

QOS 2021

Quadrennial Ozone Symposium

October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting

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QOS 2021

October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting

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I. Welcome Message

Welcome to Seoul, Korea for the Quadrennial Ozone Symposium (QOS) 2021



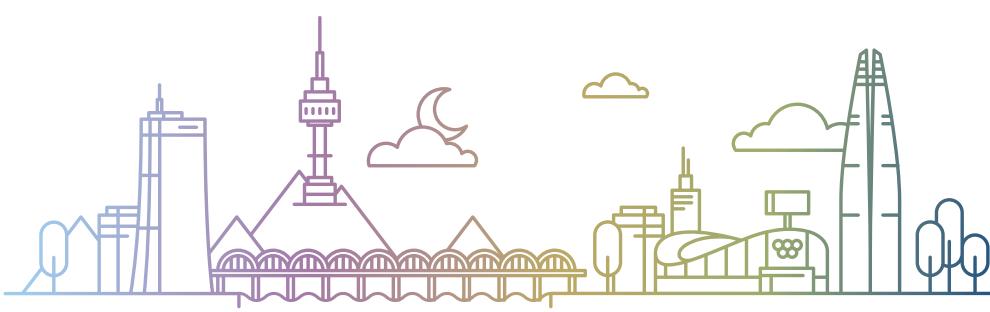
I am very pleased to invite you to attend the Quadrennial Ozone Symposium (QOS) in South Korea, on October 3 (Sunday) - 9 (Saturday), 2021. Despite its tiny fraction, ozone is a crucial gas in the Earth Atmosphere. The ozone layer in the stratosphere protects life on Earth by filtering out damaging ultraviolet radiation from the sun. In the troposphere, ozone is an important greenhouse gas and a strong pollutant at ground level. Since the last QOS that took place in Edinburgh in 2016, a variety of new developments have taken place on all facets of atmospheric ozone, including its observation and impact on human health and ecosystems. The Symposium's program addresses all these aspects. Through the foreseen keynote talks, presentations at the sessions and discussions at poster sessions and side events, QOS 2021 is of high interest for all scientists throughout the world interested in atmospheric ozone and more generally in the study of the Earth's atmosphere.

Sophie Godin-Beekmann
President of International Ozone Commission



Seoul is a mega-city with advanced modern technologies, and has a long history as the capital of Korea since 1394. The first ozone layer observation in Korea was done by Prof. Emeritus Hi-Ku Cho with the Dobson spectrophotometer in 1984 at the Department of Atmospheric Sciences, Yonsei University. Since then, ozone observation has been continued with the addition of Brewer Spectrophotometers, and Pandora instruments throughout the country. Surface ozone concentration has been also measured by the Ministry of Environment since 1989. These missions are to be followed by the launch of Geostationary Environment Monitoring Spectrometer (GEMS) in early 2021. We, LOC members would like to extend a warm and hearty welcome to you all. Hope you enjoy the symposium.

Local Organizing Committee



II. Program

UTC Time Zone	Oct 3 (Sun)	Oct 4 (Mon)	Oct 5 (Tue)	Oct 6 (Wed)	Oct 7 (Thu)	Oct 8 (Fri)	Oct 9 (Sat)
12:00-12:10	Opening & Award Ceremony	MON1 - Session A - Keynote: Ulrike Langematz (15 min) - Oral Presentation (5 min each)	TUE1 - Session A - Oral Presentation (5 min each) - Q&A (10 min)	WED1 - Session C - Keynote: Yuanhang Zhang (15 min) - Oral Presentation (5 min each) - Q&A (15 min)	THU1 - Session E - Keynote: Natalya Kramarova (15 min) - Oral Presentation (5 min each)	FRI1 - Session E - Oral Presentation (5 min each) - Q&A (15 min)	SAT1 Poster 6 - Session E - Poster Presentation (2 min per 1 poster)
12:10-12:20							
12:20-12:30							
12:30-12:40							
12:40-12:50							
12:50-13:00							
13:00-13:10		SUN1 Poster 1 - Session A - Poster Presentation (2 min per 1 poster)	MON2-Session A - Keynote: Neil Harris (15 min) - Oral Presentation (5 min each) - Q&A (20 min)	TUE2 - Session B - Keynote: Sunyoung Park (15 min) - Oral Presentation (5 min each) - Q&A (10 min)	THU2 - Session E - Oral Presentation (5 min each) - Q&A (20 min)	FRI2 - Session F - Keynote: Jason West (15 min) - Oral Presentation (5 min each) - Q&A (10 min)	SAT2 Poster 7 - Session E - Poster Presentation (2 min per 1 poster)
13:10-13:20							
13:20-13:30							
13:30-13:40							
13:40-13:50							
13:50-14:00							
14:00-14:10	Ice Breaker - An online meeting room for each session - Bring your own beverage to monitor - Video and chat available	Break (10 min)	TUE3 Poster 3 - Session A&B - Poster Presentation (2 min per 1 poster)	WED2 - Session D - Keynote: Amanda Maycock (15 min)	THU3 Poster 4 - Session D - Poster Presentation (2 min per 1 poster)	FRI3 Poster 5 - Session C - Poster Presentation (2 min per 1 poster)	SAT3 Poster 8 - Session F - Poster Presentation (2 min per 1 poster)
14:10-14:20							
14:20-14:30							
14:30-14:40							
14:40-14:50							
14:50-15:00							
15:00							Closing Remark

Session A Stratospheric ozone science

Session B Ozone-depleting substances, sources, sinks, and budgets

Session C Tropospheric ozone science

Session D Ozone, Climate, and Meteorology

Session E Ozone monitoring and measurement techniques

Session F Environmental and human health effects of atmospheric ozone and UV

II. Program

● Opening & Awards Ceremony

Date / Time: (Sun.) October 3, 2021 / 12:00 – 12:50 (UTC)

Time (UTC)	Program	Speakers
12:00-12:10	Welcome Remark	Seoung Hwan Suh (President, Yonsei University)
12:10-12:20	Opening Remark	Sophie Godin-Beekmann (President, IO3C)
12:20-12:35	Awards Ceremony Award (Dobson and Farman Award) - Dobson Award William Ball - Joseph C. Farman Award P.K. Bhartia Stacey Frith Natalyna Kramarova Gordon Labow Richard McPeters Richard Stolarski	Irina Petropavlovskikh (Secretary, IO3C)
12:35-12:50	Announcement from LOC	Ja-Ho Koo (Yonsei University)

III. Sponsors and Supporters

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International Association of
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Sciences



Stratosphere-troposphere
Processes And their Role in
Climate



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	Michel van Roozendaal	Belgium
	Mark Weber	Germany
	Xiangdong Zheng	China

IV. Committees

Local Organizing Committee

Chair Emeritus	Hi-Ku Cho	Yonsei University
Co-Chairs	Jae H. Kim	Pusan National University
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	Young-Jun Yoon	Korea Polar Research Institute
	Dong-Won Lee	National Institute of Environmental Research

Staff

Hana Lee, Dha Hyun Ahn, Songkang Kim

Keynote Speakers



Session A. Stratospheric ozone science

(Mon.) October 4, 2021 / 12:00-12:15 UTC

Polar Stratospheric Ozone: Recent Observations, Current Understanding, and Future Evolution

Ulrike Langematz

(Institute of Meteorology, Freie Universität Berlin, Germany)

Biography

Ulrike Langematz is a professor and the Director of the Atmospheric Dynamics Working Group at the Institute of Meteorology at Freie Universität Berlin. She received her Ph.D. degree (1991) in Natural Science at Freie Universität Berlin and had been Postdoctoral Fellow in the Stratospheric Research Group, Institut für Meteorologie, Freie Universität Berlin. She has been PI and member of several national and international research projects. She was a Chapter Lead Author on the 2010 and 2018 WMO/UNEP scientific assessments of ozone depletion. She was Vice-President of the IUGG-International Commission of the Atmosphere (ICMA), and a member of the SPARC-Working group on stratospheric temperature trends. Her research interests include dynamics, radiation and chemistry of the middle atmosphere, stratospheric ozone, stratosphere-troposphere coupling, past and future climate change, ozone, and solar impact on climate.

Abstract

Polar stratospheric ozone has been changing during the last decades as a function of the atmospheric concentrations of man-made ozone depleting substances (ODSs). The most impressive phenomenon of this ozone change is the dramatic decrease in total ozone column, occurring regularly over Antarctica in spring time since the mid-1980s, also known as the Antarctic ozone hole. The reasons for this seasonally limited ozone reduction are well understood: chemical ozone depletion by reactive halogens in specific meteorological conditions (i.e. persistent low temperatures within the Antarctic polar vortex) that allow heterogeneous chemical reactions on polar stratospheric clouds (PSCs). A chemical ozone depletion comparable to weak Antarctic ozone holes was also observed in individual Arctic spring seasons, as for example in March 2011. However, as the Arctic polar vortex is dynamically more active than its Antarctic counterpart, temperatures in the Arctic winter stratosphere are usually higher, leading to a weaker ozone depletion in Arctic spring.

Since the year 2000, a decline in ODSs is observed in the polar stratosphere as a result of the regulations by the Montreal Protocol and its Amendments and adjustments [1]. Chemistry-Climate Models (CCMs) project a recovery of polar stratospheric ozone from ODSs – given full compliance with the Montreal Protocol –, with return dates to 1980 baseline values before mid-century (~2030s) for the Arctic and after mid-century (~2060s) for Antarctica. [2]

While CCMs agree on the pathway of future polar ozone, open questions remain, as for example the future control of stratospheric ozone abundances by rising greenhouse gas (GHG) concentrations. Models project a ‘super-recovery’ of Arctic ozone by the end of the 21st century due to GHG induced changes in stratospheric temperature and dynamics, which will depend on the scenario of future GHG emissions.

This presentation will update our state of knowledge about stratospheric ozone in the polar regions, based on a) observations and measurement campaigns in the most recent Arctic and Antarctic winter/spring seasons, b) progress in the understanding of the chemical and dynamical processes influencing polar ozone depletion and c) a wide range of modeling results from the SPARC/IGAC Chemistry-Climate Model initiatives (CCMI).

References

- [1] WMO Scientific Assessment of Ozone Depletion: 2018, Global Ozone Research and Monitoring Project-Report No.58, 588 pp., (2018).
- [2] S. S. Dhomse et al., *Atmos. Chem. Phys.*, 18, 8409–8438 (2018).

V. Program Schedule



Session A. Stratospheric ozone science

(Mon.) October 4, 2021 / 13:00-13:15 UTC

Understanding Changes in Tropical and Mid-latitude Stratospheric Ozone

Neil Harris

(Centre for Environment and Agricultural Informatics, Cranfield University, United Kingdom)

Biography

Neil Harris is Professor of Atmospheric Informatics at Cranfield University. He obtained his B.S. degree in chemistry from Oxford University and Ph.D. degree (1989) in Chemistry at the University of California in Irvine. He joined the European Ozone Research Coordination Unit in Cambridge, where he was a NERC Advanced Research Fellow in the Dept of Chemistry until March 2016. He was awarded the NERC 50th anniversary International and the Overall Impact Awards for our role in successful development of the Montreal Protocol on Substances that Deplete the Ozone Layer. He was a Chapter Lead Author on the 1994 and 2014 WMO/UNEP ozone assessments and is a co-editor of Atmospheric Chemistry and Physics. He is co-chair of the Stratosphere-troposphere Processes and their Role in Climate of the World Climate Research Programme and has been involved in many international assessments of ozone depletion and climate change. His research interests include measurements of atmospheric halocarbons, the Tropical Tropopause Layer and emissions of trace gases as well as analyses of ozone trends.

Abstract

Advances in the understanding of trace gas chemistry and the importance of catalytic cycles has motivated scientific and societal interest in ozone depletion over the last 50 years. These built on early work using observations of ozone to understand the dynamical motions of the stratosphere on timescales from hours to years. The concerns about the human influence on stratospheric and on the UV-B penetrating through to the Earth's surface included exhaust emissions from supersonic aircraft, nitrous oxide from agriculture and other practices, atmospheric tests of nuclear bombs and the chlorine and bromine released from chlorofluorocarbons, Halons and the like. For the halogen compounds, the model calculations indicated changes in total column ozone of a few percent over a period of decades to centuries with the losses concentrated at particular altitudes. A critical question was whether they were being observed in the real world. Much of the early work was process-oriented and involved laboratory and field measurements and atmospheric modelling. Relatively little effort was put into analysing the available long-term measurements and, particularly, assessing their quality. With some notable exceptions, this work only really started in earnest after the discovery of the Ozone Hole in 1985.

This paper will summarise the development of our understanding of the tropical and mid-latitude stratospheric ozone and try to elucidate how the understanding changes relied jointly on the trends calculated from the observations, as well as on the chemical and dynamical processes. This work continues to the present day as we now try to understand the recovery of ozone as the concentrations of ozone-depleting substances decrease. It will end with a look to the future.

V. Program Schedule



Session B. Ozone-depleting substances, sources, sinks, and budgets

(Tue.) October 5, 2021 / 12:55-13:10 UTC

Long-term Observations of Ozone-Depleting Substances and Their Substitutes from a Regional Background Site in East Asia

Sunyoung Park

(Kyungpook National University, Republic of Korea)

Biography

Sunyoung Park is professor of department of oceanography at Kyungpook National University. She obtained B.S. degree (1995) and M.S. degree (1997) from Seoul National University and Ph.D. degree (2005) in University of California, Berkeley. Her research interests are the biogeochemical cycles of the major greenhouse gases (GHGs), focusing on sources, sinks, and source/sink distributions of these gases, and the chemistry related to their formation and destruction. Her recent research topics also emphasize man-made halogenated compounds (CFCs, HCFCs, HFCs, and PFCs) - stratospheric ozone-depleting substances and/or GHGs by suggesting a significant increase in the emissions of most halocarbons in East Asia.

Abstract

Stratospheric ozone depletion has been caused by an increased abundance of stratospheric chlorine and bromine, which are derived from anthropogenically produced, chlorine-containing, and bromine-containing compounds, called ozone-depleting substances (ODSs). To mitigate the damage caused by ODSs, the Montreal Protocol (MP) signed in 1987 and several subsequent adjustments and amendments have controlled the production and consumption of all of the primary long-lived ODSs – such as chlorofluorocarbons (CFCs), CCl₄, CH₃CCl₃, bromine-containing halons, and CH₃Br. The phase-out schedule for these first-generation ODSs was completed with their global ban in 2010. The MP further agreed to freeze production of hydrochlorofluorocarbons (HCFCs) – transitional substitutes of the first-generation ODSs, in developing countries by 2013 and to bring forward the final phase-out date of these chemicals to 2030. With increasing restrictions of the MP, industry began introducing the new class of HFCs (hydrofluorocarbons) in the 1990s. These third-generation replacements contain no chlorine anymore, thereby not contributing to the stratospheric ozone depletion. However, they are potent greenhouse gases with high global warming potentials[1]. The significant concern about the growing market demand for these HFCs and their large contribution to global radiative forcing led to the Kigali Amendment, where the phase-down schedule of the production and consumption of HFCs was added under the MP controls.

Therefore, anticipated recovery of the stratospheric ozone layer in about 2050-2060 and preservation of the climate benefits achieved by the MP with further global controls on HFCs rely on widespread compliance with the controls in the Protocol and thereby continued reductions in atmospheric concentrations of ODSs and their substitutes. However, recent observations showed increased emissions of CFC-11, believed to be the result of new illicit production in eastern China. In addition, ODSs emissions could persist due to the release and/or use of banks produced before the production phase-out, and inadvertent by-product formation and fugitive emissions associated with permitted production of controlled ODSs (when allowed only for non-dispersive uses like feedstocks).

To detect these unexpected emission increases and also verify expected emission trends, continuous observations of atmospheric ODSs and their substitutes are crucial. In particular, atmospheric monitoring at well-positioned regional sites is widely recognized for its importance to identification of unexpected changes in regional emissions and associated emission sources.

This study presents 13-year records of real-time high-frequency atmospheric concentrations of a comprehensive suite of ODSs and the substitutes (CFCs, CCl₄, CH₃Br, HCFCs, HFCs, PFCs plus selected very-short lived substances) obtained at a remote coastal station of Gosan (33°N, 126°E, 79 m asl) in Jeju island, Korea for 2008 – 2020. The Gosan station run as part of the global AGAGE network (Advanced Global Atmospheric Gases Experiment) serves as a regional background site of East Asia for monitoring long-range transport of polluted air masses from the surrounding region. Gosan observations are used to derive regional emission estimates of major ODSs and the substitutes and annual trends in their emission rates, locate emission sources, identify associated industrial processes, and quantify eastern Asia's contributions to the global emissions.

References

- [1] S. A. Montzka, G. J. M. Velders, World Meteorological Organization Global Ozone Research and Monitoring Project - Report No. 55, Scientific Assessment of Ozone Depletion, Chap.2 (2018).

V. Program Schedule



Session C. Tropospheric ozone science

(Wed.) October 6, 2021 / 12:00-12:15 UTC

Ozone Pollution and Research Program in China: An Overview

Yuanhang Zhang

(Peking University, China)

Biography

Yuanhang Zhang is professor of Peking University at China. He graduated from Peking University with B.S. degree (1982) and M.S. degree (1985) in Technical Physics. He received the Ph.D. degree (1990) from Center for Environmental Sciences, Peking University and had been Post Doctoral Fellow in Environmental Department, the Netherlands Energy Research Foundation for two years (1993-1995). He was Associate Professor, Director of the Division of Atmospheric Chemistry, Center for Environmental Sciences, Peking University (1995-1996) and Professor, Director (1996-2002). In addition, He was Committee member of Science and Technology, Ministry of Environment Protection, China, Vice-Chairman, Chinese Society of Environmental Sciences (2006) and Vice Chair, UNEP ABC-Asia Science Team (2009). His research interests include atmospheric chemistry, urban and regional air quality, air pollution and climate change.

Abstract

Air pollution problem in China has received great attention by social community and government for decades. Especially, stringent control strategies and national action plans were implemented during 2013-2020 to reduce emissions of major primary pollutants. As a consequence, significant air quality improvements were achieved in most of Chinese cities. National annual average concentrations decreased by 29% for PM2.5 and by 56% for SO₂ from 2015 to 2020. However, O₃ pollution was getting severe, with not only rising O₃ concentration levels, but also increasing numbers of pollution days and cities in general. Further the frequency of heavy episodes that last several days was increasing in a broad regional scale. Currently, air pollution complex in China is characterized as concurrence of high levels of PM2.5 and O₃, in which atmospheric oxidation capacity and O₃ pollution control will play central roles for continuous air quality improvement. China has a long history to study O₃ pollution and control strategy. The pioneer study could be traced to the Lanzhou Xigu photochemical smog project as early as 1974. In this study, a first version of research framework including field measurement, indoor and outdoor smog chamber, and numerical model was established to support decision making. Thereafter, intensive campaigns were set up in Beijing, Guangzhou, Shanghai cities and BTH, PRD and YRD regions in the last century. Starting from 2000s, regional air pollution was listed as a focal issue of national scientific and technical research program. Major projects were initial in 2006, then national programs were setup in 2011 and 2016 by Ministry of Science and technology (MOST), with focus on O₃ and PM2.5 formation mechanism, regional measurement network and supersite, emission inventory and ensemble air quality forecasting, etc.. In the coming five years, O₃ pollution will be paid much more attention than before in term of both pollution control and scientific research. This presentation will give an overview of O₃ pollution status and trend in China, scientific research framework and progress in recent years, and practices of control strategies in typical cities and regions, and will provide a brief outlook for future O₃ pollution control strategy integrating carbon reduction and clean air.

V. Program Schedule



Session D. Ozone, Climate, and Meteorology

(Wed.) October 6, 2021 / 13:40-13:55 UTC

The Impacts of Ozone on Climate Across Timescales

Amanda Maycock

(Institute for Atmospheric and Climate Science (ICAS), University of Leeds, United Kingdom)

Biography

Amanda Maycock is Associate Professor in Climate Dynamics of Institute for Atmospheric and Climate Science (ICAS), University of Leeds. She graduated from University of Manchester, with B.S. degree (2006). She received the M.S. degree (2008) and Ph.D. (2011) degree from Atmosphere, Oceans and Climate, University of Reading. She had been Post Doctoral Fellow in National Centre for Atmospheric Science, University of Cambridge. Her research interests include climate science, climate change, climate modelling, midlatitude dynamics, tropical widening, Stratosphere-troposphere interactions, and ozone layer.

Abstract

The talk will provide an overview of the myriad impacts of tropospheric and stratospheric ozone variability and trends on global and regional climates. I will discuss the latest science on ozone radiative forcing as synthesised in the Intergovernmental Panel on Climate Change Sixth Assessment Report, and the latest science on regional climate impacts of ozone that will inform the WMO/UNEP 2022 Scientific Assessment of Ozone Depletion. This includes the effect of ozone on climate variability and trends in the Northern and Southern hemispheres from seasonal to multi-decadal timescales. I will close with a forward look to the role of ozone trends for climate over the coming decades.

V. Program Schedule



Session E. Ozone monitoring and measurement techniques

(Thu.) October 7, 2021 / 12:00-12:15 UTC

Ozone Monitoring and Measurement Techniques

Natalya Kramarova

(NASA, Goddard Space Flight Center, Greenbelt, Maryland, USA)

Biography

Natalya Kramarova is a research scientist at the Atmospheric Chemistry and Dynamics Lab in NASA Goddard Space Flight Center (GSFC). She received her M.S. degree (2000) in physics and later a Ph.D. degree (2007) in Physics and Mathematics from Moscow State University, Russia. She worked on developing a radiative transfer algorithm and studying long-term ozone variability. In 2010-2017 Dr. Kramarova worked for Science Systems and Applications Inc. at NASA GSFC, characterizing ozone profile retrievals from NASA's UV sensors (SBUV, OMPS). In January 2018 she joined NASA GSFC. Dr. Kramarova is a member of the OMPS (Ozone Mapping and Profiler Suite) Science Team. She is working on improvements for the ozone profile retrieval algorithm and on characterization of the retrieval errors.

Abstract

In this keynote presentation I will talk about ozone measuring sensors and retrieval techniques with a focus on satellite observations. Monitoring of atmospheric ozone from space started in the 1970s, and by now we have a 50+ year long record that consists of observations acquired from multiple satellite sensors. The satellite measurements are extensively used to understand global patterns of ozone distribution and for monitoring changes of ozone levels. I will talk about approaches for instrument cross-calibrations that are critical for creating consistent climate quality records from multi-sensors observations.

There are several techniques of measuring ozone from space, and during the last two decades observations from various types of instruments (sometimes mounted on the same satellite platform) have been available. I will talk about lessons learned from comparisons and analysis of retrievals from multiple techniques and how we can use the synergy of limb and nadir sensors to improve calibrations, ozone retrievals and to produce new products, such as tropospheric ozone maps. There are numerous challenges in retrieving tropospheric ozone from space. Therefore, it is important to understand and properly attribute the sources of uncertainties in tropospheric ozone retrievals from space. Understanding the requirements for data as well as limitations of the measurements is a key to ensuring the optimal usage of space-borne tropospheric ozone data in various scientific applications.

