Spatio-temporal Analysis of Risk Factors for Foot-and-mouth Disease in Tanzania

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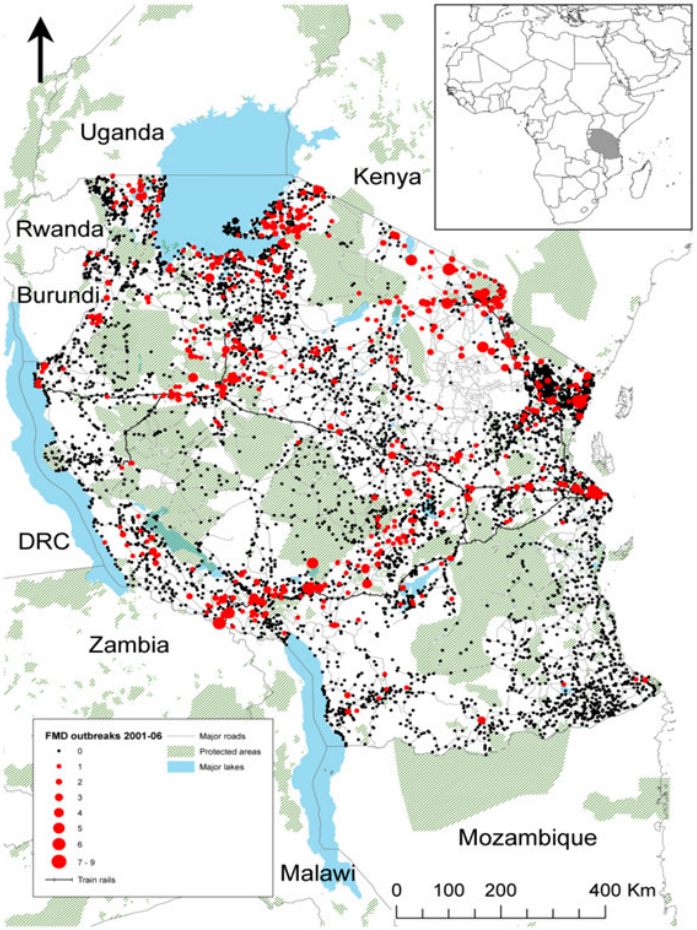
Reflections

- FMD is endemic and widely distributed
- One of the major constraints to commercial livestock farming in Tanzania
- Tanzania has adopted PCP philosophy, and now in stage 2
- Aim to fulfill outcome 7 of stage 1of FMD - PCP



Methodology

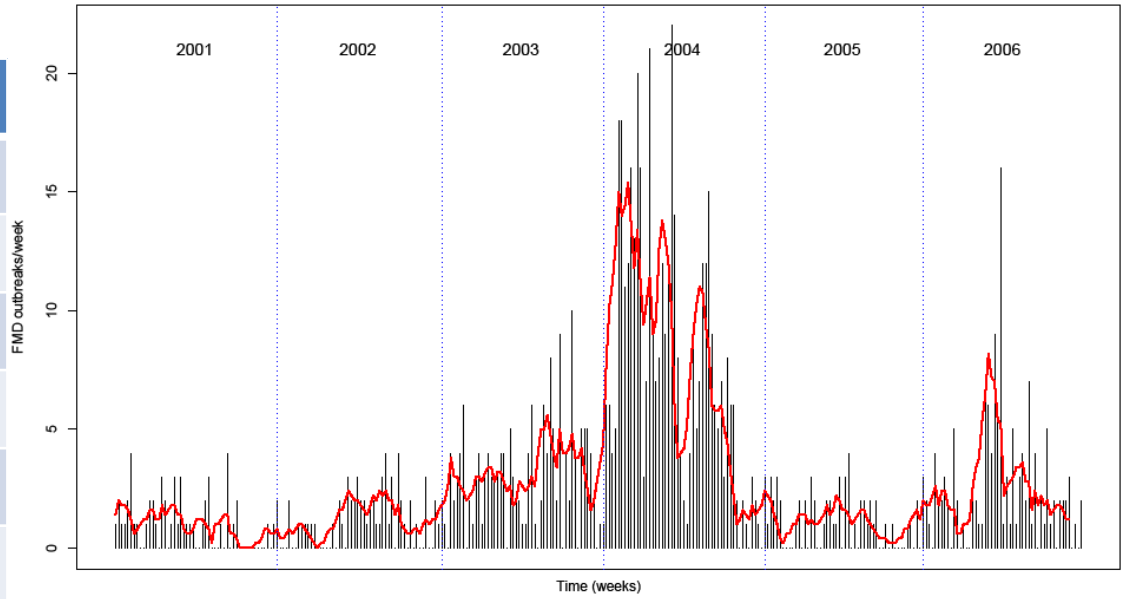
- **DATA BASE**
  - Passive surveillance data Jan 2001- Dece2006
  - 878 clinical cases
  - Location of national parks
  - Human population, distribution and activities
  - Communication networks, and
  - international borders

