

Uncertainty in Future Climates

The way the climate is currently evolving is uncertain, as are the consequences, particularly on a local scale. The global temperature is one of the key measures that reflect what is happening – ocean warming and expansion with consequent sea level rise, potential ice melt, changes in the atmosphere including circulation patterns etc.

There is little scientific doubt that a higher atmospheric concentration of CO₂ and other Greenhouse Gases (GHGs) increases the global average temperature to a greater or lesser degree and there has been a steady increase in the former since mid 20th century, accompanied by a more erratic increase in the latter. However at the end of the century the latter have plateaued and General Circulation Models (GCMs) of the climate have not captured this development.

Much of the basis for the policy advice from the IPCC relies on GCM projections. Model- and scenario-dependent uncertainty contributes to the uncertainties that the IPCC acknowledge. Difficulty in modelling clouds and aerosols contribute the largest uncertainty to temperature estimates for a given scenario and thereby impact on the extent to which the direct effects of GHG concentrations are amplified or damped. Oceans are another area where knowledge has only recently improved and still remains relatively poor. Convection processes are important but problematic to model relative to energy balance considerations.

There are a number of hypotheses for why the current mismatch is occurring and with that the performance of the models. The biggest policy uncertainty is whether this is just a short-term variation or the models are systematically over estimating future temperatures. The IPCC has expressed medium confidence in the former. This is something that needs to be continually reviewed and is an added argument for adaptive planning.

Putting aside this uncertainty in the performance of the GCMs, the IPCC itself includes sigsi

offset human-induced-effects in any given time frame.

Downscaling to regional impacts from the IPCC's global assessments increases these uncertainties.

In adaptive planning by GRWC and the local community all this uncertainty *plus and minus* needs to be reported, monitored and taken into account in any response. The point that is often forgotten is that just as there is a risk of loss from failing to act at the right time, there is also a risk of loss from acting too precipitously. Risks from a posited major acceleration in sea-level rise are slow unfolding risks, allowing some decades of time for verification of the acceleration hypothesis against the unfolding observational record. Locking in unlikely extreme events in the distant future into today's regulation has immediate and certain costs for the community, for as yet speculative benefits. Regulators and property-owning decision-makers need to base their decision on best estimates of the actual likelihoods for the full range of outcomes rather than solely on extremely unlikely events.

Good governance involves understanding the need for this balance and developing regulations that allow uncertainty to be appropriately taken into account in resource management.