V. Program Schedule



Session F. Environmental and human health effects of atmospheric ozone and UV

(Fri.) October 8, 2021 / 12:55-13:10 UTC

Mapping Global Ground-Level Ozone Concentrations for 1990 to 2017 to Support Health Impact Assessment

Jason West

(Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, North Carolina, USA)

Biography

Dr. J. Jason West conducts interdisciplinary research addressing air pollution and climate change by using models of atmospheric chemistry and transport and tools for quantitative policy analysis. His work aims to understand the relationships between air pollution and climate change and their relevance for science and policy on local through global scales. Using computer models, Dr. West is currently exploring the effects of changes in emissions on global air quality (ozone and particulate matter), the international transport of air pollutants, the health effects of air pollution, the effects of climate change on air quality and the radiative forcing of climate. Recently, Dr. West led the first study of the co-benefits of greenhouse gas (GHG) mitigation for air quality and human health to use global atmospheric models and future scenarios; results showed that the monetized co-benefits exceeded previous co-benefits estimates and exceeded the global costs of GHG mitigation through 2050.

EDUCATION

PhD, Civil and Environmental Engineering / Engineering and Public Policy, Carnegie Mellon University, 1998
MPhil, Environment and Development (Geography), University of Cambridge, 1995
MS, Civil and Environmental Engineering, Carnegie Mellon University, 1994
BSE (with honors), Civil and Environmental Engineering, Duke University, 1993

RESEARCH ACTIVITIES

Global climate change; air pollution; atmospheric modeling; ozone; fine particulate matter; human health impact assessment; risk assessment; quantitative policy analysis; radiative climate forcing; long-range air pollutant transport

Abstract

Exposure to ground-level ozone is detrimental to human health, and is associated with premature mortality. In the past, estimates of the global burden of ozone on health have been limited by a lack of understanding of ozone concentrations in many populated world regions that have few ozone monitors. Here we conduct a data fusion of ground observations and nine global chemistry-climate models to produce fine resolution global surface ozone estimates for each year 1990–2017. Ozone is estimated annually for the 6-month ozone season average of 8-hr. daily maximum values, to support health impact studies. We use ozone observations from the Tropospheric Ozone Assessment Report and the Chinese National Environmental Monitoring Center Network (8834 stations total), and global model simulation output conducted for the Chemistry-Climate Model Initiative and the Aerosols and Chemistry Model Intercomparison Project with specified meteorology. We first find the linear combination of nine global models that best reproduces observations in each world region and year to create a multi-model composite. We then use the Bayesian Maximum Entropy (BME) framework to integrate surface observations with the multi-model composite in both space and time. The BME estimate matches observations at each monitoring site, with the influence of an observation decreasing across space and time according to the covariance; far from observations, the output matches the multi-model composite. BME use of observations over time is seen in the years prior to the China data coming online starting in 2013. After estimating ozone globally at 0.5° resolution using BME, we add fine spatial detail based on a fine resolution global atmospheric model to 0.1°. Our final product improves substantially upon the simple multi-model mean ($R^2=0.81$ vs. 0.28) and multi-model composite. Our annual ozone estimates were used in the Global Burden of Disease 2019 study, which estimated roughly 365,000 premature deaths globally in 2019 from ambient ozone exposure, or 0.65% of all deaths globally. We further improve upon these estimates by using the Regionalized Air Quality Model Performance (RAMP) method to perform a regional and non-linear bias correction before BME data fusion, based on model performance with respect to the nearest observation stations. We demonstrate that including RAMP improves model performance, particularly far from observations, through a checkerboard cross-validation. Results suggest that global ozone exposure is increasing, driven by ozone increases in highly populated regions of Asia and Africa, and despite decreases in the United States and Russia. We hope that our global ozone maps will be used for a variety of applications including atmospheric science, epidemiology, and studies of crop and ecosystem impacts.

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Sun.) October 3

V. Program Schedule

● (Sun.) October 3

[POSTER 1]

Date / Time (Sun.) October 3, 2021 / 13:00-14:00 (UTC)

Session Code SUN1

Session Chair Wolfgang Steinbrecht, Ja-Ho Koo, Birgit Hassler

[SUN1_1] 13:00-13:02

Interannual Variability of Antarctic Ozone using Ozonesonde Measurements from 2015 to 2020

Hana Lee¹, Seong-Joong Kim², Taejin Choi², Jhoon Kim¹, and Ja-Ho Koo¹

¹Yonsei University, Republic of Korea, ²KOPRI, Republic of Korea

[SUN1_2] 13:02-13:04

Spatiotemporal Differences in Recovery of the Antarctic Ozone Hole using Satellite Observations

Dha Hyun Ahn¹, Seong-Joong Kim², Taejin Choi², Jhoon Kim¹, and Ja-Ho Koo¹

¹Yonsei University, Republic of Korea, ²KOPRI, Republic of Korea

[SUN1_4] 13:06-13:08

The Cause of the Spring Strengthening of the Antarctic Polar Vortex

Vladimir V. Zuev and Ekaterina Savelieva

IMCES SB RAS, Russia

[SUN1_5] 13:08-13:10

Relationships between Unusual Antarctic Ozone Hole in 2019 and Dynamical Fields

Guangyu Liu¹, Toshihiko Hirooka¹, Nawo Eguchi¹, and Krüger Kirstin²

¹Kyushu University, Japan, ²University of Oslo, Norway

[SUN1_6] 13:10-13:12

The Sudden Stratospheric Warming and Polar Processing of the Antarctic Winter 2019: Comparison with the Winters of 1988 and 2002

R. Roy^{1,2}, J. Kuttippurath¹, F. Lefèvre³, S. Raj¹, and P. Kumar¹

¹Indian Institute of Technology Kharagpur, India, ²Cochin University of Science and Technology, India,

³LATMOS/IPSL, Sorbonne Université, UVSQ, CNRS, France

[SUN1_7] 13:12-13:14

A CCM Forecast Experiments of the Ozone Reduction Event over the Southern Tip of South America in November 2009 using Ozone Assimilated Initial Data

Haruna Nakamura^{1,2}, Toshihiko Hoirooka¹, Hideharu Akiyoshi³, Takafumi Sugita³, and Akira Mizuno⁴

¹Kyushu University, Japan, ²Fujitsu Japan Corporation, Japan, ³National Institute for Environmental Studies, Japan, ⁴Nagoya University, Japan

V. Program Schedule

- [SUN1_8]** 13:14-13:16
Evaluation of Various Total Ozone Column Measurements at the King-Sejong and Jang Bogo station, Antarctica
Songkang Kim¹, Taejin Choi², Seong-Joong Kim², and Ja-Ho Koo¹
¹Yonsei University, Republic of Korea, ²KOPRI, Republic of Korea
- [SUN1_9]** 13:16-13:18
Study on Antarctic Ozone Hole Influence over the Southern Brazil, by Combining Ground-Based, Satellite Observations and Model Simulations
Lucas Vaz Peres¹, Damaris Kirsch Pinheiro², Hassan Bencherif³, Gabriela Dornelles Bittencourt², Thierry Portafaix³, Nelson Bègue³, José Valentin Bageston⁴, Vagner Anabor², and Maria Paulete Pereira Martins⁴
¹UFOPA, Brazil, ²UFSM, Brazil, ³LACy, France, ⁴INPE, Brazil
- [SUN1_10]** 13:18-13:20
Evolution of the Stratospheric Polar Vortex in the Southern and Northern Hemispheres over the 1979–2020 Period
Audrey Lecouffe, Sophie Godin-Beekmann, Andrea Pazmiño, and Alain Hauchecorne
Sorbonne University, France
- [SUN1_11]** 13:20-13:22
Polar Stratospheric Clouds Detection over Belgrano II Antarctic Station from Ground-Based Visible DOAS Measurements
Laura Gomez-Martin¹, Daniel Toledo¹, Cristina Prados-Roman¹, Jose Antonio Adame¹, H. Ochoa², and Margarita Yela¹
¹National Institute for Aerospace Technology, Spain, ²Argentinian Antarctic Institute, Argentina
- [SUN1_12]** 13:22-13:24
Investigation of Spring Breakup Dates and Polar Stratospheric Clouds Interannual Variability in Arctic stratosphere
P. Vargin¹, S. Kostrykin², E. Rakushina³, E. Volodin², and A. Pogoreltsev³
¹Central Aerological Observatory, Russia, ²INM RAS, Russia, ³Russian State Hydrometeorological University, Russia
- [SUN1_13]** 13:24-13:26
Mountain-Wave-Induced Polar Stratospheric Clouds and Their Representation in the Global Chemistry Model ICON-ART
Michael Weimer^{1,2}, Jennifer Buchmüller², Lars Hoffmann³, Ole Kirner², Beiping Luo⁴, Roland Ruhnke², Michael Steiner⁵, Ines Tritscher⁶, and Peter Braesicke²
¹MIT, USA, ²Karlsruhe Institute of Technology, Germany, ³Jülich Supercomputing Centre, Germany, ⁴ETH Zurich, Switzerland, ⁵EMPA, Switzerland, ⁶Institute of Energy and Climate Research: Stratosphere (IEK-7), Germany

V. Program Schedule

[SUN1_14] 13:26-13:28

Record Low Ozone Values Observed in the Arctic in Spring 2020

Ingo Wohltmann¹, Peter von der Gathen¹, Ralph Lehmann¹, Marion Maturilli¹, Holger Deckelmann¹, Gloria Manney^{2,3}, Jonathan Davies⁴, David Tarasick⁴, Nis Jepsen⁵, Rigel Kivi⁶, Norrie Lyall⁷, and Markus Rex¹

¹Alfred Wegener Institute for Polar and Marine Research, Germany, ²Northwest Research Associates, USA, ³New Mexico Tech, USA ⁴Environment and Climate Change Canada, Canada, ⁵Danish Meteorological Institute, Denmark, ⁶Finnish Meteorological Institute, Finland, ⁷Met Office, UK

[SUN1_15] 13:28-13:30

Simulation of Record Arctic Stratospheric Ozone Depletion in 2020

Jens-Uwe Grooß and Rolf Müller

Institute of Energy and Climate Research: Stratosphere (IEK-7), Germany

[SUN1_16] 13:30-13:32

Low Ozone VMR over the Northern Hemisphere in Winter 2019/20 - Effects of a Strong PSC Winter -

U. Raffalski¹, K. Blazaki², J. Gross³, R. E. Kajtar², and M. Milz²

¹Swedish Institute of Space Physics, Sweden, ²Luleå Technical University, Sweden, ³Karlsruhe Institute of Technology, Germany

[SUN1_17] 13:32-13:34

Observations of the 2020 Record-Breaking Ozone Holes and the Canadian Brewer and Pandora Programs

Xiaoyi Zhao¹, Vitali Fioletov¹, Michael Brohart¹, Volodya Savastiouk², Ihab Abboud¹, Akira Ogyu¹, Jonathan Davies¹, Reno Sit¹, Sum Chi Lee¹, Alexander Cede^{3,4}, Martin Tiefengraber^{4,5}, Moritz Müller^{4,5}, David Tarasick¹, Kristof Bognar⁶, Ramina Alwarda^{1,6,7}, Kimberly Strong⁶, Tim Holland⁷, Joseph Samaniego⁷, Marisa Gedney⁷, and Johan Booth⁷

¹Environment and Climate Change Canada, Canada, ²International Ozone Services Inc., Canada, ³NASA, USA, ⁴LuftBlick, Austria, ⁵University of Innsbruck, Austria, ⁶University of Toronto, Canada, ⁷NOAA, USA

[SUN1_18] 12:34-12:36

Evolution of Low Total Column Ozone Anomalies in Summer 2020 in the Northern Hemisphere Extratropics

Stacey M. Frith^{1,2}, Natalya Kramarova², Paul Newman², Eric Nash^{1,2}, Jerald Ziemke^{2,3}, and Susan E. Strahan^{2,4}

¹Science Systems and Applications, Inc., USA, ²NASA, USA, ³Morgan State University, USA, ⁴USRA, USA

[SUN1_19] 13:36-13:38

Simulation of a 2020 Arctic Ozone Hole in the World Avoided by the Montreal Protocol

Catherine Wilka¹, Susan Solomon², Doug Kinnison³, and David Tarasick⁴

¹Stanford University, USA, ²MIT, USA, ³NCAR, USA, ⁴Environment and Climate Change Canada, Canada

[SUN1_21] 13:40-13:42

Insights into the Linear Relationship between Extratropical Eddy Heat Flux and Polar Ozone Build-Up

Fumio Hasebe¹, Sayaka Kodera², and Hideharu Akiyoshi³

¹Hokkaido University, Japan, ²JMA, Japan, ³National Institute for Environmental Studies, Japan

V. Program Schedule

[SUN1_22] 13:42-13:44

Analysis of Arctic Spring Ozone Anomaly in the Phases of QBO and 11-Year Solar Cycle for 1979–2017

Yousuke Yamashita^{1,2}, Hideharu Akiyoshi¹, and Masaaki Takahashi¹

¹National Institute for Environmental Studies, Japan, ²JAMSTEC, Japan

[SUN1_23] 13:44-13:46

Dynamical Mechanism of QBO Modulation of Ozone Interannual Variability in the High-Latitude Upper Stratosphere in Boreal Spring

Jihoon Seo and Wookap Choi

Seoul National University, Republic of Korea

[SUN1_24] 13:46-13:48

High Vertical Resolution Modeling and its Impact on QBO Induced Changes in Ozone and Other Dynamically Important Trace Gases

Luke Oman¹, Olga Tweedy^{1,2}, and Susan Strahan²

¹NASA, USA, ²USRA, USA

[SUN1_25] 13:48-13:50

OMPS LP V2.0 Stratospheric Aerosol Extinction Profile Data Records

Ghassan Taha^{1,3}, Robert Loughman², and Tong Zhu⁴

¹USRA, USA, ²Hampton University, USA, ³NASA, USA, ⁴Science Systems and Applications Inc., USA

[SUN1_26] 13:50-13:52

O3as: An Ozone Trend Analysis Service within EOSC-Synergy

Tobias Kerzenmacher, Valentin Kozlov, Borja Esteban Sanchis, Ugur Cayoglu, Marcus Hardt, and Peter Braesicke

Karlsruhe Institute of Technology, Germany

[SUN1_27] 13:52-13:54

Stratospheric and Total Column Ozone from the Copernicus Atmosphere Monitoring Service (CAMS)

Reanalysis of Atmospheric Composition

Antje Inness¹, Simon ASB, Richard Engelen¹, Johannes Flemming¹, Vincent Huijnen³, Bavo Langenrock², Julien Nicolas¹, Vincent-Henri Peuch¹, Inna Polichtchouk¹, and Miha Razinger¹

¹ECMWF, UK, ²BIRA-IASB, Belgium, ³KNMI, The Netherlands

[SUN1_28] 13:54-13:56

AI for Fast Stratospheric Ozone Predictions

Helge Mohn¹, Daniel Kreyling¹, Ingo Wohltmann¹, Peter Maass², and Markus Rex¹

¹Alfred Wegener Institute Helmholtz-Center for Polar and Marine Research, Germany, ²University of Bremen, Germany

[SUN1_29] 13:56-13:58

Deep Learning Forecast of Stratospheric Ozone Advection

Luiz-Angelo Steffenel¹, Wagner Anabor², Damaris Kirsch-Pinheiro², and Hassan Bencherif³

¹University of Reims Champagne Ardenne, France, ²UFSM, Brazil, ³University of Reunion Island, France

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Mon.) October 4

V. Program Schedule

● (Mon.) October 4

[ORAL] Session A. Stratospheric Ozone Science

Date / Time (Mon.) October 4, 2021 / 12:00-12:50 (UTC)

Session Code MON1

Session Chair Wolfgang Steinbrecht, Ja-Ho Koo, Karin Kreher

[MON1_K] 12:00-12:15

Keynote Polar Stratospheric Ozone: Recent Observations, Current Understanding, and Future Evolution

Ulrike Langematz

Institute of Meteorology, Freie Universität Berlin, Germany

[MON1_1] 12:15-12:20

Polar Stratospheric Clouds: Satellite Observations, Processes, and Role in Ozone Depletion

Ines Tritscher¹, Michael C. Pitts², Lamont R. Poole³, Simon P. Alexander⁴, Francesco Cairo⁵, Martyn P. Chipperfield⁶, Jens-Uwe Groß¹, Michael Höpfner⁷, Alyn Lambert⁸, Beiping Luo⁹, Sergey Molleker¹⁰, Andrew Orr¹¹, Ross Salawitch¹², Marcel Snels⁵, Reinholt Spang¹, Wolfgang Woiwode⁷, and Thomas Peter⁹

¹Institute of Energy and Climate Research: Stratosphere (IEK-7), Germany, ²NASA, USA, ³Science Systems and Applications, Inc., USA, ⁴Australian Antarctic Division, Australia, ⁵Istituto di Scienze dell'Atmosfera e del Clima, Italy, ⁶University of Leeds, UK, ⁷Institute of Meteorology and Climate Research, Germany, ⁸CalTech, USA, ⁹ETH Zurich, Switzerland, ¹⁰Max Planck Institute for Chemistry, Germany, ¹¹British Antarctic Survey, UK, ¹²University of Maryland, USA

[MON1_2] 12:20-12:25

Variability and Trends in the Antarctic Ozone Hole: MLS Observations and Model Comparisons

Michael J. Schwartz¹, Lucien Froidevaux¹, Douglas E. Kinnison², Charles G. Bardeen², Nathaniel J. Livesey¹, Michelle L. Santee¹, Gloria L. Manney^{3,4}, Alyn Lambert¹, and Ryan A. Fuller¹

¹CalTech, USA, ²NCAR, USA, ³NorthWest Research Associates, USA, ⁴New Mexico Tech, USA

[MON1_3] 12:25-12:30

Evaluation of Interannual Variability of Arctic and Antarctic Ozone Loss Since 1989

Andrea Pazmiño¹, Florence Goutail¹, Jean-Pierre Pommereau¹, Franck Lefèvre¹, Sophie Godin-Beekmann¹, Alain Hauchecorne¹, Audrey Lecouffe¹, Martyn Chipperfield², Wuhu Feng², Michel Van Roozendael³, Nis Jepsen⁴, Georg Hansen⁵, Rigel Kivi⁶, Kristof Bognar⁷, Kimberly Strong⁷, Kaley Walker⁷, and Steve Colwell⁸

¹LATMOS/IPSL, UVSQ, Université Paris-Saclay, Sorbonne Université, CNRS, France, ²University of Leeds, UK,

³BIRA-IASB, Belgium, ⁴Danish Meteorological Institute, Denmark, ⁵NILU, Norway, ⁶Finnish Meteorological Institute, Finland, ⁷University of Toronto, Canada, ⁸British Antarctic Survey, UK

V. Program Schedule

[MON1_4] 12:30-12:35

Arctic Ozone Depletion in 2019/20: Roles of Chemistry, Dynamics and the Montreal Protocol

Wuhu Feng^{1,2}, Sandip S. Dhomse^{1,3}, Carlo Arosio⁴, Mark Weber⁴, John P. Burrows⁴, Michelle L. Santee⁵, and Martyn P. Chipperfield^{1,3}

¹University of Leeds, UK, ²NCAS, UK, ³NCEO, UK, ⁴University of Bremen, Germany, ⁵CalTech, USA

[MON1_5] 12:35-12:40

Recovery of Polar Stratospheric Ozone: Updated Metrics from Chemistry-Climate Simulations

Martyn Chipperfeld¹, Sandip S. Dhomse¹, and Doug Kinnison²

¹University of Leeds, UK, ²NCAR, USA

[MON1_6] 12:40-12:45

The Conundrum of the Recent Variations in Lower Stratospheric Ozone: An Update

Andreas Chrysanthou¹, Sandip S. Dhomse¹, Wuhu Feng¹, Yajuan Li², Ryan Hossaini³, William T. Ball⁴, and Martyn Chipperfield¹

¹University of Leeds, UK, ²Nanjing Xiaozhuang University, China, ³University of Lancaster, UK, ⁴TU Delft, The Netherlands

[MON1_7] 12:45-12:50

Evidence that Tropical Total Column Ozone no Longer Represents Stratospheric Changes

William T. Ball^{1,2}, Gabriel Chioldo³, Justin Alsing⁴, Thomas Peter³, Jerald Ziemke^{5,6}, Sean Davis⁷, Mohamadou Diallo⁸, Lucien Froidevaux⁹, Birgit Hassler¹⁰, Till Hoffmann¹¹, Daan Hubert¹², and James Keeble^{13,14}

¹TU Delft, The Netherlands, ²De Bilt, The Netherlands, ³ETH Zurich, Switzerland, ⁴Stockholm University, Sweden, ⁵NASA, USA, ⁶Morgan State University, USA, ⁷NOAA, USA, ⁸Forschungszentrum Jülich, Germany, ⁹CalTech, USA, ¹⁰DLR, Germany, ¹¹Imperial College London, UK, ¹²BIRA-IASB, Belgium, ¹³University of Cambridge, UK, ¹⁴NCAS, University of Cambridge, UK

V. Program Schedule

[ORAL] Session A. Stratospheric Ozone Science

Date / Time (Mon.) October 4, 2021 / 13:00-14:00 (UTC)

Session Code MON2

Session Chair Mark Weber, Ja-Ho Koo

[MON2_K] 13:00-13:15

Keynote

Understanding Changes in Tropical and Mid-latitude Stratospheric Ozone

Neil Harris

Centre for Environment and Agricultural Informatics, Cranfield University, United Kingdom

[MON2_1] 13:15-13:20

Regional and Seasonal Trends in tropical Ozone from SHADOZ Profiles: Reference for Models and Satellite Products

Anne M. Thompson¹, Ryan M. Stauffer¹, Krzysztof Wargan^{1,2}, Jacquelyn C. Witte³, Debra E. Kollonige^{1,2}, and Jerald R. Ziemke^{1,4}

¹NASA, USA, ²Science Systems and Applications, Inc., USA, ³NCAR, USA, ⁴Morgan State University, USA

[MON2_2] 13:20-13:25

Atmospheric Impacts of Short-Lived Chlorinated Species over the Recent Past: a Chemistry-Climate Perspective

Ewa Bednarz⁶, Ryan Hossaini¹, Luke Abraham^{2,3}, Peter Braesicke⁴, and Martyn Chipperfield⁵

¹Lancaster University, UK, ²University of Cambridge, UK, ³NCAS, UK, ⁴Karlsruhe Institute of Technology, Germany, ⁵University of Leeds, UK, ⁶Cornell University, USA

[MON2_3] 13:25-13:30

The Importance of Very Short Lived Halogens for the Recovery of Stratospheric Ozone

