Hydrometeor distribution in convective events producing lightning using cloud profiler data of summer 2018

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ECSS
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1/ Motivation & Data

Cloud profiler MIRA 35c (Ka-band zenith looking radar) since spring 2018 at our observatory Milešovka (Fig. 1; 837 m a.s.l.)

Research project Cosmic Rays and Radiation Events in the Atmosphere (CRREAT) focused on thunderstorms

→ Using **cloud profiler data**, we study hydrometeors in thunderclouds &
→ We compare measurements of cloud radar with **lightning data**:
- Lightning timing [ms]
- Peak current [kA]
- Polarity,
- Cloud-to-Ground (CG) or Cloud-to-Cloud (CC) lightning

From Siemens lightning database (BLIDS; part of EUCLID network) during 10 convective events that occurred in summer 2018 close to the Milešovka observatory (Tab. 1)

Event	Date	Time [UTC]
1	01.06.2018	11–15
2	10.06.2018	12–16
3	11.06.2018	20–23
4	27.06.2018	14–17
5	28.06.2018	8–12
6	21.07.2018	22–24
6 cont.	22.07.2018	0–5
7	02.08.2018	16–24
8	03.08.2018	11–15
9	04.08.2018	14–17
10	08.08.2018	14–18

Tab. 1 The 10 convective events in summer 2018.

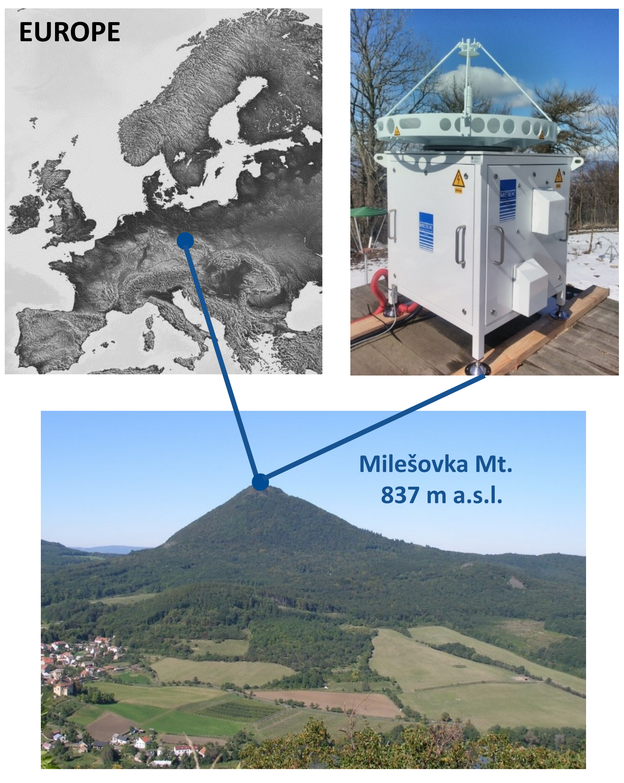

Fig. 1 Cloud profiler (35 GHz) at the Milešovka observatory (Central Europe).

2/ Methods

Cloud radar data: Doppler spectra at a temporal resolution of 2 s for 509 gates

Vair (vertical air velocity) retrieval (*Sokol et al., 2018*): small (light) particles considered as tracers of the air, i.e. vair corresponds to their vertical velocity

Classification of 5 hydrometeor classes (*Sokol et al., 2018*): cloud, rain, ice&snow, graupel, and hail based on ambient temperature (sounding measurements), horizontal wind speed, terminal velocity, and values of LDR

Any hydrometeor class assumed to have its own terminal velocity range (min. and max. values taken from COSMO NWP model)

We coupled two radar observations with any lightning flash recorded up to 1, 1.5. 2, 2.5, 3, 5, 7, 10, 15, and 20 km from the Milešovka observatory.

