

ENHANCED PARTICLE FLUXES DURING THE DECAY STAGE OF ARAGATS THUNDERSTORMS

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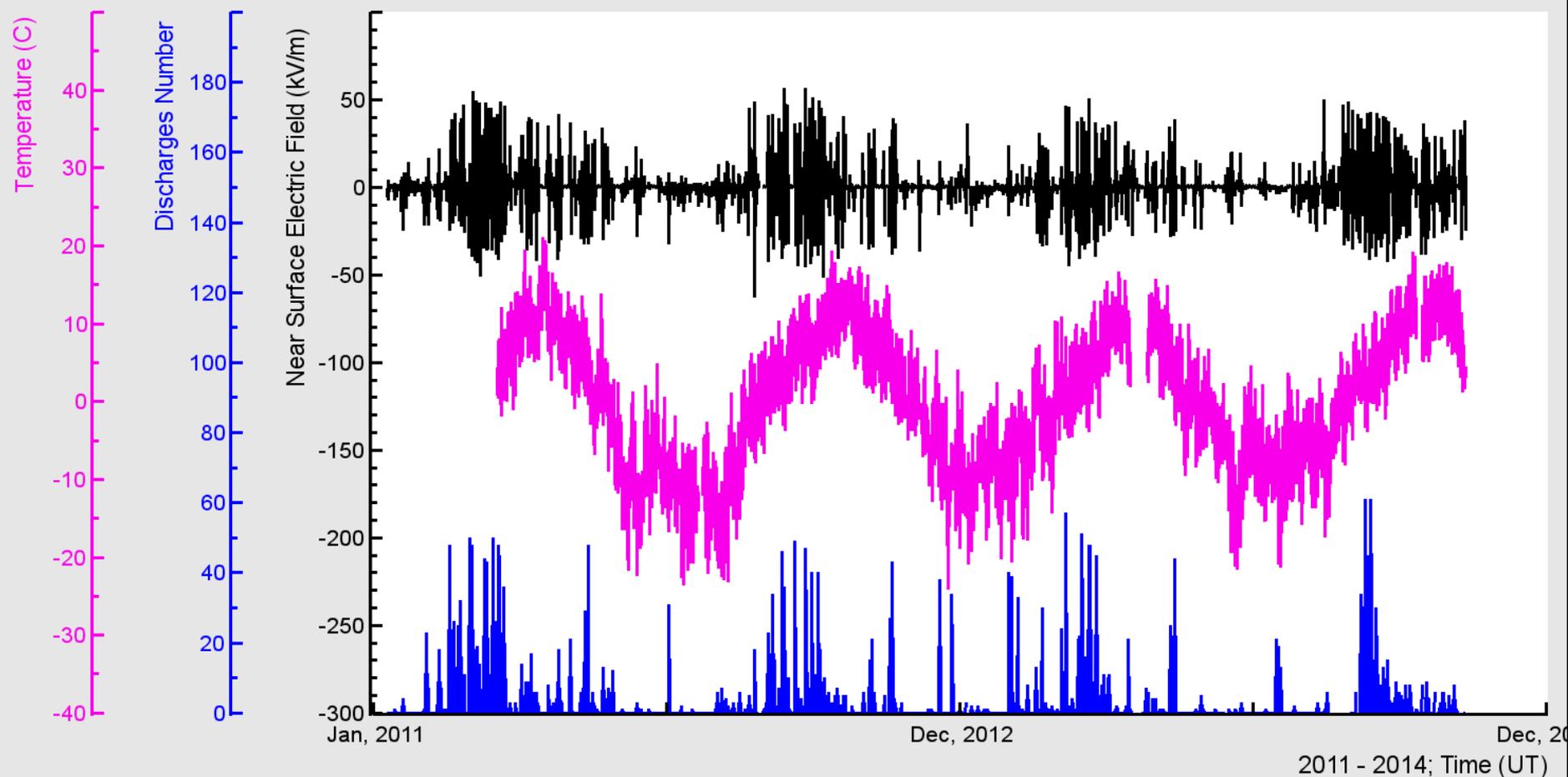
24 June 2017
13:00 local time



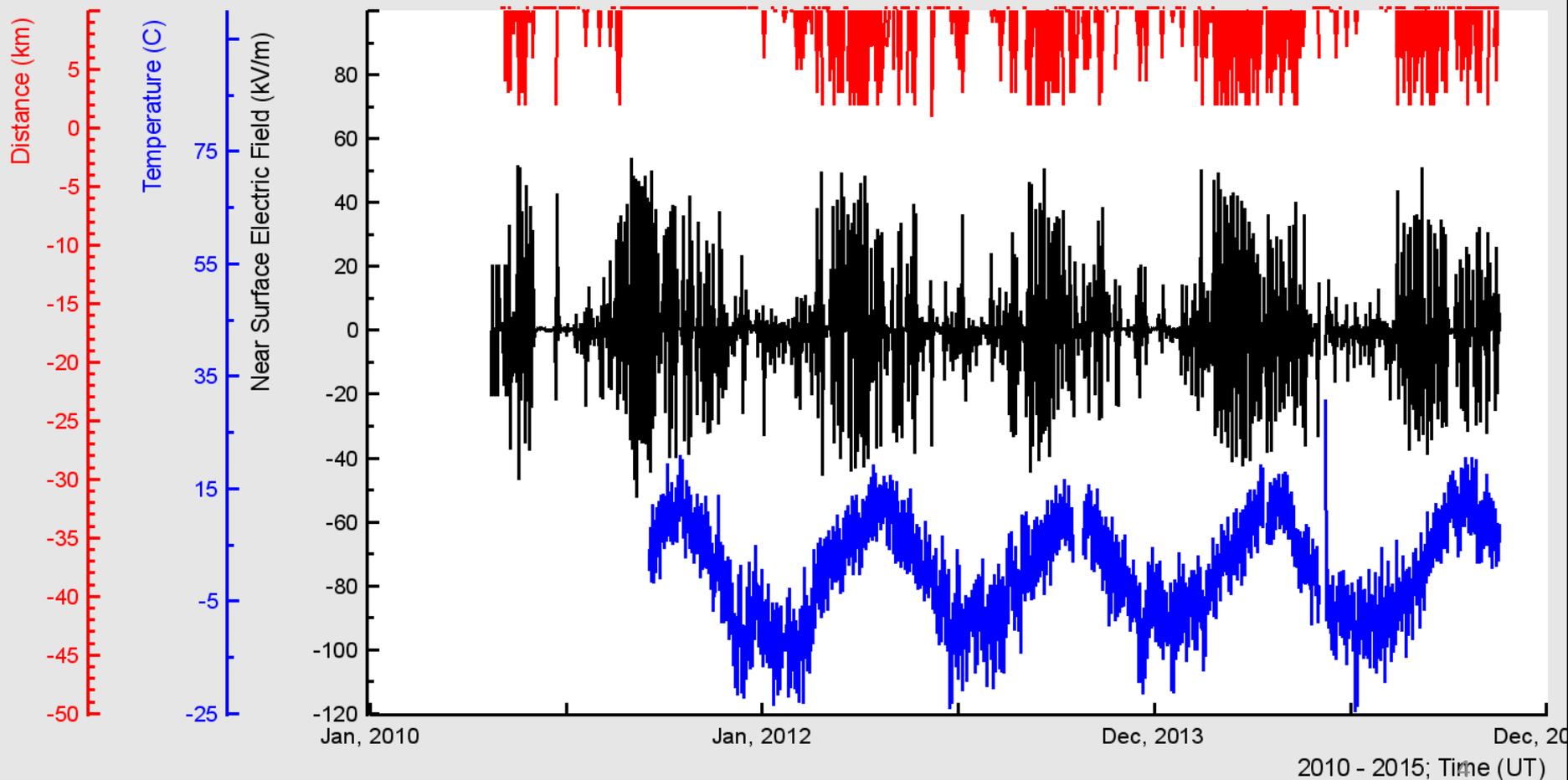
Aragats station, August 2013,
temperature of water in lake ~10 C°



Aragats - 2011-2014 – one of the best sites in world for research of atmospheric electricity

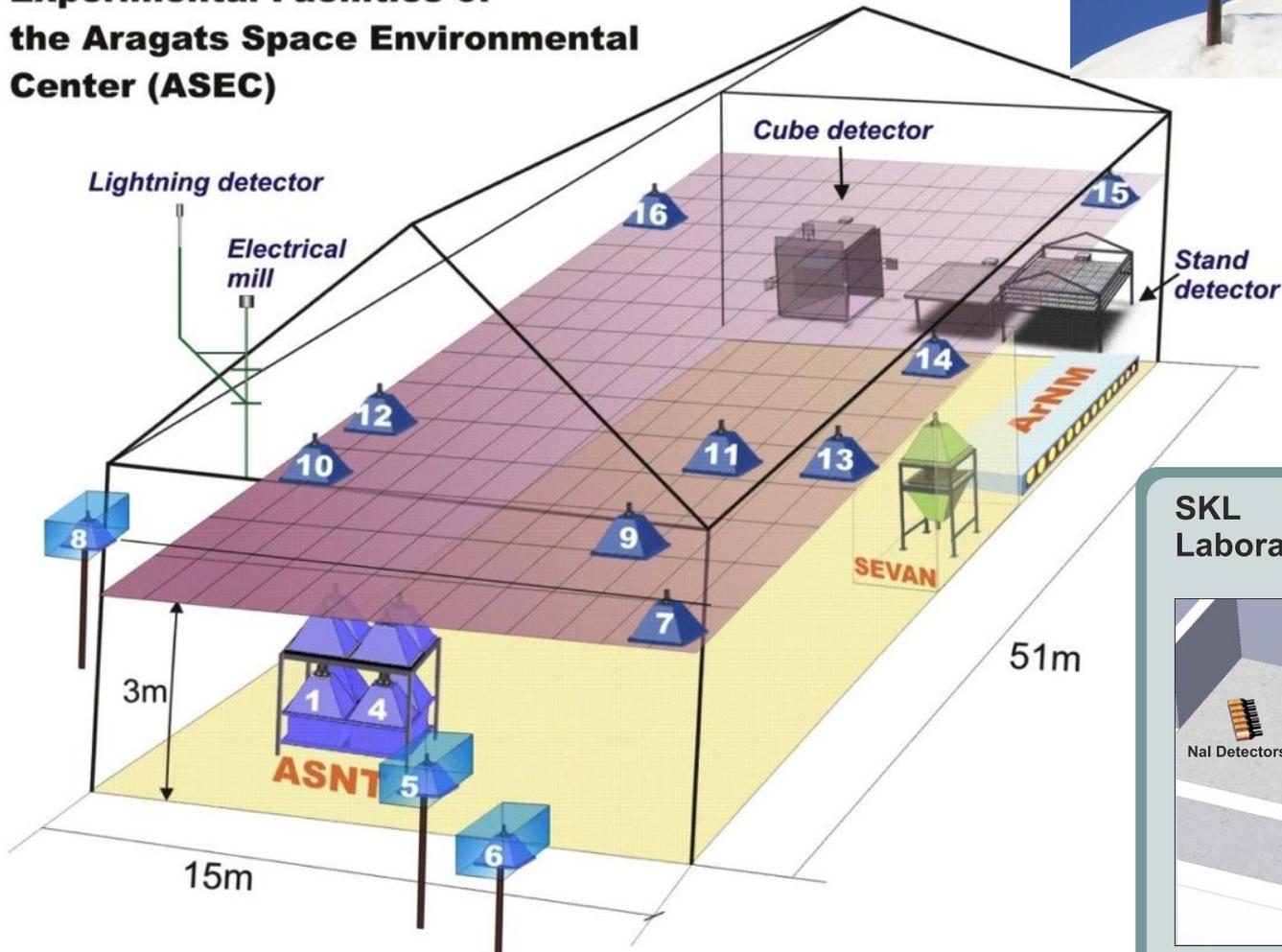


Lightning flashes are close to Aragats research station



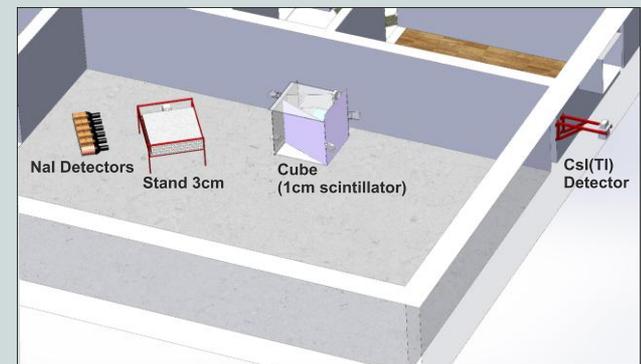
Monitoring of particle fluxes, fast and slow electric fields, lightning occurrences, skys, UV and IR radiation, meteorological conditions

