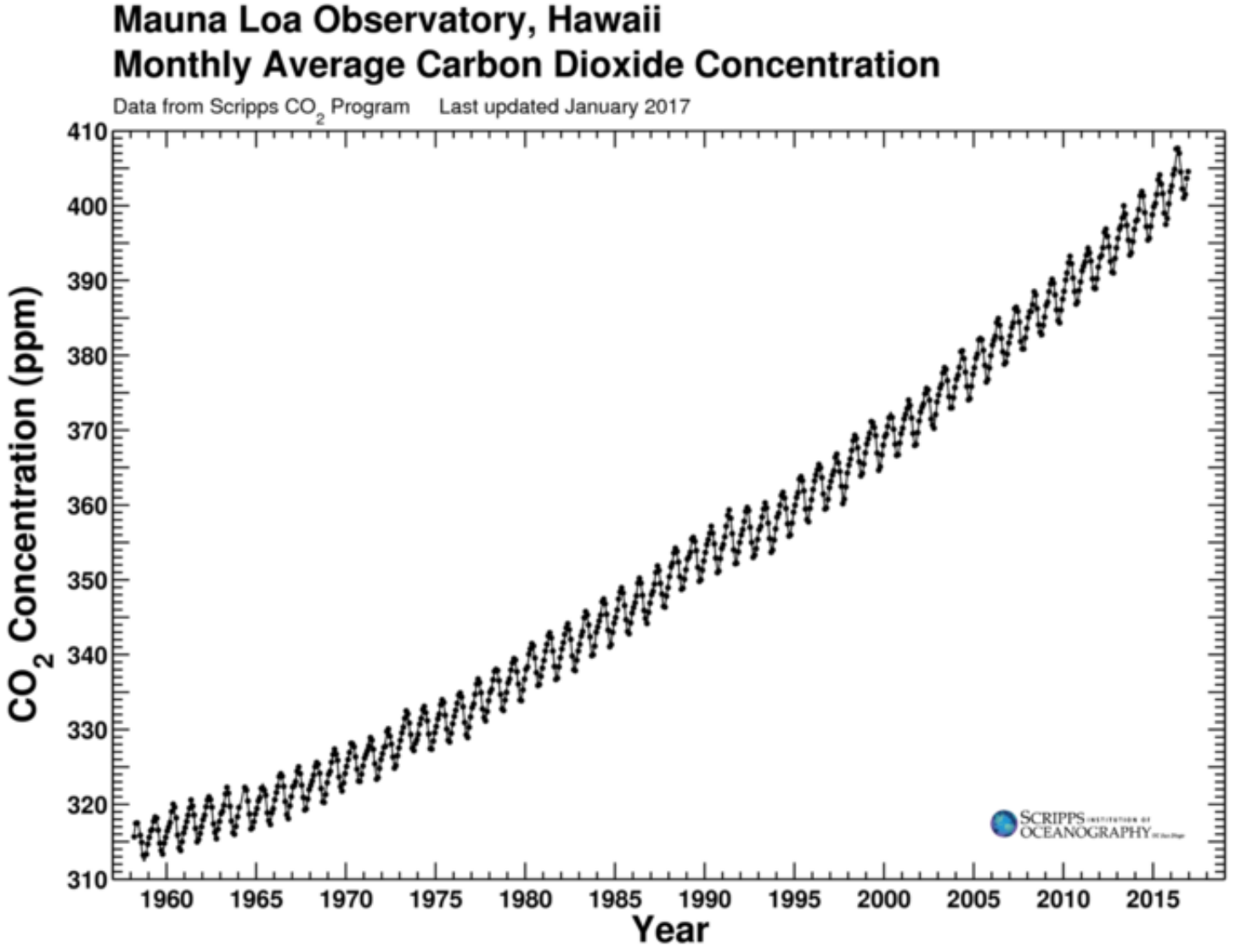


