Environmental Physics Division
Fachverband Umweltphysik (UP)

Stefanie Falk
Institut für Meteorologie und Klimaforschung
Atmosphärische Spurenstoffe und Fernerkundung
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen
stefanie.falk@kit.edu

Christian von Savigny
Institut für Physik
Felix-Hausdorff-Str. 6
17489 Greifswald
csavigny@physik.uni-greifswald.de

Overview of Invited Talks and Sessions

(Lecture hall ELP 6: HS 4; Poster ELP 6: Foyer)

Plenary Talk of the Environmental Physics Division

PV I	Mon	9:00– 9:45	ELP 6: HS 3+4	**The role of the North Atlantic Ocean for European Climate** — •Johanna Baehr

Invited Talks

UP 1.1	Mon	11:00–11:30	ELP 6: HS 4	**Atmospheric impact of energetic particle precipitation from the lower thermosphere to the surface** — •Miriam Sinnhuber
UP 2.2	Mon	16:45–17:15	ELP 6: HS 4	**Increasing water limitation of global ecosystems in a changing climate** — •Rene Orth, Jasper Denissen, Wantong Li, Sungmin O
UP 5.1	Wed	11:00–11:30	ELP 6: HS 4	**Melting from below: An abrupt transition in Antarctic sea ice-ocean system** — •Alexander Haumann, et al.

Invited Talks of the joint Symposium How to Cope with Apocalyptic Narratives? (SYAN)

See SYAN for the full program of the symposium.

SYAN 1.1	Mon	14:00–14:40	ELP 6: HS 4	**The Apocalyptic Moment Is Over - And It Won't Come Back Anytime Soon** — •Frank Uekoetter
SYAN 1.2	Mon	14:40–15:20	ELP 6: HS 4	**Shaping Cold War Futures through the Nuclear Winter Study: Narratives, Imaginaries and Legitimacy** — •Egle Rindzeviciute
SYAN 1.3	Mon	15:20–16:00	ELP 6: HS 4	**The Role of Storytelling in Climate Communication** — •Denise Müller-Dum

Invited Talks of the joint Symposium Lasers and Photonic Technologies for Environmental Challenges (SYEC)

See SYEC for the full program of the symposium.

SYEC 1.1	Tue	11:10–11:40	ELP 6: HS 1	**Nanostructured optical waveguides inside YAG crystals as a crucial step towards the development of microlasers for advanced sensing applications** — •Omar de Varona, Franzette Paz-Buclatin, Paul Santos, Pablo Molina, Leopoldo Martín, Airán Ródenas
SYEC 1.2	Tue	11:40–12:10	ELP 6: HS 1	**Laser surface modification of graphite anodes for lithium-ion batteries with improved fast-charging capability** — •Max-Jonathan Kleefoot, Jens Sandherr, Jiri Martan, Volker Knoblauch, Harald Riegel

SYEC 2.1	Tue	14:00–14:30	ELP 6: HS 4	**Development of soft glass optical fibers based on 3D printed preforms** — •Ryszard Buczynski, Pawel Wiencław, Przemyslaw Golebiewski, Dariusz Pysz, Adam Filipkowski, Grzegorz Stepniewski, Olga Czerwinska, Andrzej Burgs
SYEC 2.2	Tue	14:30–15:00	ELP 6: HS 4	**Three-dimensional Ultrashort-Pulse Laser Nanolithography of Optical Materials** — •Airán Ródenas, Omar de Varona, Franzette Paz-Buclatin
SYEC 2.3	Tue	15:00–15:30	ELP 6: HS 4	**Fibre-based plasmonic micro reactor CO2 reduction** — •Devin O'Neill, Patrick Spath, Wiebke Albrecht
SYEC 5.1	Tue	17:15–17:45	ELP 6: HS 4	**Studying atmospheric dynamics with lasers in remote places** — •Bernd Kaifler

Sessions

UP 1.1–1.5	Mon	11:00–12:30	ELP 6: HS 4	**Atmospheric Trace Gases and Aerosols**
UP 2.1–2.5	Mon	16:30–18:00	ELP 6: HS 4	**Soil and Water**
UP 3.1–3.4	Tue	11:00–12:00	ELP 6: HS 4	**Remote Sensing**
UP 4	Tue	12:30–13:15	ELP 6: HS 4	**Members' Assembly**
UP 5.1–5.5	Wed	11:00–12:30	ELP 6: HS 4	**Cryosphere and Arctic Oceans**
UP 6.1–6.3	Wed	14:30–15:15	ELP 6: HS 4	**Other Topics**
UP 7.1–7.7	Wed	16:30–18:30	ELP 6: Foyer	**Posters**

Members' Assembly of the Environmental Physics Division

Tuesday 12:30–13:15 ELP 6: HS 4

- Report on last year's activities
- Update of statutes
- Vacant position in the executive board: *representative of young scientists*
- Nomination of candidates for DPG prizes
- Any other business

UP 1: Atmospheric Trace Gases and Aerosols

Time: Monday 11:00–12:30 Location: ELP 6: HS 4

Invited Talk UP 1.1 Mon 11:00 ELP 6: HS 4

Atmospheric impact of energetic particle precipitation from the lower thermosphere to the surface — •Miriam Sinnhuber — Karlsruher Institut für Technologie

Energetic charged particles - protons, electrons and heavier ions with energies from tens of keV to hundreds of MeV - precipitate into the atmosphere at high latitudes, guided by the Earth's magnetic field. They originate from the sun, accelerated in the solar corona during flares or coronal mass ejection events, or from the terrestrial magnetosphere, accelerated during geomagnetic storms or auroral substorms by variations in the high-speed solar wind. In the atmosphere, they interact with the most abundant species by collision reactions, starting a chain of chemical-dynamical coupling mechanism. The first step is atmospheric ionization and the formation of radicals of the NOx and HOx families mainly in the mesosphere and lower thermosphere, and subsequent ozone loss. NOx can be transported into the stratosphere during polar winter, and contribute significantly to ozone loss at the top of the ozone layer. Radiative feedbacks in turn affect atmospheric dynamics possibly even down to tropospheric weather systems. This so-called geomagnetic forcing of the climate system is modulated by the quasi-continuous solar wind and sporadic solar eruptions and varies over the 11-year solar cycle; since CMIP6, it is also recommended as part of the solar forcing of the climate system. In this presentation, an overview of the state of the art will be provided, focusing on the 11-year variability as well as on the impact of extreme solar events.

