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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

<table>
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<tr>
<th>UTC Time Zone</th>
<th>Oct 3 (Sun)</th>
<th>Oct 4 (Mon)</th>
<th>Oct 5 (Tue)</th>
<th>Oct 6 (Wed)</th>
<th>Oct 7 (Thu)</th>
<th>Oct 8 (Fri)</th>
<th>Oct 9 (Sat)</th>
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</table>
| 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)  
- Q&A (15 min) | 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   | Break (10 min) | Break (10 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) | Break (10 min) | Break (10 min) |
| 12:20-12:30   | Break (10 min) | Break (10 min) | | Break (20 min) | | | Break (10 min) |
| 12:30-12:40   | Break (10 min) | Break (10 min) | | Break (20 min) | | | Break (10 min) |
| 12:40-12:50   | Break (10 min) | Break (10 min) | | Break (20 min) | | | Break (10 min) |
| 12:50-13:00   | Break (10 min) | Break (10 min) | TUE3 - Session A&B  
- Poster Presentation  
(2 min per 1 poster) | THU3 Poster 4 - Session D  
- Poster Presentation  
(2 min per 1 poster) | FRI3 Poster 5 - Session C  
- Poster Presentation  
(2 min per 1 poster) | Break (10 min) | Break (10 min) |
| 13:00-13:10   | | | | | | | Break (10 min) |
| 13:10-13:20   | | | | | | | Break (10 min) |
| 13:20-13:30   | | | | | | | Break (10 min) |
| 13:30-13:40   | | | | | | | Break (10 min) |
| 13:40-13:50   | | | | | | | Break (10 min) |
| 13:50-14:00   | | | | | | | Break (10 min) |
| 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) |
| 14:10-14:20   | | | | | | | Break (10 min) |
| 14:20-14:30   | | | | | | | Break (10 min) |
| 14:30-14:40   | | | | | | | Break (10 min) |
| 14:40-14:50   | | | | | | | Break (10 min) |
| 14:50-15:00   | | | | | | | Break (10 min) |
| 15:00         | | | | | | | Closing Remark |

**Session 1** Stratospheric ozone science  
**Session 2** Ozone-depleting substances, sources, sinks, and budgets  
**Session 3** Tropospheric ozone science  
**Session 4** Ozone, Climate, and Meteorology  
**Session 5** Ozone monitoring and measurement techniques  
**Session 6** Environmental and human health effects of atmospheric ozone and UV
## Opening & Awards Ceremony

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

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<thead>
<tr>
<th>Time (UTC)</th>
<th>Program</th>
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<tr>
<td>12:00-12:10</td>
<td>Welcome Remark</td>
<td>Seoung Hwan Suh (President, Yonsei University)</td>
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<td>12:10-12:20</td>
<td>Opening Remark</td>
<td>Sophie Godin-Beekmann (President, IO3C)</td>
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<td>12:20-12:35</td>
<td>Awards Ceremony&lt;br&gt;Award (Dobson and Farman Award)&lt;br&gt;- <strong>Dobson Award</strong>&lt;br&gt;William Ball&lt;br&gt;- <strong>Joseph C. Farman Award</strong>&lt;br&gt;P.K. Bhartia&lt;br&gt;Stacey Frith&lt;br&gt;Natalyna Kramarova&lt;br&gt;Gordon Labow&lt;br&gt;Richard McPeters&lt;br&gt;Richard Stolarski</td>
<td>Irina Petropavlovskikh (Secretary, IO3C)</td>
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<tr>
<td>12:35-12:50</td>
<td>Announcement from LOC</td>
<td>Ja-Ho Koo (Yonsei University)</td>
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III. Sponsors and Supporters

Organized by

Supported by

National Institute of Environmental Research
National Institute of Meteorological Sciences
International Association of Meteorology and Atmospheric Sciences
Stratosphere-troposphere Processes And their Role in Climate

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Korea Polar Research Institute
Institute of Natural Sciences, Yonsei University

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                   Wolfgang Steinbrecht       Germany
                   Johanna Tamminen            Finland
                   Matthew Tully               Australia
                   Michel van Roozendael      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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                         Seok-Woo Son        Seoul National University
                         Chul Han Song       Gwangju Institute of Science and Technology
                         Young-Jun Yoon      Korea Polar Research Institute
                         Dong-Won Lee        National Institute of Environmental Research

Staff

Hana Lee, Dha Hyun Ahn, Songkang Kim
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

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.
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, HFCs, HCFCs, 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), CCIF, CHFClF3, bromine-containing halons, and CHBrBr. 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, CCIF, CHFClF3, HCFCs, HFCs, PFCs plus selected very-short lived substances) obtained at a remote coastal station of Goseon (33°N, 126°E, 79 m a.s.l) in Jeju island, Korea for 2008 – 2020. The Goseon station runs 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. Goseon 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

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.
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.
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.
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 (R2=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 (RAQMP) 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 RAQMP 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.
V. Program Schedule

(Sun.) October 3
(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 Ahn³, Seong-Joong Kim², Taejin Choi², Jhoon Kim₁, and Ja-Ho Koo¹
¹Yonsei University, Republic of Korea, ²KOPRI, Republic of Korea

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, Nawa Eguchi¹, and Krüger Kirstin²
¹Kyushu University, Japan, ²University of Oslo, Norway

The Sudden Stratospheric Warming and Polar Processing of the Antarctic Winter 2019: Comparison with the Winters of 1988 and 2002
R. Roy¹, J. Kuttippurath¹, F. Lefèvre³, S. Raj¹, and P. Kumar¹
¹Indian Institute of Technology Kharagpur, India, ³Cochin University of Science and Technology, India

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 Nakamura¹, Toshihiko Hooroka¹, Hidetosuke Akiyoshi¹, Takafumi Sugita³, and Akira Mizuno⁴
¹Kyushu University, Japan, ³Fujitsu Japan Corporation, Japan, ⁴National 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 Pinheiro⁵, Hassan Bencherif⁷, Gabriela Dornelles Bittencourt⁷, Thierry Portafaix³, Nelson Bègue⁴, José Valentin Bageston⁶, Vagner Anabor⁶, 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-Martín¹, 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. Kostrykin¹, 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 Weimer¹², Jennifer Buchmüller², Lars Hoffmann³, Ole Kirner², Beiping Luo⁴, Roland Ruhnke⁵, Michael Steiner⁶, Ines Tritscher⁷, and Peter Braesicke⁷
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

