International Institute for Applied Systems Analysis
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science for global insight

# *Future land change scenarios in mountain environments: work progress*

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# Introduction

- a suitable and creative tool to deal with the uncertain future
- often unclear how scenarios have been developed
- concept of land change abstract to stakeholders
- data unavailable or does not show the clear picture (false conclusions)
- intangible driving forces (mostly external, e.g. policy)

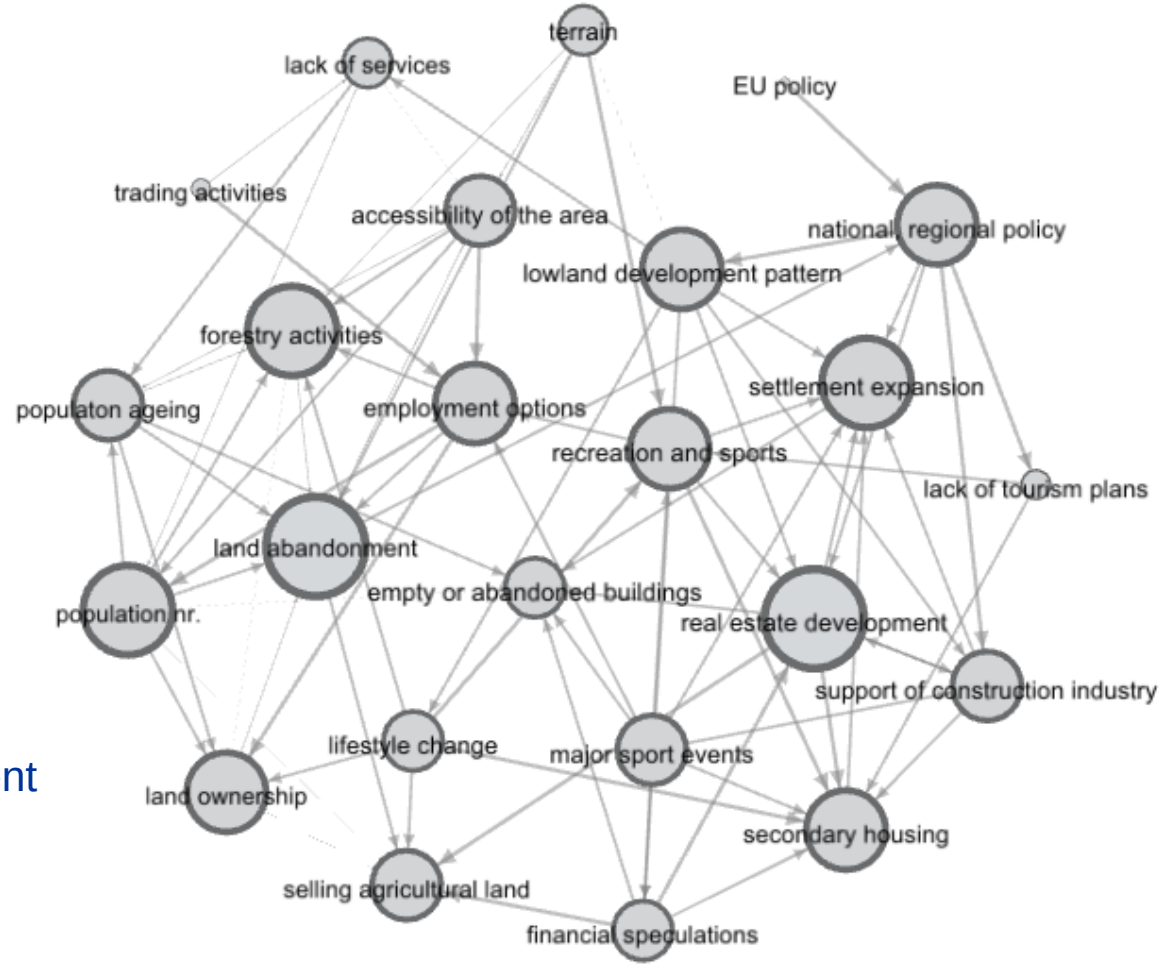
→ a generalized framework for land change scenarios on a local scale

