UP 8: Physics of the middle atmosphere

Zeit: Donnerstag 11:00–12:40 Raum: HS 22

UP 8.1 Do 11:00 HS 22

Chemiluminescent potassium emission in the Earth's atmosphere — •Stefan Noll[1,2], John M. C. Plane[3], Wuhu Feng[3], Bastian Proxauf[4], Stefan Kimeswenger[5,6], and Wolfgang Kausch[5] — [1]Universität Augsburg, Germany — [2]DLR, Weßling-Oberpfaffenhofen, Germany — [3]University of Leeds, UK — [4]MPI für Sonnensystemforschung, Göttingen, Germany — [5]Universität Innsbruck, Austria — [6]UCN, Antofagasta, Chile

The evaporation of cosmic dust particles entering the Earth's atmosphere at high speeds leads to the formation of metal layers in the mesopause region at around 90 km. The alkali metal potassium (K) can be observed via the $K(D_1)$ line at 769.9 nm, which can be stimulated by sunlight, lasers, and chemical reactions. The latter mechanism is particularly useful for studying the underlying chemistry. However, as the related weak nighttime emission is difficult to observe, only a rough mean intensity has been measured, so far. With about 2,300 high-resolution spectra from the astronomical echelle spectrograph UVES at Cerro Paranal in Chile taken between 2000 and 2015, we have been able to study K nightglow in much more detail. Nighttime, seasonal, and long-term variations have been investigated for the first time. Moreover, we have simulated the K emission with the Whole Atmosphere Climate Community Model (WACCM) in order to estimate the efficiency of the chemiluminescent emission process. Overall, the variability and quantum yield are surprisingly different from the corresponding results for the better studied nightglow emission of sodium, another light alkali metal.

UP 8.2 Do 11:20 HS 22

Upper mesospheric Sodium profiles from OSIRIS nightglow measurements — •Julia Koch[1], Landon Rieger[2], Adam Bourassa[2], Doug Degenstein[2], and Christian von Savigny[1] — [1]University of Greifswald, Greifswald, Germany — [2]University of Saskatchewan, Saskatoon, Canada

The purpose of this research is to gain a better understanding of the mechanism of the Na-D-line excitation in the terrestrial nightglow. To do so a good approach is to find out more about the Na-density profile around the globe. OSIRIS (the Optical Spectrograph and InfraRed Imager System) on the satellite Odin provides limb measurements from February 2001 and is still operational today. Sodium emits radiation at 589,0 and 589,6 nm which is covered by the OSIRIS spectral range. Although its resolution is not good enough to separate the two lines OSIRIS has a better signal-to-noise ratio than other instruments. We implemented an inversion method to retrieve upper mesospheric Na profiles from OSIRIS nightglow measurements based on an effective Chapman excitation scheme. To validate the obtained results they were also compared to sodium profiles that were previously retrieved from SCHIAMACHY data. And it can be shown that both instruments provided results that are in good agreement with each other.

UP 8.3 Do 11:40 HS 22

Stereoskopie der Airglowschicht zur Charakterisierung von Schwerewellen — •Patrick Hannawald[1], Sabine Wüst[2] und Michael Bittner[1,2] — [1]Universität Augsburg — [2]DLR, Deutsches Fernerkundungsdatenzentrum, Oberpfaffenhofen

Das sogenannte OH-Airglow in ungefähr 87km Höhe ist hervorragend für die Untersuchung der atmosphärischen Dynamik in der Mesosphäre geeignet. Aufgrund chemischer Vorgänge wird nachts Licht im nahen Infrarotbereich abgestrahlt. Atmosphärische Schwerewellen, welche die Dynamik in dieser Höhe zu einem großen Teil bestimmen, modulieren die Helligkeit dieser Schicht. Sie kann deshalb für die Beobachtung von Schwerewellen verwendet werden und erlaubt das Studium dieser, mit in-situ Messungen nur schwer zugänglichen, Schicht. Mit bodengebundenen Kameras können kontinuierliche Beobachtungen des Airglows über das gesamte Jahr hinweg durchgeführt und so z.B. die statistische Ausbreitungsrichtung von Schwerewellen bestimmt werden. Diese Informationen können zur Validation von Atmosphärenmodellen verwendet werden. Ein einzelnes Kamerasystem erlaubt nur die Ableitung der horizontalen Wellenparameter. Durch Kombination von zwei Kameras, welche von verschiedenen Standorten aus dasselbe Gebiet der Airglow-Schicht betrachten, ist es mittels Stereoskopie jedoch möglich zusätzliche Informationen über die Wellen zu erhalten und so die Dynamik in der mittleren Atmosphäre noch besser zu verstehen. Das DLR in Zusammenarbeit mit der Universität Augsburg betreibt ein solches Stereokamerasystem seit Anfang 2018. Im Vortrag werden die vorläufigen Ergebnisse anhand von Fallstudien gezeigt.

UP 8.4 Do 12:00 HS 22

Model studies on chemical effects of sprites in relation with satellite measurements — •Holger Winkler[1], Takayoshi Yamada[2,3], Yasuko Kasai[2,3], and Justus Notholt[1] — [1]Institut für Umweltphysik, Universität Bremen — [2]Terahertz Technology Research Center, National Institute of Information and Communications Technology, Japan — [3]Department of Environmental Chemistry and Engineering, Tokyo Institute of Technology, Japan.

Sprites are large scale electrical discharges in the mesosphere occurring above active thunderstorm clouds. The strong electric fields in sprites cause electron impact ionization, dissociation and excitation of air molecules and atoms as well as electron attachment to electronegative species. Mainly during the last decade, results of a number of model simulations of chemical sprite effects have been presented. However, until recently, there were no direct measurements of the chemical impact of sprites. Data from the Superconducting Submillimeter-Wave Limb Emission Sounder (SMILES) at the Japanese experiment module of the International Space Station indicate an increase of mesospheric HO_2 after three sprite events. These are the first direct observations of chemical sprite effects, and provide a unique opportunity to test our understanding of the chemical processes in sprites. We present results of plasma chemistry model simulations of sprites in relation with SMILES observations, and analyze the chemical reactions which lead to an increase of mesospheric HO_2 on time-scales of many minutes to a few hours after sprite events.

UP 8.5 Do 12:20 HS 22

Response of the middle atmospheric temperature to the solar 27-day cycle — •Piao Rong[1,2] and Christian von Savigny[1] — [1]Institute of Physics, University of Greifswald, Greifswald, Germany — [2]School of Science, Xi'an Jiaotong University, Xi'an, China

This contribution discusses the presence and characteristics of solar 27-day signatures in middle atmospheric temperature observed by the Microwave Limb Sounder (MLS) on NASA's Aura spacecraft. We use the superposed epoch analysis (SEA), the time-lagged linear regression method (sensitivity analysis), and a Monte-Carlo test method (significance test) to explore the dependence of the results on different parameters (e.g., smoothing filter, window width and epoch centers), on solar activity and season, as well as on latitude. Using different parameters does impact the results to a certain degree, but it does not affect the overall characteristics. The 27-day signature in temperature is stronger during winter than during summer. The sensitivity of temperature to solar 27-day forcing is larger at high latitudes than at low latitudes in strong solar activity years. However, in weak solar activity years, the sensitivity maximum appears at the equatorial mesopause. In addition, the sensitivity values of the strong solar activity years are smaller than the values in the weak solar activity years. That means, in weak solar activity years, the temperature may be affected by some factors other than the 27-day solar cycle to induce so high sensitivity.