CLIMATE CHANGE AND WATER RESOURCES

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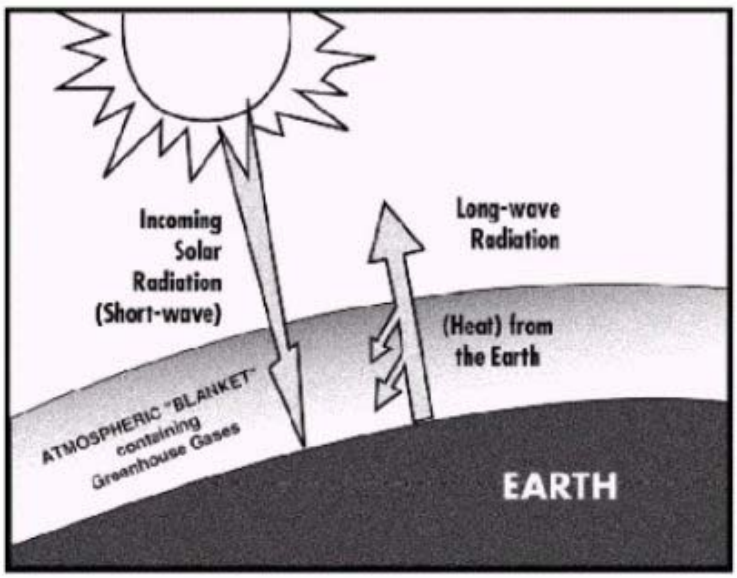

Figure 1: A simplified diagram illustrating solar radiation.
Source: CC-TRAIN

All life on this planet depends on the availability of water. Our planet is the only planet on which the existence of water in liquid phase is known. In continuous movement under and above the surface of the earth, water serves as an indispensable resource in

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the ecosystems of this planet. On the other hand water can also cause destruction and death. Floods are one of the worst natural disasters and have caused more victims and material loss than have earthquakes, eruptions of volcanoes and other similar catastrophes.

It is without any doubt that the cycle which has always been taken for granted has been modified by mankind since early history by the construction of dams, wells, canals, irrigation and drainage systems. Nowadays, governments and private entities are spending increasing amounts of money to design, construct and maintain these installations. These anthropogenic activities not only modify the hydrological cycle but also disturb the natural course of water. By erroneous land-use and water management not only the quantity of water is decreasing but also the quality of this "renewable" natural resource.

Aside from the direct impacts that human activity have on the water balance, mankind is changing the global, regional and local water balances in an indirect but in the end not less damaging manner. The changes are caused by climate changes that affect the processes of the hydrological cycle.

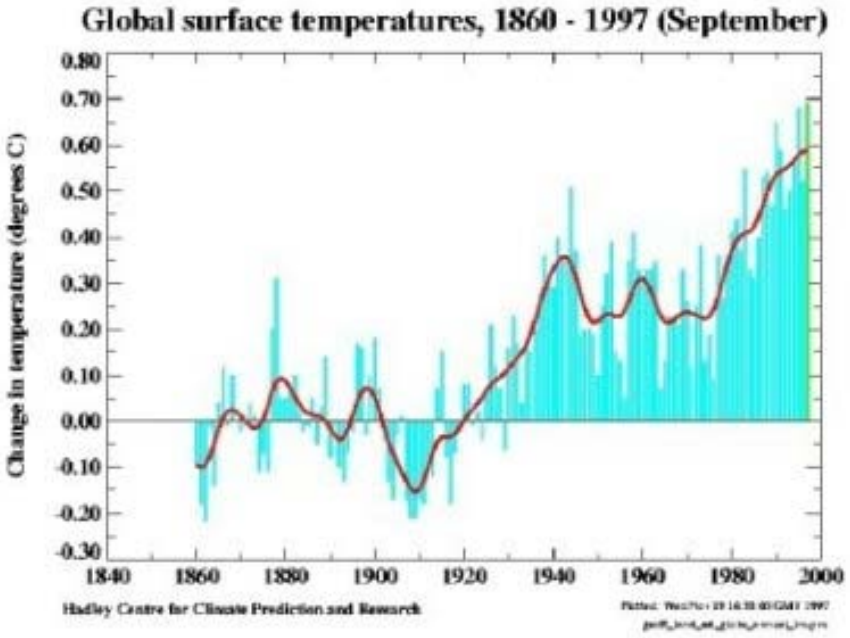

Figure 2: Surface observations, over land and sea, build up a record of global average annual temperatures since 1860. (The temperature for 1997 (green bar) includes observations up to the end of September) Source: Hadley Centre

