

CLIMATE ALERT

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Recognition Grows of Perils of Urban Summer Hot Spells

The summer heat that led to more than 700 deaths in Chicago this year was not unique to that city or to the US and raised questions anew of whether climate change might bring more such deadly events. Laurence Kalkstein, a professor of geography at the University of Delaware Center for Climatic Research, has estimated more than 1,000 people die of heat-related causes in the nation's 15 largest cities in an average summer. Health experts are now warning that heat is a public health hazard that is deadlier than most people realize.

The siege in Chicago broke records. The dead were found in closed, stifling apartments. Many

of them had temperatures of 105°F, according to the medical examiner's office. The morgue was so full it had to use refrigerated trucks to hold the overflow. Funeral homes were overwhelmed. Coffins were in short supply. Hospital emergency rooms had to divert ambulances because they didn't have enough ventilators. When the city developed a heat plan and the next heat wave arrived a few days later, an army of city workers knocked on the doors of the elderly, delivered food, water and ice and transported people to cooling centers.

Deaths during unusually hot spells can rise over 50 percent, says Kalkstein. In Chicago the final total (Continued on page 4)

Institute Honors Dr. Swaminathan

Till now, climate change discussions have centered on national or international policy, yet success in averting adverse consequences of climate change will depend largely on innovations at the local level. This year, the Climate Institute has chosen for its annual award Dr. M. S. Swaminathan for his outstanding initiative in translating climate change response actions down to the municipal or village level.

Chairman of the M.S. Swaminathan Research Foundation, Dr. Swaminathan is widely known for his work promoting the green revolution in agriculture, especially through his service as Director General of the International Rice Research Institute. He has been a catalyst in international efforts to promote global food security through agricultural innovation and has pioneered the concept of rural sustainable development, receiving numerous international prizes for his efforts. He has invested significant resources from those prizes to promote sustainable development at the village level, principally through his research foundation established in his home city of Madras, India. Dr. Swaminathan first focused the attention of South (Continued on page 6)



M.S. Swaminathan

Climate Change Workshop on Action Plans for Developing World Villages to be Held in Madras

In a very practical approach aimed at the impact of climate change on local communities, particularly in the developing world, the M.S. Swaminathan Research Foundation and the Climate Institute are holding a workshop in Madras, India in early December to draw up precise action plans. The plans will cover specific measures to ensure adequate food, clean water, efficient energy production and protection of ways to earn a living, especially in coastal regions.

Representatives of the International Geosphere/Biosphere Program; the Tata Energy Research Institute; the National Commission for Women in India and many Indian Government ministries will participate in stimulating a dialogue on response strategies to climate change. The workshop discussions will focus on food security, coastal livelihoods, energy security, and the supply and quality of water and will translate the broader national and regional goals addressed at the Manila Conference and the Berlin Conference of the Parties into a blueprint for the individual and local level.

Report Assesses Plight of Refugees Fleeing Drought, Erosion, Expanding Deserts and Shrinking Forests in Alarming Numbers

A Climate Institute study by Norman Myers with Jennifer Kent

A final assessment of the growing legions abandoning their homelands because of drought, erosion, spreading deserts and shrinking forests was released by the Climate Institute in July, 1995 at the Embassy of Sweden in Washington, DC. These "environmental refugees" are among the nearly one billion in the world struggling to survive on a cash income of less than one dollar a day, fleeing intolerable conditions in the hope of better prospects elsewhere. Marginal people driven into marginal environments is how Dr. Norman Myers of Green College, University of Oxford, the project's principal investigator, describes them in this report, **Environmental Exodus: An Emergent Crisis in the Global Arena**. The two-year project was conducted by the Climate Institute.

Although there is no official recognition of their existence, today there are nearly 25 million environmental refugees, compared to 22 million traditional refugees according to Myers' study. The numbers of environmental refugees are expected to double by 2010. Global change, bringing sea level rise, flooding, droughts and disruption of monsoon, could raise the numbers still higher, eventually reaching 200 million, Myers estimates.

Population in the 90s, Myers asserts, is likely to grow in places least able to sustain it, in the regions where the poorest people are already overloading environmentally fragile areas. In Africa these areas are home to 50 percent of the poorest, in Asia — 60 percent, in Latin America — 80 percent.

Once in their new homes, the refugees are likely to find and aggravate the problems they left behind: poverty, malnutrition, shortage of land, unemployment, huge cities unable to cope even with existing residents, pandemic

disease, government mismanagement, ethnic strife, conventional conflicts.

