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[5] University of South Africa

Space Transformation for Understanding Group Movement

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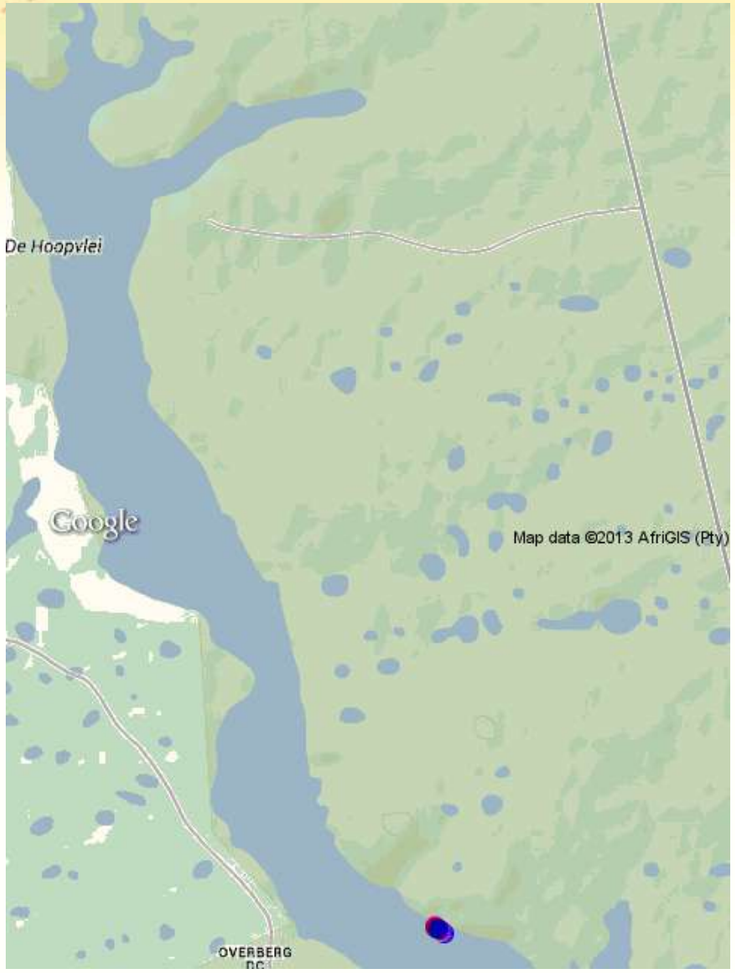
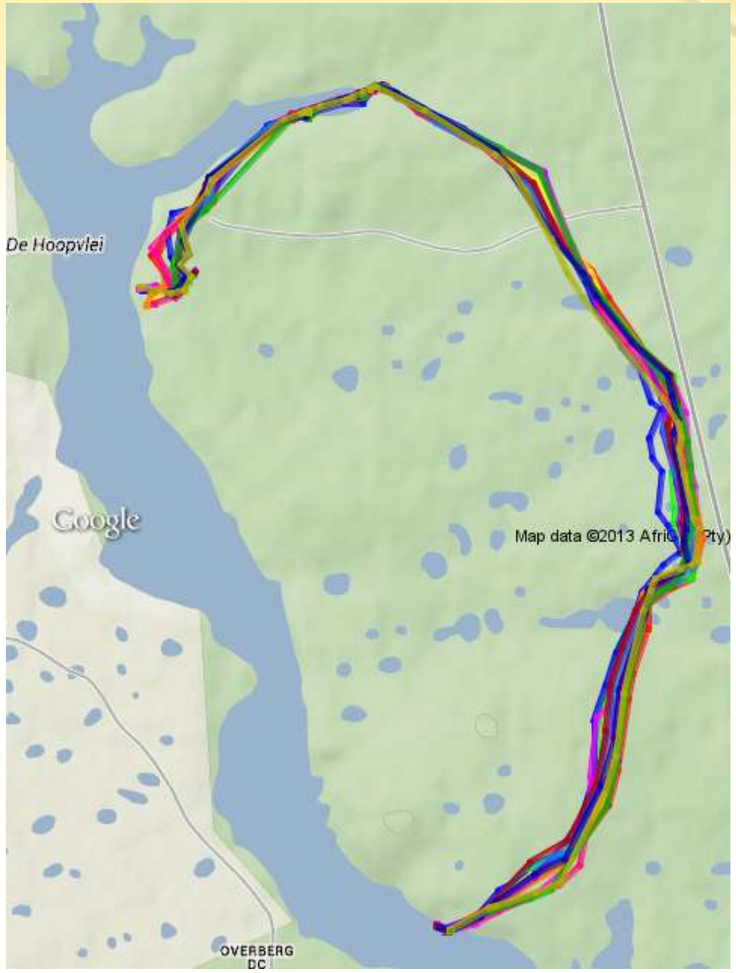
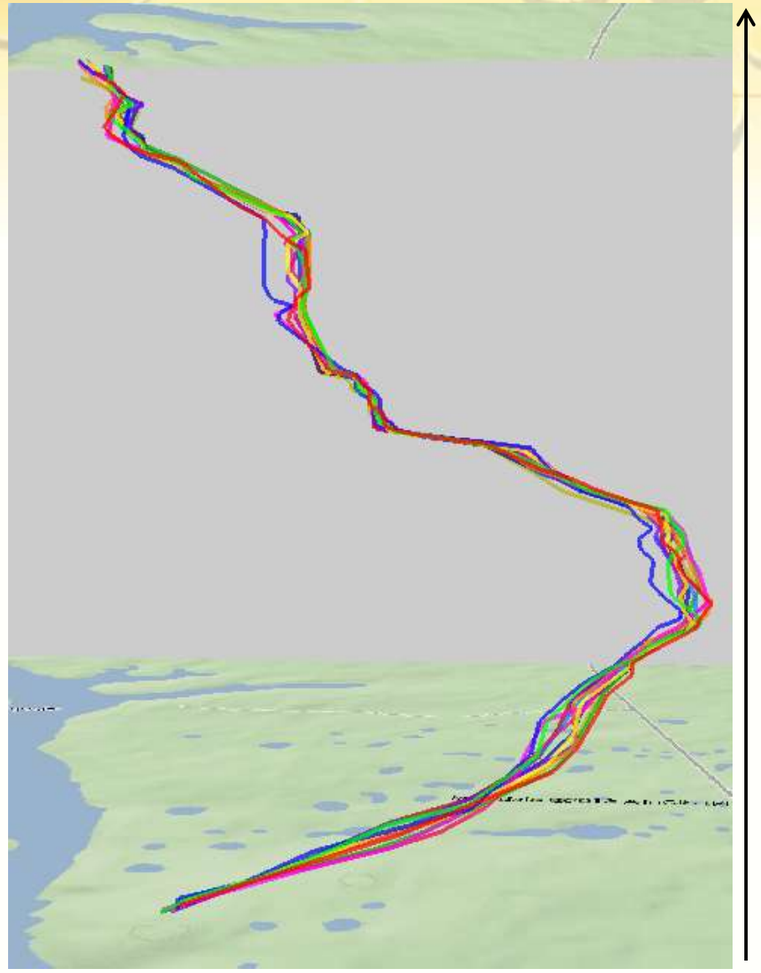
Louise Barrett[4,5], Marcus Dostie[4,5], Peter Henzi[4,5]

