

# CLIMATE ALERT

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## China Faces Hard Energy Choices: Booming Economy, Soaring Emissions

Special report by Nancy C. Wilson

**J**ames Gustave (Gus) Speth, former President of the World Resources Institute (WRI) in Washington, D.C., has succeeded William H. Draper III as the new Administrator of the United Nations Development Programme. UNDP is the world's largest multilateral source of grant technical assistance, with offices in 124 developing countries. After the announcement of his appointment to UNDP, Mr. Speth stated, "A UN agenda for development is an essential complement to its agenda for peace. I want UNDP to contribute to making peace possible by helping people attack, not each other, but the deprivation and disparities that are among the root causes of conflict."



James Gustave Speth

Mr. Speth who founded WRI in 1982, has worked extensively in the assessment of the needs and challenges of developing countries. He established WRI's Center for International Development and Environment, which provides technical assistance and services supporting grass-roots and national efforts for sustainable development in Africa, Asia, and Latin America.

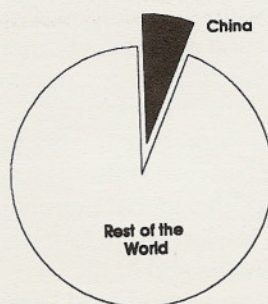
As senior advisor to the Clinton transition team, Mr. Speth headed

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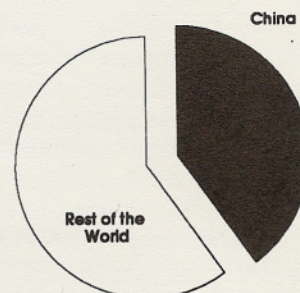
**C**urrently, China's contribution to the world total of global emissions of greenhouse gases amounts to about seven percent. But if China continues its present course of explosive expansion, if world growth rates slow, and if China does not aggressively develop a noncarbon energy system, in a worst case scenario the nation could account for 40 percent of world emissions by the year 2050 (Lu Yingzhong, 1989.)

present population of 1.17 billion — 22 percent of the world's total — is expected to exceed 1.2 billion by 2020 to 2030 and peak at 1.6 to 1.7 billion in the next century, according to a recent Chinese Academy of Sciences Report, "Resources Development and the Economy." This tremendous number of people, coupled with China's heroic efforts to transform its economy is likely to lead to ever higher emissions into the atmosphere.

Estimated Chinese Share of  
Global Greenhouse Gas Emissions



1990



2050

The average Chinese per capita emissions are about 1/15 of the per capita contribution of the United States, Canada or Australia. Despite China's draconian measures to restrict the number of births, the

China is in the midst of unprecedented development. Per capita output doubled in the 10 years from 1977 to '87. Last year Chinese leader Deng Xiaoping called for faster

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# WHAT IS AT RISK?

*Commentary by John C. Topping, Jr., President, Climate Institute*

As signatories to the Framework Convention on Climate Change wrestle with the difficult problem of stabilizing or reducing greenhouse emissions, some observers have questioned what all this fuss is about. On one hand nature is remarkably resilient, they have suggested, and can be expected to rebound readily from human perturbation of the atmosphere. Some see in the new green politics an effort to restore legitimacy to statist planning approaches that have fallen into disrepute with the widespread collapse of the centrally planned economies. The proposed cure, they suggest, may be worse than any risk posed by climate change.

Although Margaret Thatcher, an Oxford trained scientist, and perhaps the most eloquent spokesman for conservatism in the latter half of this century, recognized that good atmospheric science has no political coloration, some on the right, in the U.S. and Australia especially, have sought to promote a counter-science. This resulting politicization of the discussion of complex scientific issues has influenced the popular press to careen widely between stories that the ozone scare is over or that apocalyptic consequences are right around the corner.

## Role of Floods

The recent destructive floods in the Mississippi River Basin region of the U.S. and in South Asia have again underscored the vulnerability of human society to the vicissitudes of climate. These tragic events, however, should cause us, regardless of political philosophy, to look objectively at what risks climate change may pose for human civilization. Although the science of atmosphere and oceans is replete with uncertainty, some recent

scientific assessments should give pause to all but the most Panglossian.

