Circular and connectivity-ambiguous vs. non-circular and connectivity-explicit disease clusters –*examples from Foot-and-Mouth Disease and Avian Influenza epidemics*

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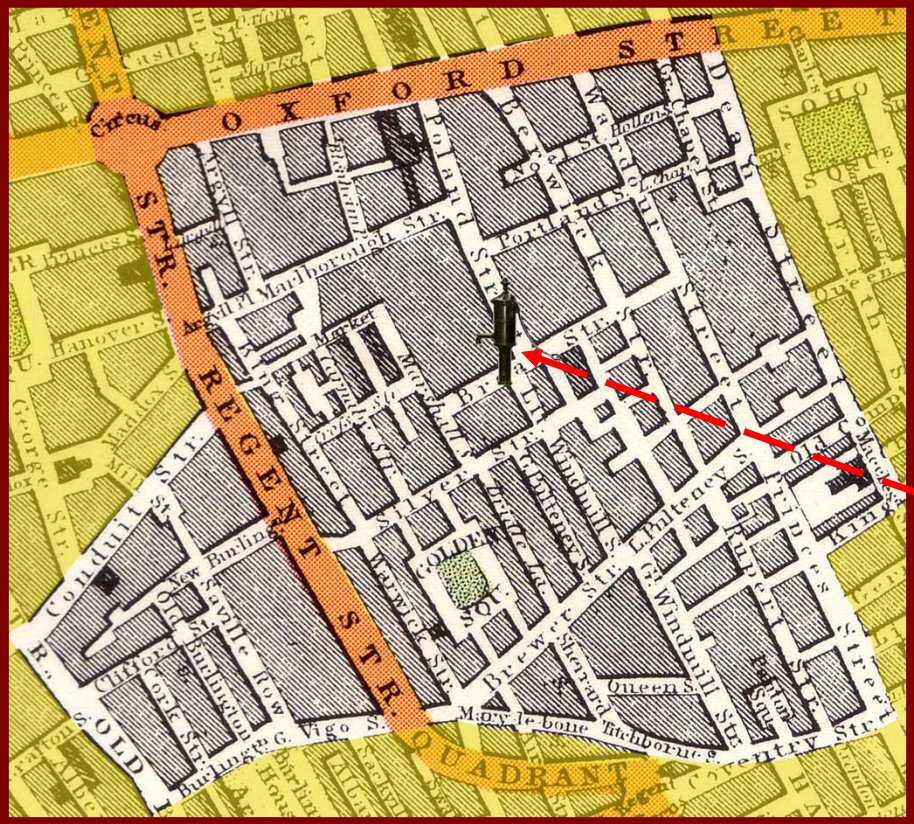
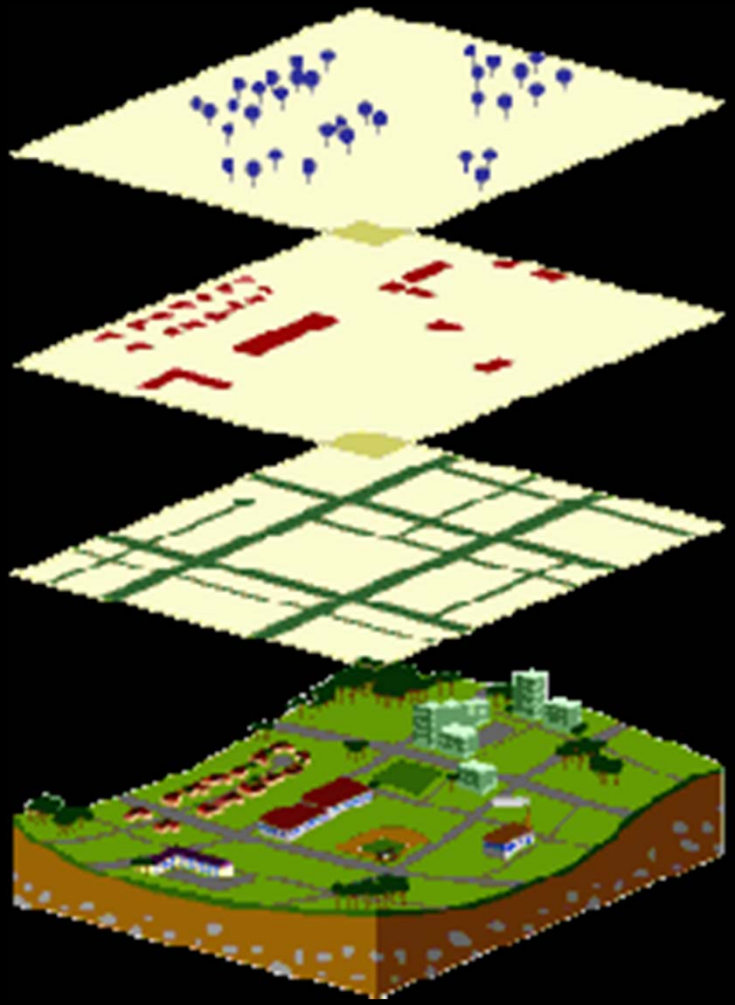
Same message, one and a half century *later*



London's water distribution map (used by John Snow in his 1855 studies) and some of his plots, which identified the source of the cholera epidemic (the pump), located *on the street*

Is “spatial” synonymous with “geographic”?



Host distribution

Housing structure

Road structure

Soil, Climate, Altitude

Geography is composed of numerous “layers.” They create numerous MULTI-DIMENSIONAL relationships. “Spatial” is only one component of “geographic” –it is a bi-variate (X, Y) but uni-dimensional (one surface)

Which ‘network’ do we need to measure?

