ANALYSIS OF LIGHTNING ACTIVITY DURING THUNDERSTORMS WITH THE OVERSHOOTING TOPS

DHMZ

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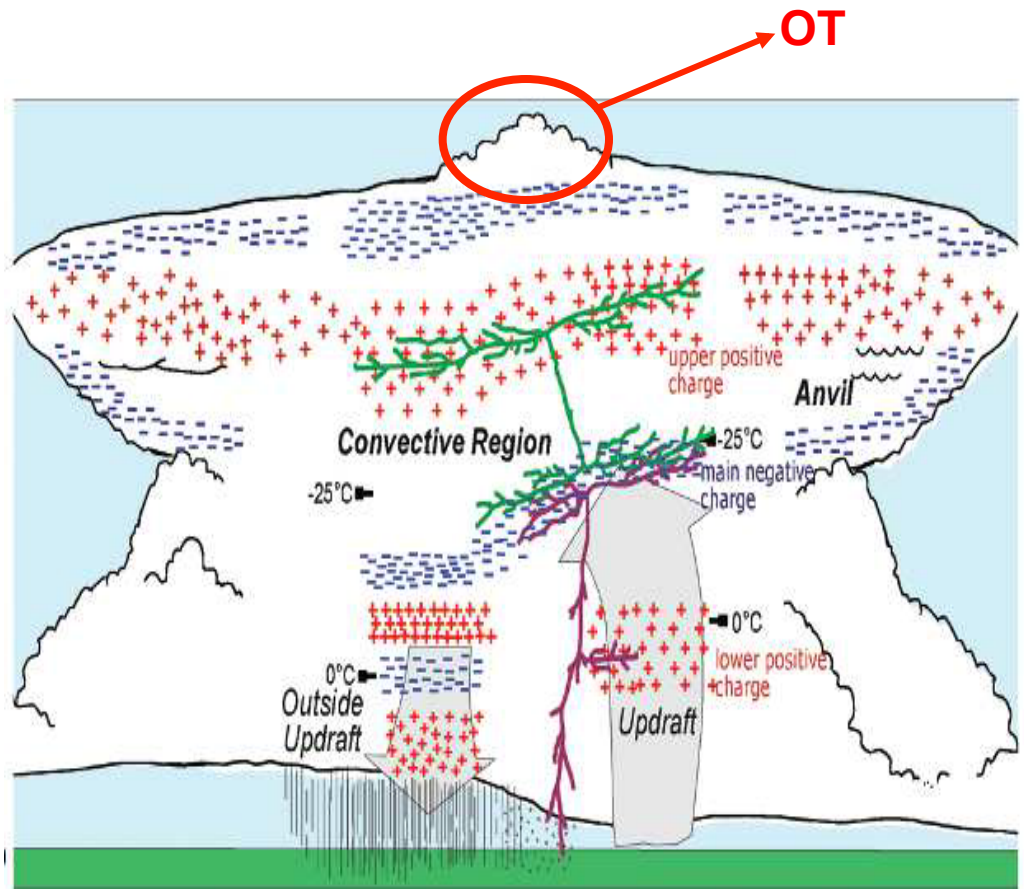
Introduction

- OT ➔ dome like pretrusion above Cb anvil, an indicator of very strong updraft in the Cb cloud

- Updraft area within the thunderstorm is linked to the electric activity of the storm

- The basic vertical electrical structure of mature convective updraft is composed of four charge regions



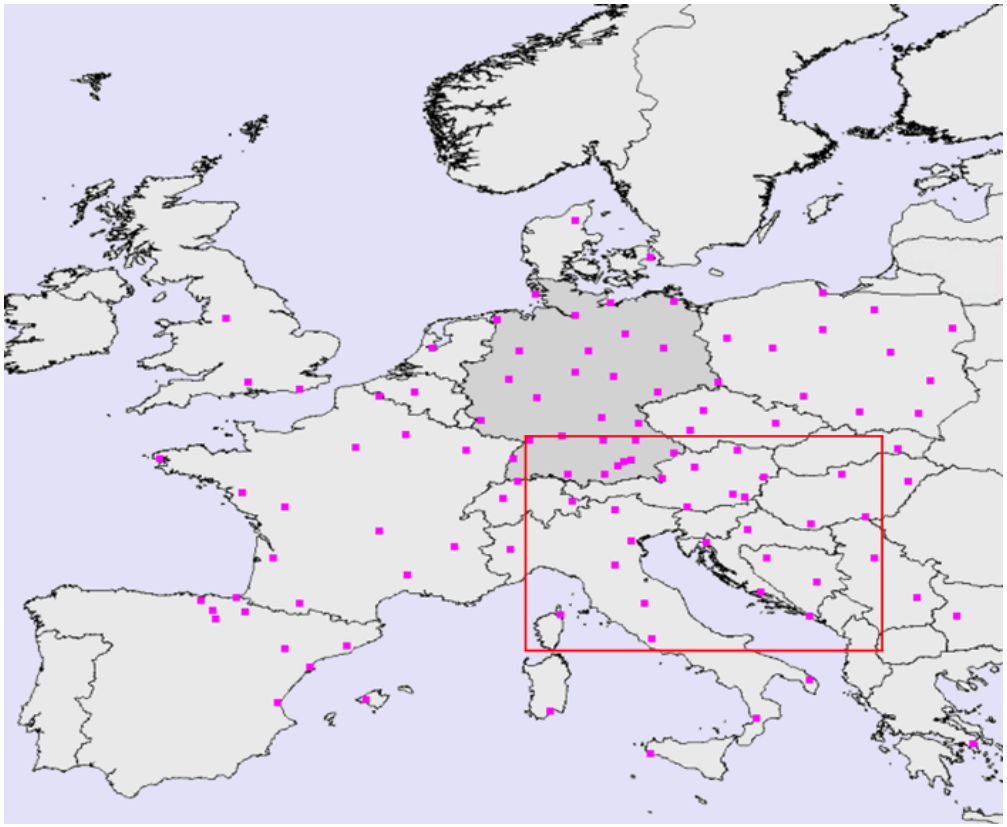
Betz et al., 2009

- The charge structures in the non-updraft regions of convective storms are more complex and variable