Recent findings from Greenland ice cores over the last 250,000 years, published in the July 15 issue of *Nature*, indicate that the period of relative climatic stability during which human civilization arose in the last 10,000 years may have been an aberration. Huge fluctuations in global mean temperature -- up to 10 degrees C in a few decades -- occurred over the last 250 millennia. The findings of wide temperature swings during the Eemian period -- between 115,000 and 135,000 years ago -- are particularly riveting. Global temperatures then were believed to be only about 2°C warmer than they are today. The current trends in increasing concentrations of greenhouse gases indicate that we are likely to match the Eemian period global temperature, perhaps by the middle of the 21st century.

It is hard to overstate the potential consequences for humanity should we reenter such a time of wide temperature fluctuations. Only a tiny fraction of today's human population, prehistoric humanity survived the buffeting of the Eemian period presumably by moving between shifting climatic zones. With a global population soaring toward ten to fourteen billion by the end of the next century, and world food supplies climatically dependent, modern humankind may be much less resilient than earlier humans to such shifts.

Policy discussions of climate change responses have almost invariably assumed that the change will be fairly linear. These discussions have contemplated that early

signals of change will permit intelligent adaptation. Some economists have ventured elaborate cost-benefit models which have discounted the benefits to humanity of incurring costs to control greenhouse emissions on the grounds that technological innovation and other adaptations can readily buffer us against adverse impacts of climate change. The realistic prospect of nonlinear change severely diminishes the utility of such models.

## Hydrological Cycle

In addition to the recently discovered evidence of wide temperature fluctuations during the Eemian period, another development of huge potential human significance is mounting evidence that as the earth warms we are likely to find an intensification of the hydrological cycle with a greater tendency toward both floods and droughts. This was borne out in a paper published in August 1992 in *Climate Dynamics* by five

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Australian atmospheric scientists. Gordon et al. simulated changes in daily rainfall intensity due to an enhanced greenhouse effect and found that more intense rainfalls

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Recent findings from Greenland ice cores over the last 250,000 years ... indicate... relative climatic stability during which human civilization arose in the last 10,000 years may have been an aberration.

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were likely with fewer days of rain. They tested the models in four regions: Australia, Western Europe, the Midwestern U.S., and India. In each case there was a tendency toward more intense rainfall and fewer days of rain. The results were especially striking in the Midwestern U.S. and India, each of which would, the models suggested, experience two to three times as many days of an inch or more of daily rainfall in a doubled CO<sub>2</sub> climate than they do at present.

Besides making severe floods such as India, Bangladesh, Nepal, and the Midwestern U.S. experienced recently much more frequent, this potential climatic trend could seriously accelerate soil erosion, rapidly underway in much of the world due significantly to human actions. Professor David Pimentel of Cornell University has estimated that over the last forty years about a third of the earth's cropland had to be abandoned because of erosion. Increases in rainfall intensity would, he projects, aggravate this trend.

This analysis underscores a point often missed in discussions of climate change: such change is only one of a number of humanly caused stresses that may interact. To that extent climate impact models often tend to underpredict a likely real world situation, by assuming climate as the principal variable. In many parts of the world climate change is likely to occur alongside extensive soil erosion or depletion and the adverse results may be additive or multiplicative.

The realistic possibility that we could be vulnerable to wide global temperature fluctuations if we seriously disturb our climate equilibrium and the high probabil-

ity that climate change will occur in tandem with other environmental stresses should cause us to strive, despite the huge difficulties, to stabilize global concentrations of greenhouse gases. Humanity has a vital interest in preserving the band of climatic stability in which human civilization arose. Achieving this while simultaneously satisfying economic aspirations of the earth's growing population will require strategies that transcend traditional left-right political divides: internalization of pollution costs, encouragement of technological innovation and more efficient use of resources. The sea change required to achieve such a stabilization will come about only through heightened recognition of how much is at

## Speth

(Continued from page 1)

the group that examined the U.S. role in natural resources, energy, and the environment. In 1991, he chaired a U.S. task force on international development and environmental security that produced the report, Partnership for Sustainable Development: A New U.S. Agenda. Membership of this task force included current chairmen of both the House and Senate committees on foreign affairs.

Before founding WRI, Mr. Speth was Professor of Law at the Georgetown University Law Center for two years, where he taught environmental and Constitutional law. In 1977 to 1981, he served as a member and eventually chairman of the Council on Environmental Quality (CEQ). As the chairman, Gus Speth was

the principal advisor to President Carter on the nation's environment program and was responsible for The Global 2000 Report to the President which raised an early concern about the emerging problem of climate change. During his time with the CEQ, he also chaired the President's Task Force on Global Resources and Environment.

