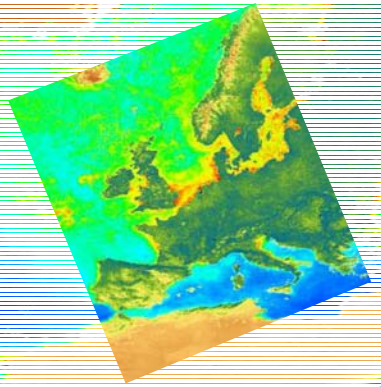
Global change impacts on ecosystem services and the vulnerability of the human-environment system – The European assessment ATEAM

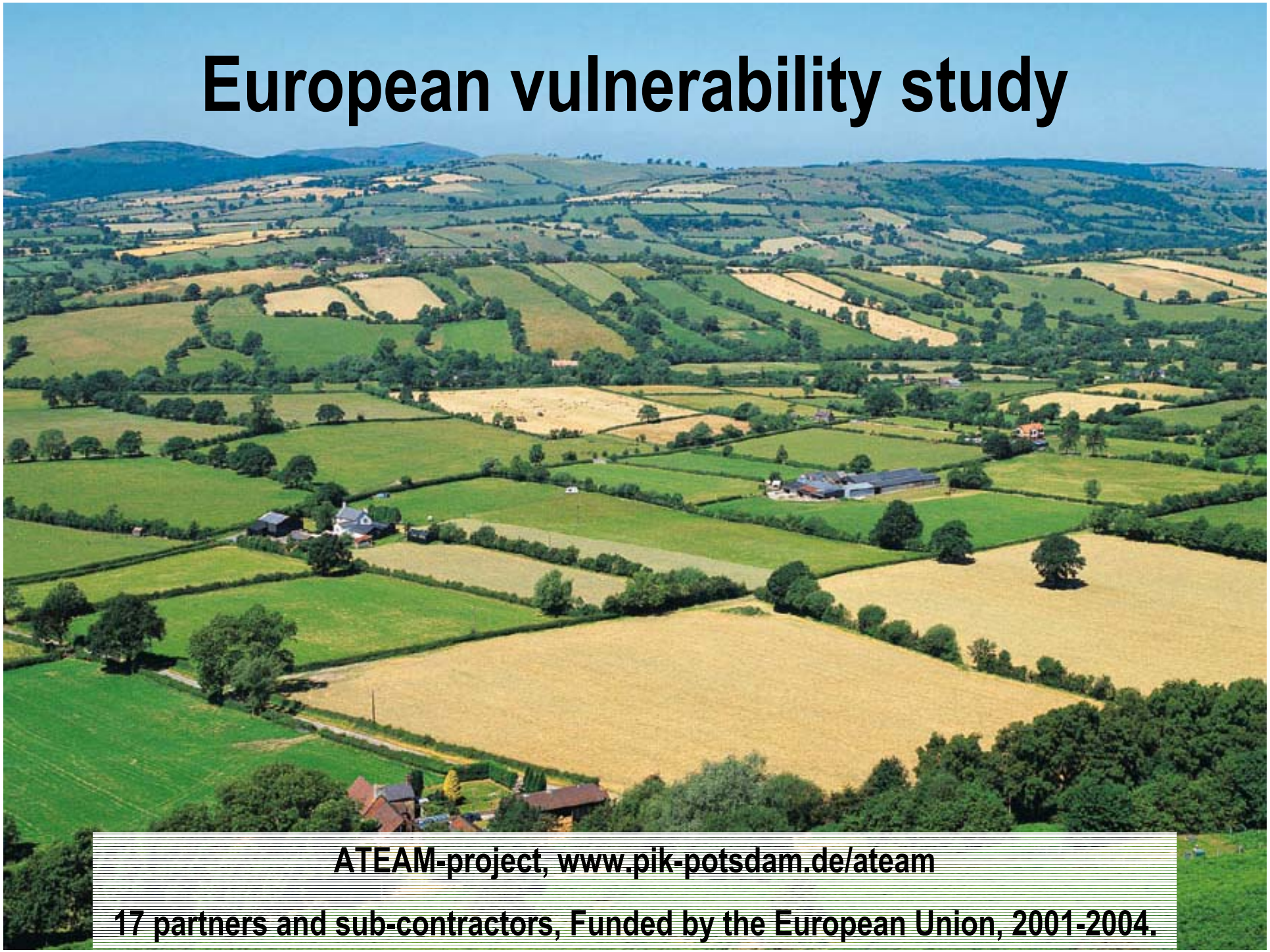
Dagmar Schröter and Marc J. Metzger



Potsdam Institute for
Climate Impact Research

P I K

European vulnerability study



ATEAM-project, www.pik-potsdam.de/ateam

17 partners and sub-contractors, Funded by the European Union, 2001-2004.

Objectives

1. **To assess potential impacts of global change on ecosystem services in Europe**

2. **To translate these impacts into maps of our vulnerability**  these maps should inform the decision-making of stakeholders about adaptation options to global change

Examples of questions to tackle

- *Which regions are most vulnerable to global change?*
- *Which sectors are the most vulnerable in a certain region?*
- *Which scenario is the least harmful for a sector?*


food production


slope stability


fire prevention


water storage


fibre production


biodiversity

The environmental dimension of vulnerability

- Ecosystems provide **services** that sustain and fulfill human life (see 1st MA book, Alcamo et al. 2003)
- To know the **potential impacts of global change on ecosystem services** within a specific region is to understand an **essential part of this region's vulnerability**.


