Assessment of Climate Change for the Baltic Sea Basin - The BACC Project - 22-23 May 2006, Göteborg, Sweden

Projections of Future Climate Change

1) Background: Global Climate Change

Drivers of Climate Change

- Changes in global climate can occur both as a result of natural variability and as a response to anthropogenic effects. The most important anthropogenic effect is change in atmospheric composition. Increases in CO_2 and other greenhouse gases (GHG) make the atmosphere less transparent for thermal radiation and therefore tend to warm up the surface and troposphere. Climate models are needed to estimate the magnitude of the temperature response as several feedback processes act in the climate system.

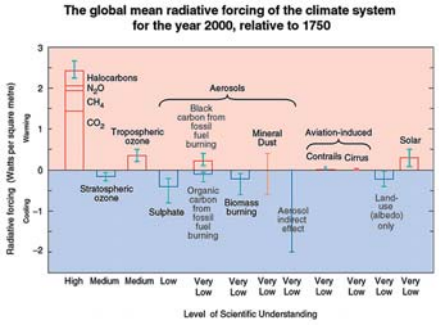

Fig. 1: Estimates of globally averaged radiative forcing resulting from various changes in external conditions from the year 1750 to the year 2000. For each forcing agent, the bar shows the best estimate of the forcing and the vertical line the uncertainty range based mainly on the variation from published studies. (From Houghton et al. 2001.)

Future Scenarios

- Projecting anthropogenic climate change requires estimates of future GHG and aerosol concentrations. Such estimates depend on many diverse factors. As precise prediction is impossible, different emissions scenarios are used. These are based on plausible and internally consistent sets of assumptions about demographic, socioeconomic and technological changes that together determine the evolution of future emissions.

SRES Emissions

- A comprehensive set of emissions scenarios was developed around four narrative storylines. They describe the potential evolution of the world in the 21st century. Of 35 different emissions scenarios, six were chosen by IPCC[1] as illustrative marker scenarios – A1B, A1T, A1FI, A2, B1 and B2.

Global Warming in the 21st Century

- IPCC (2001) estimated the annual global average warming from 1990 to 2100 to range from 1.4 to 5.8°C. This takes into account differences in both climate models and anthropogenic emissions scenarios. It excludes, however, other uncertainties (e.g. in the carbon cycle) and should not be interpreted as providing absolute lowest and highest possible global change for the period.

SRES[2] Storylines

Fig. 3: SRES Scenarios and Climate Models

A1FI, A1T and A1B scenarios

The A1 storyline describes a world of **very rapid economic growth** and **efficient international co-operation**. Technological **development is rapid and new innovations** are distributed to developing countries faster than today. Increasing economic well-being leads to **decreasing fertility in the developing world**, and the global population peaks at about **8.7 billion in the year 2050 and declines thereafter**. The A1FI, A1T and A1B illustrative scenarios describe alternative directions of technological change in the energy sector, and are therefore quite different in terms of GHG emissions. In **A1FI, energy production remains highly dependent on fossil fuels** throughout the century, whereas **A1T represents a rapid migration toward non-fossil energy sources**. **A1B represents an intermediate case** between these two types of development.

A2 Scenario

In the A2 storyline, the world is characterized by **economic blocks** that are more inclined to defending their own special interests than to co-operating with each other. As a result, **economic growth is slower** than in A1, particularly in the developing world. The distribution of new environmentally efficient technologies to the developing world is also slower. The **global population increases continuously, reaching 15 billion in the year 2100**. Although the per capita economic growth is relatively slow, the increasing population and slow introduction of non-fossil energy sources lead to a **large increase in GHG emissions**.

B1 Scenario

The B1 storyline is characterized by **efficient international co-operation and rapid distribution of new technologies**, and by the same evolution of global population as for A1. However, technological development is driven more strongly by **environmental values and social equity** than in the A1 and A2 storylines. Economic growth is slightly slower, and the gap between the developing and the industrialized world decreases more slowly than in A1, but the **introduction of clean and resource-efficient technologies** is faster. Furthermore, there is a rapid change in economic structures toward a service and information society. As a result of these changes, **GHG emissions are reduced below the present-day level by the end of the 21st century**.

B2 Scenario

The B2 storyline shares features from both A2 and B1. International **co-operation is less efficient** and the distribution of new technologies is slower than in A1 and B1. The global population increases continuously but less rapidly than in A2, reaching **10.4 billion by the year 2100**. Like B1, the B2 scenario is also oriented towards **environmental protection and social equity**, but the development of **environmentally friendly technologies proceeds more slowly** than in B1. As a result, **GHG emissions continue to grow** throughout the 21st century, although at a substantially **slower rate** than in the A2 and A1FI scenarios.

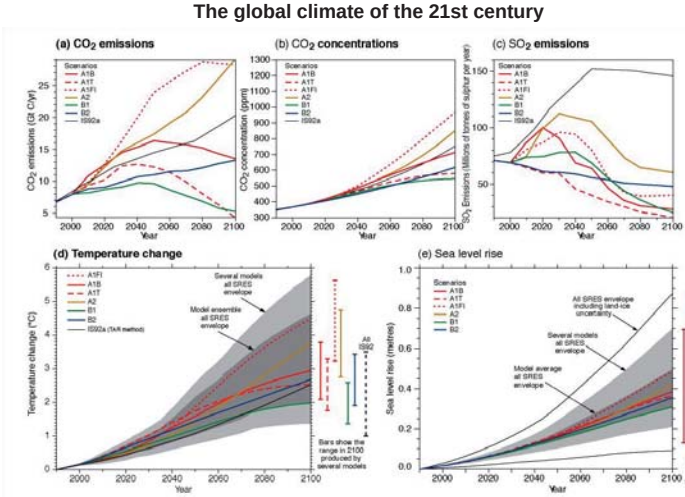

Fig. 2: Summary of some key factors related to global anthropogenic climate change in the 21st century, as presented in the IPCC 3rd Assessment Report (Houghton et al. 2001). (a) shows the CO_2 emissions of the 6 illustrative SRES scenarios along with an older scenario (IS92a) used in the IPCC 2nd Assessment Report. (b) shows projected CO_2 concentrations. (c) shows anthropogenic SO_2 emissions. (Note that the older IS92a scenario, with very large SO_2 emissions in the late 21st century, is now believed to be unrealistic.) (d) and (e) show the projected global mean temperature and sea level responses, respectively. "Several models all SRES envelope" in (d) and (e) shows the temperature and sea level rise, respectively, for a simple climate model forced with all 35 SRES scenarios and tuned separately to mimic the behaviour of 7 complex climate models. "Model average all SRES envelope" shows the average from these models for the range of scenarios.

[1] IPCC = Intergovernmental Panel on Climate Change [2] SRES = Special Report on Emission Scenarios (IPCC; Nakićenović et al. 2000)

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