Integration of human and natural processes in the evaluation of the environmental impact of manure management

Focus on land use spatial structure and evolution through time

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Frame

Research project and presentation objectives

Former work implying land use modelling

Current case study

Conclusion and perspectives

Stakes

The reduction of the environmental impacts of manure management

Joint evaluation on both water and soil quality

Consideration of the farm level of organisation

Goal

To develop a methodology based on virtual landscape to assess the environmental impacts of different manure management scenarios on soil and water quality

Methodology

Transformation processs of organic matter are slow

Hydrological processes imply watershed scale

Modelling approach: virtual landscape

Characteristics (spatial distribution)

Evolution processes

land use change, agricultural operations...
hydrological fluxes, OM mineralisation

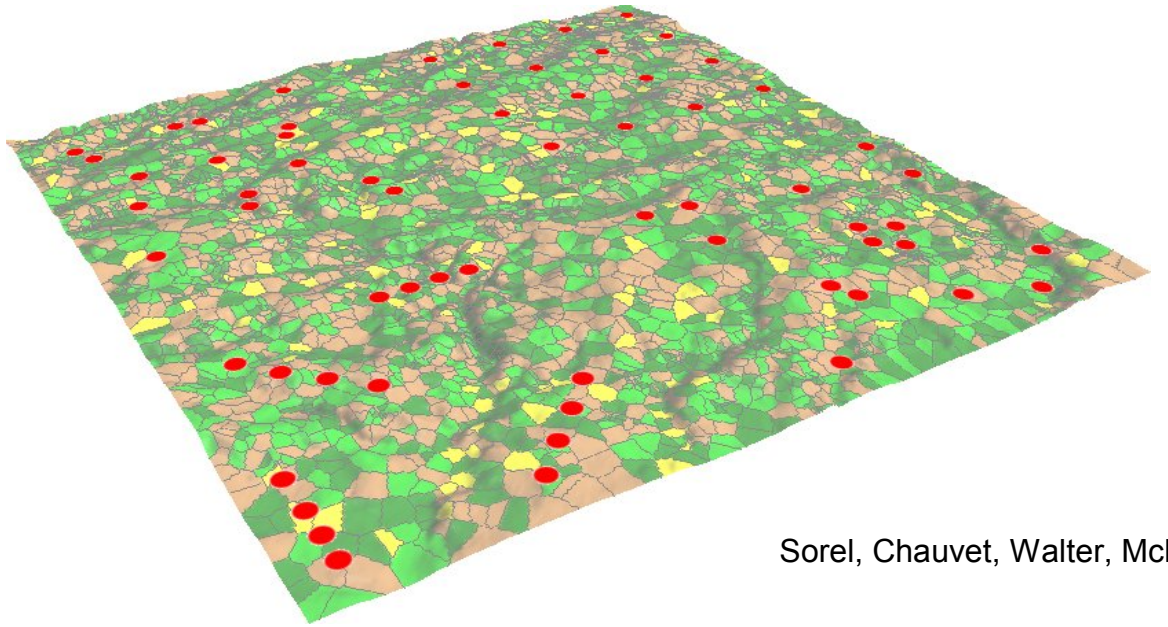
Objectives

- to model land use evolution considering its structural role over the landscape and the farm level

- derivation and hierarchisation of rules of organisation and evolution

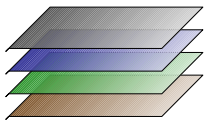
Former work

Modelling land use evolution in a sampling evaluation assessment



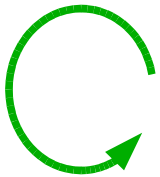
Sorel, Chauvet, Walter, McBratney, *in process*

