

Environmental patterns for Avian Influenza risk in Madagascar (Lake Alaotra)

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MINISTÈRE DES AFFAIRES ÉTRANGÈRES



✓ Context

Madagascar :

- Hyperendemic country of Human Influenza
- Deadly outbreaks (spanish flu (H1N1) in 1918 and 1919 and flu outbreak at H3N2 in 2002
- Avian Influenza Type A is present on the island
- Risk of introducing H5N1 influenza



✓ lake Alaotra : study area

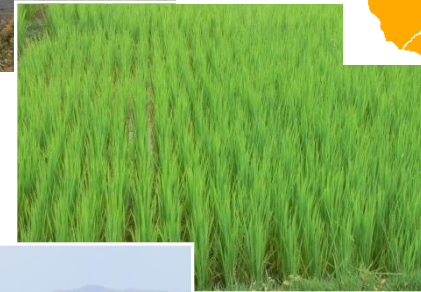
Agro ecological context

- Presence of water and rice field
- Basin of agricultural production
- Wild avifauna



Livestock practices

- High density of small breeding
- Mixed species
- Live poultry market



Population

- poor population on the shores of the lake and inadequate health monitoring

➔ Suitable area for the persistence and virus circulation




✓ Environmental risk approaches

Hypothesis :

Land use and/or water (lake + river/water point) drive the spatial distribution of AI.

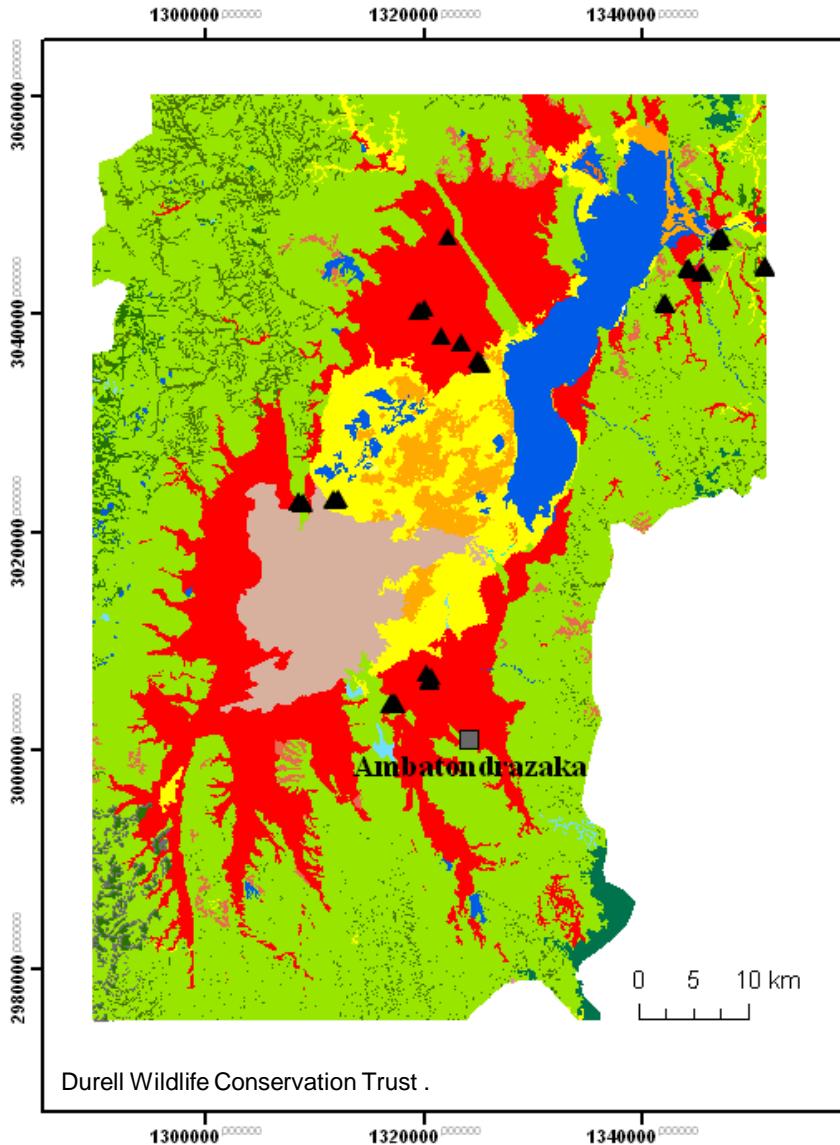
Data :