Laura A. McBride¹, Walter R. Tribett¹, Brian F. Bennett¹, Timothy P. Carty¹, Greta Eastham², Stacey Frith³, and Ross J. Salawitch^{1,4}

¹University of Maryland, USA, ²NC State University, USA, ³NASA, USA, ⁴Earth System Science Interdisciplinary Center, USA

[MON2_4] 13:30-13:35

Quantification of Very Short Lived Halogens Reaching the Stratosphere

Ross J. Salawitch^{1,2}, Laura A. McBride¹, Walter R. Tribett¹, Timothy P. Carty¹, Brian F. Bennett¹, Pamela A. Wales^{3,4}, James W. Hannigan⁵, Emmanuel Mahieu⁶, Maxime Prignon⁶, John Daniel⁷, Bradley Hall⁷, Stephen A. Montzka⁷, Elena Spinei⁸, George H. Mount⁹, Kelly Chance¹⁰, Raid M. Suleiman¹⁰, Sungyeon Choi^{3,11}, Deanna Donohoue¹², Thomas P. Kurosu³, and William R. Simpson³

¹University of Maryland-College Park, USA, ²ESSIC, USA, ³NASA, USA, ⁴USRA, USA, ⁵UCAR, USA, ⁶University of Liège, Belgium, ⁷NOAA, USA, ⁸Virginia Tech, USA, ⁹Washington State University, USA, ¹⁰Harvard-Smithsonian Center for Astrophysics, USA, ¹¹Science Systems and Applications, Inc., USA, ¹²Lawrence University, USA, ¹³CalTech, USA



V. Program Schedule

[MON2_5] 13:35-13:40

An Overview of the Asian Summer Monsoon Chemical and Climate Impact Project (ACCLIP)

Laura Pan¹, Paul Newman², Elliot Atlas³, Troy Thornberry⁴, Brian Toon⁵, Bill Randel¹, Doug Kinnison¹, Qing Liang², and Ken Jucks²

¹NCAR, USA, ²NASA, USA, ³University of Miami, USA, ⁴NOAA, USA, ⁵University of Colorado, USA

Q&A 13:40-14:00

V. Program Schedule

[POSTER 2]

Date / Time **(Mon.) October 4, 2021 / 14:10-15:00 (UTC)**

Session Code **MON3**

Session Chair **Mark Weber, Alexander Gruzdev**

[MON3_1] 14:10-14:12

Prognostic Ozone for ICON: Enabling UV Forecasts(POF)

Simon Weber¹, Roland Ruhnke¹, Christian Scharun¹, Axel Seifert², and Peter Braesicke¹

¹Karlsruhe Institute of Technology, Germany, ²German Weather Service, Germany

[MON3_2] 14:12-14:14

The Long-Term Historical Ozone Changes Detected in SOCOLv4 Simulations and Observations

Arseniy Karagodin^{1,2}, Eugene Rozanov^{1,2,3}, Timofei Sukhodolov^{1,2,3}, Tatiana Egorova¹, William Ball⁴, and Thomas Peter²

¹PMOD/WRC, Switzerland, ²ETH Zurich, Switzerland, ³St. Petersburg State University, Russia, ⁴TU Delft, The Netherlands

[MON3_3] 14:14-14:16

Comparison of Stratospheric Ozone Trends from Satellite Data and Model Simulations

Kristof Bognar¹, Doug Degenstein¹, Susann Tegtmeier¹, Adam Bourassa¹, David Plummer², Chris Roth¹, and Daniel Zawada¹

¹University of Saskatchewan, Canada, ²Environment and Climate Change Canada, Canada

[MON3_4] 14:16-14:18

Recent Lower-Stratospheric Ozone Trends in Chemistry Climate Models

Simone Dietmüller¹, Hella Garny^{1,2}, Roland Eichinger^{1,3}, and William Ball⁴

¹DLR, Germany, ²Ludwig Maximilian University of Munich, Germany, ³Charles University, Czech Republic,

⁴TU Delft, The Netherlands

[MON3_5] 14:18-14:20

The Influence of Gravity Waves on Stratospheric Ozone at Low and Middle Latitudes in Summer

Shujie Chang, Yongchi Li, Peng Chen, and Yanzhu Zheng

Guangdong Ocean University, China

[MON3_6] 14:20-14:22

Seasonal and Regional Stratospheric Ozone Trends Evaluated using Merged Satellite Datasets

Viktoria F. Sofieva¹, Monika Szelag¹, Johanna Tamminen¹, Erkki Kyrölä¹, Doug Degenstein², Chris Roth², Daniel Zawada², Alexei Rozanov³, Carlo Arosio³, John P. Burrows³, Mark Weber³, Alexandra Laeng⁴, Gabriele P. Stiller⁴, Thomas von Clarmann⁴, Lucien Froidevaux⁵, Nathaniel Livesey⁵, Sean Davis⁶, Michel van Roozendael⁷, and Christian Retscher⁸

¹Finnish Meteorological Institute, Finland, ²University of Saskatchewan, Canada, ³University of Bremen, Germany, ⁴Institute of Meteorology and Climate Research, Germany, ⁵CalTech, USA, ⁶NOAA, USA, ⁷BIRA-IASB, Belgium, ⁸ESA/ESRIN, Italy

V. Program Schedule

[MON3_7] 14:22-14:24

Long-Term Variability (1980-2020) of Total Column Ozone in Northern Hemisphere from the Reanalyses (MSR2, MERRA2, and ERA5), and a Comparison with the Dobson Data Taken at Belsk (51.84N, 20.79E), Poland

Janusz Krzyścin and Bonawentura Rajewska-Więch

Polish Academy of Sciences, Poland

[MON3_8] 14:24-14:26

Effects of ECMWF Reanalysis (ERA-Interim and ERA5) Forcing Fields on Stratospheric Ozone in the TOMCAT/SLIMCAT Chemical Transport Model

Yajuan Li¹, Sandip Dhomse^{2,3}, Martyn Chipperfield^{2,3}, Wuhu Feng^{2,4}, Andreas Chrysanthou², and Dong Guo⁵

¹Nanjing Xiaozhuang University, China, ²University of Leeds, UK, ³NCEO, UK, ⁴NCAS, UK, ⁵NUIST, China

[MON3_9] 14:26-14:28

Recent Lower Stratospheric Ozone Trends in Satellite Data and Specified Dynamics Model Simulations

Sean M. Davis¹, Nicholas Davis², Karen Rosenlof¹, Pengfei Yu³, and Robert Portmann¹

¹NOAA, USA, ²NCAR, USA, ³Jinan University, China

[MON3_10] 14:28-14:30

Influence of Natural Variability and Stratospheric Circulation Changes on Ozone Variability and Trends

Mohamadou MDiallo¹, Felix Ploeger^{1,2}, William T. Ball³, Michaela I. Hegglin⁴, Gabriel Chiodo⁵, and Martin Riese¹

¹Institute of Energy and Climate Research: Stratosphere (IEK-7), Germany, ²University of Wuppertal, Germany, ³TU Delft, The Netherlands, ⁴University of Reading, UK, ⁵ETH Zurich, Switzerland

[MON3_11] 14:30-14:32

Trends and Variability of Ozone Total, Stratospheric, and Tropospheric Columns from Long-Term FTIR Measurements of the NDACC Network

Vigouroux, C.¹, Blumenstock, T.², De Mazière, M.¹, Errera, Q.¹, García, O. E.³, Grutter, M.⁴, Hannigan, J.⁵, Hase, F.², Jones, N.⁶, Mahieu, E.⁷, Ortega, I.⁵, Palm, M.⁸, Röhling, A.², Smale, D.⁹, Stremme, W.⁴, Strong, K.¹⁰, Thölix, L.¹¹, Virolainen, Y.¹², and Wizenberg, T.⁹

¹BIRA-IASB, Belgium, ²Institute for Meteorology and Climate Research, Germany, ³Izaña Atmospheric Research Centre, Spain, ⁴UNAM, México, ⁵NCAR, USA, ⁶University of Wollongong, Australia, ⁷University of Liège, Belgium, ⁸University of Bremen, Germany, ⁹NIWA, New Zealand, ¹⁰University of Toronto, Canada, ¹¹Finnish Meteorological Institute, Finland, ¹²Saint Petersburg State University, Russia

[MON3_12] 14:32-14:34

DLM Estimation of Long-Term Ozone Trends from Dobson and Brewer Umkehr Profiles

Eliane Maillard Barras¹, Alexander Haefele¹, Achille Jouberton², René Stübi¹, Irina Petropavlovskikh³, Koji Miyagawa⁴, and Martin Stanek⁵

¹MeteoSwiss, Switzerland, ²Swiss Federal Institute for Forest, Snow and Landscape Research, Switzerland,

³CIRES, USA, ⁴NOAA, USA, ⁵Czech Hydrometeorological Institute, Czech Republic

V. Program Schedule

[MON3_13] 14:34-14:36

Ozone Trend Analysis from 22-Years of Observations in Natal (5.83°S, 35.20°W), by the Use of Multi-Linear and Empirical Decomposition Methods

Hassan Bencherif¹, Lucas Vaz Peres², Olivier Delage¹, Nelson Bègue¹, Gabriela Dornelles Bittencourt^{1,4}, Maria Paulete Pereira Martins³, Francisco Raimundo da Silva³, Thierry Portafaix¹, and Damaris Kirsch Pinheiro⁴

¹LACy, France, ²UFOPA, Brazil, ³INPE, Brazil, ⁴UFSM, Brazil

[MON3_14] 14:36-14:38

Three-Decade Measurements of Vertical Distribution and Column Content of NO₂ at Zvenigorod, Russia: Long-Term Trends and Interannual Variations

Aleksandr N. Gruzdev and Aleksandr S. Elokhov

A. M. Obukhov Institute of Atmospheric Physics, Russia

[MON3_15] 14:38-14:40

Total Ozone Trends in East Asia Using Long-Term Satellite and Ground Observations

Daegeun Shin¹, Yong-suk Oh¹, Wonick Seo¹, Chu-Yong Chung¹, and Hi Ku Cho²

¹National Institute of Meteorological Sciences, Republic of Korea, ²Yonsei University, Republic of Korea

[MON3_16] 14:40-14:42

Trends and Variations in the Total Ozone Content over the Northern Caucasus

Vladimir V. Savinykh, Nikolai F. Elansky, and Aleksandr N. Gruzdev

Russian Academy of Sciences, Russia

[MON3_17] 14:42-14:44

Total Ozone Trends at Northern High Latitudes from Ground-Based Measurements

Leonie Bernet¹, Arne Dahlback², Florence Goutail³, Georg Hansen¹, Yvan Orsolini^{1,4}, Andrea Pazmiño³, and Tove Svendby¹

¹NILU, Norway, ²University of Oslo, Norway, ³LATMOS/IPSL/UVSQ-CNRS, France, ⁴NTNU, Norway

[MON3_18] 14:44-14:46

Overview of the Stratospheric O₃ Measurements from IASI (2008-2020): Validation, Variability, Events, Evolution, Recovery and Radiative Effect

Catherine Wespes¹, Daniel Hurtmans¹, Anne Boynard^{2,4}, Sarah Safieddine², Marie Bouillon², Simon Chabrillat³, Stamatia Doniki¹, Cathy Clerbaux^{2,1}, and Pierre-François Coheur¹

¹Université libre de Bruxelles, Belgium, ²Sorbonne Université, France, ³BIRA-IASB, Belgium, ⁴SPASCIA, France

[MON3_19] 14:46-14:48

Pattern Analysis of Seven Total Ozone Column Measuring Stations in the Center, Southern of South America and Antarctica

Gerardo Carbajal Benítez¹, Héctor Estevéz², Eduardo Luccini³, Facundo Orte⁵, Héctor Ochoa⁴, Elian Wolfram^{1,5}, María Elea Barlasina¹, Lino Condori¹, and Fernando Nollas¹

¹Servicio Meteorológico Nacional, Argentina, ²UNAM, México, ³CEPROCOR-CONICET, Argentina, ⁴Argentine Antarctic Institute, Argentina, ⁵CEILAP UNIDEF (CITEDEF-CONICET), Argentina

V. Program Schedule

[MON3_20] 14:48-14:50

The Contribution of the Czech Republic to the Detection of the State of the Earth's Ozone Layer and Solar UV-radiation in Antarctica – the Contribution of the Czech Republic to the Vienna Convention and the Montreal Protocol in 2010-2020

Michal Janouch¹, Ladislav Sieger², and Hector Ochoa³

¹Czech Geographical Society, Czech Republic, ²Czech Technical University in Prague, Czech Republic,

³Instituto Antártico Argentino, Argentina

[MON3_21] 14:50-14:52

Analysis of the Ozone Transport and Seasonal Variability in the Tropical Tropopause Layer using Reanalysis Data

Hosun Ryu and Joowan Kim

Kongju National University, Republic of Korea

[MON3_22] 14:52-14:54

Multi-Level Stratospheric Ozone Variability from SHADOZ Network Data

Marinete da Silva Ferreira¹, David Mendes¹, Lucas Vaz Peres², Ana Caroline Rodrigues Castro², Damaris Kirsch Pinheiro³, Gabriela Dornelles Bittencourt³, Nelson Bègue⁴, Hassan Bencherif⁴, Maria Paulete Pereira Martins⁵, Francisco Raimundo da Silva⁵, Ryan Stauffer⁶, and Anne M. Thompson⁶

¹Federal University of Rio Grande do Norte, Brazil, ²UFOPA, Brazil, ³UFSM, Brazil, ⁴LACy, France, ⁵INPE, Brazil,

⁶NASA, USA

[MON3_23] 14:54-14:56

Characteristics of Ozone Profile Distribution over Korean Peninsula during the Asian Summer Monsoon using Multiple Satellite Measurements and Reanalysis Data

Song Eun-Ji¹, Bak Juseon¹, Hyo-Jung Lee¹, Cheol-Hee Kim¹, and Ja-Ho Koo²

¹Pusan National University, Republic of Korea, ²Yonsei University, Republic of Korea

[MON3_24] 14:56-14:58

Using Aura Microwave Limb Sounder Measurements to Place Recent Asian Summer Monsoon Seasons into Climatological Context

Michelle L. Santee¹, Gloria L. Manney^{2,3}, Nathaniel J. Livesey¹, Jessica L. Neu¹, Michael J. Schwartz¹, and Luis F. Millán¹

¹CalTech, USA, ²NorthWest Research Associates, USA, ³New Mexico Tech, USA

[MON3_25] 14:58-15:00

Lauder BrO Timeseries (1995-2021)

Richard Querel¹, Paul Johnston¹, Martyn Chipperfield², and Francois Hendrick³

¹NIWA, New Zealand, ²University of Leeds, UK, ³BIRA-IASB, Belgium

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Tue.) October 5

V. Program Schedule

● (Tue.) October 5

[ORAL] Session A. Stratospheric Ozone Science

Date / Time (Tue.) October 5, 2021 / 12:00-12:45 (UTC)

Session Code TUE1

Session Chair Birgit Hassler, Matt Tully

[TUE1_1] 12:00-12:05

Evaluating Stratospheric Ozone Changes in CMIP6 Models from 1850 to 2100

James Keeble^{1,2}, Birgit Hassler³, Antara Banerjee^{4,5}, Ramiro Checa-Garcia⁶, Gabriel Chiodo^{7,8}, Sean Davis⁴, Veronika Eyring^{3,9}, Paul T. Griffiths^{1,2}, Olaf Morgenstern¹⁰, Peer Nowack^{11,12}, Guang Zeng¹⁰, Jiankai Zhang¹³, Greg Bodeker^{14,15}, Susannah Burrows¹⁶, Philip Cameron-Smith¹⁷, David Cugnet¹⁸, Christopher Danek¹⁹, Makoto Deushi²⁰, Larry W. Horowitz²¹, Anne Kubin²², Lijuan Li²³, Gerrit Lohmann¹⁹, Martine Michou²⁴, Michael J. Mills²⁵, Pierre Nabat²⁴, Dirk Olivié²⁶, Sungsu Park²⁷, Øyvind Seland²⁶, Jens Stoll²², Karl-Hermann Wieners²⁸, and Tongwen Wu²⁹

¹University of Cambridge, UK, ²NCAS, University of Cambridge, UK, ³DLR, Germany, ⁴NOAA, USA, ⁵University of Colorado Boulder, USA, ⁶LSCE, France, ⁷ETH Zurich, Switzerland, ⁸Columbia University, USA, ⁹University of Bremen, Germany, ¹⁰NIWA, New Zealand, ¹¹Imperial College London, UK, ¹²University of East Anglia, UK, ¹³Lanzhou University, China, ¹⁴Bodeker Scientific, New Zealand, ¹⁵Victoria University of Wellington, New Zealand, ¹⁶PNNL, USA, ¹⁷Lawrence Livermore National Laboratory, USA, ¹⁸IP Paris, France, ¹⁹Alfred Wegener Institute, Germany, ²⁰Meteorological Research Institute, Japan, ²¹GFDL/NOAA, USA, ²²Leibniz Institute for Tropospheric Research, Germany, ²³Chinese Academy of Sciences, China, ²⁴CNRM, Université de Toulouse, Météo-France, CNRS, France, ²⁵NCAR, USA, ²⁶Norwegian Meteorological Institute, Norway, ²⁷Seoul National University, South Korea, ²⁸MPI-M, Germany, ²⁹China Meteorological Administration, China

[TUE1_2] 12:05-12:10

Ozone Trends on Dynamical Coordinate Systems

L. Millán¹, G. Manney^{2,3}, M. Santee¹, and N. Livesey¹

¹CalTech, USA, ²NWRA, USA, ³New Mexico Tech, USA

[TUE1_3] 12:10-12:15

New Perspective on Regional Total Ozone Trends 1995-2020 Derived from the GOME-Type Total Ozone Essential Climate Variable (GTO-ECV) Data Record

Melanie Coldewey-Egbers¹, Diego Loyola¹, Klaus-Peter Heue¹, Christophe Lerot², and Michel van Roozendael²

¹DLR, Germany, ²BIRA-IASB, Belgium

V. Program Schedule

[TUE1_4] 12:15-12:20

Global Recovery Trends Derived from Five Merged Total Ozone Datasets

Mark Weber¹, Carlo Arosio¹, Melanie Coldewey-Egbers², Vitali E. Fioletov³, Stacey M. Frith⁴, Jeannette D. Wild^{5,6}, Klaereti Tourpali⁷, John P. Burrows¹, and Diego Loyola²

¹University of Bremen, Germany, ²DLR, Germany, ³Environment and Climate Change Canada, Canada,

⁴Science Systems and Applications, Inc., USA, ⁵NOAA/NCEP Climate Prediction Center, USA, ⁶University of Maryland, USA, ⁷Aristotle University of Thessaloniki, Greece

[TUE1_5] 12:20-12:25

Updated Trends of the Stratospheric Ozone Vertical Distribution in the 60°S-60°N Latitude Range based on the LOTUS Regression Model

N. Azouz¹, S. Godin-Beekmann¹, I. Petropavlovskikh², G. Ancellet¹, D. A. Degenstein³, D. Zawada³, V. Sofieva⁴, L. Froidevaux⁵, S. Frith⁶, J. Wild⁷, S. Davis², W. Steinbrecht⁸, T. Leblanc⁵, R. Querel⁹, D. Hubert¹⁰, K. Tourpali¹¹, and R. Damadeo⁶

¹LATMOS Sorbonne Université UVSQ CNRS, France, ²NOAA, USA, ³University of Saskatchewan, Canada,

⁴Finish Meteorological Institute, Finland, ⁵CalTech, USA, ⁶NASA, USA, ⁷ESSIC/UMD&NOAA/NCEP/Climate Prediction Center, USA, ⁸Deutsche Wetterdienst, Germany, ⁹NIWA, New Zealand, ¹⁰BIRA-IASB, Belgium,

¹¹Aristotle University of Thessaloniki, Greece

[TUE1_6] 12:25-12:30

Impact of Small-scale Gravity Waves on Stratospheric Ozone

Michael Weimer¹, Catherine Wilka¹, Douglas Kinnison², Rolando Garcia², Julio Bacmeister³, and Susan Solomon¹

¹MIT, USA, ²NCAR, USA

[TUE1_7] 12:30-12:35

Repartitioning of Extratropical Stratospheric Chlorine Reservoirs by the 2020 Australian Wildfires

Susan Strahan^{1,2}, Dan Smale³, Ghassan Taha^{1,2}, Megan Damon^{1,4}, Stephen Steenrod^{1,2}, Nicholas Jones⁵, Ben Liley³, John Robinson³, and Richard Querel³

¹NASA, USA, ²USRA, USA, ³NIWA, New Zealand, ⁴Science Systems and Applications, Inc., USA, ⁵Wollongong University, Australia

Q&A 12:35-12:45

V. Program Schedule

[ORAL] Session B. Ozone-Depleting Substances, Sources, Sinks, and Budgets

Date / Time (Tue.) October 5, 2021 / 12:55-13:50 (UTC)

Session Code TUE2

Session Chair Kenneth Jucks

[TUE2_K] 12:55-13:10

Keynote Long-term Observations of Ozone-Depleting Substances and Their Substitutes from a Regional Background Site in East Asia

Sunyoung Park

Kyungpook National University, Republic of Korea

[TUE2_1] 13:10-13:15

Joint Inference of CFC Lifetimes and Banks Suggests Previously Unidentified Emissions

Megan Lickley¹, Sarah Fletcher², Matt Rigby³, and Susan Solomon¹

¹MIT, USA, ²Stanford University, USA, ³University of Bristol, UK

[TUE2_2] 13:15-13:20

Global Emissions of CFC-11 Dropped Substantially in 2019--Are They Now No Longer Elevated Above Expectations?