Host distribution

Geo-biological relationships are composed of numerous "layers", which create numerous MULTI-DIMENSIONAL relationships. Transmission across hosts does not consider geographic interactions.

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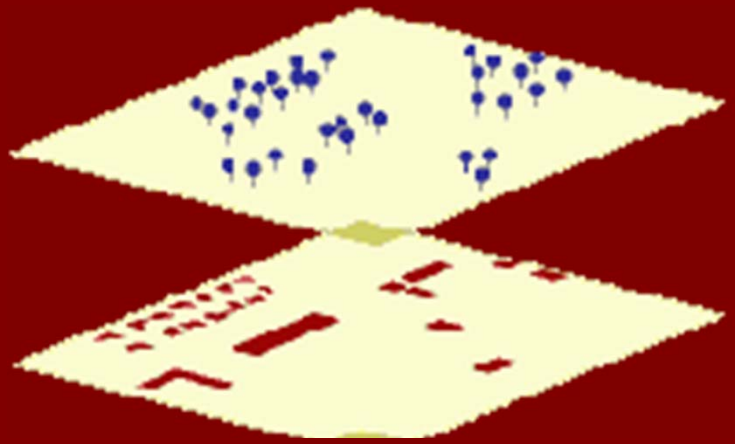

Host distribution

CLUSTERING (e.g., the STATIC housing structure)

Geo-biological relationships are composed of numerous “layers”, which create numerous MULTI-DIMENSIONAL relationships. Transmission across hosts does not consider geographic interactions. Clustering does not consider rapidly changing dynamics.

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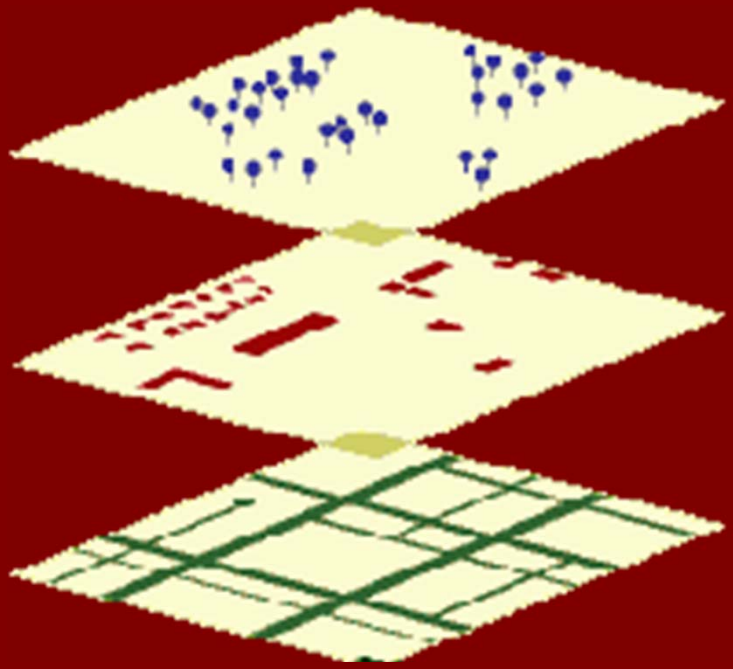

Host distribution

CLUSTERING (e.g., the STATIC housing structure)

CONTACTS (the human or human/animal network)

Geo-biological relationships are composed of numerous “layers”, which create numerous MULTI-DIMENSIONAL relationships. Transmission across hosts does not consider geographic interactions. Clustering does not consider rapidly changing dynamics. Contacts among susceptible and infected hosts provides information after the fact (too late).

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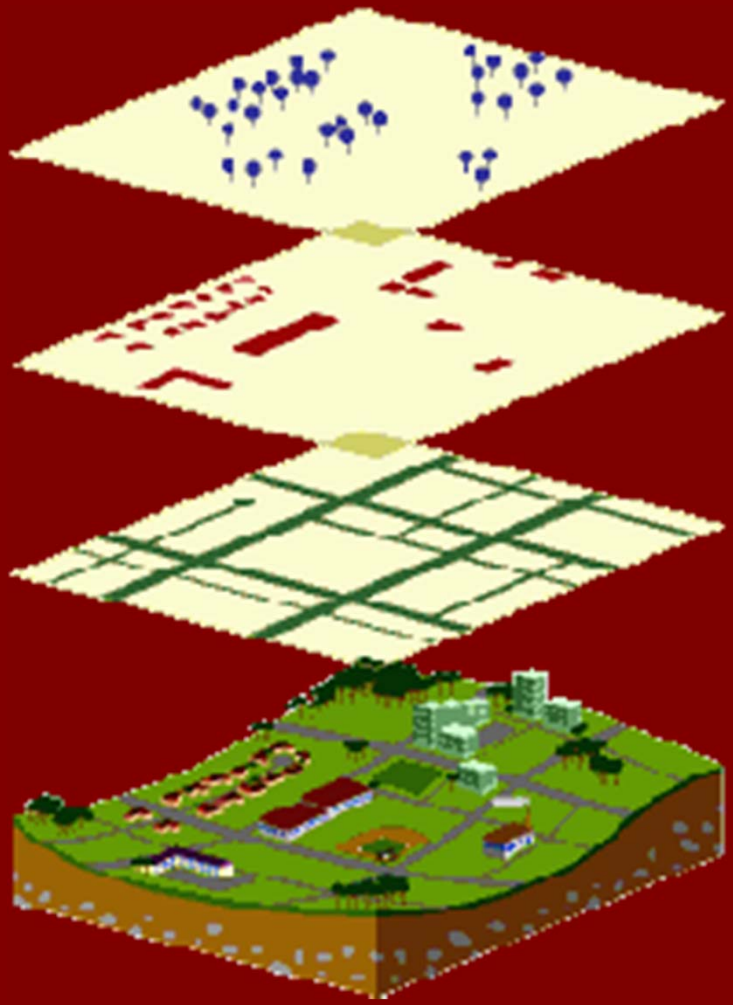