- increasing in lightning production rate ➔ could be due to very rapid vertical storm growth

Data and methods

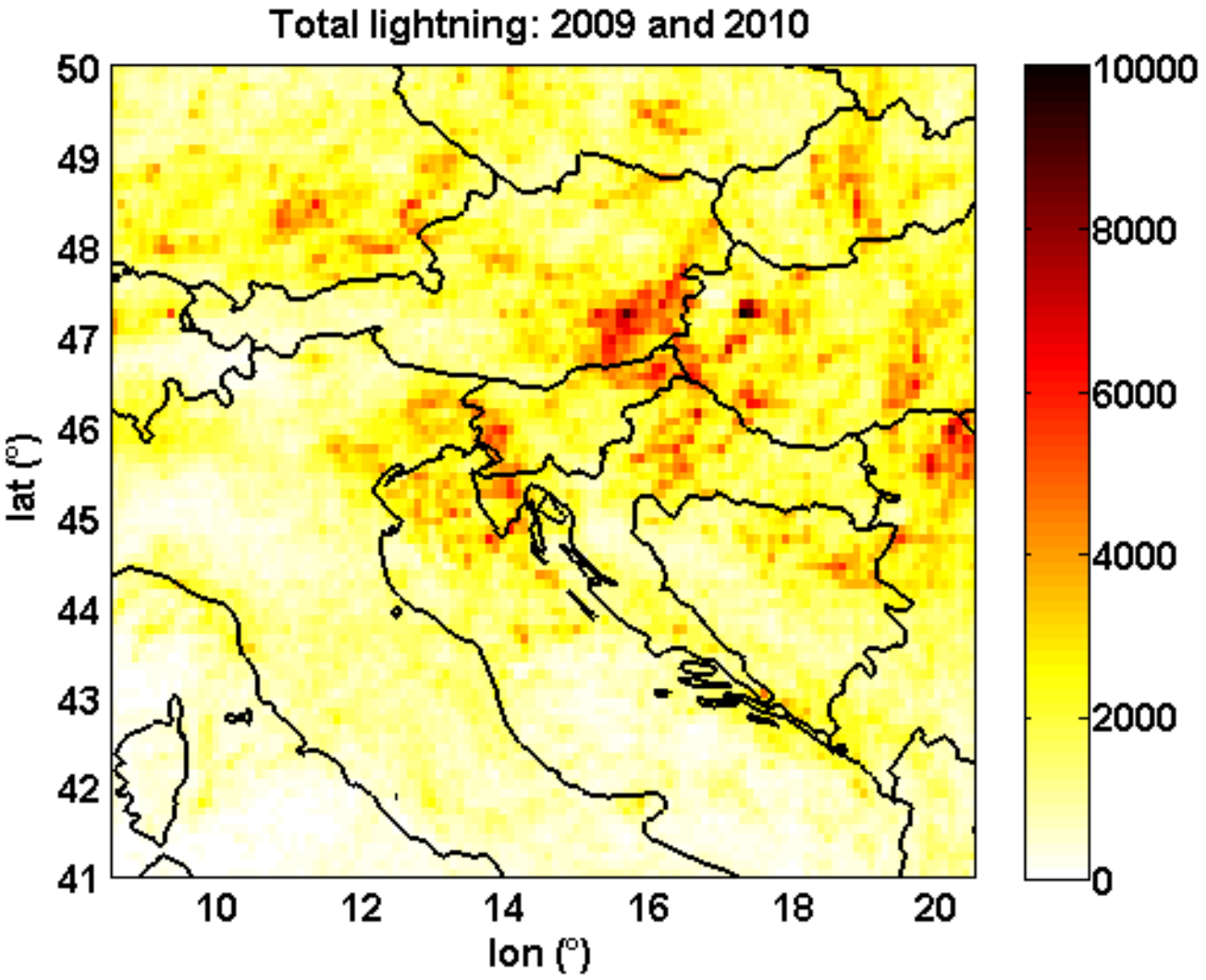
- May – September 2009 and 2010
- Region: 41.5°N 8.5°E to 49.5°N 20.5°E
- Lightning data: LINET network
- Satellite data: METEOSAT 9



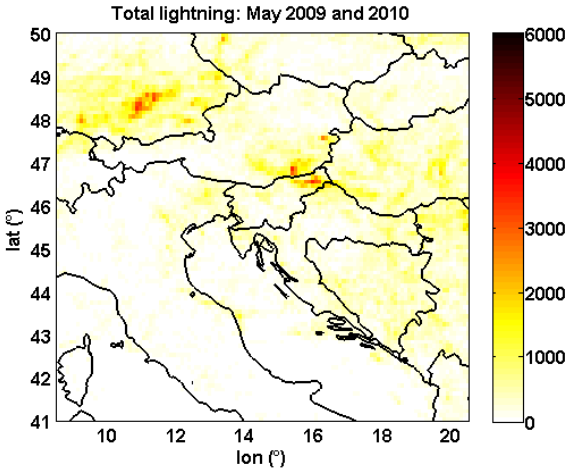
- Metosat 9 data ➔ COMB BTD method
  - OT detection
  - combines the criteria for the IRW brightness temperature and the criteria for two BTDs, 6.2 – 10.8 μm and 9.7 – 10.8 μm
- LINET network
  - lightning detection
  - detects total lightning discharge, but it also separately differs cloud-to-ground (CG) from intra-cloud and cloud-to-cloud (IC) discharges.

