

# The use of climate change scenarios for impact assessment

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# IPCC Scenarios

Climate scenarios are plausible representations (storylines) of the future that are consistent with assumptions about future emissions of greenhouse gases and other pollutants and with our understanding of the effect of increased atmospheric concentrations of these gases on global climate.

They are not predictions, like weather forecasts are. It is largely the uncertainty surrounding the assumptions which determines the range of possible scenarios and which makes them – partly - unsuitable for concrete short-term and local-scale related decision making!

# IS92 Scenarios (IPCC 1992)

IS92a assumes that the population rises to 11.3 billion by 2100 and economic growth averages 2.3% per annum between 1990 and 2100, with a mix of conventional and renewable energy sources being used.

IS92c propagates an eventually sinking of CO<sub>2</sub> emissions below its 1990 starting level. It assumes that population first grows, then declines by the middle of next century, that economic growth is low, and that there are severe constraints on fossil fuel supply.

IS92e produces the highest CO<sub>2</sub> emissions. It combines, among other assumptions, moderate population growth, high economic growth, high fossil fuel availability and a phase out of nuclear power.

# Overview IS-scenarios

Scenario estimates	1990	IS92 scenarios for 2100					
		IS92a	IS92b	IS92c	IS92d	IS92e	IS92f
Population (billion)	5.252	11.3	11.3	6.4	6.4	11.3	17.6
Economic growth rate (annual GNP;% p.a.)	--	2.3	2.3	1.2	2.0	3.0	2.3
CO <sub>2</sub> concentration (ppmv) <sub>(1)</sub>	354	708	685	471	542	954	820
Global mean temp. change (°C) <sub>(2)</sub>	--	2.18	2.13	1.47	1.75	2.64	2.52
Range (°C) <sub>(3)</sub>	--	1.5-3.14	1.46-3.06	1.29-2.18	1.18-2.56	1.83-3.73	1.74-3.59
Global mean sea-level rise (cm) <sub>(2)</sub>	--	51	50	40	45	57	56
Range (cm) <sub>(3)</sub>	--	20-90	20-89	14-76	16-82	24-98	23-96

# SRES Scenarios

## (IPCC 2000, 2001)

**Storyline:** a narrative description of a scenario (or a family of scenarios), highlighting the main scenario characteristics and dynamics, and the relationships between key driving forces.

**Scenario:** projections of a potential future, based on a clear logic and a quantified storyline.

**Scenario family:** one or more scenarios that have the same demographic, politico-societal, economic and technological storyline.

The SRES team defined four narrative storylines labelled **A1**, **A2**, **B1** and **B2**, describing the relationships between the forces driving greenhouse gas and aerosol emissions and their evolution during the 21<sup>st</sup> century for large world regions and globally . Each storyline represents different demographic, social, economic, technological, and environmental developments that diverge in increasingly irreversible ways.