pollination


fodder production


carbon sequestration


flood protection


tourist attraction


recreation


stabilising micro-climate

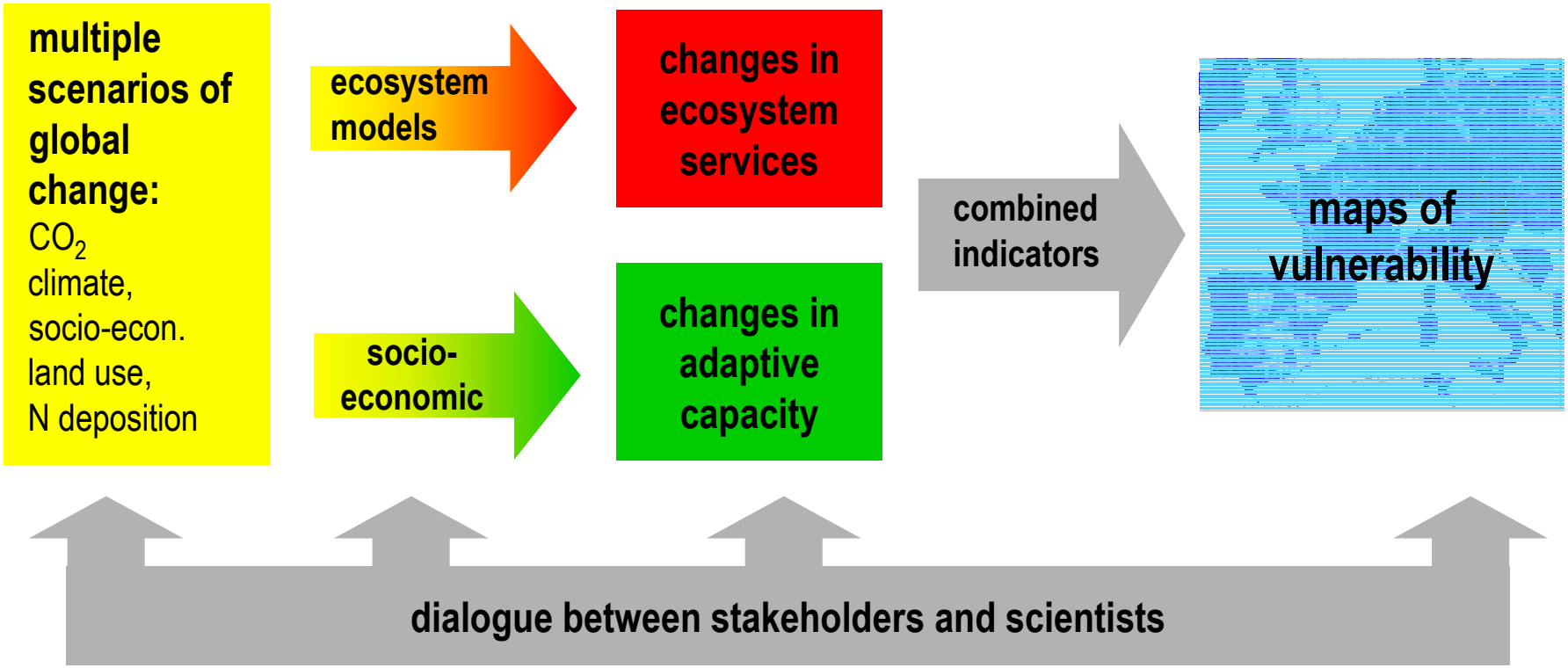

game reserve


shelter for life stock


beauty

European Vulnerability Assessment

Methodology

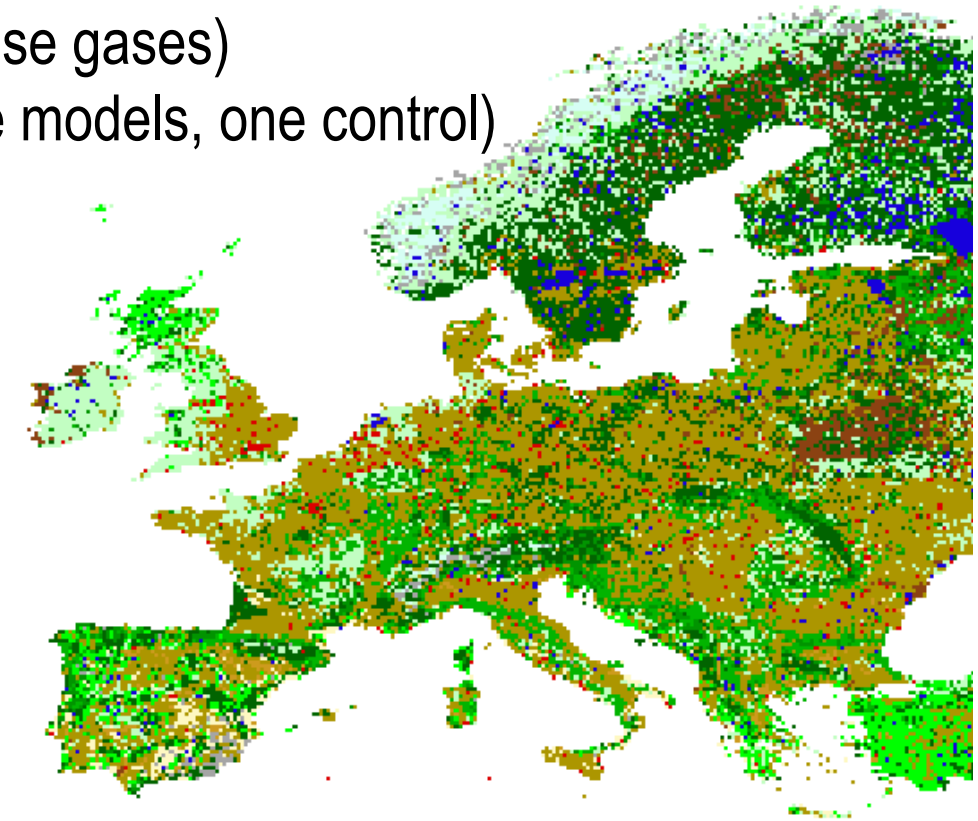


Metzger & Schröter 2004 (submitted).

Consistent global change scenarios

As **input** to our ecosystem and adaptive capacity models.

