Spatial-temporal process of Urban Growth: A Case Study of China Tianjin Area

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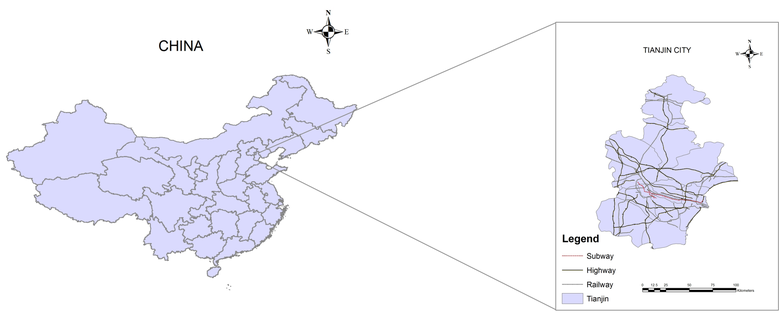
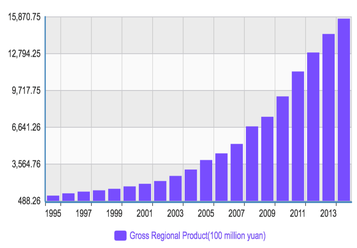
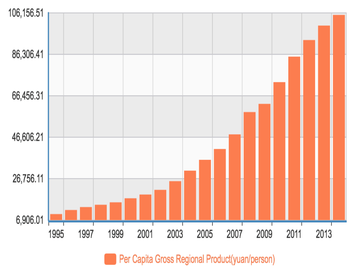
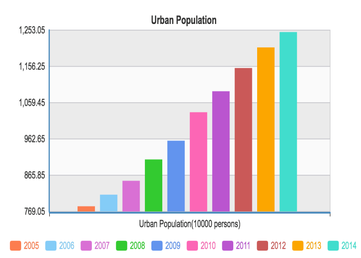
Introduction

- Urban areas are expanding at a very high speed worldwide leading to a lot of environmental and social problems.
- Thus, a lot urban growth studies are focusing on predicting future Urban land use/Land cover (LULC) for sustainable urban planning.
- This study used remote sensing (RS) data to forecast future LULC development in Tianjin area, China.





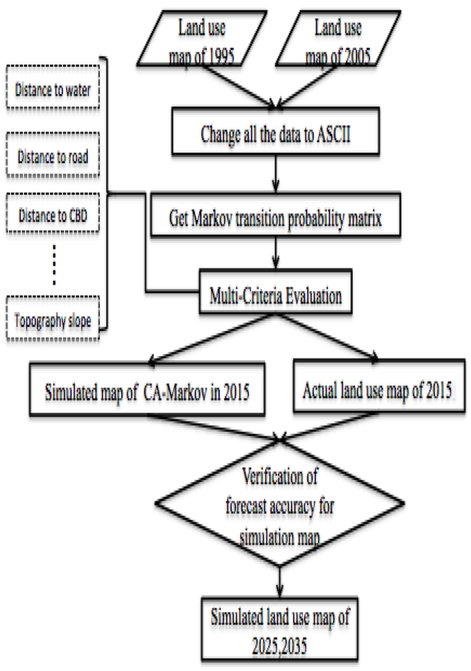




Methodology

Data

- Landsat 5 TM (1995), Landsat 7 ETM+ (2005) and Landsat 8 OLI (2015) from USGS. All imageries chosen were cloud free and in the same season.
- Administrative boundary shapefile.



Pre-processing:

- No geometric and radiometric correction (already done by USGS)
- Mosaicking, Clipping, projecting, geo-referencing etc.

Classification

- Training sample selection and creating signatures.
- Maximum (supervised) classification applied using ENVI 5.2 software.

Influence of major roads on LULC

- The size of each LULC class over an incrementing distance from majors roads was determined.
- Graphs displaying LULC classes vs major roads are generated.

Modeling

The Model

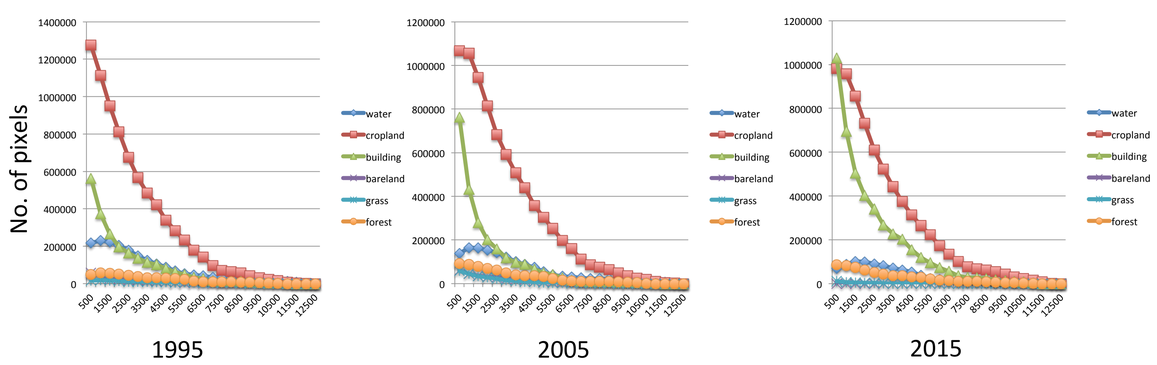
- Cellular Automata (CA)-Markov Chains (MC) Model was used for modeling future LULC in 2015 and compared with actual LULC map of 2015.
- CA-MC model was applied using Idrisi Software (Version 17.02).