Group movement

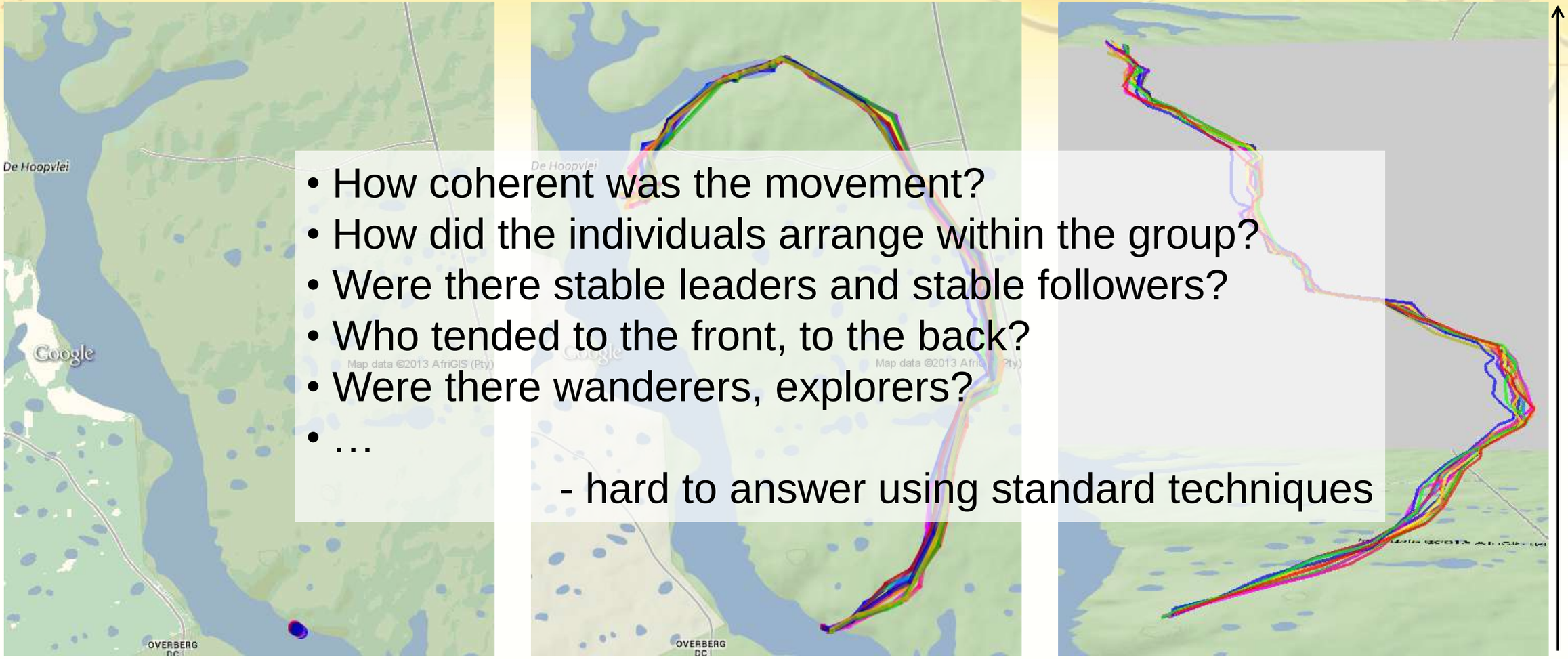






Movement of a group of 13 savannah baboons during 1 day

Group movement

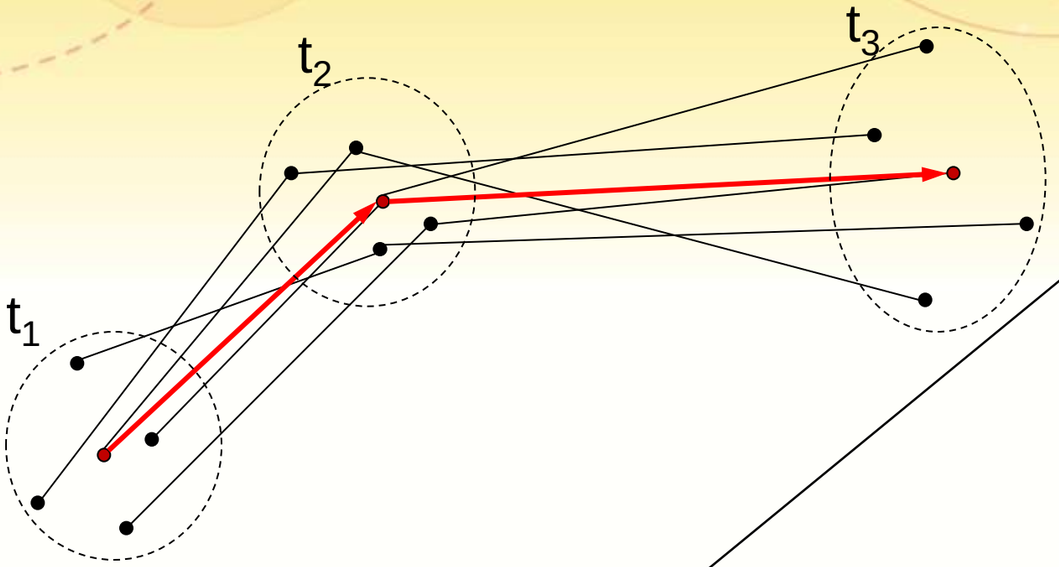


- How coherent was the movement?
- How did the individuals arrange within the group?
- Were there stable leaders and stable followers?
- Who tended to the front, to the back?
- Were there wanderers, explorers?
- …

- hard to answer using standard techniques

Movement of a group of 13 savannah baboons during 1 day

Data transformations



Construct the central trajectory of the group

Compute collective movement measures
- statistics of distances of the members to the group centre
- statistics of directions w.r.t. group movement vector

Visualize and analyze as attributes

Compute the relative positions of the members w.r.t. group centre and movement vector

Determine the relative order, direction dev., etc.

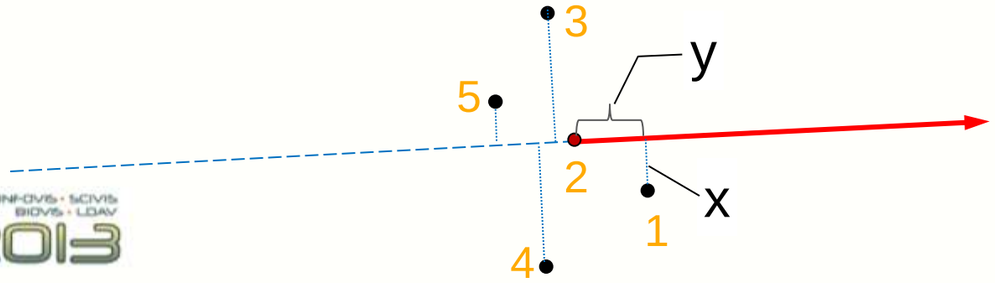
Visualize and analyze as attributes

Detect and extract trend setting events

Visualize and analyze as events

Transform the trajectories to the relative group space

Visualize and analyze as usual trajectories



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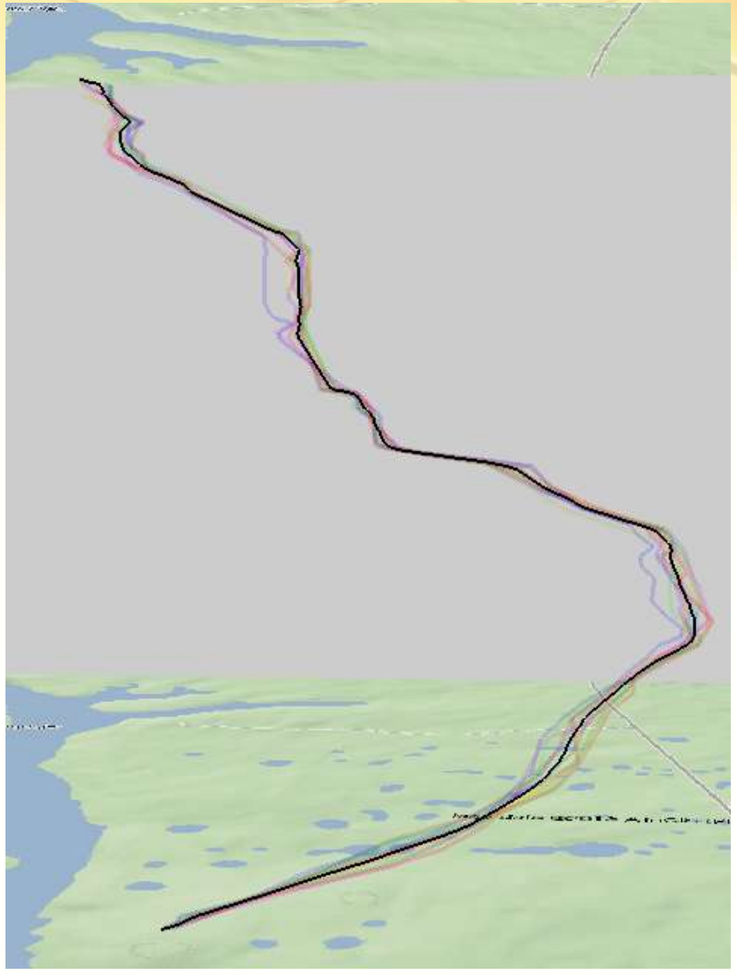
Central trajectory of the group



Attributes

Classes by Median direction deviation

- < 10.0: 178 objects (44.8%)
- [10.0..30.0): 149 objects (37.5%)
- [30.0..60.0): 39 objects (9.8%)
- >= 60.0: 31 objects (7.8%)

