Summary and Conclusions from the Study:

Effects of Climate on Mortality in Southern Quebec from 1981 to 1999 and Simulations for Future Climate Scenarios

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EXECUTIVE SUMMARY

In this report, we present statistical models that quantify the relationship between all-cause mortality and climate for certain cities and regions in Southern Quebec. Health and weather data for the period 1981-1999 are used to establish these findings.

These models are matched with long-term climate projections (for 2020, 2050 and 2080) established by the Ouranos Consortium in order to estimate future mortality variations (due to climate change) for certain cities (>100,000 inhabitants) and administrative health regions in Quebec. In order to establish these scenarios, it is assumed that the effect of climate on mortality will remain constant in the future (no adaptation at the level of the population). Two hypotheses for changes in greenhouse gas emissions are considered.

The effects of age and aging of the population on the model are analyzed semi-quantitatively for Montreal and Quebec City.

Cause-of-death models for the City of Montreal are also presented.

Certain confounding factors are considered, and controls for seasonality are implemented. The strength of the models in relation to this adjustment is presented.

Changes in the models over time are addressed by comparing the models obtained for the period 1981-1989 with those for the period 1991-1999.

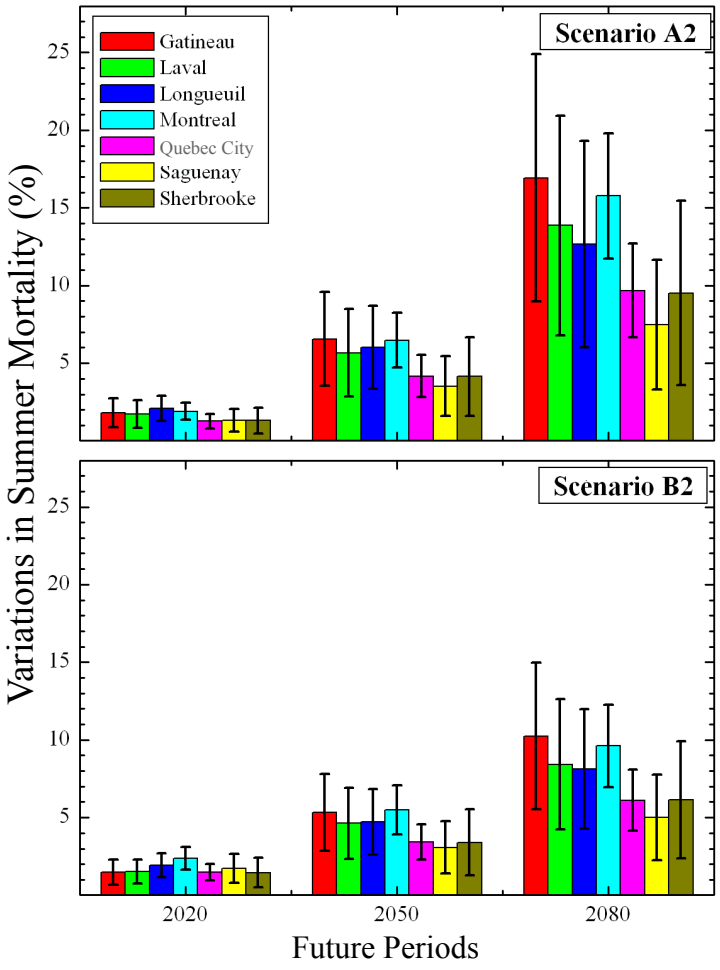
The main findings are:

- An increase in summer mortality rates in the order of 2% for the period 2020 and 10% for 2080, as well as an increase in annual mortality rates in the order of 0.5% for the period 2020 and 3% for 2080.

- There does not seem to be any significant difference between cities with regard to the vulnerability of their population to climate change.

- The increase in mortality for the population aged 65 years and over is approximately two to three times greater than that for the population between 15 and 64 years of age.

- The effect of temperature on the population aged 15 to 64 years seems to be changing over time. This age group was more vulnerable to the temperature increase during the period 1991-1999 than during the period 1981-1989. The increase in air pollution could partly explain this finding.



