

## Introduction and current progress on Work Package 7

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# WP7: Searching for coincidences and correlations between ground-based observations of atmospheric discharges and Swarm measurements.

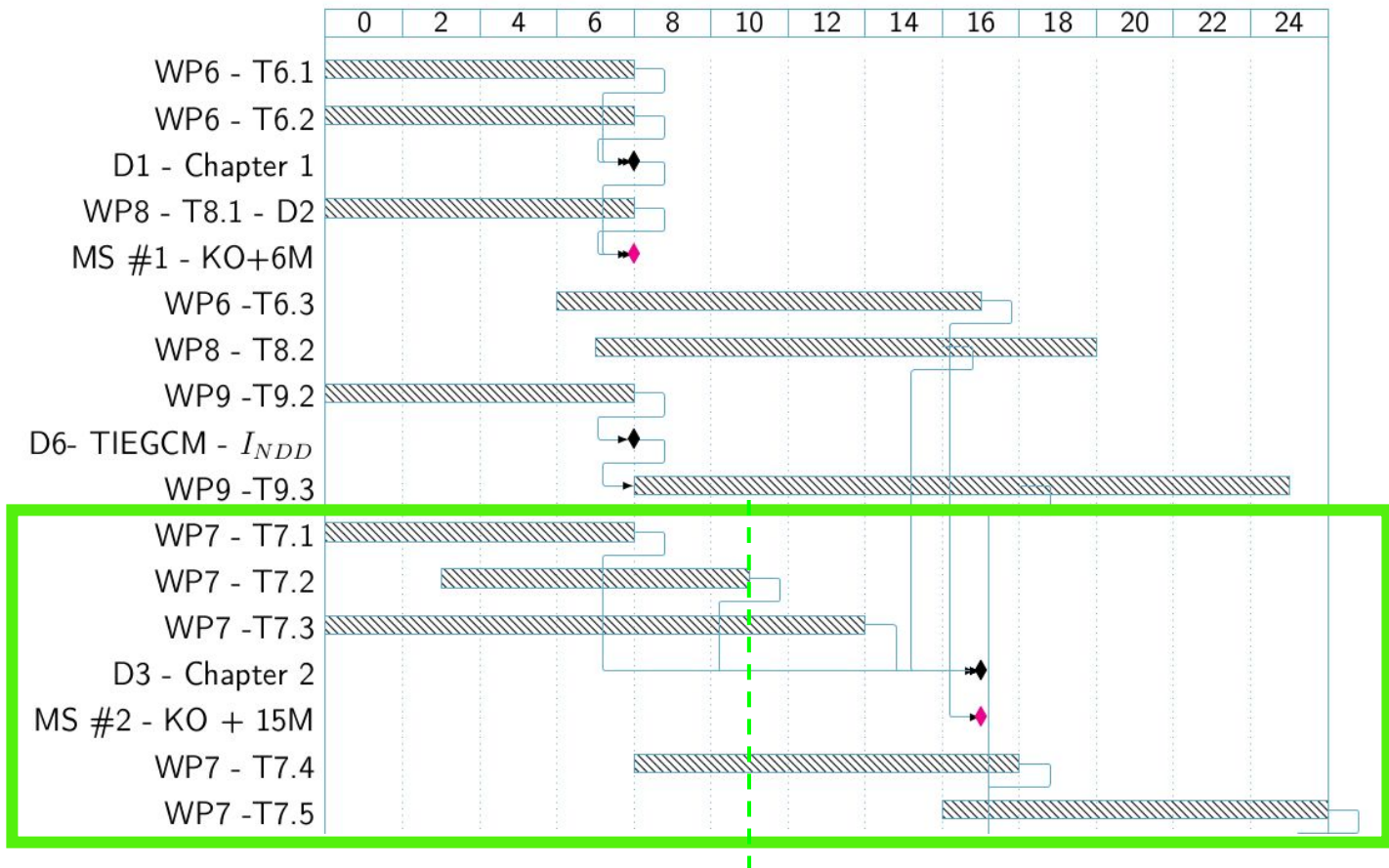
T 7.1 Creating the first database of TLE events documented optically and electromagnetically with ground-based instruments