- Spatially explicit: 10' x 10' (ca. 16 x 16 km)
- 4 time slices (1990, 2020, 2050, 2080)
- 4 Socio-Economic Scenarios
- 4 Emission Trajectories (greenhouse gases)
- 17 Climate Scenarios (four climate models, one control)
- 7 Land Use Scenarios
- 4 Nitrogen Deposition Scenarios



Sectors, ecosystem services and modelled indicators

Sectors	Services		Indicators
Agriculture	Food & fibre production Bioenergy production		• Agricultural land area (Farmer livelihood) • Suitability of crops • Biomass energy yield
Forestry	Wood production		• Tree productivity: growing stock & increment
Carbon storage	Climate protection		• Carbon storage in vegetation • Carbon storage in soil
Water	Water supply (drinking, irrigation, hydropower) Drought & flood prevention		• Runoff quantity • Runoff seasonality
Biodiversity	Beauty Life support processes (e.g. pollination)		• Species richness and turnover (plants, mammals, birds, reptiles, amphibian) • Shifts in suitable habitats
Mountains	Tourism (e.g. winter sports) Recreation		• Snow (elevation of snow line)

Metzger & Schröter 2004 (submitted).

Agriculture

- Decline in arable land (cropland, grassland)
- Surplus land (up to over 10 % of European land surface)
- Land demand for bioenergy may go up, CO_2 offset may approach 15% of 1990-emissions in 2080
- Climate driven decline in soil organic carbon, partly counteracted by land use and stimulated plant growth
- Crop suitabilitiy changes; some current agricultural areas become too hot and too dry to support agriculture

