IAMAS e-Newsletter

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Content

Introducing...
John Burrows, IAMAS Vice-President

I would like to begin by hoping that you, your families, and friends are coping in these challenging times.

I was educated at Trinity College Cambridge University, UK, receiving my B.A.(Hons) and M.A. in Natural Sciences and my Ph.D. in Physical Chemistry. I am currently working at the Institute of Environmental Physics (IUP) at the University of Bremen in Germany.

My research has been driven by the need to better understand the evolution of the Earth System during the new geological epoch of the Anthropocene. This requires the ability to separate the impact of anthropogenic activity from that of natural phenomena and their variabilities. Changes in atmospheric composition and surface parameters provide early warning of environmental and climate change. As a result the research, undertaken by myself and my collaborators (doctoral students, post-doctoral and senior scientists), has focused on improving our understanding of i) the stratospheric ozone layer, its destruction by ozone depleting substances released into the troposphere and the success of the measures enacted by the Montreal Protocol, ii) air pollution and short lived climate pollutants, iii) climate change, and iv) biogeochemical cycles. I am motivated in part by the overarching objective to provide an adequate and fit for purpose global observing system. This is required to deliver the quantitative evidence base about the atmosphere, the environment, and climatic change necessary for policymaking aiming to achieve sustainable development.

I began my research career studying the kinetics and spectroscopy of atmospheric free radicals: developing measurement techniques and studying key atmospheric reactions. However, I am best known for some pioneering and innovative developments in the remote sensing of atmospheric trace constituents from ground based, ship and in particular, space based platforms.

I am passionate about the need for international collaboration in science. In this context during the past two decades, I served in different roles in the following organisations: COSPAR Commission A, WCRP SPARC, and IGAC SSC. I have also participated in the WMO/UNEP Ozone Assessments. Prior to joining IAMAS, I spent the last 8 years as president of its International Commission on Atmospheric Chemistry and Global Pollution.

As outlined by our President IAMAS recognises the need to reach out, facilitate, and empower early career scientists within IAMAS. The latter are the tomorrow-scientific leaders. Similarly, we hope to support more international scientific projects and capacity building activities. I look forward to serving and working with you and my colleagues in IAMAS on this journey.

International Ozone Commission: The 2020 Antarctic Ozone Hole

The 2020 Antarctic ozone hole reached an average 23.5 million km^2 areal coverage in the 7 Sep. to 12 Oct. period, making it the 12^{th} largest ozone hole in the 40-year record (see Figure 1). Balloon ozone-sondes at South Pole station show that by early October 100% of the ozone in the 14–20 km layer had been destroyed.

The ozone hole is caused by man-made ozone depleting substances (ODSs) such as chlorofluorocarbons (CFCs) and halons. These ODSs are released at the surface, carried into the upper stratosphere by the very slow Brewer-Dobson circulation, and disassociated. The released chlorine eventually descends over Antarctica in the forms of reservoir species (HCl and $ClONO_2$). During winter, the reservoir species react on the surfaces of polar stratospheric clouds (PSCs) to form highly reactive chlorine species. These PSCs form at temperatures below 195 K during the polar night and into the spring (early May to late October). The hole forms during the Southern Hemisphere's (SH) late winter (August–September) as the returning solar radiation drives ozone-depleting chlorine and bromine catalytic reactions. The chlorine and bromine catalytic cycles deplete ozone in the spring at the rate of 1–2% per day in the lower stratosphere.

While the 2020 ozone hole is large, the steady ODS decline since 2000 resulted in a smaller ozone hole than would have been observed if the ODS levels were at its peak. HCl observations from the NASA Aura satellite MLS instrument show this steady chlorine decline, resulting in a discernable decrease in the ozone hole's severity that is partially obscured by year-to-year fluctuations. In the 1990 and 2000 decades, the average ozone hole routinely exceeded 25 million km^2 (see Figure 1). The area has gradually declined with occasional smaller areal ozone holes resulting from September warming events (2002 and 2019).