Experimental Facilities of the Aragats Space Environmental Center (ASEC)

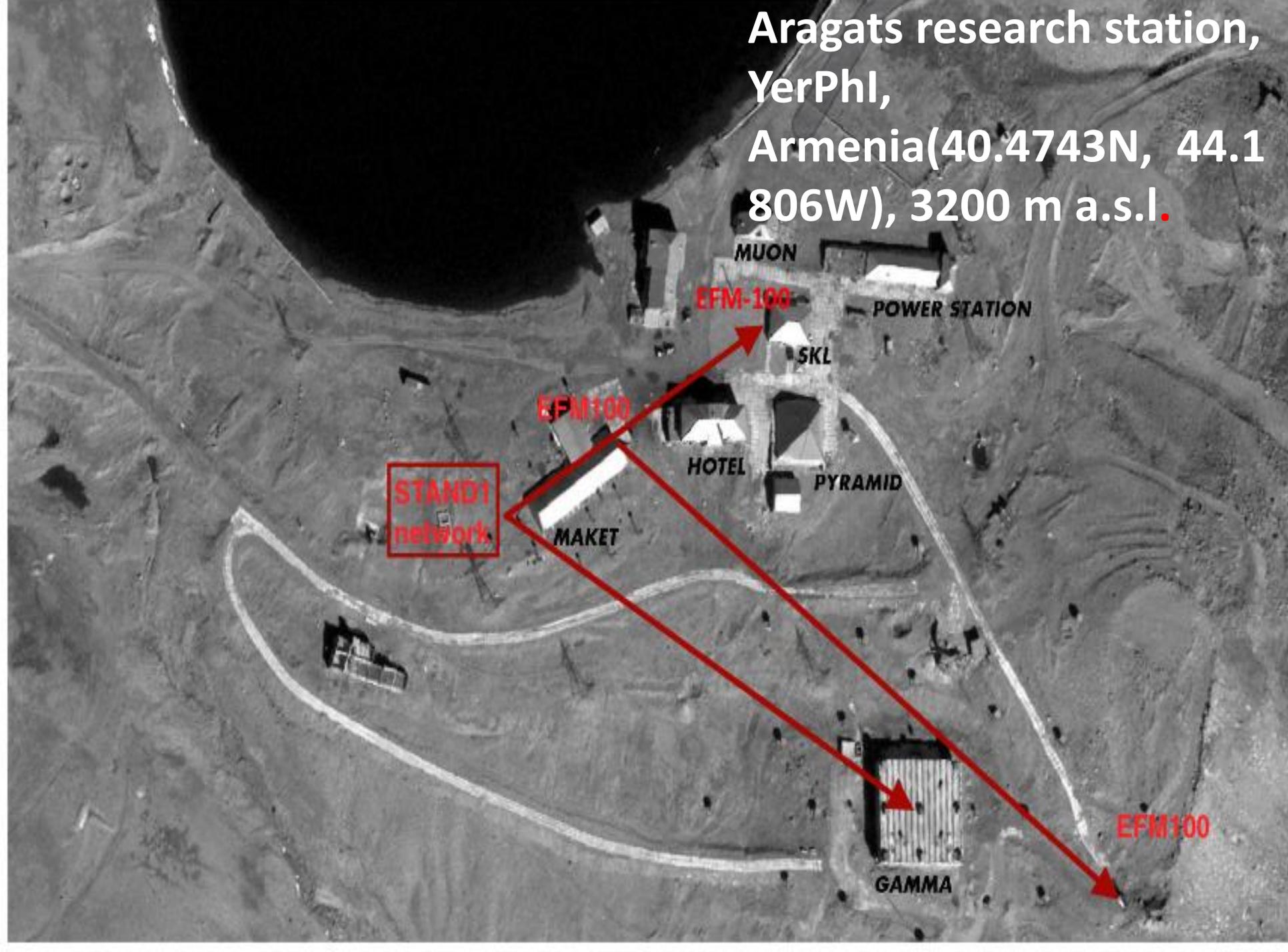


Boltek EFM 100 electrical mill and Lightning tracer; Davis instr. weather station

SKL Laboratory



**Aragats research station,
YerPhI,
Armenia(40.4743N, 44.1
806W), 3200 m a.s.l.**



MUON

EFM-100

POWER STATION

SKL

EFM100

HOTEL

PYRAMID

STAND1
network

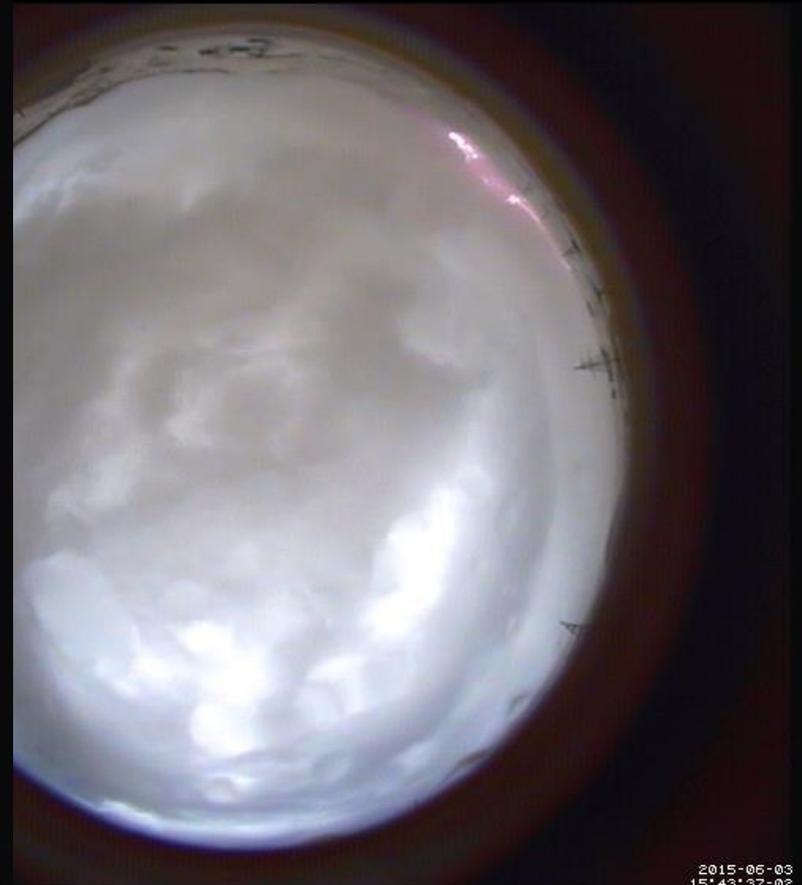
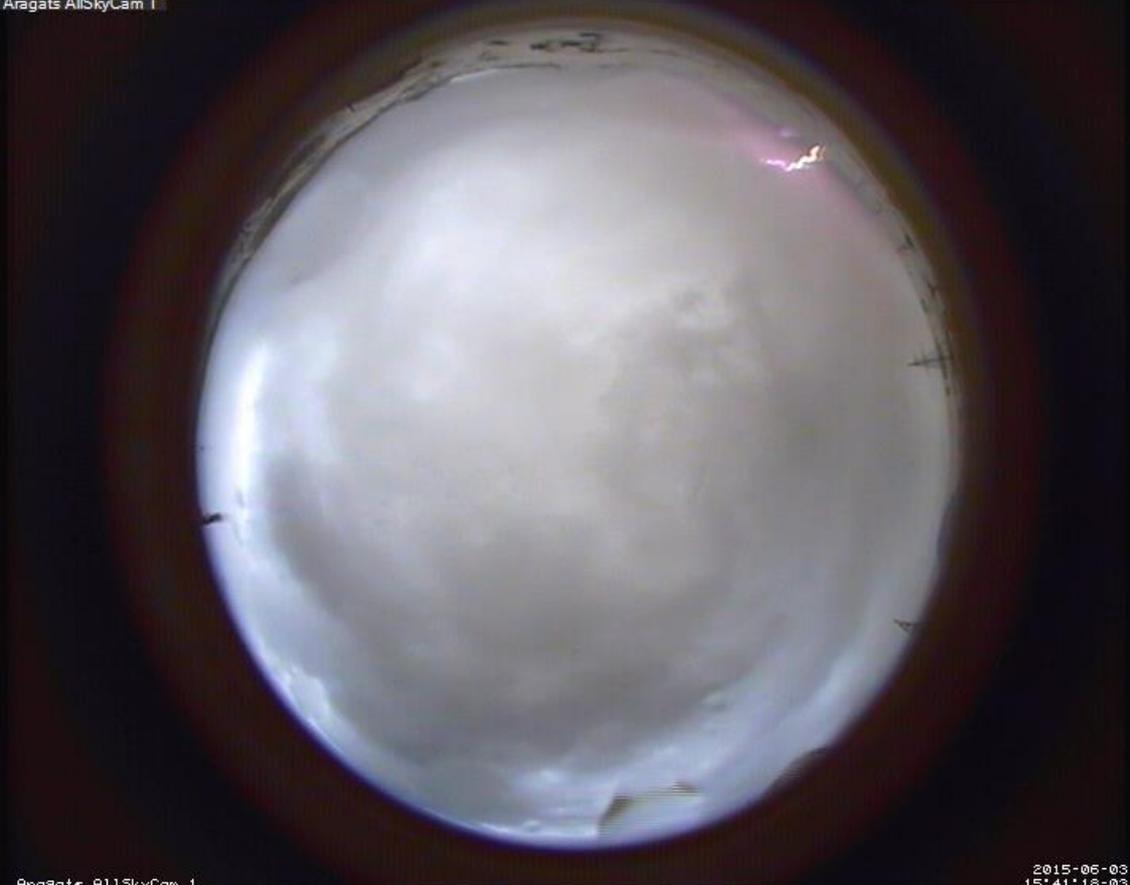
MAKET