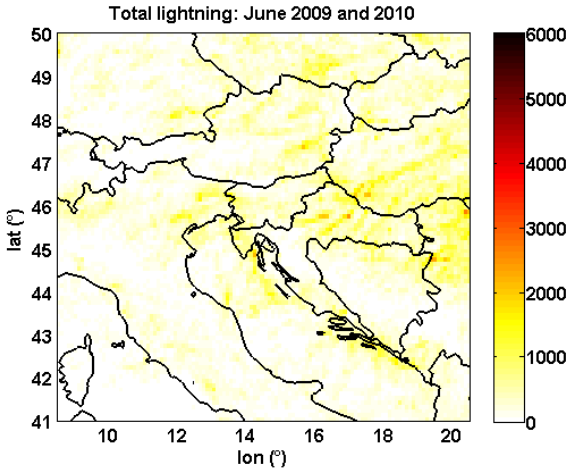
Spatial analysis

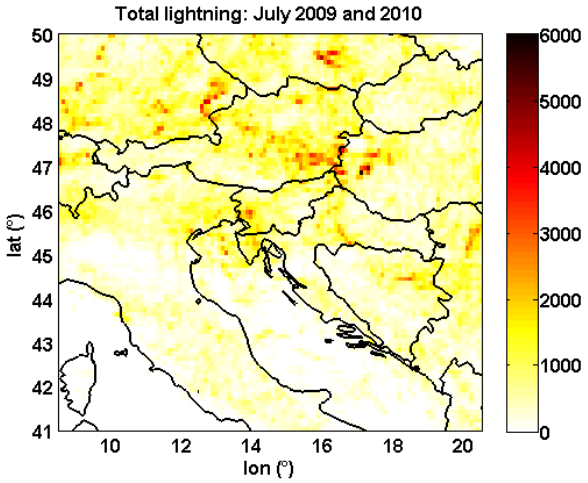
Total lightning distribution: *number of lightning detected over 0.1° x 0.1° grid boxes*

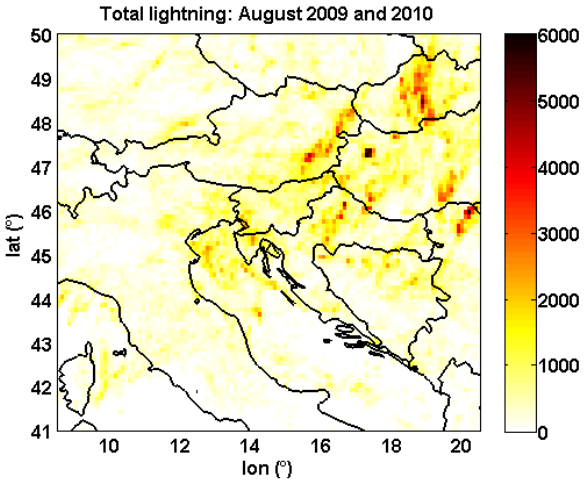


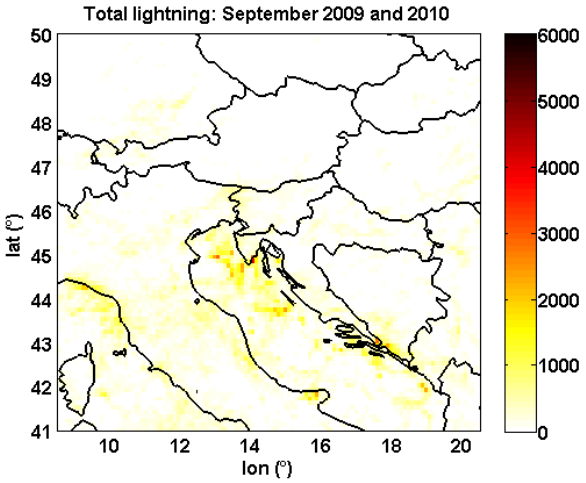
Monthly distribution: *number of lightning detected over 0.1° x 0.1° grid boxes*



