



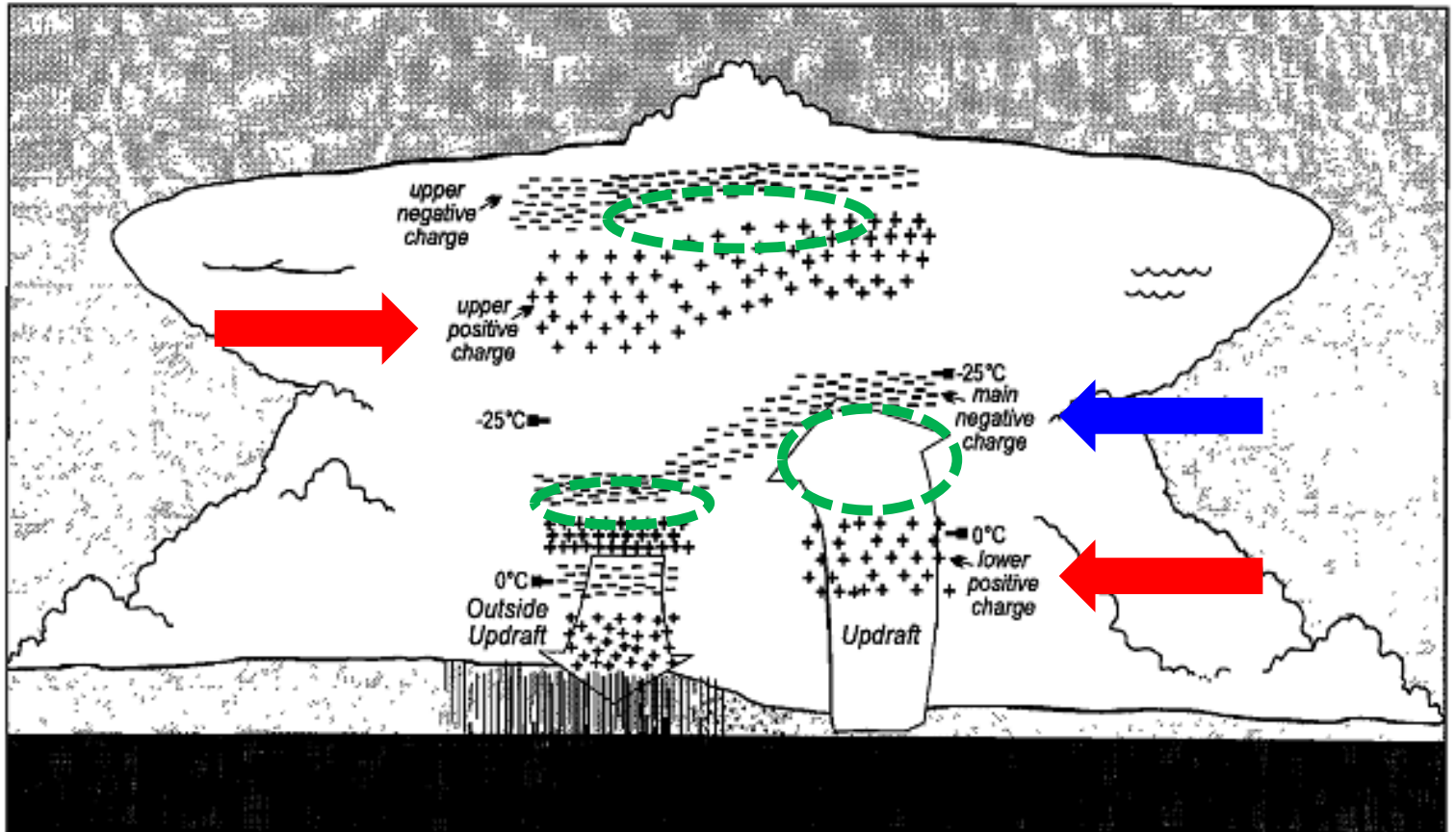
OBSERVATION OF LIGHTNING-INDUCED SIGNALS ON THE SUMMIT OF LA GRANDE MONTAGNE: PART 1 – HF MEASUREMENTS