UP 1.2 Mon 11:30 ELP 6: HS 4

Improvements of the HAGAR-V instrument and its performance during the HALO mission PHILEAS — •Ronja van Luijt, Valentin Lauther, Johannes Strobel, Andrea Rau, Lars Zlotos, and Claus Michael Volk — Institute for Atmospheric and Environmental Research, University of Wuppertal, Germany

Precise airborne in situ measurements of VOCs are useful to understand atmospheric processes and can be achieved by GC/MS. The need for high spatial resolution conflicts with typical time resolutions of 3 to 10 minutes for mobile GC/MS. We present the recently improved HAGAR-V (High Altitude Gas AnalyzeR-5 channel version), developed at the University of Wuppertal for use on the HALO aircraft, with a time resolution of 2 minutes while measuring about 30 VOC species in the ppt range by employing two identical GC channels with a single MS. Additionally, it includes a NDIR CO2 analyzer and a 2-channel GC/ECD. For the GC/MS, innovative multitasking of various processes and strong sample refocusing result in detection limits of a few ppq and precisions of 1-5% and a shorter sampling time of 40 s, yielding a significant improvement in resolving fine-scale atmospheric structure. We show the performance of the HAGAR-V instrument during the HALO mission PHILEAS investigating the impact of the Asian summer monsoon on the extratropical UTLS. HAGAR-V GC/MS measured with high resolution species with anthropogenic Asian sources, species with biomass burning sources and very short-lived NMHCs, providing key information for understanding the evolution of convectively uplifted pollutants in the UTLS.

UP 1.3 Mon 11:45 ELP 6: HS 4

A novel method of measuring the viscosity and surface tension of supercooled levitated droplets — Mohit Singh[1], Stephanie Helen Jones[1], Alexei Kiselev[1], Denis Duft[1], and •Thomas Leisner[1,2] — [1]Institut of Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Institut für Umweltphysik, Universität Heidelberg, Germany

Viscosity and surface tension of aerosol particles influence e.g. the rate of heterogeneous and photochemical reactions, the evaporation and growth processes leading to CCN formation, and the ability to act as ice nuclei. Both quantities can vary significantly during the atmospheric processing of aerosol particles. Following these changes requires a fast and reliable measurement technique, which can be applied to airborne particles under realistic atmospheric conditions where noneequilibrium conditions like supersaturation and superooling are widespread. We report a novel method to simultaneously measure the time-dependent viscosity and surface tension of charged droplets levitated in an environmental electrodynamic balance. In addition to the alternating electric field required for levitation, a secondary electric field of variable frequency is applied to induce shape oscillations in the levitated droplet. The shape oscillations are analysed by light scattering and the phase shift in the induced shape oscillations with respect to the driving field is used to determine droplet viscosity and surface tension.

UP 1.4 Mon 12:00 ELP 6: HS 4

New results from the joint research project VolImpact — •Christian von Savigny[1], Claudia Timmreck[2], Ali Hoshyaripour[3], Akos Horvath[4], Alexei Rozanov[5], John Burrows[5], Ulrike Niemeier[2], Felix Wrana[1], Anna Lange[1], Corinna Hoose[3], Johannes Quaas[6], Sandra Wallis[1], Hauke Schmidt[2], and Christopher Kadow[7] — [1]Institut für Physik, Universität Greifswald — [2]MPI für Meteorologie, Hamburg — [3]Institut für Meteorologie und Klimaforschung, KIT — [4]Institut für Meteorologie, Universität Hamburg — [5]Institut für Umweltphysik, Universität Bremen — [6]Institut für Meteorologie, Universität Leipzig — [7]DKRZ, Hamburg

Volcanic eruptions are one of the most important natural drivers of climate change on time scales from a few years up to a decade. In the DFG funded Research Unit VolImpact we investigate relevant aspects of volcanic eruptions on the atmosphere and climate in five projects, i.e. the initial development of volcanic plumes on time scales from hours to a few days, the evolution of volcanic aerosol layers in the stratosphere, interactions of volcanic aerosols and tropospheric clouds, dynamic and thermal effects of volcanic eruptions on the middle atmosphere as well as volcanic effects on the hydrological cycle. After a short overview of the VolImpact project, this talk will focus on recent results from the second phase of the VolImpact project, including results on the unusual eruption of Hunga-Tonga Hunga Ha'apai in January 2022, satellite remote sensing of microphysical parameters of stratospheric aerosols, as well as unusual optical phenomena in the atmosphere.

UP 1.5 Mon 12:15 ELP 6: HS 4

Tracing the Hunga Tonga - Hunga Ha'apai H_2O anomaly through the mesosphere — •Sandra Wallis and Christian von Savigny — University of Greifswald, Germany

The 2022 Hunga Tonga - Hunga Ha'apai eruption emitted an exceptionally large amount of approximately 150 Tg H_2O into the middle atmosphere (10 - 100 km). After an immediate subsidence, the volcanic H_2O anomaly began to rise in the tropics and crossed the stratopause (1 hPa) by the end of March 2023. We use MLS H_2O mixing ratios to trace its subsequent transport through the mesosphere (50 - 100 km altitude). This research is especially relevant to the noctilucent cloud community, because upon reaching the summer mesopause region (approximately 90 km) the H_2O anomaly could potentially have an impact on the properties of noctilucent clouds such as occurrence frequency or brightness.

