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Bavarian State Research Center
for Agriculture

Application of GPS to monitor cattle behaviour and pasture use in European Alpine regions

Institute for Agricultural Engineering and Animal Husbandry

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Introduction: The current situation in Alpine farming

- **Overview of Alpine farms**
  - App. 28,700 farms
  - 1,780,000 cattle; 1,566,000 sheep and goats
- **Workload**
  - Compared to lowlands higher workload (e.g. no fences)
  - Work with animals accounts app. 70 % of the total labour input
  - Search of cattle can take a whole day

Decrease of livestock units

Pasture succession..

Aims of the study

- **Usage of modern techniques (GPS + GSM) to optimize the farm management in Alpine regions**

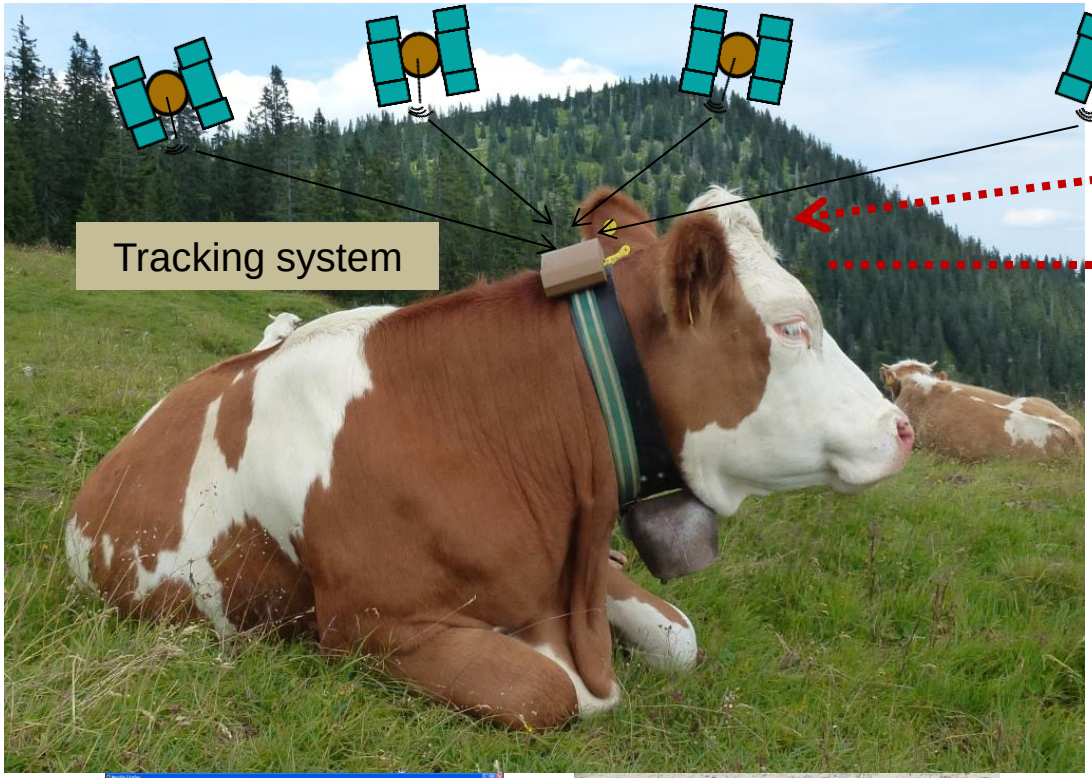
  ⟹ **Development of cattle tracking system for Alpine areas including decision-support software tools**

I. Monitoring of pasture use on Alpine farms

II. Analysis of cattle movement patterns based on GPS data

III. Recognition of cattle behaviour

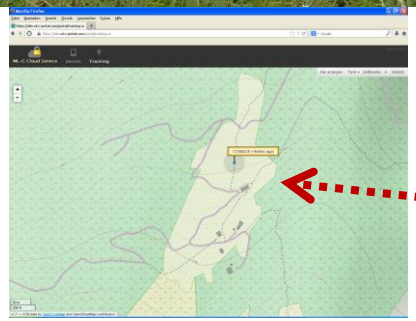
Materials and Methods: GPS tracking system

