Forbush Decreases and Cloud Cover

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According to the cosmic ray - cloud hypothesis, changes in the cosmic ray intensity over the past two and a half solar cycles caused significant changes in the Earth's cloud cover with important consequences for the climate. To test this hypothesis we investigated on a global scale the atmospheric cloud cover and the variation of the atmospheric ionization induced by galactic cosmic rays during the seven largest Forbush decreases from 1989 to 2003. A Forbush decrease is a solar induced sudden decrease in the cosmic ray intensity that occurs within about a day, followed by subsequent recovery within 4-7 days. The reduction in the cosmic ray intensity for the selected events is of the order of 10-20% and therefore comparable with the changes during an 11-year solar cycle. For each event neutron monitor data were used to determine the changes in the primary differential energy spectrum of the galactic cosmic rays for a period of 20 days starting about 5 days prior to the onset of the Forbush decrease. Using this spectral information the Monte Carlo PLANETOCOSMICS code based on Geant4 was applied to calculate the ion production rate in the atmosphere during each event period as a function of latitude, longitude, and altitude, taking into account the geomagnetic field prevailing at that time. In this way the changes in the atmospheric ionization rate were obtained for a global grid with a resolution of 5 x 5 degrees and a temporal resolution of 3 hours. After calculating daily averages these data were compared with the corresponding cloud data (ISCCP D1) allowing for lags ranging from 0 to 10 days. The results of these comparisons for different cloud heights, latitudes, and areas (ocean-land) will be presented and discussed.