SYEE 1: Symposium: Energy an Extraterrestrial Influences on the Climate

Time: Tuesday 9:30–13:00 Location: H46

Invited Talk SYEE 1.1 Tue 9:30 H46

Cosmic Rays, Clouds and Climate — •Henrik Svensmark — Danish Space Research Institute, Juliane Maries Vej 30, DK-2100 Copenhagen, Denmark

Changes in the intensity of galactic cosmic rays seems alter the Earth's cloudiness. A recent experiment has shown how electrons liberated by cosmic rays assist in making aerosols, the building blocks of cloud condensation nuclei, while anomalous climatic trends in Antarctica confirm the role of clouds in helping to drive climate change. Variations in the cosmic-ray influx due to solar magnetic activity account well for climatic fluctuations on decadal, centennial and millennial timescales. Over longer intervals, the changing galactic environment of the Solar System has had dramatic consequences, including Snowball Earth episodes.

Invited Talk SYEE 1.2 Tue 10:15 H46

The Astronomical Theory of Palaeoclimates — •Michel Crucifix — Institut d'Astronomie et de Géophysique Georges Lemaître, Université catholique de Louvain, 2, Chemin du Cyclotron, B-1348 Louvain-la-Neuve, Belgique

Links between climate and Earth's orbit have been proposed for about 160 years. Two decisive advances towards an astronomical theory of palaeoclimates were Milankovitch's (1941) canon of incoming solar radiation (insolation) and findings, in 1976, of a double precession frequency peak in marine sediment data consistent with celestial mechanics. This lecture is divided in two parts : (1) it outlines the formalism behind the calculation of Earth's orbital elements (2) it summarises the present status of the astronomical theory of palaeoclimates. For example, we know since Milankovitch that ice volume variations are largely determined by northern hemisphere summer insolation. Indeed, low summer insolation allows snow fell in winter to survive the summer and accumulate from one year to the next, causing glacial inception. However, this first-order description is not fully satisfactory. The climate response to the astronomical forcing is highly nonlinear, and the difficulty is to identify and characterise the mechanisms causing non-linearity. Some are known since Milankovitch (the snow-albedo feedback), others were largely discussed during the eighties (the isostatic response); at last, some are not well understood, yet (the response of atmospheric carbon dioxide). The lecture comments on different strategies to progress : comprehensive general circulation models, models of intermediate complexity, and palaeodata assimilation schemes.

30 min. coffee break

Invited Talk SYEE 1.3 Tue 11:30 H46

Effects of the 11-Year Solar Cycle on the Atmosphere from the Surface to the Lower Thermosphere — •Marco A. Giorgetta, H. Schmidt, J. Kieser, and G.P. Brasseur — Max Planck Institute for Meteorology, Bundesstr.53, D-20146 Hamburg

The climate on Earth shows a broad spectrum of temporal and spatial variability resulting from internal dynamics or from external forcing. One such external factor is the variability of the solar irradiation at the top of the atmosphere induced by variations in the solar activity, as observed in the 11-year solar sunspot cycle, in the 27 day solar rotation signal or in particle events. The aim of this study is to quantify effects of the solar 11-year cycle on circulation, temperature and chemical composition of the atmosphere, and to put these signals into relation to other variations. For this purpose we employ the HAMMONIA whole atmosphere model, which is a global climate model that extends from the surface to the lower thermosphere, including physical and chemical processes. The high vertical extension of the HAMMONIA model allows the analysis of solar signals from the lower thermosphere, where for example temperature differences are very strong (500K), to smaller dynamical and chemical signals in the mesosphere and stratosphere, and weak signals in the troposphere. The HAMMONIA experiments can confirm the formation of primary ozone and temperature signals in the upper stratosphere and secondary signals in the lower tropical stratosphere, the latter mostly during boreal winter. This can be explained by the modification of the propagation conditions for planetary waves from the extratropical troposphere to the tropical upper stratosphere, resulting in a modified Brewer-Dobson circulation including a reduced upwelling in the tropical lower stratosphere for solar maximum conditions. Reduced upwelling results then in higher temperature and ozone mixing ratios, as similarly derived from observational analyses.

Invited Talk SYEE 1.4 Tue 12:15 H46

Climate Change and the Role of Photovoltaics in the Energy Mix — •Eicke R. Weber — Fraunhofer-Institut für Solare Energiesysteme ISE, Heidenhofstr.2, D-79110 Freiburg

The greatest challenge for humankind in the coming decades is likely the threat of catastrophic climate change. The biggest danger is not just the threat of increasing global temperatures and rising sea levels but the possibility that the emission of gases like CO_2 changes the earth climate irreversibly and essentially ends the Holocene, the period of extraordinary temperature stability that we enjoyed in the last ca. 12.000 years. The only hope seems to be a drastic reduction of the emission of those climate altering gases and this requires a distinct change in the global energy mix. Solar energy - including especially PV energy - will have to play an important role. This presentation will conclude with a discussion of PV technologies that appear to be most promising towards this goal.