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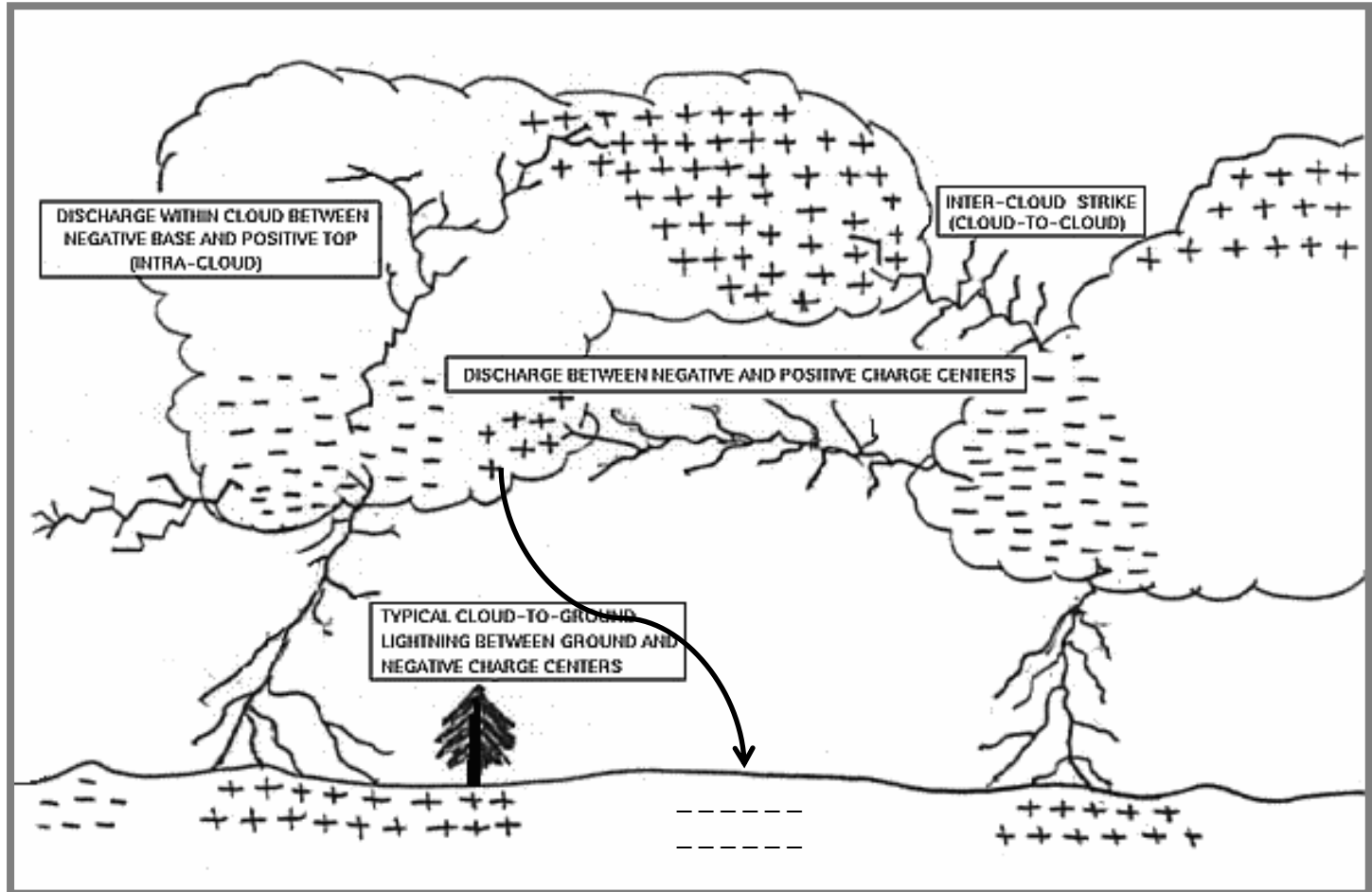
INTRODUCTION - A THUNDERCLOUD