Record Low Ozone Values Observed in the Arctic in Spring 2020
Ingo Wohltmann1, Peter von der Gathen1, Ralph Lehmann1, Marion Maturilli1, Holger Deckelmann1, Gloria Manney2, Jonathan Davies3, David Tarasick4, Nis Jepsen3, Rigel Kivi6, Norrie Lyall1, and Markus Rex1
1 Alfred Wegener Institute for Polar and Marine Research, Germany, 2New Mexico Tech, USA, 3Environment and Climate Change Canada, Canada, 4Danish Meteorological Institute, Denmark, 5Finnish Meteorological Institute, Finland, 6Met Office, UK

Simulation of Record Arctic Stratospheric Ozone Depletion in 2020
Jens-Uwe Groos 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.Blazak2, J. Gross3, R. E. Kajtar2, and M. Milz2
1Swedish Institute of Space Physics, Sweden, 2Luleå Technical University, Sweden, 3Karlsruhe Institute of Technology, Germany

Observations of the 2020 Record-Breaking Ozone Holes and the Canadian Brewer and Pandora Programs
Xiaoyi Zhao1, Vitali Fioletov2, Michael Brohart1, Volodya Savastiouk2, Ihab Abboud1, Akira Ogyu1, Jonathan Davies1, Reno Sit2, Sum Chi Lee3, Alexander Cede3,4, Martin Tiefengraber3,5, Moritz Müller3,5, David Tarasick1, Kristof Bognar4, Ramina Alwarda1,6,7, Kimberly Strong4, Tim Holland2, Joseph Samaniego1, Marisa Gedney2, 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

Evolution of Low Total Column Ozone Anomalies in Summer 2020 in the Northern Hemisphere Extratropics
Stacey M. Frith1,2, Natalya Kramarova3, Paul Newman2, Eric Nash1,2, Jerald Ziemke2,3, and Susan E. Strahan2,4
1Science Systems and Applications, Inc., USA, 2NASA, USA, 3Morgan State University, USA, 4USRA, USA

Simulation of a 2020 Arctic Ozone Hole in the World Avoided by the Montreal Protocol
Catherine Wilka1, Susan Solomon4, Doug Kinnison3, and David Tarasick4
1Stanford University, USA, 2MIT, USA, 3NCAR, USA, 4Environment and Climate Change Canada, Canada

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

Analysis of Arctic Spring Ozone Anomaly in the Phases of QBO and 11-Year Solar Cycle for 1979–2017
Yousuke Yamashita1,2, Hideharu Akiyoshi1, and Masaaki Takahashi1
1National Institute for Environmental Studies, Japan, 2JAMSTEC, Japan

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

High Vertical Resolution Modeling and its Impact on QBO Induced Changes in Ozone and Other Dynamically Important Trace Gases
Luke Oman1, Olga Tweedy1,2, and Susan Strahan2
1NASA, USA, 2USRA, USA

OMPS LP V2.0 Stratospheric Aerosol Extinction Profile Data Records
Ghassan Taha1,3, 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, Ugor 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 Huijnen2, 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

Deep Learning Forecast of Stratospheric Ozone Advection
Luiz-Angelo Steffenel1, Vagner Anabor2, Damaris Kirsch-Pinheiro2, and Hassan Bencherif3
1University of Reims Champagne Ardenne, France, 2UFSM, Brazil, 3University of Reunion Island, France
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
  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 Grooß7, Michael Höpfner8, Alyx Lambert9, Beiping Luo10, Sergey Molleker11, Andrew Orr11, Ross Salawitch12, Marcel Snels13, Reinhol 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 Froidevaux2, Douglas E. Kinnison3, Charles G. Bardeen4, Nathaniel J. Livesey5, Michelle L. Santee1, Gloria L. Manney4,4, Alyx Lambert9, 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, Nils Jepsen6, Georg Hansen6, 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 Feng¹,², Sandip S. Dhomse¹,², Carlo Arosio³, Mark Weber⁴, John P. Burrows⁴, Michelle L. Santee⁵, and Martyn P. Chipperfield¹,²
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 Chipperfield¹, 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. Ball¹,², Gabriel Chiodo³, Justin Alsing⁴, Thomas Peter⁵, Jerald Ziemke⁶,⁷, Sean Davis⁷, Mohamadou Diallo⁸, Lucien Froidevaux⁹, Birgit Hassler¹⁰, Till Hoffmann¹¹, Daan Hubert¹², and James Keeble¹³,¹⁴
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 Wargan¹², Jacquelyn C. Witte¹, Debra E. Kollonige¹², and Jerald R. Ziemke¹⁴  
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 Bednarcz², Ryan Hosein¹, Luke Abraham²³, 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. Canty¹, Greta Eastham², Stacey Frith³, and Ross J. Salawitch¹⁴  
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. Salawitch¹², Laura A. McBride¹, Walter R. Tribett¹, Timothy P. Canty¹, Brian F. Bennett¹, Pamela A. Wales⁵⁴, James W. Hannigan⁶, Emmanuel Mahieu⁶, Maxime Prignon⁶, John Daniel⁷, Bradley Hall⁷, Stephen A. Montzka⁷, Elena Spinei⁷, George H. Mount⁸, Kelly Chance¹⁰, Raid M. Suleiman¹⁰, Sungyeon Cho¹¹, Deanna Donohoue¹², Thomas P. Kurosu¹, and William R. Simpson¹  
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

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 Weber, Roland Ruhnke, Christian Scharun, Axel Seifert, and Peter Braesicke
1 Karlsruhe Institute of Technology, Germany, 2 German Weather Service, Germany

[MON3_2] 14:12-14:14
The Long-Term Historical Ozone Changes Detected in SOCOLv4 Simulations and Observations
Arseniy Karagodin, Eugene Rozanov, Timofei Sukhodolov, Tatiana Egorova, William Ball, and Thomas Peter
1 PMOD/WRC, Switzerland, 2 ETH Zurich, Switzerland, 3 St. Petersburg State University, Russia, 4 TU Delft, The Netherlands