The atmosphere contains natural concentrations of greenhouse gases that influence the radiative balance of the incoming solar energy (Figure 1). Without these greenhouse gasses the average temperature on the earth would be almost 30ºC lower, making life impossible on the higher latitudes. Human activities (primarily the burning of fossil fuels and changes in land use and land cover) are increasing the atmospheric concentrations of greenhouse gases, which alter radiative balances and tend to warm the

atmosphere. On the other hand, natural processes and human activities increase atmospheric concentrations of aerosols which have an opposite effect on radiative balances and tend to cool the atmosphere (Figure 1). Changes in greenhouse gases and aerosols, taken together, are projected to lead to regional and global changes in temperature (Figure 2), precipitation, and other climate variables—resulting in global changes in soil moisture, an increase in global mean sea level, and prospects for more severe extreme high-temperature events, floods, and droughts in some places. Based on the range of sensitivities of climate to changes in the atmospheric concentrations of greenhouse gases and plausible changes in emissions of greenhouse gases and aerosols, climate models project that the mean annual global surface temperature will increase by 1–3.5ºC by 2100, that global mean sea level will rise by 15–95 cm, and that changes in the spatial and temporal patterns of precipitation would occur. These long-term, large-scale, human-induced changes will interact with natural variability on time scales of days to decades [e.g., the El Niño-Southern Oscillation (ENSO) phenomenon] and thus influence social and economic well-being.

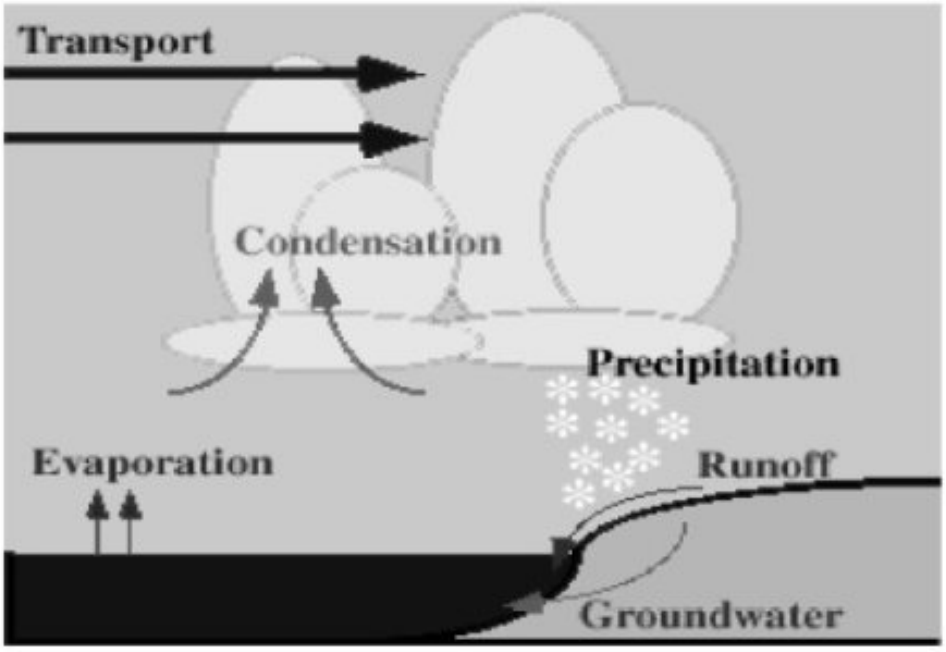

Figure 3: Simplified illustration of the hydrological cycle

Scientific studies show that human health, ecological systems, and socioeconomic sectors (e.g., hydrology and water resources, food and fiber production, coastal systems, and human settlements), all of which are vital to sustainable development, are sensitive to changes in climate—including both the magnitude and rate of climate change—as well as to changes in climate variability. Whereas many regions are likely to experience adverse effects of climate change—some of which are potentially irreversible—some effects of climate change are likely to be beneficial. Climate change represents an important additional stress on those systems already affected by increasing resource demands, unsustainable management practices, and pollution, which in many cases may be equal to or greater than those of climate change.

