KDE+ INTERNATIONAL COMPARISON of AVC clustering patterns

Animal-vehicle collisions | Traffic accidents | Roadkill | Kernel Density Estimation | Monte Carlo Simulations

Czech Republic | Finland | France | Hungary | Israel | Italy | Poland | Slovakia | Spain | Sweden | Switzerland | California (USA) | Idaho (USA)

1 INTRODUCTION

» data from 13 countries, states and regions

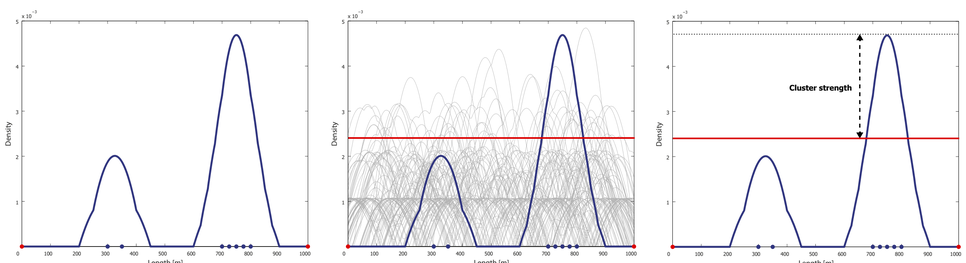
» data disunity and many differences between countries:

- » databases of animal-vehicle collisions (AVC), roadkills (RK), or traffic accidents (TA) in general (without animal culpability)
- » system of localization (GPS, linear stationing, other)
- » road network data (road sections divided at intersections, OSM)
- » territorial extent
- » time period

» KDE+ analysis for objective identification of dangerous locations (hotspots, clusters) on roads

- » to compare AVC pattern among the respective countries

2 METHODS



KDE+ method

» Clustering of traffic accidents

» Monte Carlo simulation

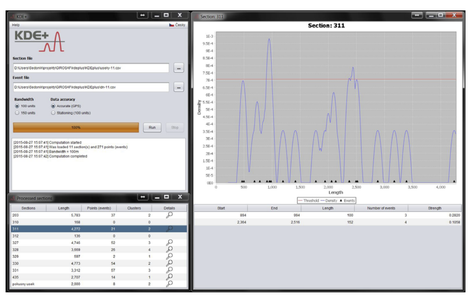
» Objective cluster significance evaluation

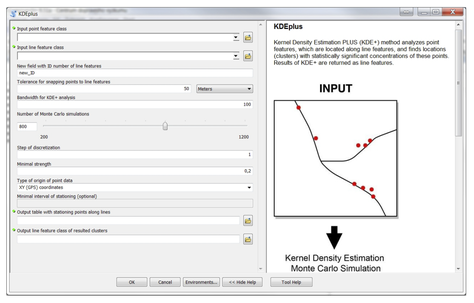
KDE+ software

» Software for cluster identification

» Application for all geographic types of AVC data (GPS coordinates or stationing)