[MON3_3] 14:14-14:16
Comparison of Stratospheric Ozone Trends from Satellite Data and Model Simulations
Kristof Bognar, Doug Degenstein, Susann Tegtmeier, Adam Bourassa, David Plummer, Chris Roth, and Daniel Zawada
1 University of Saskatchewan, Canada, 2 Environment and Climate Change Canada, Canada

[MON3_4] 14:16-14:18
Recent Lower-Stratospheric Ozone Trends in Chemistry Climate Models
Simone Dietmüller, Hella Garry, Roland Eichinger, and William Ball
1 DLR, Germany, 2 Ludwig Maximilian University of Munich, Germany, 3 Charles University, Czech Republic, 4 TU 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
1 Finnish Meteorological Institute, Finland, 2 University of Saskatchewan, Canada, 3 University of Bremen, Germany, 4 Institute of Meteorology and Climate Research, Germany, 5 CalTech, USA, 6 NOAA, USA, 7 BIRA-IASB, Belgium, 8 ESA/ESRIN, Italy
[MON3_7] 14:22-14:44
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 Dhomse2,3, Martyn Chipperfield2,3, Wuhu Feng2,4, Andreas Chrysanthou5, and Dong Guo6
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 Portmann3
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 Diouf1, Felix Ploeger1,2, William T. Ball2, Michaela I. Hegglin4, Gabriel Chiardo5, 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
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 Haefele2, Achille Joubert2, René Stübi1, Irina Petropavlovskikh3, Koji Miyagawa4, and Martin Stanek5
1MeteoSwiss, Switzerland, 2Swiss Federal Institute for Forest, Snow and Landscape Research, Switzerland, 3CRES, 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
Hassen Bencherif¹, Lucas Vaz Peres², Olivier Delage¹, Nelson Bègue¹, Gabriela Dornelles Bittencourt¹, Maria Paulete Pereira Martins², Francisco Raimundo da Silva³, Thierry Portafaix⁴, 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
Alekandr N. Gruzdev and Aleksandr S. Elohov
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
Daegueun 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 Alekandr 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 Orsolini⁴, Andrea Pazmiño⁵, and Tove Svendby¹
¹NILU, Norway, ²University of Oslo, Norway, ³LATMOS/IPSL/UVSQ-CNRS, France, ⁴NTNU, Norway

[MON3_18] 14:44-14:46
Catherine Wespès¹, Daniel Hurtmans¹, Anne Boynard², Sarah Safieddine², Marie Bouillon², Simon Chabrolat³, Stamatia Doniki¹, Cathy Clerbaux², and Pierre-François Coheur¹
¹Université Libre de Bruxelles, Belgium, ²Sorbonne Université, France, ³BIRA-IASB, Belgium, ⁴SPACIA, 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 Orte³, Héctor Ochoa⁴, Elian Wolfram⁵, María Elea Barlasina¹, Lino Condori¹, and Fernando Nollas¹
¹Servicio Meteorológico Nacional, Argentina, ²UNAM, México, ³CEPROCOR-CONICET, Argentina, ⁴Argentine Antarctic Institute, Argentina, ⁵CEILAP, UNIDEP (CITEDEF-CONICET), Argentina
V. Program Schedule

[MON3_20] 14:48-14:50
Michal Janouch¹, Ladislav Siegel², 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 Pinheiro², Gabriela Dornelles Bittencourt³, Nelson Bégue⁴, 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. Manney²,³, 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 Chipperfield¹, and Francois Hendrick³
¹NIWA, New Zealand, ²University of Leeds, UK, ³BIRA-IASB, Belgium
V. Program Schedule

(Tue.) October 5
(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
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. Manney2,3, M. Santee3, and N. Livesey3
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. Wild⁵, Klaereti Tourpali⁷, John P. Burrows², 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. Degenstein², D. Zawada³, V. Sofieva⁴, L. Froidevaux⁵, S. Frith⁶, J. Wild⁷, S. Davis⁸, W. Steinbrecht⁹, T. Leblanc⁵, R. Querel⁶, D. Hubert¹⁰, K. Tourpali¹¹, and R. Damadeo⁴
¹LATMOS Sorbonne Université UVSQ CNRS, France, ²NOAA, USA, ³University of Saskatchewan, Canada, ⁴Finish Meteorological Institute, Finland, ⁵CaiTech, 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 Kinnison⁴, Rolando Garcia⁵, 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 Strahan¹,², Dan Smale³, Ghassan Taha¹,², Megan Damon¹,², Stephen Steenrod¹,², Nicholas Jones³, Ben Liley³, John Robinson³, and Richard Querel²
¹NASA, USA, ²USRA, USA, ³NIWA, New Zealand, ⁴Science Systems and Applications, Inc., USA, ⁵Wollongong University, Australia

Q&A 12:35-12:45
[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 Feng1, Alistair Manning3, Eric Ray1, Bradley D. Hall1, Helen Walter Terrinoni4, Christina Theodorid15, 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 Hu1, Stephen Montzka1, Fred Moore1, Eric Hintsa1, Carolina Siso1, Geoff Dutton1, Kirk Thoning1, Robert Portmann1, Kathryn McKin1, Colm Sweeney1, David Nance1, Isaac Vimont2, Arlyn Andrews3, Phil DeCola4, Brad Hall4, James Elkins1, and Steven Wofsy4
1CfRES, USA, 2NOAA, USA, 3University of Maryland, USA, 4Harvard University, USA

[TUE2_4]
13:25-13:30
Observation-Based Emissions of Anthropogenic CHBr3 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 Kim4, Peter K. Salameh5, Christina M. Harth5, Bronwyn L. Dunse5, Paul B. Krummel6, 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

Comparison of Recent Observed Trends in Hydrofluorocarbons and Inferred Emissions with Projections
Guus J.M. Velders1, John S. Daniel2, Stephen A. Montzka3, Isaac Vimont4, and Matthew Rigby5
1RIVM, The Netherlands, 2Utrecht University, The Netherlands, 3NOAA, USA, 4University of Bristol, UK

