Eleven years of total lightning insights from Belgium's ground-based Lightning Location System

Dieter Poelman
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BELLS

- **Be**lgian **L**ightning **L**ocation **S**ystem since 1992

- Intracloud (IC) & cloud-to-ground (CG) detection

- BELLS modernized since 2013

- Currently 15 LF LS7002 sensors, of which 5 RMI-owned (blue), while other sensors belong to MeteoLux, OVE-ALDIS & Météorage (orange)

- Baselines down to 70km in Belgium and up to 150-200km at the periphery of the network
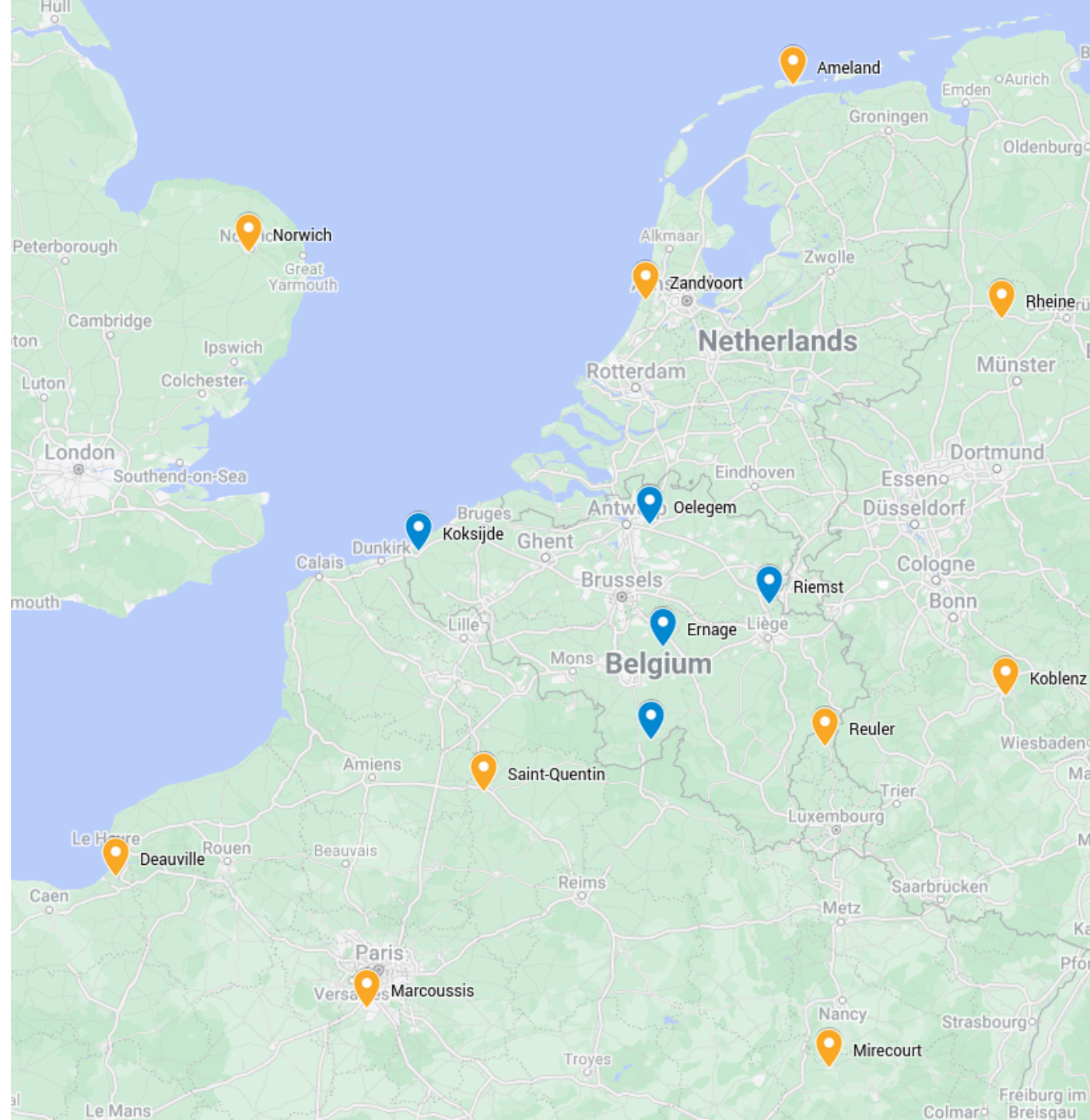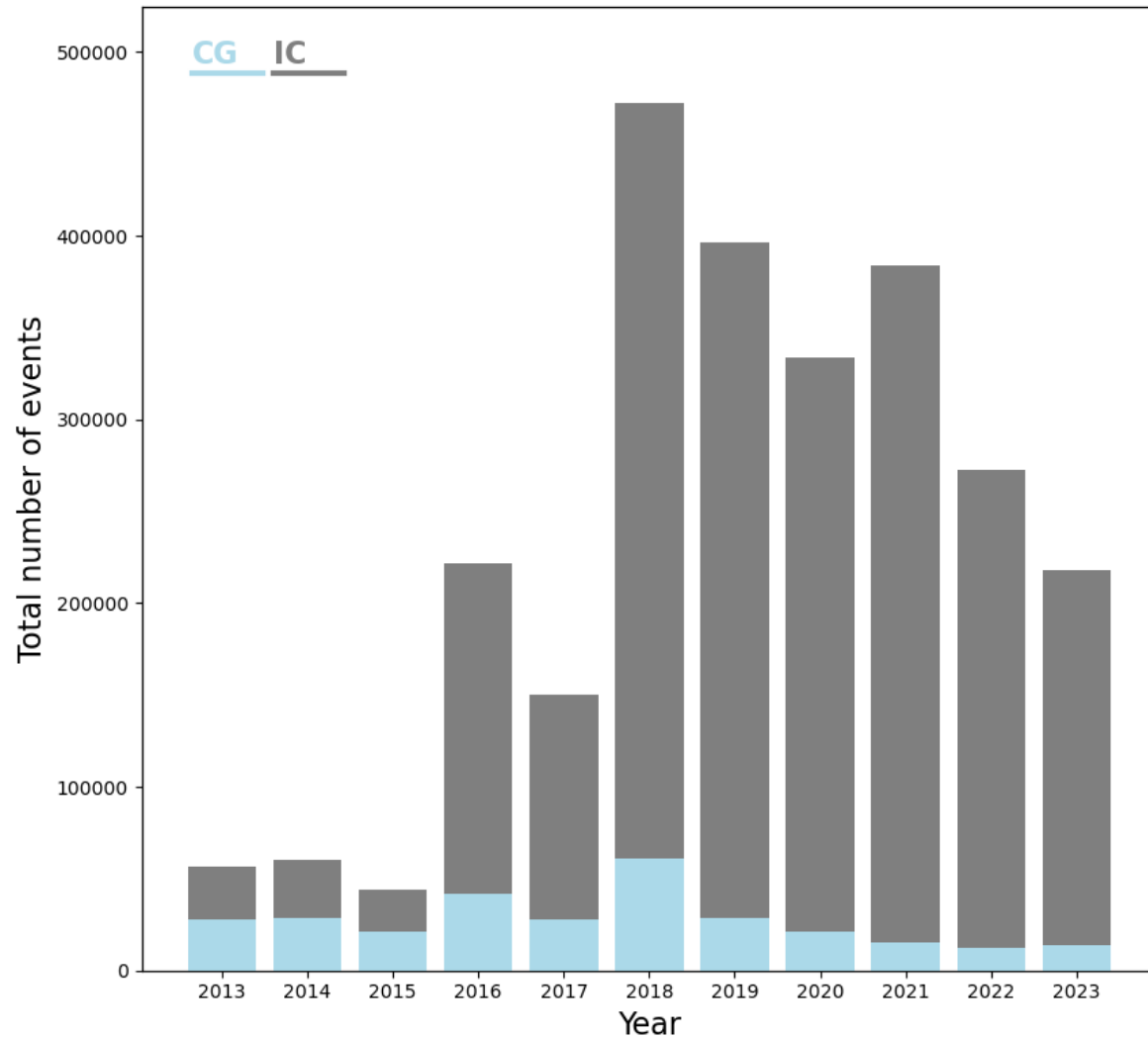
EUCLID

