Coupled component modelling for inter- and transdisciplinary climate change impact research: dimensions of integration and examples of interface design

U. STRASSER[1], U. VILSMAIER[2], T. MARKE[1], F. HANZER[1] AND J. STÖTTER[1]

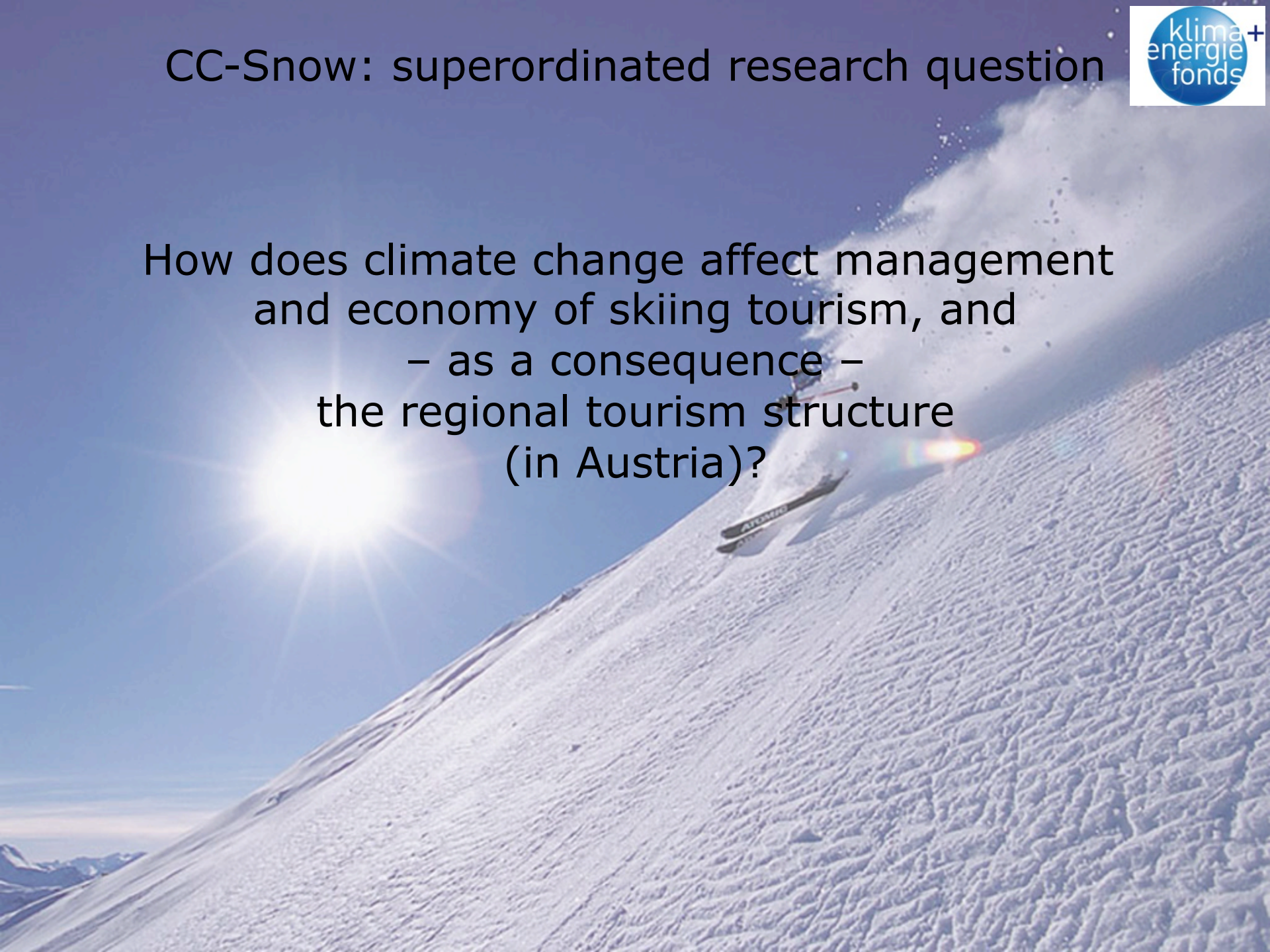
1 Institute of Geography, University of Innsbruck
2 Center for Methods and Institute for Ethics and Transdisciplinary Sustainability Research, Leuphana University of Lüneburg

VALUE
End user workshop
„Linking climate data and impacts with end user needs to enable robust adaptation“
Bern, 1.12. – 2.12.2014

Overview

- The CC-Snow project
- Interface design in coupled component modelling
  - Interface types
  - Indicators as example
  - Joint implementation and recursive modelling
- Integration in inter- and transdiciplinary modelling
  - Dimensions of integration
  - Task forces as space for integration
- The grand challenge: sustainability research
- Conclusion and outlook

CC-Snow: superordinated research question



How does climate change affect management and economy of skiing tourism, and
– as a consequence –
the regional tourism structure
(in Austria)?