UP 2: Soil and Water

Time: Monday 16:30–18:00 Location: ELP 6: HS 4

UP 2.1 Mon 16:30 ELP 6: HS 4

Das Klima-Endspiel in Zukunftsdiskursen. Potentiale katastrophaler Szenarien in der Klimakommunikation — •Gunther Seckmeyer und •Gerriet Schwen — Leibniz Universität Hannover, Institut für Meteorologie und Klimatologie

Vor 50 Jahren kristisierte die New York Times mit vernichtender Schärfe "Die Grenzen des Wachstums", wobei sie anmerkte: "Today the vision is mass death from insecticide poisoning, climatic changes, or some other form of retribution from an angry biosphere." Das sei als Zukunftsprognose vielleicht nicht falsch, aber "a false inevitability of

doom do not speed the day of salvation" - Angst- und Panikmache helfen nicht, die richtigen Entscheidungen zu treffen um Lösungen zu finden. Diese Kritik wird immer wieder vorgebracht.

Im Jahr 2022 veröffentlichten Kemp et.al. "Climate Endgame: Exploring catastrophic climate change scenarios", um mehr Aufmerksamkeit auf wahrscheinlicher werdende katastrophale Szenarien zu lenken. Gefördert vom Land Niedersachen haben wir als transdisziplinäres Team Wissenschaftler*innen zu der Bedeutung des 'Climate Endgame' in unseren Zukunftsdiskursen befragt und planen nun Veranstaltungen als soziale Realexperimente mit Akteuren aus Politik, Medien und Aktivismus, um solidarische Weltuntergangsnarrativen zu erforschen.

Die öffentliche Kommunikation ist weiterhin vom Ideal dominiert positiv zu kommunizieren. Würde ein ungeschönter Blick auf unsere Lage Kräfte freisetzen, um die schlimmsten Folgen der Klimakrise abzumildern? Und: Wie klingt eine Kommunikation klingen, welche das Ausmaß der Klimakrise vermittelt ohne Überforderung auszulösen?

Invited Talk UP 2.2 Mon 16:45 ELP 6: HS 4

Increasing water limitation of global ecosystems in a changing climate — •Rene Orth[1], Jasper Denissen[2], Wantong Li[3], and Sungmin O[4] — [1]University of Freiburg, Germany — [2]European Centre for Medium-Range Weather Forecasting, Germany — [3]Max Planck Institute for Biogeochemistry, Germany — [4]Ewha Womans University, Korea

Climate change involves changes in temperatures and precipitation in many regions. These changes in turn affect terrestrial ecosystems that require sufficient water and energy to provide essential services such as food security and the uptake of human-caused CO2 emissions.

This presentation will introduce the concept of ecosystem water and energy limitation, and identify areas where each limitation prevails. These areas are characterised by different sensitivities of evapotranspiration and vegetation productivity to temperature and precipitation. A special focus will be on the global trends of ecosystem water limitation, where our results show increased water sensitivity across recent and future decades in many regions.

The presentation will also illustrate that this increasing ecosystem water limitation has diverse implications including (i) increased vulnerability of vegetation to droughts which can lead to more frequent and pronounced drought impacts on vegetation functioning and (ii) a weakening of the greening trend of global vegetation, thereby counteracting the effect of rising temperatures and CO2 levels in many regions.

UP 2.3 Mon 17:15 ELP 6: HS 4

Dürren in Deutschland: Warum der Klimawandel hydrologische Extreme verstärkt — •Axel Kleidon — Max-Planck-Institut für Biogeochemie

Die wärmeren Temperaturen des globalen Klimawandels verstärken den Wasserkreislauf, Verdunstung und Niederschlag nehmen zu. Aber auch Extremereignisse wie Starkregen, Hochwasser, Trockenperioden und Dürren häufen und intensivieren sich. Wie passt das zusammen? Einfache physikalische Betrachtungen zeigen, welche Faktoren hauptsächlich die Stärke des Wasserkreislaufs im Erdsystem regulieren und wie dies die Wasserverfügbarkeit auf dem Festland bestimmt. Damit lassen sich die beobachteten Änderungen der Wasserbilanz in Deutschland interpretieren und die zunehmende Trockenheit in Deutschland erklären.

UP 2.4 Mon 17:30 ELP 6: HS 4

Metrology for multi-scale monitoring of soil moisture — •Markus Köhli for the SoMMet collaboration — Physikalisches Institut, Heidelberg University, Germany

Soil moisture as a key variable in agriculture, forestry, groundwater recharge, weather, climate, and greenhouse gases emission in the environment. Several measurement methods exist on multiple scales, however, poorly harmonized. Despite its significance this lack of precision marginalized the topologically complex assessment of soil moisture. Thus, there is a need to establish the chain of traceability - the metrological determination of uncertainties. In addition, there is an urgent need for real-time, high-quality, temporally and spatially consistent data on soil moisture. Such are needed to optimise water management strategies as well as climate change monitoring, modelling and mitigation. To address these needs, the project 'Soil Moisture Metrology' (SoMMet) has been set up in the framework of the European Partnership on Metrology. The consortium consists of nine National Metrology Institutes and nine research institutions. Its aim is to develop sound metrological tools and establish a metrological foundation for soil moisture measurement methods. On the point scale (10^{-1} m - 10^{1} m), novel primary and secondary standards of measurements will be developed specifically for soil samples. On the intermediate range (10^{2} m - 10^{3} m), the metrological basis of the cosmic-ray neutron sensing method will be established, in laboratory and outdoors. On the large scale (10^{3} m - 10^{4} m), satellite-based remote sensing products will be utilized to derive the soil moisture products.

