# Polar ice caps melting

**Global warming is not affecting the planet evenly and most of the existing models forecast that it will be greater in the northern hemisphere. With an overall increase of 2°C, temperatures in the Arctic could increase by a factor of two or three. The southern hemisphere, would also be affected, though less severely.**

The North Pole is already showing signs of substantial change. Over and above considerable variations between seasons and years, the surface area of the ice pack has diminished by 10% in 30 years. By the end of the 21st century half of it may have disappeared.

Some try to look on the bright side, highlighting the opening of new sea passages for trade and easier access to oil and gas fields in the far north of America and Siberia, which contain 40% of global reserves. But the disadvantages largely outweigh such benefits.

The most serious immediate problem concerns the Gulf Stream. Preliminary research has revealed that the strength of the current dropped by 20% between 1950 and 2000. Paradoxically it could temporarily result in much colder weather in Europe.

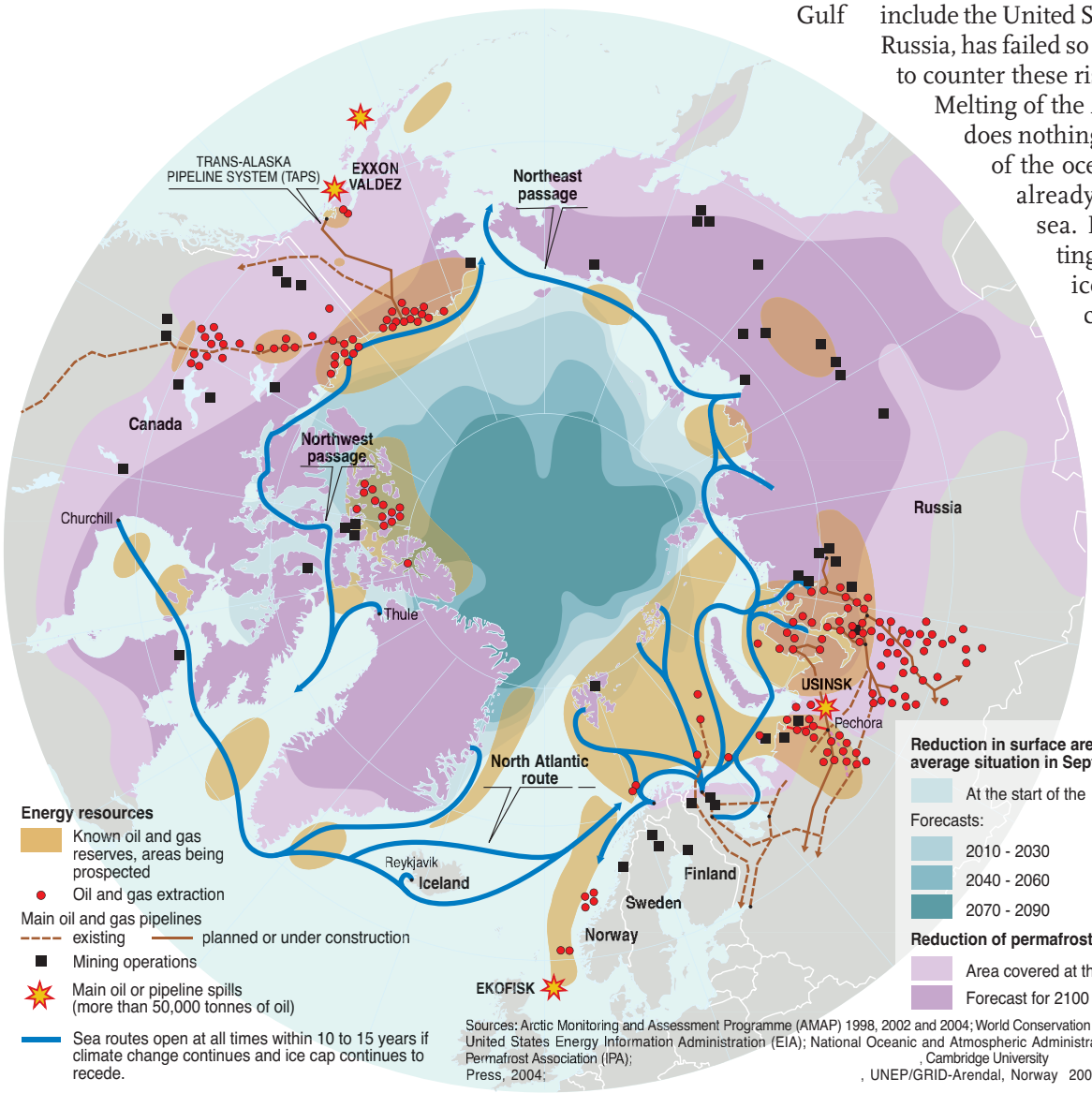
Worse still melting of the ice caps could increase the pace of global warming, by reducing refraction of solar radiation – 80% on ice, compared with 30% on bare earth and 7% on the sea.

In some places the permafrost (permanently frozen ground) is melting. Not only does it support buildings and infrastructure, but it also contains very large quantities of methane gas.

The Arctic Council, whose members include the United States, Canada and Russia, has failed so far to do anything to counter these risks.

