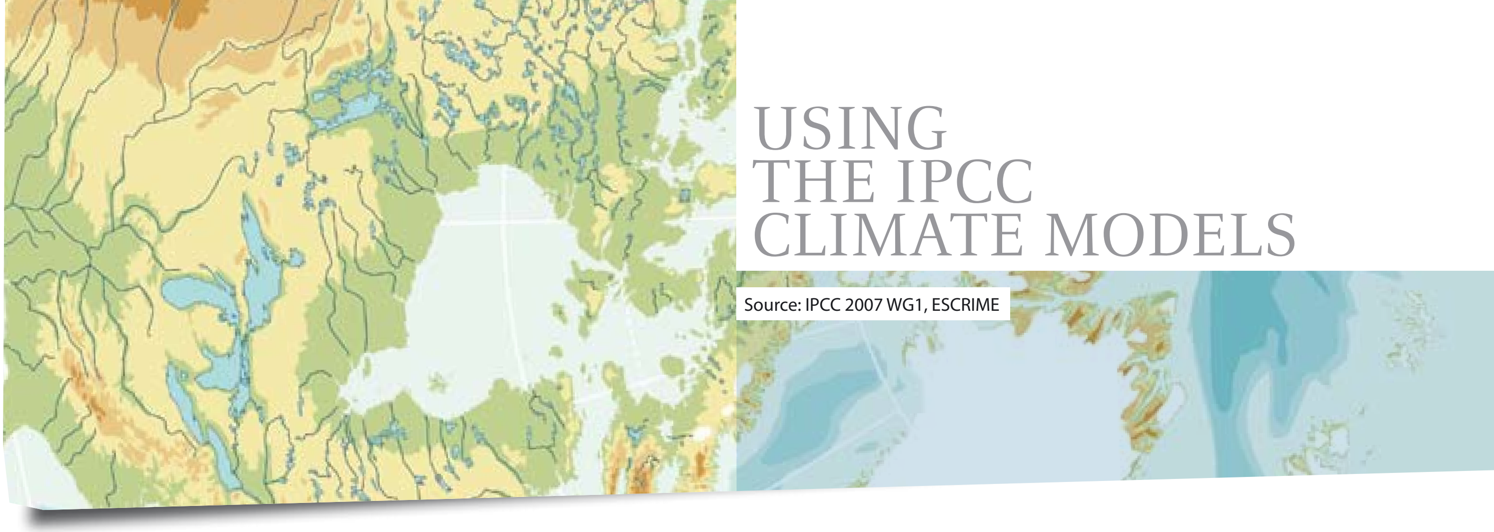
USING THE IPCC CLIMATE MODELS



Source: IPCC 2007 WG1, ESCRIME

1 The hierarchy of models

In the new IPCC (Intergovernmental Panel on Climate Change) AR4 report on Climate Change, published in 2007, several types of models are used to study how the climate changes under the impact of human activity. These different models and their complementarity are illustrated in DIAGRAM 1.

The IPCC report refers to 23 climate models, whose results for climate projections are archived by the "Program for Climate Model Diagnosis and Intercomparison, PCMDI". The results of the two French models (Institut Pierre Simon Laplace, IPSL and Centre National de Recherches Météorologiques, CNRM of Météo-France) are part of this group. These models are known as OAGCMs for "Ocean-Atmosphere General Circulation Models", as they include a three-dimensional representation of the ocean and atmosphere making it possible to determine temperatures, humidity, salinity, and wind and ocean currents. Another category of models uses output from global model simulations to provide initial and lateral boundary conditions (temperature, humidity, wind, pressure, for example), and then obtains more precision through regional models. These models are called "Regional Climate Models (RCM)". Both categories of models are important for studying and determining the current and future climate. In short, these climate models are appropriate for representing large-scale climate processes while the regional models are capable of representing smaller scale processes.

