

www.Blitzortung.org
A real-time, community based
lightning location network

Prof. Dr. Egon Wanke

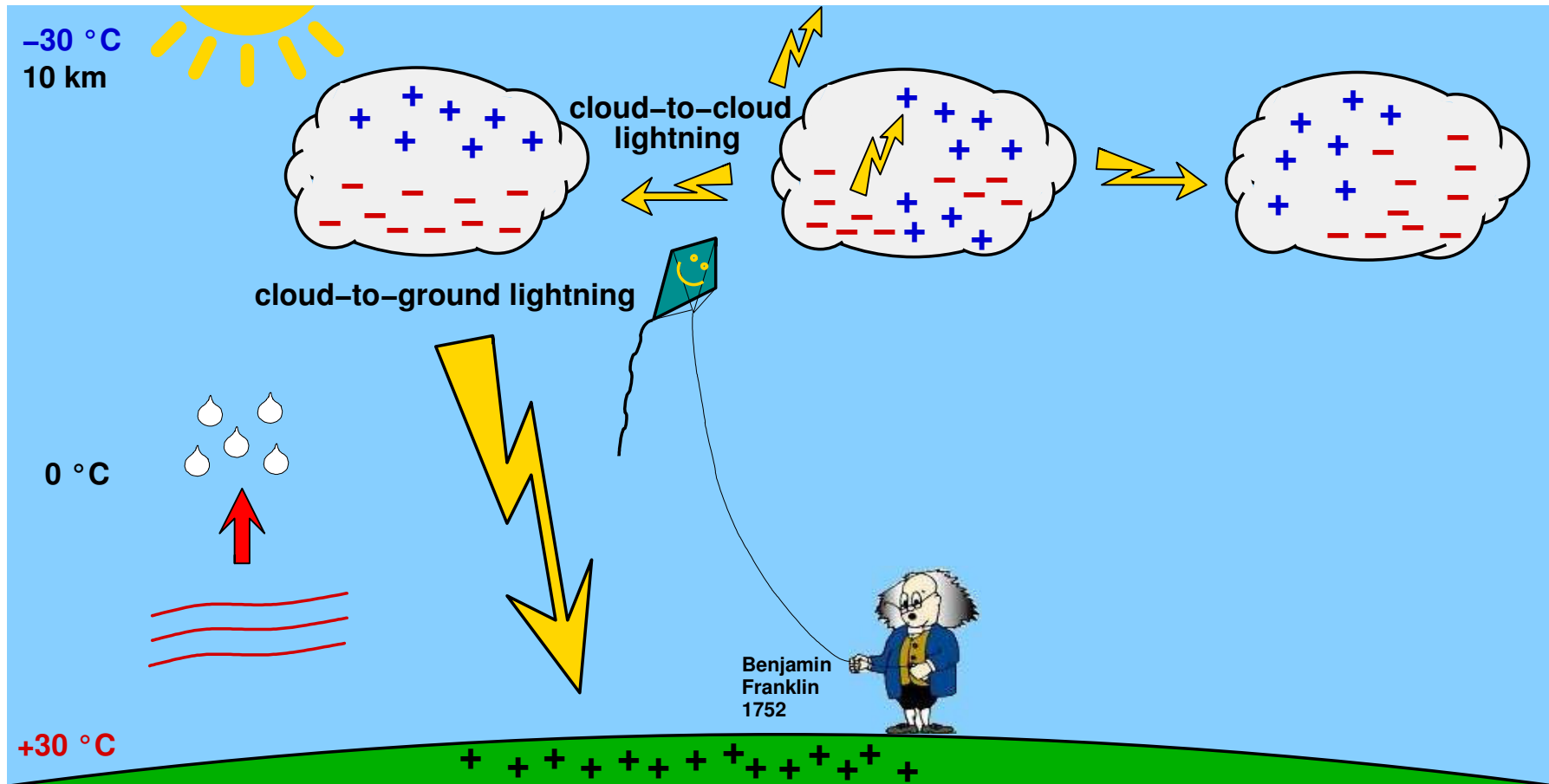
Algorithms and Data Structures
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Heinrich-Heine-Universität
Düsseldorf



DL1YDB



What causes lightnings?



Cloud-to-ground lightning discharge



Cloud-to-cloud lightning discharge?



Lightning strike into a tree



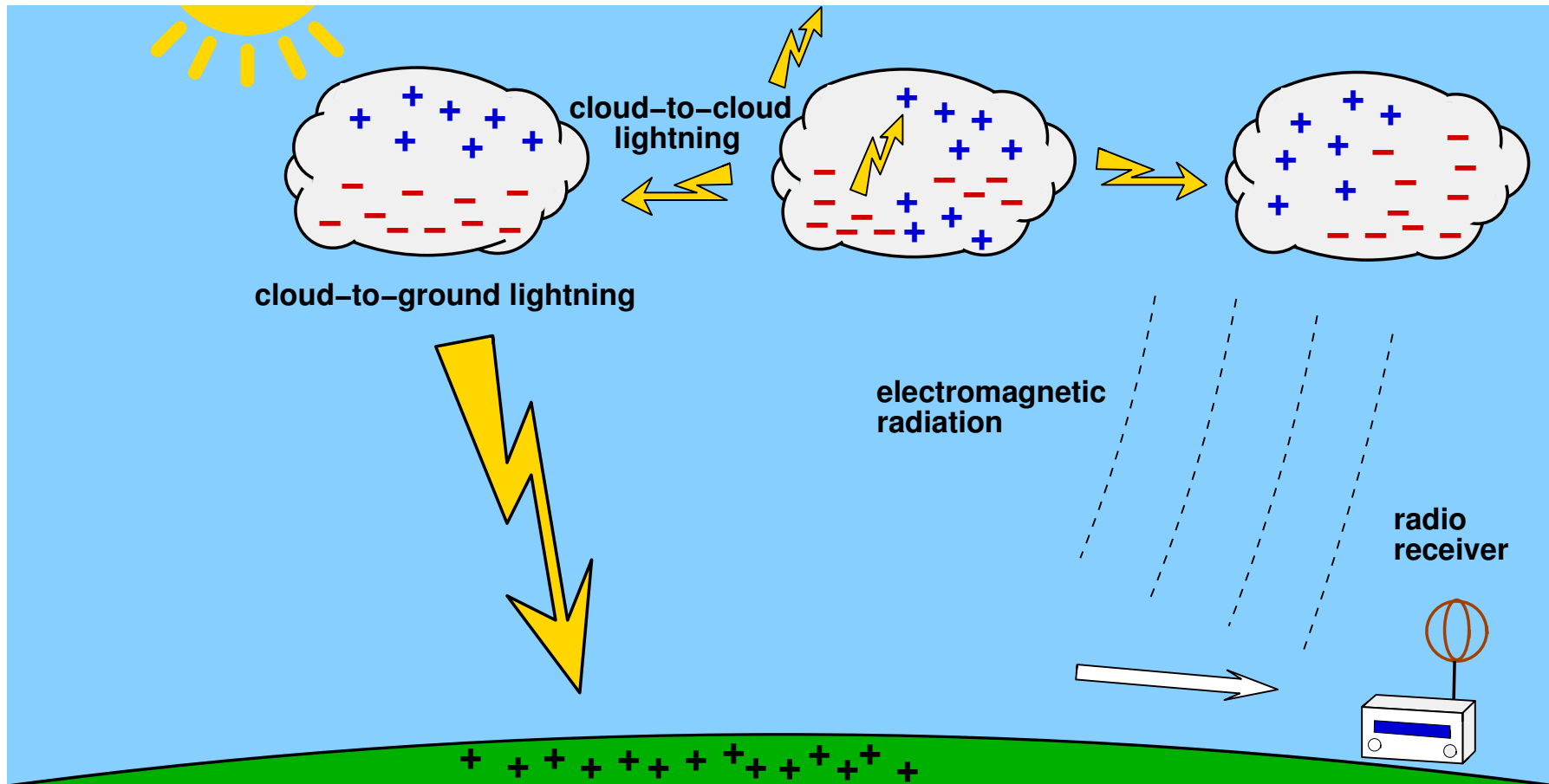
Lightning strike into a building



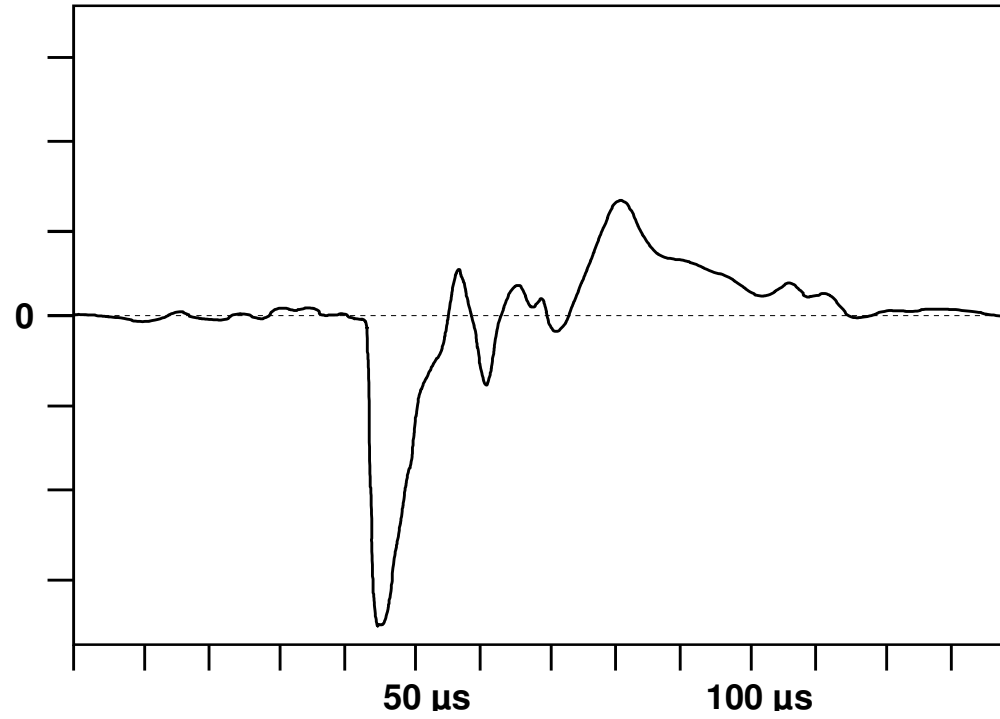
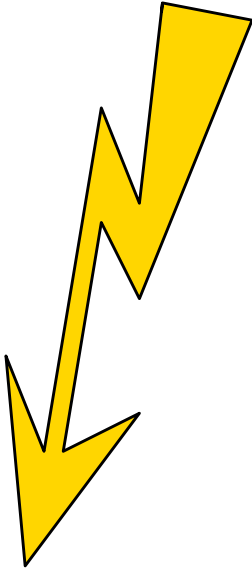
Lightning strike into a tower



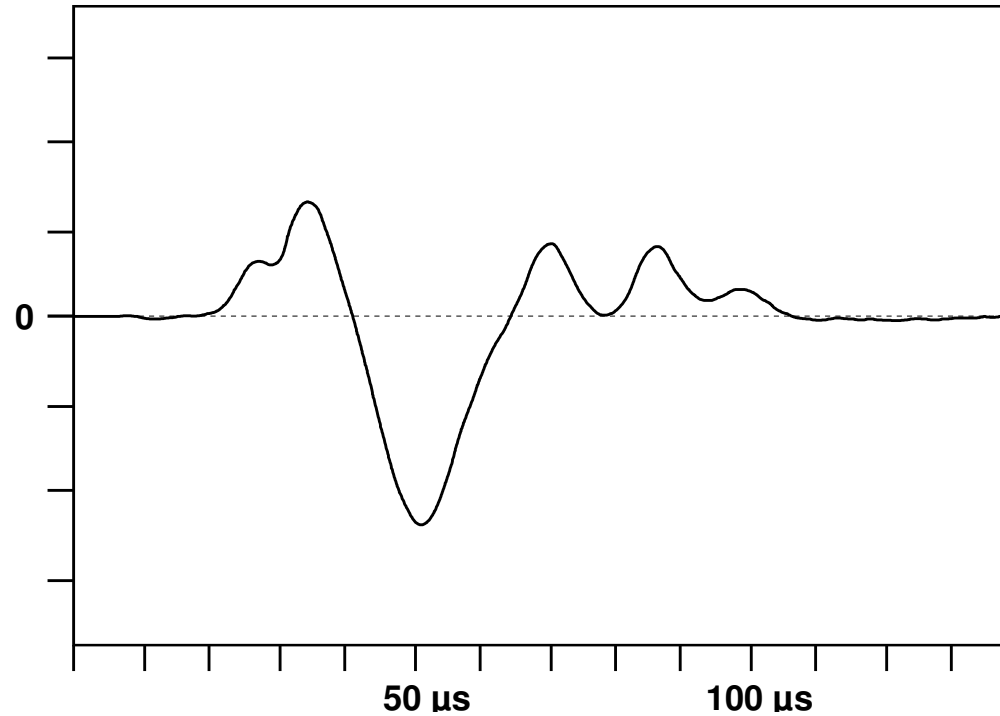
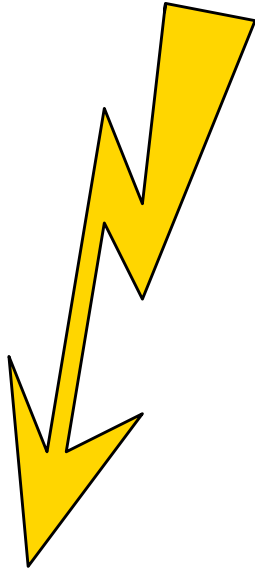
How to locate lightnings?