Melting of the Arctic ice in itself does nothing to raise the level of the oceans, as the ice is already floating on the sea. But gradual melting of the Greenland ice sheet and glaciers in other parts of the world could make a significant difference. Measurements by the Topex-Poseidon

## Climate change in the Arctic



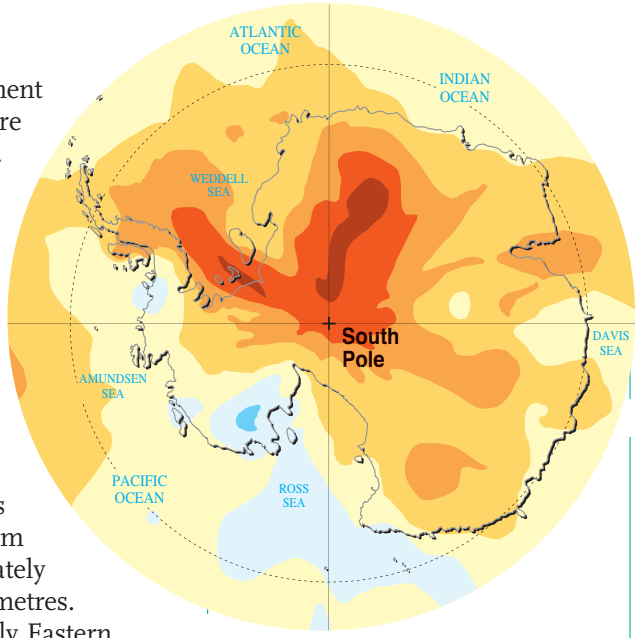

Sources: Arctic Monitoring and Assessment Programme (AMAP) 1998, 2002 and 2004; World Conservation Monitoring Centre (WCMC); United States Energy Information Administration (EIA); National Oceanic and Atmospheric Administration (NOAA); International Permafrost Association (IPA); , Cambridge University Press, 2004; , UNEP/GRID-Arendal, Norway 2005.

# faster

satellite currently indicate a 2.4 millimetre annual rise in sea level. That would result in a rise of at least 25 centimetres by the start of the next century, but increasing numbers of scenarios are forecasting a rise of one or several metres, if melting of certain parts of the Antarctic is confirmed. Setting aside such uncertainty, it appears that a third of the rise is caused by dilatation of the sea water due to the temperature increase. Melting glaciers account for a further third. As for the remainder, recent studies suggest that melted ice from the South Pole could already be accounting for as much as 15% of the total rise.

## RISING SEA LEVEL

Until very recently scientists thought only the Antarctic peninsula was affected. It warmed up 3°C between 1974 and 2000 and it was here that the huge Larsen ice shelf broke free in 2002. If all the ice on the peninsula melted the sea level would rise by an additional 45 centimetres. However it is not directly connected to the southern polar ice cap which, until recently, was thought to be stable and unlikely to be affected by global warming for at least a century. Then, in October 2004, Nasa revealed that the temperature of some parts of the continent might increase by more than 3.6°C by 2050. In December 2004 a team belonging to the British Antarctic Survey observed that the western part of Antarctic was losing 250 cubic kilometres of ice a year. It remains a relatively small amount, but if the rate of loss increased, water from this area could ultimately raise the sea level by 8 metres. For the time being only Eastern Antarctic, much the largest part (equivalent in ice to a 64 metre rise in sea level), appears to have been spared. In addition a reduction in the Antarctic ice pack could have a disastrous effect on aquatic wildlife. In particular krill, a tiny shrimp that lives on seaweed growing under the ice, play a key role in the marine food chain, feeding squid, fish and cetaceans. Krill stocks appear to have dropped by 80% over the last 30 years. Combined with overfishing worldwide and increasing damage to the coral reefs, this undoubtedly constitutes an additional source of concern.



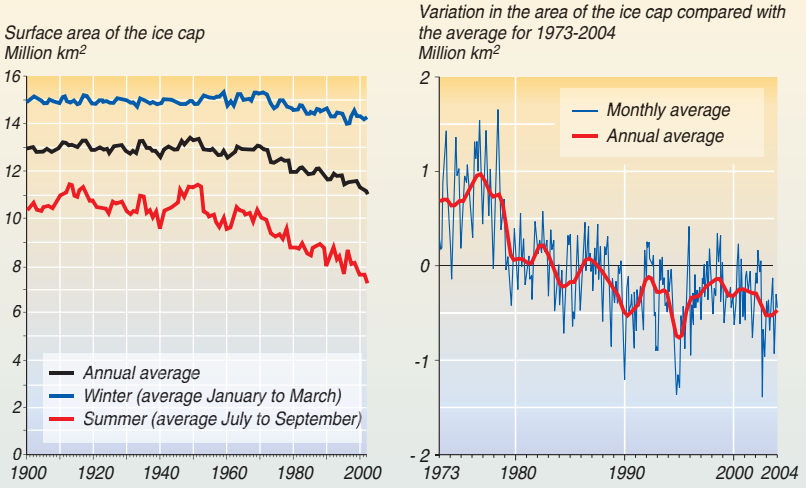

Antarctic temperature rise by 2050

**Temperature variations**

- -1.2 to -0.4°C
- -0.4 to +0.4°C
- +0.4 to +1.2°C
- +1.2 to +2°C
- +2 to +2.8°C
- +2.8 to +3.6°C
- over +3.6°C

Source: National Aeronautics and Space Administration (NASA), 2004. Based on a map drawn up by Fr d ric Durand.

The Arctic Ocean ice cap is receding




Sources: *Impacts of a Warming Arctic: Arctic Climate Impact Assessment (ACIA) Overview report, Cambridge University Press, 2004; Hadley Centre, 2005; World Meteorological Organization (WMO), 2005; Met Office (UK).*

## On the web

- **Arctic Climate Impact Assessment (ACIA):** www.acia.uaf.edu
- **International Arctic Science Committee (IASC):** www.iasc.no
- **Arctic Council:** www.arctic-council.org
- **Center for International Climate and Environmental Research-Oslo (CICERO):** www.cicero.uio.no
- **Laboratoire d'océanographie dynamique et de climatologie (LODYC):** www.lodyc.jussieu.fr
- **World Meteorological Organization (WMO):** www.wmo.ch
- **International Conference on Arctic Research Planning (ICARP):** www.icarp.dk

