



人工智能与未来城市空间规划

Artificial Intelligence and the Future of Urban Spatial Planning

CAO Buyang

Development Pattern Analytics upon Deep Learning



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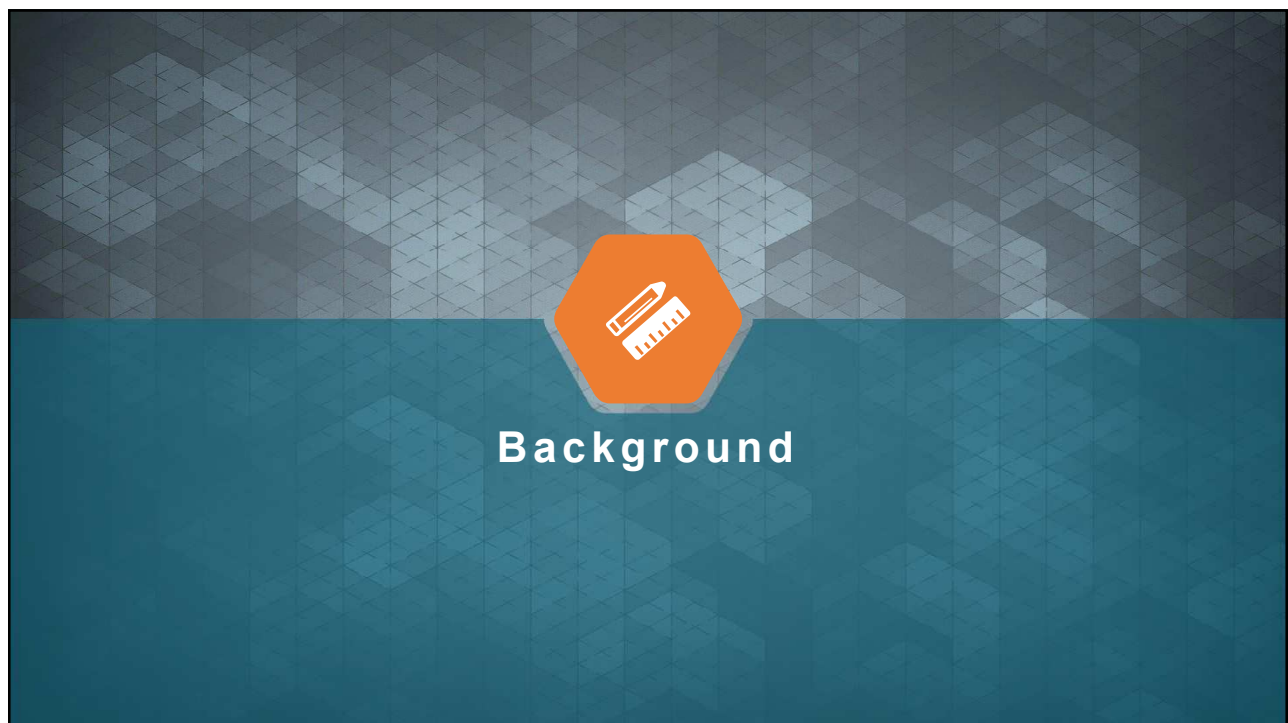
长三角城市群智能规划协同创新中心
CHINA INTELLIGENT URBANIZATION CO-CREATION CENTER FOR HIGH DENSITY REGION

Development Pattern Analytics upon Deep Learning

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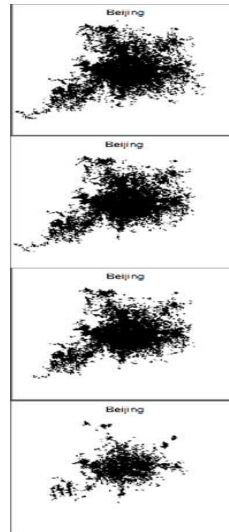
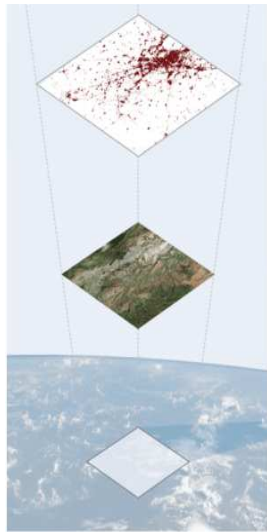
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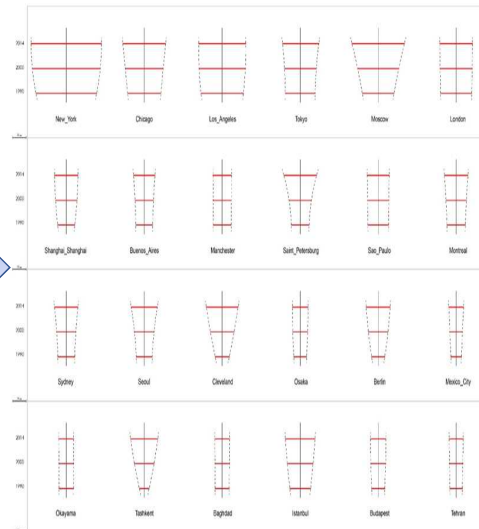


