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Supplement of

Applicability of the inverse dispersion method to measure emissions from animal housings

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Supplement

Additional information to support the findings in the main manuscript in the order of occurrence.

S1. Recovery rates during IC2

For IC2, all five OP were placed next to each other about 50 m southwest of the barn and one UA was placed 55 m southwest from the barn at 2 m above ground level. At this time, no UA was placed upwind of the barn. Thus, these recovery rates are determined with an UA placed in a disturbed wind field and should be used with caution. The background concentration was interpolated with data from before and after the CH_4 release. The OP had about 1 m spacing between each other.

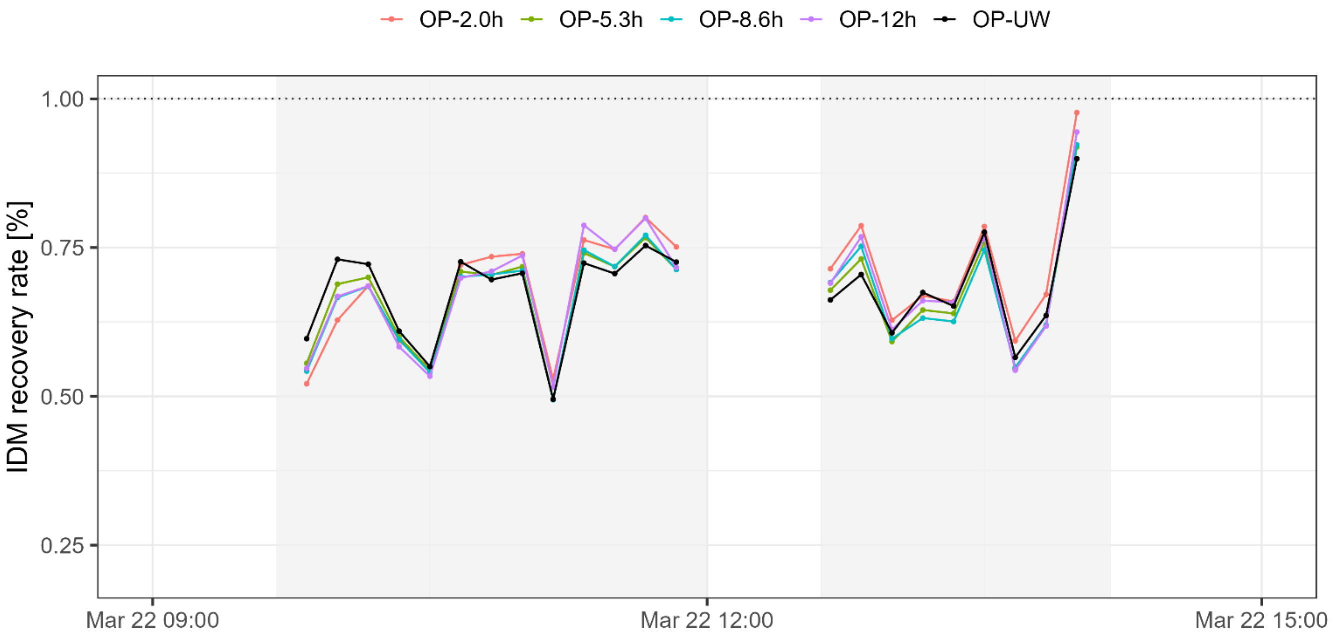

Fig. S1. Recovery rate of all OP during IC2. Note, the names of the OP are according to the setup during the measurement campaign and do not correspond with the actual fetch during IC2, which was for all ~2h.