- **SPATIAL ANALYSIS**
  - Extraction maps
  - Space time K-function,
  - Space-time permutation models based on scan statistics were calculated to evaluate the spatial distribution, the spatio-temporal interaction and spatio-temporal clustering of the affected villages

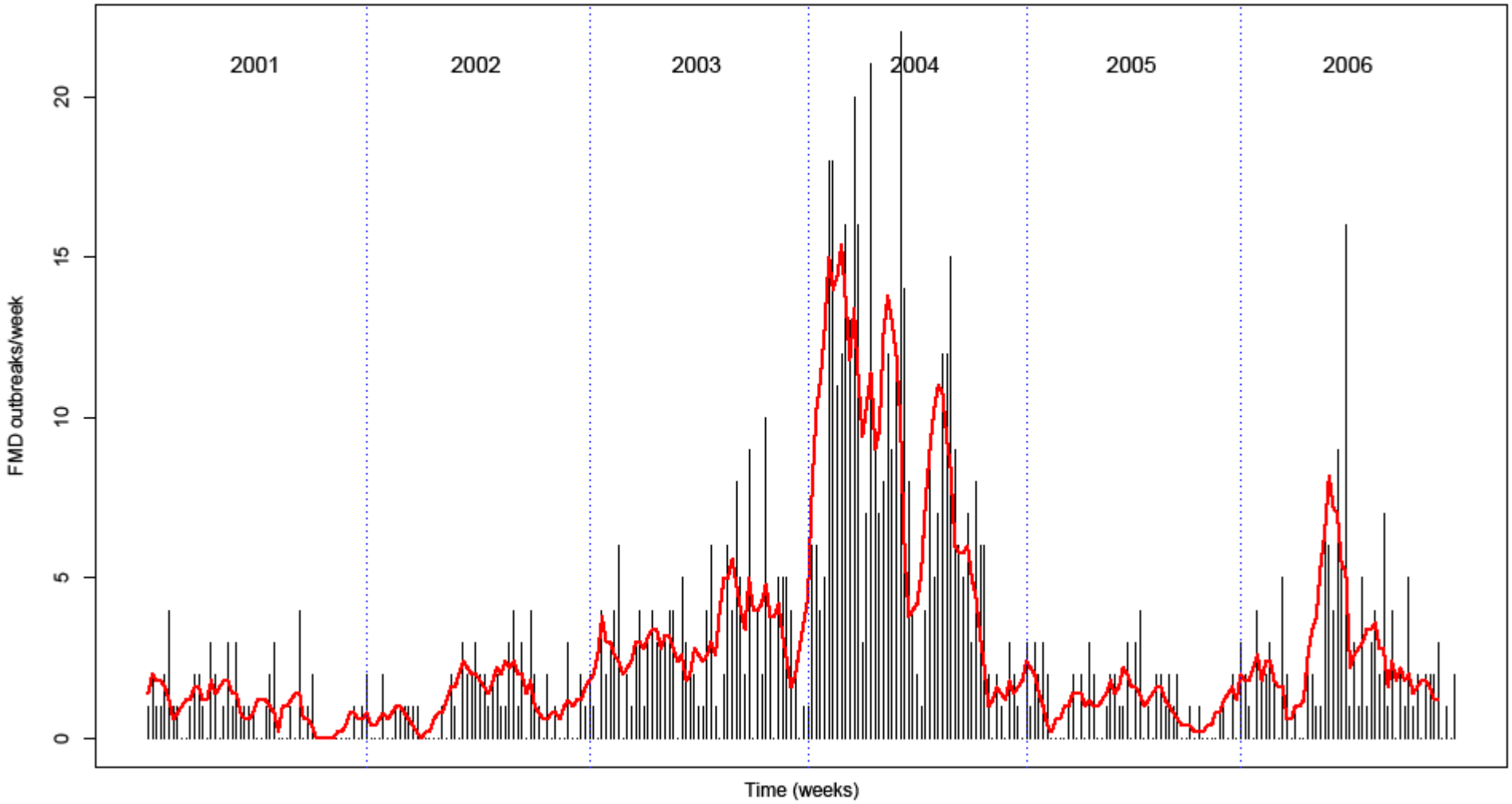
Results – temporal clustering

- Variable outbreaks

Year	FMD outbreaks
2001	52
2002	62
2003	160
2004	410
2005	59
2006	135



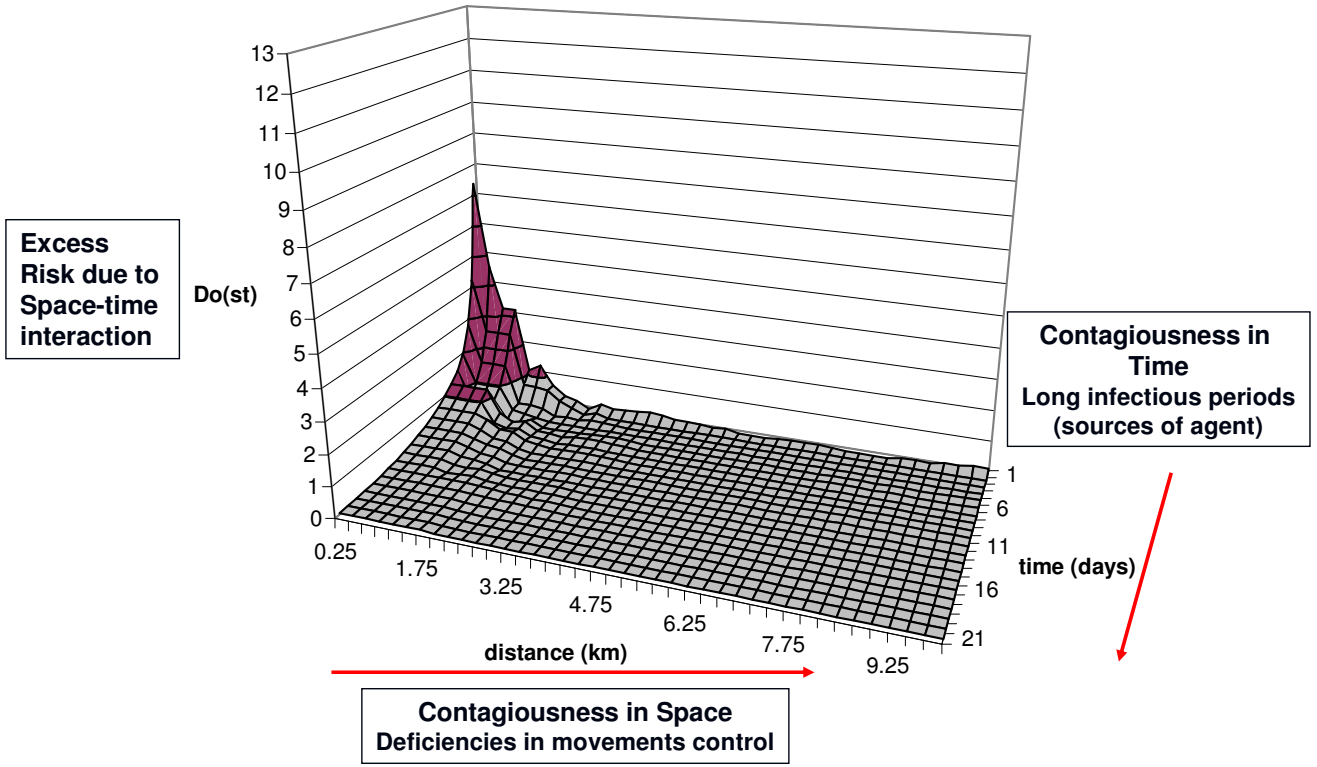
Temporal distribution of FMD outbreaks for the 2001 – 2006 reporting period



