Climate change scenarios in Europe and their potential effects on crops and pests

Part I: Climate scenarios in Europe

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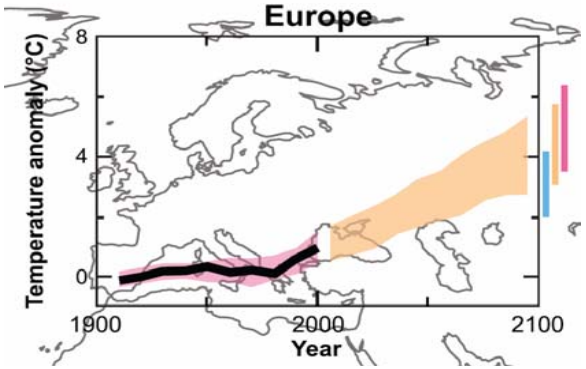
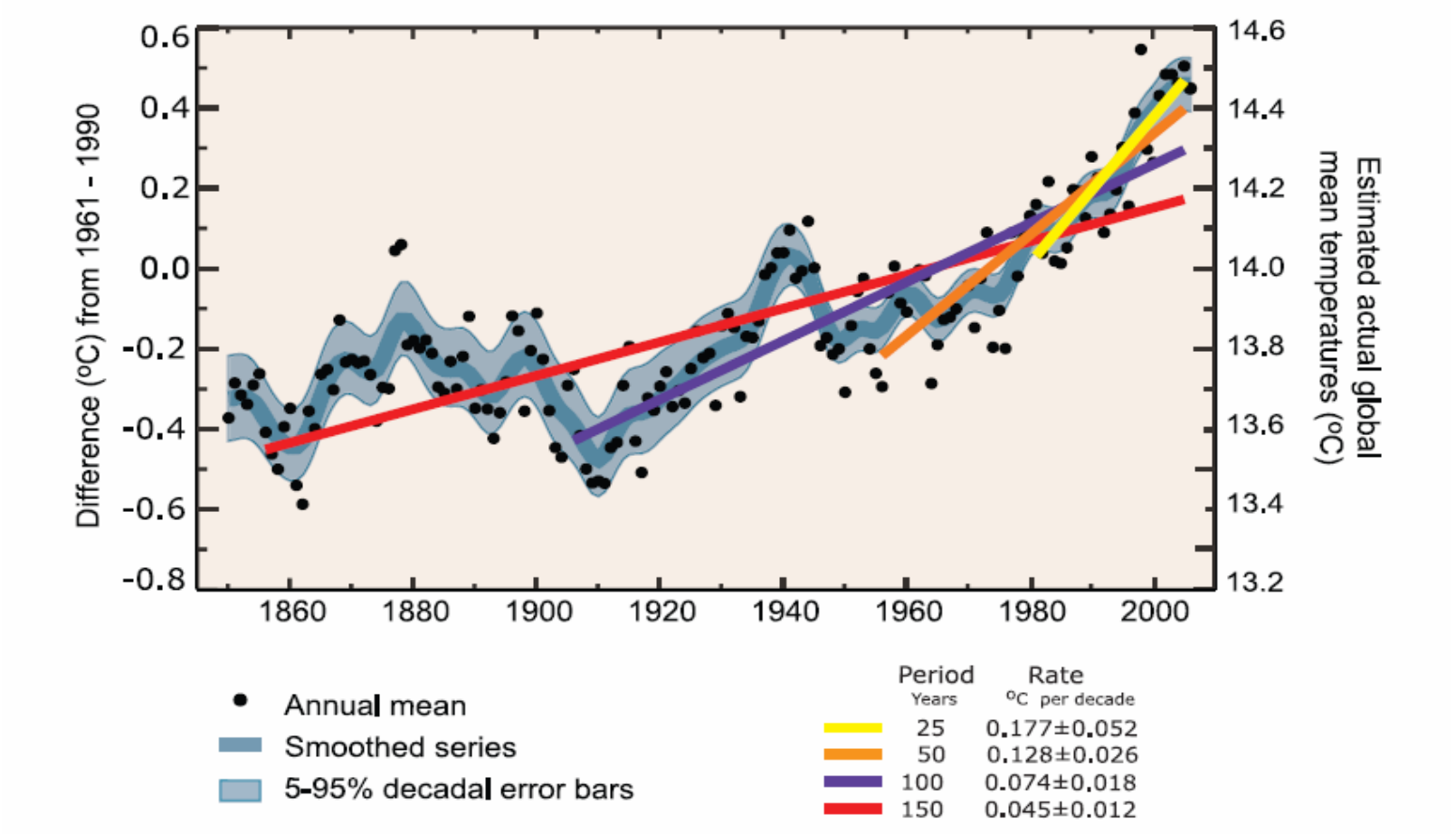


Is climate changing?

Is climate changing?