- European Cooperation for Lightning Detection operates ~170 sensors

- Network evolves, consistently upgrading from older sensor models to newer ones and optimizing sensor placement by adding or relocating sensors

- Median LA ~100m

- Stroke/flash DE of 84%/98% based on video & E-field records

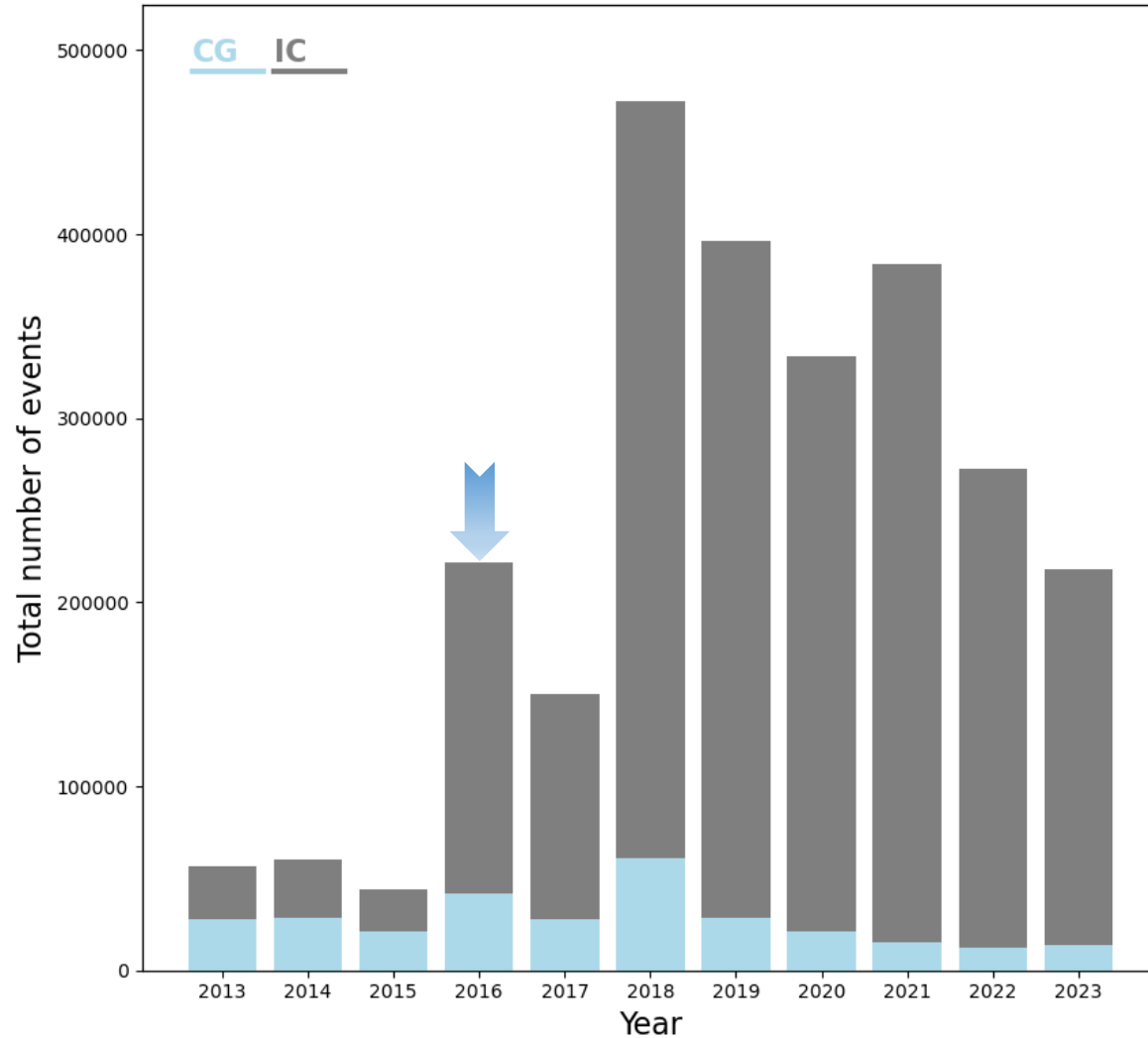- EUCLID ∝ NLDN -> CA(CG) = 92%
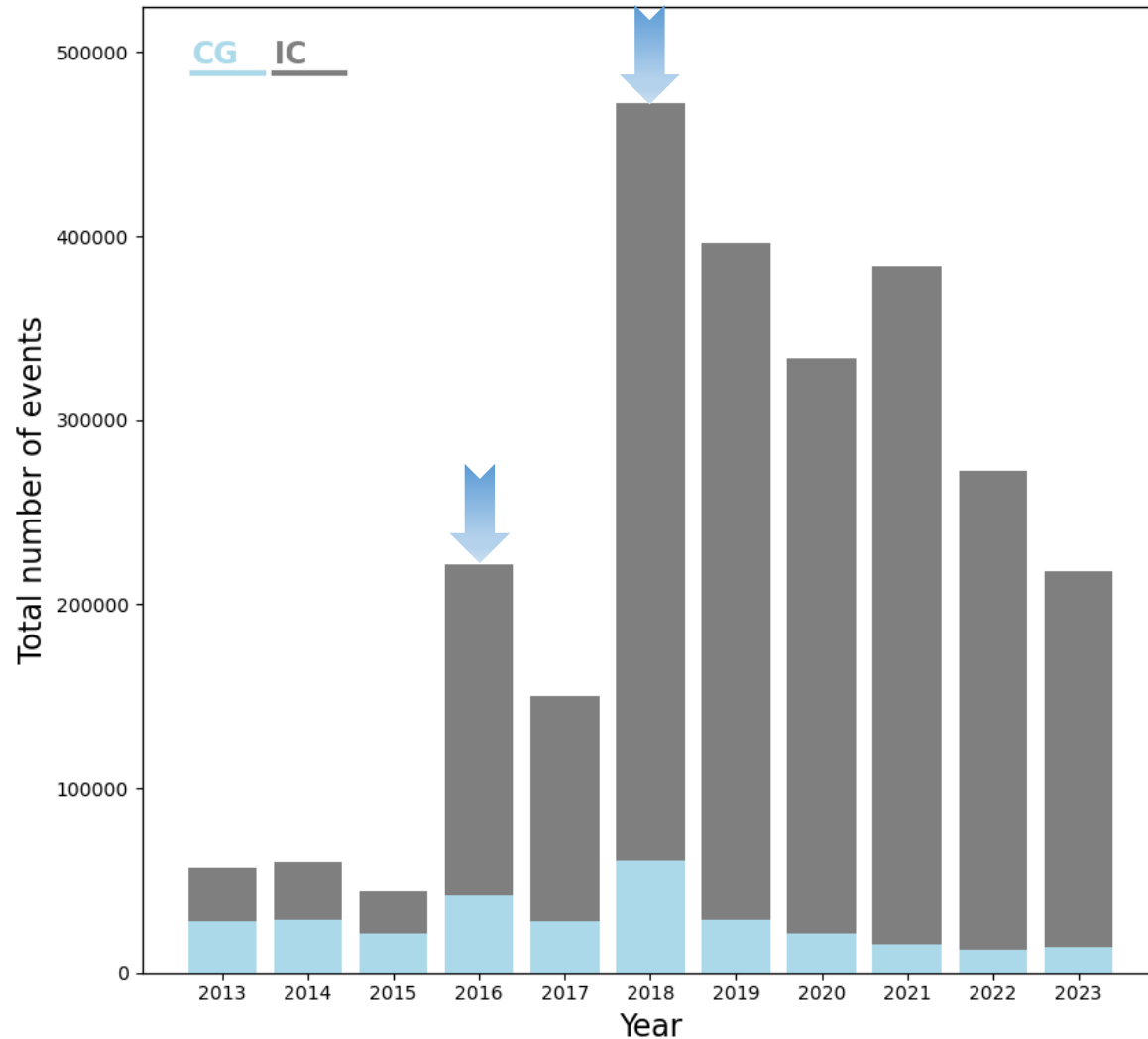 -> CA(IC) = 86%
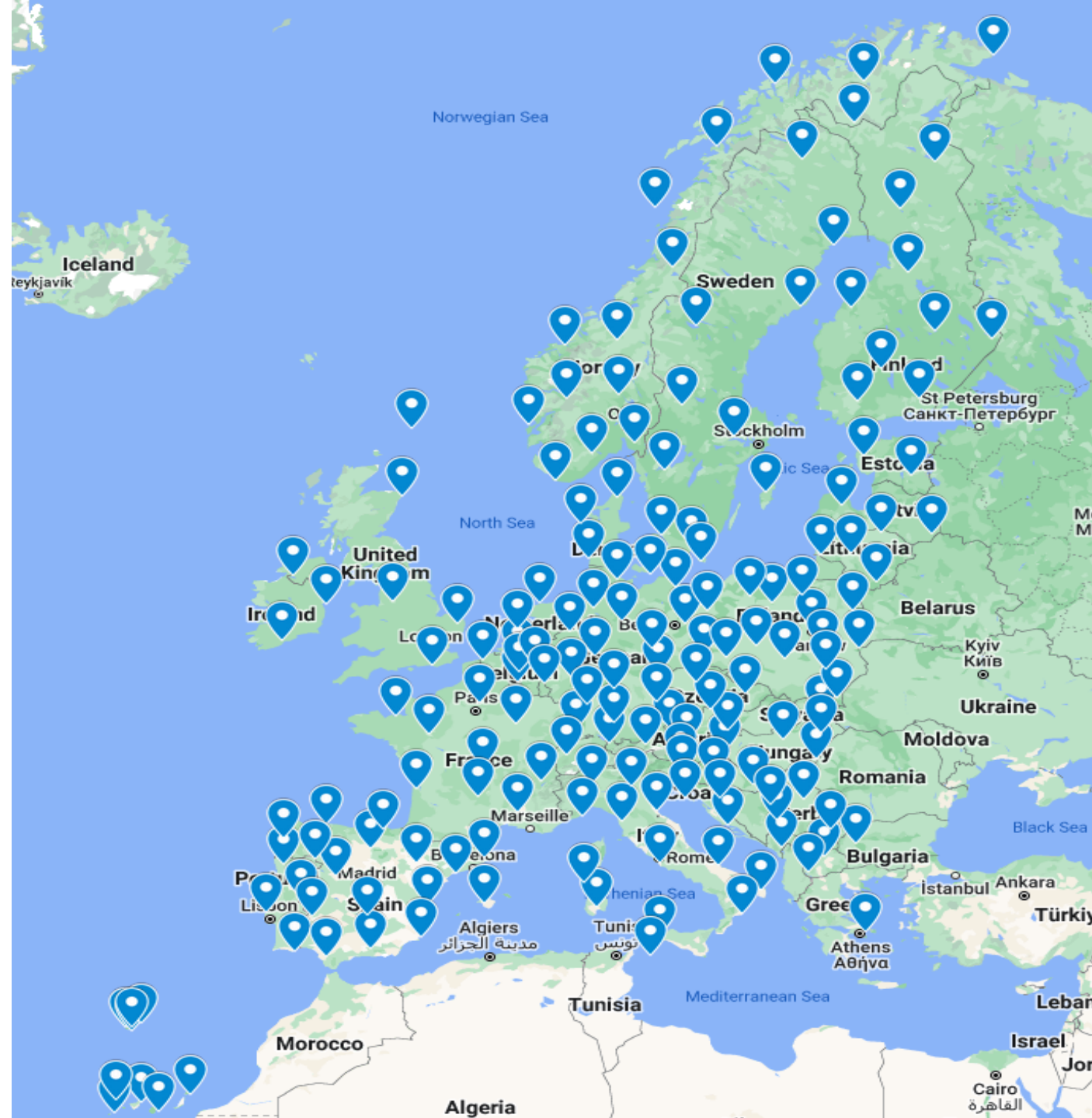
Results / temporal statistics

