

# Analysis of atmospheric discharges coinciding with Swarm detections using ground-based measurements

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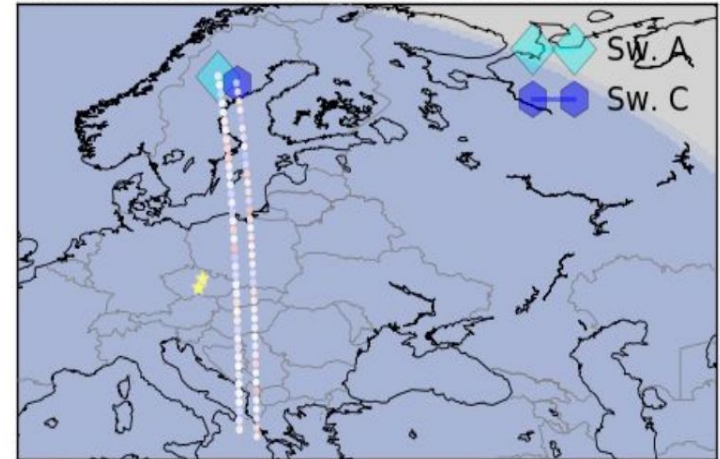
<sup>2</sup>OBSEE, Warszawa

<sup>3</sup>Space Research Centre PAS, Warszawa

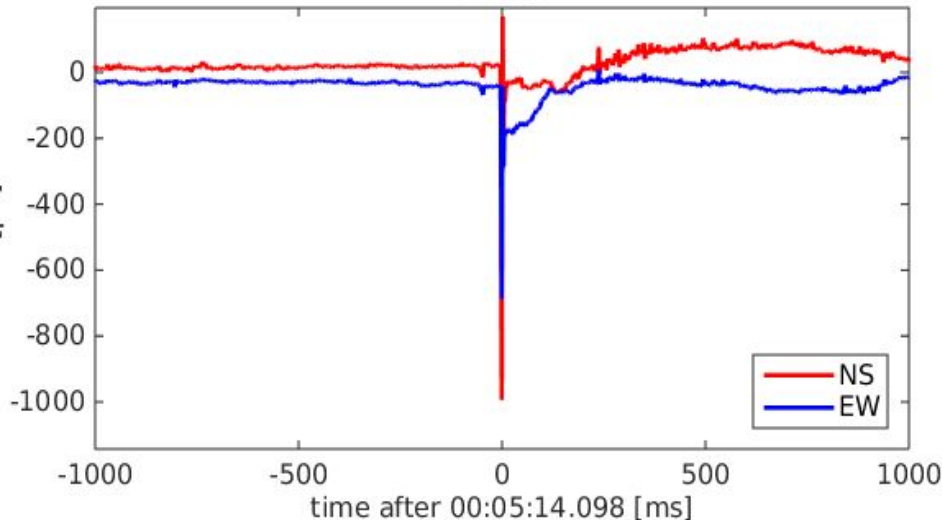
## Introduction

- In the previous meeting we showed several cases of location coincidence between strong lightning associated with TLE and Swarm location.
- After the meeting we found a signal on Swarm that coincides with the strongest discharge.

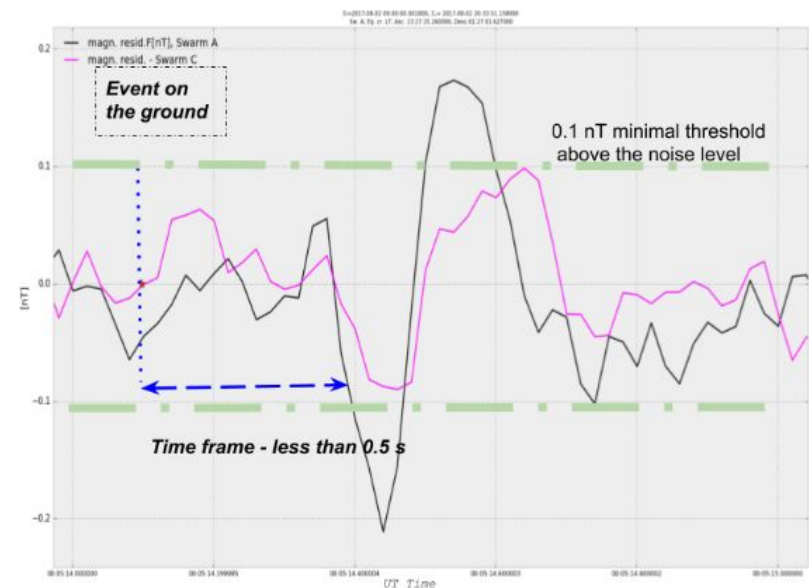
$T_0 = 2017-08-02\ 00:01:42.395000$ ,  $T_n = 2017-08-02\ 00:08:31.973000$   
 Sw. A, Eq. cr. LT, Asc: 13:27:15.260000, Desc: 01:27:01.627000