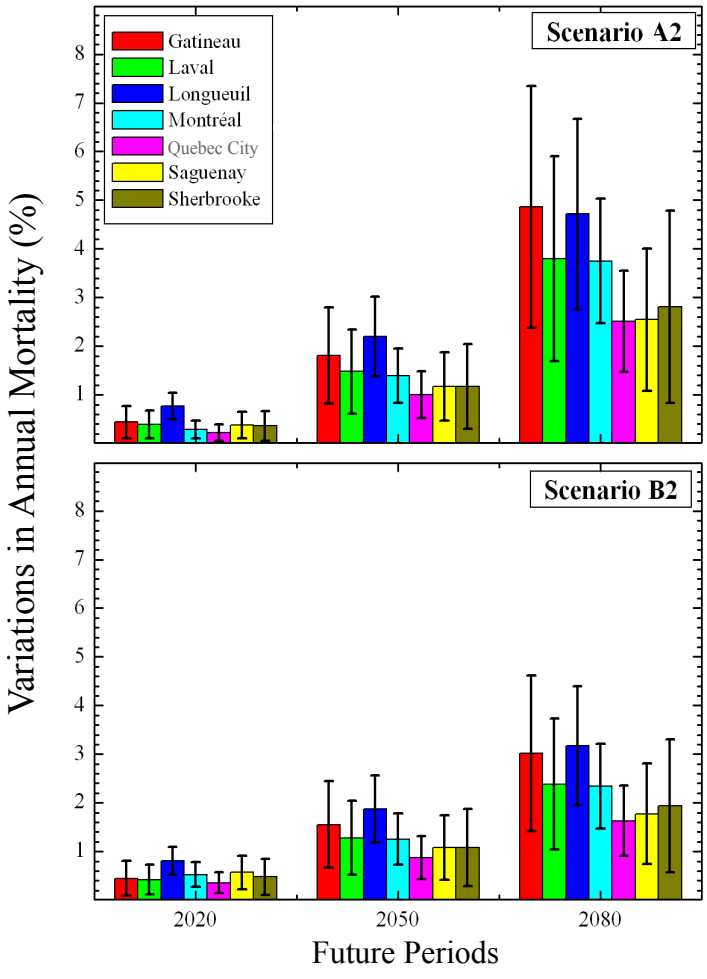


Figure 8 – Variations in Summer Mortality for Certain Cities in Southern Quebec
This figure shows the estimated variations in summer mortality for certain cities in Quebec under Scenarios A2 and B2. The variations are expressed as a percentage of the historical mortality rates for the period 1981- 1999. The confidence interval (95%) is also given.

Figure 9 – Variations in Annual Mortality for Certain Cities in Southern Quebec
This figure shows the estimated variations in annual mortality for certain cities in Quebec under Scenarios A2 and B2. The variations are expressed as a percentage of the historical mortality rates for the period 1981−1999. The confidence interval (95%) is also given.

CONCLUSION

In this report, we have presented statistical models that quantify the relationship between mortality and climate for certain cities and regions in the province of Quebec. These models were then used to estimate variations in future mortality due to climate change, through a statistical scaling technique that generates information on future temperatures at the local level. Our assessment was that the increase in summer mortality would not be offset by a decrease in winter mortality. Thus, an increase in future annual mortality can be expected, due in part to the increase in average temperatures. The mortality projections presented in this report are fairly conservative, since they do not take into account possible changes in future temperature variability and in the number of extreme events.

This report also aimed to present in greater detail certain aspects of the statistical modeling used, which is based primarily on recent methods in the literature for establishing relationships between mortality/morbidity and climate. The methodology presented here could therefore be used to quantify the relationship between morbidity and climate, and thus to deduce the variations in hospitalization rates or emergency room visits with relation to future climates. Mortality models could also serve to establish a seasonal or monthly norm for mortality rates, which could be used to determine warning levels for the population in the event of heat waves or other extreme events. In the same way, models of hospital morbidity (or emergency room visits) with relation to climate could serve to establish a similar norm for choosing warning levels intended for hospital and emergency room managers.