Observations of climate change

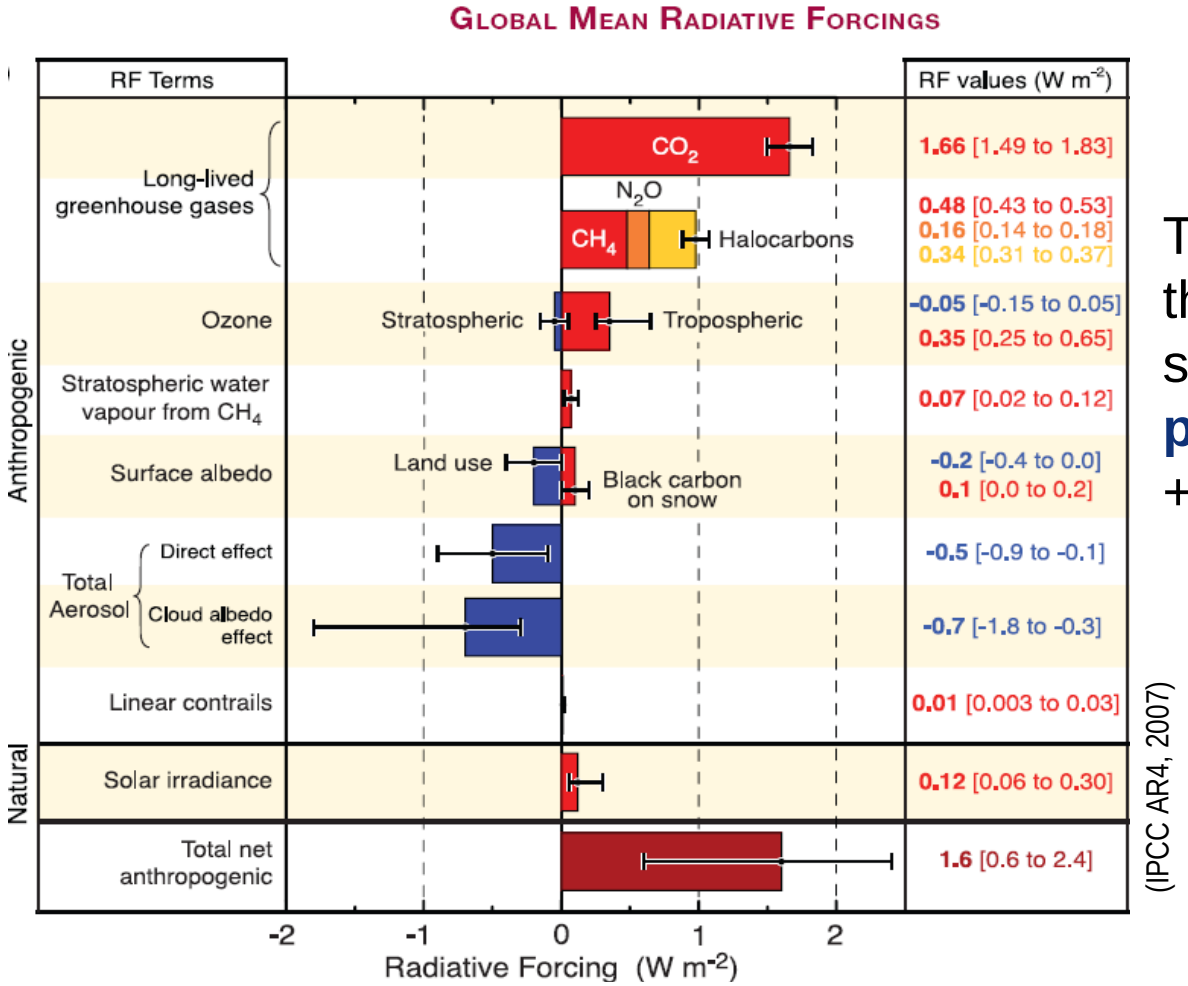


(IPCC AR4, 2007)

Why is climate changing?

Why is climate changing?

Changes in natural and human drivers of climate:



(IPCC AR4, 2007)

There is *a **very high confidence*** that the effect of human activities since 1750 has been a **net positive forcing** of +1.6 [+0.6 to +2.4] W m–2.

Can we ‘predict’ the change in the climate?