# Storylines

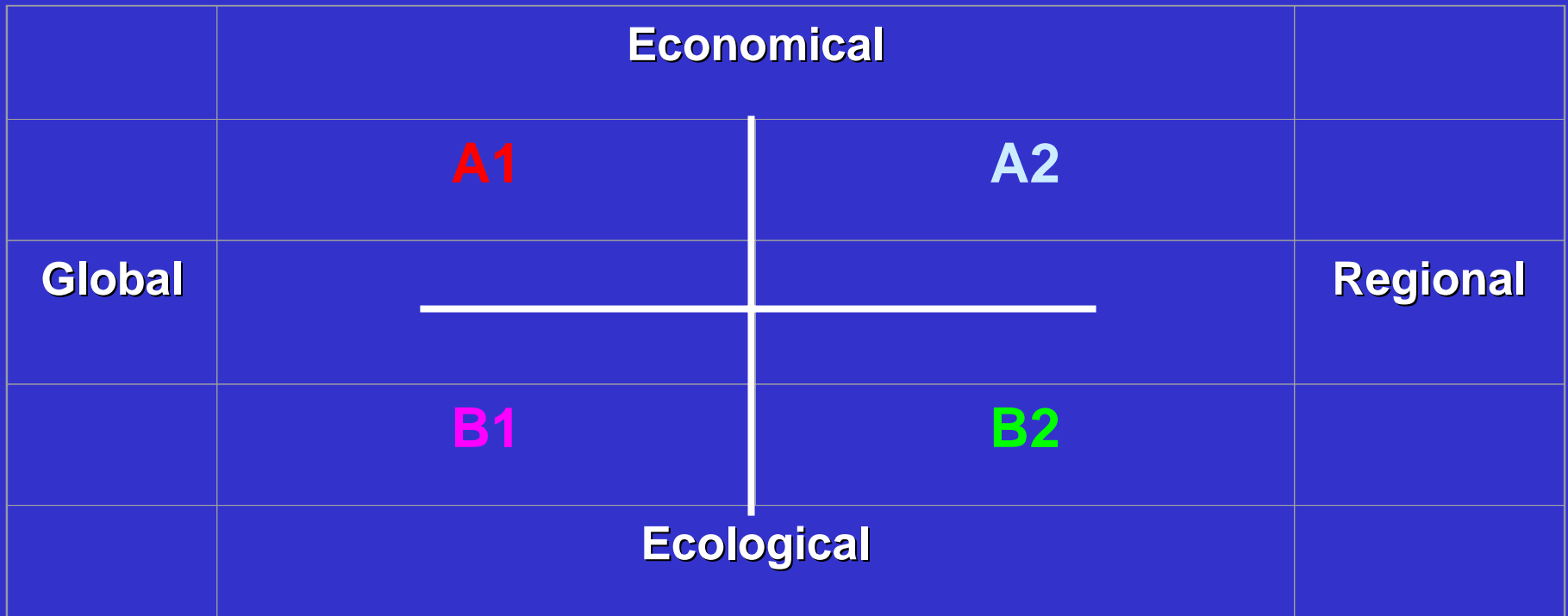
**A1:** rapid economic growth and successful economic development in which regional average income per capita converge and current distinctions between "poor" and "rich" countries could be dissolved; global population peaks in mid-century, declines thereafter; rapid introduction of new technologies

**A2:** represents heterogeneous world with continuously increasing global population and regionally oriented economic growth, more fragmented and slower than in other storylines. It "consolidates" into a series of economic regions. Less emphasis is directed on economic, social, and cultural interactions between regions. Economic growth is uneven and the income gap between now-industrialized and developing parts of the world does not narrow.