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The north-south and east-west magnetic field components associated with a TLE. Hylaty ELF station 2 August 2017.

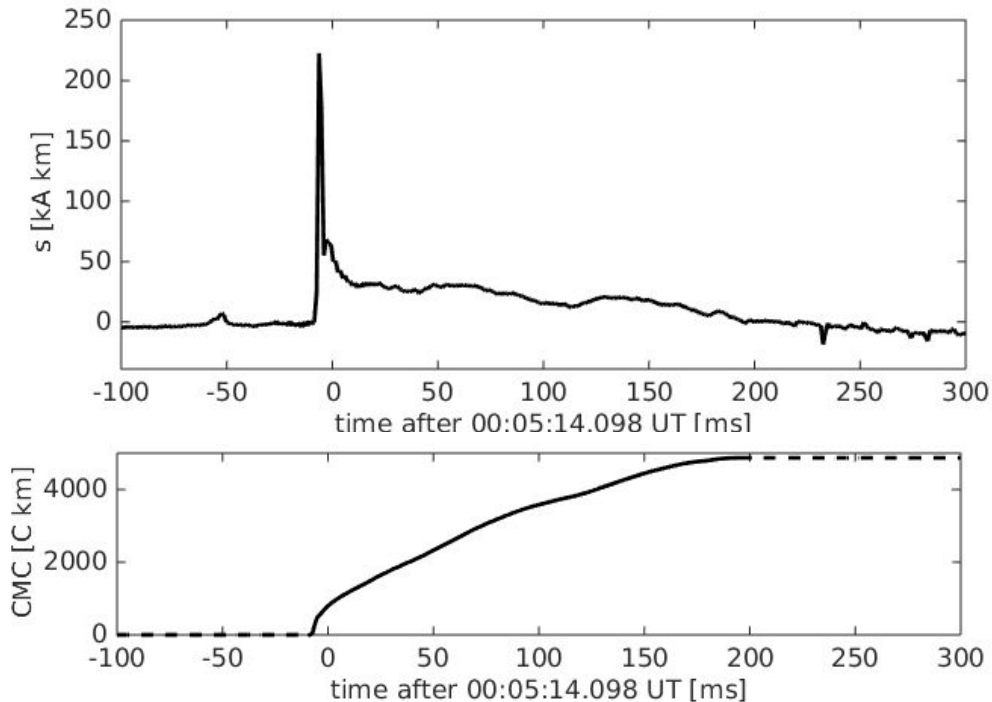


Signature of the discharge on Swarm

## The first case of lightning discharge detected on Swarm

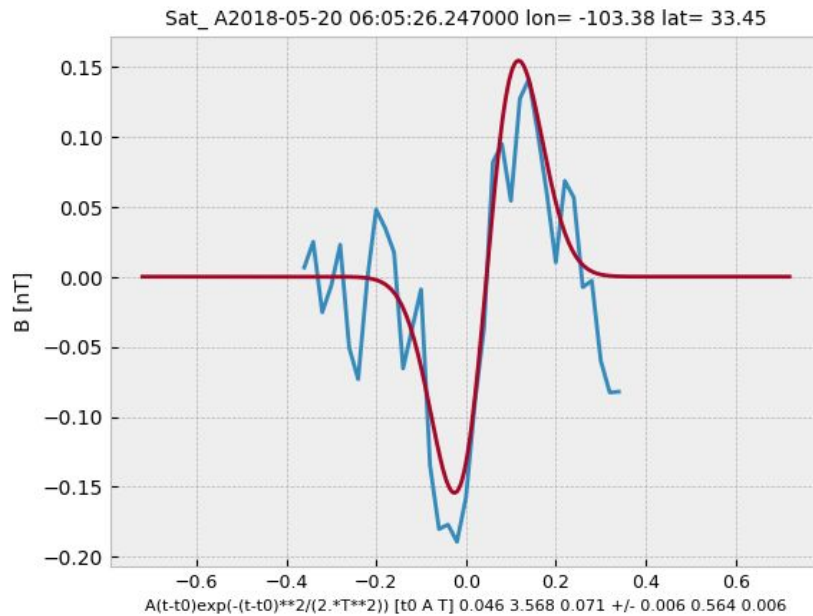