01

City Trees

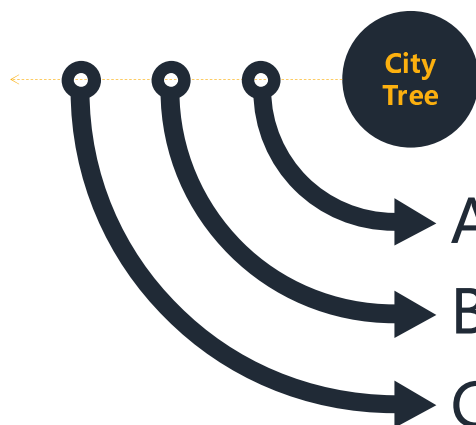


Different development categories

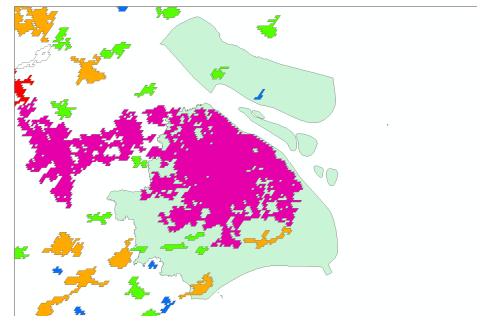


01

Our tasks



- A** Based on built-up areas
- B** Finding characteristics during urbanizations
- C** Finding patterns, regularities, periodic over the period of time



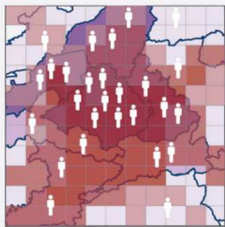
Note: We conduct the analyses for the built-up areas within Yangtze Delta, China



Methodology and results

02 Grid based Data Model

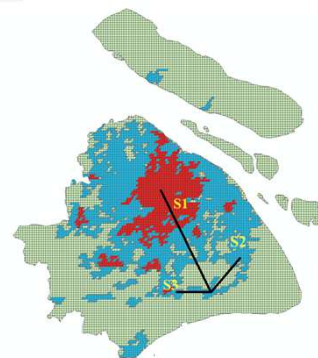
METHOD



The **GHSL method** is design to combine information from population censuses with built-up and to **downscale population** into a **grid of 1Km** of resolution, according to the presence or absence of built-up in the grid cell.

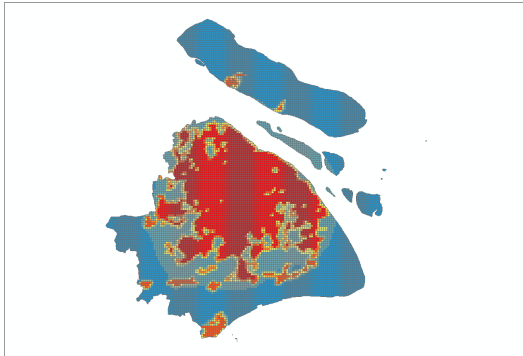
Built-up are ≠ a city area:

- Need to map city data to built-up area
- Using improved GHSL to map data based on grid (1km x 1 km)