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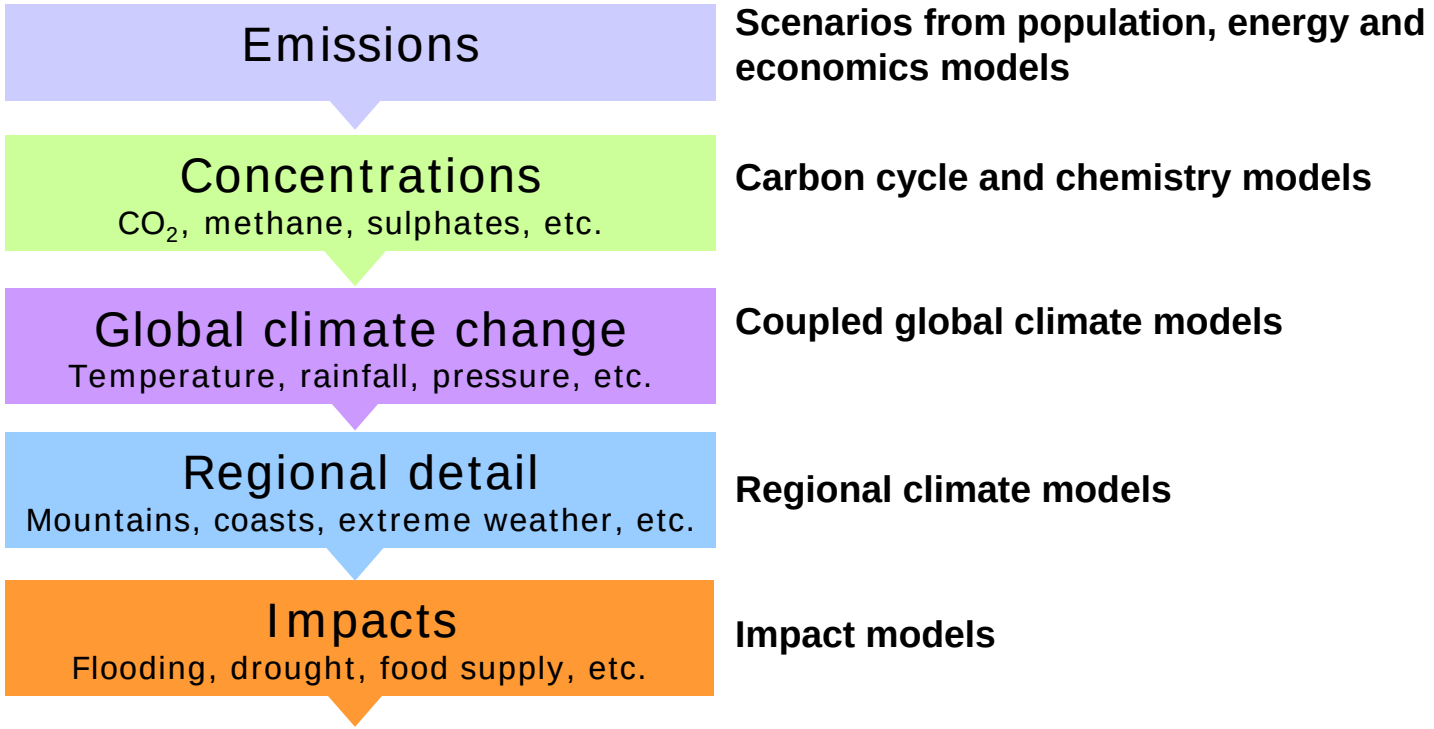
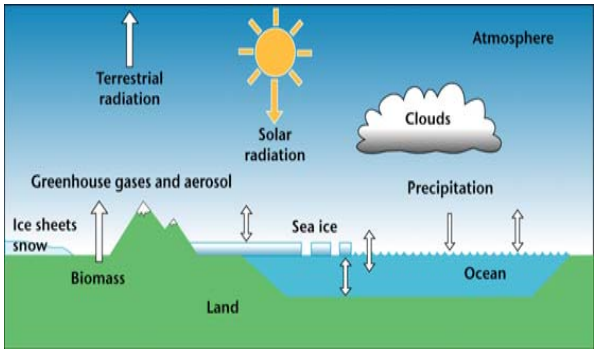
Predictions of climate changes: the ‘uncertainty cascade’



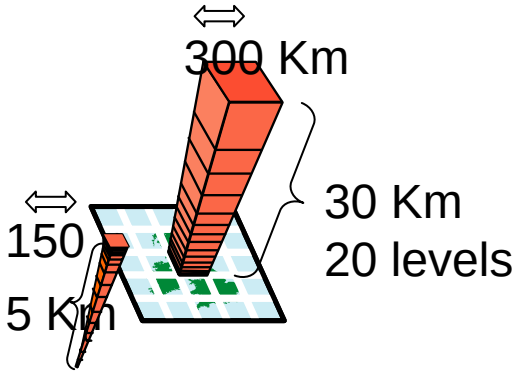
Can we 'predict' the change in the climate?

