MetaData File provided: December 2017.
Latest Revision: September 2022.

Data Set Description:

PI: Maria V. Makarova (SPbU)
Co-I: Yana Virolainen (SPbU)
Alexander Polyakov (SPbU)
Instrument: Bruker IFS 125 HR Fourier Transform Infrared Spectrometer
Site(s): St.Petersburg
Peterhof, Russia,
59.88N, 29.83E, 20m asl.
Measurement Quantities:
Total columns of more than 20 trace gases. Total columns (in molec/cm2) of O3, HCl, HF, HNO3, ClONO2, N2O, CH4, CO, C2H6, HCN, CCl3F, CCl2F2, CHF2Cl, OCS, H2CO are submitted into NDACC database.

Contact Information:

Name: Maria Makarova, Yana Virolainen, Alexander Polyakov
Address: Dept. pf Atmospheric Physics,
Saint Petersburg State University (SPbU)
1, Ulyanovskaya st., Peterhof, St. Petersburg,
198504, Russia
email: zaits@troll.phys.spbu.ru, yana.virolainen@spbu.ru, a.v.polyakov@spbu.ru
phone: +7-921-9800472
fax: +7-812-4287240

Online References:
http://troll.phys.spbu.ru/Personal_pages/Makarova/index.html

License type:

DOI:
-

Selected Articles:

Gavrilov N.M., M.V. Makarova, A.V. Poberovskii, and Yu.M. Timofeyev, 2014: Comparisons of CH4 ground-based FTIR measurements near Saint-Petersburg with GOSAT observations. Atmos. Meas. Techn., 7, 1003-1010, doi: 10.5194/amt-7-1003-2014.

Makarova M.V., O. Kirner, Yu.M. Timofeev, A.V. Poberovskii, Kh.Kh. Imkhasin, S.I. Osipov, and B.K. Makarov, 2015: Analysis of methane total column variations in the atmosphere near St. Petersburg using ground-based measurements and simulations. Izvestiya, Atmospheric and Oceanic Physics, 51, 2, 177–185, DOI: 10.1134/S0001433815010089.

Makarova M.V., Kirner O., Timofeev Y.M., Poberovskii A.V., Imkhasin K.K., Osipov S.I., Makarov B.K., 2015: Annual cycle and long-term trend of the methane total column in the atmosphere over the St. Petersburg region. Izvestiya, Atmospheric and Oceanic Physics, 51, 4, 431–438, DOI: 10.1134/S0001433815040088.

Virolainen, Y. A., Timofeyev, Y. M., Kostsov, V. S., Ionov, D. V., Kalinnikov, V. V., Makarova, M. V., Poberovsky, A. V., Zaitsev, N. A., Imhasin, H. H., Polyakov, A. V., Schneider, M., Hase, F., Barthlott, S., and Blumenstock, T., 2017: Quality assessment of integrated water vapour measurements at St. Petersburg site, Russia: FTIR vs. MW and GPS techniques. Atmos. Meas. Tech., 10, 4521-4536, https://doi.org/10.5194/amt-10-4521-2017, 2017.

Vigouroux, C., Bauer Aquino, C. A., Bauwens, M., Becker, C., Blumenstock, T., De Mazière, M., García, O., Grutter, M., Guarin, C., Hannigan, J., Hase, F., Jones, N., Kivi, R., Koshelev, D., Langerock, B., Lutsch, E., Makarova, M., Metzger, J.-M., Müller, J.-F., Notholt, J., Ortega, I., Palm, M., Paton-Walsh, C., Poberovskii, A., Rettinger, M., Robinson, J., Smale, D., Stavrakou, T., Stremme, W., Strong, K., Sussmann, R., Té, Y., and Toon, G.: NDACC harmonized formaldehyde time series from 21 FTIR stations covering a wide range of column abundances, Atmos. Meas. Tech., 11, 5049-5073, https://doi.org/10.5194/amt-11-5049-2018, 2018.

Lutsch, E., Strong, K., Jones, D. B. A., Blumenstock, T., Conway, S., Fisher, J. A., Hannigan, J. W., Hase, F., Kasai, Y., Mahieu, E., Makarova, M., Morino, I., Nagahama, T., Notholt, J., Ortega, I., Palm, M., Poberovskii, A. V., Sussmann, R., and Warneke, T.: Detection and Attribution of Wildfire Pollution in the Arctic and Northern Mid-latitudes using a Network of FTIR Spectrometers and GEOS-Chem, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-881, in review, 2019.

