UP 8: Methods - measurement techniques; Atmosphere - trace gases, mesosphere

Time: Wednesday 14:00–15:45 Location: G 1.011

UP 8.1 Wed 14:00 G 1.011

New markets for an old tracer: Applications for ^{39}Ar dating with Argon Trap Trace Analysis (ArTTA) — •Arne Kersting[1], Sven Ebser[2], Zhongyi Feng[2], Lisa Ringena[2], Maximilian Schmidt[2], Florian Ritterbusch[2], Philip Hopkins[1], Viola Rädle[1], Stefan Beyersdorfer[1], Markus K. Oberthaler[2], and Werner Aeschbach[1] — [1]Institut für Umweltphysik, Heidelberg, Germany — [2]Kirchhoff-Institut für Physik, Heidelberg, Germany

The potential of ^{39}Ar as a dating tool has long been recognized in the geoscience community. As noble gas it is not influenced by chemical or biological processes and with a half-life of 269 years it closes the dating gap between young tracers (^{3}H, CFCs, SF_6) and ^{14}C. Still, its application was hindered by its extremely low isotopic abundance making the low-level counting laboratory in Bern the only facility performing routine measurements of ^{39}Ar. Requiring 1000 L of water this application is mainly restricted to groundwater studies. Recent developments in the atom counting method Argon Trap Trace Analysis (ArTTA), reduced the required sample size for ^{39}Ar analysis down to a minimum of 1 mL STP of pure argon corresponding to a few kg of water or ice. The measurement time per sample is one day and the current construction of a second apparatus will double the throughput soon. This apparatus will for the first time render applications of the tracer ^{39}Ar in oceanography, glaciology and limnology feasible, while reducing the effort for groundwater analysis significantly. In the scope of this talk an overview of already performed field campaigns is given as well as an outlook on the potential for future studies.

UP 8.2 Wed 14:15 G 1.011

Soil moisture measurement at the hectometer scale using CRNS for mobile applications — •Markus Köhli[1,2], Jannis Weimar[1], Martin Schrön[3], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg, Heidelberg, Germany — [2]Im Neuenheimer Feld 226 — [3]Helmholtz Zentrum für Umweltforschung, UFZ, Leipzig

The method of cosmic ray neutron sensing (CRNS) - soil moisture measurement at the hectometer scale non-invasively has turned out to be feasible by detecting environmental albedo neutron density. The key feature of the method is the exceptionally different behavior of hydrogen in its reflection power of neutrons generated by cosmic rays. It slows down fast neutrons whereas any other heavier element independent of the chemical composition rather reflects them. In the recent years the understanding of neutron transport by Monte-Carlo simulations led to major advancements in precision, which have been successfully targeted meanwhile by a manifold of experiments. Whereas the homogeneous conditions are well understood, inhomogeneous topologies are now in the focus of research. In our case these are applications for partial snow cover and mobile surveys, where the influence of the road material, which biased results towards lower soil moisture values, could be calculated, measured and analytically understood. Here we present the actual status of the method especially with respect to inhomogeneous terrain.

UP 8.3 Wed 14:30 G 1.011

Night-time atomic oxygen in the mesopause region derived from satellite observations of atmospheric airglow — •Tilo Fytterer[1], Miriam Sinnhuber[1], and Christian von Savigny[2] — [1]Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany — [2]Institute of Physics, Ernst-Moritz-Arndt-Universität Greifswald, Greifswald, Germany

Atomic oxygen in its ground state [O(3P)] is involved in several exothermic reactions and collisions with CO2 and contributes to both heating and cooling rates in the mesopause region (80-100 km). Therefore, O(3P) has a strong impact on the general energy budget of the mesopause region, eventually affecting further quantities like air temperature and the wind. However, direct observations of O(3P) are relatively rare, and consequently O(3P) had to be indirectly derived from the atmospheric light emissions which are known as airglow and are observable by satellite instruments. Here, we present results of night-time O(3P) in the mesopause region by using a zero dimensional model which was adapted to match atmospheric OH airglow observations from 2003 to 2011. The measured OH transitions are obtained from the satellite/instrument configuration TIMED/SABER [OH(9-7)+OH(8-6) and OH(5-3)+OH(4-2)] and ENVISAT/SCIAMACHY [OH(6-2) and OH(3-1)].

