

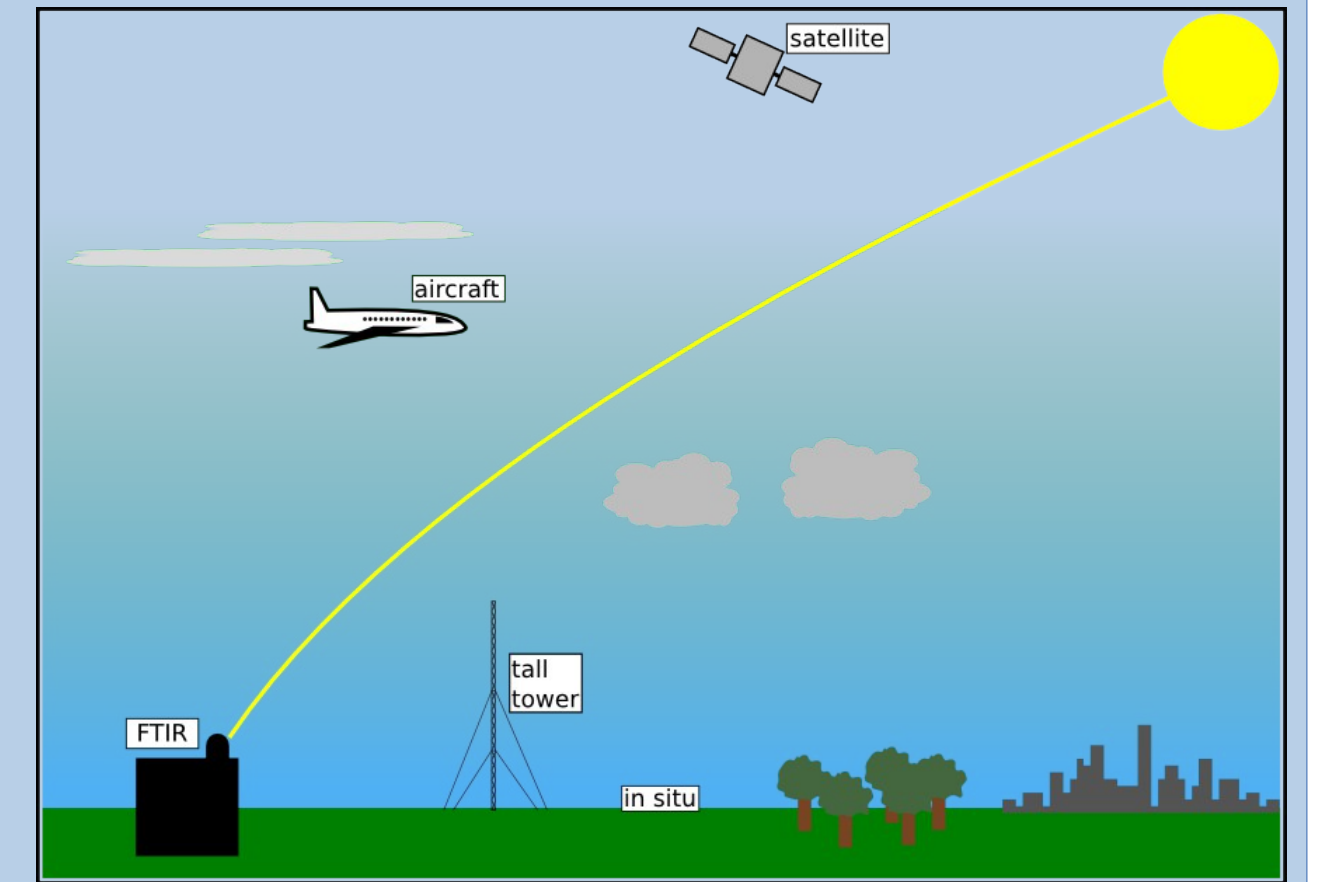
Abstract

We employ Fourier Transform InfraRed (FTIR) Spectrometry to measure the total column amount of atmospheric trace gases via solar absorption spectroscopy, e.g. within the Total Carbon Column Observing Network (TCCON).