Median distance to centre

0.35 — 64.04

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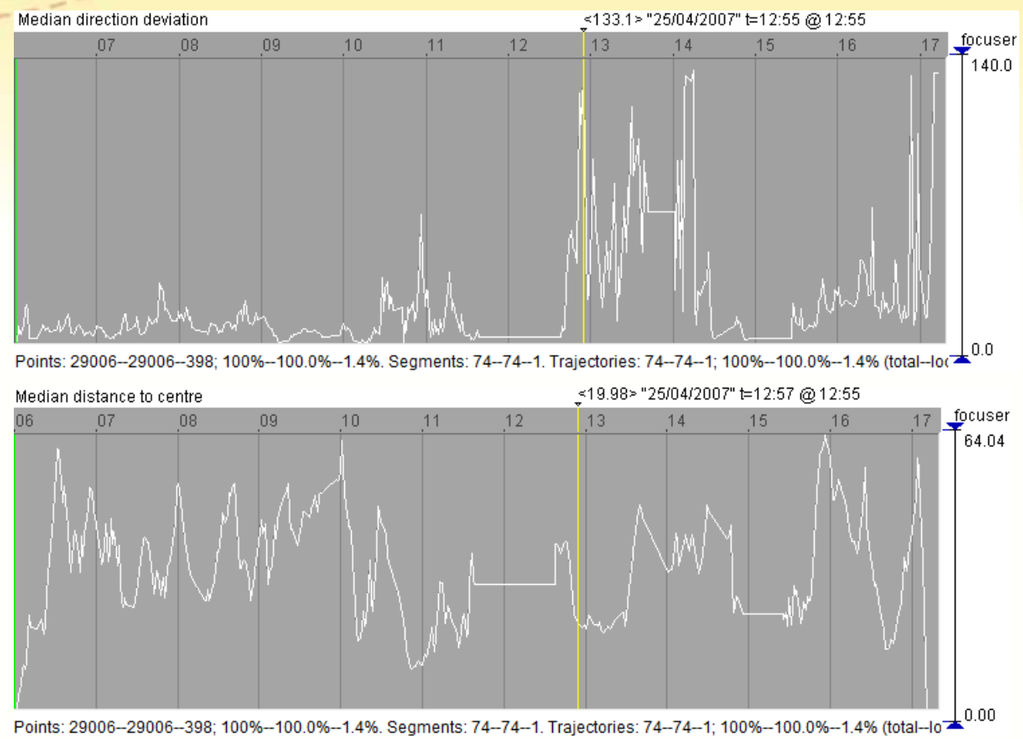
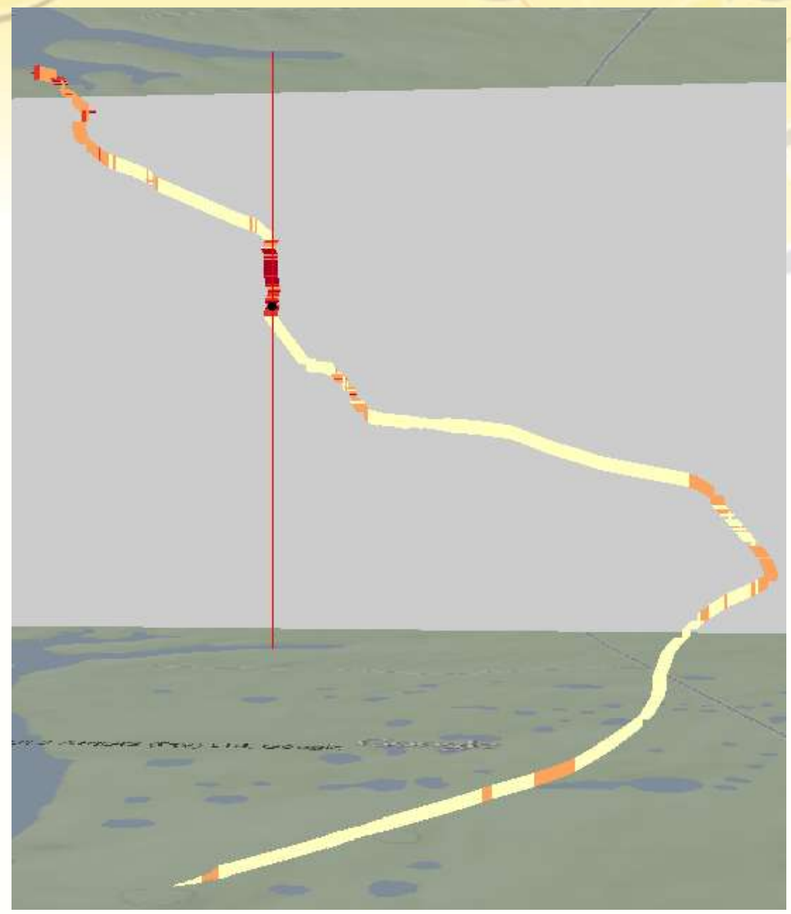
Analyzing movement of the group as a whole



25/04/2007 06:02-17:11	25/04/2007
Position N	258
Position time	12:55
Max distance to centre	47.27
Mean distance to centre	23.04
Median distance to centre	19.98
3rd quartile distance to centre	31.12
Maximal direction deviation	180.00
Mean direction deviation	106.87
Median direction deviation	133.07
3rd quartile of direction deviation	146.31



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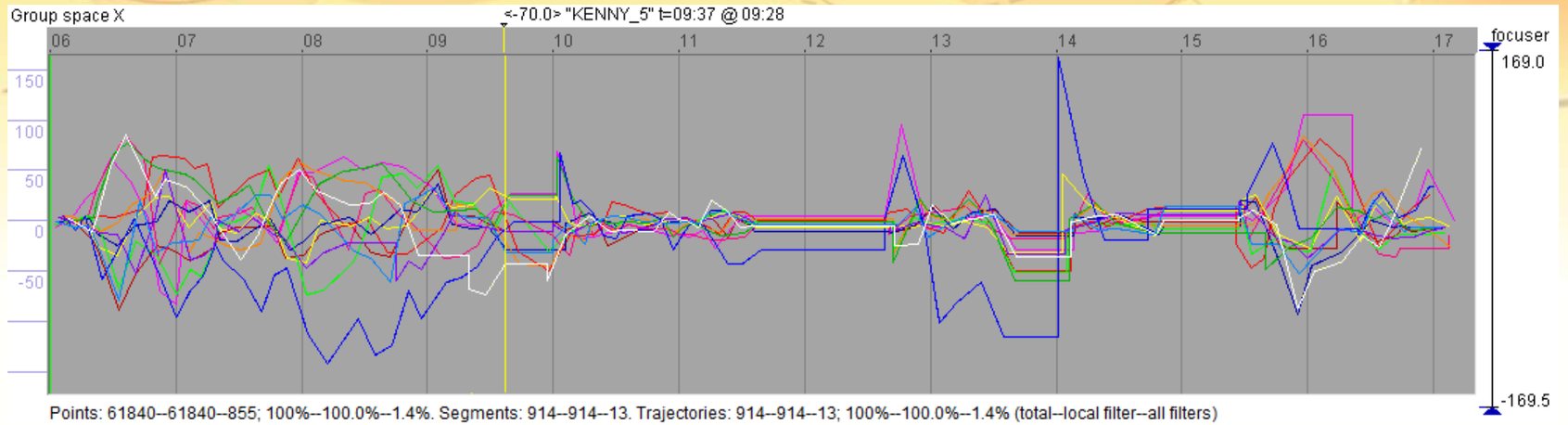
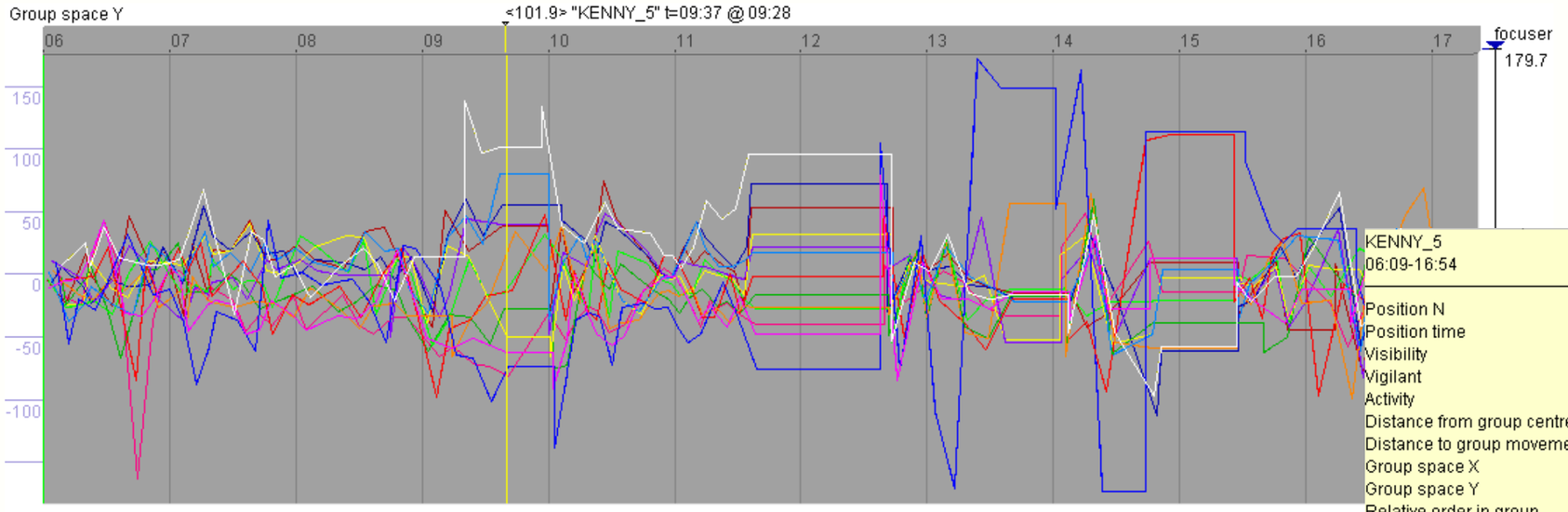
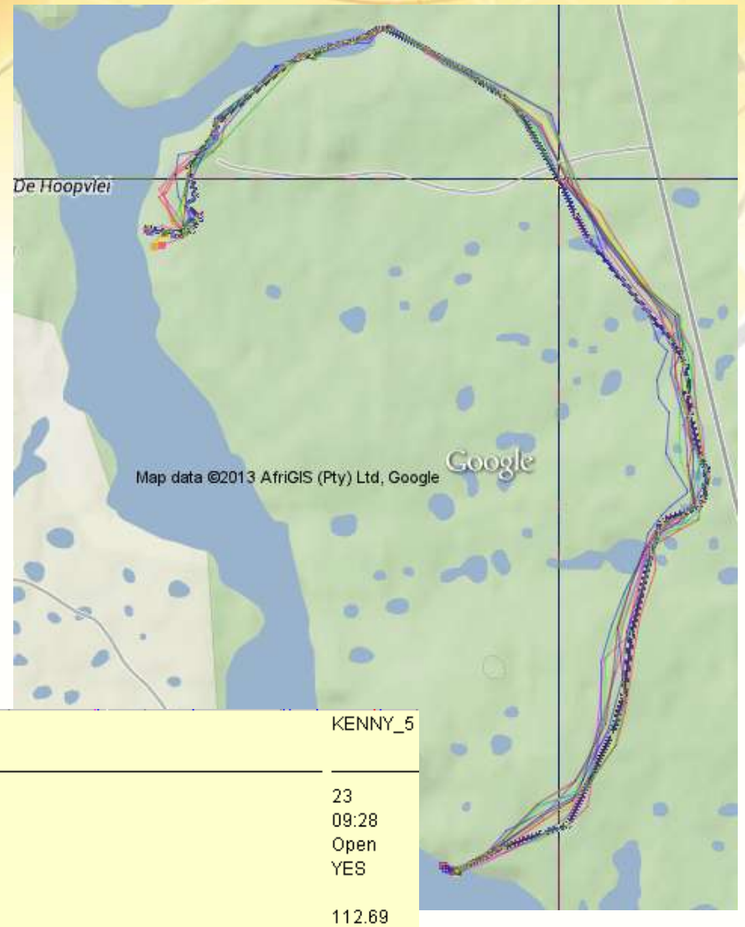
From the whole group to the individuals