A lightning signal

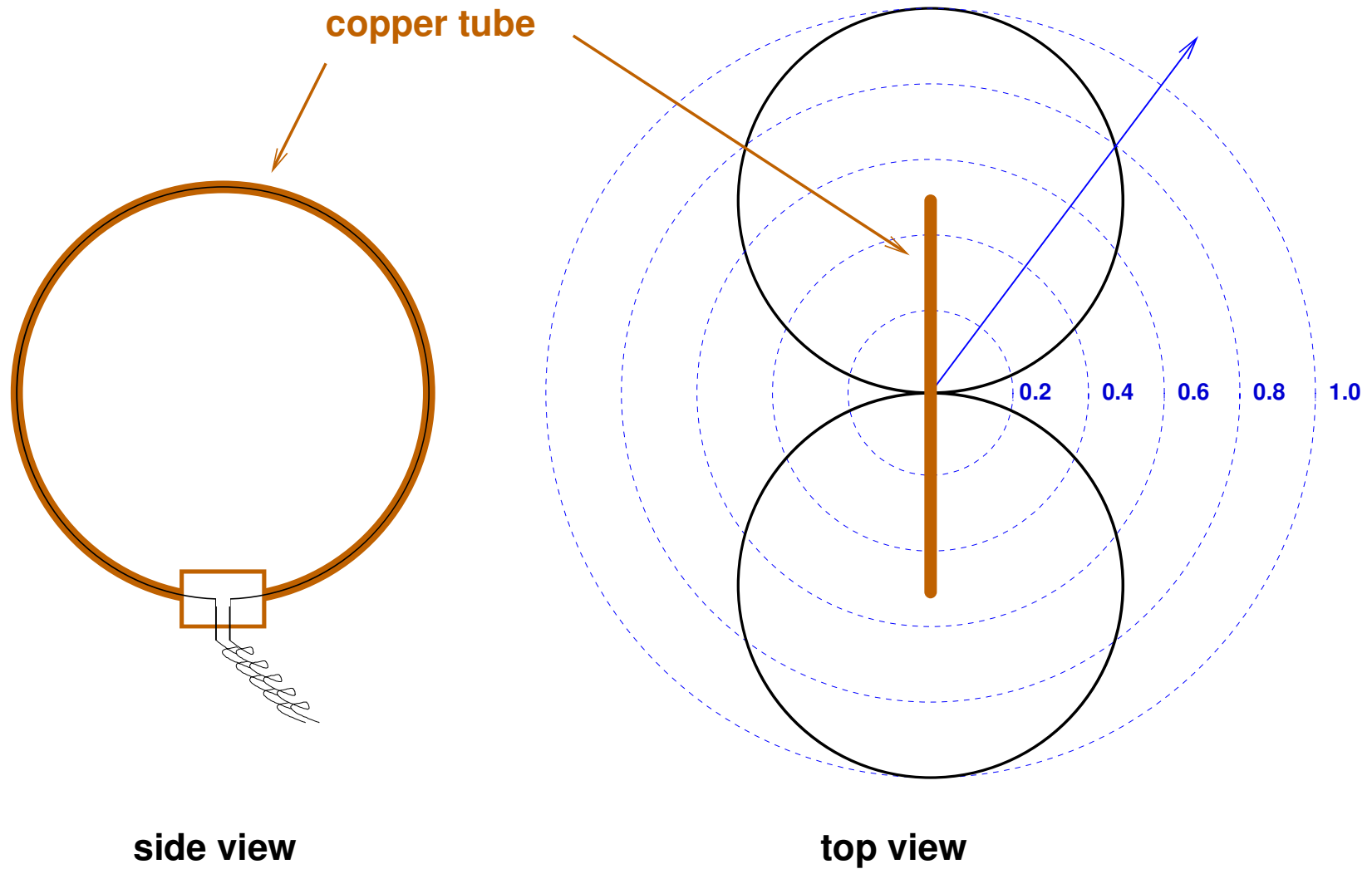


A lightning signal miles away

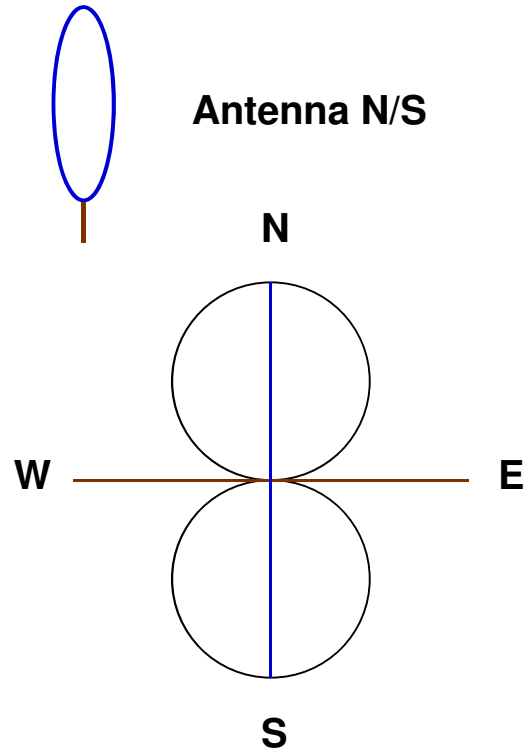


modified by dispersion, reflection, superposition, absorption ...

Magnetic Loop Antennas

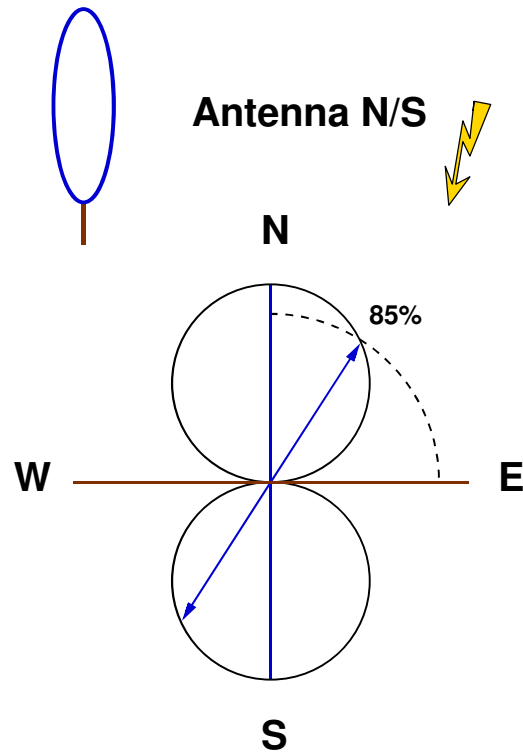


Direction Finding (DF)



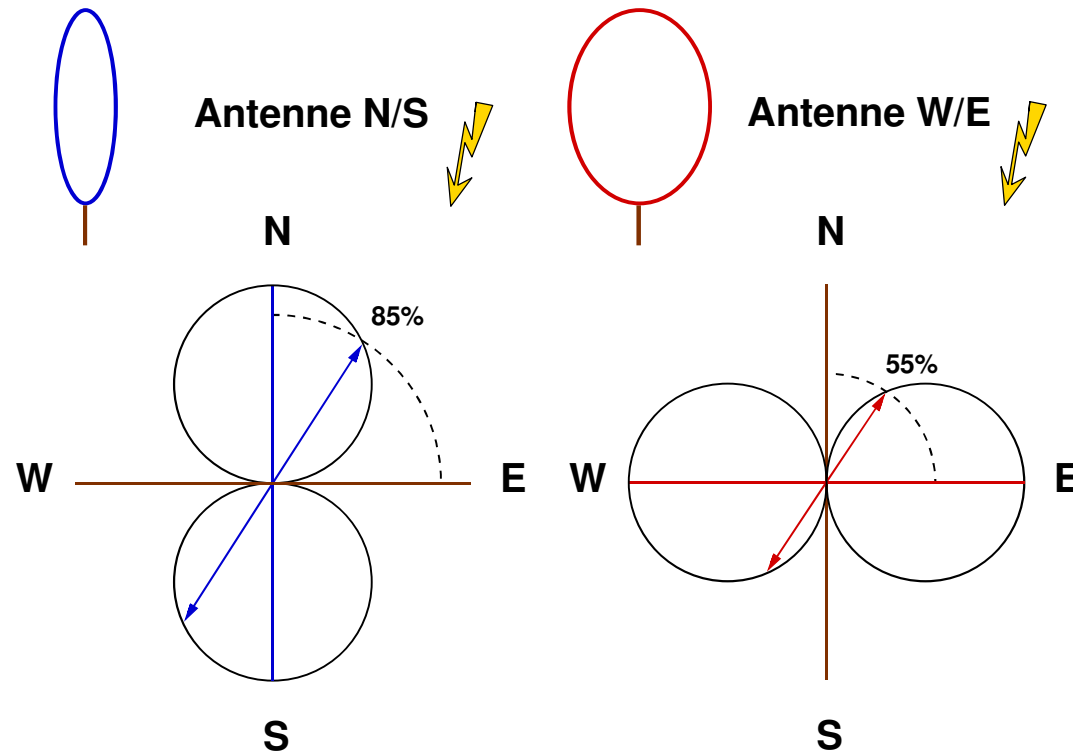
Receiving direction north/south

Direction Finding (DF)



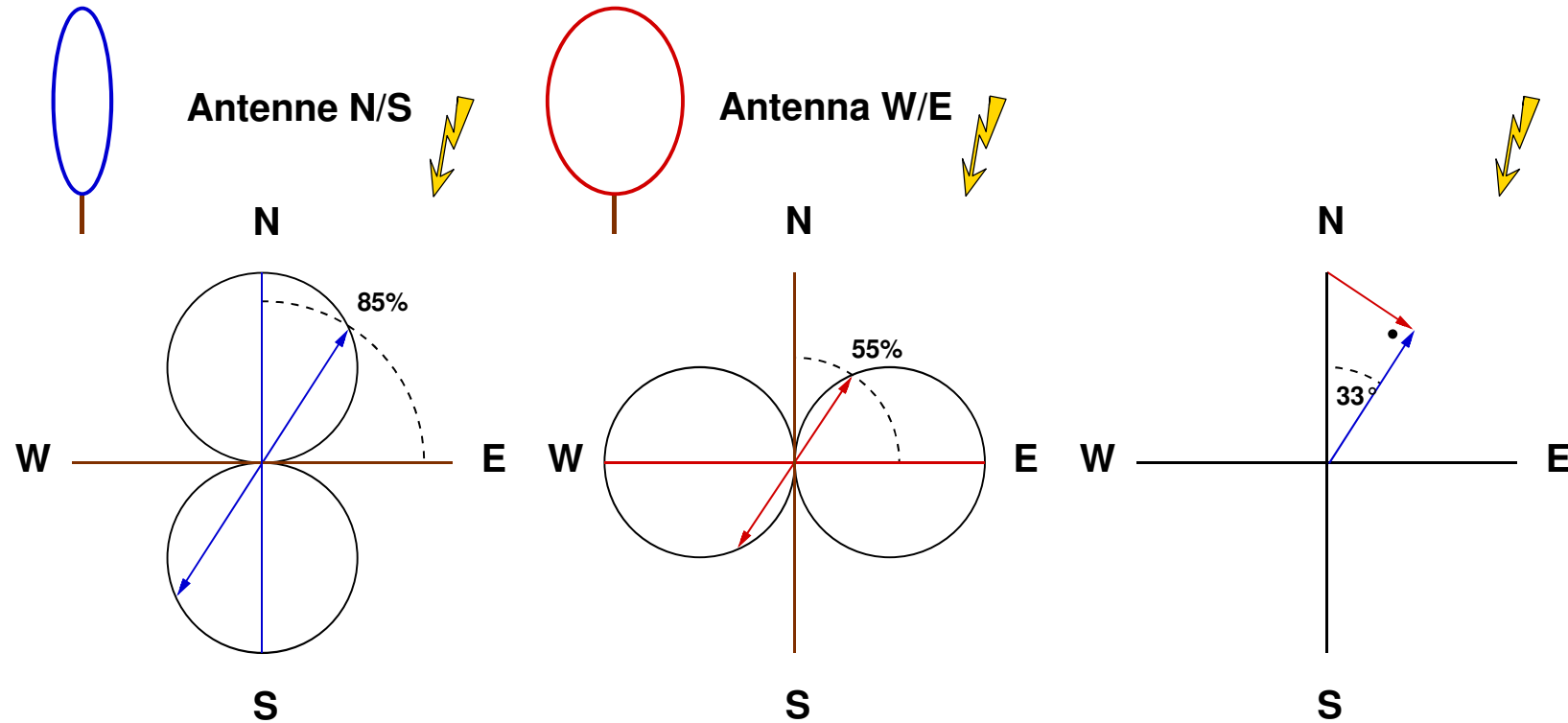
Receiving direction north/south, signal strength $B_{NS} = 0.85$

