

# ValParCH: Integrating land use change, Ecosystem Service and Biodiversity modelling to simulate pathways towards a functioning Ecological Infrastructure for Switzerland

## Other Conference Item

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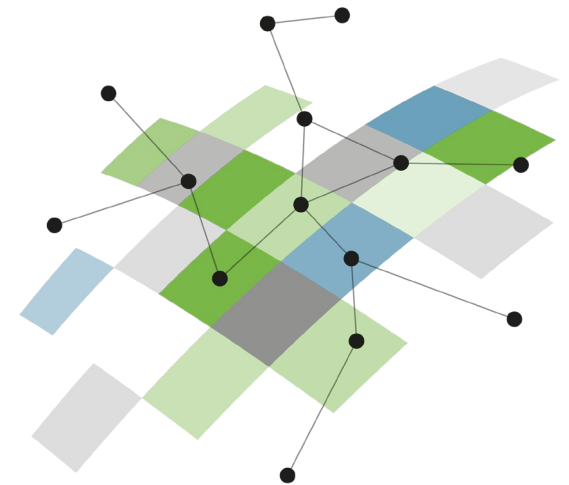
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## ValPar.CH:

Integrating land use change, Ecosystem Service and Biodiversity modelling to simulate pathways for a functioning Ecological Infrastructure for Switzerland.

Benjamin Black, Antoine Adde, Nathan Külling, Adrienne Grêt-Regamey, Antoine Guisan, Anthony Lehmann



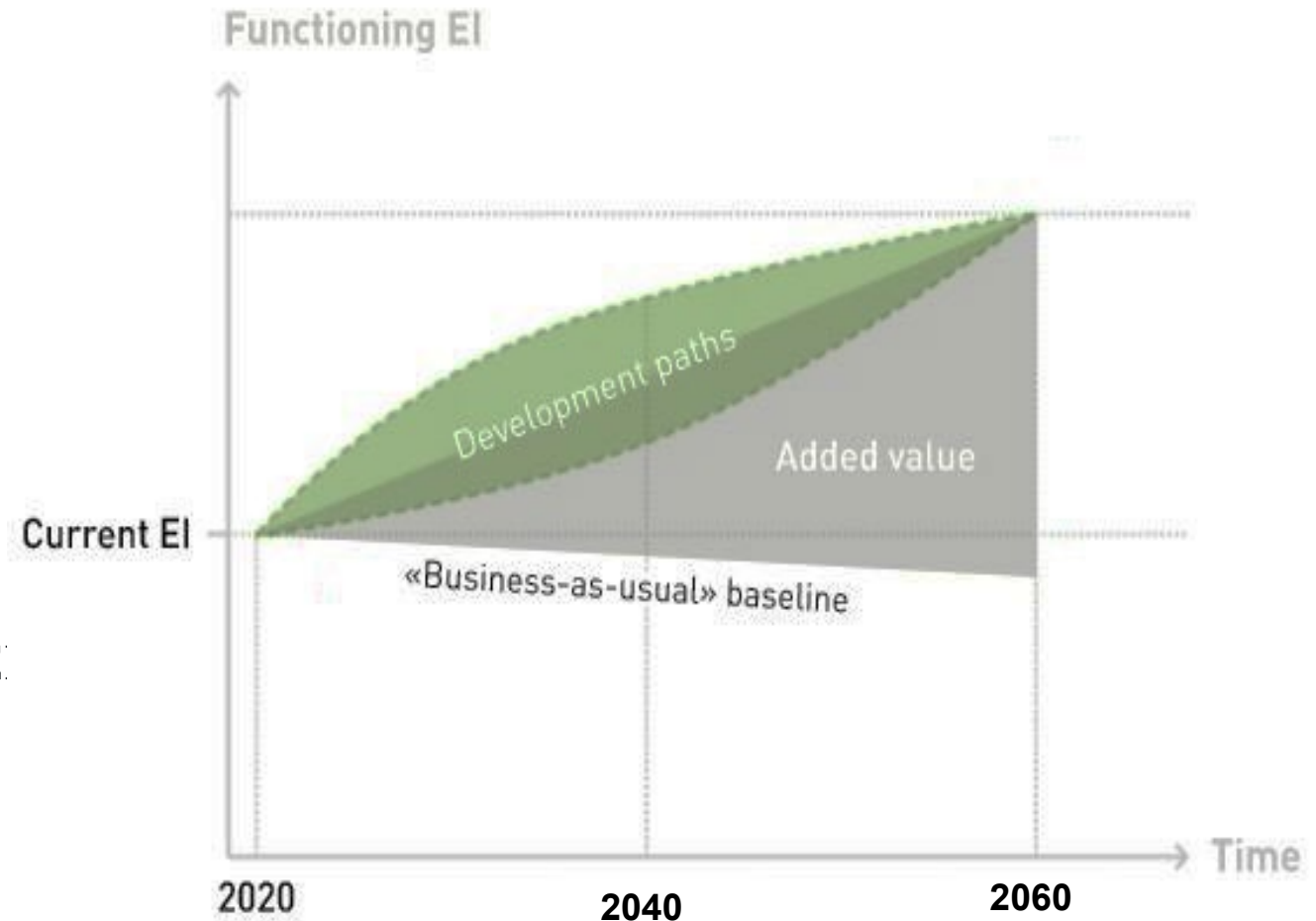
ValPar.CH

# ValPar.CH

**Project goal:** Assess the added value of a functioning Ecological Infrastructure for Switzerland.

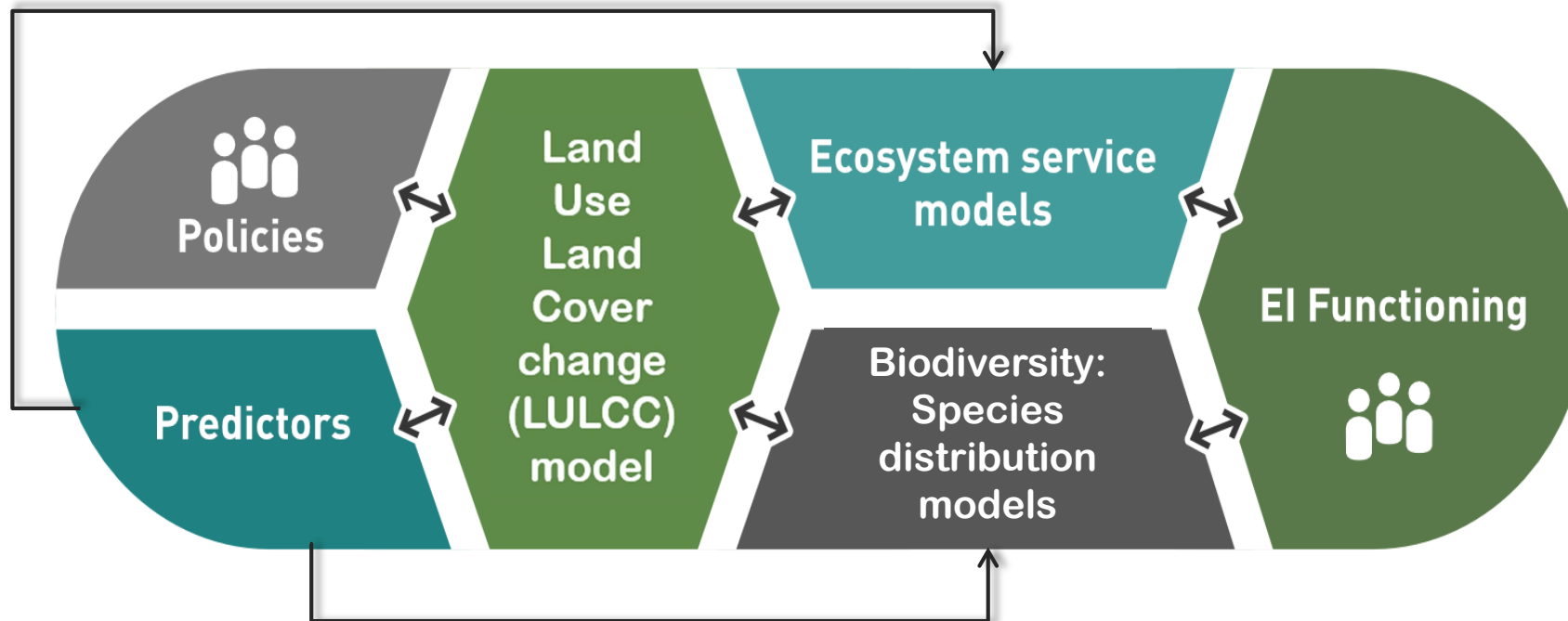
**Definition:** “Ecological Infrastructure (EI) refers to a network of high quality natural and semi-natural landscape elements planned and managed to provide ecosystem services (ES) and support biodiversity.”