UP 2.5 Mon 17:45 ELP 6: HS 4

Correcting cosmic-ray neutrons for everything: latest attempts to isolate the soil water signal from external influences — •Martin Schrön[1], Markus Köhli[2], Jannis Weimar[2], Daniel Rasche[3], and Lasse Hertle[1] — [1]Helmholtz-Zentrum für Umweltforschung GmbH - UFZ, Leipzig — [2]Physikalisches Institut, Heidelberg University — [3]Geoforschungszentrum - GFZ, Potsdam

Cosmic rays on Earth interact with the soil and are substantially moderated by hydrogen atoms. Since the reflected neutron flux is a function of the soil water content, cosmic-ray neutron measurements above the ground are widely used to estimate the average field soil moisture. However, many exernal factors spoil the accuracy of the product, which need to be corrected for. Cosmic rays do travel a long way from supernovae remnants through the solar system, the Earth's magnetosphere, the atmosphere, the biosphere, and the lithosphere, where each component has their challenges in store. Relevant effects are caused by, e.g., solar activity, the geomagnetic field, air pressure, air humidity, temperature, landscape heterogeneity, vegetation, snow, and even by scientists themselves. The list of influencing factors is long, and so is the number of approaches and proposed solutions. We will present the major influencing factors and discuss the latest attempts to tackle their correction.

UP 3: Remote Sensing

Time: Tuesday 11:00–12:00 Location: ELP 6: HS 4

UP 3.1 Tue 11:00 ELP 6: HS 4

Assessing the Impact of the 2023 Storm Daniel Flood in Pineios River Estuaries: An Analysis of Crop-Type and Inundation Mapping Using Sentinel-1/2 Imagery — •Rizos-Theodoros Chadoulis[1,2], Ioannis Manakos[1], and Constantine Kotropoulos[2] — [1]Centre for Research and Technology Hellas, Information Technologies Institute, 6th km Harilaou-Thermi Road, 57001 Thessaloniki, Greece — [2]Department of Informatics, Aristotle University of Thessaloniki, Box 451, Thessaloniki 54124, Greece

The 2023 Storm Daniel significantly affected the Pineios River estuaries, causing widespread flooding and impacting the agricultural landscape. This study aims to assess the impact of the floods on the area, utilizing Sentinel-1 and Sentinel-2 imagery for crop-type and inundation mapping. For the crop-type mapping, a time-series analysis was conducted over the 2022-2023 agricultural cycle, capturing the phenological changes of different crops, and a detailed crop-type map was produced using Machine Learning techniques and validated against in-situ observations conducted during the summer of 2023. The inundation mapping was achieved through a synergistic analysis of Sentinel-1 radar imagery and Sentinel-2 optical data, and the output was juxtaposed with the Copernicus EMS Rapid Mapping products. The proposed methodology provides accurate, evidence-based information to decision-makers, aiding in understanding the immediate effects of such events on agricultural regions but also providing valuable data for future flood mitigation and agricultural resilience planning in Thessaly.

UP 3.2 Tue 11:15 ELP 6: HS 4

Studying the global distribution of water vapour isotopologues with the Sentinel-5P mission — •Hartmut Bösch[1], Tim Trent[2], Matthias Schneider[3], Christopher Diekmann[3,4], Amelie Röhling[3], Farahnaz Khosrawi[3,5], Iris Thurnherr[6,7], and Harald Sodemann[6] — [1]Institut für Umweltphysik, Universität Bremen — [2]University of Leicester, UK — [3]Karlsruhe Institut of

Technology — [4]Telespazio GmbH — [5]Forschungszentrum Jülich — [6]University of Bergen, Norwegen — [7]ETH Zuerich, Schweiz

Atmospheric moisture is a key factor for the redistribution of heat in the atmosphere and there is strong coupling between atmospheric circulation and moisture pathways which is responsible for most climate feedback mechanisms. Water isotopologues can make a unique contribution for better understanding this coupling. In recent years, global observations of water vapour isotopologues have become available from different satellite missions. With the launch of Sentinel 5P, water isotopologue total column retrievals with much improved spatial and temporal coverage compared to previous SWIR sensors thus representing a major advance for scientific and operational applications.

In this presentation, we describe the water isotopologues retrieval from Sentinel 5P, its assessment against ground-based reference data and against IR data from IASI which are mostly sensitive to the free troposphere. We will compare our water isotopologues dataset against isotope-enabled model calculations and discuss case studies to demonstrate how we can gain insights into hydrological regimes and processes. We will conclude with an outlook outlining future developments

UP 3.3 Tue 11:30 ELP 6: HS 4

Towards continuous, semi-automatic ship-borne measurements of columnar CO_2, CH_4, CO and NO_2 for regional-scale emission monitoring — •Vincent Enders[1], Ralph Kleinschek[1], Matthias Max Frey[3], Frank Hase[2], Isamu Morino[3], Astrid Müller[3], Hiroshi Tanimoto[3], Karolin Voss[1], and André Butz[1] — [1]Institute for Environmental Physics, Heidelberg University — [2]Karlsruhe Institute of Technology — [3]National Institute for Environmental Studies, Tsukuba, Japan

Previously, we successfully deployed an EM27/SUN Fourier transform spectrometer on research vessels to measure the column-averaged mixing ratios of CO_2, CH_4 and CO above the ocean. Here, we report on its first deployment on a commercial cargo vessel paving the way towards autonomous, ship-borne operations for the validation of satellite observations as well as monitoring and quantification of anthropogenic emission sources. For this purpose, we have supplemented the setup with a VIS spectrometer for simultaneous NO_2 measurements, a tracer of fossil combustion. The new spectrometer setup is particularly aimed at validating upcoming greenhouse gas monitoring satellites designed for measuring CO_2 together with NO_2.