Direction Finding (DF)



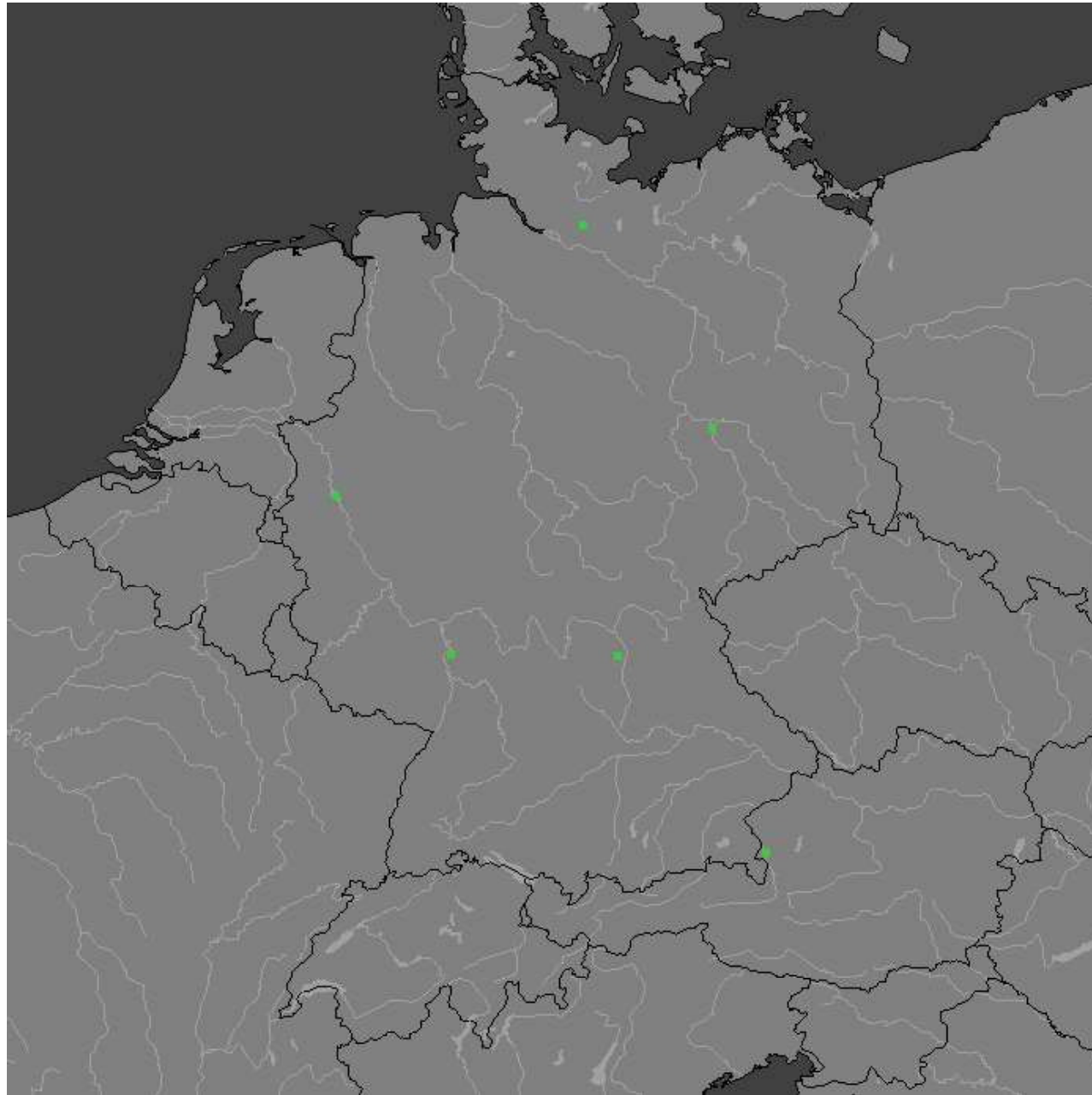
Receiving direction west/east, signal strength $B_{WE} = 0.55$

Direction Finding (DF)

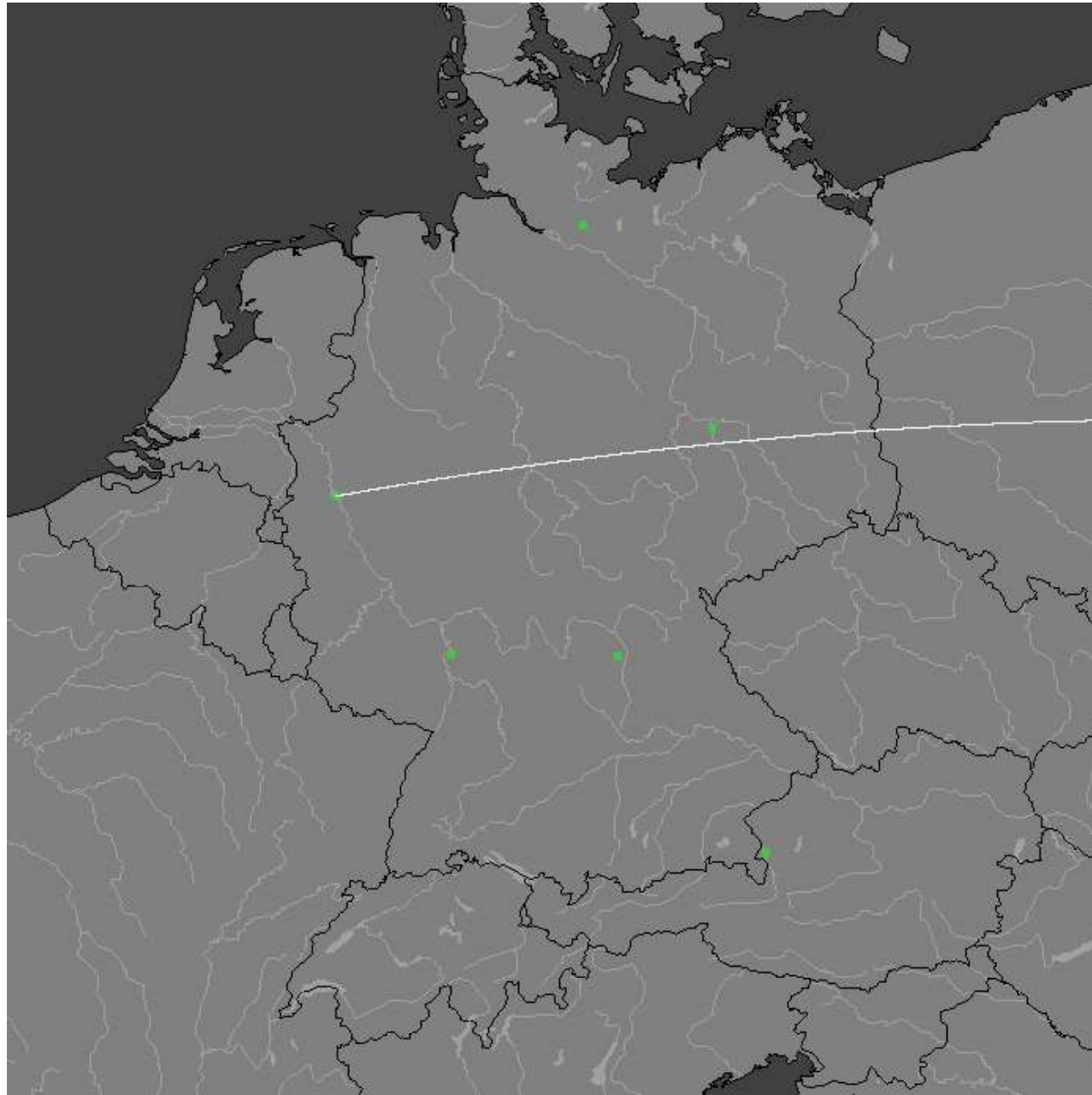


$$\tan(\alpha) = \frac{B_{WE}}{B_{NS}} = \frac{0.55}{0.85} \Rightarrow \alpha = \arctan(0.647) = 33^\circ$$

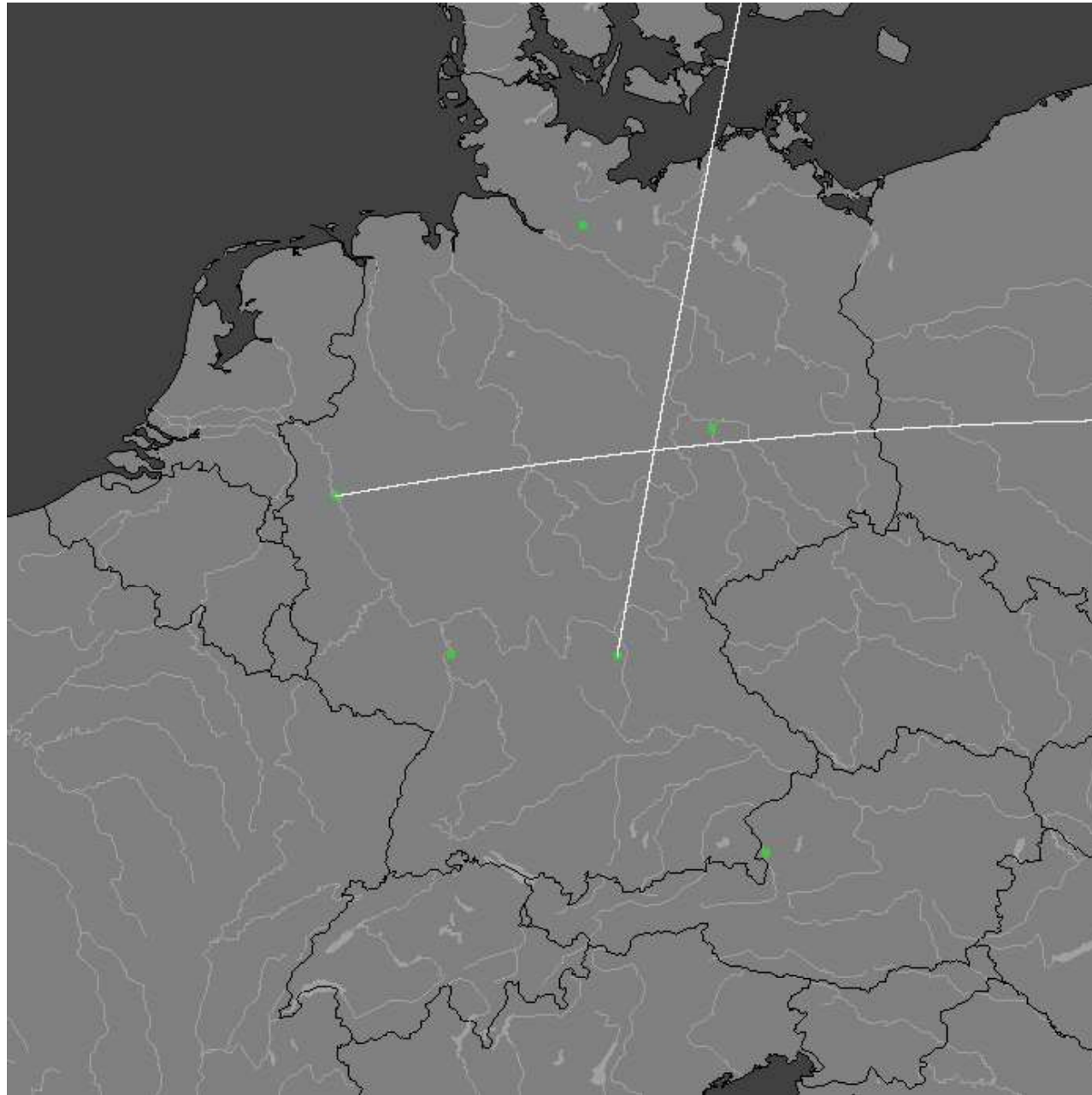
Direction Finding (DF), lightning location



