

## Future scenarios

### Future IPCC scenarios

In the past 20 years scientists have researched calculation models which try to foresee climate variations. These models are known as GCM (General Circulation Models). Some IPCC studies have been able to foresee four possible future scenarios (A1, A2, B1, B2), by taking into consideration population growth, economic development, available resources (meaning primary energy sources) and technology. These hypothetical evolutions are called “scenario families”.

A1: this scenario family foresees a rapid economic growth, the population will continue to increase until 2050 to begin decreasing after that and there will be a rapid introduction of new more efficient technologies. This family develops three groups that describe alternative directions for technological development in the energetic system: A1FI a future with fossil fuels, A1T non fossil resources, A1B a balance between fossil fuels and other sources.

A2: This scenario foresees a very heterogeneous world. There will be a constant demographic increase with very slow and irregular pro capita economic growth and technological development.

B1: This scenario as well foresees that the demographic growth will continue until the middle of the century to then start decreasing, but there will be a fast change in the economic structure towards an economy based on information and services, with a reduction in material use and the introduction of clean and efficient resource technologies, in other words there will be a sustainable kind of development with limited use of resources.

B2: The population will continue to grow but at a slower rate compared to the A2 family, the economic development will be average and technological changes slow and differentiated but always aware of sustainable development.

Each scenario is supposed to have different levels of carbon dioxide emissions for the period ranging from 1990 to 2100. The main changes pointed out by the models besides the increase of greenhouse gas concentration in the atmosphere are the following three:

- Global warming of the lower atmosphere and the planet's surface.
- Acceleration of the water cycle in the atmosphere and the ground.
- Sea level increase.

### Global warming

All mathematical models that have been studied so far foresee an overall warming of the lower layers of the atmosphere and of the planet's surface of 1.5 to 5.8 °C and a cooling of the upper layers of the atmosphere. There will be different changes at different latitudes.

High latitudes (polar and subpolar areas):

During the winter temperature increase will be greater than the global average increase and will affect the dry lands more than marine surfaces. At the poles there will be a decrease in marine ices and because ice plays a role in heat exchanges among the oceans, warming of the arctic areas and high latitudes will be greater. During the summer instead, the temperature increase will be lower than the average global one because of the strong thermal influence of the ocean.

Intermediate latitudes (mild areas):

During the summer temperature increase in the northern hemisphere will be greater than the global average, whereas during the winter it will be very similar to the global average.

Low latitudes (subtropical and equatorial areas):

Temperature increase in these areas will be minimal and lower than the average global heating. As opposed to other latitudes, it will be even throughout the seasons. This area is occupied mostly by the sea so surface temperature increases will only increase water evaporation rather than making the air temperature warmer.

### ***The water cycle in the atmosphere and the ground***

Precipitations will increase globally because of the rising temperature, and because there will be more evaporation which will mean more water vapor in the atmosphere, this will increase the amount and speed up the water cycle in the climate system.

Precipitations will increase particularly at high latitudes and the intra-tropical area both during the winter as well as during the summer. At intermediate latitudes instead, precipitation will increase only during the winter months. Locally some areas will have more dry spells and/or floods while others will have less. Rains will become more frequent and more intense so there will be an increased risk of floods.

At present we do not dispose of sufficient data to know if floods, hurricanes or tropical cyclones will increase or simply change the areas where they occur.

### **Sea levels**

The average sea level will rise because of the ice melting and, according to the more pessimistic forecasts, it could rise as much as a meter higher than it is today; whereas according to the more optimistic forecasts it will rise by only 10 to 20 cm. Intermediate scenarios expect the sea level to rise 50 cm. by 2100.

## **And if an extraterrestrial creature should land on Earth...**

In the 1700s James Hutton, geology's and modern scientific reasoning's forefather, invented the "Principle of knowledge", according to which it is necessary to study the past in order to have the key to understanding the present and attempt to foresee the future. Only through intensive scientific research it appears possible to separate the influence of human actions and activities from the long term trend which is determined by natural events. Hence the great importance of science both in terms of prevention which can cut the huge costs of intervention following natural disasters, and as a means to help plan future population developments, in other words, sustainable development. One must bear in mind that climate cycles have always occurred on planet Earth, therefore one must study and observe very carefully what happened in the past. In fact, as scientists working for ICRAM say, a hypothetical visitor from outer space, could consider Earth's climate evolution in a completely different way based on the observation's time span. Let's imagine that our extraterrestrial visitor's spaceship has broken down and he has landed on a beach in the early hours of the morning. This creature, who knows nothing at all about astronomy, will notice that the temperature will increase drastically between 8 o'clock in the morning and midday. What is going to happen in the next few hours? The extraterrestrial may think that he is destined to fry under the sun but in the following hours, as dusk and night arrive followed by a new day, will help him to understand that there is a daily cycle.

In the same way, by observing the climatic evolution of the past century, we can notice a global warming trend of the climate. This trend however is a natural part of secular variations that have been happening since the beginning of history. In the same way, if we could record climate variations for a period of time spanning hundreds of thousands of years, we would notice the alternation between glacial and interglacial cycles.

The catastrophic forecasts on sea level increases issued during the '80s by the United States Environmental Protection Agency, that foresaw an increase between 0.56 and 3.45 meters within the year 2100 have been disavowed and estimates have lowered considerably. In 1986 it was still a common belief that the sea level could rise by as much as 2 meters during the next century, while more recent forecasts expect a more likely half a meter increase in the sea level by the year 2100. Obviously even if "only" a half meter rise occurs, it would have some very negative consequences on the environment such as erosions, floods, saline intrusions, etc. As one can imagine, problems would be greater for coastal areas and flat lands.

The degree of uncertainty of the different forecast mathematical models studied so far is still too high, while local effects, which are normally not taken into consideration in global estimates, could very likely be predominant. On the other hand it is very difficult to foresee what will happen to the climate in 50 years time when we are not even certain of what the weather will be like tomorrow!

We still have many doubts even from a scientific point of view so we must do more research in order to understand better

the complex climatic patterns, and take advantage of the so-called “precaution principle”, that is to foresee the worst case scenario in order to “prevent” before the “cure” may become useless. Worst case scenario forecasts, even though uncertain, must always be taken into consideration when facing environmental planning and managing activities.

And what can each one of us citizens do in this climate of uncertainty? Obviously each and everyone one of us can help. One just needs to think that 25% of North American carbon dioxide emissions are produced by private citizens, which is the equivalent of 9 tons of CO<sub>2</sub> pro capita per year.

How much CO<sub>2</sub> do you think you produce in a year? If you care about saving the environment, you can work it out by going to <http://www.ealp.it/iclei/italco2calc.htm> and that will help you to understand how much you yourself can really do to help the whole planet!

### Bibliography for further reading

- Mare e cambiamenti globali, Iccram, 2000
- Clima e cambiamenti climatici, Enea
- Intergovernmental Panel on Climate Change, [www.ipcc.ch](http://www.ipcc.ch)
- Global Warming: Early Warning Signs, [www.climatehotmap.org/index.html](http://www.climatehotmap.org/index.html)
- World View of Global Warming, [www.worldviewofglobalwarming.org](http://www.worldviewofglobalwarming.org)
- Il clima, di Antonio Navarra e Andrea Pinchera, Editore Laterza, 2002
- Il cambiamento climatico, di Alessandro Lanza, il Mulino, 2000
- Le variazioni del clima. Dall'ultima glaciazione alle prospettive per il XXI secolo, di Mario Pinna, Franco Angeli, 1996