Polyakov A, Y. Virolainen, A. Poberovskiy, M. Makarova and Y. Timofeyev. Atmospheric HCFC-22 total columns near St. Petersburg: stabilization with start of a decrease. International Journal of Remote Sensing, 2020, 41(11), 4365-4371, DOI: 10.1080/01431161.2020.1717668

Virolainen Y.A., Polyakov A.V. , and Kirner O. Optimization of Procedure for Determining Chlorine Nitrate in the Atmosphere from Ground-Based Spectroscopic Measurements. J Appl Spectrosc 87, 319–325, 2020. https://doi.org/10.1007/s10812-020-01002-5

Vigouroux, C., Langerock, B., Bauer Aquino, C. A., Blumenstock, T., Cheng, Z., De Mazière, M., De Smedt, I., Grutter, M., Hannigan, J. W., Jones, N., Kivi, R., Loyola, D., Lutsch, E., Mahieu, E., Makarova, M., Metzger, J.-M., Morino, I., Murata, I., Nagahama, T., Notholt, J., Ortega, I., Palm, M., Pinardi, G., Röhling, A., Smale, D., Stremme, W., Strong, K., Sussmann, R., Té, Y., van Roozendael, M., Wang, P., and Winkler, H.: TROPOMI–Sentinel-5 Precursor formaldehyde validation using an extensive network of ground-based Fourier-transform infrared stations, Atmos. Meas. Tech., 13, 3751–3767, https://doi.org/10.5194/amt-13-3751-2020, 2020.

Blumenstock, T., Hase, F., Keens, A., Czurlok, D., Colebatch, O., Garcia, O., Griffith, D. W. T., Grutter, M., Hannigan, J. W., Heikkinen, P., Jeseck, P., Jones, N., Kivi, R., Lutsch, E., Makarova, M., Imhasin, H. K., Mellqvist, J., Morino, I., Nagahama, T., Notholt, J., Ortega, I., Palm, M., Raffalski, U., Rettinger, M., Robinson, J., Schneider, M., Servais, C., Smale, D., Stremme, W., Strong, K., Sussmann, R., Té, Y., and Velazco, V. A.: Characterization and potential for reducing optical resonances in Fourier transform infrared spectrometers of the Network for the Detection of Atmospheric Composition Change (NDACC), Atmos. Meas. Tech., 14, 1239–1252, https://doi.org/10.5194/amt-14-1239-2021, 2021.

Sha, M. K., Langerock, B., Blavier, J.-F. L., Blumenstock, T., Borsdorff, T., Buschmann, M., Dehn, A., De Mazière, M., Deutscher, N. M., Feist, D. G., García, O. E., Griffith, D. W. T., Grutter, M., Hannigan, J. W., Hase, F., Heikkinen, P., Hermans, C., Iraci, L. T., Jeseck, P., Jones, N., Kivi, R., Kumps, N., Landgraf,

J., Lorente, A., Mahieu, E., Makarova, M. V., Mellqvist, J., Metzger, J.-M., Morino, I., Nagahama, T., Notholt, J., Ohyama, H., Ortega, I., Palm, M., Petri, C., Pollard, D. F., Rettinger, M., Robinson, J., Roche, S., Roehl, C. M., Röhling, A. N., Rousogenous, C., Schneider, M., Shiomi, K., Smale, D., Stremme, W., Strong, K., Sussmann, R., Té, Y., Uchino, O., Velazco, V. A., Vigouroux, C., Vrekoussis, M., Wang, P., Warneke, T., Wizenberg, T., Wunch, D., Yamanouchi, S., Yang, Y., and Zhou, M.: Validation of methane and carbon monoxide from Sentinel-5 Precursor using TCCON and NDACC-IRWG stations, Atmos. Meas. Tech., 14, 6249–6304, https://doi.org/10.5194/amt-14-6249-2021, 2021.

Polyakov, A., A. Poberovsky, M. Makarova, Y. Virolainen, Y. Timofeyev, and A. Nikulina, Measurements of CFC-11, CFC-12, and HCFC-22 total columns in the atmosphere at the St. Petersburg site in 2009–2019 // Atmos. Meas. Tech., 14, 5349–5368, 2021, https://doi.org/10.5194/amt-14-5349-2021

Makarova, M. V., Alberti, C., Ionov, D. V., Hase, F., Foka, S. C., Blumenstock, T., Warneke, T., Virolainen, Y. A., Kostsov, V. S., Frey, M., Poberovskii, A. V., Timofeyev, Y. M., Paramonova, N. N., Volkova, K. A., Zaitsev, N. A., Biryukov, E. Y., Osipov, S. I., Makarov, B. K., Polyakov, A. V., Ivakhov, V. M., Imhasin, H. Kh., and Mikhailov, E. F.: Emission Monitoring Mobile Experiment (EMME): an overview and first results of the St. Petersburg megacity campaign 2019, Atmos. Meas. Tech., 14, 1047–1073, https://doi.org/10.5194/amt-14-1047-2021, 2021.

Ionov, D. V., Makarova, M. V., Hase, F., Foka, S. C., Kostsov, V. S., Alberti, C., Blumenstock, T., Warneke, T., and Virolainen, Y. A.: The CO2 integral emission by the megacity of St Petersburg as quantified from ground-based FTIR measurements combined with dispersion modelling, Atmos. Chem. Phys., 21, 10939–10963, https://doi.org/10.5194/acp-21-10939-2021, 2021.

