How does a climate change influence water resources? assignment

How does a climate change influence water resources? Climate change is the biggest challenge that we face in the world today. It is already leading to significant changes in the world's physical environment. Extreme weather events are becoming more frequent. Glaciers are melting. Sea ice and snow cover are declining. Animals and plants are responding to earlier seasons. Global warming has already driven up mean sea levels by 110-20 centimetres during the last 100 years, and this is forecast to rise by up to another 88 centimetres by 2100.

In this essay I will discuss how climate change influences water resources and how the impact of climate change on hydrology can be minimised. Water is essential to human life and many of life's activities, from direct issues such as drinking water and agriculture, to other essential modern activates such as industry and power generation. Consequently, there have been a number of studies into the potential effects climate change can have on hydrology and water resources. These studies are usually estimated by constructing scenarios for changes in climatic inputs to a hydrological model from the output of general circulation models (G.

C. M's). The main motive for creating such a model is to better understand how climate changes affect hydrology so it is paramount that these models are appropriate for measuring the impact on water quantity and quality. Such research over time is vital, as it will help predict future changes and in particular seasonal flow predictions. As sea levels rise due to increases in global temperatures the risks of flooding are much higher and therefore a greater emphases on water management based on the minimisation and adaptation to these changes in capacity must be made (I.

E. flood defences). Also as climate change affects the quality and quantity of water, supply strategies must adapt. These practices will have a major impact on how climate change will affect the water sector and in some countries water managers regard climate change exclusively, as S. Subak explains: 2In the UK, water supply companies were required by regulators in 1997 to “ consider” climate change in estimating their future resource. A major concern with climate change is the possibility of changes in the hydrologic cycle.

The hydrologic cycle (or the water cycle), describes the continuous movement of water on, and below the surface of the Earth And any changes to the cycle can be disastrous. The variation of water is mainly influenced by precipitation and changes can have devastating effects on hydrology and therefore water resources, such as the frequency of which floods and droughts occur. Effects have been observed showing in general that the Northern hemisphere has had more rainfall and the tropics and subtropics less rainfall than in previous years. Along with this, 3T.

J Osborn monitored that the occurrence of intense rainfall has risen in the United Kingdom and 4HadCM2 experiments show a rise in the relative inconsistency of seasonal and annual precipitation levels as a result of climate change. With the increase in droughts agriculture will suffer, as the amount of water held in the ground is vital to the growth of vegetation. Simulations of soil moisture conducted by 5Gregory et al show that with an increase in greenhouse gases is directly linked with lower levels of soil moisture in the Northern Hemisphere.

It is also thought that climate change may affect the capacity of water that soil can hold as Boix-Fayos et al. explains: 6'Infiltration and water-holding capacity of soils on limestone are greater with increased frost activity'. This shows that if temperatures increase and freezing is less frequent then typical moisture may not be absorbed by the soil. Therefore during the increased winter rainfall (rather than snow or hail), the amount of effective rainfall, which would be absorbed and consequently recharge the soil, will decrease, as the soil can no longer hold such amounts. Bouraoui et al simulated reductions in groundwater (lakes, rivers, ect) recharge near Grenoble, France, almost completely resulting from the rise of evaporation and the decrease of soil capacity. Macro-pore and fissure recharge occurs where soil is highly fractured and rapid recharge occurs whenever it rains and so will be more affected by variations in rainfall. 8 K Sandstrom, found that small changes in rainfall will lead to a dramatic change in recharge and therefore water resources when he found that a reduction of 15% in rainfall resulted in a 40-50% reduction in recharge.

These findings were mirrored by 9 L. C, Loaiciga et al, when they tested a range of climate changes on ground water levels in Texas and found that in six out of the seven G. C. M based scenarios ran, ground water levels were greatly reduced. Areas, which are recharged by seasonal streamflow runoffs, will be significantly affected by increases in evaporation levels as this would lead to lower levels of water storage. This would lessen the life span of vegetation and have a knock on affect to inhabitants who really on these foods. However generally variations in runoff trends follow levels of precipitation (I.

