

Title: Geoclimatic change – amplified consequences for health

Climate change is already manifesting in droughts, floods and extreme heat events around the globe. At the same time, the skill with which global circulation models project climate change is improving rapidly, to the point where attribution of individual events, and the changed probabilities of their occurrence due to climate change, is now possible. Model outputs are largely consistent with long term observed data. I provide a short overview of recent events linked to climate change, globally and in South Africa. At the same time, the consequence of changes to the planetary system through human population growth, land degradation, water use and forest loss among others, are amplified through climate change. This means that climate change consequences for health are not just direct, through flood, drought and heat, but also through ecosystem mediated effects, such as changes in infectious disease risk, reduced food yields, mental health and cultural impoverishment. Even more distal consequences such as livelihood loss, population displacement and subsequent conflict, may all have climate change as a contributing factor to pre-existing social-economic vulnerabilities. I present recent research first on direct effects of climate change, with examples of observed changes in mortality due to extreme heat in European cities, and on the African continent, and then recent work on indirect climate- and land use effects in more complex systems. Globally, there is an increase in the emergence of infectious disease, particularly zoonotic in origin. In some cases, the loss of forests can be directly linked to these changes, but the complex interaction between multiple hosts, climate and land use, challenge our existing systems' understanding. In an attempt to unravel some of these causal linkages, we look at animal mass mortality events, as models of disrupted systems. More than 200000 saiga antelope died in three weeks in Kazakhstan due to haemorrhagic septicaemia. The weight of evidence points to a temperature-triggered growth effect on *Pasteurella multocida* occurring naturally in the nasal passages of these antelope. This, and other examples of direct and indirect effects of climate and land use changes on health, identifies research gaps for heat and health, which are unpacked in some detail.