Direction Finding (DF), lightning location



Direction Finding (DF), lightning location



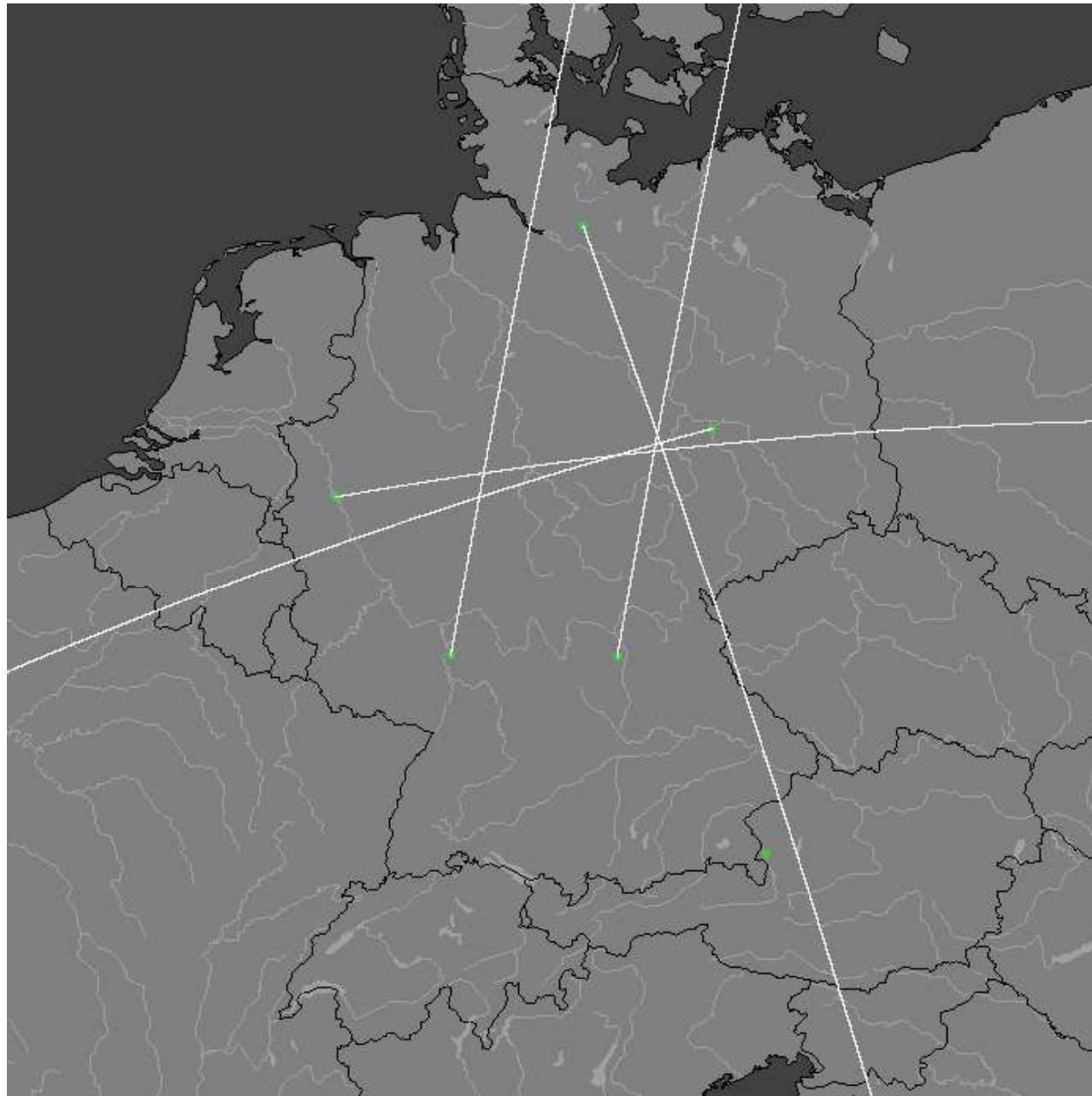
Direction Finding (DF), lightning location



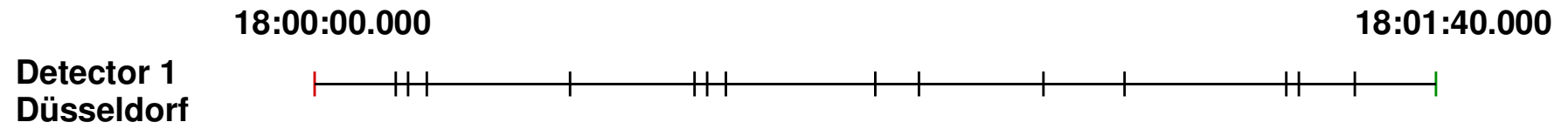
Direction Finding (DF), lightning location



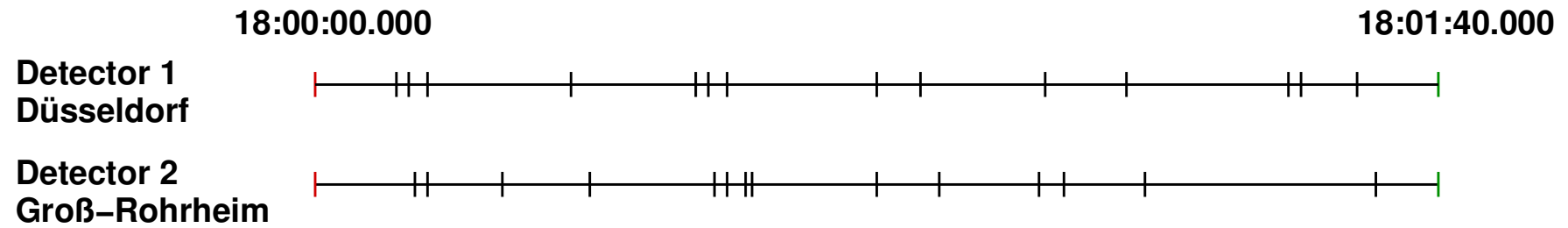
Direction Finding (DF), lightning location