KENNY_5 06:09-16:54	KENNY_5
Position N	23
Position time	09:28
Visibility	Open
Vigilant	YES
Activity	
Distance from group centre	112.69
Distance to group movement vector	70.03
Group space X	-70.03
Group space Y	101.85
Relative order in group	1
Direction deviation from group	5.25
Minimal direction deviation from group in past 15 minutes	5.6814214
Time distance to minimal direction deviation from group in past 15 minutes	4.0
Minimal direction deviation from group in next 15 minutes	2.9357384
Time distance to minimal direction deviation from group in next 15 minutes	16.0

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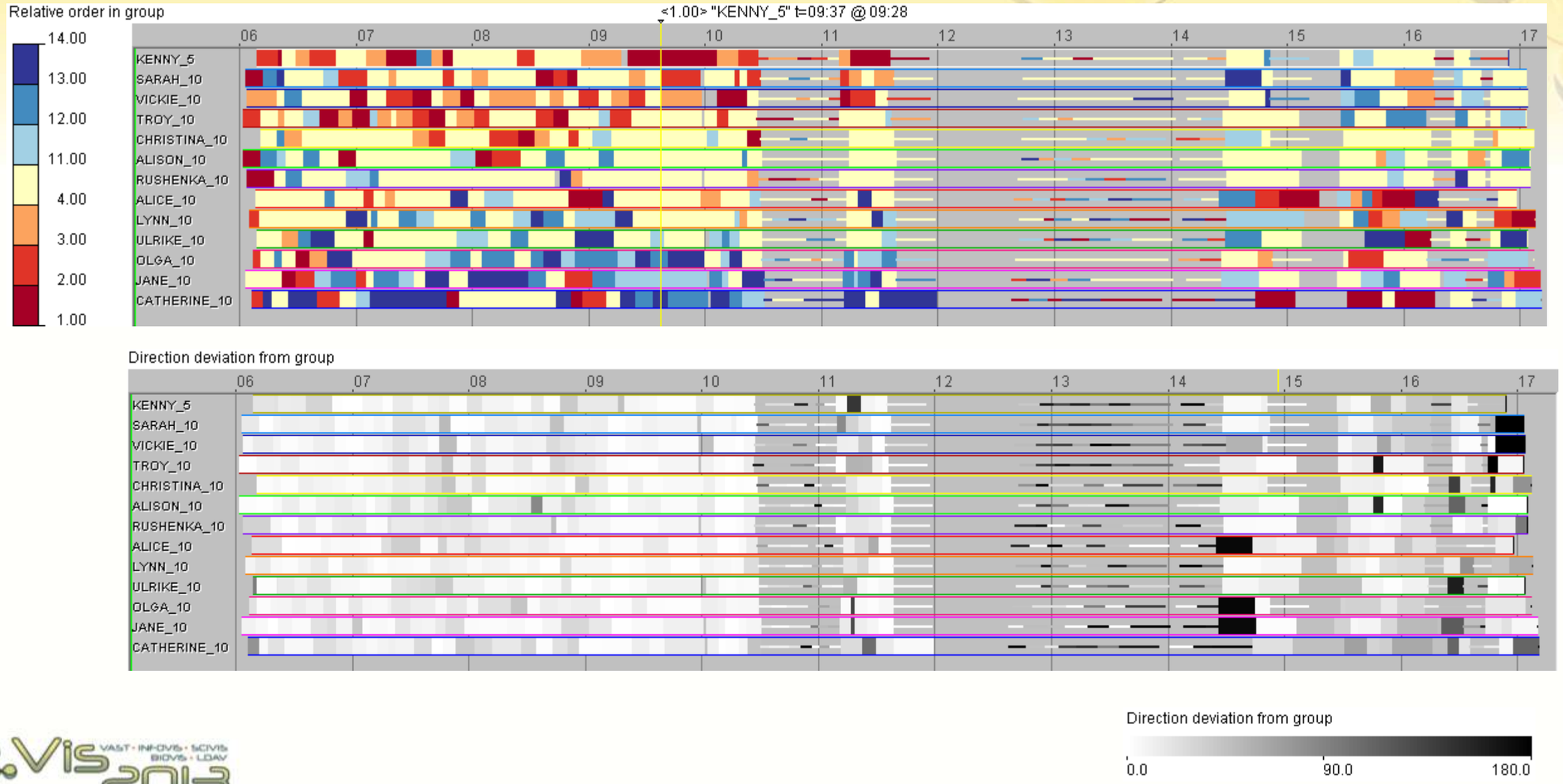
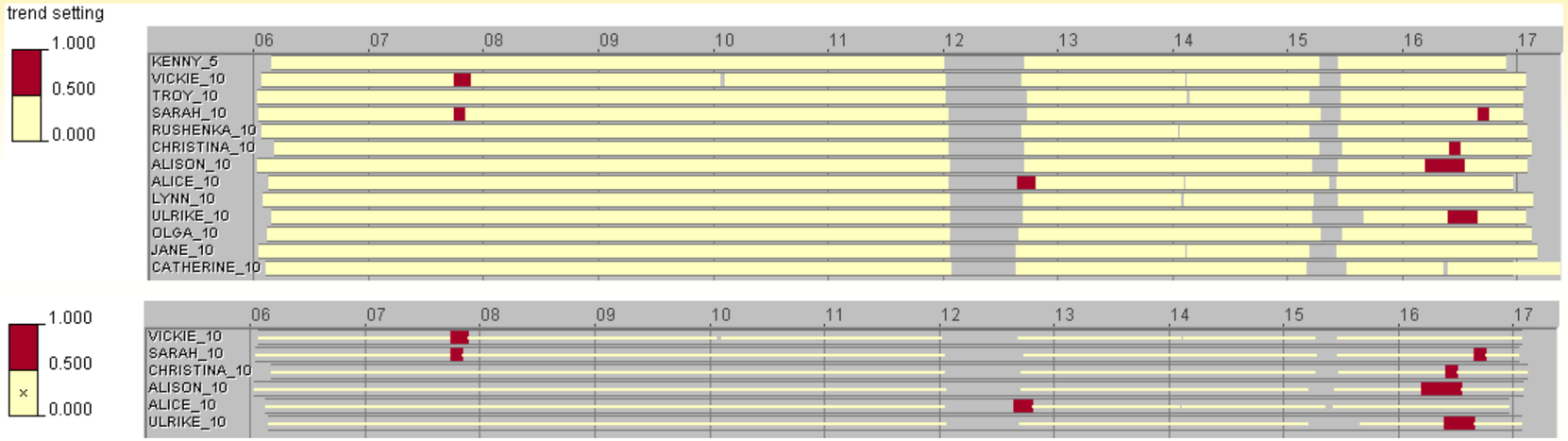
Behaviors of the members in the group



