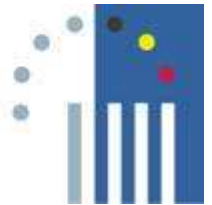


# Measuring And Modelling Urban Dynamics (MAMUD)

**BELSPO Earth Observation Day**  
**February 12, 2008, Namur**

**BELGIAN SCIENCE POLICY**



# Objective of the project

Investigate how remote sensing can contribute to a better monitoring, modelling and understanding of urban dynamics, and its impact on the urban and suburban environment

<http://www.mamud.be>



Vrije  
Universiteit  
Brussel



Université  
de Liège



# Partners

## **Cartography and GIS Research Group**

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## **Vlaamse Instelling voor Technologisch Onderzoek (Vito)**

G. Engelen, H. van der Kwast

## **EC Joint Research Centre, Ispra (Italy)**

C. Lavalle

# Work packages

## Extraction of urban land-use/land-cover information and elevation data

Exploiting potential of multi-angle image acquisition (HiRes data)

Extracting historic info on 3D structure of urban areas (HiRes stereo)

Producing time-series of land-cover gradients (MedRes data)

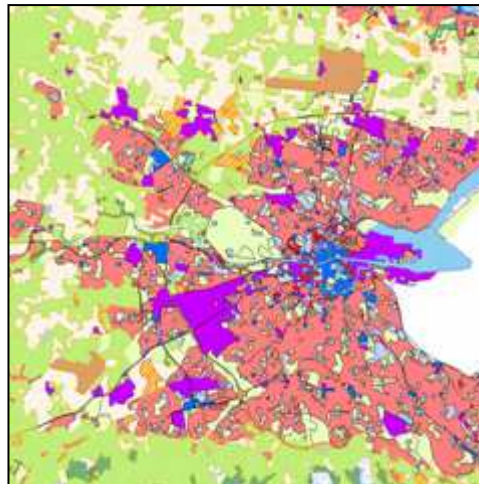
## Developing spatial metrics to describe urban form and dynamics

Examining potential of spatial metrics for urban growth modelling

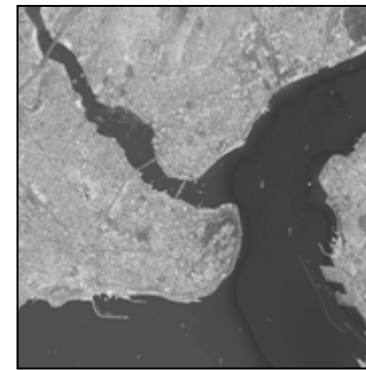
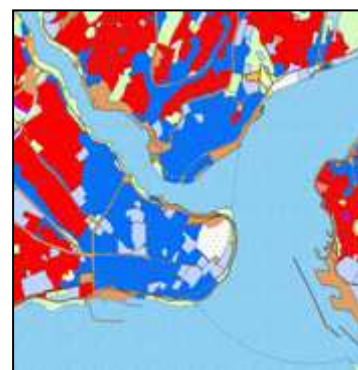
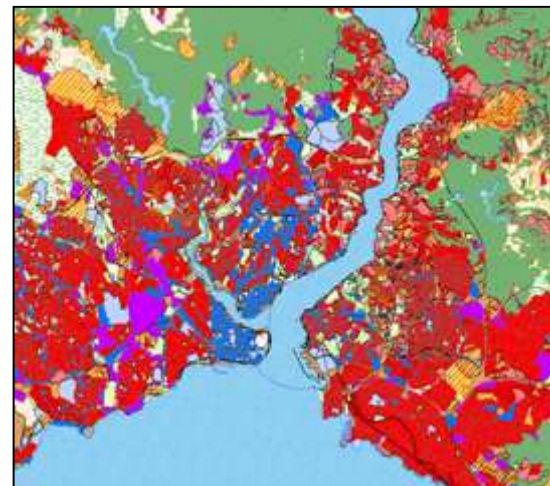
Measuring and modelling the impact of urban dynamics

# Study areas

DUBLIN



ISTANBUL



# High-resolution urban mapping

## Extraction of urban land-cover/land-use information and elevation data

- Developing 3D model with Ikonos Triplet

- Approaches to reduce impact of occlusion and to improve 3D model quality

- Extracting 3D model from archive imagery

- Not explicitly stereoscopic acquisition

- Images from same or different sensors (Ikonos/QB)

- Comparison with models produced from triplet

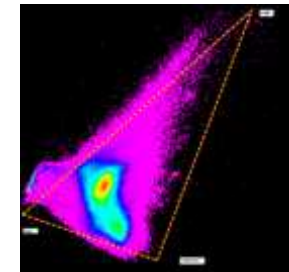
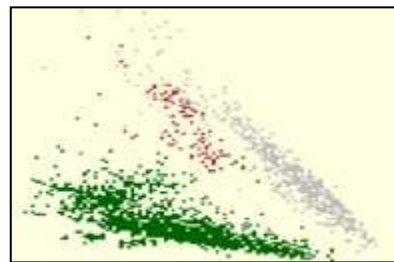
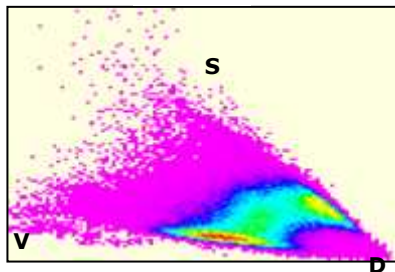


