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Contrasting Responses of Heat Mitigation Strategies on Surface and Air Temperature and on Thermal-Stress Indices Deduced from Mesoscale Modelling

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With recent advances in subkilometric numerical weather prediction (NWP) for urban areas[1], it has become possible to develop numerical platforms to assess landscape modifications and in particular heat mitigation scenarios in urban areas. One of the major barriers that exist for urban planners and health institutes to rely on such data is that they might be reluctant to consider the large amount of data produced by such numerical simulations. This study aims at analyzing results in a more holistic approach, with the objectives of developing training data for statistical assessment of the impact of heat mitigation strategies in a particular city.

In a recent study[2], evaluations of scenarios for the urban landscape modifications were performed in Canada for Montreal and Toronto metropolitan areas with the Global Environmental Multiscale (GEM) atmospheric model with grid spacing of 250 m (with the Town Energy Balance TEB and the Interactions between the Soil, the Biosphere and the Atmosphere ISBA surface schemes) and applied during two overheating periods in 2010 when large impacts on the mortality rate were observed. More than 20 scenarios were assessed with realistic but ambitious scenarios, including increase of vegetation fraction with or without irrigation, and of thermal reflectivities. Various responses on the temperature reduction were found with an overall improvement, and down to -3 ^{o}C during the daytime, but negative effects were also found on the thermal stress during daytime when increasing albedo values.

More insights into the results are provided in this study, using various normalized efficiency metrics, as for example those based on previous work[3] and extended to the mean radiant temperature and to thermal stress indices computed in these experiments (UTCI and WBGT[4]). Dependencies of the measures on the various environmental conditions will be presented and greening strategies will be analyzed in combination with the soil water availability.

References:

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