CC-Snow: coupling

Downsaling of RCM data

Wegener Center for Climate and Global Change
Group: Andreas Gobiet (ReLoClim)

Snow modelling

Local scale

Institute of Geography, University Graz
Group: Ulrich Strasser (Alpine Hydroclimatology)

Regional scale

Institute of Geography, University Innsbruck
Group: Johann Stötter

+

GRID-IT Innsbruck
Group: Hannes Kleindienst

Economy

Joanneum Research Graz
Group: Franz Prettenthaler

+

Wegener Center for Climate and Global Change
Group: Karl Steininger (EconClim)

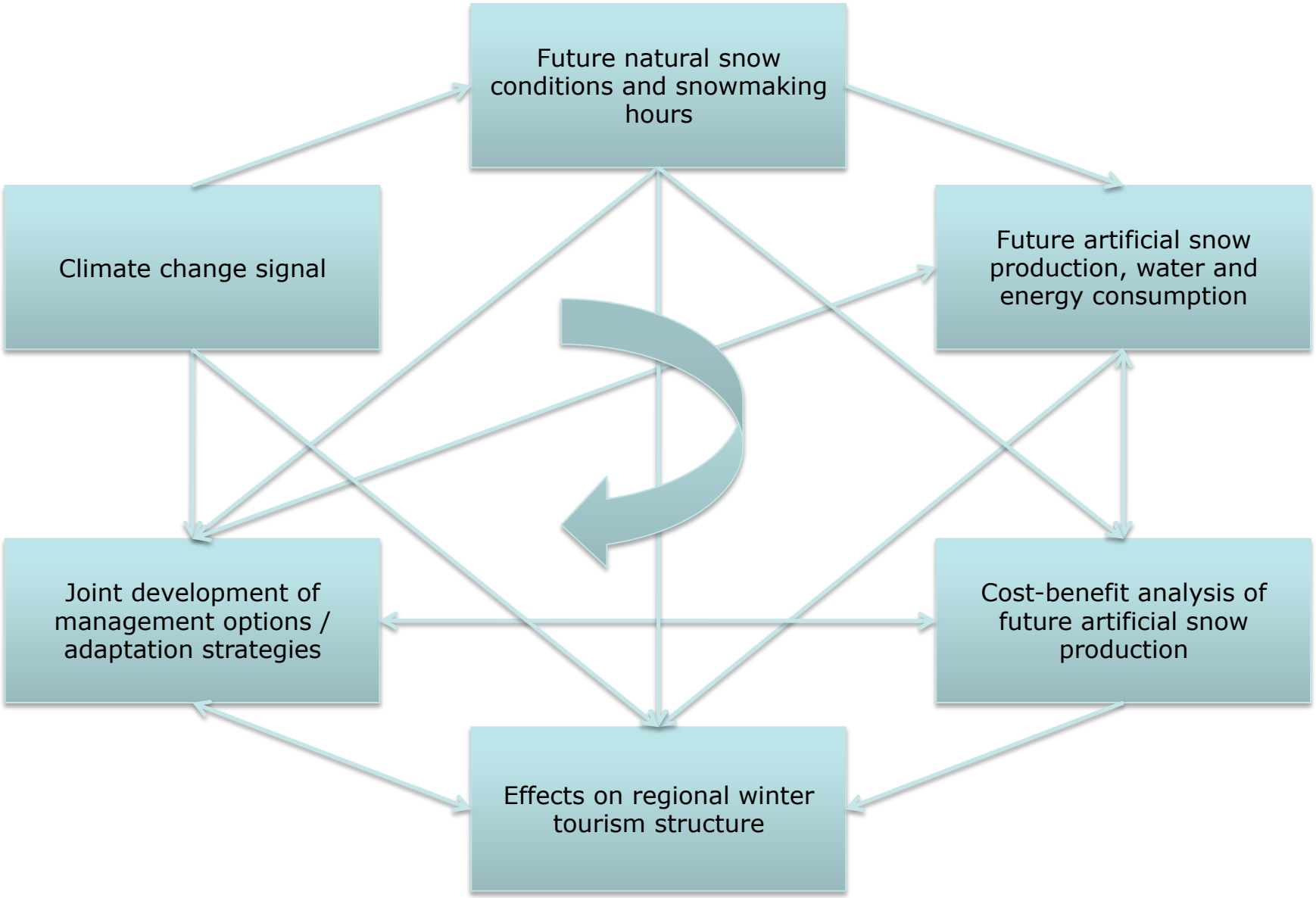
Tourism

Institute of Geography, University Innsbruck
Group: Johann Stötter

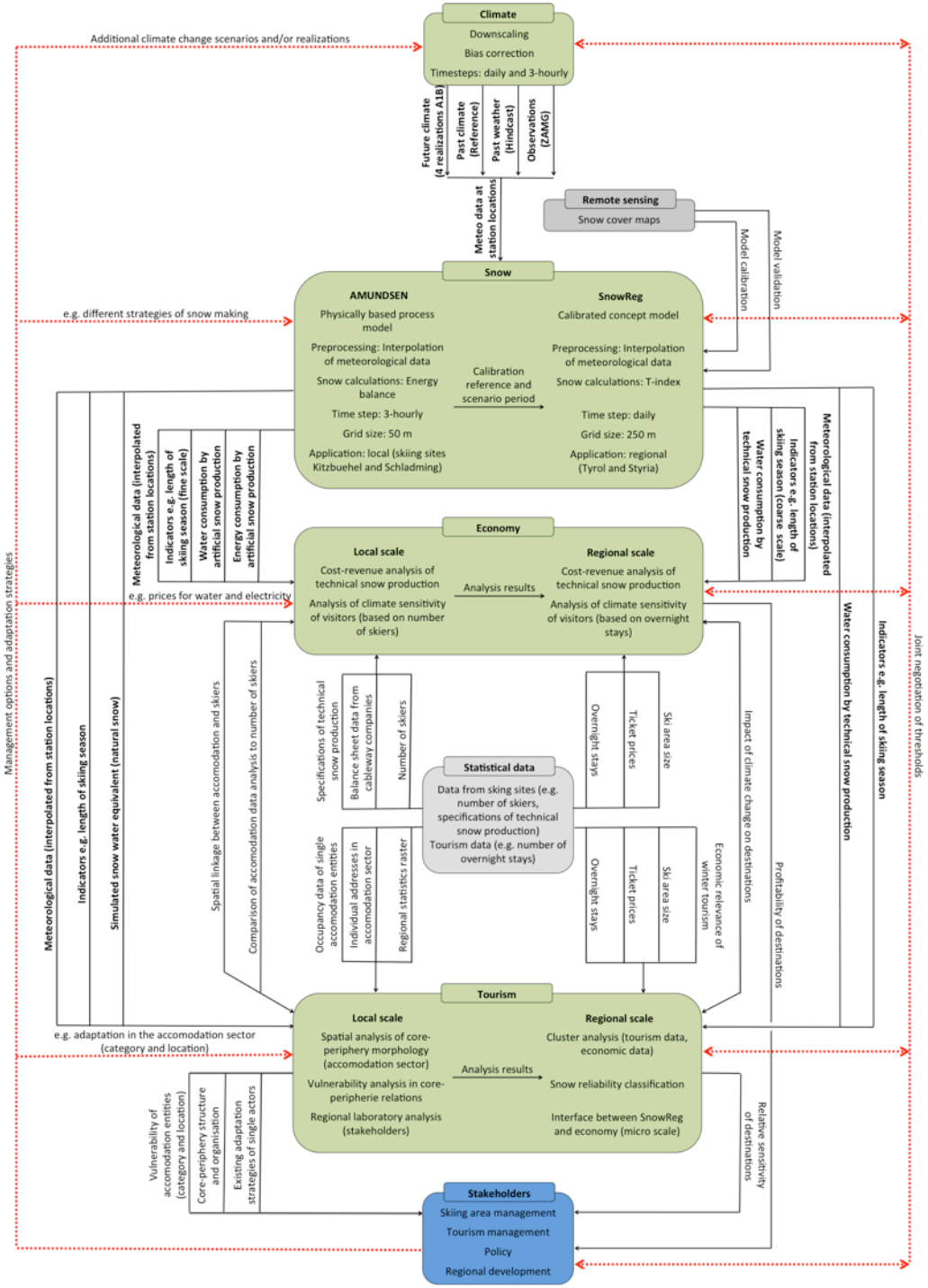
+

Institute of Geography, University Graz
Group: Friedrich Zimmermann

CC-Snow: model components and I/O



CC-Snow: model components and I/O

