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## CLOUDS: A toolbox for decision support and climate risk

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The world is currently witnessing a rapid exacerbation of the effects of climate change on anthropic and environmental systems. Through the latest Assessment Report 6, the Intergovernmental Panel on Climate Change (and so the EU with the Climate Change Adaptation strategy) has launched an urgent call to action to implement mitigation and adaptation strategies, to improve the resilience of these systems. Climate models are complex, requiring multi-disciplinary knowledge about climatology, physics, hydrology, hydraulics, mathematics and statistics, among others, to be conceived and implemented. Complexity is not limited to the model preparation and functioning, but it extends to the interpretation of the outputs by the users. Models' assumptions and the uncertainties related to the outcomes pose an issue of accessibility and usability in the short period, with consequences on the decision-makers' (corporations, and governments) ability to correctly address the issues at hand.

Several requirements to conduct climate risk assessment have been and are being developed by governmental and non-governmental organizations, particularly for infrastructure projects, and this is creating a demand for new services besides the traditional engineering and scientific services. Golder Associates is a global consulting firm providing services to governments and corporations, with a particular emphasis on the energy and infrastructure sectors. Golder has seen an increase in demand for Climate Risk Assessment services, requiring up-to-date climate data and projections to determine the current and future exposure, hazard, and vulnerability to climate change of its clients' assets and activities. The firm stands as an example of the challenges in translating the results and uncertainties of climate models and data into adaptation and mitigation strategies, often leading to an increase in uncertainties in major capital investments.

To address this issue, we are developing a decision-support toolbox named CLOUDS (CLimate OUtputs for Decision Support) to help identify and calculate a set of key performance indicators and variables. The aim of CLOUDS is to provide a more straightforward representation of the complexity of the climate models' outputs, still maintaining the accuracy of the estimates of climate-change effects but addressing the needs of decision-makers. CLOUDS consist of methodologies and routines, derived from the available suite of global circulation models, a set of indicators useful to decision-makers in preparing climate risk assessment analysis of existing assets and future infrastructure projects. The indicators are chosen considering their ability to define the exposure, hazards, and vulnerability to climate change in various contexts, and their

connection with the output of the models. The advantage of creating such a toolbox in cooperation and collaboration with a consultancy firm stands in the opportunity to test and adapt the toolbox on a wide range of projects in different business sectors, geographic conditions, and sizes. Therefore, this allows us to study the effectiveness of CLOUDS and by comparing its performances in terms of time and cost with projects using other decision-making tools. Finally, CLOUDS fosters the transfer of knowledge between the academic, the governmental, and the business communities, required to face the consequences of climate change.