

## Fact Sheet 1 : The Water Cycle and Climate Change

*“Climate and freshwater systems are interconnected in complex ways. Any change in one of these systems induces a change in the other.”*  
IPCC AR4, ch3, p175-176

Our earth is heating up and will continue to do so for some time. How fast it heats depends on many factors, including how much oil, coal and petrol we continue to burn. In their 4<sup>th</sup> Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) uses various scenarios to give *best estimates* of a 1.8 to 4.0°C rise in temperature by 2100, with a wider *likely range* between 1.1 and 6.4°C. Just stop and read that number again. It is possible that if we continue to be highly dependent on fossil fuels, the earth could be, on average, 6.4°C hotter. Most people ignore this number because it is too scary and stick with the ‘median’ of just under 3°C. But even this is high. Activists and scientists around the world are doing their best to persuade business and government to take steps to keep the change below 2°C.

In South Africa it is likely that in the next thirty to fifty years, temperatures will increase between 1-3°C. Inland areas and minimum temperatures will increase the most.

What does all of this have to do with water? Quite a lot. Water plays an important role in the earth’s climate. And the climate plays an important role in the hydrological cycle.

### **Rains and storms**

Warm air can hold more water than cold air. This makes the climate more variable. It also leads to more intense floods and droughts. On average. The local manifestation of climate-water changes can be quite different as we shall see. Globally, predictions for changes in precipitation are variable – it will increase in some river basins and decrease in others; increase in one season and decrease in another. South Africa reflects this global variation. The IPCC’s 4<sup>th</sup> Assessment Report projects a decrease in runoff of 10-30% in southern Africa. Runoff is that part of rainfall that does not evaporate.

The ‘hotspot’ in South Africa is the winter rainfall area in the Western Cape. Here 5-30% less rain could fall during winter and autumn with dramatic implications for water provision and farming. Decreases in rainfall are predicted across the country in winter; whereas summer rain could increase making especially the northern and eastern parts of the country wetter. Mountains add to difficulty in pin-pointing exactly how much rain will fall where. They play a strong role in the type, amount, intensity and duration of precipitation. For example, often the tops of mountains are wetter than the bottoms, and the leeward side drier than the windward. The transition zone

between winter and summer rainfall is another area where it is difficult to make specific predictions.

### **Evapotranspiration**

On hot days, more water evaporates from rivers, oceans and the soil leaving the ground drier and the air wetter. The role of evapotranspiration from plants is a bit more complex as it is affected not only by temperature but also by higher concentrations of carbon dioxide in the air. Alterations in plant physiology and increased growth, both caused by higher carbon dioxide concentrations, lead to competing effects. There is more leaf area for evapotranspiration, but less water is conducted through the stomata. Net evapotranspiration depends on various things such as plant type, temperature, water and nutrients. In South Africa an increase in evapotranspiration of 5–15% is projected by 2050. This ‘drying out’ is a problem for growing food. It also increases the risk of fire.

### **Water quality**

Water quality is also impacted by climate change. Groundwater and estuaries can get saltier. There are two reasons for this. When sea level rises, as it will when the world gets warmer, it ‘intrudes’ into coastal groundwater tables and estuaries. This is already a threat in the Sandveld region north of Velddrif where farmers are using a lot of groundwater and the levels are dropping rapidly. (WC cc strategy). Secondly, there is reduced recharge which increases the concentration of salts.

Pollutants will also thrive. Sediments, nutrients, dissolved organic carbon, pathogens and pesticides will increase due to higher water temperatures, more intense rain and longer periods of low flow. When water is warmer, it can not purify itself effectively. Warm water holds less dissolved oxygen, which is used for biodegradation. Higher rainfall washes more nutrients, pathogens and toxins into the river. Water-borne disease increases with extreme rain.

### **Groundwater and runoff**

The IPCC predicts that ground water recharge will decrease in southern Africa. Both the timing and quantity of rainfall affect recharge rates. When less rain falls, both groundwater recharge and surface runoff are reduced *more* than the reduction in rainfall. In a scenario for Bredasdorp, Western Cape, it is estimated that an 8% reduction in precipitation results in a 31% reduction in groundwater recharge, and 30% reduction in surface runoff (LTMS). In Jonkershoek, rainfall has decreased by 14% since 1945 and annual runoff by 20% (WC cc strategy).

**Summary of predictions for South Africa** (main source LTMS)

- increase in evapotranspiration of 5–15% is projected by 2050
- 1–3°C temperature increase over next 30–50 years
- temperature increases higher inland and wrt daily minimum
- southwest of Western Cape – general drying in most seasons, 5–30% reduction in rain during winter and autumn
- Northern and eastern part of SA will be wetter in summer and autumn, especially in steep areas
- Changes in intensity and frequency of precipitation remains uncertain
- Fewer stormflow events over most of country except Northern Cape where projected to increase (and where few currently occur)
- More soil erosion
- More *variable* streamflows, despite *higher* predicted flows overall, except in Western Cape which will have *lower* variability and *lower* overall predicted streamflows
- Western Cape rainfall: drying from west to east, less winter, possibly more summer, less regular, possibly more intense; temperature increase mean, min and max (W.Cape status quo June 2005)

## Impacts of changes to climate and the water cycle

We know that changing the temperature of the planet will affect the water cycle and the weather. What does this mean in practical terms for us? What are we likely to see and experience?

**Water shortages** will increase, especially in the Western Cape. This means we'll have to figure out how to use less, despite the fact that hotter days will make us want to use more. It will mean increased tension around whose water use is more important – while there could be pressure to stop swimming pools, there could also be pressure for poor people to use less through price hikes that only rich people can afford.

**The risk of fire** will grow. This is already a huge problem in informal settlements. It will be exacerbated even further if water is limited and people aren't able to contain the fire quickly. Greening the environment makes a big difference – so start planting those indigenous trees!

**Floods will increase** in urban settings leaving many people homeless and in need of dry temporary shelter. Urban design, stormwater drainage, floodlines and disaster management will all have to improve.

**Water will be more expensive.** The cost of securing water resources to meet demand will increase. This is because the easily available water has already been used and additional water is deeper in the ground and further away. With deteriorating surface and groundwater quality, the cost of treatment could also increase. Who will pay for this?

**Infrastructure at risk.** Water treatment plants are vulnerable to damage from storms. Municipalities are not meeting water quality targets at existing treatment plants – maintenance is poor and there is insufficient capacity to treat the volumes of waste water that need to be treated. Mudslides, rockfalls and heavy rain damage roads and bridges.

**Food production is more difficult, risky and costly.** Most South Africans buy their food. Climate change will impact on farmers crops making them more expensive, but also on food gardens, making them less reliable. This is due to rising temperatures, changes to the timing and quantity of rainfall, and to higher evaporation rates.

**Water-borne diseases** will be more likely. “... as stormwater flows into sewerage pipes in areas such as Gugulethu, fears are growing of an outbreak of water-borne diseases.” *Cape Times, 8 July 2008.*

**Ecological integrity** of wetlands, rivers and estuaries will be further threatened.