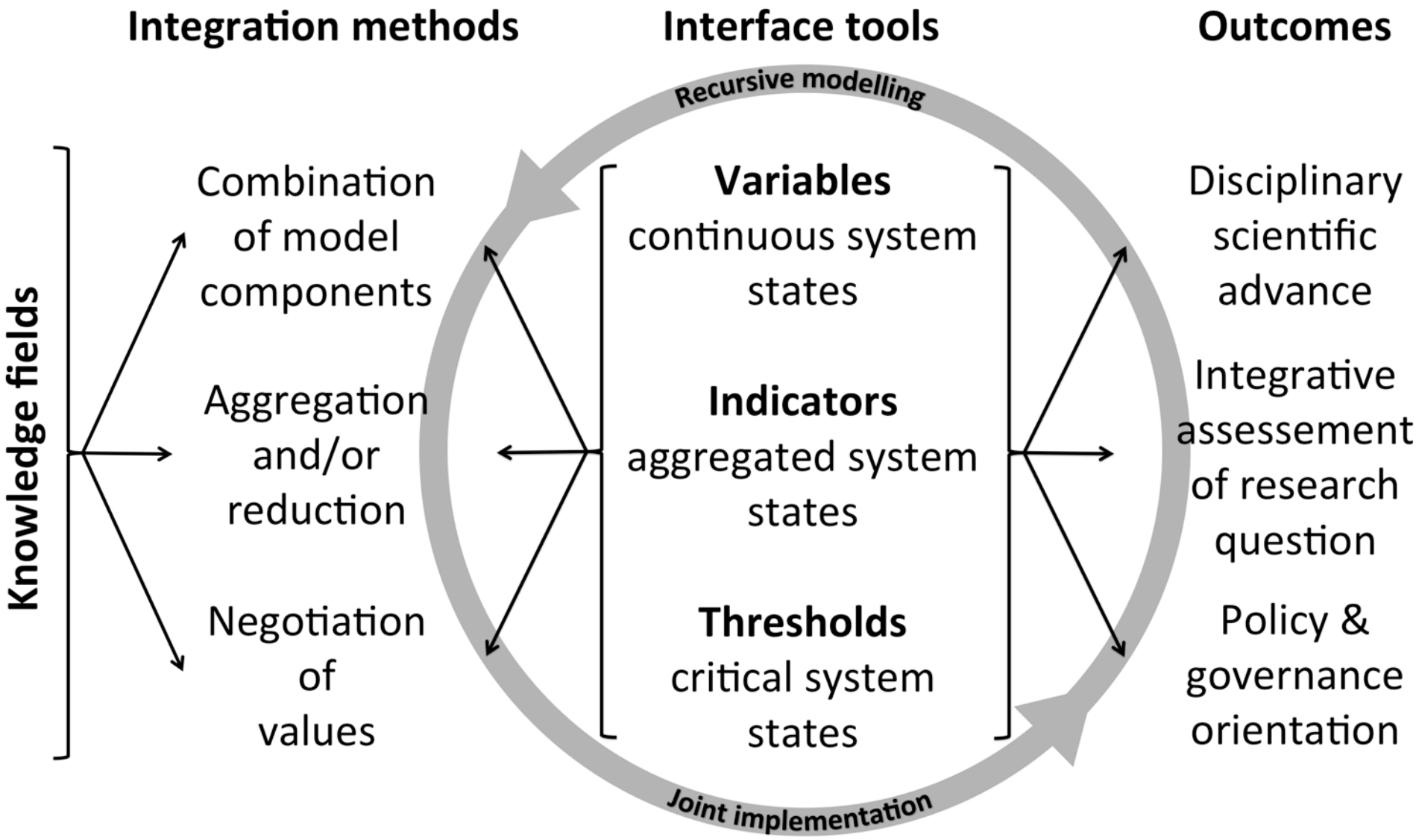


Types of knowledge at the science/society interface

- System knowledge (genesis and potential developments)
- Target knowledge (*where to go*, values, change demand, inhabitants/politicians/NGOs)
- Transformation knowledge (*what to do*, measures/options to change the system, attitude → behaviour, consequences, social/ legal/cultural courses of action)