GAMMA

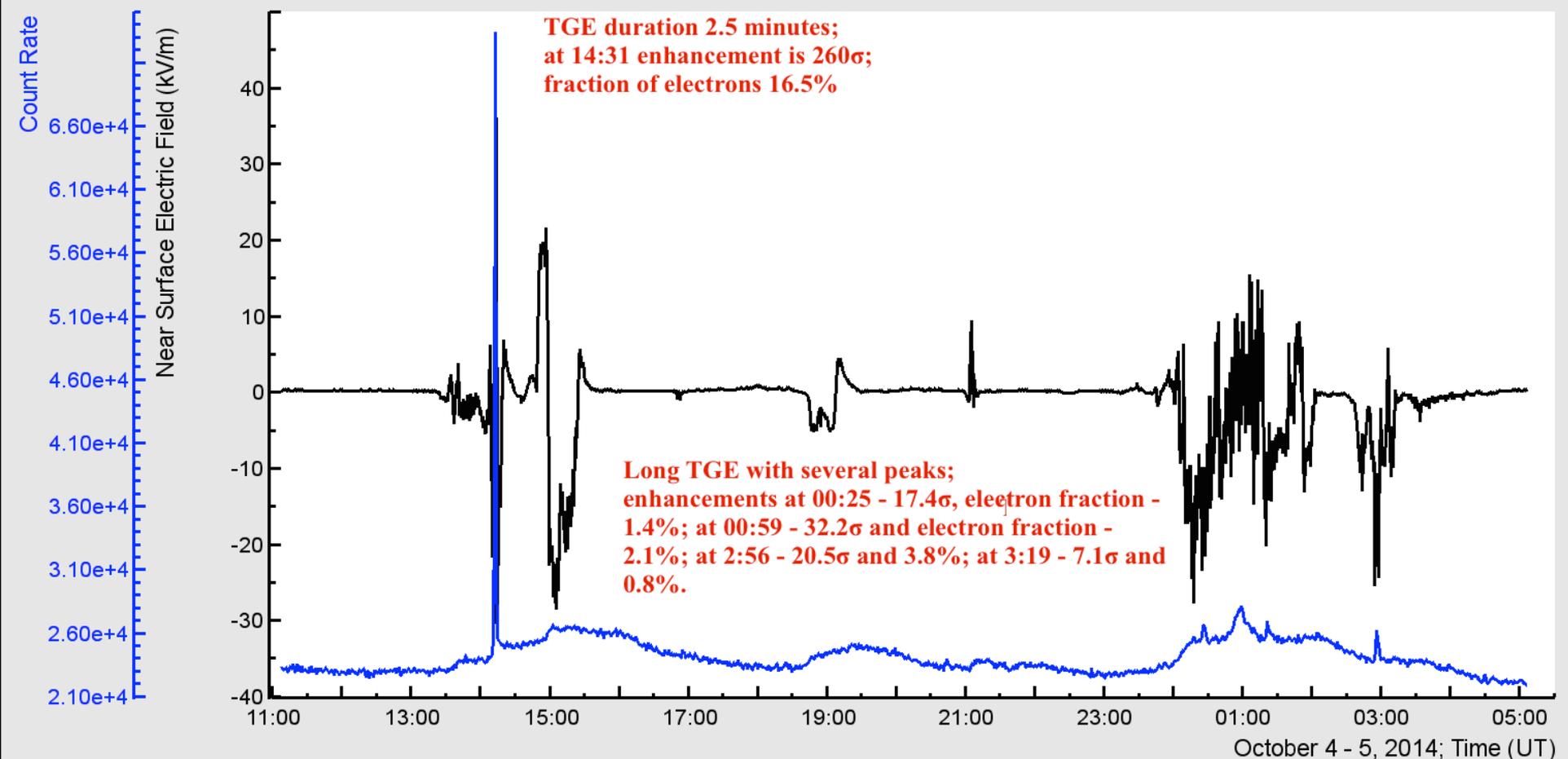
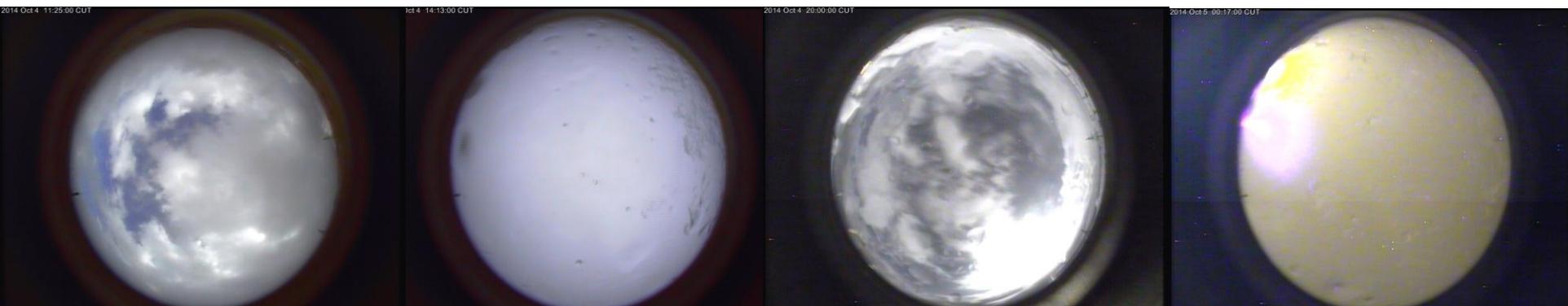
EFM100

RAZ-200 – device for measuring near-surface electric field



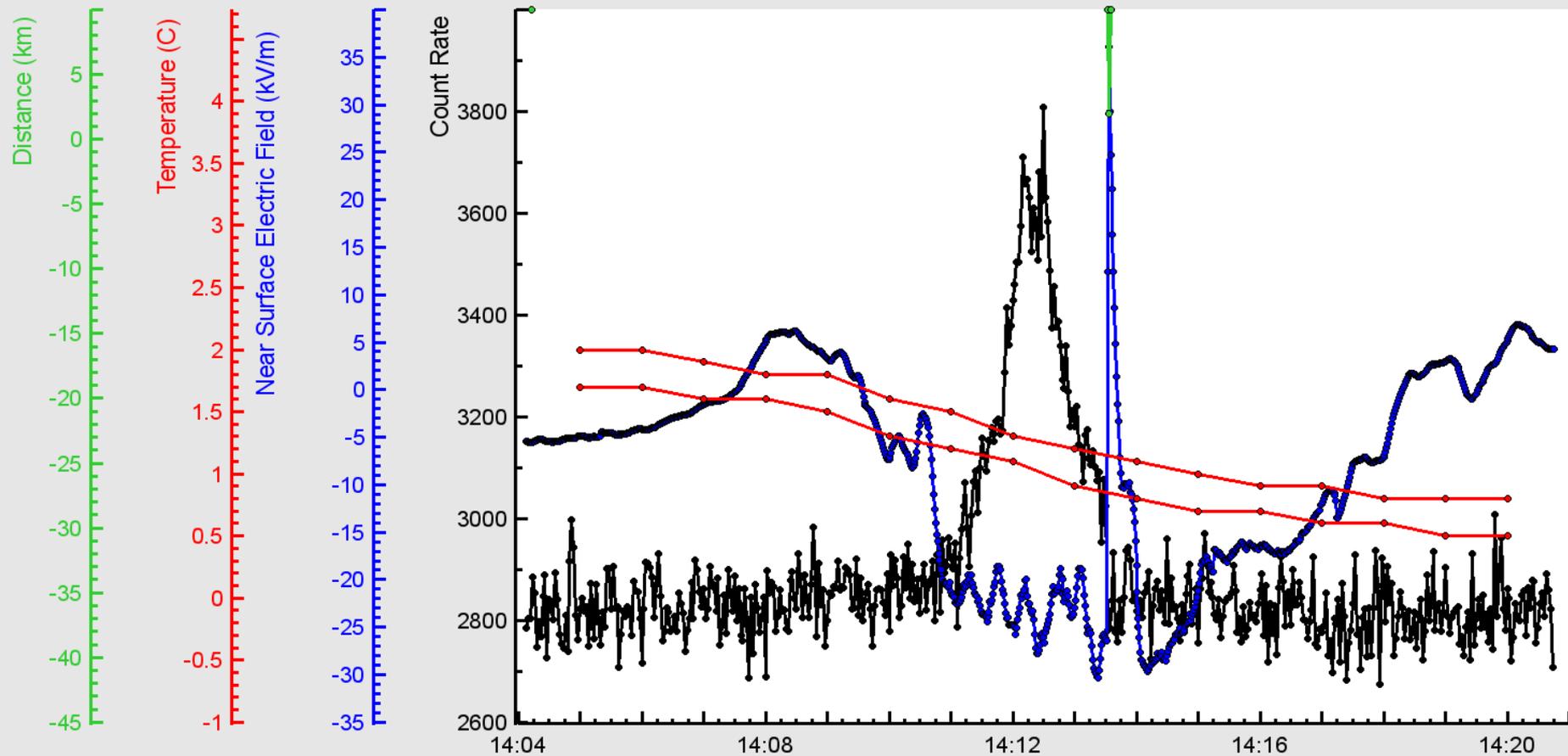


2014 largest Short and Long Thunderstorm ground enhancements

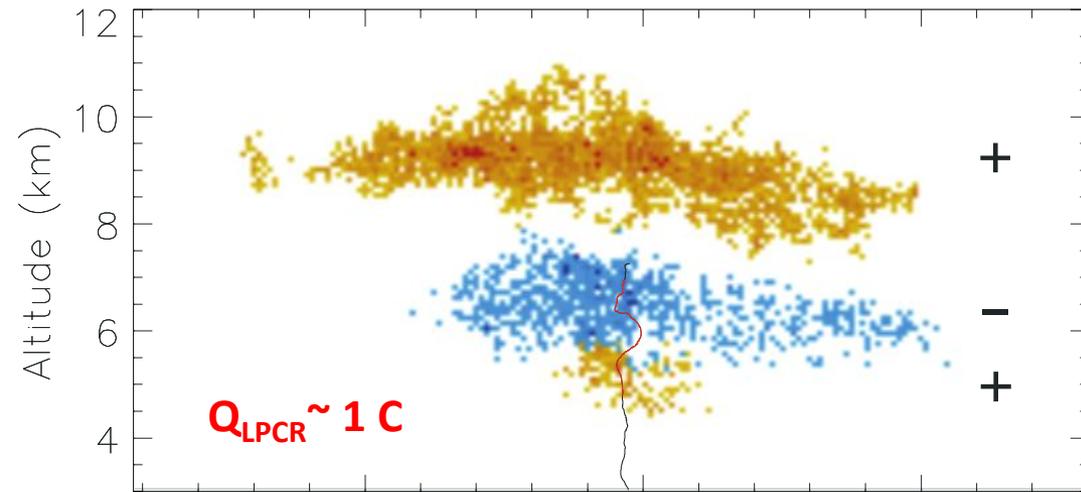


Huge TGE interrupted by lightning flash.

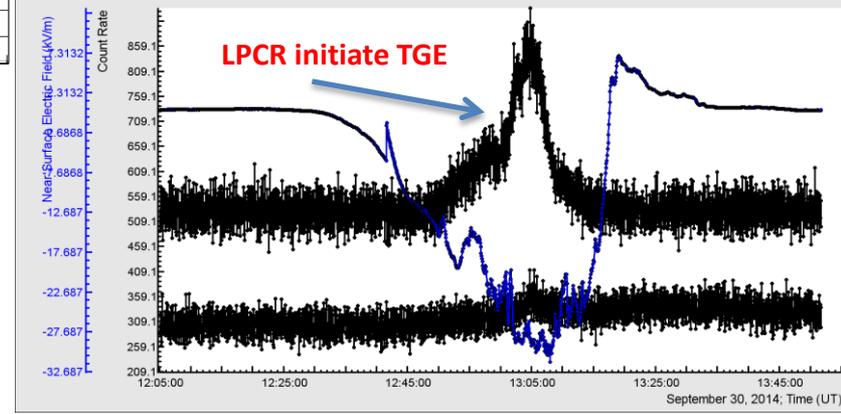
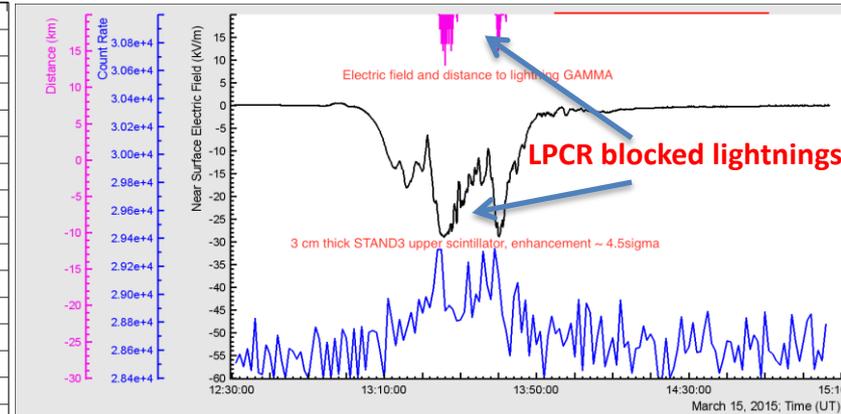
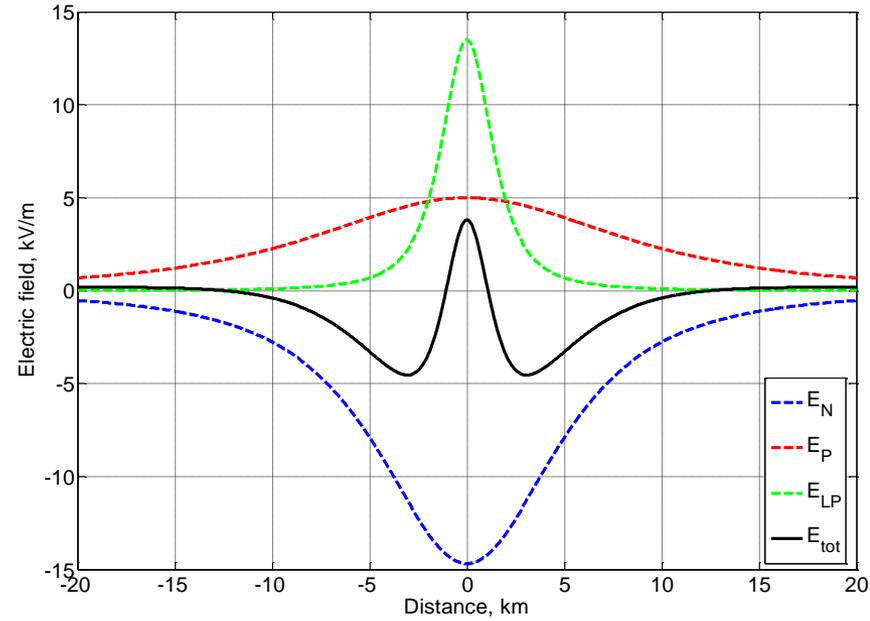
Cloud base on 25 m from detectors, RE – 98%, lightning flash distance – 2km