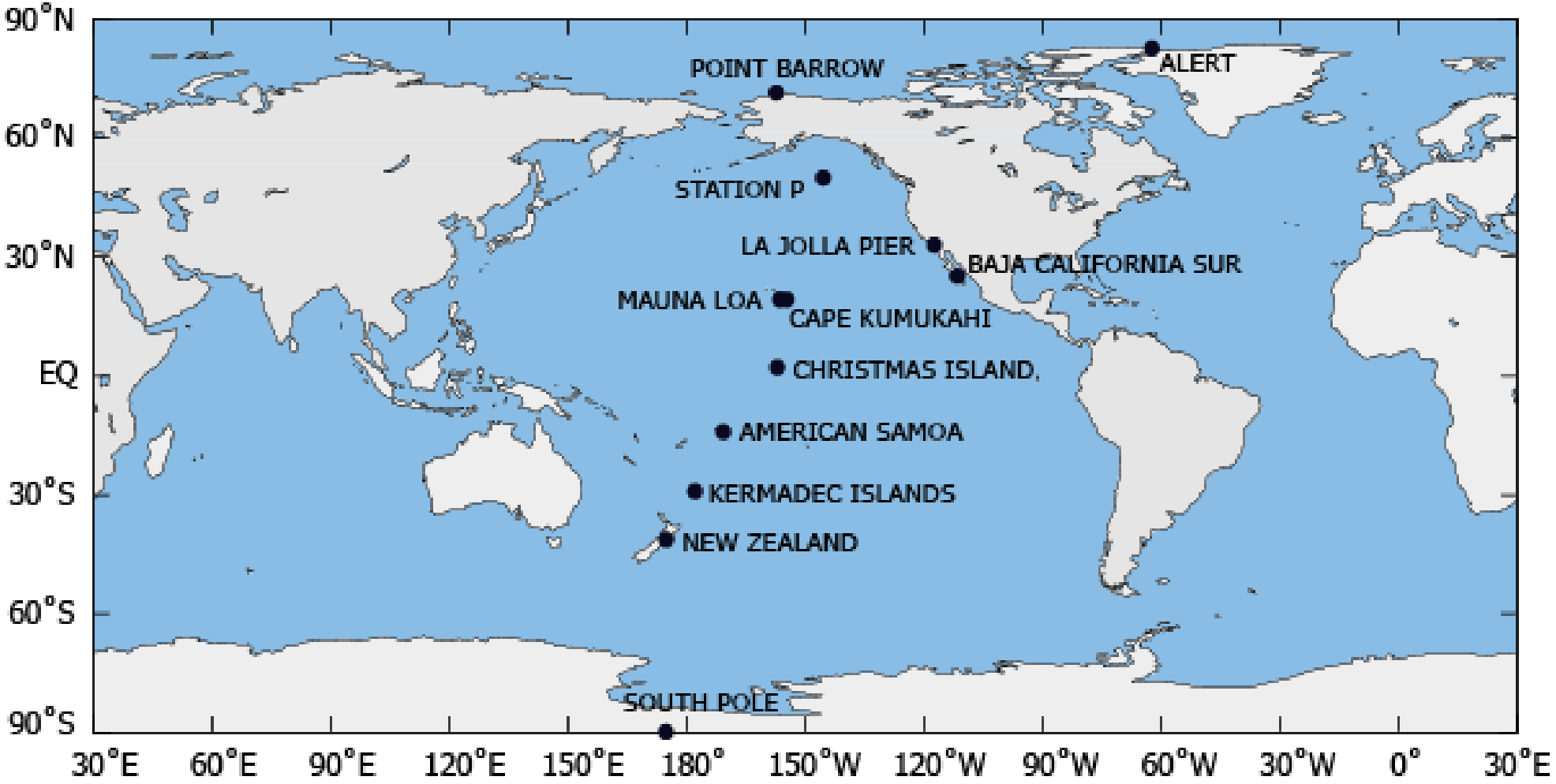
Figure 1. NDIR sensor configurations.