- Annual distribution of the number of CG + IC events from 2013-2023 in Belgium

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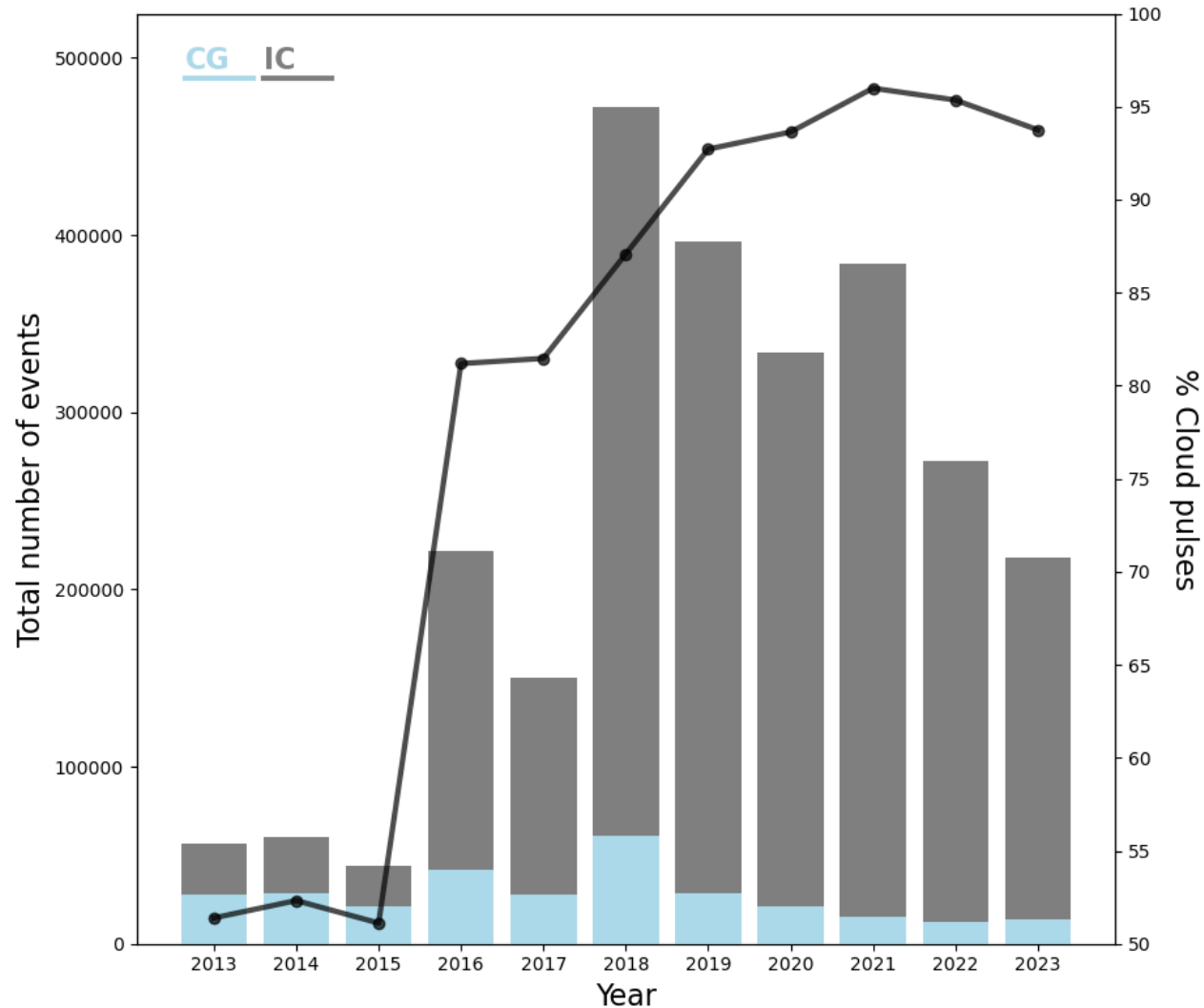- Annual distribution of the number of CG + IC events from 2013-2023 in Belgium

