# Stratospheric $CH_4$ and $CO_2$ profiles retrieved with Onion Peeling DOAS from SCIAMACHY solar occultation measurements


**S. Noël, K. Bramstedt, M. Buchwitz, M. Hilker, P. Liebing, M. Reuter, A. Rozanov, H. Bovensmann, and J. P. Burrows**

Institute of Environmental Physics/Remote Sensing, University of Bremen, FB 1, P.O. Box 330440, D-28334 Bremen, Germany

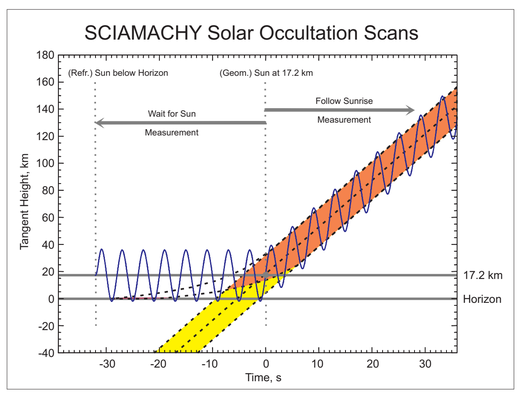
## Introduction

⇨ Stratospheric profiles of methane and carbon dioxide have been determined from solar occultation measurements of the SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY (SCIAMACHY) on ENVISAT.

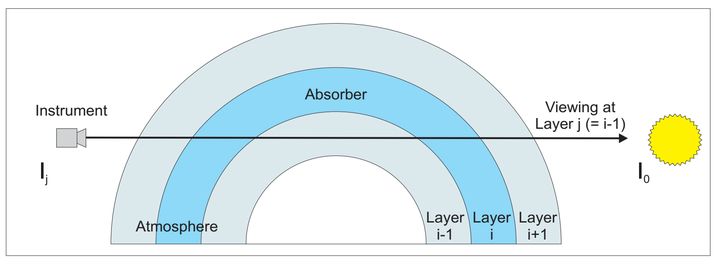
⇨ These data have been retrieved using an update of the "Onion Peeling DOAS" (ONPD) method (see Noël et al., AMT, 2011), which combines an onion peeling approach with a weighting function DOAS (Differential Optical Absorption Spectroscopy) fit.

⇨ The data cover the whole SCIAMACHY time series (August 2002 to April 2012), but due to the sun-fixed orbit of ENVISAT the solar occultation measurements are restricted to the latitudinal range between about 50°N and 70°N.

⇨ The new data set (V4.5.2) is part of the Climate Research Data Package (CRDP) generated in the context of the ESA GHG-CCI project.




## Onion Peeling DOAS




⇨ The atmosphere is divided into horizontal layers

⇨ For each layer, a weighting function DOAS fit is performed

⇨ The retrieval starts at the top layer and then propagates downwards, taking into account the results of the upper layers

⇨ SCIAMACHY spectra are interpolated to the retrieval grid before the retrieval

⇨ Fit interval: 1559 -1671 nm;

⇨ Fitted: $CH_4$ and $CO_2$ densities, polynomial offset, spectral shift & squeeze

⇨ p, T from ECMWF (used for linear correction of spectra before fit and VMRs)

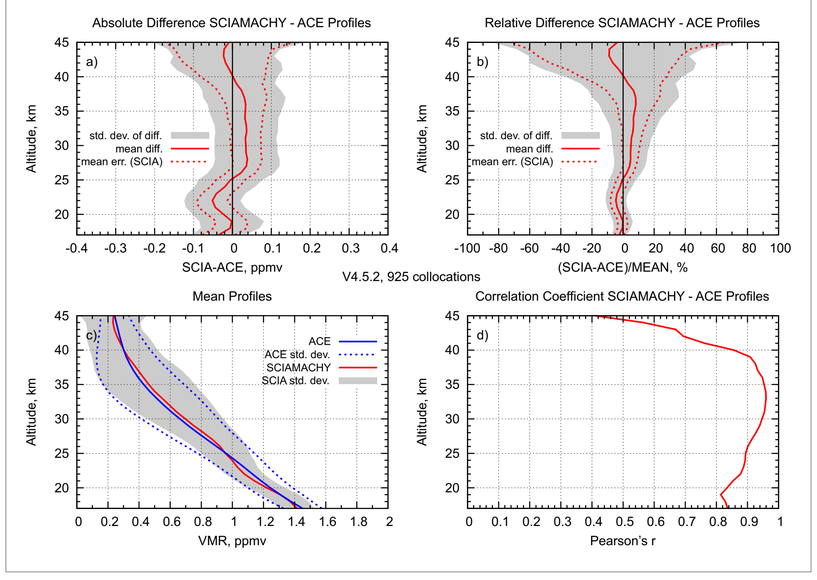
⇨ Retrieval altitude grid: 0 – 50 km, 1 km steps (no retrieval below 10 km)