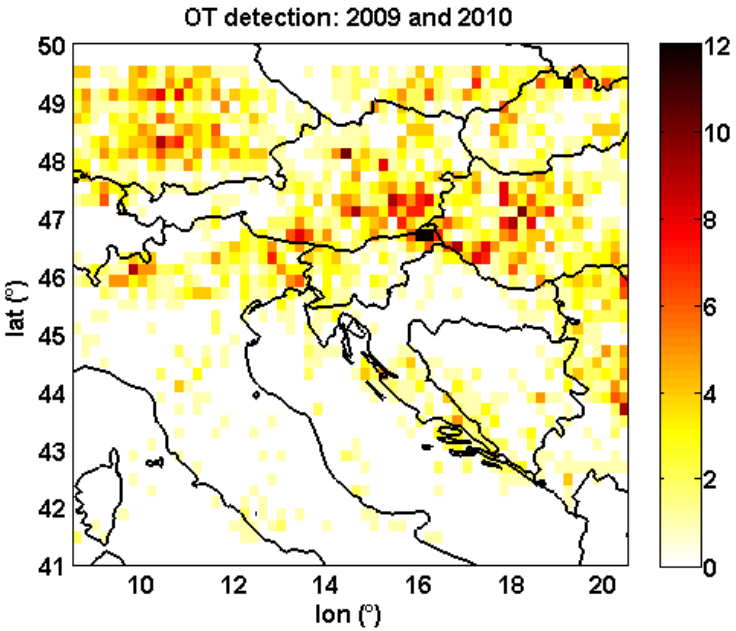


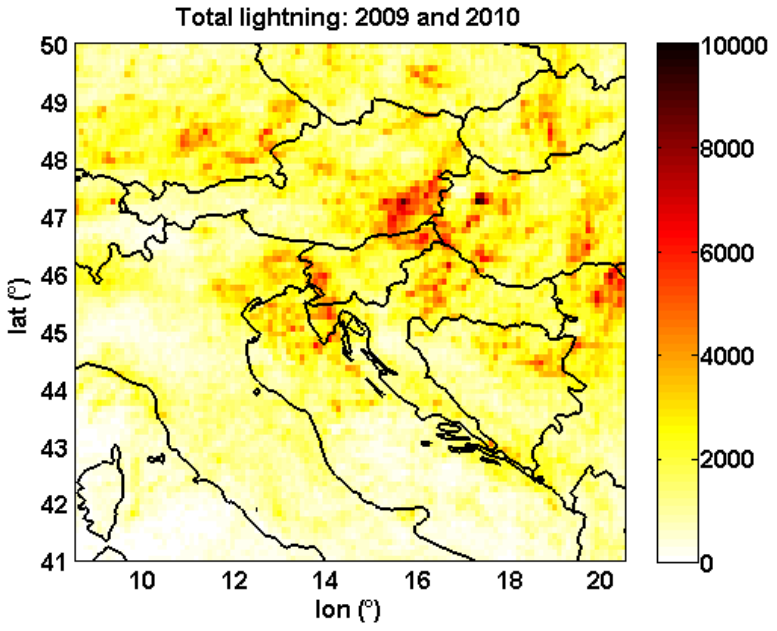


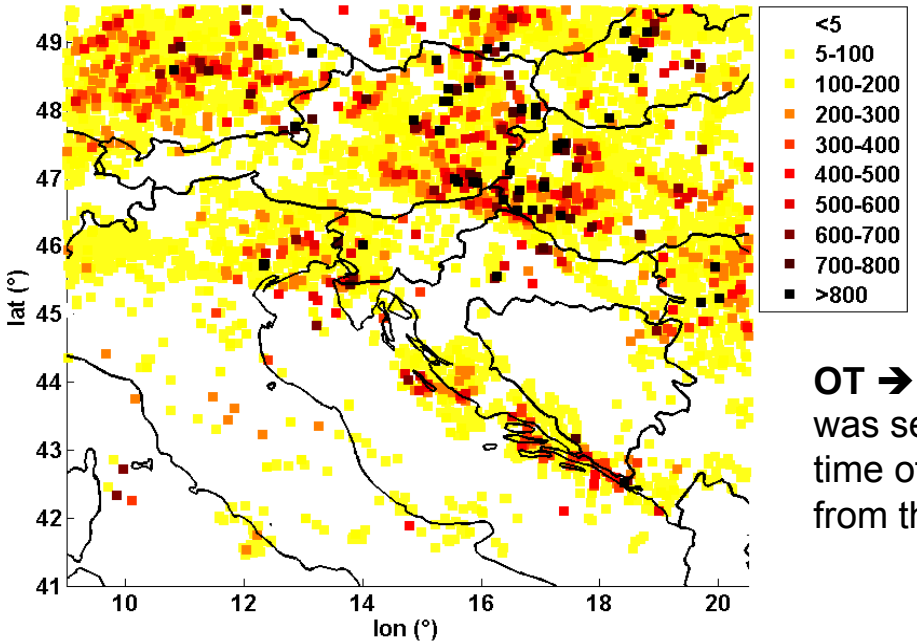




OT distribution: *number of detected OTs over 0.2° x 0.2° grid boxes*

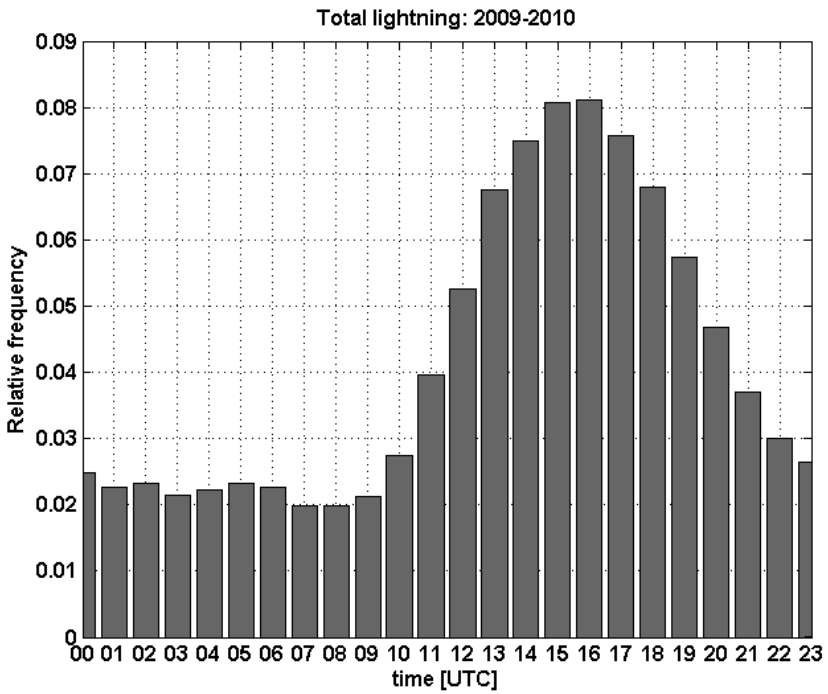


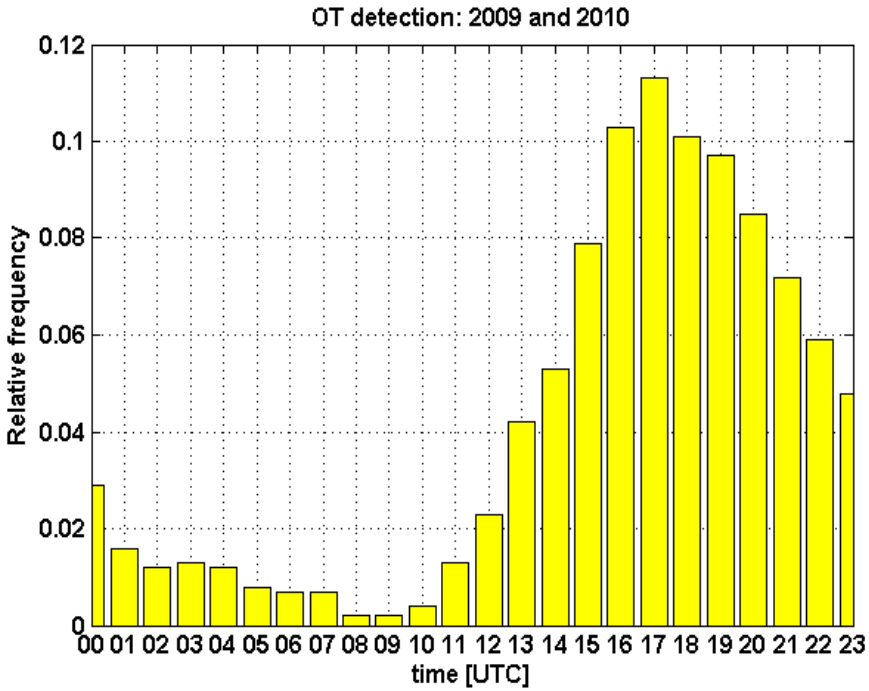




OT ➔ occurrence of lightning discharge was searched ***5 min before and