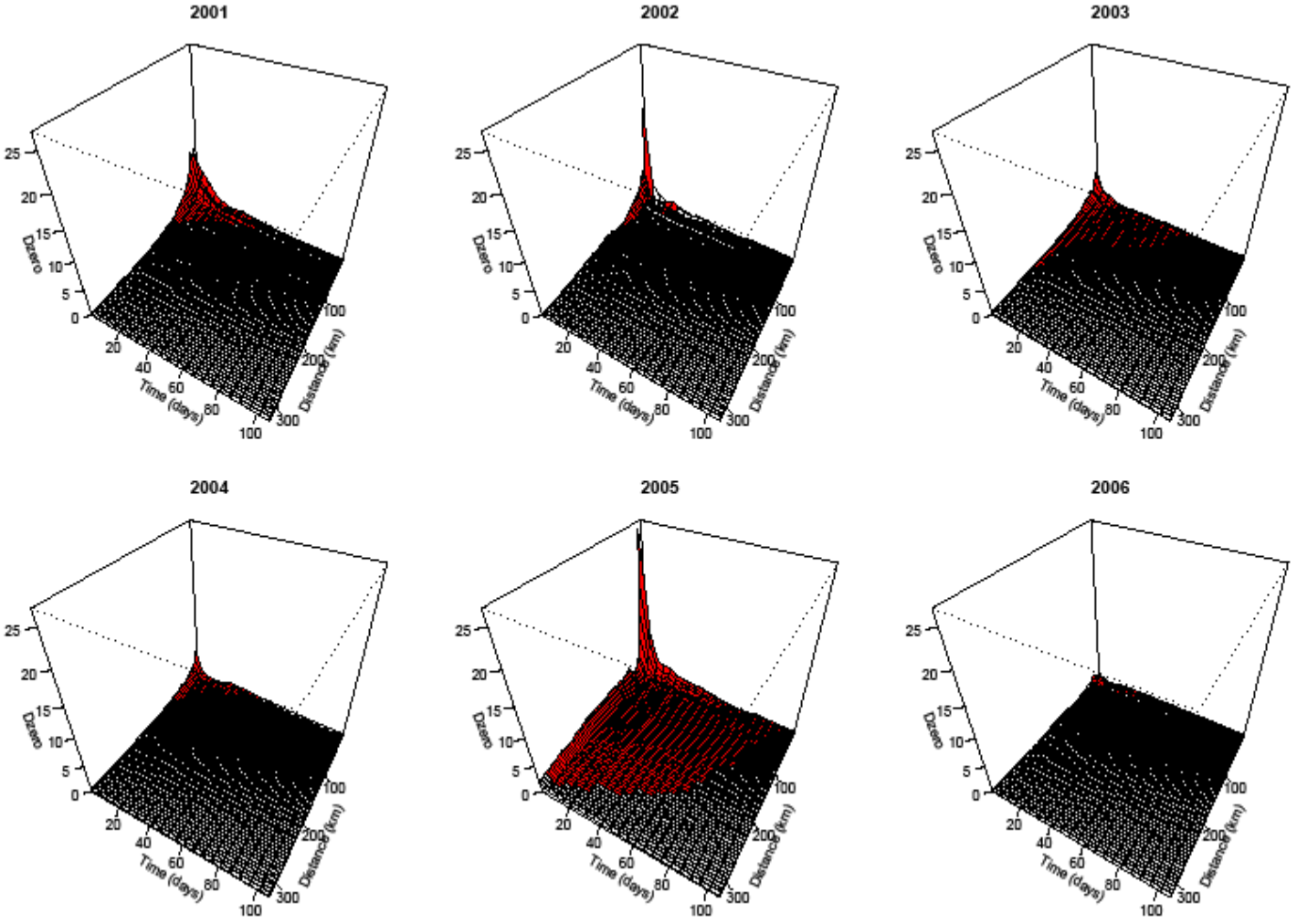
Space-time interaction

$$D_0(s,t) = D(s,t) / \{K(t)K(s)\}$$

Excess risk or proportional increase in number of cases attributable to the time-space interaction