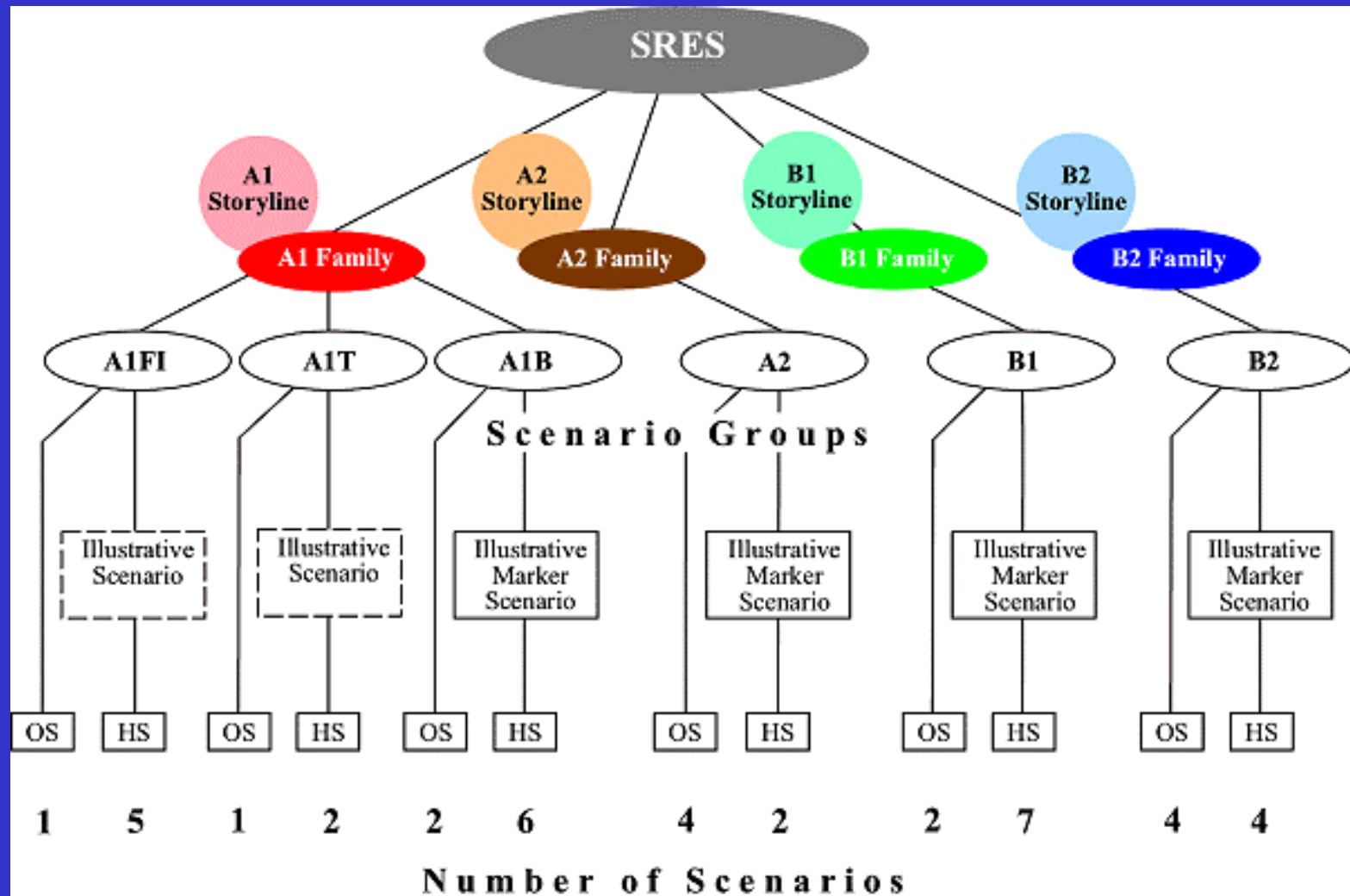
**B1:** same global population as in A1, but with rapid changes in economic structures toward a service and information economy, reductions in material intensity, and the introduction of clean and efficient technologies, coherent approach to a more sustainable development.

**B2:** emphasis on local solutions to economic, social, and environmental sustainability, with continuously increasing population (lower than A2) and intermediate economic development. International institutions decline in importance, with a shift toward local and regional decision-making structures and institutions. Human welfare, equality, and environmental protection all have high priority