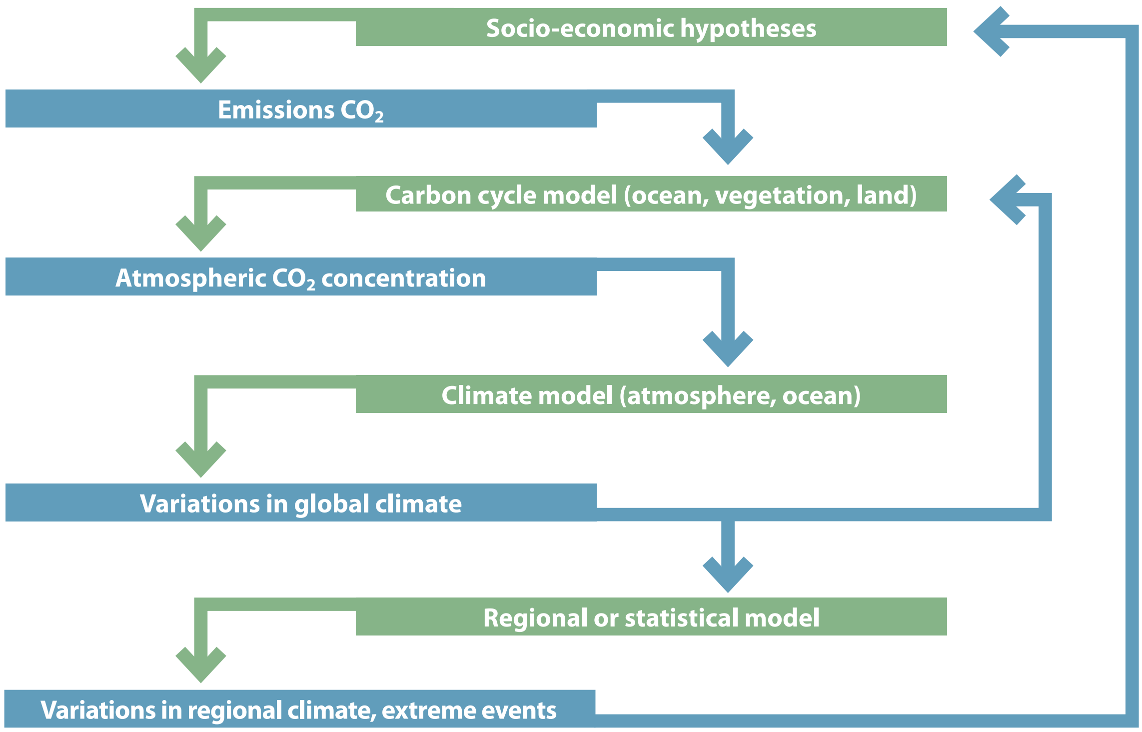
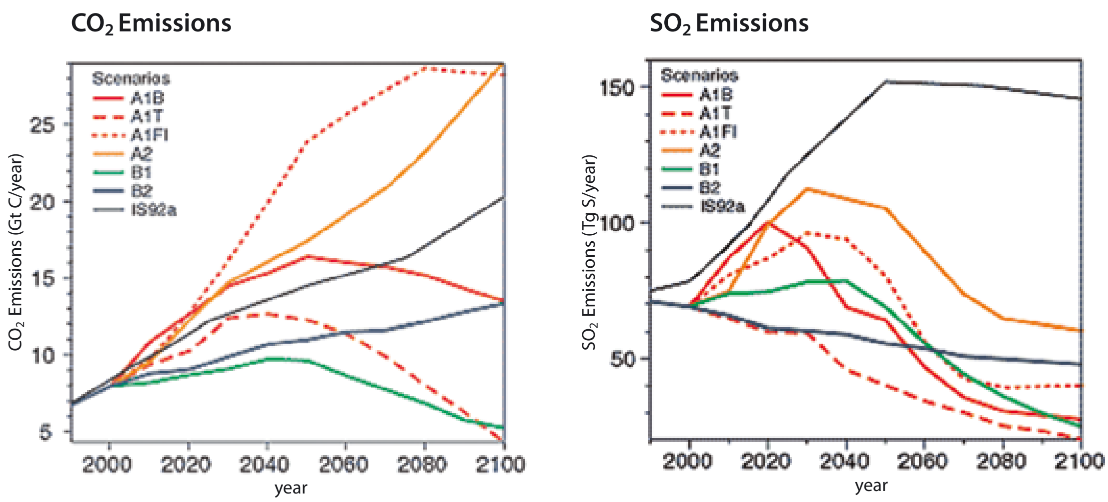


DIAGRAM 1 The different stages of future climate change according to the AR4 report. JEAN-LOUIS DUFRESNE (ESCRIME)

2 Model forcing

To produce climate projections, the atmospheric concentration of greenhouse gases is modified during the simulation according to different scenarios drawn up by economists. This modification of the atmospheric composition disturbs the planet's radiation balance. This is why such a disturbance is called a radiative forcing. For the AR4, the SRES scenarios (Special Report on Emissions Scenarios) for the three main future scenarios (A2, A1B and B1) have been used. Greenhouse gases (CO_2, CH_4, N_2O, O_3, CFCs) and sulphates (SO_4) are responsible for the radiation disturbance in the scenarios (see FIGURE 1). The radiative forcing is said to be positive when it tends to increase temperatures and negative when it reduces them. These scenarios were supplemented by a simulation in which greenhouse gases were maintained at their 2000 concentration (the COMMIT scenario).



MODIFIED AND BASED ON CONTRIBUTION OF WORKING GROUP I TO THE THIRD ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS. SUMMARY FOR POLICYMAKERS. FIGURE 5. CAMBRIDGE UNIVERSITY PRESS.

FIGURE 1 (a) Shows the CO_2 emissions of the six illustrative SRES scenarios. (b) Shows anthropogenic SO_2 emissions. Emissions of other gases and other aerosols were included in the model but are not shown in the figure.

