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Forest management under deep uncertainty
- decision support vs. decision making

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Focus

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Studies on the exposure to risks, uncertainty, and complexity in the strategic management of ecosystems

- Deep Uncertainty & Complexity
- Management of natural resources
- Organisations & their decision making
- Interface between knowledge production & decision making : science ➲ practice

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Outline

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"Time divides the entirety of things into that part about which we can reason, and that part about which we cannot." (G.L.S. Shackle 1972)

1: Introduction

Goals – Background: Decision making & Deep Uncertainty in Forest Management & Planning

2: Two modes of dealing with deep uncertainty: Science vs. Decision making

3: Example „Climate Risk Maps" as scientific Decision Support tools & empirical findings: decision making of forest experts in the face of deep uncertainty

4: Conclusions & Questions

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I. Forestry & the long-term management of forest resources

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Forest Management Decisions

- Choice of tree species
- Choice of rotation time/ harvesting age
- Choice of management regime/ silvicultural strategies: harvesting, thinning, re-juvenation etc.
- Nature protection & Biodiversity; Securing natural productivity
- Maintenance of forest functions: production, protection of water&soil, recreation

Characteristics & challenges of long-term forest management

- Complementary & interdependent forest functions
- Identity of product & means of production
- heterogeneous forest owners
- Long-term forest production > 100-150 years
- irreversibility of decisions & effects
- Very site-specific conditions for Management (experiential knowledge)
- complexity of forests as socio-ecological systems
- Forests as public goods w/ social functions & strong social claims

+ climate change

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Forest Resource Management & Uncertainty: ontological dimension

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- Complexity: variability of natural systems & non-linear, chaotic and unpredictable nature of natural processes
- Contingency & unpredictability of social processes
  individual level: diversity in human views, norms and values, perceptions and behaviour
  meso-/macro level: social, economic and cultural dynamics & technological changes
- Interrelations between social and natural processes in socio-ecological systems
- Interdeterminacy: future states of systems evolve from interactions between actors and their environments in specific contexts only in the future.
- Self-referentiality: formation of actions and decisions as result of a concurrence of different actors' individual assumptions about both reality and the assumptions of other actors

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Forest Resource Management & Uncertainty: epistemological dimension

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- missing or incomplete theoretical knowledge about complex systems and their future states
- available data (inexactness, inaccuracies, metrical uncertainty, measurement errors, lack of data, immeasurable data or conflicting evidence, where data are available but allow room for competing interpretations)
- design and application of models (e.g. setup of system boundaries, model structure or initial state).
- irreducible ambiguity in interpretation of data: different values and norms = diverging framing of the process of gaining knowledge.

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II. Dealing with deep uncertainty: Science vs. Decision making

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Time & Uncertainty as irreducible frontiers for both science & forest management

- Framing of time & uncertainty distinguishes science from management:
- Science: models, probabilities, rationality, abstraction; optimizing;
  CC as problem of missing knowledge/ causal explanation
- Practical ForestManagement: decisions!, plurality of contexts; satisficing and legitimizing; ethics
  CC as decision making problem

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Handling of Uncertainty in strateg. Forest Management

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* Aspects: Individuum – Organisation - Discourse
* Phenomena: instruments – practices – cctors - communication
* Modes of handling uncertainty & complexity

a) uncertainty-strategies: level of procedures

- Established system of forest planning
- Nature-oriented FM: „Learning from Nature“
- Organisational flexibility & Diversification
- Adaptive Management & „Muddling through“

b) Reduction of uncertainty: Planning & optimization of decision making

- Modelling
- Adaptation strategies: CC-related forest conversion

c) Compensation of uncertainty: Symbolic Level

- „Resilience“; Sustainability; „Naturnähe“, „Robustness“

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III. Science vs. Decision Making: a: The example of Climate Risk Maps

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- established since 2008 (Bavaria)
- Goal: Identification of silvicultural hotspots
  Decision support for forest conversion & planning
- Modelling of future tree species fitness (precipitation & temperature & pests/diseases)
- digital topographical model and soil parameters
- mark interface between scientific decision support & forest management markieren
- From simple biome shift models for single tree species to
  * high definition climate risk and tree species fitness maps
  * for various tre species
  * for various climate change scenarios
- developed for/ used in all german states („Bundesländer“)