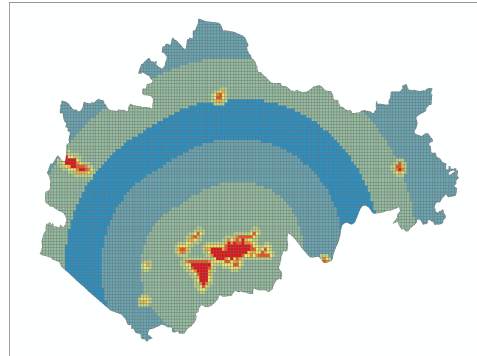


03 Grid based Data Model

Data mapping examples

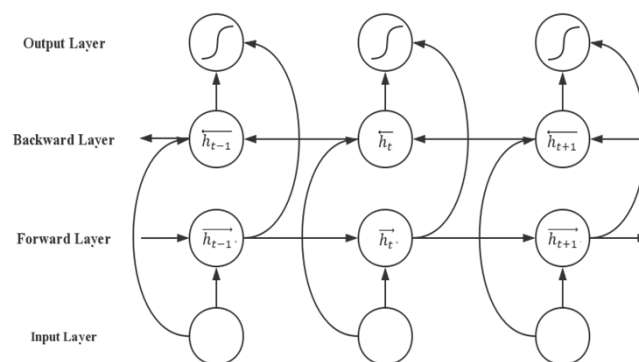


Shanghai



City of Bengpu, Anhui Province

02 BiLSTM Classifier



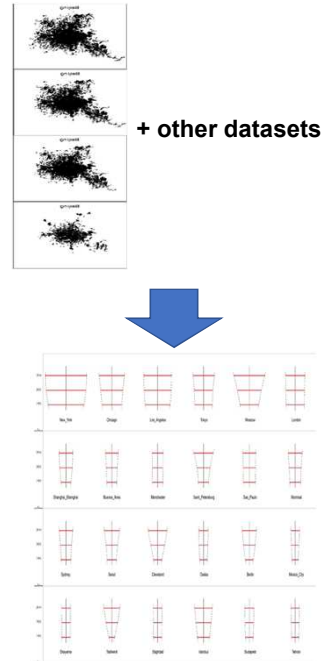
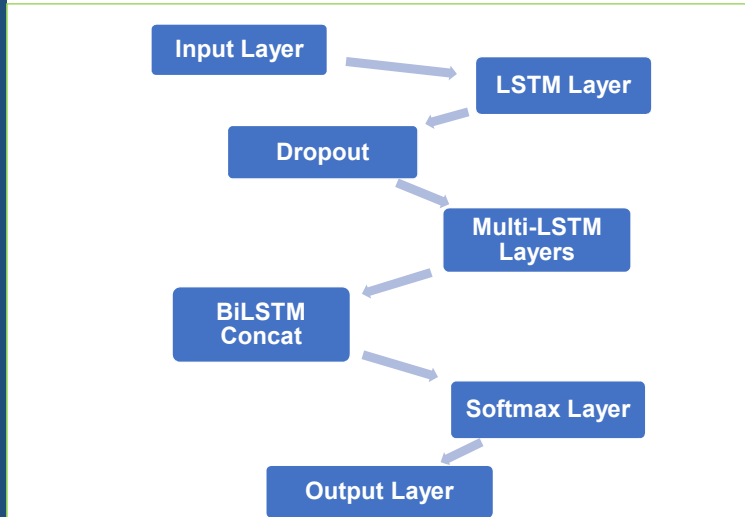
$$h_t = [\vec{h}_t; \overleftarrow{h}_t]$$

Using BiLSTM to classify the development patterns (categories) for built-up areas

02

BiLSTM Classifier

Our classification model



02

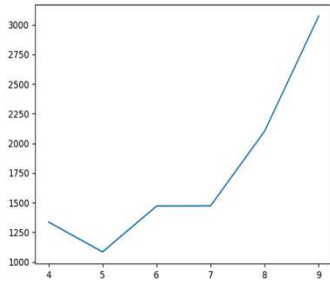
BiLSTM Classifier

Attributes used in the classifier

Model	Accuracy
LSTM	0.79310346
BiLSTM	0.8965517

Attributes	Classification accuracy (one attribute only)
Population in the area	0.820689664
GDP of the area	0.6137930926
Financial income of the area	0.565517
Financial expenditure of the area	0.524138
Total investment in fixed assets	0.613793
Total retail sales	0.558621
Import/export	0.448276
Industrial output	0.641379
Passenger traffic	0.77931
Freight volume	0.57931
Total consumption expenditure	0.613793
Number of employed people	0.572414
Total household disposable income	0.57931