# Aim of the research

- develop a scenario formulation and spatial allocation framework for analysing future land changes
- generate scenarios in 2 different local to regional scale case study areas → transferability of the approach
- allow the modification of the individual parts of the framework (for example, improved spatial allocation module)
- integral development of the framework: stakeholders and different scientific disciplines from the beginning on → evaluation of the model each time step, not only assessment at the end
- the framework promotes the identification of indicators: tangible driving forces

# Fuzzy Cognitive Mapping

- factors, connected with each other, represented in a form of a graph
- qualitative model of a system structure
- identification of most significant concepts in a system
- a starting point in the development of a model



# DPSIR

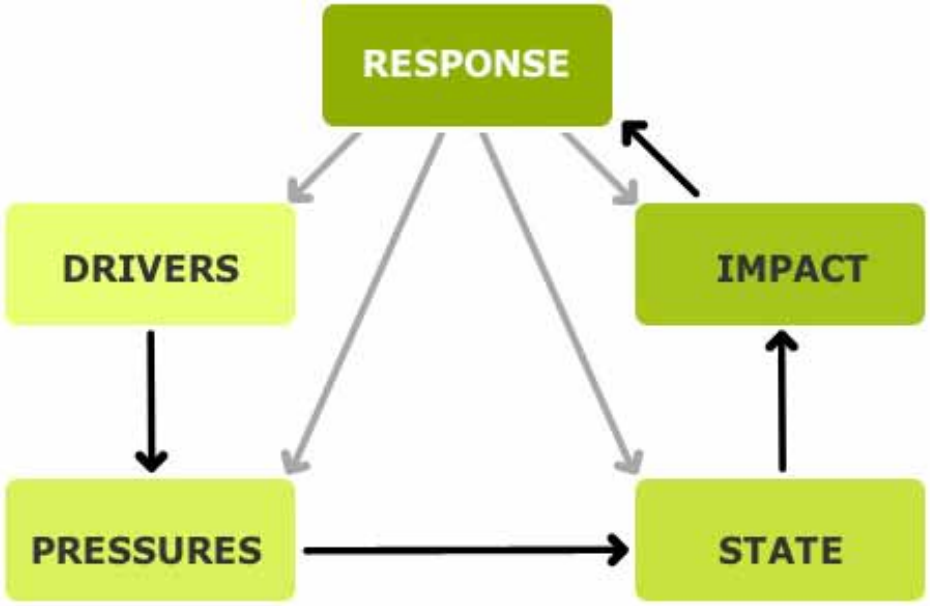
- to structure the interactions between the environment and socio-economic activities (EEA 2006) in the LC model