Ventilation

CO_2 at Mauna Loa, Keeling curve



Location of Mauna Loa



Ventilation research/advice

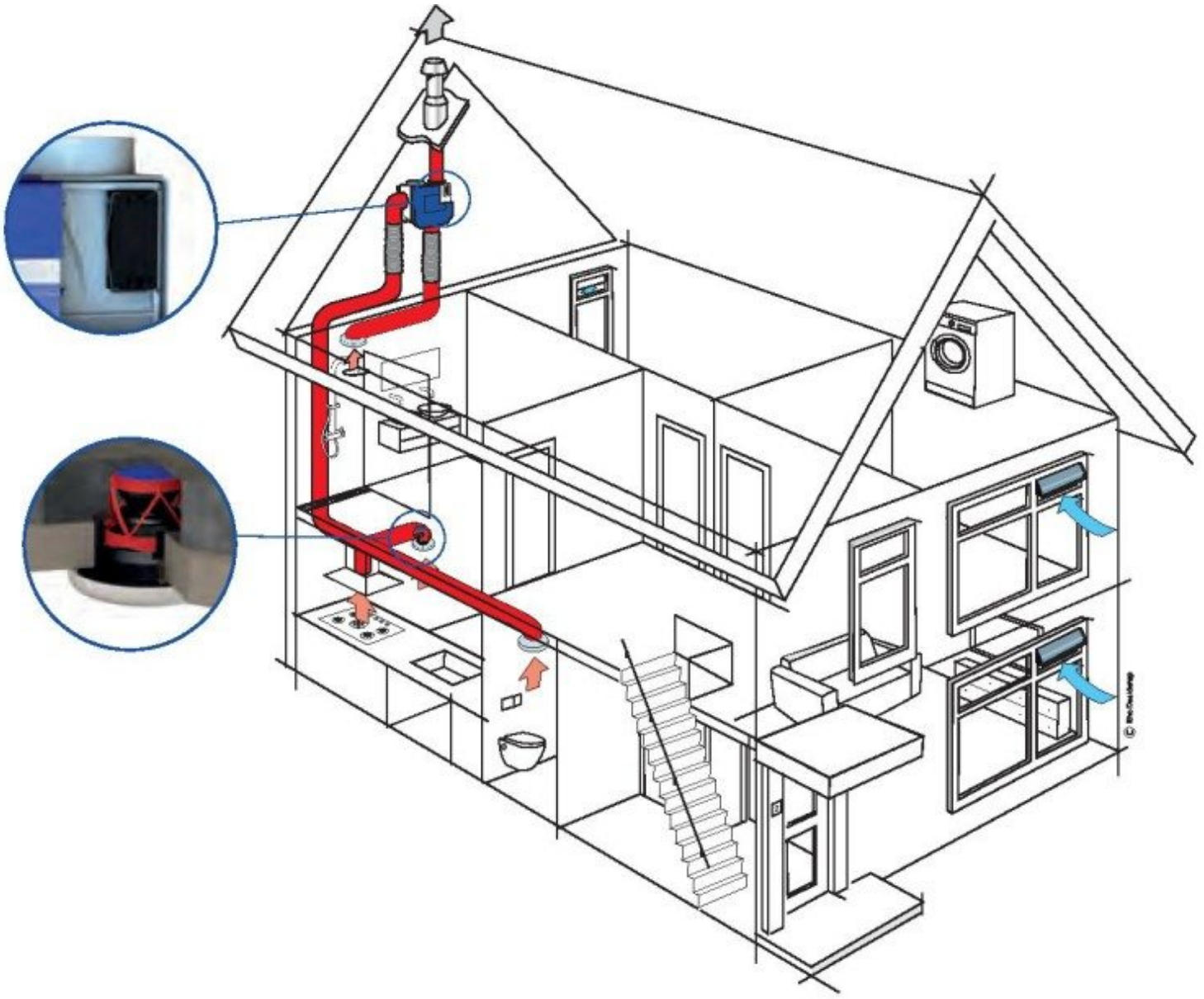
- RIVM (rivm.nl) Lots of papers
- Milieu centraal (milieucentraal.nl)
- Bouwbesluit (bouwbesluitonline.nl)
- 20 to 30 m^3/hour for each human