**Objective:** Simulate the future development of E. under multiple scenarios (pathways) intended to secure a functioning EI by 2060.

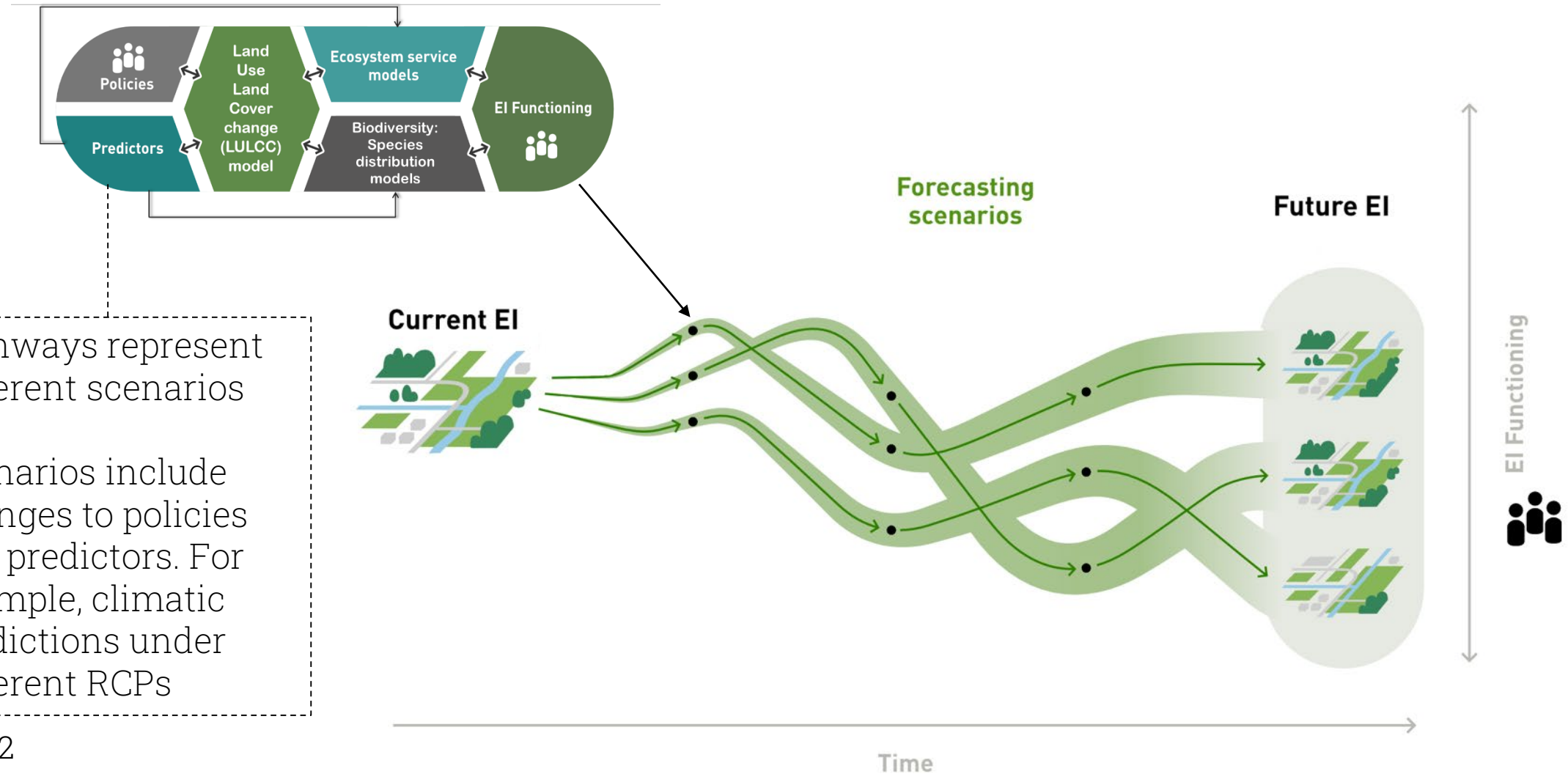


# Operationalizing Ecological Infrastructure

“Ecological Infrastructure (EI) refers to a network of high quality **natural and semi-natural landscape elements** planned and managed to provide **ecosystem services (ES)** and support **biodiversity**.”

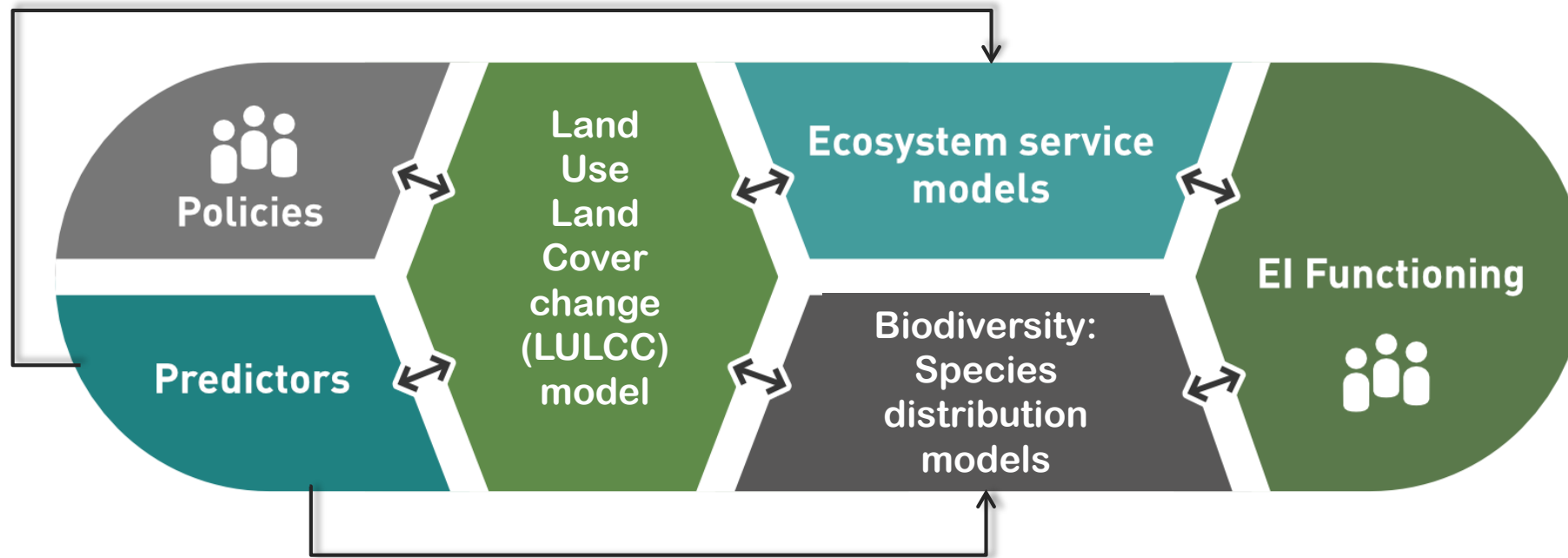


# Simulating EI development pathways



- Pathways represent different scenarios
- Scenarios include changes to policies and predictors. For example, climatic predictions under different RCPs