Vulnerability

exposure

sensitivity

adaptive capacity

potential impact

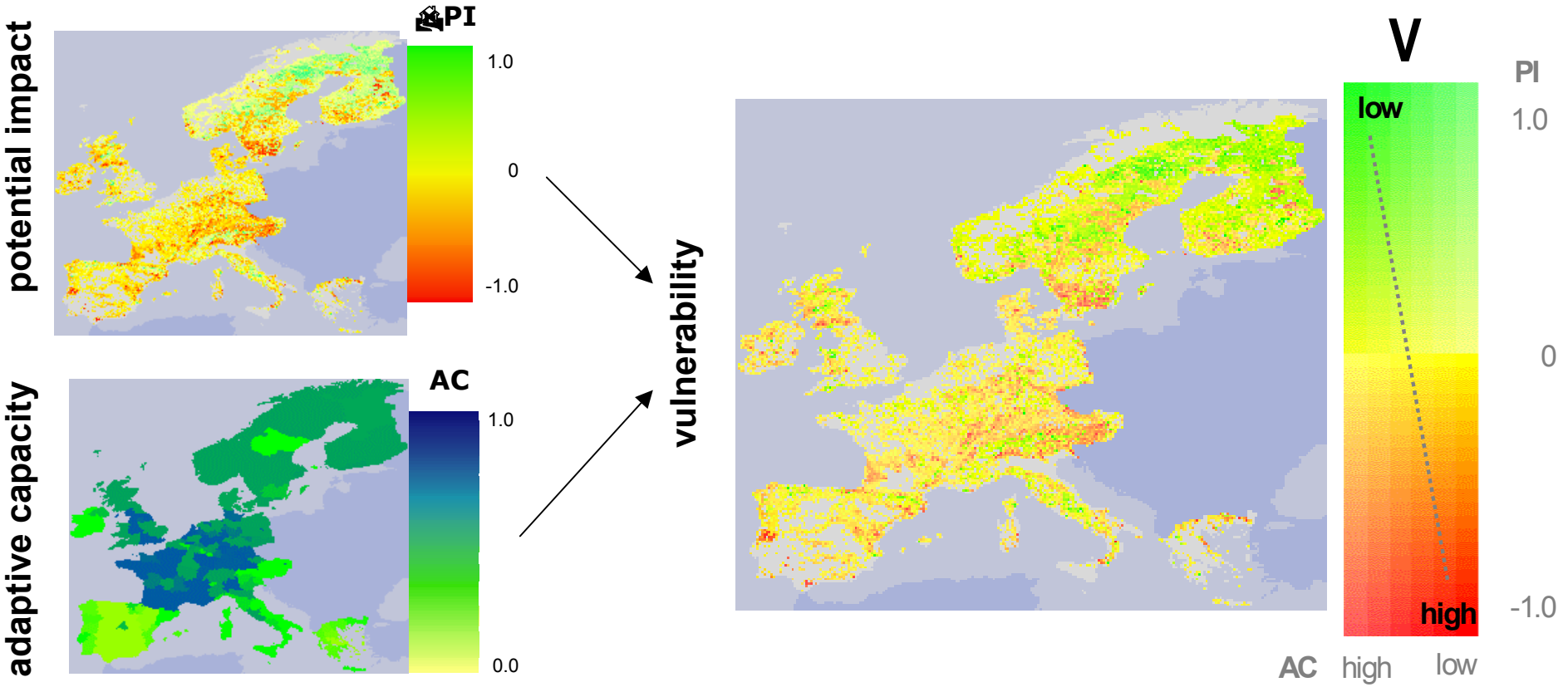
vulnerability