- clear steps in the chain of the system

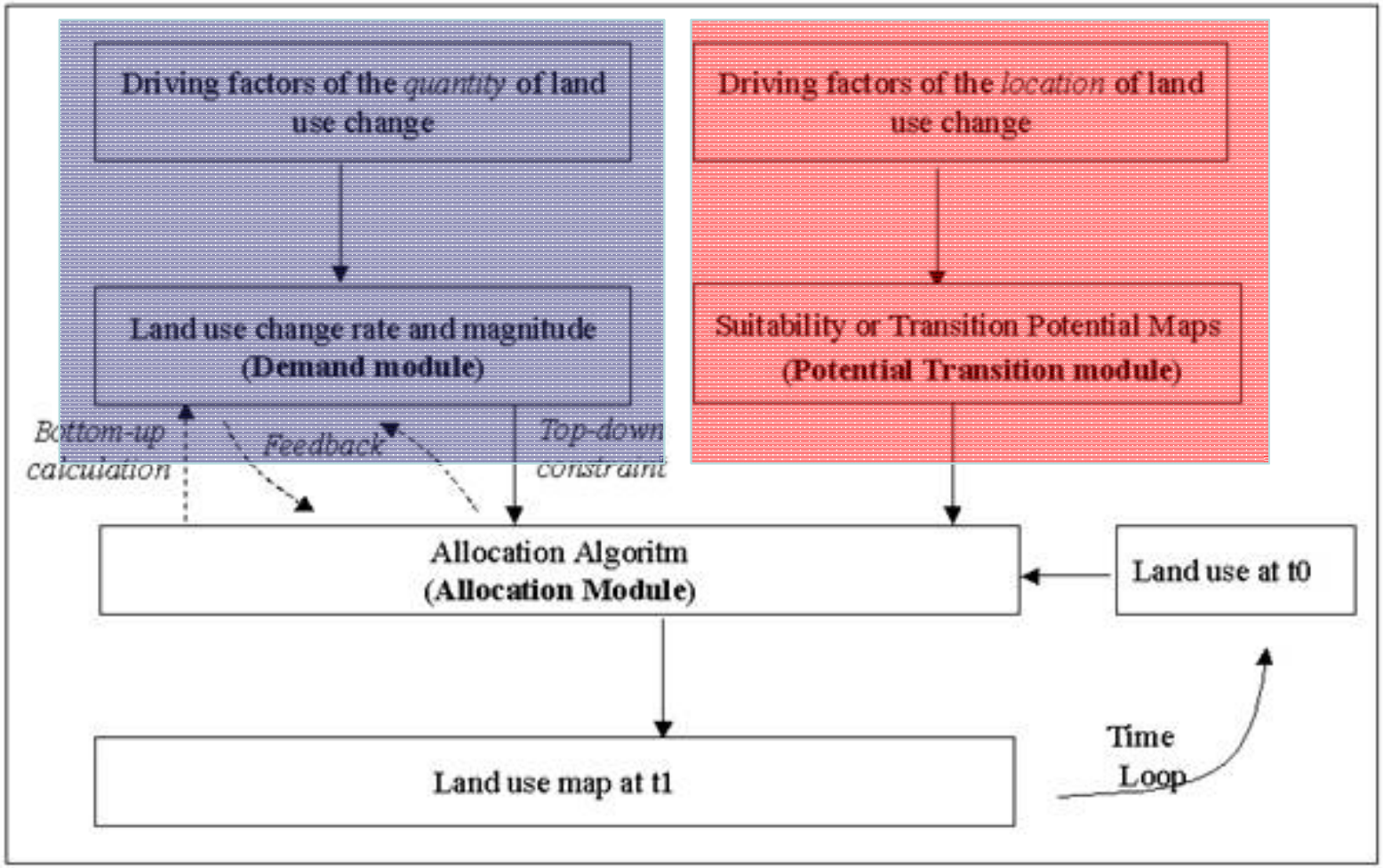
DPSIR as a tool for:

- deriving (tangible) indicators
- framework for models
- comparing decision outcomes

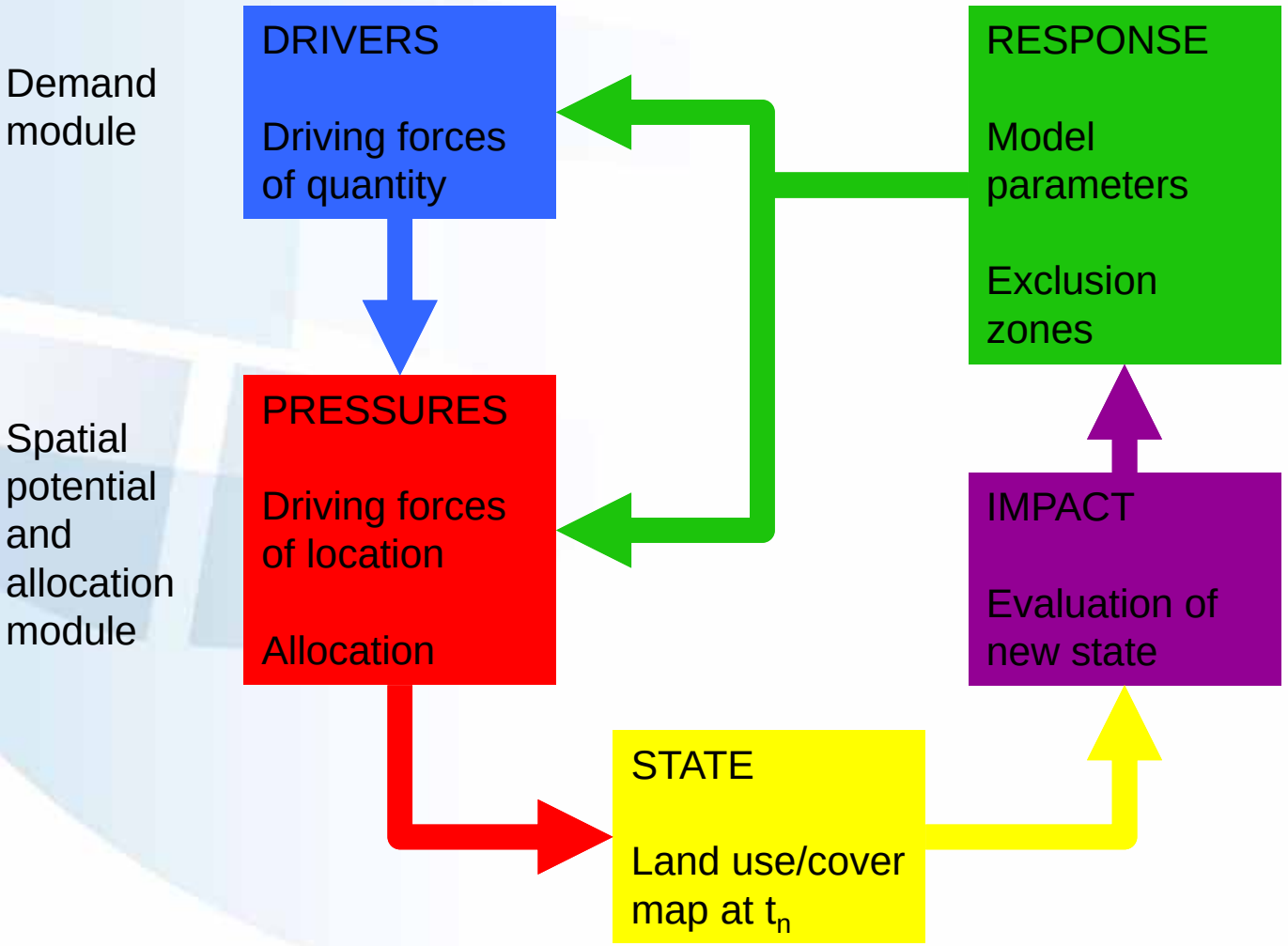
(scenarios and options)