Stolzenburg et al., 1998

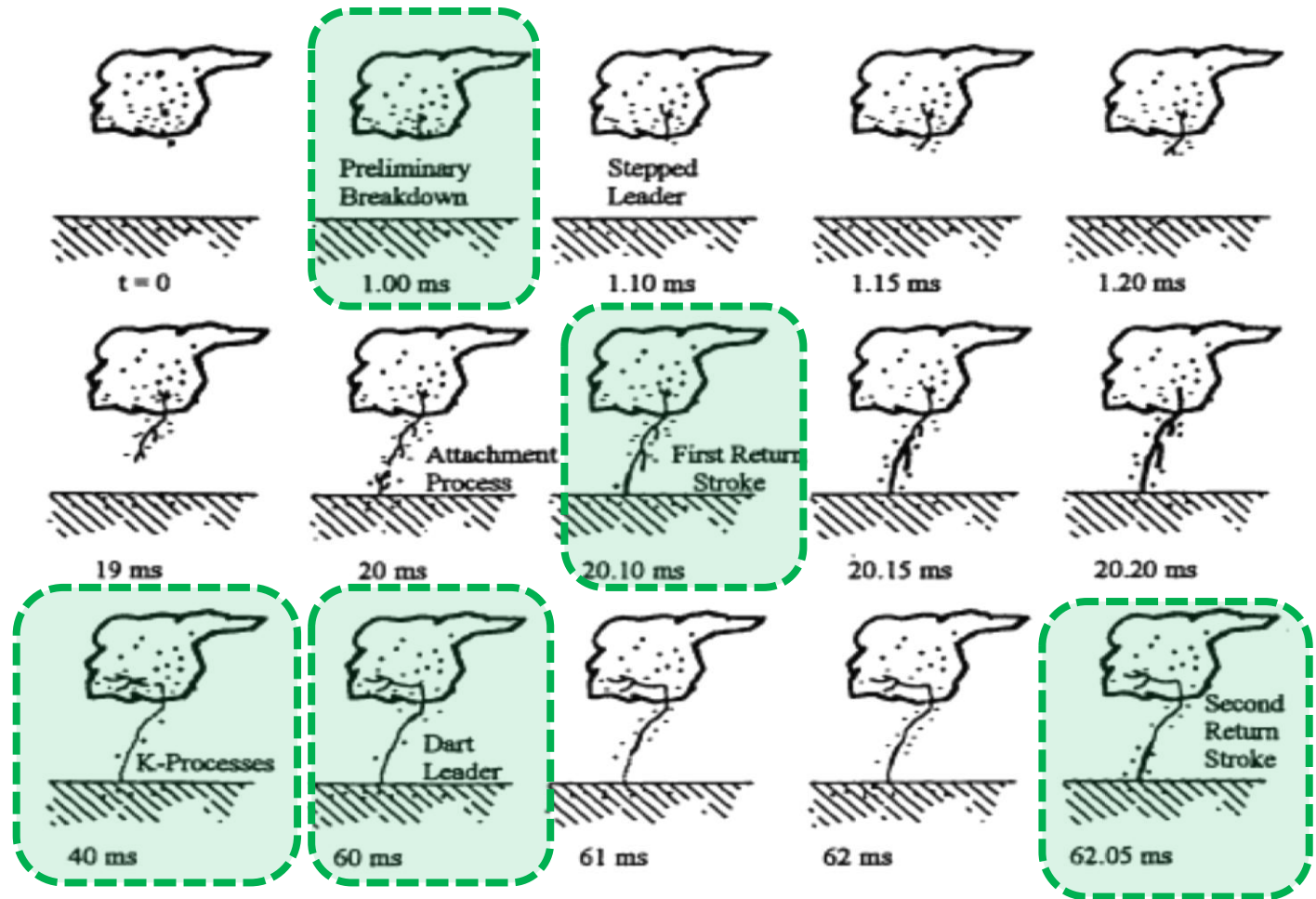
ice particles: graupel, snowflakes, hail