Variables

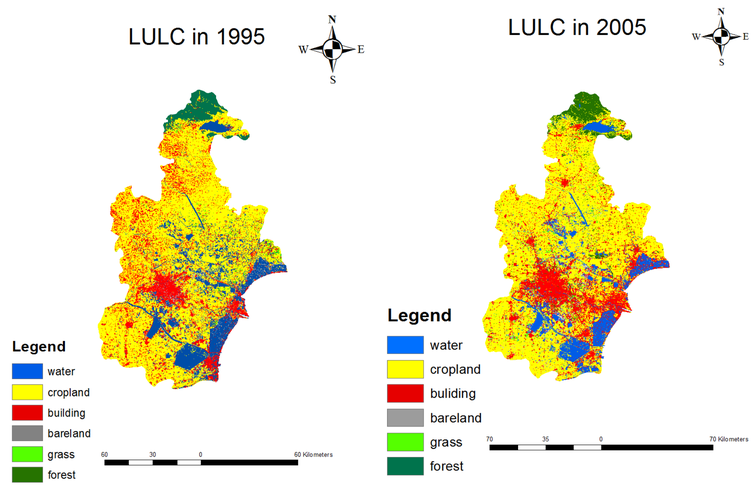
- Distance to all LULC classes (Built, forest cropland, grassland, bareland and water) and distance to roads.
- Social data availability limitations encountered (e.g. population density).

Results

Major roads influence on LULC



LULC Modeling



LULC Type	Area Change (Km^2)	Dynamic Change Speed (%)
water	-417.34	-2.38
cropland	-27.34	-0.039
building	143.31	0.71
bareland	49.99	2.28
grass	88.11	6.48
forest	163.27	3.53

- Built area expanding at a fast rate

Markov transition probability matrix 1995—2005

	Water	Cropland	Building	Bare Land	Grass	Forest
Water	0.5551	0.2555	0.1459	0.0259	0.0083	0.0094
Cropland	0.0314	0.7780	0.1151	0.0217	0.0235	0.0303
Building	0.0426	0.4273	0.4716	0.0258	0.0154	0.0173
Bare land	0.1721	0.2038	0.5286	0.0653	0.0205	0.0097
Grass	0.0227	0.8615	0.0679	0.0047	0.0085	0.0347
Forest	0.0283	0.1714	0.0198	0.0055	0.0121	0.7630

Markov transition probability matrix 2005—2015

	Water	Cropland	Building	Bare Land	Grass	Forest
Water	0.4211	0.2355	0.3147	0.0000	0.0008	0.0278
Cropland	0.0250	0.7281	0.2123	0.0001	0.0016	0.0329
Building	0.0211	0.1950	0.7607	0.0000	0.0060	0.0171
Bare land	0.0272	0.3679	0.5755	0.0000	0.0039	0.0255
Grass	0.0135	0.5517	0.3913	0.0000	0.0056	0.0379
Forest	0.0113	0.4115	0.1582	0.0000	0.0045	0.4145

- Built area is increasing at a rapid rate.
- The port area also growing at a much faster rate because the hub is transport, shipping and industrial center.

Simulation and prediction

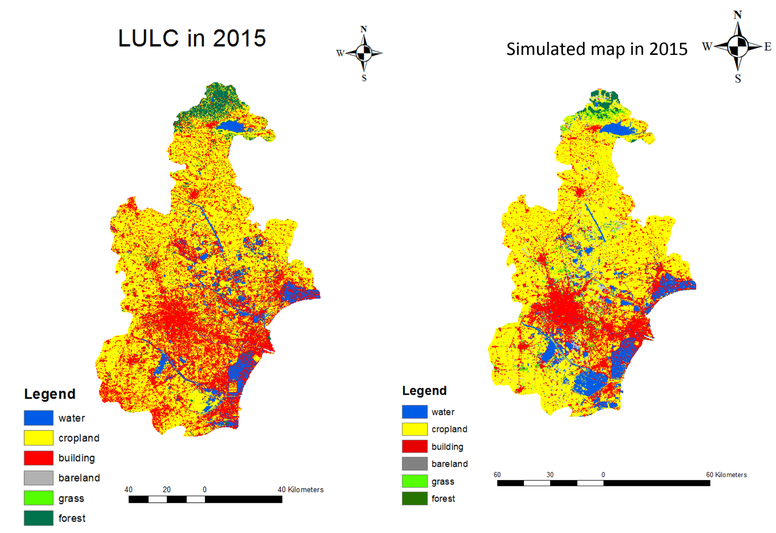


Image similarity/Association Data

Chi-square	31767312.0000
df	25
P-level	0.0000
Cramer's V	0.5127
Kappa	0.6917

➢ Kappa value (69%) shows good simulation result although miss matches observed.

Conclusions

- Built area increasing at a very fast rate than all other LULC classes.
- Cropland and water decreasing. This could be attributed to the fact that the classification for water include paddy fields. There could be confusion between water and cropland which require rechecking.
- Simulation and modeling results are generally good but a considerable number of miss matches.