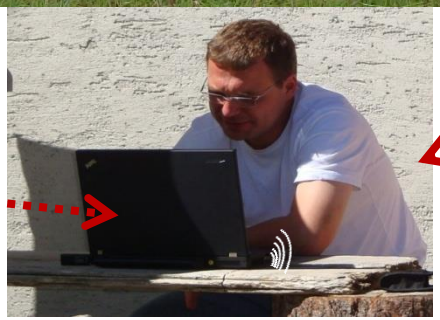


At least 4 GPS Satellite signals

GSM, GPRS Terminal

Data transmission





Configuration and control of animals

Web-database

Materials and Methods

I. Monitoring of pasture use

- GPS data of cattle from 3 Alpine farms over 2 pasture seasons

II. Cattle movement patterns based on GPS data

- GPS data from 6 heifers over 18 days, 14 h/day, 5 min GPS interval
- Dataset subsampled from 5 to 240 min GPS interval
- Distance walked by each heifer calculated based on GPS interval
- Correlation analysis (r_s) between successive distances pairs

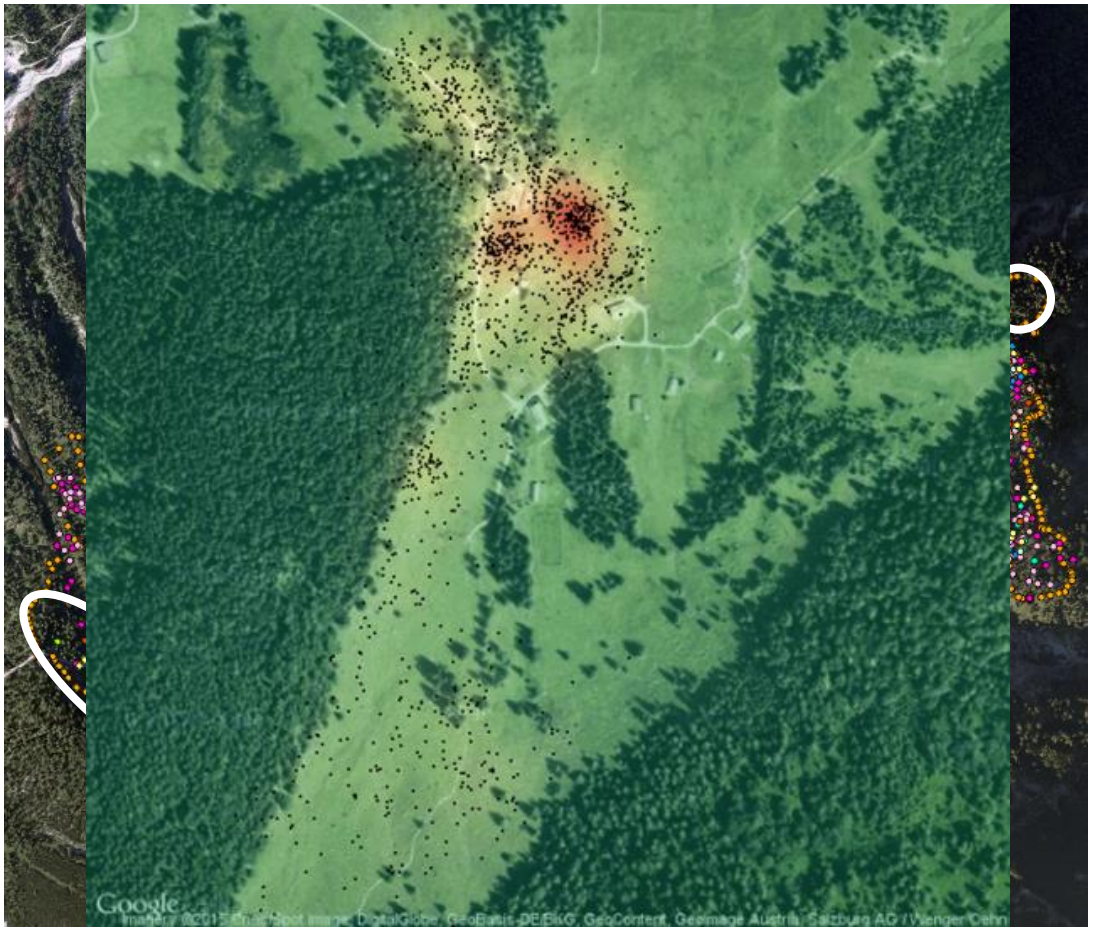
Materials and Methods

III. Recognition of cattle behaviour

- GPS data from 9 heifers over 7 days, 1 and 5 min GPS interval