Part of page 20 of the RIVM rapport binnenmilieu

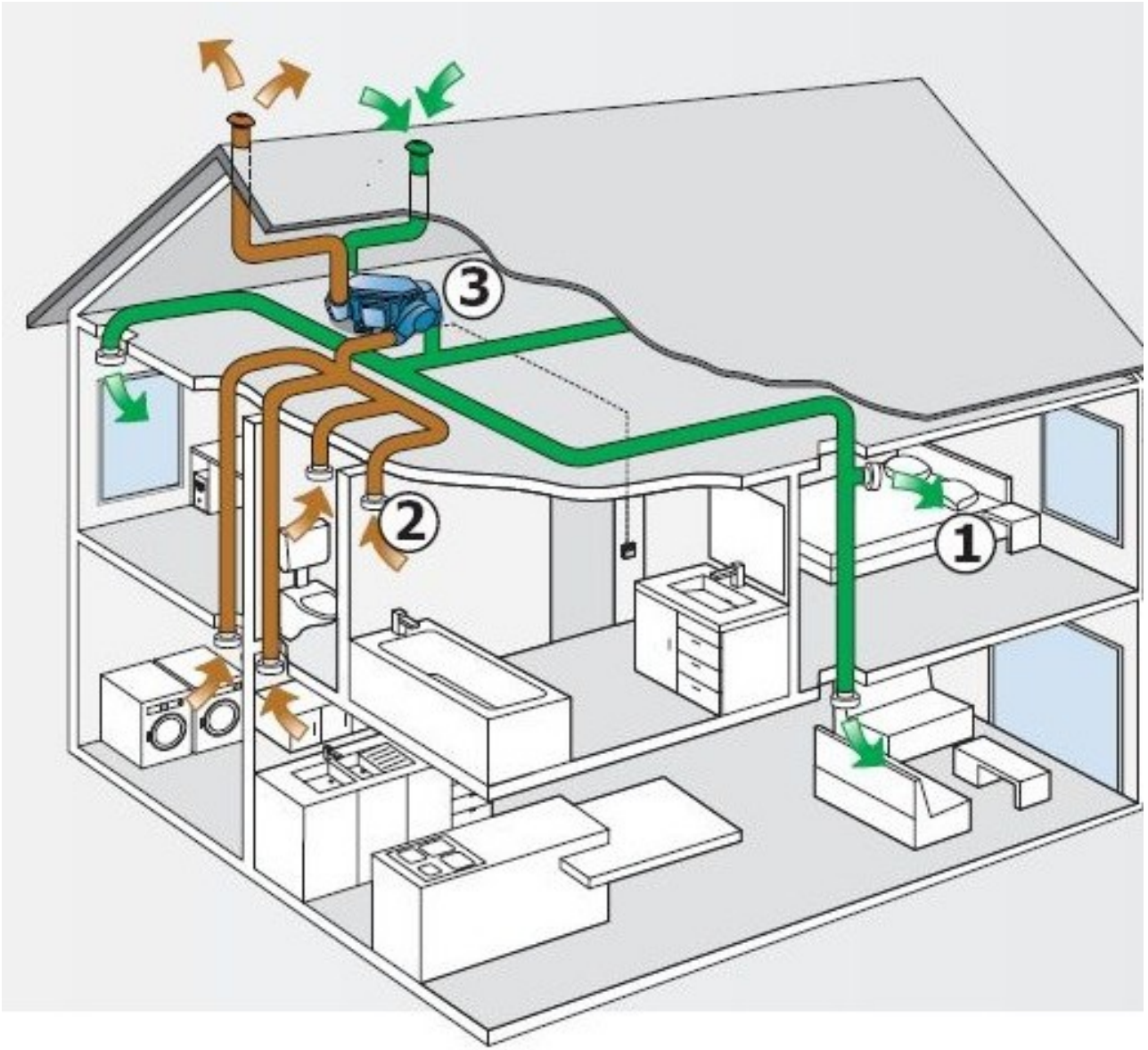
Binnenmilieu-indicator (in woningen tenzij anders aangegeven)	**Gezondheidseffecten**	**Concentratie of vóórkomen in woningen**	
Ventilatie		verblijfruimte	slaapruimte
Woningen CO_2 concentratie > 1200 ppm	Verhoogde kans op gezondheidseffecten door ophoping van schadelijke stoffen. Dit kan leiden tot vermoeidheid, hoofdpijn, geurhinder (sick building syndrome), verhoogde kans op overdracht van infectieziekten en vermindering van leerprestaties.	59%	47%
Scholen CO_2 concentratie > 1200 ppm		80%	
		88%	
Kinderdagverblijven CO_2 concentratie > 1000 ppm			40%
		89%	
		69%	
CO_2 concentratie > 800 ppm			96%