# The point of no-return

**The Kyoto protocol came into force on 16 February 2005, heralding the advent of a more mature attitude. Mankind, we were told, had finally woken up to the increasing pressure that it is exerting on the environment. Unfortunately a closer look shows that such claims have more to do with wishful thinking than actual fact.**

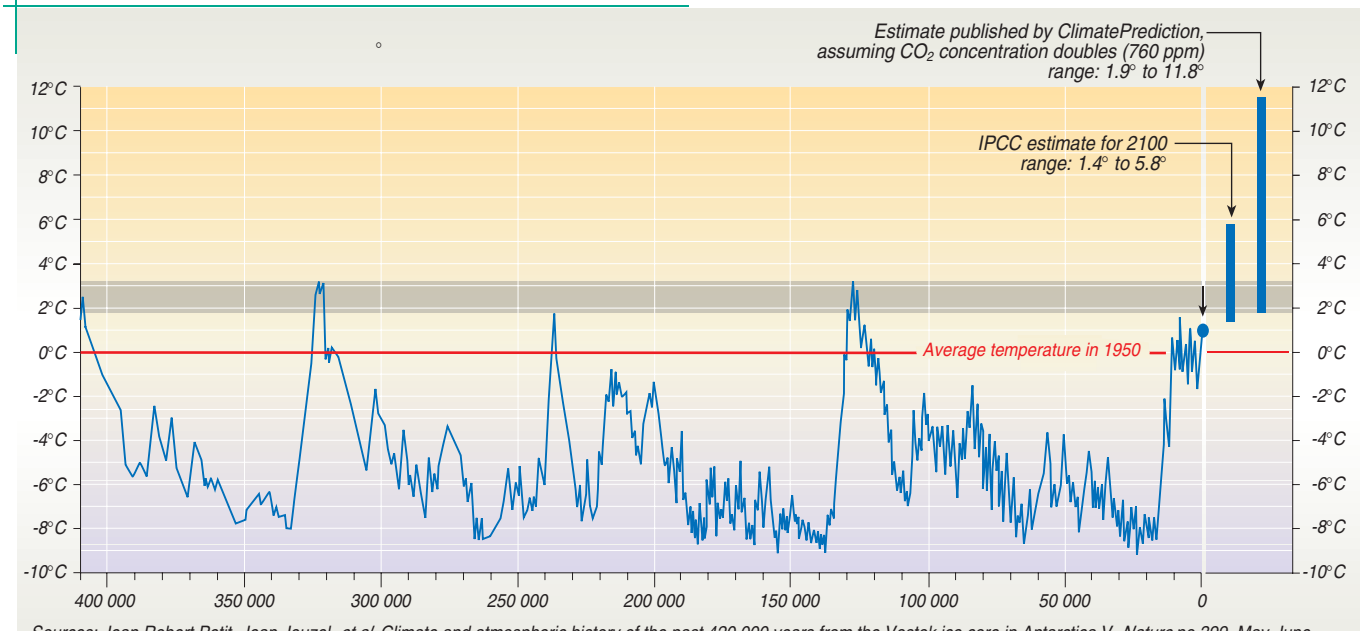
Forecasts of global warming have become more alarmist in recent years. The 2001 report by the Intergovernmental Panel on Climate Change (IPCC) confirmed that the greenhouse effect had significantly increased since the 19th century. Carbon dioxide ($CO_2$) emissions contributed to a worldwide temperature increase of 0.8°C between 1860 and 2000. The same report predicted that temperatures would rise faster, increasing by 1.4°C to 5.8°C between 2000 and 2100. Given that during the last ice age, 15,000 years ago, the planet as a whole was only about 5°C colder, this would be a considerable increase.

A study published by Oxford University in 2005, based on the results of 2,578 computer simulations, forecast an even higher temperature rise: between 1.9°C and 11.5°C, most of the results ranging from 2°C to 8°C. The greatest source of concern is the notion of the point of no-return. Due to climatic inertia, even if drastic measures were taken now, the impacts of the current disturbance would persist for years. They might even be irreversible. A consensus has emerged that the critical threshold could correspond to an overall temperature rise of 2°C. To prevent this, the $CO_2$ concentration should not exceed 550 parts per million (ppm), or perhaps even 400 ppm. But in fact it rose from 270 ppm around 1850 to 380 ppm in 2004, an unprecedented increase in the 420,000 years of climate history that scientists have been able to reconstitute. Over that period the $CO_2$ concentration varied between 180 ppm and 280 ppm. The current annual rate of increase stands at 2 ppm, which means a critical threshold could be reached within 10 to 30 years. It also means we need a fourfold cut in $CO_2$ emissions by industrialised countries by 2050.