Integration: Vulnerability

2080A1

wood production

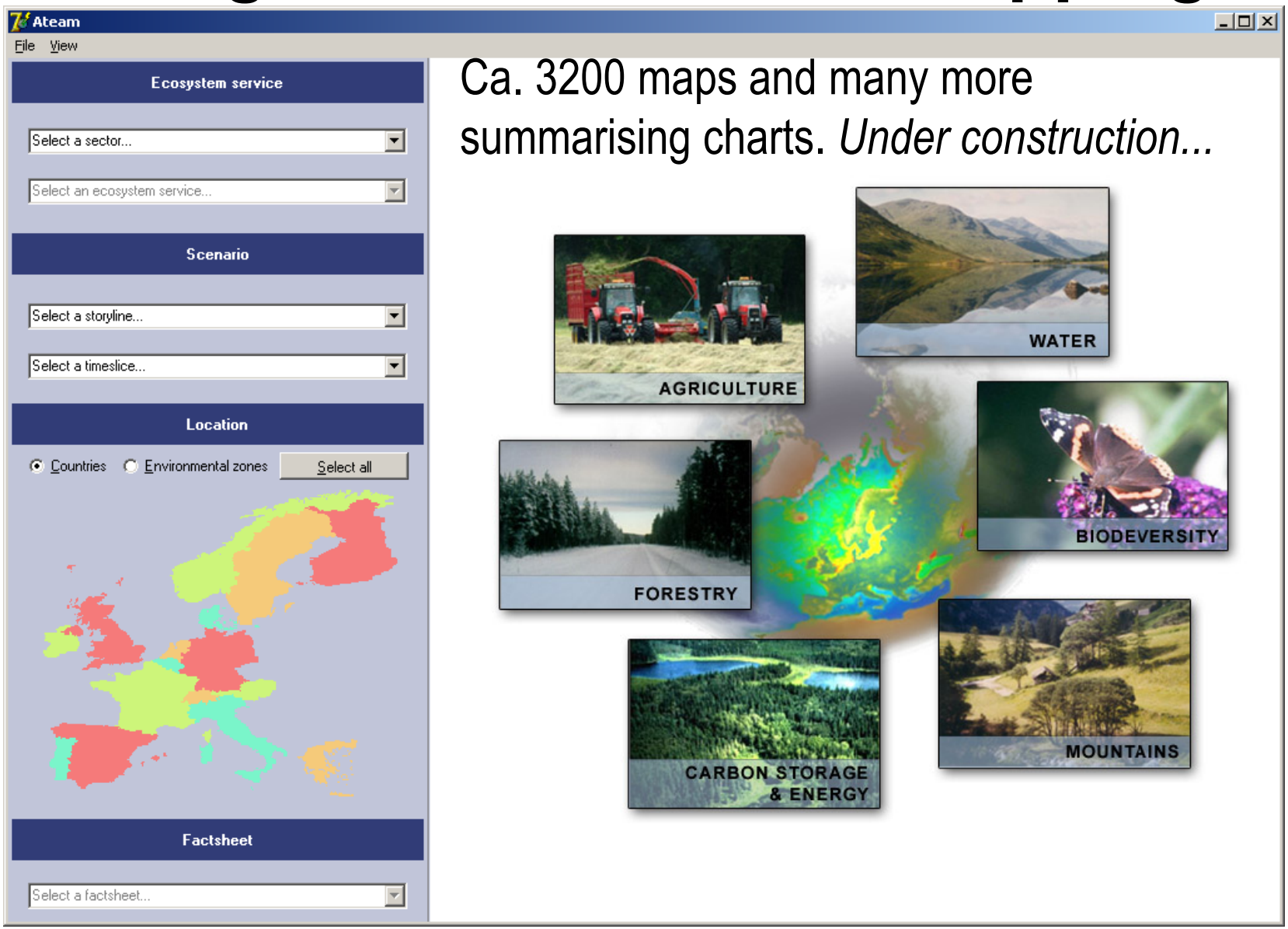
Visual overlay



V = f(PI, AC)

