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The potential of high-resolution climate models in tackling climate change uncertainty

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While there is overwhelming evidence that climate change has already started and is increasingly affecting a growing number of societal sectors, projections of future climate change have remained highly uncertain. The last IPCC report suggests that the response in terms of the equilibrium climate sensitivity is constrained to merely between 1.5 and 6ºC (with a probability range of about 80%). This staggering range of uncertainty has neither shifted nor narrowed during the last 3 decades. The uncertainty of some regional outcomes is even larger.

In this presentation it is argued that the limited computational resolution of current climate models represents one of the key challenges behind this uncertainty. Current global climate models operate at resolutions of about 100 km, thereby requiring parameterizations of many small-scale processes – the most important being moist convection (relating to thunderstorms, rain showers and shallow convective clouds). Research conducted during the last decade has indicated that these processes may be represented more accurately by using km-resolution models, which might lead to a step change in climate projections, do to their ability to represent atmospheric processes much closer to first principles. A major effort is currently underway to refine the computational resolution of current global and regional climate models. In this presentation the prospects of this approach are discussed. It is argued that km-resolution climate models provide an attractive pathway to further strengthen the climate modeling approach, while requiring a major computational challenge and significant technical innovation.