T 7.2 Searching for coincidence with Swarm locations

T 7.3 Mapping thunderstorm activity using ELF measurements

T 7.4 Analyzing thunderstorm activity in time windows corresponding to Swarm locations

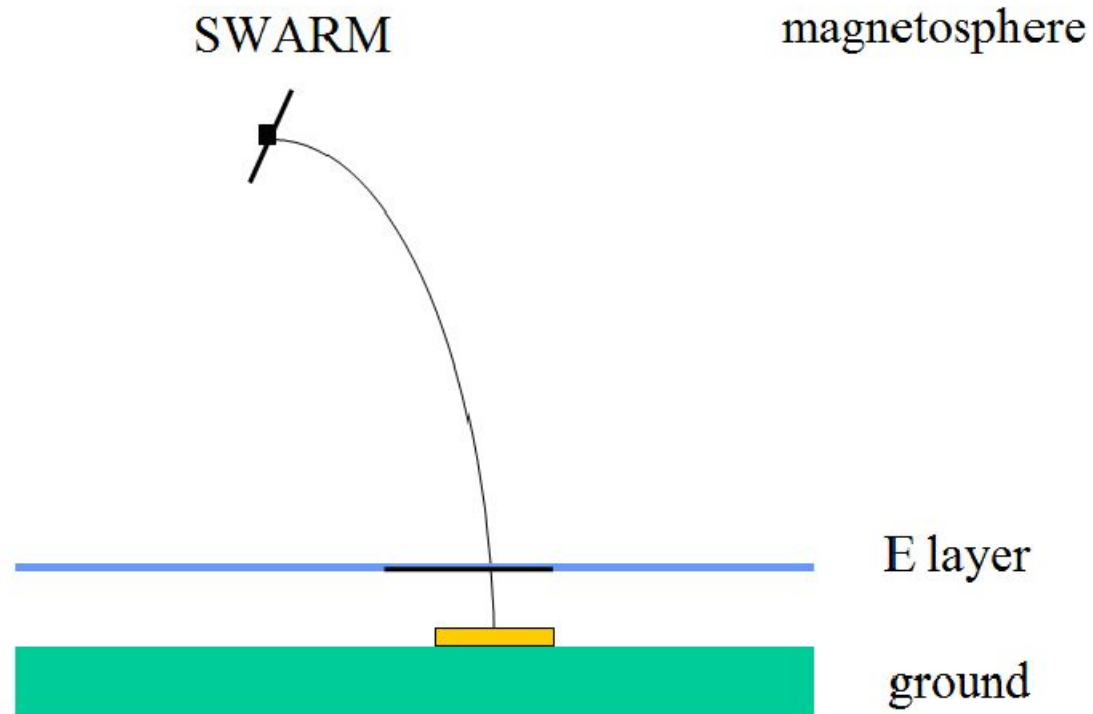
T 7.5 Updating the database of TLE events and searching for coincidence with Swarm locations



Schedule for WP7 presented in the proposal

## T7.2 Searching for coincidence with Swarm locations

The first database contained **720 cases** and has already been checked for the location coincidence. Only in 6 cases, one or two Swarm satellites were close to the event location (the magnetic field line leading to the event location coincides with Swarm location). These cases will be analyzed in detail in WP8.



In the E-layer the EM impulse generated by lightning is converted into an Alfvén wave and propagates along the Earth's magnetic field line. [WP5]