ProClim 1997

Integration through model coupling



Features of the interface types

Variables	Indicators	Thresholds
Continuous system states	Aggregated system states	Critical system states
Time series with modeltemporal resolution	Temporally aggregated means and trends	Single dates with modeltemporal resolution
Spatially distributed	Spatially distributed	Local
Quantitative → quantitative	Quantitative → qualitative	Quantitative → qualitative
Process-oriented	Descriptive	System dependent
Analytical	Application-oriented	Actor-oriented
Provide disciplinarydata information	Provide general, transferable measures	Provide warning signals

The three interface types can be characterized

1. Variables are process-oriented, analytical and disciplinary
2. Indicators are descriptive, application-oriented and more general transferable hybrids of system states and negotiated values
3. Thresholds are system-dependent, acteur-oriented warning signals or critical system states

Indicators are key elements for measuring, explaining, visualizing, comparing and communicating results between the research groups, the stakeholders and the broader public.

Indicators: examples

Skiing season duration

How does the skiing season duration change (natural snow)?

How does the skiing season duration change if current or potential future snow production techniques are applied?

Snow production hours

How do technical snow production hours change (wet temperature)?

How does the cost-benefit analysis look like for technial snow production?

White winter landscape

How does the number of days with attractive landscape change?

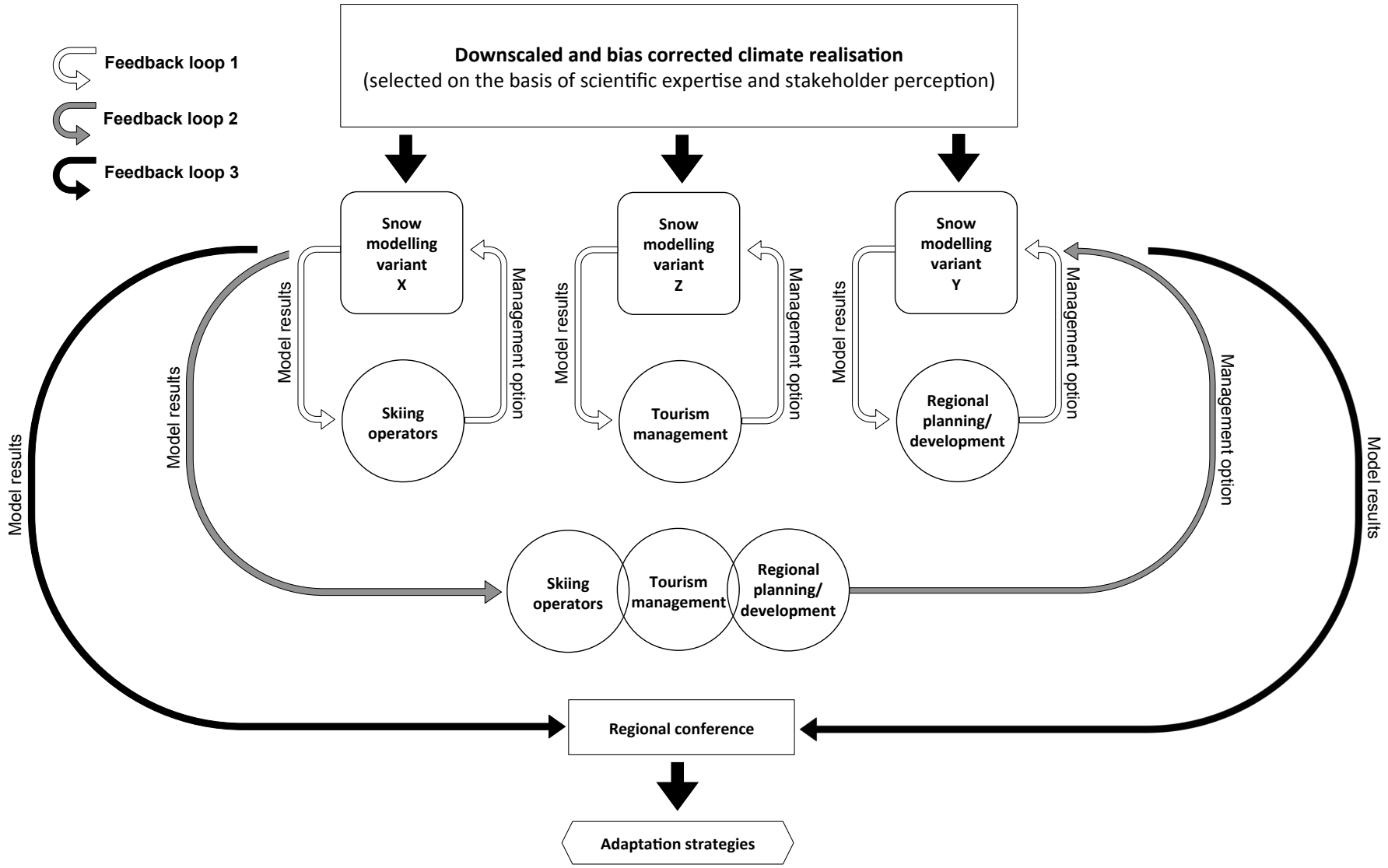
How does the regional structure of winter tourism change?