Host distribution

CLUSTERING (e.g., the STATIC housing structure)

CONTACTS (the human or human/animal network)

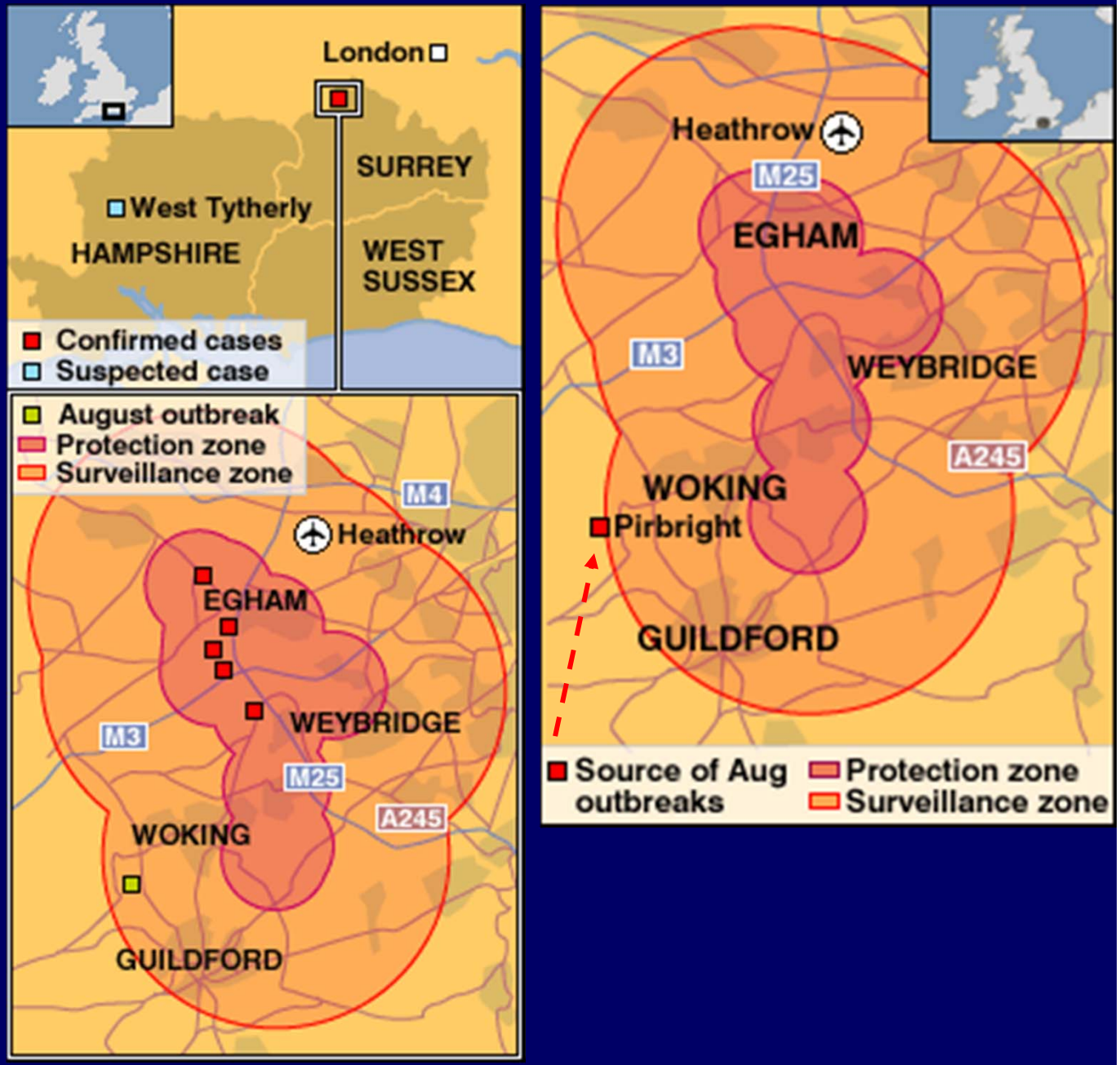
CONNECTIVITY (e.g., the road network)

Geo-biological relationships are composed of numerous “layers”, which create numerous MULTI-DIMENSIONAL relationships. Transmission across hosts does not consider geographic interactions. Clustering does not consider rapidly changing dynamics. Contacts among susceptible and infected hosts provides information after the fact (too late). Connectivity provides information on a pre-existing network.

The 2007 British FMD epidemic – the role of CONNECTIVITY

The press reported the association between connectivity and epidemic spread .