after*** the time of the scan within the ***range of 0.05°*** from the pixel position

Temporal analysis

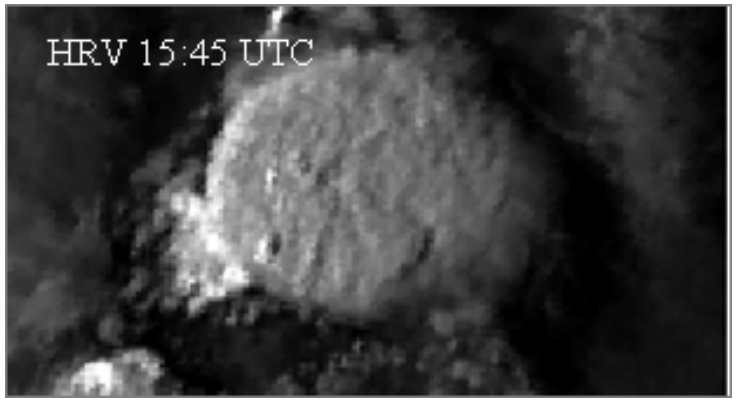


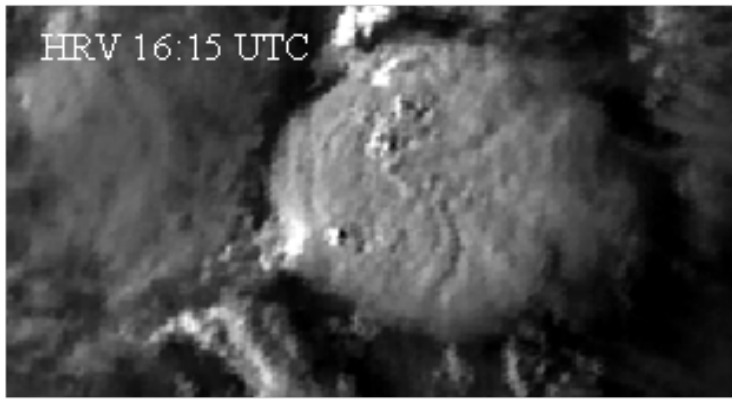


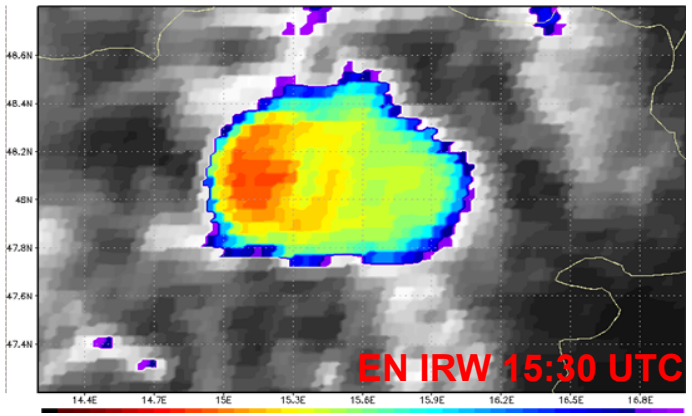
- largest number if lightning discharges ➔ between 13:00 and 19:00 UTC
- between 06:00 and 10:00 UTC ➔ weak lightning activity