Attributes



topography
field pattern
land use
soil phosphorus content

Evolution processes

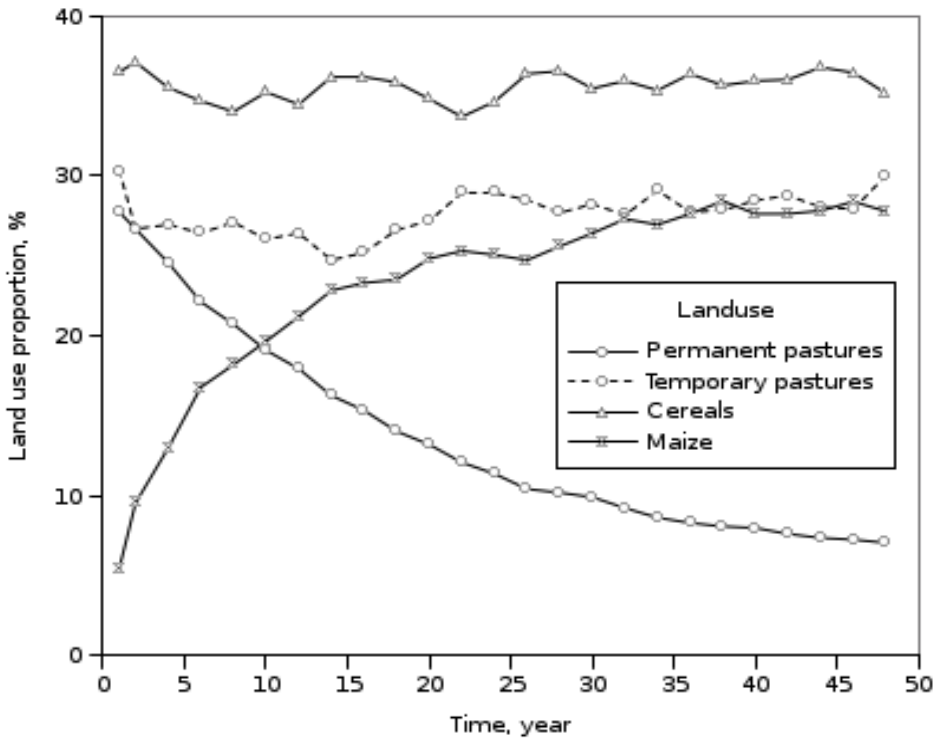


land use transition
fertilisation practices
soil P budget

The land use evolution process

Markov chain applied to land use transition matrix (Cressie, 1991)

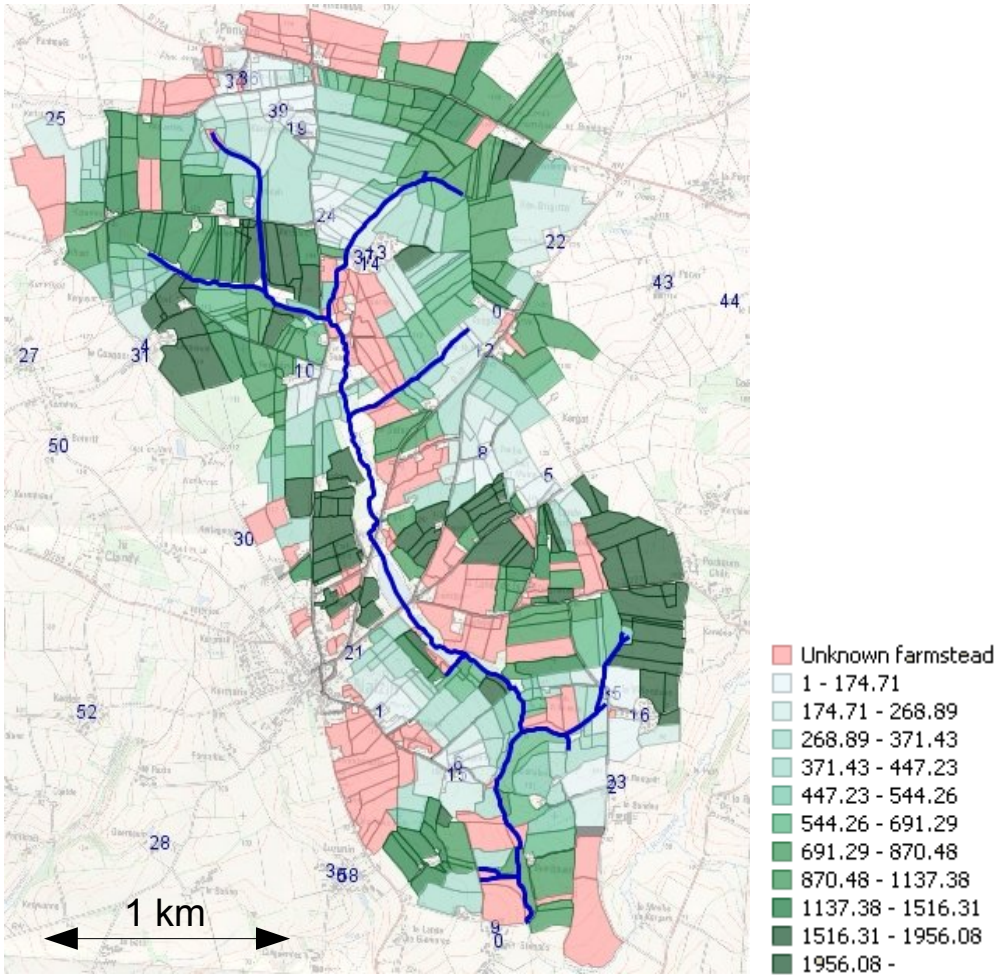
		Year Y+1			
		perm. pasture	temp. pasture	corn	maize
Year Y	perm. pasture	95%	3.5%	1%	0,5%
	temp. pasture	1%	65%	24%	10%
	corn	0%	20%	80%	0%
	maize	0%	9%	1%	90%



