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Global circuit air-Earth conduction current density measurements for solar-terrestrial studies

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Global thunderstorm and shower cloud activity generate charge separation in the atmosphere. This results in a global potential difference between the positively charged lower ionosphere and the surface of approximately $3x10^5$V. Ionisation from cosmic rays and natural radioactivity permit a small vertical electric current density (of order $1x10^{-12}Am^{-2}$) to flow between the lower ionosphere and the surface, in fair-weather regions. The magnitude of this vertical current density is determined by the ionospheric potential and the total (columnar) electrical resistance of the atmospheric column through which it flows, following Ohm's Law. This current density provides a physical link between solar activity influences on the ionosphere with the meteorologically active lower atmosphere. Additionally, the columnar resistance is closely related to the incident cosmic radiation intensity, of both galactic and solar sources. Changes in the cosmic ray intensity or ionospheric potential (such as during geomagnetic storms) are detectable at the surface through changes in the air-earth current density, particularly at sites with low or steady air pollution levels. A new instrument for determination of the air-earth conduction current density at the surface is described here, and measurements made at Reading University Atmospheric Observatory in Southern England in different solar conditions presented.