Trend setting



Trend setting ::= movements of an individual are “copied” by others after a time lag.
More specifically:
Trend setting at time unit ***t*** occurs when an individual takes a movement direction significantly deviating from the direction of the group and at a later moment ***t*+Δ** the group takes the same direction as the individual at time ***t***

Parameters:
Deviation at ***t*** is at least 45˚
Δ = 15 minutes
Deviation at ***t***+Δ is at most 5˚
Not during a group stop

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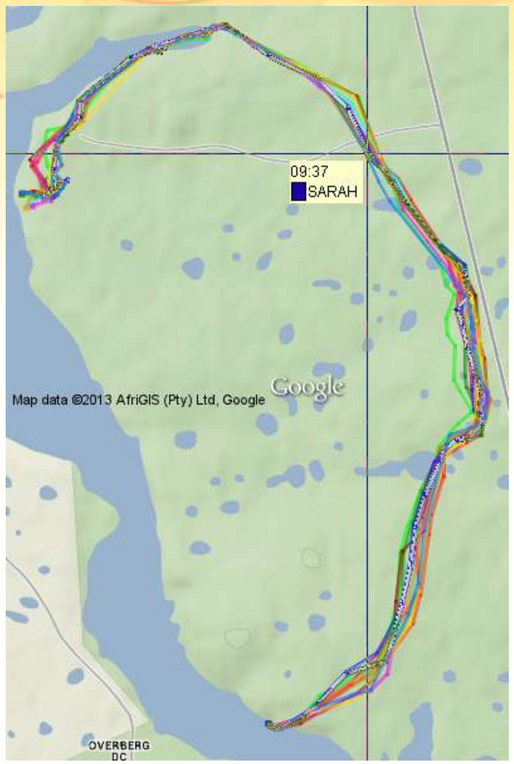
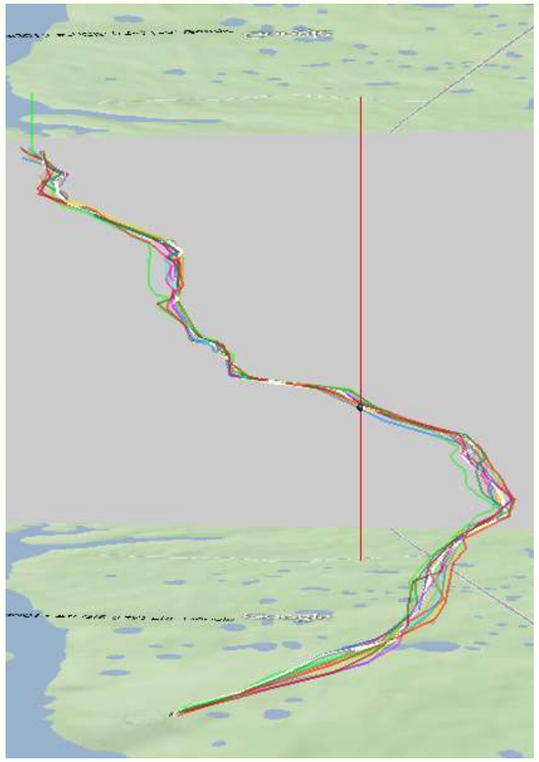
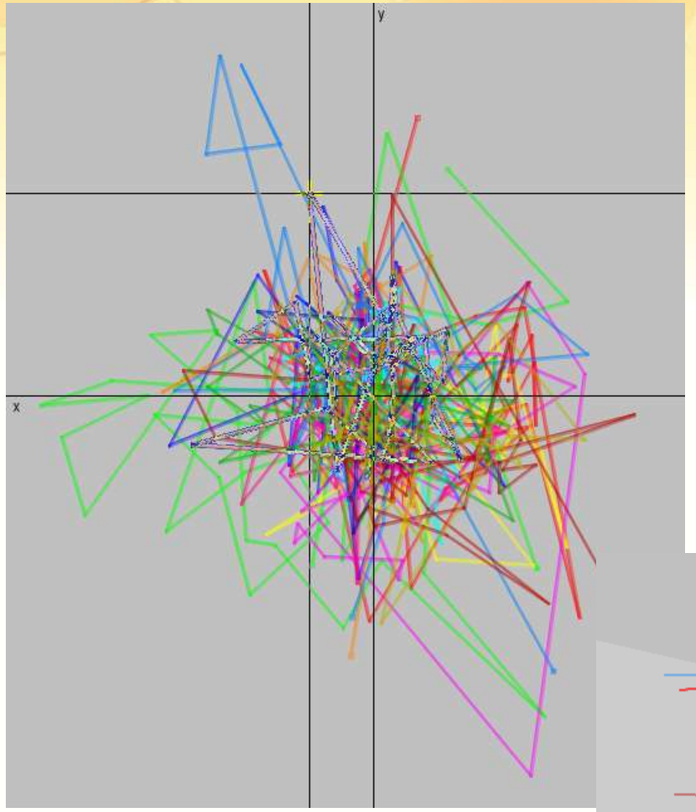
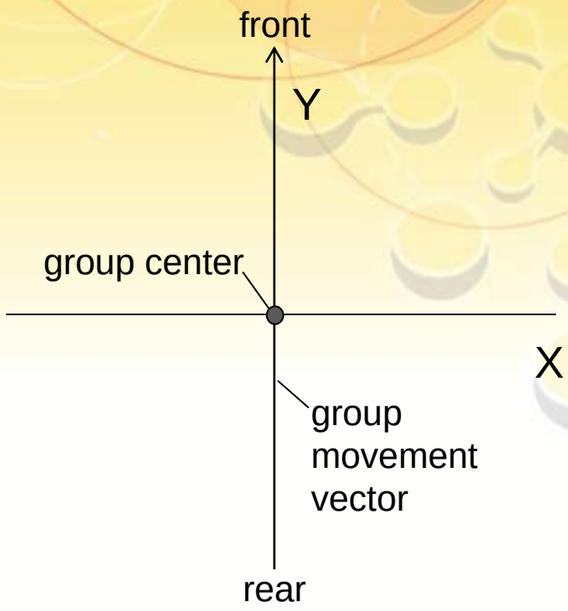
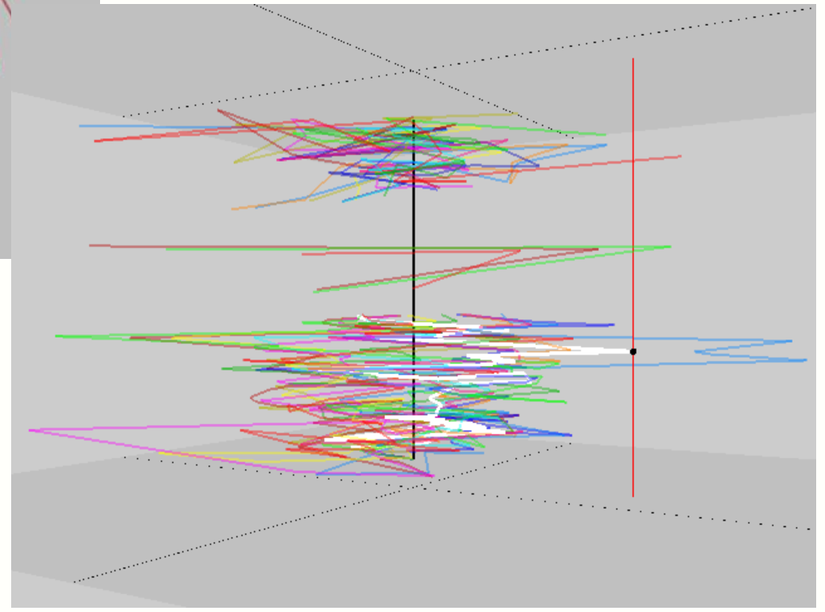
Geographic space → group space











