2021 *online* IRWG Meeting Agenda

Meeting A will focus on NDACC/IRWG business:

1 June, 14:00UT

Generally short presentations and mostly discussion

a)	*Everyone*	*Discussions of site status and observation issues during COVID slowdown,*
b)	**Bavo L*	*CAMS27 Update,*
c)	**Jeannette W*	*Update on the NDACC archive status and switch to Langley,*
d)	**Geoff T*	*HITRAN Recent Testing*
e)	**co-chairs*	*HITRAN 16 / ATM 20 / WACCM 2020 & testing by all groups,*
f)	*co-chairs*	*Future meetings, formats, timeframes, activities discussions,*

Meeting B will focus on IRWG group activities:

2 June, 14:00UT

Short presentations and mostly discussion

a)	**Corinne V*	*TOAR-II update, participation, contributions,*
b)	**Ivan O*	*IRWG collaboration to analyze effects of the COVID*
c)	**Jim H*	*OCS update*
d)	**Thomas B*	*Channeling / Beamsplitters follow-up*
e)	**Mathias P*	*SFIT4 Updates & Improvements*
f)	**Bavo L, Ivan O*	*SFIT4 Processing environment and uncertainty calculations*

* Speakers are asked to connect no earlier then 30 min before start time to test their connection and presentation.

Meeting C will focus on Science contributions from young presenters:
4 June, 17:00UT
quasi-EGU/AGU 12/3 from young researchers on their current research.

a) Irene Pardo Cantos, Univ of Liege

"Determination and Analysis of the Time Series of CFC-11 from Lauder and Jungfraujoch."

b) Tyler Wizenberg, Univ of Toronto

"Ground-based FTIR Retrievals of PAN at the Polar Environment Atmospheric Research Laboratory"

c) Beatriz Herrera, Univ of Toronto

"Atmospheric Ammonia in Urban and Remote Regions"

d) Denghui Ji, Univ of Bremen

"Ground-based remote sensing of aerosol properties using the Emission FTIR NYAEMFT and the Raman-Lidar KARL in Ny-Ålesund, Spitsbergen (78°N)"

e) Yuan You, Univ of Toronto

"Quantifying the impact of the COVID-19 pandemic restrictions on CO, CO2, and CH4 in downtown Toronto using open-path Fourier transform spectroscopy"

f) Jamal Makkor, Univ of Bremen

"Digitization and use of Historical Jungfraujoch Spectra from 1951"

g) Shima Bahramvash Shams, Washington State Univ

"Evaluation of MERRA-2 Ozone Product over High Latitudes during SSW's"

h) Shoma Yamanouchi, Univ of Toronto

"Overview of the Long-term Analysis of Toronto-Area Atmospheric Composition"

All speakers in Meeting C are asked to connect no earlier than 30 min before start time to test their connection and presentation.

Joint TCCON/COCCON/NDACC poster session June 8-10 exact time TBD

Denis Czurlok, Bruker Optics, Presentation and Discussion 17 June 14:00 UT (arranged by Thorsten W)

Zoom Meeting Details

Topic: IRWG Meeting A
Time: Tuesday Jun 1, 2021 02:00 PM Universal Time UTC

Join Zoom Meeting
https://ucar-edu.zoom.us/j/3118300816

Meeting ID: 311 830 0816
Passcode: 9tNFt6a4
One tap mobile
+16699006833,,3118300816#,,,,*52643265# US (San Jose)
+12532158782,,3118300816#,,,,*52643265# US (Tacoma)

Dial by your location
+1 669 900 6833 US (San Jose)
+1 253 215 8782 US (Tacoma)
+1 346 248 7799 US (Houston)
+1 929 205 6099 US (New York)
+1 301 715 8592 US (Washington DC)
+1 312 626 6799 US (Chicago)
Meeting ID: 311 830 0816
Passcode: 52643265
Find your local number: https://ucar-edu.zoom.us/u/adDy5j0lu8

