Global Changes and Local Trends

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Weather is a difficult thing to predict. When compared with the other years we often remarked that a particular year is dry or cold. Most aspects of climate seem unpredictable and rainfall varies mostly where it is sparest : in deserts, and in wet localities during the dry seasons. Yearly variations in temperature on a given date is very high in places where temperature fluctuates mostly during the year. Flooding in recent years in the Mississippi Valley and along many rivers in Europe drives home the capriciousness of nature.

The Peruvian fishing industry, as well as some of the world's largest sea bird colonies, thrives on the abundant fish in the anchovy-rich waters of the Peru Current, a mass of cold water that flows up the western coast of South America and finally veers offshore at Ecuador towards the Galapagos archipelago. North of this, warm tropical inshore waters prevail along the coast. Each year a warm counter current known as **El Nino** ("little boy" in Spanish, referring to the infant Jesus because the phenomenon appears around Christmastime) moves down the coast of Peru. Some **El Ninos** are strong enough to force the cold Peru current offshore, taking with it the food supplies of millions of birds as well as the livelihoods of local fishermen.

During the years between strong El Nino events, a steady wind blows across the equatorial central Pacific Ocean from an area of high atmospheric pressure centered over Tahiti to an area of low pressure centered over Darwin, Australia. The difference in atmospheric pressure between the western Pacific and the eastern Pacific normally fluctuates somewhat between the years in a see-saw pattern, with high pressure in the west corresponding to low pressure in the eastern regions. This fluctuation of pressure is called the **Oscillation Southern** (SO). Occasionally, the SO will bring extremely high pressures in the western Pacific, resulting in the reversal of the trade winds and, in some instances, the normally westward-flowing ocean currents. Such conditions, coupled with a strong El-Nino, cause warm water to pile up along the western coast of South America and greatly weaken or even halt upwelling. The simultaneous occurrence of unusually strong El-Nino and unusually high atmospheric pressure in the western Pacific is called an **El Nino-South Oscillation** (ENSO) event or sometimes, **a warm event**. Such events not only affect the Peruvian fishing industry, but also have important widespread climatic effects. It is important to note that the term "El Nino" which was coined by

Peruvian fishermen to describe an annual change in environmental conditions, is used by many to refer to all the global events that occur in an ENSO year. This "El Nino" is often used synonymously with "ENSO" or "warm event" when discussing global changes even though it has a more restrictive meaning.

Historical climatic data (i.e. atmospheric pressure, sea surface temperature and air temperature) recorded from 1959 until the present shows the occurrence of significant ENSO events in 1957-1958, 1965-1966, 1972-1973, 1982-1983 and 1986-1987. An unusually long ENSO event began in 1991 and extended until 1995. The climatic and oceanographic effects of an ENSO event extend over much of the world affecting ecosystems in such distant areas as India, Sri Lanka, South Africa, Brazil and Western Canada. When the El Nino counter current warms the water of the eastern Pacific, rainfall in western North America increases with moderate temperatures, leading to warm winters. The warming of the waters of the eastern Pacific is associated with a cooling of the waters of the western Pacific, which results in reduction in the intensity of the monsoon rainfall in that region. The ENSO event in 1982-1983, one of the largest in recorded history, disrupted fisheries and destroyed kelp beds in California, caused reproductive failures of sea birds in the central Pacific Ocean, and resulted in widespread mortality in coral in Panama. Precipitation was also dramatically affected in many terrestrial ecosystems, notably in the deserts of Northern Chile, normally one of the driest places on earth which received the first recorded rainfall for over a century. However, the ENSO event which occurred between 1997-1998, is the largest ever recorded and also affected our coral reefs in Hikkaduwa.

Just as fishermen noticed that the waters off Peru sometimes become unusually warm, they also noticed that those waters occasionally become unusually cold. They referred to this phenomenon as La Nina ("Little Girl" in Spanish). Usually strong La Nina conditions can also have widespread effects on environmental conditions. A **cold event** is one associated with unusually cool sea surface temperatures in the eastern Pacific (a strong La Nina) along with the unusually high atmospheric pressure in the eastern Pacific associated with the southern oscillation. During such events, cold sea surface temperatures extend well to the west in the equatorial Pacific. The global climate effects of a cold event tend to be opposite to those of an ENSO event (El Nino)

Eutrophication

Human activities such as agriculture have real ecological affects that alter natural processes, processes that sustain life on earth. The highest rate of human population growth on earth (2 – 3.5%) prevails in the sub-Saharan Africa, a vast region where human survival has long been linked closely to

ecosystem health because of its dependence on subsistence level farming and fishing. As the human population grows and spreads, more and more of the world's neutral water is at risk.

Pollutants and water enter a lake by the same route, and the same applies to ground water pollution. The pollutants themselves are multitude. The convenient way to sub-divide them is to consider materials that only become pollutants when present in excess and in moderate amounts they could be accommodated. There are also materials that are unwanted at any concentrations.

The nutrients (N & P) that nourish a productive aquatic ecosystem are all well and good in "natural" quantities. Nowadays many lakes, they are present in excess, and the result is "galloping eutrophication", otherwise called hypertrophication. The causes are, firstly, sewage (plus runoff from feedlots) and, secondly, agricultural fertilizer washed in from nearby fields (plus runoff from golf courses, ornamental parks and gardens). These nutrients enrich any water body they reach with lavish amounts of nitrates and phosphates. Sewage contains a much higher proportion of phosphates than does natural water, in which algal growth is usually limited by phosphorus shortage. Dense blooms of algae therefore grow in lakes polluted with sewage such as Beira and Kandy lakes. The result is a surface covered with warm lumpy, green scum, with trapped air bubbles. As the algae dies and decomposes, the oxygen in the water is used up, and fish, tadpoles, and invertebrate animals suffocate. The rate at which oxygen is used is a measure of this kind of pollution.