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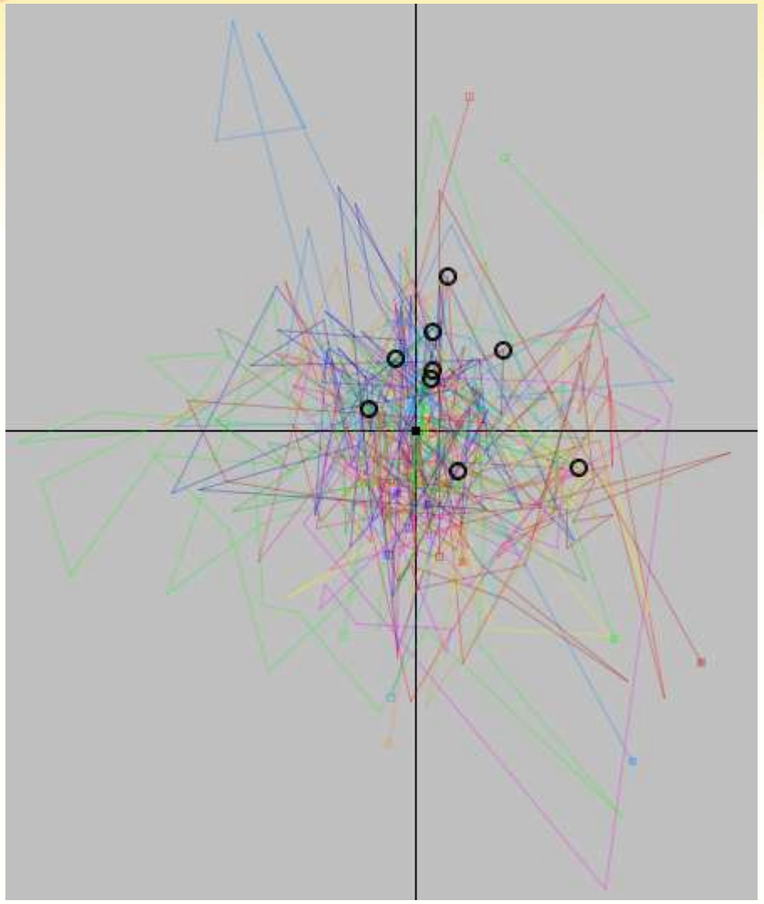
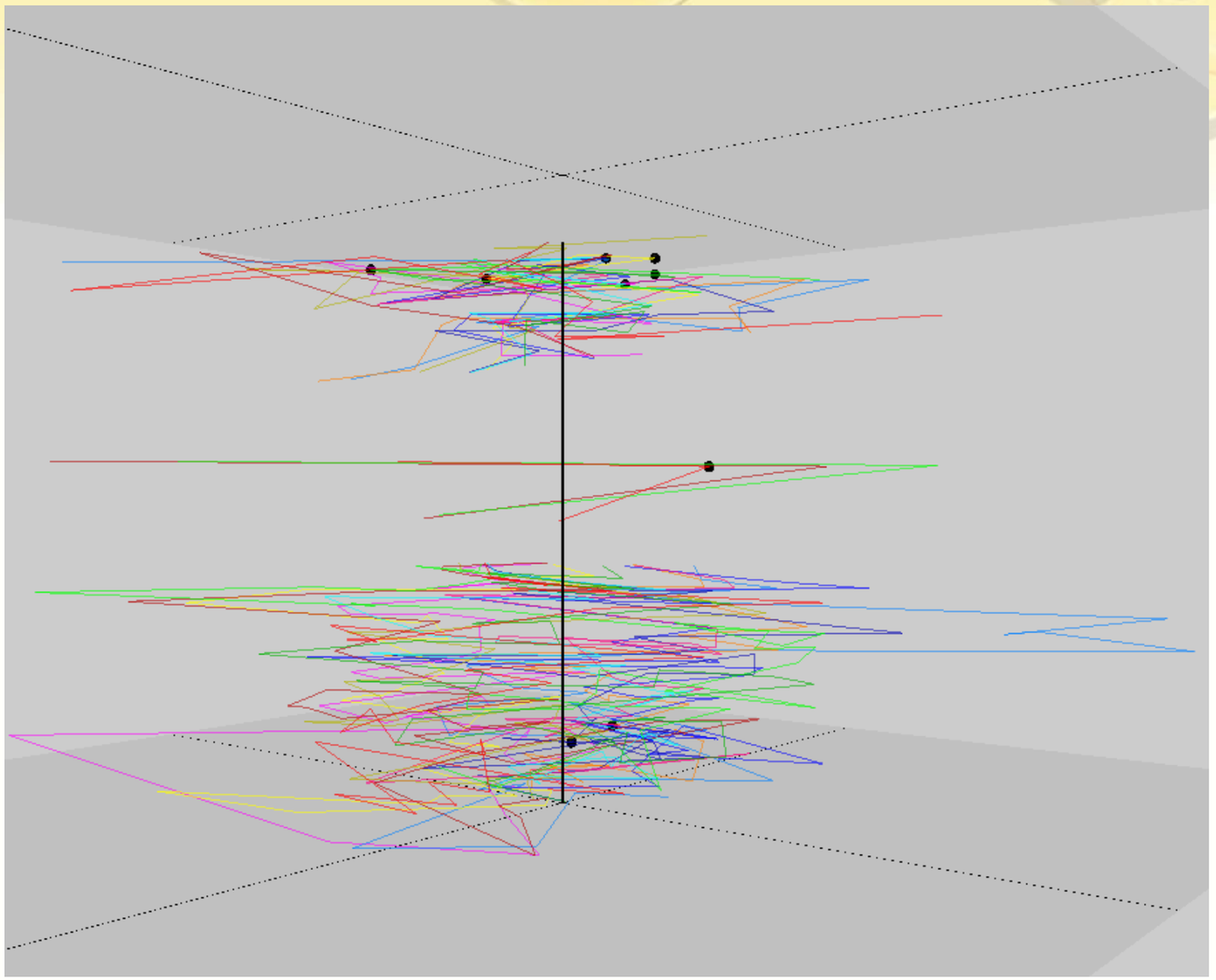
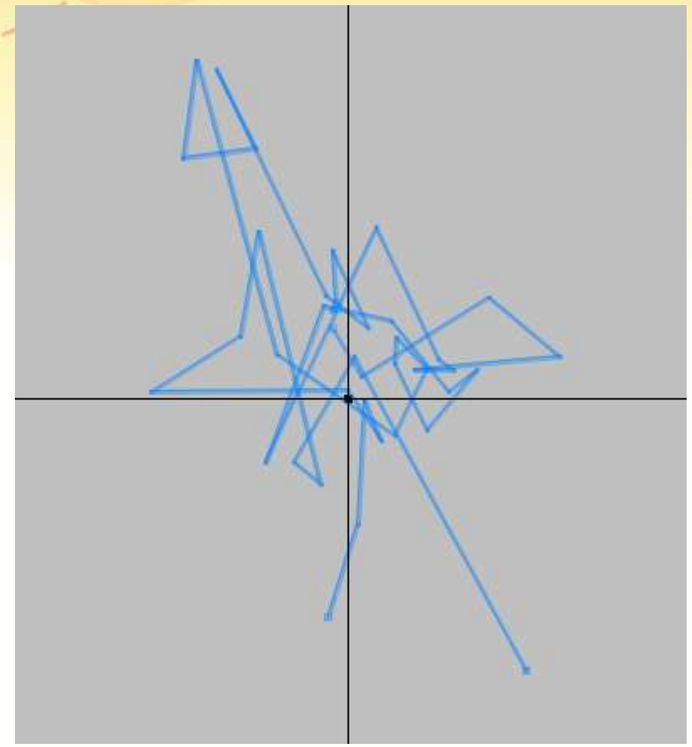
Positions of the trend setting events