S2. Methane release

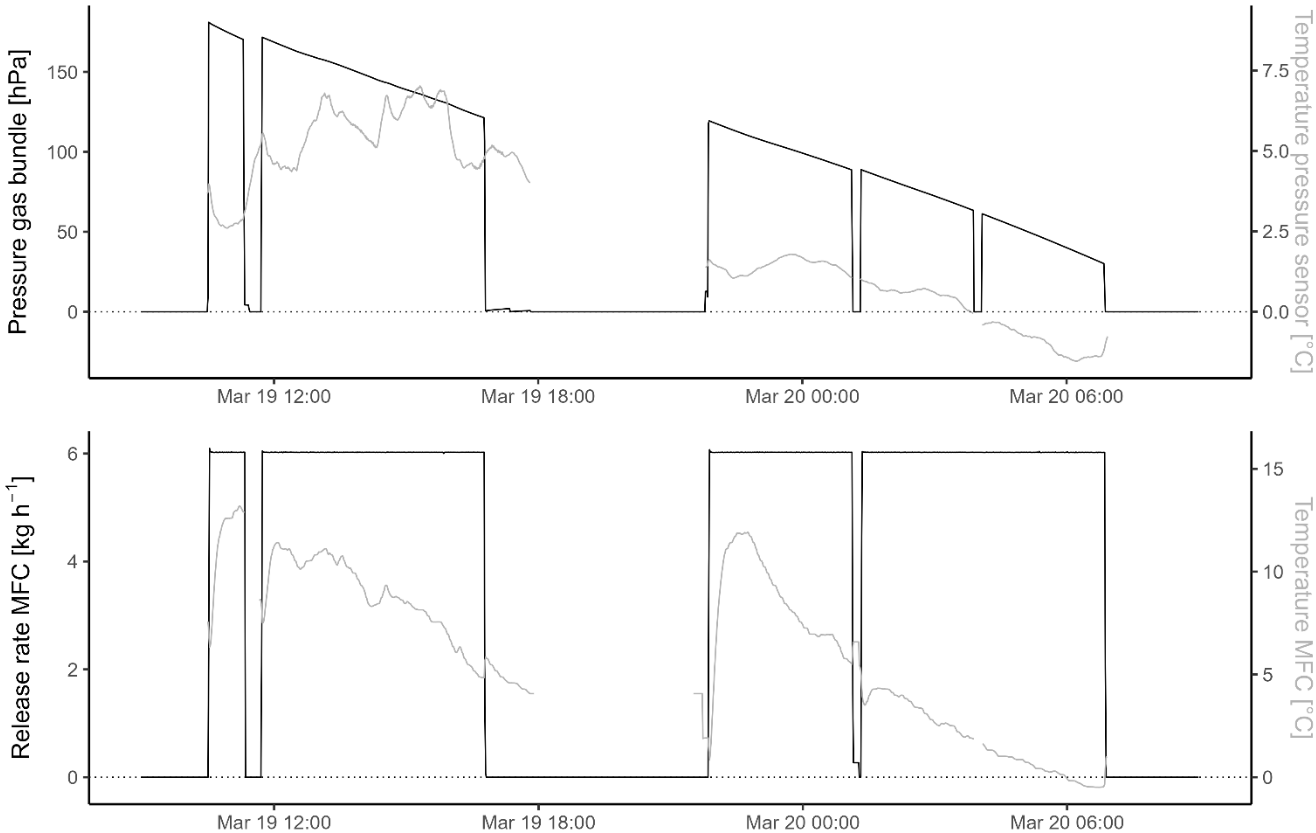

Fig. S2. Top panel: Pressure and temperature logged with the Keller pressure sensor. Bottom panel: Mass flow and temperature logged with the Bronkhorst mass flow controller (MFC) during the two release phases. The lines in light grey correspond to the secondary y-axis.

S3. Precision of the used OP

The precision was calculated according to Häni et al. (2021). Note, that there is a mistake in Eq. 2 of that study and the correct formula is

$$Precision = \frac{2.9 * MAD(\Delta C) * l_{path}}{\sqrt{2}}, \quad \text{(S1)}$$

where MAD is the median absolute deviation, ΔC the concentration difference between the OP downwind and OP-UW in ppm ($\Delta C = C_{DW} - C_{UW}$) and l_{path} the single path length of the OP. The unit of the precision is ppm-m.