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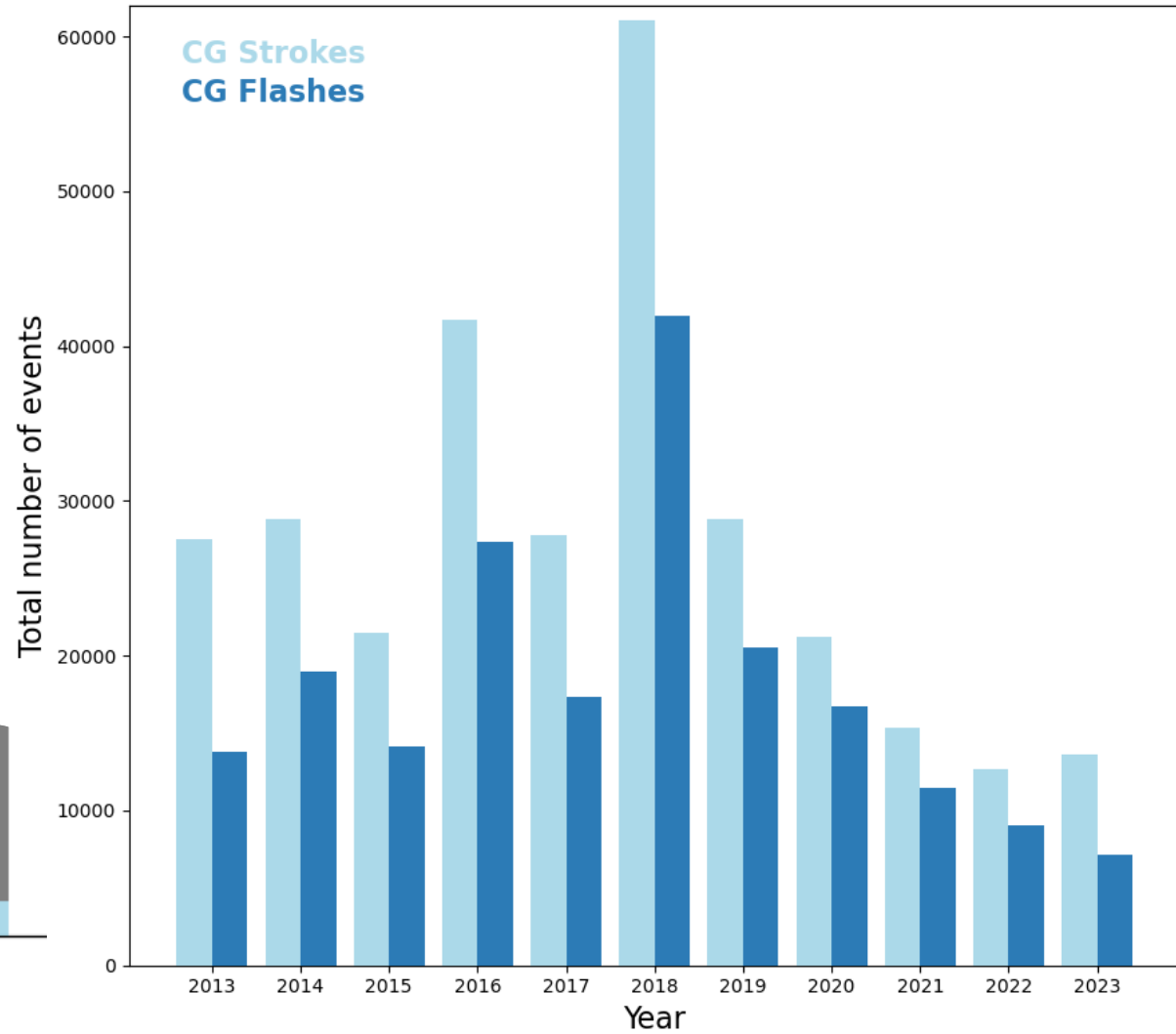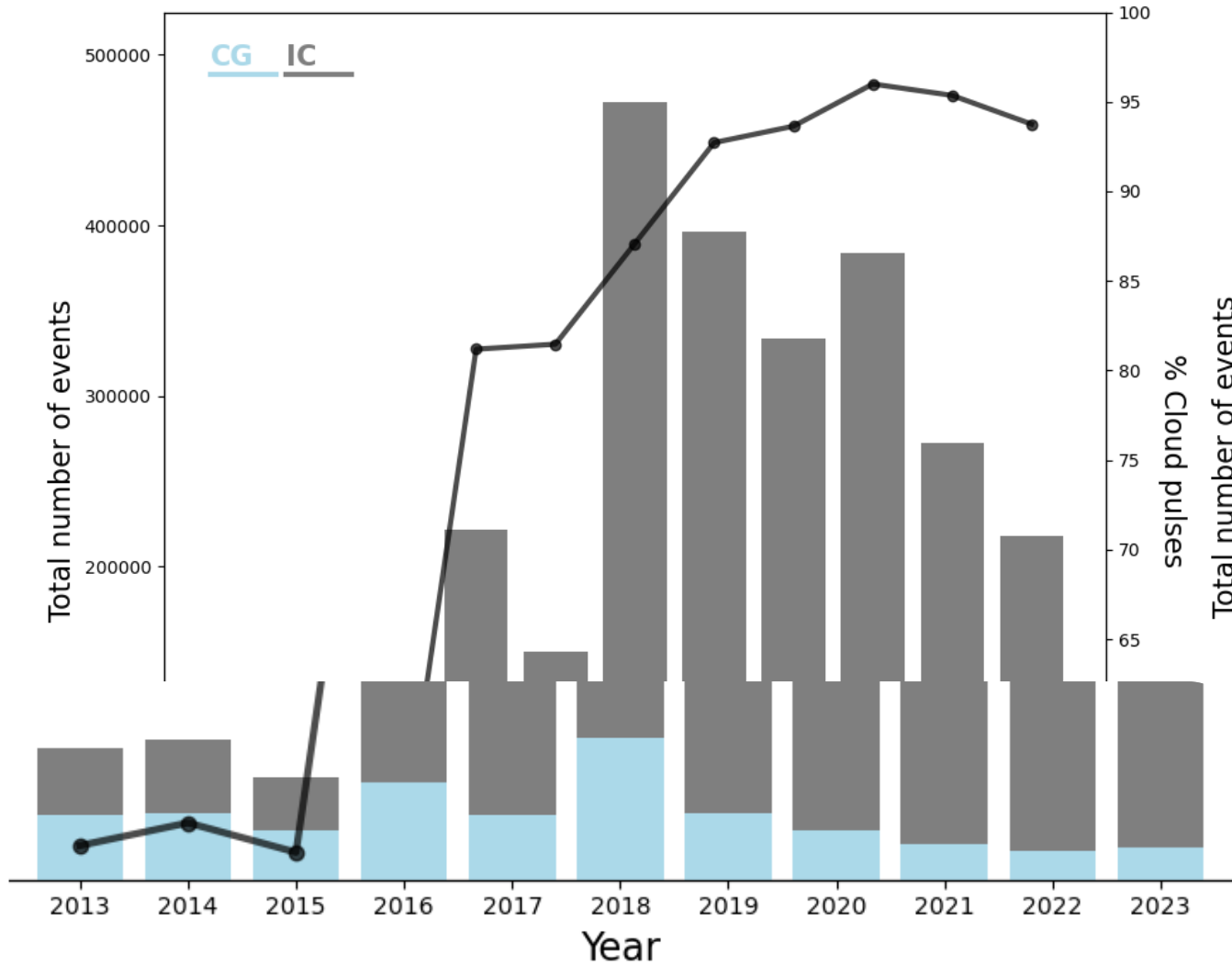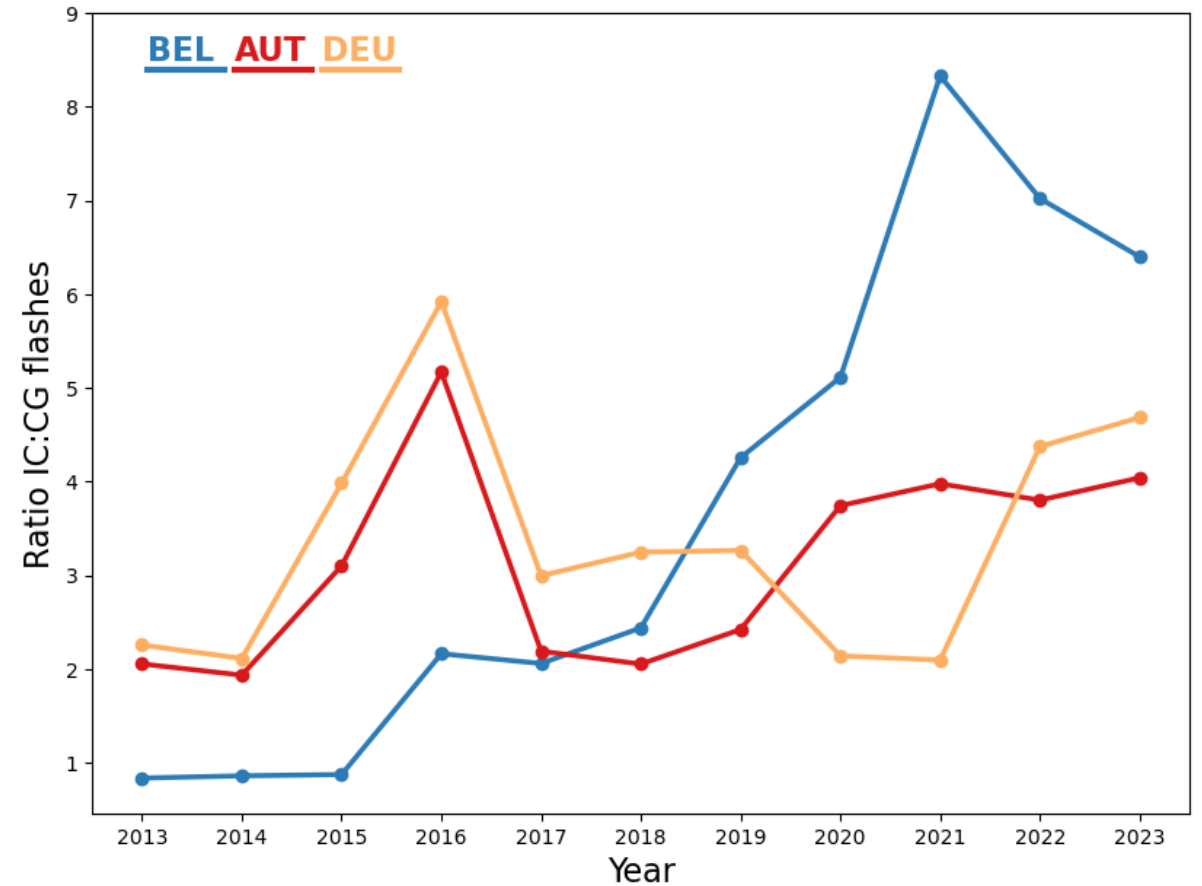
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- During recent years about 95% of all detections are IC pulses (*solid line*)