INTRODUCTION - RETURN STROKES



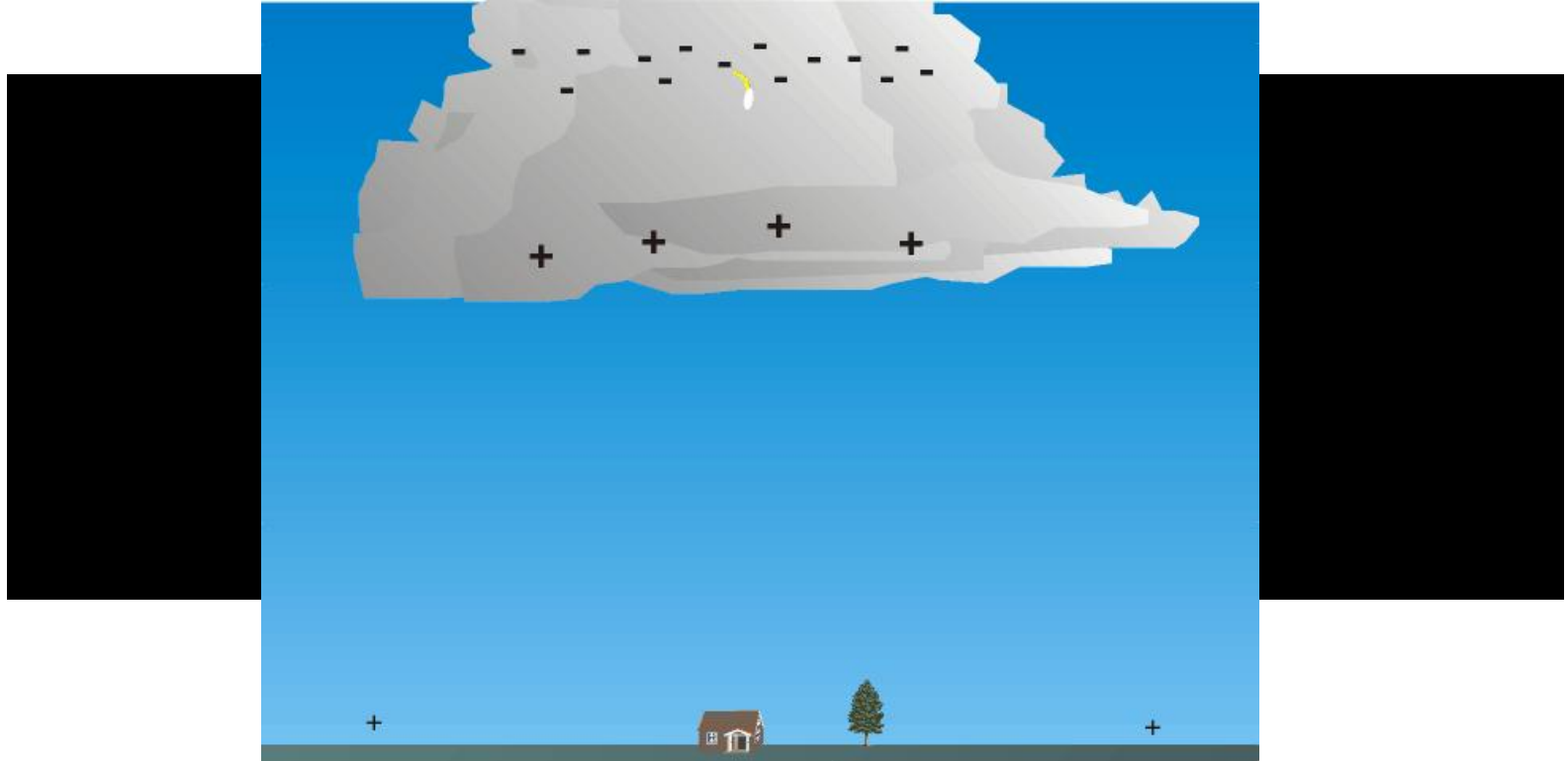
- cloud-to-ground x intra-cloud, inter-cloud flashes
- negative x positive cloud-to-ground flashes
- single stroke x multiple stroke flashes

INTRODUCTION - A LIGHTNING FLASH



Rakov and Uman, 2003

INTRODUCTION – A LIGHTNING FLASH



<http://www.nrcan.gc.ca/>

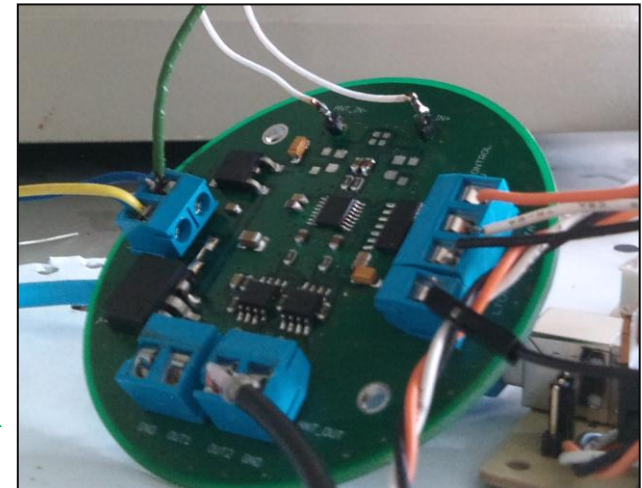
INSTRUMENTATION - SENSORS



a simple loop 8/2012 - 6/2013

SLAVIA SENSOR
(Shielded Loop Antenna with a
Versatile Integrated Amplifier)