The ozone hole's severity fluctuates because of meteorological variations. First, year-to-year variations of the stratospheric quasi-biennial oscillation modulate advection of air masses with higher or lower inorganic chlorine into the Antarctic polar vortex. Second, planetary-scale waves propagating upward from the upper troposphere drive the poleward and downward Brewer-Dobson circulation. Years with larger (smaller) upward propagation of waves result in warmer (colder) spring conditions and more advection of ozone into the polar cap (e.g., warmer years are 1988, 2002, 2019). The area values in Figure 1 are color coded to indicate warmer (red) and colder (blue) years. The colder temperatures of 2020 resulted in more severe ozone hole.

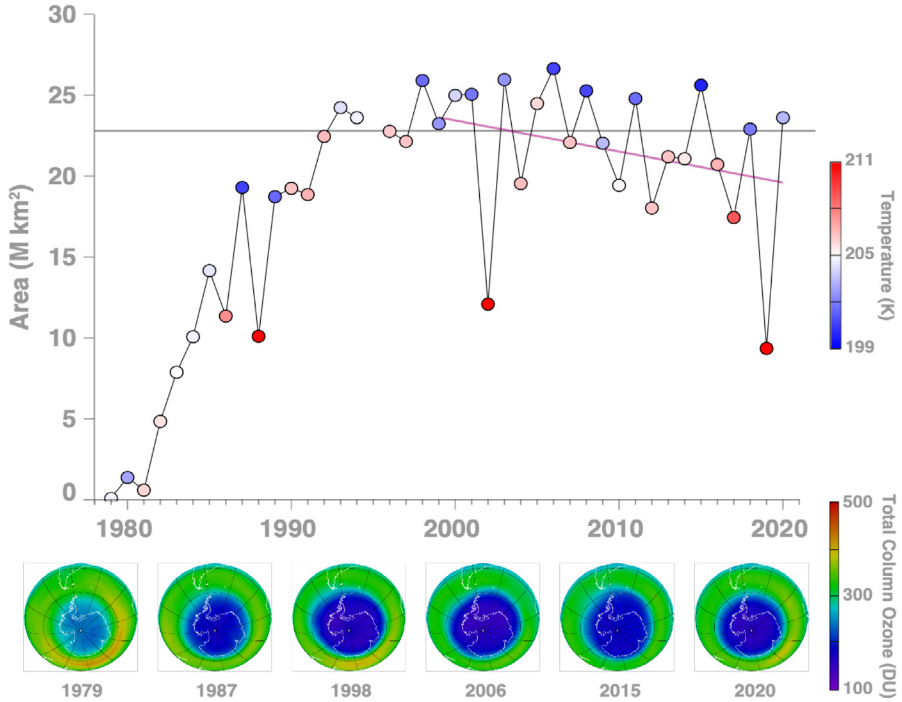

Figure 1. The average of daily ozone area for the 7 Sep.–12 Oct. period are shown as the filled circles. The color of a circle represents the average September 60˚–90˚S, 50-hPa temperature. The thin horizontal black line shows the 1991–2006 average, while the thin red line shows the ozone hole area 1998–2020 trend. Polar projections of the ozone hole are shown at the bottom, featuring Sep. 1979, 1987, 1998, 2006, 2015 and 2020 from satellite instruments. Note the depleted ozone (purple to blue) inside of the polar vortex that is contrasted with the higher ozone (green to yellow/orange) surrounding the vortex.

The ozone hole is projected to gradually decline back to 1980 levels in approximately 2070 if ODS levels continue to decline in compliance with the Montreal Protocol.

NASA Ozonewatch: https://ozonewatch.gsfc.nasa.gov/
NOAA South Pole ozone hole: https://www.esrl.noaa.gov/gmd/hats/
NASA Aura Microwave Limb Sounder: https://mls.jpl.nasa.gov/index-eos-mls.php
Twenty Questions About the Ozone: https://www.esrl.noaa.gov/csl/assessments/ozone/2018/twentyquestions/
International Ozone Commission: http://io3c.org

– Paul A. Newman, Sophie Godin-Beekman, Irina Petropavlovskikh, Eric R. Nash

IAMAS-IACS-IASPO Meeting Update

As noted previously, the Busan IAMAS-IACS-IAPSO Joint Assembly planned for 2021 has been postponed until 2025. An IAMAS-IACS-IAPSO virtual assembly will be held the week of 19-23 July 2021. Details are forthcoming.