- Behavioural observation based on Time-sampling, 8 h/day, 5 min interval
- 8 behavioural classes observed, 4 behavioural classes in final analysis (“walking”, “grazing”, “standing” and lying”)
- Calculation of distance walked and turn angle of each heifer → adehabitatLT package in R
- Identification of the differences among the classes of behaviour scores → Wilcoxon runk sum test

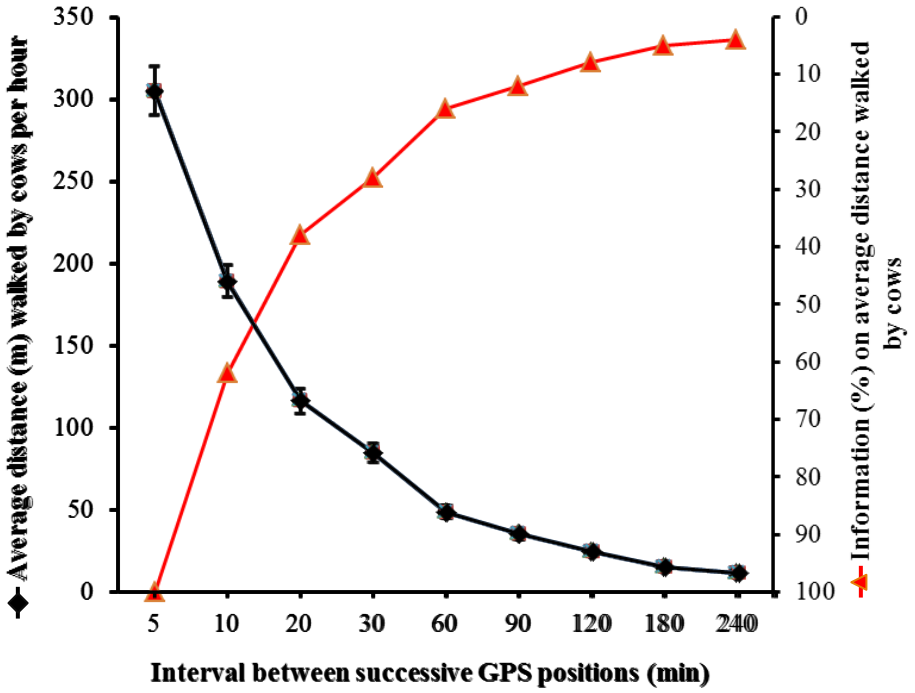
Results: I. Monitoring of pasture use

- Earlier recognition of non-grazed pasture areas based on GPS data → prevention of succession and degradation
- Identification of pasture areas with higher concentration of activity
- Potential for optimization of pasture management