Is this ventilation? (Airco)

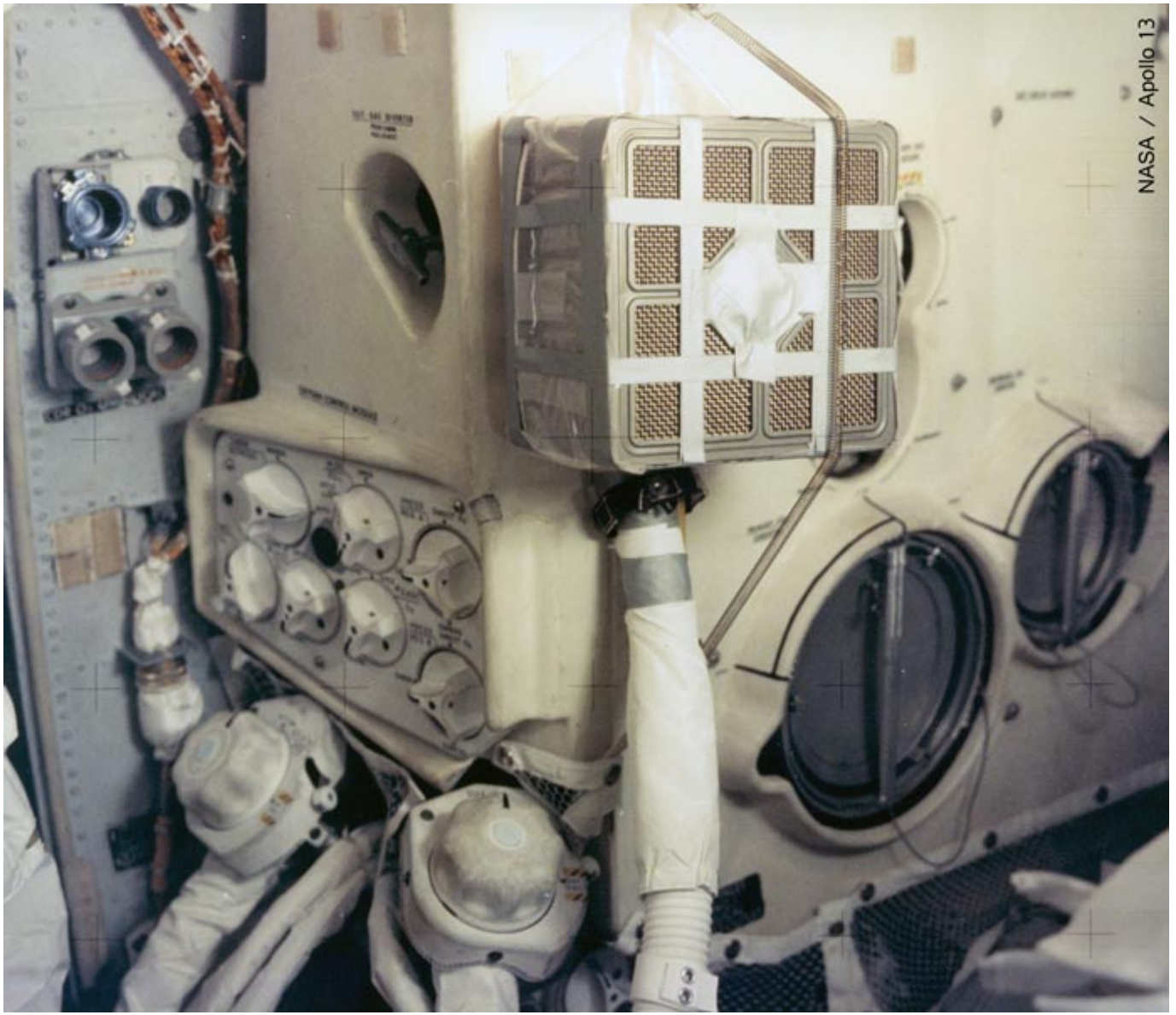
Simple ventilation



Advanced ventilation