⇨ Additional corrections applied after the retrieval to take limited spatial and spectral resolution into account, especially:

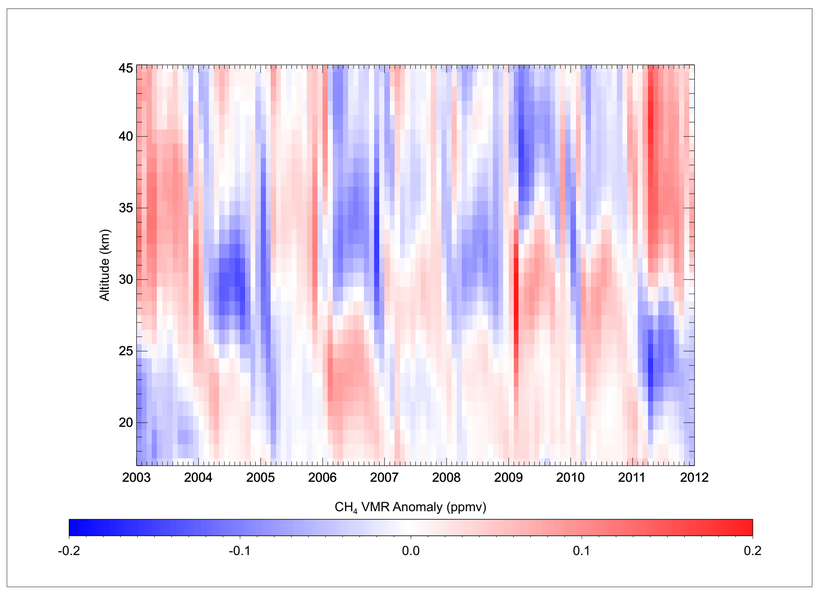
- Vertical smoothing (4.3 km boxcar) for regularisation
- Saturation / non-linearity corrections

## Results

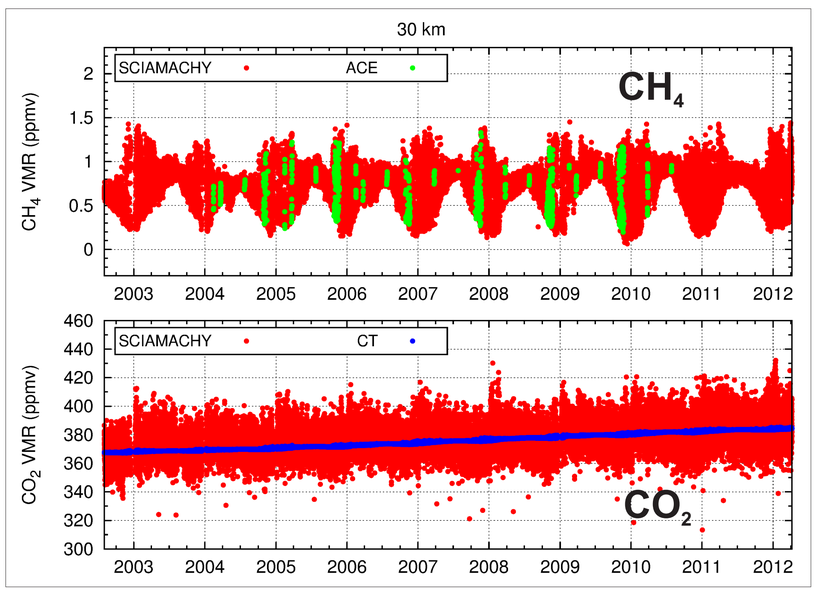
### $CH_4$: Comparison with ACE-FTS Data V3