Since mid-September 2023, the instrument is deployed on a commercial vessel, traveling back and forth along the East Coast of Japan. The current study focuses on testing the autonomous operations and on acquiring a dataset that allows us to evaluate the potential for identifying anthropogenic emission sources from Japan and the upwind Asian continent using the ratio between CO_2 and NO_2.

UP 3.4 Tue 11:45 ELP 6: HS 4

Portable ground-based scattered sunlight spectrometer for carbon dioxide and methane measurements — •Lukas Weis[1], Benedikt Löw[1], Ralph Kleinschek[1], Tobias Schmitt[1], Frank Hase[2], and André Butz[1] — [1]Institute of Environmental Physics, Heidelberg University, Germany — [2]Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany

As atmospheric greenhouse gases continue to increase, there is a strong interest in understanding their sources and sinks. Quantifying urban emissions is vital to mitigating human-induced climate change. Our ground-based 'reflected sunlight' approach offers sensitivity to horizontal greenhouse gas distributions across kilometers, bridging the gap between localized in-situ and regional total column measurements.

We've adapted a portable EM27/SUN Fourier transform spectrometer (EM27/SCA) for carbon dioxide (CO_2) and methane (CH_4) retrieval from ground-scattered sunlight within the NIR spectral range. Deployed in an elevated position the EM27/SCA points into a source region along a multi-kilometer horizontal slant path. In 2022 the prototype demonstrated good agreement with CLARS-FTS during side-by-side measurements overlooking the Los Angeles Basin in California, USA.

We present results from this campaign and ongoing work on our second-generation instrument. The most notable improvement is a modular tracking system with optical fiber coupling, enhancing both flexibility and field of view homogenization to reduce the impact of target inhomogeneity on retrievals.

UP 4: Members' Assembly

Time: Tuesday 12:30–13:15 Location: ELP 6: HS 4

(for members of PA Environmental Physics)

UP 5: Cryosphere and Arctic Oceans

Time: Wednesday 11:00–12:30 Location: ELP 6: HS 4

Invited Talk UP 5.1 Wed 11:00 ELP 6: HS 4

Melting from below: An abrupt transition in Antarctic sea ice-ocean system — •Alexander Haumann[1,2] and et al.[3] — [1]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany — [2]Ludwig Maximilian University of Munich, Munich, Germany — [3]other institutions

After increasing for more than three decades, Antarctic sea ice extent rapidly declined in 2015/16 and exhibits multiple record minima since. This rapid decline has been unexpected and raises the question if global warming has now reached the high-latitude Southern Ocean. In my talk, I will provide evidence that Antarctic sea ice experienced an abrupt transition from a high to low extent state due to a complex interaction with the ocean. I will show that a combination of deep water warming, a signal that is expected from global climate change, and surface ocean destabilization abruptly shifted the ice-ocean system to a new state, with wide implications for the ecosystems and the Antarctic Ice Sheet, and possibly the global climate.

UP 5.2 Wed 11:30 ELP 6: HS 4

Analyzing ^{39}Ar depth profiles in the Arctic Ocean with the new ArTTA measuring technique — •Carl Kindermann[1], Yannis Arck[1], David Wachs[1], Julian Robertz[2], Markus Oberthaler[2], and Werner Aeschbach[1] — [1]Institute of Environmental Physics, Heidelberg University, Heidelberg, Germany — [2]Kirchhoff-Institute for Physics, Heidelberg University, Heidelberg, Germany

Timescales of ventilation of the Arctic Ocean are still only poorly known. The commonly used tracers for ocean ventilation studies like CFCs and SF_6 are limited to young water masses that occur either close to the surface or in highly ventilated deep waters. The radioisotope ^{39}Ar with its half-life of 268 years covers time scales of 50 to 1000 years, perfectly suited for the investigation of ventilation timescales of deep and intermediate water masses. The new measurement technique called Argon Trap Trace Analysis (ArTTA) is based on quantum-optical methods to catch and count single ^{39}Ar atoms. In contrast to the previously used low-level counting method, which required about 1000 liters of water, ArTTA only requires sample sizes of a few liters of ocean water. The benefit of ArTTA for ocean studies is evident by enabling a better resolution of the water column at great depths. This contribution presents results of ^{39}Ar depth profiles analyzed in the project Ventilation and Anthropogenic Carbon in the Arctic Ocean (VACAO), which is part of the Synoptic Arctic Survey carried out in summer 2021 (SAS21). Samples, taken in the Nansen, Amundsen and Makarov Basins, were measured with ArTTA.

UP 5.3 Wed 11:45 ELP 6: HS 4

Snowdepth on Antarctic Sea Ice Retrieved from Microwave Satellite Data — •Christian Melsheimer and Gunnar Spreen — Institute of Environmental Physics, University of Bremen, Bremen, Germany

Snow on sea ice has a large effect on heat and energy fluxes because it is a strong thermal insulator and is very bright; a thick snow layer even

influences the freeboard of the underlying ice. Therefore, comprehensive and up-to-date satellite-based data about the variable snow layer on sea ice are very much sought after. Until now, more research has gone into snow on Arctic sea ice, and also the amount of direct snow measurement data from the Arctic is much larger than the amount of data from the Antarctic.