# T7.2 Searching for coincidence with Swarm locations

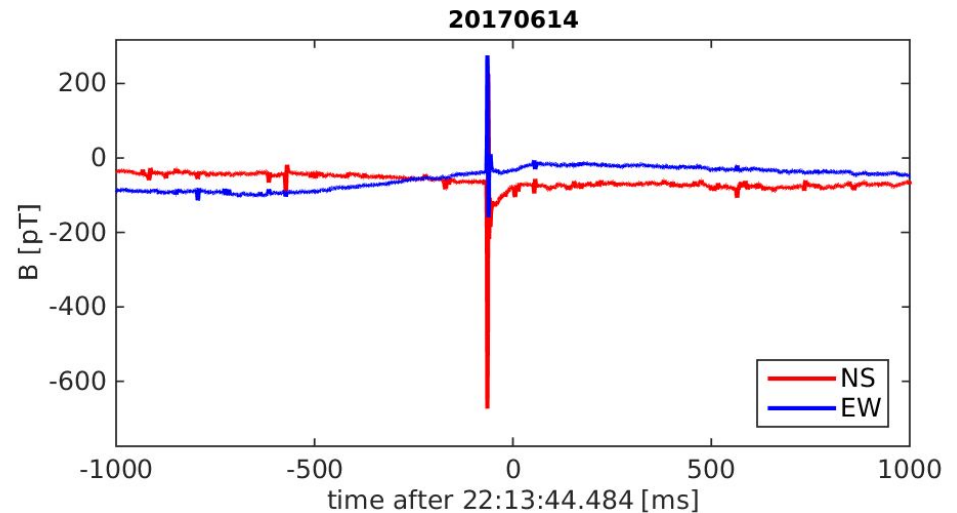
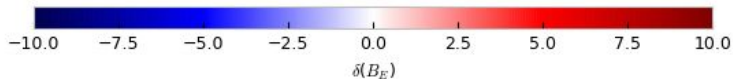
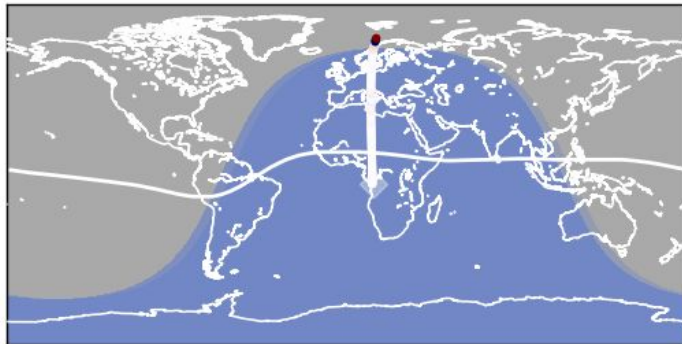
## Case 1

### Coincidence with Swarm B

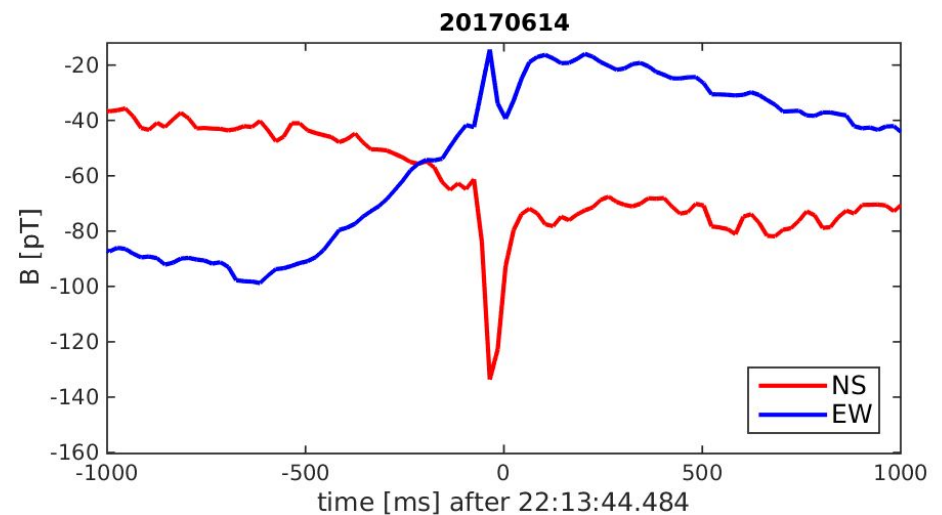


A video frame showing the sprite recorded in Nydek on 14 June 2017 at 22:13:44 UT

$T_0=2017-06-14\ 22:03:36.165000$ ,  $T_n=2017-06-14\ 22:24:04.883000$   
Sw. B, Eq. cr. LT, Asc: 23:00:15.140000, Desc:11:00:25.610000



The north-south and east-west magnetic field components associated with the sprite event. Distance 972 km.