Stephen A. Montzka¹, Geoff S. Dutton¹, Lei Hu¹, Robert W. Portmann¹, Martyn P. Chipperfield², Sean Davis¹, Wuhu Feng², Alistair Manning³, Eric Ray¹, Bradley D. Hall¹, Helen Walter Terrinoni⁴, Christina Theodoridi⁵, and Isaac Vimont¹

¹NOAA, USA, ²University of Leeds, UK, ³Met Office, UK, ⁴AHRI, USA, ⁵NRDC, USA

[TUE2_3] 13:20-13:25

Investigating Regional CFC-11 Emissions and Their Changes using Results from HIPPO, ATom, and NOAA Long-Term Atmospheric Sampling

Lei Hu^{1,2}, Stephen Montzka², Fred Moore^{1,2}, Eric Hintsa^{1,2}, Carolina Siso^{1,2}, Geoff Dutton^{1,2}, Kirk Thoning², Robert Portmann², Kathryn McKain^{1,2}, Colm Sweeney², David Nance^{1,2}, Isaac Vimont^{1,2}, Arlyn Andrews², Phil DeCola³, Brad Hall², James Elkins¹, and Steven Wofsy⁴

¹CIRES, USA, ²NOAA, USA, ³University of Maryland, USA, ⁴Harvard University, USA

[TUE2_4] 13:25-13:30

Observation-Based Emissions of Anthropogenic CH₃Br from Eastern China and Discrepancies between Top-down and Bottom-up Estimates

Haklim Choi¹, Mi-Kyung Park¹, Paul J. Fraser², Hyeri Park¹, Sohyeon Geum¹, Jens Mühle³, Jooil Kim³, Peter K. Salameh³, Christina M. Harth³, Bronwyn L. Dunse², Paul B. Krummel², Nada Derek², Ian Porter⁴, Ray F. Weiss³, and Sunyoung Park¹

¹Kyungpook National University, Republic of Korea, ²CSIRO, Australia, ³UCSD, USA, ⁴La Trobe University, Australia

V. Program Schedule

[TUE2_5] 13:30-13:35

Comparison of Recent Observed Trends in Hydrofluorocarbons and Inferred Emissions with Projections

Guus J.M. Velders^{1,2}, John S. Daniel³, Stephen A. Montzka³, Isaac Vimont³, and Matthew Rigby⁴

¹RIVM, The Netherlands, ²Utrecht University, The Netherlands, ³NOAA, USA, ⁴University of Bristol, UK

[TUE2_6] 13:35-13:40

Integrated Ozone Depletion: A New Metric for Ozone Recovery

John Pyle^{1,2}, James Keeble^{1,2}, Luke Abraham^{1,2}, Martyn Chipperfield^{3,4}, and Paul Griffiths^{1,2}

¹University of Cambridge, UK, ²NCAS, UK, ³University of Leeds, UK, ⁴National Centre for Earth Observation, UK

Q&A 13:40-13:50

V. Program Schedule

[POSTER 3]

Date / Time **(Tue.) October 5, 2021 / 14:00-15:00 (UTC)**

Session Code **TUE3**

Session Chair **Matt Tully, Karin Kreher, Steve Montzka**

[TUE3_1] 14:00-14:02

The MIPAS Climatology of Bromine Nitrate (BrONO_2) in Comparison to Atmospheric Modelling

Michael Höpfner, Oliver Kirner, Gerald Wetzel, Björn-Martin Sinnhuber, Florian Haenel, Johannes Orphal, Roland Ruhnke, Gabriele Stiller, and Thomas von Clarmann
Karlsruhe Institute of Technology, Germany

[TUE3_2] 14:02-14:04

Multiyear Study of OCIO in the Austral Low Stratosphere as Observed from the Belgrano (78° S) and Marambio (64° S) NDACC Sites

Cristina Prados-Roman¹, Gaia Pinardi², José Antonio Adame¹, Olga Puentedura¹, Mónica Navarro Comas¹, Laura Gómez-Martín¹, Héctor Ochoa³, Michel Van Roozendael², and Margarita Yela¹

¹National Institute for Aerospace Technology, Spain, ²BIRA-IASB, Belgium, ³Argentinian Antarctic Institute, Argentina

[TUE3_3] 14:04-14:06

The Chemical Impact of Extreme Solar Events in the Middle Atmosphere

Thomas Reddmann¹, Monali Borthakur¹, Miriam Sinnhuber¹, Ilya Usoskin², and Jan-Maik Wissing³

¹Karlsruhe Institute of Technology, Germany, ²University of Oulu, Finland, ³University of Rostock, Germany

[TUE3_4] 14:06-14:08

Exploring Short-Term Variations in Mesospheric Ozone due to Large-Scale Solar Flares using a Ground-Based Millimeter-Wave Radiometer at Rikubetsu, Japan and Aura/MLS Ozone Measurements

Tomoo Nagahama, Akira Mizuno, Taku Nakajima, and Tianliang Yang
Nagoya University, Japan

[TUE3_5] 14:08-14:10

Revising 11-Year Solar Cycle Signal in the Stratospheric Ozone using MLS and SORCE Satellite Measurements

Sandip Dhomse¹, Martyn Chipperfield¹, Wuhu Feng¹, and Ryan Hossaini²

¹University of Leeds, UK, ²University of Lancaster, UK

[TUE3_6] 14:10-14:12

Investigating the Ozone-Climate Feedback of Geomagnetic Forcing using ICON-ART-LINOZ

Maryam Ramezani Ziarani, Thomas Reddmann, Katerina Kusakova, and Miriam Sinnhuber
Karlsruhe Institute of Technology, Germany

V. Program Schedule

- [TUE3_7]** 14:12-14:14
The Stability and Homogeneity of Long-Term Satellite and Ground-Based Stratospheric Ozone Profile Data Records
Daan Hubert¹, Tijl Verhoelst¹, Arno Keppens¹, Steven Compernolle¹, Carlo Arosio², Viktoria Sofieva³, and Jean-Christopher Lambert¹
¹BIRA-IASB, Belgium, ²University of Bremen, Germany, ³Finnish Meteorological Institute, Finland
- [TUE3_8]** 14:14-14:16
Analysis of Vertical Ozone Profiles by the SABER Satellite and SHADOZ: Comparison of the Last 17 Years between Subtropical and Tropical Latitudes
Gabriela Dornelles Bittencourt^{1,2}, Damaris Kirsch Pinheiro¹, Hassan Bencherif², Nelson Bègue², Lucas Vaz Peres³, Francisco Raimundo da Silva⁴, and Maria Paulete Pereira Martins⁴
¹UFSM, Brazil, ²LACy, France, ³UFOPA, Brazil, ⁴INPE, Brazil
- [TUE3_9]** 14:16-14:18
Characterization of Total Ozone Column of Two Measuring Stations in the North, and South Hemisphere of America
Gerardo Carabajal Benítez¹ and Héctor R. Estévez Pérez²
¹National Meteorological Service, Argentina, ²UNAM, Mexico
- [TUE3_10]** 14:18-14:20
Stratospheric Aerosol and Gas Experiment III on the International Space Station (SAGE III/ISS): Validation of Ozone using In-situ Measurements
S. Kizer^{1,2}, M. Roell², D. Flittner², R. Damadeo², C. Roller^{1,2}, D. Hurst^{3,4}, E. Hall^{3,4}, A. Jordan^{3,4}, P. Cullis^{3,4}, B. Johnson⁴, and R. Quere¹
¹Science Systems and Applications, Inc., USA, ²NASA, USA, ³CIRES, USA, ⁴NOAA, USA, ⁵NIWA, New Zealand
- [TUE3_11]** 14:20-14:22
The Impact of Continuing CFC-11 Emissions on the Stratosphere
Eric L. Fleming^{1,2}, Qing Liang¹, Luke D. Oman¹, Paul A. Newman¹, Feng Li^{1,3}, and Margaret M. Hurwitz⁴
¹NASA, USA, ²Science Systems and Applications, Inc., USA, ³USRA, USA, ⁴NOAA, USA
- [TUE3_12]** 14:22-14:24
Technical, Economic, and Policy Impacts to CFC-11 Emissions during the Product Lifecycle in Comparison to Derived Emissions
Helen Walter-Terrinoni¹, Nick Harbeck¹, Stephen A. Montzka², Jose' Pons³, Christina Theodoridi⁴, and Helen Tope⁵
¹AHRI, USA, ²NOAA, USA, ³Sicamu, Inc., USA, ⁴NRDC, USA, ⁵Energy International Australia, Australia
- [TUE3_13]** 14:24-14:26
Impacts of Space Industry Emissions on Stratospheric Ozone
Christopher Maloney^{1,3}, Martin Ross², Robert Portmann¹, and Karen Rosenlof¹
¹NOAA, USA, ²The Aerospace Corporation, USA, ³University of Colorado, USA

V. Program Schedule

[TUE3_14] 14:26-14:28

Potential Impacts of Supersonic Aircraft Emissions on Ozone and Resulting Forcing on Climate

Jun Zhang¹, Donald J. Wuebbles¹, Douglas E. Kinnison², and Steven L Baughcum³

¹University of Illinois at Urbana-Champaign, USA, ²NCAR, USA, ³Boeing Company, USA

[TUE3_15] 14:28-14:30

Impact of Unmitigated HFC Emissions on Stratospheric Ozone at the End of the 21st century as Simulated by Chemistry-Climate Models

Eric Dupuy¹, Hideharu Akiyoshi¹, and Yousuke Yamashita^{1,2}

¹National Institute for Environmental Studies, Japan, ²JAMSTEC, Japan

[TUE3_16] 14:30-14:32

The Response of Stratospheric Ozone and Dynamics to Changes in Atmospheric Oxygen

Iga Józefiak¹, Timofei Sukhodolov^{2,3,4}, Tatiana Egorova^{2,3}, Eugene Rozanov^{2,3,4}, Gabriel Chiodo^{3,5}, Andrea Stenke³, and Thomas Peter³

¹University of Geneva, Switzerland, ²PMOD/WRC, Switzerland, ³ETH Zurich, Switzerland, ⁴Saint Petersburg State University, Russia, ⁵Columbia University, USA

[TUE3_17] 14:32-14:34

Annual Kigali Index (AKI): A Novel Measurement-Based Policy Tool for Checking the Compliance of the Initiated HFC Phase-Down

Stefan Reimann¹, Martin K. Vollmer¹, Stephan Henne¹, Lukas Emmenegger¹, Matt Rigby²

¹EMPA, Switzerland, ²University of Bristol, UK

[TUE3_18] 14:34-14:36

Measurements of HFC-23 and HCFC-22 from Ground-based FTIR Spectrometers at Rikubetsu (44°N), Japan and Syowa Station (69°S), Antarctica

Hideaki Nakajima^{1,2}, Masanori Takeda², Isao Murata², Tomoo Nagahama³, Isamu Morino¹, and Geoffrey C. Toon⁴

¹National Institute for Environmental Studies, Japan, ²Tohoku University, Japan, ³CalTech, USA, ⁴(Now) NARO, Japan

[TUE3_19] 14:36-14:38

Rising Global Emissions of HCFC-141b Inferred from Atmospheric Measurements

Luke M. Western¹, Sunyoung Park², Alistair J. Manning³, Alison L Redington³, Stephan Henne⁴, Xuekun Fang⁵, Lei Hu^{6,7}, Stephen A. Montzka⁶, Paul J. Fraser⁸, Christina M. Harth¹⁰, Ove Hermansen⁹, Jooil Kim¹⁰, Paul B. Krummel⁸, Lambert Kuijpers¹¹, Chris Lund⁹, Jens Mühle¹⁰, Simon O'Doherty¹, Stefan Reimann⁴, Peter K. Salameh¹⁰, Daniel Say¹, Christina Theodoridi¹², Martin K. Vollmer⁴, Helen Walter-Terrinoni¹³, Dickon Young¹, Ray F. Weiss¹⁰, Ronald G. Prinn¹⁴, and Matthew Rigby¹

¹University of Bristol, UK, ²Kyungpook National University, Republic of Korea, ³Met Office, UK, ⁴EMPA, Switzerland, ⁵Zhejiang University, China, ⁶NOAA, USA, ⁷CIRES, USA, ⁸CSIRO, Australia, ⁹Norwegian Institute for Air Research, Norway, ¹⁰UCSD, USA, ¹¹A/gent Consultancy B.V., The Netherlands, ¹²NRDC, USA, ¹³AHRI, USA, ¹⁴MIT, USA

V. Program Schedule

[TUE3_20] 14:38-14:40

On the Effects of the Ocean on Atmospheric CFCs and HFCs lifetimes and Emissions

Peidong Wang¹, Jeffery R. Scott¹, Susan Solomon¹, John Marshall¹, Andrew R. Babbin¹, Megan Lickley¹, David W. J. Thompson², Timothy DeVries³, Qing Liang⁴, and Ronald G. Prinn¹

¹MIT, USA, ²Colorado State University, USA, ³UCSB, USA, ⁴NASA, USA

[TUE3_21] 14:40-14:42

Comparison of Inorganic Chlorine in the Southern Hemispheric Lower Stratosphere During Late Winter 2019

Markus Jesswein¹, Heiko Bozem², Hans-Christoph Lachnitt², Peter Hoor², Thomas Wagenhäuser¹, Timo Keber¹, Tanja Schuck¹, and Andreas Engel¹

¹University of Frankfurt, Germany, ²Johannes Gutenberg University of Mainz, Germany

[TUE3_22] 14:42-14:44

Organic, Inorganic and Total Bromine in the Extratropical Tropopause and Lowermost Stratosphere in Fall 2017: Origins, Transport Pathways and Consequences for Ozone

Meike K. Rotermund¹, Vera Bense², Martyn P. Chipperfield³, Andreas Engel⁴, Jens-Uwe Groß⁵, Peter Hoor², Tilman Hüneke^{1,7}, Timo Keber⁴, Flora Kluge¹, Ben Schreiner¹, Tanja Schuck⁴, Bärbel Vogel⁵, Andreas Zahn⁶, and Klaus Pfeilsticker¹

¹University of Heidelberg, Germany, ²Johannes Gutenberg University Mainz, Germany, ³University of Leeds, UK, ⁴Goethe University Frankfurt, Germany, ⁵Institute of Energy and Climate Research: Stratosphere (IEK-7), Germany, ⁶Karlsruhe Institute of Technology, ⁷(Now) Encavis AG, Germany

[TUE3_23] 14:44-14:46

ENSO-Driven Wildfires Cause Large Variability in the Naturally Emitted, Ozone Depleting Trace Gas Methyl Bromide

Melinda R. Nicewonger¹, Eric S. Saltzman², and Stephen A. Montzka¹

¹NOAA, USA, ²UC Irvine, USA

[TUE3_24] 14:46-14:48

Pollution Trace Gases C₂H₆, C₂H₂, HCOOH, and PAN in the UTLS: Observations and Simulations

Gerald Wetzel¹, Felix Friedl-Vallon¹, Norbert Glatthor¹, Jens-Uwe Groß², Thomas Gulde¹, Michael Höpfner¹, Sören Johansson¹, Farahnaz Khosrawi¹, Oliver Kirner¹, Anne Kleinert¹, Erik Kretschmer¹, Guido Maucher¹, Hans Nordmeyer¹, Hermann Oelhaf¹, Johannes Orphal¹, Christof Piesch¹, Björn-Martin Sinnhuber¹, Jörn Ungermann², and Bärbel Vogel²

¹Karlsruhe Institute of Technology, Germany, ²Institute of Energy and Climate Research: Stratosphere (IEK-7), Germany

[TUE3_25] 14:48-14:50

Short-Term Variations of HCl and HF Trends Observed with FTIR at Tsukuba and Rikubetsu, Japan

Isao Murata¹, Yoshihiro Tomikawa^{2,3}, Isamu Morino⁴, Hideaki Nakajima⁴, Hideharu Akiyoshi⁴, and Tomoo Nagahama⁵

¹Tohoku University, Japan, ²National Institute of Polar Research, Japan, ³SOKENDAI, Japan, ⁴National Institute for Environmental Studies, Japan, ⁵Nagoya University, Japan

V. Program Schedule

[TUE3_26] 14:50-14:52

A Method for Calculating Offsets to Ozone Depletion and Climate Impacts of Unexpected Production of Ozone-Depleting Substances

Gabrielle Dreyfus¹, Stephen A. Montzka², Stephen O. Andersen¹, and Richard ("Tad") Ferris¹

¹IGSD, USA, ²NOAA, USA

[TUE3_27] 14:52-14:54

Revising the Ozone Depletion Potentials Metric for Short-Lived Chemicals

Donald J. Wuebbles¹, Jun Zhang¹, Douglas E. Kinnison², and Alfonso Saiz-Lopez³

¹UIUC, USA, ²NCAR, USA, ³Institute of Physical Chemistry Rocasolano, Spain

[TUE3_28] 14:54-14:56

Arctic Ozone Depletion Induced by Solar Proton Events – A Statistic Study based on Satellite Observation and WACCM-D Model

Jia Jia¹, Kenneth Nilsen¹, Niilo Kalakoski², Antti Kero¹, Pekka T. Verronen^{1,2}, and Monika E. Szelag²

¹University of Oulu, Finland, ²Finnish Meteorological Institute, Finland

[TUE3_29] 14:56-14:58

Quantifying Present and Near-Future Rocket Launch Impacts on the Stratosphere

Tyler Brown, Michele T. Bannister, and Laura E. Revell

University of Canterbury, New Zealand

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Wed.) October 6

V. Program Schedule

● (Wed.) October 6

[ORAL] Session C. Tropospheric Ozone Science

Date / Time (Wed.) October 6, 2021 / 12:00-13:20 (UTC)

Session Code WED1

Session Chair Gangwoong Lee, Lin Zhang

[WED1_K] 12:00-12:15

Keynote **Ozone Pollution and Research Program in China: An Overview**

Yuanhang Zhang
Peking University, China

[WED1_1] 12:15-12:20

Change in Tropospheric Ozone in the Recent Decades and Its Contribution to Global Total Ozone

Junhua Liu^{1,2}, Sarah A. Strode^{1,2}, Qing Liang², Luke D. Oman², Peter R. Colarco², Eric L. Fleming^{3,2}, Michael E. Manyin^{3,2}, Jerald R. Ziemke^{4,2}, and Lok N. Lamsal^{1,2}

¹USRA, USA, ²NASA, USA, ³Science Systems and Applications, Inc., USA, ⁴Morgan State University, USA

[WED1_2] 12:20-12:25

Free Tropospheric Ozone Reductions due to Reduced Emissions in the COVID-19 Pandemic

W. Steinbrecht¹, D. Kubistin¹, C. Plass-Dülmer¹, J. Davies², D.W. Tarasick², P. v. d. Gathen³, H. Deckelmann³, N. Jepsen⁴, R. Kivi⁵, N. Lyall⁶, M. Palm⁷, J. Notholt⁷, B. Kois⁸, P. Oelsner¹, M. Allaart⁹, A. Piters⁹, M. Gill¹⁰, and R. Van Malderen¹², A.W. Delcloo¹¹, R. Sussmann¹², E. Mahieu¹³, C. Servais¹³, G. Romanens¹⁴, R. Stübi¹⁴, G. Ancellet¹⁵, S. Godin-Beekmann¹⁵, S. Yamanouchi¹⁶, K. Strong¹⁶, B. Johnson¹⁷, P. Cullis^{17,18}, I. Petropavlovskikh^{17,18}, J.W. Hannigan¹⁹, J.-L. Hernandez²¹, A. Diaz²⁰, T. Nakano²¹, F. Chouza²², T. Leblanc²², C. Torres²⁰, O. Garcia²⁰, A.N. Röhling²³, M. Schneider²³, T. Blumenstock²³, M. Tully²⁴, C. Paton-Walsh²⁵, N. Jones²⁶, R. Querel²⁶, S. Strahan^{22,27}, R.M. Stauffer²², A.M. Thompson²², A. Inness²⁸, R. Engelen²⁸, K.-L. Chang^{17,18}, O.R. Cooper^{17,18}, G.P. Brasseur^{19,29}, I. Bouarar²⁹, and B. Gaubert¹⁹

¹Deutscher Wetterdienst, Germany, ²Environment and Climate Change Canada, Canada, ³Alfred Wegener Institute, Germany, ⁴Danish Meteorological Institute, Copenhagen, ⁵Finnish Meteorological Institute, Sodankylä, ⁶British Meteorological Service, Scotland, ⁷University of Bremen, Germany, ⁸Institute of Meteorology and Water Management, Poland, ⁹Royal Netherlands Meteorological Institute, The Netherlands, ¹⁰Met Éireann Forecast, Ireland, ¹¹Royal Meteorological Institute of Belgium, Belgium, ¹²Karlsruhe Institute of Technology, Germany, ¹³University of Liège, Belgium, ¹⁴MeteoSwiss, Switzerland, ¹⁵LATMOS, France, ¹⁶University of Toronto, Canada, ¹⁷NOAA, USA, ¹⁸CIRES, USA, ¹⁹NCAR, USA, ²⁰AEMET, Spain, ²¹Meteorological Research Institute, Japan, ²²NASA, USA, ²³Karlsruhe Institute of Technology, Germany, ²⁴Bureau of Meteorology, Australia, ²⁵University of Wollongong, Australia, ²⁶NIWA, New Zealand, ²⁷USRA, USA, ²⁸ECMWF, UK, ²⁹MPI-M, Germany

V. Program Schedule

[WED1_3] 12:25-12:30

Tropospheric Ozone Hourly and Daily Maps Measured from EPIC, OMPS, OMI, and MLS Satellite Instruments: Data Validation, Global Long-Term Trends and NH Ozone Loss in 2020

Jerry R. Ziemke, Natalya A. Kramarova, Liang-Kang Huang, David P. Haffner, Krzysztof Wargan, Gordon J. Labow, Stacey. M. Frith, Pawan K. Bhartia, Jay R. Herman, and Richard D. McPeters
NASA, USA

[WED1_4] 12:30-12:35

Geophysical Signatures in the Sentinel-5p TROPOMI Tropospheric Ozone Data Record and Comparison to Ozonesonde, OMI and GOME-2B

Daan Hubert¹, Klaus-Peter Heue^{2,3}, Jean-Christopher Lambert¹, Tijl Verhoelst¹, Arno Keppens¹, Steven Compernolle¹, Angelika Dehn⁴, Debra E. Kollonige^{5,6}, Christophe Lerot¹, Diego Loyola², Fabian Romahn², Anne M. Thompson⁶, Pepijn Veefkind⁷, Claus Zehner⁴, and the SHADOZ ozonesonde station PIs and staff

¹BIRA-IASB, Belgium, ²DLR, Germany, ³Technische Universität München, Germany, ⁴ESA/ESRIN, Italy,

⁵Science Systems and Applications, Inc., USA, ⁶NASA, USA, ⁷KNMI, The Netherlands

[WED1_5] 12:35-12:40

Evaluation of Simulated O₃ Production Efficiency During the KORUS-AQ Campaign

Yujin J. Oak¹, Rokjin J. Park¹, Jason R. Schroeder^{2,3}, James H. Crawford², Donald R. Blake⁴, Andrew J. Weinheimer⁵, Jung-Hun Woo⁶, Sang-Woo Kim¹, Huidong Yeo¹, Alan Fried⁷, Armin Wisthaler^{8,9}, and William H. Brune¹⁰

¹Seoul National University, Republic of Korea, ²NASA, USA, ³(Now) CARB, USA, ⁴UC Irvine, USA, ⁵NCAR, USA,

⁶Konkuk University, Republic of Korea, ⁷University of Colorado, USA, ⁸University of Oslo, Norway, ⁹University of Innsbruck, Austria, ¹⁰Penn. State University, USA

[WED1_6] 12:40-12:45

The Impact of Los Angeles Basin Pollution and Stratospheric Intrusions on the Surrounding San Gabriel Mountains as Seen by Surface Measurements, Lidar, and Numerical Models

Fernando Chouza¹, Thierry Leblanc¹, Mark Brewer¹, Patrick Wang¹, Sabino Piazzolla¹, Gabriele Pfister², Rajesh Kumar², Carl Drews², Simone Tilmes², Louisa Emmons², and Matthew Johnson³