We have applied an existing snow depth retrieval for *Arctic* sea ice without modifications to *Antarctic* sea ice. This retrieval method uses the brightness temperatures at 10 and 17 GHz from the satellite radiometer AMSR2 (Advanced Microwave Scanning Radiometer, on the Japanese Satellite GCOM-W). We have compared snow depth data on Antarctic sea ice thus retrieved with airborne snow depth measurements from two flight campaigns (Operation Ice Bridge, OIB). This showed that the satellite retrieval produces meaningful results but strongly underestimates the snow depth. Therefore, we now train the retrieval method with Antarctic snow depth measurements, preferably from one of the already mentioned OIB flights and compare the results with independent snow depth measurements.

UP 5.4 Wed 12:00 ELP 6: HS 4

Bromine explosions and catalytic ozone depletion in the Arctic spring-time boundary layer — •Stefanie Falk[1,2], Luca Reissig[1], Andreas Richter[3], Hans-Werner Jacobi[4], and Björn-Martin Sinnhuber[1] — [1]Karlsruher Institut für Technologie — [2]Ludwig-Maximilians-Universität München — [3]Institut für Umweltphysik, Universität Bremen — [4]Institute of Environmental Geosciences (IGE), Université Grenoble Alpes / CNRS / Grenoble INP / INRAE / IRD

Ozone depletion in the polar boundary layer is observed frequently during springtime and is related to an enhancement of reactive bromine. Consequently, increased amounts of volume mixing ratio and vertical column densities of BrO have been observed by in situ observation, ground-based and airborne remote sensing, and satellites. Such activated reactive bromine serves as a source of tropospheric BrO at high latitudes, which otherwise is underestimated in global models. We have implemented a treatment of reactive bromine deposition, release, and recycling on sea ice and snow-covered terrestrial surfaces in the global chemistry-climate model ECHAM/MESSy Atmospheric Chemistry (EMAC).

Within the BromoPole project, we will compare EMAC model predictions with bromide concentrations determined in snow samples taken at Spitsbergen (Ny-Ålesund) and BrO observations from satellite (e.g. TROPOMI) and improve the modeled AirSnow mechanism in EMAC. Possible applications in ICON will be explored.

UP 5.5 Wed 12:15 ELP 6: HS 4

Applications of ^{39}Ar-ATTA in Alpine ice samples - surface ages and constraints on diffusion — •Joshua Marks[1], David Wachs[1,2], Pascal Bohleber[3,4], Andrea Fischer[3], Yannis Arck[1], Martin Stocker[3], Susanne Preunkert[1,5], Markus Oberthaler[2], and Werner Aeschbach[1] — [1]Institute of Environmental Physics, Heidelberg, Germany — [2]Kirchhoff-Institute for Physics, Heidelberg, Germany — [3]Institute for Interdisciplinary Mountain Research, Innsbruck, Austria — [4]Ca' Foscari University of Venice, Venice, Italy — [5]Institut des Géosciences de l'Environnement (IGE), Grenoble, France

In the study of alpine ice cores, dating with radiometric methods is an important tool. Common tracers used for dating like ^{3}H, ^{210}Pb and ^{14}C do not cover the important age range of several 100 years. ^{39}Ar with its half-life of 269 years is well suited for dating between 50 and 1000 years. However, due to its low abundance of 10-15 a very selective measurement method is needed. This is implemented by the quantum technology of Argon Trap Trace Analysis (ArTTA) which enables ice dating with samples of only few kg of ice.

This work focuses on the further development of the sampling methods and sample preparation for the ArTTA dating tool. Several alpine glaciers have been investigated with surface age profiles. Furthermore, the possible contamination of samples by diffusion of argon into the ice has been addressed and a first estimation of effective magnitude of diffusion was conducted

UP 6: Other Topics

Time: Wednesday 14:30–15:15 Location: ELP 6: HS 4

UP 6.1 Wed 14:30 ELP 6: HS 4

Resource-aware Research on Universe and Matter: Call-to-Action in Digital Transformation — •Ben Brüers — Deutsches Elektronen Synchrotron DESY, Zeuthen

Given the urgency to reduce fossil fuel energy production to make climate tipping points less likely, we call for resource-aware knowledge gain in the research areas on Universe and Matter with emphasis on the digital transformation. A portfolio of measures is described in detail and then summarized according to the timescales required for their implementation. The measures will both contribute to sustainable research and accelerate scientific progress through increased awareness of resource usage. This talk is based on the publication arXiv:2311.01169, which is the result of a three-days workshop on sustainability in digital transformation held in May 2023.

UP 6.2 Wed 14:45 ELP 6: HS 4

Atmospheric Gravity Wave Spectra: A Study Using Lidar Data — •Mohamed Mossad, Irina Strelnikova, Robin Wing, Gerd Baumgarten, Michael Gerding, Jens Fiedler, and Eframir Franco-Diaz — Leibniz Institute of Atmospheric Physics, Kühlungsborn, Germany.

Gravity waves (GWs) play a crucial role in Earth's atmospheric dynamics. The propagation, breaking and dissipation of GWs drive the general circulation of the atmosphere, redistributing energy and momentum through the different layers of the atmosphere. Changes in wind and temperature measured by lidars and other instruments help us understand the spectral properties of GWs, such as their frequencies, amplitudes, and scales. Better understanding of these parameters and the sources that produce GWs is important to model parameterizations of their impact on the average state of the atmosphere.

In this study, we analyze lidar data from Kühlungsborn (54°N, 12°E) and ALOMAR (69°N, 16°E) to examine the GW spectra in the atmosphere. We present a thorough analysis of GW spectra across various atmospheric conditions, focusing on seasonal and altitudinal variations. This work contributes to a deeper comprehension of energy transfer within the atmosphere, bridging theoretical models with empirical observations and offering insights beneficial for climatological research and environmental forecasting.