No consideration of the farm level

Other methods: land use rotation tables...

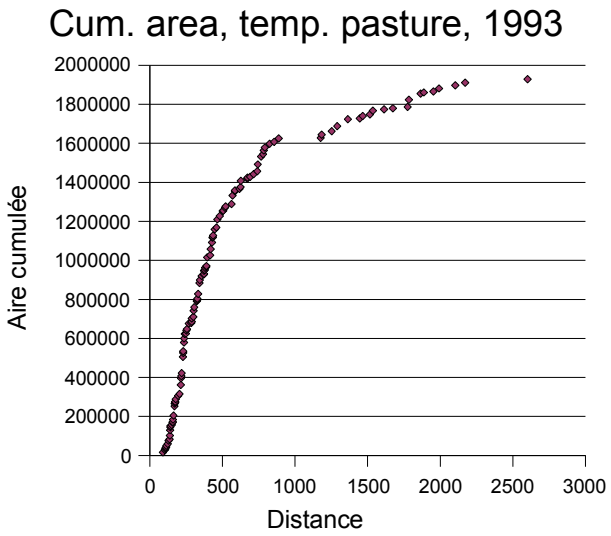
Case study on the Stimoes watershed (Brittany, France)

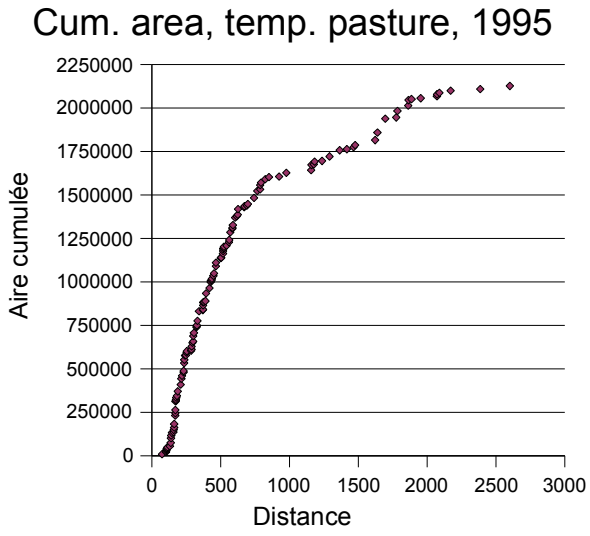


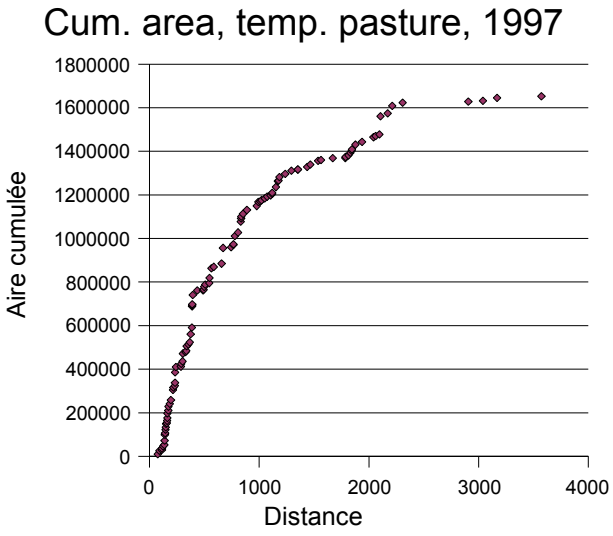
land use evolution 1993-2000
35 farmsteads (4 types of activity)
660 fields