Climate system

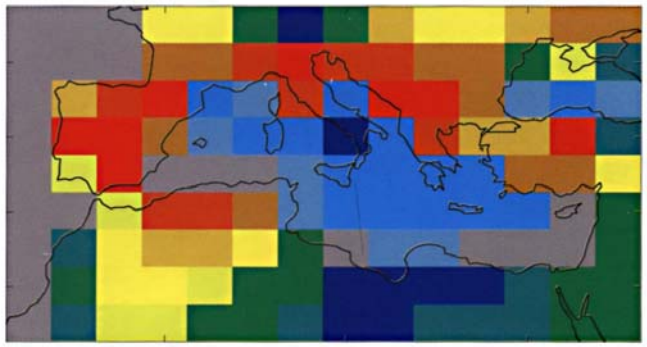


Numerical model

AOGCM

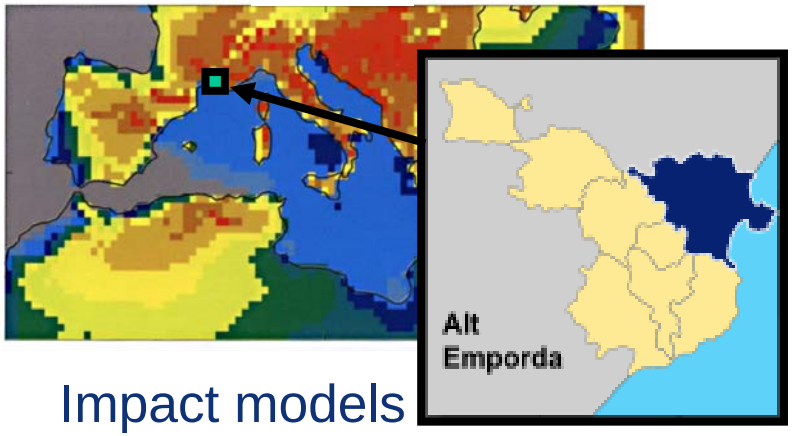


AOGCM



Downscaling

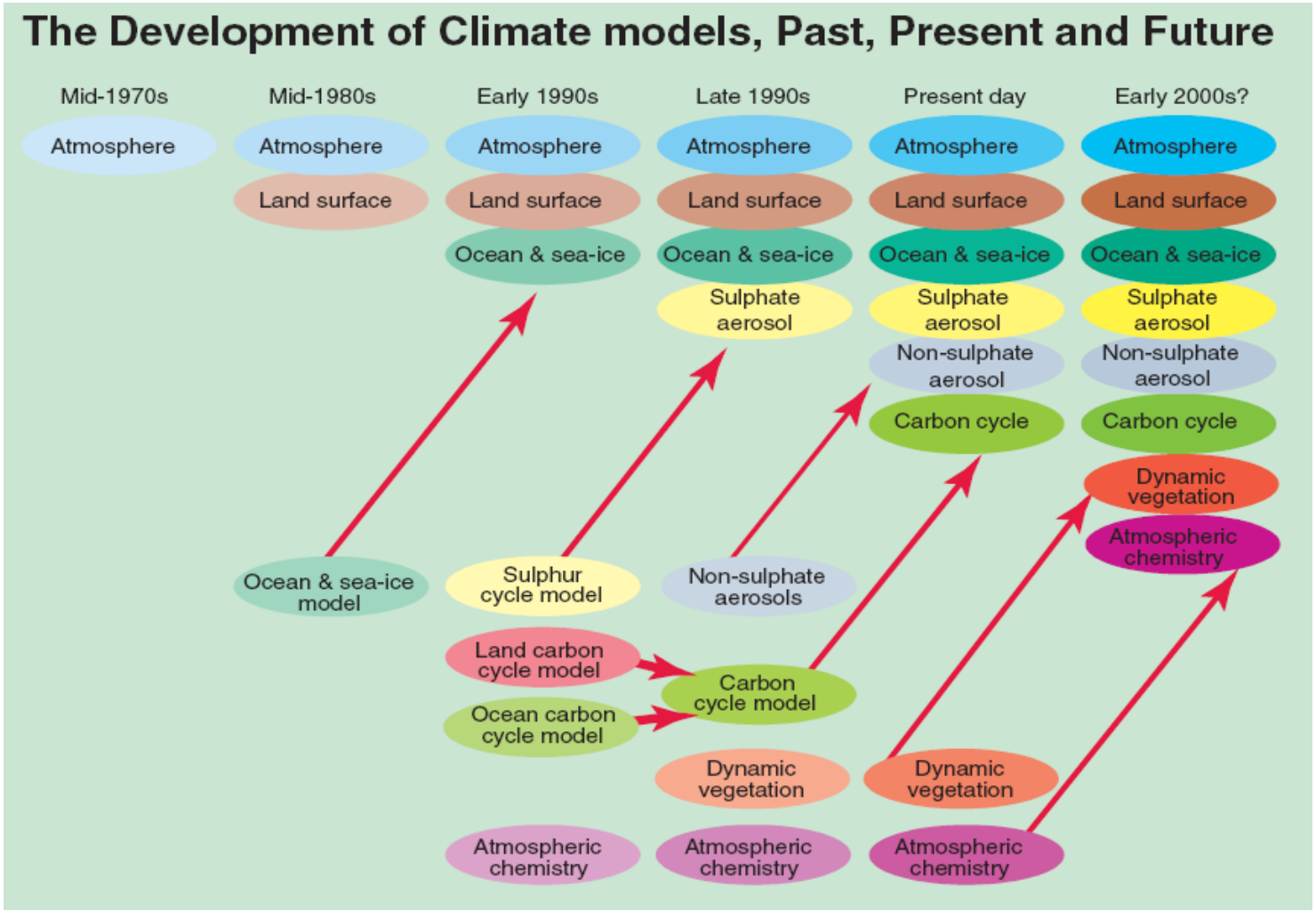
RCM



Impact models

(Redrawn from UK Hadley Centre originals)