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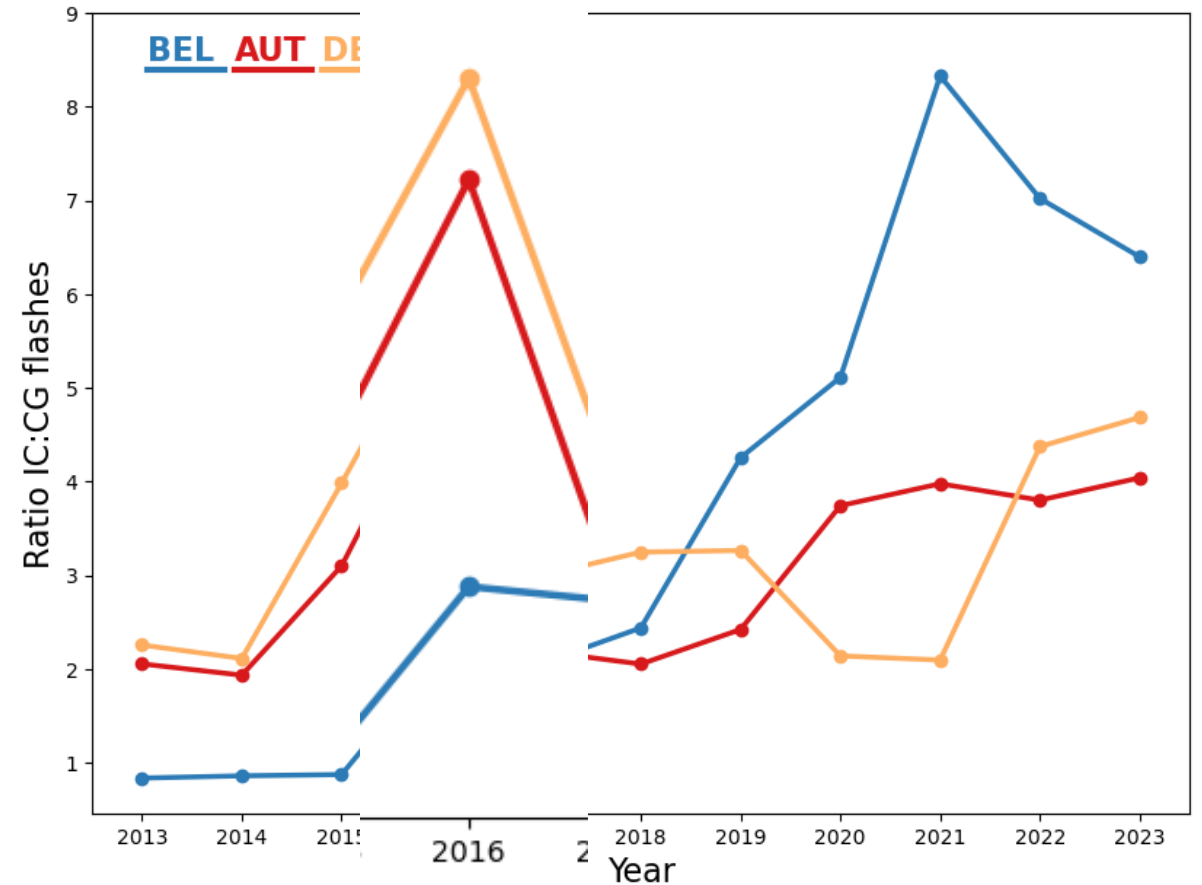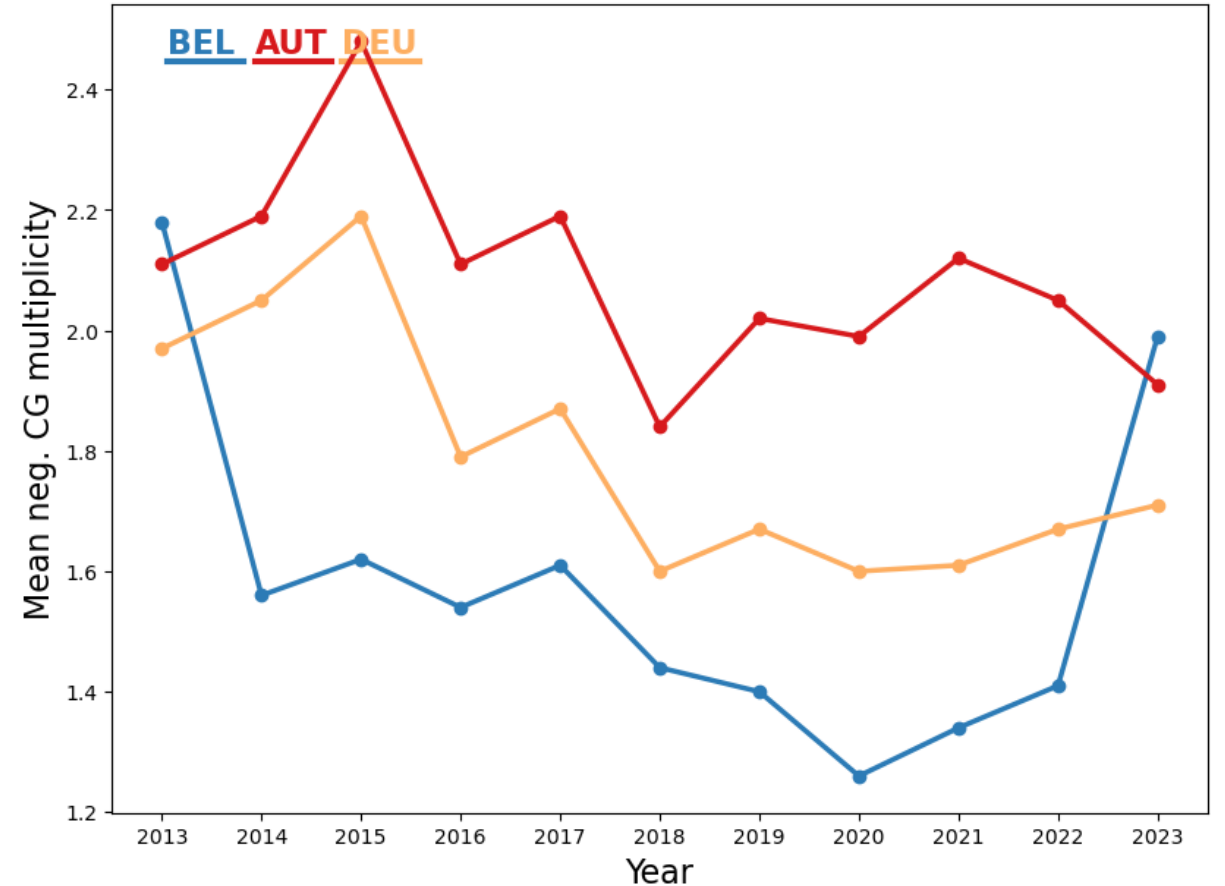- AUT/DEU peak in 2016 caused by EUCLID's grouping algorithm at that time