one SLAVIA sensor from 7/2013
two SLAVIA sensors from 9/2013

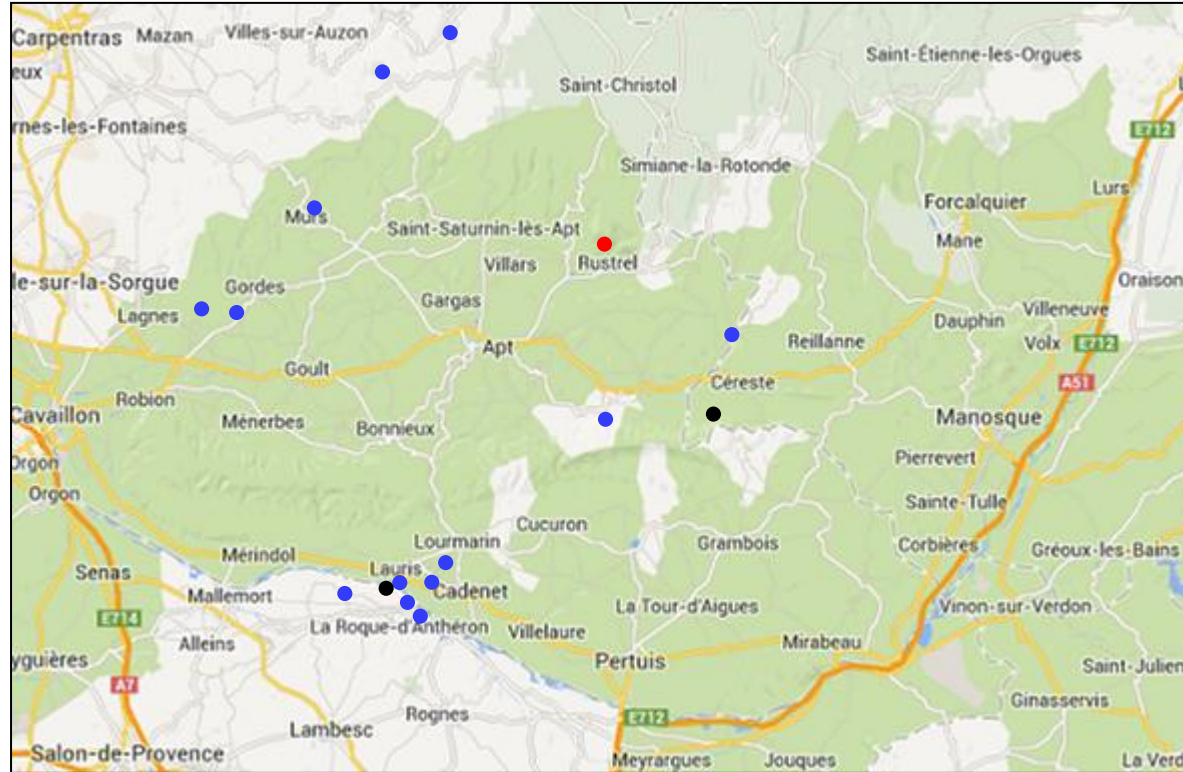


INSTRUMENTATION - ANALYZER

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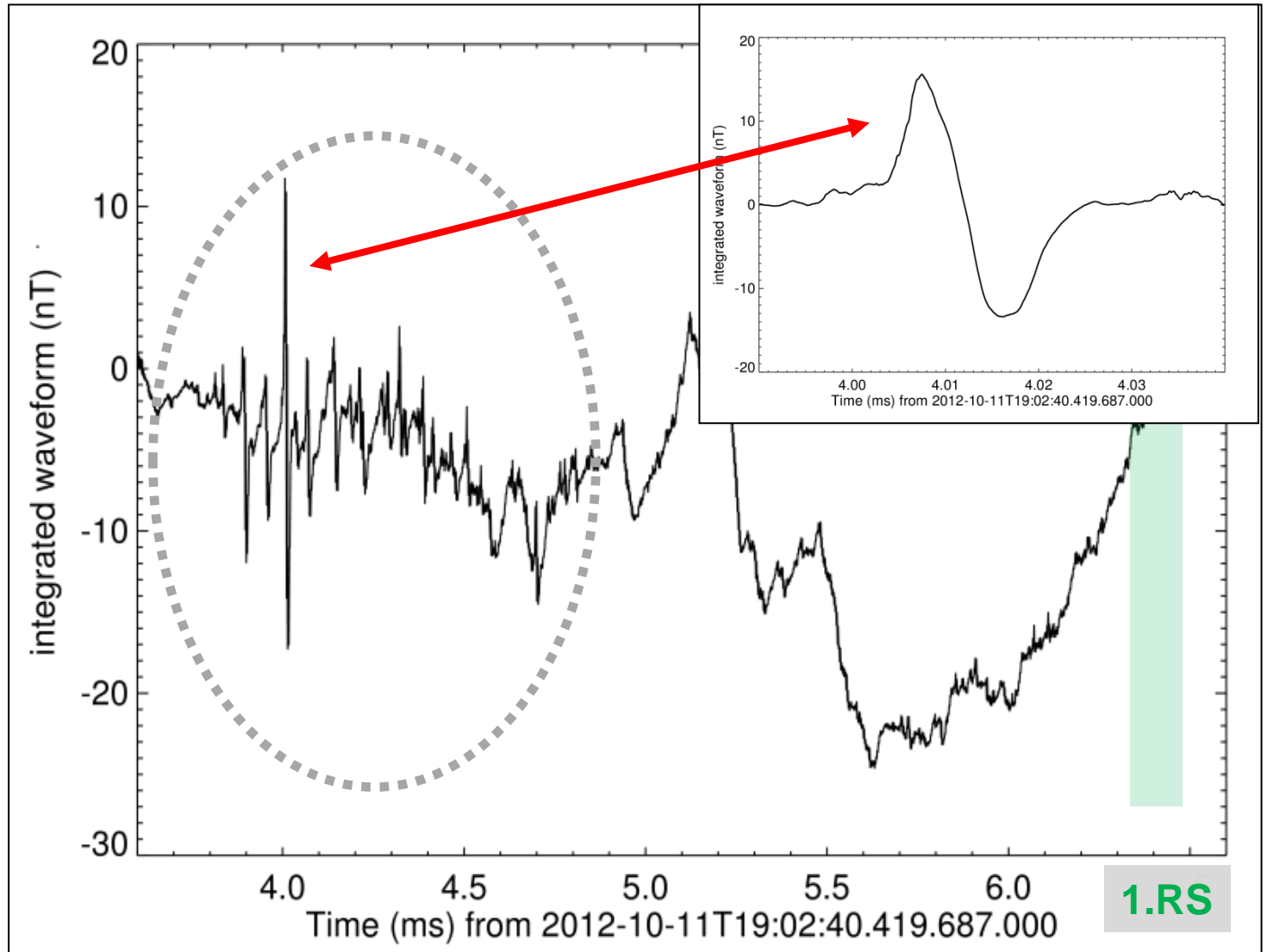