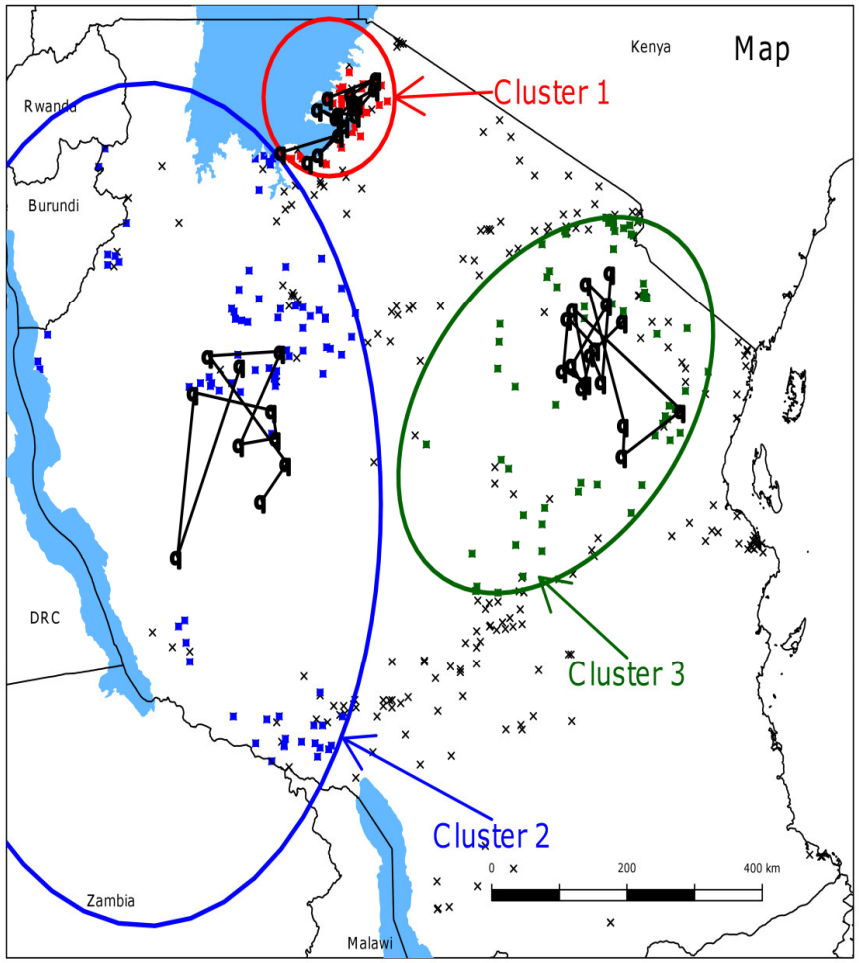
Space-time interaction

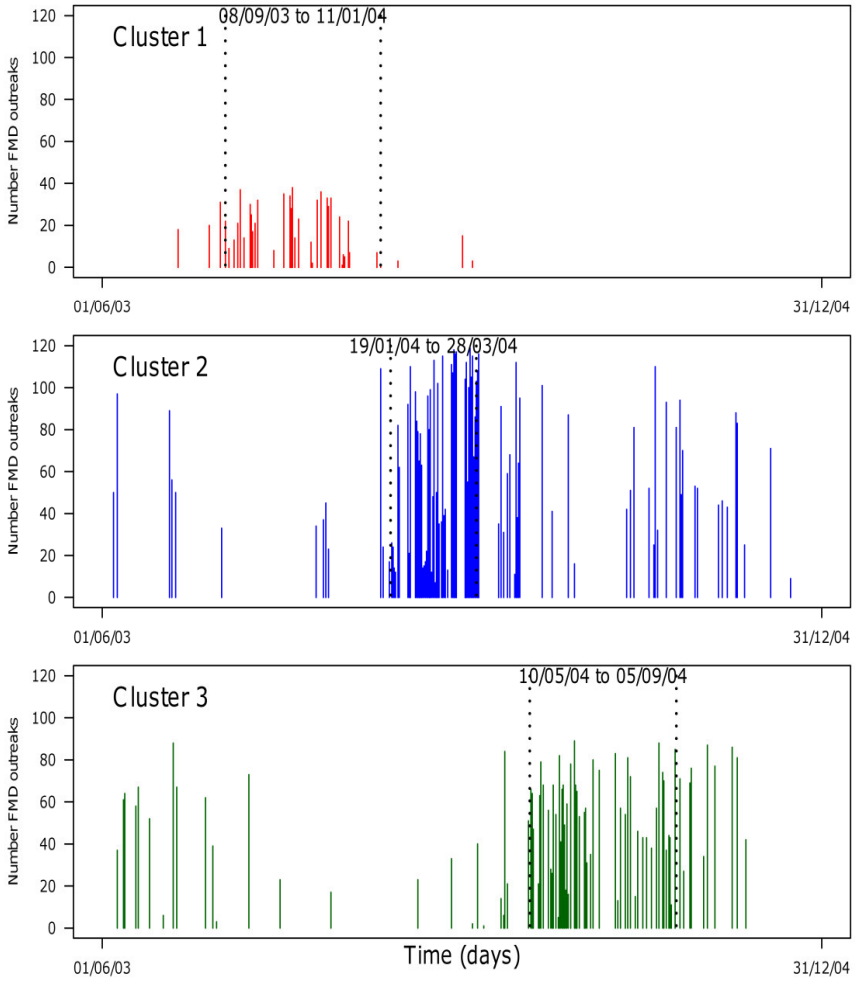


The spatio-temporal interaction

- Significant ($P \leq 0.01$)
- FMD affected villages were clustered at 80-100km in 2001 and 2002, but 2001 had a larger temporal component (50days)
- In 2003 there was an increase of the clustering in both dimensions which would indicate an increase of the infectiousness in time (65days) and space (200km)
- 2004 limited clustering ≈ 2001
- 2005 intense clustering at shorter distances (30km) and time (5days)
- 2006

