Human Brucellosis Occurrences in Inner Mongolia of China and Surrounding Areas: A GIS and Ecological Niche Modeling Approach

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Brucellosis

- An infectious disease from contact with animals carrying the pathogenic bacteria *Brucella*

- Primarily carried by sheep, goats, cattle, and swine

- The clinical presentation can be acute, subacute or chronic, varying from **joint, muscle and back pain** to **flu-like symptoms**, and **even more serious conditions** in different organ systems.

Features

- **Occupational**: agriculture worker, shepherd, butcher, slaughter-house worker, and cattle dealer

- **Environmental**: lower temperature and less sunshine

Geography

- A major source of diseases in the Mediterranean region, Asia, Middle East, Sub-Saharan Africa, Latin America and Balkan Peninsula

- **Inner Mongolia** accounted for approximately 50% of the total reported cases in China during 2005-2010

Research Goals

- Examining spatial-temporal distribution of human Brucellosis cases in Inner Mongolia from 2006 to 2010

- Examine the association of the environment with human Brucellosis occurrences in Inner Mongolia region
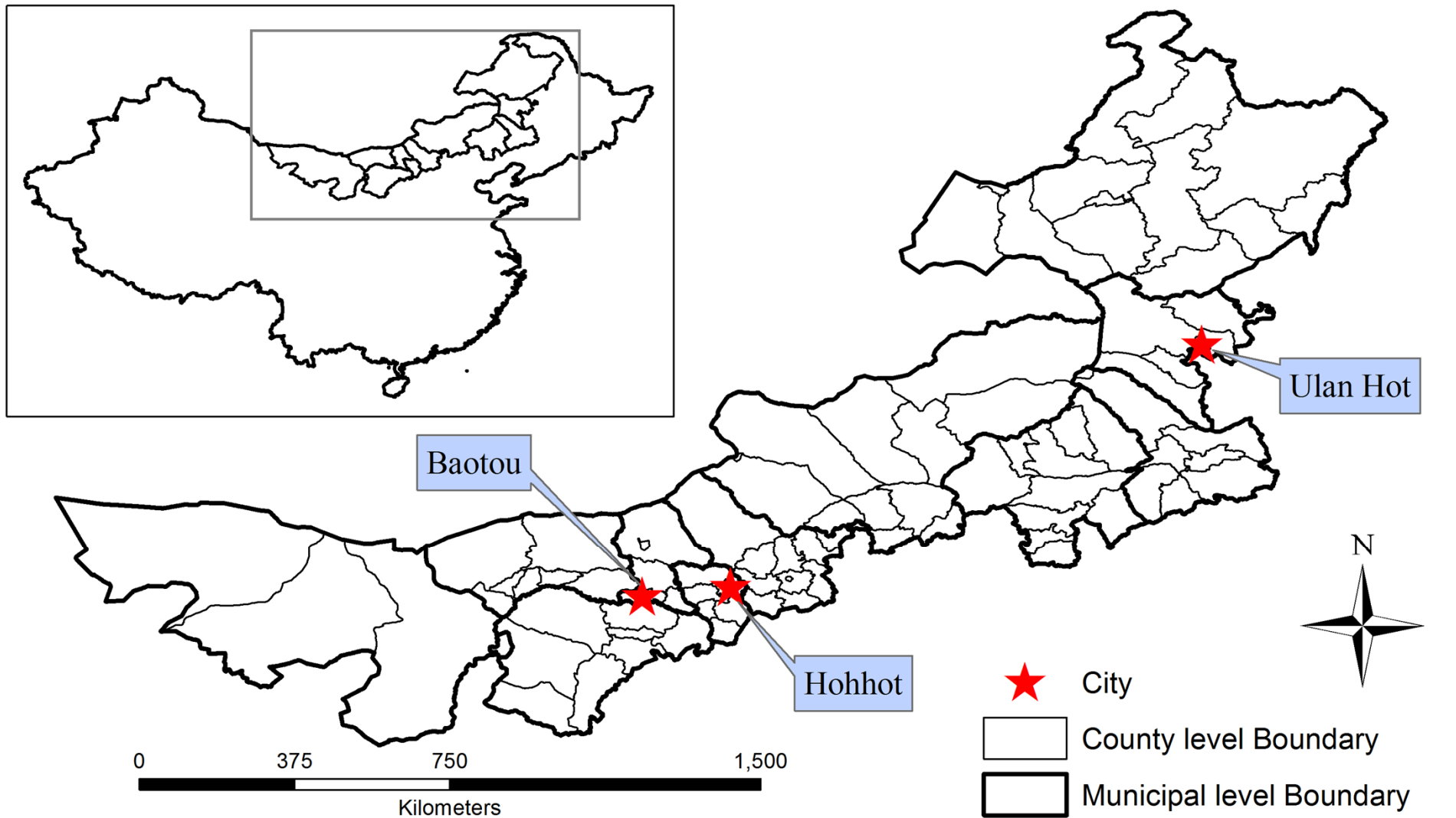
Study Area