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Biome shift models

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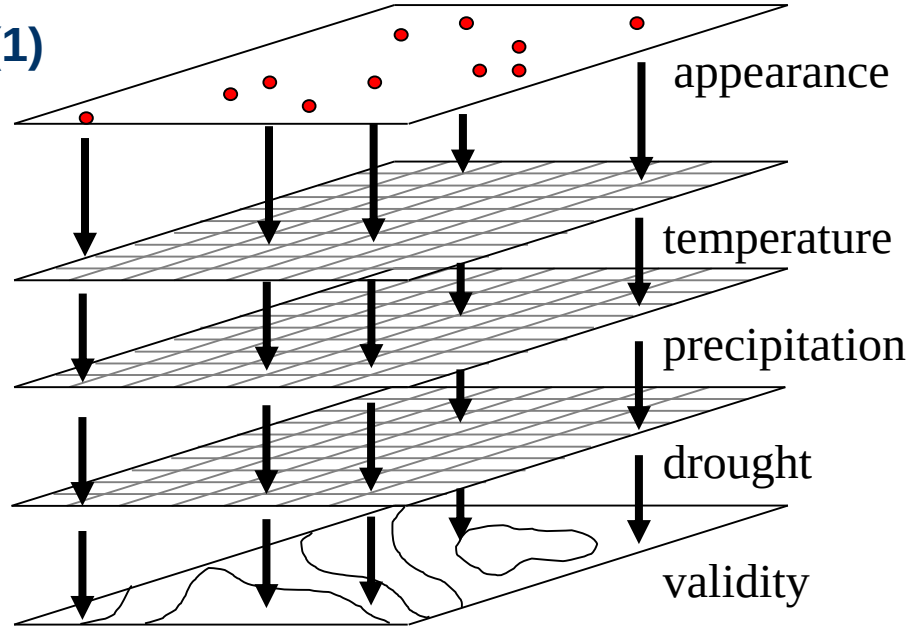
(1)



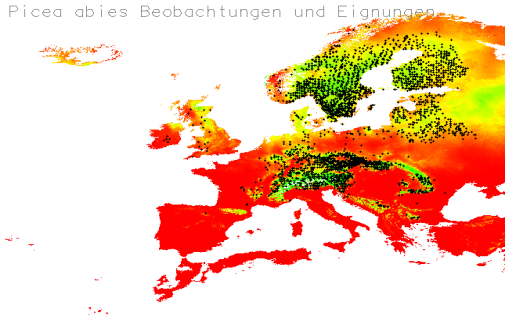
(2) *Choice of predictors*

(3)

ID	Picea	Temp	Nieder	G	...
1	0	3.25	1390	j	...
2	1	5.57	1840	j	...
3	1	7.21	2130	n	...
4	0	2.94	1420	j	...
5	1	8.43	1789	j	...
...	...	...	...	...	...

(4) $P(Sp1) = f(Temp, precip,...)$

(5)