¹CalTech, USA, ²NCAR, USA, ³NASA, USA

[WED1_7] 12:45-12:50

Contribution of Stratospheric Ozone Intrusion to the Interannual Variation of Tropospheric Ozone in East Asian Monsoon Region

Xiaodan Ma¹, Tianliang Zhao¹, and Jianping Huang²

¹NUIST, China, ²NOAA, USA

[WED1_8] 12:50-12:55

Surface Ozone Concentrations in Austria from 1990 – 2019: Evolution and Lessons for the Future

Monika Mayer, Stefan Schreier, Christoph Staehle, Christian Schmidt, and Harald E. Rieder

University of Natural Resources and Life Sciences (BOKU), Austria

V. Program Schedule

[WED1_9] 12:55-13:00

Global and Regional Anthropogenic and Natural Emissions for the Modeling of Ozone and Other Tropospheric Compounds

Antonin Soulie¹, C. Granier^{1,2}, H. Denier van der Gon³, J. Kuenen³, S. Arellano⁴, S. Darras⁵, J. Doubalova⁶, B. Galle⁴, M. Gauss⁷, M. Guevara⁸, J.P. Jalkanen⁹, C. Lioussse¹, D. Simpson⁷, and K. Sindelarova⁶

¹CNRS, France, ²CIRES, USA, ³TNO, The Netherlands, ⁴Chalmers University, Sweden, ⁵CNRS, France,

⁶Charles University, Czech Republic, ⁷Norwegian Meteorological Institute, Norway, ⁸Barcelona Supercomputing Center, Spain, ⁹Finnish Meteorological Institute, Finland

[WED1_10] 13:00-13:05

A Modeling Study on the Roles of Cloud Distribution in Global Ozone Chemistry

Kengo Sudo^{1,2} and Ryoki Matsuda¹

¹Nagoya University, Japan, ²JAMSTEC, Japan

Q&A 13:05-13:20

V. Program Schedule

[ORAL] Session D. Ozone, Climate, and Meteorology

Date / Time (Wed.) October 6, 2021 / 13:40-15:00 (UTC)

Session Code WED2

Session Chair Masatomo Fujiwara, Andrew Klekociuk

[WED2_K] 13:40-13:55

Keynote The Impacts of Ozone on Climate Across Timescales

Amanda Maycock

Institute for Atmospheric and Climate Science (ICAS), University of Leeds, United Kingdom

[WED2_1] 13:55-14:00

Prescribing Stratospheric Ozone Aggravates Southern Hemisphere Climate Change during Austral Spring in Response to Quadrupled CO₂

Feng Li^{1,2} and Paul Newman²

¹USRA, USA, ²NASA, USA

[WED2_2] 14:00-14:05

Robust Effects of Ozone Feedbacks on Surface Climate Following Spring Arctic Ozone Depletion

Marina Friedel¹, Gabriel Chiodo^{1,2}, Andrea Stenke¹, Daniela I.V. Domeisen¹, Stephan Fueglistaler³, Julien Anet⁴, and Thomas Peter¹

¹ETH Zürich, Switzerland, ²Columbia University, USA, ³Princeton University, USA, ⁴ZHAW School of Engineering, Switzerland

[WED2_3] 14:05-14:10

Enhanced Climate Response to Ozone Depletion from Ozone-Circulation Coupling

Pu Lin^{1,2} and Yi Ming²

¹Princeton University, USA, ²NOAA, USA

[WED2_4] 14:10-14:15

The Southern Annular Mode in CMIP6 Model Simulations

Olaf Morgenstern

NIWA, New Zealand

[WED2_6] 14:20-14:25

Climate Change Favours Large Seasonal Loss of Arctic Ozone

Peter von der Gathen¹, Rigel Kivi², Ingo Wohltmann¹, Ross J. Salawitch³, and Markus Rex^{1,4}

¹Alfred Wegener Institute, Germany, ²Finnish Meteorological Institute, Finland, ³University of Maryland, USA,

⁴Universität Potsdam, Germany

[WED2_7] 14:25-14:30

Shedding New Light on the Radiative Impacts of Ozone-Depleting Substances

Gabriel Chiodo^{1,2} and Lorenzo M. Polvani^{2,3}

¹ETH Zurich, Switzerland, ²Columbia University, USA, ³Lamont-Doherty Observatory, USA

V. Program Schedule

[WED2_8] 14:30-14:35

Persistent Perturbations in the Composition of the Southern Hemisphere Stratosphere from the Australian New Year's Fires as Observed by the Aura Microwave Limb Sounder

Michelle L. Santee¹, Alyn Lambert¹, Lucien Froidevaux¹, Gloria L. Manney^{2,3}, Nathaniel J. Livesey¹, Frank Werner¹, Luis F. Millán¹, William G. Read¹, Jessica L. Neu¹, and Michael J. Schwartz¹

¹NASA, USA, ²NorthWest Research Associates, USA, ³New Mexico Tech, USA

[WED2_9] 14:35-14:40

Stratospheric Ozone Depletion by the Australian Black Summer Wildfires from Satellite and Ground-Based Observations

Sergey Khaykin¹, Sophie Godin-Beekmann¹, Andrea Pazmiño¹, A. Bazureau¹, F. Goutail¹, A. Hauchecorne¹, and R. Quere²

¹LATMOS, France, ²NIWA, New Zealand

[WED2_10] 14:40-14:45

Stratospheric Temperature and Ozone Anomalies Associated with the 2020 Australian Bushfires

L. A. Rieger¹, W. J. Randel², A. E. Bourassa¹, and S. Solomon³

¹University of Saskatchewan, Canada, ²NCAR, USA, ³MIT, USA

Q&A 14:45-15:00

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Thu.) October 7

V. Program Schedule

● (Thu.) October 7

[ORAL] Session E. Ozone Monitoring and Measurement Techniques

Date / Time (Thu.) October 7, 2021 / 12:00-12:45 (UTC)

Session Code THU1

Session Chair Andrea Pazmiño

[THU1_K] 12:00-12:15

Keynote Ozone Monitoring and Measurement Techniques

Natalya Kramarova

NASA, Goddard Space Flight Center, Greenbelt, Maryland, USA

[THU1_1] 12:15-12:20

Version 8 Ozone Profile and Version 8 Total Column Ozone Records from the Ozone Mapping and Profiler Suites

Lawrence E. Flynn¹, Zhihua Zhang², Eric Beach², Chunhui Pan³, Irina Petropavlovskikh¹, C. Trevor Beck¹, and Ding Liang⁴

¹NOAA, USA, ²IM Systems Group, Inc., USA, ³University of Maryland, USA, ⁴Government Systems Technologies Inc., USA

[THU1_2] 12:20-12:25

Gaps and Advances in the Validation of Satellite EO Data and their Uncertainties: Case Studies on Atmospheric Ozone Data Sets

Tijl Verhoelst¹, Daan Hubert¹, Arno Keppens¹, Steven Compernolle¹, Jean-Christopher Lambert¹, Alberto Redondas², and Alexander Cede^{3,4}

¹BIRA-IASB, Belgium, ²AEMET, Spain, ³NASA, USA, ⁴LuftBlick, Austria

[THU1_3] 12:25-12:30

Satellite Data Harmonization for the TOAR-II Tropospheric Ozone Assessment

Arno Keppens, Daan Hubert, Tijl Verhoelst, Steven Compernolle, and Jean-Christopher Lambert
BIRA-IASB, Belgium

[THU1_4] 12:30-12:35

Using Machine Learning Techniques to Create the Homogenized 25 Year Data Record GOME-Type Ozone Profile Essential Climate Variable (GOP-ECV)

Diego Loyola¹, Melanie Coldewey-Egbers¹, Barry Latter², Richard Siddans², Brian Kerridge², Michel van Roozendael³, and Christian Retscher⁴

¹DLR, Germany, ²NCEO, UK, ³BIRA-IASB, Belgium, ⁴European Space Agency, Italy

V. Program Schedule

[THU1_5] 12:35-12:40

Update of the Homogenization of the Long-Term Global Ozonesonde Records

Roeland Van Malderen¹, Deniz Poyraz¹, Herman G.J. Smit², Gonzague Romanens³, René Stübi³, Gérard Ancellet⁴, Sophie Godin-Beekmann⁴, Natalia Prats⁵, Carlos Torres⁵, Wolfgang Steinbrecht⁶, Marc Allaart⁷, Ankie Piters⁷, Ana Díaz⁵, Jose L. Hernandez⁵, Rigel Kivi⁸, Richard Querel⁹, Matt Tully¹⁰, Peter von der Gathen¹¹, Barbora Klikova¹², Martin Motl¹², Pavla Skrivankova¹², Bogumil Kois¹³, Norrie Lyall¹⁴, Michael Gill¹⁵, Nis Jepsen¹⁶, Peter Oelsner⁶, Vincenzo Rizi¹⁷, Marco Iarlori¹⁷, David W. Tarasick¹⁸, Bryan J. Johnson¹⁹, Anne M. Thompson²⁰, and Ryan M. Stauffer²⁰

¹Royal Meteorological Institute of Belgium, Belgium, ²Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ³MeteoSwiss, Switzerland, ⁴LATMOS, France, ⁵AEMET, Spain, ⁶Deutscher Wetterdienst Meteorologisches Observatorium, Germany, ⁷KNMI, The Netherlands, ⁸Finnish Meteorological Institute, Finland, ⁹NIWA, New Zealand, ¹⁰Bureau of Meteorology, Australia, ¹¹Alfred Wegener Institut, Germany, ¹²Czech Hydrometeorological Institute, Czech Republic, ¹³Institute of Meteorology and Water Management, Poland, ¹⁴British Meteorological Service, UK, ¹⁵Met Éireann Forecast, Ireland, ¹⁶Danish Meteorological Institute, Denmark, ¹⁷Università Degli Studi dell'Aquila, Italy, ¹⁸Environment and Climate Change Canada, Canada, ¹⁹NOAA, USA, ²⁰NASA, USA

[THU1_6] 12:40-12:45

On the Use of Satellite Observations to Fill Gaps in the Halley Station Total Ozone Record

Lily N. Zhang¹, Susan Solomon¹, Kane A. Stone¹, Jonathan D. Shanklin², Joshua D. Eveson², Steve Colwell², John P. Burrows³, Mark Weber³, Pieter van F. Levelt^{4,5}, Natalya A. Kramarova⁶, and David P. Haffner^{6,7}

¹MIT, USA, ²British Antarctic Survey, UK, ³University of Bremen, Germany, ⁴KNMI, The Netherlands, ⁵TU Delft, The Netherlands, ⁶NASA, USA, ⁷Science Systems and Applications, Inc., USA

V. Program Schedule

[ORAL] Session E. Ozone Monitoring and Measurement Techniques

Date / Time (Thu.) October 7, 2021 / 12:55-13:45 (UTC)

Session Code THU2

Session Chair Yugo Kanaya

[THU2_1] 12:55-13:00

The World Brewer Reference Triads and Uncertainties in Primary Calibration

Xiaoyi Zhao¹, Vitali Fioletov¹, Michael Brohart¹, Volodya Savastiouk², Ihab Abboud¹, Akira Ogyu¹, Jonathan Davies¹, Reno Sit¹, Sum Chi Lee¹, Alexander Cede^{3,4}, Martin Tiefengraber^{4,5}, Moritz Müller^{4,5}, Debora Griffin¹, and Chris McLinden¹

¹Environment and Climate Change Canada, Canada, ²International Ozone Services Inc., Canada, ³NASA, USA, ⁴LuftBlick, Austria, ⁵University of Innsbruck, Austria

[THU2_2] 13:00-13:05

The Official Version 1.8 Direct Sun Total Column Ozone Product of Pandora within the Pandoria Global Network (PGN)

Martin Tiefengraber^{1,2}, Alexander Cede^{1,3}, Manuel Gebetsberger¹, Moritz Müller¹, and Alberto Redondas⁴

¹LuftBlick, Austria, ²University of Innsbruck, Austria, ³NASA, USA, ⁴AEMET, Spain

[THU2_3] 13:05-13:10

Ground-Based Validation of GEMS Ozone Column and Profile Data

Arno Keppens¹, Gaia Pinardi¹, Tijl Verhoelst¹, Daan Hubert¹, Corinne Vigouroux¹, Bavo Langerock¹, Minqiang Zhou¹, Jean-Christopher Lambert¹, Pucai Wang², Youwen Sun², Cheng Liu³, Isao Murata⁴, Hideaki Nakajima⁵, Isamu Morino⁵, Tomoo Nagahama⁶, and the GEMS AO Validation Team

¹BIRA-IASB, Belgium, ²Chinese Academy of Sciences, China, ³University of Science and Technology of China, China, ⁴Tohoku University, Japan, ⁵National Institute for Environmental Studies, Japan, ⁶Nagoya University, Japan

[THU2_4] 13:10-13:15

Optimized Umkehr Profile Algorithm for Ozone Trend Analyses

Irina Petropavlovskikh^{1,2}, Koji Miyagawa², Audra McClure-Begley^{1,2}, Bryan Johnson², Jeannette Wild^{3,4}, Susan Strahan^{5,6}, Krzysztof Wargan^{6,7}, Richard Querel⁸, Lawrence Flynn⁹, Eric Beach¹⁰, and Sophie Godin-Beekmann¹¹

¹CIRES/NOAA, USA, ²NOAA/GML, USA, ³CISESS/NOAA, USA, ⁴NOAA/NWS/NCEP/CPC, USA, ⁵USRA, USA,

⁶NASA/GSFC, USA, ⁷SSI Inc., USA, ⁸NIWA, New Zealand, ⁹NOAA/STAR, USA, ¹⁰IMSG, USA, ¹¹LASP/IPSL, France

V. Program Schedule

[THU2_5] 13:15-13:20

Implementation of a New Value of the Ozone Absorption Cross-Section per Molecule at 253.65 nm (Air) for Global Atmospheric Ozone Measurement

Paul J. Brewer¹, Andrew S. Brown¹, Sangil Lee², Joele Viallon³, Robert I. Wielgosz³, Joseph J. Hodges⁴, Jennifer Carney⁴, James Norris⁴, Louise Sorensen⁵, Joann Rice⁶, Christoph Zellweger⁷, Hiroshi Tanimoto⁸, and Bernhard Niederhauser⁹

¹National Physical Laboratory, UK, ²Korea Research Institute of Standards and Science, Republic of Korea,

³Bureau International des Poids et Measures, France, ⁴National Institute of Standards and Technology, USA,

⁵California Air Resources Board, USA, ⁶Environmental Protection Agency, USA, ⁷Swiss Federal Laboratories

for Materials Science and Technology, Switzerland, ⁸National Institute for Environmental Studies, Japan,

⁹Federal Institute of Metrology, Switzerland

[THU2_6] 13:20-13:25

The 25th Anniversary of the Juelich Ozone Sonde Intercomparison Experiment (JOSIE): 25 Years of Ozonesonde QA/QC and Data Quality Improvements

Herman G.J. Smit¹, Anne M. Thompson², Bryan J. Johnson³, Jonathan Davies⁴, David W. Tarasick⁴, Jacqueline C. Witte⁵, René Stuebi⁶, Roeland Van Malderen⁷, Ryan M. Stauffer², Holger Voemel⁵, Peter von der Gathen⁸, Debra E. Kollonige², Samuel J. Oltmans³, Francis J. Schmidlin², Bruno Hoegger⁶, Gary Morris⁹, Rigel Kivi¹⁰, Tatsumi Nakano¹¹, Richard Querel¹², Marc Allaart¹³, and many more members of the JOSIE-ASOPOS-O3SDQA Teams

¹Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ²NASA, USA, ³NOAA, USA,

⁴Environment and Climate Change Canada, Canada, ⁵NCAR, USA, ⁶MeteoSwiss, Switzerland, ⁷Royal

Meteorological Institute of Belgium, Belgium, ⁸Alfred Wegener Institute, Germany, ⁹St. Edward's University,

USA, ¹⁰Finnish Meteorological Institute, Finland, ¹¹JMA, Japan, ¹²NIWA, New Zealand, ¹³KNMI, The Netherlands

Q&A 13:25-13:45

V. Program Schedule

[POSTER 4]

Date / Time (Thu.) October 7, 2021 / 13:55-15:05 (UTC)

Session Code THU3

Session Chair Seok-Woo Son, Ulrike Langematz

[THU3_1] 13:55-13:57

Stratospheric to Tropospheric Fractions in the Tropopause Transition Layer using Water and Ozone Concentrations

Paul A. Newman¹, Leslie R. Lait¹, Junhua Liu¹, Qing Liang¹, Chaitri Roy², and A. R. Ravishankara²

¹NASA, USA, ²Colorado State University, USA

[THU3_2] 13:57-13:59

Tropospheric Ozone Variability in Associations with Tropical Climate Variability

Vishnu M Warrier and Vazhathottathil Madhu

Cochin University of Science and Technology, India

[THU3_3] 13:59-14:01

Ozone Trends in the Lower Stratosphere from Ozone Sondes

W. Steinbrecht¹, R. Van Malderen², D. Poyraz², D. Hubert³, J. Davies⁴, D.W. Tarasick⁴, P. v. d. Gathen⁵, H. Deckelmann⁵, N. Jepsen⁶, R. Kivi⁷, N. Lyall⁸, B. Kois⁹, P. Oelsner¹, M. Allaart¹⁰, A. Piters¹¹, M. Gill¹¹, G. Romanens¹², R. Stübi¹², G. Ancellet¹³, S. Godin-Beekmann¹³, B. Johnson¹⁴, P. Cullis^{14,15}, I. Petropavlovskikh^{14,15}, J.-L. Hernandez¹⁶, A. Diaz¹⁶, T. Nakano¹⁷, C. Torres¹⁶, M. Tully¹⁸, R. Querel¹⁹, D.E. Kollonige^{20,21}, R.M. Stauffer²⁰, A.M. Thompson²⁰, and H.G.J. Smit²²

¹Deutscher Wetterdienst, Germany, ²Royal Meteorological Institute of Belgium, Belgium, ³BIRA-IASB, Belgium, ⁴Environment and Climate Change Canada, Canada, ⁵Alfred Wegener Institute, Germany, ⁶Danish Meteorological Institute, Denmark, ⁷Finnish Meteorological Institute, Finland, ⁸British Meteorological Service, Scotland, ⁹Institute of Meteorology and Water Management, Poland, ¹⁰KNMI, The Netherlands, ¹¹Met Éireann Forecast, Ireland, ¹²MeteoSwiss, Switzerland, ¹³LATMOS, France, ¹⁴NOAA, USA, ¹⁵CIRES, USA, ¹⁶AEMET, Spain, ¹⁷Meteorological Research Institute, Japan, ¹⁸Bureau of Meteorology, Australia, ¹⁹NIWA, New Zealand, ²⁰NASA, USA, ²¹Science Systems and Applications, Inc., USA, ²²Institute of Energy and Climate Research (IEK), Germany

[THU3_4] 14:01-14:03

Persistent Stratospheric Warming due to 2019–2020 Australian Wildfire Smoke

Karen H. Rosenlof¹, Pengfei Yu², Sean M. Davis¹, Robert W. Portmann¹, Owen B. Toon³, Charles G. Bardeen⁴, Christopher Maloney^{4,1}, Hagen Telg^{3,1}, and John E. Barnes¹

¹NOAA, USA, ²Jinan University, China, ³University of Colorado, USA, ⁴NCAR, USA

V. Program Schedule

[THU3_5] 14:03-14:05

Formation of Lower-Tropospheric High-Ozone Layer in Spring over Southeast Asia

S.-Y. Ogino¹, K. Miyazaki², M. Fujiwara³, M. I. Nodzu⁴, M. Shiotani⁵, F. Hasebe³, J. Matsumoto^{1,4}, J. Witte⁶, A. M. Thompson², Nguyen Hoang Anh⁷, and Nguyen Vinh Thu⁷

¹JAMSTEC, Japan, ²NASA, USA, ³Hokkaido University, Japan, ⁴Tokyo Metropolitan University, Japan, ⁵Kyoto University, Japan, ⁶NCAR, USA, ⁷NCHMF, Vietnam

[THU3_6] 14:05-14:07

The ENSO Induced Tropospheric Ozone Dipole based on Chemistry-Climate Model Simulation

Vazhathottathil Madhu^{1,2} and Kengo Sudo²

¹Cochin University of Science and Technology, India, ²Nagoya University, Japan

[THU3_7] 14:07-14:09

Variability of the Spectral Ultraviolet Irradiance and Total Ozone in Italy: The Role of Atmospheric Dynamics

Ilias Fountoulakis^{1,5}, Henri Diémoz^{1,2}, Anna Maria Siani³, Alcide di Sarra⁴, and Daniela Meloni⁴

¹Aosta Valley Regional Environmental Protection Agency, Italy, ²National Research Council, Italy, ³Sapienza Università di Roma, Italy, ⁴Agenzia nazionale per le Nuove Tecnologie, Italy, ⁵National Observatory of Athens, Greece

[THU3_8] 14:09-14:11

Northern Hemisphere Climate Response to Projected Stratospheric Ozone Recovery

Denise Seiling and Ulrike Langematz

Freie Universität Berlin, Germany

[THU3_9] 14:11-14:13

Investigation of Ozone Changes in 10-Year Period in Tehran

Nasim Hossein Hamzeh and Sara Karami

Atmospheric Science and Meteorological Research Center, Iran

[THU3_10] 14:13-14:15

Roles of Ozone-Wave Interaction on the Stratospheric Pathway of the Arctic-Mid-Latitude Climate Linkage

Tetsu Nakamura¹, Daniel Kreyling², Jinro Ukita³, Ingo Wohltmann², Ralf Jaiser², and Dörthe Handorf²

¹Hokkaido University, Japan, ²Alfred Wegener Institute for Polar and Marine Research, Germany, ³Niigata University, Japan

[THU3_11] 14:15-14:17

The Stratospheric Brewer-Dobson Circulation in ERA5 and ERA-Interim Reanalyses

Felix Ploeger, Mohamadou Diallo, Paul Konopka, and Martin Riese

Institute of Energy and Climate Research (IEK), Germany

V. Program Schedule

[THU3_12] 14:17-14:19

The Impact of the Southern Hemisphere Polar Vortex on Surface Climate and the Role of Ozone Feedbacks

Nora Bergner¹, Gabriel Chiodo^{1,2}, Marina Friedel¹, Daniela Domeisen¹, and Thomas Peter¹

¹ETH Zürich, Switzerland, ²Columbia University, USA

[THU3_13] 14:19-14:21

Projections Changes in the Total Column Ozone over the 21st Century in CMIP6 Models

Ana Letícia Campos Yamamoto, Marcelo de Paula Corrêa, and Roger Rodrigues Torres

Federal University of Itajubá, Brazil

[THU3_14] 14:21-14:23

Coupling of the Fast Stratospheric Ozone Chemistry Module (SWIFT) to the Atmospheric General Circulation Model for the Earth Simulator (AFES)