## THE WEIGHT OF EVIDENCE

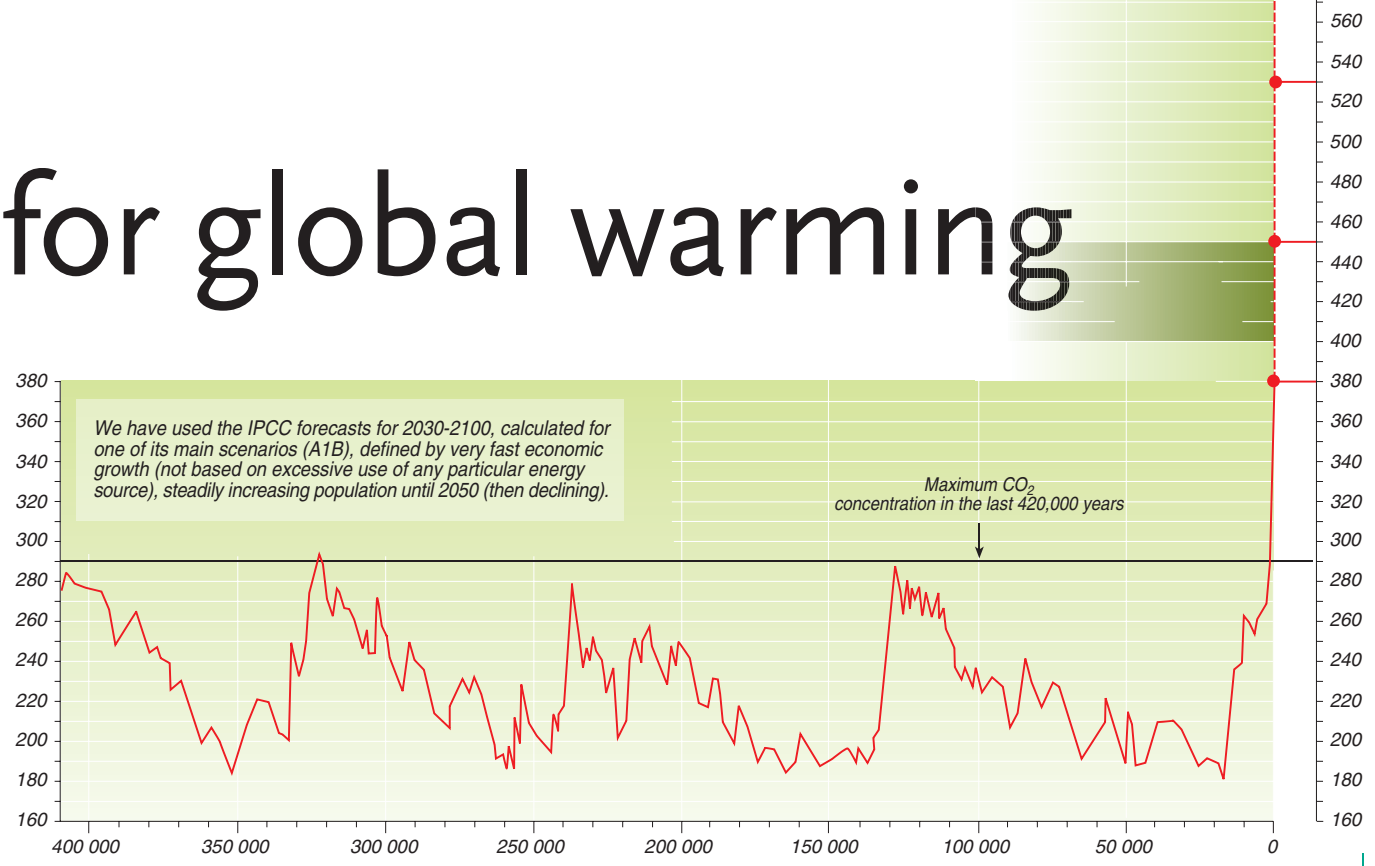
Admittedly we are dealing with forecasts, not absolute certainties. But the importance of the risks and the growing consensus among scientists should encourage us to apply the precautionary principle and take effective measures. What, then, would the Kyoto protocol achieve if it was fully implemented, in other words if the United States ratified it and Europe met its commitments? It would only reduce global warming forecast for the end of the century by 0.06°C (or 2% to 3%). Furthermore the protocol does not set any limits on emissions in developing

Beyond the critical threshold




*Sources: Jean Robert Petit, Jean Jouzel, et al, Climate and atmospheric history of the past 420,000 years from the Vostok ice core in Antarctica V, Nature no 399, May-June 1999; David Stainforth, ClimatePrediction.net, 2005; Intergovernmental Panel on Climate Change (IPCC); UNEP/GRID-Arendal, Norway, 1998.*

# for global warming




*Source: Jean Robert Petit, Jean Jouzel, et al., Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica V, Nature No 399, May-June 1999; David Stainforth, ClimatePrediction.net, 2005; Intergovernmental Panel on Climate Change (IPCC); UNEP/GRID-Arendal, Norway, 1998.*

Record of temperature and CO2 concentration over the last 400,000 years

countries, which understandably want to catch up with industrialised countries. The failure, at the end of 2004, of the negotiations at the Buenos Aires conference, which was supposed to prepare a follow-up to Kyoto, is an indication of the present deadlock.

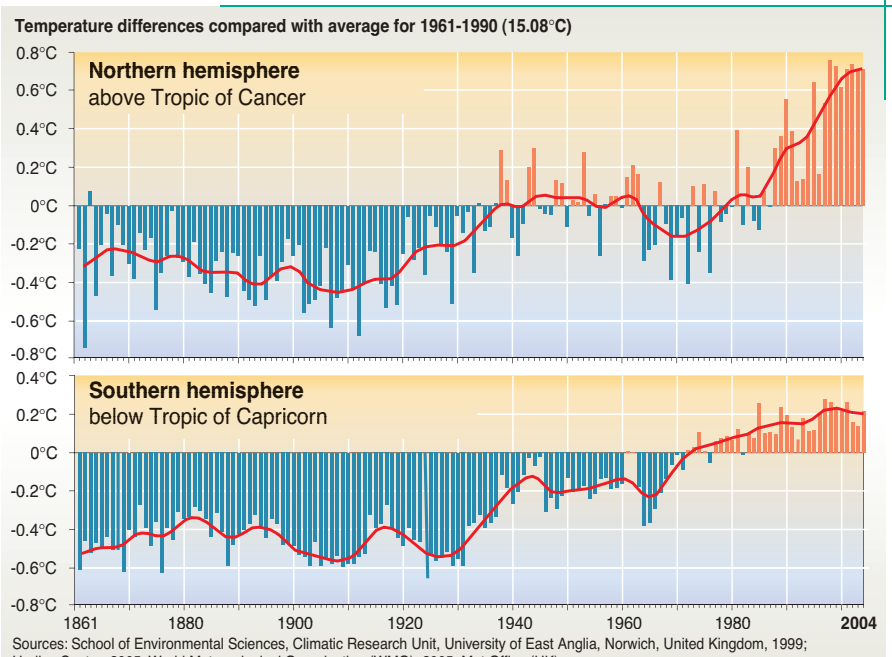
Yet, although the forecasts are still uncertain, the signs of an imminent upset are accumulating. The last decade (1995-2004) was the hottest since the start of regular records in the 19th century. It saw an increase in the number of extreme events: the frequency and intensity of El Nino increased; the heat wave that affected Europe in 2003 could become a recurrent feature; in 2004 the US and Asia suffered an unprecedented number of typhoons. It is perhaps too soon to say they are all connected, but the available evidence increasingly points that way.