UP 6.3 Wed 15:00 ELP 6: HS 4

The occurrence and sources of Ni in ambient air particulates using Synchrotron Radiation Based X-ray Fluorescence and X-ray Absorption Near Edge Structure — •Abdallah Shaltout[1], Messaoud Harfouche[2], and Diane Eichert[3] — [1]Spectroscopy Department, Physics Research Institute, National Research Centre, El Behooth St., 12622 Dokki, Cairo, Egypt — [2]Synchrotron-light for Experimental and Scientific Applications in the Middle East (SESAME), P.O. Box 7, Allan 19252, Jordan — [3]ELETTRA Sincrotrone Trieste, Strada Statale, Science Park 34149 Basovizza, Trieste, Italy

High concentrations of Ni in the ambient air might induce carcinogenic effects. The present work aims at investigating the presence of Ni in ambient air particulates using advanced X-ray synchrotron radiation techniques. Total suspended and fine particulates (TSP, PM2.5) were collected from residential and industrial areas of Cairo, Egypt. Quantitative results indicate remarkable high concentrations of Ni in the ambient air particulates which are higher than the annual allowance thresholds as indicated by the world health organization (WHO). Elemental maps of Ni were acquired to unravel the natural spatial distribution of Ni on the filters carrying the ambient air particulates. Complementary X-ray absorption near edge structure (XANES) spectroscopy at the Ni K-edge (8.331 keV) was used to determine Ni speciation. Our results demonstrate that Ni is predominantly found under its divalent oxidation state in the studied ambient air particulates.

UP 7: Posters

Time: Wednesday 16:30–18:30 Location: ELP 6: Foyer

UP 7.1 Wed 16:30 ELP 6: Foyer

Revisiting the question "Why is the sky blue?" — •Anna Lange[1], Alexei Rozanov[2], and Christian von Savigny[1] — [1]Institute of Physics, University of Greifswald, Germany — [2]Institute of Environmental Physics, University of Bremen, Germany

The common answer to the question "Why is the sky blue" is usually Rayleigh scattering. In 1953 Edward Hulburt demonstrated, that the blue colour of the zenith sky at sunset is to 1/3 caused by Rayleigh scattering and to 2/3 caused by ozone absorption. In this study, an approach to quantify the contribution of ozone to the blue colour of the sky for different viewing geometries is implemented using the radiative transfer model SCIATRAN and the CIE XYZ colour system. The influence of ozone on the blue colour of the sky is calculated for solar zenith angles of 10°-90° and a wide range of viewing geometries. For small solar zenith angles, the influence of ozone on the blue colour of the sky is minor, as expected. However, the effect of ozone increases with increasing solar zenith angle. The calculations for the Sun at the horizon confirm Hulburt's estimation with remarkably good agreement. More stratospheric aerosols reduce the ozone contribution at and near the zenith for the Sun at the horizon. The exact contribution of ozone depends strongly on the assumed total ozone column. The calculations also show that the contribution of ozone increases with increasing viewing zenith angle and total ozone column. Variations in surface albedo as well as full treatment of polarised radiative transfer were found to have only minor effects on the contribution of ozone to the blue colour of the sky.

UP 7.2 Wed 16:30 ELP 6: Foyer

Langzeitmessungen von Halogenoxiden in der Arktis: Projektübersicht und erste Ergebnisse — •Bianca Lauster[1,2], Sebastian Donner[1], Udo Friess[2], Ulrich Platt[2], Lucas Reischmann[1], William Simpson[3], Steffen Ziegler[1] und Thomas Wagner[1,2] — [1]Max-Planck-Institut für Chemie, Mainz — [2]Universität Heidelberg — [3]University of Alaska Fairbanks

Die Halogenchemie ist ein zentrales Element des troposphärischen Ozonabbaus im polaren Frühjahr. Entstehungsmechanismen reaktiver Halogene, ihr Transport und deren Wechselwirkungen sind jedoch nicht vollständig verstanden. Darüber hinaus hat das sich ändernde arktische Klima potentiell einen starken Einfluss auf die Halogenaktivierung.

Im Dezember 2023 wurde ein LP-DOAS (Lang-Pfad Differentielle Optische AbsorptionsSpektroskopie) Instrument in Utqiagvik (Barrow), Alaska, für Langzeitmessungen aufgebaut. Das Instrument wurde speziell für seinen vorherigen Einsatz an der deutschen Forschungsstation Neumayer in der Antarktis konzipiert, wo es über zwei Jahre lang erfolgreich betrieben wurde (Nasse, 2019). Mit den jetzigen Messungen in der Arktis sollen die komplexen Wechselwirkungen zwischen Halogenen und anderen Spurengasen, wie z.B. NO2, auch unter dem Einfluss anthropogener Luftverschmutzung näher untersucht werden.

Um die Datenqualität zu verbessern, wurde der Instrumentenaufbau vorab basierend auf den Erkenntnissen aus der vorangegangenen Messkampagne optimiert. Hier werden die Instrumenteneigenschaften sowie die Zielsetzung des Projekts präsentiert und erste Ergebnisse der LP-DOAS Daten mit Fokus auf Datenqualität und -analyse gezeigt.

UP 7.3 Wed 16:30 ELP 6: Foyer

Characterisation and deployment of a Pandora DOAS instrument in Heidelberg — •Johannes Hägele, Karolin Voss, Ralph Kleinschek, and André Butz — Institute of Environmental Physics, Heidelberg University, Germany

Over the past five decades, Differential Optical Absorption Spectroscopy (DOAS) has been used successfully for the measurement of various atmospheric trace gases such as O_3 and NO_2. In order to establish a global network of DOAS measurements, NASA and ESA collaborate on the Pandonia Global Network using their custom-built Pandora instruments.