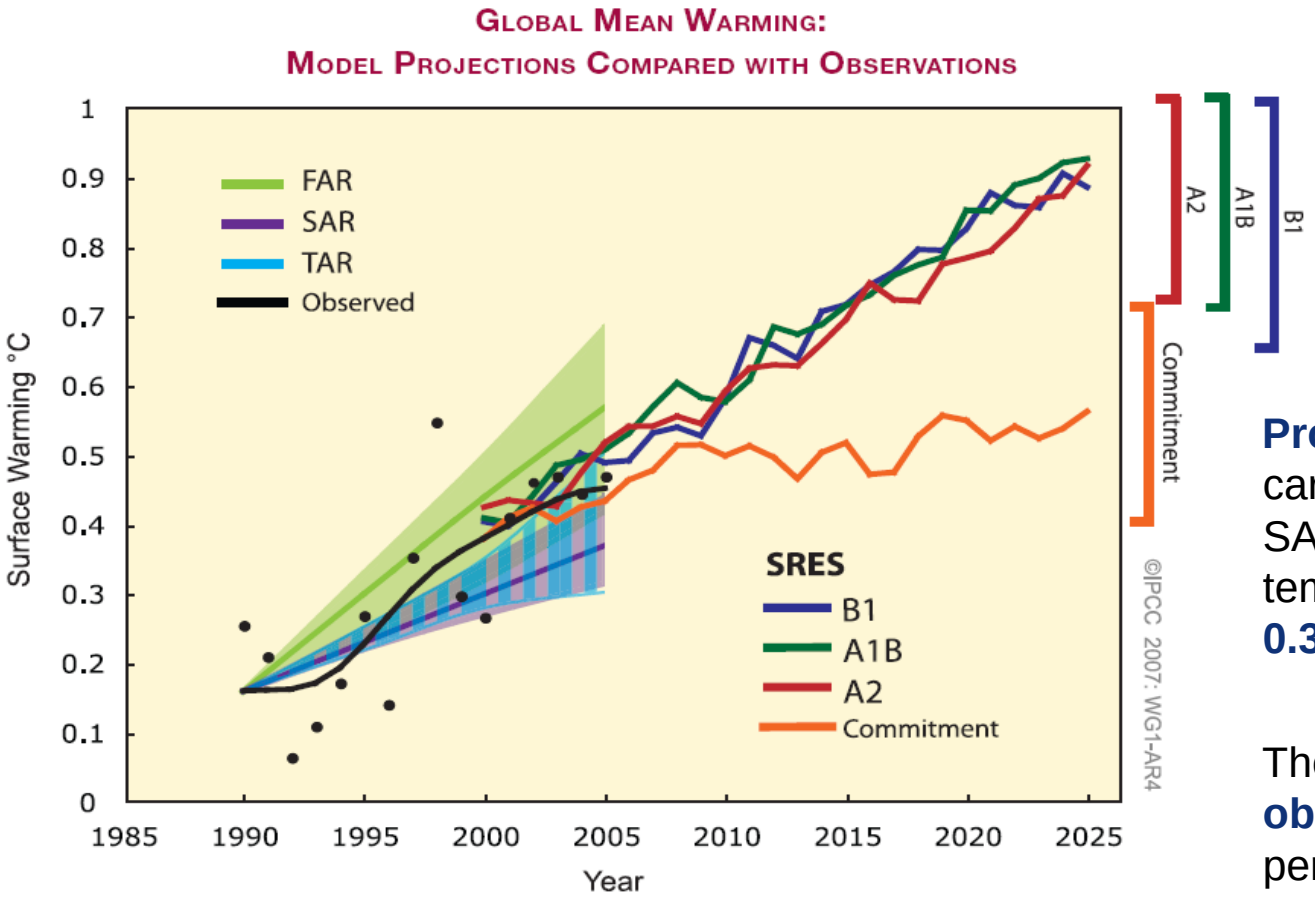
Development of climate models



(IPCC AR3, 2001)

Do models work?

Do models work?



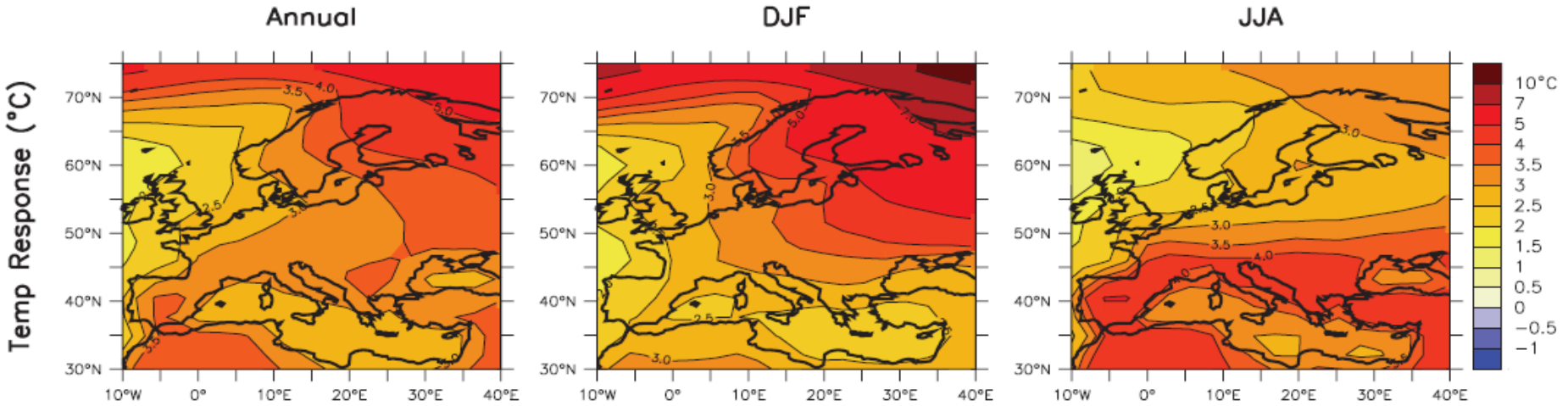
Projections for 1990 to 2005 carried out for the FAR and the SAR suggested global mean temperature increases of about **0.3°C** and **0.15°C** per decade,

These results are comparable to **observed values of about 0.2°C** per decade.