Supervised LU/LC classification approach

# Medium-resolution urban mapping

## Extraction of urban land-cover/land-use information and elevation data

- Extracting sub-pixel information on urban land cover
  - ➔ From time-series of medium resolution data
  - ➔ With Spectral Mixture Analysis (SMA)
  - ➔ Calibration and validation of SMA models for different time periods



- Extracting historic 3D information from stereoscopic archive imagery
  - ➔ SPOT-5, KFA-1000
  - ➔ Will complement land-cover gradient info with vertical dimension

# Development of urban metrics

## Developing spatial metrics to describe urban form and dynamics

Spatial Metrics = measures to describe spatial characteristics of the urban environment

- Link between RS and functional land use
- Objective description of urban form and dynamics

- Selection of spatially explicit metrics from literature
- Definition of new metrics
  - Implemented and tested on LC and 3D data from project
  - Examining the impact of spatial resolution
  - Analysis of metric sensitivity to uncertainty in gradient information
  - Rule-based approach to detect irrational spatio-temporal changes
- Definition of alternative typologies to describe urban form and urban dynamics with spatial metrics



# Urban growth modelling

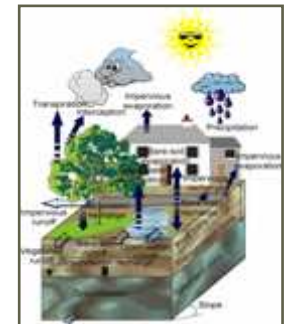
## Examining potential of spatial metrics for urban growth modelling

- Growth model with Cellular Automata, based on the MOLAND model
  - Predicts land-use changes based on census, job-data, suitability, zoning,...
  - Historic calibration and validation with existing land-use maps (MOLAND)
- Spatial metrics to aid model calibration
  - Can metrics help to derive LU data from images?
  - Can they complement existing LU maps?
  - Can spatial patterns generated by the model be discerned by metrics?
- Forecasting future land use and urban growth patterns under alternative policy scenarios
  - To measure impact of urban dynamics

# Impact of urban dynamics

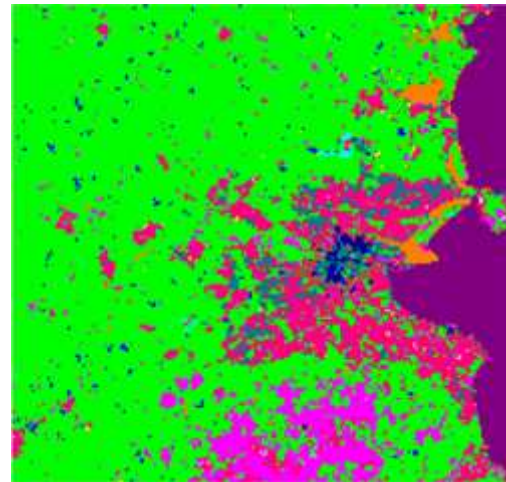
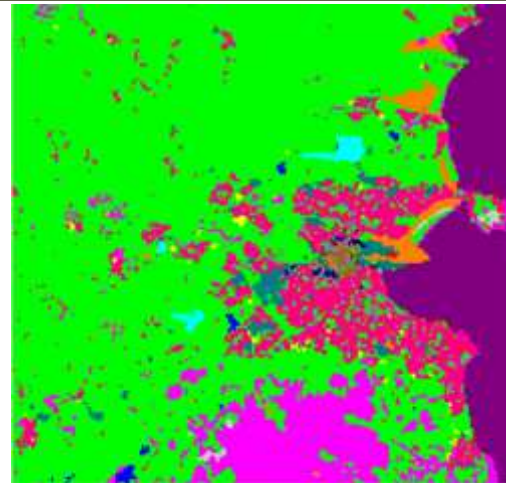
## Measuring and modelling the impact of urban dynamics

- Population estimates based on urban land-cover and elevation metrics
  - Relationship between census data and metrics
  - Dasymmetric mapping approach
- Developing quality-of-life indicators to characterise urbanisation impact
- Assessing the impact of urban development on the rural landscape
- Development of quantitatively calibrated rainfall-runoff model 1985-2005
  - Time-series of sub-pixel imperviousness maps will be used as an important driving parameter for changes in runoff
  - Predictive modelling of the rainfall-runoff, based on the results of the land-use model simulations → flood risk assessment

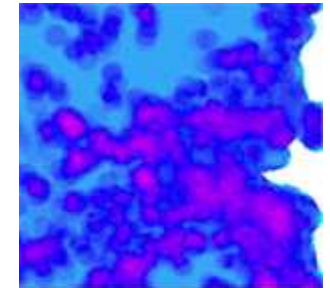
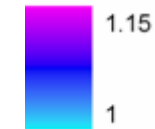


# Some preliminary results

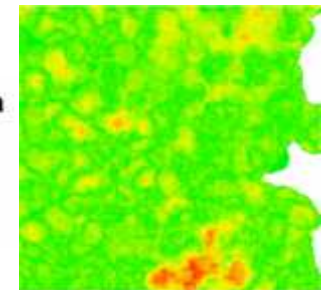
Land-use map Dublin 1990 →



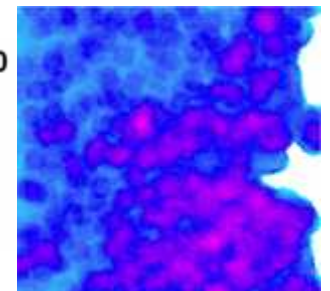
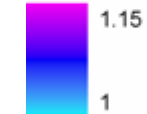
LU 1990  
frac\_am



Fuzzy Kappa



SPARK 1990  
frac\_am



SPARK classification Dublin 1990 →