» Java application, Toolbox for ArcGIS



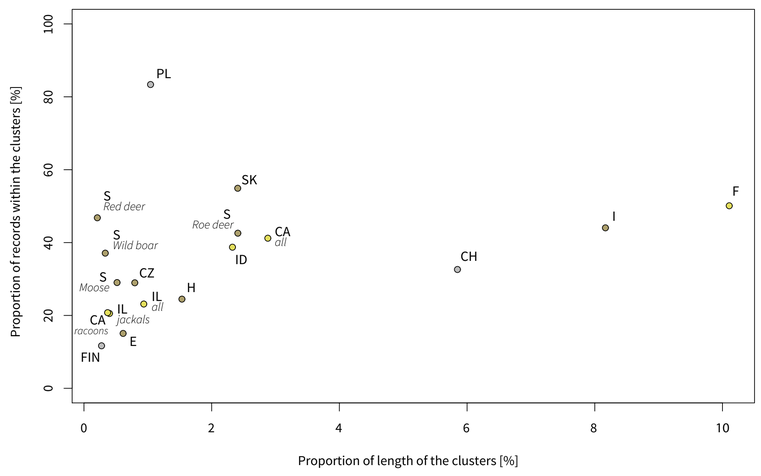


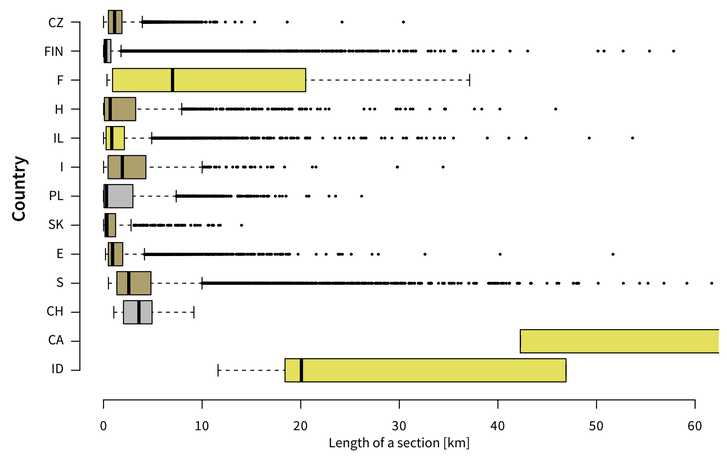
Brief description of methodology

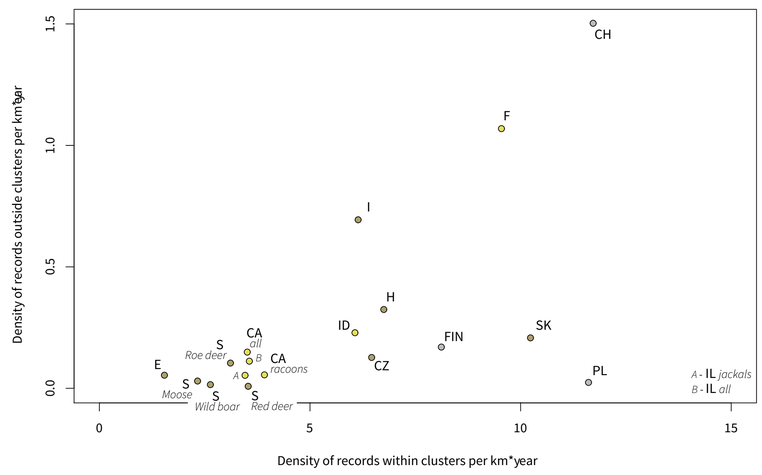
KDE+ is a clustering technique which objectively determines locations with statistically significant concentrations of AVC (Bíl et al., 2013). These locations, which we refer to as clusters, are significantly different from the pattern of uniform distribution. Therefore, the presence of clusters indicates the least likely arrangement of collisions on the road segment. The ranking of the clusters and stability of the method are unique features of KDE+. The method can even work when up to 50 % of data is randomly missing.