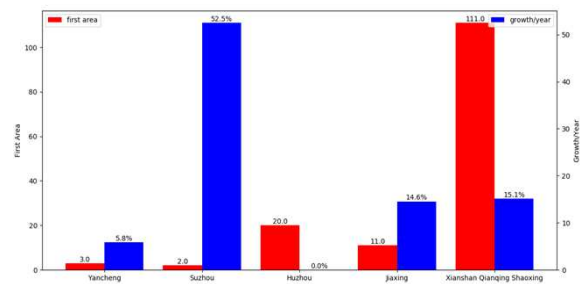
02 DTW Clustering



Clustering built-up areas upon their development patterns over the time, the best number of clusters is 5:

- Explosive growth
- Rapid growth
- Moderate growth
- Slow growth

Centroid CityID	Centroid CityName	# areas in the cluster
3855	Xianshan Qianqing Shaoxing	8
2953	Yancheng	54
3559	Suzhou	55
3336	Huzhou	23
3727	Jiaxing	60

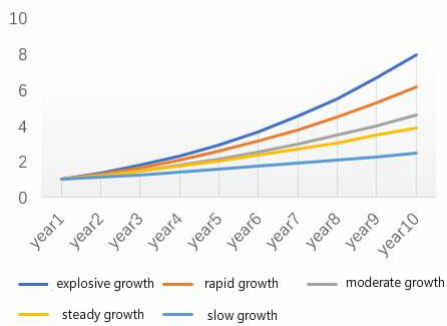


Growth rates changing (in clusters) over the time

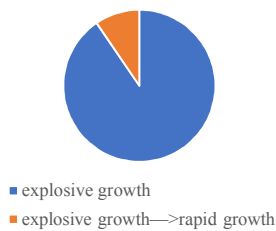
02 DTW Clustering



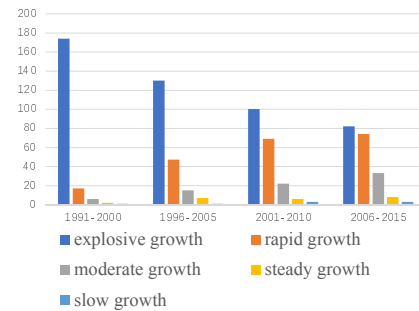
Trend of total export-import volume



Budding Type Built-up Area