Spatio-temporal clustering





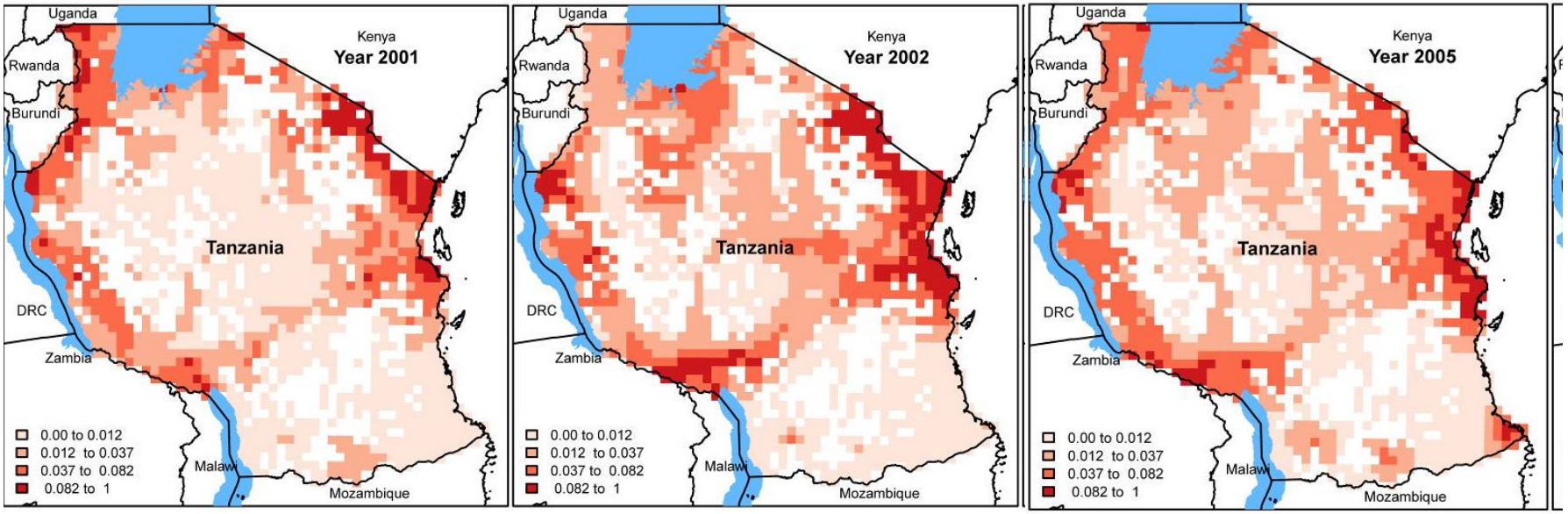
Sapatio-teporal clustering

- Three statistically significant clusters
  i. From 08/09/2003 to 11/01/2004; affecting 47 villages (RR = 7.97; $P \leq 0.001$)
  ii. From 19/01/2004 to 28/03/2004 affecting 99 villages (RR = 2.76; $P \leq 0.01$)
  iii. From 10/05/2004 to 05/09/2004 affecting 86 villages (RR = 2.72; $P \leq 0.01$)
- The spatio-temporal clusters were consecutive in time