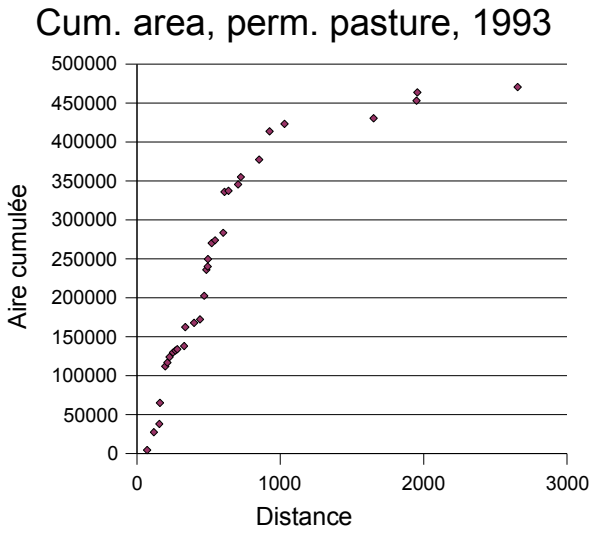
soil hydromorphy

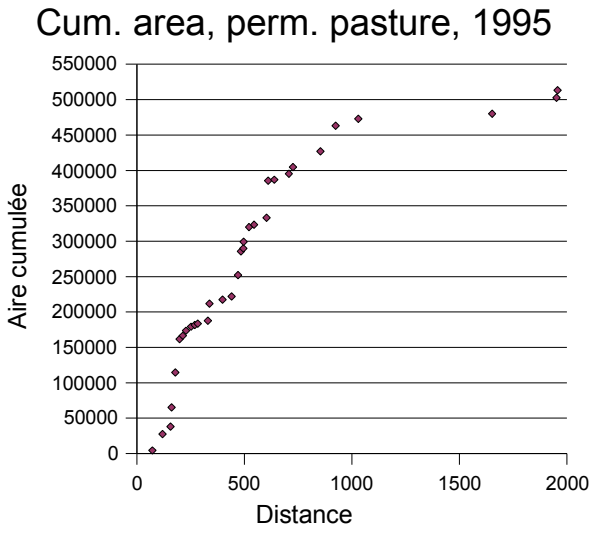
Distance-land use relation? 1/2





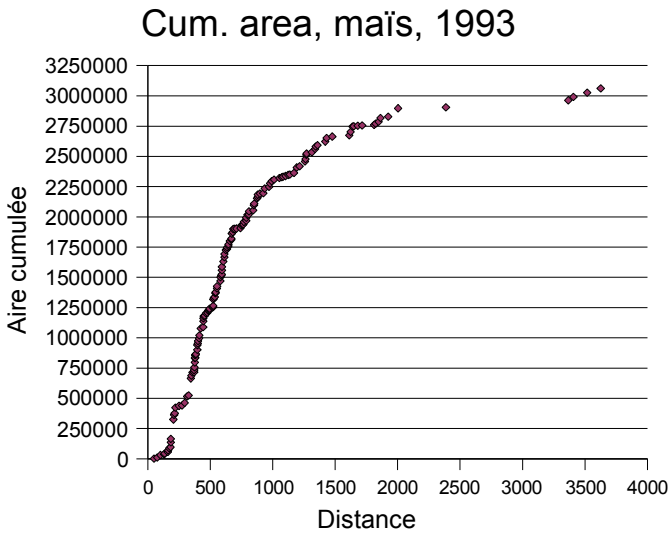


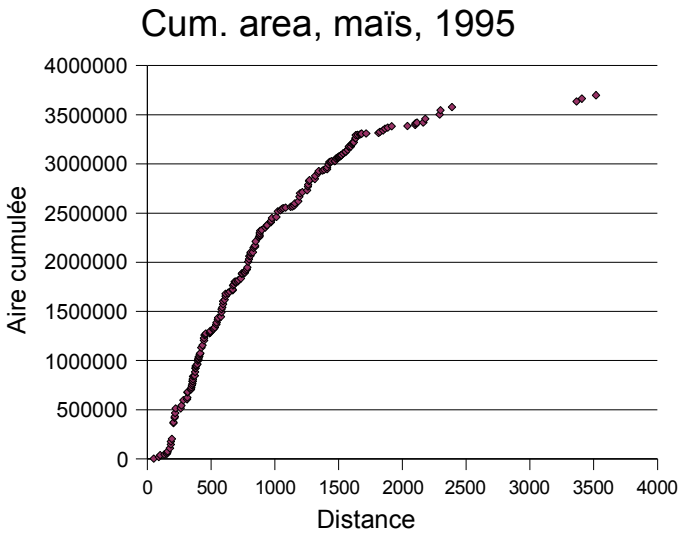