A sequence of sprites associated with the discharge detected on Swarm

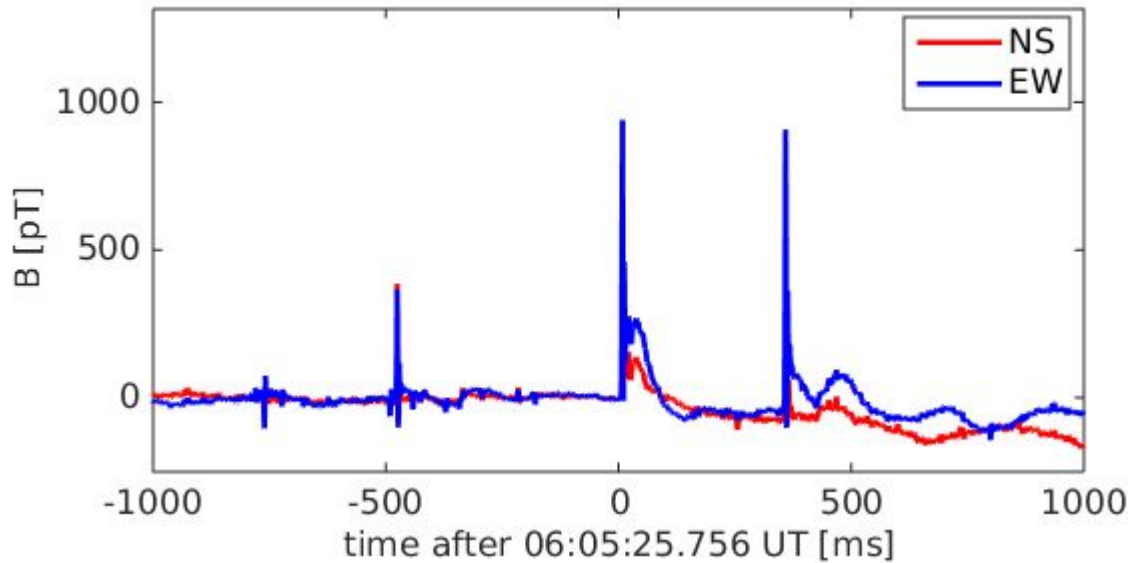


Current moment waveform and charge moment change reconstructed from the magnetic field component.

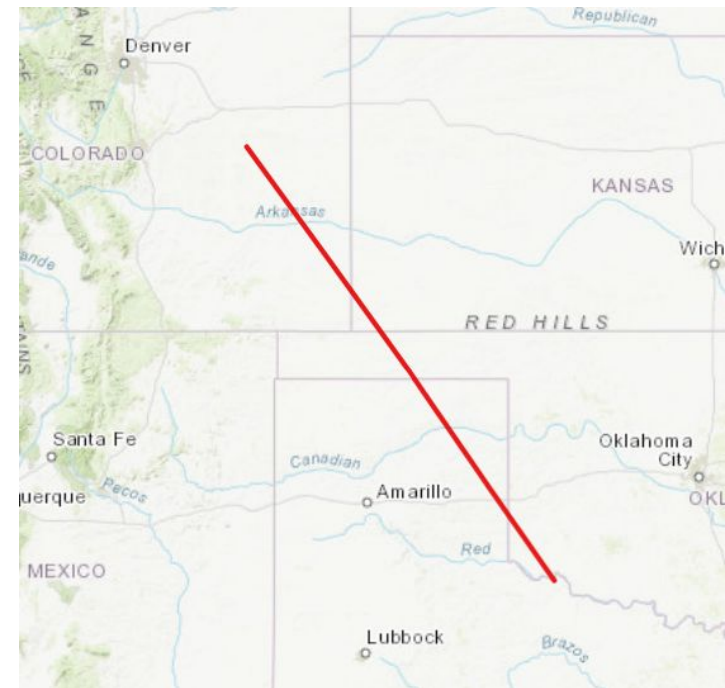
# The second case of lightning discharge detected on Swarm