Several structural phenomena have been confirmed, even if it is still difficult to predict their consequences accurately. In addition to warming in the polar regions (see section on pages ??-??), the increase in the temperature of the oceans is damaging coral reefs, a habitat essential to marine wildlife. The sea level could rise by between 25 centimetres and 1 metre due to dilatation of water as it warms up. Nor does that allow for melting of the ice caps. Some studies are predicting 150 million climate refugees by 2050. Changes in rainfall patterns could affect farming and the areas in which diseases propagate. The consequences for biodiversity are also likely to be particularly serious, with many species struggling to adapt to such rapid changes. Even without climate change human beings have already caused the sixth largest wave of biological extinction the Earth has ever known, simply on account of the destruction and pollution we habitually wreak.

## On the web

- **United Nations Framework Convention on Climate Change (UNFCCC):** www.unfccc.int
- **Intergovernmental Panel on Climate Change (IPCC):** www.ipcc.ch
- **Worldwatch Institute:** www.worldwatch.org
- **Global resource information database (GRID-Arendal):** www.grida.no/climate

Average temperature variation on Earth since 1861




*Sources: School of Environmental Sciences, Climatic Research Unit, University of East Anglia, Norwich, United Kingdom, 1999; Hadley Centre, 2005; World Meteorological Organization (WMO), 2005; Met Office (UK).*

# When water becomes a rare commodity

**Despite the international community's commitments many people still do not enjoy the right of access to clean water and half the world's population is in danger of running short of this vital commodity in 30 years.**

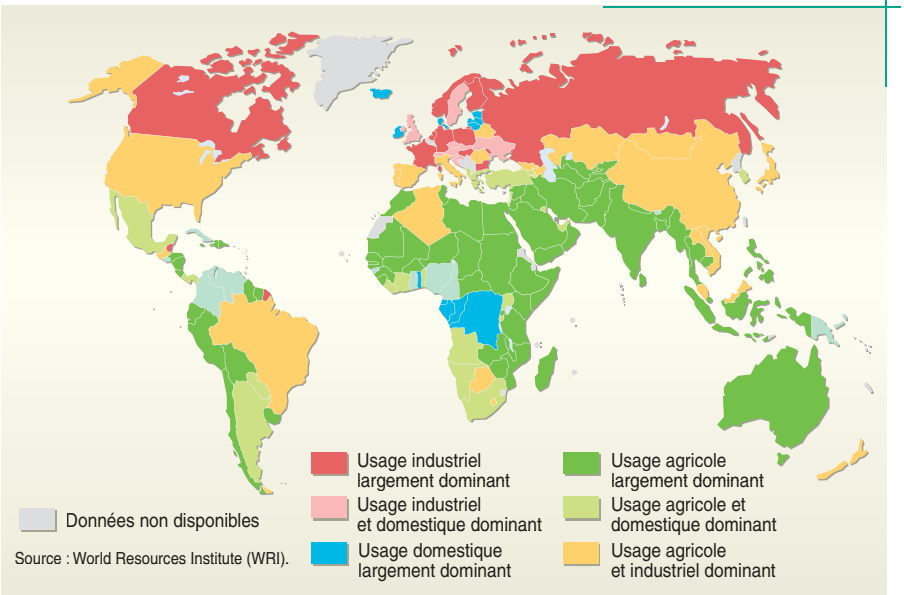
More than 1.1 billion human beings do not have access to drinking water and 2.4 billion lack proper sanitary facilities. For some people water may seem abundant, but reserves are very unevenly spread. Whereas a few countries hold 60% of the planet's fresh water reserves, Asia, home to 60% of the world's population, only has 30% of the total. Water shortages are a permanent state of affairs in a triangle stretching from Tunisia down to Sudan and across to Pakistan. Each person has an average of less than 1,000 cubic metres of fresh water a year, a situation described as a "chronic shortage".

Water quality is also a problem. The larger the amount consumed, the more waste water is produced. In developing countries 90% of waste water and 70% of industrial waste runs straight into the surface water without any form of treatment.

As a result more than 5 million people die every year of water-related diseases, 10 times more than the number of victims of armed conflicts. The world's population is set to rise from 6 billion people in 2000 to 8 billion in 2025. The average amount of fresh water available per person per year will consequently decrease by almost a third. If water use goes on increasing at the present rate the UN estimates that in 20 years' time 1.8 billion people will be living in areas affected by a constant water shortage, with 5 billion others located in places where it will be difficult fully to satisfy their needs.

