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Observation of charged aerosol layers and distant lightning from electric field measurements onboard balloons

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Electric field measurements have been performed during a balloon flight launched from Niamey in the frame of the AMMA campaign. The instrument measured the vertical component of DC and AC atmospheric electric fields using the double probe technique. During the ascent of the balloon, distinct features with duration of 10 to 20 seconds typically were observed on the quasi-DC vertical electric field on a number of occasions and understood as the signature of charged cloud layers crossed by the balloon. Several of these events were, in particular, detected above the tropopause showing the existence of thin (a few tens of meters) cirrus layers of charged ice particles in the lower stratosphere. Simultaneous with the quasi-DC variation of the electric field, AC electric fields above $\sim$ 10 Hz are intensified. This feature may result either from the electrostatic turbulence in the clouds generated by the randomly moving charged particles or to the impact of charged particles on the electrodes or the gondola itself.

At the end of the flight and after sunset, the balloon was travelling close to a moderately active convective system at horizontal distances of about 30 to 50 km. The analysis of the signals from simple light pulse detectors on the gondola show that faint optical events interpreted as intra-cloud lightning occur at a very high rate of about 5 s^{-1} or more. The typical electric field variations associated with such events will be presented and discussed in terms of charge annihilation and re-building. Fewer events with a much larger intensity are also observed by the optical detectors and may be interpreted as major CG lightning. Several of them seem to arise from a cascade of

intra-cloud lightning.