## Colorado 20180520

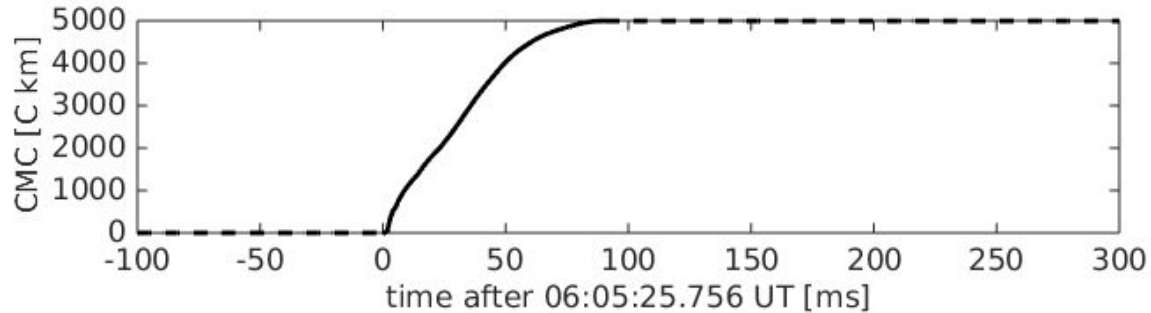
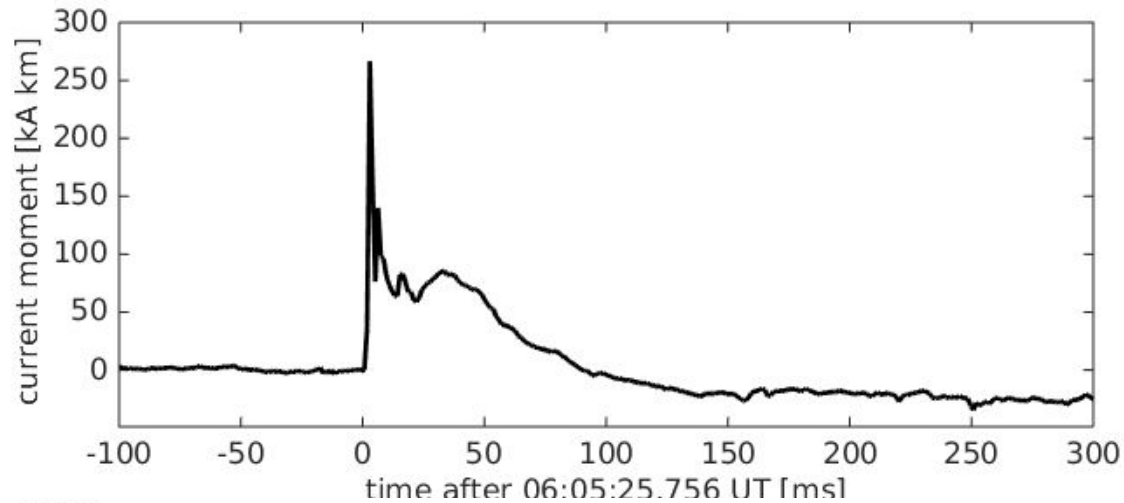


The north-south and east-west magnetic field components recorded by the Hugo station