Together with the United Nations Environment Programme (UNEP) and the World Bank, UNDP shares in administration of the Global Environment Facility (GEF), a financing and technical assistance vehicle. The GEF promotes initiatives to limit climate change and stratosphere ozone depletion and to protect biological diversity and international waters. With Speth at the helm of UNDP this agency is expected to increase its involvement in such global environmental issues.



# China

(Continued from page 1)

economic growth and loosened restrictions setting off a boom. In the first six months of 1993, China's industrial output shot up 25 percent and gross domestic product was 14 percent higher than a year earlier, — far beyond the official target of nine percent.

Growth at such a rapid clip is fueling inflation. At the end of June, prices in the nation's major cities were officially reported to be 21.6 percent higher than a year earlier. Some reports estimate that recent monthly inflation (converted to an annual rate, which is not released by the government) is much higher. Alarmed officials have installed Zhu Rongji, a 65-year-old Deputy Prime Minister, as head of the central bank to try to rein in the surging economy.

While China's current greenhouse gas emission numbers are low, the nation is the fastest growing major contributor to the gases associated with global warming. With its potential fossil fuel consumption and growing population it is possible total Chinese CO<sub>2</sub> emissions will reach 1.6 billion tons by 2020 and 2.25 by the year 2050. This 2050 estimate is uncomfortably close to the present CO<sub>2</sub> emissions total from all industrial countries of 2.7 billion tons.

"China is a big country in terms of coal consumption," says one Chinese report. Last year China was the world's largest consumer of coal, burning more than one billion tons to meet three quarters of its energy needs. China has the largest proven recoverable resources of coal and has demonstrated a willingness to use them.

The use of fossil fuel accounts for 95 percent of China's primary energy consumption, comparable to an equivalent amount for the former Soviet Union and 87 percent for the

U.S. Of China's 500,000 gigawatt (GW) hours of energy production, 65 percent are from coal, 14 percent from oil, and one percent from gas. In terms of global consumption of fossil fuel, 23 percent originates in the U.S., 18.5 percent in the former Soviet Union, and 8.4 percent in China. China's energy and industrial carbon emissions, obviously in large part coming from coal, amounted to 650 million metric tons (mmt) in 1990, with methane accounting for 4.8 mmt (the CO<sub>2</sub> equivalent of 90 mmt).

The leading factor that would drive China to restrict its use of fossil fuels is concern about human health conditions, particularly the effect of burning coal on rampant respiratory disease. Citizens in many cities wear surgical masks when they go outside in wintertime as protection against coal dust. Recent statistics from the World Bank indicate lung disease is the leading cause of death in China. The Chinese public is worried about the rising price rapid economic development is exacting in deteriorating air quality and polluted water as well.

The seven major rivers that flow through cities are choked with sewage, and 85 percent of Chinese cities are short of clean water. In the countryside, according to the World Bank, only one Chinese in seven has safe drinking water. During 1991, factories dumped 25 billion tons of industrial waste into the already strained waterways. The abundance of prawns and scallops in coastal waters has dropped markedly in the last decade.

The Chinese intellectual, scientific community is concerned also about longer term trends, aware of the threats global warming could pose. These concerns were laid out in a 1990 study by the Coordinating Group on Climate Change, an interagency committee of eight Chinese government departments.

## Potential Impacts of Global Warming on China

- A loss of at least five percent of overall agricultural production as a result of warming, because of increased evaporation, degradation of grassland, wind erosion of soil, drought, and increased frequency of typhoons.
- Several forest species, *Pinus Koraiensis*, *Cunningham lanceolata*, *Pinus Masoliana* and *Pinus Yunnanensis* face serious losses and some forest areas will be converted to steppe, covered by non-productive hot or warm-natured shrubs and grasses.
- Significant damage to coastal areas from even a moderate sea level rise would occur, with extensive flooding and destruction of existing saltwater farmland and fishery farms, large food sources for coastal China. Half of the Pearl River Delta, about 3,500 square kilometers, might be inundated, and wide-scale flooding is projected for more developed areas of the Yangtze River and Yellow River delta.
- Permafrost areas which cover about 12 percent of China's land surface would be severely affected. A rise of 2 degrees C for a sustained period of 10-20 years would thaw 40 to 50 percent of China's permafrost, with a large area of thaw settlement and slope landslide and loss of highways, railways and buildings.