During winter in the high Arctic, there is no sunlight available because the sun is permanently below the horizon. We deployed a new near-infrared detector in our instrument in Ny Ålesund (79° N) to increase sensitivity in low light conditions and use the sunlight reflected by the moon as an infrared light source above the atmosphere to perform absorption spectroscopy. At autumn equinox we are able to take both, sunlight and moonlight spectra, thus validating the new approach. Here we present the successful retrieval of total column dry air mole fractions of CO₂ and CH₄ in the 2012/2013 and 2013/2014 winter and it's validation with TCCON.

What we do ...

- Ground based solar absorption spectroscopy with high resolution Fourier-Transform Infrared Spectrometers
- Retrieve concentration of atmospheric constituents using infrared spectral absorption lines
- Get continuous information on the total column
- High precision: < 0.2 %
- World wide network of stations



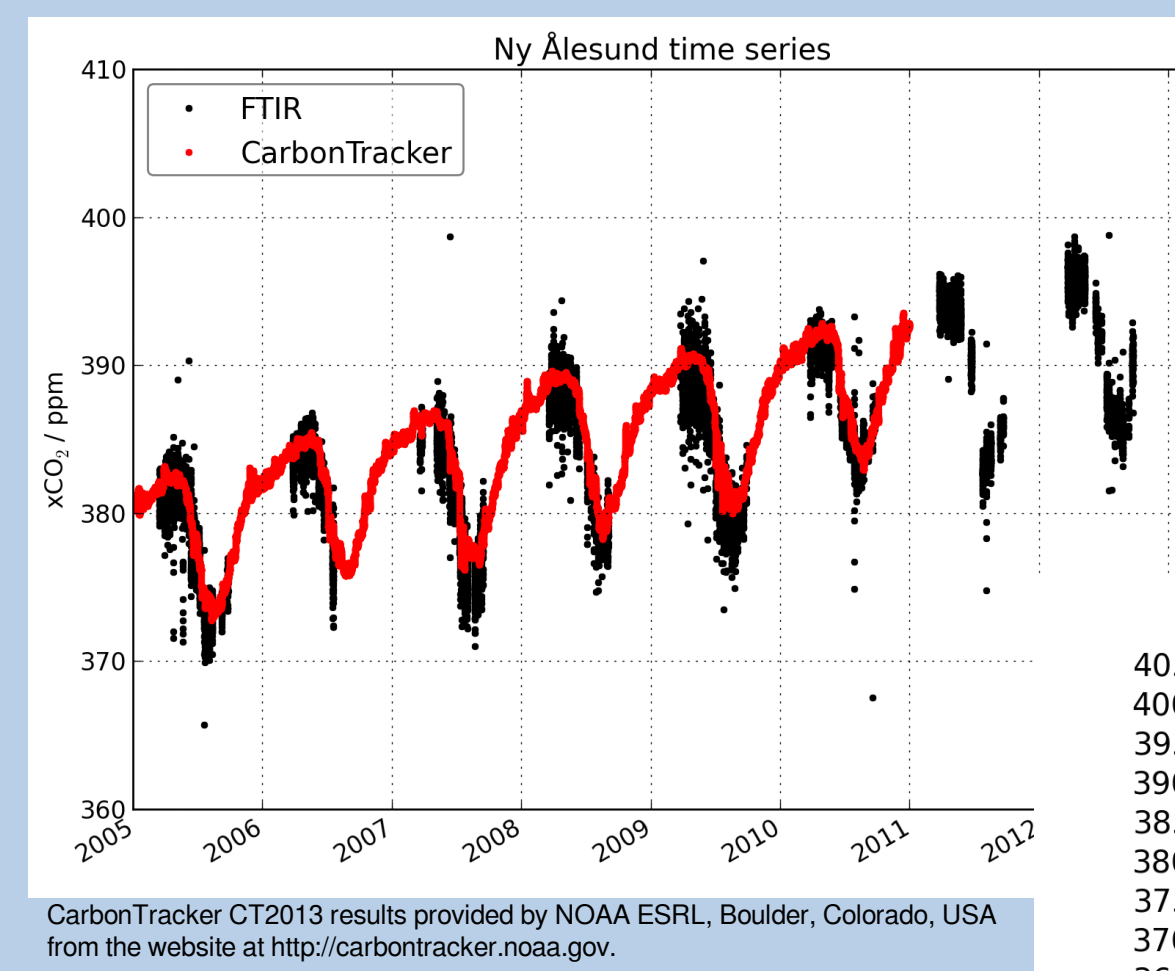
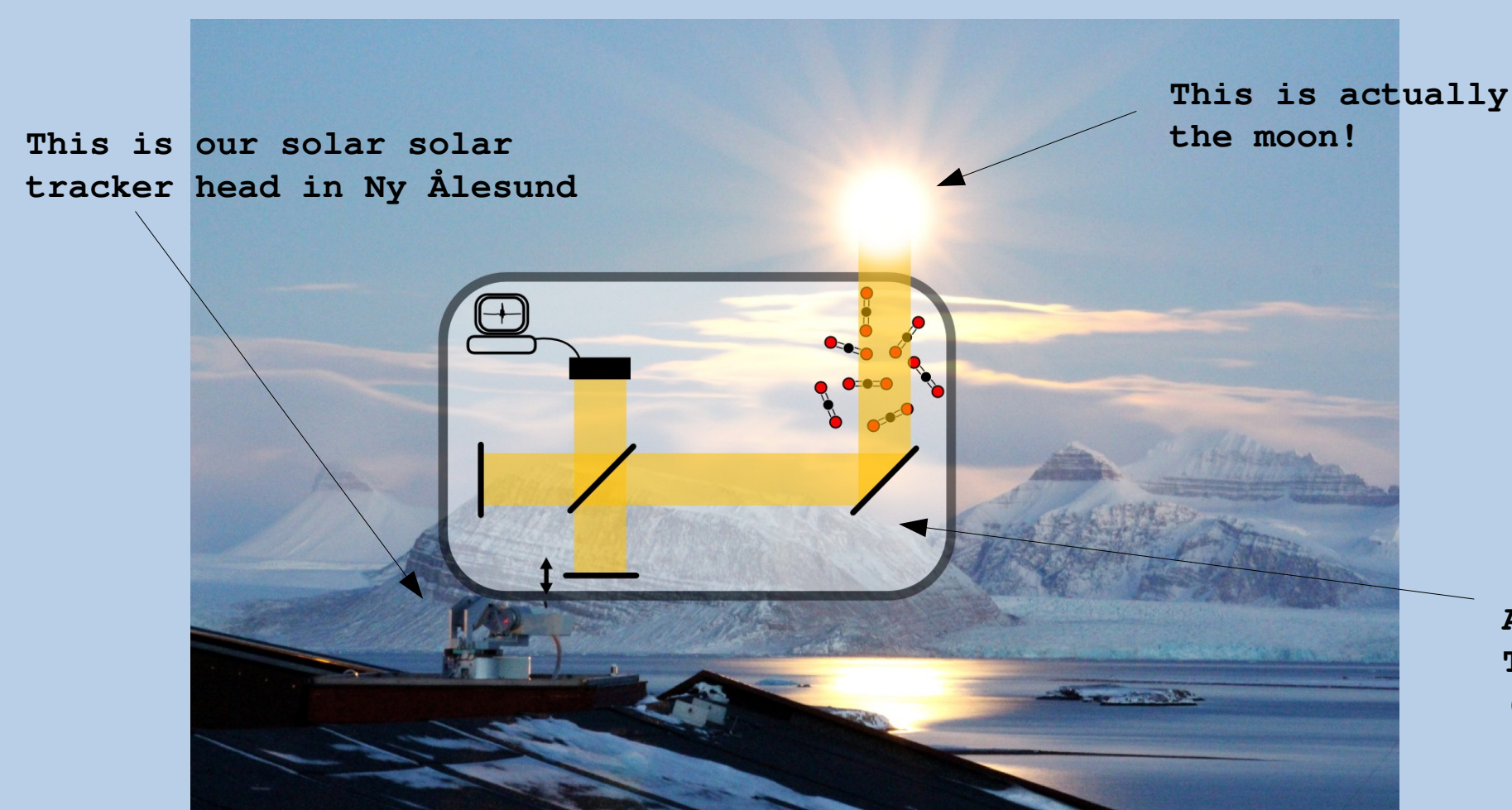
However ...

- At our site in Ny Ålesund, Svalbard in the high arctic, we cannot perform measurements in the winter, because the sun is permanently below the horizon.
- This results in data gaps in our time series' and we cannot there is no possibility to validate model simulations in the winter.