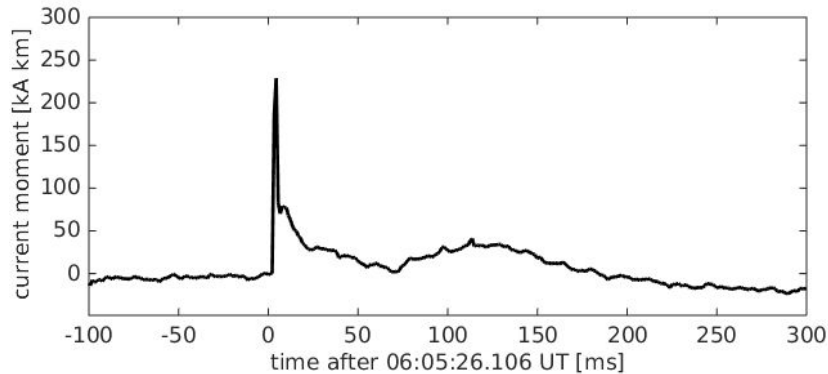


Location of the Hugo station and the discharge location

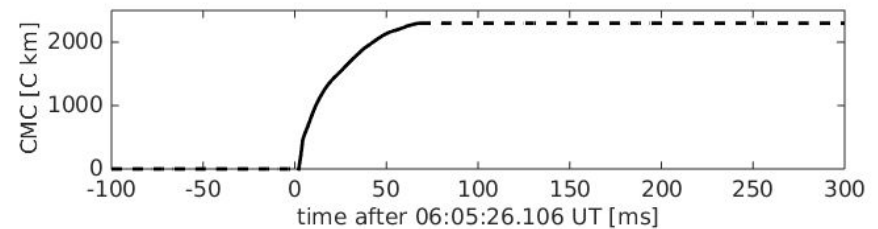
## The second case of lightning discharge detected on Swarm



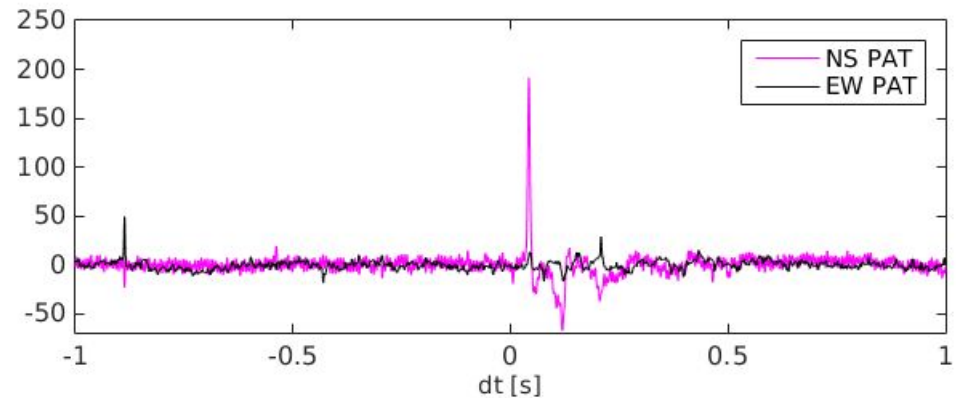
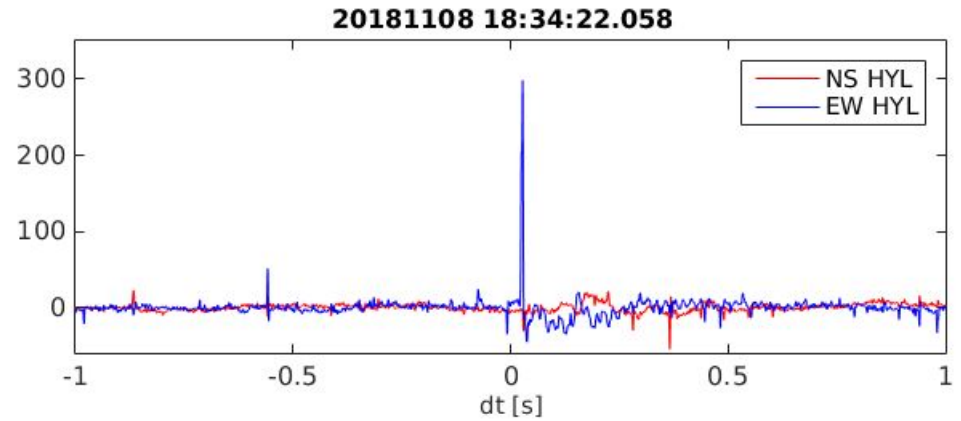
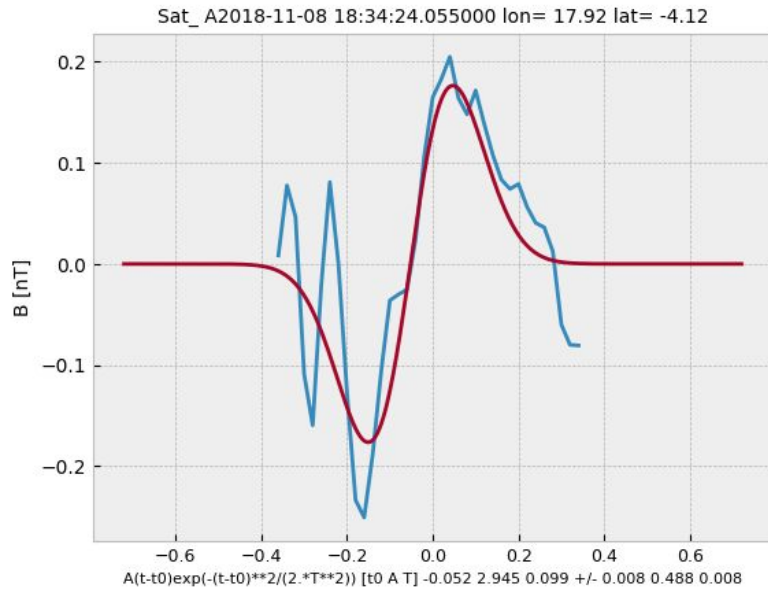
CMC  $\approx$  5000 C km  
assuming the same distance as  
the second discharge (616km)