# Model

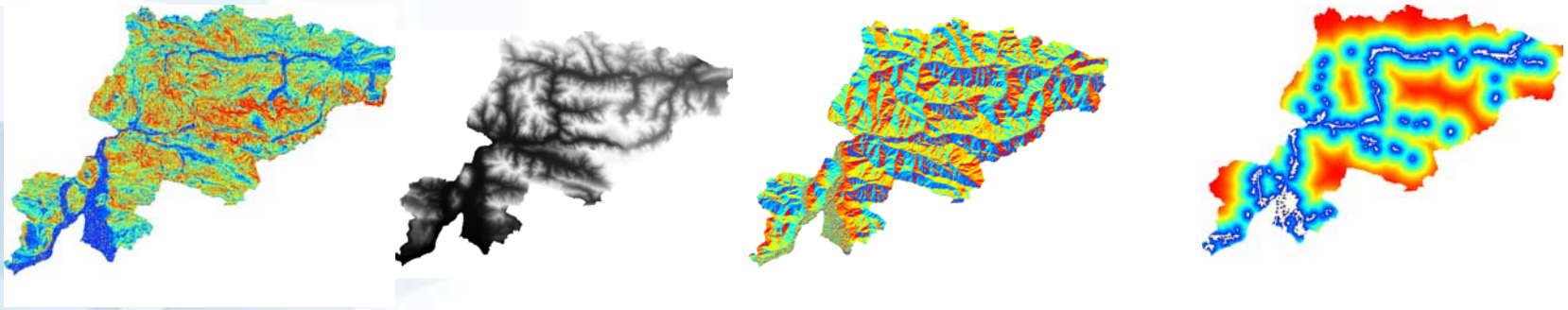

Driving factors of the quantity of land use change
Driving factors of the location of land use change
Land use change rate and magnitude (Demand module)
Suitability or Transition Potential Maps (Potential Transition module)
Bottom-up calculation
Feedback
Top-down constraint
Allocation Algoritm (Allocation Module)
Land use at t0
Land use map at t1
Time Loop

# Model


Demand module
DRIVERS
Driving forces of quantity
RESPONSE
Model parameters
Exclusion zones
Policy/options module
Spatial potential and allocation module
PRESSURES
Driving forces of location
Allocation
IMPACT
Evaluation of new state
Evaluation module
STATE
Land use/cover map at $t_n$

# Spatial demand and allocation

- statistical analysis of past land change and identified indicators to derive empirical evidence on the relationship between them and demand for space
- suitability map: slope, elevation, aspect, distance to services, markets (cities), distance to roads (accessibility), recreational areas...