The signal after a 15-Hz low-pass filter and downsampling to 50 Hz

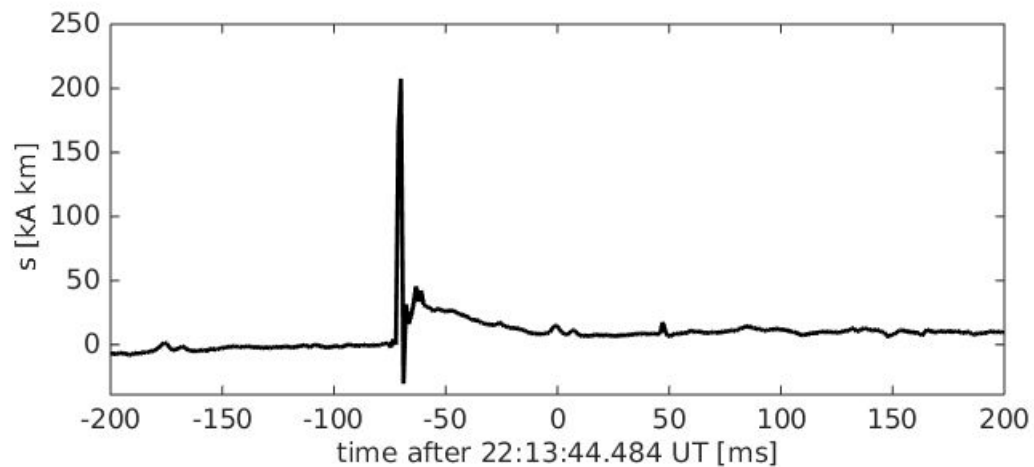
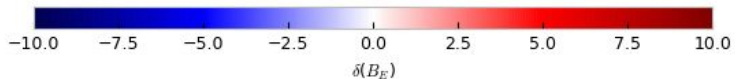
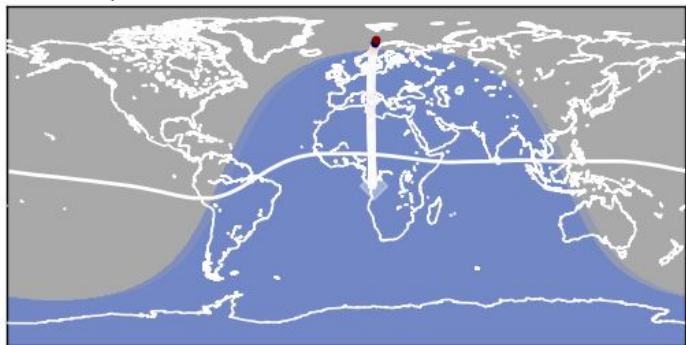
## T7.2 Searching for coincidence with Swarm Locations

### Case 1: Coincidence with Swarm B

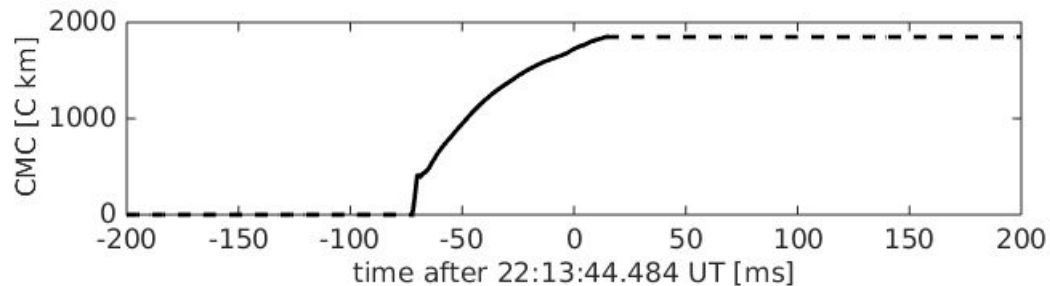


A video frame showing the sprite recorded in Nydek on 14 June 2017 at 22:13:44 UT

$T_0=2017-06-14\ 22:03:36.165000$ ,  $T_n=2017-06-14\ 22:24:04.883000$   
Sw. B, Eq. cr. LT, Asc: 23:00:15.140000, Desc:11:00:25.610000



Current moment waveform reconstructed from the magnetic field component recorded by the Hylaty ELF station. Distance 972 km.