International Commission on Polar Meteorology: MOSAiC

Over 600 scientists from 19 countries participated in MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate), the largest research expedition to the Arctic in history, collecting year-round data from the central Arctic. Following in the footsteps of Fridtjof Nansen's ground-breaking expedition with his wooden sailing ship Fram in 1893-1896, the MOSAiC expedition brought the modern research icebreaker Polarstern close to the north pole for a full year.

As part of a project called SSAASI-CLIM (Sea Salt Aerosol above Arctic Sea Ice - sources, processes and CLimate Impacts), I was privileged to participate in the setup phase at the beginning of the vessel's drift with the sea ice. After an impressive Farewell Ceremony Polarstern left Tromsø on September 20th 2019. We headed north east to a position that would provide the ship the longest possible drift with the sea ice. My task during transit was to turn a container full of equipment and boxes into an aerosol lab, with various air sampling systems, and particle counters, plus a number of guest instruments. There were also packages to get ready, which would be raised by a tethered balloon to sample aerosols at different heights, and a cloud and aerosol spectrometer put on the crow's nest for measurements. On top of that the non-trivial task to set up data transfer and storage. Busy times!

With decreasing multi-year sea ice in the Arctic, it took a while to find a floe that was suitable as our outdoor lab for the coming twelve months. On October 6th Polarstern moored alongside its new home at 85°N, 135°E. We had already said "goodbye" to the sun, and now said a cautious "hello" to a female polar bear with cub, who came to visit us almost daily. On the ice floe I was now involved in establishing "Met-City", a cluster of atmospheric instrumentation. For SSAASI-CLIM I installed "rocket traps" to capture blowing snow, and snow particle counters on one of the Met towers, measuring falling snow at two different heights.

One of the met towers during installation with Polarstern in the background, and the rocket traps in the background on the right. Credit: Matt Shupe

All too soon it was time to transfer to Russian ice breaker Akademik Fedorov for the return journey. Akademik Fedorov had accompanied Polarstern into the ice, and had used the setup phase to deploy a distributed network of buoys. For me it was time to sleep, rest, eat, repeat, only interrupted to watch Northern lights, and beautiful bioluminescence in the ship's wake. The day we saw the sun again for the first time the ship almost listed, and again a few days later when we got mobile reception (but only on portside)!

At the end of October Akademik Fedorov arrived in winter-wonderland Tromsø. Fittingly a plane with an image of Fridtjof Nansen on its tail fin took me back to autumnal UK.

– Amélie Kirchgaessner

Joint Workshop by IAMAS-CNC and IAP, CAS on Atmospheric Observation

On November 16, 2020, the Workshop on Atmospheric Observation in the 14th Five-Year Plan was successfully held in Beijing. This workshop was jointly hosted by the Chinese National Committee of the International Association of Meteorology and Atmospheric Sciences (IAMAS-CNC) and the Institute of Atmospheric Physics, Chinese Academy of Sciences (IAP, CAS). Prof. Daren Lyu, academician in China and former IAMAS member-at-large, chaired this workshop. The major objective of the workshop is to discuss future research direction and strategic planning of atmospheric observation in China.

Nearly one hundred attendants participated in the workshop, including officials from the National Natural Science Foundation of China (NSFC), and experts from major Chinese universities and research institutes such as Peking University, Fudan University, the Polar Research Institute of China, and the National Satellite Meteorological Center.

The workshop invited 12 leading scientists from the fields of atmosphere, ocean, remote sensing, space science, and polar science to deliver keynote presentations. In the discussion session, experts from various fields actively spoke on issues such as how to determine the research directions according to national objectives and international needs, the current techniques and challenges in atmospheric observation, perspectives, and areas of major focus in the future.

This one-day workshop was a great success for scientists to have active discussion and free exchange. Most importantly, it helped to provide the vision and research direction of atmospheric observation in China.

Prof. Daren Lyu, academician, speaks on the opening of the workshop.