after Zimmermann 2008

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Climate Risk Maps

now and then

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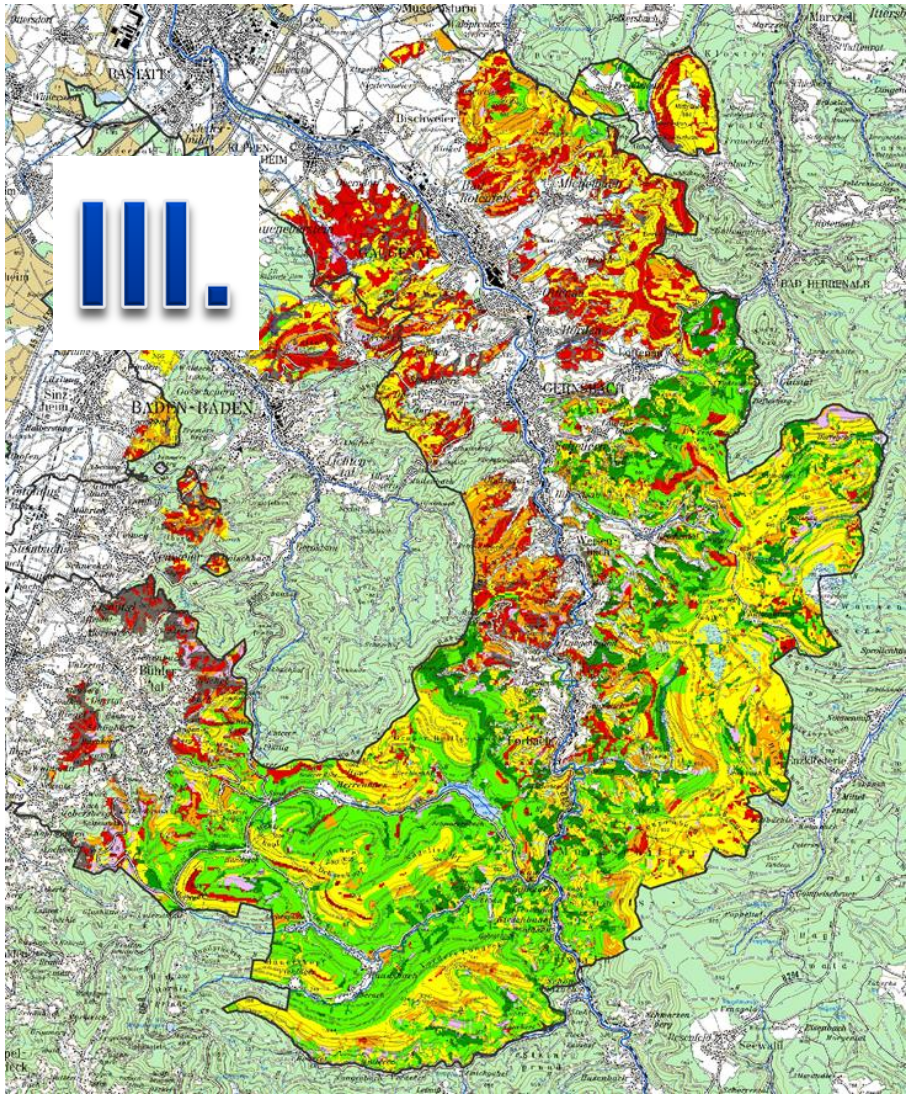

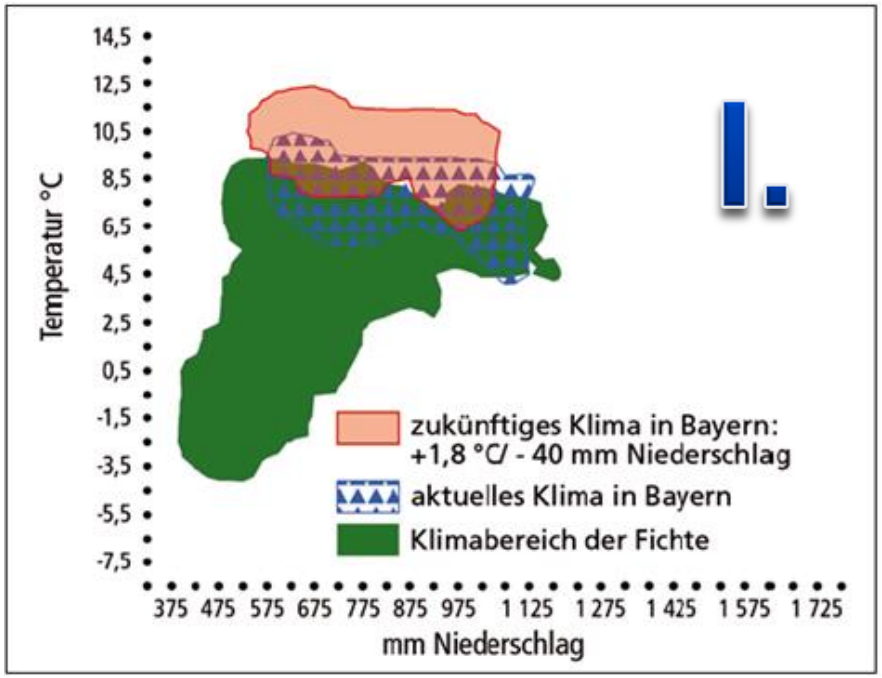

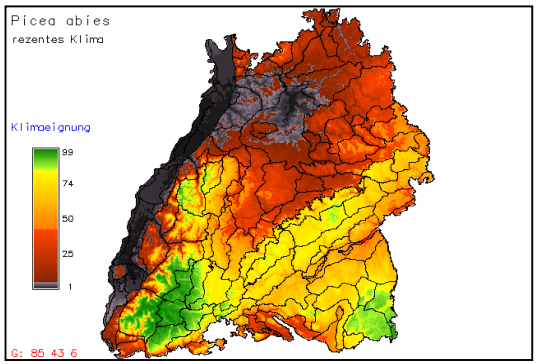

II.