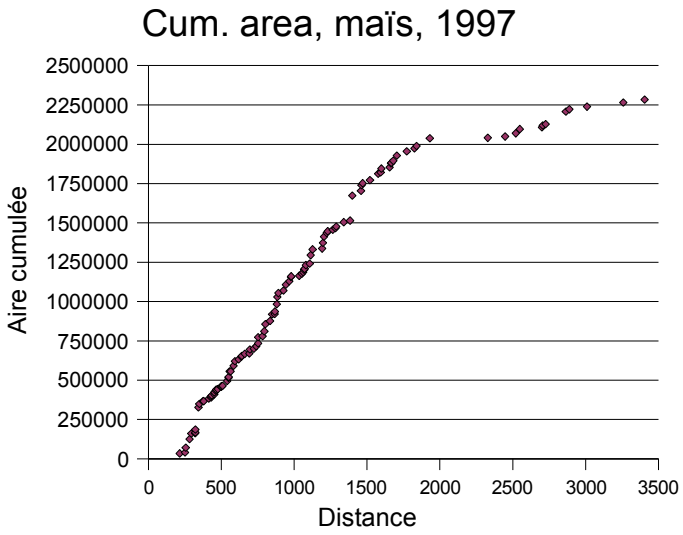


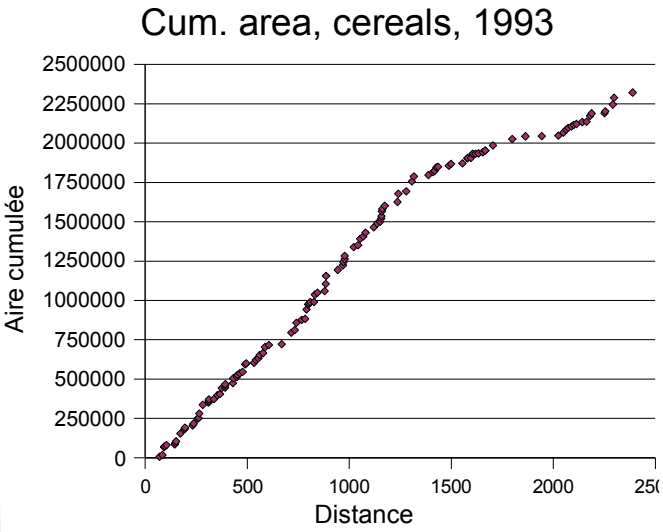
Close to the farmstreads

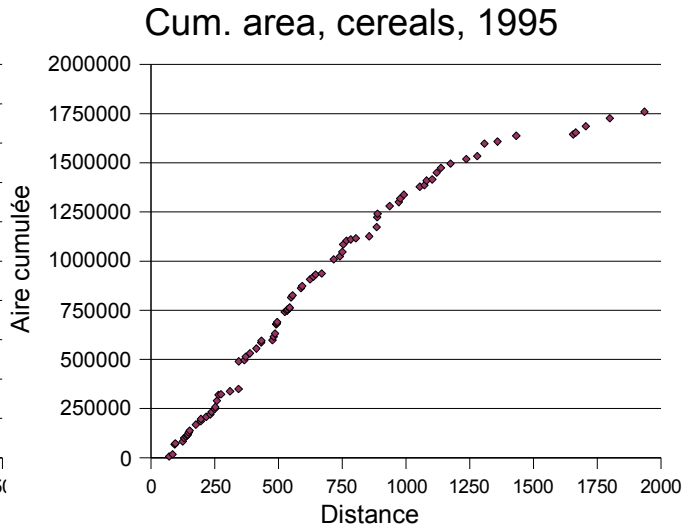
Distance-land use relation? 2/2

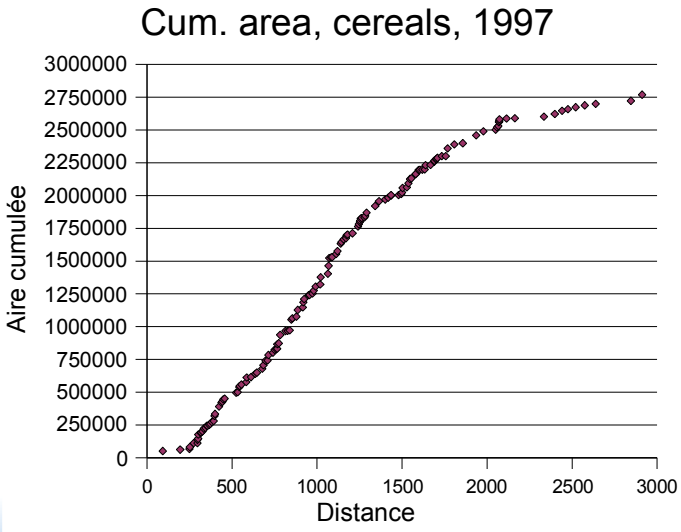