Integrated Ozone Depletion: A New Metric for Ozone Recovery
John Pyle1, James Keeble1, Luke Abraham1, Martyn Chipperfield3, and Paul Griffiths1
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]

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<td>Matt Tully, Karin Kreher, Steve Montzka</td>
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<th>[TUE3_1]</th>
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<tr>
<td><strong>The MIPAS Climatology of Bromine Nitrate (BrONO$_2$) in Comparison to Atmospheric Modelling</strong></td>
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<td>Michael Höpfner, Oliver Kirner, Gerald Wetzel, Björn-Martin Sinnhuber, Florian Haenel, Johannes Orphal, Roland Ruhnke, Gabriele Stiller, and Thomas von Clarmann</td>
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<th>[TUE3_2]</th>
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<td><strong>Multiyear Study of OCIO in the Austral Low Stratosphere as Observed from the Belgrano (78° S) and Marambio (64° S) NDACC Sites</strong></td>
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<td>Cristina Prados-Roman$^1$, Gaia Pinardi$^2$, José Antonio Adame$^1$, Olga Puentedura$^1$, Mónica Navarro Comas$^1$, Laura Gómez-Martín$^1$, Héctor Ochoa$^2$, Michel Van Roozendael$^2$, and Margarita Yela$^1$</td>
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<td>$^1$National Institute for Aerospace Technology, Spain, $^2$BIRA-IASB, Belgium, $^3$Argentinian Antarctic Institute, Argentina</td>
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<th>[TUE3_3]</th>
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<td><strong>The Chemical Impact of Extreme Solar Events in the Middle Atmosphere</strong></td>
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<td>Thomas Reddmann$^1$, Monali Borthakur$^1$, Miriam Sinnhuber$^1$, Ilya Usoskin$^2$, and Jan-Maik Wissing$^3$</td>
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<td>$^1$Karlsruhe Institute of Technology, Germany, $^2$University of Oulu, Finland, $^3$University of Rostock, Germany</td>
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<th>[TUE3_4]</th>
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<td><strong>Exploring Short-Term Variations in Mesospheric Ozone due to Large-Scale Solar Flares using a Ground-Based Millimeter-Wave Radiometer at Rikubestu, Japan and Aura/MLS Ozone Measurements</strong></td>
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<td>Tomoo Nagahama, Akira Mizuno, Taku Nakajima, and Tianliang Yang</td>
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<th>[TUE3_5]</th>
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<td><strong>Revising 11-Year Solar Cycle Signal in the Stratospheric Ozone using MLS and SORCE Satellite Measurements</strong></td>
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<td>Sandip Dhomse$^1$, Martyn Chipperfield$^1$, Wuhu Feng$^1$, and Ryan Hossaini$^2$</td>
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<td>$^1$University of Leeds, UK, $^2$University of Lancaster, UK</td>
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<th>[TUE3_6]</th>
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<td><strong>Investigating the Ozone-Climate Feedback of Geomagnetic Forcing using ICON-ART-LINOZ</strong></td>
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<td>Maryam Ramezani Ziarani, Thomas Reddmann, Katerina Kusakova, and Miriam Sinnhuber</td>
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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 Verhoest², Arno Keppens³, Steven Compemolle¹, Carlo Arosio², Viktoria Sofieva³, and Jean-Christopher Lambert⁴
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 Bittencourt¹,², 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 Carbajal 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. Kizer¹,²; M. Roelf², D. Flittner³, R. Damadeo³, C. Roller¹,², D. Hurst¹,², E. Hall¹,², A. Jordan³,⁴, P. Cullis³,⁴, B. Johnson⁴, and R. Quere⁵
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. Fleming¹,², Qing Liang¹, Luke D. Oman¹, Paul A. Newman¹, Feng Li¹,², 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 Theodoridi¹, 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 Maloney¹,², Martin Ross³, 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 Yamashita¹,²
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 Sukhodolov²,³, Tatiana Egorova²,³, Eugene Rozanov²,³, Gabriel Chiodo⁴,⁵, Andrea Stenke⁶, and Thomas Peter⁷
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. Vollmer², Stephan Henne¹, Lukas Emmenegger³, 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 Nakajima¹,², Masanori Takeda¹, Isao Murata², Tomoo Nagahama³, Isamu Morino¹, and Geoffrey C. Toon⁴
¹National Institute for Environmental Studies, Japan, ²Tohoku University, Japan, ³CalTech, USA, ⁴Now) 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. Redington⁴, Stephan Henne⁴, Xuekun Fang⁴, Lei Hu⁵, Stephen A. Montzka⁶, Paul J. Fraser⁶, Christina M. Harth⁷, Ove Hermansen⁸, Jooli Kim⁹, Paul B. Krummel⁸, Lambert Kuijpers¹⁰, Chris Lund¹⁰, Jens Mühle¹⁰, Simon O’Doherty¹, Stefan Reimann¹, Peter K. Salameh¹, Daniel Say¹, Christina Theodoridi¹,², Martin K. Vollmer⁴, Helen Walter-Terrinoni¹³, Dickon Young¹, Ray F. Weiss¹⁰, Ronald G. Prinn¹⁰, and Matthew Rigby⁷
¹University of Bristol, UK, ²Kyungpook National University, Republic of Korea, ³Met Office, UK, ⁴EMPA, Switzerland, ⁵Zhejiang University, China, ⁶NOAA, USA, ⁷CIES, 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 HFCslifetimes and Emissions**
Peidong Wang1, Jeffery R. Scott1, Susan Solomon1, John Marshall1, Andrew R. Babin1, Megan Lickley1, David W. J. Thompson2, Timothy DeVries3, Qing Liang4, and Ronald G. Prinn5
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 Grooß5, Peter Hoor2, Tilman Hünke2, Timo Keber1, Flora Kluge4, Ben Schreiner1, Tanja Schuck1, Bärbel Vogel1, Andreas Zahn1, 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, C3H8, HCOOH, and PAN in the UTLS: Observations and Simulations**
Gerald Wetzel1, Felix Friedl-Vallon1, Norbert Glatthor1, Jens-Uwe Grooß2, Thomas Guilde1, Michael Höpfner1, Sören Johansson1, Farahnaz Khoorsawi1, Oliver Kirner1, Anne Kleinert1, Erik Kretzschmer1, Guido Maucher1, Hans Nordmeyer1, Hermann Oelhaf1, Johannes Orphal1, Christof Plesch1, Björn-Martin Sinnhuber1, Jörn Ungermann1, and Bärbel Vogel1
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 Tomikawa2,3, 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. Andersen³, and Richard (“Tad”) Ferris⁴
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. Verronen¹, and Monika E. Szeląg²
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
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