- Land use map with high spatial resolution 
- Data bases 2008 and 2009 (domestic avifauna)
 - 78 and 79 farms
 - 301 and 742 animals sampled (duck, geese, chicken)
 - farms density/number of sampled animal/number of positive (serology)





Land use map



- # Farms (2009)
- eucalyptus
 - euchornia
 - rainforest
 - disturbed humid forest
 - riparian forest
 - marsh
 - disturbed marsh
 - culture
 - phragmites
 - pin
 - water
 - rice field
 - salvinia
 - shrub savannah
 - grassland savannah
 - savannah marsh
 - typho

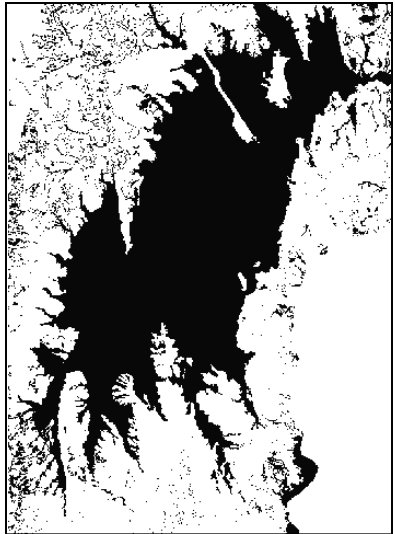




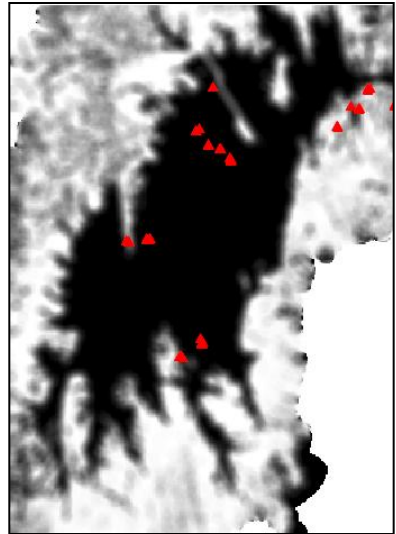
✓ Environmental indices

1 Landscape identification: Method

- Buffer of 1 km around farms



Raster 0/1



Focal statistics
▲ Farms

Num_IDBD	Longitude	Latitude	Raster_Value
A_1	48,640250	-17,404267	0,644
A_10	48,624750	-17,434233	0,556
A_11	48,624783	-17,433967	0,558
A_115	48,399333	-17,487967	0,000
A_116	48,678700	-17,426700	0,594

Values extraction



✓ Environmental indices

Landscape identification: Results

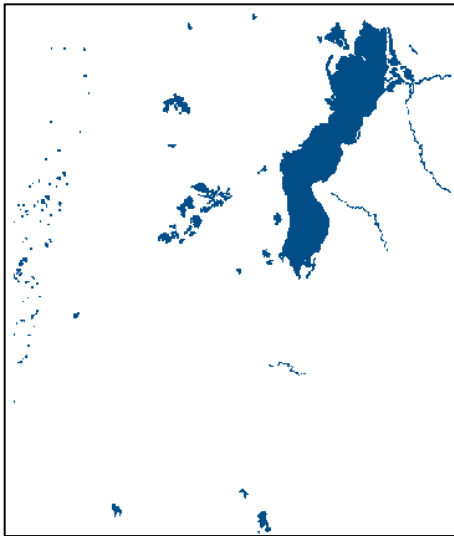
Three landscapes :

- Landscape of grassland savannah (43 farms, 61 ateliers)
- Landscape of rice field (51 farms, 93 ateliers)
- Mixed landscape (61 farms, 87 ateliers)