Daniel Kreyling¹, Tetsu Nakamura², Jinro Ukita³, Ingo Wohltmann¹, Ralf Jaiser¹, and Dörthe Handorf¹

¹Alfred Wegener Institute for Polar and Marine Research, Germany, ²Hokkaido University, Japan, ³Niigata University, Japan

[THU3_15] 14:23-14:25

Long-Term Changes in Tropospheric Ozone in Antarctica and Possible Drivers

P. Kumar¹, J. Kuttippurath¹, P. von der Gathen², I. Petropavlovskikh^{3,4}, B. Johnson⁴, A. McClure Begley^{3,4}, P. Cristofanelli⁵, P. Bonasoni⁵, M. E. Barlasina⁶, and R. Sánchez⁶

¹Indian Institute of Technology Kharagpur, India, ²Alfred Wegener Institute, Germany, ³University of Colorado, USA, ⁴NOAA, USA, ⁵National Research Council, Italy, ⁶Servicio Meteorológico Nacional, Argentina

[THU3_17] 14:27-14:29

Early Vortex Break-Up Events in the ACCESS-CM2-Chem Model

Fraser Dennison

CSIRO, Australia

[THU3_18] 14:29-14:31

Analysis of Completeness, Coherency and Plausibility of Ground-Based Ozone Datasets within the Copernicus Climate Change Service

Fabrizio Marra¹, Karin Kreher², and Fabio Madonna¹

¹National Research Council (CNR), Italy, ²BK SCIENTIFIC (BKS), Germany

[THU3_19] 14:31-14:33

Evaluation of a Stratospheric Ozone Reduction Event of Tropical Origin Influenced by the Secondary Effect of the Antarctic Ozone Hole over the Southern Brazil through CFSV2: July/August 2013

Gustavo Rasera¹, Vagner Anabor¹, Luiz Angelo Steffenel², Damaris Kirsch Pinheiro¹, and Lissette Guzmán Rodríguez¹

¹UFSM, Brazil, ²Université de Reims Champagne Ardenne, Laboratoire LICLIS / LRC CEA DIGIT, France

V. Program Schedule

- [THU3_21]** 14:35-14:37
Developing Artificial Intelligence-Based Prediction Systems to Monitor the Quantitative Effect of Australian Bushfires on the Antarctic Ozone Hole
Thomas Y. Chen
Academy for Mathematics, Science, and Engineering, USA
- [THU3_22]** 14:37-14:39
Air-Temperature and Humidity Dependence of the Ozone Generation Rate in the Surface Air Layer
P.N. Antokhin, O.Yu. Antokhina, V.V. Antonovich, V.G. Arshinova, M.Yu. Arshinov, B.D. Belan, S.B. Belan, D.K. Davydov, G.A. Ivlev, A.V. Fofonov, A.V. Kozlov, T.M. Rasskazchikova, D.E. Savkin, D.V. Simonenkov, T.K. Sklyadneva, and G.N. Tolmachev
V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia
- [THU3_23]** 14:39-14:41
Bias Correction of Multi-Sensor Satellite-Acquired Total Column Ozone
Hiroaki Naoe¹, Takashi Maki¹, Makoto Deushi¹, and Keisuke Ueno²
¹Meteorological Research Institute, Japan, ²Aerological Observatory, Japan
- [THU3_24]** 14:41-14:43
Towards Understanding the Mechanism for the Downward Propagation of Ozone Depletion on Surface Climate
Chaim I Garfinkel¹, Ian White¹, Edwin Gerber², Martin Jucker³, and Seok-Woo Son⁴
¹Hebrew University, Israel, ²New York University, USA, ³UNSW Sydney, Australia, ⁴Seoul National University, Republic of Korea
- [THU3_25]** 14:43-14:45
Montreal Protocol Benefits Simulated with SOCOLv4.0
Tatiana Egorova¹, Jan Sedlacek¹, Timofei Sukhodolov^{1,3}, Arseniy Karagodin^{1,2}, and Eugene Rozanov^{1,2,3}
¹PMOD/WRC, Switzerland, ²ETH Zürich, Switzerland, ³St. Petersburg State University, Russia
- [THU3_26]** 14:45-14:47
Ozone Hole Impacts on Southern Annular Mode Persistency and Predictability in Idealized ICON-ART Climate Change Simulations
Marleen Braun and Peter Braesicke
Karlsruhe Institute of Technology, Germany
- [THU3_27]** 14:47-14:49
Monitoring of Surface Ozone in the Moscow Region
Danil Vladimirovich Borisov¹, Irina Nikolaevna Kuznetsova¹, Irina Yurievna Shalygina¹, Murat Islemgaleevich Nahaev¹, Elena Aleksandrovna Lezina², and Vladimir Aleksandrovich Lapchenko³
¹Hydrometeorological Research Center of Russian Federation, Russia, ²Budgetary Environmental Protection Institution, Russia, ³Karadag Scientific Station, Russia

V. Program Schedule

[THU3_28] 14:49-14:51

Effective Radiative Forcing of Stratospheric Ozone Recovery

Katerina Kusakova, Björn-Martin Sinnhuber, Maryam Ramezani Ziarani, and Peter Braesicke

Karlsruhe Institute of Technology, Germany

[THU3_29] 14:51-14:53

Assessment of Tropical UTLS Ozone in Chemistry-Climate Models

Joowan Kim and Hosun Ryu

Kongju National University, Republic of Korea

[THU3_30] 14:53-14:55

Effect of Ozone Enhancement in UT/LS for the Long-Term Total Ozone Trend Analysis in Seoul, Korea

Sang Seo Park¹, Yun Gon Lee², Jhoon Kim³, Hi Ku Cho³, and Hyunkwang Lim³

¹UNIST, Republic of Korea, ²Chungnam National University, Republic of Korea, ³Yonsei University, Republic of Korea

[THU3_31] 14:55-14:57

The Present and Future Ozone Trend in South Korea

Taegyung Lee¹, Ja-Ho Koo¹, and Sungbo Shim²

¹Yonsei University, Republic of Korea, ²National Institute of Meteorological Sciences, Republic of Korea

[THU3_32] 14:57-14:59

Effect of Stratospheric Ozone on Simulation of Winter Surface Temperature in the Northern Hemisphere in Climate Models

Yong-Cheol Jeong¹, Sang-Wook Yeh¹, Seungun Lee², Rokjin J. Park², and Seok-Woo Son²

¹Hanyang University, Republic of Korea, ²Seoul National University, Republic of Korea

[THU3_33] 14:59-15:01

Impact of Stratospheric Ozone on the Subseasonal Prediction in the Southern Hemisphere Spring

Jiyoung Oh^{1,2}, Seok-Woo Son¹, Jung Choi¹, Eun-Pa Lim³, Chaim Garfinkel⁴, Harry Hendon³, Yoonjae Kim², and Hyun-Sun Kang²

¹Seoul National University, Republic of Korea, ²Korea Meteorological Administration, Republic of Korea,

³Bureau of Meteorology, Australia, ⁴Hebrew University, Israel

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Fri.) October 8

V. Program Schedule

● (Fri.) October 8

[ORAL] Session E. Ozone Monitoring and Measurement Techniques

Date / Time (Fri.) October 8, 2021 / 12:00-12:45 (UTC)

Session Code FRI1

Session Chair Nathaniel Livesey

[FRI1_1] 12:00-12:05

The Importance of Correcting the Time Response of the Electrochemical Concentration Cell (ECC) Ozonesonde

Holger Vömel¹, Herman G. J. Smit², David Tarasick³, Bryan Johnson⁴, Samuel J. Oltmans⁴, Henry Selkirk⁵, Anne M. Thompson⁵, Ryan M. Stauffer⁵, Jacquelyn C. Witte¹, Jonathan Davies³, Roeland van Malderen⁶, Gary A. Morris⁷, Tatsumi Nakano⁸, and René Stübi⁹

¹NCAS, USA, ²Institute of Energy and Climate Research (IEK), Germany, ³Environment and Climate Change Canada, Canada, ⁴NOAA, USA, ⁵NASA, USA, ⁶Royal Meteorological Institute, Belgium, ⁷St. Edward's University, USA, ⁸JMA, Japan, ⁹MeteoSwiss, Switzerland

[FRI1_2] 12:05-12:10

An Updated Examination of the Post-2013 Ozonesonde Total Column Ozone "Dropoff"

Ryan M. Stauffer¹, Anne M. Thompson¹, Debra E. Kollonige^{2,1}, David W. Tarasick³, Holger Vömel⁴, Gary A. Morris⁵, Roeland Van Malderen⁶, Bryan J. Johnson⁷, Patrick D. Cullis^{8,7}, René Stübi⁹, and Herman G. J. Smit¹⁰

¹NASA, USA, ²Science Systems and Applications, Inc., USA, ³Environment and Climate Change Canada, Canada, ⁴NCAS, USA, ⁵St. Edwards University, USA, ⁶Royal Meteorological Institute of Belgium, Belgium, ⁷NOAA, USA, ⁸University of Colorado, USA, ⁹MeteoSwiss, Switzerland, ¹⁰Institute of Energy and Climate Research: Troposphere (IEK-8), Germany

[FRI1_3] 12:10-12:15

The Changing-Atmosphere Infra-Red Tomography Explorer CAIRT – A Candidate for ESA's Earth Explorer 11

Björn-Martin Sinnhuber¹, Peter Preusse², Martyn Chipperfield³, Quentin Errera⁴, Felix Friedl-Vallon¹, Bernd Funke⁵, Sophie Godin-Beekmann⁶, Maya Garcia Comas⁵, Michael Höpfner¹, Manuel López Puertas⁵, Vincent-Henri Peuch⁷, Felix Plöger², Inna Polichtchouk⁷, Piera Raspollini⁸, Stefanie Riel⁹, Martin Riese², Miriam Sinnhuber¹, Gabi Stiller¹, Jörn Ungermann², Thomas von Clarmann¹, and Kaley Walker¹⁰

¹Karlsruhe Institute of Technology, Germany, ²Institute of Energy and Climate Research (IEK), Germany, ³University of Leeds, UK, ⁴BIRA-IASB, Belgium, ⁵Instituto de Astrofísica de Andalucía, Spain, ⁶National Centre for Scientific Research, France, ⁷ECMWF, UK, ⁸National Research Council (CNR), Italy, ⁹Airbus Defense and Space, Germany, ¹⁰University of Toronto, Canada

V. Program Schedule

[FRI1_4] 12:15-12:20

The Continuity Microwave Limb Sounder (C-MLS) – Capitalizing on New Technology to Continue the MLS Record of Daily Global Middle Atmosphere Composition Observations

Nathaniel J. Livesey¹, Goutam Chattopadhyay¹, Adrian Tang¹, Robert A. Stachnik¹, Robert F. Jarnot¹, Luis F. Millán¹, William G. Read¹, Richard E. Cofield¹, Michelle L. Santee¹, Mau-Chung (Frank) Chang², and Rulin Huang²

¹NASA, USA, ²UCLA, USA

[FRI1_5] 12:20-12:25

TOPAS Ozone Profile Retrieval from TROPOMI Nadir Measurements in the Ultraviolet Spectral Range and Improvements by Combining with CrIS Infrared Measurements

Nora Mettig¹, Mark Weber¹, Alexei Rozanov¹, Carlo Arosio¹, John P. Burrows¹, and Pepijn Veefkind²

¹University of Bremen, Germany, ²KNMI, The Netherlands

[FRI1_6] 12:25-12:30

Diurnal Variation of GEMS Total Column Ozone Data: Ground-Based Validation and Consistency with Other Satellite Missions

Kanghyun Baek¹, Jae-Hwan Kim¹, and David P. Haffner²

¹Pusan National University, Republic of Korea, ²Science Systems and Application Inc., USA

Q&A 12:30-12:45

V. Program Schedule

[ORAL] Session F. Environmental and Human Health Effects of Atmospheric Ozone and U

Date / Time (Fri.) October 8, 2021 / 12:55-13:50 (UTC)

Session Code FRI2

Session Chair Julian Gröbner, Johanna Tamminen

[FRI2_K] 12:55-13:10

Keynote **Mapping Global Ground-Level Ozone Concentrations for 1990 to 2017 to Support Health Impact Assessment**

Jason West

Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, North Carolina, USA

[FRI2_1] 13:10-13:15

Surface UV Radiation Contribution to the Increase of Melanoma Incidence Rate in Europe in the Last 20 Years

Agnieszka Czerwińska and Janusz Krzyścin

Institute of Geophysics, Polish Academy of Sciences, Poland

[FRI2_2] 13:15-13:20

Solar Ultraviolet Radiation Temporal Variability Analisys from 2-Years of Continuous Observation in an Amazonian City of Brazil

Gabriela Reis¹, Samuel Souza¹, Helvécio Neto², Rardiles Branches¹, Rodrigo da Silva¹, Lucas Vaz Peres¹, Damaris Kirsch Pinheiro³, Kevin Lamy⁴, Hassan Bencherif⁴, Thierry Portafaix⁴, and Marcelo de Paula Corrêa⁵

¹UFOPA, Brazil, ²INPE, Brazil, ³UFSM, Brazil, ⁴LACy, France, ⁵Federal University of Itajubá, Brazil

[FRI2_3] 13:20-13:25

Erythemal UV-B Dose Measurements Comparison Recorded by RBCC-E and BSRN at Izaña Atmospheric Observatory

Sergio F. León-Luis^{1,2}, R.D. García^{1,2}, Alberto Redondas², Virgilio Carreño², Javier López-Solano^{1,2}, Alberto Berjón^{1,2}, and Daniel Santana^{2,3}

¹Tragsatec, España, ²AEMET, Spain, ³LuftBlick Earth Observation Technologies, Austria

[FRI2_4] 13:25-13:30

Total Ozone and DNA UV Changes in the Future due to Greenhouse Gases

Kostas Eleftheratos¹, John Kapsomenakis², Christos S. Zerefos², I. Fountoulakis³, Patrick Jöckel⁴, and Martin Dameris⁴

¹National and Kapodistrian University of Athens, Greece, ²Academy of Athens, Greece, ³National Observatory of Athens, Greece, ⁴DLR, Germany

V. Program Schedule

[FRI2_5] 13:30-13:35

Characterizing Subarctic Biomes for Land Surface Modeling of Ozone Pollution and Climate Risk

Stefanie Falk¹, Ane Victoria Vollsnes¹, Aud B. Eriksen¹, Lisa Emberson², Connie O'Neill², Frode Stordal¹, and Terje K. Berntsen¹

¹University of Oslo, Norway, ²University of York, UK

[FRI2_6] 13:35-13:40

A Satellite-Based UV and VIS Climatology for Biological and Agricultural Applications for Greece and Cyprus: Preliminary Results and Validation

Fountoulakis Ilias¹, Kosmopoulos Panagiotis¹, Papachristopoulou Kyriakoula^{1,2}, Raptis Ioannis-Panagiotis^{1,2}, Eleftheratos Kostas^{2,3}, Garane Katerina⁴, Bais Alkiviadis⁴, Melina-Maria Zempila⁵, Kontoes Charalampos¹, and Kazadzis Stelios⁶

¹National Observatory of Athens, Greece, ²National and Kapodistrian University of Athens, Greece,

³Academy of Athens, Greece, ⁴Aristotle University of Thessaloniki, Greece, ⁵RAL - RAL Space, UK, ⁶PMOD/WRC, Switzerland

Q&A 13:40-13:50

V. Program Schedule

[POSTER 5]

Date / Time (Fri.) October 8, 2021 / 14:00-14:50 (UTC)

Session Code FRI3

Session Chair Corinne Vigouroux, Valerie Thouret

[FRI3_1] 14:00-14:02

Two Complementary Tropospheric Ozone Column Data Records based on Total Columns from GOME, SCIAMACHY, GOME-2, OMI and TROPOMI and Stratospheric Columns from BASCOE/MLS

Klaus-Peter Heue^{1,2}, Diego Loyola¹, Fabian Romahn¹, Melanie Coldewey-Egbers¹, Christophe Lerot³, Simon Chabrillat³, and Quentin Errera³

¹DLR, Germany, ²TUM, Germany, ³BIRA, Belgium

[FRI3_2] 14:02-14:04

Tropospheric Ozone Column Dataset Derived by Combination of Nadir and Limb Satellite Measurements

Viktoria F. Sofieva¹, Risto Hänninen¹, Mikhail Sofiev¹, Monika Szelag¹, Hei Shing Lee¹, Johanna Tamminen¹, and Christian Retscher²

¹Finnish Meteorological Institute, Finland, ²ESA/ESRIN, Italy

[FRI3_3] 14:04-14:06

Inter-Comparison and Evaluation of Tropospheric Ozone Reanalysis Products from CAMS, and TCR

Vincent Huijnen¹, Kazuyuki Miyazaki², Johannes Flemming³, Antje Inness³, and Takashi Sekiya⁴

¹KNMI, The Netherlands, ²NASA, USA, ³ECMWF, UK, ⁴JAMSTEC, Japan

[FRI3_4] 14:06-14:08

Evaluation of Tropospheric Ozone Reanalyses with Independent Ozonesonde Observations in East Asia

Sunmin Park¹, Seok-Woo Son¹, Myung-Il Jung¹, Jinkyung Park¹, and Sang Seo Park²

¹Seoul National University, Republic of Korea, ²UNIST, Republic of Korea

[FRI3_5] 14:08-14:10

Evaluation of the Total Column Ozone and Tropospheric Ozone in the CCMI1 Models over East Asia

Seo-Yeon Kim¹, Sunmin Park², and Seok-Woo Son¹

¹Seoul National University, Republic of Korea, ²Korea University, Republic of Korea

V. Program Schedule

- [FRI3_6]** 14:10-14:12
Improving the Current Understanding of Tropospheric Ozone Processes with Coordinated Ozone Profiling by the Tropospheric Ozone Lidar Network (TOLNet)
John T. Sullivan¹, Michael J. Newchurch², Timothy A. Berkoff¹ Guillaume Gronoff^{1,3}, Shi Kuang², Andrew O. Langford⁴, Christoph J. Senff^{4,5}, Raul J. Alvarez II⁴, Thierry Leblanc⁶, Fernando Chouza⁶, Jia Su⁷, M. Patrick McCormick⁷, Matthew S. Johnson¹, Kevin Strawbridge⁸, Fred Moshary⁵, Michael Shook¹, and Gao Chen¹
¹NASA, USA, ²University of Alabama, USA, ³Science Systems and Applications Inc., USA, ⁴NOAA, USA, ⁵CIRES, USA, ⁶CalTech, USA, ⁷Hampton University, USA, ⁸Environment and Climate Change Canada, Canada
- [FRI3_7]** 14:12-14:14
Stratosphere-Troposphere Exchange of Ozone and Carbon Monoxide over the North Pacific Ocean in Northern Winter using Two Chemical Reanalysis Data Sets
Haosen Xi and Masamoto Fujiwara
Hokkaido University, Japan
- [FRI3_8]** 14:14-14:16
Effect of Synoptic Scale Dynamics on the Vertical Distribution of Ozone over the Arabian Sea and Indian Ocean During the Boreal Winter of 2018
P. R. Satheesh Chandran^{1,2}, S. V. Sunilkumar¹, M. Muhsin^{1,3}, Maria Emmanuel^{1,2}, and Hemanth Kumar⁴
¹VSSC, India, ²University of Kerala, India, ³National Institute of Technology, India, ⁴NARL, India
- [FRI3_9]** 14:16-14:18
Comparison between Two Events with Ozone-Poor Masses Originating from the South Pole and the Tropics over the City of Durban, South Africa
Fabio Henrique Corrêa¹, Gabriela Dornelles Bittencourt¹, Damaris Kirsch Pinheiro¹, and Hassan Bencherif²
¹UFSM, Brazil, ²LACy, France
- [FRI3_10]** 14:18-14:20
Origin of Tropospheric Air Masses in the Tropical West Pacific Inferred from Balloon-Borne Ozone and Water Vapour Observations from Palau
Katrin Müller, Ingo Wohltmann, Peter von der Gathen, Ralph Lehmann, and Markus Rex
Alfred-Wegener-Institute, Germany
- [FRI3_11]** 14:20-14:22
Multi-Year of Dynamics of Vertical Ozone Distribution in the Troposphere over the South of Western Siberia
P.N. Antokhin, V.G. Arshinova, M.Yu. Arshinov, B.D. Belan, S.B. Belan, D.K. Davydov, A.V. Fofonov, T. M. Rasskazchikova, D.E. Savkin, D.V. Simonenkov, T.K. Sklyadneva, and G.N. Tolmachev
V.E. Zuev Institute of Atmospheric Optics r SB RAS, Russia

V. Program Schedule

[FRI3_14] 14:26-14:28

Ozone Observations over Open Oceans on R/V Mirai from 67°S to 75°N since 2012: Testing Global Chemical Reanalysis TCR-2 in terms of Arctic Processes and Low Ozone Levels at Low Latitudes

Yugo Kanaya¹, Kazuyuki Miyazaki^{2,1}, Fumikazu Taketani¹, Takuma Miyakawa¹, Hisahiro Takashima^{1,3}, Xiaole Pan^{1,4}, Saki Kato³, Kengo Sudo^{1,5}, Takashi Sekiya¹, Jun Inoue⁶, Kazutoshi Sato⁷, and Kazuhiro Oshima^{1,8}

¹JAMSTEC, Japan, ²CalTech, USA, ³Fukuoka University, Japan, ⁴Chinse Academy of Sciences, China,

⁵Nagoya University, Japan, ⁶National Institute of Polar Research, Japan, ⁷Kitami Institute of Technology, Japan, ⁸Rokkasho Institute of Environmental Sciences, Japan

[FRI3_15] 14:28-14:30

South America and Africa Biomass Burning Influence on the Seasonality of the Tropospheric Ozone over Natal, Brazil

Damaris Kirsch Pinheiro¹, Hassan Bencherif², Lucas Vaz Peres³, Gabriela Dornelles Bittencourt¹, Nelson Bègue², Maria Paulete Pereira Martins⁴, and Francisco Raimundo da Silva⁴

¹UFSM, Brazil, ²LACy, France, ³UFOPA, Brazil, ⁴INPE, Brazil

[FRI3_16] 14:30-14:32

Surface Ozone Concentration over Russian Territory in 2020-2021

E.V. Stepanov¹, V.V. Andreev², M.Yu. Arshinov³, B.D. Belan³, S.B. Belan³, Chelibanov⁴, V.P. Chelibanov⁴, D.K. Davydov³, N.F. Elansky⁵, G.A. Ivlev³, A.V. Kozlov³, S.N. Kotelnikov¹, I.N. Kuznetsova⁶, V.A. Lapchenko⁷, E.A. Lezina⁸, O.V. Postolyakov⁵, D.E. Savkin³, I.A. Senik³, G.N. Tolmachev³, A.V. Fofonov³, and I.V. K.A. Shukurov⁵