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 Liu1,2, Sarah A. Strode1,2, Qing Liang3, Luke D. Oman4, Peter R. Colarco2, Eric L. Fleming3, Michael E. Manyin3, Jerald R. Ziemke3, and Lok N. Lamsal1,2
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
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
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 Heue2,3, Jean-Christopher Lambert1, Tijl Verhoest1, Arno Keppens1, Steven Compere2, Angelika Dehn4, Debra E. Kollonige5,6, Christophe Lerot1, Diego Loyola2, Fabian Romahn2, Anne M. Thompson6, Pepijn Vreekind7, Claus Zehner8, 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 O, Production Efficiency During the KORUS-AQ Campaign
Yujin J. Oak1, Rokjin J. Park1, Jason R. Schroeder2,3, James H. Crawford4, Donald R. Blake5, Andrew J. Weinheimer5, Jung-Hun Woo5, Sang-Woo Kim1, Huidong Yeo1, Alan Fried7, Armin Wisthaler8,9, 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 Drews3, Simone Tilmes3, Louisa Emmons3, 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. Granier¹, H. Denier van der Gon³, J. Kuenen⁳, S. Arrellano⁴, S. Darras⁵, J. Doubalova⁶, B. Galle⁶, M. Gauss⁴, M. Guevara⁵, J.P. Jalkanen⁵, C. Liousse¹, D. Simpson¹, 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 Sudo¹,² 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

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 Li¹² and Paul Newman³
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 Chiodo¹², Andrea Stenke¹, Daniela I.V. Domeisen¹, Stephan Fueglistaler², Julien Anet³, 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 Lin¹² 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 Wohltmann², Ross J. Salawitch³, and Markus Rex¹⁴
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 Chiodo¹² and Lorenzo M. Polvani²³
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. Manney¹²³, 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. Querel²
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
V. Program Schedule

(Thu.) October 7
(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 Beach³, Chunhui Pan⁴, 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 Verhoest¹, Daan Hubert¹, Arno Keppens¹, Steven Compernolle¹, Jean-Christopher Lambert¹, Alberto Redondas², and Alexander Cede³⁴
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 Verhoest, 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 Siddans³, Brian Kerridge³, Michel van Roozendael⁴, 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 Ozoneonde Records
Roeland Van Malderen¹, Deniz Poyraz¹, Herman G.J. Smit², Gonzague Romanens³, René Stübi², Gérard Aancellet⁴, Sophie Godin-Beekmann⁴, Natalia Prats⁵, Carlos Torres⁵, Wolfgang Steinbrecht⁶, Marc Allaart⁷, Ankie Piter², Ana Diaz⁸, Jose L. Hernandez⁹, Rigel Kivi¹⁰, Richard Querel¹¹, Matt Tully¹², Peter von der Gathen¹¹, Barbora Klikova¹², Martin Motl¹², Pavla Skrivankova¹², Bogumil Kois¹³, Norrie Lyall¹⁴, Michael Gill¹⁵, Nis Jepsen¹⁶, Peter Oelsner²⁰, 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 Institute, 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 Colwell³, John P. Burrows³, Mark Weber³, Pieteremel F. Levelt⁴, Natalya A. Kramarova⁴, and David P. Haffner⁴⁷
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
**[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

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**[THU2_1] 12:55-13:00**  
**The World Brewer Reference Triads and Uncertainties in Primary Calibration**  
Xiaoyi Zhao¹, Vitali Fioletov¹, Michael Brohart¹, Volodya Savastiouk², Inab Abboud¹, Akira Ogyu¹, Jonathan Davies¹, Reno Sit¹, Sum Chi Lee¹, Alexander Cede¹³, Martin Tiefengraber⁴⁵, Moritz Müller⁴⁵, Debora Griffin¹, and Chris McLinden¹  
¹Environment and Climate Change Canada, Canada, ²International Ozone Services Inc., Canada, ³NASA, USA, ⁴LuftBlick, Austria, ⁵University of Innsbruck, Austria

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**[THU2_2] 13:00-13:05**  
**The Official Version 1.8 Direct Sun Total Column Ozone Product of Pandora within the Pandonia Global Network (PGN)**  
Martin Tiefengraber¹², Alexander Cede¹³, Manuel Gebetsberger¹, Moritz Müller¹, and Alberto Redondas⁴  
¹LuftBlick, Austria, ²University of Innsbruck, Austria, ³NASA, USA, ⁴AEMET, Spain

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**[THU2_3] 13:05-13:10**  
**Ground-Based Validation of GEMS Ozone Column and Profile Data**  
Arno Keppens¹, Gaia Pinardi¹, Tjij Verhoest¹, Daan Hubert¹, Corinne Vigouroux¹, Bavo Langerock¹, Minqiang Zhou¹, Jean-Christopher Lambert¹, Pucai Wang³, Youwen Sun², Cheng Liu², Isao Murata¹, 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

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**Optimized Umkehr Profile Algorithm for Ozone Trend Analyses**  
Irina Petropavlovskikh¹², Koji Miyagawa⁷, Audra McClure-Begley¹², Bryan Johnson⁷, Jeannette Wild⁸⁹, Susan Strahan⁶⁷, Krzysztof Wargas⁶⁷, Richard Querel⁷, Lawrence Flynn⁷, Eric Beach⁷⁰, and Sophie Godin-Beekmann¹¹  
¹¹CIRENS/NOAA, USA, ²NOAA/GML, USA, ³CISSS/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**