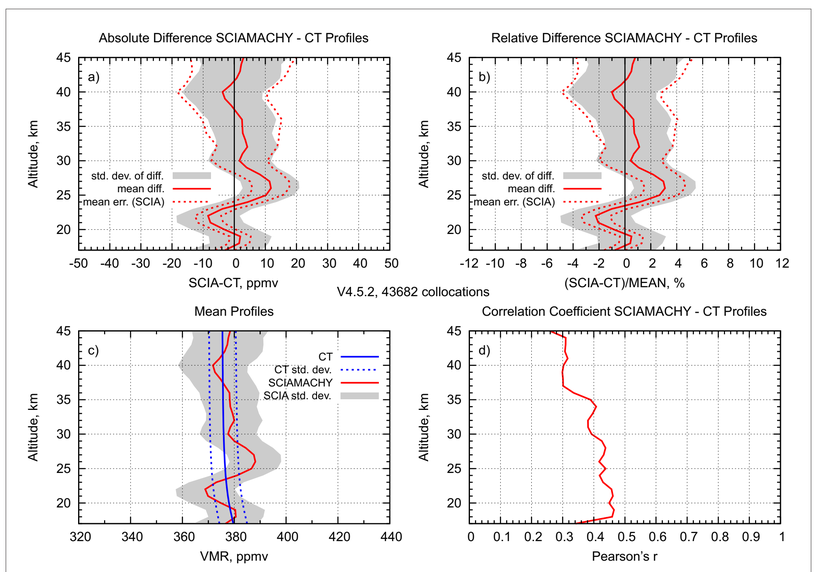

### Monthly Anomalies ($CH_4$)



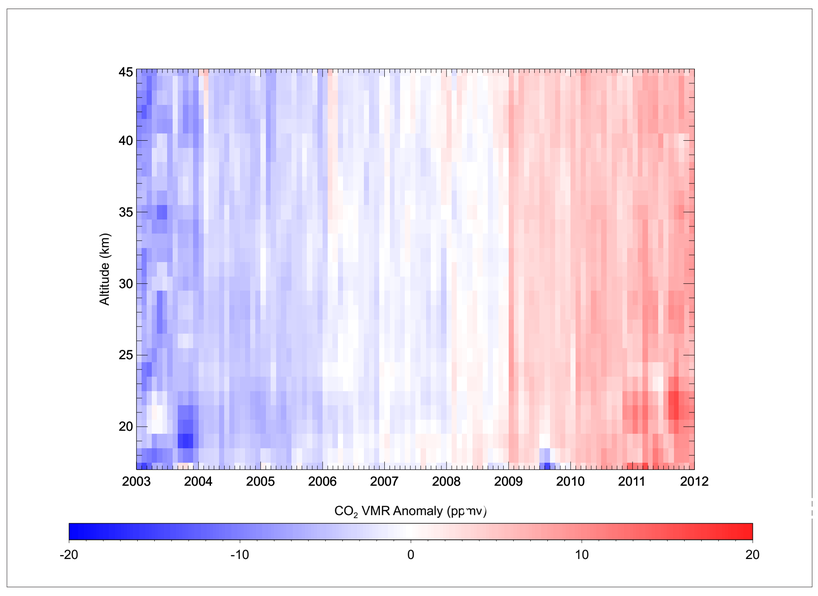

### Time Series



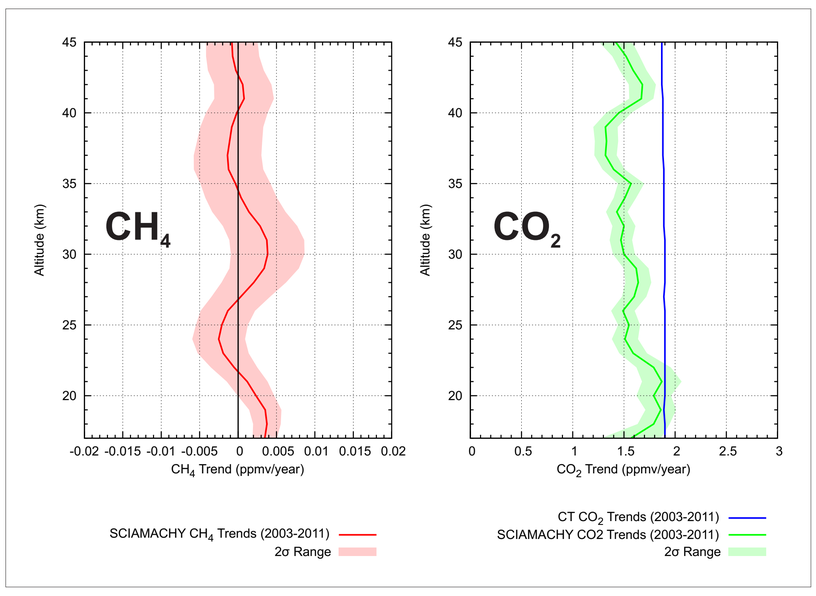

### $CO_2$: Comparison with CT2013




### Monthly Anomalies ($CO_2$)




### Changes 2003 - 2011 (from anomalies)




## Conclusions

⇨ **Improved version 4.5.2 of ONPD $CO_2$ and $CH_4$ products available**

⇨ **Complete SCIAMACHY time series (August 2002 to April 2012) has been processed, incl. state 47 orbits**

⇨ **Reasonable results between about 17 and 45 km**

⇨ **First comparisons indicate accuracies of about:**

- **5-10% for $CH_4$ (compared to ACE-FTS V3)**
- **2-3% for $CO_2$ (compared to CarbonTracker; no other measurement data available)**

⇨ **Main issue: Vertical oscillations (specifically $CO_2$); probably retrieval artefact ➔ additional regularisation required?**

## Selected References

H. Bovensmann et al., SCIAMACHY - Mission Objectives and Measurement Modes, J. Atmos. Sci., 56, 127-150, 1999.

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Universität Bremen
Stefan.Noel@iup.physik.uni-bremen.de

See also: www.iup.uni-bremen.de