# Operationalizing Ecological Infrastructure



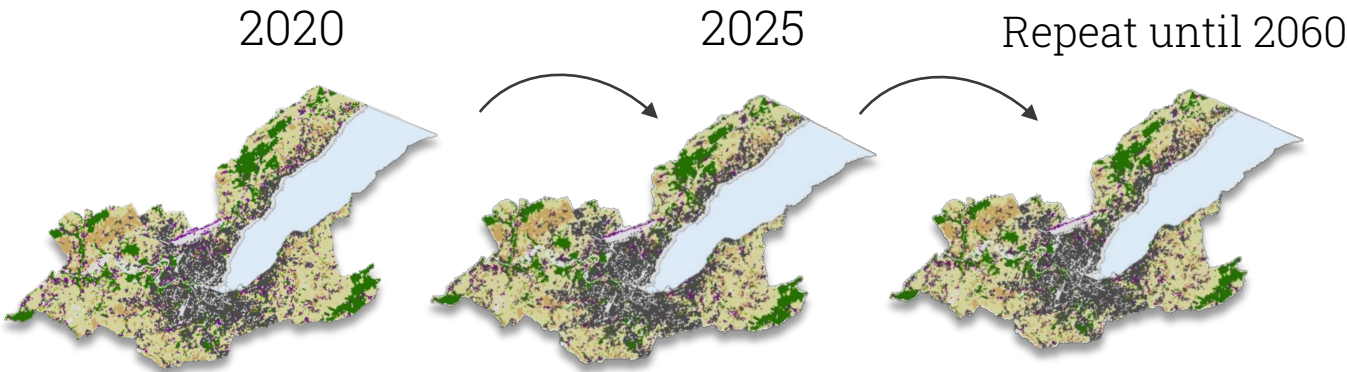
## Challenges:

- Model Integration: harmonizing predictors and outputs
- Coherent result of EI functioning

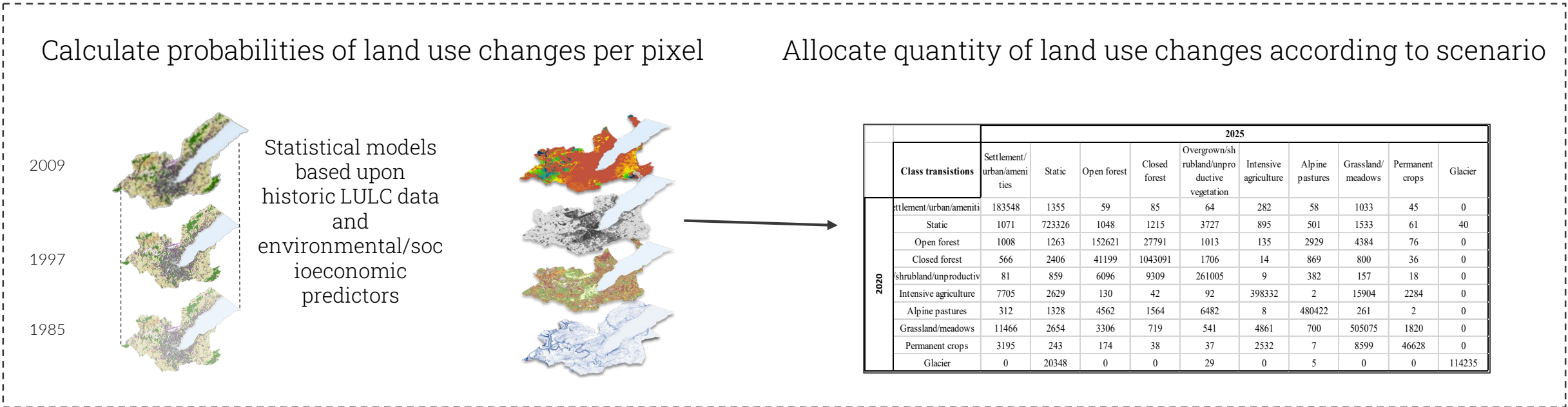


Land Use Land Cover change (LULCC) model

Cellular Automata model to simulate LULCC in space and time



At each time step:





## Ecosystem service models

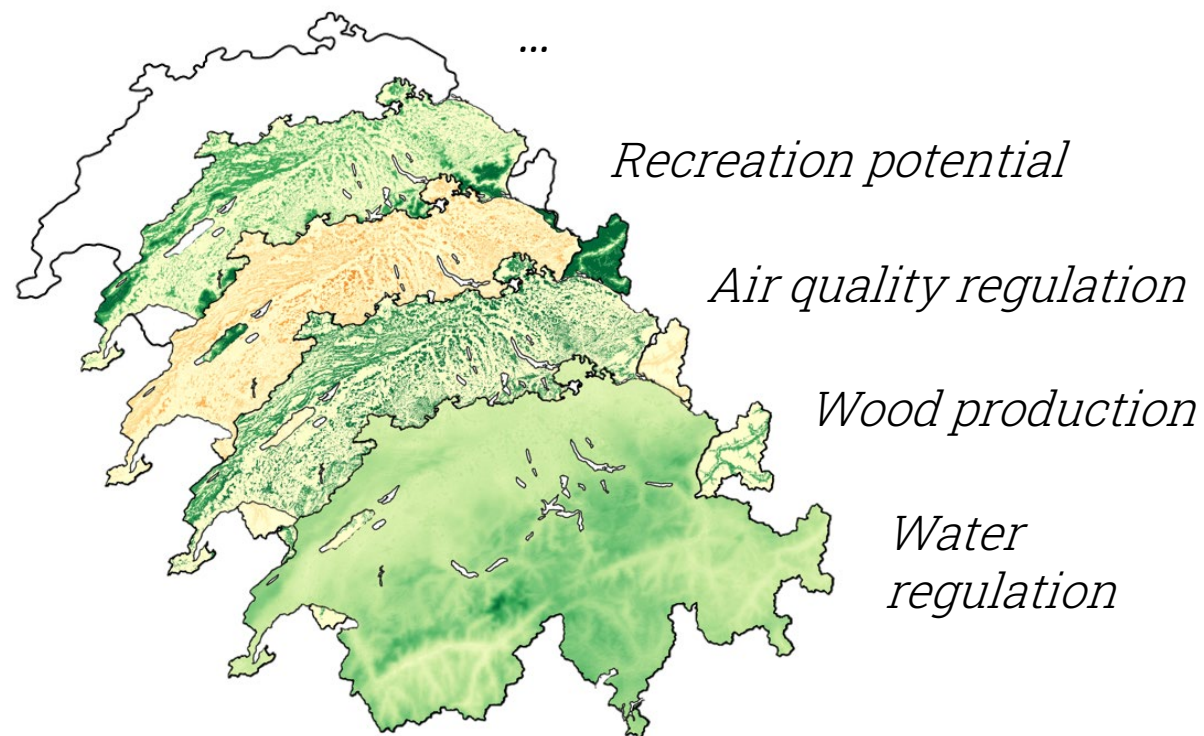
For each ES (17 total):