The total charge moment change associated with the event was of 1850 C km

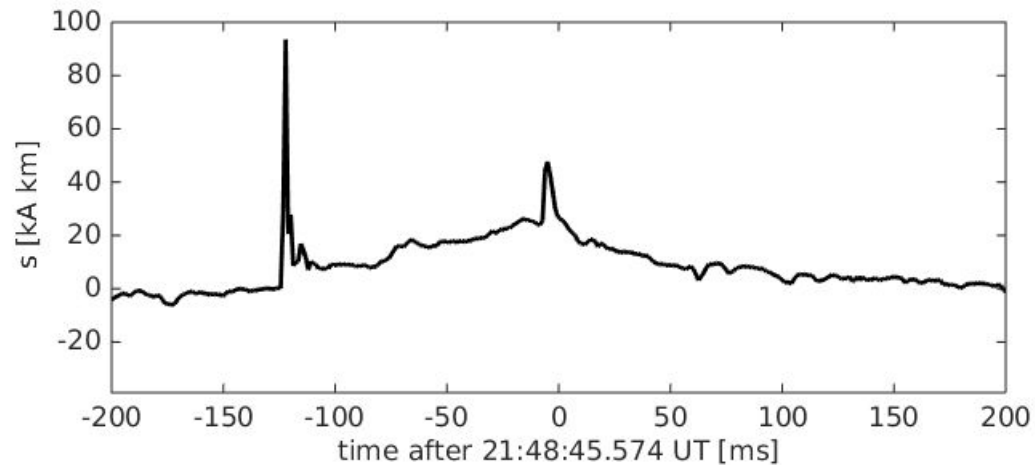
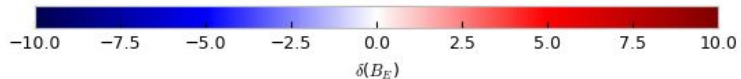
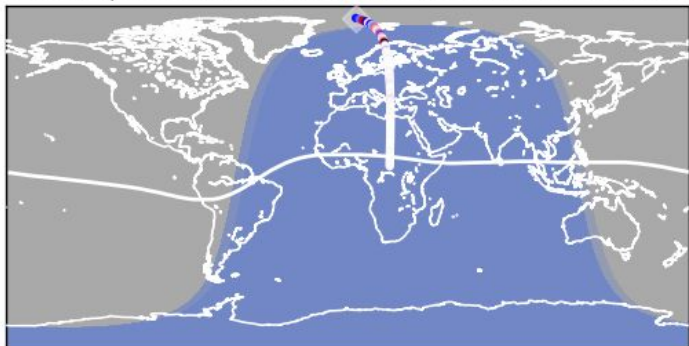
## T7.2 Searching for coincidence with Swarm locations

### Case 6: Coincidence with Swarm A

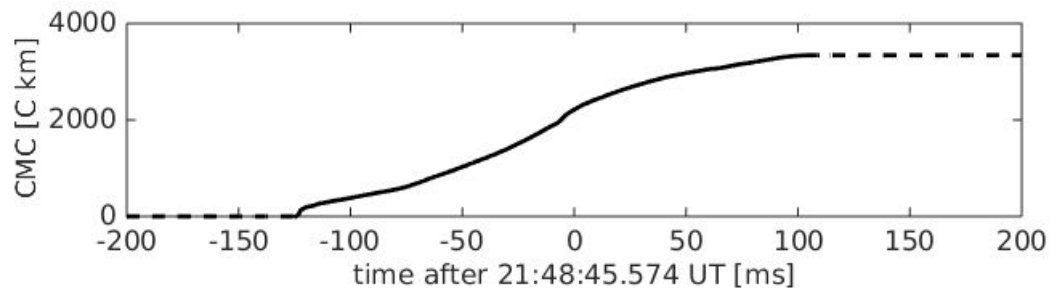


Sprite recorded in Nydek  
on 24 August 2017 at 23:37:37 UT

$T_0=2017-08-24\ 21:38:32.002000$ ,  $T_n=2017-08-24\ 21:59:00.737000$   
Sw. A, Eq. cr. LT, Asc: 11:28:33.503000, Desc:23:28:20.873000



Current moment waveform reconstructed from the magnetic  
field component recorded by the Hylaty ELF station.  
Distance 693 km.