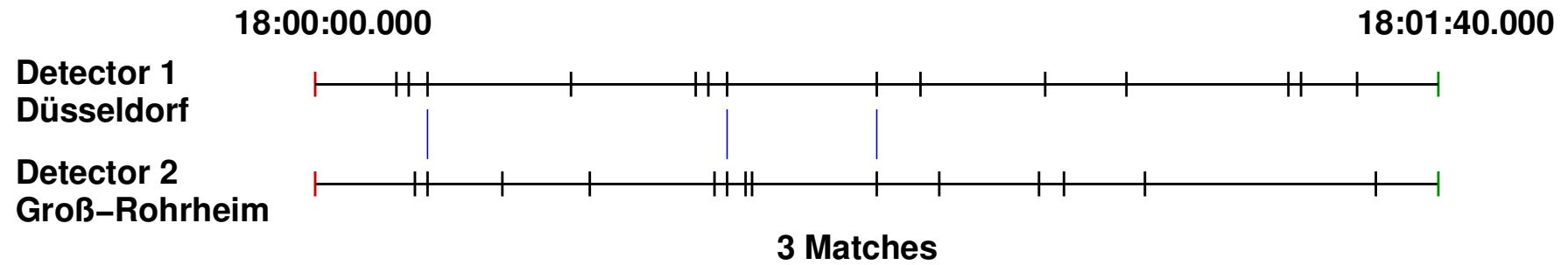
Direction Finding (DF), synchronisation



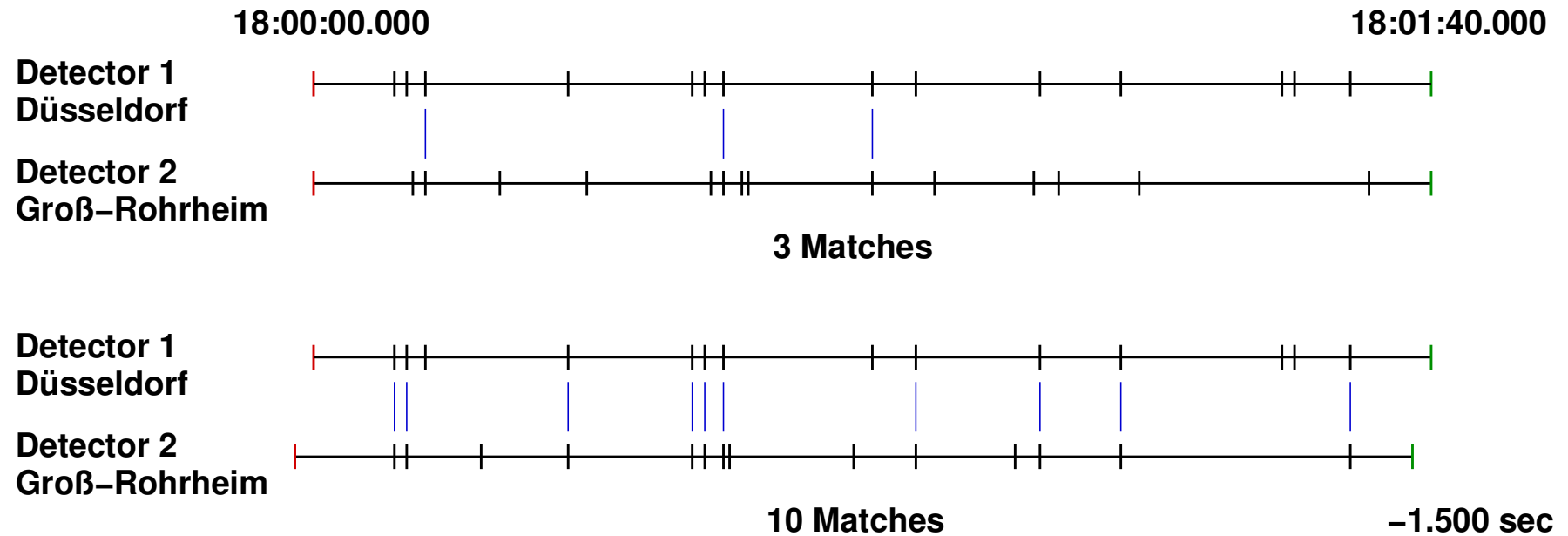
Direction Finding (DF), synchronisation



Direction Finding (DF), synchronisation

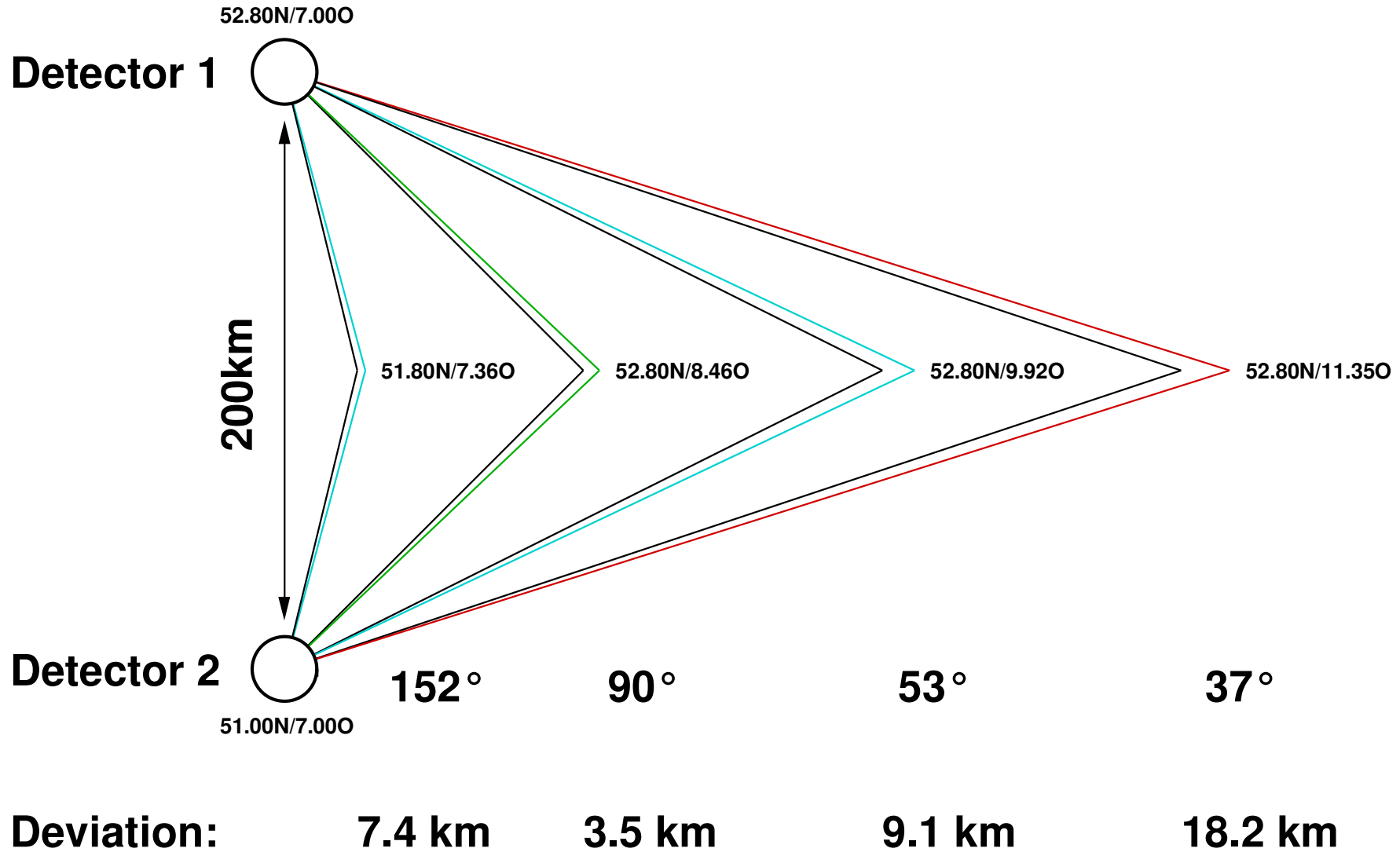


Direction Finding (DF), synchronisation

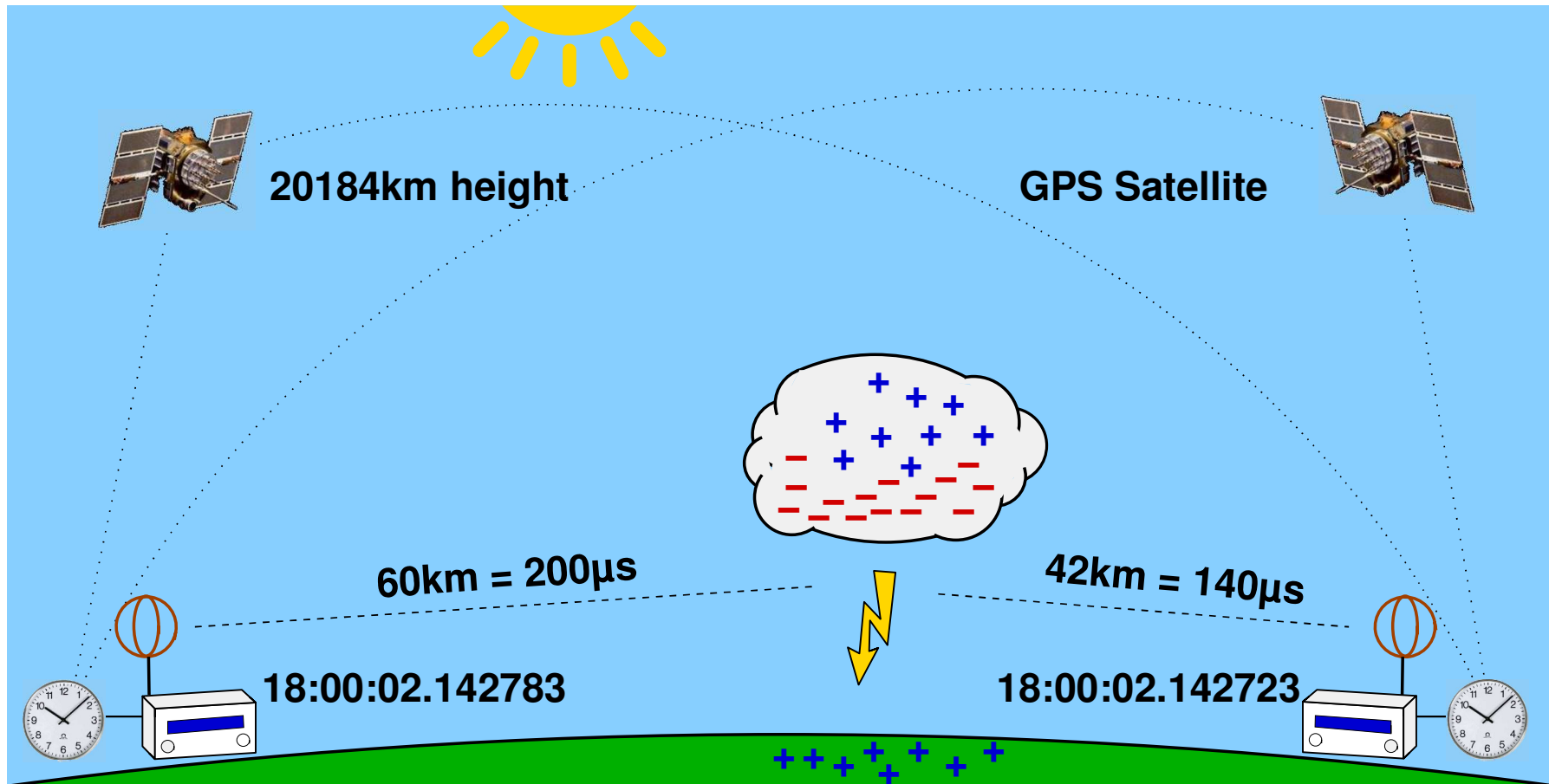


Direction Finding (DF), impact of Deviations

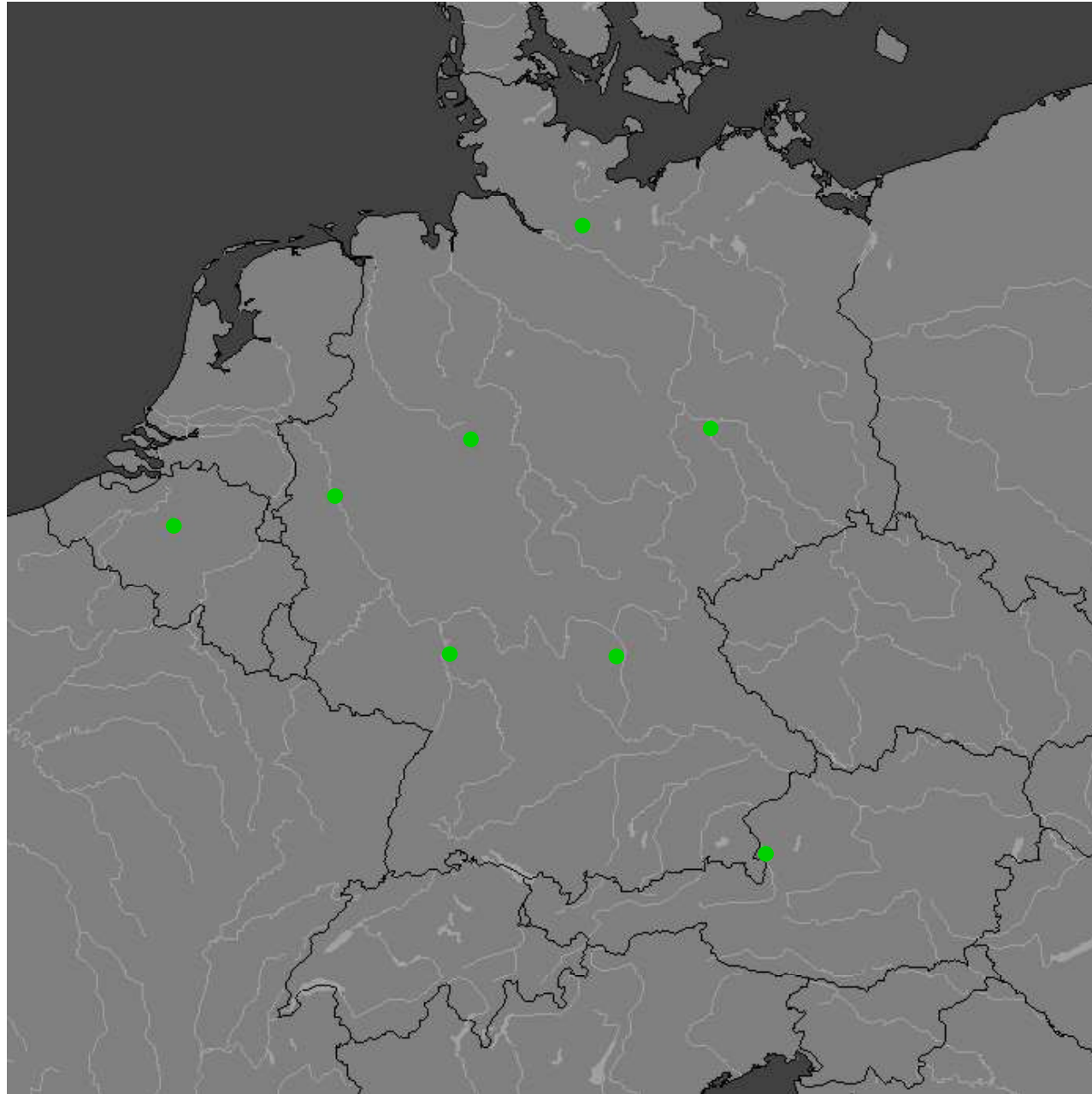
Error for a deviation of $\pm 1^\circ$ (0.55%)



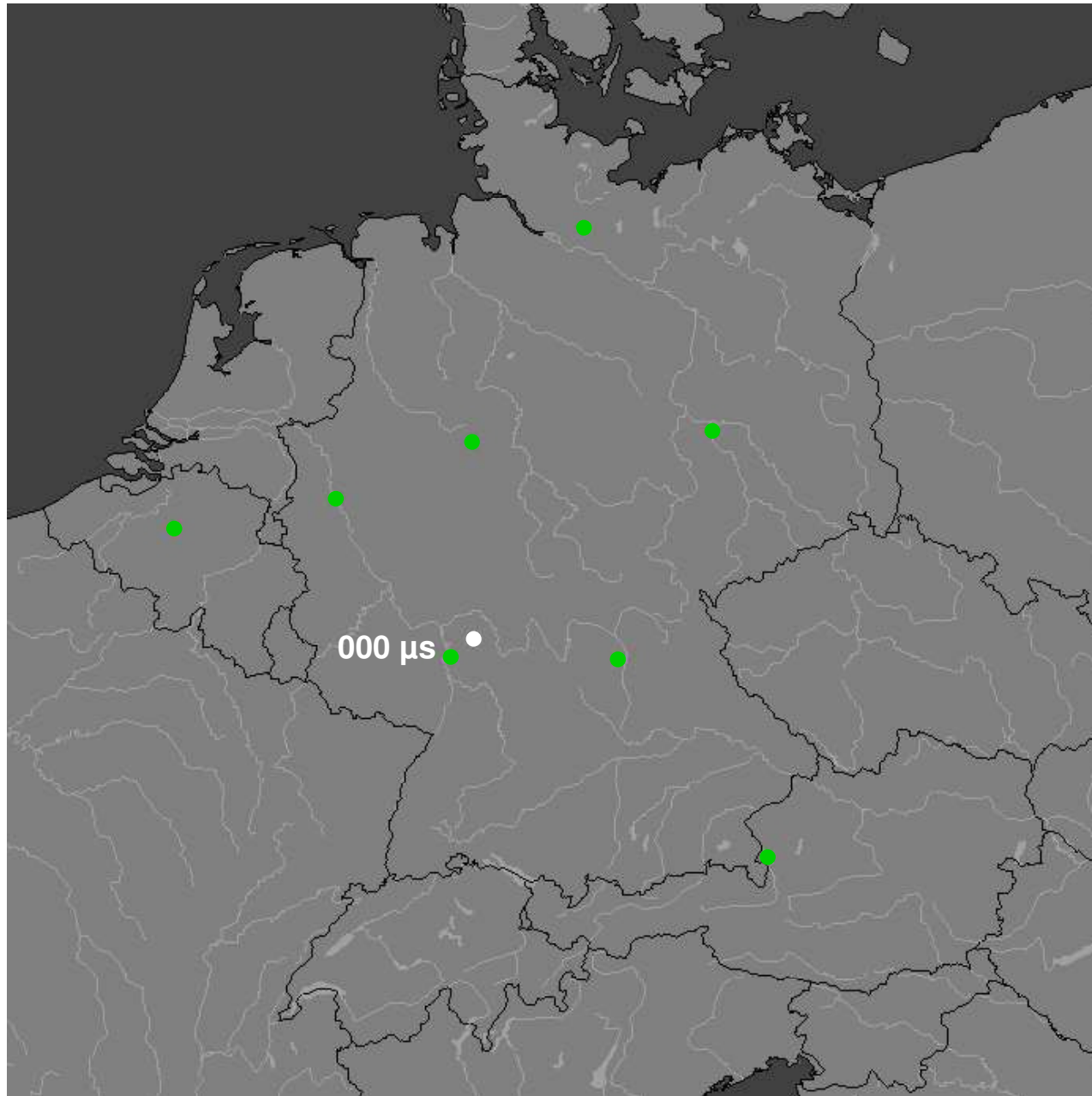
Lightning location with times of arrival (TOA)



