Summary of the Final Report of Research Results

1) Title of the proposed research

Validation of TANSO CH_4 columns and profiles by ground-based solar absorption FTIR

2) Principal Investigator (PI) and Co-Investigators (Co-Is)

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4) Summary of the Final Report of Research Results

In the framework of the NDACC (Network for the Detection of Atmospheric Composition Change) a ground-based high resolution Fourier Transform Spectrometer (FTS) is operated at the IRF (Swedish Institute of Space Physics) in Kiruna. The instrument is a BRUKER IFS 120/125HR with a spectral resolution of 0.0025 cm^{-1}. Solar absorption spectra are measured in the spectral region from 2 to 14 μm. Vertical profiles and column amounts of several minor constituents are derived by a constrained least squares fitting technique. Profile information is retrieved by making use of the pressure broadening of the absorption lines. To make sure that the line shape is measured correctly by the instrument gas cell measurements are made routinely and are analyzed with the software LINEFIT.

Spectra were recorded on 75 days per year on average. These spectra were analysed and CH_4 data were archived on the NDACC data base. This column data was used to validate GOSAT - TANSO FTS Level 2 SWIR products of CH_4. These comparisons were presented during the GOSAT RA PI meeting in May 2011.

In addition, validation with Karlsruhe FTIR data was offered to GOSAT team. An FTIR spectrometer is operated in Karlsruhe since September 2009. It is a TCCON certified instrument and data are archived in the TCCON data base. The surrounding is flat and ideal for validation of

satellite data. These data were used to validate GOSAT data and were published in
Deng et al., ACP, 2014; Dils et al., AMT, 2014; Guerlet et al., JGR, 2013; Oshchepkov et al., Applied Optics, 2013; Schepers et al., JGR, 2012; and Yoshida et al., AMT, 2013.
(See publication list below for details).

5) List of publications relating to the proposed research

Dils, B., M. Buchwitz, M. Reuter, O. Schneising, H. Boesch, R. Parker, S. Guerlet, I. Aben, T. Blumenstock, J. P. Burrows, A. Butz, N. M. Deutscher, C. Frankenberg, F. Hase, O. P. Hasekamp, J. Heymann, M. De Mazière, J. Notholt, R. Sussmann, T. Warneke, D. Griffith, V. Sherlock, and D. Wunch: The Greenhouse Gas Climate Change Initiative (GHG-CCI): comparative validation of GHG-CCI SCIAMACHY/ENVISAT and TANSO-FTS/GOSAT CO2 and CH4 retrieval algorithm products with measurements from the TCCON, Atmos. Meas. Tech., 7, 1723-1744, doi:10.5194/amt-7-1723-2014, 2014.

Deng, F., D. B. A. Jones, D. K. Henze, N. Bousserez, K. W. Bowman,, J. B. Fisher, R. Nassar, C. O'Dell, D. Wunch, P. O. Wennberg, E. A. Kort, S. C. Wofsy, T. Blumenstock, N. M. Deutscher, D. W. T. Griffith, F. Hase, P. Heikkinen, V. Sherlock, K. Strong, R. Sussmann, and T. Warneke: Inferring regional sources and sinks of atmospheric CO2 from GOSAT XCO2 data, Atmos. Chem. Phys., 14, 3703–3727, doi:10.5194/acp-14-3703-2014, 2014.

S. Guerlet, A. Butz, D. Schepers, S. Basu, O. P. Hasekamp, A. Kuze, T. Yokota, J.-F. Blavier, N. M. Deutscher, D. W. T. Griffith, F. Hase, E. Kyro, I. Morino, V. Sherlock, R. Sussmann, A. Galli and I. Aben: Impact of aerosol and thin cirrus on retrieving and validating XCO2 from GOSAT shortwave infrared measurements, J. Geophys. Res., Vol. 118, Issue 10, 4887–4905, DOI: 10.1002/jgrd.50332, 2013.

Y. Yoshida, N. Kikuchi, I. Morino, O. Uchino, S. Oshchepkov, A. Bril, T. Saeki, N. Schutgens, G. C. Toon, D. Wunch, C. M. Roehl, P. O. Wennberg, D. W. T. Griffith, N. M. Deutscher, T. Warneke, J. Notholt, J. Robinson, V. Sherlock, B. Connor, M. Rettinger, R. Sussmann, P. Ahonen, P. Heikkinen, E. Kyro, J. Mendonca, K. Strong, F. Hase, S. Dohe, and T. Yokota: Improvement of the retrieval algorithm for GOSAT SWIR XCO2 and XCH4 and their validation using TCCON data, Atmos. Meas. Tech., 6, 1533–1547, doi:10.5194/amt-6-1533-2013, 2013.

Oshchepkov, S., A. Bril, T. Yokota, Y. Yoshida, T. Blumenstock, N. M. Deutscher, S. Dohe, R. Macatangay, I. Morino, J. Notholt, M. Rettinger, C. Petri, M. Schneider, R. Sussmann, O. Uchino, V. Velazco, D. Wunch, and D. Belikov: Simultaneous retrieval of atmospheric CO2 and light path

modification from space-based spectroscopic observations of greenhouse gases: methodology and application to GOSAT measurements over TCCON sites, Applied Optics, Vol. 52, Issue 6, pp. 1339-1350, http://dx.doi.org/10.1364/AO.52.001339, 2013.

Schepers, D., S. Guerlet, A. Butz, J. Landgraf, C. Frankenberg, O. Hasekamp, J.-F. Blavier,N. M. Deutscher, D. W. T. Griffith, F. Hase, E. Kyro, I. Morino, V. Sherlock, R. Sussmann, and I. Aben: Methane retrievals from Greenhouse Gases Observing Satellite (GOSAT) shortwave infrared measurements: Performance comparison of proxy and physics retrieval algorithms, J. Geophys. Res., VOL. 117, D10307, doi:10.1029/2012JD017549, 2012.