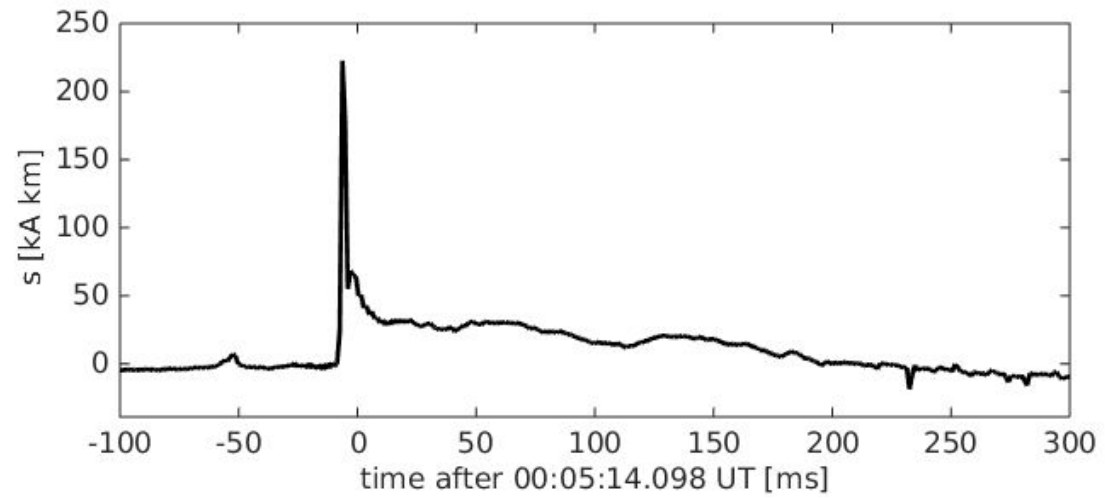
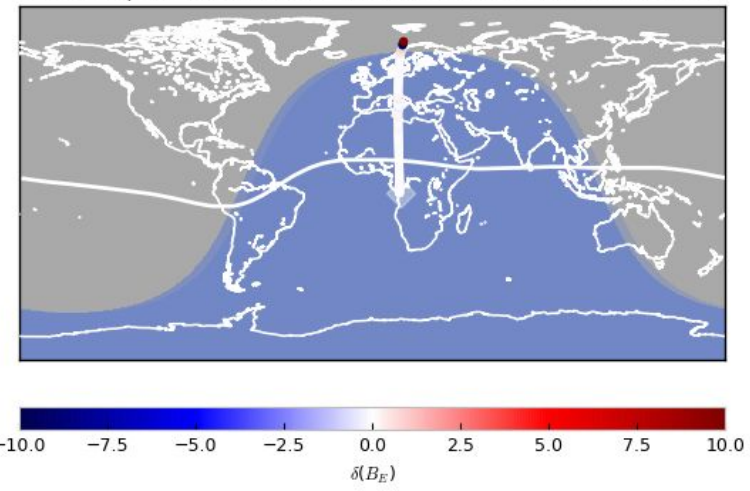