Here, we report on our progress in deploying a Pandora setup at the Institute of Environmental Physics in Heidelberg. The instrument is suitable for both direct sun and moon as well as sky scanning measurements and uses 2 Czerny-Turner spectrometers with a wavelength range of 280-530 nm and 380-900 nm, respectively. It will be set up at the institute's roof close to the city centre. So far, we have optically and electronically characterized the spectrometers using a set of different lamp and dark measurements. For spectrometer 1, the electronic readout induces a spatially oscillatory signal of unknown origin which influences the instrument noise.

UP 7.4 Wed 16:30 ELP 6: Foyer

Single particle polarimetry of volcanic ash in a plasma traps — •Franko Greiner[1], Alexander Schmitz[1], Thor Hansteen[2], and Christian von Savigny[3] — [1]Institute of Experimental and Applied Physics, Kiel University, Kiel, Germany — [2]Dynamics of the Ocean Floor, GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany — [3]Institute of Physics, University of Greifswald, Greifswald, Germany

Numerous aspects of volcanic effects on the atmosphere and climate remain poorly understood. A significant but often overlooked factor is the presence of volcanic ash in aerosol plumes, which is typically ignored in satellite observations in the optical spectral range due to limited data on the ash's complex refractive index (CRI). Accurate identification of volcanic ash in these observations requires understanding both the CRI and its variability among different eruptions.

We propose a new, less assumption-dependent laboratory method for measuring the CRI of volcanic ash. Using a plasma trap and assessing angle-resolved Mie scattering of single ash particles, this approach aims to provide high-precision CRIs. The project's main goal is to explore whether the CRI of a specific volcanic event may be determined based on ash amorphicity and chemical composition.

UP 7.5 Wed 16:30 ELP 6: Foyer

Determination of radioactivity levels and radiological hazards of soils from the Bitola region — •Irena Zlatanovska[1], Trajče Stafilov[2], Robert Šajn[3], Bojana Dimovska Gonovska[4], Snežana Dimovska[5], Jovan Janusheski[5], and Lambe Barandovski[1] — [1]Institute of Physics, Faculty of Natural Sciences and Mathematics, Ss Cyril and Methodius University in Skopje, POB 162, 1000 Skopje, Macedonia — [2]Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss Cyril and Methodius University in Skopje, POB 162, 1000 Skopje, Macedonia — [3]Geological Survey of Slovenia, Dimičeva ul. 14, 1000 Ljubljana, Slovenia — [4]Scientific Tobacco Institute, St. Kliment Ohridski University, Kičevska bb, 7500 Prilep, Macedonia — [5]Republic Institute for Health Protection, 50 Divizija 6, 1000 Skopje, Macedonia

To determine the radioactivity levels in soil and evaluate the associated radiological impact, 58 topsoil samples from the town of Bitola and its environs were collected. Gamma spectrometry measurements indicated significant variability in activity concentrations, with median values for 40K, 226Ra, and 232Th exceeding global medians. Calculations for the absorbed dose rate and annual effective dose rate were performed to assess radiological health hazards for the residents. The obtained results were statistically processed, and maps of spatial distribution were prepared, clearly indicating the combined influence of geology and human activities on the outcomes.

UP 7.6 Wed 16:30 ELP 6: Foyer

Investigating the size distribution of stratospheric aerosols following volcanic eruptions during the SAGE-I mission from 1979 to 1981 — •Christian Löns, Felix Wrana, and Christian von Savigny — University of Greifswald

As part of my master's thesis, I retrieved particle size information from satellite solar occultation measurements of SAGE-I, which collected data from February 1979 to 1981. The particle size was derived with a fixed distribution width using a Mie code via two aerosol extinction coefficients at 450 nm and 1000 nm. To verify the results, they were compared with in situ particle counter measurements from Laramie. At altitudes of 15 km to 25 km, a good usability of the data set is observed, which improves with an increase in aerosol extinction and thus a lower influence of NO_2 on the 450 nm channel. While the volcanic eruptions of Mt. St. Helens (1980) and Alaid (1981) in the northern mid-latitudes tended to increase the average aerosol size, the tropical volcanic eruptions of Sierra Negra (1979) and Ulawun (1980) led to a reduction in the median radius.

UP 7.7 Wed 16:30 ELP 6: Foyer

Ground-based Hyperspectral Imaging of Greenhouse Gases

Using a Physics Inversion Algorithm — •Helge Haveresch, Marvin Knapp, Benedikt Löw, Leon Scheidweiler, Felix Külheim, Ralph Kleinschek, and André Butz — Institute of Environmental Physics, Heidelberg University, Im Neuenheimer Feld 229, 69120 Heidelberg

Emissions of carbon dioxide (CO_2) and methane (CH_4) drive anthropogenic climate change significantly. Monitoring point sources of greenhouse gas emissions is crucial for validating mitigation strategies. We present the results of imaging CH_4 emission plumes from a coal mine in Silesia using a NEO HySpex SWIR-384 hyperspectral camera in a ground-based geometry. The camera is positioned at a distance of kilometres from the source, capturing images in the shortwave infrared (1-2.5 μm) approximately every minute. Methods like the matched filter technique only work well for CO_2 and CH_4 analysis given homogeneous backgrounds. However, based on statistical analysis, this method fails in heterogeneous scenes, as seen at passively degassing volcanoes like Mount Etna, where aerosols accompany gases. To overcome this, we developed a physics-based inversion routine based on the single scattering solution of atmospheric radiative transfer, which retrieves aerosol parameters and measures CO_2 and CH_4 columns. The method shows promising agreement with previous results obtained by the matched filter analysis for homogeneous scenes at the coal mine. For measurements of volcanic CO_2 emission under heterogeneous conditions at Mt. Etna, we discuss implications and challenges.