Predicting hotspots of urban growth based on population projections for the greater Tirana area, Albania

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Outline

1. Urban growth – a global and regional phenomenon
2. Demographic changes in and around Tirana, Albania
3. Urban growth mapping using remote sensing
4. Spatially explicit modelling urban growth based on population projections
5. Conclusions

Urban transformation - a global phenomenon

- rapid urbanization processes across the globe
- long-lasting structures
- globalization:
  - economic integration
  - human migration
- changing life-styles, fertility and mortality rates
- concurrent demand for services and infrastructure
- results in high impacts on environment, socio-demography and the economy

Urban transformation in postsocialist countries

- political and economic transition acts as expedited globalization
- demographic changes cause direct and intense urban growth
- large regional variation

=> Example of Greater Tirana Area, Albania

Guardian

GooglePics

What will Tirana look like in 10 years?

"I do not know. The most interesting thing about this country is that you can never predict the future."

Edi Rama [Mayor of Tirana], 2006

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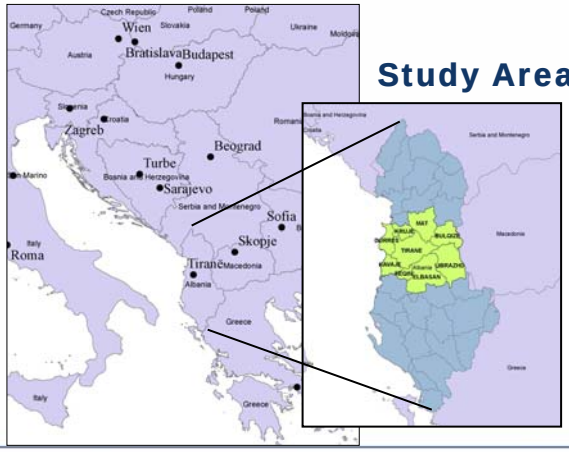
Aim of this study

⇒ Assessment of the present and likely future urban pattern of the Greater Tirana Area driven by population projections



Study Area

Approach

1) urban = sealed surface
2) urban growth = pixels that transition from non-urban to urban
3) proportion of population numbers to urban area is stable over time

Demographic changes in Albania as a driving factor of urban transformation

	1950 - 1990	1990 to today	Projection 2021
Fertility	very high	similar to Europe	decline
Mortality	moderate	moderate	moderate
Migration - national	strictly limited	large rural-urban	large rural-urban
- international	none	large	none

90s: Economic and political crisis

2008: Financial crisis

Institute of Sttatistics, Albania

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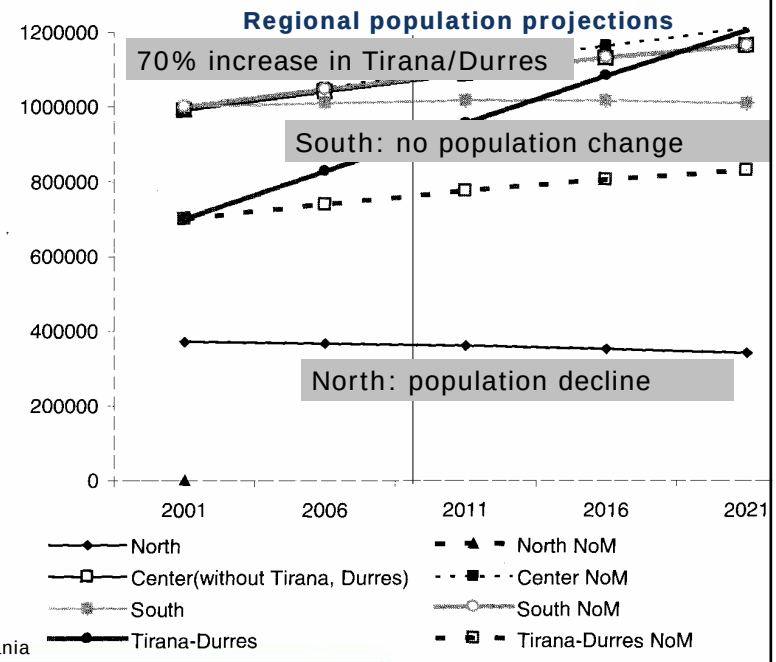
Regional demographic changes

Large increase projected for Tirana/Durres

Tirana and Durres:
1988: 605,600
2001: 770,495
2008: 972,948



Source: Institute of Statistics, Albania

Mapping urban growth

- **Multitemporal land use data:**
  - Landsat data 1988, 2000, 2007
  - Support Vector Machine classification (urban/non-urban)
  - accuracy assessment (Kappa):
    1988 (64), 2000 (78), 2007(89)
- **GIS and environmental data**: slope, road network, etc
- **Census data 2001**: population figures (district)
- **Population projections:** Institute of Statistics, based on household census (2001) and living standard measurement survey (2002)