E. when precipitation increases so does runoff) rather than increases in temperature. However in some areas large unpredicted changes have resulted from not only precipitation but also temperature because precipitation has fallen as rain rather than snow in winter and hence has reached rivers quicker than in past years. Lakes are particularly vulnerable to changes in climate. Variations in air temperature, precipitation, and other meteorological components directly cause changes in evaporation, water balance, lake level, ice events and the lake ecosystem.

Under extreme climatic conditions, lakes may disappear entirely. Changes in inflows to endorheic lakes can have very substantial effects: The Aral Sea, for example, has been significantly reduced in size by increased levels of irrigation water and the Great Salt Lake in the United States has increased in size as a result of increased precipitation. Many endorheic lake systems include significant internal thresholds, where change may be more catastrophic an increases and decreases in size.

For example Lake Balkash currently consists of a briny part and a fresh part, connected by a narrow strait. Several rivers flow into the fresh part, preventing the entire lake from becoming completely salinised. However if this were to change this would lead the fresh section of the lake to become salinised and would render the lake useless for drinking water. Although an increase in flood risk is frequently thought of as one of the potential and most devastating effect of climate change, relatively few studies have looked at possible changes in water levels.

This is largely due to difficulties in defining credible scenarios for change in considerable increase of precipitation that would trigger flooding. A number of studies have tried to calculate changes in flood frequencies, using monthly precipitation levels, and some have looked at the possible additional effects of changes in rainfall intensity. One such group was 10Reynard et al, who estimated that a change in the degree of different occurrences of floods in the Thames and Severn, by: 11'Assuming first that all rainfall amounts change by the same proportion and then that only " heavy" rainfall increases. When temperatures rise flood risks increases because winter rainfall increases. It is the total volume of rainfall over several days, which is the underlying factor not the peak amount of rainfall. The effect of changes in precipitation resulting from climate change on future flooding in Bangladesh was studied by 12Mirza et al. They used standardised precipitation change scenarios and found that in the most extreme scenario that for a 2?? C rise in global mean temperature, the average flooding of the Ganges, Brahmaputra, and Meghna could be as much as 19% higher

Droughts may be expressed in terms of decreased levels of rainfall, soil moisture or low water levels. A ' hydrological' drought is defined by when river or water levels are low, and a ' water resources' drought occurs when these low levels impact water use, as low river flows in summer may not necessarily create a water resources drought. Water resources droughts therefore depend not only on the climatic and hydrological inputs but also on the other external influences on the water resource must be taken into account. 13 N.

W Arnell studied the variations in the total minimum annual runoff using several scenarios. He found that the pattern of ‘ low flow’ varies in a similar way to average annual runoff however percentage changes have a tendency to be larger. Arnell created a different index of low flow across Europe and the average difference between streamflow and the flow exceeded 95% of the time, while flows are below this threshold under four scenarios. The results propose a decrease in the amount of low flows across much of Western Europe under most scenarios, as a result of lower flows during summer.

But an increase of low flows in Eastern parts due to the increase in winter flows, however in these regions the season of lowest flows tends to be summer rather than winter. There have been similar studies into changes in low flow indicators at local levels. For example D Gellens and E Roulin, simulated variations in low flows in a number ofl Belgian catchments under a range scenarios. They show how the same scenario could produce different variations in different catchments, depending largely on the geological conditions.

Areas with large amounts of water storage tend to have higher summer flows during the climate variation and low flows in areas with little storage tend to be reduced because these areas don’t have the benefits of increased winter recharge. However hydrological trend data have a tendency to be over a relatively short period of time and many data sets come from individual areas with previous histories of human interference. Variations in hydrological behaviour are common and detecting any changes in behaviour due to climate change is difficult.