Data

- Disease
  - Aggregated Brucellosis cases over counties
- Environmental
  - EVI, LST, MIR, precipitation
  - 19 bioclimatic variables
- Socioeconomic
  - Small ruminants
  - Population
  - Accessibility

19 Bioclimatic Variables

(from <u>WorldClim</u>)

Variable	Name
BIO1	Annual Mean Temperature
BIO2	Mean Diurnal Range
BIO3	Isothermality
BIO4	Temperature Seasonality
BIO5	Max Temperature of Warmest Month
BIO6	Min Temperature of Coldest Month
BIO7	Temperature Annual Range
BIO8	Mean Temperature of Wettest Quarter
BIO9	Mean Temperature of Driest Quarter
BIO10	Mean Temperature of Warmest Quarter
BIO11	Mean Temperature of Coldest Quarter
BIO12	Annual Precipitation
BIO13	Precipitation of Wettest Month
BIO14	Precipitation of Driest Month
BIO15	Precipitation Seasonality
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter
BIO19	Precipitation of Coldest Quarter

Methods

- Statistical tests

- Mapping raw & smoothed rates

- Local Moran's I (LISA)

- Correlation analysis

- Ecological niche modeling (ENM) - location
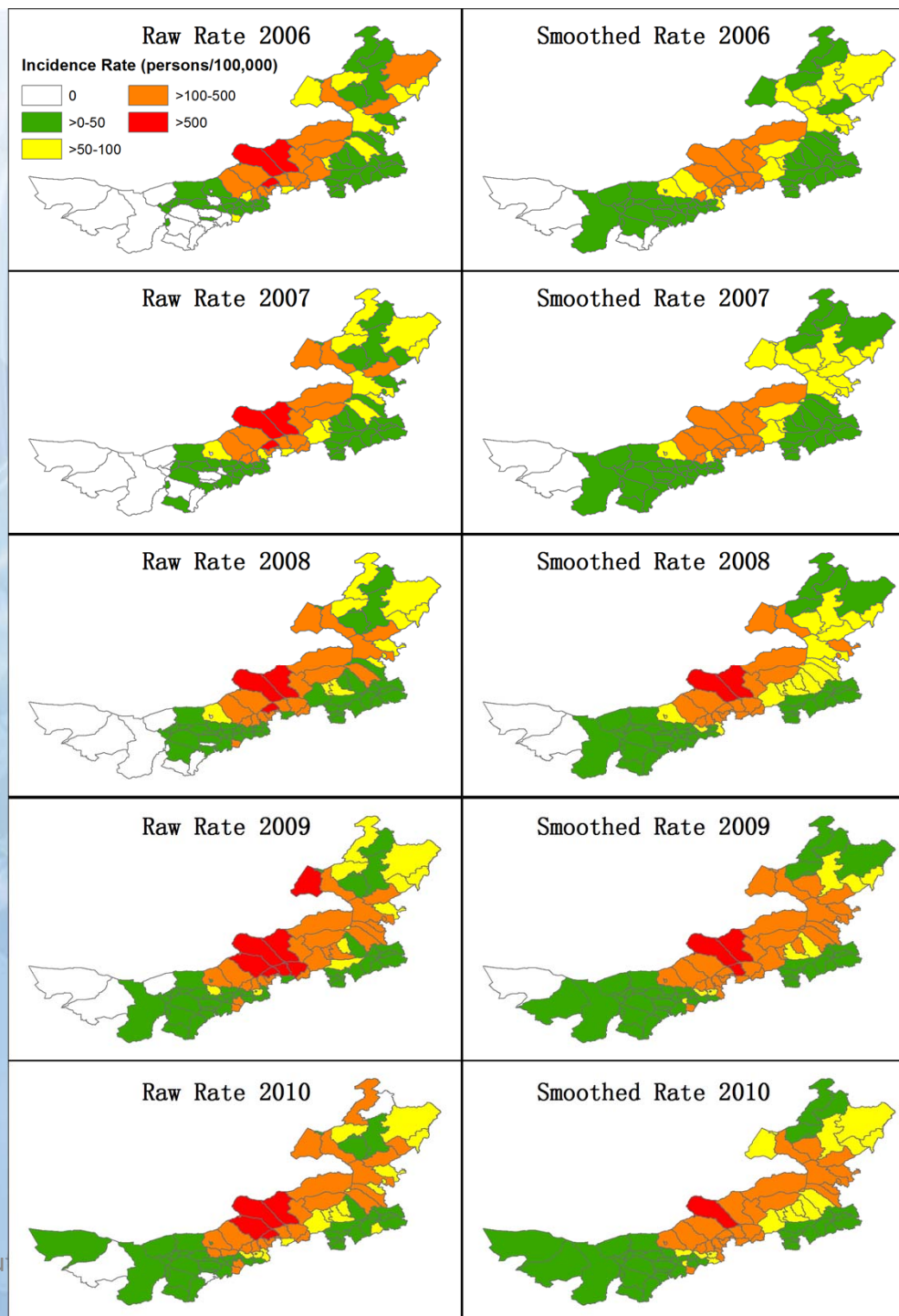
- Multiple stepwise regression - county