The hydrological cycle (Figure 3) on our planet is induced by energy that is supplied by the sun and includes precipitation, infiltration, surface and groundwater flow, evaporation, transpiration and condensation as basic processes. The hydrological cycle moves enormous quantities of water around the world (Figure 4).
This movement is partly relatively fast as one drop of water stays an average of 14 days in a river and about 10 days in the atmosphere. But these units of time can change into centuries for glacial and thousands of years for water that slowly moves through a deep aquifer.

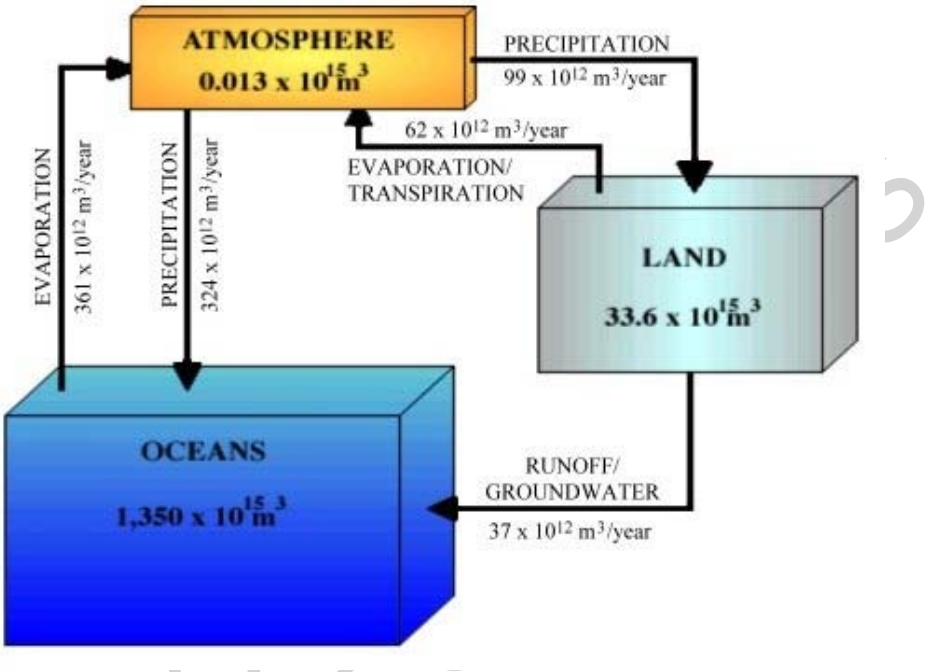

Figure 4: Fluxes in the hydrological cycle

Human efforts to alter the atmospheric stages of the hydrological cycle date back to ancient times. Prayer, dances, human and animal sacrifices, and other rituals have been tried to bring rain. Cloud seeding is a more scientific, but still uncertain, attempt to induce precipitation. Although it is questionable whether any of these intentional efforts have significantly altered precipitation patterns, the balance of evidence now suggests that humans are influencing the global climate and, thereby, altering the hydrological cycle, however inadvertently.

Climate Change and its impact on the availability of water resources will intensify in many regions of the world the competition for water between the different users. New technologies might be implemented to decrease the use of water but it is also expected that new technologies could increase the demand of water especially related to the quality of the water used in the process. Changing weather patterns and offset of seasons might increase water demand of industry and agricultural practices. Furthermore, the ongoing increase of the population on this planet and the changes of water use habits will boost the need for fresh water causing problems especially in regions where natural resources are already under severe pressure regarding quantity as well as quality (e.g. developing countries and urban areas.) Often, it is mentioned that

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regional conflicts and wars will develop around the right to use water. Climate Change might bring relieve in some of those areas, but unfortunately it is expected that in many regions where water is already becoming scarce, climate change will only aggravate the existing situation.

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