Topic: IRWG Meeting B
Time: Wednesday Jun 2, 2021 02:00 PM Universal Time UTC

Join Zoom Meeting
https://ucar-edu.zoom.us/j/3118300816

Meeting ID: 311 830 0816
Passcode: 9tNFt6a4

Topic: IRWG Meeting C
Time: Friday Jun 4, 2021 05:00 PM Universal Time UTC

Join Zoom Meeting
https://ucar-edu.zoom.us/j/3118300816

Meeting ID: 311 830 0816
Passcode: 9tNFt6a4

Ground-based FTIR Retrievals of PAN at the Polar Environment Atmospheric Research Laboratory

Tyler Wizenberg[1], Kimberly Strong[1], Emmanuel Mahieu[2], and Bruno Franco[3]

[1] Department of Physics, University of Toronto, Toronto, ON, Canada
[2] UR SPHERES, Institute of Astrophysics and Geophysics, Université de Liège, Liège, 4000, Belgium
[3] Spectroscopy, Quantum Chemistry and Atmospheric Remote Sensing (SQUARES), Université libre de Bruxelles (ULB), Brussels, 1050, Belgium

Peroxyacetyl Nitrate (PAN) is a key reservoir species of tropospheric nitrogen radicals (NOx = NO + NO2), having significant implications for the production of tropospheric ozone. The atmospheric lifetime of PAN is strongly temperature dependent, ranging from approximately 1 hour at 298K to several weeks at the colder temperatures of the upper troposphere and lower stratosphere (UTLS). This property allows PAN to be transported vast distances in the UTLS from mid-latitude sources to the high Arctic region, where it can influence NO_x and O_3 budgets, contributing to the pollution phenomenon known as 'Arctic haze'. Previous measurements of PAN in the Arctic were made primarily on a campaign basis via in situ measurement techniques, providing limited information on long-term concentrations and trends. In this presentation, we will describe a new ground-based retrieval method for PAN using the Bruker 125HR Fourier transform infrared spectrometer at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut, and its application to obtain a long time series of total columns over the high Arctic. Comparisons against measurements from the Infrared Atmospheric Sounding Interferometer (IASI) satellite instruments and the GEOS-Chem chemical transport model will be shown, and evidence of a significant enhancement in PAN total columns in August 2017, resulting from the long-range transport of wildfire plumes, will be discussed.

Evaluation of MERRA-2 ozone product over high latitudes during SSWs

Shima Bahramvash Shams[1], Von P. Walden[1], James W Hannigan[2]

[1] Washington State University, Pullman, WA, United States,
[2] NCAR, National Center for Atmospheric Research, Boulder, CO, United States,

Stratospheric circulations are a critical part of the Arctic ozone cycle. Sudden stratospheric warming events (SSWs) are caused by the strongest alteration of stratospheric dynamics. During SSWs processes trace gases are highly variable over high latitudes. It is critical to have a clear understanding of Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) ozone performance during these periods. Using the unique density of observations around the Greenland sector of the Arctic, a comprehensive comparison of high latitude observations with MERRA-2 ozone dataset during the 6 major SSWs from 2004 to 2020 is reported. In conclusion, MERRA-2 captured the high variability of ozone fluctuations during SSWs over high latitudes. MERRA-2 shows good agreement with ozonesondes and solar Fourier transform infrared (FTIR) interferometer observations in stratospheric layers with a mean

difference ratio of 3% (±7%). However, higher uncertainties are observed in the lower stratosphere and troposphere where the standard deviation of difference ratio is around 20%.

Atmospheric ammonia in urban and remote regions

Beatriz Herrera[1,2], Kimberly Strong[2]

[1] *Department of Physical and Environmental Sciences, University of Toronto, Toronto, Canada*
[2] *Department of Physics, University of Toronto, Toronto, Canada*

The most abundant alkaline compound in the atmosphere is ammonia (NH_3). NH_3 neutralizes acids and contributes to the formation of aerosols and particulate matter, with potential consequences to the environment, human health, and radiative forcing. NH_3 is primarily emitted by agricultural sources; however, it is also present in urban and remote environments. NH_3 emissions and depositions strongly depend on environmental conditions such as temperature and moisture. NH_3 has a short lifetime on the order of hours to a few days and exhibits a strong temporal and spatial variability. This research investigates atmospheric NH_3 in urban and remote environments, including the Arctic, using a combination of ground-based FTIR (Fourier Transform InfraRed) measurements, satellite data, and atmospheric models. I will discuss the main research objectives and the future work towards using FTIR-NH_3 retrievals to examine NH_3 variability and trends at various NDACC – IRWG urban and remote sites distributed worldwide.