**THU_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, Joelle Viallon³, Robert I. Wielgosz³, Joseph J. Hodges⁴, Jennifer Carney⁴, James Norris⁴, Louise Sorensen⁴, Joann Rice⁴, Christoph Zellweger⁵, Hiroshi Tanimoto⁶, and Bernhard Niederhausen⁶

¹National Physical Laboratory, UK, ²Korea Research Institute of Standards and Science, Republic of Korea, ³Bureau International des Poids et Mesures, 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

**THU_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. Stauffer⁸, Holger Voemel⁹, Peter von der Gathen⁹, Debra E. Kollonige⁹, Samuel J. Oltmans³, Francis J. Schmidlin⁹, Bruno Hoegger⁹, Gary Morris⁹, Rigel Kivi¹⁰, Tatsumi Nakano¹¹, Richard Querel¹², Marc Allaart¹³, and many more members of the JOSIE-ASOPOS-03SDQA 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

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**[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

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**[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

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**[THU3_3]**  
13:59-14:01  
*Ozone Trends in the Lower Stratosphere from Ozone Sondes*  
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

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**[THU3_4]**  
14:01-14:03  
*Persistent Stratospheric Warming due to 2019-2020 Australian Wildfire Smoke*  
Karen H. Rosenlof¹, Pengfei Yu², Sean M. Davis³, Robert W. Portmann¹, Owen B. Toon⁴, Charles G. Bardeen⁵, Christopher Maloney⁶, Hagen Telg⁷, 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. Matsumoto⁵, J. Witte⁶, A. M. Thompson⁷, Nguyen Hoang An⁸, and Nguyen Vinh Thu⁹
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 Madhu¹,² 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 Fountoulakis¹,², Henri Diémoz¹,², 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 Wohltmann⁴, Ralf Jaiser⁵, and Dörthe Handorf⁵
¹Hokkaido University, Japan, ²Alfred Wegener Institute for Polar and Marine Research, Germany, ³Nigata 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 Chiodo¹,², 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 Leticia 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. Kuttipurath¹, R. von der Gathen², I. Petropavlovskikh³, ⁴, B. Johnson⁴, A. McClure Begley⁴, ⁵, P. Cristofanelli⁶, P. Bonasoni⁷, M. E. Barlasina⁷, and R. Sánchez⁸
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 Kreher⁹, and Fabio Madonna¹
¹National Research Council (CNR), Italy; ²B K 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 LICIIS / 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
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 Jucker², and Seok-Woo Son³
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 Sukhodolov¹,², Arseniy Karagodin¹,², and Eugene Rozanov¹,²,³
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 Islemagaleevich Naahav¹, 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 Oh¹,², Seok-Woo Son¹, Jung Choi¹, Eun-Pa Lim³, Chaim Garfinkel⁶, Harry Hendon⁷, Yoonjae Kim⁷, and Hyun-Sun Kang²
¹Seoul National University, Republic of Korea, ²Korea Meteorological Administration, Republic of Korea, ³Bureau of Meteorology, Australia, ⁶Hebrew University, Israel
V. Program Schedule

(Fri.) October 8
(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) Ozoneonde
Holger Vömel1, Herman G. J. Smit2, David Tarasick3, Bryan Johnson4, Samuel J. Oltmans4, Henry Selkirk5, Anne M. Thompson5, Ryan M. Stauffer6, Jacquelyn C. Witte7, Jonathan Davies8, Roeland van Malderen9, Gary A. Morris10, Tatsumi Nakano6, and René Stübi11
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. Stauffer5, Anne M. Thompson5, Debra E. Kollonige5, David W. Tarasick3, Holger Vömel9, Gary A. Morris5, Roeland Van Malderen6, Bryan J. Johnson5, Patrick D. Cullis5,7, René Stübi11, and Herman G. J. Smit9
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 Funke1, Sophie Godin-Beekmann4, Maya García Comas5, Michael Höpfnert1, Manuel López Puertas6, Vincent-Henri Peuch7, Felix Plöger5, Inna Polichtchouk1, Piera Raspollini8, Stefanie Rief9, Martin Riese8, Miriam Sinnhuber1, Gabi Stiller1, Jörn Ungermann2, Thomas von Clarman1, 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 Defence 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

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

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 Pinheiro², Kevin Lamy³, Hassan Bencherif³, Thierry Portafaix⁴, and Marcelo de Paula Corrêa⁵
¹UFOPA, Brazil, ²INPE, Brazil, ³UFSM, Brazil, ⁴LACy, France, ⁵Federal University of Itajubá, Brazil

Erythemal UV-B Dose Measurements Comparison Recorded by RBCC-E and BSRN at Izaña Atmospheric Observatory
Sergio F. León-Luis¹,², R.D. García¹,², Alberto Redondas³, Virgilio Carreño³, Javier López-Solano¹,², Alberto Berjón¹,², and Daniel Santana²,³
¹Tragsatec, España, ²AEMET, Spain, ³LuftBlick Earth Observation Technologies, Austria

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

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

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 Kyriakoula¹², Raptis Ioannis-Panagiotis¹², Eleftheratos Kostas²³, Garane Katerina³, Bais Alkiviadis⁴, Melina-Maria Zempla⁵, 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
**[POSTER 5]**