Source:
http://news.bbc.co.uk/2/hi/uk_news/6990913.stm



- The 2007 British FMD epidemic took place in a highly urbanized area, where road density was high

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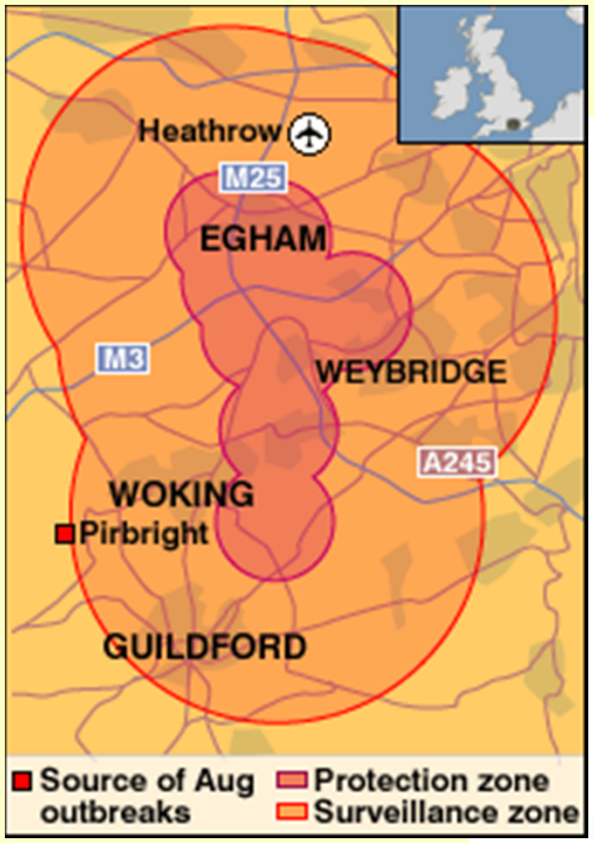
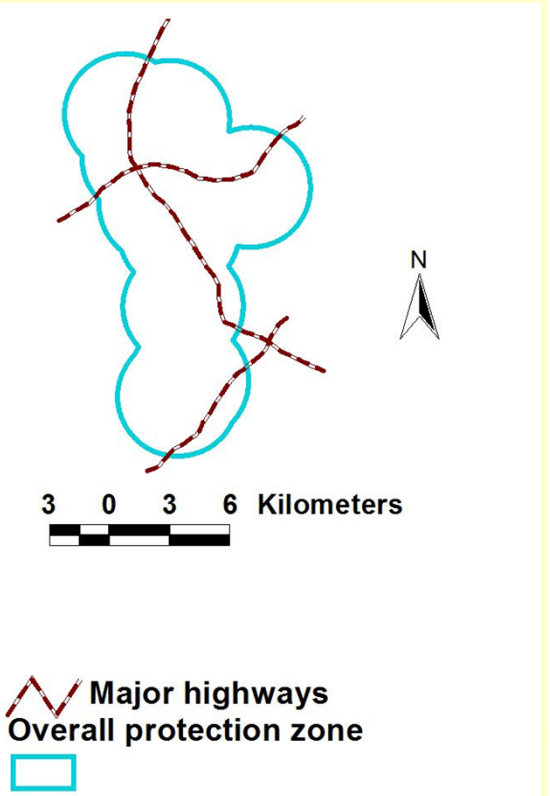
London
3 M3
B'stoke
3 M3
Guildford A 322
Windlesham
Bagshot
Lightwater
Bisley
50
TOYOTA

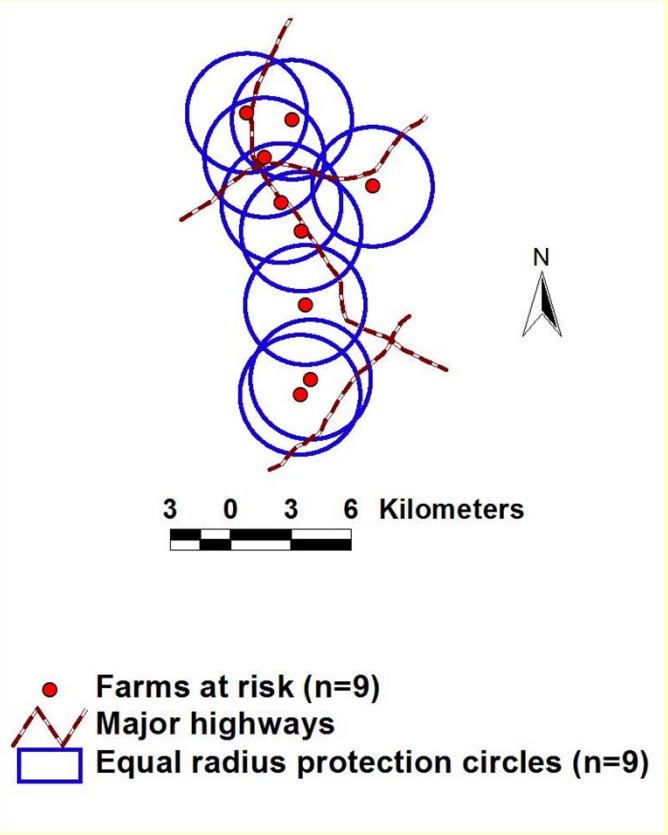
Source: BBC

[http://news.bbc.co.uk/2/hi/uk_news/6990913.stm]

Were all cases equal?







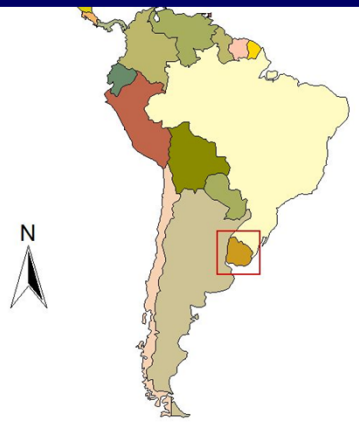
Not all cases were homogeneously distributed over space: those closer to roads (and road intersections) were clustered.

