Assessing the incremental benefits and costs of coping with development pressure and climate change: a South African case study

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There are two key elements to adaptation to climate change and climate variability that must be captured in the framework used to decide between alternative strategies for adaptation. The first is that information about climate change contains variation due to both known and unknown sources that, in turn, gives rise to risk (that can be characterized in quantitative terms) and uncertainty (that cannot be characterized in quantitative terms). The more uncertain climate change is, the harder it is to plan for. This uncertainty gives rise to a second important element of adaptation to climate change, namely: The "regrets" that are experienced when planning for climate change in the present (*ex ante*) based on one set of climate expectations that later on (*ex post*) turns out to be "wrong". In this case, the planned adaptation decision is also "wrong" because it is not optimal for the climate that actually occurs, *ex post*. These regrets can be translated into economic opportunity costs, based on the losses that society incurs by not making the best *ex ante* choice. In situations where the range of possible climate changes that could occur becomes very broad (or very uncertain), then the decision-making framework needs to be changed so that the robustness of adaptation decisions over a wide range of climates is more important (i.e. has lower economic regrets) than making a decision that is optimal for one or a small number of climate states.

This decision-making framework is being applied in the Western Cape of South Africa, where a large dam is being built in the Berg River to reduce the competition for water between urban and agricultural users. Water resource planning in the region in general does not take into account climate change due to uncertainties in current climate projections. The Berg River Dynamic Spatial Equilibrium Model (BRDSEM), a dynamic, multiregional, non-linear programming model, was applied to estimate the incremental benefits and costs of coping with development pressure and climate change with and without long-term adaptation measures. Two adaptation measures were considered: Building the Berg River Dam ("storage first") and replacing the existing regulatory framework for allocating water in the basin with a system of efficient water markets ("markets first"). The results indicated that Cape Town is currently poorly adapted to the current level of development, while both the markets first and storage first policies are true "no regrets" options, resulting in net benefits. However, the markets first strategy results in society experiencing 1.84 billion rand lower regrets cost compared to the storage first strategy. There are four main conclusions: (1) Adjusting to development, first, can reduce climate change damages, even if no action is taken to adjust to climate change specifically; (2) that this climate benefit can be even greater than the subsequent net benefits of specifically adjusting to climate change by increasing storage capacity; (3) the regrets costs of the markets first strategy point towards planning for climate change (even though it might not happen); (4) however, the regrets cost for the storage first strategy pointed to low costs for both action and inaction to cope with climate change.