UP 8.4 Wed 14:45 G 1.011

Retrieval of the $O_2(^1\Sigma)$ and $O_2(^1\Delta)$ volume emission rate and temperature in the mesosphere and lower thermosphere using SCIAMACHY MLT limb scans — •Amirmahdi Zarboo[1], Stefan Bender[2], Miriam Sinnhuber[1], John P. Burrows[3], and Johannes Orphal[1] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Norwegian University of Science and Technology, Trondheim, Norway — [3]University of Bremen, Bremen, Germany

We present the retrieved volume emission rates (VERs) from airglow of the daytime and twilight $O_2(^1\Sigma)$ and $O_2(^1\Delta)$ band emissions in the visible (811–595 nm) and near infrared (1200–1360 nm) and the retrieved temperature from daytime $O_2(^1\Sigma)$ emission in the mesosphere and lower thermosphere (MLT). SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY (SCIAMACHY) on-board European Space Agency Envisat satellite observes up-welling radiation in the limb viewing geometry with its special MLT mode in the 50 to 150 km altitude range. We analyze the daily averaged latitude distributions and the time series of the retrieved VERs in the altitude range from 53 to 149 km and the retrieved temperatures in the altitude range from 80 to 120 km. The $O_2(^1\Sigma)$ VER peaks are observed at about 90 km altitude, while $O_2(^1\Delta)$ VER emissions are observed to decrease with altitude, with the largest values at the lowest edge of the observations (about 53 km). Comparisons of the temperature retrievals with other satellite instruments are made. We do some sensitivity tests of the temperature retrievals in order to investigate the variations due to different parameters as well.

UP 8.5 Wed 15:00 G 1.011

Validation of the extended Multiple Airglow Chemistry model with in-situ measurements of the Energy Transfer in the Oxygen Nightglow campaign — •Olexandr Lednyts'kyy[1], Christian von Savigny[1], and Edward Llewellyn[2] — [1]Ernst-Moritz-Arndt-University of Greifswald, Greifswald, Germany — [2]University of Saskatchewan, Saskatoon, Canada

Coupling of electronically excited states of molecular and atomic oxygen (O_2 and O) with each other through collisions was implemented in the Multiple Airglow Chemistry (MAC) model to reflect the photochemistry in the upper Mesosphere and Lower Thermosphere (MLT) region. Additionally, temperature, concentrations of O_2 and molecular nitrogen were simulated with the NRLMSISE-00 model and used in the MAC model to retrieve concentrations of MLT minor species based on airglow emissions. The MAC model was extended with two upper Herzberg states that allowed the excitation of the green line emission to be explained and refuted the concept of integrity of identity of the O_2 electronic states. The photochemical models of McDade *et al.* were tuned using *in-situ* measurements of the Energy Transfer in the Oxygen Nightglow (ETON) campaign conducted in March 1982. The developed, and verified, extended cubic equation (ECE) was based on quenching processes that were in addition to those of McDade *et al.* The ECE results in overestimated [O], the McDade *et al.* models result in underestimated [O] while the extended MAC model results in [O] in the best agreement with ETON *in-situ* [O].

UP 8.6 Wed 15:15 G 1.011

Wave driven dynamical processes to couple the lower and the middle atmosphere over the year — •Kathrin Baumgarten, Michael Gerding, and Franz-Josef Lübken — Leibniz-Institute of Atmospheric Physics at the University of Rostock , Kühlungsborn, Germany

Atmospheric waves, e.g., gravity and tidal waves, play a key role for our understanding of the circulation in the Earth's atmosphere. Due to the propagation and interaction of these waves, they couple different atmospheric layers from the troposphere to the mesosphere by the transport of momentum and energy over a wide range of scales. The propagation of gravity waves is strongly affected by tides as they modulate the mean background wind field. Since 2010 a daylight capable RMR lidar for high resolution density and temperature measurements at Kühlungsborn (54° N, 12° E) is in operation to investigate wave phenomena in the middle atmosphere between 30 and 75 km altitude. An extensive data set of about 7500 hours is used to derive the seasonal variation of different gravity and tidal waves. Therefore, a 1-dimensional spectral filtering technique is used to separate gravity and tidal waves. Inertia gravity waves and tides show a reduced activity during summer as theoretically expected due to the mean prevailing winds. Gravity waves with periods of only a few hours or less behave contrary to this. This is presumably caused by large horizontal phase speeds allowing these gravity waves to propagate into the mesosphere. We will present the seasonal variation of gravity waves as well as tides to demonstrate their particular influence in different regions of the middle atmosphere.

UP 8.7 Wed 15:30 G 1.011

About 27-day signatures in standard phase height measurements above Europe — •Christian von Savigny[1], Dieter H. W. Peters[2], Günter Entzian[2], and Georg Teiser[1] — [1]Ernst-Moritz-Arndt-University of Greifswald, Greifswald, Germany — [2]Leibniz-Institute of Atmospheric Physics, University of Rostock, Kühlungsborn, Germany

We report on 27-day signatures in standard phase height measurements performed using a radio transmitter in central France and a receiver in Kühlungsborn (54° N, 12° E, Mecklenburg, Germany). Using the superposed epoch analysis technique solar 27-day signatures with amplitudes of several tens of meters are found. The statistical significance of the obtained results was tested with a Monte-Carlo approach and the solar 27-day signatures are found to be highly significant. The sensitivity parameter for the 27-day solar response of standard phase height is in good agreement with the sensitivity parameter for the 11-year solar cycle. Surprisingly, the amplitude of the 27-day signature is larger during solar minimum than during solar maximum. In addition, distinct differences in the signature's amplitude with season exist. These findings indicate that the observed effects are not exclusively driven by photochemical effects, but that dynamical processes play an important role, especially in winter.