Determination and analysis of the time series of CFC-11 from Lauder and Jungfraujoch

Irene Pardo Cantos[1], Emmanuel Mahieu[1]

[1]*Univ. of Liege*

The monitoring of the chlorofluorocarbons (CFCs) and their successive substitutes - the hydrochlorofluorocarbons (HCFCs) and the hydrofluorocarbons (HFCs) - is essential to track the evolution of their atmospheric concentrations and emissions in accordance with the Montreal Protocol on Substances that Deplete the Ozone Layer. In this study, we used the retrievals of ground-based high-resolution Fourier transform infrared (FTIR) solar spectra and model data (TOMCAT/SLIMCAT developed by Martyn Chipperfield) in order to analyse the CFC-11 total columns above the Jungfraujoch (46.5°N, 3580 m a.s.l.) and Lauder (45°S, 370 m a.s.l) stations. The Jungfraujoch time series has been scaled allowing the creation of a significant time series from June 1986 to December 2020. We analysed and compared ground-based FTIR and model data for both stations to obtain the trends for the last 20 years. A deceleration in the CFC-11 total column decrease has been observed from 2013 in both stations as reported by Montzka et al., 2018 and Rigby et al., 2019. Lauder time series however shows an acceleration in the decrease over the period between 2008 and 2012. Currently, we are (in collaboration

with Dan Smale) therefore studying the possible causes of this behaviour since the drop is mainly observed on the tropospheric column.

Overview of the Long-term Analysis of Toronto-Area Atmospheric Composition

T S. Yamanouchi, K. Strong, L. Clarisse, C. Clerbaux, P.-F. Coheur, S. Conway, D.B.A. Jones, E. Lutsch, O. Colebatch, S. Roche, and M. Van Damme

19-year time series of total columns of C2H2, C2H6, CH4, CH3OH, CO, H2CO, HCl, HCN, HCOOH, HF, HNO3, N2O, NH3, and O3, measured using Fourier transform infrared (FTIR) spectroscopy from 2002 to 2019, were analyzed to study Toronto-area atmospheric composition. In particular, three scientific objectives were addressed in this study: to quantify trends in the time series of trace gas concentrations, to determine how emissions from biomass burning events affect air quality over Toronto and whether observations in Toronto can be used to quantify wildfire emissions, and to examine the spatial representativeness and temporal variability of the FTIR NH3 columns over Toronto.

Trends and enhancement events were determined by fitting trended Fourier series to the total columns, and bootstrapping was used to identify the statistical significance. Trends from 2002 to 2019 were examined, and the GEOS-Chem chemical transport model was used to identify major sources of CO and CH4 over Toronto, which were CH4 oxidation and wetland emissions, respectively.

Transport of wildfire plumes over the site results in enhanced columns of biomass burning species. Several simultaneous enhancements of CO, HCN, and C2H6 were observed, and the measured columns were used to derive emission ratios and emission factors for HCN and C2H6 for fire events in 2012, 2015, and 2017. For the 2015 and 2017 events, simultaneous enhancements of HCOOH and CH3OH were observed, and their emission ratios and emission factors were also examined.

Atmospheric NH3 is a pollutant, and a major source of fine particulate matter. In this study, three NH3 datasets were used: TAO FTIR total columns, three years of surface in situ measurements, and ten years of total column measurements from the Infrared Atmospheric Sounding Interferometer (IASI). The datasets were used to quantify NH3 temporal variability over Toronto, Canada. All three time series showed positive trends in NH3 over Toronto: 3.56 ± 0.85 %/year from 2002 to 2019 in the FTIR columns, 8.88 ± 5.08 %/year from 2013 to 2017 in the surface in situ data, and 8.38 ± 1.54 %/year from 2008 to 2018 in the IASI columns. The multiscale datasets were also compared to assess the representativeness of the FTIR measurements.

Quantifying the impact of the COVID-19 pandemic restrictions on CO, CO2, and CH4 in downtown Toronto using open-path Fourier transform spectroscopy

Yuan You, Brendan Byrne, Orfeo Colebatch, Richard L. Mittermeier, Felix Vogel, and Kimberly Strong

During the global COVID-19 pandemic, anthropogenic emissions of air pollutants and greenhouse gases (GHGs), especially traffic emissions in urban areas, have declined. Long-term measurements of trace gas concentrations in urban areas can be used to quantify the impact of emission reductions on GHG mole fractions. Open-path Fourier transform infrared (OP-FTIR) spectroscopy is a non-intrusive technique that can be used to simultaneously measure multiple atmospheric trace gases in the boundary layer. This study investigates the reduction of surface CO, CO2, and CH4 mole fractions during the stay-at-home periods in downtown Toronto, Canada, which is the fourth largest city in North America. Mean CO mole fraction enhancement above background declined by 51±23% and 42±24% during the 2020 and 2021 stay-at-home periods, respectively, relative to a reference period before the 2020 restrictions started. The mean afternoon CO2 mole fraction enhancement above background declined by 3.9±2.6 ppm (36±24%) and 3.5±2.8 ppm (33±26%) during the stay-at-home periods in 2020 and 2021 relative to the 2020 reference period. CH4 mole fraction enhancement above background did not show significant decline during the 2020 stay-at-home period relative to the 2020 reference period. Diurnal variation in CO during the stay-at-home period in 2020 was also significantly reduced relative to the reference period in 2020. Reductions in trace gas mole fraction enhancements are coincident with the decline of local traffic during the stay-at-home periods, with reduction in CO and CO2 enhancements of 0.74±0.15 ppb and 0.18±0.05 ppm per percentage decrease in traffic, respectively.

Digitization and use of historical Jungfraujoch spectra from 1951.

Jamal Makkor[1], Mathias Palm[1], Emmanuel Mahieu[2] and Justus Notholt[1]

[1] Univ of Bremen
[2] Univ of Liege

The sphinx station in Jungfraujoch Switzerland is one of the oldest and leading atmospheric measurement stations in the Europe. The first solar atlases were developed there by Migeoette et al during the late fifties. The spectra produced there were printed on paper rolls using a Pfund type spectrometer. The initial goal of this work is to digitize all these rolls, calibrate the spectra and save them in a computer readable format.

The digitized spectra are used to calculate the total column of CO and other gases. CO showed an overall decline over the years and a significant monthly variation. The future goal is to investigate other gases as well as perform a modeling using the calculated total column values and the measured weather parameters.

Ground-based remote sensing of aerosol properties using the Emission FTIR NYAEMFT and the Raman-Lidar KARL in Ny-Ålesund, Spitsbergen (78°N)

Denghui Ji, Mathias Palm, Christoph Ritter, Philipp Richter, Xiaoyu Sun, Matthias Buschmann, and Justus Notholt

Univ of Bremen

Arctic amplification, the phenomenon that the Arctic is warming faster than the global mean is still not fully understood. The Transregional Collaborative Research Centre TR 172 -- Arctic Amplification: Climate Relevant Atmospheric and Surface Processes (AC3) funded by the DFG contributes towards this research topic.
This excessive Arctic warming is both a consequence and a driver of rapid changes in the Arctic and in part created by aerosol feedbacks. Since different aerosol types have different climate effects, the observation of aerosols is urgently needed in the Arctic. Thus, for the purpose of measuring aerosols in the troposphere, a Fourier-Transform InfraRed spectrometer (FTS) for measuring down-welling emission measurements and a Raman-Lidar are operated at the AWIPEV research base in Ny-Ålesund, Spitsbergen (78°N).
The height of the aerosol layer, aerosol backscatter, extinction, depolarization, the lidar ratio and the color ratio are measured by the Raman-Lidar. Based on that information, a retrieval algorithm, LBLDIS, for aerosol types (dust, sea salt, black carbon and sulfate), optical thickness and effective radius is modified and used for analyzing the emission spectra measured by the FTS.
Combining the two observations, the aerosols can be observed more comprehensively. The most probable origin of the dominant aerosol types is explored by tracking the origin of air masses through back-trajectory calculations using the FLEXPART atmospheric transport model.