Projection of future climate: Europe and Mediterranean

Changes in Temperature

Changes in temperature



Future (2080-2099) - present (1980-1999)

A1B scenario

Region[a]	Season	Temperature Response (°C) Min	25	50	75	Max	T yrs
NEU	DJF	2.6	3.6	4.3	5.5	8.2	40
	MAM	2.1	2.4	3.1	4.3	5.3	35
48N,10W	JJA	1.4	1.9	2.7	3.3	5.0	25
to	SON	1.9	2.6	2.9	4.2	5.4	30
75N,40E	Annual	2.3	2.7	3.2	4.5	5.3	25
SEM	DJF	1.7	2.5	2.6	3.3	4.6	25
	MAM	2.0	3.0	3.2	3.5	4.5	20
30N,10W	JJA	2.7	3.7	4.1	5.0	6.5	15
to	SON	2.3	2.8	3.3	4.0	5.2	15
48N,40E	Annual	2.2	3.0	3.5	4.0	5.1	15

(IPCC AR4, 2007)

Projection of future climate: Europe and Mediterranean

Changes in Temperature

Annual mean temperatures in Europe are *likely* to increase more than the global mean.

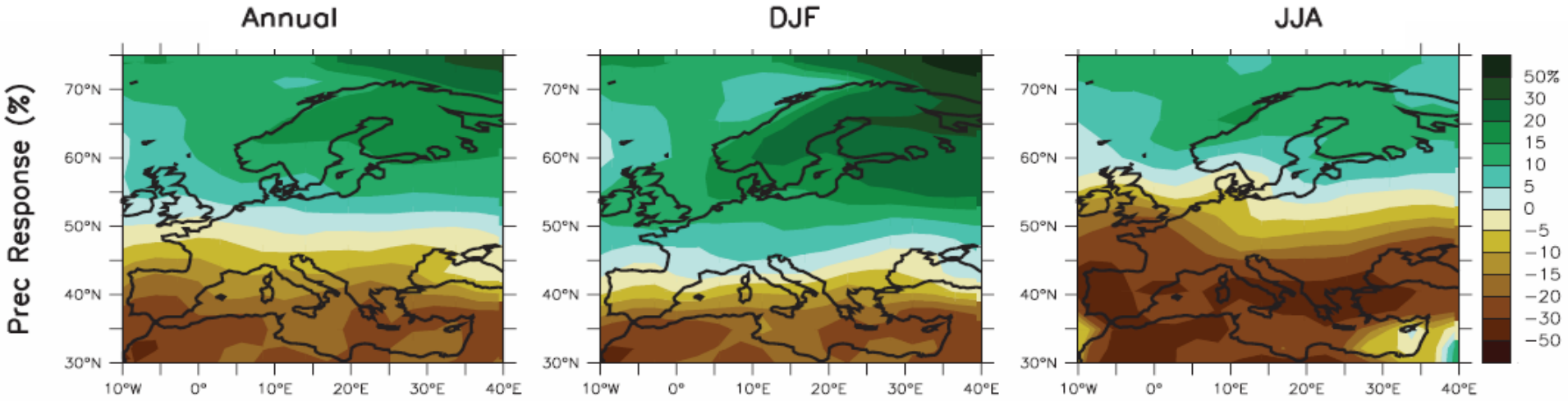
Seasonally, the largest warming is *likely* to be in **northern Europe in winter** and in the **Mediterranean area in summer**.

Minimum winter temperatures are *likely* to increase more than the average in **northern Europe.**

Maximum summer temperatures are *likely* to increase more than the average in **southern and central Europe**.

Changes in Precipitation

Changes in precipitation



Future (2080-2099) - present (1980-1999)

A1B scenario

Region[a]	Season	Precipitation Response (%) Min	25	50	75	Max	T yrs
NEU	DJF	9	13	15	22	25	50
	MAM	0	8	12	15	21	60
48N,10W	JJA	-21	-5	2	7	16	
to	SON	-5	4	8	11	13	80
75N,40E	Annual	0	6	9	11	16	45
SEM	DJF	-16	-10	-6	-1	6	>100
	MAM	-24	-17	-16	-8	-2	60
30N,10W	JJA	-53	-35	-24	-14	-3	55
to	SON	-29	-15	-12	-9	-2	90
48N,40E	Annual	-27	-16	-12	-9	-4	45

(IPCC AR4, 2007)

Projection of future climate: Europe and Mediterranean

Changes in precipitation

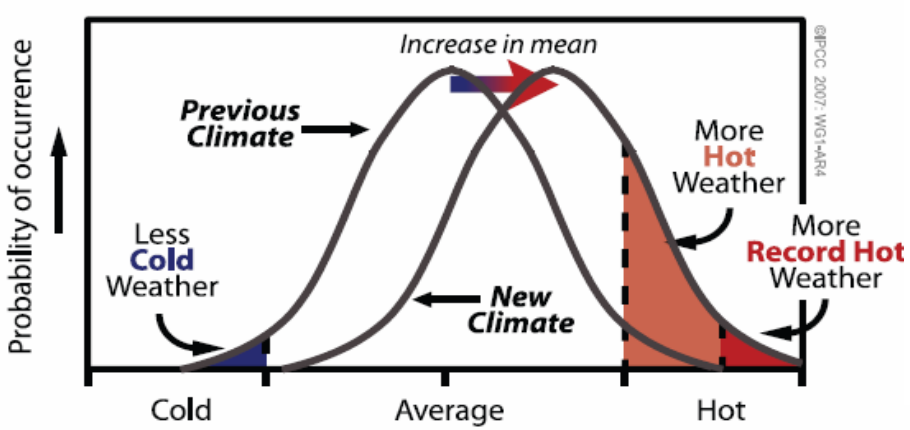
Annual precipitation is *very likely* to **increase** in most of **northern Europe** and **decrease in most of the Mediterranean area**.