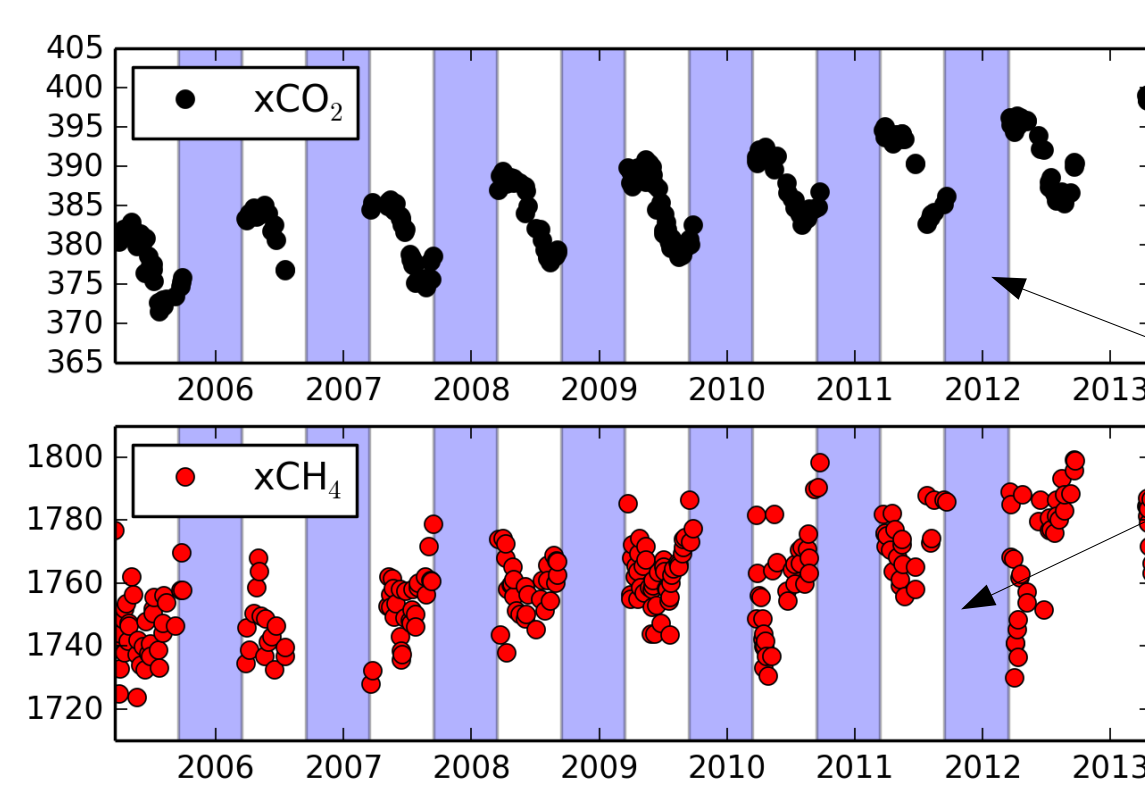


What to do about the lack of sunlight ?

→ Use the moon as light source



CarbonTracker CT2013 results provided by NOAA ESRL, Boulder, Colorado, USA from the website at <http://carbontracker.noaa.gov>.

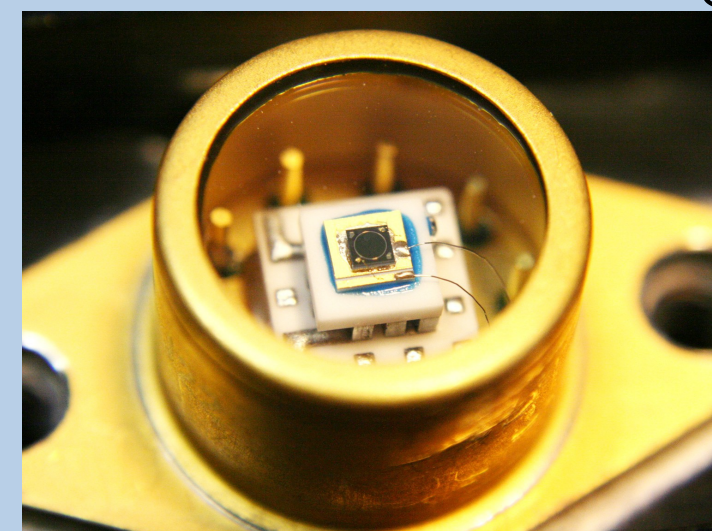


Note the gaps in winter

A quick sketch of a Fourier-Transform InfraRed Spectrometer (FTIR)

This required ...