Although destitution drives many refugees from their homelands, the available areas where they seek a new livelihood are too wet, too dry, or too steep for agriculture, and the newcomers are likely to cause a further round of deforestation, desertification, soil erosion and environmental decline.

Unless action is taken, the "plateauing" of food and agriculture yields which began in 1985 will lead to more widespread shortfalls with international trade surpluses unable to make up the default, Myers warns. Adding to the prospect of food shortages will be a looming water shortage, more loss of forests and further desertification. By 2025, the earth's population will have grown by 2.5 billion, a 55 percent increase in 30 years. Cities in the developing world, with clearly inadequate facilities, will struggle with four billion residents. The world's coastal zones will contain two-thirds of the earth's inhabitants, vulnerable to sea level rise, surges and tidal waves. There will be a squeeze on grainlands, and tropical forests will be almost gone. The number of people living with insufficient water supplies will have increased 10-fold since 1990.

The best way to deal with the emerging environmental refugee problem is to pre-empt it, Myers advises, decreasing the motivation to migrate by improving livelihoods in homelands. Both donor countries and developing countries should target development aid to the factors contributing to creating environmental refugees, emphasizing primary human needs: basic nutrition, health, water and sanitation, primary

education and family planning. If funding were doubled to \$25 billion a year, the challenge would be largely surmounted, Myers asserts, (and only one-third of that sum needs to come from developed countries).

Myers lists initiatives developing countries themselves could take to stem the flow of environmental refugees, and their price tags. (Please see box.)

He also recommends greatly expanding tree planting and shifting health expenditures from curative to preventive disease. The sums are not large when compared with

Initiative	Cost (\$billion/year)
Eliminate deaths from famine	\$0.5
Cut malnutrition of women & children	less than 2
Reduce hunger among the poorest	a little over 6
TOTAL	less than 9

military expenditures in many developing countries, he points out. In the long run, enhanced management of relief efforts should be inaugurated, but Myers feels relief organization difficulties have

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become so entrenched and gained so much momentum that it will take a decade to slow them down. He suggests for these organizations more funds, improved staffing and planning for relief food and refugee camps, and better programs for the refugees unable to return home.

There is only one choice for the developed countries, says Myers. "Export the wherewithal for sustainable development for communities at risk — or import growing numbers of refugees."

Project Reviews at Oxford and UN

The over-all thrust of the project was reviewed in late February by about 40 experts at a scientific conference at Oxford University, hosted by Sir Crispin Tickell. Sir Crispin chaired a symposium at the United Nations on March 28 attended by 30 representatives of UN missions and agencies to discuss issues and raise last-minute questions before publication of the final report.

Dr. Nafis Sadik, executive director of the United Nations Population Fund (UNFPA), described the movement of people around the world "[o]n a scale unknown in history — and certain to grow." The World Refugee Survey in 1992 calculated there were nearly 17 million refugees in need of protection and assistance in December 1991. In 1994, it is estimated 22 million fled across international borders from political, ethnic and religious persecution. Five million more "unrecognized" refugees crossed international borders, and 30 million were displaced in their own countries, bringing the total to 57 million.

While political instability and ethnic conflict account for much of the refugee movement attracting headlines in the press, there is far less publicity on population movements caused by environmental disruption, including changes in climate. The term "environmental refugees" has come into usage only recently because "migration caused by ecological disasters increases gradually, over extended periods, as conditions deteriorate, often

under the combined action of environmental distress and high levels of population growth."

Dr. Sadik stressed that population is a prominent factor in many cases of environmental decline and unsustainable development, although many other variables, including imprudent technologies, defective markets, inefficient economies and faulty policies are at work. Population pressures have been a leading cause in the expansion of arable lands, in turn exacerbating desertification, deforestation and deterioration of the natural environment. Population growth has led to an increase in livestock, rising methane emissions, and has also aggravated tropical deforestation and growth in carbon dioxide emissions from fossil fuels. The Myers' environmental refugee assessment, she concluded, is an important contribution to placing human beings and their needs at the center of population and development activities.

The people who migrate are politically, economically and socially invisible, participants pointed out in the discussion following Myers' presentation. They have no clout, and they have lost their ability to cope in an environmentally stressed situation. Three-fourths of them are women and children.