The second discharge had the CMC of 2300 C km

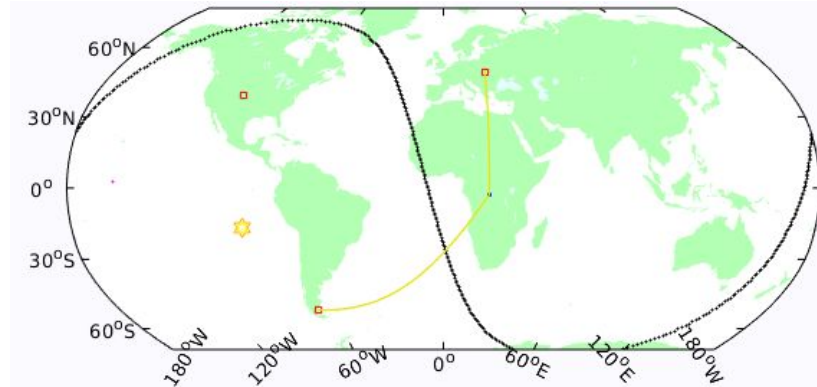


# The third case of lightning discharge detected on Swarm

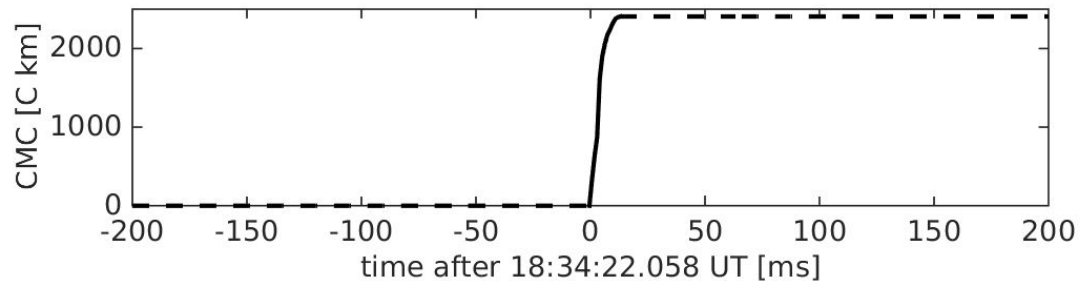
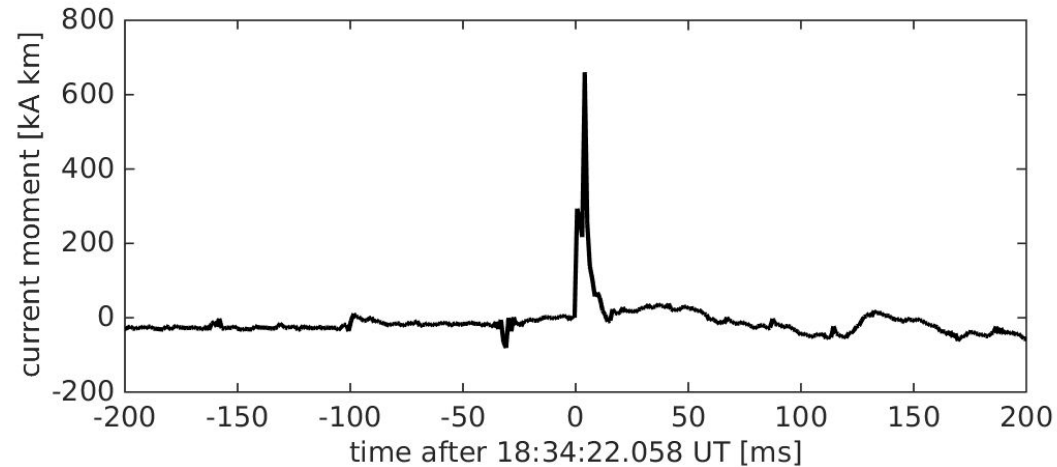