Reference

Häni, C., Bühler, M., Neftel, A., Ammann, C., and Kupper, T.: Performance of open-path GasFinder3 devices for CH4 concentration measurements close to ambient levels, Atmospheric Measurement Techniques, 14, 1733-1741, https://doi.org/10.5194/amt-14-1733-2021, 2021.

S4. Wind direction filtering

Table S1. Wind directions outside these intervals were not used to determine recovery rates.

	OP-2.0h	OP-5.3h	OP-8.6h	OP-12h
Wind direction interval	21° - 94°	21° - 71°	30° - 64°	30° - 61°

S5. Experimental setup

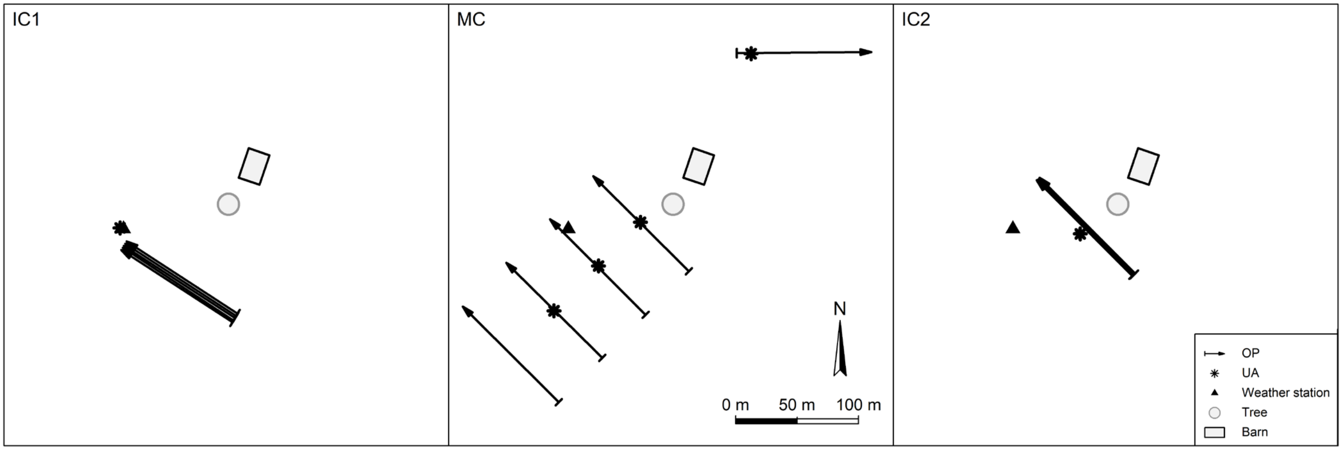

Fig. S3. Experimental setup for IC1, MC and IC2.