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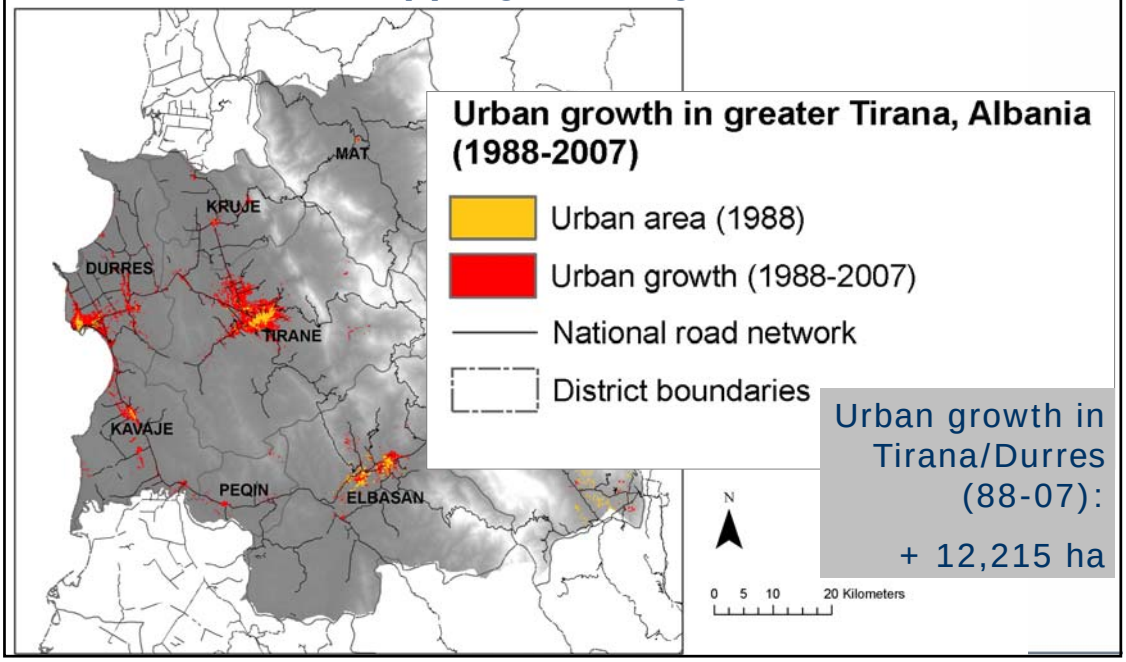
Mapping urban growth



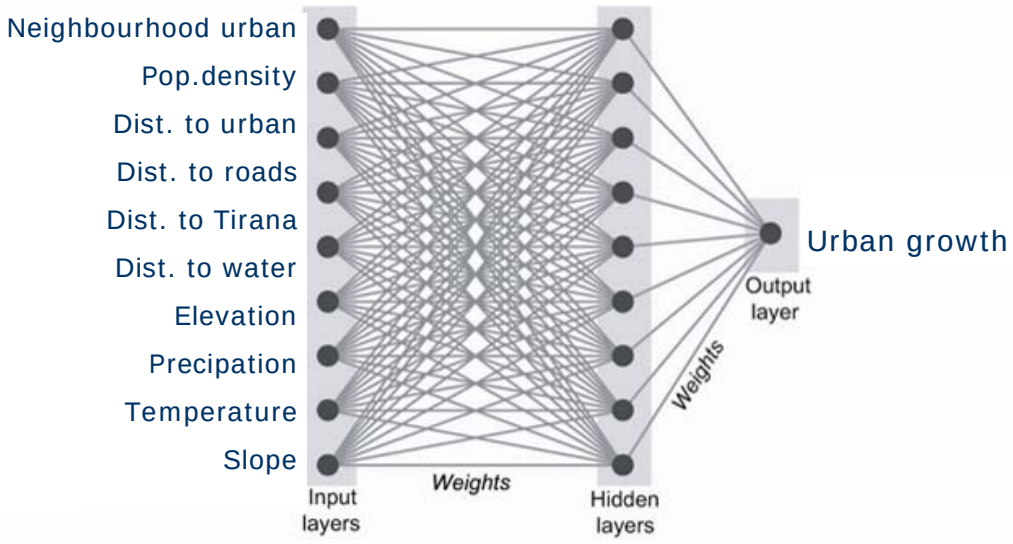
Urban growth in Tirana/Durres (88-07):

+ 12,215 ha

Spatially explicit modeling using machine learning

- modeling spatio-temporal patterns of urban growth using an artificial neural networks (Land Transformation Model – LTM)