In **central Europe**, precipitation is *likely* to increase in winter but decrease in summer.

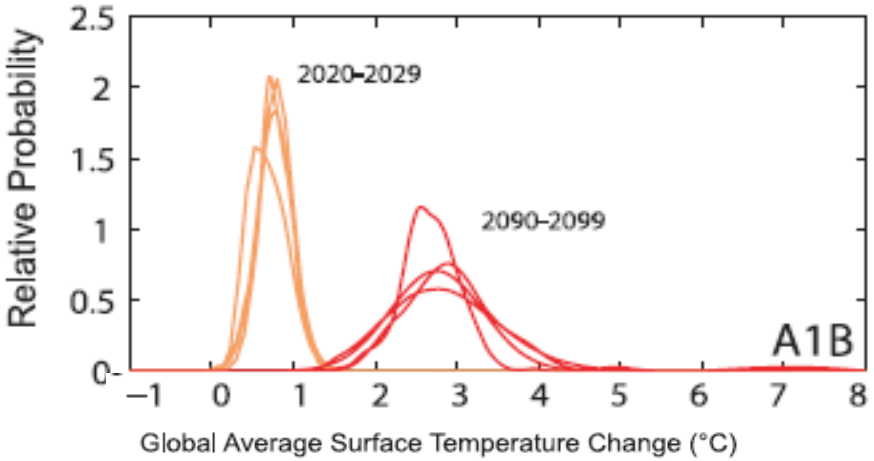
Changes in Extreme Events

Extreme events

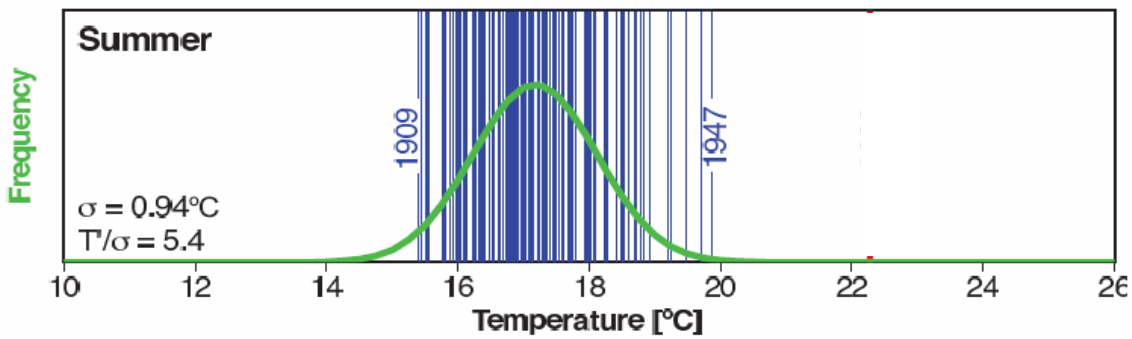
Theory



Model prediction



Observations



(Schär et al., 2004)

(IPCC AR4, 2007)

Projection of future climate: Europe and Mediterranean

Extreme events

Extremes of daily **precipitation** are *very likely* to **increase in northern Europe**.

The annual number of precipitation days is *very likely* to **decrease** in the **Mediterranean area**.

Risk of **summer drought** is *likely* to **increase in central Europe** and in the **Mediterranean** area.

Ongoing work

Ongoing work: ENSEMBLES

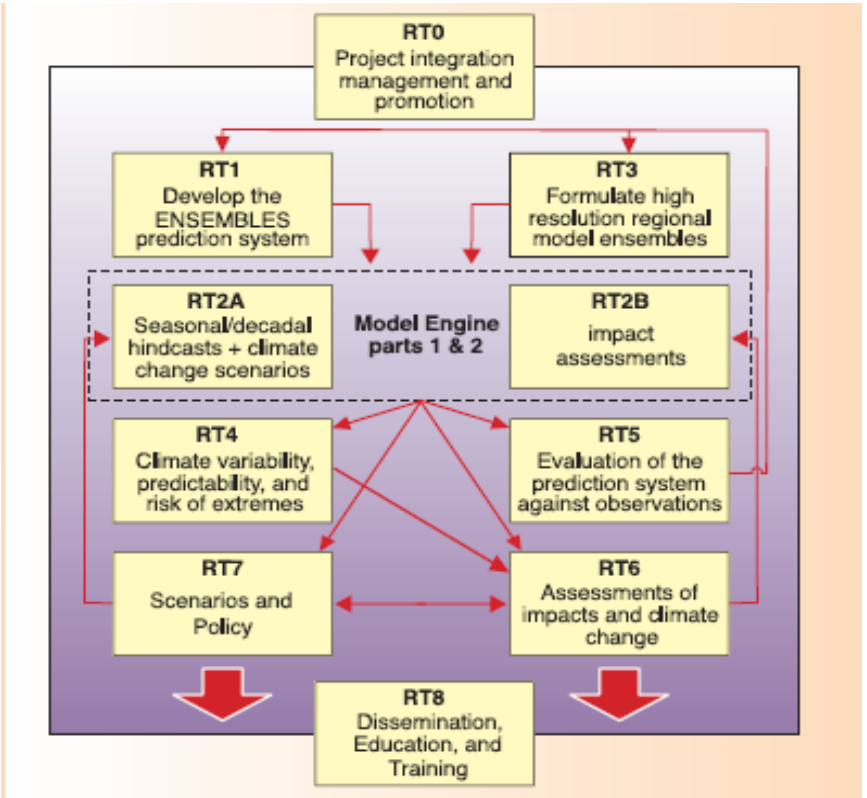
ENSEMBLE based predictions of climate changes and their impacts

