UP 15: Symposium Einfluss der Sonne auf das Klima der Erde

Zeit: Donnerstag 14:00–16:00 Raum: HS 2

Hauptvortrag UP 15.1 Do 14:00 HS 2

Solar irradiance variability — •Sami Solanki — Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau, Germany

The Sun ist now known to be a variable Star.

Since 1978 satellite based radiometers have been measuring changes in solar irradiance, so that the available record now covers 3 solar cycles. These data have uncoverd a rich structure of the variable solar irradiance. In addition, the physical understanding of irradiance variations and the detailed reconstruction of this quantity (both for the time in which observations are available and for earlier times) have made great strides over the last years. However, there are some significant differences between observations and models regarding the spectral irradiance, which is of great promise for affecting the Earth's atmosphere and also climate.

In this talk an overview of the measurements and the modelling of total and spectral irradiance variations is given, highlighting in particular the progress of the last few years, but also pointing out the problems.

Hauptvortrag UP 15.2 Do 14:30 HS 2

Influence of Galactic Cosmic Rays and solar variability on aerosols, clouds and climate: Results from the CLOUD experiment at CERN — •Joachim Curtius — Institute for Atmosph. & Envir. Sciences, Univ. of Frankfurt/Main, Germany

The potential influence of ions produced from galactic cosmic rays on the formation of new aerosol particles in the atmosphere may play an important role relevant for aerosol properties, cloud formation and climate. Variability of galactic cosmic rays due to modulating influences from the sun therefore may affect (regional) climate on various time scales. A quantitative understanding of the role of ions for atmospheric aerosol formation has not been reached, but also the dependence of aerosol formation on the concentration of the nucleating substances such as gaseous sulfuric acid, ammonia and amines is missing.

Here results from the CLOUD experiment at CERN are presented. CLOUD is a new aerosol and cloud chamber facility at CERN. The chamber can be exposed to a pion beam from CERN to simulate various levels of atmospheric ionization. CLOUD has been set up to investigate aerosol and cloud processes under well-controlled laboratory conditions. We find that cosmic ray ionization substantially increases the nucleation rate of pure sulfuric acid/water particles while charge effects are much less pronounced for ternary systems including ammonia or dimethylamine. The results from the CLOUD experiments have been used to develop a new parameterization of aerosol nucleation which has been included in a global climate model. Impacts of our findings for cloud formation and climate are discussed.

Hauptvortrag UP 15.3 Do 15:00 HS 2

NO_x - the energetic particle - climate connection? — •Thomas Reddmann — KIT Karlsruhe

In addition to the variability of the solar spectrum in the UV and VIS part, and the modulation of cosmic galactic radiation with the solar cycle, the solar wind impresses the signs of solar activity to the upper parts of the Earth's atmosphere. Energetic particles as protons in the MeV range from eruptive processes on the Sun's surface, or electrons accelerated within the magnetosphere of the Earth, sometimes to relativistic energies, ultimately reach the lower thermosphere and mesophere. This particle precipitation causes local ionization and subsequently reactive gases as NO_x and HO_x are produced. Observations from satellites during the last decade, for example from the atmospheric instruments MIPAS and SCIAMACHY on the European ENVISAT satellite, have shown that following solar eruptive events or geomagnetic storms the concentration of the reactive gases can reach considerable amounts. During polar winter when NO_x is long-lived, downward transport of NO_x can bring it even to the stratosphere and to the ozone layer where it causes additional ozone loss. For the middle atmosphere, where ozone essentially determines the radiative heating rate, the dynamical state of the middle atmosphere is therefore somehow coupled to the precipitation of the particles, and via stratosphere-troposphere coupling this may even propagate to the surface and impact climate. On the other hand, the strength of the downward transport itself strongly depends on the dynamical state of the middle atmosphere. This chemical dynamical coupling and the role of energetic particles is a topic of current research. Recent results of observations and model simulations will be presented and open questions of this mechanism will be discussed.

Hauptvortrag UP 15.4 Do 15:30 HS 2

Impact of the solar 11-year and 27-day cycles on the Earth's middle atmosphere — •Christian von Savigny — Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Greifswald, Germany

Separating potential anthropogenic effects from natural variability - induced by solar variability in particular - is an important issue in atmospheric science. This is especially true for the middle atmosphere where both anthropogenic and solar effects are generally significantly larger than near the surface. This contribution will provide an overview of the current understanding of the impact of solar variability at the 11-year and 27-day time scales on the middle atmosphere with a special focus on temperature effects. The existence of an 11-year solar cycle signature in middle atmospheric temperature is well established, but estimates of the quantitative temperature sensitivity to changes in solar forcing differ considerably. The majority of the studies yield sensitivities of mesospheric temperature to solar forcing of about 1 - 4 K / (100 sfu). Recent studies suggest that the sensitivity values for the 11-year and the 27-day cycles are very similar, implying that the same underlying physical/chemical processes drive atmospheric temperature variability at these very different time scales. These studies also provide evidence that solar variability affects the middle atmosphere essentially instantaneously showing time lags of 1-2 days at most. The individual contributions of the chemical and physical processes driving the atmosphere's temperature response to changes in solar forcing are, however, not well known.