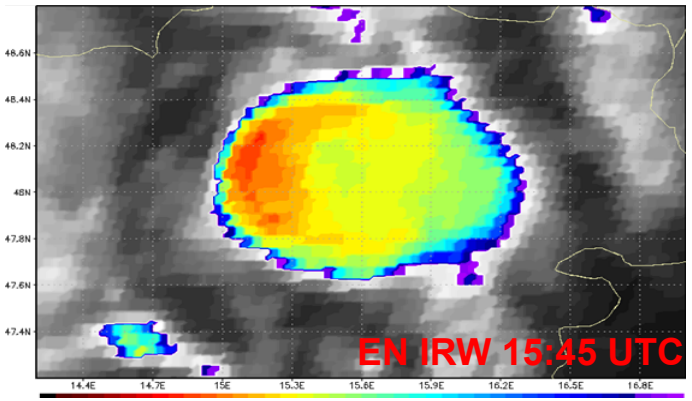
- OTs ➔ pronounced peak around 17:00 UTC
- between 06:00 and 10:00 UTC OT detection are rather rare

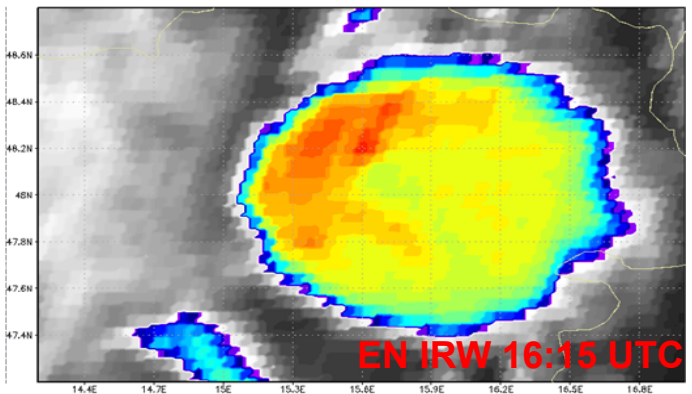
Example: 23 August 2010

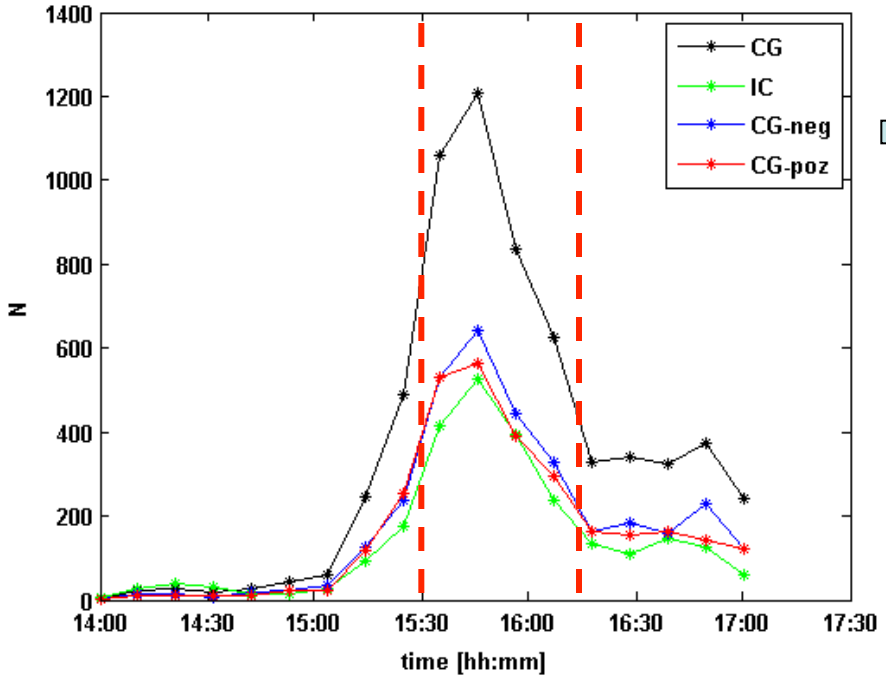










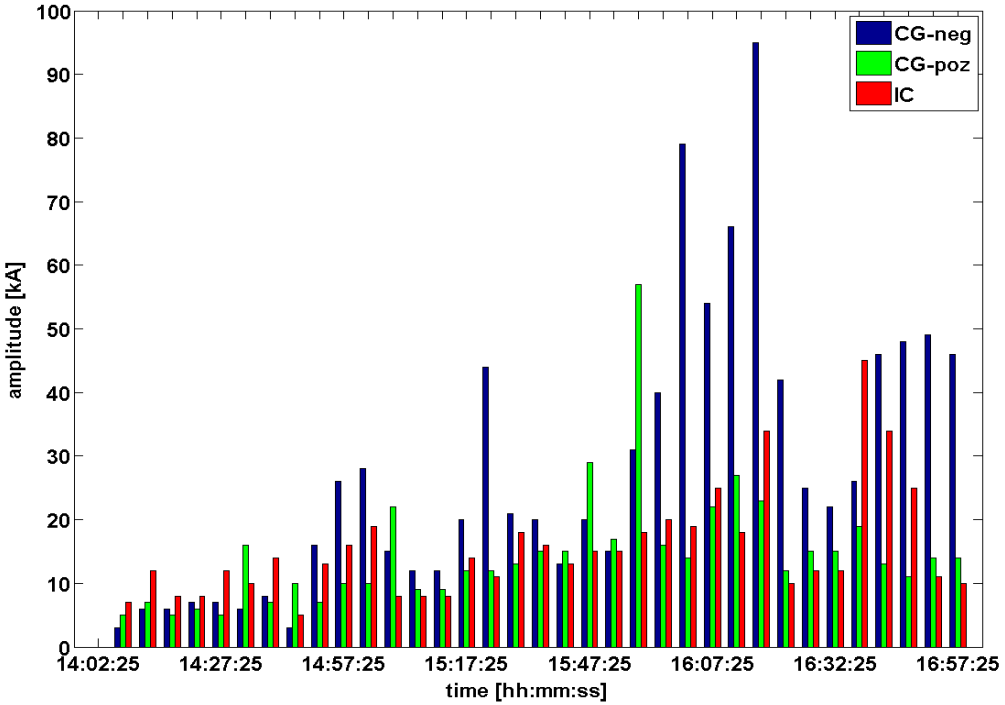