¹A. M. Prokhorov General Physics Institute, RAS, Russia, ²RUDN University, Russia, ³IAO SB RAS, Russia,

⁴Instrument-Making Company OPTEK, Russia, ⁵A.M. Obukhov Institute of Atmospheric Physics RAS,

Russia, ⁶Hydrometeorological Research Center of Russian Federation, Russia, ⁷Institute of Biology of the Southern Seas of RAS, Russia, ⁸Mosecomonitoring, Russia

[FRI3_17] 14:32-14:34

Application of Adjacened-Avarage to Analysis of Longterm Surface Ozone Courses

Eugene V. Stepanov

A. M. Prokhorov General Physics Institute, RAS, Russia

[FRI3_18] 14:34-14:36

Variation of Surface Ozone, NOx, CO, BTEX, SO₂ and NH₃ in Kannur- A South Indian Coastal City

Nishanth T¹, Resmi CT², and Satheesh Kumar MK³

¹Sree Krishna College Guruvayur, India, ²Erode Arts and Science College, India, ³MAHE, India

V. Program Schedule

- [FRI3_19]** 14:36-14:38
Preliminary Study of the Characterization of Surface Ozone in the Marambio Station for the Period 2012-2018
Gerardo Carbajal Benítez, María Elena Barlasina, and Lino Fabian Condori
National Meteorological Service (SMN), Argentina
- [FRI3_20]** 14:38-14:40
Long-Term Changes in Seasonal Cycle of Surface Ozone over Japan with Continuous Air Quality Monitoring Records for 1980-2015
Natsumi Kawano, Tatsuya Nagashima, and Seiji Sugata
National Institute for Environmental Studies, Japan
- [FRI3_21]** 14:40-14:42
Surface Ozone Trends over a 21-year Period at El Arenosillo Observatory: Emission Precursors, Weather Conditions and Implications on Air Quality
José A Adame¹, Isidoro Gutierrez-Alvarez², Paolo Cristofanelli³, Alberto Notario^{4,5}, Jose A. Bogaet¹, Antonio Lopez¹, Alvaro Gómez¹, Juan P. Bolívar², and Margarita Yela¹
¹National Institute for Aerospace Technology (INTA), Spain, ²University of Huelva, Spain, ³National Research Council of Italy, Italy, ⁴Universidad de Castilla-La Mancha, Spain, ⁵ICCA-UCLM, Spain
- [FRI3_22]** 14:42-14:44
Patterns and Trends of Ozone and Carbon Monoxide at Ushuaia (Argentina) Observatory
José A Adame¹, Olga Puentedura¹, Laura Gómez¹, Lino Condori², Gerardo Carbajal^{2,4}, María E. Barlasina², and Margarita Yela¹
¹National Institute for Aerospace Technology (INTA), Spain, ²National Meteorological Service (SMN), Argentina, ⁴Pontificia Universidad Católica Argentina, Argentina
- [FRI3_23]** 14:44-14:46
Introducing New Lightning Schemes to a Chemistry Climate Model CHASER (MIROC)
Yanfeng He¹, Kengo Sudo^{1,2}, and H.M.S. Hoque¹
¹Nagoya University, Japan ²JAMSTEC, Japan
- [FRI3_24]** 14:46-14:48
Ozonesonde Profiles at Reunion Island (21.1°S, 55.5°E) in the Indian Ocean, and Impact of Convection on the Upper-Tropospheric Composition
Jerome Brioude¹, Stephanie Evan¹, Damien Héron², Jean-Marc Metzger³, Kevin Lamy¹, and Françoise Posny¹
¹LACy, France, ²LMD, CNRS-UMR8539, France, ³OSU-R, UMS3365, CNRS, France

QOS 2021

**October 3 (Sunday) - 9 (Saturday), 2021
Online Meeting**

V. Program Schedule

(Sat.) October 9

V. Program Schedule

:(Sat.) October 9

[POSTER 6]

Date / Time **(Sat.) October 9, 2021 / 12:00-13:10 (UTC)**

Session Code **SAT1**

Session Chair **Sang Seo Park**

[SAT1_1] 12:00-12:02

Internal Consistency of the IAGOS Ozone Measurements for the Last 25 Years

Romain Blot¹, Philippe Nedelec¹, Damien Boulanger¹, Paweł Wolff¹, Bastien Sauvage¹, Jean-Marc Cousin¹, Andreas Zahn², Hannah Clark³, and Valérie Thouret¹

¹Université de Toulouse, France, ²Karlsruhe Institute of Technology, Germany, ³IAGOS-AISBL, Belgium

[SAT1_2] 12:02-12:04

Dobson Global Calibration System: More than Half a Century of Successful QA/QC

Ulf Köhler¹, Wolfgang Steinbrecht¹, Voltaire A. Velazco¹, Glen McConville², and Robert D. Evans²

¹Deutscher Wetterdienst Meteorologisches Observatorium, Germany, ²NOAA, USA

[SAT1_3] 12:04-12:06

Total Ozone Column Variability Analysis over Natal in 21st Century

Alanna Maués de Souza¹, Lucas Vaz Peres¹, Rodrigo da Silva¹, Damaris Kirsch Pinheiro², Hassan Bencherif³, Francisco Raimundo da Silva⁴, and Maria Paulete Pereira Martins⁴

¹UFOPA, Brazil, ²UFSM, Brazil, ³LACy, France, ⁴INPE, Brazil

[SAT1_4] 12:06-12:08

Comparison of Dobson and Brewer Retrieved Total Ozone Column using Different Ozone Absorption Cross Sections in the Retrieval Algorithm

Karl Voglmeier, Ulf Köhler, Voltaire A. Velazco, and Wolfgang Steinbrecht

Deutscher Wetterdienst, Germany

[SAT1_5] 12:08-12:10

Intercomparison of Total Ozone Column (TOC) Measurements in Hohenpeissenberg from Three Spectrometer Systems: Dobson, Brewer and BTS Solar

Voltaire A. Velazco¹, Ulf Köhler¹, Ralf Zuber², Wolfgang Steinbrecht¹, and Karl Voglmeier¹

¹Deutscher Wetterdienst, Germany, ²Gigahertz Optik GmbH, Germany

[SAT1_6] 12:10-12:12

Umkehr Ozone Profile Analysis and Satellite Validation for Selected Brewer and Dobson Spectrophotometers

Konstantinos Fragkos^{1,3}, Koji Miyagawa², Panagiotis Fountoukidis¹, MariLiza Koukouli¹, Katerina Garane¹, Dimitris Balis¹, Irina Petropavlovskikh², and Alkiviadis Bais¹

¹Aristotle University of Thessaloniki, Greece, ²NOAA, USA, ³INOE 2000, Romania

V. Program Schedule

- [SAT1_7]** 12:12-12:14
Consistency of Brewer and Dobson Total Column Ozone Measurements of the World's Longest Time Series at Arosa/Davos, Switzerland
Julian Gröbner¹, Herbert Schill¹, Luca Egli¹, and René Stübi²
¹PMOD/WRC, Switzerland, ²MeteoSwiss, Switzerland
- [SAT1_8]** 12:14-12:16
Advanced NO₂ Retrieval Technique for the Brewer Spectrophotometer Long-Term Changes over Rome and «Lockdown Effect» over Aosta, Italy
Henri Diémoz¹, Anna Maria Siani², Stefano Casadio³, Anna Maria Iannarelli³, Giuseppe Rocco Casale², Francesca Frasca², Vladimir Savastiouk⁴, Alexander Cede^{5,6}, Martin Tiefengraber^{5,7}, and Moritz Müller⁵
¹ARPA Valle d'Aosta, Italy, ²Sapienza University of Rome, Italy, ³Serco Italia, Italy, ⁴International Ozone Services Inc., Canada, ⁵LuftBlick, Austria, ⁶NASA, USA, ⁷University of Innsbruck, Austria
- [SAT1_9]** 12:16-12:18
Harmonized Retrieval of Middle Atmospheric Ozone from Two Microwave Radiometers in Switzerland
Eric Sauvageat¹, Eliane Maillard Barras², Klemens Hocke¹, Alexander Haefele², and Axel Murk¹
¹University of Bern, Switzerland, ²MeteoSwiss, Switzerland
- [SAT1_10]** 12:18-12:20
Traceability of Total Ozone Column Measurements with the Portable Reference Spectroradiometer for Ultraviolet Radiation (QASUME)
Luca Egli, Gregor Hülsen, and Julian Gröbner
PMOD/WRC, Switzerland
- [SAT1_11]** 12:20-12:22
The Reevaluated Intraday Total Column Ozone Series from the Dobson Spectrophotometer No.84 Operating at Belsk (51.84N, 20.79E), Poland, since March 23, 1963
Bonawentura Rajewska-Więch, Janusz Krzyścin, and Janusz Jarosławski
Institute of Geophysics, Poland
- [SAT1_12]** 12:22-12:24
Comparison of Total Ozone Column and UVI Retrieved from Brewer, PANDORA and OMI at Athens, Greece during 2018-2021
Raptis Ioannis-Panagiotis^{1,2}, Kouklaki Dimitra², Eleftheratos Kostas^{2,3}, Fountoulakis Ilias¹, and Kazadzis Stelios^{4,1}
¹National Observatory of Athens, Greece, ²National and Kapodistrian University of Athens, Greece,
³Academy of Athens, Greece, ⁴PMOD/WRC, Switzerland
- [SAT1_13]** 12:24-12:26
New Millimeter-Wave Spectrometer for Simultaneous Multi-Line Observations Operating at Syowa Station
Akira Mizuno¹, Taku Nakajima¹, Tomoo Nagahama¹, Daichi Tsutsumi¹, Genma Mizoguchi¹, Naoto Sekiya², Takuma Hayashi², Yoshihiro Tomikawa³, Mitsumu K. Ejiri³, Masaki Tsutsumi³, and Kaoru Sato⁴
¹Nagoya University, Japan, ²University of Yamanashi, Japan, ³National Institute of Polar Research, Japan,
⁴The University of Tokyo, Japan

V. Program Schedule

[SAT1_15] 12:28-12:30

Continuity of the Swiss Total Ozone Column Series after Dobson Automation and the Instruments Relocation

René Stübi¹, Herbert Schill², Jörg Klausen¹, Eliane Maillard Barras¹, Alexander Haefele¹, Julian Gröbner², and Luca Egli²

¹Meteoswiss, Switzerland, ²PMOD/WRC, Switzerland

[SAT1_16] 12:30-12:32

Comparison of Total Ozone Measurements in Melbourne, Australia, Performed with a Low-Cost Microspectrometer and a Brewer MK-III

Kåre Edvardsen¹, Anders Nordli¹, Matt Tully², and Steve Rhodes²

¹The Arctic University of Norway, Norway, ²Bureau of Meteorology, Australia

[SAT1_17] 12:32-12:34

Comparing Lauder Total Column Ozone Retrievals from FRM4DOAS with Dobson and NIWA UV Spectrometer Retrievals

Richard Querel¹, Alex Geddes¹, Ben Liley¹, Francois Hendrick², Martina Friedrich², and Caroline Fayt²

¹NIWA, New Zealand, ²BIRA-IASB, Belgium

[SAT1_18] 12:34-12:36

Reprocessing of the RBCC-E Izaña Observatory Triad Ozone Series

Alberto Berjón^{1,2}, Alberto Redondas², Javier López-Solano^{1,2}, Virgilio Carreño², Francisco C. Parra-Rojas², and Sergio F. León-Luis^{1,2}

¹Tragsatec, Spain, ²AEMET, Spain

[SAT1_19] 12:36-12:38

Total Ozone Uncertainty Model on Brewer Algorithm

Parra-Rojas F.C.¹, Redondas A.¹, Berjón A.^{1,2}, López-Solano J.^{1,2}, Carreño V.¹, and León-Luis S.F.^{1,2}

¹AEMET, Spain, ²Tragsatec, Spain

[SAT1_20] 12:38-12:40

EUBREWNET: An Overview of Recent Advances

J. López-Solano^{1,2}, A. Redondas², J. Rimmer³, A. Berjón^{1,2}, F.C. Parra-Rojas², V. Carreño², and S.F. León-Luis^{1,2}

¹Tragsatec, Spain, ²AEMET, Spain, ³University of Manchester, UK

[SAT1_21] 12:40-12:42

Eubrewnet Brewer Updated Algorithm, Total Ozone in Six European Stations: Sodankylä, Davos, Uccle, Thessaloniki, Madrid and Izaña

Redondas A.¹, Parra-Rojas F.C.¹, Berjón A.^{2,1}, López-Solano J.^{2,1}, Bais A.³, Gröbner J.⁴, De Bock V.⁵, Karppinen T.⁶, and Vilaplana JM⁷

¹AEMET, Spain, ²Tragsatec, Spain, ³Aristotle University of Thessaloniki, Greece, ⁴PMOD/WRC, Switzerland,

⁵Royal Meteorological Institute of Belgium, Belgium, ⁶Finnish Meteorological Institute, Finland, ⁷National Institute for Aerospace Technology, Spain

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[SAT1_22] 12:42-12:44

Comparison of the Ozone Vertical Profiles based on the Umkehr Observations by Collocated the Dobson and Brewer Spectrophotometers at Belsk, Poland, for the Period 2011-2016

Janusz Jarosławski, Janusz Krzyścin, and Bonawentura Rajewska-Więch
Polish Academy of Sciences, Poland

[SAT1_23] 12:44-12:46

Ozone Measurement Complex in Tomsk (Russia)

Arshinov M.Y., Bazhenov O.E., Belan B.D., Belan S.B., Davydov D.K., Ivlev G.A., Kharchenko O.V., Kozlov A.V., Nevzorov A.A., Nevzorov A.V., Romanovkii O.A., and Tolmachev G.N.
V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

[SAT1_24] 12:46-12:48

Brewer Spectrophotometer Internal Spectral Stray Light Correction based on Physical Principles

Vladimir Savastiouk¹ and Henri Diémoz²

¹International Ozone Services Inc., Canada, ²ARPA Valle d'Aosta, Italy

[SAT1_25] 12:48-12:50

Implementation of the Comorian Observatory for Atmospheric Sciences: Ozone and UV Radiation Measurements

Mohamed Toihir Abdoulwahab¹, Hassan Bencherif², Thierry Portafaix², Gerrie Coetzee³, Sivakumar Venkataraman⁴, and Kevin Lamy²

¹Agence Nationale de l'Aviation Civile et de la Météorologie, France, ²LACy, France, ³South African Weather Service, South Africa, ⁴University of KwaZulu-Natal, South Africa

[SAT1_26] 12:50-12:52

Ozone Monitoring by NDACC FTIR Spectrometry: Improved Retrieval Strategy and Impact of Instrumental Line Shape Characterisation

Omaira E. García¹, Esther Sanromá^{1,3}, Matthias Schneider², Frank Hase², Sergio F. León-Luis^{1,4}, Thomas Blumenstock², Eliezer Sepúlveda¹, Alberto Redondas¹, Virgilio Carreño¹, Carlos Torres¹, and Natalia Prats¹

¹AEMET, Spain, ²Karlsruhe Institute of Technology, Germany, ³(Now) Employment Observatory of the Canary Islands, Spain, ⁴(Now) Tragsatec, Spain

[SAT1_27] 12:52-12:54

Ozone Observation of Dobson Spectrophotometer in Yonsei University

Jaemin Hong, Songkang Kim, Jhoon Kim, and Ja-Ho Koo
Yonsei University, Republic of Korea

[SAT1_28] 12:54-12:56

Machine-Learning-Based Satellite-Corrected Global Stratospheric Ozone Profile Dataset from a Chemical Transport Model

Sandip Dhomse¹, Carlo Arosio², Mark Weber², and Martyn Chipperfield¹

¹University of Leeds, UK, ²University of Bremen, Germany

V. Program Schedule

[SAT1_29] 12:56-12:58

Homogeneity of Total Ozone Data from Three Reanalyses

Peter Krizan, Michal Kozubek, and Jan Lastovicka

Institute of the Atmospheric Physics of the Czech Academy of Science, Czech Republic

[SAT1_30] 12:58-13:00

Reanalysis of the Long-Term Atmospheric Composition Datasets from the JPL Lidars at Table Mountain Facility, California, and Mauna Loa Observatory, Hawaii

Thierry Leblanc, Mark Brewer, Fernando Chouza, Darryl Koon, and Patrick Wang

NASA, USA

[SAT1_31] 13:00-13:02

Assessment of Interannual Variability of the Ozone Column in the Upper Troposphere and Lower Stratosphere between Different Reanalysis of the S-Rip

Mateus Dias Nunes¹, Simone M. Sievert. C. Coelho¹, Paulo Yoshio Kubota¹, and Michaela I. Hegglin²

¹INPE, Brazil, ²University of Reading, UK

[SAT1_32] 13:02-13:04

Measurements of Ozone Columns by IKFS-2 Spectrometer aboard Meteor-M N2 Satellite

Yana Virolainen, Alexander Polyakov, Georgy Nerobelov, and Yury Timofeyev

St. Petersburg State University, Russia

V. Program Schedule

[POSTER 7]

Date / Time **(Sat.) October 9, 2021 / 13:20-14:30 (UTC)**

Session Code **SAT2**

Session Chair **Sang Seo Park**

[SAT2_1] 13:20-13:22

The Stratospheric Aerosol and Gas Experiment (SAGE) IV Pathfinder

Robert Damadeo, Charles Hill, and Michael Oblund

NASA, USA

[SAT2_2] 13:22-13:24

Using Measurements from the Disturbance Monitoring Package in SAGE III/ISS Data Processing

Marsha LaRosee¹, David Huber³, Charles Hill², Kevin Leavor¹, Amy Rowell², Andrew Peterson², Robert Damadeo², Robert Manion¹, and David Flittner²

¹Science Systems and Applications, Inc., USA, ²NASA, USA, ³NOAA, USA

[SAT2_3] 13:24-13:26

Diurnal Scaling Factors for SAGE III/ISS: Using a 3D Model to Account for Time of Day Differences between Observing Platforms

Sarah Strode^{1,2}, Ghassan Taha^{1,2}, Luke Oman¹, and Mark Schoeberl³

¹NASA, USA, ²USRA, USA, ³Science and Technology Corporation, USA

[SAT2_4] 13:26-13:28

Total Ozone Columns from Multiple Satellite Sensors Homogeneously Validated against Global Ground-Based Measurements

Katerina Garane¹, Maria Elissavet Koukouli¹, Christophe Lerot², Tijl Verhoelst², Klaus-Peter Heue³, Pieter Valks³, Jonas Vlietinck², Fabian Romahn³, Walter Zimmer³, Dimitris Balis¹, Jean-Christopher Lambert², Michel van Roozendael², Diego Loyola³, and Christos Zerefos⁴

¹Aristotle University of Thessaloniki, Greece, ²BIRA-IASB, Belgium, ³DLR, Germany, ⁴Academy of Athens, Greece

[SAT2_5] 13:28-13:30

Measurements of Ozone and Related Species from Space using the Atmospheric Chemistry Experiment (ACE)

Kaley A. Walker, Patrick E. Sheese, and Jiansheng Zou

University of Toronto, Canada

[SAT2_6] 13:30-13:32

Error Budget Assessment for OMPS Limb Ozone Retrieval

Carlo Arosio¹, Alexei Rozanov¹, Mark Weber¹, Victor Gorshelev¹, Natalya Kramarova², Chris Roth³, and John P. Burrows¹

¹University of Bremen, Germany, ²NASA, USA, ³University of Saskatchewan, Canada

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[SAT2_7] 13:32-13:34

Assessment of AIRS, IASI, and CrIS Ozone Vertical Retrievals over the Central Himalaya

Prajjwal Rawat^{1,4}, Manish Naja¹, Evan Fishbein², R. Kumar³, P. Bhardwaj³, S. N. Tiwari⁴, S. Venkataramani⁵, and S. Lal⁵

¹Aryabhatta Research Institute of Observational Sciences, India, ²NASA, USA, ³NCAR, USA, ⁴Deen Dayal Upadhyaya Gorakhpur University, India, ⁵Physical Research Laboratory, India

[SAT2_8] 13:34-13:36

Continuing Validation of Stratospheric Ozone Profiles from the EUMETSAT Atmospheric Composition SAF

Peggy Achtert and Wolfgang Steinbrecht

Deutscher Wetterdienst Meteorologisches Observatorium, Germany

[SAT2_9] 13:36-13:38

Tropical Tropospheric Ozone from Sentinel-5P TROPOMI Data: Improvements and Synergies of the CHORA and CHOVA Cloud Related Ozone Retrievals

Kai-Uwe Eichmann, Swathi M. Satheesan, Mark Weber, and John P. Burrows

University of Bremen, Germany

[SAT2_11] 13:40-13:42

Assessment of Satellite Total Ozone Retrieval Errors in Polar Regions

David P. Haffner^{1,2}, Pawan K. Bhartia², Natalya A. Kramarova², Richard D. McPeters², Ramaswamy Tiruchirapalli^{1,2}, Gordon J. Labow^{1,2}, Jerald R. Ziemke^{3,2}, and Stacey M. Frith^{1,2}

¹Science Systems and Applications, Inc., USA, ²NASA, USA, ³Morgan State University, USA

[SAT2_12] 13:42-13:44

Early Results of Retrieving BrO from the Geostationary Environment Monitoring Spectrometer

Heesung Chong¹, Jhoon Kim¹, Gonzalo González Abad², Christopher Chan Miller², Rafael P. Fernandez^{3,4}, Alfonso Sáiz-López³, Caroline Nowlan², Xiong Liu², Kelly Chance², Dha Hyun Ahn¹, Hyeji Cha¹, Ja-Ho Koo¹, and Sang Seo Park⁵

¹Yonsei University, Republic of Korea, ²Harvard-Smithsonian Center for Astrophysics, USA, ³Institute of Physical Chemistry Rocasolano, Spain, ⁴National Scientific and Technical Research Council (CONICET), Argentina, ⁵UNIST, Republic of Korea

[SAT2_13] 13:44-13:46

Validations of GEMS Formaldehyde Retrieval Algorithm during IOT

Gitaek Lee¹, Rokjin J. Park¹, Hyeong-Ahn Kwon², Seunga Shin¹, Michel Van Roozendael³, and Francois Hendrick³

¹Seoul National University, Republic of Korea, ²Harvard-Smithsonian Center for Astrophysics, USA, ³BIRA-IASB, Belgium

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[SAT2_15] 13:48-13:50

Validations of Ozone Profiles from Satellite Remote Sensings using Ozonesonde Measurements over the Jang Bogo Station, Antarctica

Hana Lee¹, Taejin Choi², Dha Hyun Ahn¹, Seong-Joong Kim², Jaeil Yoo², Natalya Alekseyevna Kramarova³, Juseon Bak⁴, Jhoon Kim¹, and Ja-Ho Koo¹

¹Yonsei University, Republic of Korea, ²KOPRI, Republic of Korea, ³NASA, USA, ⁴Pusan National University, Republic of Korea