Spatial distribution

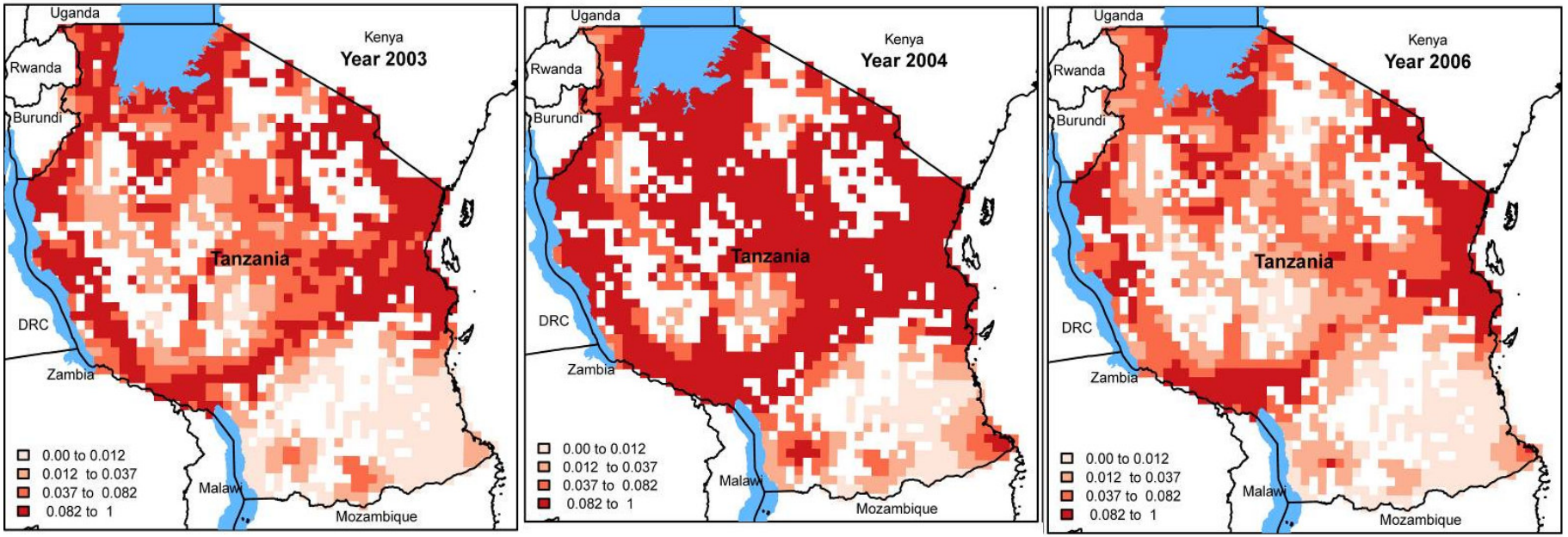
- Two distinct spatial patterns were identified
  - Pattern I. **Endemic** – occurred in 2001, 2002, and 2005; and
  - Pattern II. **Epidemic** – occurred in 2003, 2004 and 2006

Spatial pattern I (Endemic phase)



- High risk areas concentrated along the international borders
- The distribution of the high risk areas was limited in space, e.g. Tunduma (Tanzania – Zambia border) and Arusha (Tanzania – Kenya border)

Spatial pattern II (epidemic phase)