The north-south and east-west magnetic field components recorded by the Hylaty station (top) and Patagonia station (bottom)

## The third case of lightning discharge detected on Swarm



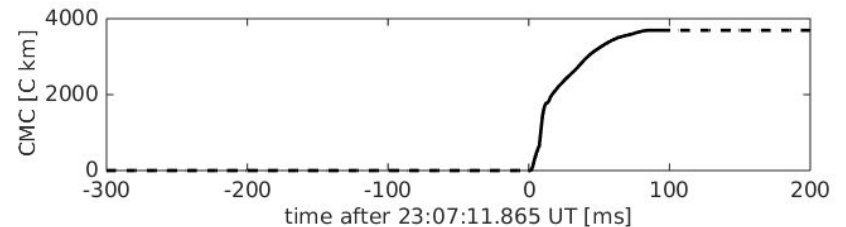
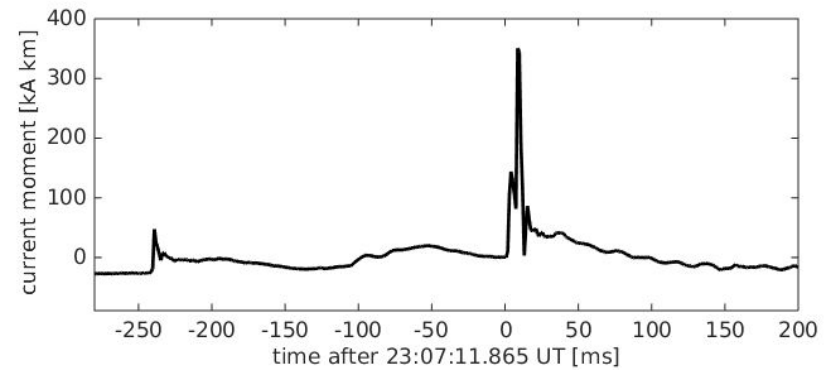
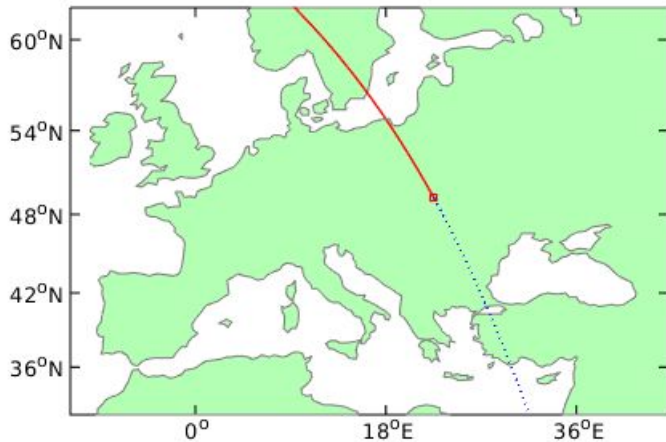
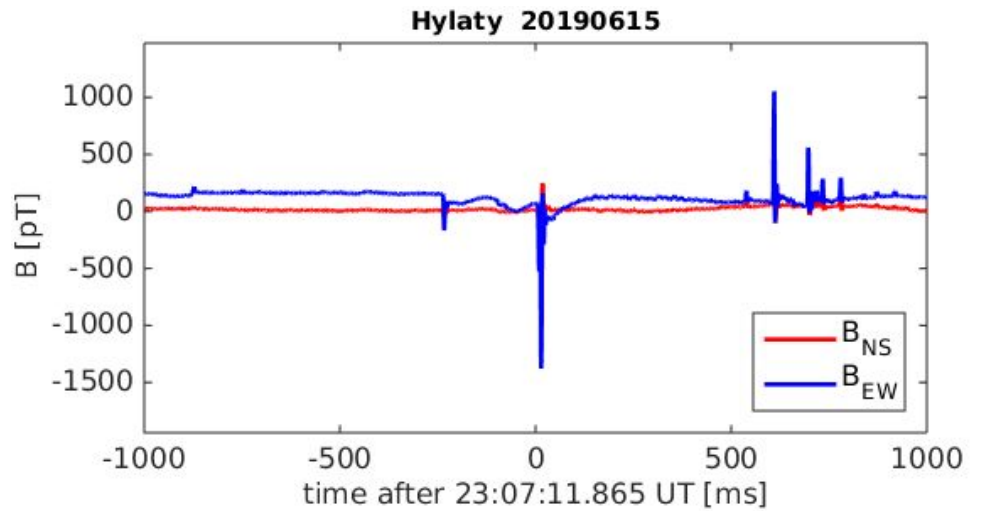
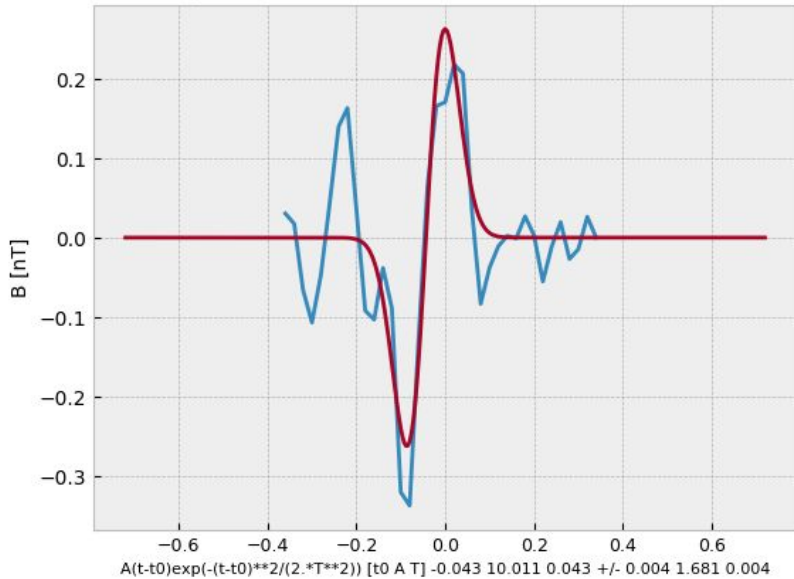
Discharge location based on ELF recordings from the Hylaty and Patagonia stations



CMC  $\approx$  2400 C km  
assuming the distance  
of 5920 km

# A new case of lightning discharge detected on Swarm

Sat\_A2019-06-15 23:07:12.248000 lon= 17.43 lat= 54.33



Direction of arrival based on the Hylaty data

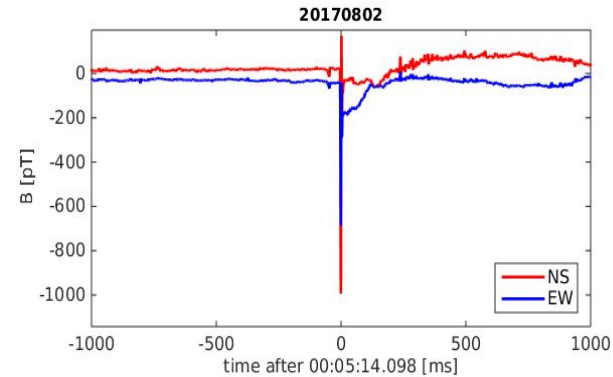
CMC  $\approx$  3700 C km assuming the distance of 670 km



# Summary

We found the first cases of coincidence between strong lightning discharges measured by ground based instruments and the signal observed by Swarm magnetometer.

We are looking for more cases of coincidence.



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