S6. Turbulence parameters

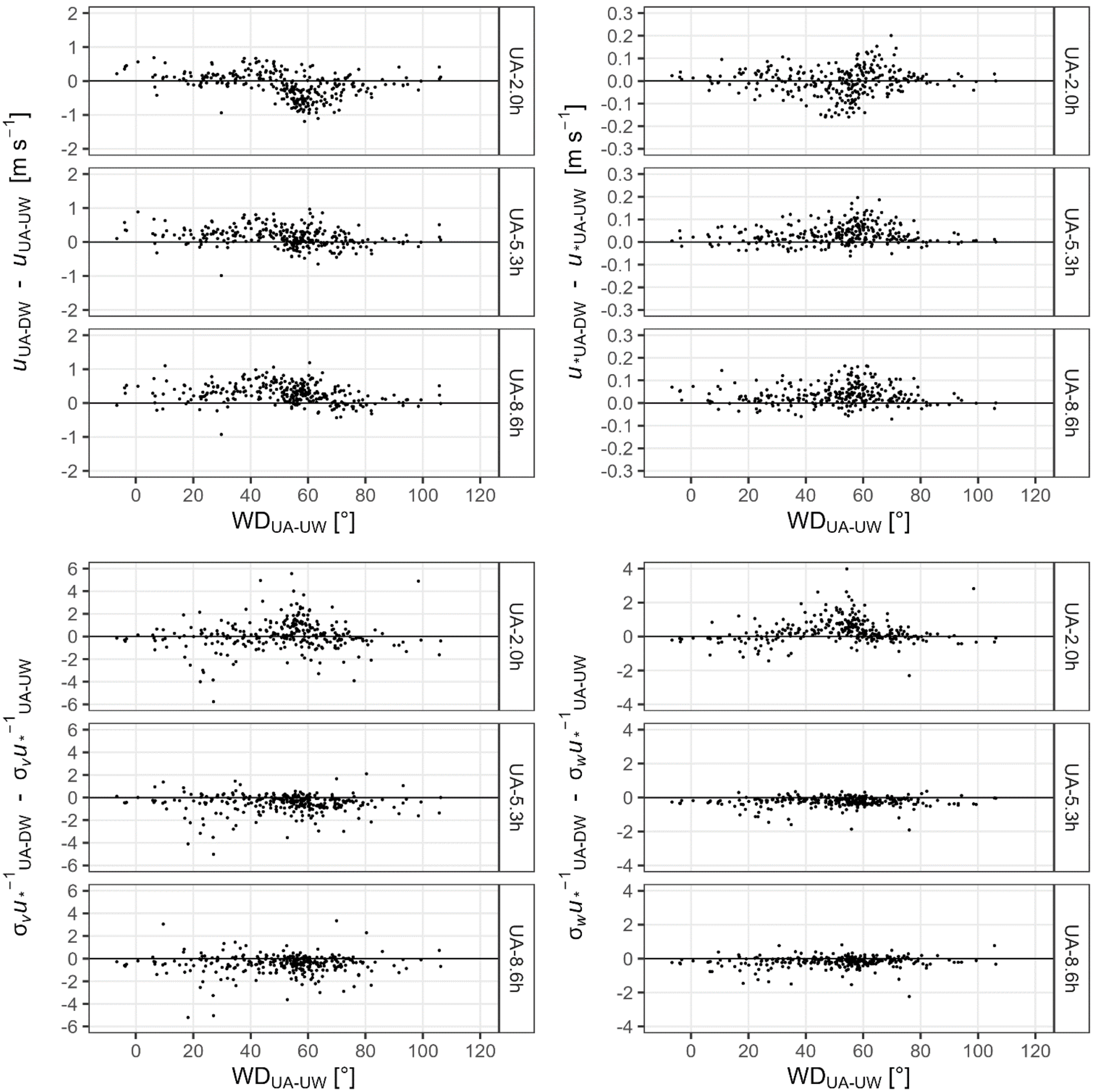

Fig. S4. Difference in turbulence data of the downwind UA compared to the UA-UW during the entire measurement campaign. Given are u = wind speed, u_* = friction velocity, σ_v/u_* = standard deviation of the v wind divided by friction velocity, σ_w/u_*= standard deviation of the w wind divided by friction velocity.

S7. Recovery rates determined with the downwind 3D ultrasonic anemometers

Recovery rates of the daytime and nighttime release with the downwind UA located in the disturbed wind field were also determined. On average, UA-5.3h and UA-8.6h showed similar data loss than UA-UW, whereas the data loss for UA-2.0h was somewhat higher. The recovery rates determined from the downwind UA in the disturbed wind field were on average always below 1 and did not substantially differ during the MC (Fig. S5). The median recovery rates for the entire campaign ranged between 0.58 - 0.70. Performing a Kruskal-Wallis test, these median recovery rates did not differ significantly from those of UA-UW. Compared to the UA-UW, a dependency of the fetch is less visible in the recovery rates. These recovery rates should be treated with caution as UA were used located in the disturbed wind field.