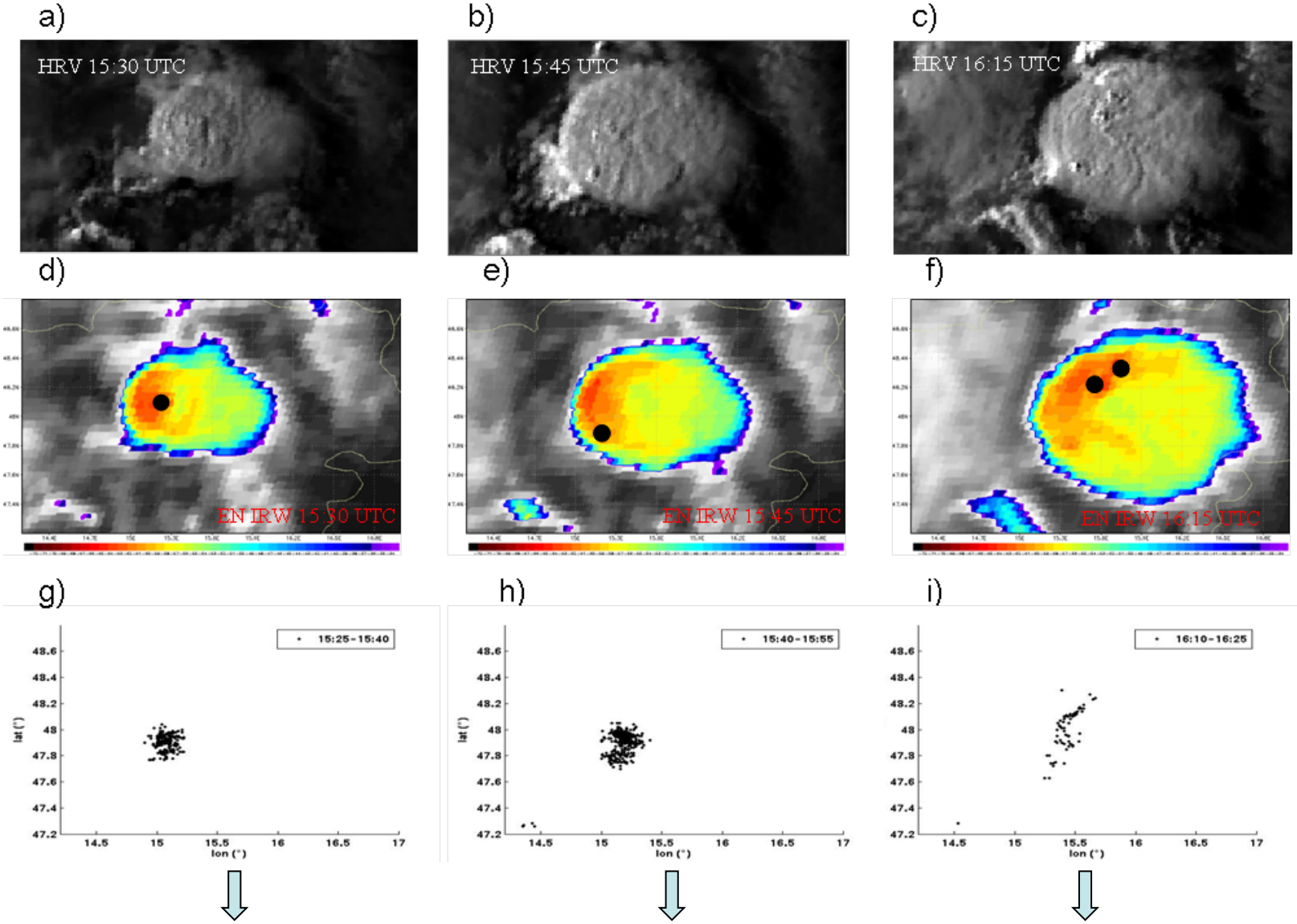
Temporal distribution of lightning discharges:

- between 15:15 and 16:15 UTC max. lightning activity
- sharp incrase of lightning activity starts at about 15:00 UTC

Temporal distribution of maximum 5-min lightning current :