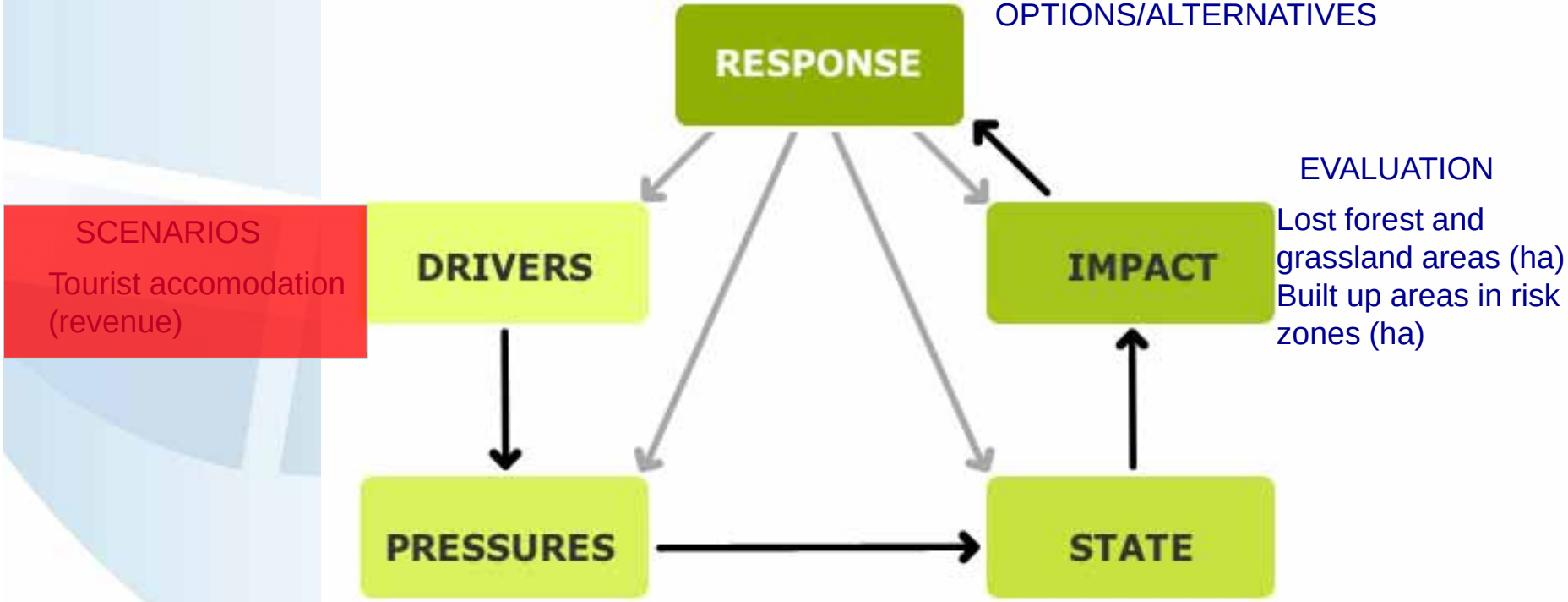


- spatial allocation in Dinamica EGO taking into account suitability and constraints (excluded slopes over 15 degrees, protected areas...) – new patches trained with observed data

# DPSIR - Italy

Protected areas (zoning)
Excluded areas (zoning)
Intensification of existing built-up areas
Protection of grasslands/forest

OPTIONS/ALTERNATIVES




SCENARIOS
Tourist accomodation (revenue)

EVALUATION
Lost forest and grassland areas (ha)
Built up areas in risk zones (ha)