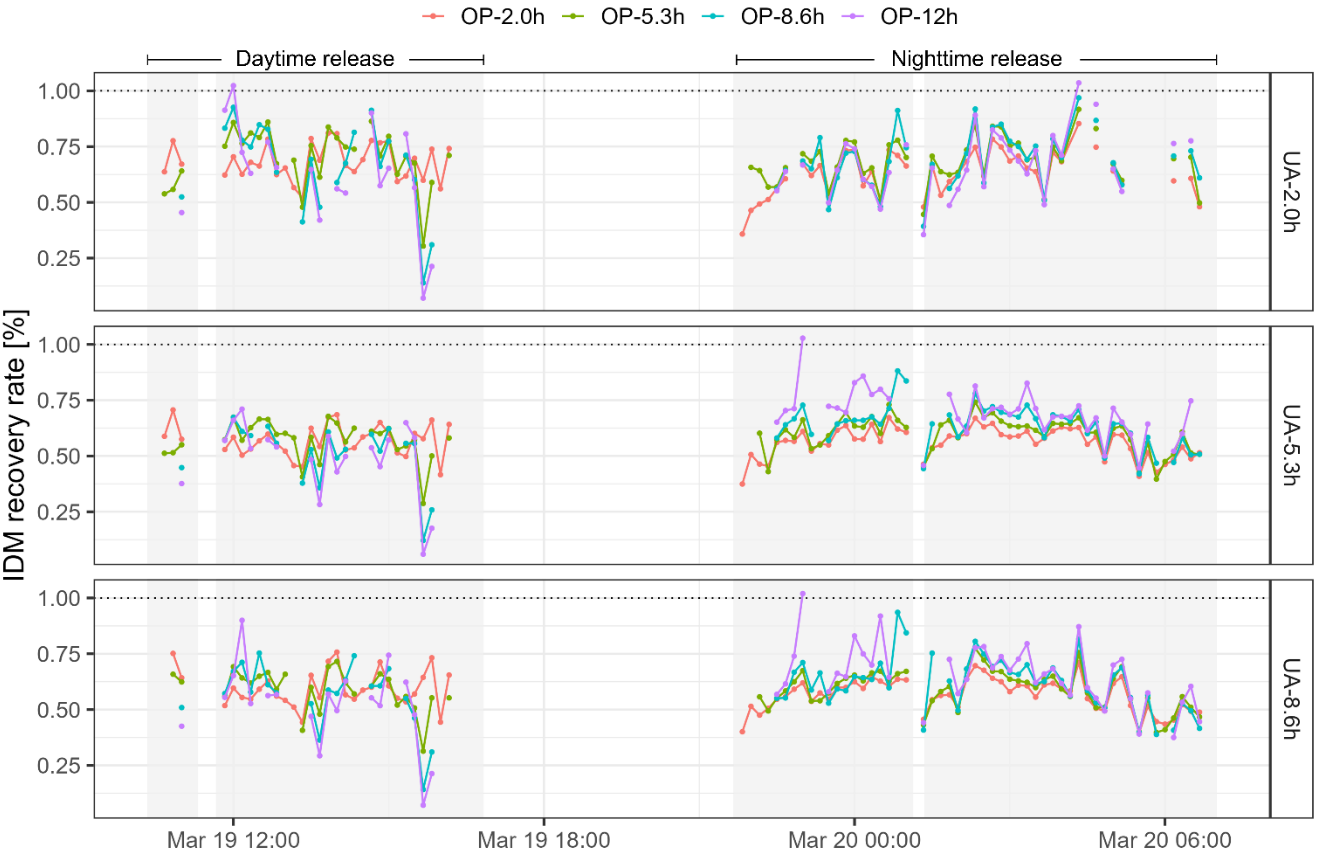

Fig. S5. Recovery rates for the measurement campaign based on the data from the of UA-2.0h, UA-5.3h and UA-8.6h, which were all located in the disturbed wind field. Each panel represents an UA and the colours indicates the OP. Grey shaded area are the times as CH_4 was released.