Acidification

Episodic acidification of epicontinental waters on earth has become a major global issue over the last two decades. Since then, environmental scientists and policy makers mainly in the western world are working together to overcome this devastating environmental tragedy. A recent study concluded that acid rain would devastate the ecology the sizeable chunk of Asia within 20 years unless China invests a large amounts of money to control air pollution from its coal fired power plants. Acid precipitation occurs primarily when SO_2 and NO_x are emitted by the burning of coal, natural gases and petroleum products which are oxidized in the atmosphere forming sulfuric and nitric acids. Further, volcanic eruptions and SO_2 and CS_2 originate from anaerobic oxidation and in the ocean bed respectively and also contributes to the acid rain. It is well documented that a large anthropogenic emission of SO_2 and NO_x have profound influence on atmospheric chemistry of Europe and North America with subsequent deleterious effects on aquatic and terrestrial ecosystems. Apparently, both wet and dry acid depositions transfer elements from the atmosphere to the biosphere via the hydrosphere.

The main victims of acid precipitation are freshwater fauna and flora which are sensitive to extreme pH. However, significant damage to forests, crop plantations, wildlife and architecture have also been

recorded. A significant decrease in fish population has been documented in the Scandinavian, British, Scottish and North American lakes and streams as a result of acid precipitation (Harvey, 1980). The damage to wildlife by acid rain, especially to aquatic invertebrates has been widely documented. Most crystalline shields and non-carbonated sedimentary rocks can be considered as being sensitive to acid precipitation. The presence of geologically sensitive areas downwind of existing major emission sources lead to three problem areas where acidification is a major issue: Southern Scandinavia, Northeastern USA/Eastern Canada and China. Projected rapid increase in emissions creates potential future problem areas in Nigeria, Venezuela, Southern Brazil and South and Southeast Asia including Sri Lanka. It is a known fact that the buffering capacity of epicontinental waters, plays an important role in mediating surface water acidification.

The chemical composition of rainwater has been determined in many studies because of the acid rain phenomenon to summarize historical and geographical evolution of acid rain in relation to atmospheric and aquatic chemistry, fisheries, soils, forestry and agriculture. Following the studies on climate and weather in Sri Lanka, scientists have compared the rainwater chemistry in dry and wet zones of the island which shows absence of extreme acidity. In Sri Lanka there is no national programme for monitoring of rain water but there is a tendency to believe that acid rain is not a problem for the country. However, scientific evidence is there to prove that there are signs of acid rain. Further, it has been planned to establish coal-fired thermal plants to meet the power demand in Sri Lanka. Therefore, acidity in rain water could increase in the future, due to projected thermal plants, anticipated industrialization and passive transportation of air pollutants from neighboring countries.

Asia- Brown Cloud

A hazy brown cloud covering South Asia to a depth of three kilometers (two miles) is disrupting seasonal monsoon weather patterns, damaging agriculture, and risking the lives of hundreds of thousands of people in the region. The pollution that is forming the haze could lead to several hundreds of thousands of premature deaths as a result of higher levels of respiratory diseases in Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. These initial findings clearly indicate that this growing cocktail of soot, particles, aerosols and other pollutants are becoming a major environmental hazard for Asia. The haze is the result of forest fires, the burning of agricultural wastes, dramatic increases in the burning of fossil fuels in vehicles, industries and power stations and emissions from millions of inefficient cookers burning wood, cow dung and other bio-fuels.

Studies indicate that the level of fatalities is rising along with the levels of pollution. Results from seven cities in India alone, including Ahamadabhad, Calcutta, Delhi and Mumbai (Bombay), estimate that some kinds of air pollution were annually responsible for 24,000 in the early 1990s. By the mid-1990s they resulted in an estimated 37,000 premature fatalities. There are also global implications not

because of a pollution parcel like this, which stretches three kilometers high and can travel half way round the globe in a week. The concern is that the regional and global impacts of the haze are set to intensify over the next 30 years as the population of the Asian region rises to an estimated five billion people. The findings on the Asian Brown Cloud have come from observations gathered by 200 scientists working on the Indian Ocean Experiment (INDOEX) supplemented by new satellite readings and computer modeling. The scientists are calling for an action plan to address the threats across Asia as a whole. The haze problem is comparable, if not more severe, in South East and east Asia including China.

This blanket of pollution cuts the amount of sunlight or solar energy hitting the Earth's surface by as much as 10 to 15 percent. At the same time its heat absorbing properties are estimated to be warming the lower parts of the atmosphere considerably. This combination of surface cooling and lower atmosphere heating appears to be altering the winter monsoon, leading to a sharp fall in rainfall over northwestern parts of Asia and increase of rainfall along the eastern coast of Asia. Comprehensive regional models and regional aerosol and climate observations are needed for verification. Project Asian Brown Cloud aims to establish observatories to study the haze and its impacts on agriculture, water supplies, and human health. UNEP has said in a statement that the project is intended to shed more light on the complex science linking pollution hazes in the region with issues such as global warming.