Source: Prof. Ye Ruqiu, Coordinating Group on Climate Change, 1990.

The study, coordinated by Prof. Ye Ruqiu of the National Environmental Protection Agency and a member of the Institute's Advisory Board, projects significant impacts. (See box.)



Government action will be driven by near-term considerations, and early efforts are likely to be concentrated on energy efficiency and switching of fuel to noncarbon fuels.

China has shown more awareness of environmental problems than most developing countries and a greater interest in grappling with them. The Chinese government, "is paying more attention to the effect of CO<sub>2</sub> emissions on global climate change," says Yu Yongnian, Senior Engineer, Central Mining Research Institute, in a section entitled, "Global Climate Change and the Energy Policy of China," part of a 1991 ESCAP report, Energy Policy Implications of the Climate Effects of Fossil Fuel Use in the Asia-Pacific Region. "Since the early 1980s [China] has pursued a policy of energy saving and environmental control," in which progress has been made, he asserts.

There are many steps the Chinese could take which would both benefit their own economy and the global atmosphere by: raising energy efficiency and conservation, making more use of alternative fuels, encouraging afforestation, increasing investment in infrastructure, and establishing price incentives to counterbalance underpriced energy.

The core of China's emission reduction strategy is increased efficiency. China has tremendous potential for improvement, especially in the power generation and industrial sector. The nation uses energy at 30 percent efficiency as compared with Japan at 57 percent and the U.S. at 51 percent. Less than one-fourth of the billion tons of coal which are mined annually are converted to electricity, a relatively clean and convenient usage, although this percentage is expected to rise to 35 percent of total coal produced by 2000. Other inefficiencies exist in coal delivery: one-third of the nation's railway freight capacity is used just to transport coal. In 1989, railway freight charges were estimated to

constitute about 80 percent of the cost of coal delivered to the power sector.

A lack of coal transportation capacity contributes to electric power shortages, reducing efficiency throughout the economy. Power generation efficiency can be raised from 30 to 37 or 38 percent through advanced technologies. Heat efficiency of boilers can be upgraded from 55 to 65 percent and of kilns from 25 to 30 percent respectively.

### Measures to Improve China's Energy Efficiency

1. To control strictly the development of small industrial boilers, transforming 400,000 small-sized ones, and developing central heating and combined network electricity supply
2. To restrict tightly the development of small thermal power plants based on air condensation and to transform existing ones
3. To rectify small enterprises whose products consume more energy than standards set by the state.
4. To accelerate the use of briquets for domestic consumption in place of raw coal burning.
5. To develop urban coal gasification. It is estimated urban cooking efficiency can be increased from 22 to 50 percent by gasification.
6. To conduct research on new technology for energy conservation and environmental protection and extend its use.
7. To recover light hydrocarbons in the petroleum industry and reduce release of natural gas into the air.
8. To control population growth and encourage family planning.

*Source: Prof. Ye Ruqiu, Coordinating Group in Climate Change, 1990.*

The 1990 Coordinating Committee proposed specific measures to improve China's energy efficiency and conservation, ambitious goals some of which will require considerable expenditures in capital equipment. (See box.)

Alternative fuels can supplement the benefits of energy efficiency measures, but of course each alternate has its drawbacks. Hydropower floods vast areas, increases siltation, and reduces the supply of arable land. Nuclear power has a difficult waste disposal problem and its large scale plants are not suited to many remote villages in much of rural China.

Water power does offer an attractive alternative to coal's high rate of greenhouse gas emissions. China has the largest untapped hydroelectric potential in the world, with an exploitable capacity of 436 (GW), but only five percent has been developed. Hydropower will grow from 40 GW in 1990 to 80 by 2000.

Bulldozers have already begun moving earth on preliminary work for the Three Gorges Dam on the Yangtze, described as the most important construction in China since the Great Wall. The power from the Three Gorges dam would be a tremendous asset in fueling China's industrial revolution; its generation would vastly reduce air pollution and its damaging effects on lungs. The 17-18-year project has been discussed for more than 70 years and was formally approved in 1992. It is not the highest dam in the world nor would it contain the world's largest reservoir, but its projected hydroelectric output of 17.7 GW is exceeded only by a dam in the former Soviet Union, Turukhansk, with a planned capacity of 20.0 GW.