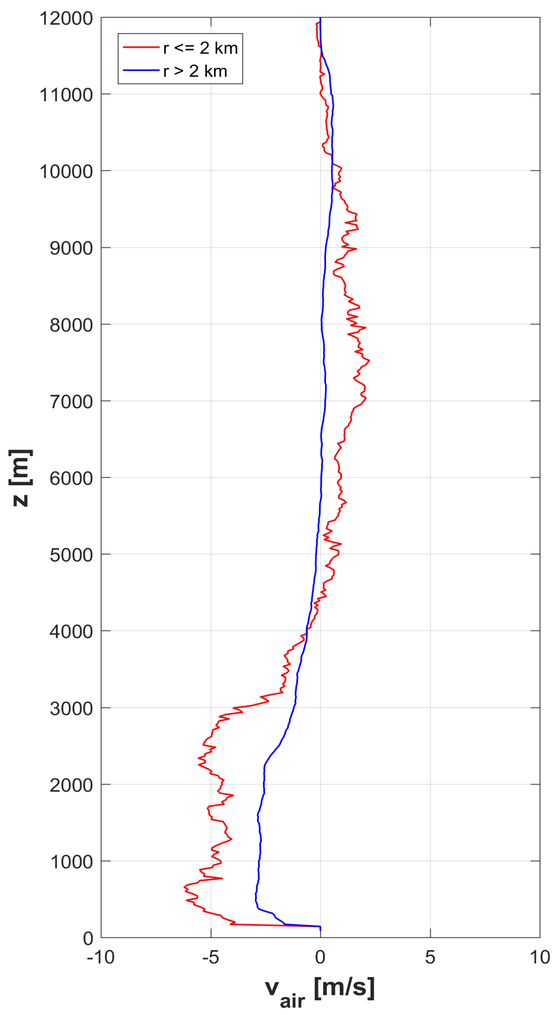

Fig. 2 Vertical profile of vair upward from the radar during 10 convective events in summer 2018. Red (blue) curve depicts average vair, when a lightning discharge was observed up to 2 km (2–20 km) from the Milešovka observatory. Note that z [m] represents the height above the cloud radar.

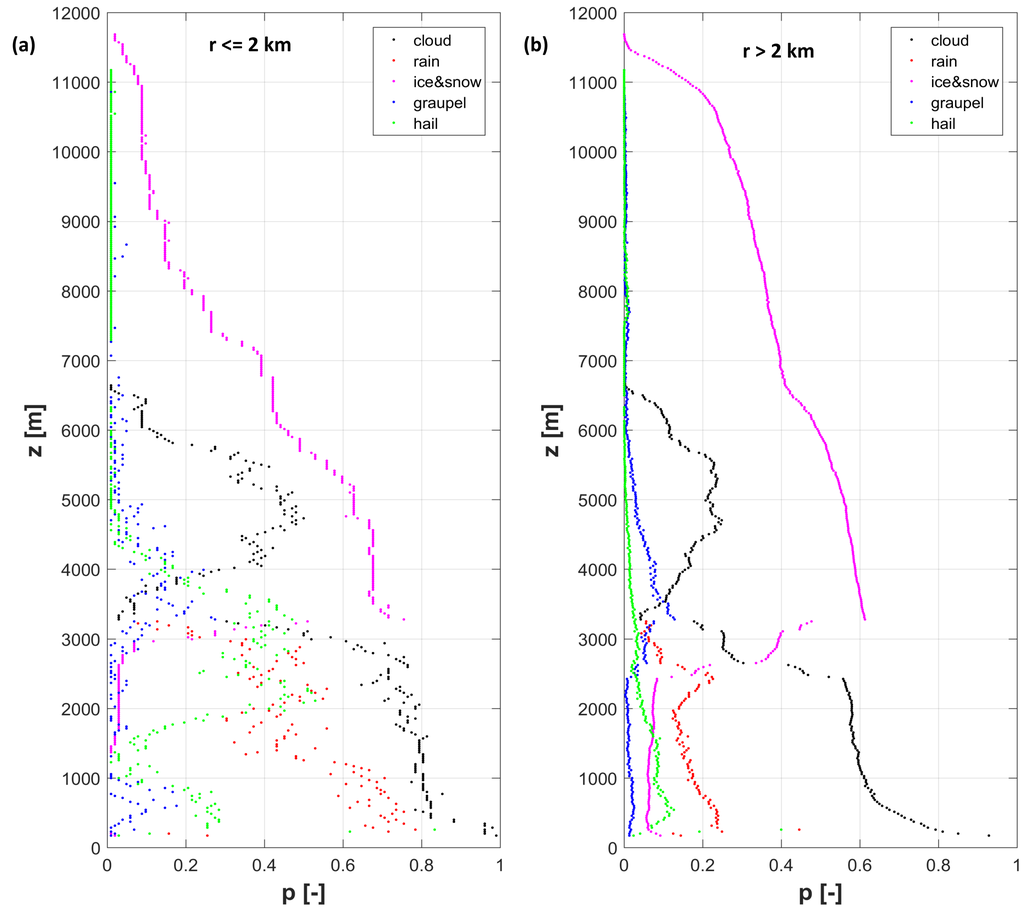

Fig. 3 Vertical profile of the probability of occurrence of hydrometeors (p [-]) during 10 convective events in summer 2018 (Tab. 1): (a) lightning discharge was observed up to 2 km from the Milešovka observatory (r ≤ 2 km), (b) lightning discharge was recorded from 2 to 20 km from the observatory (r > 2 km).

Sokol Z, Minářová J, Novák P. 2018. **Classification of Hydrometeors Using Measurements of the Ka-Band Cloud Radar Installed at the Milešovka Mountain (Central Europe)**. *Remote Sen.* **10**(11): 1674. DOI: 10.3390/rs10111674.

We acknowledge BLIDS for providing lightning data during the 10 convective events.

3/ Results

Nearby lightning if downward motion predominates the lower altitudes (Fig. 2)

Higher probability of hail and rain at lower altitudes (up to 4 km approximately) for nearby lightning flashes (Fig. 3)

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