Water “ quality” is a function of naturally occurring materials, which depend on atmospheric, geological, and climate variables, physical, and biological characteristics. However this implies that there is some sort of benchmark for quality but in practice different uses of water have different standards. Pollution with respect to water quality can be defined as a decline of the chemical, physical, or biological characteristics of the water to such an extent that it impacts the water or ecosystem within the water.

Chemical water quality is the chemical load asserted on to the water resource. The load is determined by geological and land uses such as Agriculture, industry, and public water use. Agricultural is most likely to be affected by climate change because a changing climate might alter agricultural practices. A changing climate may also change the chemical composition of the soil. A. C. Avila et al conducted experiments, which simulated an increase in base cation weathering rates when temperature and precipitation increased.

This showed that concentrations of base cations such as calcium, sodium, and potassium increased as well as alkalinity. Water temperature is not only based upon atmospheric temperature fluctuations but also on wind and solar radiation. So increased levels of ozone, which will block more solar radiation will have a knock-on effect on biological and chemical processes in stream water. Higher temperatures alone would lead to changes in concentration of some chemical species and also dissolved oxygen and algal blooms.

Water temperature in lakes is more complicated as lakes respond in different ways because thermal stratification is formed in summer, as well as in colder regions in winter. 16J. L. Meyer et al assessed the effect climate change had on thermal stratification by creating scenarios based on hypothetical lakes. They show that lakes in subtropic zones and in subpolar zones are subject to greater relative changes in thermal stratification trends than equatorial lakes and that deep lakes are more sensitive to change than shallow lakes in the subtropic zones.

The consequences of direct variations in water quality may be acute, as 17Varis and Somlyody explains: ‘ Increases in temperature would deteriorate water quality in most polluted water bodies by increasing oxygen-consuming biological activities and decreasing the saturation concentration of dissolved oxygen’. However water quality in many water sources are heavily dependent on human activities. Agricultural and other land use practices have a very significant effect on water quality. As to do actions to manage point and non-point source pollution and treat wastewaters flowing out into the environment.

In such water sources, future water quality will be very dependent on future human interference, including water management policies, and in relative terms the effect of climate change may be very small. However a substantial effort is being expended around the world to improve water quality and these efforts will have a very significant impact on minimising the effects of climate change on water quality. It is important that water management continues to improve to ensure quality and quantity of water resources. Most strategies are used to help alleviate increasing demands for water resources or for protection against risk.

In the United Kingdom water supply companies are pursuing both the demand and supply management in response to the increase in demand for water and these strategies are potentially feasible in the face of climate change. Nowhere, however, are water management actions being implemented pacifically to cope with climate change, although an increasing number of countries are considering climate change when assessing future resource management possibilities. In the United Kingdom climate change must be considered by water supply companies when assessing future resource equirements, although at present companies are unlikely to have new resources justified by climate change alone. 18Frederick, 19Young et al and 20Anderson and Hill believe that management of water is moving toward the use of demand-side options because they are regarded as being more environmentally sustainable, cost-effective, and flexible. It is apparent that a combination of both the supply and demand sides are needed indicating a change in infrastructure in some cases in particular with regard to developing countries, where it is often the demand to meet basic human health demands.

However there are also a number of policies, which are the complete opposite of this and tend to disregard climate change and instead focus on the demand for water. Such examples include the removal of subsidies to agriculture and floodplain habitation. A have a successful demand side policy there must be efforts to reduce the need for supply augmentation, although they may not prevent such needs completely. Water management is evolving continually, and an increasing number of options, which take the demand side into account, are being implemented and this evolution will affect the impact of climate change.

In conclusion it is apparent that climate change will continue to challenge existing water management practices, especially in regard to developing countries with less experience in incorporating uncertainty into water planning. Future water management policies must take climate change into account to minimise the effect it has on water quantity and therefore the ability to supply the demand for quality water. It must also be noted that if there are no changes to the output of greenhouse gases and other forms of pollution then the amount of quality water will be greatly reduced and eventually non-existent.

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