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How many refugees return to their homeland? The answer varies according to time and location. In some cases, those who migrated into West Africa because of drought in the late 60s stayed on. In the Cote d'Ivoire, e.g., there is partial evidence that they stayed and adopted a slash and burn life style. In Morocco, no one knows how many stayed. Among those that migrate to the U.S. from Mexico, about half stay, according to Myers. In Africa, large numbers eventually return home.

Ecosystems do not coincide with political boundaries and neither do forced migrations. The huge migration problems of environmental refugees differ from those of the traditional political refugees; they are very widespread, reaching way beyond the local arena.

Forests Are Dumping Grounds

People have been driven into the forest, since the 50s, Myers noted. The forest has been the dumping ground for no one knows how many millions. There is a gross lack of attention to the migrants. No one has a handle on the scope of the problem; it is not on the agenda of any international agency or government.

The same mechanisms that are influencing climate change are contributing to forced migration, said Anthony Edwards of UNEP, and we have less time than we thought to manage environmental change. The "suicidal degradation, destruction of soil and surface cover," with increasing global impact, could lead all of us to become environmental refugees. It is in our enlightened self interest as well as our humanitarian concern to attempt to deal with the problem. However, our response to the environmental refugee problem, even if it were perfect, would be woefully inadequate, commented Edwards. To give people money to stay home would require huge sums. But even if we cannot solve the problem, we should make every effort to persuade the potential refugees to stay home. If we continue on our present course,

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Refugees

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nothing will happen until the refugees land on the shores of the developed countries in unacceptable numbers.

Dr. Arnfinn Jorgensen-Dahl of the Population Fund suggested periodic reports on the number of people who have been displaced by severe environmental degradation in an attempt to get political attention. Short-term dramatic events, such as the gassing in the Japanese subway,

National Aeronautics and Space Administration and National Oceanic and Atmospheric Administration; the Rockefeller Foundation, the Swedish International Development Authority, and the United Nations Environment Programme.

For information on how to order the report, please see the publications order form on page 7. Dr. Norman Myers can be reached at Upper Meadow, Old Road, Headington, Oxford OX3 852, UK. FAX: 44-1865-741538.

number of deaths in Philadelphia, Boston and New York may rise while — because the local population has become acclimatized — death rates in Dallas and New Orleans may show no change. This phenomenon has shown up in Canada, the Netherlands, China and the Middle East. The critical temperature varies: it may be 29° C in Montreal, 30° in New York City, 33° in Shanghai, 38° in St Louis, 39° in Dallas — in general increasing toward the equator.

Historically, health officials searching records have found heat-related deaths amounted to 1,265 in the US in 1980 in a "heat storm" that killed dozens of people in St. Louis and Kansas City, MO. The average summer temperature variation of 4° C was associated with a much larger variation in the number of days above the tolerance threshold and a 20-fold variation in heat-related deaths. The Chicago Public Health Department found there were 232 excess deaths in a 1988 city heat wave and 885 deaths in July and August 1955, previously the city's hottest summer on record. .

The elderly and the very young are particularly at risk. Heat wears down the body's defenses, putting more stress on weak hearts and bodies less capable of controlling internal temperatures. For some reason, males make up 55 percent of the heat-related deaths, perhaps because they are more active and more likely to take risks, perhaps because they are less in touch with their families. Hot weather deaths are also associated with preexisting cardiovascular, respiratory and immune system disorders as well as accidents.

Architecture can be a contributing factor. Many inner city buildings are constructed to hold in warmth in winter but not to let it escape on a hot summer day. The red brick tenements with flat, black roofs in more northern cities are more lethal



Scott Stefanski Photo

Dr. Norman Myers and Sir Crispin Tickell at meeting at Green College, Oxford University

affecting relatively many fewer people, get a huge amount of coverage while the tremendous long-term problems of the refugees are considered less newsworthy.

Suggestions were made to involve the whole UN family of agencies in ameliorating the problems; nearly all are involved in some capacity — UNDP, UNEP, UNICEF, the Department of Human Affairs of the UN Secretariat. There are a great many small programs that work, but small scale activity is not enough. Perhaps we can channel activity to the local level, such as the Grameen Bank, and then figure how to build their capacity to "go to scale."

Sponsorship for the environmental refugee project came from the United Kingdom Overseas Development Administration, the United Nations Population Fund, the Moriah Fund, the following U.S. Government agencies: Department of State, Environmental Protection Agency,

Heat Stress

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reached 733 (according to a report released by the Chicago Health Department on September 22 — nearly 200 more than the Cook County medical examiner's earlier count of 536 which had shocked officials and the rest of the country. The Health Department report said that in July there were normally 72 deaths a day in the city, for a monthly total of 2,232. But this year there were 2,965 deaths during the month, totaling 733 "excess deaths.")

Although the body can adapt to persistent oppressive weather over several days, it cannot cope indefinitely. The number of deaths starts to rise after a certain local threshold has been passed, a critical temperature exceeded for several days in succession. The effect on the mortality rate does not occur in a uniform way. The

than the white frame shacks farther south. Top floors with tar roofs can be 10° F hotter than the floors below. In the suburbs where air conditioning was much more readily available, Chicago had

People living in poverty, including many urban populations in developing countries, are particularly susceptible to heat stress.

many fewer deaths. In sub-tropical cities, where people have become more acclimatized, the number of hot days are more constant and the urban structure is different, the local tolerance threshold is higher and there are fewer deaths.

People living in poverty, including many urban populations in developing countries, are particularly susceptible to heat stress. Poor housing, exacerbated by the "urban heat island" effect are risk factors. Immigrants, moving from a rural to urban environment, are vulnerable to weather extremes for a considerable time as people acclimate gradually when they move to a new locale. Acclimatization takes a few days to gear up and in some cases takes several years to complete. With the rapid increase in urbanization of the world's population, the number of vulnerable urban dwellers will also rise. Temperature is not the only factor in the rise of heat-related deaths; air quality and humidity also play a part. Exposure to air pollutants is a public health concern and the presence of fine particles can cause excess deaths. Ozone exacerbates asthma and damages lung function in children and the elderly.

Although there is no Federal definition of a heat-related death, a standard has been a body temperature of 104° F or more. Previously the National Weather Service has issued excessive heat warnings when the temperature reaches 105° F (a somewhat arbitrary figure) for three hours for two consecutive days. However, "there is no established relationship between outdoor temperature of 105° F and human health," Kalkstein has said.

Excess deaths can be calculated by identifying when daily mortality levels are significantly higher than average. The difference between the daily level of mortality and the average level equals the excess deaths. The figure for the physiologic tolerance level is unique to each locality.

Based on 20 years of research on weather and mortality statistics, Kalkstein has developed a formula to predict when potentially deadly heat will arrive in an area. He has now devised a three-tier early warning system for responding to heat waves and is working with the City of Philadelphia on a pilot program to put it into practice. Based on studies funded by EPA and two NOAA climate centers, a hot weather health watch/warning system has been developed to warn the public a potentially hazardous situation is imminent. The duration, timing and type of air mass causing the heat are all important factors; a confluence of factors can make the heat wave especially dangerous. Six forecasting variables are monitored four times during a 24-hour period for identification of "high risk/offensive air masses" associated with increased mortality. Low wind, high humidity and intense solar radiation — mixed in "oppressive" air masses —

make a deadly combination. When the dimensions of a high risk air mass appear, the days within the mass which will have elevated mortality are determined by a statistical procedure which considers the number of consecutive days the air mass is expected to last, the date in the season (whether it is early or late in the summer) and the maximum temperature.

Using National Weather Service forecast data, it is possible to predict the arrival of a high risk mass up to two days before it arrives. Coordinating with the NWS, the City Health Commissioner will issue first a **health watch** two days ahead of time. Next day conditions are re-evaluated and the watch is either canceled or elevated to a **health alert**. A re-evaluation the following day leads either to a cancellation or an upgrade to a **health warning**.

The warning system then identifies the days most likely to be associated with high daily mortality. Depending on the number of excess deaths predicted, one of three levels of health warning will be issued:

- 1) 1 - 4 deaths predicted
- 2) 5-14 deaths predicted
- 3) 15 or more deaths predicted

Philadelphia suffered 118 deaths in a June 1993 hot spell which prompted initiation of this project. Most of the dead were residents aged 60 or older. The new early warning system, based on the actual physical response of people to oppressive weather and including the two-day advance warning, allows more time for preventive measures. Philadelphia's pilot plan includes home visits by special teams, inspections of nursing and boarding homes, water deliveries to the homeless, and a buddy system to check on neighbors and relatives.

The summer of 1995 provided a taste of what steamier summers may be like although to date no one has calculated the excess deaths worldwide. Europe and the

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Laurence Kalkstein

Heat Stress

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Middle East endured some of the hottest weather in more than 110 years. Headlines reported on the "sweltering Britons," the Irish "stunned" by a heat wave, a pollution alert in Paris. Temperatures rose to dangerous levels in the Middle East, sparking forest fires that ravaged the eastern foothills of Jerusalem and forced closure of Israel's main highway. In Asia, Indian weather experts say it has been 50 years since there has been such sustained, blasting heat, sweeping 1500 miles from the Arabian Sea to the Bay of Bengal, home to a population of more than 500 million. New Delhi, "in the heart of the furnace," had nearly two weeks of temperatures above 110 degrees. In Japan the mercury topped 30° C (86° F) for 32 consecutive days, surpassing a record of more than 60 years. Canada reported the third warmest summer on record. Thousands of cattle died in the heat in Iowa. Unusual tides and hot weather killed an estimated 50 million fish in a Texas river. Record heat smothered New England.

The NWS is working with EPA to establish a national system of warnings over the next several years. Scientists now have greater confidence that predictions of a global temperature rise are more reliable, and a policymakers draft of a working group of the Second Assessment Report of the Intergovernmental Panel on Climate Change speaks of an anticipated increase in the intensity and duration of heat waves. It is estimated that the frequency of extremely hot days in temperate climates, such as the US, UK, and Australia, would double if average summer temperatures rose 2 - 3° C. More heat waves will bring more danger and more deaths unless actions such as those in Philadelphia are taken to forestall them.

Would some who die during heat waves have succumbed soon afterward? Time series analysis indicates that mortality rates up to a month after heat waves are frequently below the long-term base level, suggesting 20 - 40 percent of deaths would have occurred within several weeks.

Would a succession of more frequent heat waves cause constant excess mortality? Studies suggest that successive heat waves in a season are associated with diminished mortality as the season progresses, but an increase in the frequency of heat waves should still lead to an overall increase in total mortality.

Would there be a reduction of winter deaths under global warming? Evidence indicates the sensitivity of mortality to hotter summers is substantially greater than to warmer winters. It seems likely that global warming would cause a clear net increase in mortality.

Scientists are making model-based predictions of probable additional deaths during future summers in a warmer world. Using climate change scenarios, they calculate the number of days each year that are expected to have "offensive" air mass situations. The sum of the number of offensive days and average daily excess mortality yields an annual estimate of excess deaths. The modelers have used two sets of estimates: 1) assumes the population cannot acclimatize to increasing warmth, 2) assumes the population acclimatizes physiologically, but socio-economic conditions do not improve enough to keep pace, e.g. sufficient housing amenable to heat for the rising population will not be built. Under the second assumption, extra deaths would occur even with some acclimatization.

Dr. Kalkstein can be reached at the Center for Climatic Research, Department of Geography, University of Delaware, Newark, DE 19716. FAX: 302/831-6054.

Award

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Asian policy-makers on the potential implications of climate change when he served as chairman of a February 1989 conference in New Delhi.

The award will be presented at a dinner the evening of Monday, December 4 during a workshop on climate change which he is chairing, December 4-6, 1995 in Madras. It will draw ministers, scientific and civil leaders from throughout India to develop a village-level strategy to protect the most vulnerable people against the detrimental effects of climate change.

Ozone Losses Continue in Antarctic and Arctic

The 1992 and '93 ozone holes were the most severe on record, according to Dan Albritton, director of the Aeronomy Laboratory, a National Oceanic and Atmospheric Administration installation in Boulder, Colorado, focused on the chemistry and dynamics of the atmosphere. The '94 hole covered 3.86 million square miles, about the size of Europe, and was as deep and extensive as the extremes of the two previous years, the World Meteorological Organization has reported. At the end of September and early October, ozone loss was about 60 percent of pre-hole averages and during a few days reached 70 percent. There were losses of 100 percent at some altitudes.

The ozone layer over the Arctic also shrank by a record amount this year, and ozone levels in the Arctic were down about a third of normal levels, according to a Finnish institute meteorologist. Ozone over Europe and North America has declined 10 percent since the late 1950s, meaning that about 15 percent more radiation is hitting the earth's surface, and the Northern Hemisphere's ozone layer thinned by 25 - 30 percent in

1991 and 93. Substantial Arctic ozone losses may occur for short spells during very cold stratospheric periods in sun-lit upper-middle latitudes. Examples were episodes of extremely low ozone levels (deficiencies of more than 20 percent) in 1992, 93 and early 95.

Peak global losses are still to come, according to Albritton, topping off around the year 2000. By then the losses would reach 12 to 13 percent in winter in northern mid-latitudes. As long as the atmospheric levels of chlorine and bromine compounds continue to increase, greater ozone losses at polar and mid-latitudes can be expected. After 2000, although the losses will shrink, they will continue for several decades, because of the long life of the chemicals which react with ozone. All of these estimates presume

there will not be a volcanic eruption which throws sulfate aerosols into the lower stratosphere, causing additional ozone destruction for up to a year or more, as the Mt. Pinatubo outburst did in 1992. The passage of the 1987 Montreal Protocol and its London and Copenhagen Amendments in 1990 and 1992 have slowed the growth of ozone-depleting gases, encouraging scientists and public officials that the protocol is having its desired effect. Full compliance with a strengthened Montreal Protocol by all nations would allow chlorine levels to return to 1970 amounts of 2 ppbv by 2060-70, according to a WMO/UNEP publication.

Recent research increases our understanding of the role of particles in accelerating ozone loss by chlorine/bromine. A small amount of CFC particles may go

into reactive chlorine, larger amounts into unreactive. But if there is ice or sulfate present, providing a surface, the particles may shift the process from unreactive to reactive, increasing ozone destruction.

Methyl bromide in the atmosphere is very efficient at destroying ozone, and 40 percent of the sources of bromide are human. It is used as a fumigant for soils and commodities, including the quarantine treatment of some products for international trade, and as a transport fuel additive, and to kill pests in houses. It is also released in biomass burning and in use of leaded gasoline. More than half the methyl bromide released in to the atmosphere comes from natural sources in the ocean. There is good news and bad news about this chemical. New findings show that oceans remove some methyl bro-
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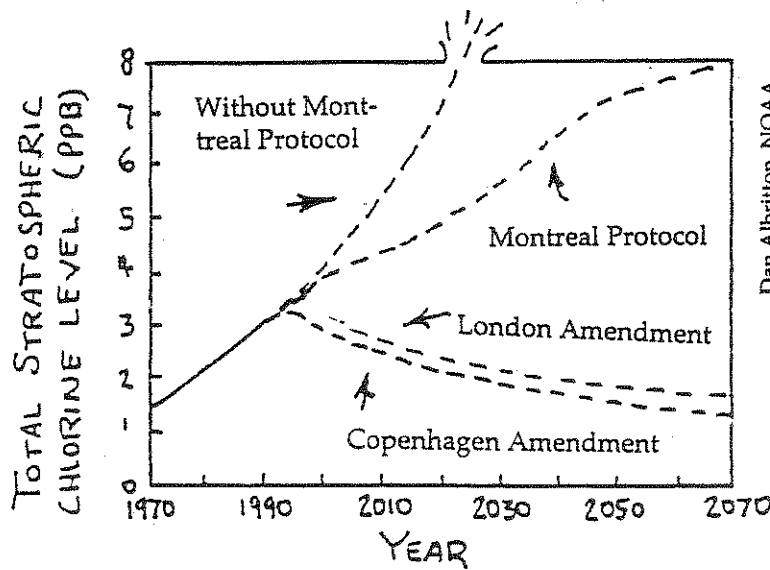
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Ozone

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side but that stratospheric bromine chemistry has been found to be more potent against ozone. Its ozone depleting potential is some where between 0.3 and 0.9. There is no single alternative chemical to substitute for all its uses. "The ozone layer will never recover if the developing countries do not adopt some control measures for HCFCs and methyl bromide and if they increase their consumption of these substances at any significant rate," says a UNEP release.

It has also now been found that subsonic aircraft emissions may alter clouds and hence climate; an extremely difficult research problem to sort out.



Dan Albritton, NOAA

A SUCCESS STORY

New research also shows CFCs and other gases are causing lower stratospheric ozone loss which leads to a local cooling. If there is a local cooling, less heat is radiated downward. In this case, ozone

"sustain for decades unprecedented levels of stratospheric chlorine," suggesting there should be a "dialogue" between backers of the protocol and the convention.

depletion introduces surface cooling, complicating detection of greenhouse warming from CO₂. There is also a conflict between using HFCs to advance the Montreal Protocol and adherence to the climate convention. HFCs have a global warming potential. More than modest substitutions of HCFCs for CFCs could increase peak chlorine levels and

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Inside

A Report on
Environmental Refugees
by Norman Myers

The Climate Institute is a private nonprofit organization formed to advance public understanding of climate change including the greenhouse effect and of strategies to avert stratospheric ozone depletion.

