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The role of physics in climate science and sustainability science with special emphasis on Southern Africa

In the Anthropocene epoch, we are at a watershed where the impact of decisions made in the next five years will have impact on the future of humanity. Physics has significant roles in multiple aspects of this existential crisis. Fundamentally, in terms of evidence-based reasoning, providing the background to the conclusion that the climate is changing significantly, and at a rate not observed in the last 10 000 years, is crucial. In this paper, some of the less frequently mentioned aspects of the role of physics will be explored.

For example, in comparison with the northern hemisphere, reliable data for local weather from Southern Africa is in short supply, but Is essential in building understanding of global patterns. The new science of attribution requires good observations of extreme events, to deduce whether a disaster is attributable to the change in climate, or would have been experienced in the natural climate as a rare event. A related concern is the state and effectiveness of early warning systems within Southern Africa, which rely not only on accurate observation, but fast interpretation.

In climate science, network modelling is being adapted from information science to complement more classical climate models; and in multiscale modelling, it has become clear that the understanding of African thunderstorm systems in terms of convection, thermodynamics and turbulence is not yet adequate. The contribution of Southern African research in physics to understanding Antarctic ice breakup and the science of the Southern Ocean, a major carbon reservoir, could become significant. Less obvious is the role of theoretical physics in identifying the behaviour of bistable and related complex systems, for example the El Niño Southern Oscillation.

Complex system behaviour also has application in the stability of power supply networks, particularly as renewable energy generation and energy storage capacity are added to national and international generation and transmission networks in Southern Africa and the risk of catastrophic outages rises.

Many more examples exist and indicate that there is potential for incorporating climate and sustainability science fundamentals into physics curricula, in improving science communication skills among physicists, and in building international physics research links in Southern Africa in the context of climate and sustainability science.

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