Electrodynamic coupling processes in the solar–terrestrial environment

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The solar–terrestrial system consists of many neighboring physical regions, which include the photosphere, solar corona, solar wind, magnetosphere, ionosphere, atmosphere and lithosphere. The electrodynamic coupling among neighboring regions leads to the generation of many observed natural phenomena. The following important electrodynamic coupling processes will be presented and reviewed in this talk. (a) The plasma shear flows in the solar photosphere lead to the formation and eruption of solar prominences. (b) The coupling between solar wind and magnetosphere lead to the transport of particles and energy from the solar wind to magnetosphere. (c) The solar wind-magnetosphere-ionosphere coupling leads to magnetospheric substorms, auroras and auroral kilometric radiation. (d) The charges and currents associated with a thunderstorm may interact with the middle atmosphere and the ionosphere. These interactions lead to the transient luminous events, which include elves, halos, blue jets, sprites, and gigantic jets. The upward currents flow into the ionosphere with the associated electric field causes the plasma ExB motion, leading to the variation of total electron content (TEC) and formation of plasma bubbles. (e) The coupling among lithosphere, atmosphere and ionosphere may lead to TEC variations and formation of nighttime plasma bubbles in the ionosphere. The stressed-rock in the lithosphere can generate currents before earthquake and acts as a dynamo to provide currents for the lithosphere-atmosphere-ionosphere coupling. Observations of daytime and nighttime TEC variations and nighttime plasma bubbles can be used as precursors for earthquake prediction.