The tripole structure of electric field

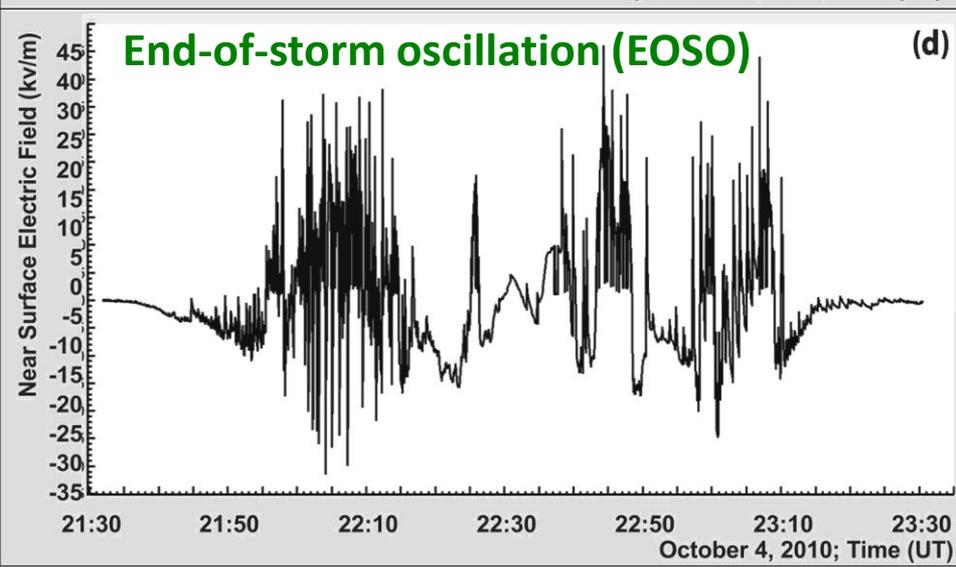
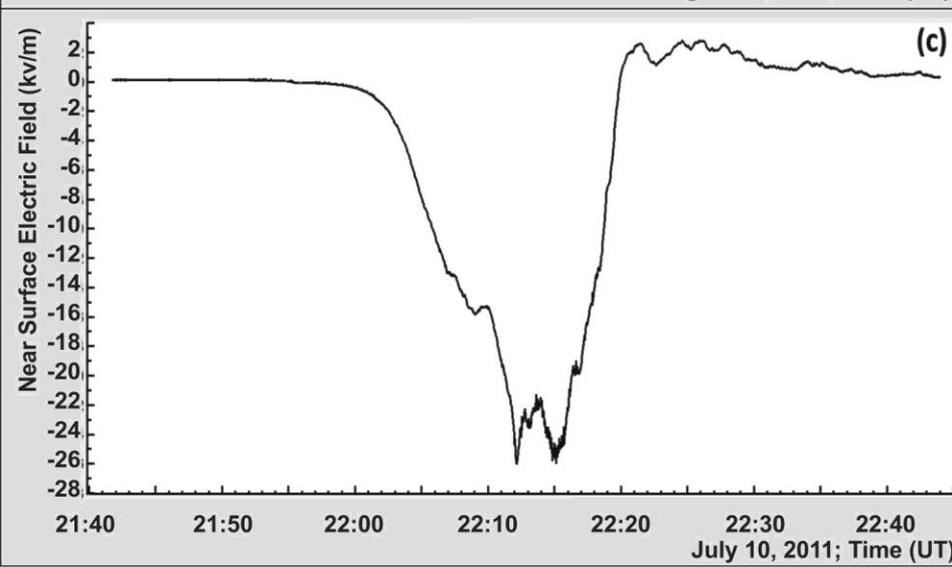
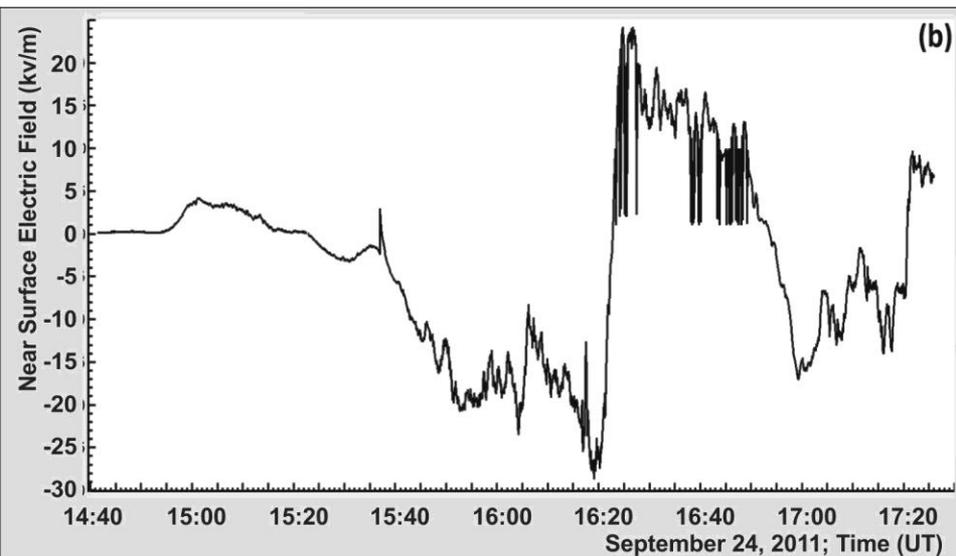
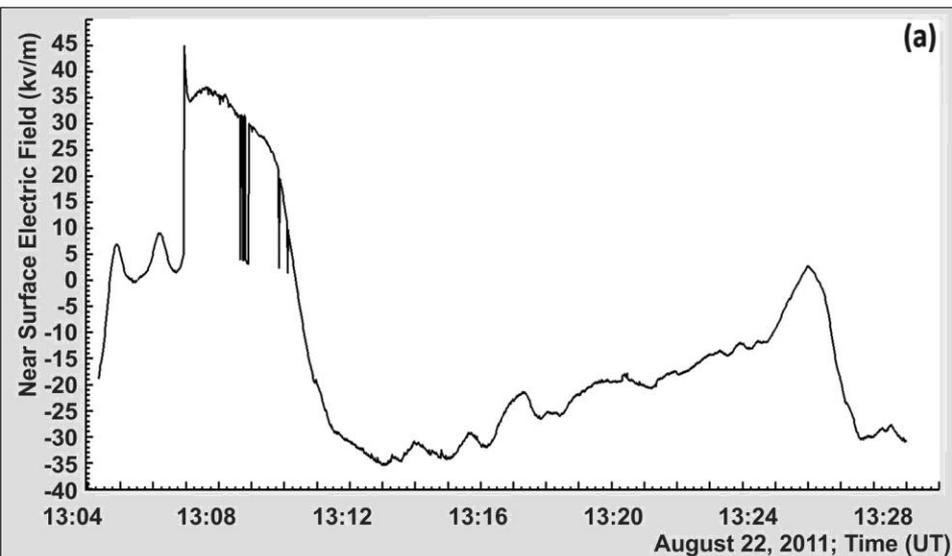


-5 0 5
 $Q_p=40, Q_N=-40, Q_{LP}=3, H_p=12, H_N=7, H_{LP}=2$

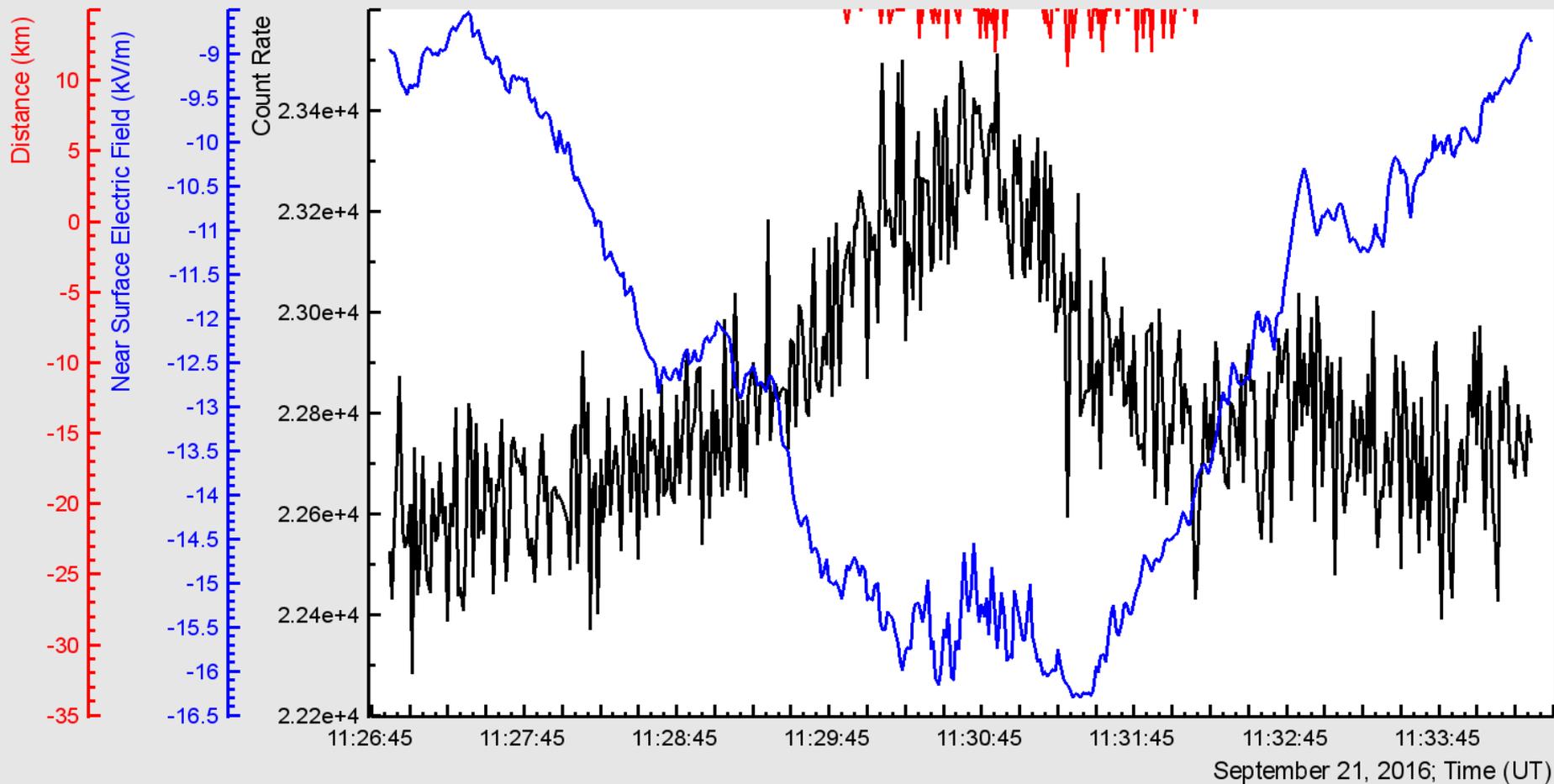


Credit:
 Nag, A., Rakov, V.A., 2009 Geophys. Res. Lett. 36, L05815,
<http://dx.doi.org/10.1029/2008GL036783>.
 Marshall T C, Stolzenburg M. 1998, J Geophys Res, 103:
 19769-19775