OBSERVATIONS OF LIGHTNING PRE-STROKE PULSE ACTIVITY

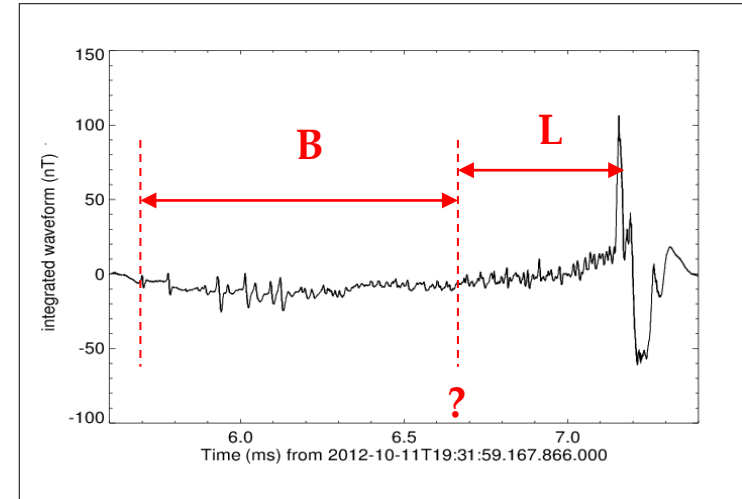
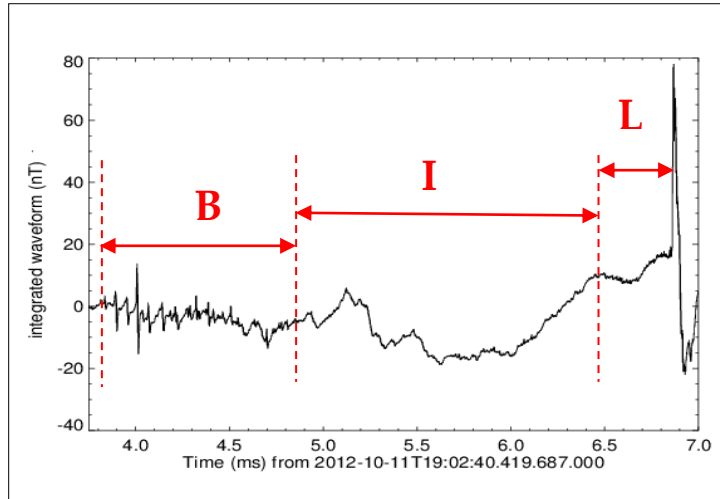


- Return strokes preceded by trains of pulses (reported by MÉTÉORAGE and by LMA)
- Return strokes preceded by trains of pulses (reported only by LMA)
- Location of our magnetic field sensor

