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Cosmic-ray generation, propagation and atmospheric effects

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Cosmic rays, produced by high-energy extra-solar events, ionize the earth's atmosphere. Ionized aerosol particles can combine and form "seed" particles for cloud formation. In addition, cosmic-ray ionization increases the atmospheric conductivity. Variations of these quantities would be expected to have an effect on climate, and they do vary. The solar corona has a temperature of one million degrees and is continually "boiling off," producing "the solar wind." The solar wind is plasma that fills the solar system to a distance of about 90 times the earth-sun distance. The cosmic rays that fill the galaxy must do work against the solar wind to reach the earth's orbit and hence lose intensity. The work done is measured in hundreds of megavolts. The intensity of the solar wind, and hence the intensity of cosmic-rays at earth orbit varies irregularly over an approximately 11-year cycle and sometimes, falls to deep minima. The 17th century "Maunder Minimum," when solar modulation, the energy necessary to reach earth orbit, fell nearly to zero, was accompanied by what has been known as the "Little Ice Age," causing much hardship in Europe. This is evidence that changes in cosmic-rays intensity can be associated with an impact on climate. Another important climatological consideration due to cosmic-ray impacts on the terrestrial atmosphere is the production of 1.5 million-year Be-10 by the spallation process. Radioactive Be-10 is used to date sections of Greenland and Antarctic ice cores to analyze past climates. Calculations of these quantities from basic principles are presented.

Biography

Keran O'Brien is a physicist at USAEC's Health and Safety Laboratory and was the Director of Radiation Physics Division from 1981 to 1987. He retired from Federal service in 1987. He was appointed adjunct research professor of physics at Northern Arizona University in 1988. He serves on the editorial board of several journals. He was appointed to Committee on Dosimetry for the National Science Foundation National Research Council Advisory Committee on the Radiation Effects Research Foundation from January 1991 to December 1997. He received the American Nuclear Society's divisional Outstanding Service Award for Technical Excellence in 1976 and was also elected as a Fellow of the American Nuclear Society in 1981. He published more than 100 papers and four book chapters.

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