The total charge moment change associated with the event  
was of 3340 C km

## T7.2 Searching for coincidence with Swarm locations

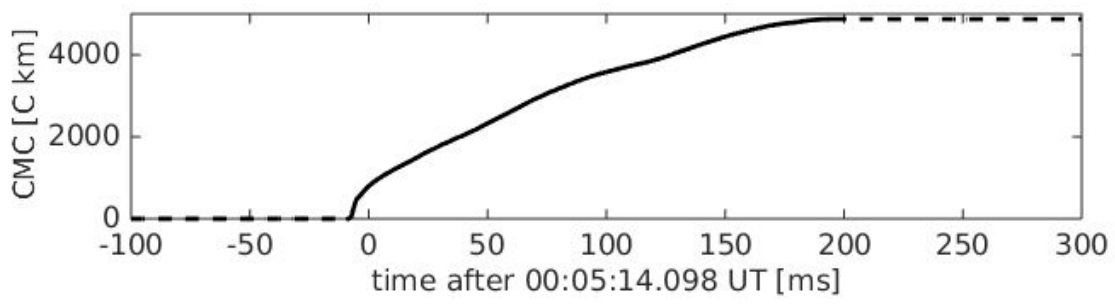
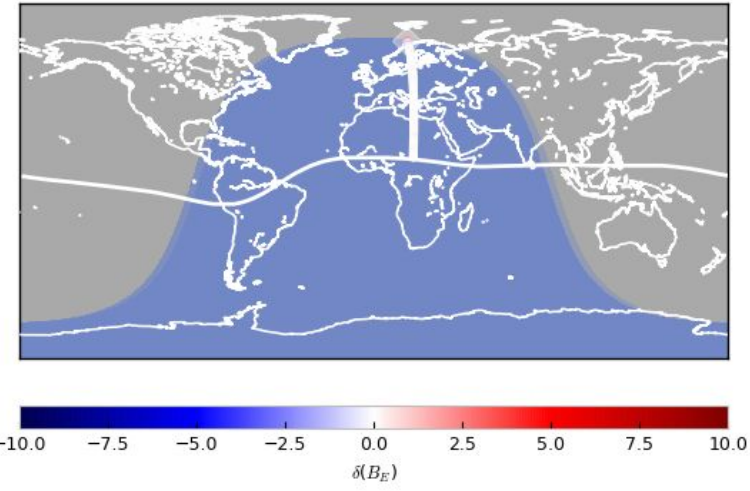
### Case 3: Location coincidence with Swarm A & Swarm B

$T_0=2017-06-14\ 22:03:36.165000$ ,  $T_n=2017-06-14\ 22:24:04.883000$   
 Sw. B, Eq. cr. LT, Asc: 23:00:15.140000, Desc:11:00:25.610000



Current moment waveform reconstructed from the magnetic field component recorded by the Hylaty ELF station.  
 2 August 2017. Distance 557 km.

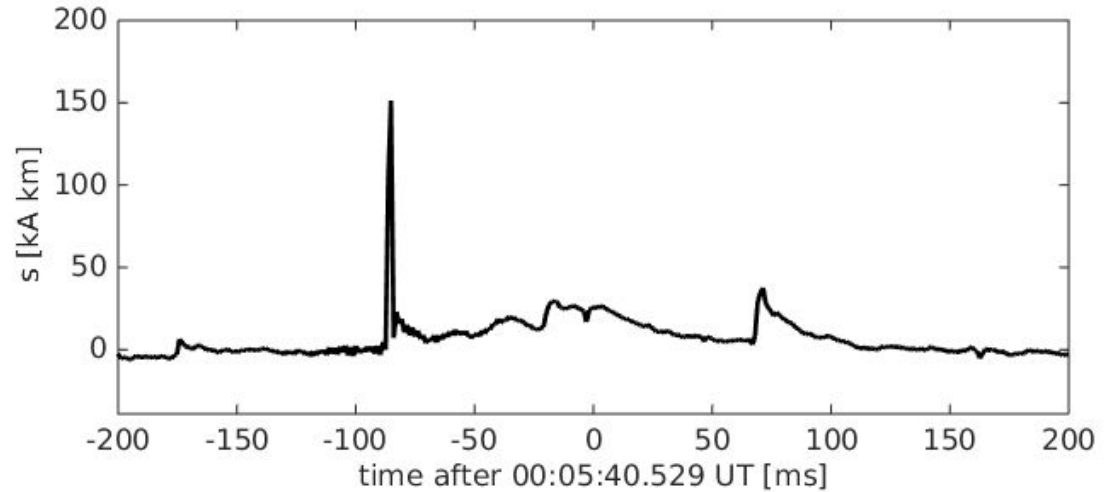
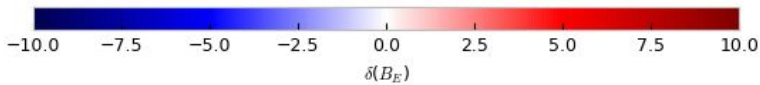
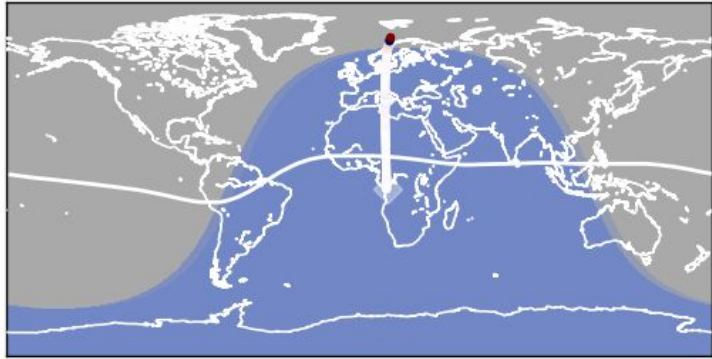
$T_0=2017-08-02\ 00:00:00.001000$ ,  $T_n=2017-08-02\ 00:15:31.779000$   
 Sw. C, Eq. cr. LT, Asc: 13:32:53.015000, Desc:01:32:40.348000