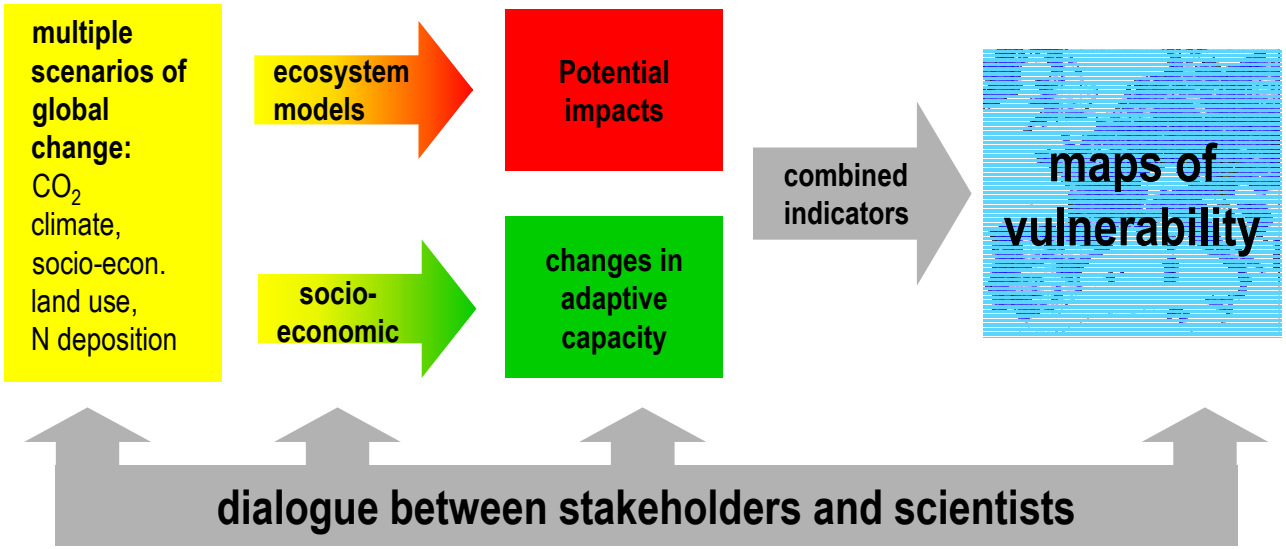
A relationship that is not specified beyond *high PI* and *low AC* 🎭 *high V*, etc...

… our digital atlas: ATEAM mapping tool



...which areas, and who is vulnerable to global change?

How can we adapt?



Schröter et al. 2004 (in press), Metzger & Schröter 2004 (submitted).

Conclusions: Vulnerability

- **Vulnerable region: Mediterranean** seems most vulnerable within Europe - **multiple potential impacts** [water, forestry, agriculture, tourism, carbon storage] *and* **low generic adaptive capacity**
- **Vulnerable sectors:**
  - Agriculture? Soil. **Extensification potential.** How do farmers decide? CAP...
  - Forestry? **Fire risk.** Biofuel potential. Shift to other species.
  - Carbon storage. **Soil respiration and fire vs. net primary production**
  - Mountain tourism. **Reliable snowcover declines.** Risks and discomfort?
  - Water. Droughts, floods. **Seasonality changes**. Hydropower, storage capacity.
  - Biodiversity. Current debate. Syndrome of impoverishment? **Dynamic reserve management.**
- **Dialogue between science and stakeholders** is an important part of the results. Informed by best science, fair, focussed and sustained.
  Coordination, moderation, **social learning.**
- The **digital Atlas** developed with stakeholders is a useful communication tool in this dialogue.
  - What will be **most helpful** to stakeholders? Maps of V? Maps of AC? Maps of 'raw data'? Which time slices? Scenarios?