Demand for built up land in ha for hotels and individual objects

All new built up areas in ha

# Scenarios - Italy

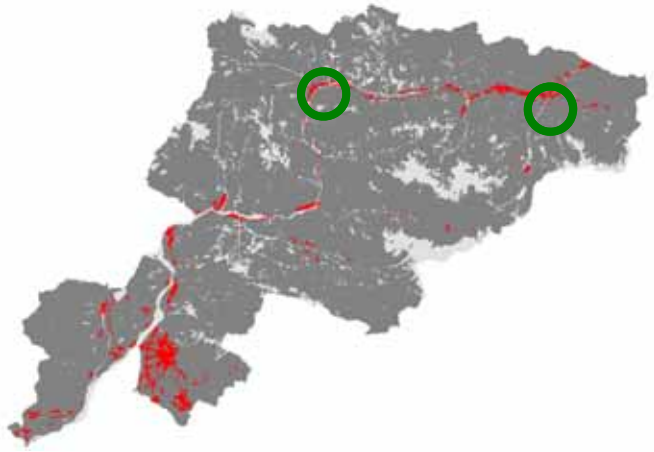
- goal: 30 % increase in accommodation until 2035
- 2 different possible development strategies
- spatial demand submodel for hotels and other accomodation

| 30 % Accommodation Increase Scenario | New hotel beds | New other beds | New urban areas |
|---|---|---|---|
| Intensification (80 % of growth in hotels) | 1415 | 354 | ? |
| Extensification (70 % of growth in housing) | 531 | 1238 | ? |

# Allocated scenarios

Intensification scenario:
80 % of increase on the account of hotels

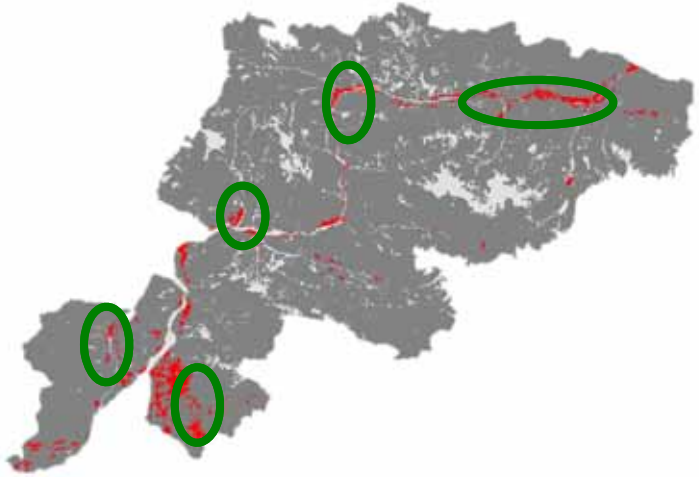
6.7 % increase of urban areas



- Less human influence (in spatial terms) with hotel development (regional level)
- Local degradation of landscape (sometimes more important for people than risk)