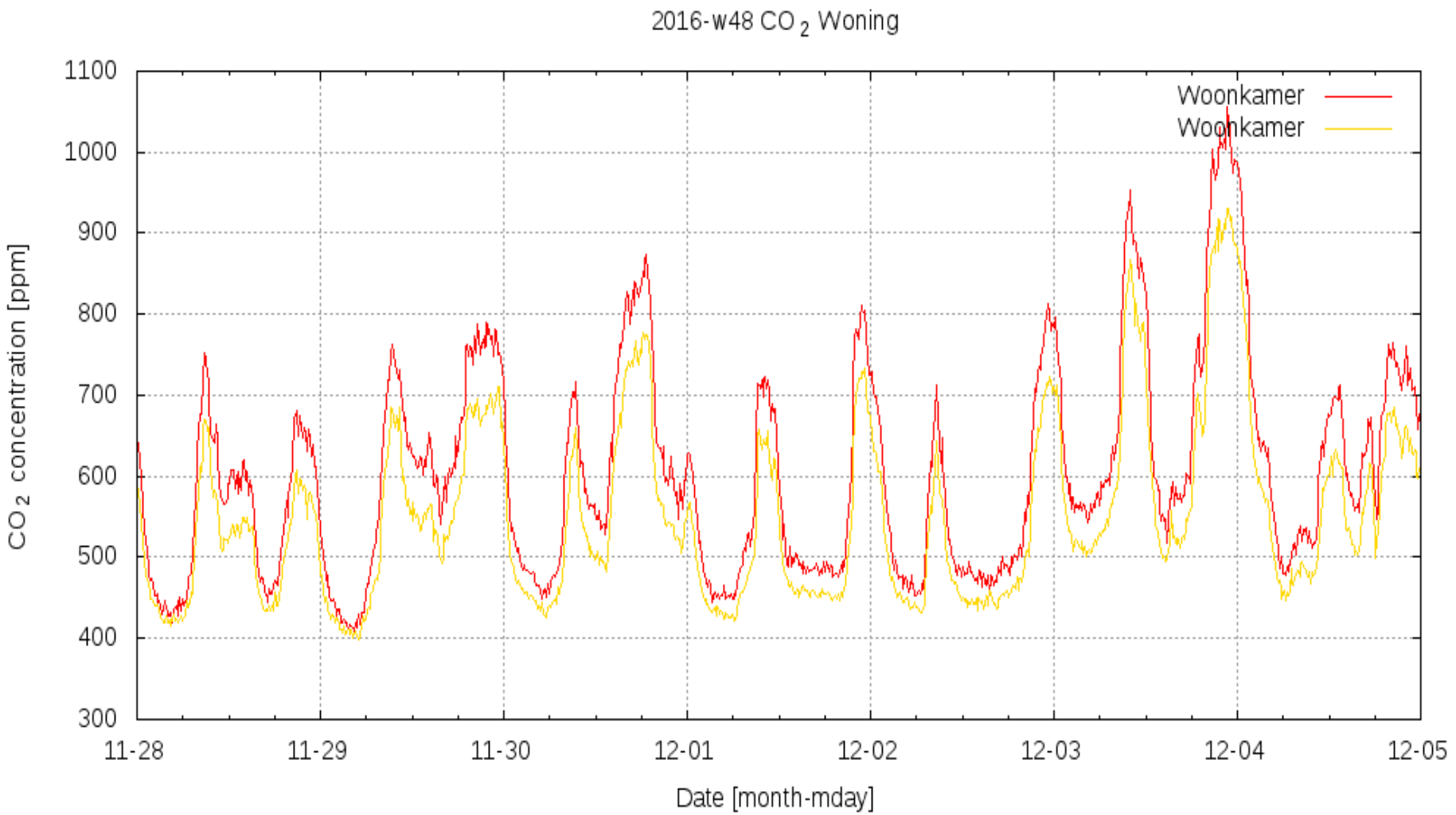


Problems: Apollo 13

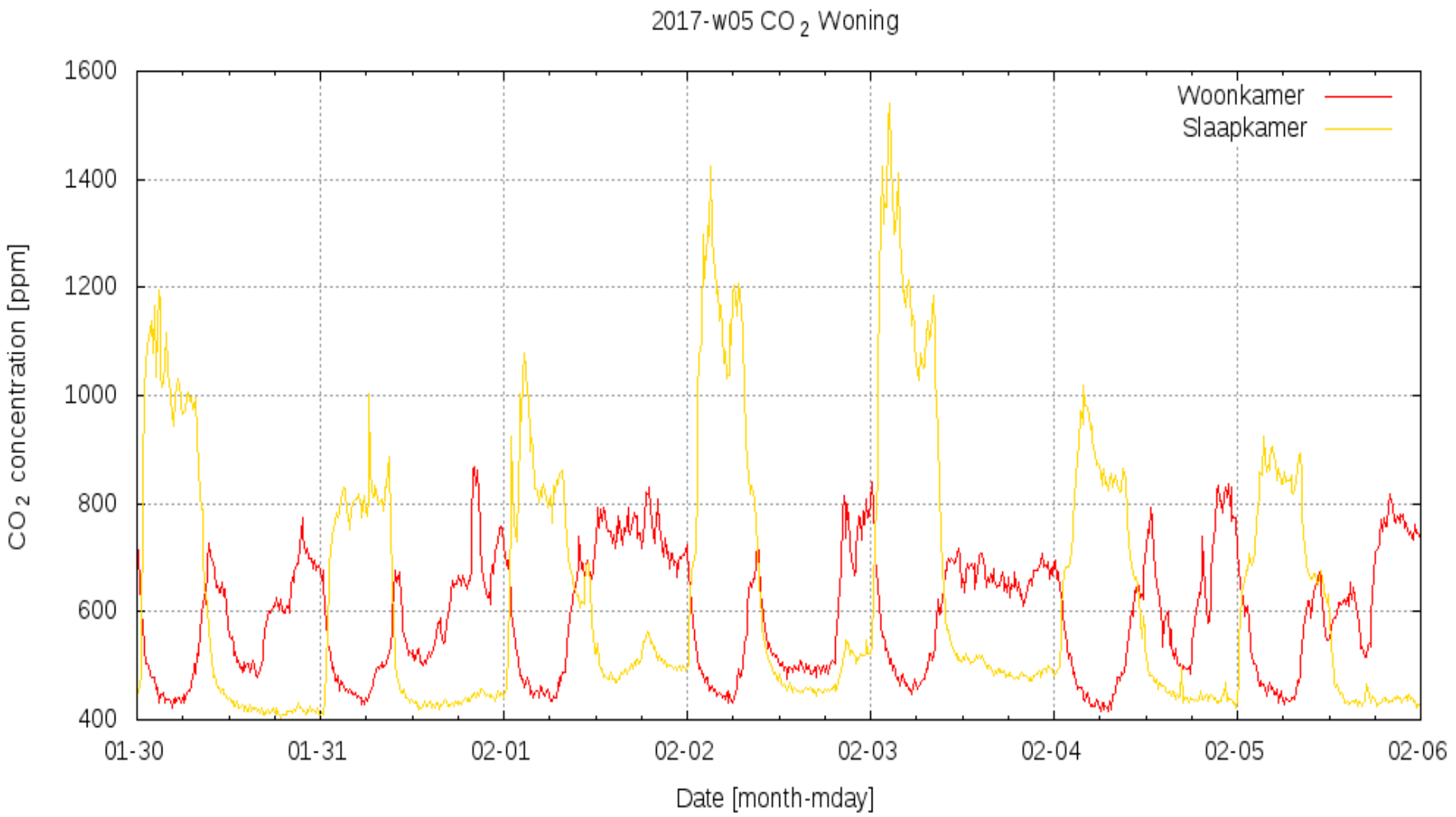


My own numbers

2 sensors at the same place



Bedroom values > Living room values



Results

- Reliable measuring of CO2 is difficult
- Mechanical ventilation is needed

Questions?