Neural network architecture

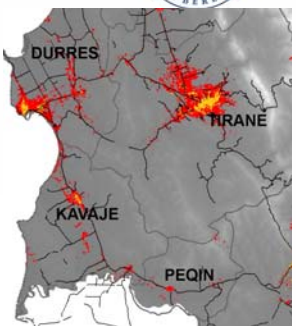


Neural network setup

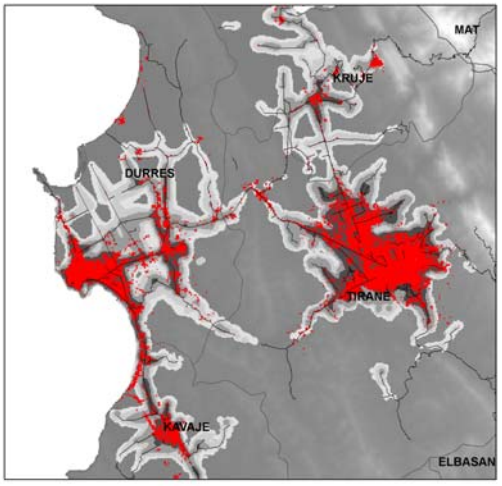
- three-layer network
- output: increase of urban from 1988 to 2007
- supervised learning
- training on randomly selected 10% of the data, testing on remainder
- 250,000 training cycles
- best cycle: 2,500
  - accuracy: PC = 61, Kappa = 0.6

Hotspots of change

Real change

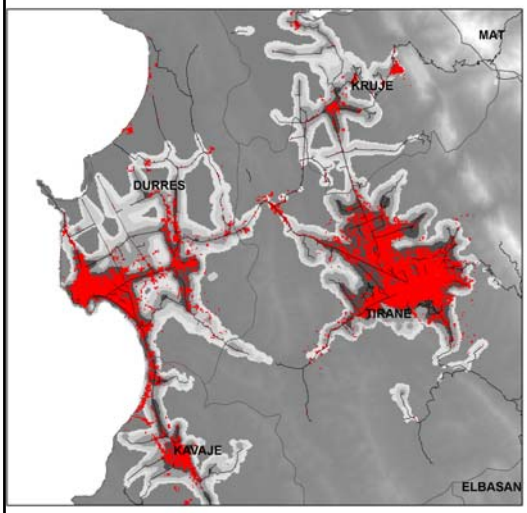


Propensity to change



- urban areas grow together into a connected region along the road network
- hotspots of urban growth extend beyond Tirana and Durres into neighbouring districts

Future urban growth based on population predictions



1988-2007 (Tirana – Durres):

- Population increase: 370,000
- Urban growth: 122 km² (1 inhabitant/333 m²)
- Expected increase until 2021: **232,126**

=> expected urban growth until 2021: **7,719 ha**

5. Conclusions

Allocation of change based on machine learning

Demand for future urban based on population predictions

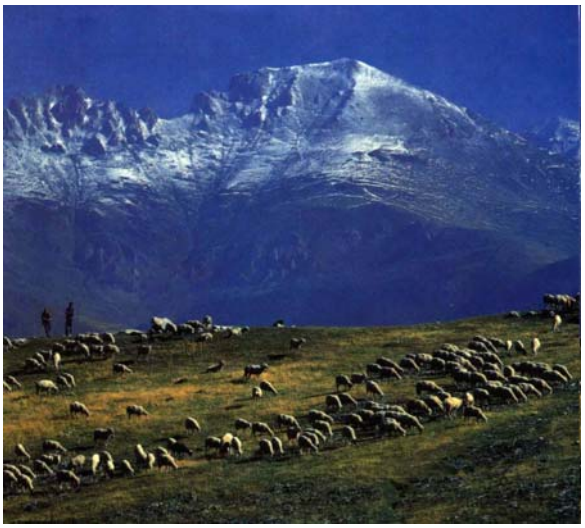
Identification of hotspots of urban growth

Mapping land use change with support vector machines

=> Exploration of future urban changes to support decision-making

5. Conclusions

- Demographic development exerts large influence on land use, particularly on urbanization => integrated data sets
- Machine learning overcomes some limitations of data shortcomings in space and time
- Incorporation of non-linear functional relationships
- Postsocialist Eastern Europe exemplifies a human-environment system under rapid and dramatic changes;
- Allows insights for other systems under transition



GooglePics

Thank you for your attention!

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Projection - 2021:1,205,074

Durres:
2008:246,401
2001: 247,345
1988: 242,500

Tirana:
2008: 726,547
2001:523,150
1988: 363,100

Change 88-07:
+ 367,348 inhabitants
+ 122150000m²
Pro 1 neuen Einwohner 333 m² neu versiegelt

Prognose: 232126 neue Einwohner
=> 77,186,185m² = 7,719 ha