# Relationships „SRES Stories“



# SRES Scenario Family



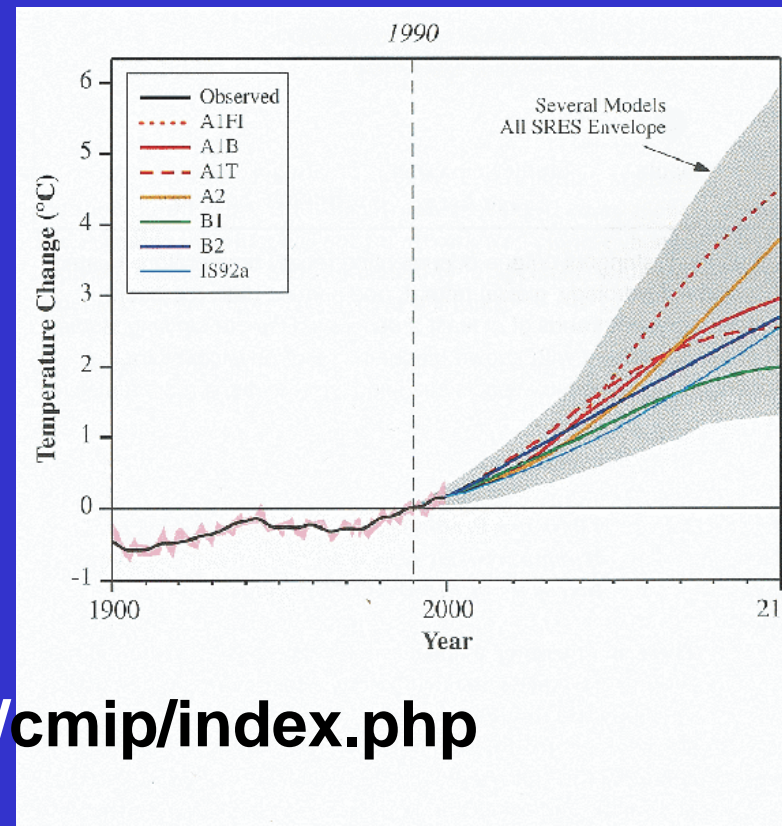
# Use in Climate Modelling

1. Translate storylines, e.g. A1, A1FI, A1T into emission trajectories
2. Use this as forcing for the variety of AOGCM  
→ allows to make model results comparable!

Overall model results come to the same conclusion!

CMIP:

<http://www-pcmdi.llnl.gov/projects/cmip/index.php>



# Regional Impact Assessment

Needs downscaling, since AOGCM resolution is too coarse!

*Statistical downscaling:* fast, but assumes that transfer function will be constant in the future

*Nested downscaling:* computationally demanding, large variance

Limits in the „truth (prognostic limit)“ of regional model simulations!

**Model outputs commonly have to be manipulated and combined with observed climate data to be usable, for example, as inputs to impact models (IPCC, TAR, WGI, p 743, Ch. 13)**

# Summary

**We can use existing regional scenarios, since new ones will not provide more certainty or other insights than the existing ones!**

**Resolutions below a grid size of 0.1...0.5° does not make sense!**

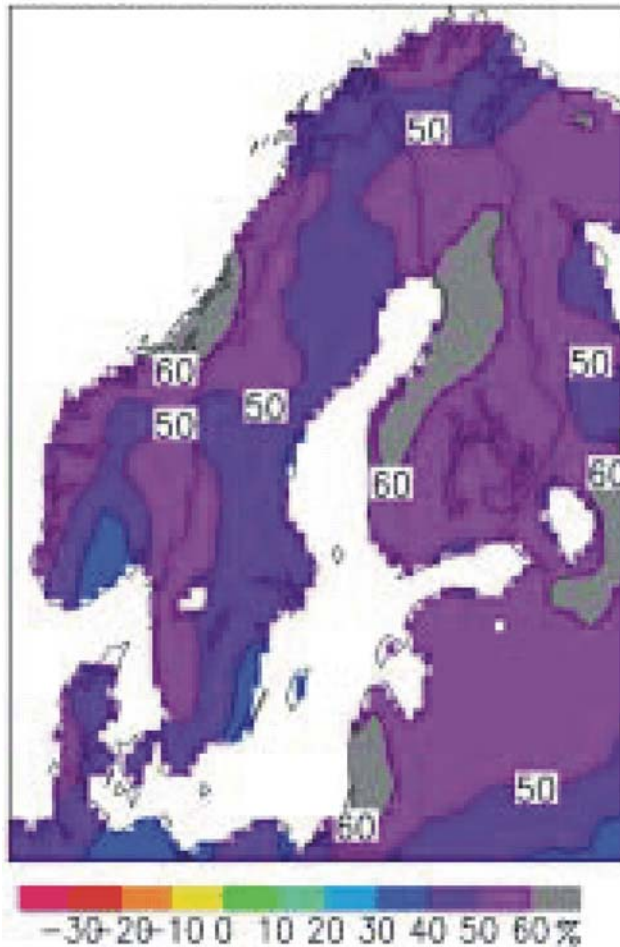
**Uncertainty in the scenarios is inherent and unresolvable (*model uncertainty and Uncertainty in the assumptions*)!**

**With respect to spatial planning/regional adaptation to climate change policy must understand that absolute validity is impossible!**

**We have to deal with this type of knowledge: *More than Nothing!***

# Winter precipitation change (A2)

DJF: ECHAM



HadCM