1. Selection of ES indicator

2. Data acquisition and processing

3. Method selection

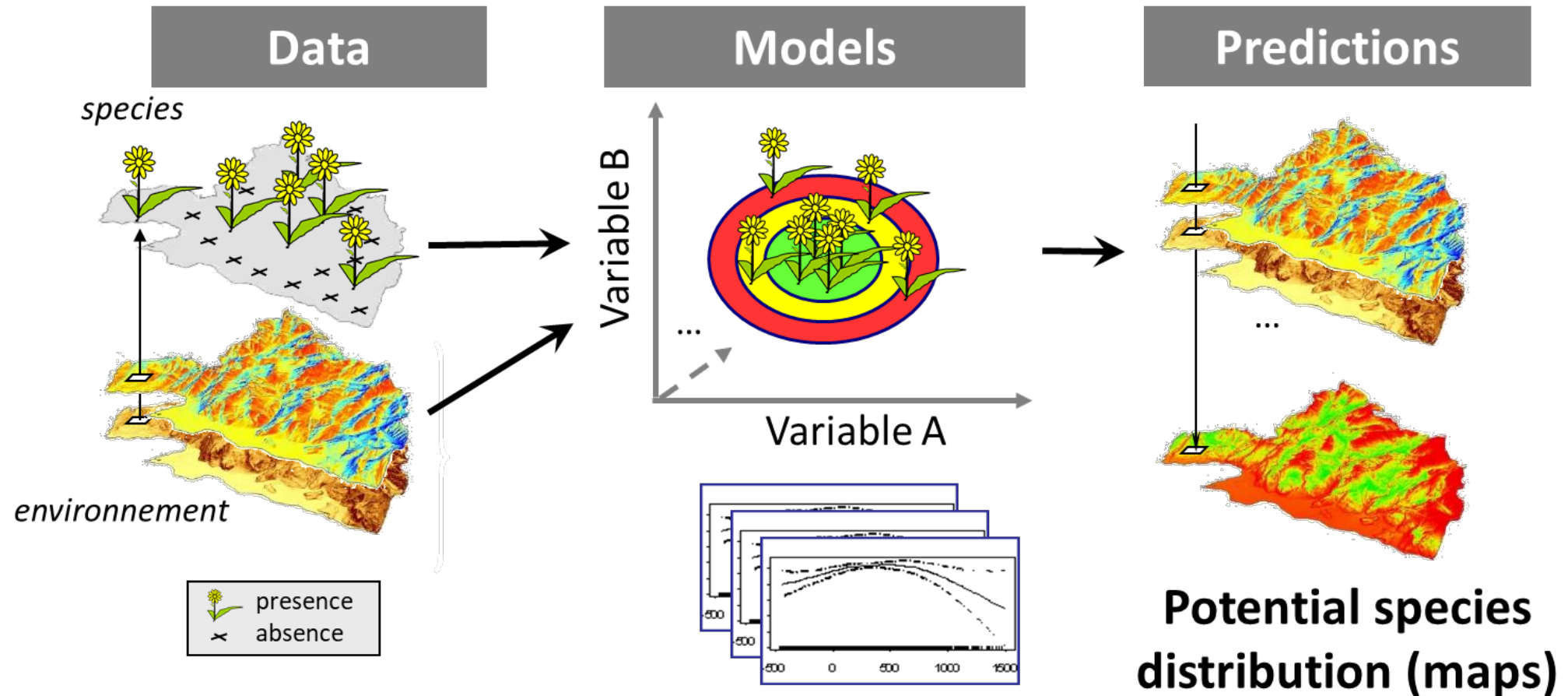
- Data extrapolation
- Process Modeling
- Experts consultation
  - Lookup tables





Biodiversity:  
Species  
distribution  
models (SDMs)

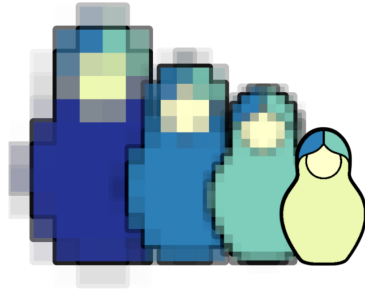
# SDMs: Generalizing species distributions in space (and time)



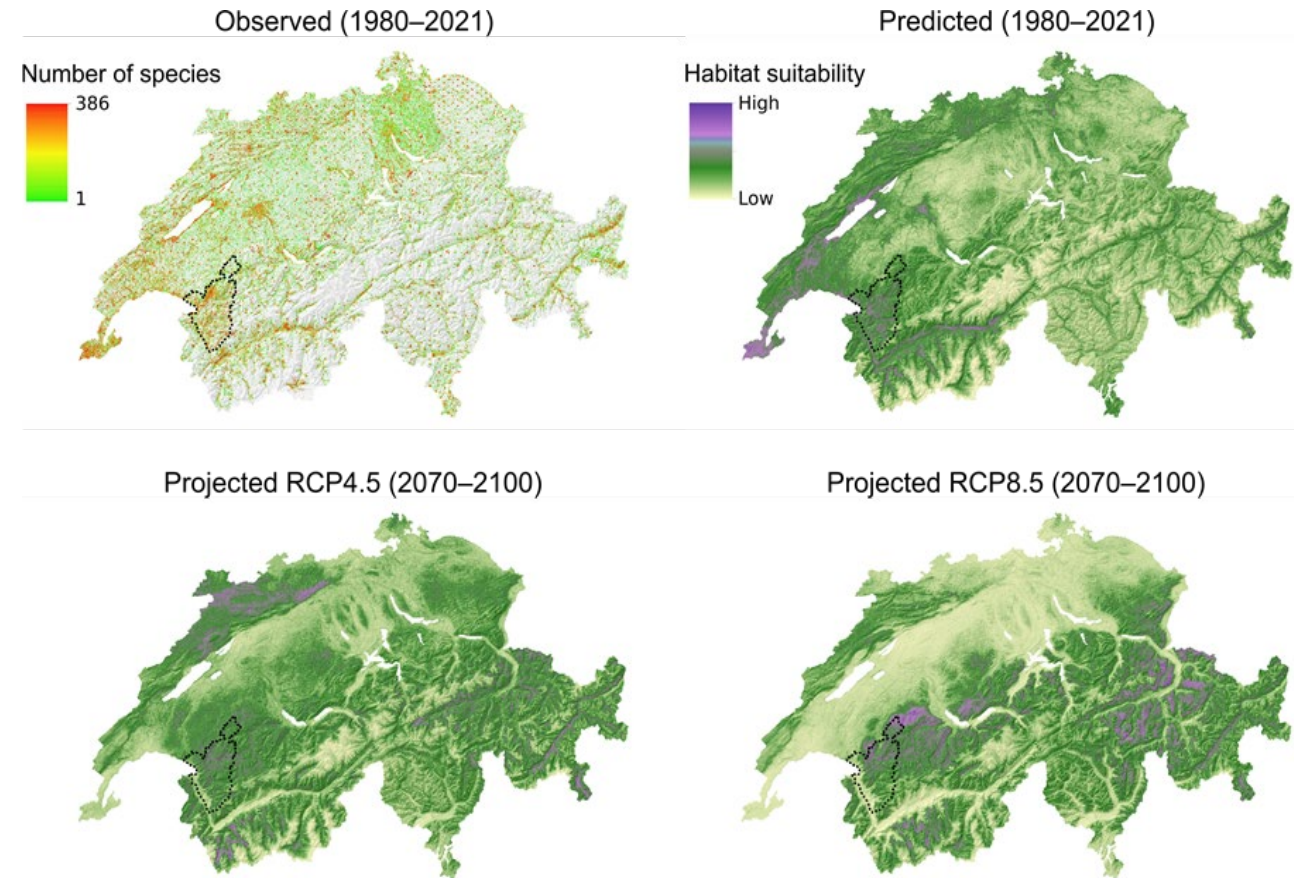
## Biodiversity: Species distribution models