Results: II. Cattle movement patterns based on GPS data

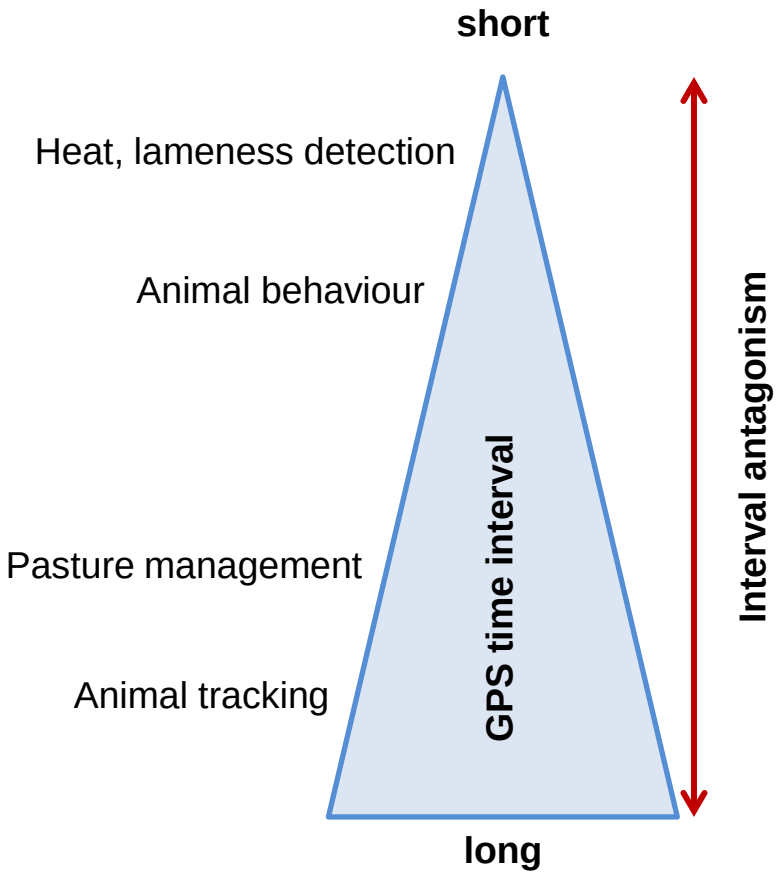
- Influence of GPS time interval on interpretation of animal movement data and further behaviour analyses



- 38 % less information by increasing interval from 5 to 10 min
- Only 16 % of information left by 60 min interval

Results: II. Cattle movement patterns based on GPS data

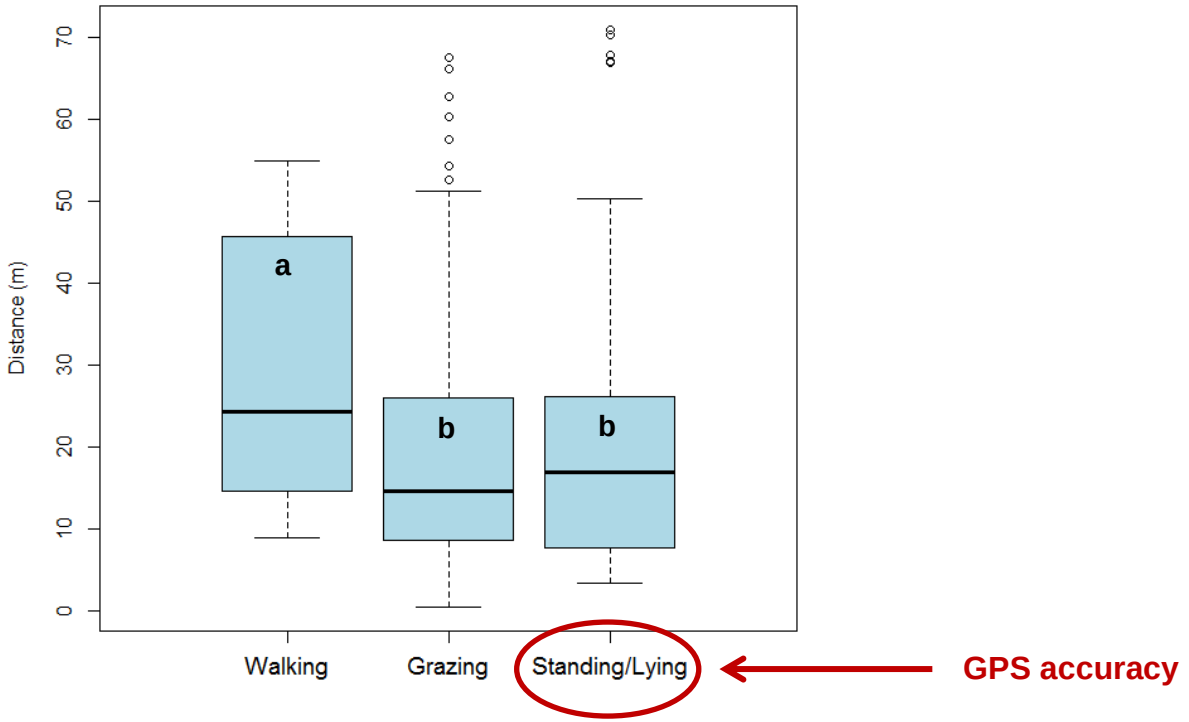
- Optimal GPS sampling interval is crucial for interpretation of results
- Data collection in short time intervals with subsampling for further analyses?
- Short time intervals → higher data transmission costs, shorter battery life