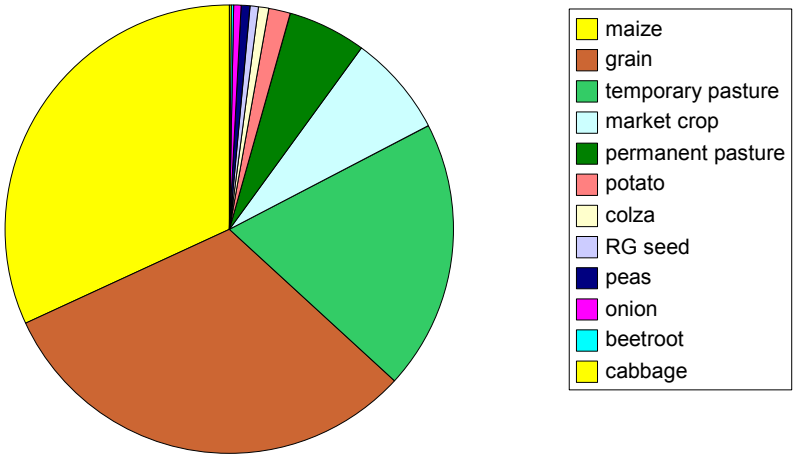




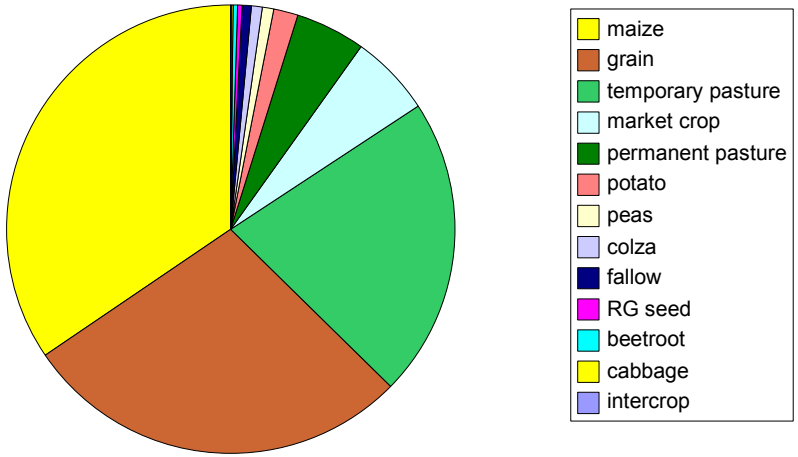


Hydromorphy-land use relation ?

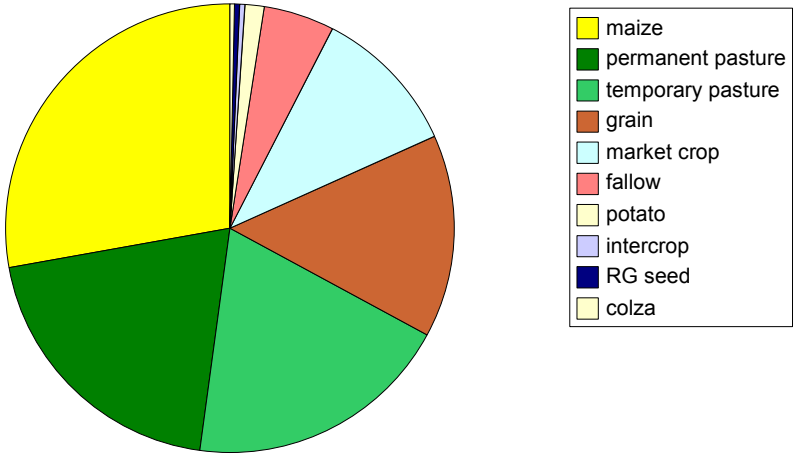
Land use proportion of the area of hydromorphic class 1