Fitness: Fichte 2020

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Climate Risk Maps in decision making contexts

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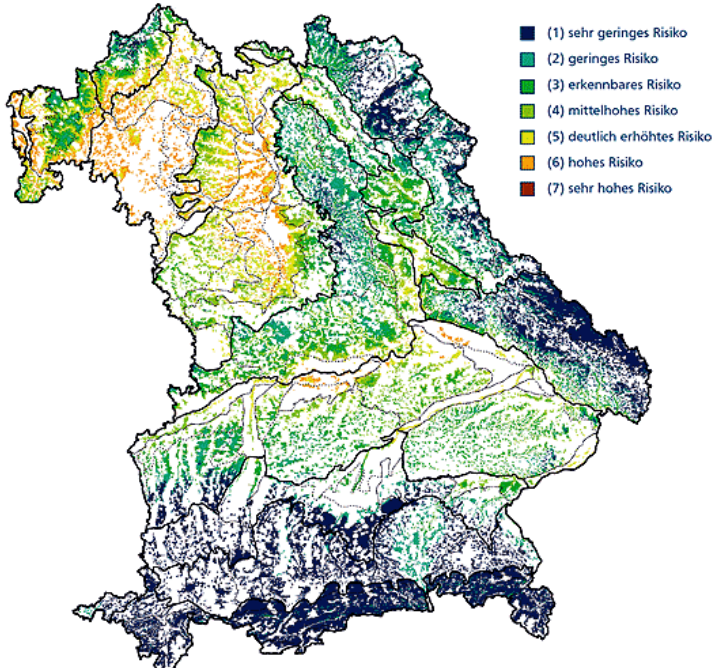
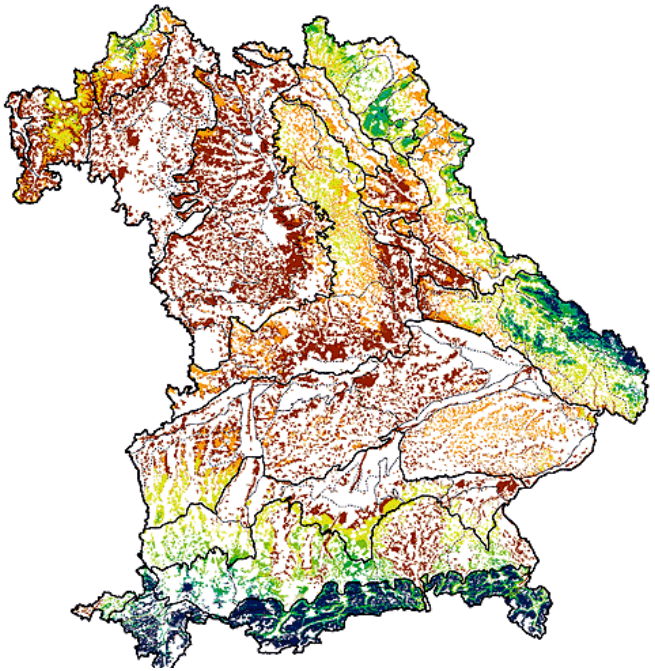


current climate conditions (1971-2000)



future climate conditions (2071-2100)

Risk map for Spruce in Baden-Württemberg (SW-Germany)

Production Risk as Product of probabilty & severeness of damages
„average“ soil conditions, WETTREG-Regionalisation, Scenario B1

https://www.waldwissen.net/waldwirtschaft/waldbau/umbau/lwf_risikokarten_als_planungshilfen/index_DE

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Scientific handling of deep uncertainty in Climate risk maps

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- decision making outcomes/ future effects presented in probabilities
- Scenario-based thinking: alternative potential futures, prognostic approach
- explicitly long time horizons considered
- selected conditions & variables
- problem of visualisation: clearness/ concreteness of graphs and diagrams vs. uncertainty

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IIIb: Decision making in the face of uncertainty: empirical results CC-adaptation