### N-SDM

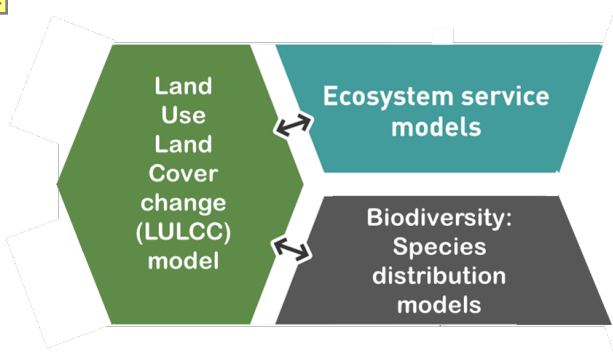
Nested  
Species  
Distribution  
Modelling



- High-performance computing SDM pipeline developed within ValPar.ch
- Allows:
  - combining multi-level species data (nested)
  - uniting leading-edge SDM techniques
  - modelling thousands of species simultaneously within a competitive time frame

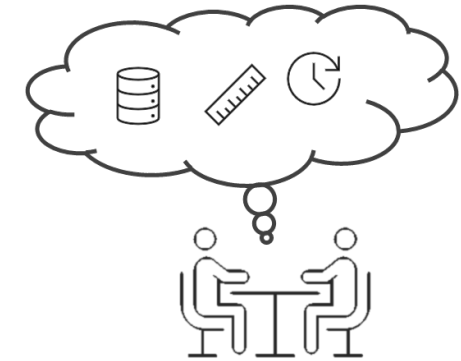


*Adde et al. (in prep) "N-SDM: a high-performance computing pipeline for Nested Species Distribution Modelling"*



# Model integration: Data

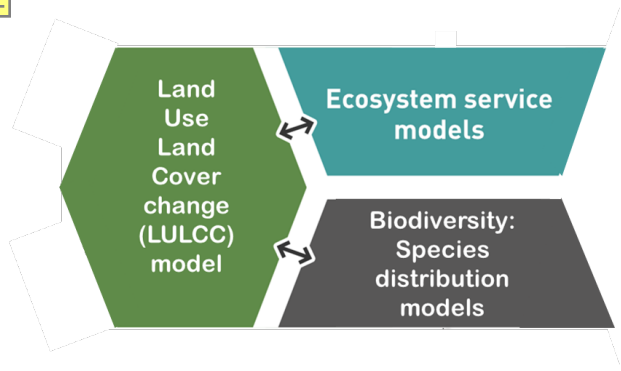
- Common spatial resolution, extent and CRS
- Aggregation of land use classes
- Predictor selection to maximise commonality between models <-> selection of ES models.
- Minimise predictors that cannot be projected in time.
- Data prepared by one group to minimize inconsistencies and duplication of efforts.
- Cloud-based data sharing, plan for Data management plan dissemination of results



1. Data				
Table description	Table data in questionnaire	When provided	Who provided	How consistent and able to use within the data set
Data collection and documentation				
<b>Data type and source</b>	Information collected in the field or from existing data sources. Data is collected in a structured manner and is stored in a digital format. Data is collected in a structured manner and is stored in a digital format.	During the project	All team members	The data is collected in a structured manner and is stored in a digital format. The data is collected in a structured manner and is stored in a digital format.
<b>Field data collection</b>	Information collected in the field or from existing data sources. Data is collected in a structured manner and is stored in a digital format. Data is collected in a structured manner and is stored in a digital format.	During the project	All team members	The data is collected in a structured manner and is stored in a digital format. The data is collected in a structured manner and is stored in a digital format.
<b>Copyright and use</b>	Information collected in the field or from existing data sources. Data is collected in a structured manner and is stored in a digital format. Data is collected in a structured manner and is stored in a digital format.	During the project	All team members	The data is collected in a structured manner and is stored in a digital format. The data is collected in a structured manner and is stored in a digital format.
<b>Metadata</b>	Information collected in the field or from existing data sources. Data is collected in a structured manner and is stored in a digital format. Data is collected in a structured manner and is stored in a digital format.	During the project	All team members	The data is collected in a structured manner and is stored in a digital format. The data is collected in a structured manner and is stored in a digital format.