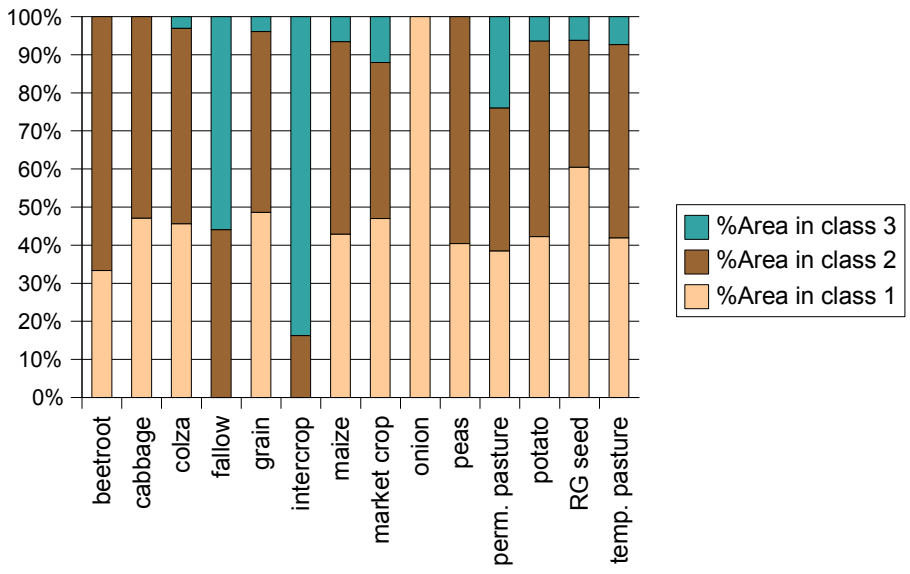
Land use proportion of the area of hydromorphic class 2



Land use proportion of the area of hydromorphic class 3



Land use proportion in each hydromorphic class



Land use transition probabilities

Land use N	Land use N+1 other	grain	fallow	maize	market	potato	perm. pasture	temp. pasture	RG seed
other	13,2	**36,0**		**27,2**	7,0	2,6	1,8	12,3	
grain	4,6	**16,8**	0,8	**49,9**	11,0	5,0		11,5	0,4
fallow	1,2	11,9	**46,4**	**16,7**	2,4	1,2	1,2	19,0	
maize	1,3	**45,6**	1,3	**31,7**	8,5	3,1	0,1	8,3	
market	0,3	**46,5**	1,6	**27,3**	8,9	5,1	0,8	9,5	
potato	2,3	**45,0**		**38,2**	8,4			6,1	
perm. pasture	0,2	0,2	0,2	0,9			**98,1**	**0,5**	
temp. pasture	1,6	**6,9**	0,4	16,7	3,8	0,7	0,3	**69,6**	
RG seed		**16,7**		25,0					**58,3**

Land use N-1	Land use N other	grain	fallow	maize	market	potato	perm. pasture	temp. pasture	RG seed
other	12,3	3,1		2,0	2,1	2,0	0,3	1,2	
grain	**50,0**	**17,0**	13,4	**42,1**	**38,2**	**44,9**		**12,6**	**41,7**
fallow	0,8	0,8	**47,6**	0,9	0,5	0,7	0,2	1,3	
maize	**17,2**	**54,8**	**24,4**	**31,9**	**35,3**	**33,3**	0,3	10,8	
market	0,8	13,1	7,3	6,4	8,7	12,9	0,5	2,9	
potato	2,5	4,5		3,2	2,9			0,7	
perm. pasture	0,8	0,1	1,2	0,3			**97,9**	0,2	
temp. pasture	15,6	6,4	6,1	13,0	12,4	6,1	**0,7**	**70,3**	
RG seed		0,2		0,2					**58,3**

Rotation schemes?

Conclusion and perspectives

There are some rules about spatial organisation and evolution

To be done:

- ***analyses by type of farm***
- ***induction graph***

For simulation purposes:

- stochastic rules
- consideration of production objectives to match

Thank you for your attention!