The total charge moment change associated with the event was of 4870 C km

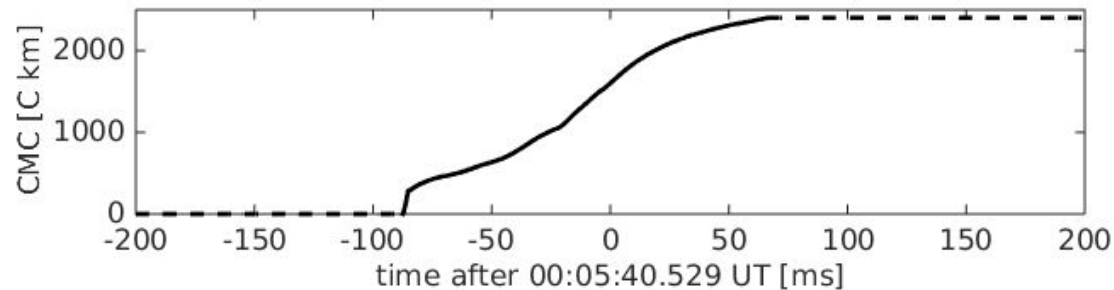
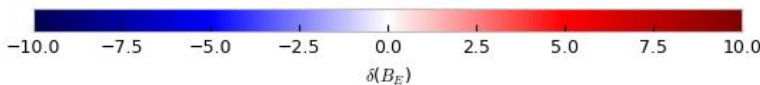
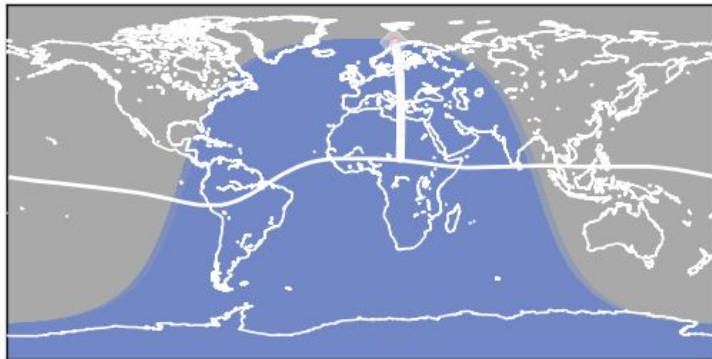
## T7.2 Searching for coincidence with Swarm locations Case 4: Location coincidence with Swarm A & Swarm B

$T_0=2017-06-14\ 22:03:36.165000$ ,  $T_n=2017-06-14\ 22:24:04.883000$   
Sw. B, Eq. cr. LT, Asc: 23:00:15.140000, Desc:11:00:25.610000



Current moment waveform reconstructed from the magnetic field component recorded by the Hylaty ELF station.  
2 August 2017. Distance 549 km.

$T_0=2017-08-02\ 00:00:00.001000$ ,  $T_n=2017-08-02\ 00:15:31.779000$   
Sw. C, Eq. cr. LT, Asc: 13:32:53.015000, Desc:01:32:40.348000



The total charge moment change associated with the event was of 2400 C km



## Summary

The first database of TLE events contained 720 cases.

In 6 cases, one or two Swarm satellites were close to the event location.

For these cases the current moment waveform and charge moment change were calculated.

The strongest event had a very large charge moment, equal to 4870 C km, which should be sufficient for observing it in the vector magnetic data on Swarm.