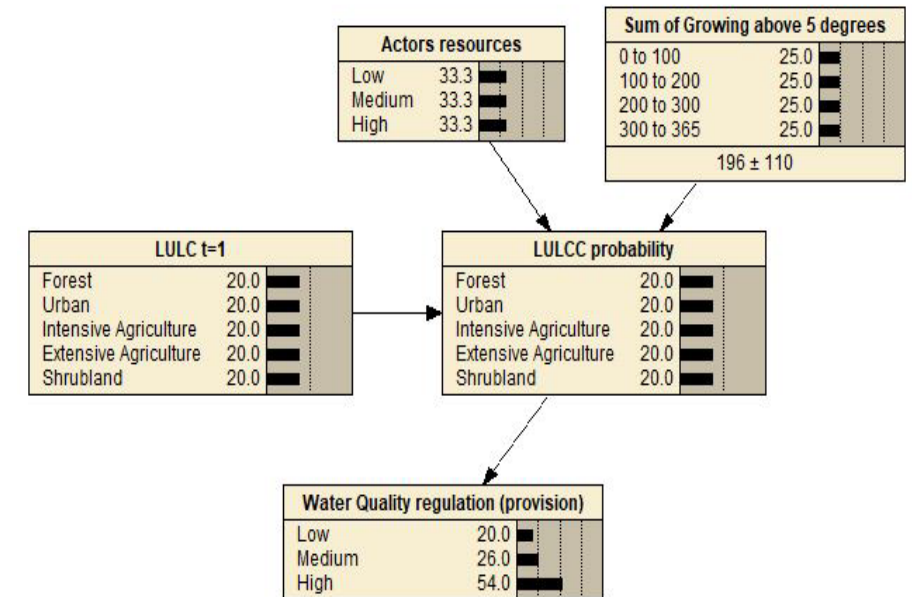


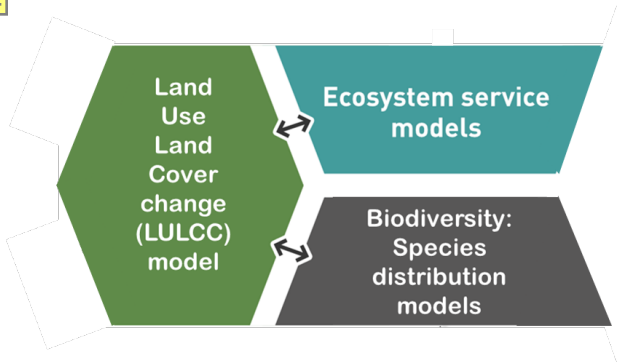
ArcGIS StoryMaps



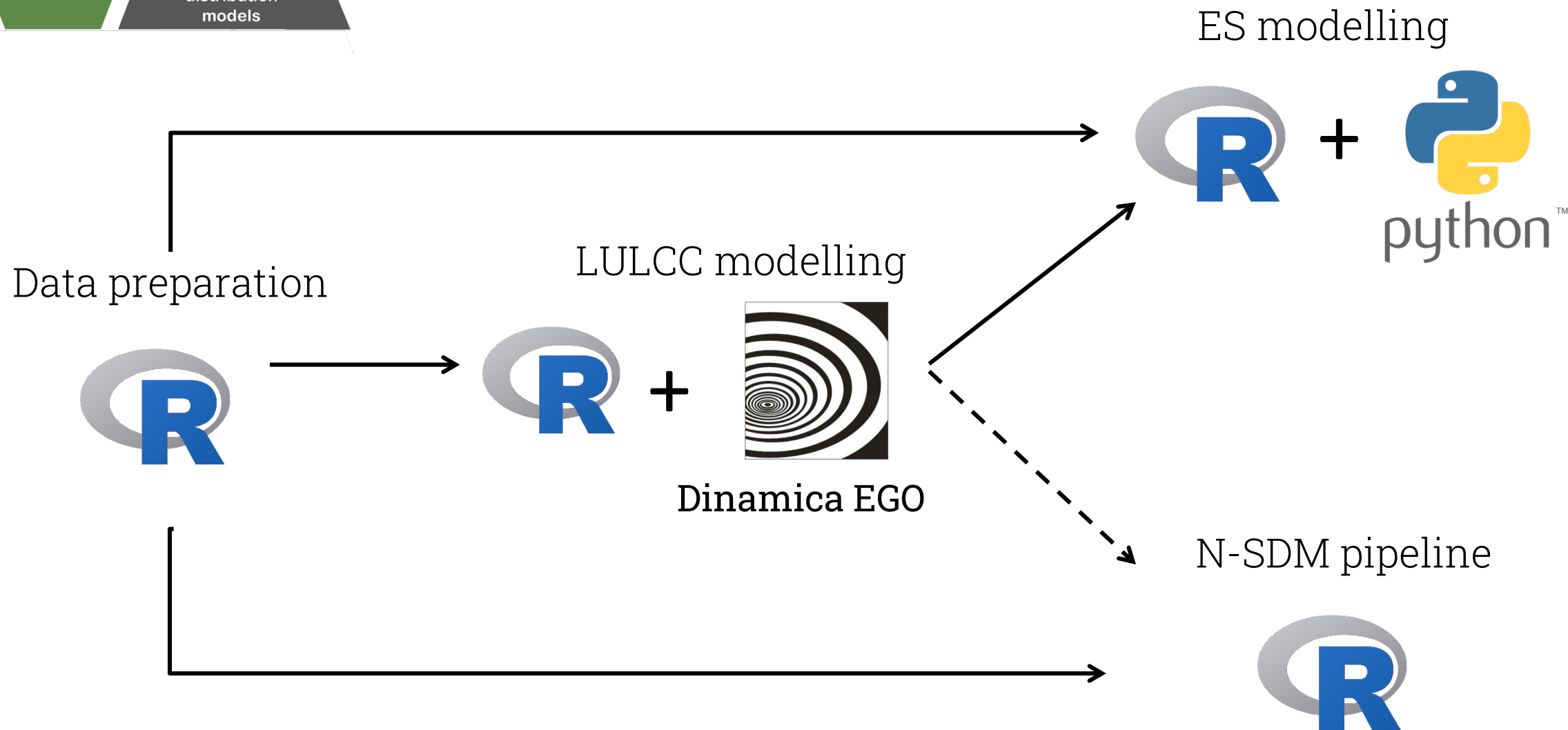
## Model integration: Model choice

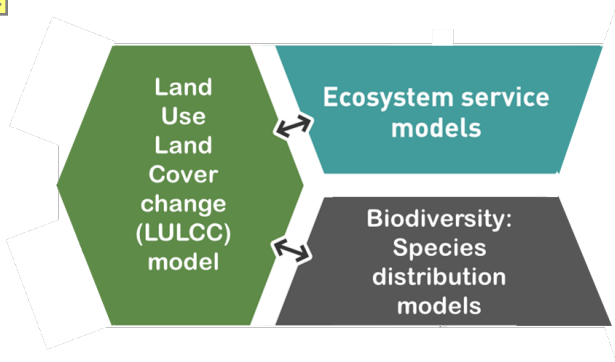
- Proposal specified: **spatialized dynamic Bayesian Networks**.
- Developed for ~1 year but collaboration made it clear that it wasn't viable.
- Switch to: Dinamica EGO: non-commercial, better integration, natively spatial.
- Lesson: Sometimes integrative projects require reconsideration of approach despite 'sunk costs'





## Model integration: Software

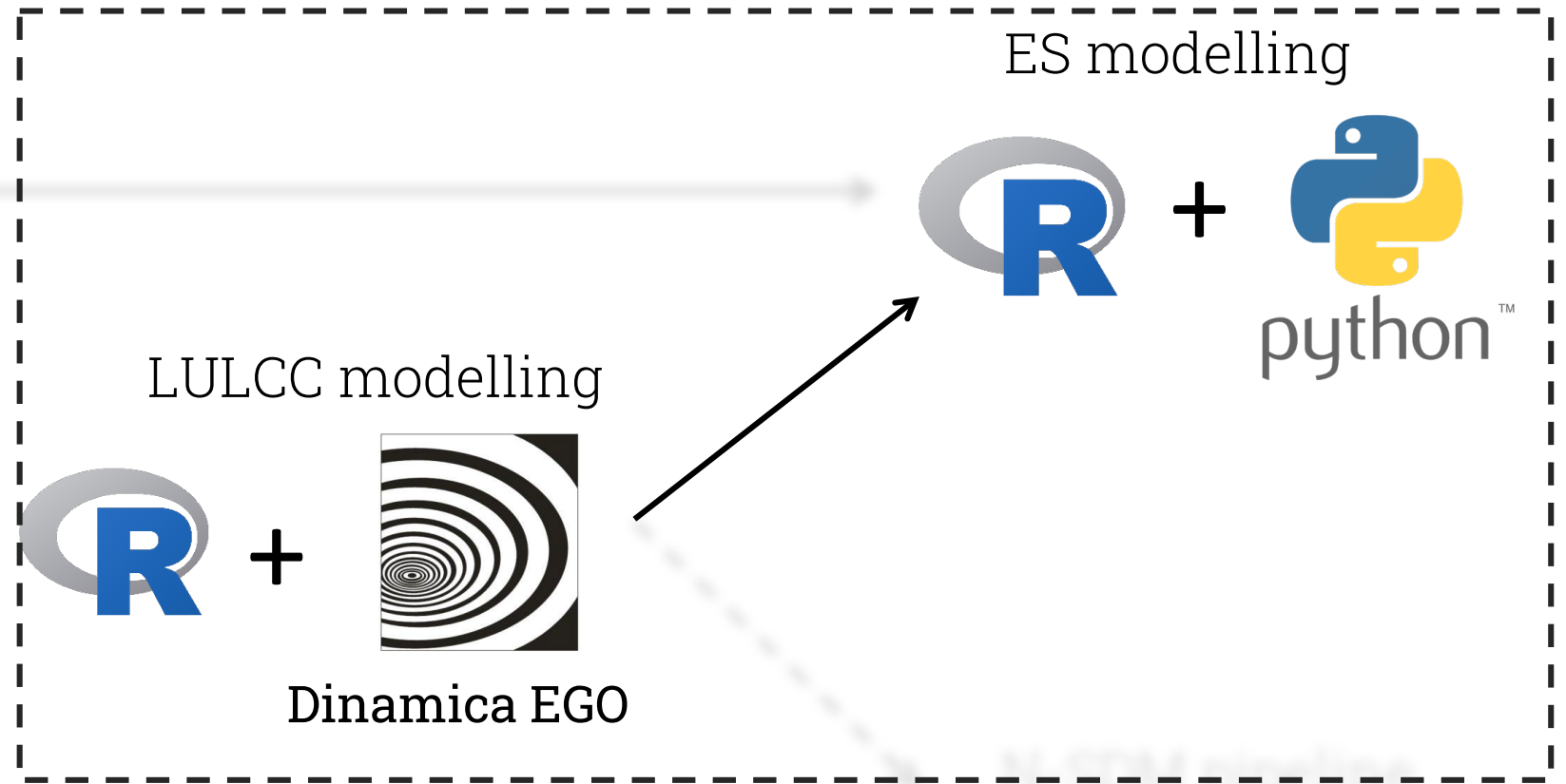




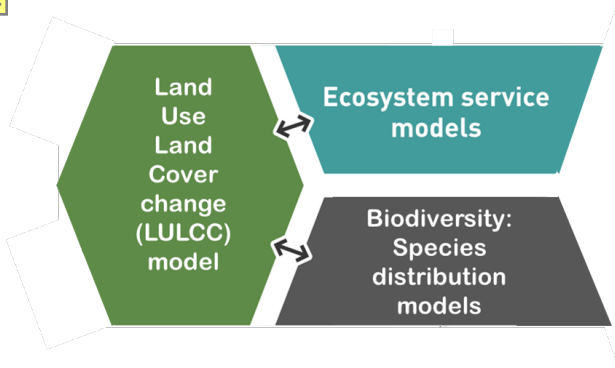
## Model integration: Challenges

Direct integration possible through incorporation of R and Python scripts within Dinamica EGO