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Practical handling of uncertainty/complexity

empirical results from studies 2012ff (e.g. Detten & Faber 2013)

- in Germany
- Quantitative survey (>500 interviewees)
- Qualitative interviews (> 30 interviewees)
- Public & private forest enterprises from several „Bundesländer“
- Different levels: top-management, district managers, local forest managers, forest planning officers

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Results from empirical studies among forest professionals/ decision makers in Germany

I) Studies regarding decision making **time horizon perception of time & future** and uncertainty of long-term decisions/ plannings of forest practicioners

- Importance of routines
- Extrapolation of exemplary observations from the past and present
- Despite an decidedly expressed long-term orientation, real planning horizons do not exceed 10 or 15 years (~ only 1/10 of the avg. age of a tree/ forest)

➢Long-term time horizons do not play an effective & distinct role for decision-making of forest practitioners

Decision making in the face of deep uncertainty & risks

II) Studies regarding the decision making of forest managers regarding climate change adaptation: **organization level**

- Context related: latent tension between pragmatism of district managers (strategies: distribution of risk or „muddling through“) and Top Management („Adaptation Programs“) & various different risk cultures (private forest owners vs. public forest enterprises)
- Expectations from the external environment, legitimization in decision making as leading motifs/ criteria
- Isomorphism: orientation from „successful“ climate change adaptation measures / instruments from the social/ professional environment
- Importance of established *frames* ; retrospective sensemaking („strategies“) & rhetorical/ symbolical compensation of paradoxes & contradictions (guiding principles: „Naturnähe“) or normative solutions (goal of legitimization; choice of favourite scenarios etc.)

IIIb: Decision making in the face of uncertainty: empirical results CC-adaptation

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III) Studies regarding the decision making of forest managers regarding climate change adaptation; **individual level**

- Goal of autonomous decision making; muddling through/ pragmatic approach; strong objection to scientific knowledge (legitimization function)
- Diffuse concepts of future & time scales; „keeping options“
- Main motifs: legitimization, flexibility, independency & freedom, reversibility, distribution of risk
- Satisficing (vs. optimization & strong rationality claim)

IV: Conclusions, Hypotheses & Questions

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- In the organisational decision-making context, threats & risks are interpreted mainly as legitimization-problems
- … in the scientifical context as (stochastical) characteristics of ecosystems
- Different (& generally context-specific) time-horizons & handling of time/ uncertainty
- Threats & risk contain political questions (authority; ex. "Douglas fir & Naturnähe":; expert status; polit. influences)
- Historical experiences as scripts for perception/ framing of current threats & risks (ex. "Waldsterben" = forest decline)
- Uncertainty is handled on diff.levels: Modelling (Reduction) & normativ/ symbolic ("Nachhaltigkeit") (compensation) & pragmatic ("muddling through", risk streuung); goal: "Normalisation"
- Optimizing/ Rationality vs. Satisficing/ Legitimization Goals
- Visual representations & available instruments determine framing of perception & handling of risks
- Models as fictions – in which society reflects its own contingency

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Science vs. Decision-making

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	Characteristics of research/ scientific argumentation (natural sciences)	Characteristics of decision-making (e.g. forest management)
Addressing decision making	Probabilistic: decision making outcomes/ future effects presented in probabilities	decidedness of decision making, procrastination, muddling through
Addressing the future	Scenario-based: display/ thinking in alternative potential futures	decision making means narrowing of the future by choosing one option - & often commitment to one future scenario
Handling of uncertainty	Uncertainties as outcomes	uncertainty as starting point; decisions as cut off of uncertainty
time-frame	Long-term: explicitly long time horizons considered	short-term/ incremental steps
Use of concepts	narrow definitions: narrow conditions & reduced fuzziness; selected variables	no/ pragmatic/ unstable/ ad hoc definitions: multitude of conditions & fuzziness;
normativity	value-free representations	normative assumptions, value-laden perceptions & interests

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Discussion?

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- Requirements for science/ practitioner-dialogue
- Application of instruments (models, maps, charts…): quick & easy preparation - but narrowing of perspective & strategies
- Steering paradigm vs. uncertainty paradigm
- Mutual learning & experimentational management ?

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„Foresters do long-term management.
It‘s precisely for this reason that
they do not have to care
if they *really know*
how to do long-term management.“

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