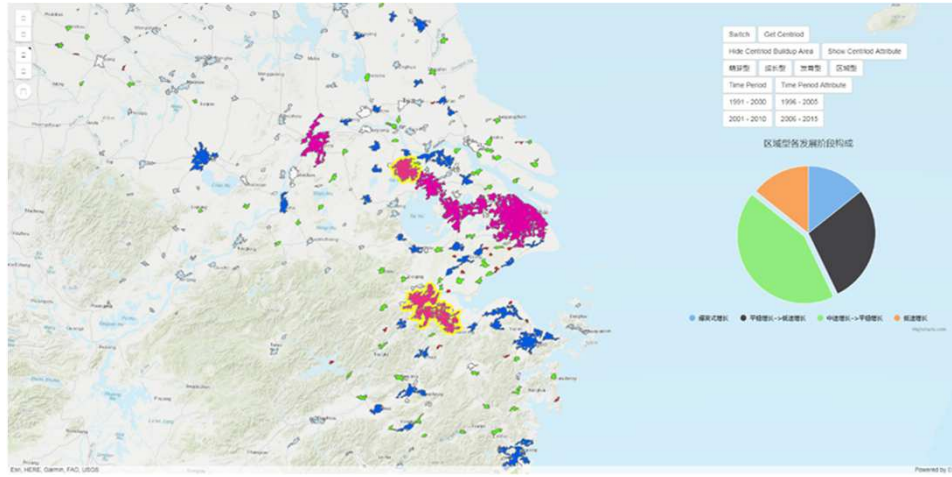


Number of different development patterns in different periods



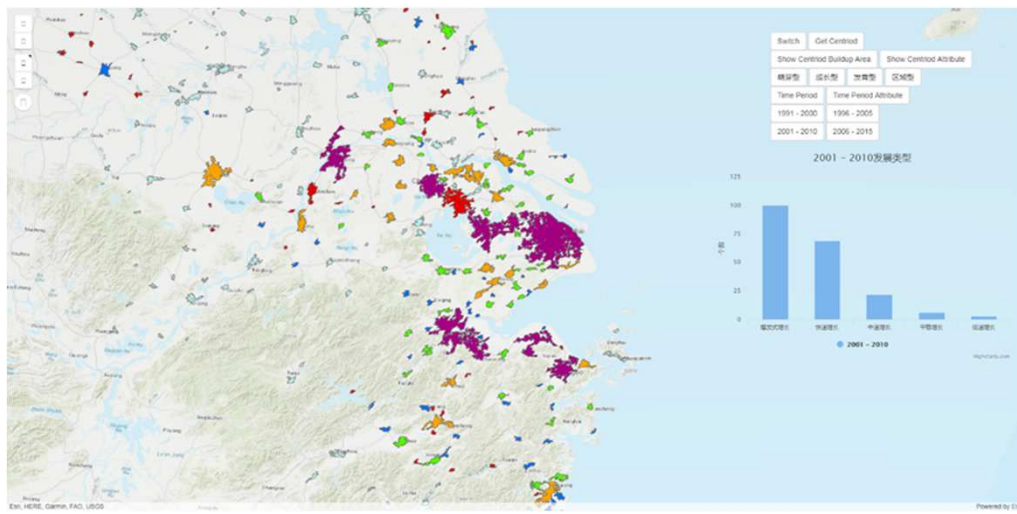
02 Visualization (ArcGIS)

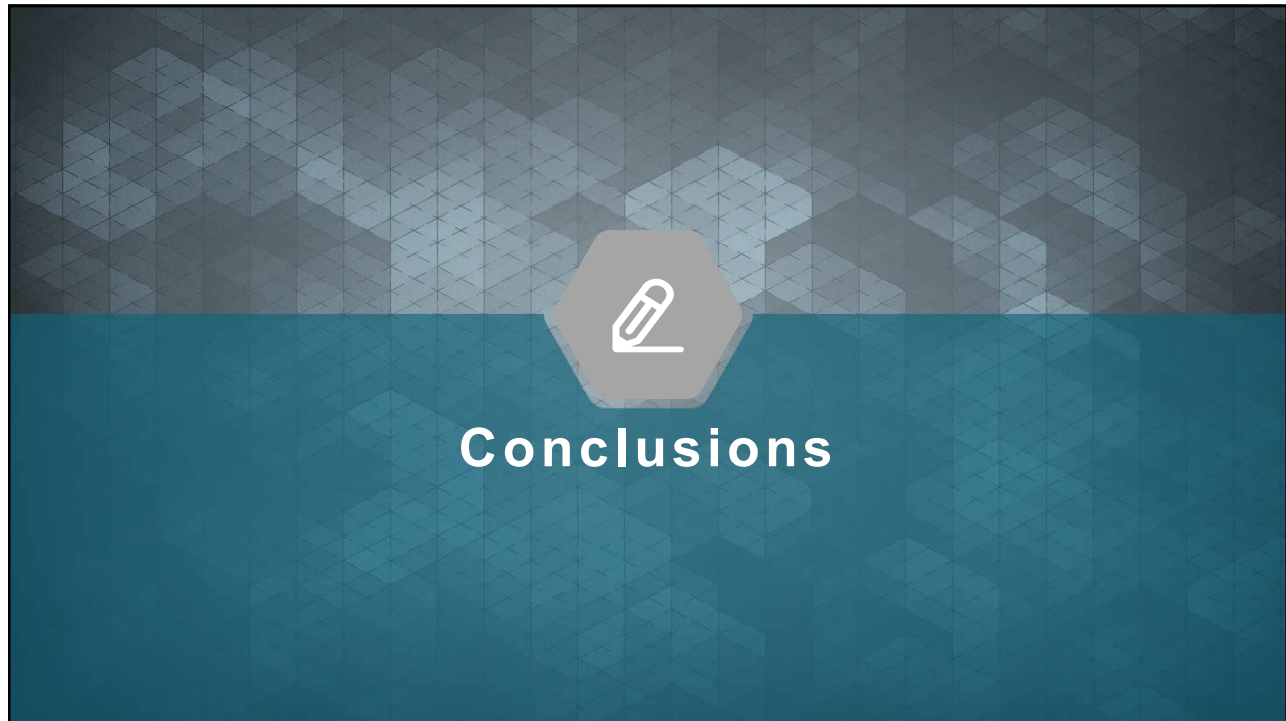
Different development categories



02 Visualization (ArcGIS)

Number of development categories in different years





03

Conclusions

BiLSTM is able to capture multi-dimensional time series as whole and their trends

The population growth trend is consistent with the development trend of an area



The result of clustering using multi-dimensional time series is coincident with city trees and their categories



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Thank You