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- AUT/DEU peak in 2016 caused by EUCLID's grouping algorithm at that time

- Recent IC:CG ratio in BEL is a factor of two higher compared to AUT & DEU

- Small baselines in BELLS facilitate IC detection
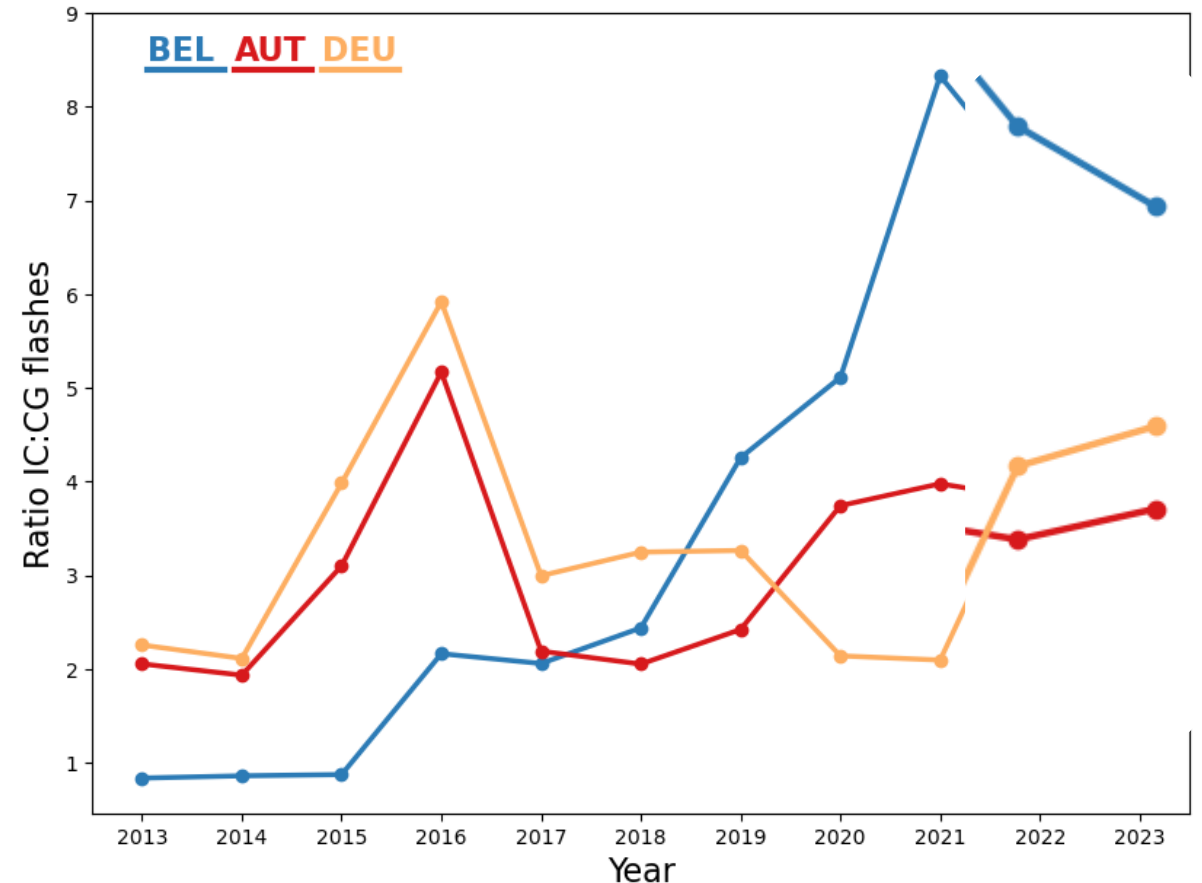
Results / flash multiplicity

- Multiplicity of a flashes indicates the number of associated CG strokes

- Averaged over 11 years, multiplicity in BEL is 1.5. This is lower compared to what is observed by EUCLID in AUT and DEU.

- All 3 countries show a decreasing trend between 2013-2020, followed by an increase thereafter