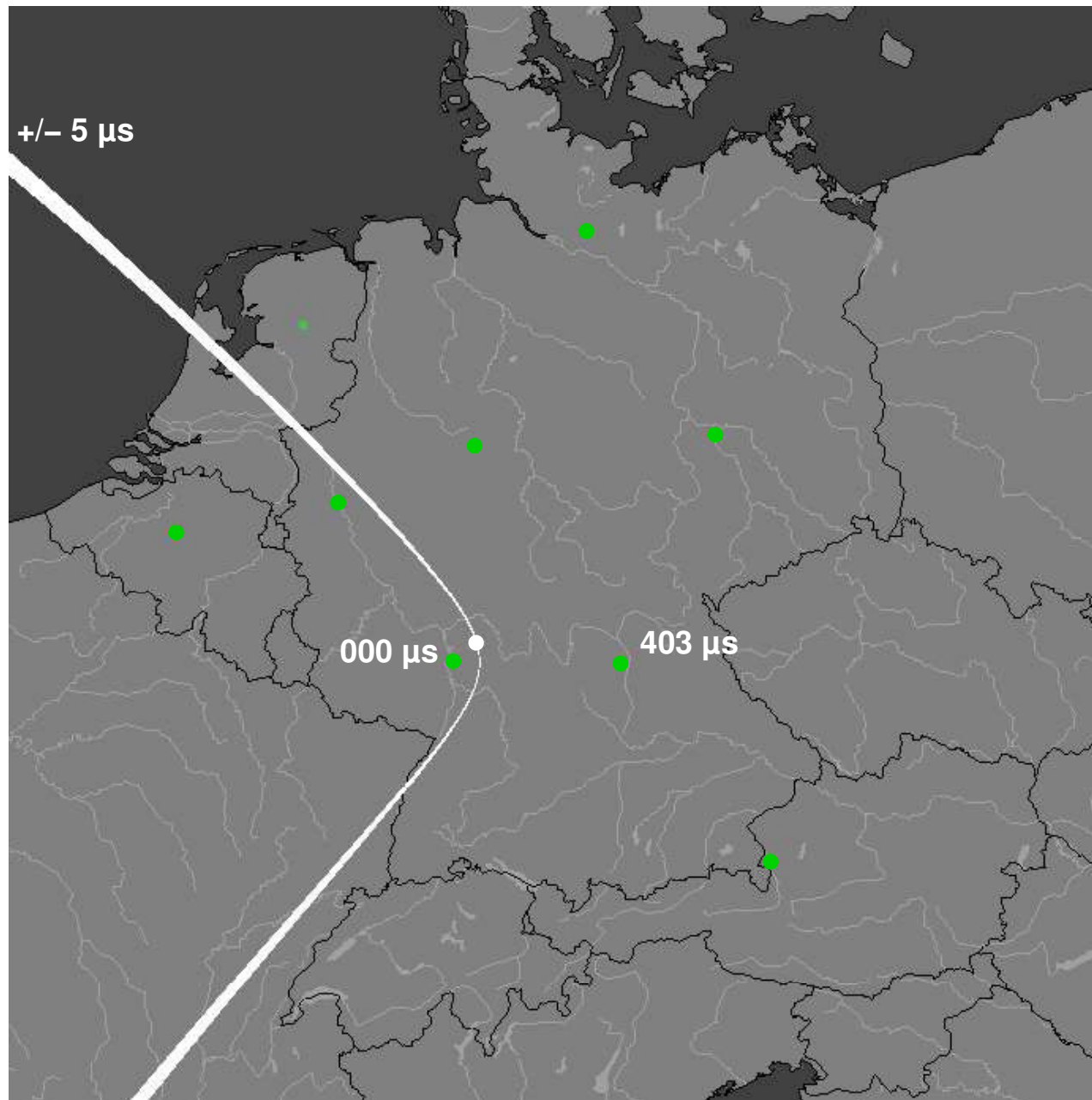
Lightning location (TOA)



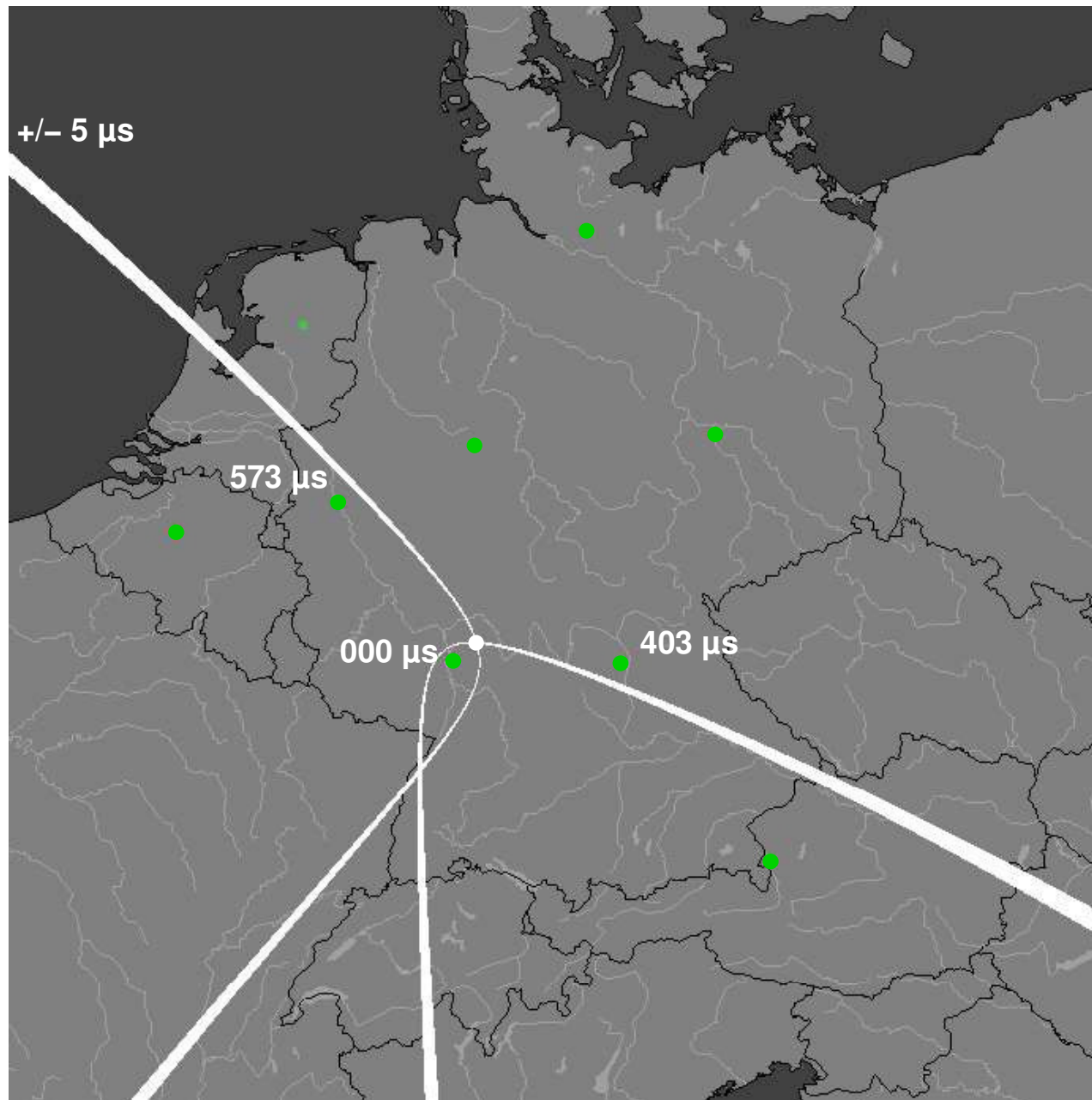
Lightning location (TOA)



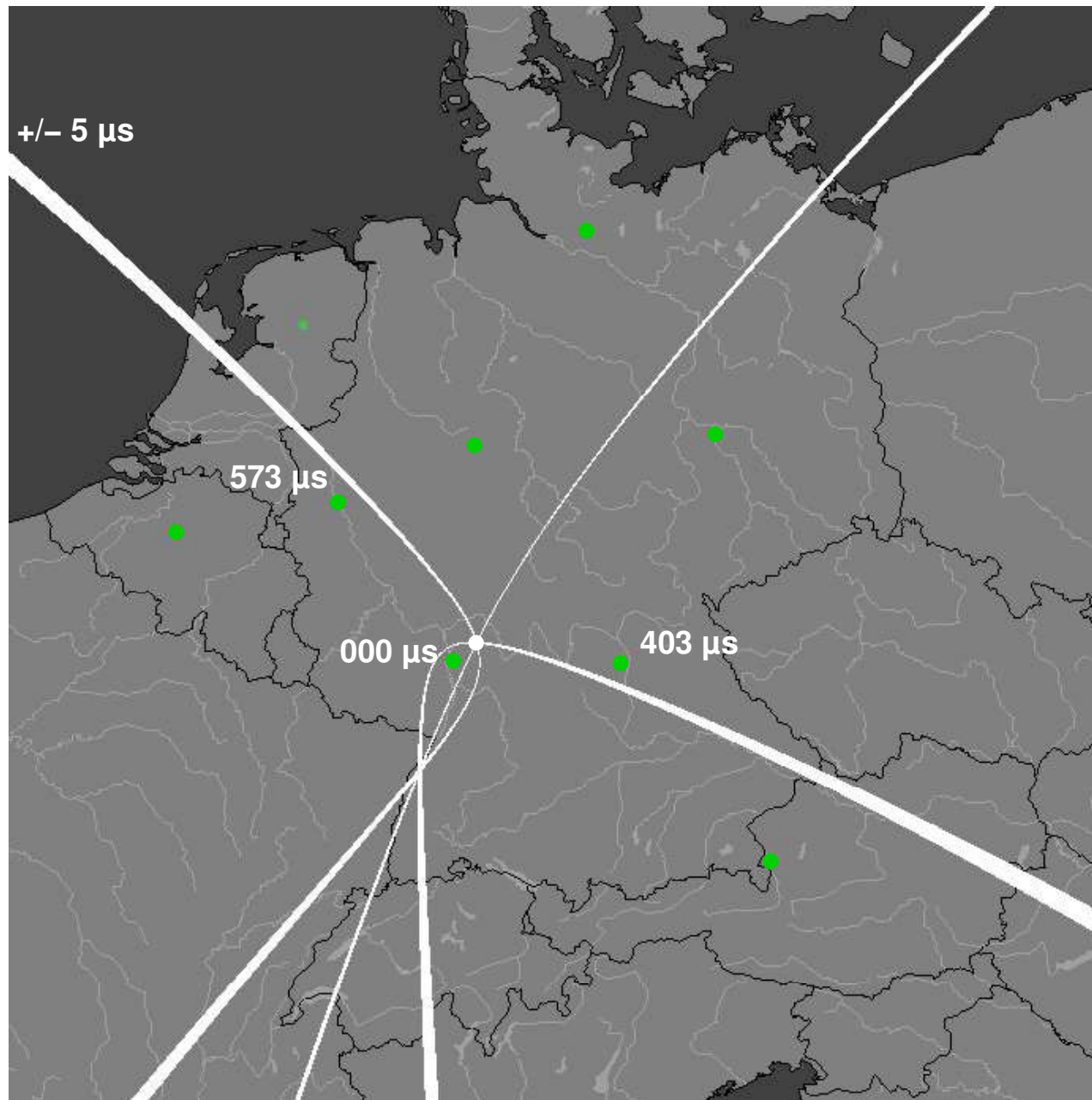
Lightning location (TOA)