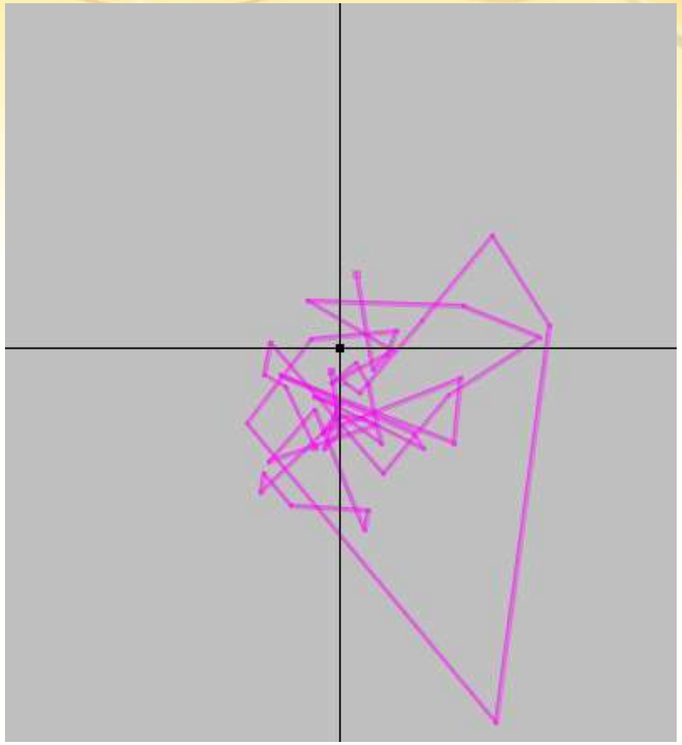




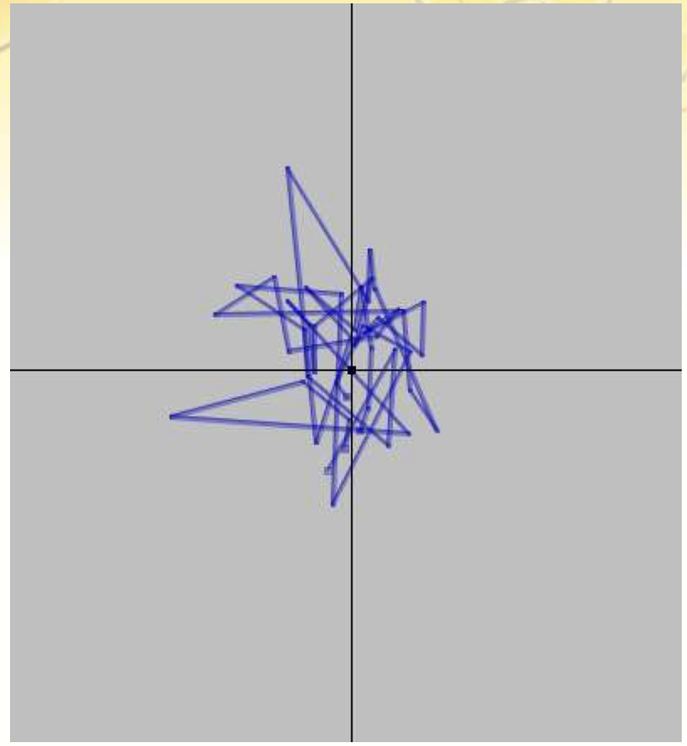
Footprints of individuals in the group space



Kenny



Olga

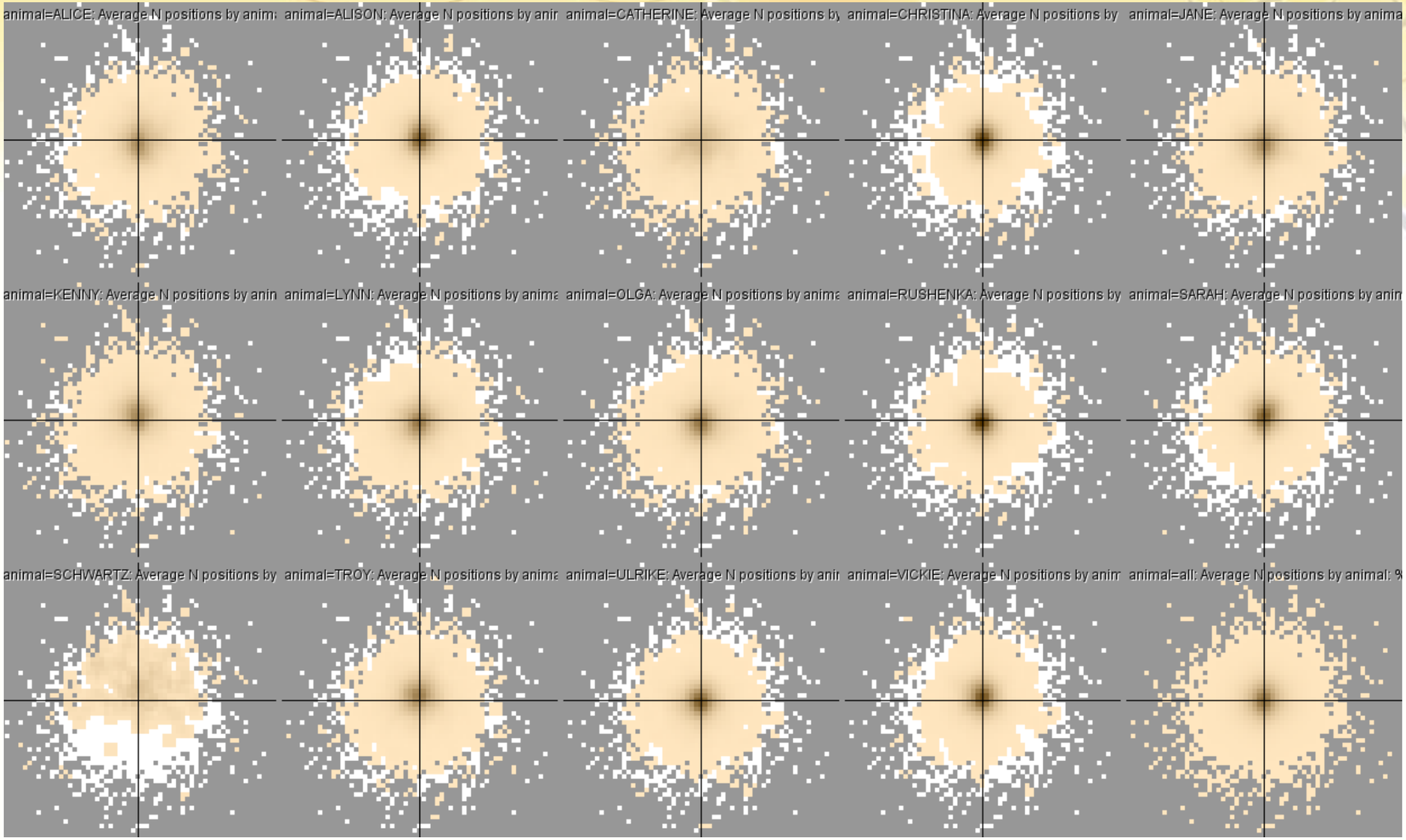


Sarah

Animal researchers wish to gain more general knowledge about individuals' movement behaviors in the group by analyzing data from long observation period.

Aggregation and summarization of the transformed data support the required generalization.

Distributions of the individuals' positions in the group space



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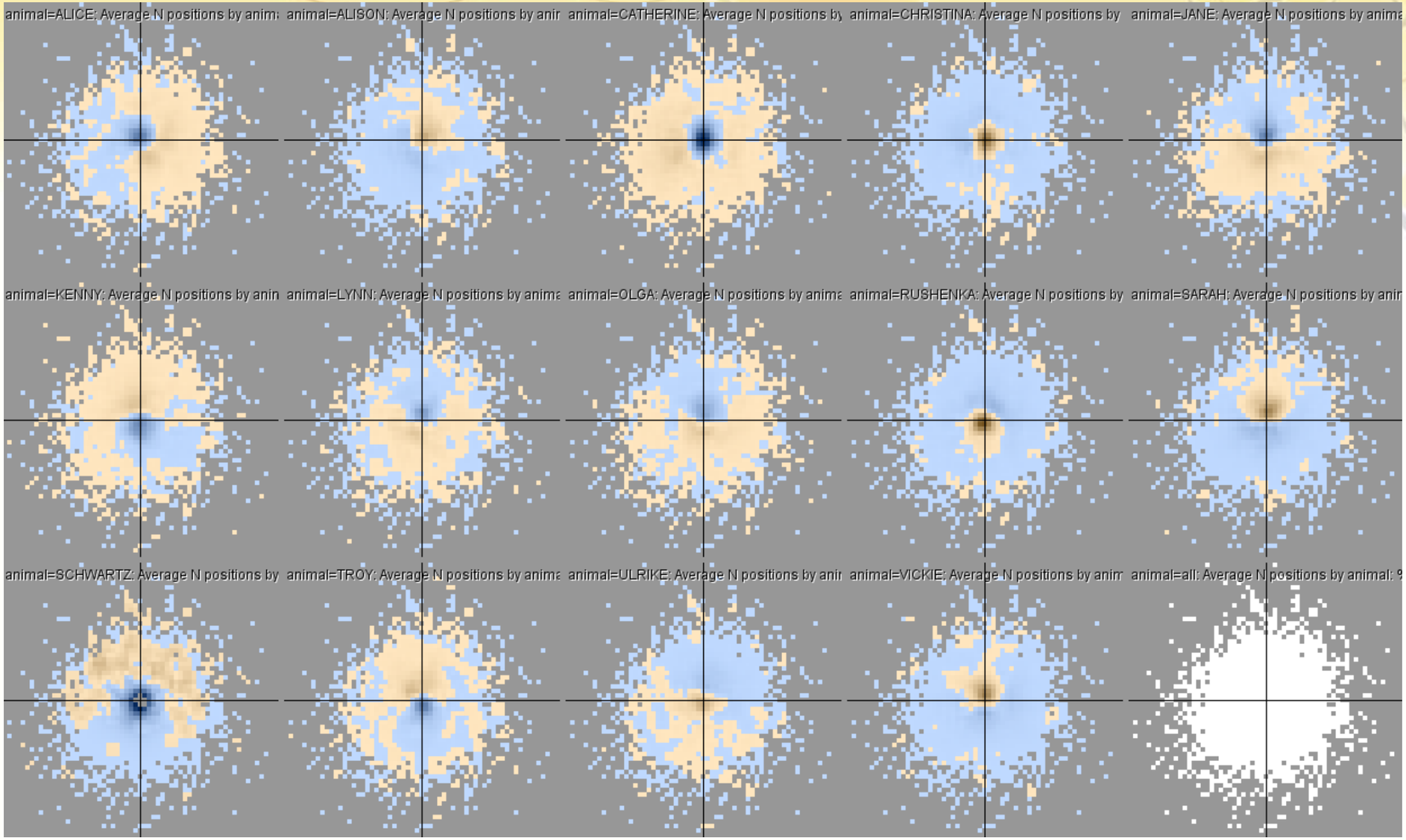