OBSERVATIONS OF LIGHTNING PRE-STROKE ACTIVITY

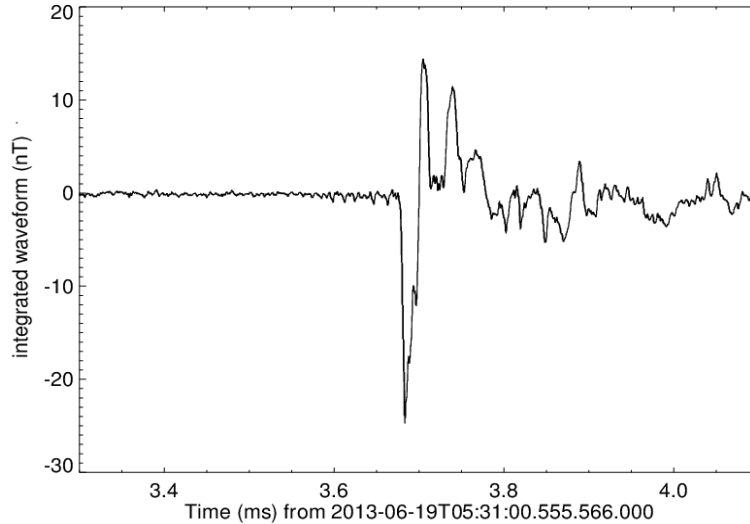


OBSERVATIONS OF LIGHTNING PRE-STROKE ACTIVITY



- Maximum time separation PB pulse/RS
- Maximum ratio PB pulse/RS (p-p amplitudes)
- Number of pulses in trains
- Duration of PB trains
- Inter-pulse intervals
- Pulse amplitudes normalized by their maximum in each individual sequence
- Ratio of pulse amplitudes and the corresponding RS in each individual sequence
- Evolution of the inter-pulse interval within the B part of the BIL type pre-stroke sequence
- Differences between BL and BIL types of sequences