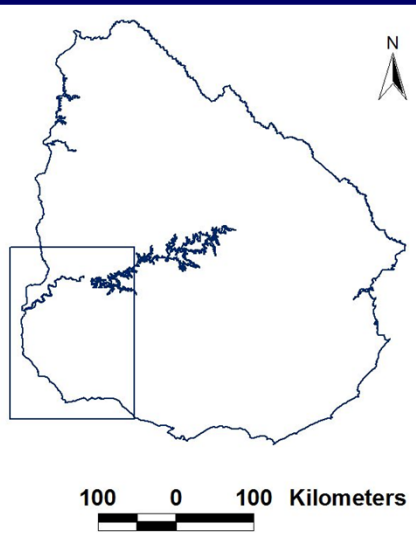
Was that structure unique?

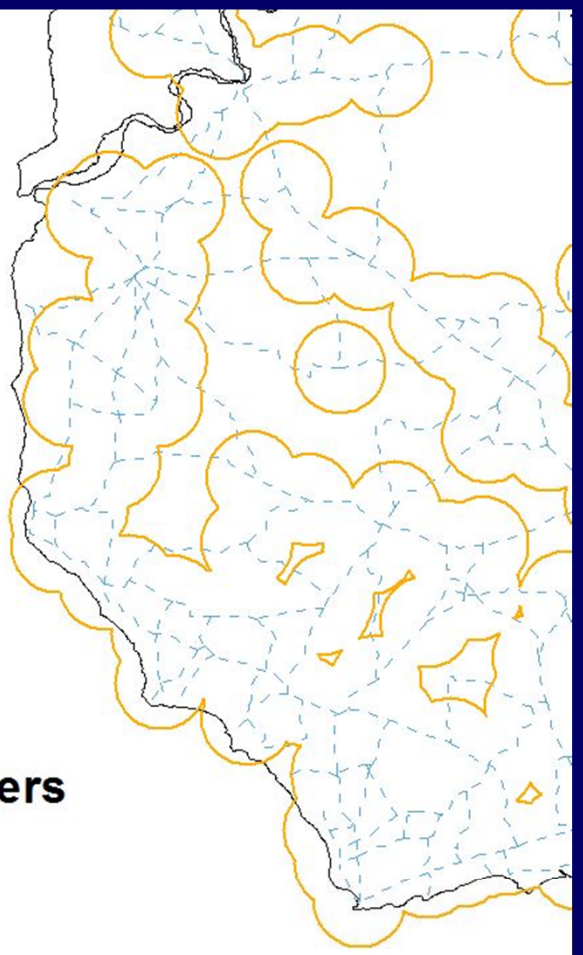
- FMD and Avian Influenza epidemics in environments where 100% of the population’s members were susceptible (exotic epidemics)