Extensification scenario:
70 % of increase on the account of other beds

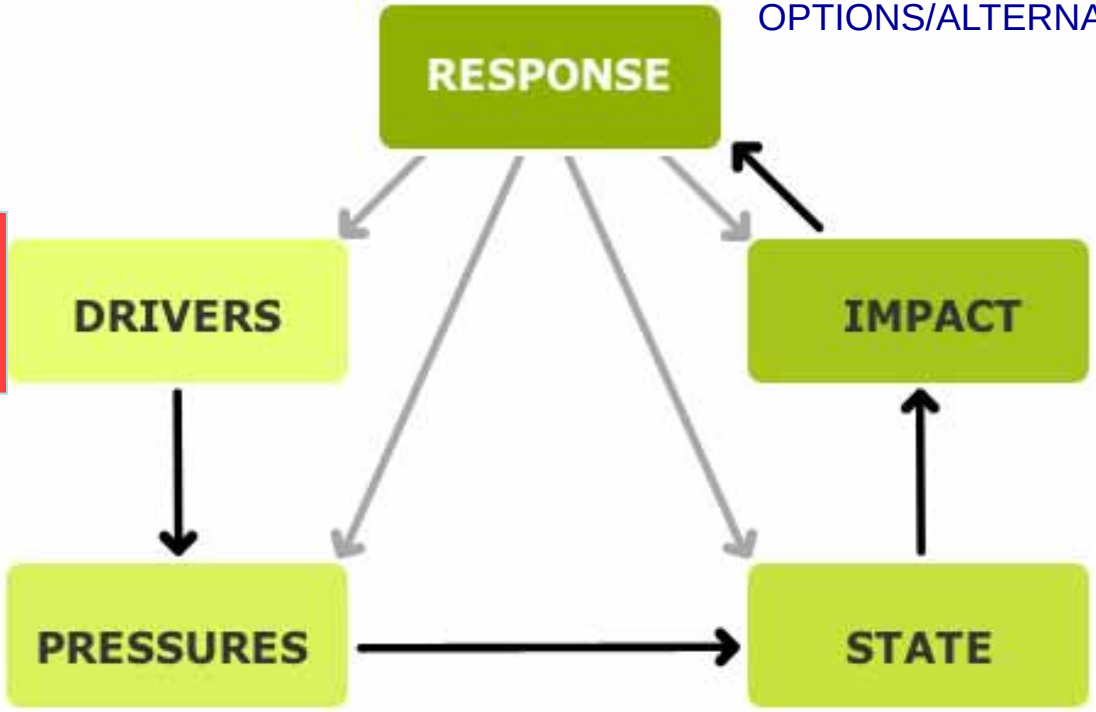
7.5 % increase of urban areas



# DPSIR – Romania

Protected nature (zoning)
Excluded forests (zoning, slope)
Forest policy enforcement (clear cut size)

OPTIONS/ALTERNATIVES




SCENARIOS

Allowed forest harvesting
Allowed clear felling

EVALUATION

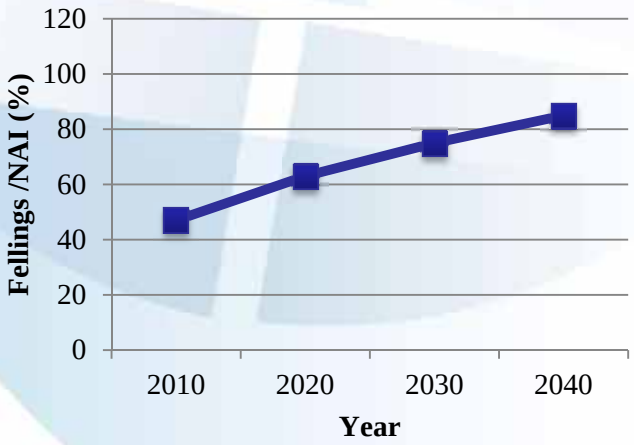
Lost forest and grassland areas (ha)
Deforested areas in risk zones (ha)

-Estimated deforestation in ha

New clear cut areas

# Scenarios - Romania

- Goal: increase of allowed felling from 47 to 85 % of annual forest growth
- Spatial demand submodel for spatial demand for clear felling areas




Allowed fellings per net annual increment (NAI) in % until 2040 (adapted from Schelhaas et al. 2006)

| Forest harvesting Increase Scenario until 2040 | Clear cut potential (%) | Mean clear cut size (ha) | Deforested areas |
|---|---|---|---|
| Investor friendly increase | 5 | 2.5 | ? |
| Sustainable increase | 3 | First 10 years 2.5, then 2.0 | ? |

# Scenarios - Romania

Investor friendly

- 32.74 sq km clear felling

Sustainable increase

- 19.6 sq km clear felling

- No globally significant risk increase (also due to prevailing forest expansion), local importance of deforestation
- Implementation of a simple risk policy would not have a significant increase of costs of forest exploitation

# Discussion

- land changes could lead to increase in risk – this should be taken into account as a feedback in the model → a risk evaluation model? CHANGES project

- in order to evaluate available decision (options), **plausible** scenarios of land change were developed – positive and negative extremes not taken into account (which is one useful characteristic of scenarios)
- uncertainties in data and the allocation module – high accuracy after validation, it still models the spatial patterns as observed in the data (what if there is a big change in the spatial pattern?) ← big issue in land change modeling for informed decision making

# Research/study progress

Published/accepted

- 1 peer reviewed journal article on land changes, 2 peer reviewed conference proceedings
- 5 oral presentations, 5 poster presentations

Planned

- journal article on future deforestation scenarios (Buzau), prepared, will be submitted in the following weeks
- journal article on local scale land change scenario formulation, in preparation
- CHANGES book chapter (2 or 3 chapters)
- book chapter in Participatory environmental modeling (june 2014)

Study

- all ECTS points gathered

# Other

- long lasting data gathering/generation process
- secondment at ITC very useful, shaped and changed my research a lot

- CHANGES opened a lot of new questions, some will not be answered – new project ☺ ?
- ideally more collaboration with other ESRs, not only for CHANGES, also for my model (not possible due to objective reasons)

- the research and meetings were exciting and fun

# Thank you for your attention