Photos: www.planai.at

Indicators: quantification

Indicator	Quantification	Result type
Ski-opening natural snow I	120 mm swe after Nov 1 for at least 5 consecutive days	date (doy)
Ski-opening natural snow II	30 cm snow height after Nov 1 for at least 5 consecutive days	date (doy)
Hours of technical snow production	Wet bulb temperature < threshold	number of hours
Ski-opening artificial snow	120 mm swe after Nov 1 for at least 5 consecutive days	date (doy)
Ski-closing natural snow	Duration from ski-opening with SWE < 80 mm for at least 10 consecutive days	date (doy)
Ski-closing artificial snow	Duration from ski-opening with swe < 80 mm for at least 10 consecutive days	date (doy)
White winter landscape	> 15 mm swe between Nov and April	number of days
Season length natural snow	Closing day minus opening day	number of days
Season length artificial snow	Closing day minus opening day	number of days
Operation time natural snow	> 120 mm swe between opening and closing day	number of days
Operation time artificial snow	> 120 mm swe between opening and closing day	number of days
Heavy snowfall 3 days	3 days heavy snowfall > 200 mm swe	number of events
Heavy snowfall 1 day	1 day heavy snowfall > 100 mm swe	number of events

Joint implementation and recursive modelling



Integration in inter- and transdisciplinary research

Integration as a key to successful inter- and transdisciplinary research for socially and culturally robust knowledge production and adaptation.

- Process of integration: an underestimated aspect of the research process
- Lack of attention in research architectures (process design, time and financial resources)
- No resources for stepwise project design, recursivity, joint interface development, boards of integration
- Researchers are often not prepared for integrative research (training, experiences)
- Disregard of the integration work by reviewers of the funding agencies and journals, *and the involved scientists themselves ...*

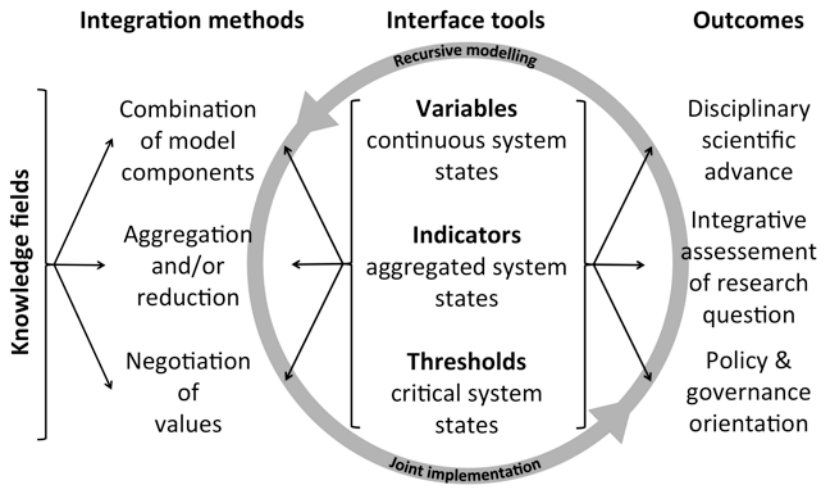
Dimensions of integration

- *Communicative* (level of terms, communicative practices to improve mutual understanding, the „joint language“)
- *Cognitive* (understanding of disciplinary concepts and methods, developing a joint theoretical basis)
- *Social* (clarification of interests and objectives, roles and responsibilities, team-building, leadership)