More FMD epidemics

- Uruguay, 2001







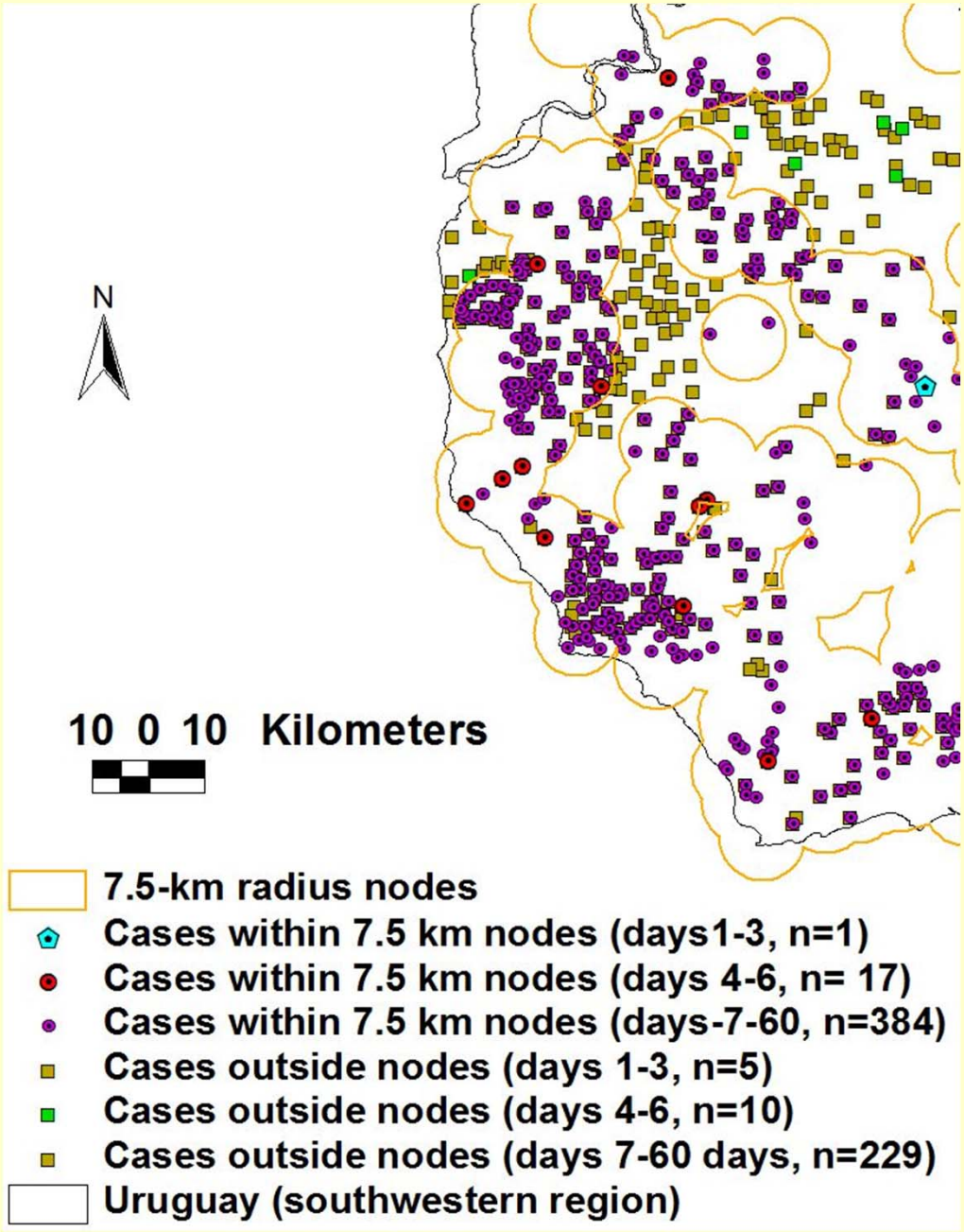
10 0 10 Kilometers

7.5-km radius nodes

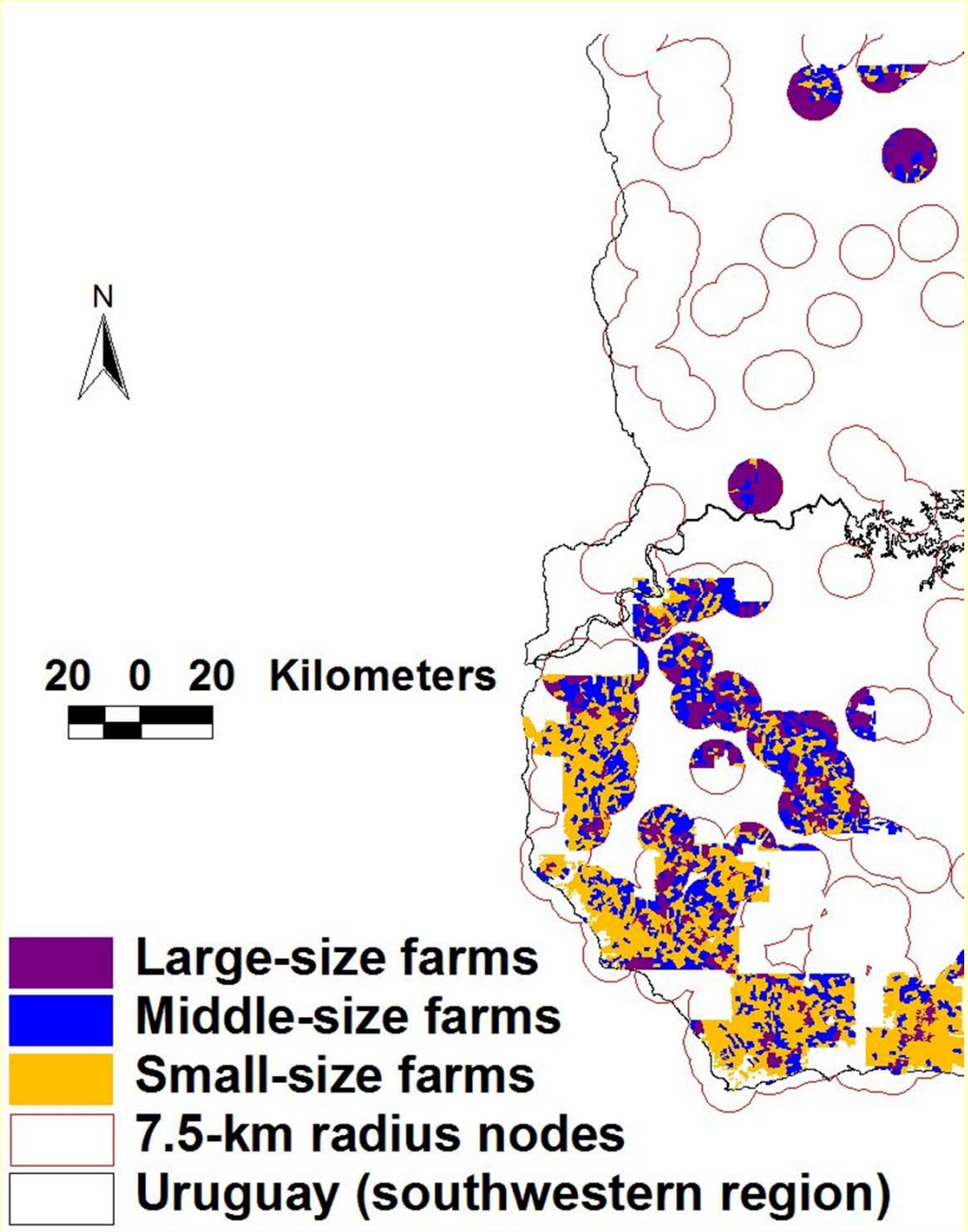
Road network

Uruguay (southwestern region)