Raw Rates
&
Smoothed Rates
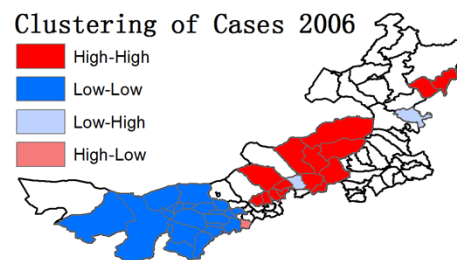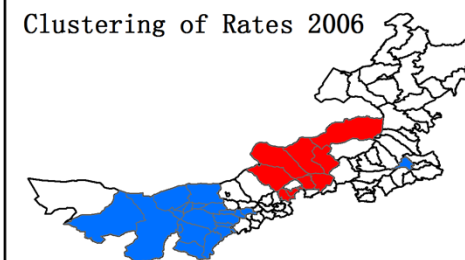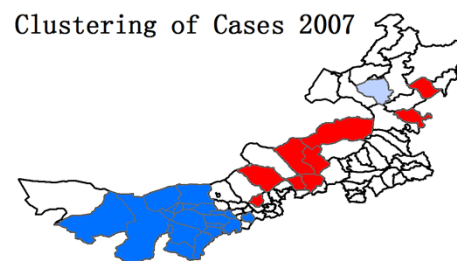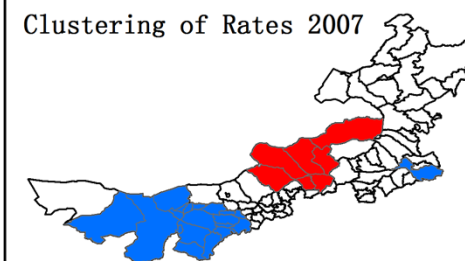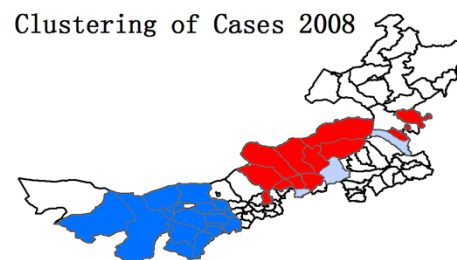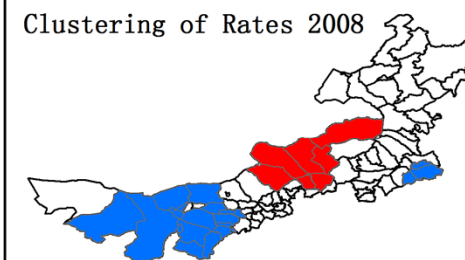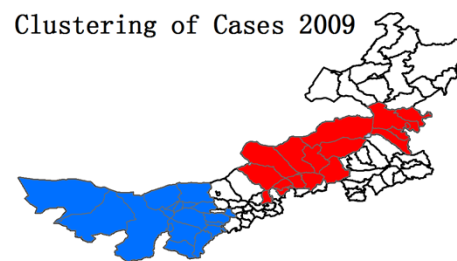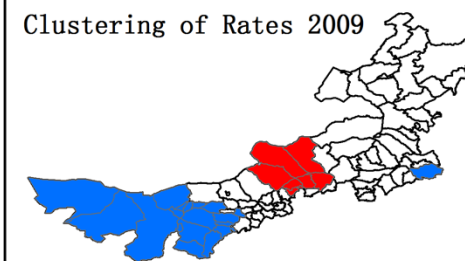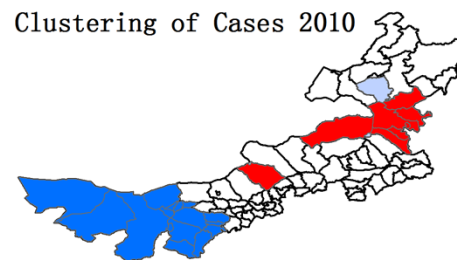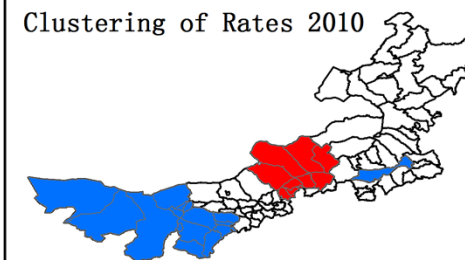
Clustering