5 year (2004-2009) FP6 project

15Meuro

77 partners + 19 affiliated

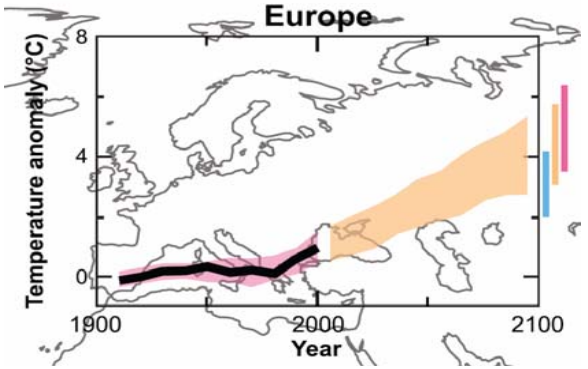
8 research themes



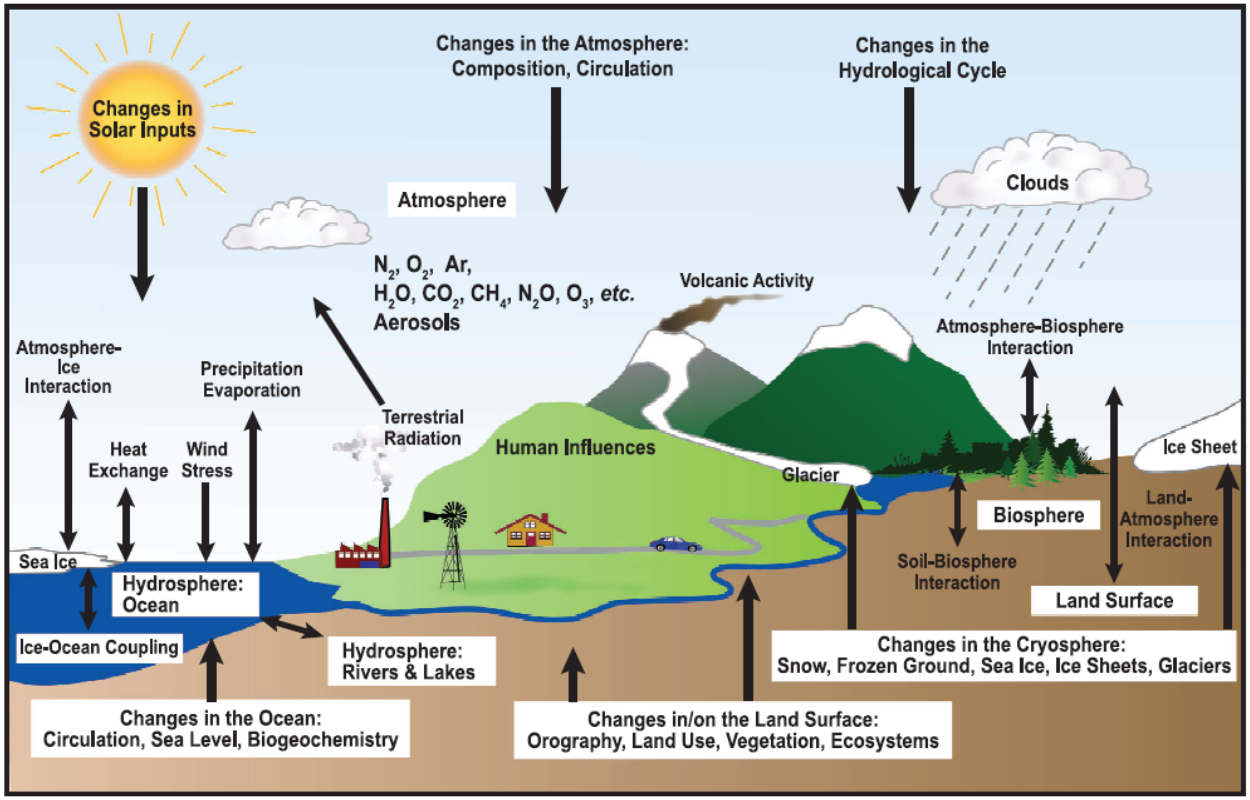
http://www.ensembles-eu.org/

Conclusions

- Climate is changing and will continue to change
- Europe will be affected by the changing climate
- Expected changes in temperature (Max and Min), precipitation and extreme events
- Our understanding of the climate system and its prediction (better models, new physics, higher resolution, probabilistic approach) is improving



The climate system



The complexity of the climate system and the multiple interactions that determine its behavior impose limitations on our ability to understand fully the future course of Earth's global climate. There is still an incomplete physical understanding of many components of the climate system and their role in climate change. (IPCC 4AR, 2007)

The Emission Scenarios of the IPCC Special Report on Emission Scenarios (SRES)[17]

A1. The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil-intensive (A1FI), non-fossil energy sources (A1T) or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

A2. The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

B1. The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

An illustrative scenario was chosen for each of the six scenario groups A1B, A1FI, A1T, A2, B1 and B2. All should be considered equally sound.

The SRES scenarios do not include additional climate initiatives, which means that no scenarios are included that explicitly assume implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol.