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Limitations and best practice for bottom-up climate risk assessments

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Abstract: Climate change poses significant risks to the health and successful management of socio-environmental systems. Climate impact assessments aim to guide adaption by identifying system vulnerabilities. However, we argue that two widely applied methods of quantitative climate impact assessment – referred to as 'top-down' and 'bottom-up' – are currently falling short in adequately achieving this. This is despite the representation of bottom-up climate risk assessments as overcoming the limitations of traditional top-down approaches. Here we outline (a) how bottom-up approaches are falling short in practice and (b) what is needed for 'best practice' to ensure bottom-up assessments yield their intended value.

One of the key steps in a bottom-up assessment involves selecting system stressors, which are intended to be key determinants of the outcomes of system objectives. Our review of published climate risk literature revealed that most applications of bottom-up risk assessment methods only examine system vulnerability to a narrow range of stressors. These are most commonly changes in mean annual climate variables and seasonality without explicitly considering changes in other variables (e.g. extreme rainfall and diurnal temperature range). We consider it unlikely that despite the diversity of applications across various sectors and case studies in literature, the majority of systems are most sensitive to variations in mean climate states. In addition, most studies do not adequately justify their selection of system stressors. We demonstrate the limitations of this approach using an agriculture-themed case study. By not adequately exploring the kinds of climate changes (i.e. system stressors) that impact system performance, bottom-up risk assessments can misrepresent climate risk and lead to maladaptation.

For 'best practice', we recommend that bottom-up risk assessments include a preliminary sensitivity analysis whereby future changes most likely to impact system performance are identified. This analysis can be viewed as 'calibrating' a bottom-up assessment and ensures that system vulnerabilities to climate are adequately identified. A comparison with climate impacts estimated using top-down climate projections can then further serve as a diagnostic to ensure critical modes of system sensitivity have been identified. Considering that bottom-up approaches are being implemented more in practice, it is important that they are tailored to different applications so they can live up to their intended benefits in supporting robust decision making.