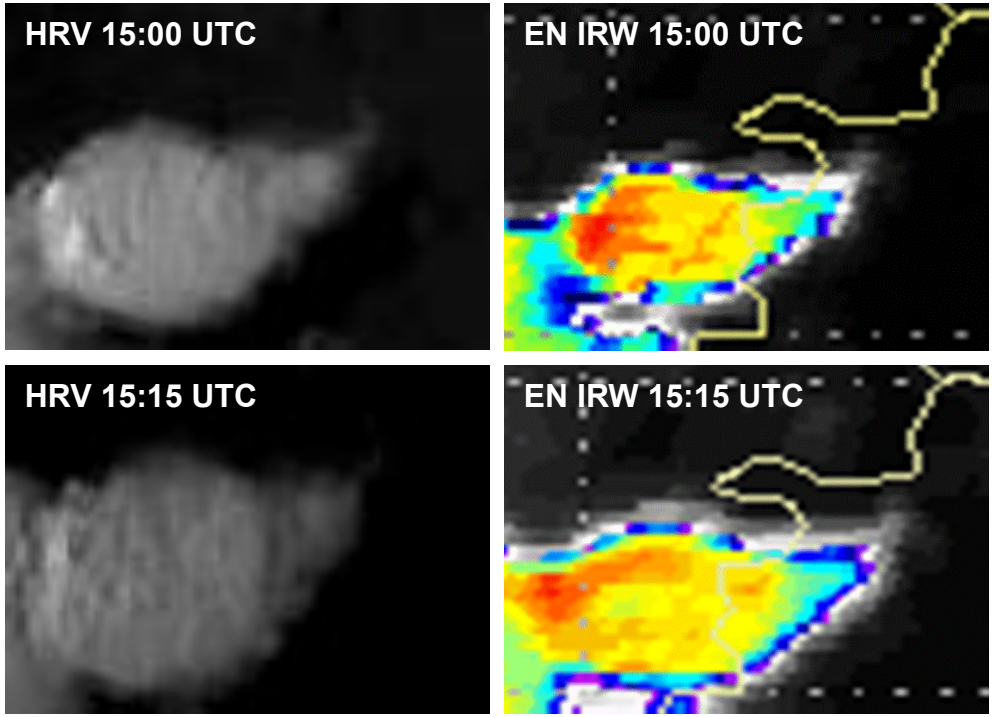
- larger values of electric current at the time of OT detections
- correspond well with max. number of lightning discharges

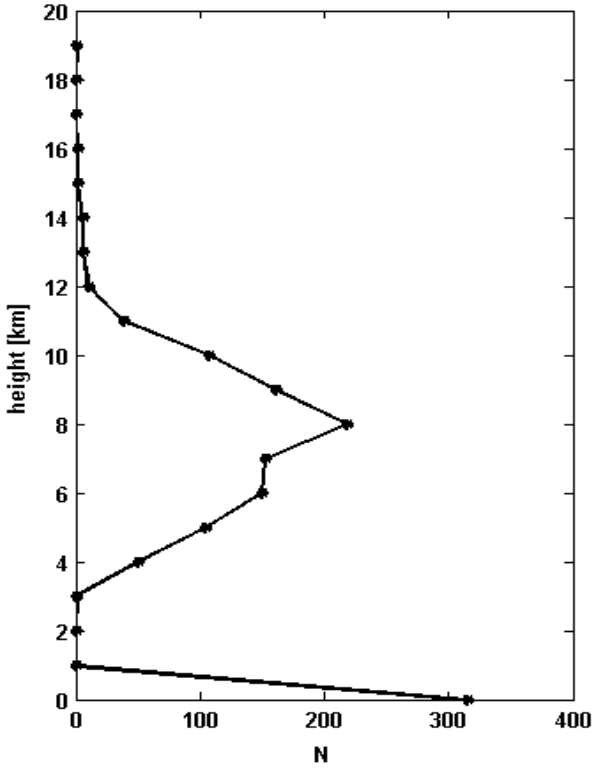




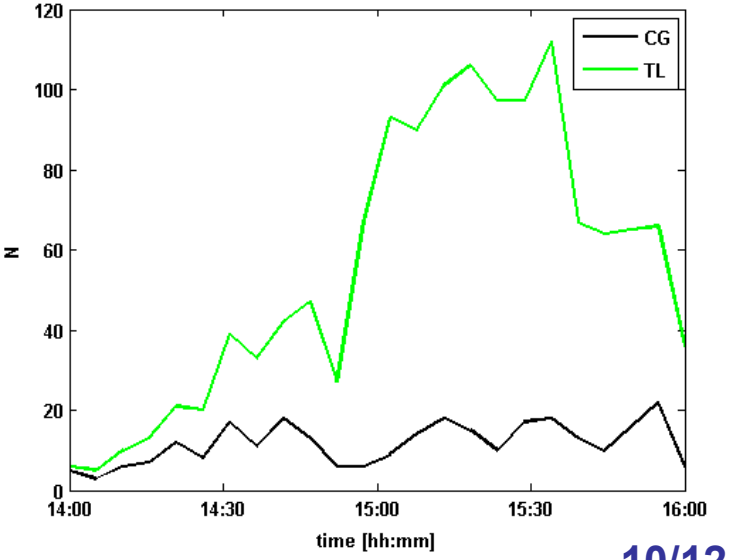
Map of total lightning activity (IC + CG) above 12 km ➔ very good correlation with locations of the OTs observed on HRV images

Example: 30 July 2009





• total lightning (TL) information clearly is the best early indicator of a strengthening updraft within a thunderstorm



Summary

- The largest numbers of lightning strokes, as well as OTs were detected in the western Hungary, southeastern Germany and Austria and northern Adriatic coastal region.

- Over the sea, OTs often appear close to the coastline, what is in agreement with the lightning occurrences.

- The largest number of OTs occur between 13 and 19 UTC, from 06 to 10 UTC OT detections are rather rare.

- Sharp increase of lightning activity and larger values of the electric current are evident at the time of the OT detections.

- Total lightning is the best early indicator of a strengthening updraft within a thunderstorm.

Thank you for your attention!

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