Results: III. Recognition of cattle behaviour

- Identification of behaviour based on spatial movement patterns

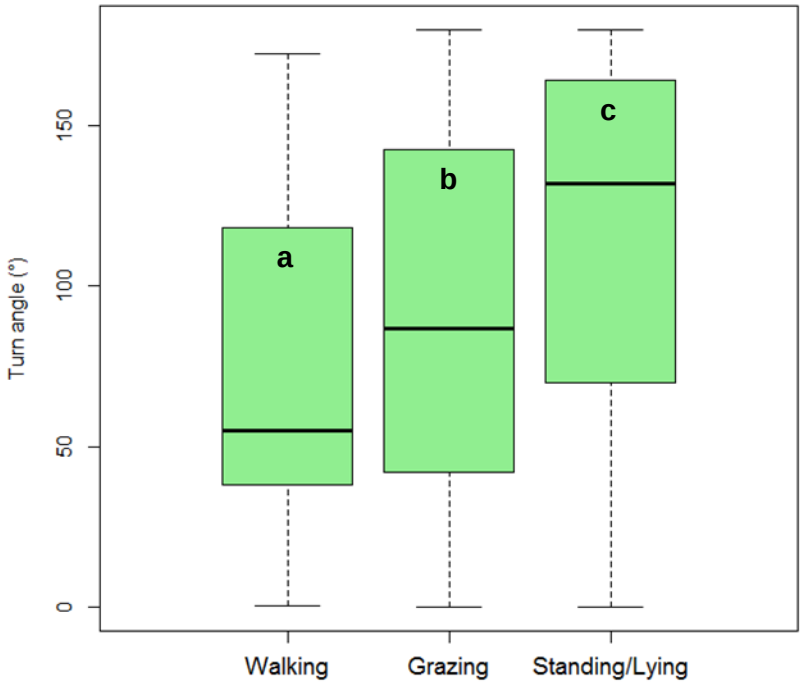
Distance walked (m) based on 1 min GPS interval in different behavioural classes



a,b P≤0.05

Results: III. Recognition of cattle behaviour

Turn angle (°) based on 5 min GPS interval in different behavioural classes



a,b,c P≤0.05

Conclusions and Perspectives

- **Conclusions:**
  - Potential for optimization of pasture management and workload using GPS tracking system
  - Sampling frequency of GPS positions is crucial for further analyses related to animal activity and movement
  - Animal behaviour such as walking, grazing and standing/lying could be distinguished based on GPS data basis
- **Perspectives:**
  - Recognition of a wider spectrum of behavioural data ⟹ additional information from other sensors needed
  - Development of classification algorithms for heat and lameness detection

Thank you for your attention!