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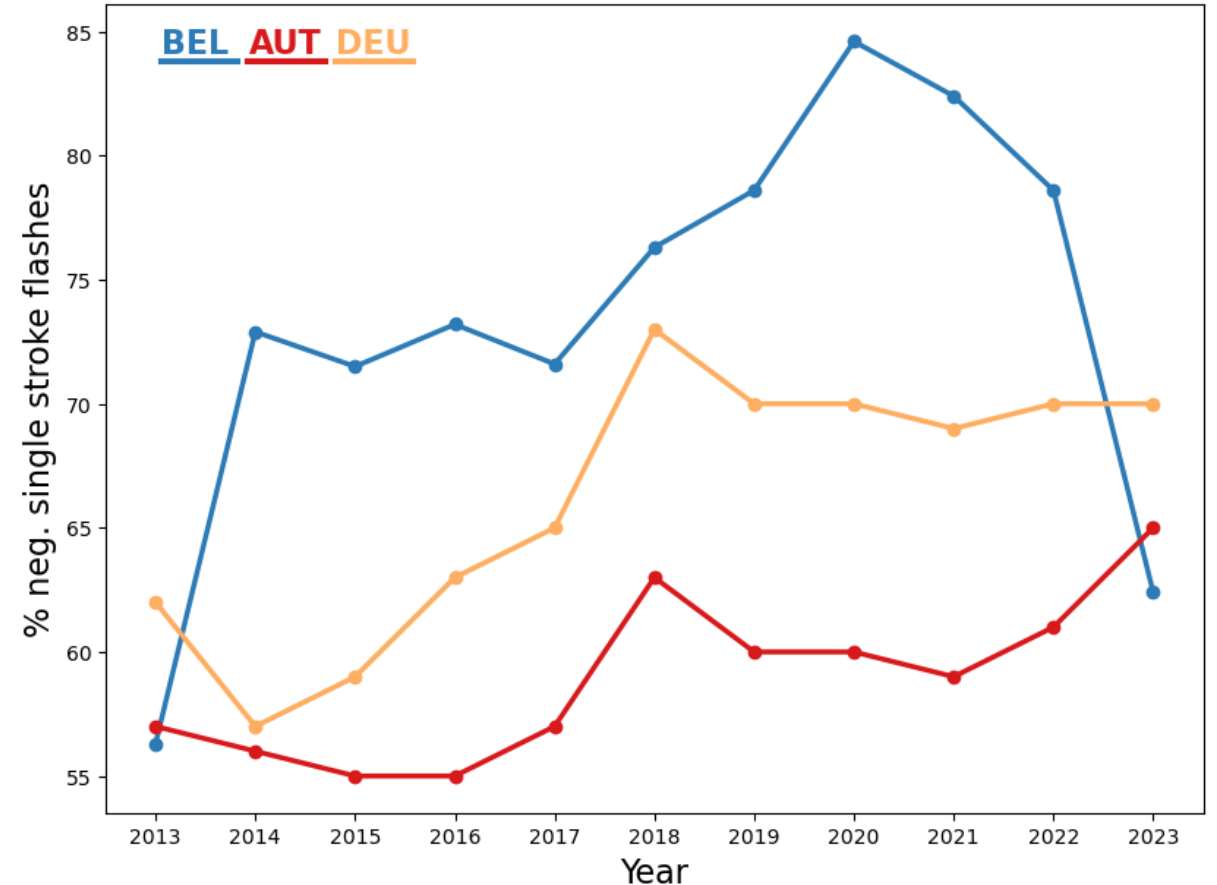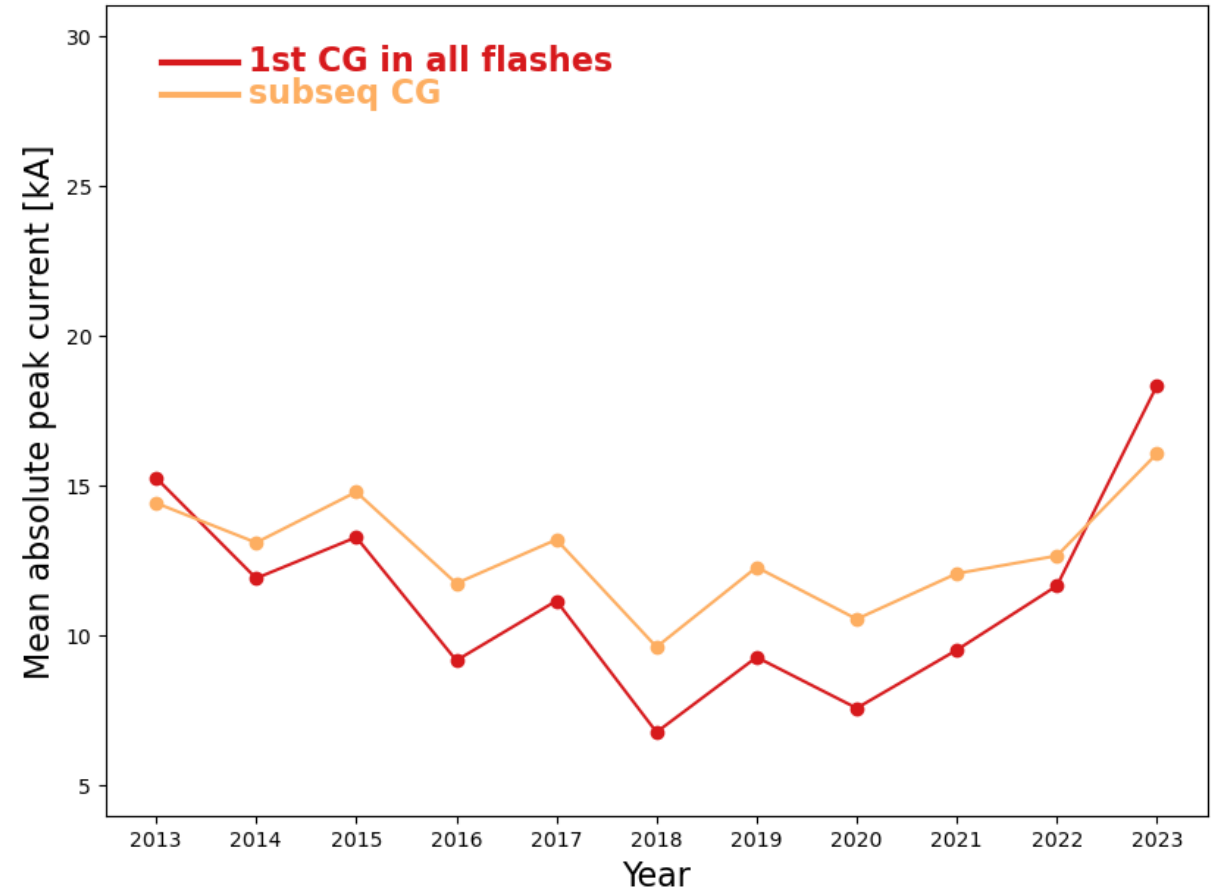
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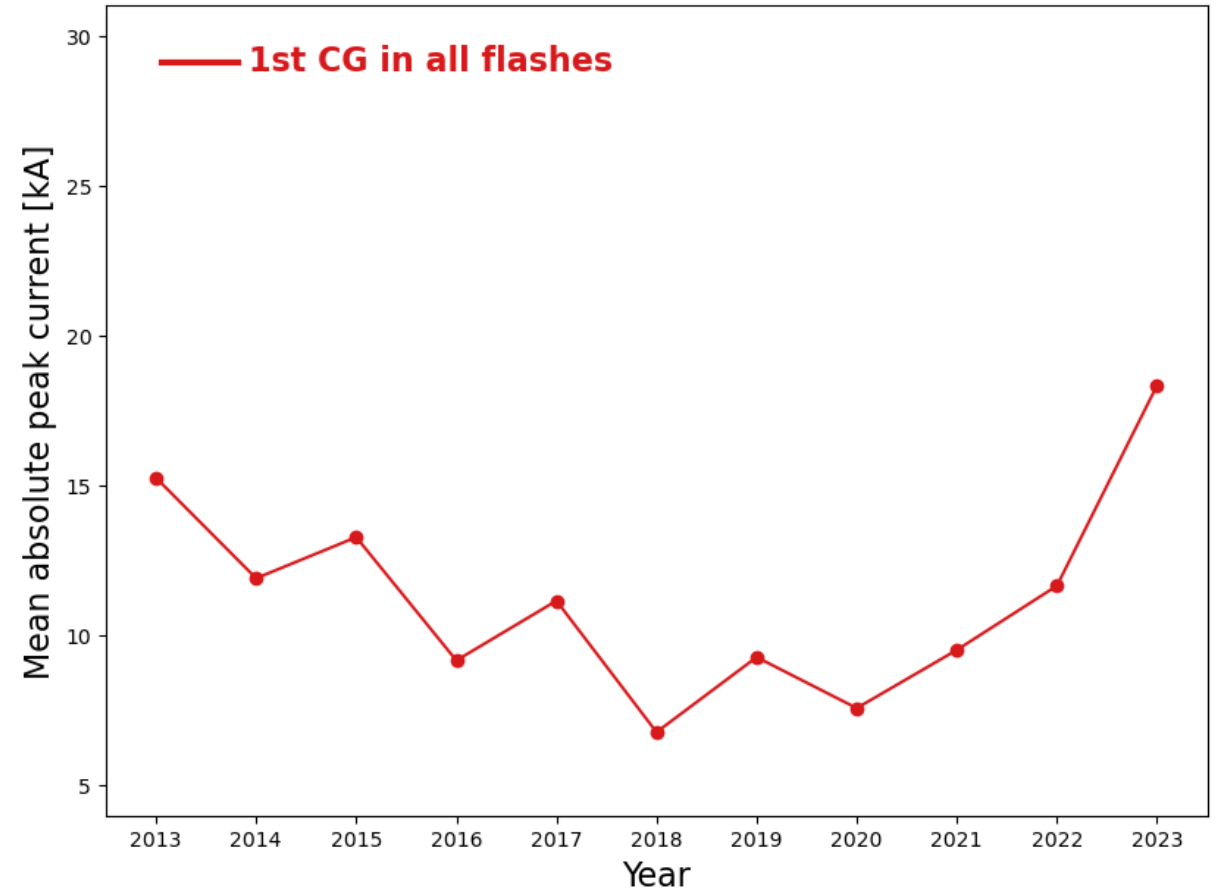
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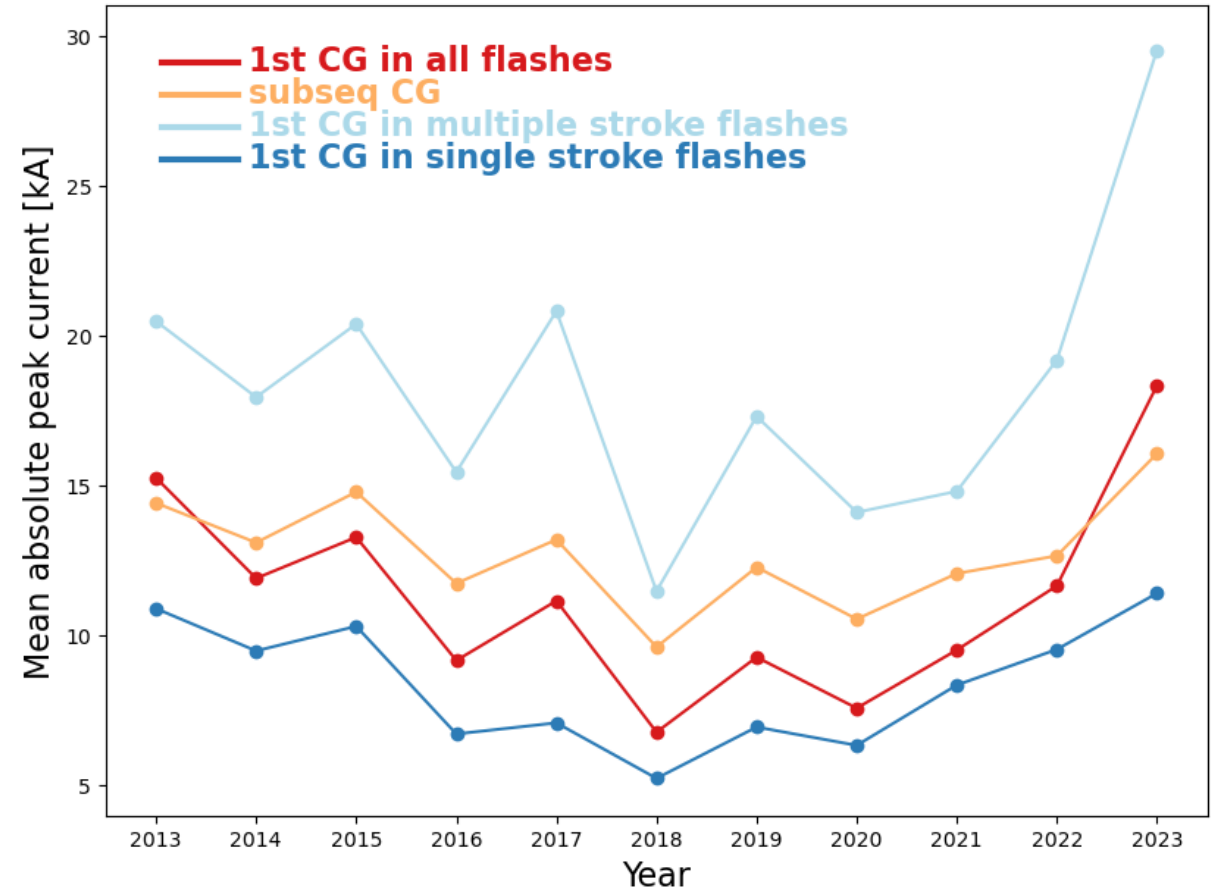
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- The high % of single-stroke flashes in BEL lowers $|I_p|$ of all flashes below the value found for subsequent strokes