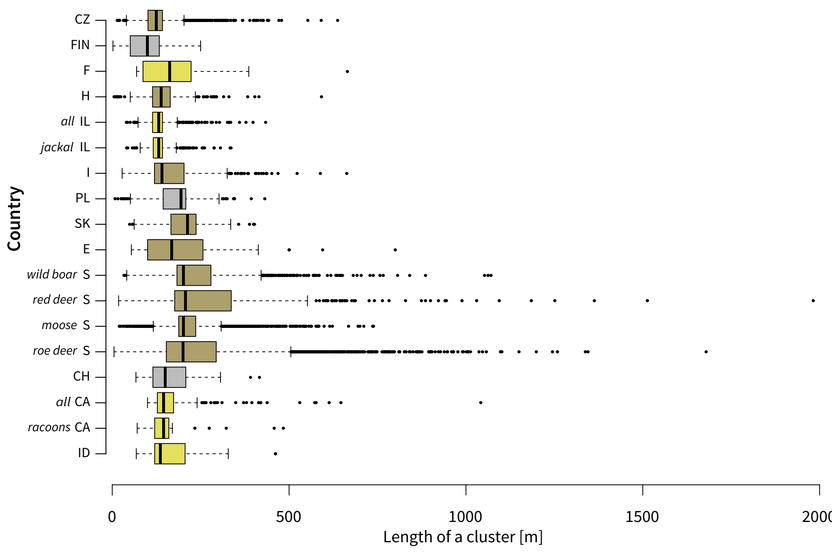
3 RESULTS

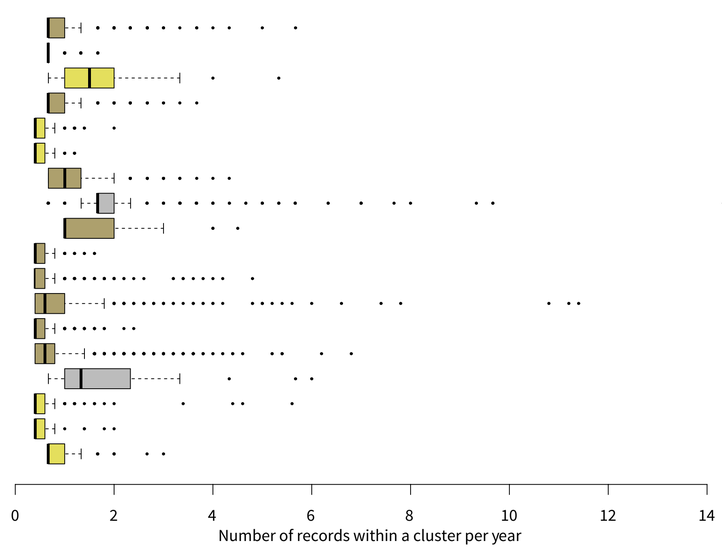
Country	Czechia (CZ)	Finland (FIN)	France (F)	Hungary (H)	Israel (IL)		Italy (I)	Poland (PL)	Slovakia (SK)	Spain (E)	Sweden (S)				Switzerland (CH)	California (CA)		Idaho (ID)
Territorial extent	entire country – highways, 1st, 2nd and 3rd class roads	entire country – 1st, 2nd and 3rd class roads	Highway A10	entire country – 1st and 2nd class roads	entire country – 1st, 2nd and 3rd class roads		Bolzano region	Opole Voivodeship	Highway D1	Catalonia	entire country – 1st, 2nd and 3rd class				parts of highways A1, A5, A9	Highways I5, I280		Highway I84
Type of records	all AVC	traffic accidents	all roadkills	all AVC	all roadkill	jackals	all AVC	traffic accidents	AVC	ungulates	Roe deer	Moose	Wildboar	Red deer	traffic accidents	all roadkill	racoons	Barn owls
Time period	2013 – 2015	2011 – 2013	2006 – 2008	2012 – 2014	2011 – 2015		2012 – 2014	2011 – 2013	2013 – 2014	2007 – 2011	2010 – 2014				2013 – 2015	2010 – 2014		2013 – 2015
AVC	20 825	17 455	543	5 420	5 005	2 332	2 368	3 853	634	6 050	78 951	18 676	10 641	7 119	334	1 625	317	550
Length of the network [km]	39 083	30 370	94	4 270	6 948		693	8 853	706	19 273	89 706				53	1 323		503
Length of clusters [%]	**0.8**	**0.3**	**10.1**	**1.5**	**0.9**	**0.4**	**8.2**	**1.0**	**2.4**	**0.6**	**2.4**	**0.5**	**0.3**	**0.2**	**5.8**	**2.9**	**0.4**	**2.3**
AVC in clusters [%]	**29.0**	**11.7**	**50.1**	**24.5**	**23.1**	**20.5**	**44.0**	**83.4**	**54.9**	**15.1**	**42.6**	**29.0**	**37.1**	**46.8**	**32.6**	**41.2**	**30.3**	**38.7**

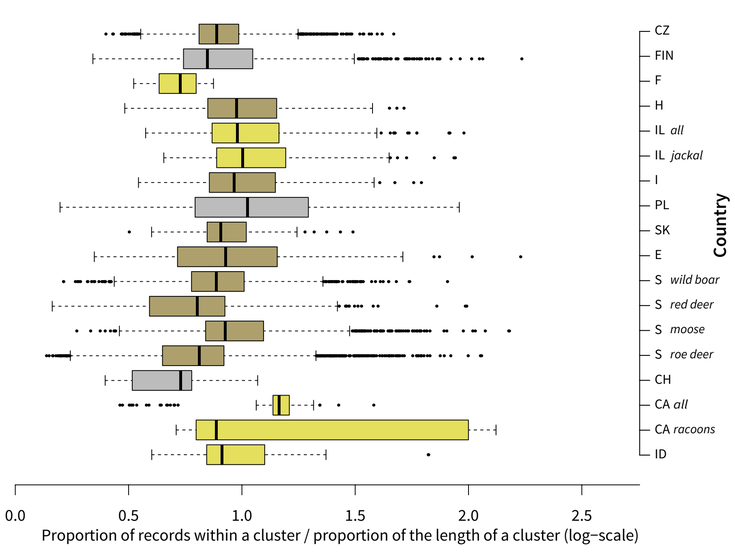




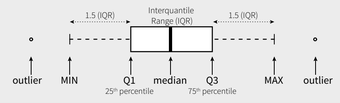








Legend: Animal-vehicle collisions | Roadkills | Traffic Accidents



4 CONCLUSIONS

» KDE+ method divides AVC (roadkills, traffic accidents) into two groups: within clusters and outside clusters

» Similarities and differences of AVC patterns identified

» National data of varying quality

- » GPS locations still not used as a standard for geolocation

» Road segments often too long

- » Improper road segmentation

» Limited number of road links from certain countries available

- » The results are therefore only valid for a region or even several roads

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Bíl, M., Andrášik, R., Janoška, Z., 2013: **Identification of hazardous road locations of traffic accidents by means of kernel density estimation and cluster significance evaluation.** *Accident Analysis and Prevention 55, 265–273.*

Bíl, M., Andrášik, R., Svoboda, T., Sedoník, J., 2016: **The KDE+ software: a tool for effective identification and ranking of animal-vehicle collision hotspots along networks.** *Landscape Ecology 31, 231–237.*