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

Session Code  **FRI3**

Session Chair  **Corinne Vigouroux, Valerie Thouret**

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**[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 Heue¹, Diego Loyola¹, Fabian Romahn¹, Melanie Coldewey-Egbers¹, Christophe Lerot⁴, Simon Chabrilat⁴, 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 Szela³, Hei Shing Lee¹, Johanna Tamminen¹, and Christian Retscher³  
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-II 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 CCM11 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. Sullivan 1, Michael J. Newchurch 2, Timothy A. Berkoff 1, Guillaume Gronoff 1,3, Shi Kuang 2, Andrew O. Langford 4, Christoph J. Senff 3, Raul J. Alvarez II 4, Thierry Leblanc 5, Fernando Chouza 6, Jia Su 7, M. Patrick McCormick 1, Matthew S. Johnson 1, Kevin Strawbridge 6, Fred Moshary 7, Michael Shook 1, and Gao Chen 7
1NASA, USA, 2University of Alabama, USA, 3Science Systems and Applications Inc., USA, 4NOAA, USA, 5CRES, 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. Sunilkumar 1, M. Muhsin 1,3, Maria Emmanuel 1,2, and Hemanth Kumar 4
1 VSSC, India, 2 University of Kerala, India, 3 National Institute of Technology, India, 4 NARI, 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 Corrêa 1, Gabriela Dornelles Bittencourt 1, Damaris Kirsch Pinheiro 1, and Hassan Bencherif 2
1 UFSM, Brazil, 2 LACy, 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 Dynamics of Vertical Ozone Distribution in the Troposphere over the South of Western Siberia
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 Miyazaki², Fumikazu Taketani¹, Takuma Miyakawa¹, Hisahiro Takashima¹, Xiaole Pan¹, Saki Kato³, Kengo Sudo¹, Takashi Sekiya¹, Jun Inoue⁴, Kazutoshi Sato¹, and Kazuhiro Oshima¹
¹JAMSTEC, Japan, ²CalTech, USA, ³Fukuoka University, Japan, ⁴Chinese 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
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 Russia, Russia, ⁸Mosecomonitoring, Russia

[FRI3_17] 14:32-14:34
Application of Adjacened-Average 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 MK²
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-Alvarez ², Paolo Cristofanelli³, Alberto Notario⁴, Jose A. Bogeat¹, Antonio Lopez¹, Alvaro Gómez¹, Juan P. Bolivar², 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 Carbajal²,³, María E. Barlasina³, and Margarita Yela¹
¹National Institute for Aerospace Technology (INTA), Spain, ²National Meteorological Service (SMN), Argentina, ³Pontificia Universidad Católica Argentina, Argentina

[FRI3_23] 14:44-14:46
Introducing New Lightning Schemes to a Chemistry Climate Model CHASER (MIROC)
Yanfeng He¹, Kengo Sudo¹,², 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 Metzger², Kevin Lamy¹, and Françoise Posny¹
¹LACy, France, ²LMD, CNRS-UMR8539, France, ³OSU-R, UMS3365, CNRS, France
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, Pawel Wolff¹, Bastien Sauvage¹, Jean-Marc Cousin¹, Andreas Zahn², Hannah Clark³, and Valérie Thouret³
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, Glén McConville², and Robert D. Evans³
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 Fragkos¹,², Koji Miyagawa², Panagiotis Fountoukidis¹, MariLiza Koukouli¹, Katerina Garane¹, Dimitris Balis², Irina Petropavlovskikh³, and Alkiviadis Bais³
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 Casale4, Francesca Frasca5, Vladimir Savastiuok6, Alexander Ced6, Martin Tiefengraber5,7, and Moritz Müller8
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, Elane Maillard Barras2, Klemens Hocke3, Alexander Haefelec4, 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-Panagiotis1,2, Kouklaki Dimitra3, Eletheratos Kostas3, Fountoulakis Ilias4, and Kazadzis Stelios4
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 Tomikawa2, Mitsumu K. Ejiri3, Masaki Tsutsumi2, 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 Berjón¹,², Alberto Redondas³, Javier López-Solano¹,², Virgilio Carreño², Francisco C. Parra-Rojas³, and Sergio F. León-Luis¹,²
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-Solano¹,², A. Redondas³, J. Rimmer³, A. Berjón¹,², F.C. Parra-Rojas³, V. Carreño², and S.F. León-Luis¹,²
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.¹,², López-Solano J.¹,², Bais A.³, Gröbner J.⁴, De Bock V.⁴, Karppinen T.⁵, and Vilaplana JM⁶
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
V. Program Schedule

[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

[12:44-12:46] Ozone Measurement Complex in Tomsk (Russia)
V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

Vladimir Savastiouk1 and Henri Diémoz2
1International Ozone Services Inc., Canada, 2ARPA Valle d’Aosta, Italy

[12:48-12:50] Implementation of the Comorian Observatory for Atmospheric Sciences: Ozone and UV Radiation Measurements
Mohamed Toihir Abdoulwahab1, Hassan Bencherif1, 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

[12:50-12:52] Ozone Monitoring by NDACC FTIR Spectrometry: Improved Retrieval Strategy and Impact of Instrumental Line Shape Characterisation
Omaira E. García1, Esther Sanromá1,2, Matthias Schneider2, Frank Hase3, Sergio F. León-Luis1,4, Thomas Blumenstock5, Eliezir 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

[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

[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 Chipperfield3
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
[POSTER 7]

Date / Time  (Sat.) October 9, 2021 / 13:20-14:30 (UTC)
Session Code SAT2
Session Chair Sang Seo Park

The Stratospheric Aerosol and Gas Experiment (SAGE) IV Pathfinder
Robert Damadeo, Charles Hill, and Michael Obland
NASA, USA

Using Measurements from the Disturbance Monitoring Package in SAGE III/ISS Data Processing
Marsha LaRose1, David Huber3, Charles Hill3, Kevin Leavor1, Amy Rowell2, Andrew Peterson2, Robert Damadeo2, Robert Manion1, and David Flittner2
1Science Systems and Applications, Inc., USA, 2NASA, USA, 3NOAA, USA

Diurnal Scaling Factors for SAGE III/ISS: Using a 3D Model to Account for Time of Day Differences between Observing Platforms
Sarah Strode1,2, Ghassan Taha1,2, Luke Oman1, and Mark Schoeberl3
1NASA, USA, 2USRA, USA, 3Science and Technology Corporation, USA

Total Ozone Columns from Multiple Satellite Sensors Homogeneously Validated against Global Ground-Based Measurements
Katerina Garane1, Maria Elissavet Koukouli1, Christophe Lerot2, Tijl Verhoest3, Klaus-Peter Heue3, PieterValks3, JonasVlietinck3, Fabian Romahn3, Walter Zimmer3, Dimitris Balis1, Jean-Christopher Lambert1, Michel van Roozendael1, Diego Loyola2, and Christos Zerefos4
1Aristotle University of Thessaloniki, Greece, 2BIRA-IASB, Belgium, 3DLR, Germany, 4Academy of Athens, Greece

