EARTH SCIENCE

The fundamental truth about life is that everything is inexorable linked- from our own planet's orbit and axis down to the minutest sediment at the bottom of a stream in Idaho. No small step is actually small, because it creates a ripple in both time and space and impacts everything in the chain of life.

To begin, the **earth's** nearly circular path as it orbits the sun is tilted by 23.5 degrees; nothing less, nothing more and this creates the seasons. Summer is when the Northern Hemisphere faces the sun and the opposite when it faces away from it when winter comes. When this axis is disturbed, tilting at more than the present angle, we would have chaos. At an angle of let's say 90 degrees with the sun directly overhead the North Pole, sunlight would be continuous enough to cause the ocean to boil and the lower hemisphere to freeze. Huge storms would ravage what is left of the earth. Even the earth's elliptical orbit creates subtle but impactful differences in climate. The outside atmosphere itself has an effect on climate; the earth's albedo which helps in deflecting sunlight has lowered due to global warming. Today, the expanse of agricultural land from cultivation and the world's oceans, now less covered with ice are contributing factors to our atmosphere's ability to deflect sunlight.

Another important component in this global temperature control system is **Atmospheric circulation** which is defined as the large-scale movement of air along with ocean circulation which distributes heat evenly on the planet's surface. Due to diverse variables, the large scale structure of this atmospheric circulation varies on a yearly basis although its core structure remains constantly the same.

But there are variations of course or individual weather systems (midlatitude depressions, or tropical convective cells) which tend to occur randomly and as such, make it impossible to predict weather for an extended period of time although so far, the climate itself as a whole has remained stable. The earth's wind belts and jet streams which surround it are controlled by three so-called cells: the Hadley Cell, the Ferrel Cell and the Polar Cell. While these are the three major players, a third cell named the Pacific Ocean Cell may hold the key to two recent climate phenomenons, the El Nino phenomenon and its reverse counterpart, the El Nina (Miller, 1981).

Another important cycle is the **Hydrologic Cycle** which refers to the continuous movement of water both on, above and below the surface of the earth. The one distinguising characteristic of this cycle is that it shouldn't really end because in principe, a cycle has no beginning nor end. Water itself changes into vapor, ice and back to liquid form again over and over. This balance remains stable and fairly constant over time as individual water molecules could come and go. Some of the most important components of this cycle include evaporation which refers to the transformation of water from a liquid state to a gas one as it goes from the earth or from bodies of water and into the overlying atmosphere.

What fuels this process is solar radiation; a similar term is evapotranspiration which actually incorporates the transpiration process from plants. It is important to note that atmospheric water is attributed mainly from the proces of evaporation (90%) and the rest from transpiration. The total amount of evapotranspiration is approximately 505,000 km^3 of water, 434,000 km^3 of which evaporates from the world's oceans. Precipitation refers to the condensed water vapor that falls to the Earth's surface which of course occurs commonly as rain, but also includes other forms or states such as snow, hail, fog drip, graupel, and sleet. The numbers for precipitation is approximately 505,000 km^3 of water fall of which 398,000 km^3 of it falls over the world's oceans. This in turn of course is the source of all the world's other bodies of water.

But even as this cycle is certainly important, too much of it, or imbalanced variations of it can affect the land itself. **Erosion proceses** is defined as the displacement of solids such as the soild, mud and rock usually by the agents of earth currents such as, wind, water, or ice by downward or down-slope movement as a natural response to the effects of gravity. Even living organisms themselves can cause erosion and called as bioerosion.

Some may confuse erosion with weathering, but in this latter process, the breaking down of material does not involve any kind of movement although technically, both processes can be concurrent. While it is a natural process, erosion can be accelerated by human intervention. Unwise agricultural practices such as deforestation, overgrazing by farm animals, unmanaged construction activity and road or trail building have been proven to speed up the process. But this can be reversed with other techniques that will help preserve it such as tree coverage and terrace-building. It has to be emphasized that a certain degree of erosion is actually essential although in excess it can cause varying degrees of problems such as ecosystem damage and the outright loss of soil. But other processes such as mass movement is important as it performs the function of moving material from higher elevations to lower elevations where transporting agents like streams and glaciers can then pick up the deposited material and then move it to even lower elevations. One can find this process occuring on all slopes in varying speeds; too fast and it becomes a lethal landslide. Its slow form can be identified as a topographical manifestation called a scree slope.

Chemical erosion is tied to the water cycle and is called surface runoff which describes the flow of water from melting rain or snow over a land surface that is indcidentally filled with man-made pollutants or contaminants. When it does, it is called nonpoint source pollution; common soil contaminants include petroleum, pesticides, herbicides, insecticides and even fertilizers that are potentially toxic (Van Breenan, 1990).As a whole, the state of climate and of its processes determine the distribution, size, shape and destinies of plant and animal organisms on the planet; in short, climate will determine when or how living organims live and die. The general circulation of the atmosphere itself as was discussed in the first part, will determine the types of topographies that occur all over the world. Factors such as temperature cycles and water cycles will create either deserts or fertile forests which then determine what species can survive in these landscapes. The continuing change in the global climate, due to both natural mechanisms or to human actions will also change and modify these habitats, determining which survives or who becomes extinct, deliberately or not (Gates, 1980).

Our biosphere and in particular its vegetation plays a crucial role in the establishment and maintenance of our atmosphere's chemical composition. This vegetation carries out the vital task of exchanging over 60 billion tons of carbon through the natural mechanisms of photosynethesis and respiration and that the slightest imabalance in this delicate exchange has disastrous consequences part of which we are already experiencing (Schneider, 1984).

This excess carbon dioxide has of course created the Greenhouse effect that we are already experiencing. While the water cycle and the evaporation process will do their part to keep us cool, the aborption of too much carbon dioxide in the worlds oceans has a great impact on the greater marine food chain. Too much CO2 makes the water acidic which strips carbonate ions essential for marine organisms to build calcium carbonate shells and exoskeletons; as a result, vital phytoplankton die and the chain is disrupted with potential for mass extinction of sea life. On land, climate change will ultimately alter forest distribution and compostion.

In this altered state, the animals that used to live in familiar habitats may find their homes changed and may be prompted to migrate, a phenomenon already being observed around the world.

Even something as seemingly inert as soil is affected by climate change- but soil formation is indeed affected, the changes resulting from such factors as organic matter supply from biomass and soil temperature regime. There is also soil hydrology caused by shifts in rainfall zones as well as fluctuations in evapotranspiration. Soil is also affected when the sea level rises. But not all is doom and gloom; one benefit may a gradual improvement in fertility and the physical conditions of soils in humid and subhumid climates.

Another welcome change, but something that most people would not like to see happen, is to have more arable lend in areas where global warming has melted the permafrost. The FAO though is not sure, nor is it optimistic about changes although it emphasizes that the effect on the soil would directly impact how human will live based on the resulting agricultural output.

It cites the uncertainties in the interaction with changes in the location and intensity of major ocean currents and resultant possible modifications in sea surface temperatures; add to that is the general uncertainty as well of cloudiness and land cover and the resulting changes in the earth’s albedo and actual evapotranspiration.

> *Indirect effects of climate change on soils through* CO_2*-induced increases in growth rates or water-use efficiencies, through sea-level rise, through climate-induced decrease or increase in vegetative cover, or a change in human influence on soils because of the changes in options for the farmer, for example, may well each be greater than direct effects on soils of higher temperatures or greater rainfall variability and larger or smaller rainfall totals* (FAO, 1995).

But in general, it would be hard to predict exactly what would happen, but one thing is sure- the effects would be global and no one and nothing would be spared.

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