[SAT2_16] 13:50-13:52

Southern Hemisphere Additional Ozonesondes (SHADOZ) Project Update: 2021 Archive, Outreach and Data Quality Assurance Activities

Debra E. Kollonige¹, Anne M. Thompson², and Ryan M. Stauffer²

¹Science Systems and Applications, Inc., USA, ²NASA, USA

[SAT2_17] 13:52-13:54

Long Term Ozonesonde Observations at Sodankylä

Rigel Kivi¹, Pauli Heikkinen¹, Kenneth Nilsen², Roeland Van Malderen³, Deniz Poyraz³, Ryan M. Stauffer⁴, and Herman G. J. Smit⁵

¹Finnish Meteorological Institute, Finland, ²University of Oulu, Finland, ³Royal Meteorological Institute of Belgium, Belgium, ⁴NASA, USA, ⁵Institute of Energy and Climate Research: Troposphere (IEK-8), Germany

[SAT2_18] 13:54-13:56

SHADOZ Watukosek Station Update: Comparisons between (1998-2013; 2016-2020) Ozonesonde and Satellite Vertical Profiles

Ninong Komala¹, Habib Khirzin Al-Ghazali¹, Laily Fajarwati¹, Dian Yudha Risdiyanto¹, Dwinanda Puspitasari Harahap¹, Sigit Purnomo¹, and Anne Thompson²

¹National Institute of Aeronautics and Space, Indonesia, ²NASA, USA

[SAT2_19] 13:56-13:58

Evaluating Long-Term Changes in Atmospheric Ozone

David W. Tarasick¹, Herman G.J. Smit², Anne M. Thompson³, Gary A. Morris⁴, Jacquelyn C. Witte⁵, Jonathan Davies¹, Tatsumi Nakano⁶, Roeland Van Malderen⁷, Ryan M. Stauffer³, Bryan J. Johnson⁸, René Stübi⁹, Samuel J. Oltmans⁸, and Holger Vömel⁵

¹Environment and Climate Change Canada, Canada, ²Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ³NASA, USA, ⁴St. Edward's University, USA, ⁵NCAR, USA, ⁶JMA, Japan, ⁷Royal Meteorological Institute of Belgium, Belgium, ⁸NOAA, USA, ⁹MeteoSwiss, Switzerland

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[SAT2_20] 13:58-14:00

ASOPOS (Assessment of Standard Operating Procedures (SOPs) for OzoneSondes) 2.0: Ozonesonde Measurement Principles and Best Operational Practices

Debra E. Kollonige^{1,2}, Anne M. Thompson², Herman G.J. Smit³, Ryan M. Stauffer², David W. Tarasick⁴, Bryan J. Johnson⁵, Roeland Van Malderen⁶, Holger Vömel⁷, Peter von der Gathen⁸, Gary Morris⁹, and Richard Querel¹⁰

¹Science Systems and Applications, Inc., USA, ²NASA, USA, ³Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ⁴Environment and Climate Change Canada, Canada, ⁵NOAA, USA, ⁶Royal Meteorological Institute of Belgium, Belgium, ⁷NCAR, USA, ⁸Alfred Wegener Institut, Germany, ⁹St. Edward's University, USA, ¹⁰NIWA, New Zealand

[SAT2_21] 14:00-14:02

Antarctic Ozone Depletion Measured by Davis Ozonesondes 2003-2020

Matt Tully¹ and Andrew Klekociuk²

¹Bureau of Meteorology, Australia, ²Australian Antarctic Division, Australia

[SAT2_22] 14:02-14:04

Repeated Ozone Vertical Profiles over Cyprus using Adapted Ozonesondes

Maximilien Desservettaz¹, Christos Keleshis¹, Christos Constantinides¹, Panayiota Antoniou¹, Yunsong Liu¹, Mihalis Vrekoussis¹, Greg Kok², Jonathan Harnetiaux², and Jean Sciare¹

¹The Cyprus Institute, Cyprus, ²Environmental Science, USA

[SAT2_23] 14:04-14:06

New Insights from the Jülich Ozone-Sonde Intercomparison Experiments: Calibration Functions Traceable to One Ozone Reference Instrument

Herman G.J. Smit¹, Deniz Poyraz², Roeland Van Malderen², David W. Tarasick³, Holger Voemel⁴, Bryan J. Johnson⁵, Jonathan Davies³, Rene Stuebi⁶, Ryan M. Stauffer⁷, Anne M. Thompson⁷, Marc Allaart⁸, Gary Morris⁹, and Tatsumi Nakano¹⁰

¹Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ²Royal Meteorological Institute of Belgium, Belgium, ³Environment and Climate Change Canada, Canada, ⁴NCAR, USA, ⁵NOAA, USA, ⁶MeteoSwiss, Switzerland, ⁷NASA, USA, ⁸KNMI, The Netherlands, ⁹St. Edward's University, USA, ¹⁰JMA, Japan

[SAT2_24] 14:06-14:08

50 Years of Balloon-Borne Ozone Profile Measurements at Uccle, Belgium

Hugo De Backer¹, Roeland Van Malderen¹, Dirk De Muer¹, Deniz Poyraz¹, Willem W. Verstraeten¹, Veerle De Bock¹, Andy Delcloo¹, Alexander Mangold¹, Quentin Laffineur¹, Marc Allaart², Frans Fierens³, and Valérie Thouret⁴

¹Royal Meteorological Institute of Belgium, Belgium, ²KNMI, The Netherlands, ³Belgian Interregional Environment Agency (IRCEL - CELINE), Belgium, ⁴Université de Toulouse, France

V. Program Schedule

[SAT2_25] 14:08-14:10

Homogenisation of the Observation de Haute Provence ECC Ozonesonde Data Record: Comparison with Lidar and Satellite Observation

G. Ancellet¹, S. Godin-Beekmann¹, R. Bodichon⁵, A. Pazmiño¹, H.G.J. Smit², R.M. Stauffer³, and R. Van Malderen⁴

¹LATMOS, France, ²Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ³NASA, USA,

⁴Royal Meteorological Institute of Belgium, Belgium, ⁵IPSL, Sorbonne Université-UVSQ-CNRS/INSU, France

[SAT2_26] 14:10-14:12

Update on Lauder Ozonesonde Homogenisation

Richard Querel¹, Hisako Shiona¹, Alex Geddes¹, Deniz Poyraz², and Roeland Van Malderen²

¹NIWA, New Zealand, ²Royal Meteorological Institute of Belgium, Belgium

[SAT2_27] 14:12-14:14

The Cell Temperature of ECC Ozonesondes in Relation to the Measured Pump Temperature: Impact of Freezing and Boiling Effects Observed during JOSIE

Deniz Poyraz¹, Herman G.J. Smit², Roeland Van Malderen¹, Tatsumi Nakano³, and René Stuebi⁴

¹Royal Meteorological Institute of Belgium, Belgium, ²Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ³JMA, Japan, ⁴MeteoSwiss, Switzerland

[SAT2_28] 14:14-14:16

South Pole Station Ozonesonde 35-Year Record 1986-2020: Altitude Layer Metrics and Potential Recovery Layers Observed

Bryan Johnson¹, I. Petropavlovskikh^{1,2}, P. Cullis^{1,2}, and J. Booth¹

¹NOAA, USA, ²CIRES, USA

[SAT2_30] 14:18-14:20

Development and Testing of a Novel SO₂ Sonde

Paul J. Walter¹, James H. Flynn², Sergio Alvarez², Jonathan Harnetiaux³, Elizabeth Klovenski², Alex Kotsakis⁴, Gary A. Morris¹, Mark D. Spychala⁵, and Subin Yoon²

¹St. Edward's University, USA, ²University of Houston, USA, ³En-Sci, USA, ⁴NASA, USA, ⁵Army Research Laboratory, USA

[SAT2_31] 14:20-14:22

The Highest UV Index of the Marambio Station UV Time Series (2000-2020) Was Measured in November and December 2020

Kaisa Lakkala¹, Ricardo Sanchez², Margit Aun³, Jukka Kujanpää¹, Germar Bernhard⁴, Rigel Kivi¹, Leif Backman¹, Outi Meinander¹, Veijo Aaltonen¹, Eija Asmi¹, Antti Arola¹, Gustavo Copes², Germán Fogwill², Bjorn Johnsen⁶, Alberto Redondas⁵, Victoria Sofieva

¹Finnish Meteorological Institute, Finland, ²National Meteorological Service, Argentina, ³University of Tartu, Estonia, ⁴Biospherical Instruments, Inc, USA, ⁵AEMET, Spain, ⁶Norwegian Radiation and Nuclear Safety Authority, Norway

V. Program Schedule

[SAT2_32] 14:22-14:24

Comparison of SAGE III/ISS NO₂ Measurements with Ground-Based Observations from Lauder, NZ

David E. Flittner¹, Kimberlee Dubé², and Richard Quere³

¹NASA, USA, ²University of Saskatchewan, Canada, ³NIWA, New Zealand

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[POSTER 8]

Date / Time (Sat.) October 9, 2021 / 14:40-15:05 (UTC)

Session Code SAT3

Session Chair Stefan Reis, Kaley Walker

[SAT3_1] 14:40-14:42

Estimations of UV Index and Biological Dose Rates in Asia for GEMS Measurements

Hana Lee¹, Jhoon Kim¹, Ukkyo Jeong^{2,3}, Won-Jin Lee⁴, and Dongwon Lee⁴

¹Yonsei University, Republic of Korea, ²NASA, USA, ³University of Maryland, USA, ⁴National Institute of Environmental Research, Republic of Korea

[SAT3_2] 14:42-14:44

Estimation of UV Index over South Korea using Empirical Models, Random Forest, and Deep Neural Network

Jaemin Kim and Yun Gon Lee

Chungnam National University, Republic of Korea

[SAT3_3] 14:44-14:46

Changes in 2005-2020 Aura OMI Total Column Ozone and Ultra-Violet Index (UVI) over Indonesia and Their Connections to Regional Cloud Cover

Ninong Komala

National Institute of Aeronautics and Space, Indonesia

[SAT3_5] 14:48-14:50

Assessment of Impact of Tropospheric Ozone on Forest Site of Delhi, India by the Use of Mathematical Models

Pallavi Saxena¹, Monojit Chakraborty², Saurabh Sonwani¹, and Tushar Gautam¹

¹University of Delhi, India, ²LEA Associates South Asia Pvt. Ltd., India

[SAT3_6] 14:50-14:52

The Relationship between Ozone and Cardiorespiratory Mortality for Different Age Groups for Attica Region

Lida Dimitriadou^{1,2}, Kostas Eleftheratos², Christos Zerefos^{1,3,4,5}, and Panagiotis Nastos²

¹Academy of Athens, Greece, ²National and Kapodistrian University of Athens, Greece, ³Academy of Athens, Greece, ⁴Navarino Environmental Observatory, Greece, ⁵Mariopoulos-Kanaginis Foundation for the Environmental Sciences, Greece

[SAT3_7] 14:52-14:54

The SOUVENIR Project (Solar UV Extensive Network for Information and Reporting)

G. Fasano^{1,2}, H. Diémoz¹, A. M. Siani², L. Scacchi³, M. Depaoli⁴, M. Zublena¹, and I. Fountoulakis¹

¹ARPA Valle d'Aosta, Italy, ²Sapienza University of Rome, Italy, ³University of the Aosta Valley, Italy,

⁴Consultant Dermatologist

V. Program Schedule

[SAT3_8] 14:54-14:56

Comparison of Global UV Spectral Irradiance Measurements from a BTS Array Spectroradiometer versus a Double Brewer MK-III Spectrometer

C. González¹, J. M. Vilaplana¹, J. A. Bogaet¹, and A. Serrano²

¹National Institute for Aerospace Technology, Spain, ²Universidad de Extremadura, Spain

[SAT3_9] 14:56-14:58

Modelling Spectral UV Radiation at Marambio Base, Antarctic Peninsula Region, using Artificial Neural Networks

Klára Čížková^{1,2}, Kamil Láska², Ladislav Metelka¹, and Martin Staněk¹

¹Czech Hydrometeorological Institute, Czech Republic, ²Masaryk University, Czech Republic

[SAT3_10] 14:58-15:00

Variation of Stratospheric Ozone Concentration and Genotoxic Effects of Solar UV Radiation in Southern Brazil

Bruna Cogo Borin^{1,2}, Maurício Beux dos Santos^{1,2}, James Eduardo Lago Lonero^{1,2}, and André Passaglia Schuch^{1,2}

¹UFSM, Brazil, ²Southern Regional Space Research Center, CRS/INPE-MCTIC, Brazil

[SAT3_11] 15:00-15:02

Climatology of UV Index in South Region of Brazil

Bibiana Culau Lopes¹, Damaris Kirsch Pinheiro¹, Hassan Bencherif², Thierry Portafaix², and Nathalie Tissot Boiaski¹

¹UFSM, Brazil, ²LACy, France

[SAT3_12] 15:02-15:04

UV Index Behavior during Events of Influence of Antarctic Ozone Hole in Southern Region of Brazil

Bibiana Culau Lopes¹, Gabriela Dornelles Bittencourt¹, Damaris Kirsch Pinheiro¹, Hassan Bencherif², and Lucas Vaz Peres³

¹UFSM, Brazil, ²LACy, France, ³UFOPA, Brazil

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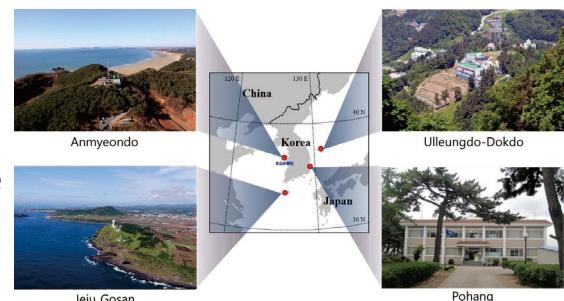
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Global Atmosphere Watch Team / Innovative Meteorological Research Department

[KMA GAW stations]

- ▶ Korean GAW activities and related research
- ▶ Comprehensive monitoring of Asian dust and haze
- ▶ Observation and Analysis study on atmospheric compositions
(A total of 36 atmospheric constituents, including greenhouse gases, reactive gases, aerosols, and stratospheric ozone/UV)



< Atmospheric species monitored in Korea >

	Greenhouse Gases	Reactive Gases	Aerosols	Stratospheric O ₃ / Ultra Violet	Atmospheric Radiation	Atmospheric Deposition
Anmyeondo	CO ₂ , CH ₄ N ₂ O SF ₆ CFCs	O ₃ CO NO _x SO ₂	PM ₁₀ Size distribution(_{0.01~20 μm}) Optical properties ¹⁾ Water soluble Ions ²⁾ Elements ³⁾	Total Column O ₃ UV-A UV-B	Solar Terrestrial	Acidity Conductivity
Jeju Gosan	CO ₂ , CH ₄ N ₂ O SF ₆		PM ₁₀ Size distribution(_{0.5~20 μm}) Number concentration(_{0.01~3 μm}) Optical Depth		Solar	
Ulleungdo	CO ₂ , CH ₄ N ₂ O SF ₆	CO	PM ₁₀ Size distribution(_{0.5~20 μm}) Optical Depth	UV-A UV-B		Precipitation ion components
Dokdo						
Pohang	CO ₂ , CH ₄			O ₃ profile UV-A UV-B		

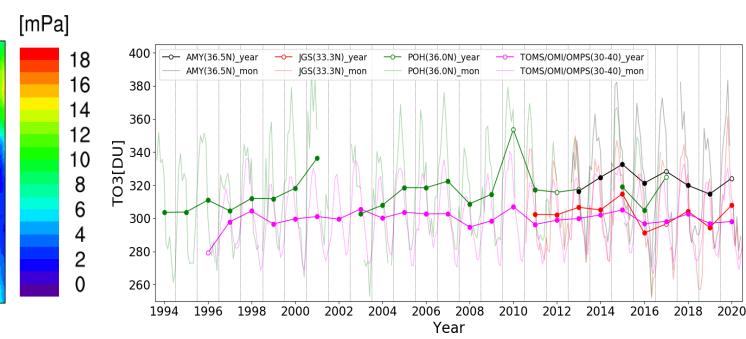
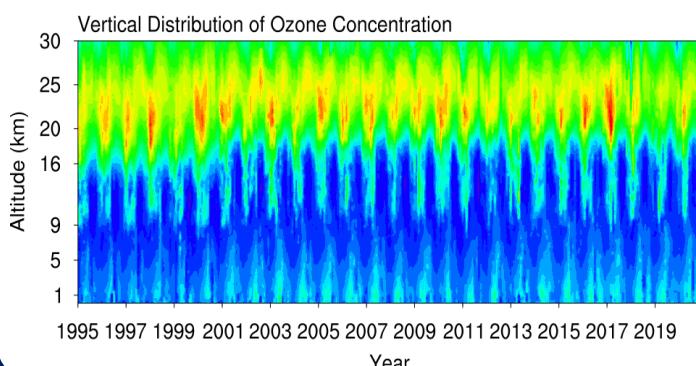
1) AOD, Scattering coefficient, Absorption coefficient, Vertical properties

2) F⁻, Cl⁻, NO₃⁻, SO₄²⁻, Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺

3) Al, Ca, Fe, K, Mg, Na, S, Ti, Mn, Zn, Cu, V, Cr, Co, Ba, Pb, Ni

Stratospheric Ozone observation

- ▶ The analysis of stratospheric ozone is performed through observation of the vertical ozone (obtained from ozonesonde at Pohang) and the total column ozone (obtained from Brewer spectrophotometer at Anmyeondo and Jeju-Gosan)
- ▶ Vertical ozone has been observed in Pohang since 1995, and the total amount of ozone has been observed in Anmyeondo and Jeju-Gosan since 2013 and 2011, respectively.
- ▶ Observation of total column ozone was also conducted in Pohang since 1995, but was stopped in 2017
- ▶ An ozonesonde is launched once a week to monitor the vertical distribution of ozone up to an altitude of 30 km

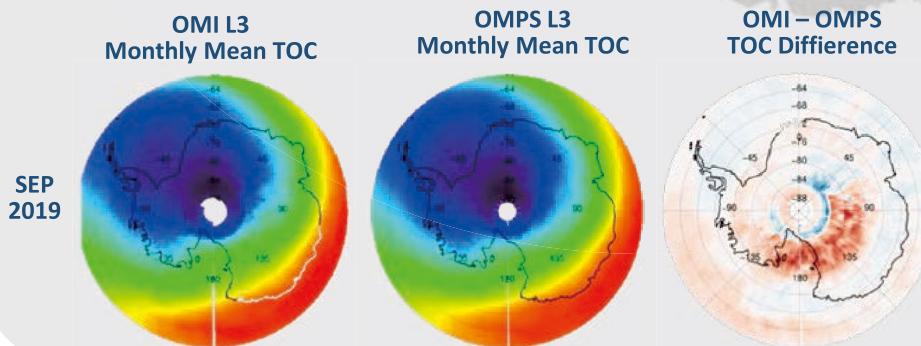


Assessment for the climate and environment change in Antarctica and its global influence

In Antarctica, rapid warming has been appreciable only over its western part, in contrast with the rapid arctic warming at the Pan-Arctic scale. Despite the importance of Antarctic warming that is associated with ice sheet disintegration and sea level rise, the reason why there is a significant asymmetry in climate responses remains uncertain. Synthetic analyses through multiple data sources, such as modern in-situ observation data, observation model-combined reanalysis data, reconstructed data using paleo-proxy records, multimodel simulation data, and self-generated sensitivity simulation data with climate models, the Korea Polar Research Institute discovered the cause of the west-east climate asymmetry that originates from the harmony of the atmosphere-ocean coupled feedback off West Antarctica and the Antarctic terrain, as an internal mode.

Continuous observations of the physical properties of aerosol particles (e.g., number concentration, size distribution, and Cloud condensation nuclei concentration) have been carried out since March 2009 at King Sejong Station in the Antarctic Peninsula.

We have recorded total amount of ozone concentrations since 1998 to the present at King Sejong Station and since 2014 at Jang Bogo Station. From these observations and satellite records, we detected the slow recovery of ozone during springtime that might be related to steadily reducing ozone depleting substances.

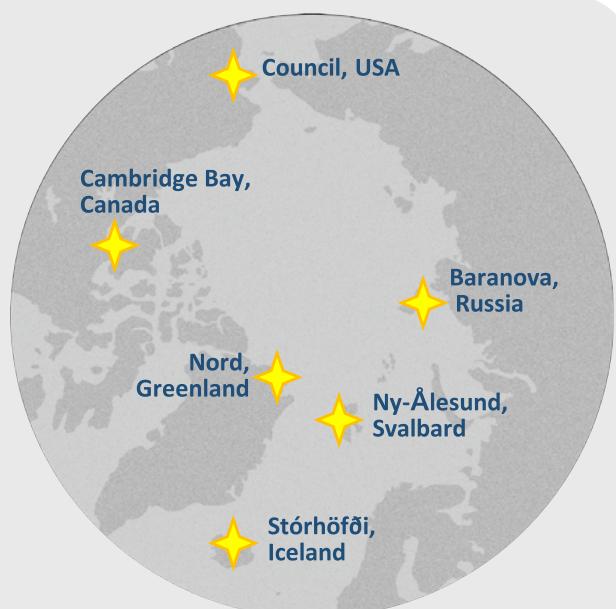


Total ozone column (TOC) data from KOPRI's King Sejong and Jang Bogo Antarctic Research stations were used to evaluate satellite derived TOC (*Remote Sens.* 2021, 13(8), 1594; <https://doi.org/10.3390/rs13081594>)

Circum-Arctic Environmental Changes: Monitoring, Assessment, Projection and Adaptation Strategy Development(CA-MAP)

The rapid climate change in the Arctic has various impacts on the global climate as well as the midlatitudes. As part of the project to detect rapidly changing environments in the Arctic, the project team is conducting continuous permafrost environment research based on six observation nodes.

Under the CA-MAP project supported by Korean Government(MSIT), KOPRI scientists are collaborating with numerous domestic and international researchers in the field of permafrost climate monitoring and assessments, long term ecological change, atmospheric composition monitoring, etc.



Arctic permafrost observation nodes operated by KOPRI : KOPRI has collaborated with Arctic Council countries to develop research program for each site.

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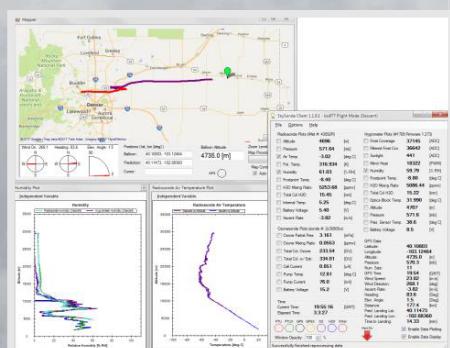
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- ☒ Coming Soon: iMet-X4; UAV sensor package with multiple atmospheric variable measurement options including O3/NO2

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