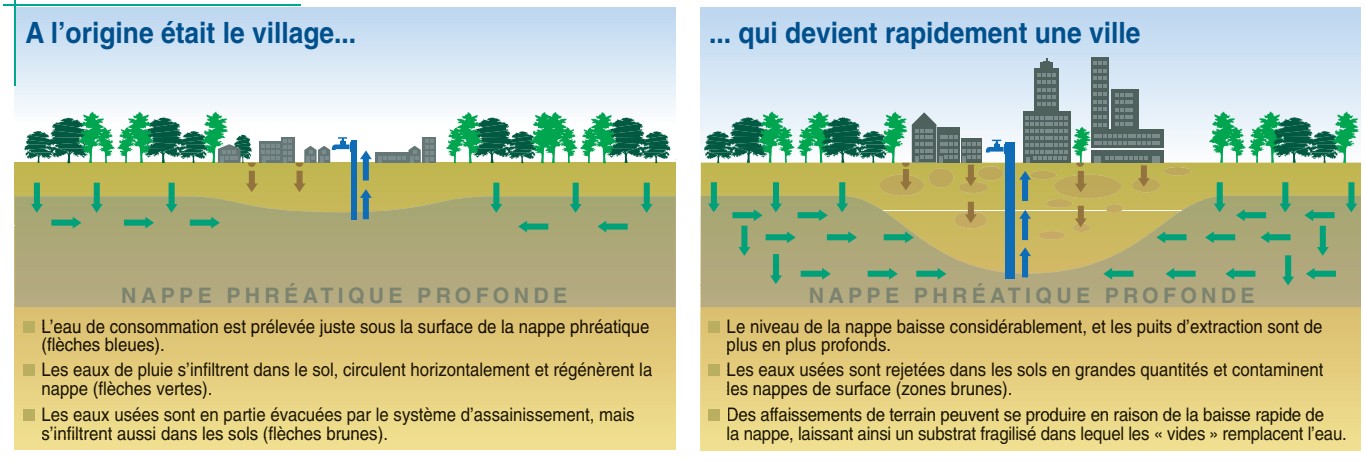
As the population drift from the countryside to the towns continues the situation will deteriorate further, with increasing numbers packing into the planet's giant metropoles. By

Water usage



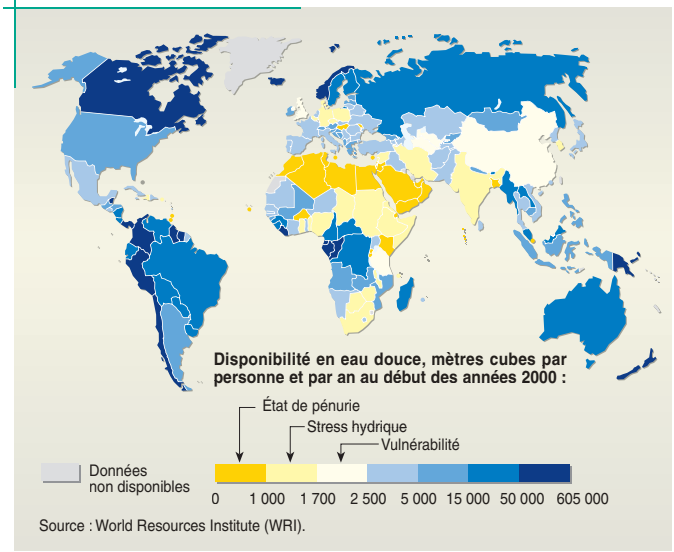

Source : World Resources Institute (WRI).

Urban development changing the picture

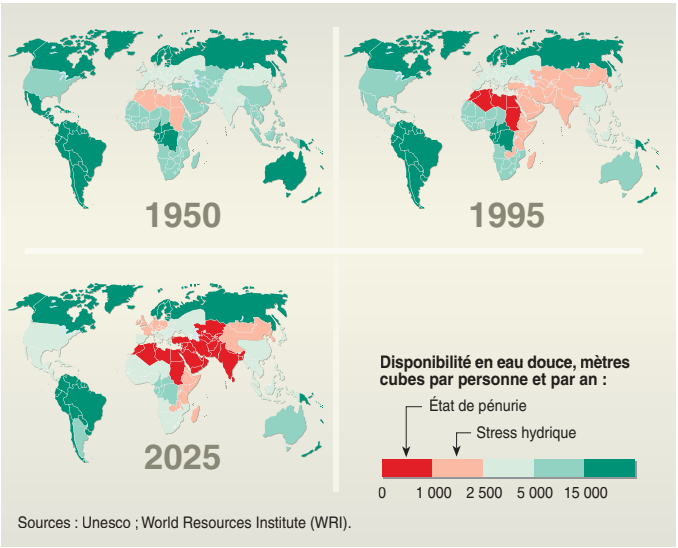



- L'eau de consommation est prélevée juste sous la surface de la nappe phréatique (flèches bleues).
- Les eaux de pluie s'infiltrent dans le sol, circulent horizontalement et régénèrent la nappe (flèches vertes).
- Les eaux usées sont en partie évacuées par le système d'assainissement, mais s'infiltrent aussi dans les sols (flèches brunes).

- Le niveau de la nappe baisse considérablement, et les puits d'extraction sont de plus en plus profonds.
- Les eaux usées sont rejetées dans les sols en grandes quantités et contaminent les nappes de surface (zones brunes).
- Des affaissements de terrain peuvent se produire en raison de la baisse rapide de la nappe, laissant ainsi un substrat fragilisé dans lequel les « vides » remplacent l'eau.




Source : World Resources Institute (WRI).




Sources : Unesco ; World Resources Institute (WRI).

2020 27 of the world's 33 largest cities (population exceeding 8 million people) will be located in the South. The corresponding influx of people will lead to a 40% increase in domestic water consumption.

But wastage increases as the standard of living improves. The many amenities appearing in well-off homes encourage extravagant use of water, regardless of its relative scarcity and its rising cost (which, driven upwards by private utilities, may be prohibitive for the poor). Europeans currently use eight times more fresh water on a daily basis than their grandparents. The average inhabitant of Sydney, Australia, uses more than 1,000 litres of drinking water a day, compared with 300 to 400 litres for an American and 100 to 200 litres for a European. In some developing countries the average daily consumption per capita barely exceeds a few litres.

Vast amounts of water are simply wasted. Only 55% of all water produced is actually used. The rest is lost, either because it drains away or evaporates during irrigation, or because it leaks from the mains. To feed the world's population the productivity of farming must substantially improve. Irrigation, which already accounts for 70% of all the water produced, will need to increase by 17% over the next 20 years.