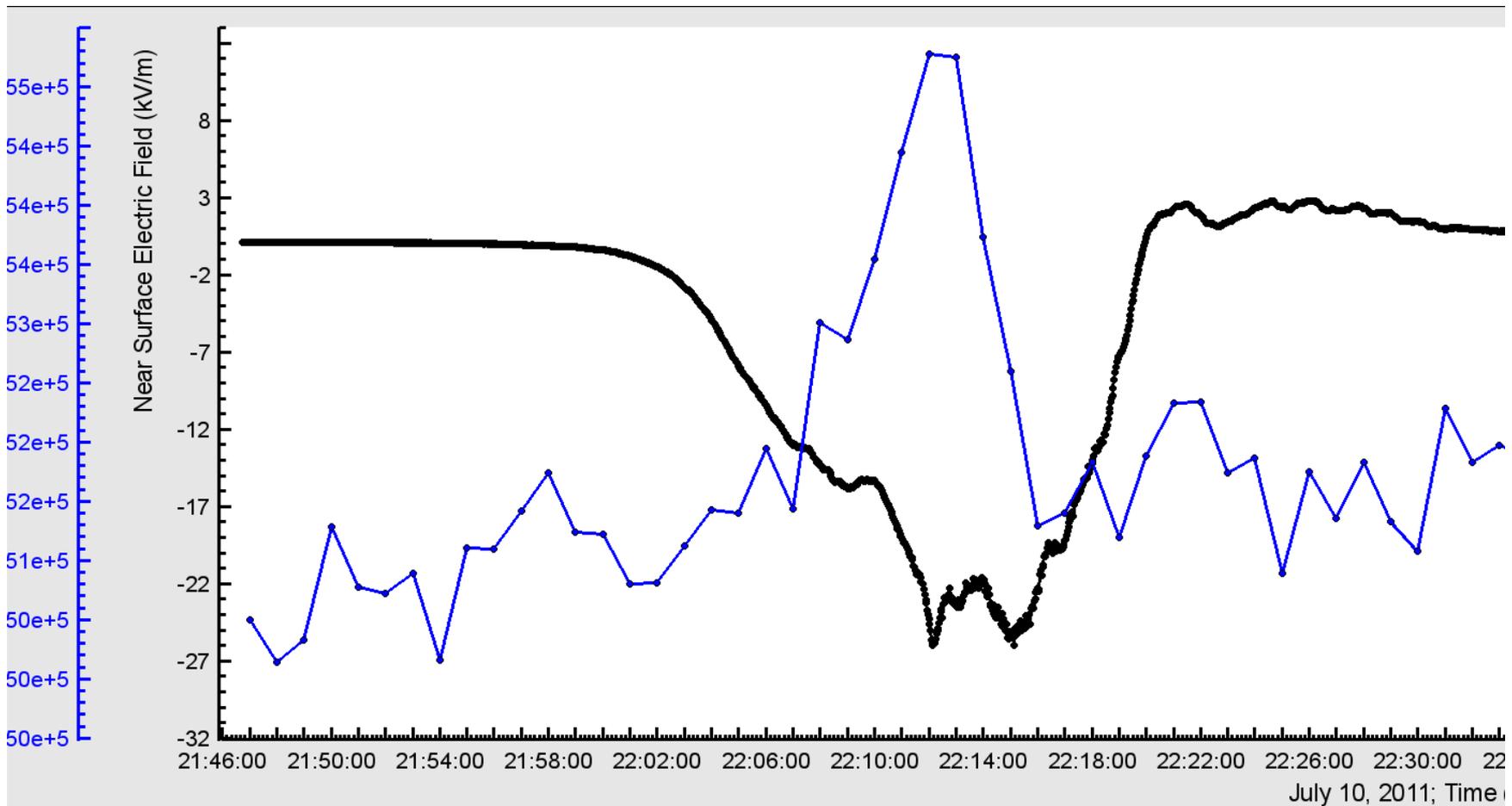
Chilingarian, A. and Mkrtchyan, H., Role of the Lower Positive Charge Region (LPCR) in initiation of the Thunderstorm Ground Enhancements (TGEs), Physical Review D 86, 072003 (2012).



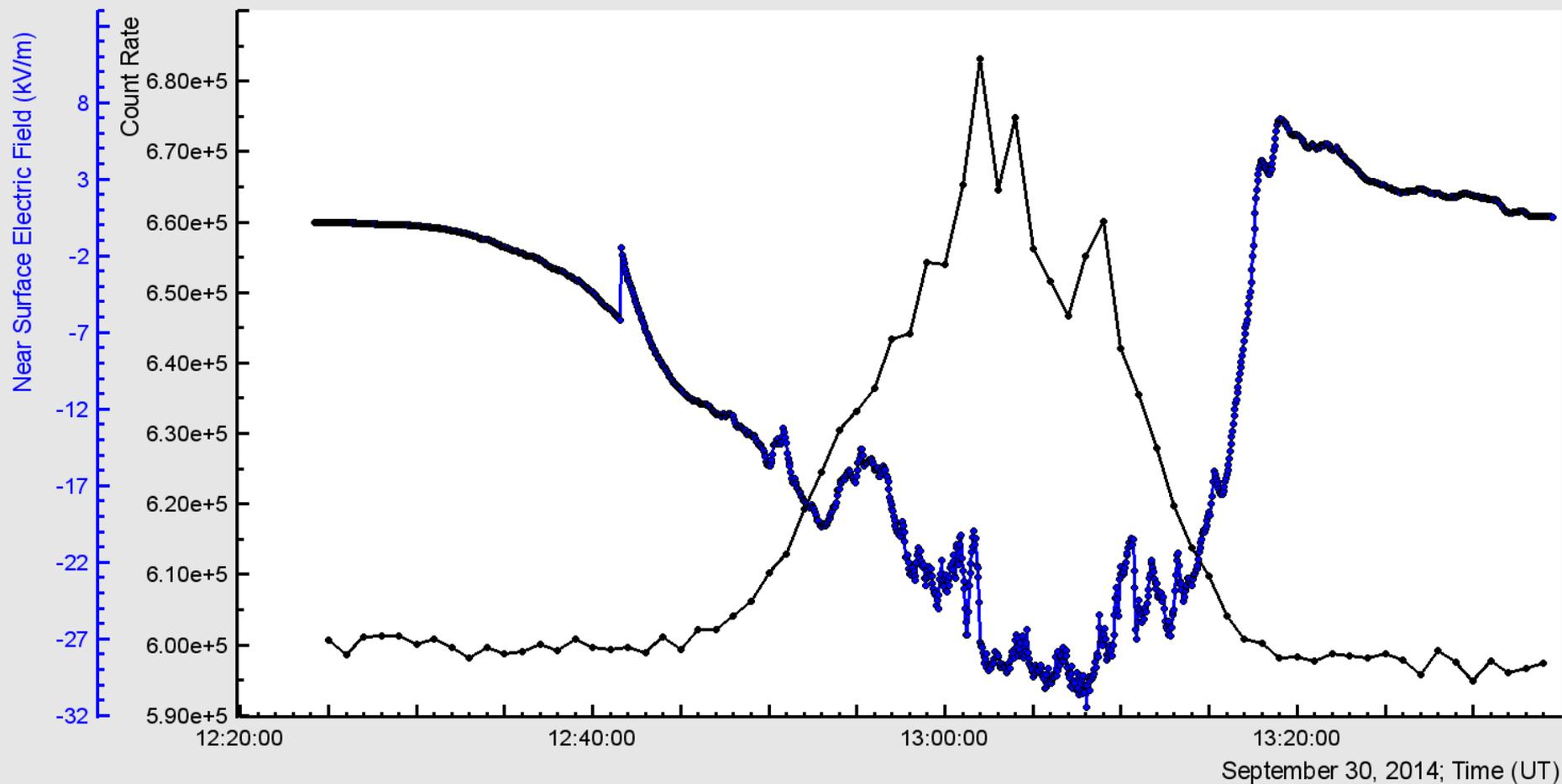
“Classical” shape of TGE and corresponding Electrostatic field disturbances; TGE lasting ~ 5 min reach maximum on minimal value of electrostatic field having small bumps emerging from this minimum (signaling on creation of LPCR).



3 type of the TGE events according to the near-surface electrical field disturbances. MAKET 60cm



Huge TGE, AMMM- 13.7% enhancement $\sim 80\sigma$!

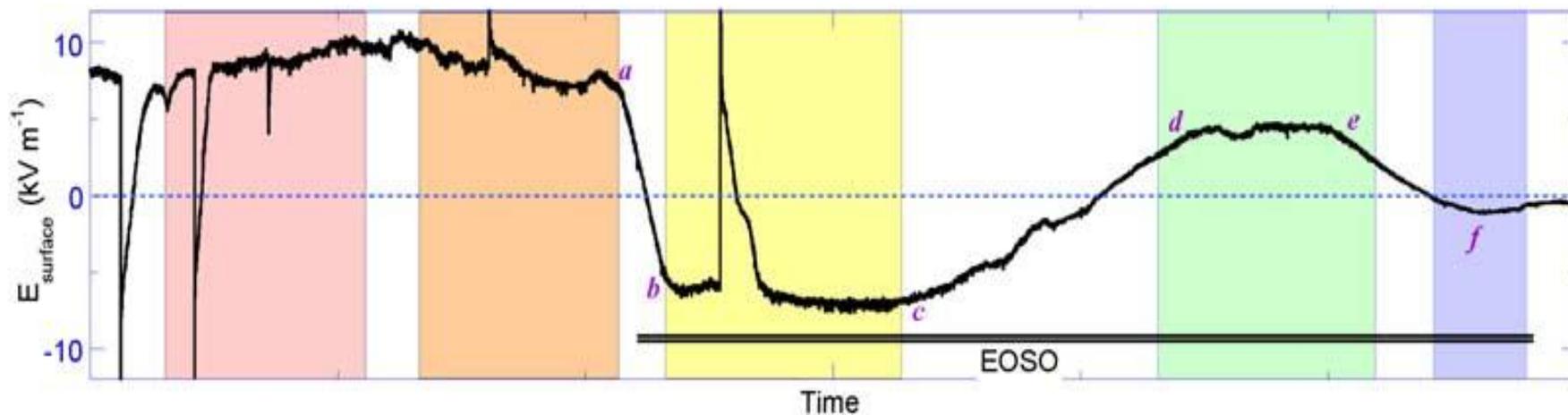
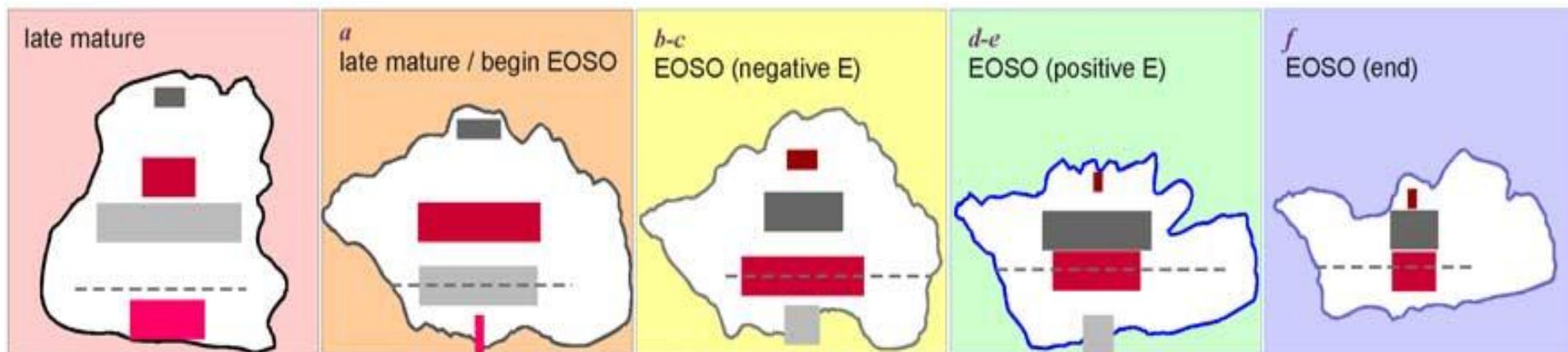


End-of-storm oscillation (or EOSO).

- Over several minutes, E decreases in a swing to strongly negative values (i.e., dominated by positive charge overhead), which lasts for 10 – 30 min. **At Aragats up to 20 minutes; the location of clouds at Aragats are very low !**
- The period of large negative E is followed by a slightly slower return swing to slightly weaker but large positive E values, which in turn last for 10 – 40 min.