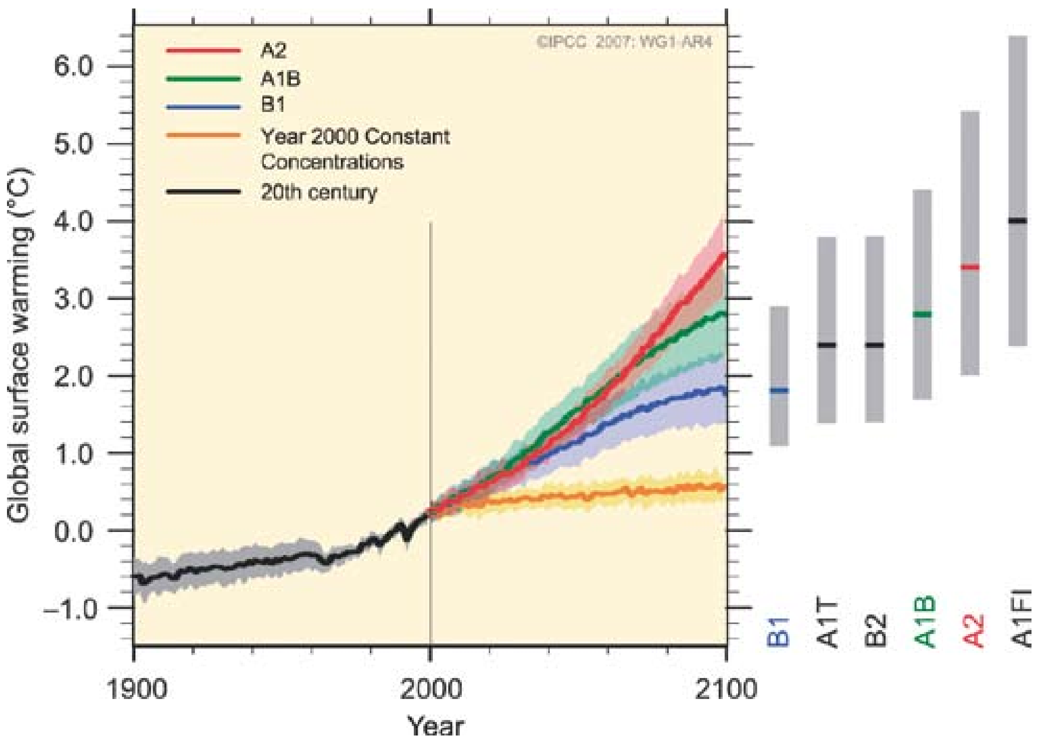
3 Changes in mean global temperature

The radiation disturbance caused by changes to the atmospheric components is responsible for a mean surface temperature increase over this century (up to 2100) (see FIGURE 2).

In 2050, the mean global temperature increase is estimated at between 0.3 and 0.6°C for the simulation under which atmospheric composition is held at the 2000 level during the 21st century (COMMIT scenario), whereas the SRES projections estimate a higher temperature increase: between 0.8 and 1.4°C for SRES B1, between 1.2 and 1.7°C for SRES A2, and between 1.2 and 1.9°C for SRES A1B.

Between the periods 2090-2099 and 1980-1999, the mean global temperature increase under COMMIT is between 0.3 and 0.9°C (likely range[1]), with 0.6°C being the last estimate. The temperature projection for SRES A2 is higher than that for SRES A1B. More specifically, the increase of the mean global temperature values for 2100 range between 1.1 and 2.9°C (1.8°C on average) for SRES B1, between 1.7 and 4.4°C (2.8°C) for SRES A1B and between 2.0 and 5.4°C (3.4°C) for SRES A2.

1. See section 2 of the « technical sheet » for further information



MODIFIED AND BASED ON WORKING GROUP I CONTRIBUTION TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS. FIGURE SPM.5. CAMBRIDGE UNIVERSITY PRESS.

FIGURE 2 Solid lines are multi-model global averages of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The grey bars at right indicate the best estimate (solid line within each bar) and the likely range assessed for the six SRES marker scenarios. The assessment of the best estimate and likely ranges in the grey bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints.

4 Abbreviations

CNRM	Centre National de Recherches Météorologiques
ECMWF	European Center for Medium-range Weather Forecasting
ESCRIME	Etude des Scénarios Climatique Réalisés par l'IPSL et Météo-France (Climate Scenarios Study by IPSL and Météo-France). A project aiming to compile the analyses of the many different climate simulations performed for the IPCC AR4, 2007, and more specifically those developed by the French community's models.
IPCC	Intergovernmental Panel on Climate Change
IPSL	Institut Pierre Simon Laplace
NCEP	National Centers for Environmental Prediction
NCAR	National Center for Atmospheric Research
OAGCM	Ocean-Atmosphere General Circulation Models
SRES	Special Reports on Emissions Scenarios
NCAR	National Center for Atmospheric Research