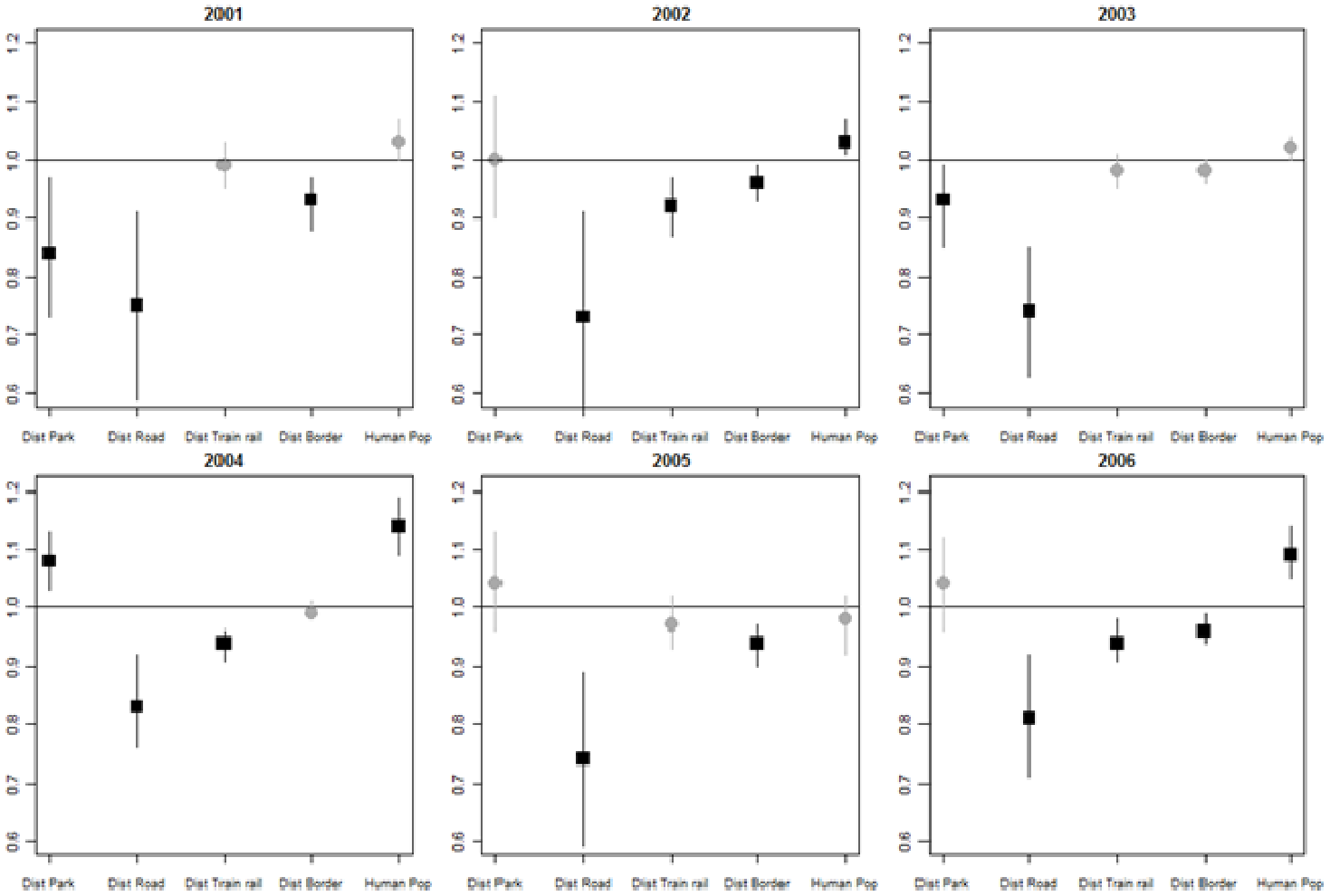


- Pattern II, Occurred 2003, 2004 and 2006 . High risk areas were more expansive
- High risk zone expanded towards the north and the central parts
- The concentration was more important along the main communication lines
- Dar es Salaam & Coast region – consistently at high risk
- The Southern regions remained in general as low risk area

Risk factors

- **Risk factors identified**
  - Distance to the main roads (risk was reduced with increased distance ≈ 10Km),
  - Distance to the railway lines
    - Weak relationship as compared to roads
  - Distance to the international borders
  - human population density and
  - Distance to the national park

Odds ratios of the risk factors



Odds ratios of the risk factors

	Odds Ratio (95% Credible intervals)					
	Year					
RF	2001	2002	2003	2004	2005	2006
N Park	**0.84 (0.73-0.97)***	1.00 (0.90-1.11)	**0.93 (0.85-0.99)***	**1.08 (1.03-1.13)***	1.04 (0.96-1.13)	1.04 (0.96-1.12)
Road	**0.75 (0.59-0.91)***	**0.73 (0.56-0.91)***	**0.74 (0.63-0.85)***	**0.83 (0.76-0.92)***	**0.74 (0.59-0.89)***	**0.81 (0.71-0.92)***
Train rail	0.99 (0.95-1.03)	**0.92 (0.87-0.97)***	0.98 (0.95-1.01)	**0.94 (0.91-0.96)***	0.97 (0.93-1.02)	**0.94 (0.91-0.98)***
Border	**0.93 (0.88-0.97)***	**0.96 (0.93-0.99)***	0.98 (0.96-1.00)	0.99 (0.98-1.01)	**0.94 (0.90-0.97)***	**0.96 (0.94-0.99)***
Human Popula	1.03 (1.00-1.07)	**1.03 (1.01-1.07)***	1.02 (1.00-1.04)	**1.14 (1.09-1.19)***	0.98 (0.92-1.02)	**1.09 (1.05-1.14)***

Conclusion

- Results confirm the heterogeneity of FMDV transmission in Tanzania;
- FMD occurrence in Tanzania is more related to animal movement and human activities via communication networks than trans-boundary movements or contact with wildlife;
- Southern regions are generally low risk areas and may be a potential FMD free zone if appropriate control measures are put in place;
- FMD PCP could therefore target these areas

Thank you very much!

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