Attempts to solve the water shortage based exclusively on technology, such as desalination of sea water, will only have a limited impact due to their cost. We must improve the efficiency of our water usage, particularly for irrigation, refurbish drinking water production and distribution resources, protect reserves and combat pollution. According to various funding agencies this will require an annual investment of $180bn over the next 25 years, compared with $75bn at present.

Unfortunately there is disagreement as to which remedies should be promoted. Privatisation of water, recommended by international donors and some governments, still only concerns 5% of global resources. Many non-governmental organisations condemn this mercantile approach, maintaining that access to water is a "basic human right", that should either be free or charged at its real cost. But even then the poorest people will not unable to pay for their water. We consequently face a dual challenge: we must manage water wisely and protect the right of access of the poorest people to this vital resource.

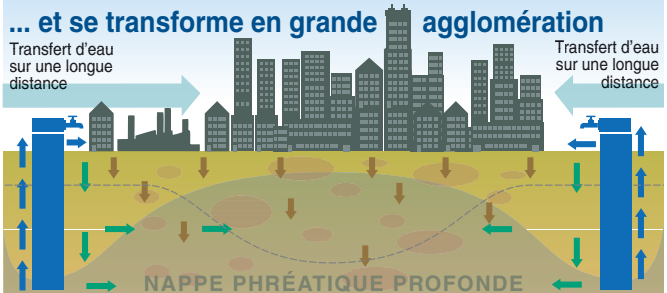
## On the web

- **International Rivers Network (IRN):** www.irn.org
- **United Nations Educational, Scientific and Cultural Organisation (UNESCO):** www.unesco.org/water/
- **United Nations Environment Programme (UNEP/GRID-Arendal):** www.grida.no
- **Planète bleue:** www.planetebleue.info
- **The World Conservation Union (IUCN):** www.iucn.org/themes/wani
- **H²O:** www.h2o.net

### La ville grandit et s'étend...


- Sous la ville, l'épuisement de l'aquifère profond entraîne la cessation progressive du pompage. Le niveau de la nappe remonte, mais son exploitation est abandonnée en raison de la contamination par les eaux usées domestiques et industrielles.
- L'alimentation de la ville se fait désormais par des puits à la périphérie, où le niveau de la nappe commence à baisser. Du lieu d'extraction au consommateur, il faut transporter l'eau sur une plus grande distance.

### ... et se transforme en grande agglomération




- Les nappes situées en périphérie ne suffisent plus à alimenter la grande cité.
- La nappe phréatique urbaine reste inutilisable tant que les infrastructures d'assainissement ne sont pas modernisées et que le processus de décontamination naturelle n'est pas achevé.
- La pénurie oblige l'agglomération à s'approvisionner à partir de sources distantes à des coûts généralement plus élevés.

# Ocean resources under threat

**The planet's one ocean – for the various oceans form a single ecosystem – covers 361m square kilometres, or 71% of the Earth's surface. Exploitation of renewable and non-renewable resources has steadily increased. Some renewable resources are the focus of keen rivalry. No sooner do we realise their potential than they threatened by over-exploitation.**

The oceans supply about 80% of all living aquatic resources, amounting to 110m tonnes. (Mt). The rest (28 Mt) comes from inland waters. At sea, production relies to a large extent (80%) on fishing, simply harvesting natural resources, the remainder coming from mariculture, which encompasses the various techniques of fish farming.

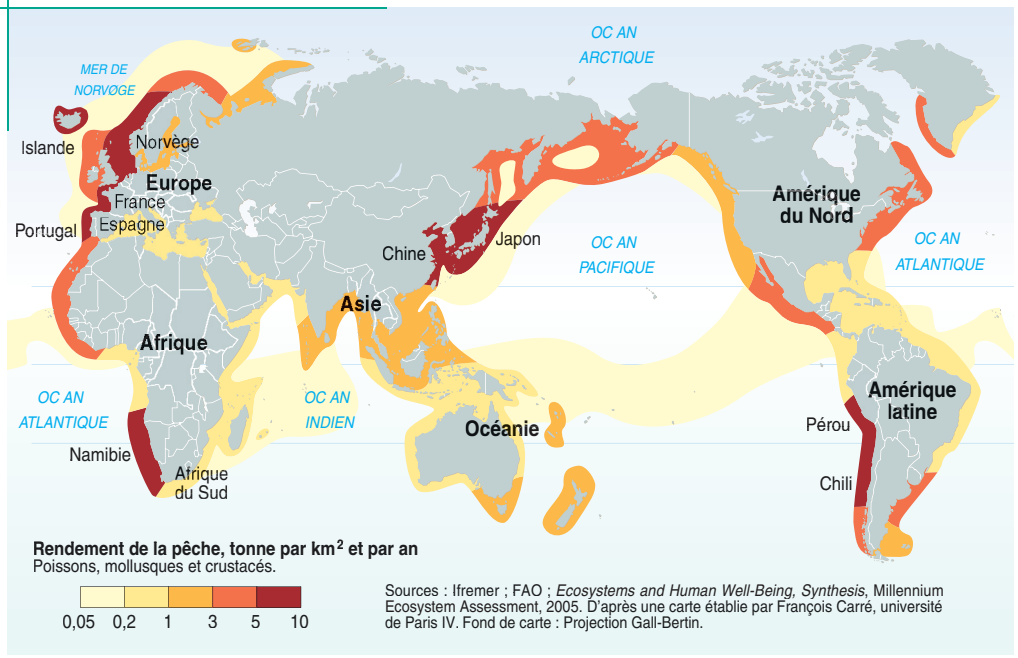
For thousands of years fishing was relatively inefficient, but the situation changed radically over the last century, thanks to major advances in the techniques used to catch and store fish. Catches totalled 20 Mt in 1950, rising to 70 Mt in 1970 then stabilising between 80 Mt and 90 Mt. The spectacular increase in 1950-70 was largely due to the development of industrial uses for fish, transforming it into by-products (meal and oil) for use manufacturing pet food.