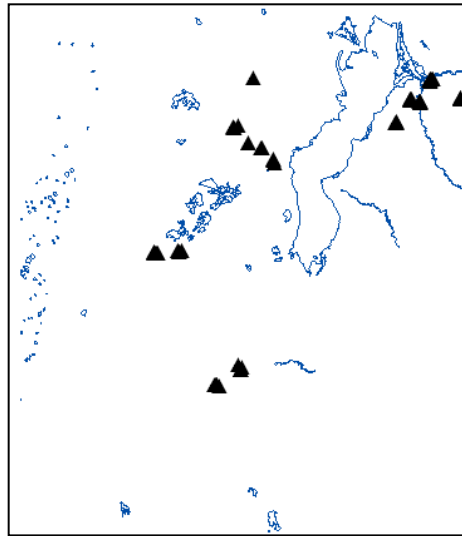


✓ Environmental indices

2 Water distance



Raster « water »



Polylines « water »

▲ Farms

Num_IDBD	Raster_Value	Near_distance (m)
A_1	0,644	234,15
A_10	0,556	382,69
A_11	0,558	388,40
A_115	0,000	4301,61
A_116	0,594	3445,23

Calcul of distances



✓ Statistic Methods

- Generalized linear model (binomial family)

Variables	OR	CI _{0.95}	<i>p</i> value
Duck	10.85	10.45 - 11.27	***
Geese	5.24	5.05 - 5.44	***
Year 2009	0.39	0.38 - 0.41	***
Farm density (15,90)	2.04	1.98 - 2.09	**
log(Distance_water)	0.70	0.70 - 0.71	***
Mixed landscape	1.95	1.88 - 2.02	*
Rice landscape	3.38	3.23 - 3.53	**



- Species (ducks, geese /chickens)
- 2009 less risky than 2008
- Farm density
- Water distance
- Rice field

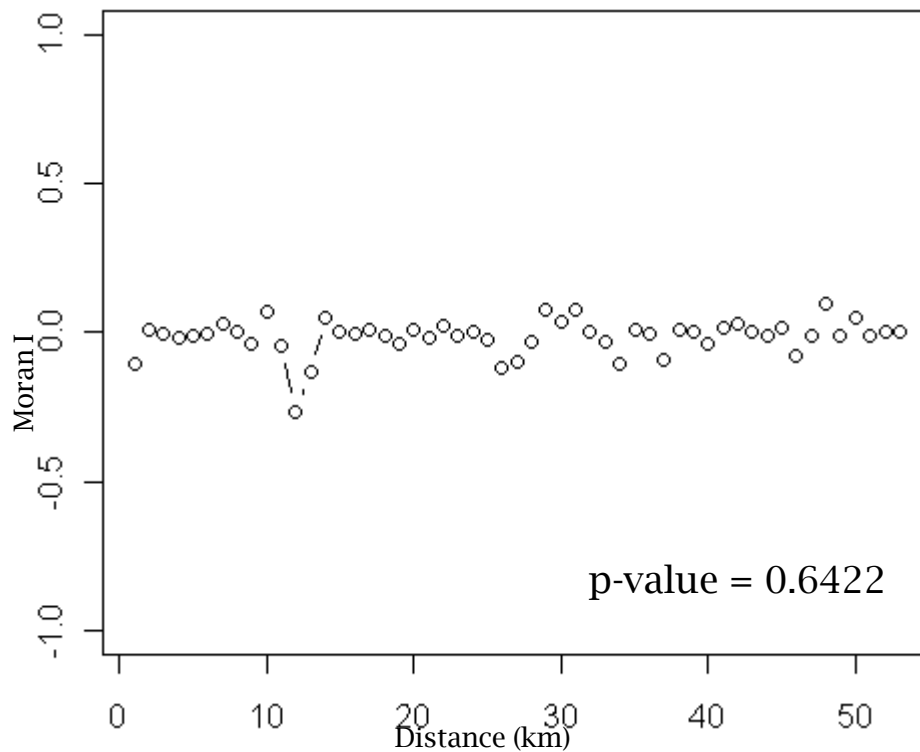
*** $p < 0.001$
 ** $p < 0.1$
 * $p < 0.5$



✓ Statistic Methods

Spatial Autocorrelation between farms

Moran test (\rightarrow 50 km).