Bergmann et al. (2012)

Inter- und transdisciplinary modelling

- Coupled component modelling is a method, the interfaces are at the same time tools and results
- The coupled model has a double role: it is the basis *for* and the aim *of* the integration process

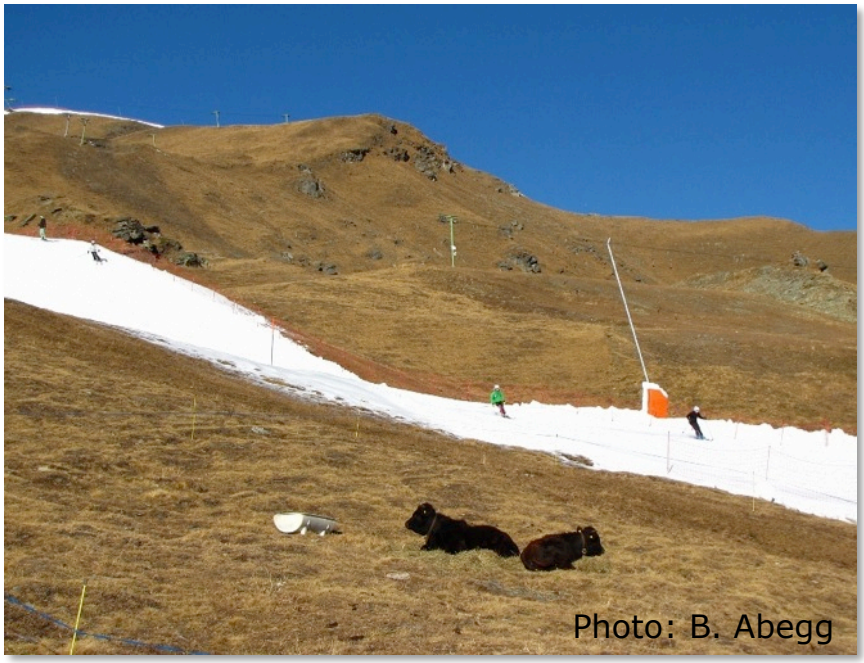


The task force

- Space for integration
- Representatives of the involved research teams, societal fields, end users
- Realizes communicative, social, cognitive integration
- Continuous cooperation throughout the entire course of the research process
- Definition and negotiation of roles and responsibilities
- Formulation of commitments and objectives
- Communication of the results to all involved scientists
- Prerequisites: willingness to learn, openness and disclosure

Inter- und transdisciplinary knowledge integration: a non-linear research process

- Mutual learning through *communicative*, *cognitive* und *social integration*
- *Joint implementation*: realization of disciplinary basic research, integrative research and development of options for action
- *Recursive modelling*: knowledge integration and continuous improvement of the model