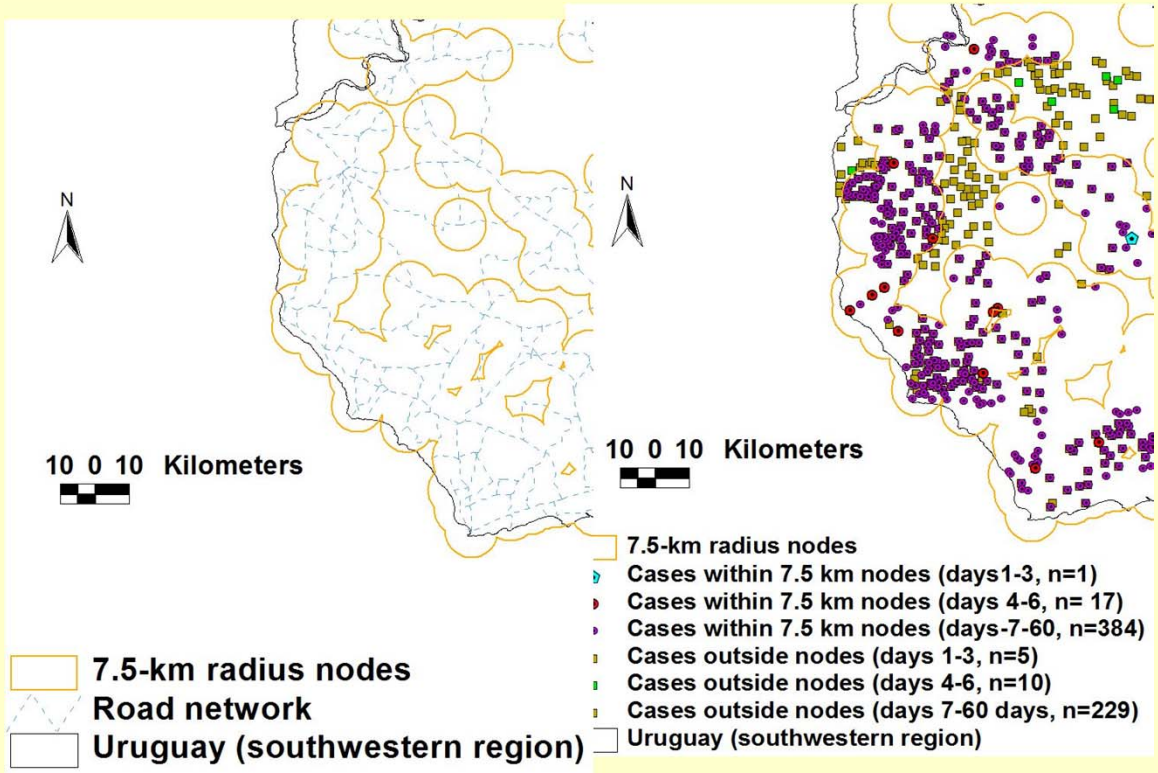
Most cases were located close to road intersections

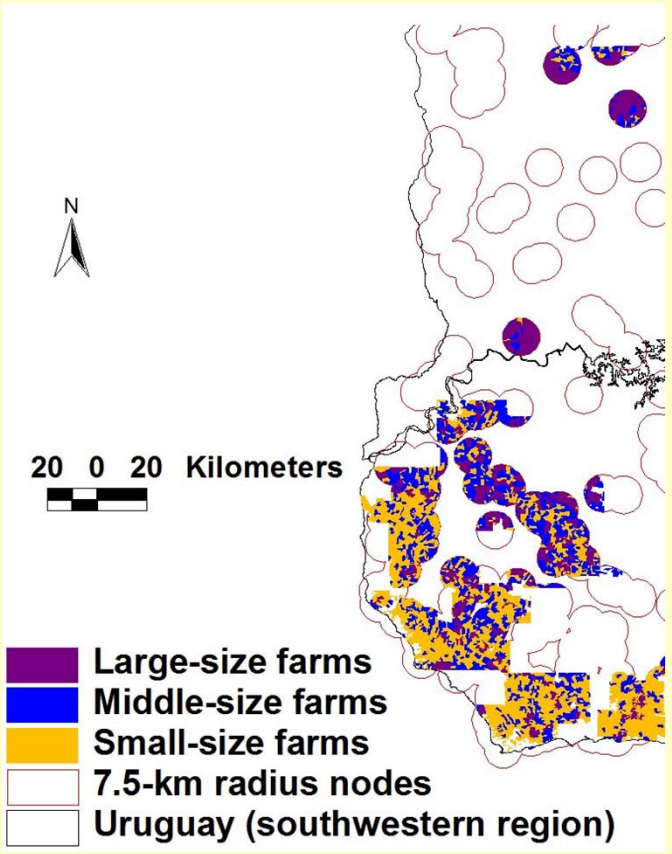


Cases were also associated with farm size: smaller farms predominated near road intersections