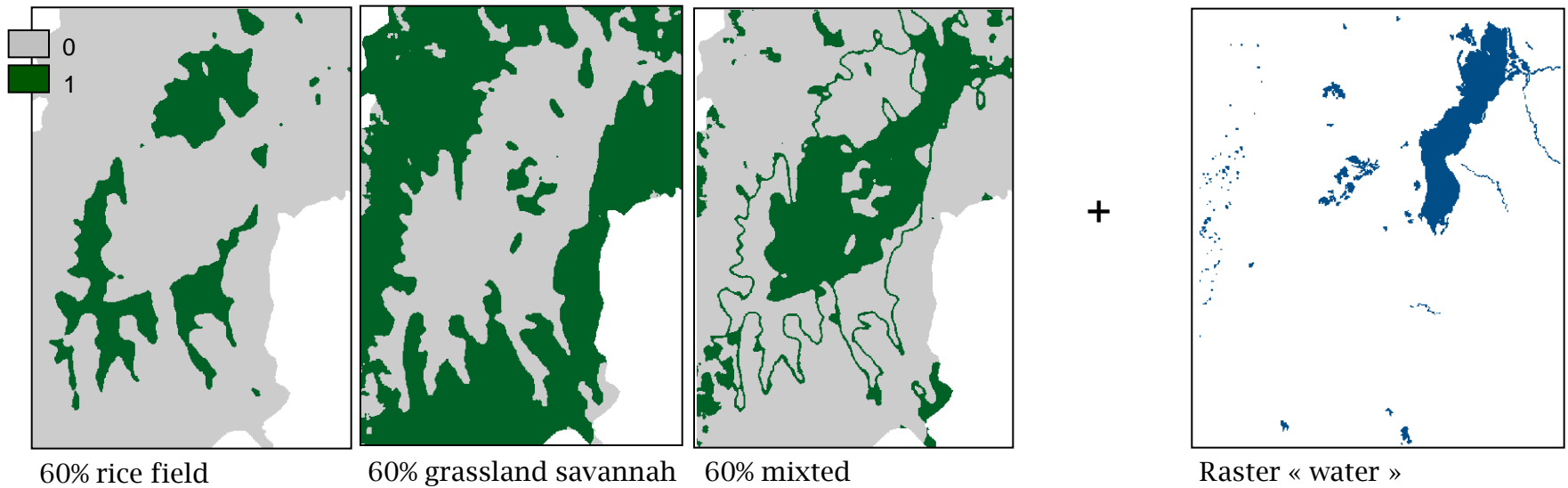


**No spatial autocorrelation
between farms**



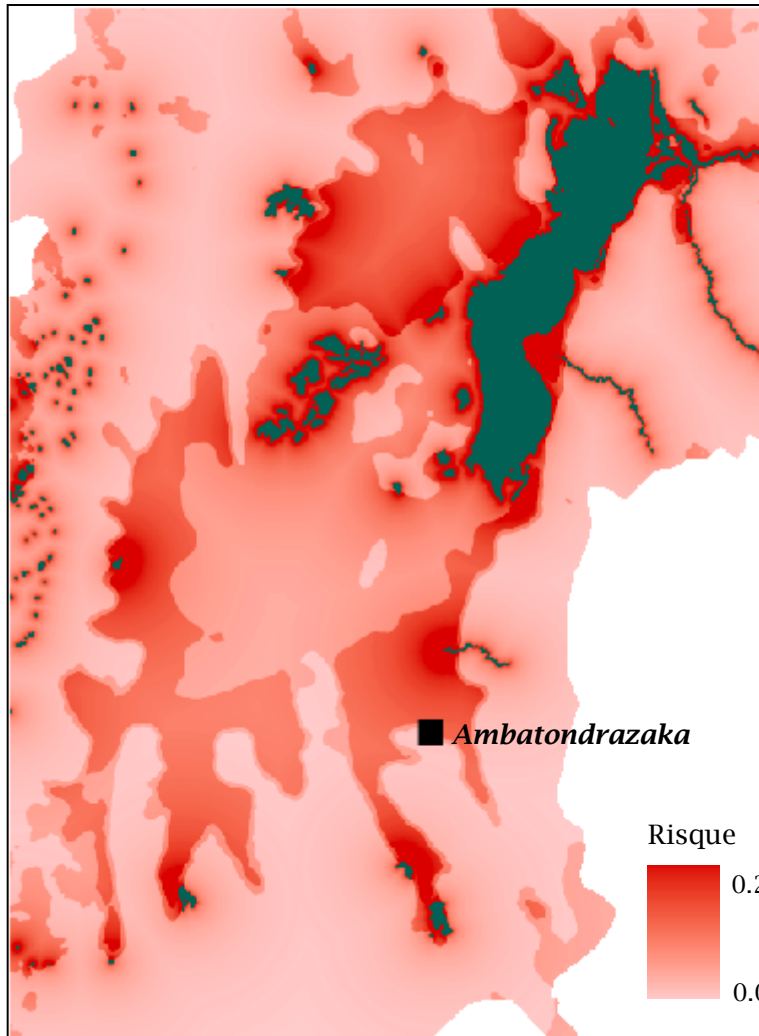
✓ Risk mapping

Three rasters (corresponding to the three landscape identified)

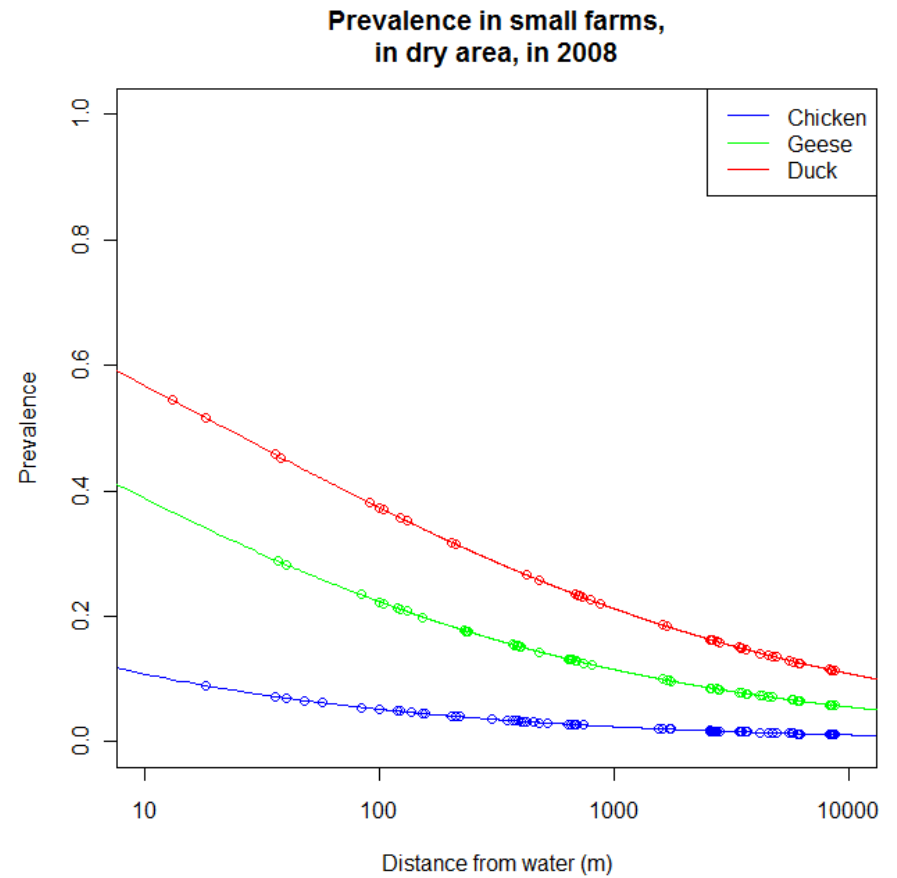




✓ Risk mapping



Risk mapping (chicken/Landscapes/2008)





✓ Discussion/Conclusion

- The proximity to water and rice landscape = more exposure
- Ducks: species more at risk
- Year: 2008 was riskier than 2009
- Spatial autocorrelation : there is no spread of the virus from one farm to another

M. Gilbert, P. Chaitaweesub, T. Parakamawongsa, et al. Free-grazing Ducks and Highly Pathogenic Avian Influenza, Thailand . 2006. Emerging Infectious Diseases. Vol. 12, No. 2.

A. Caron, C. Abolnik, J. Mundava,N. et al. 2010. Persistence of Low Pathogenic Avian Influenza Virus in Waterfowl in a Southern African Ecosystem. EcoHealth.

N. Gaidet,T. Dodman, A. Caron et al. Avian Influenza Viruses in Water Birds, Africa. 2007. Emerging Infectious Diseases . Vol. 13, No. 4.



Thank you

