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Diurnal variation of the global fair weather current from measurements at a Negev desert station in Israel

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The global electrical circuit (GEC) postulates a constant downward flowing current (Jz) equal to ∼2 pA m-2 (Williams, 2009). We have been measuring the vertical fair-weather atmospheric electrical current from May 2011 continuously at the Wise astronomical observatory in the Negev desert, Israel. The instrument used is a modified version of the GDACCS design described by Bennet and Harrison (2008) which is capable of measuring the fair-weather current density with an accuracy of 0.4 pA m-2. The sensors are placed on a flat 1.5m x 1.5m concrete surface 150m away from the observatory. The signal is passed in a differential mode to the computer at the observatory, sampled at 250Hz by the data acquisition program (LabView) and saved to 1 minute files with a GPS time stamp every 1 second. The results show a clear daily pattern in the fluctuation of the fair weather vertical current Jz measured at the surface. The presence of airborne dust should reduce the conductivity (due to the attachment of small ions to aerosol particles). When analyzing the data with larger temporal resolution we note a strong correlation between the wind speed at the surface, the relative humidity and the Jz, suggesting the movement of space charge and rapid changes in the atmospheric conductivity. Additionally, we report initial indications for a response in Jz to the external forcing of geomagnetic conditions such as storms induced by solar flares, as evident from the correlation we find between Jz and Kp in solar quiescent and storm conditions.

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Williams, E. R. (2009), The global electrical circuit, Atmos. Res., 91, 2-4, doi:10.1016/j.atmosres.2008.05.018