We hope to share to formalise the scripts used to do this as custom Dinamica 'functors' for others to utilise



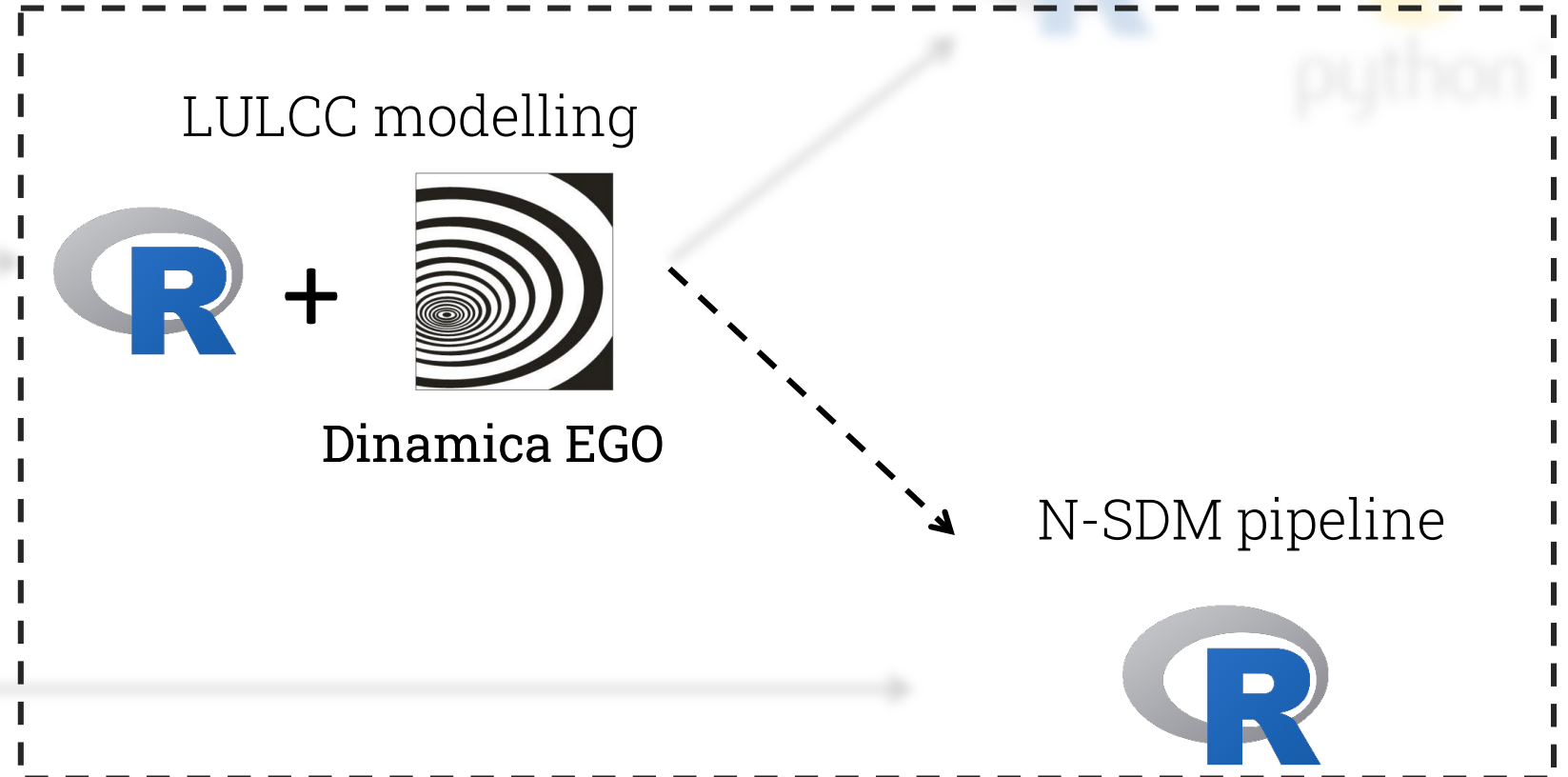




## Model integration: Challenges

Direct integration  
not possible due  
to the N-SDM  
pipeline utilising  
HPC cluster

Simulated LULC  
layers transferred  
manually

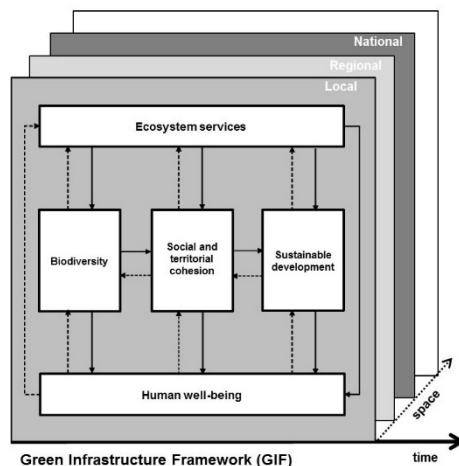




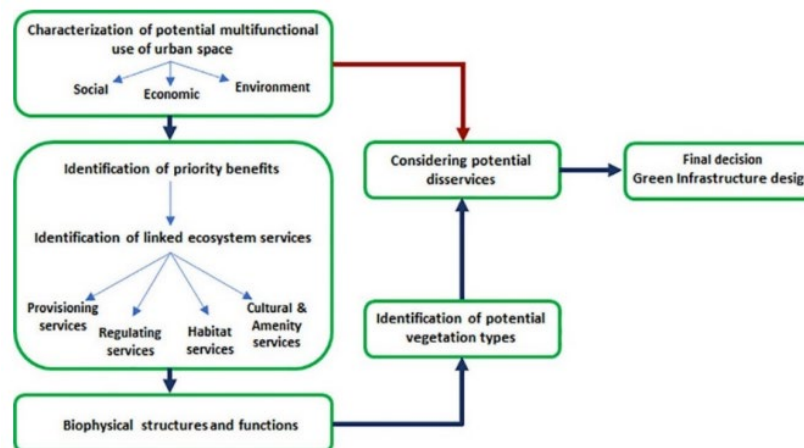


# EI output: Challenges

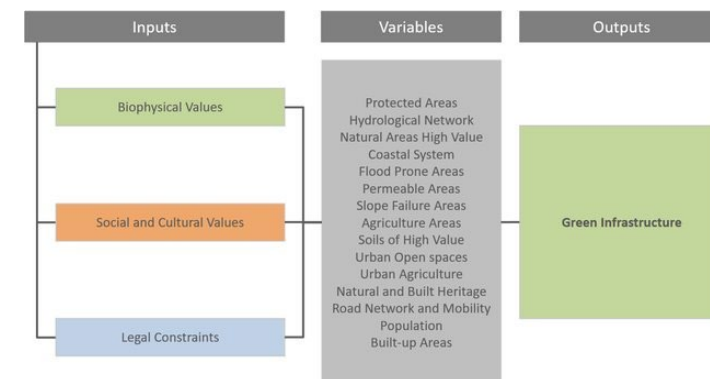
- Definition of 'functioning' EI is problematic:
  - Subjective/Anthropocentric
  - Implies antonymous state ('non-functioning') and threshold
- Numerous conceptual frameworks, limited attempts to operationalise