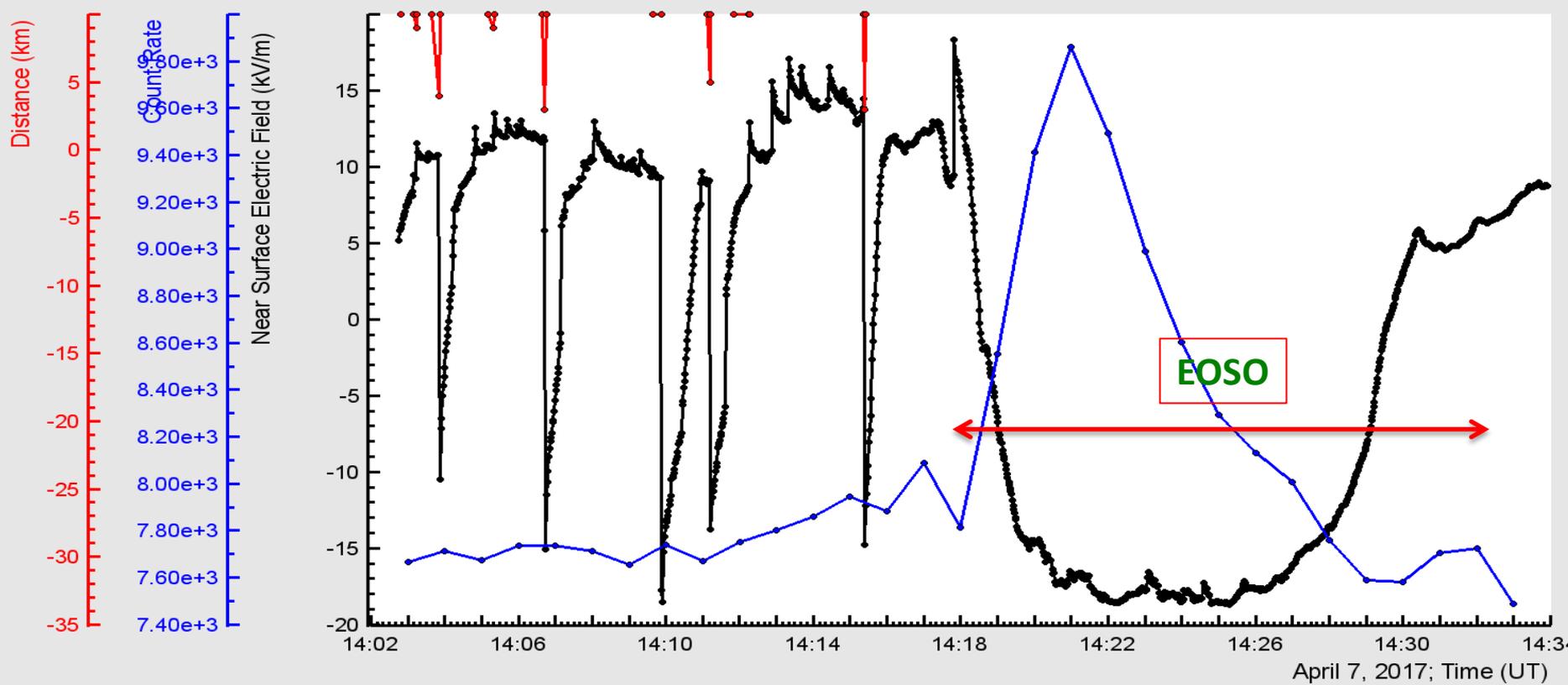
T.C.Marshall, M.Stolzenburg, Paul R. Krehbiel et. al., Electrical evolution during the decay stage of New Mexico thunderstorms
JGR 114, D02209 (2009).

Boxes in the five upper panels are 3.5–9.5 km in altitude and 10 km in the horizontal dimension.



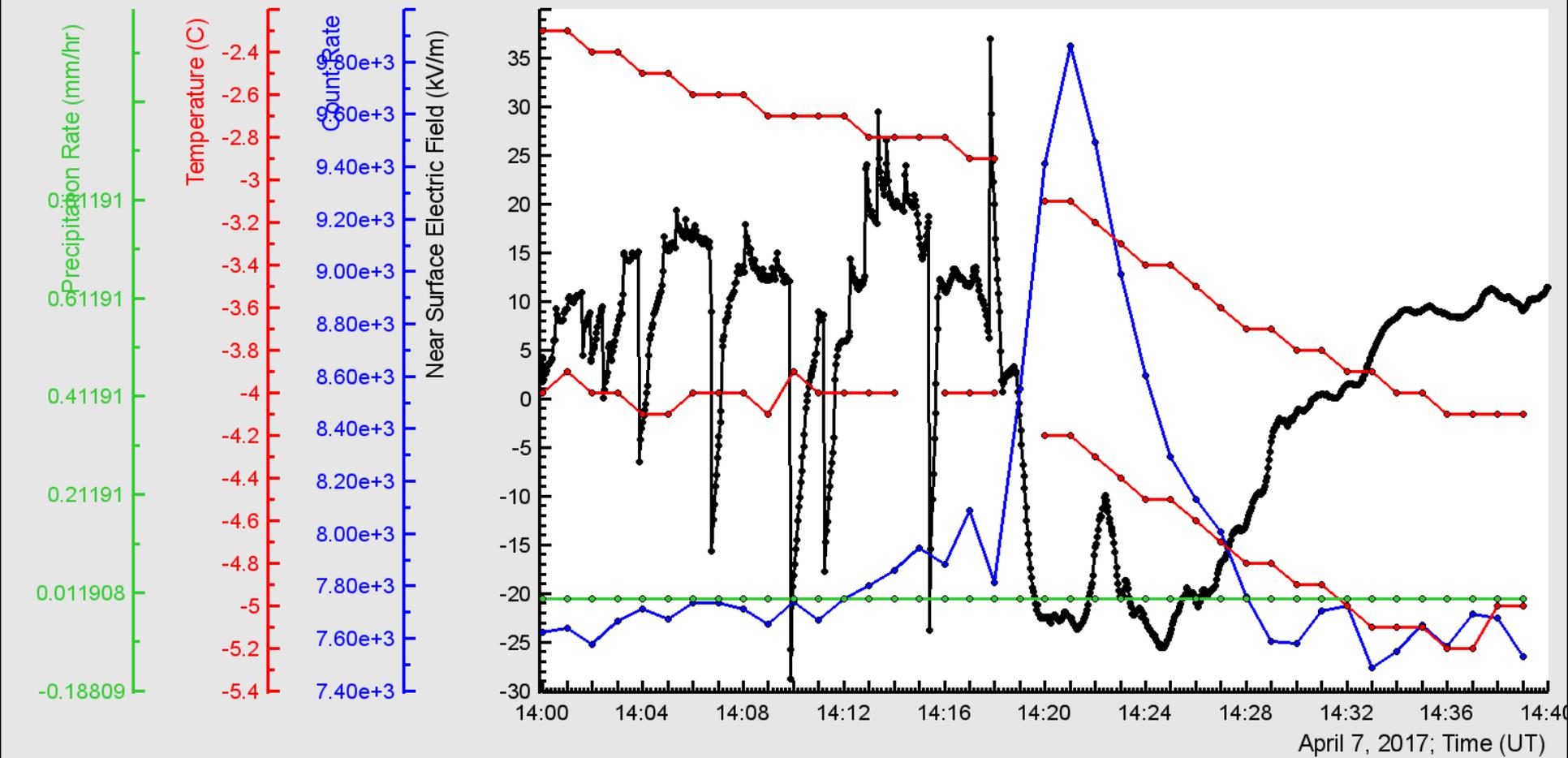
Electrostatic field (black) and distance to lightning (red) was measured by electric mill EFM-100 located on 13 m long mast in the center of Aragats research station; Particle flux was measured by 3 cm thick plastic scintillator. Boxes on the top of picture are taken from Marshall et al, *JGR 114, D02209* (2009).

Observed TGE does not relate to lightning flash – large negative electric field is required only (typical for EOSO).