This market engulfs huge volumes of fish (sometimes as much as 35% to 40% of catches). It has caused overfishing of certain species and major crises, such as the massive drop in herring catches in the north-east Atlantic in 1968, or a similar fall in anchovy catches off the coast of Peru from 1972 onwards. These crises led to the setting up of exclusive fishing grounds extending 200 nautical miles out from the coastline. Within each area the relevant country enjoys exclusive fishing rights and can apply quotas for specific species. As marine wildlife lives mainly on the edges of the oceans, it must of necessity be shared between neighbouring countries, resulting in disputes such as the cod war that flared between Iceland and the United Kingdom in 1975. Norway and Russia have still not managed to reach agreement on fishing limits. In Asia, overfishing is one of the reasons for the boom in fish farming, with annual production rising from 6 Mt to 25 Mt in just 25 years.

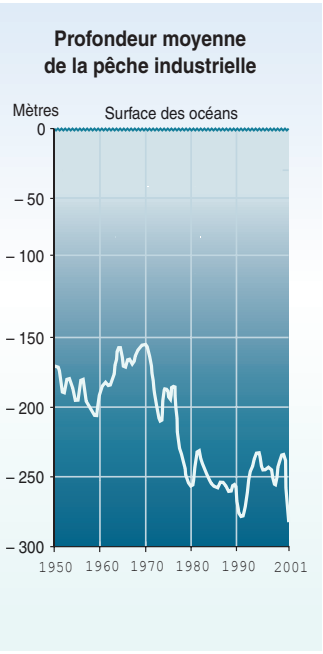
The availability of fish as a foodstuff (with a global average of about 16 kg per person per year) is stable but very unevenly spread. China, where consumption is expanding fast, and the developed countries enjoy plentiful supplies, in contrast to countries in Africa and Central America, already suffering from chronic malnutrition.

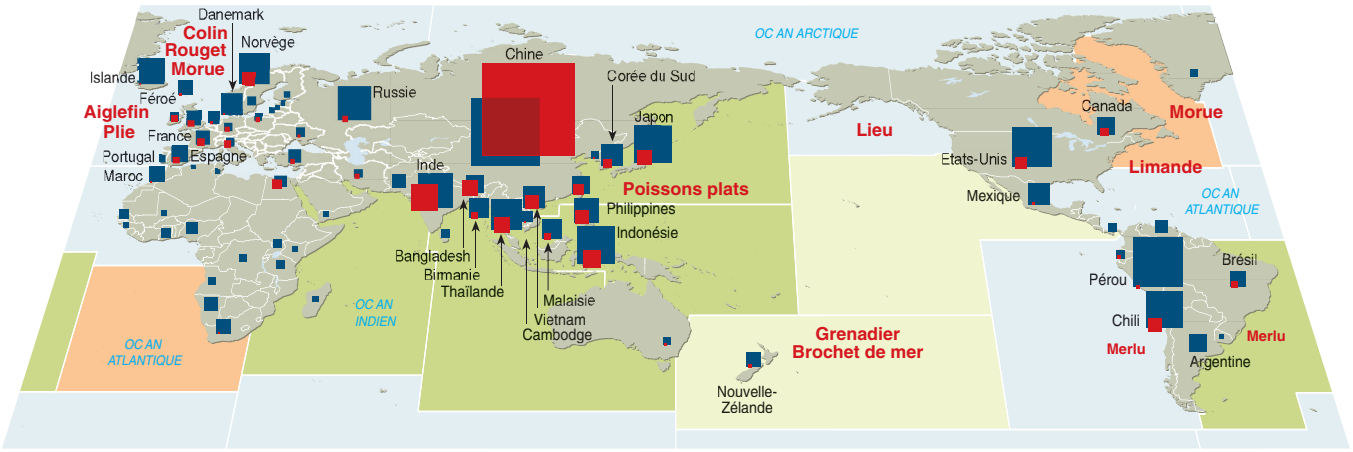
Other uses for the sea are being explored, in particular scope for gene-

## Fishing yields




Sources : Ifremer ; FAO ; *Ecosystems and Human Well-Being, Synthesis*, Millennium Ecosystem Assessment, 2005. D'après une carte établie par François Carré, université de Paris IV. Fond de carte : Projection Gall-Bertin.






World fish production in 2002

rating energy from the movement of the water (waves, swell and currents), or from the vertical temperature gradient between warm surface water and the chill ocean depths. Although there is huge potential, attempts to use such energy sources have so far only been experimental and limited in scale. Pilot projects include the tidal power station on the Rance estuary in northern France, built in 1966, and a similar facility in northern Russia, built two years later.

Non-renewable resources found in and under the sea comprise mainly fossil fuels such as coal, with coalfields, mined on land, extending out into the sea, and above all hydrocarbons, currently the focus of active prospecting. But the seabed conceals other mineral resources too.

## UNEXPLOITED RICHES

80 the nodules containing various metals scattered all over the deep seabed attracted considerable interest, but the cost of bringing them to the surface was prohibitive. The same is true of the metal-rich muds deep in the Red Sea.

Lastly seawater itself provides sodium chloride, on salt marshes, magnesium, bromine, accounting for 80% of the world's needs. And of course, after desalination, it is a source of fresh water.

## On the web

- **United Nations Food and Agriculture Organisation (FAO):** www.fao.org/fi/
- **Intergovernmental Oceanographic Commission (IOC):** www.ioc.unesco.org
- **International Council for the Exploration of the Sea:** www.ices.dk
- **Institut français de recherche pour l'exploitation de la mer (Ifremer):** www.ifremer.fr
- **Onefish:** www.onefish.org
- **International Maritime Organisation (IMO):** www.imo.org

Dwindling stocks of Atlantic cod