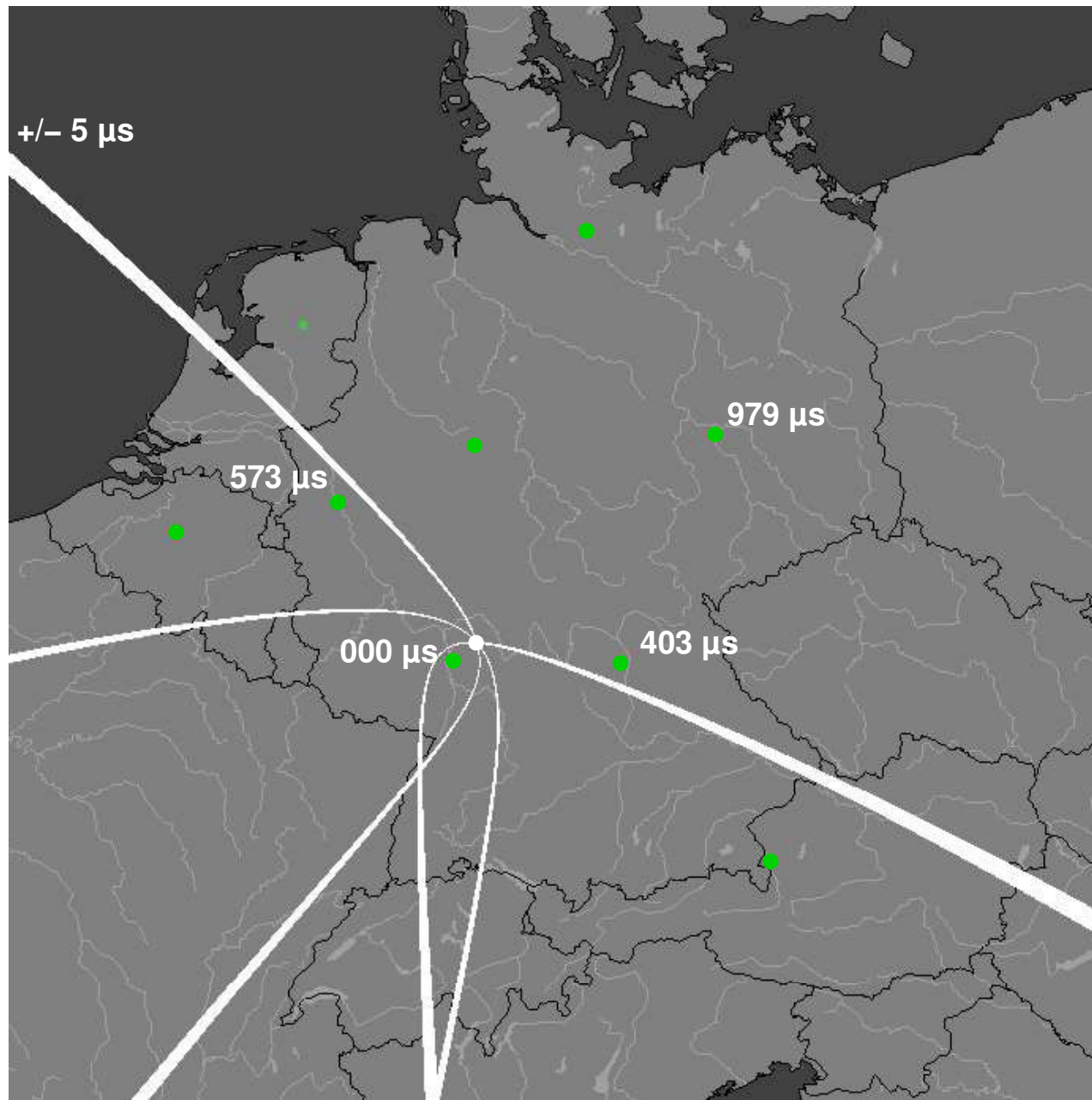
Lightning location (TOA)



Lightning location (TOA)

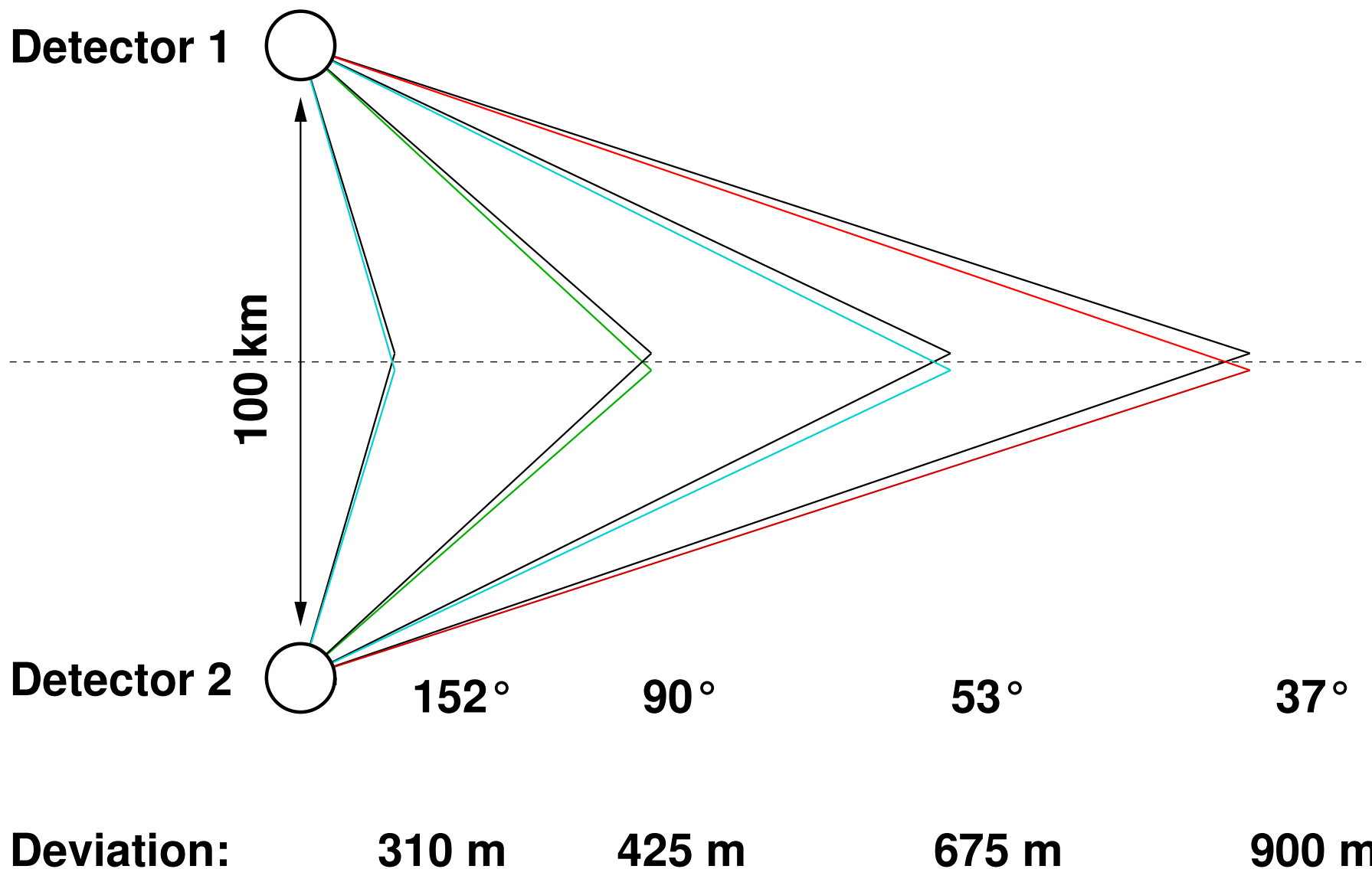


Lightning location (TOA)



Lightning location (TOA), impact of deviations

Error for a deviation of $\pm 1\mu\text{s}$



Professional Lightning Location Hardware

Vaisala (Global Atmospheric, Inc., (LLP, GDS, ARSI))

(NLDN, ALDIS, BLDN, BLIDS, CELDN, CESI-SIRF, EIMV, METEORAGE, NORDLIS, ...)

- LPATS (Lightning Position and Tracking System)
- IMPACT (Improved Accuracy Using Combined Technology)
- SAFIR (Surveillance et Alerte Foudre par Interférométrie Radioélectrique)



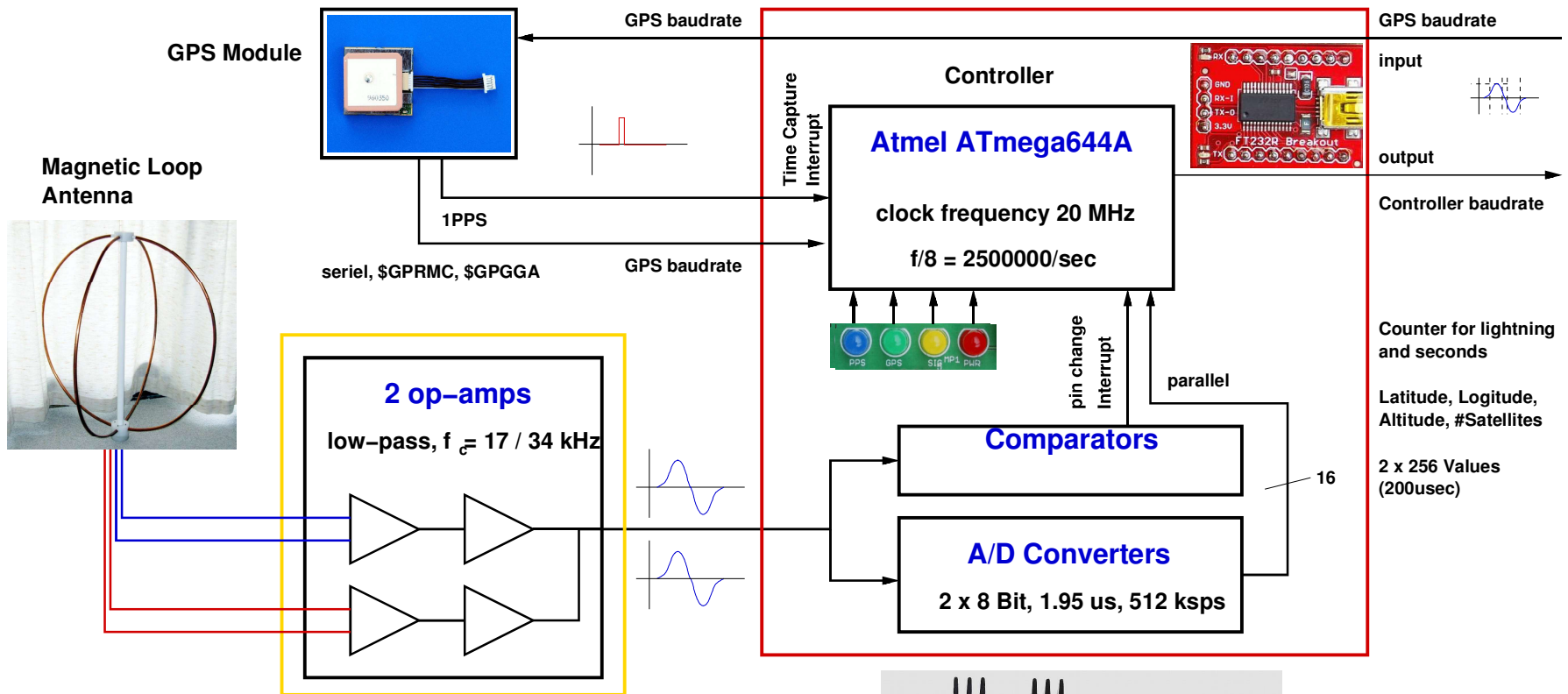
WWLLN, TOA Systems, nowcast, ...