- Much lower intensity requires reduction of spectral resolution and ...
- A new thermo-electrically cooled InGaAs detector with better signal-to-noise ratio



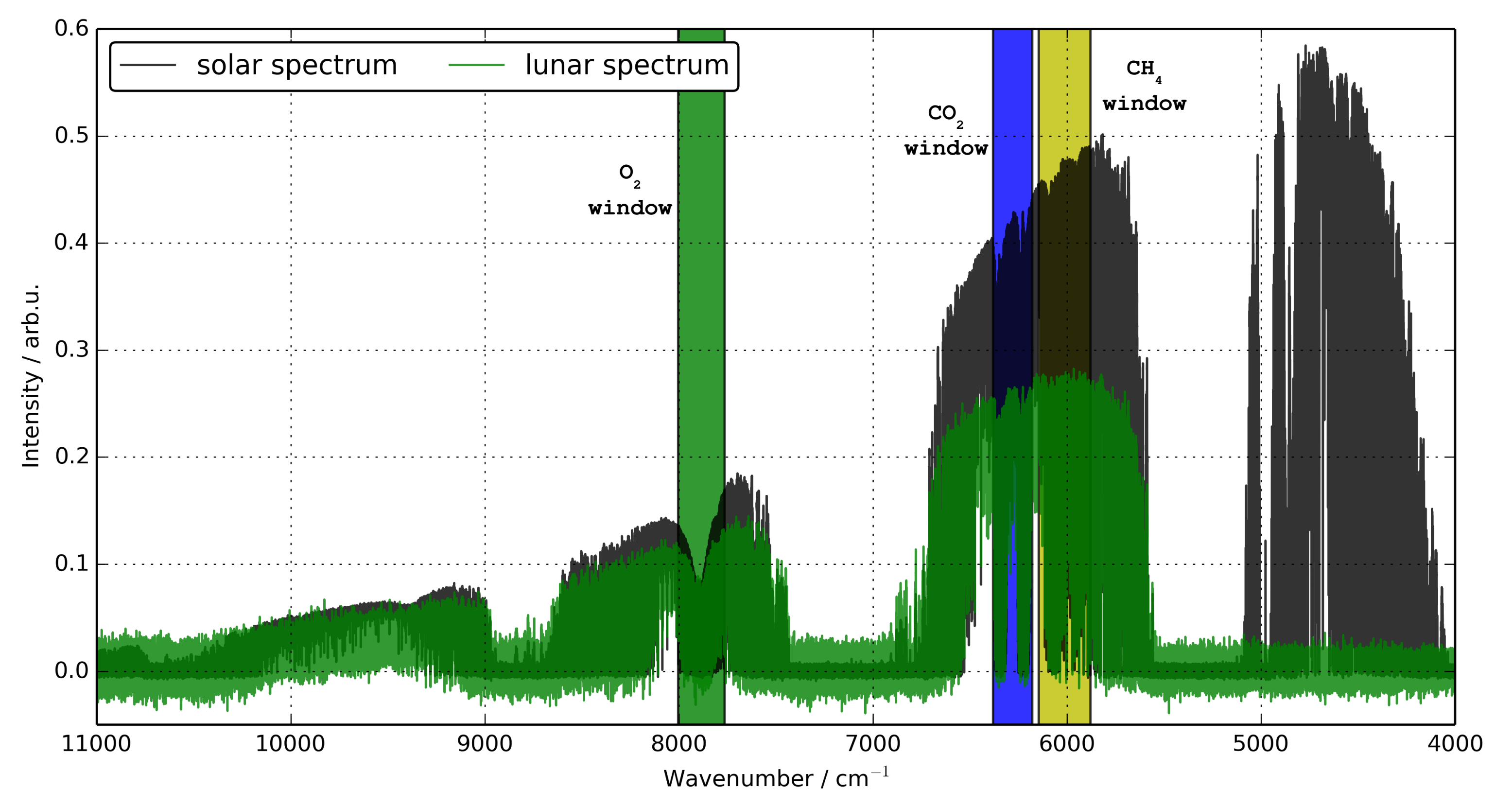
New TE cooled InGaAs diode



New detector

And we get spectra ...