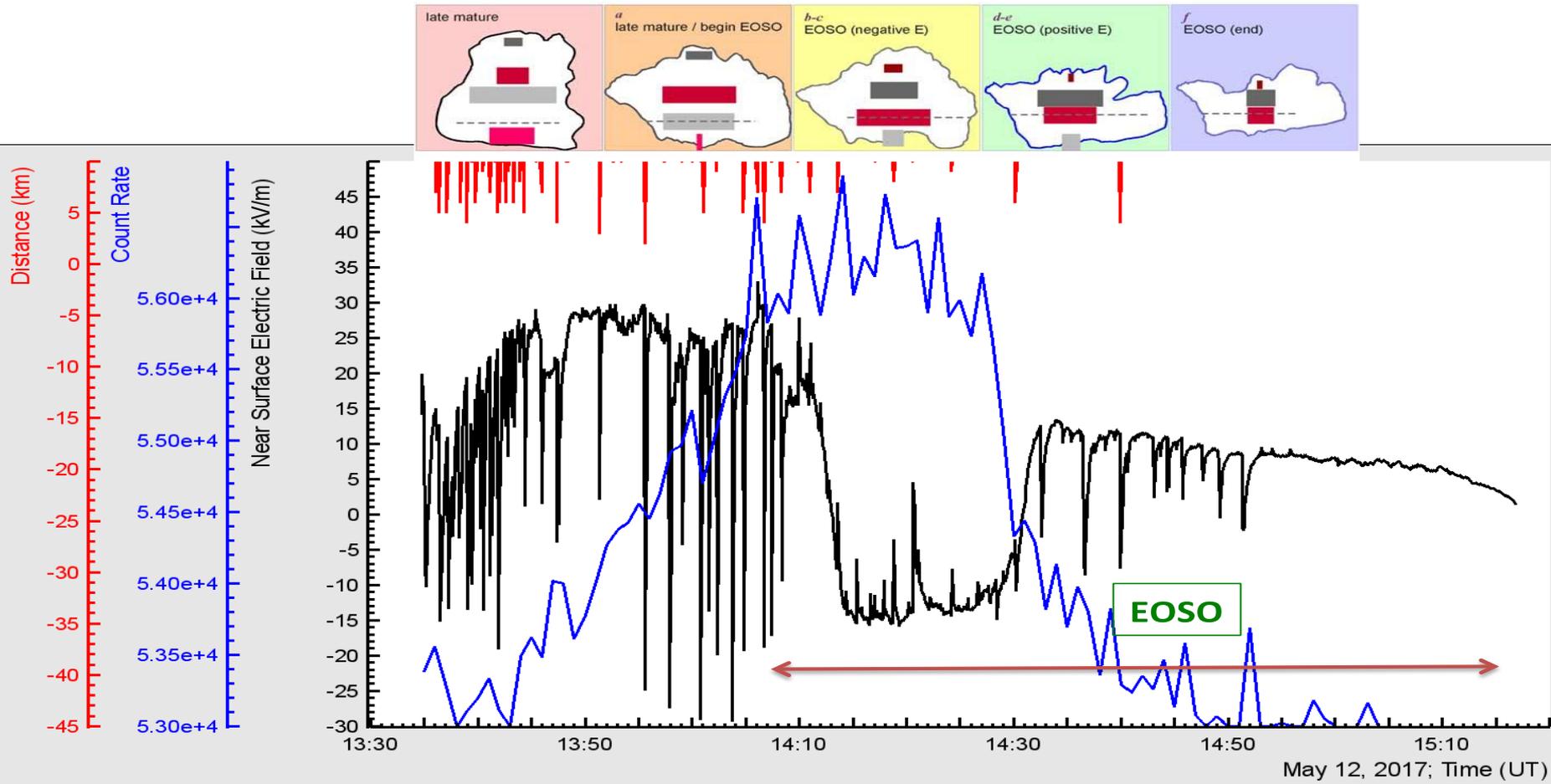


No rain, maybe snow? Cloud height ~ 130 m



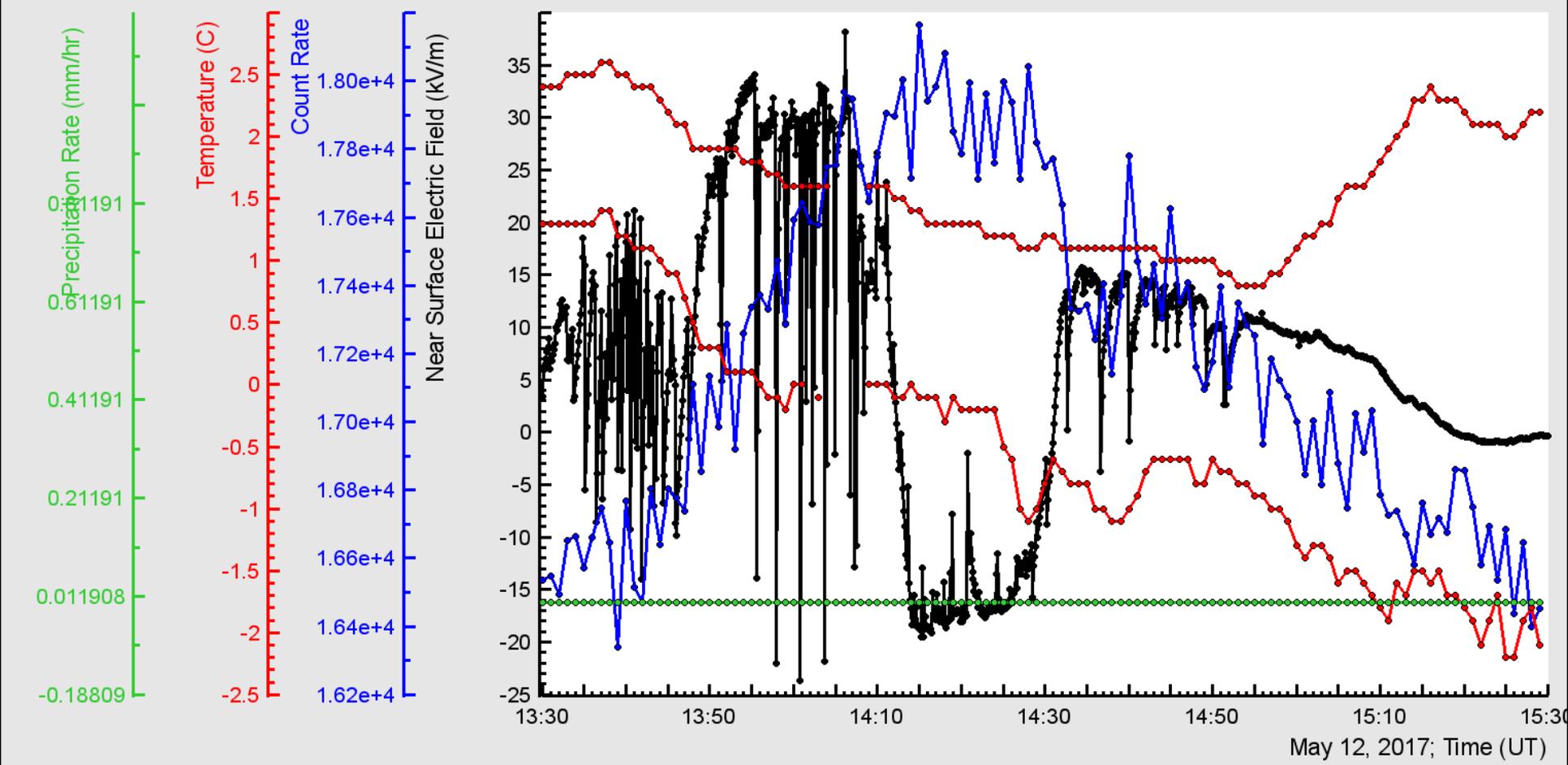
Conceptual representation of the End-of-storm oscillation (EOSO) scenario.

Red lines in upper part of panel show distance to lightning; black curve – disturbances of the near-surface electric field; blue – the particle 1-minute count rate measured by the 1-cm thick plastic scintillator. Boxes on the top of picture are taken from Marshall et al, *JGR 114, D02209 (2009)*.