The ‚grand challenge‘

1992 Rio de Janeiro: UN Conference ‚Environment and Development'

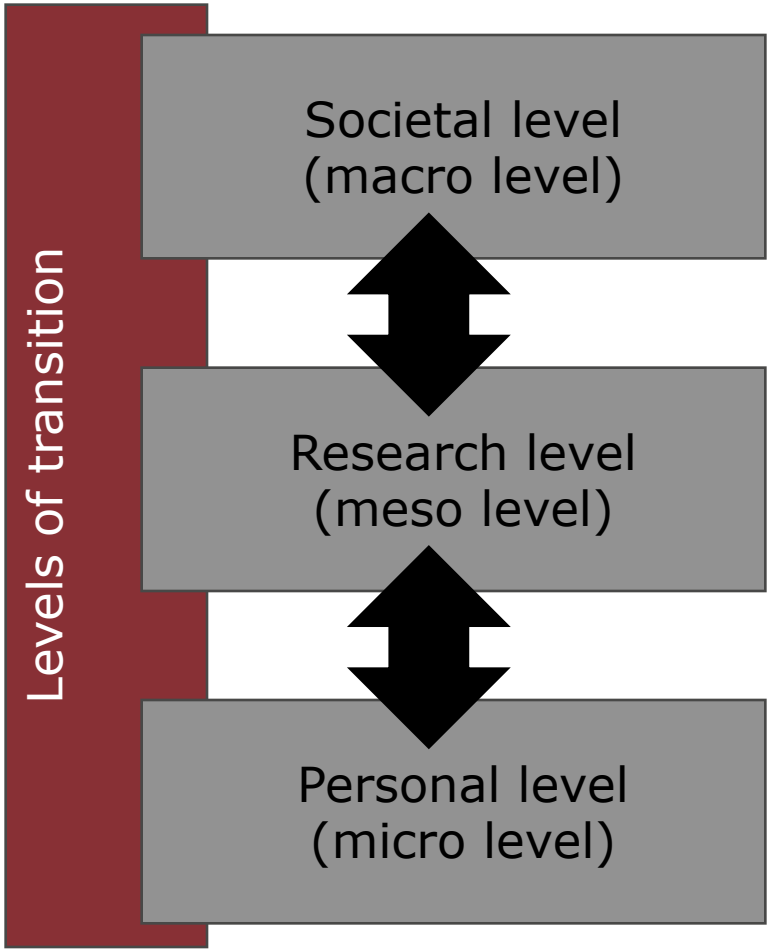
„The **cooperative relationship** existing between the scientific and technological community **and the general public** should be extended and deepened into a **full partnership**." […]

„Existing **multidisciplinary approaches** will have to be **strengthened** and **more interdisciplinary studies** developed **between the scientific and technological community and policy makers** and with the **general public** to provide leadership and practical know-how to the concept of **sustainable development**.

The **public should be assisted in communicating** their sentiments to the scientific and technological community concerning **how science and technology might be better managed** to affect their lives in a beneficial way."

Agenda 21, Ch. 31.1

Conditions for inter- and transdisciplinary research



- Foster discourse on changing roles, tasks and responsibilities of societal domains, in particular the role of science in society (e.g. MASIS Report 2009)
- Create institutional spaces and networks for cross-sectorial research
- Provide funding schemes for joint research

- Acknowledge diversely generated knowledge and the plurality of perspectives
- Link knowledge production to decision making to create a transformative impact of the research
- Integrate empiric, pragmatic, normative and value-oriented aspects
- Develop integration processes and interface design

- Provide personal conditions for integration
- Reflect self-concepts and concepts of the other
- Contribute with courage and openness: inter- and transdisciplinarity is constituted in complementarity.

Cultural diversity ...

Photo: www.wikipedia.org

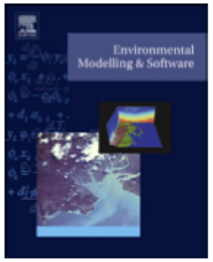
- Discover and respect multiple perspectives
- Identify diversity as advantage
- Leave pre-assembled pathes
- Devolop joint understanding: a *success model!*

Environmental Modelling & Software 60 (2014) 180–187

Contents lists available at ScienceDirect

Environmental Modelling & Software

journal homepage: www.elsevier.com/locate/envsoft



Coupled component modelling for inter- and transdisciplinary climate change impact research: Dimensions of integration and examples of interface design

U. Strasser [a, *], U. Vilsmaier [b], F. Prettenhaler [c], T. Marke [a], R. Steiger [d], A. Damm [c, e], F. Hanzer [a], R.A.I. Wilcke [e], J. Stötter [a]

[a] Institute of Geography, University of Innsbruck, Innrain 52f, 6020 Innsbruck, Austria
[b] Center for Methods and Institute for Ethics and Transdisciplinary Sustainability Research, Leuphana University, Lüneburg, Germany
[c] Center for Economics and Innovation Research, Joanneum Research, Graz, Austria
[d] MCI Management Center, Innsbruck, Austria
[e] Wegener Center for Climate and Global Change, University of Graz, Austria

ARTICLE INFO

Article history:
Received 22 November 2013
Received in revised form
8 June 2014

ABSTRACT

In environmental research the importance of interfaces between the traditional knowledge fields in natural and social sciences is increasingly recognized. In coupled component modelling, the process of developing interface designs can support the communicative, social and cognitive integration between

Thank You for Your attention!

Photo: A. Kellerer-Pirklbauer