Individual differences become more prominent after subtracting the average position distribution from the individual position distributions.

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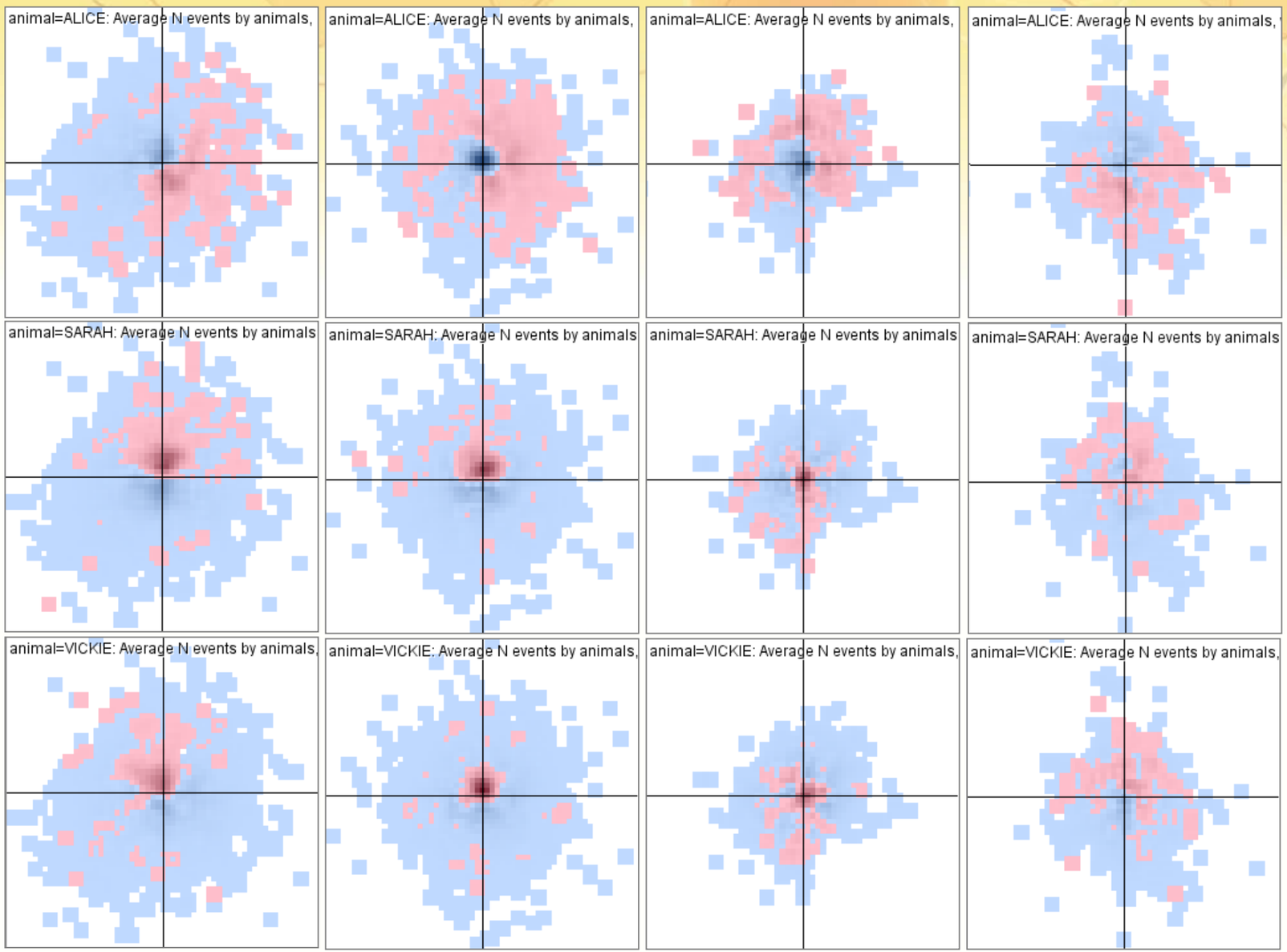
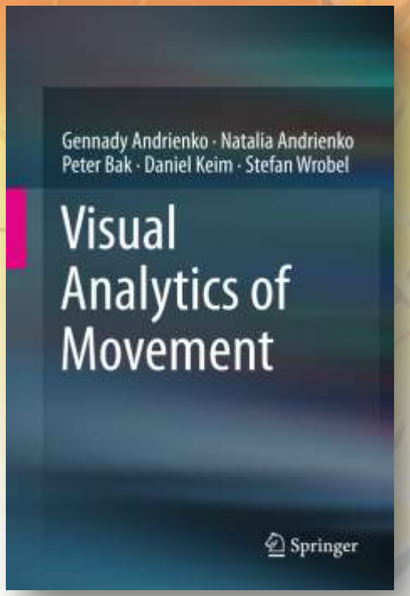
Temporal variation of the distribution patterns

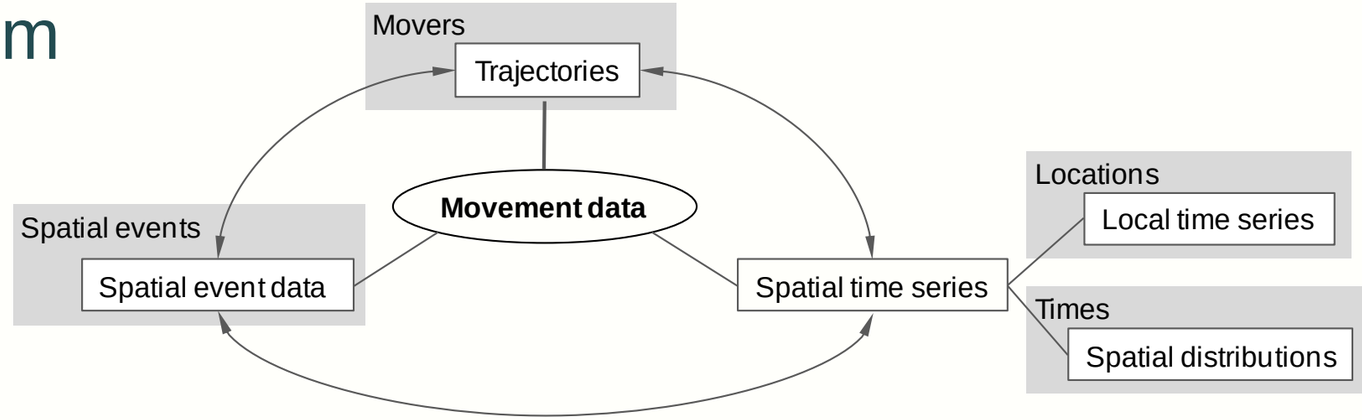


Conclusion

- Goal: support specific tasks in group movement analysis
  - Study the movement of the group as a whole (changes of the group's position and spatial footprint)
  - Study the behaviors of the individuals within the group (positions in relation to others and changes of these positions over time)
- Key idea: space transformation
  - Transformed data can be analyzed using usual movement analysis methods
- Test application results: interesting and important insights into collective movement behaviors of baboons
- Other possible applications: race sports

- Conceptual foundations
- Multi-perspective view of movement data
- Systematic presentation of visual analytics methods for the different views of movement and analysis tasks
- Transformations between different representations of movement
- Discussion of properties of movement data that affect the analysis and methods for investigating them
- Many illustrated examples using diverse real datasets
- Glossary





Questions?

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