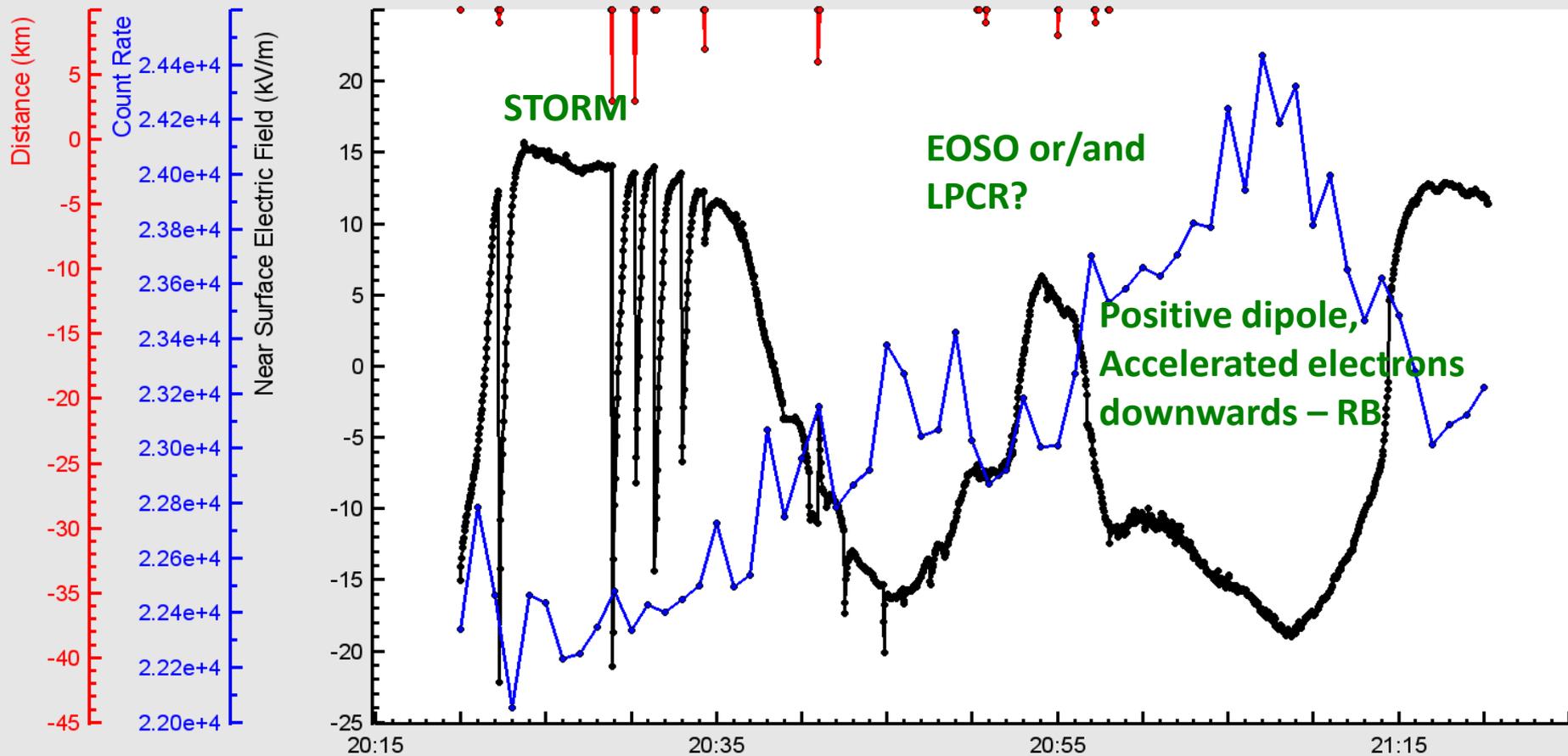




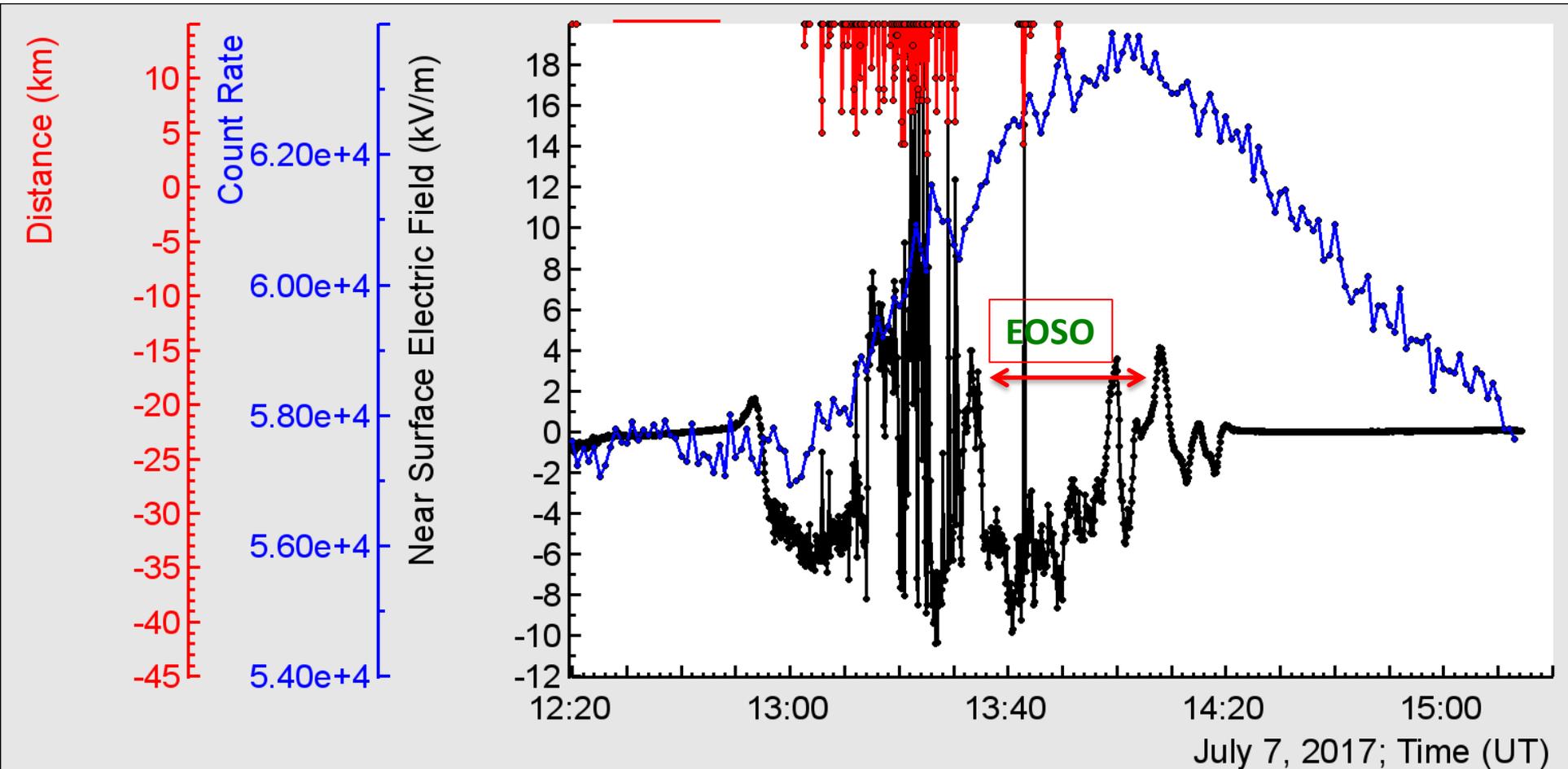
No rain. Cloud height ~ 200 m by spread



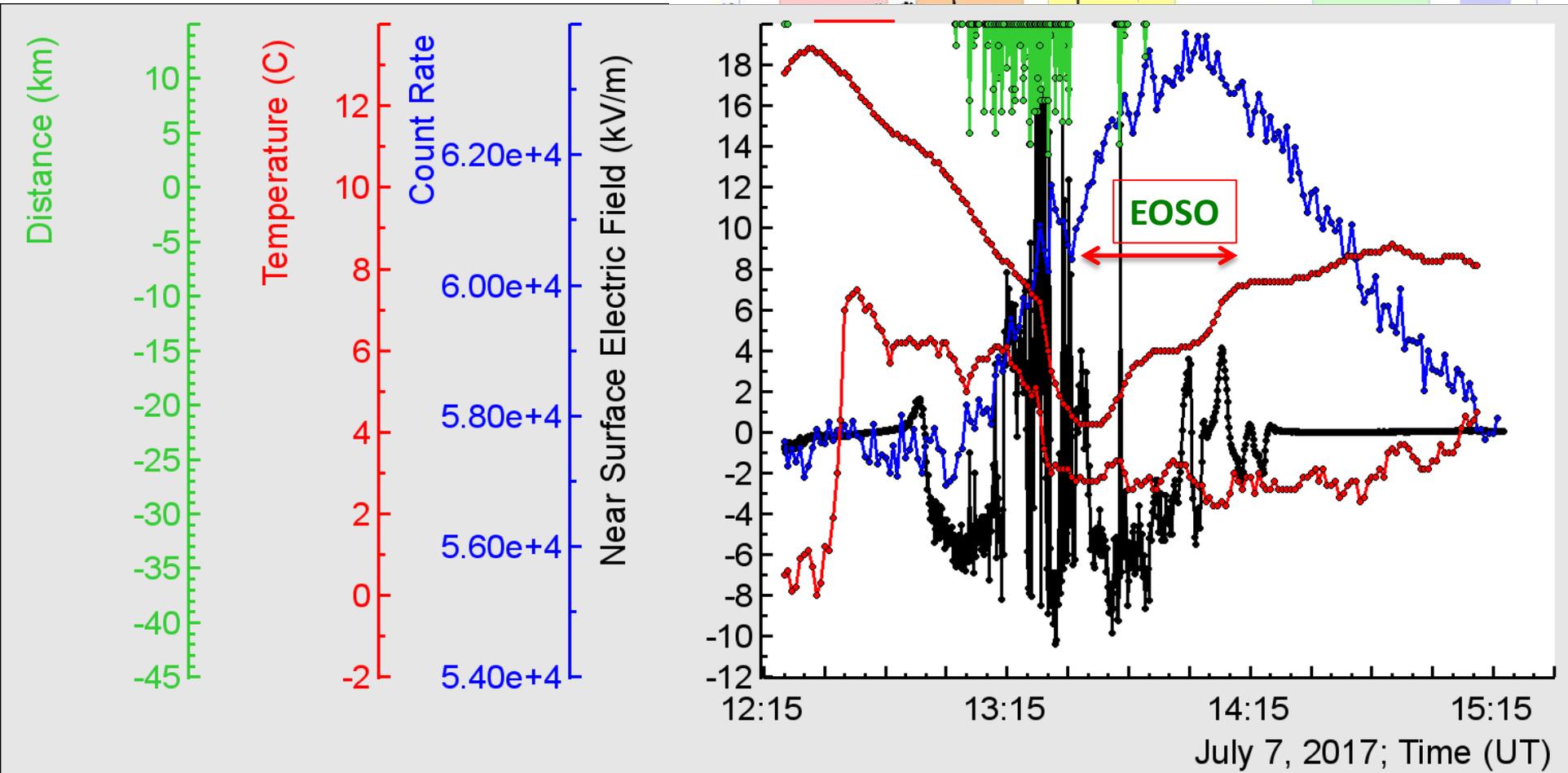
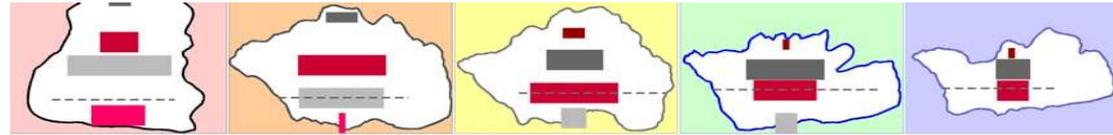
Double End of Storm Oscillation or EOSO+LPCR?



EOSO – 4-th type of electrostatic field disturbances accompanying TGE



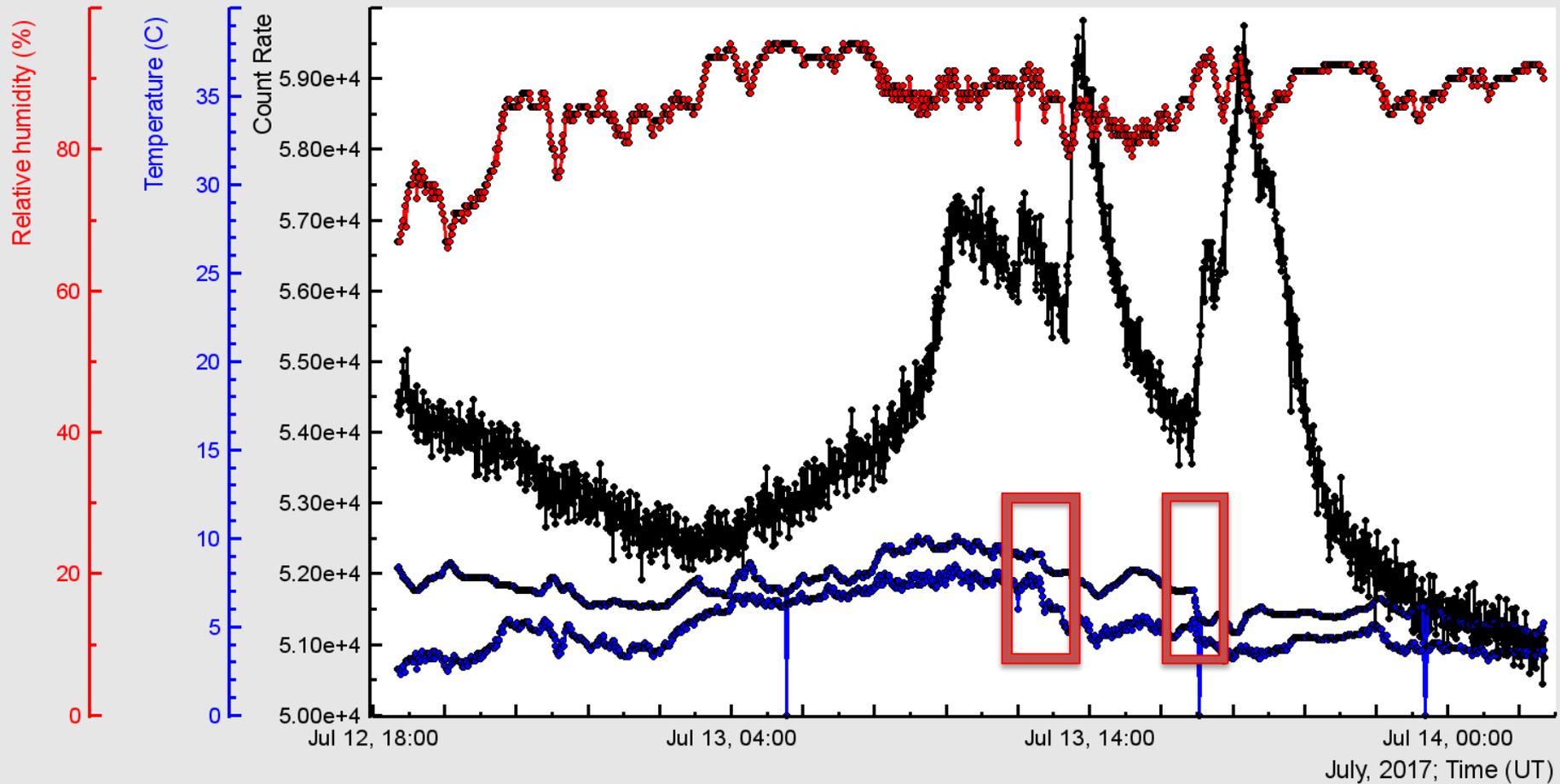
Cloud base minimal distance (on maximal particle flux): ~
spread * 122 m ~ (4.2 – 3.2)*122 ~ 125 m



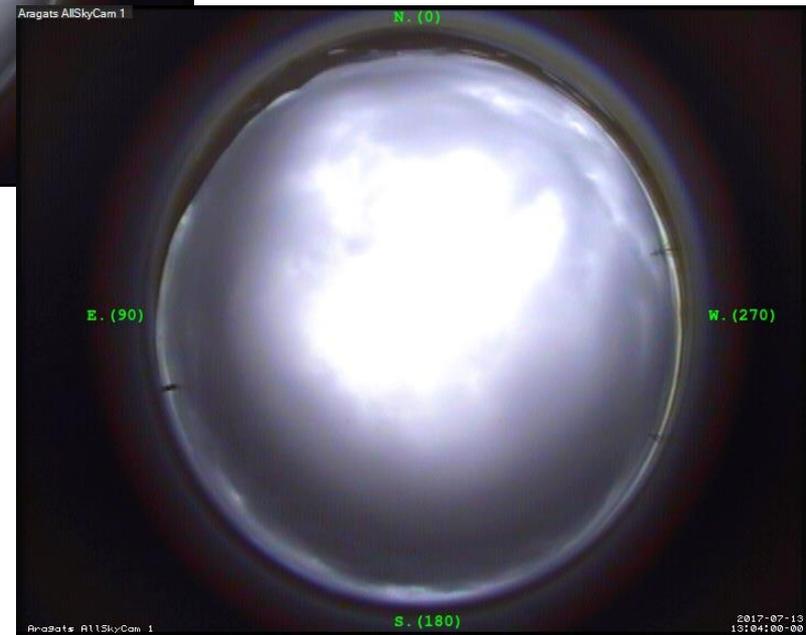
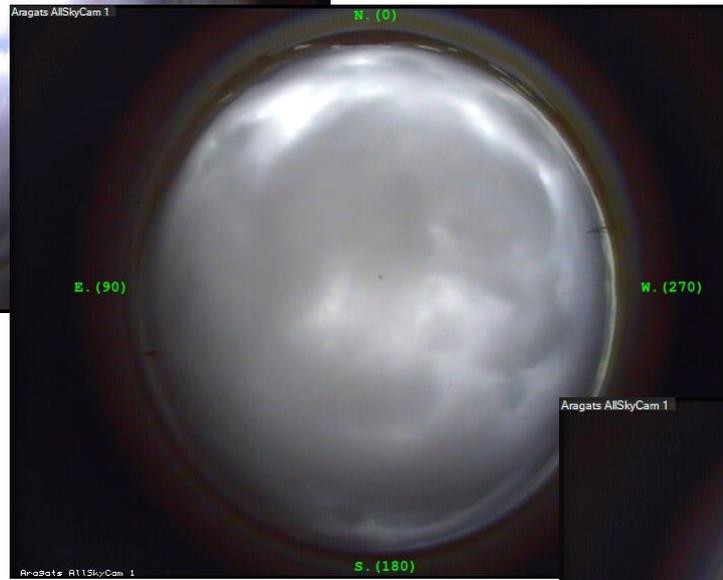
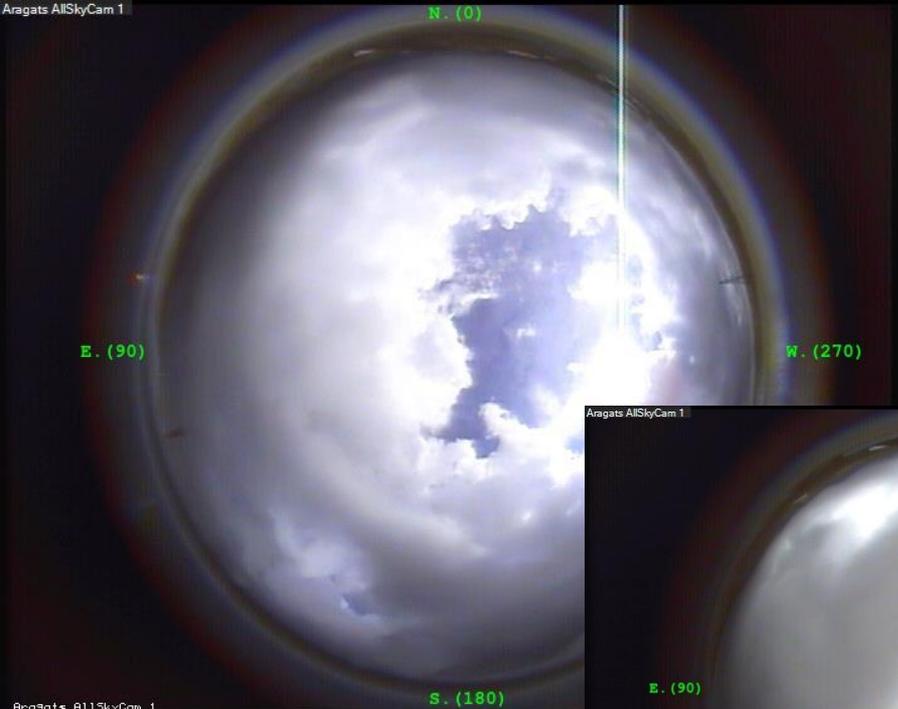
TGE and electrification of the clouds

- TGE occurred on various configurations of the intracloud electric field;
- Often we can see signature of the emerging LPCR;
- Also EOSO can be compatible with TGE;
- In this case we should consider fallout of the main negative layer and large field between main positive (now in the bottom) and negative screening layers (now in the middle);
- The cloud base location do not exceed 200 m;
- The changing particle fluxes are provide pattern of electric field configuration.

Before particle bursts Spread (difference between temperature and dew point) get minimal values!



Skies during 1 peak



Skies during second peak





**Opening door of experimental hall
on Aragats**