S8. Wind direction and friction velocity

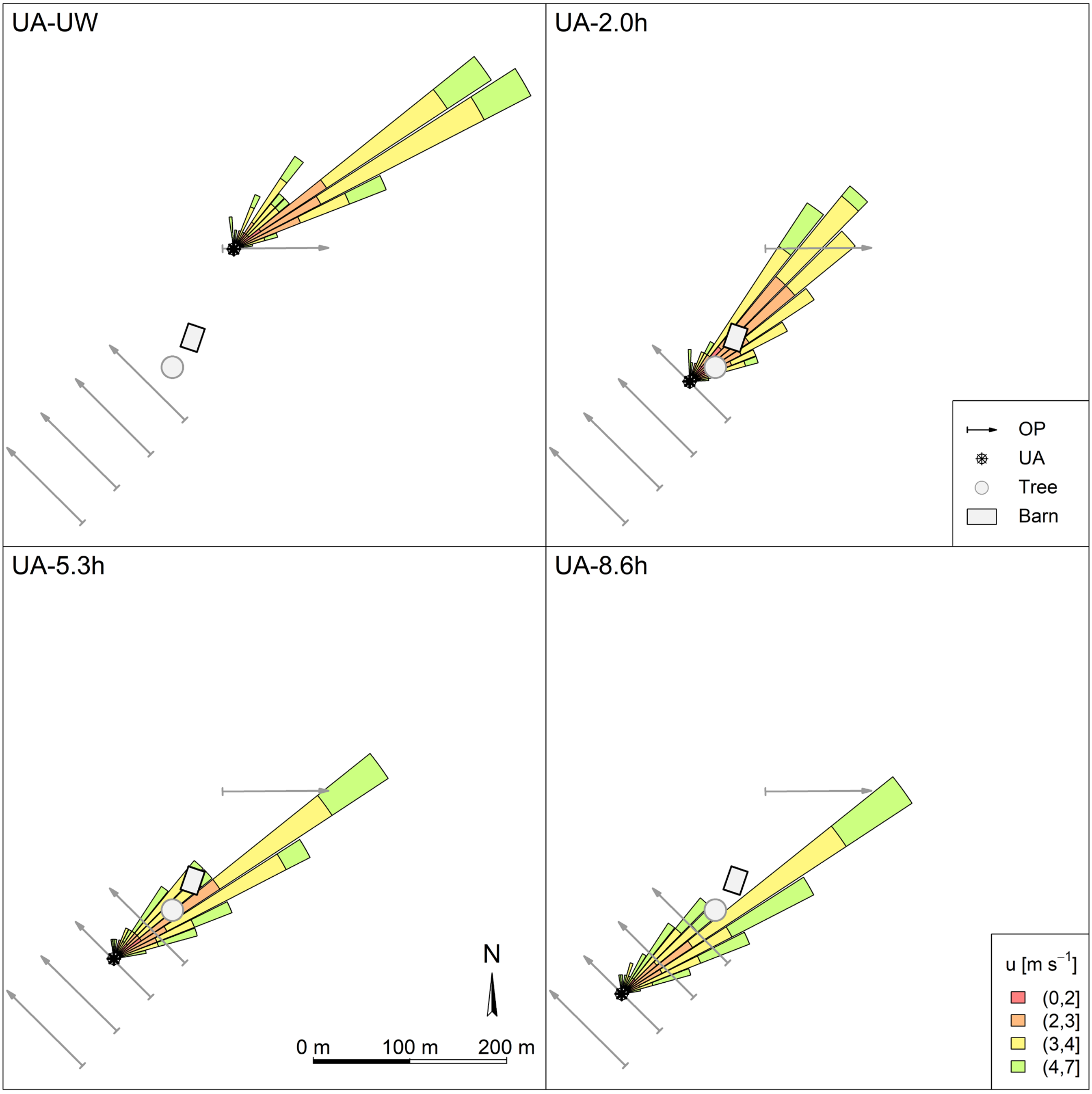

Fig. S6. Schematic overview and wind rose of the four 3D ultrasonic anemometers (UA). The data is from the two release phases. The wind rose indicates the frequency of occurrence of wind directions and wind speed in each wind direction sector (6° intervals with start point 0°). The longer the wedge, the more frequent the wind direction. The colours indicate the wind speed.