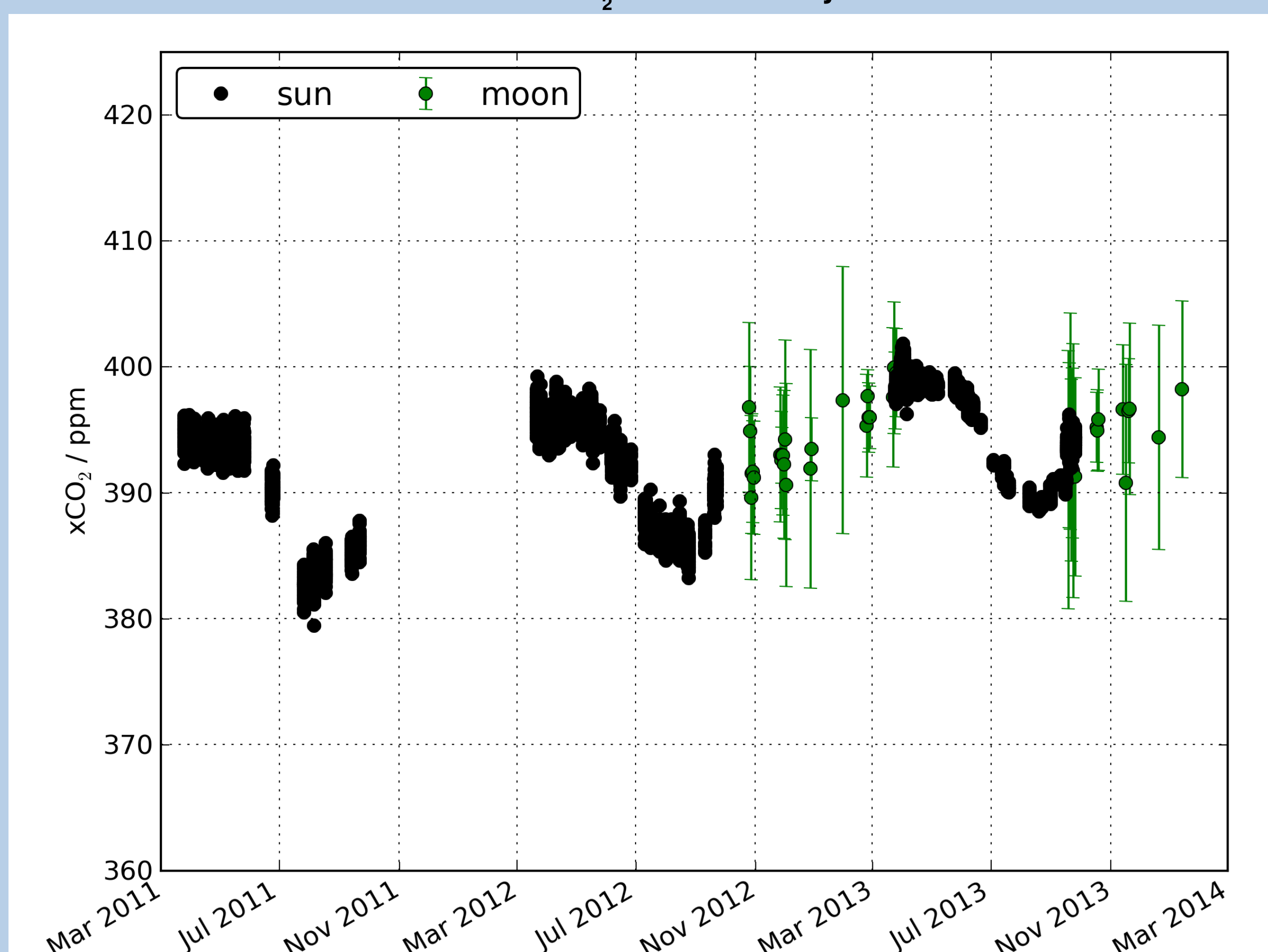
- That are still quite noisy, S/N about 10 times less than from solar spectra, ...
- But good enough to perform a profile scaling retrieval



Results ...

- We deployed the new detector in Ny Ålesund in 2012 and measured spectra throughout the winter 2012/13 and 2013/14

Total column CO₂ time series Ny Ålesund



Total column CO₂ time series Ny Ålesund