OBSERVATION OF RETURN STROKES

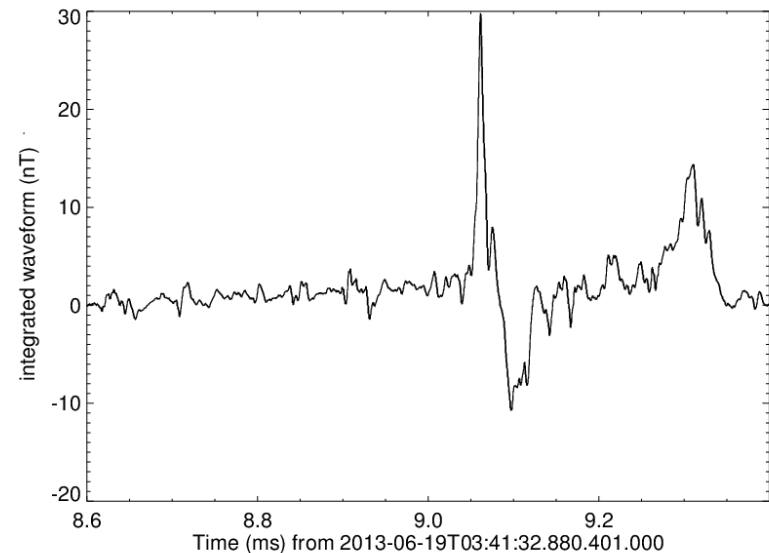


single-stroke
negative
cloud-to-ground
lightning flash

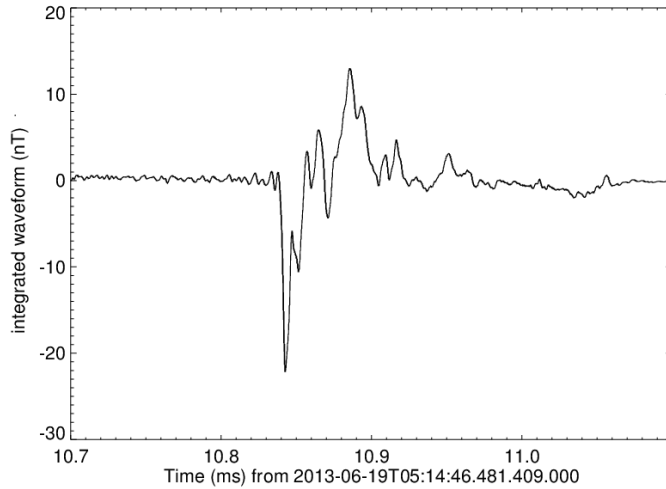
-44.6 kA 113 km

single-stroke
positive
cloud-to-ground
lightning flash

+94.9 kA 198km



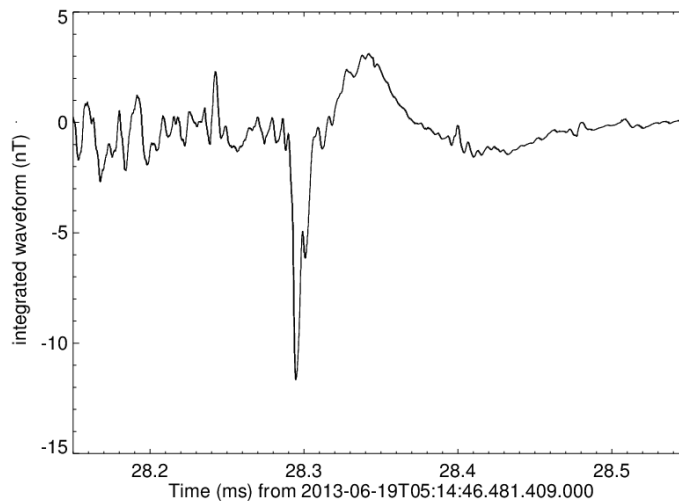
OBSERVATION OF RETURN STROKES



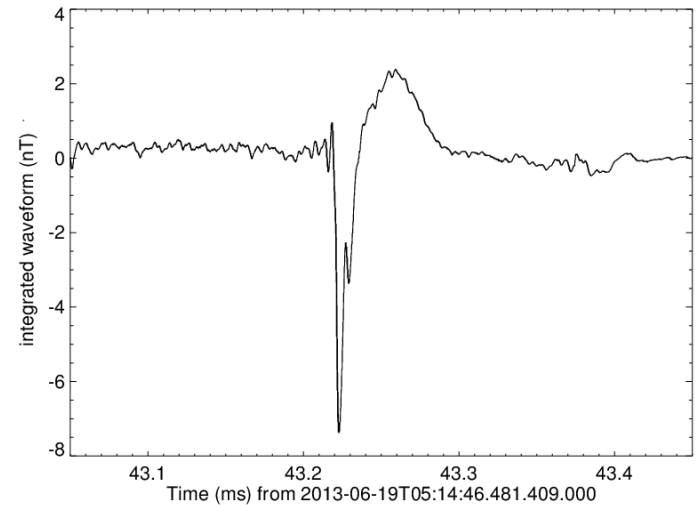
3-stroke negative cloud-to-ground lightning, 108 km

-32.9, -17.4, -13.1 kA

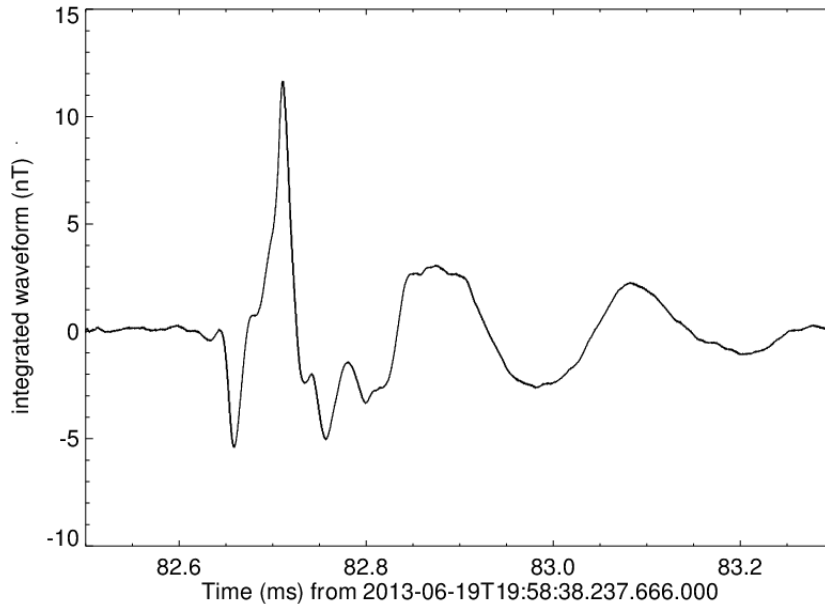
~ 17 ms later



~ 32 ms later



OBSERVATION OF RETURN STROKES



**the most distant
lightning stroke**

+415 kA 1240 km

the closest lightning stroke 9 July 2013

SUMMARY

- Analysis of measurements of signals radiated by lightning currents can serve us as a useful tool for their investigation.
- We plan to use our measurements to support the TARANIS spacecraft mission of CNES from below, to investigate processes leading to TLE and TGF.
- We can also learn more about the in-cloud processes leading to lightning initiation.
- Better understanding of return stroke currents can have implications for lightning protection.



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