ENM outputs
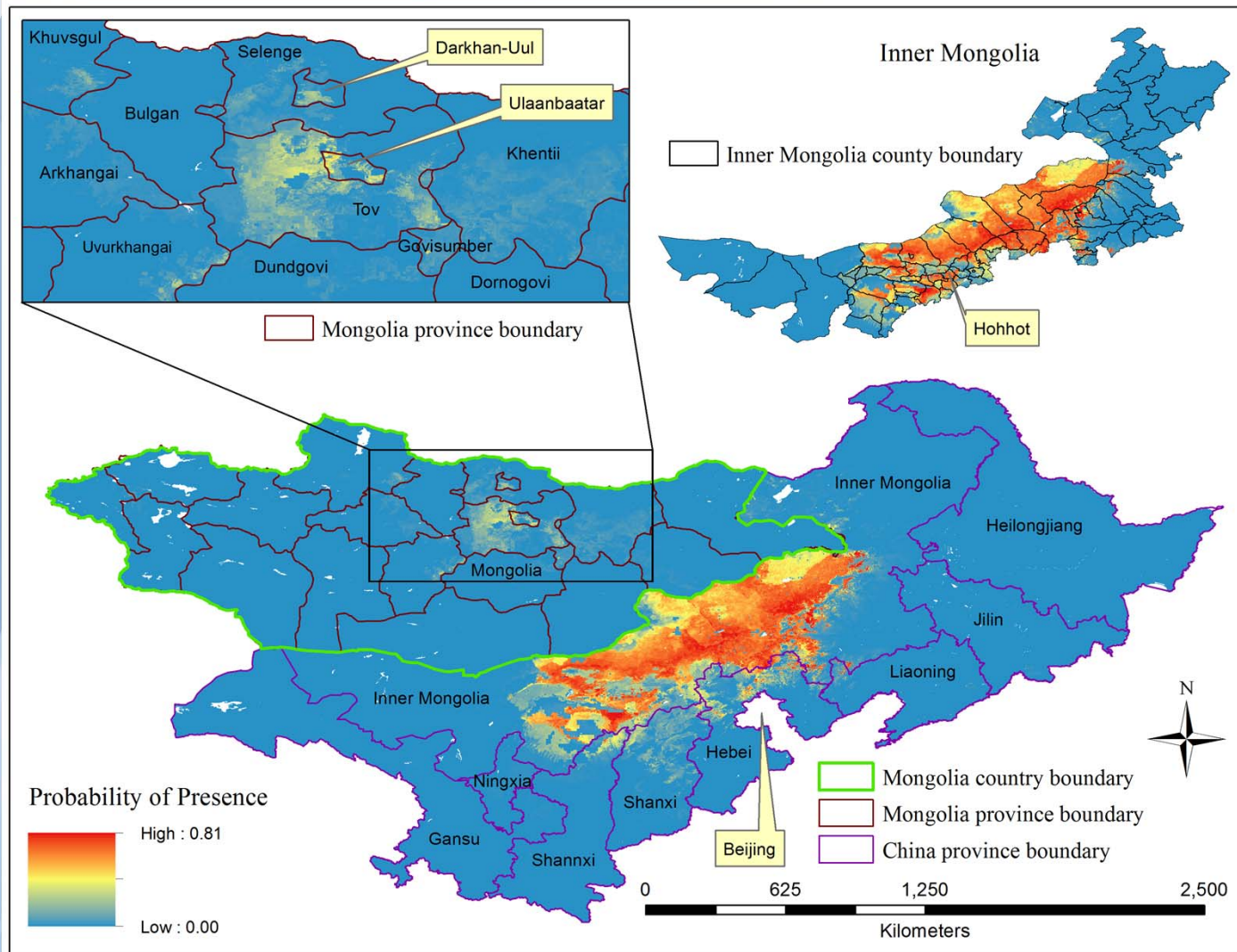
County-level regression

	2006	2007	2008	2009	2010	Average
Variables						
bio 3	-0.436	-	-	-	-	-
LST mean	-	-0.766	-0.767	-0.730	-0.965	-0.990
MIR mean	0.227	0.752	0.748	0.742	0.877	0.905
access	-	-	-	-	-0.235	-0.220
alt	0.339	-	-	-	-	-
ca05 tot	0.246	-	-	-	-	-
SHEEP10 tot	0.194	0.290	0.314	0.302	0.366	0.305
Assessment						
R^2	0.317	0.357	0.377	0.356	0.466	0.425
adjusted R^2	0.275	0.334	0.355	0.333	0.441	0.397

Conclusions

- **An increasing trend** for human Brucellosis occurrence **from the west to the east and central Inner Mongolia**, with the incidence rates in central Inner Mongolia higher than other regions

- The major variables contributing to the model include the **density of small ruminants** (especially **sheep**), **altitude**, **precipitation seasonality** and **temperature annual range**.

- The **incidence rates** in the highest regions may be **skewed by the small numbers of total population**.

Conclusions (continued)

- The **density of sheep** (positively) and the mean of **LST** (negatively) and **MIR** (positively) were correlated with the incidence rates of human Brucellosis **at the county level**.

- **Parts of Mongolia** and **northern Hebei, Shanxi and Shannxi**, in addition to Inner Mongolia, have some risk for human Brucellosis occurrence, based on their suitable conditions.

- Counties in Inner Mongolia are classified into a series of categories with different levels of **probability of presence of human Brucellosis**.

Thanks for listening!

Questions?