- Similar trend based on EUCLID is found in DEU, but not in AUT.
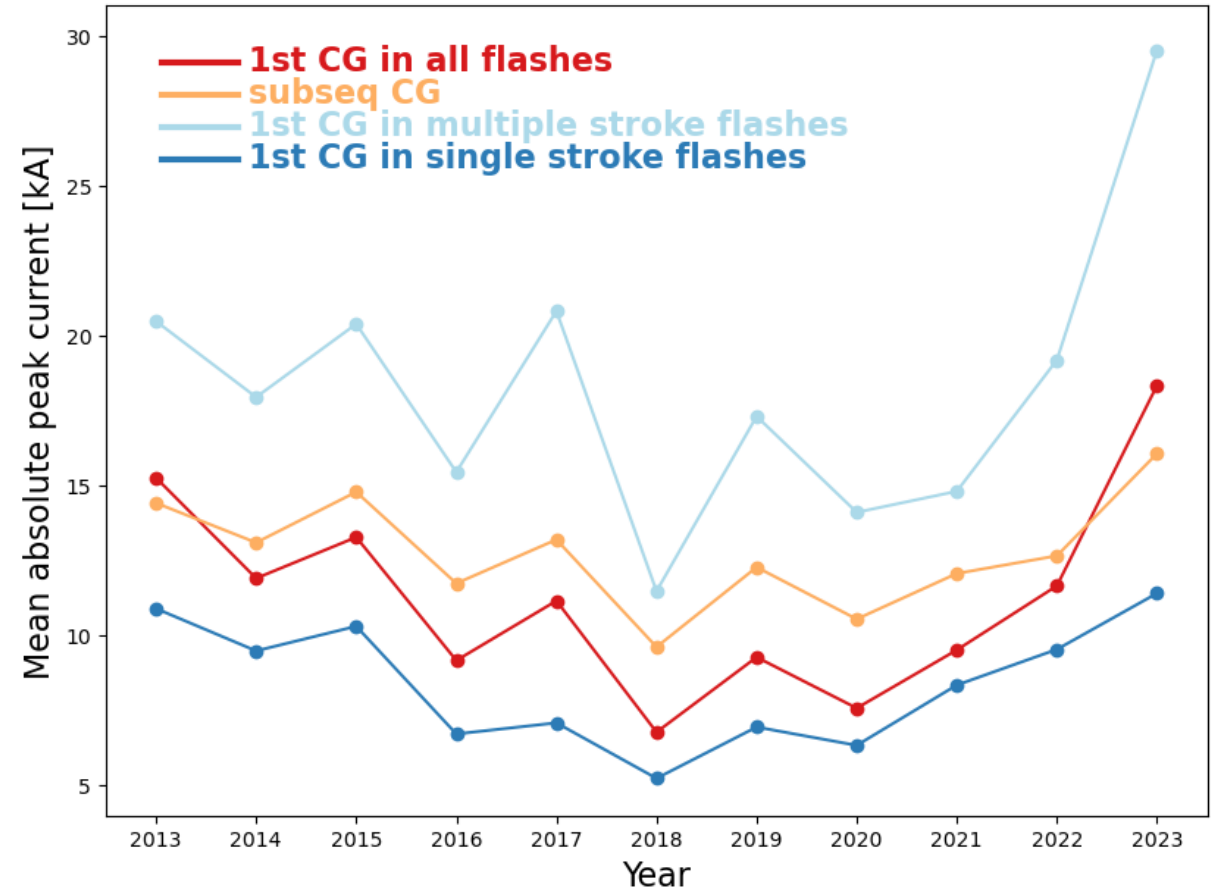
Conclusions

- Short sensor baselines in BELLS facilitate the detection of cloud discharges

- The low multiplicity in BEL is caused by BELLS' high IC sensitivity and some misclassification of IC pulses as isolated single-stroke CG flashes

- A reduced peak current (factor 2-3) in single-stroke flashes compared to first strokes in multiple-stroke flashes indicates a degree of misclassification of IC pulses as isolated single-stroke CG flashes

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Thank you