The Yangtze carries 523 million tons of sediment a year, and critics charge the Three Gorges would slow the river flow, causing it to drop sediment. Silt would accumulate, making the river unnavigable. Approxi-



mately 1.2 million people would have to be permanently relocated. One of China's most spectacular scenic sites would be harmed. While official cost figures for building the dam are \$10 billion, a dam constructed downstream in the '70s and '80s soared three times over original estimates. Actually the main purpose of the Three Gorges is flood control, and in fact several smaller hydroelectric dams would be cheaper and simpler to build. But supporters say a single flood could cause more damage than the dislocation from dam construction, that the dam is better built than not built. Some Western environmental groups are calling on the World Bank not to finance the project, but the Chinese government believes it can attract sufficient support from foreign lenders and investors.

Some Chinese view nuclear energy as the "major non-carbon fuel for the near future," with a potential of producing 6 GW of energy by 2000, according to a UNEP report, Greenhouse Gas Abatement Costing Studies: Phase One Report. China plans to begin construction in 1995 of the nation's largest nuclear plant, rated at 4.0 GW, in Guangdong, a booming southern province suffering serious power shortages. Scheduled to be online by 2000, it will be China's fifth nuclear plant and the third in Guangdong.

But because peasants comprise nearly 80 percent of China's population, decentralized power systems, closer to the people and more environmentally benign, are likely to be more appropriate for China's expanding power generation. Comparatively large scale nuclear plants with the long transmission lines that would be needed to cover villages in widely scattered rural areas would be less suitable for China's near term needs. As China struggles to meet its intense energy demands to fuel its ambitious development, it will face crucial

decisions in the next decade, whether to bet on major advances in such technologies as solar, photovoltaic, and wind. If the government decides to go with traditional systems, it will lock itself into centralized structures similar to those of the industrialized world.

The prospect of afforestation as a response strategy is bright, forecast to rise from 13 percent of land at present to 16-17 percent by the end of the century. If the target is realized, 690 million tons of carbon could be assimilated and no CO2 emission would result from net deforestation. The least expensive way of developing forests is to improve open forests through better management. Fast-growing, high productivity species for carbon sequestering, such as *pinus massonia*, eucalyptus, poplar, and Chinese fir are listed as good choices for planting.

Conservation strategies include:

- economy of energy and materials through turning waste to utility, finding substitutes and new resources for materials, technical innovation, comprehensive exploration
- intensive farming measures through multiple crops, multiple layer farming, advanced irrigation

systems, and technical and scientific fertilizer application.

The costs in 1990 US dollars of using different limiting strategies, have been listed in a UNEP report published in August 1992, Greenhouse Gas Abatement Costing Studies: Phase One Report. The estimates include investment, operation, maintenance and fuel. Adoption of coal-saving stoves by rural households would be the most cost effective measure, increasing cooking efficiency from 10 to 20 percent, and the Chinese government has set a policy thrust of extending this device to 90 percent of rural households by the end of this decade. Other steps in order of cost priority for potential of emission saving are: introduction of solar cookers, extending gas to urban areas, solar photovoltaic devices, wind generation, combined cycle cogeneration, afforestation, solar heaters, nuclear power and hydropower. Retrofitting of kilns and boilers and changes such as fluidized bed and high-temperature boilers would save lesser amounts.

A recent World Bank Report, Sustaining Rapid Development in East Asia and the Pacific, gives a bleak assessment for avoiding large

### New Measure of China's Role in World Economy

A new calculation by the International Monetary Fund, relying on the buying power of each nation's currency rather than its dollar value, has concluded that China's economy is more than four times as large as previously measured. This ranking places China as the third largest economy, producing six percent of world output in 1990, up from three percent in 1970, behind only the United States at 22.5 percent and Japan at 7.6 percent. With this new method, the IMF found China produced about \$1.7 trillion in goods and services last year, far above previous estimates of \$400 billion, and making China — whose economy has grown twice as fast as the world economy — one of the fastest growing in the world. If such a phenomenal growth rate continues, the World Bank has said the combined economies of China, Hong Kong and Taiwan will be larger than the U.S. economy in less than a decade. Per capita income in China by the new measure was about \$1600 last year (as against \$370 under the old method) and compared to the U.S. level of \$22,204.