Laforteza *et al.* 2013



Semeraro *et al.* 2021

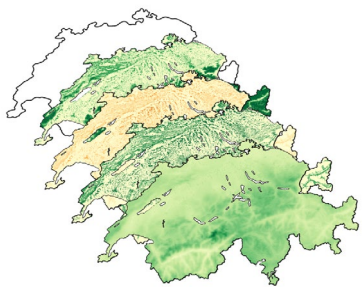


Amado *et al.* 2020

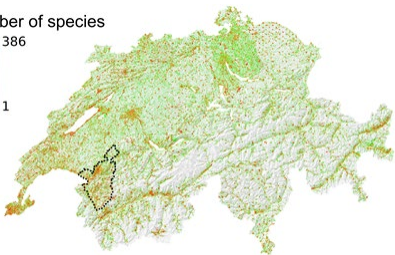
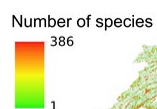


# EI output: ValPar.CH approach

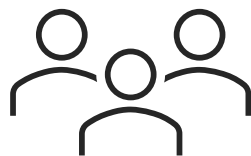
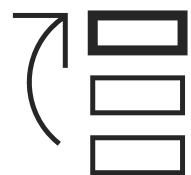
ES supply maps



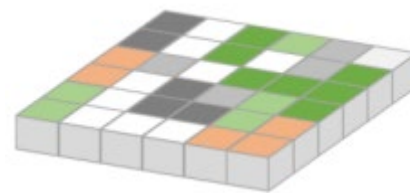
Biodiversity metric map



Participatory  
weighting of EI  
factors



Spatial prioritization of  
EI quality



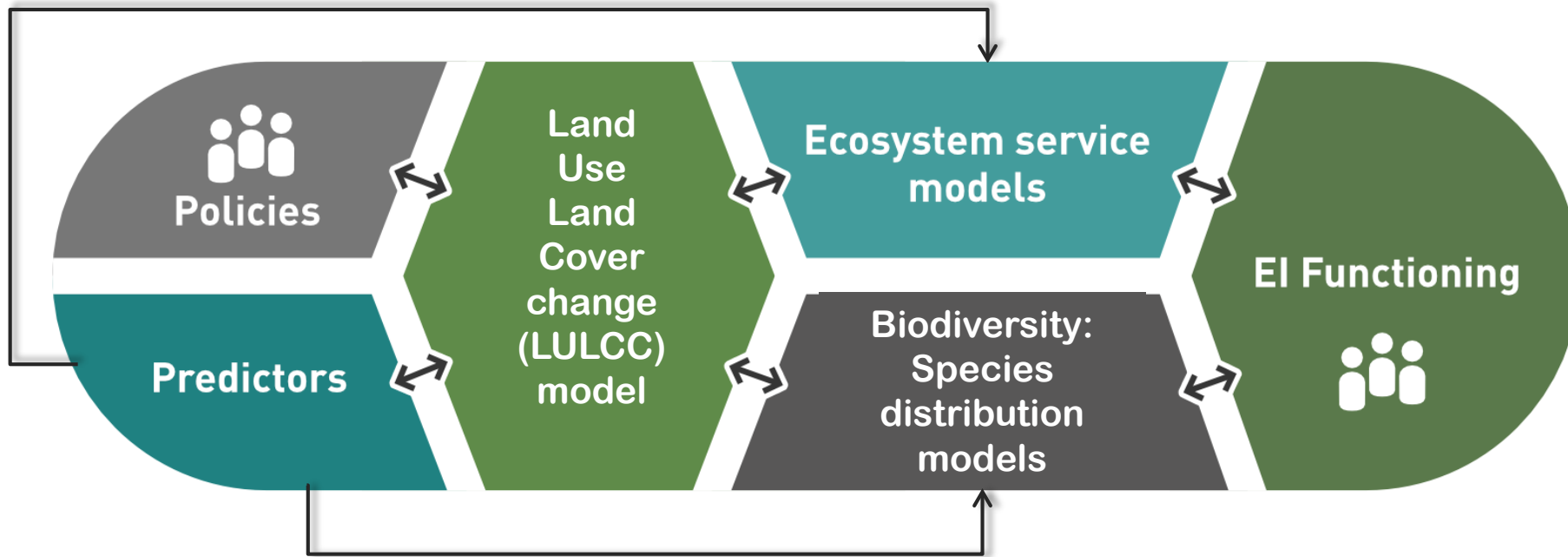
Comparison

Visions / normative  
goals for EI  
functioning



# Summary

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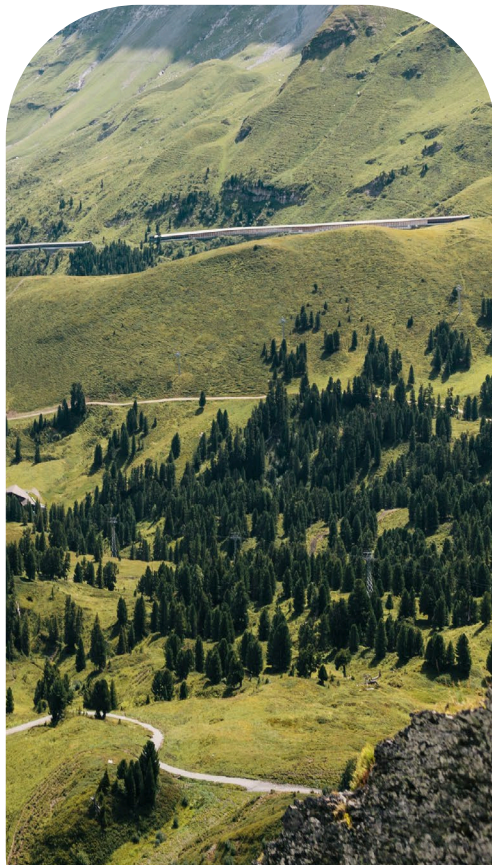
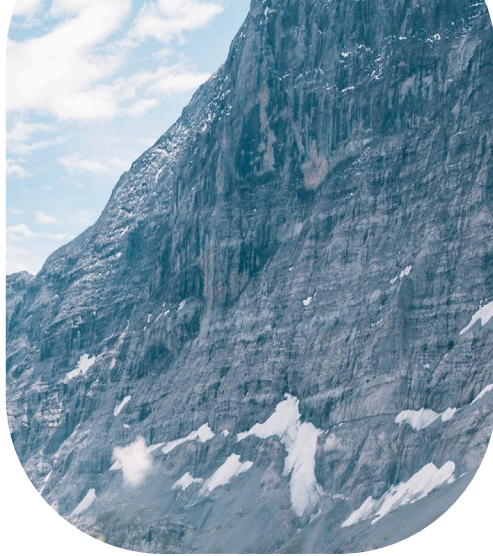
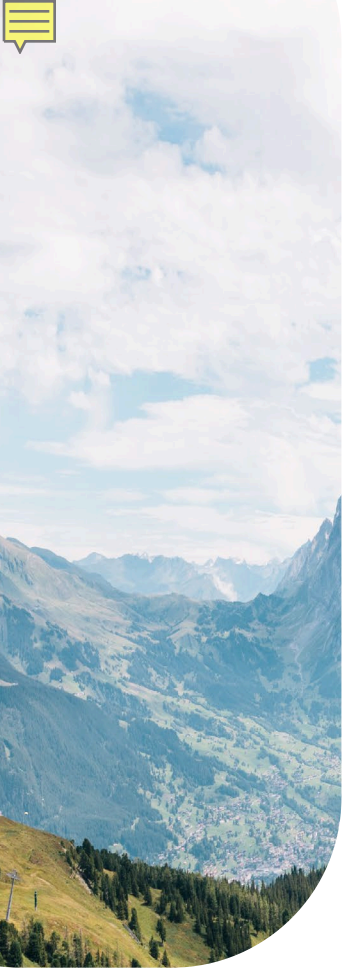


## Lessons learned:

- Integration has to be intentional
- Collaboration is key: minimizes duplicated efforts, guards against incompatibility
- Flexibility

[Valpar.CH website](http://Valpar.CH/website)





Thank you for  
listening

I will now take  
any questions.