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

Error Budget Assessment for OMPS Limb Ozone Retrieval
Carlo Arosio1, Alexei Rozanov1, Mark Weber1, Victor Gorshelev1, Natalya Kramarova3, Chris Roth3, and John P. Burrows1
1University of Bremen, Germany, 2NASA, USA, 3University of Saskatchewan, Canada
V. Program Schedule

**[SAT2_7]** 13:32-13:34
Assessment of AIRS, IASI, and CrIS Ozone Vertical Retrievals over the Central Himalaya
Prajwal Rawat¹, Manish Naja², Evan Fishbein³, R. Kumar⁴, P. Bhardwaj⁵, S. N. Tiwari⁶, S. Venkataramani⁷, and S. Lai⁸
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. Haffenr.², Pawan K. Bhartia², Natalya A. Kramarova², Richard D. McPeters³, Ramaswamy Tiruchirapalli⁴, Gordon J. Labow⁵, Jerald R. Ziemke⁶, and Stacey M. Frith⁷
²Science Systems and Applications, Inc., USA, ³NASA, USA, ⁴Morgan 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. Fernandez³,⁴, 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
V. Program Schedule

Validations of Ozone Profiles from Satellite Remote Sensings using Ozoneonde Measurements over the Jang Bogo Station, Antarctica
Hana Lee¹, Taejin Choi², Dha Hyun Ahn¹, Seong-Joong Kim², Jaeil Yoo³, Natalya Alekseyevna Kramarova³, Juseon Bak¹, 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 Ozoneondes (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

Long Term Ozoneonde Observations at Sodankylä
Rigel Kivi¹, Pauli Helikkinen¹, Kenneth Nilsen², Roeland Van Malderen³, Deniz Poyraz³, Ryan M. Stauffer⁴, and Herman G. J. Smit³
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

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

Evaluating Long-Term Changes in Atmospheric Ozone
David W. Tarasick¹, Herman G.J. Smit², Anne M. Thompson³, Gary A. Morris⁴, Jacquelyn C. Witte⁵, Jonathan Davies⁶, Tatsumi Nakano⁶, Roeland Van Malderen⁷, Ryan M. Stauffer⁷, Bryan J. Johnson⁸, René Stübi⁹, Samuel J. Oltmans¹⁰, and Holger Vömel¹¹
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
V. Program Schedule

**[SAT2_20]** 13:58-14:00
**ASPOS (Assessment of Standard Operating Procedures (SOPs) for OzoneSondes) 2.0:** Ozoneonde Measurement Principles and Best Operational Practices

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 Tully → and Andrew Klekociuk →
1Bureau of Meteorology, Australia, 2Australian Antarctic Division, Australia

**[SAT2_22]** 14:02-14:04
**Repeated Ozone Vertical Profiles over Cyprus using Adapted Ozonesondes**
Maximilien Desservettaz →, Christos Keleshis →, Christos Constantinides →, Panayiota Antoniou →, Yunsong Liu →, Mihalis Vrekoussis →, Greg Kok →, Jonathan Harnetiaux →, and Jean Sciare →
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**
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 Backer →, Roeland Van Malderen →, Dirk De Muer →, Deniz Poyraz →, Willem W. Verstraeten →, Veerle De Bock →, Andy Delcloo →, Alexander Mangold →, Quentin Laffineur →, Marc Allaart →, Frans Fierens →, and Valérie Thouret →
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 Ozone Record: Comparison with Lidar and Satellite Observation
G. Ancellet¹, S. Godin-Beekmann¹, R. Bodichon⁶, A. Pazmiño¹, H.G.J. Smit⁴, R.M. Stauffer⁵, and R. Van Malderen⁴
¹LATMOS, France, ²Institute of Energy and Climate Research: Troposphere (IEK-8), Germany, ³NASA, USA, ⁴Royal Meteorological Institute of Belgium, Belgium, ⁵PSL, Sorbonne Université-UVSQ-CNRS/INSU, France

[SAT2_26] 14:10-14:12
Update on Launder Ozoneonde Homogenisation
Richard Querel¹, Hisako Shiona¹, Alex Geddes¹, Deniz Poyraz², and Roeland Van Malderen⁴
¹NIWA, New Zealand, ²Royal Meteorological Institute of Belgium, Belgium

[SAT2_27] 14:12-14:14
The Cell Temperature of ECC Ozoneondes 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 Nakano⁵, and René Stuebi⁶
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 Ozoneonde 35-Year Record 1986-2020: Altitude Layer Metrics and Potential Recovery Layers Observed
Bryan Johnson¹, I. Petropavlovskikh¹₂, P. Cullis¹₂, and J. Booth¹
¹NOAA, USA, ²CRES, 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, Elizabth Klovenski⁴, Alex Kotsakis⁵, Gary A. Morris¹, Mark D. Spychala⁶, 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 Johnsen⁵, Alberto Redondas³, 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 Querel³

¹NASA, USA; ²University of Saskatchewan, Canada; ³NIWA, New Zealand
[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 Jeong²³, Won-Jin Lee³, 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 Dimitriadou¹², Kostas Eleftheratos³, Christos Zerefos¹³⁴⁵, and Panagiotis Nastos²
¹Academy of Athens, Greece, ²National and Kapodistrian University of Athens, Greece, ³Academy of Athens, Greece, ⁴Navarino Environmental Observatory, Greece, ⁵Mariolopoulos-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. Fasano¹², H. Diémoz¹, A. M. Siani², L. Scacchi³, M. Depaoli³, 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. Bogeat¹, 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 Čížková¹, Kamil Láska¹, 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 Borin¹,², Maurício Beux dos Santos¹,², James Eduardo Lago Londero¹,², and André Passaglia Schuch¹,²
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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Zhihua Zhang
THU1_1
Global Atmosphere Watch Team / Innovative Meteorological Research Department

- 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 >

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1) AOD, Scattering coefficient, Absorption coefficient, Vertical properties
2) F⁺, Cl⁻, NO₂⁻, 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 observation and satellite records, we detected the slow recovery of ozone during springtime that might be related to steadily reducing ozone depleting substances.

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.
Environmental Science: Atmospheres

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Fundamental questions
Elemental answers

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

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