Source: *International Monetary Fund and World Bank*



increases of atmospheric emissions. If the industrial countries should manage to reduce their CO<sub>2</sub> emissions by 20 percent, the report states, within 10 years the loss will be offset by increases in China and other East Asian countries. "No adequate programs are in place or in sight to tackle this major environmental challenge to East Asia and to the global community," the report concludes.

But there are grounds for hope and optimism, as the government of China and of many of the nations of East Asia become more aware of the necessity for action. Chinese per capita output doubled in the 10 years from 1977 to '87. While such growth, bringing with it more atmospheric emissions, is not an unmitigated blessing, the economic boom is giving China the resources to pay for pollution abatement as well as the option of sacrificing growth where necessary.

Another encouraging factor is the savings rate, especially high in China, 60 percent more than the industrial country average.

China will have to take an unconventional road to industrialization,

## Variations in Western Warm Pacific Pool

A huge swath of ocean near New Guinea, covering more of the earth's surface than the continental United States, is the largest single expanse of warm water on the planet. It has a sea surface temperature consistently above 28 degrees C, about two to five degrees higher than other equatorial waters.

A group at the Center for Remote Sensing at the University of Delaware, USA tracked this Western Pacific Warm Pool using 10 years of satellite data ending in 1991. Both mean annual sea-surface tempera-

tures and the size of the pool increased from 1983 to 1987 and then fluctuated.

The group speculates that the possible cause of these variations may include changes in solar irradiance, El Nino-Southern Oscillation events, volcanic activities and global warming. They suggest that further satellite observations may provide insight into the initiation and development of ENSO and may improve our understanding of upper-ocean processes, sea-air exchanges and the global atmosphere.

says the Chinese Academy of Sciences report, Resources Development and the Economy. If external sources of capital are available, the introduction of many environmentally desirable and economically attractive measures — that could not readily be financed by internal savings alone — could be accelerated. But while international policies will make some difference, the real resources will come not from the World Bank or foreign investors but of necessity from the Chinese themselves. The route they follow may be different from the developed

nations, featuring efficiency, conservation and a low consumption rate of resources. The speed with which the Chinese undertake these measures may depend on how concerned they are about air and water pollution in the short run as well as how much they worry about damages atmospheric emissions will inflict in the long run.

**Reference:** Lu Yinghong, "The CO<sub>2</sub> issues and energy policies in the PRC," *Global Warming and Climate Change; Perspectives from Developing Countries*, ed. Sujatu Gupta, R. K. Pachauri, New Delhi, 21-23 Feb. 1989.

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## UN Sustainable Development Commission Holds First Session, Takes up Agenda 21

The United Nations Commission on Sustainable Development (UNCSD), created to act on environmental accords instituted at last year's Earth Summit in Rio de Janeiro, made considerable progress towards that goal during its first two-week session, held at UN Headquarters in New York on June 14-25, 1993.

The Commission adopted a work program which sets up a timetable for review of the nine "chapter clusters" in Agenda 21. Under this program Poverty, Financial Resources and Mechanisms, Technology Transfer, and Capacity Building will be reviewed annually, while Land, Desertification, Forests, and Biodiversity will be reviewed in 1995 on a multi-year basis. Atmosphere and Oceans will be considered in 1996.

The Commission also reached a consensus on guidelines for voluntary reports that all countries are expected to provide concerning their progress in implementing Agenda 21 measures. Based on the individual country reports, the UN will prepare an annual overview and thematic reports on progress being made worldwide in each area of Agenda 21.

At a subsequent high-level ministerial meeting on June 24, Timothy E. Wirth, State Department Counsellor and head of the US delegation to the conference, announced that the United States was joining with Colombia, the current head of the 129 developing countries calling themselves the Group of 77, in an effort to resolve the issue of environmental technology transfer to developing nations.

## Variability in South Asian Summer Monsoons

While there have been model studies showing a rise in the mean of South Asian summer monsoon rainfall based on an increase in atmospheric concentration of CO<sub>2</sub>, only recently have coupled ocean-atmospheric climate models been developed – and integrated for a sufficient length of time – allowing greater understanding of monsoon variations between years. A group at the National Center for Atmospheric Research in Colorado, USA, has developed a coupled model, and it has shown increased surface temperatures and evaporation and greater precipitation in the South Asian summer monsoon region. Average monsoon rainfall showed more variability. Observations confirmed a trend of this increased variability associated with warmer land and ocean temperatures in the monsoon region.

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