On the electric breakdown field of the mesosphere and the influence of electron detachment - DTU Orbit (06/04/2019)

It has been suggested recently that electron associative detachment from negative atomic oxygen ions provides an additional source of free electrons in electric discharges of the mesosphere, the sprites, and gigantic jets. Here we study attachment under some simplifying assumptions and show that the threshold field decreases with time and can reach values well below the conventional threshold field. The concept of a fixed threshold field therefore itself breaks down. We find that the growth rate decreases with decreasing electric field and that long exposure time of electric fields therefore is needed for electron avalanches to grow. Detachment is likely to affect the conductivity of streamer filaments and other long-lasting space charge structures like gigantic jets or the ionization state of the mesosphere when illuminated by thunderstorm fields. Detachment by itself does not directly affect small-scale streamer formation or explain the time delays of sprites as proposed by others. © 2013 American Geophysical Union. All Rights Reserved.