Voronin B.A., Makarova M.V., Poberovskii A.V., Bykov A.D.,Dudnikova E.A., Tennyson J., The absorption spectrum of short-lived isotopic variant of water, H215O: Tentative detection at the Earth's atmosphere, Journal of Quantitative Spectroscopy and Radiative Transfer, Volume 276, 2021, https://doi.org/10.1016/j.jqsrt.2021.107929.

Hannigan, J. W., Ortega, I., Shams, S. B., Blumenstock, T., Campbell, J. E., Conway, S., et al. (2022). Global atmospheric OCS trend analysis from 22 NDACC stations. Journal of Geophysical Research: Atmospheres, 127, e2021JD035764. https://doi.org/10.1029/2021JD035764

Vandenbussche S, Langerock B, Vigouroux C, Buschmann M, Deutscher NM, Feist DG, García O, Hannigan JW, Hase F, Kivi R, Kumps N, Makarova M, Millet DB, Morino I, Nagahama T, Notholt J, Ohyama H, Ortega I, Petri C, Rettinger M, Schneider M, Servais CP, Sha MK, Shiomi K, Smale D, Strong K, Sussmann R, Té Y, Velazco VA, Vrekoussis M, Warneke T, Wells KC, Wunch D, Zhou M, De Mazière M. Nitrous Oxide Profiling from Infrared Radiances (NOPIR): Algorithm Description, Application to 10 Years of IASI Observations and Quality Assessment. Remote Sensing. 2022; 14(8):1810. https://doi.org/10.3390/rs14081810

Alberti, C., Tu, Q., Hase, F., Makarova, M. V., Gribanov, K., Foka, S. C., Zakharov, V., Blumenstock, T., Buchwitz, M., Diekmann, C., Ertl, B., Frey, M. M., Imhasin, H. Kh., Ionov, D. V., Khosrawi, F., Osipov, S. I., Reuter, M., Schneider, M., and Warneke, T.: Investigation of spaceborne trace gas products over St Petersburg and Yekaterinburg, Russia, by using COllaborative Column Carbon Observing Network (COCCON) observations, Atmos. Meas. Tech., 15, 2199–2229, https://doi.org/10.5194/amt-15-2199-2022, 2022.

Instrument Description:

Bruker IFS 125 HR Fourier Transform Infrared Spectrometer started its operation at the St.Petersburg site in January, 2009. Solar tracking system for atmospheric observations was designed and performed at the Dept. of Atmospheric Physics, SPbU. The maximum optical path difference (OPD) for the Bruker IFS 125 HR installed at the St.Petersburg site is 450 cm which corresponds to the spectral resolution of 0.002 cm-1.

Typical Bruker IFS 125 HR setup for the solar IR measurements:

- spectral resolution of 0.005 cm-1 (OPD=180 cm);
- KBr beamsplitter (optionally - CaF);
- liquid nitrogen cooled MCT and InSb detectors;
- standard NDACC optical filter is used for measurements by MCT detector and two non-standard broadband filters are used for measurements by InSb detector.

Instrument alignment is controlled once a month using HBr or N2O gas cell spectra. Instrumental line shape parameters are derived from cell spectra by LINEFIT software (developed by F. Hase, IMK KIT).

Algorithm Description:

Two processing softwares are routinely used for spectra processing:

- SFIT4 V0.9.4.4 (for HCl, HF, N2O, CH4, CO, C2H6, HCN, OCS, H2CO, CCl3F, CCl2F2, CHF2Cl retrievals) implements both, Optimal Estimation and Tikhonov-Phillips approaches. Current version of SFIT includes procedure of uncertainty estimation, these uncertainties are included in the HDF archived data files (https://www2.acom.ucar.edu/irwg);

-PROFFIT 9.6 (for O3, HNO3, CLONO2 retrievals) is used for the inversion of the spectra. PROFFIT is able to retrieve profiles and vertical column abundances of several species in several microwindows simultaneously. For the profile retrieval the Phillipps-Tikhonov approach is used. For some species the inversion is performed on a logarithmic scale to avoid negative vmr values.

Both retrieval codes use HITRAN 2008, NCEP T&P profiles, and gases (except H2O) a priori profiles from the WACCM V6. Pre-fitted water vapour profiles are used as a priori for gases retrievals.

Expected Precision/Accuracy of Instrument:

HDF-files contains corresponding error estimates (for each target gas, for every spectrum).

Instrument History:

January 2009 - Bruker IFS 125 HR and self-made solar tracking system setup;
August 2010 - instrument electronics failure (repaired in September 2010);
May 2012 - HBr cell measurements were started;
December 2017 - instrument maintanance by engineer from Bruker company;
September 2020 - new Sios reference laser and instrument maintanance by engineer from Bruker company;
March 2022 - new electronics for solar tracking system;
June 2022 - new InSb detector.