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Long-term variation of strong geomagnetic storms and its effect on ionospheric and telluric currents

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With the present study we intend to contribute to the understanding of the near space coupling to the Earth through the analysis of long-term changes of strong geomagnetic storms and consequent variations in ionospheric and telluric currents affecting the Earth surface environment, such as electrical systems and pipelines. Geomagnetic storms affect electric currents in the ionosphere increasing not only its intensity but also its time variability, which in turn induce electric fields at the Earth surface that drive telluric currents. The Earth currents thus originated are also known as geomagnetic induced currents (GICs). The temporal variability of geomagnetic activity and ionospheric currents increases particularly at very high activity levels and at high latitudes with consequent stronger induced telluric currents. The aa index and the Akasofu's epsilon parameter were used in the present analysis. Strong geomagnetic activity, measured by aa, present a clear long-term behavior in the amount of strong activity periods occurrence, which we describe as a Suess cycle modulated by a Gleissberg cycle. Epsilon, considered here as an indicator of the auroral electrojet intensity, presents a similar behavior, as expected, but with a lesser steep trend. We extend these results to telluric currents, which may respond almost linearly to epsilon.