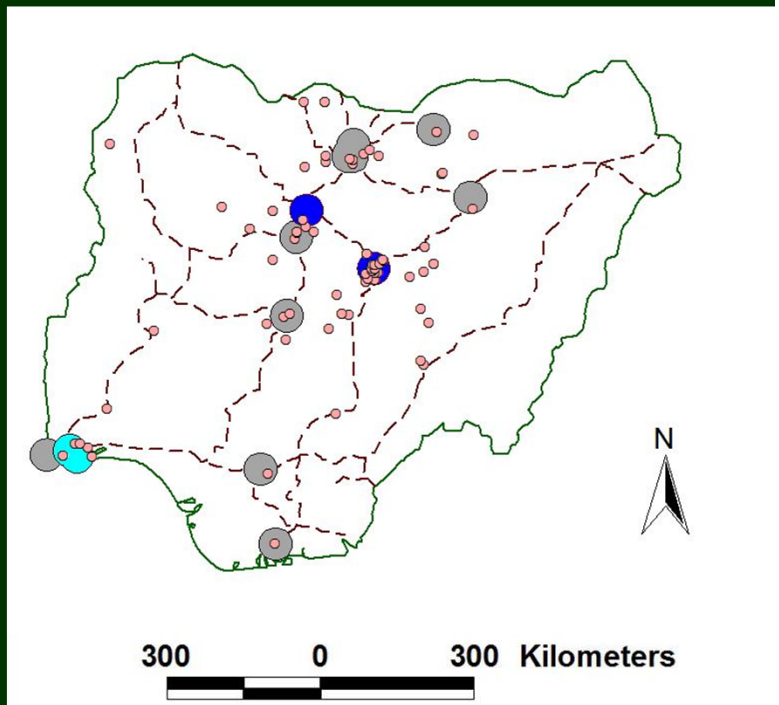
Roads, road intersections, cases, and location size (farms) were neither randomly nor homogeneously distributed

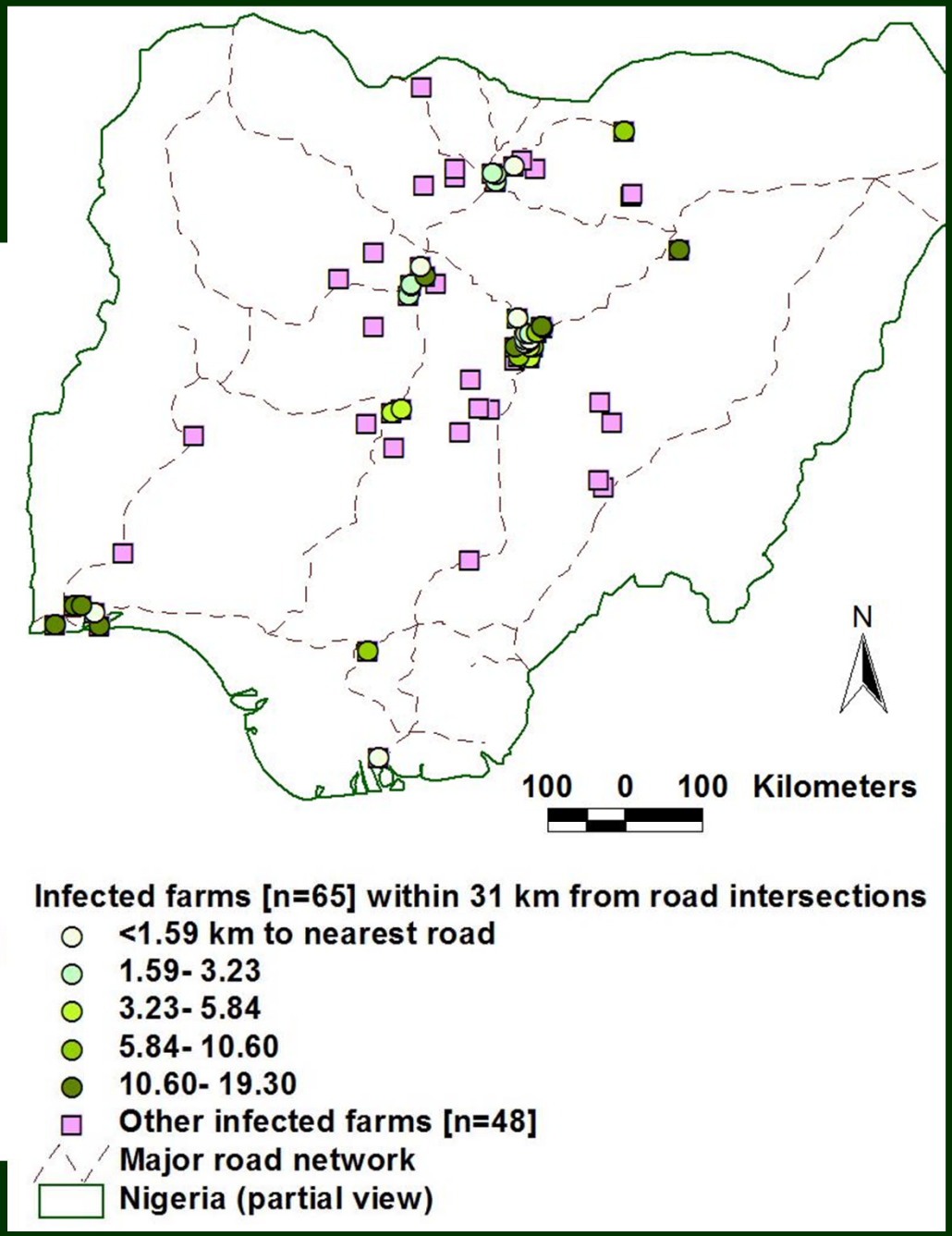




The 2006 Nigerian H5 N1 Avian Influenza epidemic

57.5% of all infected farms (65/113) were <19.3 km from a road intersection





Are all epidemic cases equal?

Apparently not.

Instead of building control zones of identical radius (an assumption based on the hypothesis that all cases are equal), we could consider the actual ***CONNECTING NETWORK***.