Blitzortung.org: Objectives

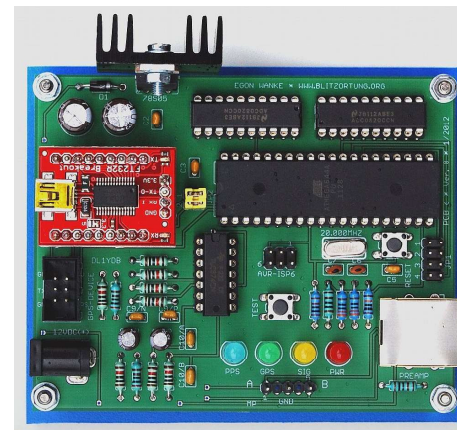
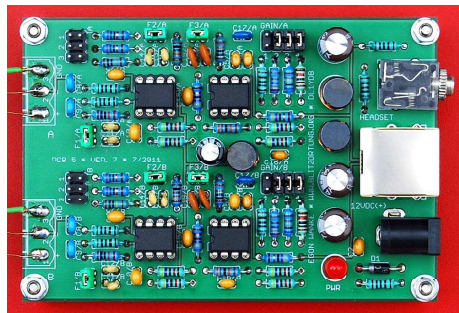


- for wether observation and storm chasing (not for loss assessments for insurances)
- real time
- acceptable precision
- low-budget (less than 200 Euro)
- community based
- large number of detectors
- just for fun

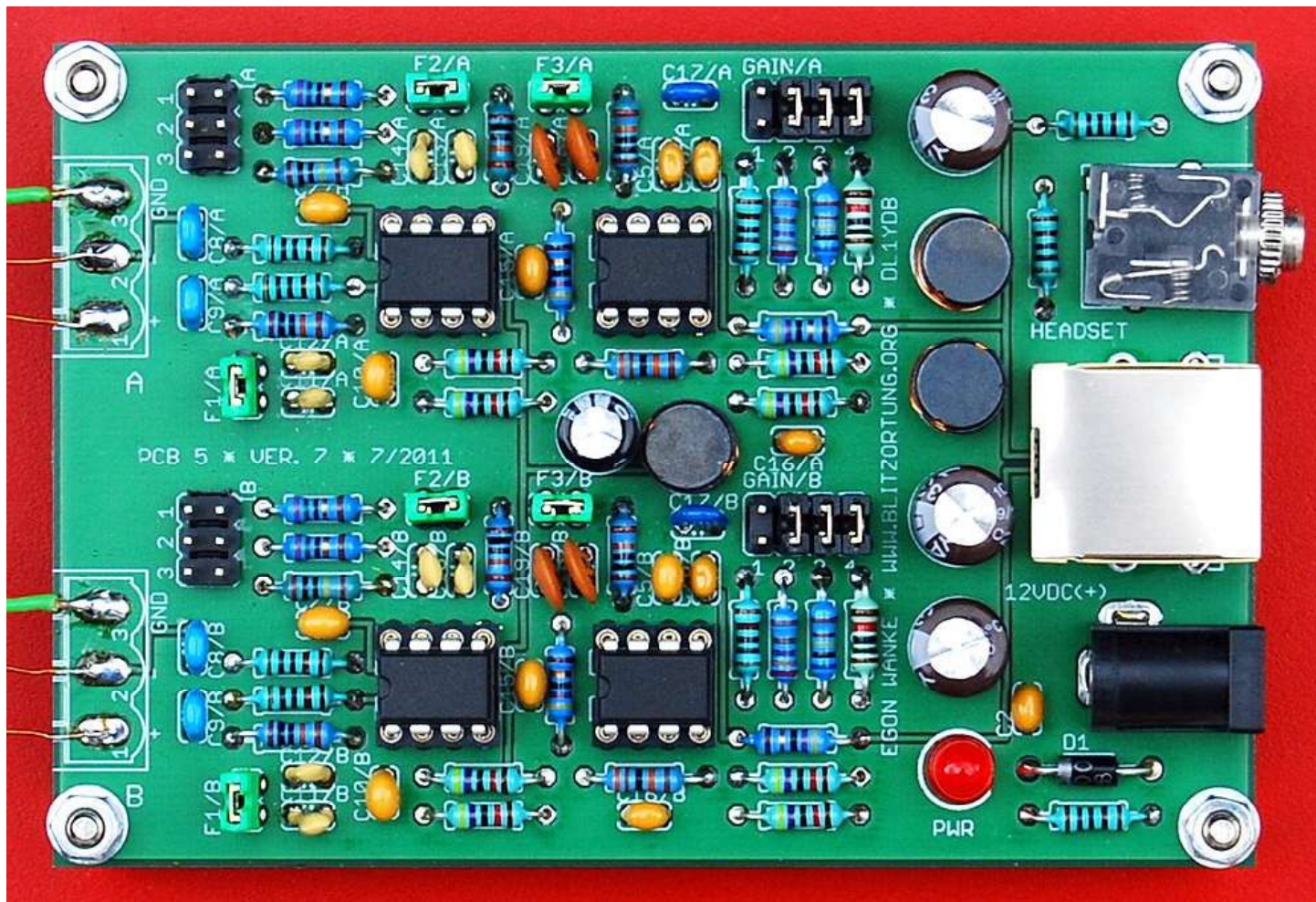
Blitzortung.org: Hardware



VLF Pre-Amplifier



Blitzortung.org: PCB 5 Version 7



Gain: 170

111

70

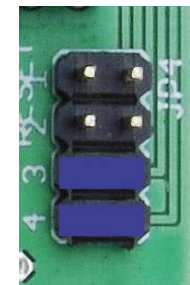
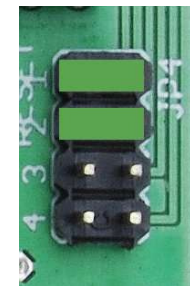
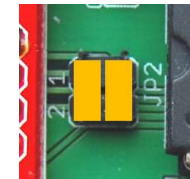
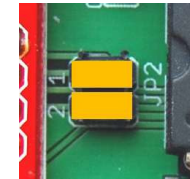
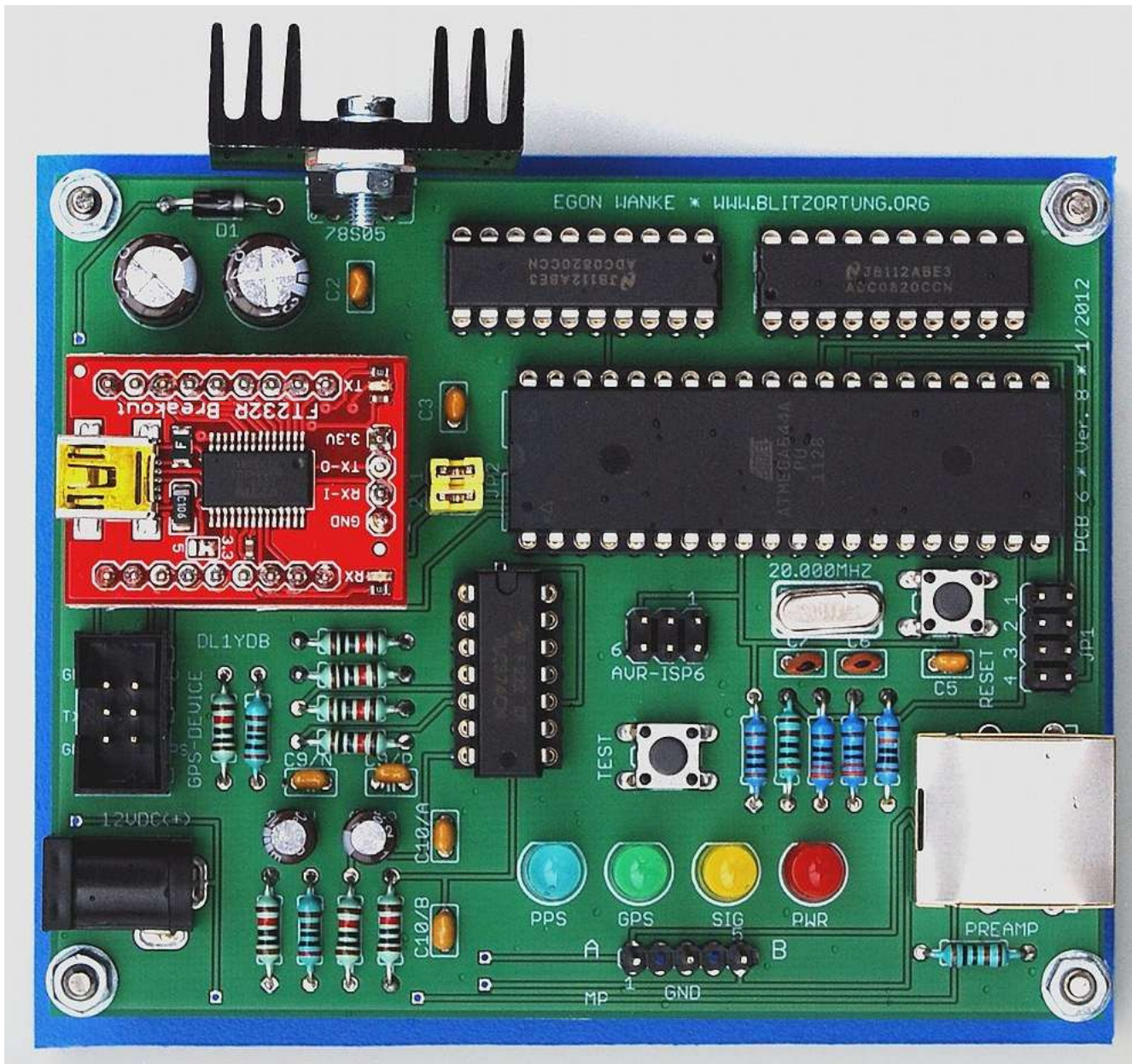
43

28

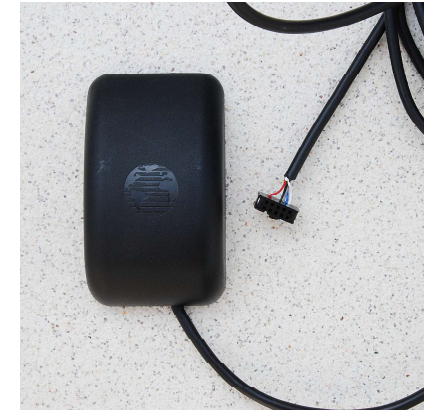
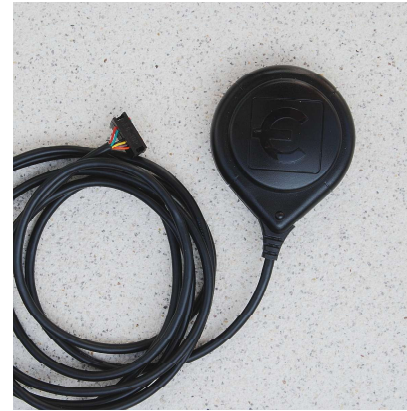
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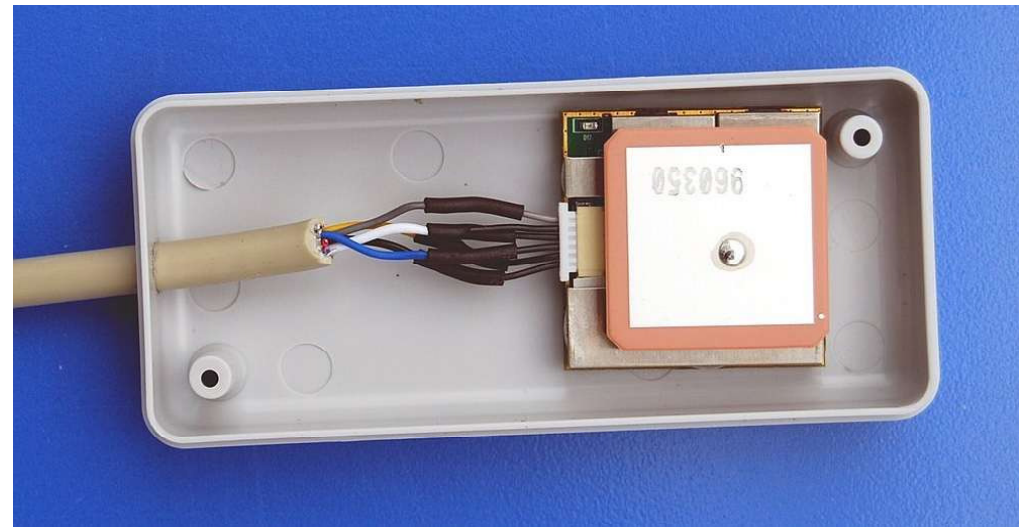
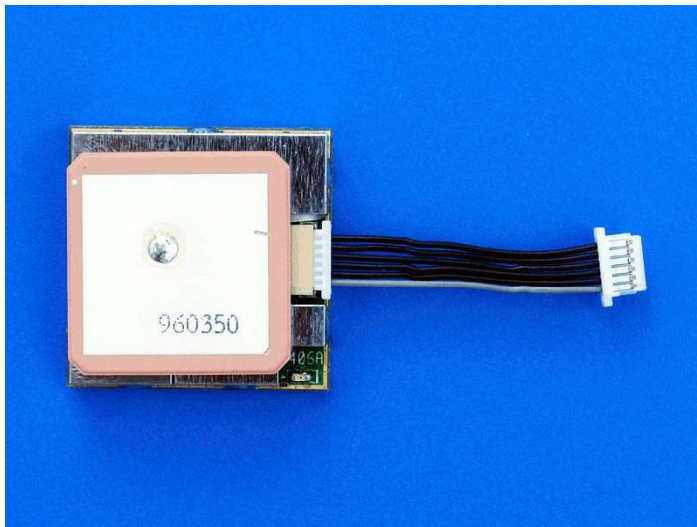
Blitzortung.org: PCB 6 Version 8usb



Blitzortung.org: GPS Modules



VT-100, Garmin 16 HVS/LVS, Fortuna U2, Garmin 35 HVS/LVS



EM-406A